***Disclaimer**: This document is provided for use by persons outside of the Kansas Department of Transportation as an informational document only. The Kansas Department of Transportation, the State of Kansas, nor its officers or employees, by making this document available for use by persons outside of KDOT, undertake any duties or responsibilities of any such person or entity who chooses to use the document. It is not intended to be a standard and should not substitute for the exercise of good engineering judgment by engineers nor the determination by contractors of the appropriate manner and method of construction on projects under their control. It is the user's obligation to make sure that he/she uses the appropriate practices.*

FOREWORD

This manual has been published to provide construction personnel engaged in inspection activities with a convenient guide for the procedures and methods that are acceptable for the construction of state highway projects under the supervision of the Kansas Department of Transportation.

The procedures, methods and guidelines herein are meant as a guide only and may be modified and/or revised to better fit any given situation or circumstance.

The Construction Manual is not intended as a textbook of highway engineering, but rather as a reference book of guidelines. It is essential that the user have a thorough understanding of the specifications as well as this manual.

Many of the guidelines herein contained are general in character and are not to be construed as replacing, modifying, or superseding any of the provisions of the specifications, plans or contract.

In keeping with the idea that the Highway Construction Industry is an, ever-changing entity, requiring constant re-evaluation of policy and procedures, the format was devised to provide for addition, change, and elaboration of content without the necessity of republishing the entire manual. Each recipient of this manual is requested to suggest needed additions and changes. The suggestions should be submitted through the appropriate channels to the office of the Bureau Chief of Construction and Materials. If revisions are necessary, they will be published by the Headquarters Construction staff and transmitted to the recipients of manuals, whose responsibility it shall be to post these revisions.

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PART I

1.00 GENERAL

1.01 PURPOSE

This edition of the Construction Manual is prepared for the information and guidance of those concerned with contract administration. It is a guide to uniform methods and procedures in the sampling and testing of fieldwork and materials, construction surveying, construction inspection and the preparation of records and reports necessary to achieve proper quality and quantity control.

Problems will arise in connection with the construction work, not covered by this Manual, but it does contain valuable information that will serve as a guide to personnel assigned to construction projects. Nor will it be possible to always adhere completely to all the instructions because of the many and varied field conditions that will be encountered during construction.

Bear in mind that this Manual does not alter, supersede, replace or in any way affect the intent of the Plans and Specifications or Contract. It is instead, a book of reference and instruction used in the administration of construction projects unless specified otherwise in the Contract Documents.

Whenever the words "he", "she", "him" or "her" occur in this manual, no particular gender is intended by use of such words.

1.02 DEFINITIONS

Section 101 of the Standard Specifications interprets the intent and meaning of abbreviations and definitions of terms most commonly used in connection with highway construction projects under the supervision of the Kansas Department of Transportation (KDOT). Utilize these terms in all reports and correspondence relating to such projects.

Additional acceptable terms and definitions are included in current publications of the American Association of State Highway and Transportation Officials (AASHTO).

1.03 KANSAS DEPARTMENT OF TRANSPORTATION

1.03.01 ORGANIZATION AND OVERVIEW OF ORGANIZATIONAL STRUCTURE

The 1975 Legislature established the Kansas Department of Transportation, administered under the direction and supervision of Secretary of Transportation.

KDOT Structure:

- **Office of the Secretary:** The Secretary serves as the Chief Executive Officer of the Department. The Governor appoints the Secretary, and the Senate confirms the appointment.
- **Highway Commission:** The Commission serves in an advisory capacity to the Secretary and has limited authority. The Commission has twelve members, two from each of the six transportation districts within the State. The Governor appoints Members to four-year terms, who continue to serve until a replacement is appointed.
    - The Commission is responsible for reviewing the status of the State's highways in order to propose and recommend to the Secretary plans for improvement of the entire system of roads and highways.
    - The Commission has authority, by vote of two-thirds of its members, to disapprove any determination by the Secretary as to the location of any

highway or any authorization by the Secretary for the construction or reconstruction of any highway.

- The Commission has no authority to limit the Secretary's ability to administer and supervise the internal operations and management of KDOT.
- Since 1985, the Secretary has delegated to the Commission the Authority to evaluate and select Economic Development and City Connecting Link Geometric Improvements. KDOT solicits applications from local entities.

1.03.02 SECRETARY OF TRANSPORTATION

The Secretary of Transportation has the power, responsibility, authority and jurisdiction to coordinate the planning, development and operation of the various modes and systems of transportation within the State. The Secretary is responsible for all KDOT activities.

1.03.03 THE DEPUTY SECRETARY OF ENGINEERING AND STATE TRANSPORTATION ENGINEER

The Deputy Secretary of Engineering and State Transportation Engineer is by law a licensed professional engineer. The Deputy Secretary for Engineering is the chief engineering officer for KDOT, directs and coordinates all KDOT engineering activities, and is the technical advisor and spokesperson for, the Secretary on engineering matters.

The Deputy Secretary for Engineering assists the Secretary in overall engineering management of KDOT and has authority of the Secretary when the Secretary is unable to assume the responsibilities or delegates such responsibilities.

The Deputy Secretary of Engineering is also responsible for the Division of Planning and Development, the Division of Engineering and Design, and the Division of Operations.

DIVISION OF PLANNING AND DEVELOPMENT

The Division of Planning and Development monitors and analyzes federal transportation legislation, and provides coordination with AASHTO. In addition, this Division provides research and data collection services concerning highway use and transportation needs. This Division produces the official State map, local maps, and numerous other maps. This Division provides assistance to local public transit systems with an emphasis on providing services for elderly persons, persons with disabilities and the public. This Division coordinates policy on rail transportation and the rail and freight service programs. This Division also prepares and presents the multiyear Kansas Highway Improvement Program, and provides an indication of what projects KDOT will undertake, at various funding levels. This Division monitors and maintains the priority formulas for project selection. This Division administers all of the non-construction, safety programs for KDOT including programs that deal with driver behavior modification to reduce drunken driving, increase use of seat belts and child passenger restraints. This Division is responsible for traffic engineering activities to determine the appropriate traffic signing and speed limits for projects under KDOT's jurisdiction.

DIVISION OF ENGINEERING AND DESIGN

The Division of Engineering and Design is responsible for the Pre-construction phase of State-highway improvement projects, and assists local governments with Pre-construction work for projects that rely on Federal or State money. The Division is responsible for determining specific project locations on the State Highway System and conducting any environmental

studies or similar activities that may be necessary. In addition, the Division is responsible for preparing the design of the project, performed by agency staff or by consultants under agency staff supervision. This Division is also responsible for acquiring the right-of-way and coordinating utility movements prior to construction. This Division is responsible for the KDOT's bridge inspection program, which includes underwater inspection and structural evaluations, and for administering contracts with consultants.

This Bureau also performs Geotechnical investigations, pavement design and research, maintains the pavement management system data base, and provides technical assistance to field forces on various types of construction.

DIVISION OF OPERATIONS

The Division of Operations is the largest of all organizational units in KDOT with approximately 80% of KDOT's positions. This Division's employees reside in all but four of the State's counties. This Division oversees all of the construction inspection of projects on the State Highway System and for administrative oversight of federally funded, city and county road projects. Private contractors perform the actual construction. This Division is also responsible for maintenance of the State Highway System. While KDOT contracts some activities, KDOT personnel perform most maintenance. In addition, this Division oversees materials testing and research to verify that the materials used in construction and maintenance projects meet the applicable standards. These responsibilities include developing the specifications and performing compliance testing.

1.03.04 DIVISION OF FISCAL & ASSET MANAGEMENT

The Director of Fiscal & Asset Management serves as the chief financial and administration officer for KDOT, is responsible for directing and coordinating all KDOT financial and administration activities, and is the technical advisor and spokesperson for the Secretary on financial and administrative matters.

The Director of Fiscal & Asset Management assists the Secretary in overall financial and management matters of KDOT and has the authority of the Secretary when the Secretary is unable to assume the responsibilities.

The Director of Fiscal & Asset Management oversees the Bureau of Fiscal Services, Office of Finance & Budget, Office of Financial and Investment Management and the Office of Inspector General.

The Division of Fiscal & Asset Management is responsible for the budget, accounting, procurement, financial investment and financial management. Budget management includes developing and monitoring KDOT's budget. Financial management includes developing the financial plan (including bond and investment strategies and policies), accounting and certain procurement activities.

The Inspector General's office is responsible for making management decisions relative to agency operations by conducting periodic reviews of KDOT programs for compliance with established procedures, regulations and guidelines, and by submitting recommendations for improvements for efficient and effective operations.

1.03.05 DIVISION OF PARTNER RELATIONS

The Director of the Division of Partner Relations oversees the Office of Public Affairs, the Bureau of Personnel Services, the Office of Support Services, and the Office of Information Technology Services.

The Division of Partner Relations is responsible for human resources, information systems, computer training and support service operations for KDOT. Human resource management includes personnel administration, training, and equal employment opportunities. Information system management includes system and technology planning, software development and maintenance, operation of certain hardware and various communication support activities. The computer training section includes software program assistance and training.

This Division keeps the public informed and aware of KDOT's policies, projects, programs and procedures through interaction with the news media and public groups. It oversees the operations of the toll-free Kansas Road Conditions Hotline, including updating construction detour information on the Hotline, as well as the toll-free KDOT Connection Customer Information Hotline.

This Division implements and guides KDOT's Public Involvement Program. This Program fosters two-way communication, facilitates citizen participation and helps KDOT and its customers work together to provide a safe and efficient transportation system.

This Division also includes The Equal Employment Opportunity and American Disability Act Officer who is responsible for compliance with internal Equal Employment Opportunities and the American Disability Act.

1.03.06 OFFICE OF CHIEF COUNSEL

The Chief Counsel directs the legal affairs of KDOT, including prosecuting and defending all lawsuits and/or claims brought by or against the Secretary of Transportation. This office also handles open records requests.

The Chief Counsel oversees the Office of Contract Compliance.

The Contract Compliance Administator handles compliance with Disadvantaged Business Enterprises (DBE) and external Equal Employment Opportunities.

1.03.07 DIVISION OF AVIATION

The Division of Aviation administers the Kansas Airport Improvement Program (KAIP). The KAIP is the aviation component of the Kansas Comprehensive Transportation Program, which allocates funding for improvements to the Kansas public-use airports. In addition, the Division administers the Federal Airport Inspection Program, conducts statewide airport system planning, publishes the Kansas Airport Director and the Kansas Aeronautical Chart, provides technical support to airports, and coordinates assistance from the Federal Aviation Administration.

Note: Of the above Divisions, only the Division of Engineering and Design and the Division of Operations are directly involved in highway design, construction, and maintenance. The remainder of this manual will be primarily related to the functions of the Division of Operations.

1.03.08 BUREAU OF CONSTRUCTION AND MATERIALS

This Bureau operates under the supervision and direction of the Bureau Chief, who is accountable to the Director, Division of Operations. This Bureau Chief develops and reviews policies and procedures for highway construction, prepares specifications and Engineer's estimates, oversees KDOT's Construction Management System (CMS) and coordinates programs for establishing uniform control of construction methods.

This Bureau establishes and administers a suitable quality control/quality assurance (QC/QA) program for materials incorporated into KDOT work. In support of this function, the bureau develops and reviews specifications and test procedures, performs tests on various materials and reports the test results, monitors field test activities, oversees the certified inspection and testing (CIT) program and certifies compliance of project materials.

In addition, KDOT functions as a central clearing office for contract administration and through its staff, provides technical and administrative assistance to District personnel in matters that pertain to the execution of contracts.

1.03.09 DISTRICT ORGANIZATION

The State consists of six district areas to provide local administration of the highway program. The District Engineer administrators the construction program in each. Each district is organized and staffed to administer the basic program. Headquarters provides specialized services and technical assistance.

1.03.10 DISTRICT ENGINEER

The District Engineer:

- Oversees all construction and related activities of KDOT within their district;
- Staffs construction projects;
- Performs the final inspection and acceptance of completed projects;
- Handles outside business and public relation contacts involving district operations or district personnel;
- Makes recommendations for construction and maintenance within the district, and establishes priorities for such work when approved;
- Makes recommendations for proper equipment and supplies, and secures the proper and effective utilization and maintenance of such equipment and supplies;
- Implements employee and public safety policies and procedures within the district;
- Is directly responsible to the Director of Operations, but must effectively cooperate with the Headquarters Bureaus who speak for the applicable Directors on matters of design, construction, materials, right-of-way, maintenance and other activities. In cases of difference of opinion, the District Engineer may appeal directly to the Deputy Secretary of Engineering and State Transportation Engineer for review of decision.

1.03.11 DISTRICT CONSTRUCTION AND MATERIALS ENGINEER/ASSISTANT DISTRICT ENGINEER

The District Construction and Materials Engineer/Assistant District Engineer:

- Directs Field Engineers in matters involving construction contract administration;

- When assigned the responsibility, acts for and assumes the duties of the District Engineer during the absence of the District Engineer;
- Makes assignments of Field Engineers and field engineering personnel to construction projects;
- Inspects construction projects with the Field Engineer; assists and counsels the Field Engineer;
- Recommends necessary changes in plans and change orders;
- Keeps informed as to the status of work on each construction project and reviews project reports, records and estimates;
- Keeps the District Engineer advised of construction activities;
- Must effectively cooperate with the various Headquarters Bureaus who speak for the applicable Directors;
- Attends Pre-construction Conferences and has continual lines of communication with the field personnel;
- Coordinates training instruction for field personnel in inspection, documentation and field engineering;
- Performs such other duties and responsibilities as may be assigned by the District Engineer;
- Directs Field Engineers in sampling, field-testing and use of construction materials.
- When assigned the responsibility, acts for and assumes the duties of the District Engineer during the absence of the District Engineer;
- Reviews and checks all concrete and asphaltic mix designs;
- Is responsible for quality and use of materials on projects;
- Maintains personal contact with each Field Engineer and with Staff Engineers of the Bureau of Construction and Materials to make certain that all materials incorporated in the work are properly tested and inspected and that they meet the requirements of the specifications;
- Coordinates training instruction for field personnel in sampling, testing and documentation procedures;
- Is directly responsible to the District Engineer;

1.03.12 METRO AND AREA ENGINEER

The Metro and Area Engineers are directly responsible to the District Engineer, but work very closely with the District Construction and Materials Engineer/Assistant District Engineer and District Maintenance Engineer. The Metro and Area Engineers handle project management and public involvement within their area.

1.03.13 FIELD ENGINEER

Field Engineer:

- Includes Metro Engineer, Field Engineering Administrator, Area Engineer, Construction Engineer/Manager, and/or Construction Coordinator;
- Supervises and directs the activities of all personnel involved in the construction of one or more projects in accordance with the requirements of the plans and specifications;

- Spot checks all phases of the work periodically and checks the activities and performance of personnel on a day-by-day basis to verify that the work is progressing satisfactorily and on schedule, this includes work on Consultant Inspected projects;
- Maintains close contact with the Contractor's representative to make sure cross sections, staking and inspection occurs according to the Contractor's work schedule. Also, confirms that all misunderstandings which may arise are addressed before becoming problems;
- Confers with public officials, utility owners, other agencies and the general public as necessary to make certain their interests are considered in planning work stages;
- Checks that staff performs the contract work according to the Contract Documents, and that all materials incorporated in the work have been tested and accepted by the proper authority. Checks that progress and events are properly documented, that all records and reports are filed, and that the State's interests are protected;
- Keeps the District Construction & Materials Engineer/Assistant District Engineer apprised of the construction work as it progresses, including unusual problems and any changes in plans or additional work requiring change orders;
- Trains personnel to use safe work habits. Also, enforces public safety practices and procedure requirements;
- Prepares project reports, records and estimates. Conducts Pre-construction Conferences and approves location of and inspects utility moves.

1.03.14 PROJECT ENGINEER AND ENGINEERING TECHNICIANS

Project Engineer and Engineering Technicians:

- Is directly responsible to the Field Engineer but may work under the direct supervision of a Project Engineer or Engineering Technician Senior or Specialist who is serving as a Party Chief, Project Coordinator, or one in charge of the inspection of important or complex construction operations;
- Directs and lays out work for a construction survey party;
- Supervises and inspects operations, phases or stages of construction and material production operations. Keeps documentation records and makes necessary reports of these operations;
- Performs all calculations required in laying out interchanges, bridges, curves, grades, slope stakes or measurement of quantities;
- Operates survey instruments in layout, traverses, leveling, cross sectioning, slope staking, final measurement and other survey operations;
- Inspects and samples materials, performs tests on samples, keeps records and prepares reports of these operations;
- Performs miscellaneous tasks, keeps records and prepares reports, as directed by the Field Engineer, Project Coordinator or Party Chief in charge of the construction operation;

1.04 RELATIONS

1.04.01 GENERAL

The Construction personnel of KDOT are in daily contact with, and under the critical eyes of, a large number of citizens; and, as a public service organization, KDOT is judged by its

employees as well as by its work. Every employee has a definite responsibility to build good will toward KDOT.

1.04.02 GENERAL PUBLIC

Courtesy is a prime requisite of every employee. This applies to answering questions and accepting criticism or suggestions. Some questions which employees may think simple or elementary may be of great importance to the person asking the question. We need to listen to the public's comments. By listening with an open mind, we sometimes find that we have overlooked a detail obvious to others not as close to the work. Whenever you can answer a factual question, do so. If the question is a matter of policy, or concerns information you do not have, take the matter to your supervisor. Never let a question, a suggestion, or a criticism go unheeded. Follow through on such matters until the persons have a satisfactory answer.

On occasion, a construction project may be especially difficult to supervise and may create temporary inconvenience for the local people and the traveling public. In such situations and problems, handle with extensive private and public contact work, releasing information through local news media. These outlets are ordinarily quite happy to be of service in this regard. The Bureau of Transportation Information or the District Public Involvement Liaison will give assistance, upon request, in designing such a program for public information.

In case of contact with newspapers, radio or television, the Metro/Area/Construction Engineer/Manager should furnish information with the Public/Community Affairs Manager on matters for which they have personal responsibility and in which they are well informed. Refer questions concerning policy or programs to the District Engineer for consideration.

If any KDOT employee observes conditions that might develop into public controversy and misunderstandings, promptly transmit this information through channels so that early news releases can inform the public of the facts. It is important that information given to the public not be slanted or evasive.

Complaints received from the general public are for the most part referred to the Metro/Area Engineer, District Engineer or Public/Community Affairs Manager most familiar with the situation. Be prompt in contacting the individual. To delay in the hope that it will "cool down" may only add more fuel to the fire if the individual feels they are being ignored. It is best to talk personally with the person making the complaint; often it is just something they want to get off their chest. Listen, and above all, <u>be courteous</u>. Never lose your temper or your composure. If your authority allows you to make a decision on the matter, advise the person what can be done, and when it will be done. Promptly prepare a brief memo advising all interested persons as to how the matter was concluded. If your authority does not allow you to make a decision, inform the individual that the problem is beyond your authority, and you will forward the issue to the appropriate personnel. Promptly prepare a brief detailing the situation, and forward through channels. Follow up to make sure the issue was addressed, and the individual was notified of the resolution.

1.04.03 ADJACENT PROPERTY OWNERS

Before contract work starts on a project, the Field Engineer should try to advise abutting property owners of the planned construction and discuss with them the probable effect the contract work may have on their operations. They have an opportunity to arrange their operations before the work affects them seriously. If individual contact is not practical, a group meeting

might be an option. This consideration for the property owners will improve the attitude of the public toward KDOT.

Trespassing on private property exists when the owner of the property has not been consulted prior to action by others on the property. Before making surveys of any kind on private lands, contact the owners of these lands as required by law. Seldom will owners deny access when they are informed as to the purpose of the work and are informed that no damage to their property will result. After making this assurance to the owner, work carefully to prevent any damage.

1.04.04 LOCAL OFFICIALS

County and City officials frequently manifest a great deal of interest in construction performed in their county, or city, whether it is county, city, state or federally financed.

Whenever such officials visit the project, be courteous to them, answer their questions and explain in detail those phases of construction relative to their inquiries. Through acts of courtesy and an attitude of due respect, the Field Engineer often may obtain information which will be of material value in the supervision of the work. Listen to suggestions by local officials as to changes in the work. Obtain all the facts and give a suitable explanation when it is evident that their suggestions are not feasible. Make no commitments other than, if warranted, their suggestions will be referred to the proper district official for consideration.

1.04.05 UTILITIES

Good public relations will have a beneficial effect in dealing with utility companies. The Field Engineer will be working with the companies to facilitate the removal, protection or relocation of existing utilities. Develop a relationship of mutual cooperation and consideration.

The Field Engineer is urged to make personal contact as soon as possible with officials of the appropriate utility company. Invite a representative from any affected utility to the Pre-construction Conference. These efforts will tend to create good relations and give the companies as much time as possible to perform the needed work.

1.04.06 CONTRACTOR

Proper relations between the Contractor and KDOT personnel are of the utmost importance. In establishing and maintaining this desired relationship, abide by the following guidelines:

- Treat the Contractor fairly and impartially.
- Adhere to the plans, specifications and contract requirements, as closely as possible.
- Exhibit maximum integrity to maintain public confidence in KDOT.
- Make every reasonable effort to maintain harmonious relations with the Contractor and their employees; however, avoid excessive fraternization.
- Do not discuss the Contractor's methods of handling the work with outsiders.
- Do not put yourself under obligation to the Contractors or their personnel.
- Be ready to advise the Contractor when requested, but avoid snap decisions. Do not assume the duties and responsibilities of the Contractor.
- Refrain from intense arguments over disputed matters. Refer matters that cannot be resolved peacefully to higher authority.
- Issue instructions relative to the work to the Contractor, superintendent or foreman, not to workers on the project. Suggested changes or instructions issued pertaining to

the work should be, for the benefit of the project, based on sound judgment and supported by the specifications.

- Maintain a written record of specific instructions issued.
- Endeavor to anticipate the needs and difficulties of the Contractor. Discuss the work schedule with the Contractor and coordinate the inspection accordingly.

1.04.07 INTERDEPARTMENTAL RELATIONS

Harmonious working relations among all employees of KDOT are most important. An understanding of the functions and problems of other departments, as well as the manner in which they fit into the overall organization, will improve the teamwork within KDOT. Each employee has a responsibility to promote and foster good relations with their fellow workers. An employee shall carry out the instructions of their supervisor. Each supervisor should conduct themselves in such a way as to earn the full support, respect, and cooperation of those employees for whom they are responsible. Each employee must know their responsibility and must have the authority to handle it.

A major factor promoting good working relations is to keep your supervisor fully informed about all pertinent events that happen on work for which you are responsible. This principle applies equally at all levels of authority.

The Field Engineers should brief their staff on plans and schedules for work immediately.

1.04.08 FEDERAL HIGHWAY ADMINISTRATION

The role of the Federal Highway Administration (FHWA) in relation to federally financed highway construction is to review and require modification, as necessary, to construction oversight and materials acceptance procedures to the extent necessary to be able to provide assurance to Congress that the Contractor constructs these projects in close conformance with approved plans, specifications and change orders. This assurance is necessary before FHWA pays Federal-aid funds to KDOT. This relationship involves only FHWA and KDOT, and does not directly involve the Contractor. In effect, KDOT has a contract, or project agreement with the FHWA that KDOT will construct a project in accordance with certain plans and specifications.

FHWA representatives, when in the field and inspecting projects constructed with Federal-aid funds, are on the project to review KDOT's performance in overseeing that the Contractor constructs the project in accordance with the approved plans, specifications and estimates as contained in the KDOT-FHWA agreement. The FHWA's representative has no responsibility or authority to direct or supervise the Contractor's work or to give directions, either oral or written, to the Contractor.

FHWA Engineers make inspections on federally financed projects designated as full-oversight. These are all Interstate projects with estimated construction costs in excess of $1,000,000, plus other projects on National Highway System (NHS) routes, which FHWA or KDOT may designate as full-oversight. In addition, FHWA periodically performs detailed inspections on randomly selected, federally financed projects. These randomly selected projects may be on or off the NHS, and may be under State or local agency jurisdiction. During such inspections, FHWA will closely scrutinize all project records pertaining to the work under review.

At the end of the inspection, FHWA will discuss with KDOT project personnel, the findings and recommendations related to job procedures and contract performance found during

these inspections. The FHWA will direct significant findings and recommendations to the attention of KDOT office staff, as appropriate.

FHWA field representatives, in connection with their periodic construction inspections of full oversight projects, review and report on pending and foreseeable revisions or alterations, which KDOT will formalize by execution of contract change orders. Notify FHWA of all contemplated changes, whether major or minor in character, at the earliest date coinciding with their visit to the project. Federal regulations require FHWA concurrence in major changes prior to executing work on the change. Occasionally, the need arises for making a change on relatively short notice. In such cases, initiate an Advance Request for Major Change Order Approval (DOT Form No. 221), by phone or email if necessary, and obtain authorization from FHWA prior to executing the work on the change.

1.05 INTEGRITY OF THE INSPECTOR

1.05.01 INTEGRITY

Absolute integrity on the part of all KDOT personnel is essential to maintain public confidence in KDOT.

KDOT personnel should not engage in outside work, unless the District Engineer previously clears the matter. No one in KDOT shall perform work for, and receive compensation from the Contractor.

No one in KDOT whose job involves negotiating, approving or administering any contract or transaction on behalf of KDOT shall have any financial or personal interest, direct or indirect, in the case.

If any KDOT employee has any interest in real property acquired for highway purposes, fully document the facts and circumstances of this interest. Do not participate in acquisition of the property as an agent of KDOT.

Do not use KDOT equipment for personal business, unless allowed by SOM.

The acceptance of gifts and favors from the Contractor, or suppliers, though it may appear trivial, can create an unhealthy moral atmosphere that could adversely affect public confidence and create a condition where improprieties that are more serious can occur. The solicitation or acceptance of a loan by a KDOT employee from a Contractor is an example of a serious conflict of interest action.

The Field Engineers must be on the alert for any indication of impropriety on their part or their personnel. Immediately correct any case of dishonesty or serious conflict of interest encountered, or bring to the attention of the District Engineer.

1.06 EQUIPMENT

1.06.01 ENGINEERING EQUIPMENT

Personnel assigned engineering equipment are personally responsible for its care and condition.

The surveying equipment is expensive, precise instruments. The retention of their value and the results of the work depend to a large degree upon the proper care and functioning of this equipment. Do not allow any person to handle equipment who does not, at all times, show proper regard and care for the equipment. Take appropriate disciplinary action when care is not shown.

See Part III of this Manual for detailed instructions for the handling and care of surveying equipment.

Transporting equipment to the work site is often more detrimental than the use it receives after arriving on the job. Proper housekeeping habits in the survey vehicle, following the rule, "A place for everything and everything in its place." will tend to protect engineering equipment, reduce frequency of replacing worn out equipment and prevent loss.

The proper care of equipment applies to all equipment, not just survey equipment.

Frequently check equipment such as axes, sledgehammers, picks and hatchets.

Always protect field office equipment, such as computers, calculators, etc., from excessive dust and moisture. Keep instruments, such as hand levels, thermometers, etc., in their boxes in a safe place.

Keep laboratory and field-testing equipment clean and in good working condition, and handle with care. Tests performed by this equipment have an important role in the control of materials, so replace any damaged or worn out equipment.

1.06.02 VEHICULAR EQUIPMENT

See the Standard Operating Manual (SOM), which is available to all personnel for maintenance and handling of KDOT owned vehicles. All employees assigned a vehicle are expected to care for it according to the requirements of the Manual.

Use KDOT owned motor vehicles exclusively in the performance of KDOT business and performance of employee's duties in that business. Do not use these vehicles for transportation from home to office and return, unless authorized by the District Engineer.

The Field Engineer should make periodic checks to determine that each employee operating a motor vehicle in performance of their work is complying with requirements concerning that vehicle.

Storage of Motor Vehicles - When not in use, store all KDOT owned motor vehicles in the equipment yards of the District, Area, Project or Headquarters, when possible. Unless such sites are within a garage or other building, keep all vehicles locked even though they may be stored within a fenced compound. When an employee must take a vehicle to their home, garage or park the vehicle off the street. When out of town, parking in front of a hotel or motel is a reasonable and safe place for parking.

1.07 SAFETY

1.07.01 GENERAL

The Field Engineer and/or Project Coordinator are responsible for providing safety leadership at all times and safety enforcement, when necessary. Give employees thorough instructions on the safe use of tools, materials, equipment and the safe prosecution of the work. See that all KDOT employees wear appropriate protective equipment when in construction and/or hazardous areas in accordance with the latest personnel SOM and the KDOT Maintenance Manual.

Most KDOT employees realize that construction equipment used on today's highway construction projects is getting bigger, heavier and faster with the passage of time. With this increase in size and speed of operation, the degree of hazard goes up proportionately. Safety measures and practices must keep pace.

Safety is everybody's business. The primary responsibility of your safety lies with you, the individual. Accidents may result in loss of life, permanent disability, pain and suffering, economic loss to the individual and employer and rising insurance rates. Cooperation in safety

programs is the mutual obligation of every employee. In view of this, each employee should endeavor to:

- Work safely on or off the job.
- Realize your actions may cause accidents or injuries.
- Have regard at all times for the safety of others.
- Use knowledge and influence to prevent accidents.
- Contribute ideas and suggestions for improvement of safety.

1.07.02 VEHICULAR TRAFFIC

Traveling public - Today's high volume of traffic combined with difficult construction near highly populated areas makes it imperative that project personnel be concerned with not only maintaining construction standards and schedules, but also the safe and smooth operation of traffic in and around construction areas. Intensive supervision and inspection by field personnel is necessary to obtain guidance and protection of traffic through work areas on the construction project. Place adequate traffic control devices where they are most needed and effective. Handle traffic control in accordance with the Standard Traffic Control Sheets incorporated in the plans, Standard Specifications and latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways.

Use flaggers where needed. All flaggers should be familiar with instructions and procedures contained in the State of Kansas Traffic Control Handbook for Flaggers. They shall be provided with and wear proper apparel. Signs and barricades should leave no doubt as to when roads are completely closed and where detours are located. Remove or cover traffic control devices, when no longer needed.

On each project, assign an inspector the responsibility for checking traffic control. Make checks and document the condition, placement and adequacy of traffic control devices throughout the duration of their use on a daily basis (more often if necessary), on weekends and on holidays or shutdown periods. Make periodic inspections at night to verify that traffic control devices are operating as intended. If the person noting the defect cannot make the correction, notify the proper party; this would be the District Maintenance Engineer for KDOT signs and devices, or the Contractor's representative for their signs and devices.

KDOT owned vehicles - The operators of KDOT-owned vehicles should be aware of their responsibility not only to their employer, but also to the traveling public. Operate the vehicles in a safe and courteous manner and obey all traffic laws.

As required by position description, possess a valid driver's license of the appropriate class and that is current as to place of residence, and otherwise complies with renewal requirements.

Use good driving habits and practice recommended safety rules. The public easily identifies KDOT-owned vehicles; poor driving habits shall not be tolerated.

The following is a list of some of the causes most frequently found in accidents involving KDOT-owned vehicles:

- Following too close;
- Improper backing;
- Driving too fast for existing conditions;
- Improper entry into traffic flow;
- Faulty vehicle equipment.

1.07.03 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

The National Occupational Safety and Health Act (OSHA) requires all employers to provide a safe working environment for their employees. In the performance of the Contract, the Contractor shall comply with all applicable Federal, State and local laws governing safety, health and sanitation. The Contractor shall provide all safeguards, safety devices and protective equipment. They should also take responsibility for any other needed actions, reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the Contract. To confirm active involvement and awareness of the Contractor's safety program and procedures, the inspector is encouraged to attend safety meetings periodically held by the Contractor on the project.

1.07.04 CREW SAFETY

Working in traffic - In areas where all but the local traffic has been detoured, construction signs and barricades afford some protection to employees working within project limits, provided construction is in progress and restricted travel conditions are evident.

For survey work on a highway that is not restricted to traffic, provide adequate warning to motorists. Inform the motorists that the crew or other persons are working on the highway so that they will know what to expect. Portable warning signs, arrow boards and cones are available for that purpose, and each crew must have a set on hand, utilizing them whenever working in traffic. Place the signs at an adequate distance from the work to permit the motorist opportunity to slow down or stop safely if necessary. Ordinarily, place the signs on the road shoulder in each direction from the crew and move ahead as the survey work progresses. Place cones at each leg of the tripod on instruments set up in the roadway.

Portable warning signs are effective only if they tell the correct story. Never leave these signs in place overnight or for periods when work is not being performed in the vicinity.

KDOT employees on construction sites must wear the appropriate safety apparel that is in accordance with the latest personnel SOM and the KDOT Maintenance Manual.

In addition, remain alert for possible danger at all times, whenever performing work within active construction sites. When conditions are extremely noisy, take extra precaution.

Unless used as an aid in warning traffic through use of mounted signs and flashing lights, park vehicles off the roadway. This may require parking the vehicles some distance from the work. When conditions permit, park the vehicles far enough from the edge of pavement to provide clearance of at least 30 feet.

Perform periodic inspections to determine that all employees are making proper use of protective devices.

Ground level operations - When possible, schedule work to minimize being in areas where heavy equipment is used or where operations are concentrated in a relatively small area.

Before entering an area for purposes of inspection or performance of work, an individual should verify that the area is safe. For example, verify the Contractor properly shores and braces deep trenches. Likewise, do not enter an area to perform a task requiring undivided attention, when noisy, heavy equipment is operated nearby, unless safety provisions are made such as having another person nearby acting as a lookout, etc.

Use extra precautions when working near bridge construction, pile driving, pipe laying or other operations involving the use of cranes or draglines. Never walk under any load

suspended by crane or dragline, and remain a safe distance away from cables that are under heavy load. Remain a safe distance away from a crane or dragline working near a power line.

Above ground operations - Be aware of additional hazards related to height and the limited working area. Never require an individual to work at high elevations if they are adversely affected by height. Dress appropriately and wear hard hats, safe shoes, cuff-less pants, etc. Use care when ascending and descending ladders. Exercise extreme caution on windy days. When working over water, life jackets and/or safety belts may be required. OSHA requires Bridge Contractors to install safety nets when workers must be in excess of 25 feet above the ground if the use of catch platforms, temporary floors, safety lines or safety belts is impractical.

Processing plants - Concrete batch plants, asphalt plants, prestressed concrete yards, etc., present many hazards such as moving machinery, vehicular traffic overhead operations, ladders and stairs and various hot materials. The almost continual high level of noise compounds the seriousness of the hazards. Always wear hard hats and take extra precaution when working in these areas.

1.07.05 ACCIDENT REPORTS

Personal Injuries - Should a KDOT employee suffer any personal injury because of an occupational accident, immediately notify the immediate supervisor or KDOT Senior Manager.

Obtain detailed information on reporting personal injury accidents from the SOM entitled "Workers' Compensation".

Immediately, report personal injury accidents to KDOT employees, according to the SOM. This is the responsibility of the employee's supervisor or KDOT Senior Manager, in the event the employee is unable to make the report.

Vehicle accidents - The SOM requires that accidents involving KDOT employees and vehicles be reported promptly. In accidents involving other vehicles, the employee and the other vehicle's operator are required to exchange names, addresses, description and license number of their vehicles, the name of the owner of each vehicle and the name of the insurance company covering each vehicle. Do not give any other information, unless requested by a traffic or police officer at the scene.

Do not discuss facts and conditions relating to the cause of the accident with the driver of the other vehicle, and do not admit any liability for the accident. Refer all inquiries and attempts at settlement from the adverse party to the proper local authorities.

Where the accident involves an unattended vehicle or other property, leave the required information by note on or in the affected unit in a conspicuous place. Also, report the accident to the local police, highway patrol or sheriff, immediately.

Obtain detailed information on reporting motor vehicular accidents from the SOM 1.10.1 titled "Accident, Damage & Loss Reporting".

1.07.06 HAZARDOUS MATERIALS ACCIDENTS

Due to the possibility of serious personal injury and property damage, KDOT employees are encouraged to be familiar with the necessary actions to take if they are involved in or see an accident involving hazardous materials. Each employee should know how to refer to the Emergency Response Guidebook in order to report a hazardous materials incident effectively. Periodically give instructions to employees as to the proper procedures for reporting an accident involving hazardous materials.

The following is a guideline for reporting a hazardous materials accident:

a. If possible, determine the type of material and if the container is damaged.

b. Notify the State of Kansas Division of Emergency Management (KDEM).
24 Hour Emergency (785) 296-8013 or 1-800-275-0297
Business Hours (785) 274-1409

c. Identify the call as a Hazardous Materials Emergency, and give the operator the following information:

1. Your name
2. Location of the accident
3. Type of material involved, if known
4. Damage to container or material
5. Telephone number you are calling from

d. Remain at the telephone until KDEM calls back. The Division of Emergency Preparedness will give special instructions as to flagging, traffic control, etc.

Send Form "A" "Hazardous Materials Incidents Accidents Continuous Releases" to KDEM within one business day of the verbal report. The Area Office involved should handle the reporting.

For more detailed instructions, refer to the KDOT Maintenance Manual, Chapter 12, "Environmental Protection and Safety".

1.07.07 ACCIDENT PREVENTION MEETINGS

It is the policy of KDOT to provide brief safety meetings for employees. The instructions for these meetings are contained in the SOM 2.6.2 "Safety". It may be difficult to schedule the meeting at the time outlined in the S.O.M., however, the Field Engineer shall schedule the meeting at the most opportune time to obtain the maximum attendance by the employees under their supervision.

1.08 PERSONNEL

1.08.01 EMPLOYMENT REGULATIONS

For rules and regulations relative to employment, vacation, sick leave, etc., see the Civil Service Division's rules and regulations, the SOM, and the State of Kansas Active State Employee Benefits Guide. These publications are available in all Construction offices.

1.08.02 EXPENSES, TIME RECORDS AND EQUIPMENT RECORDS

Obtain the rules and regulations relative to methods and procedures for recording and distributing expenses, labor and equipment charges in the SOM and the Division of Operations Administrative Reference Manual (ARM). These instructions are available in the Field Engineer's office.

1.09 HISTORICAL SITES

1.09.01 ARCHAEOLOGICAL AND PALEONTOLOGICAL SALVAGE

It is in the public interest to preserve historical and pre-historical objects such as Indian ruins, sites, buildings, artifacts, fossils or other objects of antiquity that may have significance from a historical or scientific standpoint. When it appears that significant historic or prehistoric

objects have been or are about to be encountered, the Field Engineer should immediately take steps to preserve them and notify the District Engineer.

1.10 LABOR REGULATIONS

1.10.01 GENERAL

All contracts let by the Secretary for the construction, re-construction, improvement and maintenance of highways contain provisions governing the employment and payment of wages to persons employed by the Contractors, subcontractors and others to perform the work. Obtain the Federal labor provisions in the "Required Contract Provisions Federal Aid Construction Contracts" Form FHWA-1273 that is included in all Federal-Aid construction contracts. The State labor provisions for Kansas funded construction contracts are included in the Contract as a Special Provision.

The Federal Highway Administration Labor Compliance Manual, latest edition, defines the policies and procedures that are applicable to the labor compliance provisions of Federal-Aid construction contracts.

1.10.02 ENFORCEMENT OF LABOR PROVISIONS

To fulfill the contract properly, the Contractor must conform to the labor provisions included therein. It is the Field Engineer's responsibility to see that the Contractor properly carries out labor requirements.

a. Required Notices and Posters. On all projects, there is certain information that must be displayed in a conspicuous place on the project so interested persons may view it and become aware of the contents. The following is a list of notices and posters that must be posted at the point where the majority of employees assemble for work.

Notices and Posters for Kansas Funded Contracts

(1) Notice to Workers About Unemployment Insurance K-CNS 405 - To be posted by employers covered by Kansas' Unemployment Insurance statutes.

(2) Notice: Your Employer is Subject to the Kansas Workers Compensation Law (K-WC 40) - To be posted by all Kansas Employers to inform employees of benefits and where to get help or information.

(3) Kansas Law Provides Equal Opportunity – To be posted by all Kansas Employers to inform employees where to report discrimination.

(4) Notice of Hours (Child Labor), K-ESLR 100 - Informs employees that any child under 18 year of age is prohibited from working in a vocation that has been declared dangerous or injurious to life, health, morals or welfare of a minor.

Additional Notices and Posters Required for Federal-Aid Projects

(1) False Statements Notice, FHWA 1022, Title 18 CFR 1020 and CRF 635.119 - Points out the consequences of impropriety on the part of any Contractor or KDOT employee working on the project.

(2) Wage Rate Information, FHWA 1495 and 1495A - Points out that this project is subject to the minimum wage rate provisions of Section 113, United States Code and the overtime Rate Provisions of the Work Hours Act of 1962. Attached to this poster will be an approved list of wage rates and job classifications, as subsequently modified or amended, which appears in the contract.

(3) Equal Opportunity Poster, (EEO) EEOC P/E-1 (41 CRF 60-1.4(b)(1)) - Points out that on this project discrimination is prohibited by Title VII of the Civil Rights Act of 1964 and Executive Order 11246.

- EEO Postings, (41 CFR-60-741.44) - The Contractor must post their EEO Policy Statement and the name, address and telephone number of their EEO Officer.
- Safe Work Place Poster, OSHA-2203/3165 (29 CFR 1903.2(a)(1)) - The Contractor is required under the provisions of OSHA to post this poster in a conspicuous place.

(4) Emergency Phone Numbers Postings, (29 CFR 1926-50(f)) - The Contractor is required to post the telephone numbers of the physicians, hospitals, or ambulances in areas where 911 is not available.

(5) Notice to Employees, Form USDOT-WH-1321 (29 CRF 5.5(a)(1) – Informs employees who to contact it they are not receiving appropriate rate of pay for their classification.

(6) Your Right Federal Minimum Wage Form USDOL-1088 – Informs employees of the current minimum wage.

(7) Your Rights Under the Family Medical Leave Act, WH-1420 (29 CFR 825.300(a) – Informs employees of rights under the 1993 Family Medical Leave Act.

(8) Notice Employee Polygraph Protection Act, Form USH-1462 – Does not allow the use of polygraph testing in Pre-employment and employment screening.

(9) Notice to Employees, Form USDOT-WH-1313 (29 CFR 4.6(e), 184) - notify each employee of the compensation due.

(10) A.R.R.A. Whistleblower Protection Act Poster on all A.R.R.A. projects.

b. Wage Rate Interviews. Project personnel are required to conduct wage rate interviews as often as deemed necessary to verify compliance, and as a minimum, at least every three months during the life of the project with at least one interview per project. Make an attempt to interview employees of the various crafts for the duration of the project. Record these interviews on Wage Rate Interview Form DOT Form 209 or 209S. Conduct interviews in private. Keep all information from each interview confidential.

Compare information obtained from the wage rate interview with the Contractor's weekly certified payrolls to verify that the employee is being paid the proper hourly rate plus fringe benefits (when applicable) in the classification of work actually being performed. Bring any discrepancies noted between the wage rate interview and the weekly payroll to the attention of the Contractor and resolve in a timely manner.

The wage rates for each quarter of the calander year are to be compiled on a KDOT manufactured spreadsheet from each contract that the construction office is administering, excluding Klink projects, from the project's Notice to Proceed to the issue of the project's Notice of Acceptance.

This spreadsheet is then sent to the District Office to be reviewed and compiled with all area projects in the District, and then submitted to Bureau of Construction and Materials.

A copy of the wage rate interview forms (209 or 209S) are to be sent into the District Office along with the spreadsheet, but the original copies of the wage rate interview forms are to be filed at their respective Construction Office for a minimum of 3 years.

c. Wage Rates and Payrolls.

(1) Wage Rates - As mentioned above, all contracts (except County Force Account contracts) are let to bids and entered into by KDOT for highway, road, street and bridge

construction contain provisions and regulations governing the employment and payment of laborers and mechanics engaged by Contractors, subcontractors and others to perform the contract work.

Federal-Aid projects are subject to the requirements stipulated in the Davis-Bacon and Related Acts. Kansas funded projects are not; however, Kansas Statutes stipulate that prevailing wage rates be paid to employees in accordance with wage areas, job classifications and wage rates. It has been determined that these minimum wage rates will be the same as the prevailing rates established for the area by the U. S. Department of Labor and listed on the General Wage Decision within the contract for use on Federal-Aid projects.

The Contractor or subcontractor should pay all laborers and mechanics at not less than one and one half times their basic rate for all hours worked in excess of 40 hours per week. They need not add fringe benefits to the basic hourly rate when computing overtime.

(2) Payrolls - Contractors are required to submit a copy of their own and their subcontractor's Weekly Payrolls to the Field Engineer along with a certification indicating the attached payroll is correct and complete. The payroll should be mailed so that it will be received no later than 7 calendar days after the close of the Contractor's pay period. When a Contractor has more than one contract included under the same project number, they may submit only one payroll rather than one for each individual contract. If a Contractor has contracts for contiguous (adjoining) projects, they need submit only one payroll rather than one for each individual project. When the Contractor has State-tied projects, they may submit one payroll per week with the project numbers of the projects on which work was performed appearing on the payroll.

(a) Payroll Information. Submitted payrolls shall contain the following information.

1. Contain the employee's full name and identification number. **Do not use the employee's Social Security number.**
2. Number the payrolls consecutively, and mark the last payroll submitted final. These payrolls reflect all work through completion of the project.
3. **If no work is scheduled for an extended period, note on the last payroll submitted, the date in which work will resume. Negative payrolls will not be required during the extended period of no work performed.**
4. Show the work classifications or classification code numbers. At their option, the Contractor may use code numbers in lieu of actual classifications, as long as they furnish the Field Engineer a descriptive copy of the codes. The classification shown on the payroll should essentially coincide with the classification shown on the General Wage Decision in the contract.
5. Show hourly wage rates, including fringe benefits, if applicable, for each employee.
6. Show daily total hours and weekly total hours worked in each classification.
7. List itemized deductions. Under the Copeland Anti-Kickback Act, it is a criminal offense, subject to severe penalties, for any Contractor or subcontractor to induce any person to give up any of the compensation to which they are entitled under the contract. However, certain deductions such as income tax, social security, health insurance premiums, etc., which are made for the benefit of the employee are not only allowable, but often are required by State and Federal law.
8. Make Fringe Benefits on behalf of the person employed in accordance with 29 CFR Part 3.

(b) Owner Operators.

- Truck Owner Operators – Include the names of owner-operators on applicable payrolls. The classification "Owner-Operator" is all that need appear. Do not show any other information, such as hours worked, amount paid, etc. Drivers, other than owner-operators, are subject to the wage rates posted in the contract and must appear on the weekly payroll, if the drivers are included in the "site of work". These operators may appear on the payrolls submitted by the prime Contractor, or the prime Contractors may add the truck owner's payrolls to the prime Contractor's payroll as an addendum.
- Operators for Equipment (other than trucks) Hired, Leased or Rented by the Contractor - If the operator is hired and paid wages on an hourly basis, show the name and all normal required payroll information on the applicable payrolls.

If the owner is operating the equipment for a lump sum hourly rate which includes the operator's wages plus rent and expenses for the equipment, the Contractor (after reaching an agreement with the owner) must submit a statement designating the amount of the hourly rate that is for wages and the amount for rent of equipment. The statement should be submitted prior to the commencement of work by the owner of the equipment. The hourly lump sum rate should be sufficient to cover the minimum required wage rate plus a reasonable rental rate for the equipment. The operator should be shown on applicable payrolls as described in paragraph 1.10.02c.2.(a).

If the owner is operating this equipment to perform a task for a total lump sum fee, they should be shown on applicable payrolls as "Owner-Operator". No other information need be shown on the payroll. When the task is complete, the Contractor shall submit a certification stating the total number of hours worked and the total amount paid to perform the work. The Field Engineer may then deduct from the applicable pay rate a reasonable rental fee for the equipment; divide the remainder by the number of hours worked to confirm that minimum wage requirements have been met.

When the Contractor rents equipment with an operator to perform part of the work called for in the contract, all such work at the site is covered by the Davis-Bacon and Related Acts.

(c) Employment of Apprentices. Only employ apprentices, registered in a bona fide program approved by the Bureau of Apprenticeship and Training of the U.S. Department of Labor may be employed on contract work. Before using apprentices on the job, the Contractor shall present written evidence of their registration, their current wage rate and the schedule of payment showing progression upward from an Apprentice/Trainee to a bona fide journeyman. The Contractor may pay them at the rate provided in their agreement (even if it is lower than the Davis-Bacon wage rate), which rate will be a percentage of the journeyman's rate, dependent on their length of service. The ratio of journeymen compared to apprentices or trainees shall not exceed three journeymen to one apprentice, or as stipulated in the Code of Federal Regulations.

(d) Confidentiality of Certified Payroll Records. Restrict access to information contained on certified payroll records only to the following agencies:

- KDOT Bureau of Construction and Materials, KDOT Office of Engineering Support, KDOT Office of Inspector General;
- Federal Highway Administration (FHWA), Kansas Division Office;
- United States Department of Labor (USDOL);
- Kansas Department of Human Resources (State funded projects only); and

- Office of Contract Compliance

Should an agency/organization, not listed above, request access, follow these steps:

1. Federal Aid Projects – Submit a "Freedom of Information Request" in writing to the Division Administrator, FHWA, Kansas Division. If FHWA grants the request, they will contact the Bureau of Construction and Materials, who will contact the Field Engineer to provide copies of the certified payroll records and send them to the Division Administrator, FHWA. The FHWA office will sanitize the payroll reports and provide sanitized records to the requestor.

2. State Funded Projects – Submit an "Open Records Request" by the requesting organization to the Office of Chief Counsel, KDOT. If Office of Chief Counsel grants the request, they will notify the Bureau of Construction and Materials, who will contact the Field Engineer to provide copies of the requested certified payrolls to the Office of Chief Counsel. The Office of Chief Counsel will sanitize the payroll reports and provide copies of the sanitized records to the requestor.

d. Payroll Checks. Field Engineers should establish a check system to record dates they receive payrolls the office and record checks made on various payrolls.

Thoroughly check the first payroll submitted. Conduct random checks thereafter making at least one check each month.

When checking payrolls, the Field Engineer or designee should check:

(1) To verify that the required information listed in paragraph 1.10.02c.2.(a) has been included on the payroll.

(2) To verify that the rates paid conform to minimum wage requirements shown on the General Wage Decision in the contract, and that the wage rates on the payroll agree with rates reported on wage rate interviews.

(3) The accuracy of extensions and overtime computations.

(4) To verify that proper fringe benefits have been paid.

(5) To verify that deductions are itemized and approved by the employee or are authorized by law.

(6) The Contractor's timekeeping procedures and/or records to verify that they agree with the payroll.

Mark and initial the payroll as checked. If the payroll has discrepancies and clerical errors, notify the Contractor so they can promptly make corrections. Do not return the original submitted payroll to the Contractor under any circumstances. **Preserve payrolls for a period of 3 years from the completion of the project**. Make corrections by supplemental payrolls, prepared and submitted in the same manner as the original. It is not necessary to submit a completely revised payroll transcript.

No payroll is correct if improper classifications are used, or if any workers are paid less than the minimum rate set forth for the classification under which their duties fall.

e. Violations. The Field Engineer is to investigate any complaint or violation of the labor standards referred to them. Prepare a report of each investigation and the actions taken, and submit to the District Engineer and the Bureau of Construction and Materials. There are provisions in the contract for withholding from the Contractor, unpaid wages owed to the

affected employees. This will usually be a small amount and in practically all cases, the Contractor will make restitution payment to the affected employees immediately upon notice sent by the Field Engineer. KDOT will not tolerate deliberate violations of the labor requirements regarding wages.

f. Determining Wage Skill Classifications. In checking payrolls and investigating complaints with regard to wage difficulties, there may be difficulty determining the actual classification, which an employee is working. Sometimes the solution is not vivid enough to determine definitely the classification in which the employee fits. The Field Engineer usually does not have the information as to the duties of a carpenter's helper as compared to those of a carpenter, for example, so the final analysis in the case others may resolve disputes. When a dispute arises, the Field Engineer should immediately obtain and assemble all the information available and consult the District office concerning the problem.

Policies and previous determinations regarding wages, labor and labor skill classification are contained in the FHWA's Labor Compliance Manual. Questions as to the proper skill classification for the work performed by employees are to be resolved as follows:

- In Wage Area 1, the Field Engineer should refer to the job descriptions contained in the "Standard Job Classification And Description For Heavy, Highway And Municipal Utility Construction In Kansas", latest revision, prepared by the Kansas Contractors Association.
- In Wage Area 4 and 5, which are union areas, the General Wage Decision for these areas generally reflects union negotiated rates. Therefore, classify employees in accordance with the information contained in the contract. Each local trade union has established craft jurisdictional lines, recognized by each local union. Do not interpret this to require Contractors and subcontractors to hire union workers, but interpret it to require the Contractors and subcontractors to properly classify and pay employees for the time spent working in the classification. For example, if KDOT awards a non-union Contractor a contract, they may hire a worker in the classification of "Laborer (Group 1)" to do work claimed by other trade unions. This worker may tie reinforcing steel, bolt structural steel, build wooden forms, operate equipment, etc., so long as they are paid in the classification of work for which they are performing the duties, i.e., ironworker, carpenter, or power equipment operator.

<u>Additional Skill Classifications and Wage Rates.</u>

Wage rates and skill classifications of work are determined in accordance with Davis-Bacon and Related Acts by the United States Department of Labor (USDOL) prior to the letting of contracts for KDOT highway work. However, the nature of work may require new skill classifications of work and wage rates, after the award of the Contract.

Classify all workers employed under the contract and not listed in the General Wage Decision, in conformance with the wage decision. Meet the following criteria, and then submit the additional skill classification, wage rate and fringe benefits for approval:

(1) The skill classification is appropriate, and the work to be performed by the skill classification requested is not performed by a skill classification in the wage decision; and

(2) The skill classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage decision.

If the Contractor, the workers to be employed in the skill classification (if known), or their representative, and the Engineer agree on the skill classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of action taken will be completed as set forth in the following section.

Determinants For Proper Wage Rates. Consider the following factors:

(1) Prevailing area wage practice;
(2) Union Bargaining agreement;
(3) Field experience in hiring employees for the type of work (classification) required.

Procedures for Requesting Authorization of Additional Skill Classification and Rate.

Federal-Aid Projects:

(1) The Contractor shall complete items 3 through 16 of Standard Form (SF) 1444, Request for Authorization of Additional classification and Rate, and submit the request to: Chief, Bureau of Construction and Materials, Kansas Department of Transportation, Harrison Center, 700 SW Harrison, Topeka, Kansas 66603-3754.
(2) The Bureau of Construction and Materials will approve, modify or not approve the request. If approved or modified, the request will be forwarded to the USDOL for approval, modification or disapproval. If not approved, notify the Contractor of necessary changes and have them re-submit.
(3) After receiving approval, modification or disapproval from the USDOL, the Bureau of Construction and Materials will then forward it to the Contractor and the Field Engineer.

Kansas Funded Projects:

(1) The Contractor shall complete items 3 through 16 of Standard Form (SF) 1444, Request for Authorization of Additional Classification and Rate, and submit the request to: Chief, Bureau of Construction and Materials, Kansas Department of Transportation, Harrison Center, 700 SW Harrison, Topeka, Kansas 66603-3754.
(2) The Chief, Bureau of Construction and Materials will approve, modify or disapprove every request within 30 days after receipt and so notify the requesting parties and the Field Engineer.

Statement of Compliance Form (FHWA-348)

The Contractor and subcontractors are required to submit a Weekly Statement of Compliance with each copy of the weekly payrolls. This affidavit relates to Anti-Kickback regulations and is required throughout the course of the project.

1.11 EQUAL EMPLOYMENT OPPORTUNITY

1.11.01 GENERAL

KDOT, as an equal opportunity employer, makes decisions regarding an individual's conditions of employment on the basis of merit and ability without regard to gender, sexual orientation, gender identity, race, religion, color, national origin, ancestry, military or veteran status, disability, or age.

Federal Orders, Regulations, and State laws prohibit the Contractor or subcontractor from discriminating against any employee, or applicant for employment, because of race, color, religion, sex, age, disability, veteran status or national origin.

1.11.02 APPLICABILITY

This program is applicable to all Federally-Aided and State funded construction projects in the amount of $10,000.00 or more.

1.11.03 DUTIES OF FIELD ENGINEER

The Field Engineer should inform the Contractor that either State or Federal personnel might review contractual EEO requirements for compliance. If the contract is selected for a review, the Contractor will be required to verify that they are carrying out such requirements.

The Engineer should:

- Obtain the name, address and phone number of the Contractor's EEO Officer at the Pre-construction Conference.
- Verify that the Contractor displayed the required EEO notices or posters in an area readily accessible to all employees and applicants for employment.
- Confirm that the Contractor submits the necessary annual EEO reporting forms as outlined in S.O.M. "Equal Employment Opportunity Construction Contract Compliance - Reporting Requirements".
- Conduct project site inspections to see that the Contractor provides all facilities on a non-segregated basis.
- Interview Contractor's employees to determine their familiarity with the Contractor's EEO policies and the methods used to inform them of such policies.
- When the contract stipulates on-the-job trainees, the Engineer should verify the Contractor submits a training program for approval prior to issuance of Notice to Proceed, makes a positive effort to obtain minority or female trainees, and provides adequate training in the approved classification.
- Assist the Contractor in obtaining a list of local minority organizations or other recruiting sources from which minority referrals may be obtained. Assistance may be obtained from the Office of Contract Compliance.

1.12 UTILITY RELOCATION AND ADJUSTMENT

1.12.01 GENERAL

Complete any utility adjustment or relocation required to clear the proposed construction, six weeks prior to the proposed letting date, when possible. Some situations may arise to prevent this from happening, such as not getting right-of-way acquired on schedule, or a utility needs to coordinate their relocation concurrent with the Contractor's operation.

These adjustments are one of two types. Reimbursable (Agreement) or Non-Reimbursable (Permit). Where facilities to be constructed, relocated or adjusted are to cross or otherwise occupy highway rights of way, they are to be constructed and maintained in accordance with the current "Utility Accommodation Policy for Kansas Department of Transportation".

1.12.02 PERMITS

KDOT issues permits for non-reimbursable utility relocation projects. Do not install a facility over, under or within KDOT's right-of-way without the utility owner first applying for and obtaining a permit in accordance with the provisions of the current "Utility Accommodation Policy for the Kansas Department of Transportation".

Prepare the application for this permit as required, and provide sufficient information to identify the location of the work, easily. Attach a plan to each copy of the application describing the general location of the work and accurately showing the distance of the proposed facility from the centerline of the road or some other limiting factors. KDOT may require a joint field inspection of proposed utility installations within highway rights–of-way limits, subsequent to the completion of the utility company survey and application, but prior to the issuance of the permit.

Inspect the utility company's work as it is in progress, and when work is completed.

Where utility adjustment or new occupancy of State right-of-way is made by agreement, a dummy permit shall be prepared and cross-referenced to the agreement on DOT Form No. 304. The dummy permit shall be signed by the person preparing the form, and distributed and filed in the usual manner. In the Description on the face of the permit form, briefly describe the location, the project number, and the date of the utility agreement. There is neither requirement for bond, nor any utility signature. The Field Engineer shall verify that a sketch, drawing, or plan of the installation is on file.

1.12.03 AGREEMENTS

Reimbursement Agreements are usually entered into where affected facilities are located wholly or in part on private right-of-way due to the owner possessing the fee title, an easement or other real property interest. In some instances, facilities may occupy public right-of-way, but have retained underlying or prior rights from a previous highway project. Depending on circumstances, relocation costs of such facilities may be reimbursable.

Reimbursement for relocation of municipally owned facilities will be determined by terms of the City Agreement covering the project.

These agreements will be either a Lump Sum Agreement or an Actual Cost Agreement. Explanation of these agreements is contained in Subsection 1.12.08 and 1.12.09, respectively.

Federal participation in the cost of reimbursable utility agreements is covered in Chapter 1, Subchapter G, Part 645A of the Federal Aid Policy Guide. The Bureau of Design, Coordinating Section handles eligibility for reimbursement, processing of Utility Plans, Estimates, Agreements and the like.

With the issuance of notice or authorization to proceed, the Field Engineer becomes responsible for the field administration of the work under the Utility Agreement.

Although the paperwork on utility adjustments clears through the Bureau of Design Utilities Section, the supervision of the work and the certification of payments are the responsibility of the District and Construction office in charge of the work. The Field Engineer must check the work to verify compliance with the Utility Agreement and keep sufficient records to verify the utility company has performed the work in accordance with terms of the agreement.

Under the terms of the agreement, the utility company is required to advise the District Engineer five days before the date that it will begin the adjustment work. The Field Engineer will advise the District Engineer and the Bureau of Design Utilities Section by letter when work actually starts.

The utility company will also notify the Field Engineer in writing of the date of completion of the adjustment and the Field Engineer, in turn, will forward this information to the District Engineer, Bureau of Construction and Materials and Bureau of Design Coordinating Section.

1.12.04 UTILITY CHANGE ORDERS

The Engineer may authorize utility companies to perform work involving minor changes in quantities or minor items not included in the approved estimate that may be necessary to accomplish the intent of the approved utility agreement. The Engineer may take this action without necessity of formal approval, with the understanding that the Field Engineer's record and final billing will provide adequate documentation of such minor changes.

Any proposed change of a major nature either in the method, design or materials used in the adjustment of the facilities must have prior approval of the Bureau of Design Utilities Section before beginning any work differing from that shown on the approved Highway Utility Agreement.

In cases of emergency, the Engineer should approve the change by telephone through the Bureau of Design Coordinating Section before beginning any work.

When a major change order originates because of requirements of the highway project, the Utility or Field Engineer should notify the Bureau of Design Coordinating Section in writing of the proposed change and reasons for its necessity. In addition, the Field Engineer shall request the utility company to submit its estimate of cost with plans to the Bureau of Design Coordinating Section for processing. The Bureau of Design Coordinating Section will review and consult with the Field Engineer on all requested utility field changes to determine final action.

On change orders made at the request of the utility company and not required by the highway construction, although incidental thereto, follow the same procedure of preparing the change order and channels for approval.

1.12.05 PRE-CONSTRUCTION CONFERENCE

Following the award and execution of the highway improvement contract, representatives of the utility companies and other affected and interested parties should attend a Pre-construction Conference. At this conference such items concerning the necessary relocation, adjustments, permits and agreements can be discussed and work schedules prepared. For Pre-construction Conference details see section 2.06 Pre-construction Conference of the Construction Manual.

1.12.06 PROGRESS OF WORK

The District Engineer issues the notice to proceed with work. The Field Engineer will assign an Inspector to inspect the work under the utility agreement.

The Field Engineer, through the Inspector, shall keep a record of the progress of the utility adjustments.

1.12.07 INSPECTION OF WORK

Inspect all utility adjustments; both Permit and Agreement, to make sure the facilities are located as shown on the approved plans.

Exercise caution to see that utility forces and project personnel use the same reference datum when setting grade stakes. The utility company should confer with the Field Engineer

prior to establishing any underground, overhead or lateral installations. Record adjusted utility elevations and location in field books for transfer to "As Built" plans.

1.12.08 LUMP SUM AGREEMENTS

When a utility company performs a utility relocation under a lump sum agreement, daily records are not required of person-hours, material items or equipment time. The Field Engineer must check the work to verify compliance with the Utility Agreement, and keep sufficient records to verify the utility company has performed the work in accordance with terms of the agreement

The Lump Sum Agreement requires somewhat more detail in the preliminary estimate stage as it must be accurate, comprehensive and verifiable.

1.12.09 ACTUAL COST AGREEMENTS

For this type of agreement, the Inspector should maintain a utility diary to record information necessary to properly document and support utility billings. The utility diary is to be a general source document, not necessarily a detailed document. The Inspector should conduct random, periodic field inspections during the week and document items such as:

- Progress of utility work
- Major items installed
- Labor and equipment force
- Materials on hand
- Weather
- Any rock excavation
- Major items of salvaged material
- Traffic control
- Conditions that may lead to additional expense or delay

If the utility company hires a Contractor to perform the work on a unit price basis, daily records of personnel and equipment are not essential, but make a daily record of work operations by stations and number of units of work completed.

If the utility company has the work performed by a Contractor on a force account basis, make daily records of personnel and equipment, in the same manner as typical KDOT work performed a force account basis.

In connection with the data to be recorded, it is not intended that our inspectors act as timekeepers for the working forces, nor count each nut and bolt, or other minor items of materials used. It is required, however, that sufficient records be kept to enable the Field Engineer to verify that the billing submitted by the utility company is substantially correct. The Field Engineer is not required to certify to anything of which they have no knowledge or means to check; such as overhead rates, wages, engineering material and other such costs. This does not include field data materials inspections, working dates, and similar matters that are susceptible to determinations in the field.

The utility plans, estimates and agreement, together with any contract documents between a utility and its Contractor (where applicable) will provide a basis for determining extent of field records necessary.

1.12.10 INSPECTION OF RECOVERED MATERIAL

The utility company is to notify the Field Engineer in writing of the time and location for inspection of material removed for proper disposal. The Field Engineer will arrange for office personnel to perform the inspection. In some cases, it may be desirable for the District Engineer and/or FHWA to be present. Have the utility company inspect only that material to be disposed of as junk or scrapped. Removed material that is to be returned to reusable stock, and is to be credited to the project in accordance with the utility company's normal salvage pricing procedures, requires only that the Field Engineer determine and keep records of the quantities of the major items declared by the utility company as reusable.

Field or District personnel are not to be arbiters as to whether or not materials are suitable for reuse by the utility. However, a general statement as to condition of materials recovered and to be junked or scrapped by the utility would be appropriate.

Make a notation in the field records of major items of materials left in place, such as pipe, poles, etc., where the quantities are large.

Inspection of removed material is not required under Lump Sum Agreements.

1.12.11 FINAL BILLING

The utility company should submit the billing for all reimbursable agreements directly to the Field Engineer for review. The Field Engineer will then prepare a voucher and forward voucher and statement to the Bureau of Design Coordinating Section.

1.12.12 PROCEDURES FOR UTILITY RELOCATION ON KDOT PROJECTS

(Includes projects managed by Bureau of Design; excludes projects managed by Bureau of Local Projects)

a. Background. The Bureau of Design Coordinating Section is responsible for coordinating the relocation of utilities on KDOT projects. The Coordinating Section has developed a number of procedures to enable utility relocations to be completed before a project is let. Nevertheless, KDOT has had some problems with utilities not being relocated or accounted for prior to the letting. Often, the utility conditions are not accurately reflected in the "Status of Utilities Report". The non-relocation, late relocation or incorrect relocation of utilities causes extra costs to both the KDOT and the Contractor. These utility relocation problems are one of the major causes of construction contract claims. To help the situation, KDOT is implementing the following procedures on projects in which the Utilities Section is coordinating the utility relocation process.

b. Procedures. (To a limited degree, the procedures are listed chronologically).

(1) Bureau of Design Coordinating Section. The Coordinating Section will send a notice of survey letter to the utilities believed to be in the general location of the proposed alignment. This letter and accompanying documents will include the following:

- The survey limits.
- Time to complete the survey.
- County map noting the area of the survey.
- Form A provides an avenue for the company to respond with information about the facilities the company may have in the general area. It also requests contact information.

- The preliminary design field survey will detail the location of utility facilities within the survey limits.
- The actual design work will begin and plans will be developed to the Field Check stage.

(2) Bureau of Design Coordinating Section and District.

- The Coordinating Section will send plans to District/Area with a request to verify the utility locations, noting any additional information (Utility Field Check).
- District/Area should contact the local Utility Company to verify utility locations and for any other assistance needed.
- Updated information is returned to the Coordinating Section and new information is incorporated into the plans.
- The Utilities Section will initiate a tracking process on utility adjustments for each project.

(3) Bureau of Design, Coordinating Section – Utilities.

- When plans are at the "approval to appraise" stage, the Coordinating Section will send the plans and Utility Questionnaire (Form B) to the identified utility companies involved.
- Completed Utility Questionnaire (Form B, copy attached) from the utility companies includes:
  - Determination if utility adjustment is necessary.
  - Location of utility facilities, and if utilities are on public or private ROW or both.
  - Date to expect utility relocation plans, cost estimate and reimbursement consideration.
  - Identity of the entity (Utility or Consulting Firm) preparing the relocation plans and cost estimate.
  - Whether relocation work will be contracted out by bid or under an existing contract.
  - Estimate of time interval between approval to proceed date and commencement of relocation work date.
  - Time to complete the utility relocation work.
  - Time frames when the utility relocation work may not be completed. This information may also be obtained after further communications between the Coordinating Section staff and Utility Company staff.
  - Through submittal letter on the plans and Form B, the Coordinating Section provides a scheduled date for Utility Companies to submit their reimbursement consideration, relocation plans, and cost estimate.
  - The Coordinating Section provides to the Utility Companies the scheduled letting date and date utility facility relocations are to be completed. Through ongoing communications, the Utilities Section will keep Utility Company staff aware of project schedule changes.

- Bureau of Right of Way should be in the process of acquiring the necessary Right of Way (R/W).

- Utility Companies will not be expected to start any relocation until the R/W has been cleared and staked.
- When the Coordinating Section receives Form B from the Utility Company, they will:
- Send a copy to the appropriate District & Area office.
- Advise companies with utility facilities on existing R/W to apply for a permit from the KDOT Area Office to relocate their utility facilities onto new KDOT R/W.
- Continue tracking process to see that Utility Company remains ready to start the relocation.
- Prepare a relocation reimbursement agreement with the Utility Company if the Utility Company has property rights for their facilities. (KDOT policy provides for the reimbursement of costs for municipal utility facilities in cities with a population of 2500 or less and for all Rural Water District utility facilities, while excepting the property right requirement).
- Determine how much time the Utility Company will require to move its facilities, taking into account date/time/seasonal restrictions for accomplishing the relocation work.

(4) District/Area. After the plans have been sent to the District/Area to verify the utility locations, the District/Area should:

- Begin a relocation tracking process for each project. This process should include status of permit applications and status of utility facility relocation work, whether the relocation is being done under permit or under a different agreement.
- Report progress to the Coordinating Section for their use in tracking progress, in reporting utility information at the Monthly Production Control Meetings, and in preparing the "Status of Utilities Report" for the project bid letting proposal.

(5) Bureau of Design Utilities Section. Eight to six weeks before the scheduled letting, the Utilities Section will send a "Status of Utilities Report" to the Bureau of Construction and Materials - Plans and Proposal Section.

(6) Bureau of Construction and Materials. The Estimating Section of the Bureau of Construction and Materials will prepare a proposal and create an estimate for the project after reviewing the plans submitted by the Bureau of Design. This information is forwarded to the Plans and Proposal Section of the Bureau of Construction and Materials, where all proposal information is merged, including the "Status of Utilities Report". The "Status of Utilities Report" is generated by the Coordinating Section based on the information provided by the Utility Companies and supplemented by the information provided by the District/Area. The proposal information is sent electronically to the KDOT printing section and at the same time the proposal is sent electronically to the District/Area. (Note: This should be between 4 and 8 weeks prior to the letting). As soon as printed plans are available, 2 copies are mailed to the District. (Note: Often the plans may not be printed until 4 weeks prior to the letting). The District forwards the plans to the Field Construction Office that will be administering the project.

(7) District/Area, Field Construction Office Procedures.

(a) The Field Construction Office should confirm the accuracy of the "Status of Utilities Report".

(b) The Field Construction Office should contact the utility companies involved and verbally verify that the Utility:

- is in the process of relocating; or
- will be relocated by the date shown in the "Status of Utilities Report" included in the proposal; or
- has completed relocation.

(c) After contacting the local utility representative, the Field Construction Office will make a site visit to field verify the "Status of Utilities Report" and relocations. As a result of these contacts and site visit, the following actions need to take place:

- If a utility has not been relocated, determine when the utility will be relocated, determine whether the utility has resources in place to accomplish the relocation, and make sure the utility performs the relocation.
- If the utility is to be moved during construction, verify the schedule with the utility.
- If utilities have been relocated as noted in the "Status of Utilities Report", make a note the work has been completed.

(d) A report (with copies to the District Engineer) either by e-mail or by phone should be made to the Construction Letting Engineer at least 3 weeks prior to the letting. Information to be reported includes:

- Have all of the utilities been relocated as indicated in the Proposal?
- If utilities are relocated per the information in the proposal, make a note that the utilities have been relocated.
- If specific utilities are to be moved concurrent with project construction, determine that the necessary actions are on schedule to make that happen.
- If utilities were supposed to have been relocated, but have not been relocated as indicated in the "Status of Utilities Report", identify which utilities still need to be relocated and the present expected date for the relocation work to be complete. Also, identify if any other utilities will be affected by these later relocations.
- If the "Status of Utilities Report" indicates the utility will be relocated by some estimated future date, determine that the utility is ready to actually relocate and have the relocation completed by the date shown on the "Status of Utilities Report".
- Add any information about the utility adjustment (i.e. when, likelihood that it will actually occur, extra construction costs, etc.) that may be helpful in determining whether the KDOT should proceed with the project.

(8) Bureau of Construction and Materials. Based on the information presented from the Field Construction Office, the Construction Letting Engineer will make a decision as follows:

- If utilities have been relocated per the "Status of Utilities Report", and there are no conflicts, continue with the letting as scheduled.
- If the utilities have not been relocated, but the existing dates shown in the "Status of Utilities Report" are correct, and in the Field Construction Office's best estimation, the relocation will occur as shown in the "Status of Utilities Report", continue with the letting as scheduled.

- If the utilities have not been relocated, and it appears they will not be relocated by the dates shown in the "Status of Utilities Report", recommend the project be pulled from the letting and rescheduled.
- If the utilities have not been relocated, but it is necessary to keep the project in the letting, adjust the "Status of Utilities Report" to the best information available, and advise all parties.
- Advise the Deputy Secretary of Engineering and State Transportation Engineer of any recommendation to pull the project from the letting.
- On projects pulled from the letting, notify all parties of the final decision.

(9) District/Area, Field Construction Office.

- At the preconstruction conference, advise the Contractor to contact Kansas One Call before any excavation is begun. Also, advise the Contractor that KDOT is not on One Call, and to call the local KDOT office for utility information.
- At the pre-construction conference, discuss any special conditions in the "Status of Utilities Report".

1.12.13 PROCEDURES FOR UTILITY RELOCATION FOR LOCAL PROJECTS
(Includes only projects managed by the Bureau of Local Projects)

a. Background. The Local Public Authority (LPA) is responsible for having utilities relocated on projects the LPA generates. The Bureau of Local Projects (BLP) has developed a procedure regarding utility relocations. The BLP requires utilities to be moved before the project is let, or notifies the Contractor through the "Status of Utilities" that relocation will be accomplished prior to or during the construction of the project. KDOT has had some problems with the utilities not being relocated or accounted for prior to the letting. Often, the utility conditions are not accurately reflected in the "Status of Utilities Report". The non-relocation, late relocation, or incorrect relocation of utilities causes extra costs to the Contractor who has assumed that the "Status of Utilities Report" is accurate. These utility relocation problems are one of the major causes of construction contract claims. To help this situation, the following revised procedures are being implemented for LPA projects.

b. Procedures.

(1) Bureau of Local Projects. The Bureau of Local Projects (BLP) has a process to determine if projects are to remain in a scheduled letting. Currently, the BLP form "List of Utilities and Status of Same" (Form 1304) has columns that provide the projected date for completing relocation work, and the actual date a utility is moved. Normally the LPA completes the projected completion date column because the actual date is not available until near the letting date. This form is then submitted approximately two to four month ahead of the letting.

The process includes requesting the LPA to advise the BLP approximately two months ahead of the letting, or prior to the obligation of funds of the actual dates the utility relocations were completed or are planned to be adjusted. In addition the BLP will review the 1304 forms to determine the utilities status. If the Form 1304 does not show the utilities have been relocated (at the time funds are normally obligated), or new information is not received regarding the actual relocation dates, the project will normally be rescheduled unless the Road Team Leader of BLP determines the project may continue without the completed relocations. If the Form 1304 shows the utilities will be moved during construction, funds will be obligated for the project provided

other utility issues are not of concern. BLP uses the Form 1304 to develop the "Status of Utilities Report".

(2) Bureau of Construction and Materials. After the Bureau of Construction and Materials receives the plans and "Status of Utilities Report" from the BLP, the Estimating Section generates the estimate and proposal. The proposal, which includes the "Status of Utilities Report", is forwarded to the Plans and Proposal Section of the Bureau of Construction and Materials for copying and distribution. The completed proposal information is sent electronically to the KDOT printing section and to the District/Area. (Note: This should be 4 to 8 weeks prior to the letting). As soon as printed plans are available, the Plans and Proposal Section mails two copies to the District. (Note: Often the plans may not be printed until four weeks prior to the letting). The District forwards the plans to the Field Construction Office that will be performing the contract administration for the project.

(3) District/Area, Field Construction Office.

(a) The Field Construction Office should confirm the accuracy of the "Status of Utilities Report".

(b) The Field Construction Office should contact the LPA person in charge (City Engineer, County Engineer, etc.) and verbally verify that the Utilities:

- are in the process of relocating; or
- will be relocated by the dates shown in the "Status of Utilities Report" included in the proposal; or
- have completed relocation.

(c) The Field Construction Office should contact the utility companies involved and verbally verify that the Utilities:

- are in the process of relocating; or
- will be relocated by the dates shown in the "Status of Utilities Report" included in the proposal; or
- have completed relocation.

(d) After contacting the LPA and local utility representative, the Field Construction Office will make a site visit to field verify the "Status of Utilities Report" and relocations. As a result of these contacts and site visit, the following actions need to take place:

- If a utility has not been relocated, determine when the utility will be relocated, determine whether the utility has resources in place to accomplish the relocation, and make sure the utility performs the relocation.
- If the utility is to be moved during construction, verify the schedule with the utility.
- If utilities have been relocated as noted in the "Status of Utilities Report", make a note the work has been completed.

(e) A report (with copies to the District Engineer and BLP) either by e-mail or by phone should be made to the Construction Letting Engineer at least 3 weeks prior to the letting. Information to be reported includes:

- Have all of the utilities been relocated as indicated in the Proposal?
- If utilities are relocated per the information in the proposal, make a note that the utilities have been relocated.
- If specific utilities are to be moved concurrent with project construction, determine that the necessary actions are on schedule to make that happen.
- If utilities were supposed to have been relocated, but have not been relocated as indicated in the "Status of Utilities Report", identify which utilities still need to be relocated and the present expected date for the relocation work to be complete. Also, identify if any other utilities will be affected by these later relocations.
- If the "Status of Utilities Report" indicates the utility will be relocated by some estimated future date, determine that the utility is ready to actually relocate and have the relocation completed by the date shown on the "Status of Utilities Report".
- Add any information about the utility adjustment (i.e. when, likelihood that it will actually occur, extra construction costs, etc.) that may be helpful in determining whether the KDOT should proceed with the project.

(4) Bureau of Construction and Materials. Based on the information presented from the Field Construction Office, the Construction Letting Engineer will make a decision as follows:

- If utilities have been relocated per the "Status of Utilities Report", and there are no conflicts, continue with the letting as scheduled.
- If the utilities have not been relocated, but the existing dates shown in the "Status of Utilities Report" are correct and, in the Field Construction Office's best estimation, the relocation will occur as shown in the "Status of Utilities Report", continue with the letting as scheduled.
- If the utilities have not been relocated, and it appears they will not be relocated by the dates shown in the "Status of Utilities Report", recommend the project be pulled from the letting and rescheduled.
- If the utilities have not been relocated, but it is necessary to keep the project in the letting, adjust the "Status of Utilities Report" to the best information available and advise all parties, including the BLP. The Construction Letting Engineer may consult the Road Team Leader of BLP for assistance in contacting the LPA.
- Advise the Deputy Secretary of Engineering and State Transportation Engineer of any recommendation to pull the project from the letting.
- On projects pulled from the letting, notify all parties of the final decision.

(5) District/Area, Field Construction Office.

- At the Pre-construction conference, advise the Contractor to contact Kansas One Call before any excavation is begun.
- At the pre-construction conference, discuss any special conditions in the "Status of Utilities Report".

1.13 RIGHT-OF-WAY REVIEW

1.13.01 PRE-CONSTRUCTION REVIEW

The Field Engineer shall make a complete check and cross check of all plans, right-of-way agreements, easements, utility permits and agreements, and other right-of-way documents pertinent to the project. Then, check all obstructions and encroachments against those shown on the plans. If there are any questions not fully explained regarding any right-of-way matters or any omissions, discuss them in detail with the District Engineer.

1.13.02 UTILITIES

Conduct all notices and negotiations to and with the utilities occupying highway right-of-way in accordance with latest utility adjustment procedures.

1.13.03 ENCROACHMENTS

If possible, send written notification to remove encroaching advertising signs, in advance of construction, to the owners at the same time notices are sent to the utilities. Discuss other encroachments not removed, such as buildings, with the District Engineer if their removal is not provided for in the plans or right-of-way agreements.

1.13.04 MAILBOX ADJUSTMENTS

The Field Engineer should contact the postal authorities advising them of the developing situation, and make sufficient inquiry to give advice to the mailbox owner, when requested.

As soon as possible after the contract letting, the Field Engineer should give a written notice to the mailbox owner to remove their mailbox. In the notice, contain information regarding construction and probable starting date. Also, include the owner's responsibility for moving the mailbox, interim arrangements for receiving mail and resetting of the mailbox in accordance with KDOT's mailbox policy and special provisions, when included as part of the contract.

The Contractor will carefully remove and lay back on the owner's property all mailboxes remaining in place when work starts on a portion of the project in order to clear the site for construction operations.

1.13.05 BORROW

The definition of "borrow" used here is road material excavated from areas obtained by the State, outside the normal right-of-way lines, exclusive of additional widths obtained from backslopes and related construction; and in addition, excludes areas obtained for channel changes. Do not classify excavation due primarily to a channel change as borrow, even though the material is used in the road construction.

We expect to obtain reimbursement for borrow on all projects in the State system built with funds from the FHWA. This will include not only grading but any other work involving borrow material from outside the normal right-of-way lines.

If the Contractor agrees to accept plan quantities for payment, they must submit a letter stating they agree to accept plan quantities. Keep this letter in the project files for justification of payment.

The plans will include a tabulation of borrow pits on the summary sheet. This will be your guide for the final summary. The final summary should be listed in accordance with borrow descriptions on the plan profile sheets and further split made at property lines and right-of-way

line. When there is a discrepancy in project quantities, calculate the quantities for the borrow pits by cross-sectioning the areas in accordance with the specification. Show a recap of these quantities on a DOT Form 266, and use for final quantities.

It is important that borrow excavation be made in reasonable accordance with the plans so that maximum Federal-Aid reimbursement may be obtained.

Contractor-furnished borrow will be obtained from excavation areas selected by the Contractor and approved by the Engineer at some location beyond the right-of-way limits. The Contractor must submit Form DOT 104 and the Engineer must approve Form DOT 104 before performing any excavation at the site. The Contractor must also address what erosion and pollution control procedures will be used, or include them in the approved project Storm Water Pollution Prevention Plan.

The same process is necessary if the Contractor wishes to substitute a Contractor-furnished borrow pit for one or more of the pits shown on the plans. In this case, the Contractor assumes all additional costs.

1.14 SALES TAX EXEMPTION

1.14.01 GENERAL

The sales tax exemption law was written primarily to allow the Contractors on contracted county secondary and city funded projects to purchase material tax exempt for incorporation into the project. The special provision in the contract will indicate the contract is exempt.

1.14.02 EXEMPTION CERTIFICATE NUMBER

The Department of Revenue will assign the sales tax exemption certificate number to each project. The Contractor is advised of the number assigned by letter with copies to the Field Engineer and District Engineer. The Contractor will furnish a copy of the Sales Tax Exemption Certificate to all suppliers and subcontractors for their files.

1.14.03 PROJECT COMPLETION CERTIFICATION

Upon completion of a tax-exempt project, the Contractor must sign a certification stating that they incorporated all tax-exempt materials purchased into the project for which KDOT issued the exemption. The Field Engineer will prepare Form DOT 77, and submit to the Contractor with the final papers. The Contractor must retain all invoices for exempt purchases for a period of five years from the date of certification, and are subject to audit by the Kansas Department of Revenue. Submit Form DOT 77 as per instructions in the Construction Form Manual and CMS.

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2.00 CONTRACT ADMINISTRATION

2.01 BIDDING REQUIREMENTS AND CONDITIONS

The specifications establish the conditions under which the Contractor's bid will be accepted by KDOT. It also establishes the Contractor's personal responsibility for knowledge of job conditions and familiarity with plans and specifications. The Field Engineer should be aware of the contents of this section even though they are not involved in bidding procedures.

2.02 AWARD AND EXECUTION OF CONTRACT

The specifications outline the procedures and obligations involved in award of the contract to the successful bidder. The Field Engineer will know that these conditions have been met when they receive an executed copy of the contract or an official notice that the Contractor may proceed with the work. NOTE: Contracts cannot be downloaded, until the Bureau of Construction and Materials has entered the Approval Date in CMS on the Contract Info-1 or Contract Info-1 Non C screen.

2.03 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

2.03.01 GENERAL

In effect, Section 107-Legal Relations and Responsibility to the Public of the Standard Specifications calls the Contractor's attention to the existence of laws and regulations that govern this phase of construction. This reference does not intend or require that the Field Engineer is to exercise police enforcement power. In the event it is observed that the Contractor is violating a law or regulation, the matter is to be brought to the Contractor's attention, requesting compliance. Where flagrant violations affecting the work are observed, the Field Engineer has the authority to require proper compliance therewith before permitting the work to proceed.

2.03.02 PUBLIC CONVENIENCE AND SAFETY

The Contractor bears a contractual obligation of providing for the convenience of the public. The scope and limits of this obligation are in the specifications.

The "public" is anyone passing through or affected by construction operations. This includes pedestrians and residents, as well as vehicular traffic.

The specifications leave the manner of conducting the operations and providing for convenience to the discretion of the Contractor. However, the Field Engineer must confirm that the Contractor has made adequate provisions for the convenience of the public in a manner that fulfills the intent of the specifications.

2.03.03 TRAFFIC CONTROL DEVICES

Before permitting work operations to start or continue, the Field Engineer will determine that the Contractor has provided, and properly erected the necessary traffic control devices, and has provided flaggers, if required, to adequately warn the traveling public of work operations that may be a hazard to the public.

Where traffic is maintained on a construction project, advance warning is required sufficiently in advance of construction operations to alert drivers in time for them to become aware of conditions ahead, prior to entering the work area.

As stated in Part I of the Construction Manual, the design and erection requirements for signs and other traffic control devices are provided in the plans and by the Manual of Uniform Traffic Control Devices and KDOT Highway Sign Manual.

Unless provided as part of the construction contract, the State or local government entity is responsible for furnishing, erecting and maintaining all signs along any project detour and on the regular route of the highway or street approaching the beginning and end of the detour

Unless provided otherwise, the Contractor is required to erect and maintain the barricades and road closed signs at **each** end of the project and at **each** intermediate crossroad. The Contractor is solely responsible for all signs within the closed section of highway that may be necessary to protect the work and safeguard the local traffic.

2.04 SCOPE OF WORK

2.04.01 QUANTITY CHANGES

a. General. It is well to assume that conditions of the work will not necessarily be those anticipated when the plans and proposal were prepared, and that certain omissions, errors, and plan changes will need correction before the project is properly completed.

The contract quantities are, in most cases, educated calculations, and variation of a few percentage points is common during actual work. There are several items of work which are bid on a "planned quantity" basis, and unless either party questions the planned quantity, payment is made on the basis of the planned amount.

Some quantities, such as asphalt materials, cannot be accurately computed in advance of the actual construction. The estimated quantity is somewhat theoretical, and the Contractor is expected to provide all the material required for that item of work at the unit bid price established in the contract. Items that are found to be unnecessary by the Field Engineer may be eliminated as provided for in Section 104-Scope of Work of the Standard Specifications.

Whether through error in the planning process, or through changed conditions in the field, situations arise when the quantities indicated in the plans are considerably more or less than those actually provided in the contract. The Field Engineer should check the applicable specification for the contract item to determine whether changes in contract quantities are handled in any special way. If no special condition exists for the item in question, Section 104-Scope of Work of the Standard Specifications will apply. Section 104 explains how to handle changes in quantity for major and minor contract items. Standard Specification, Section 101-Definitions and Terms defines major and minor contract items.

b. Advance Requests. The Bureau of Construction and Materials requires Advance Requests for:

- Increases or additions to Money Critical projects. District, Area, and Construction Offices are provided with a list of all Money Critical projects following the Letting each month. Funds for these projects are limited, and it is necessary to require Advance Requests so these funds can be kept within budget; Increases of $10,000 to a line item, except State Park Projects; and
- Increases of $30,000 to a line item on Non-Money Critical projects; and
- New line items added to the contract.

- Force accounts prior to start of work.

To obtain approval for an Advance Request, email to the Bureau of Construction and Materials a DOT Form 221 (Advance Request for Major Change Order Approval), a copy of the Change Order created in KDOT's Construction Management System (CMS), or **clearly** detail all required information within the email. In the email subject line include the contract number and complete project number. If the Advance Request includes a new unit price, submit the Contractor's letter (required contents in 2.04.01c.(1)) along with the Advance Request.

Only include one copy of information, and only include information relevant to the Advance Request. Do not attach every email that may have been generated on the subject or project. If an additional email only contains an attachment, then just include that attachment to the Advance Request email.

c. Adding New Items to an Existing Contract.

(1) Contractor's Price Request. Before beginning work on the new item, the Construction Office should obtain a letter from the Contractor for the requested price of the added work.

The Contractor's letter should include:

- The added item and the requested unit price of the added item.
- For Lump Sum items, a breakdown of the unit price. This does not mean a recap of the total, broken down for labor, equipment and materials, but the following:
  - the labor cost by class of each worker, wage, and hours worked;
  - the equipment cost by type of equipment and hours used; and
  - material invoices.
- Any applicable additions for profit and overhead (For Force Account Payment, see Section 109-Measurement and Payment of the Standard Specifications)
- Subcontractor's letter if applicable.

(2) Price Approval/Advance Request. Forward the Advance Request for the new item to District and the Bureau of Construction and Materials, Attention: Change Order Section for review and approval. When submitting prices for approval, include as much information as possible about the added item. Include the following information in the Advance Request:

- What item is being added?
- How much is being added?
- Why is it being added?
- Are there plan revisions?
- Any special conditions affecting the cost of the item.
- A copy of the Contractor's letter requesting the price.
- A copy of the subcontractor's quote to the Contractor.
- Does this affect the working days or calendar completion date of the project?
- Construction Office's review and recommendation*

* If based on your knowledge of the work, the information is incomplete, the price is too high, etc., notify the Contractor, and the request need not be submitted to the Bureau. Also, a breakdown of the price, a further explanation of why the price is high, or other supporting information can be requested of the Contractor before submitting to the Bureau.

When the price is received by the Bureau, it will be evaluated to determine if it is acceptable. The following are some of the items considered in the review of a price:

- Is this an item normally bid on our projects, how does it compare to the bid averages?
- How does this price compare to similar work on projects in the area?
- Is this item somehow different than those bid (deeper, special equipment required, short time frame, etc.)?
- Is the quantity large or small compared to the bid average quantity?
- Where is this work being done (area of the state, rural/urban)?
- Will the Contractor need to mobilize equipment to perform work?
- Is traffic a consideration (high volume, low volume, night time work, etc.)?
- Does the work affect the calendar completion of the entire project?
- Is this specialty work (environmental clean up, non-highway type work, etc.)?
- Compare proposed price with unit price for similar work in other states.
- Require an itemized break down of the proposed price.
- Are equipment rates based on Blue Book rates?
- If equipment is rented, did Contractor provide documented rental rates?
- If equipment is owned, did Contractor provide documented company ownership rates?
- Look at the production rate expected.
- How much has been added to the price to accelerate the work?
- Will the added work affect other work on the project?
- How reasonable does the price seem?
- Do we really need to do the work?

Following the Bureau review of the proposed unit price, the person submitting the request will be notified of the approval or non-approval by e-mail. If the price is not approved, a breakdown of the price may be requested, or further negotiations may be necessary to reduce the price to an acceptable level.

Normally, all prices are approved by the Bureau of Construction and Materials, however there are some occasions when the District Engineer or the District Construction and Materials/Assistant District Engineer may approve prices. If they do approve a price, the Bureau of Construction and Materials will need a copy of the correspondence approving the price, and a copy of the Contractor's request. **NOTE:** Keep in mind that whoever approves a price might be called upon to explain their basis for the approval.

Should it be impossible for a price to be negotiated with the Contractor, it may be necessary to do the work on a Force Account basis. Both sides need to be aware of this, and adequate records kept in accordance the requirements of the specifications. Get actual equipment rates for equipment to be used from the Contractor. Before work starts, submit these rates to Construction and Materials, Change Order Section for approval. As a minimum, the make, model and year are always needed to ascertain the acceptable rate. See Section 109-Measurement and Payment of the Standard Specifications for Force Account Payment.

(3) Change Order. All changes in unit prices and additional items of work must be made valid through a Change Order to the Contract.

Reference the Advance Request (including the date and person approving) in the explanation when the Change Order is created.

After the Bureau approves the Change Order, send it to the Contractor for their signature.

2.04.02 DETOURS

All detours are provided and maintained by the Secretary, unless included as a part of the construction contract. The Field Engineer shall notify the District Engineer by letter, of any need for construction detours. Describe the portion of the road which must be closed to traffic, and state the date on which it will probably be closed. When possible, deliver this notice to the District Engineer at least one week prior to the date traffic will be routed over the detour. Also, copy the local Maintenance Superintendent.

The local Maintenance Superintendent is responsible for the detour. However, the Field Engineer should cooperate and notify them of any observed detour signs which have become damaged, misplaced, or torn down, and of any other conditions which require attention. In this manner the Field Engineer should aid the Maintenance Department in keeping all detours well marked, and in a safe and serviceable condition. It is not intended that responsibility for documentation of inspections and condition of the detour rest upon the Field Engineer.

2.04.03 USE OF MATERIAL FOUND ON THE PROJECT

In the interest of conservation of aggregates or other materials required in the construction of the project, the specifications permit the Contractor, with the approval of the Field Engineer, to use materials encountered in the excavation of the roadway in lieu of materials normally furnished by them from outside sources. See Section 106-Control of Materials of the Standard Specifications. The materials so removed will be measured as roadway excavation subject to replacement with other suitable materials by the Contractor, if and as required, for construction of embankments, backfills, and other appurtenances required in the contract. It will be the general rule not to permit the removal of such materials from areas of the roadway beyond the limits of excavation as indicated by grades and cross sections of the finished graded roadway.

When a material removed from the roadway is used by the Contractor for material normally furnished by them, it should first be agreed upon between the Contractor and the Field Engineer as to the quantity of material to be replaced. Consider the differential in shrinkage factors for the two materials.

With specific written approval of the Field Engineer, aggregates and other granular materials may be removed from the right-of-way outside of the grading limits for specific uses under the contract. In no event shall aggregates be removed from the right-of-way, beyond the roadway grading limits, for use on other projects or contracts or for purposes other than those required under the contract. Material required for restoration of an excavation area on the right-of-way will be furnished by the Contractor at their expense.

2.05 PROJECT ORGANIZATION

2.05.01 PROJECT ASSIGNMENT

The District Office will assign projects to the Construction Office. The Construction Engineer will assign all engineering personnel required for project surveying, testing, inspection and office work, as needed. The number and classification of required employees will depend on the size and scope of the project. In many cases, the availability of experienced employees will be limited, so it may be necessary to employ temporary labor for the routine tasks. Additional inspection personnel may be provided by approved consulting firms through the Inspection As

Needed program. **All** personnel must have the proper certifications in the area they are inspecting. Surveying is normally a contract bid item, and is thus performed by the prime Contractor or a subcontractor hired by the prime Contractor.

Specialization in construction inspection is not advisable. Although it is desirable to assign positions based on experience in the work assigned, give consideration to the employee's future potential by providing a broad work experience. Therefore, rotate work assignments so that overall efficiency does not suffer.

The Field Engineer is responsible for providing adequate supervision and inspection on projects assigned to their office. Each employee must have a clear understanding of duties and responsibilities so they can carry out their assignment. Some employees need closer supervision than others will, and it is important that each one knows to whom they can go for advice. Experienced employees should be given the responsibility of helping those in training.

2.05.02 DELEGATION OF AUTHORITY

To have an efficient organization, the line of authority must be well defined. Each Inspector should be **delegated authority** in line with administrative responsibilities. The Field Engineer has a responsibility to review that the delegated duties are being properly discharged.

It is good policy to delegate the responsibility for inspection supervision to one or more experienced Inspectors. As Project Coordinator, this employee must have authority to direct and coordinate the activities of all inspection personnel, and make day-to-day decisions involving engineering judgments of an immediate nature. The Field Engineer ordinarily delegates to the Inspector the review of all contract survey documents to confirm contract compliance.

2.05.03 CONSTRUCTION ENGINEERING

Fiscal Management Coding Manual, Section CM-3, Item 2.4.1, states that this includes all engineering and inspection necessary to and pertaining directly to the project under construction, including testing of materials, geologic and soils investigations, checking false work plans, revision of plans during construction, completed construction plans, etc. All costs relative to construction engineering for projects must be so recorded even though it may be accomplished some time prior to the letting of the contracts (construction preparation & survey activities).

2.05.04 CONTRACT DOCUMENTS

After the project assignments have been made, the District Office will transmit one or more complete sets of plans to the Field Engineer. Additional copies of the plans are available through the Bureau of Construction and Materials. It is not necessary to have a complete set of cross sections with every set of plans; likewise, some detail or plan sheets are applicable only to certain construction operations, and extra copies should be furnished only to those involved in particular operations.

Proposals are no longer printed and distributed by the Plans and Proposal section of the Bureau of Construction and Materials. Electronic copies may be found on the internet and printed from there.

The Original Contract and Bond are retained by Fiscal Services.

2.05.05 PROJECT ORIENTATION AND REVIEW

After being assigned a project, the Field Engineer and Project Inspectors should obtain and study the plans, specifications and special provisions thoroughly to determine whether any conflicts, problems, or changes can be anticipated due to existing field conditions. Discuss all major findings with the District Construction & Materials/Assistant District Engineer before any action is taken.

If any problems of significant proportion are encountered such as essential plan changes, the need for extra work, major quantity changes or poorly defined requirements relating to an item of work, take immediate action to resolve or clarify the issue. In any event, the Field Engineer should know KDOT's official position regarding these issues before they are presented at the Pre-Construction conference.

When any significant errors are discovered prior to letting, notify the Construction Letting Engineer in the Bureau of Construction and Materials. The Construction Letting Engineer may send an addendum regarding the error to the Contractors prior to the letting.

2.05.06 PRE-BID CONFERENCE

On occasion, it may be found that the plans or proposal may have some potentially controversial issues, major plan changes or other significant considerations. In such a situation, a Pre-Bid Conference involving the District, Designer, Headquarters personnel and the Federal Highway Administration officials, if applicable, should be held, and the issues resolved. Such a meeting should be held in advance of the bid letting so that the details can be prepared for presentation to the Contractor prior to bidding.

2.05.07 PROJECT PERSONNEL CONFERENCE

Before construction begins, the Field Engineer should arrange a semi-formal meeting with all KDOT and Consultant/LPA project personnel so that they may know of the work ahead, and their functions with regard to the work. Such a meeting will allow any questions regarding the work to be answered, and thereby increase personnel effectiveness. Notes should be kept of topics covered, and a report prepared for the project files.

Some of the items that could be covered at the meeting are the following:

- The delegation of work and lines of authority.
- The Field Engineer should check that every Inspector assigned to the project is thoroughly familiar with the Standard Specifications, special provisions and plans that are relevant to the segment of work they will be inspecting.
- Explain employee's responsibilities, and how they fit into the overall engineering supervision and inspection.
- Verify that ALL project personnel have the proper certifications to inspect their assigned work.
- When inspection is performed by non-KDOT personnel, request a list of technicians and the work they will be performing. **VERIFY** the technicians hold the proper certificates for that work. If the verification process identifies technicians whose certifications may expire before the project is scheduled for completion, notify the Consultant and make note so they are not performing work after their certification expires.

- As personnel changes and work progresses, verify technicians hold proper certifications for the work they are performing.
- What to do when unacceptable work or improper methods or equipment are encountered on the job.
- What are the legal relations and responsibilities of employee toward the public, the Contractor and visiting officials?
- Regulations concerning misrepresentations, misstatement of fact, false reporting, etc.
- Explain documentation of procedures, quality and quantity control and record accounting practice.
- Scope of the project and probable methods of proceeding.
- How to handle traffic control conflict.
- As work progresses, work assignments may change. Hold subsequent group meetings of the personnel to point out such changes and, if necessary, provide an opportunity to reiterate some project policies and methods where laxity may be developing.

2.06 PRE-CONSTRUCTION CONFERENCE

Prior to this meeting, the Field Engineer and staff shall have studied the Contract Documents, and made a field inspection of the project so that they will be well informed as to the requirements and existing conditions.

Those persons invited to attend the conference should include the following:

- The Field Engineer
- The Project Coordinator
- Project Inspection Personnel
- The Chief, Bureau of Construction and Materials
- The Office of Contract Compliance
- District Personnel
- The Contractor and subcontractors
- Design Consulting Engineer (if applicable)
- Utility Company Representatives (if applicable)
- City or County Officials (if applicable)
- Federal Highway Administration (if applicable)
- Bureau of Program and Project Management
- Newspaper Representatives
- Structural Steel Fabricator (if applicable)

The Field Engineer is responsible for conducting the discussions, and for making a written record of the conference discussions. CMS contains a base form that should be used for the meeting notes. The information in the written record should be entered in CMS with copies distributed to the District Engineer and to all participants. The written record should be put in the project file.

Among the subjects to be discussed are the following:

a. Progress Schedule or Network Schedule.

- Contractor's proposed operating schedule.
- Contractor's equipment to be used.

- Computation of working day charges and execution of working day statements.
- Required time schedule, completion date requirements, cleanup days, liquidated damages, Incentives and/or Disincentives.

b. Pollution Control Schedule.

- Storm Water Pollution Prevention Plan (SWPPP), if applicable (including permit).
- Importance of expediting pollution control items.
- Specification and/or special provision requirements.
- Before construction activities begin, the Contractor and all subcontractors are required to be certified that they understand the NPDES permit, on Form No. UN-40.

c. Designation of Supervisors.

- The Project Coordinator, Utility Coordinator and Chief Inspectors in charge of various major phases of work (where applicable) should be designated by the Field Engineer.
- The Contractor should designate the superintendent, safety officer and E.E.O. officer for the project. Names, addresses and telephone numbers should be given, if possible.

d. Subcontractors. (Also, see Section 2.09.01)

- If known at the time, the Contractor should advise who their subcontractors will be and the work to be sublet.
- Stipulations to be included in subcontract agreements.
- Field Engineer/Contractor relations and responsibility toward subcontractors.
- DOT Form No. 260 must be submitted with "Request of Approval of Subcontractor" (DOT Form No. 259).
- If the contract has DBE Goals, and cannot be met, the Contractor must present good faith documentation to prove they attempted to obtain minority subcontractor.
- Authorized representatives.
- The Contractor should be advised that subcontracts between prime and subcontractor must be in writing.

e. Utilities and Railroads.

- Status of all utilities.
- Progress schedule for removal, relocation and adjustments.
- Temporary crossings needed.
- Legal relations and responsibilities.
- Cooperation between the Contractors, public and utility companies.
- Licenses, permits, RR insurance and agreements required in connection with the work.
- Applicable local ordinances.

f. Project Procedures and Quality Control.

- Have the Contractor explain in detail the proposed methods of construction operations. Items will depend upon the nature of the project, but the following are examples to be reviewed:
  - Number and thickness of lifts (where appropriate).
  - Blading, rolling and consolidation procedures.
  - Making and checking joints (where appropriate).
- Discuss equipment to be used in the various phases.
- Discuss methods of inspection and quality control techniques, as well as methods of correcting unsatisfactory work.

g. Haul Roads.

- Contractor should designate proposed haul roads to be used.
- Dust pollution control.
- Possible weight restrictions.
- Prior approval from applicable governing agency, and general responsibilities regarding traffic and public.
- Set up time of inspection of haul roads as per specifications.

h. Traffic Control.

- Review standard traffic sheets and/or traffic control plan sheets incorporated in plans. All traffic control items will conform to plans and specifications.
- Responsibility for traffic control and their maintenance.
- Contractor should be advised of the name, if available, of the KDOT representative responsible for checking traffic control on the project.
- Contractor should advise the name of the person in their working force that will be delegated responsibility for traffic control.
- Review flagging requirements and procedures.

i. Special Requirements.

- Unusual conditions and special provisions.
- Anticipated conflicts and problems.
- Clarification of construction details.
- Discuss any addenda sent out on the project.

j. Environmental Protection. When required, an environmental packet containing permits from the following agencies will be on file at the District Office and the Area Office.

- Army Corps of Engineer.
- Kansas State Board of Agriculture.
- Kansas Corporation Commission.
- Kansas Department of Wildlife and Parks.
- Kansas Department of Health and Environment.

Note: Give special attention to the items listed and summarized on the cover of the environmental packet.

k. Labor Requirements and Equal Employment Opportunity (EEO).

- Payroll requirements and wage rate interviews.
- EEO Affirmative Action requirements.
- Location of Project Bulletin Board with required posters (See Section 1.10.02 "Enforcement of Labor Provisions").

l. Safety Regulations.

- OSHA.
- Does Contractor have a definite safety program?
- Has responsibility for safety been assigned a top company official?
- Are all occupational deaths, injuries and illnesses investigated, recorded and reported?
- The prime Contractor has the responsibility for seeing that subcontractors comply with safety and labor regulations.

m. Materials.

- Contractor's Process Control Plan. This plan requires the Contractor to identify the certified technicians that will be performing the process control testing. **VERIFY** these technicians hold the proper certificates for that work. If the verification process identifies technicians whose certifications may expire before the project is scheduled for completion, notify the Contractor and make note so they are not performing work after their certification expires. As personnel changes and work progresses, verify technicians hold proper certifications for the work they are performing.
- Inspection procedures, time and place of testing and accepting materials.
- Contractor's responsibility of furnishing sample test reports and/or certifications.
- Storage of materials and payment for the same.
- Locating and equipping field laboratories.
- List of suppliers should be furnished to the Field Engineer by the Contractor indicating where they plan on obtaining the various materials for the project.

n. Partnering. Weekly or at least once a month hold project meetings. These meetings may be held on the job site, at the project/lab trailer or at the construction office in charge of the project. A formal partnering conference may be conducted if requested by either the Contractor or KDOT. If project specific partnering conference is scheduled for the project, the Principles of Partnering should be discussed. Copies of the Partnering Brochure may also be distributed at this time.

Provide Utility Company representatives an opportunity to leave when the discussion of "Utilities and Railroads" has been completed. The items to be discussed during the remainder of the meeting have no relevant bearing upon their activities on the project.

o. Handling and removal of the logo signs within construction limits. These signs are **not** KDOT property. They are owned by the company advertising, and they pay rent to KDOT through our contractor, Kansas Logos, Inc., for the ability to display them on our signs.

The following information is included on standard plan sheet TE402. Contractors need to be aware of their responsibility to contact Kansas Logos, Inc., but the topic should also be addressed at the Pre-Construction Conference.

The Contractor will notify Kansas Logos, Inc. at 1-800-449-4420 one week in advance of when the logo panels need to be removed from the sign structure. Kansas Logos, Inc. will remove, store and reinstall the logo panels upon completion of construction. If Kansas Logos, Inc. does not remove the logo panels within one week of notice, the Contractor will remove the logo panels and take reasonable care of them until Kansas Logos, Inc. can retrieve the logo panels.

p. Miscellaneous. Packets containing information and/or questionnaires should be prepared for such standard items as EEO, Davis-Bacon (payrolls) and Safety. These could be sent to the Contractor and subcontractors prior to the Pre-Construction Conference, or handed out at the Conference. This will minimize the discussion necessary for the topics at the Conference, leaving more time for the discussion of construction items and techniques.

The Pre-Construction Conference, if properly conducted, can be of material aid in getting the project properly started. Participants should come prepared to make worthwhile contributions to the Conference and improvement of general relations. As moderator, the Field Engineer should attempt to keep within the scheduled agenda once the Conference has begun, and discourage any extraneous or digressive commentary in a diplomatic manner.

2.07 CONTROL OF WORK

2.07.01 AUTHORITY

The term Engineer means the Deputy Secretary of Transportation and State Transportation Engineer acting directly or through duly authorized representatives for engineering and administrative supervision of the contract including those persons who have specific authority as delegated by the Engineer or specifications in the administration of the contract.

Whenever the term Field Engineer is used, it shall be considered to mean: Metro Engineer, Field Engineering Administrator, Area Engineer, Construction Engineer/Manager, and/or Construction Coordinator.

In general, the authority of the Field Engineer in relation to the contract extends only to the direction of the work, and the enforcement of the terms of the contract as set forth in its several constituent parts. Beyond the authority given to the Field Engineer in the specifications, variation or revisions made in the terms or requirements of the contract are by formal action of KDOT.

Field supervision and control of the work is the responsibility of the Field Engineer assigned to the project by the District Engineer. The Field Engineer has delegated authority and is responsible for administering the contracts so they are constructed according to the Contract Documents. The Field Engineer will use KDOT's policies, control procedures, approved programs, and policies of the District to obtain work meeting the Contract Documents. All personnel assigned to the project report to the Field Engineer. The Field Engineer may delegate authority to assistants, as necessary, for proper performance of work without relinquishment of overall responsibilities.

2.07.02 RESPONSIBILITY, AUTHORITY AND BEHAVIOR OF THE INSPECTOR

a. Responsibility. The Inspector is responsible for determining that the work is being constructed in accordance with the requirements of the Contract Documents. This does not give the Inspector the right to unnecessarily or willfully disrupt the operations of the Contractor.

The Inspector must:

- become thoroughly familiar with the Contract Documents and review them frequently, as they apply to the work inspected;
- be capable of recognizing immediately if the inspected work conforms to the contract requirements; and
- know how the work fits into the overall schedule.

If any specified tolerance governing the Contractor's work is found to be unrealistic, the Inspector shall report it to the Inspector's supervisor.

If any material or any portion of the work does not conform to the requirements, the Inspector should so notify the Contractor, tell them why it does not conform, and record it in the daily report. Should the Contractor ignore the notice and continue the operation, then the Inspector's supervisor should be promptly advised.

The Inspector should avoid any inspection, testing or other activity that could be construed as a responsibility of the Contractor; this may be interpreted as prejudice to KDOT's position in the event of a dispute or claim.

When the Inspector is assigned to an operation, they should cover it as long as the work is proceeding, or see to it that another Inspector takes over, should the Inspector have to leave. This applies particularly to work that will not be viewed again, such as driving piles, laying pipe in a trench, and placing concrete.

The Inspector's daily diary should include a recording of the day's happenings, the Contractor's activity on the work being inspected, equipment and personnel being used, controlling item of work, instructions given the Contractor and any agreements made. The daily diary is not a place for personal opinions. The Inspector must remember that in the event of contract disputes, this daily diary assumes legal importance.

Carefully perform inspections and testing in a timely manner. Test samples should be carefully handled and protected, and test results reported to the Contractor without delay. It is a needless waste of time and money when a Contractor is informed of an unsatisfactory result of a test that was performed two or three days previously.

When possible, check materials as soon after they are delivered. An Inspector who rejects material after it has been placed in its permanent position is not working in the best interest of KDOT.

Inspect work as it progresses. For example, postponing the inspection of the placing of reinforcing steel and other embedded items until they are 100% complete does nothing but delay progress. Steel clearance should be inspected the day prior to concrete placement or earlier.

Unacceptable work should be recognized in its early stages and reported to the Contractor before it develops into an expensive and time consuming correction. An Inspector who is thoroughly familiar with the contract requirements should recognize these situations almost immediately.

Occasionally, a problem may arise which the Inspector is unable to handle alone. They should report this to their supervisor for prompt action. Unresolved problems can sometimes develop into critical situations and claims.

An Inspector has the responsibility to be available at all times to provide prompt inspection and a decision on acceptance, when required. A Contractor should not have to delay work while the Inspector is locating a supervisor to make this decision. Similarly, the Contractor is expected to give adequate notice to the Inspector when an operation will be ready for inspection.

Whenever possible, anticipate problems in advance. The Contractor may be unaware of a sleeve or other embedded item that must be set in the forms. It is incumbent upon the Inspector to point this out to the Contractor. By this advance notice, the Inspector contributes to maintaining progress of the work.

When work is to be corrected by the Contractor, the Inspector should follow it up daily. Otherwise, the corrections may be forgotten, or the work covered over.

The Inspector should stand behind any decisions made on the Contractor's work. Any false statements made by the Inspector may cause immeasurable damage to the relations between the Contractor and inspection personnel.

The Inspector should be safety minded, alert and observant. It is the Inspector's responsibility to report any recognizable, unsafe condition. If a dangerous condition is observed on the job, the Inspector shall call it to the attention of the Contractor, and then note it in the daily report.

The Inspector should also report to their supervisor any situation that may cause a delay to the completion of the project.

b. Authority. The Inspector must be delegated certain authority to perform required duties properly. The Inspector should not hesitate to use given authority when the situation demands it, but not, abuse such authority. In exercising authority, the Inspector should consider that the Inspector's authority is a delegation from their supervisor(s), and should act accordingly in making decisions. The Inspector should recognize there will be situations when they should seek such assistance before making the decision. In addition, the Contractor is entitled to know when their work is not proceeding in an acceptable manner.

The Inspector should have the authority to approve materials and workmanship that meet the contract requirements, and should give this approval promptly, where necessary.

The Inspector should not have the authority to approve deviations from the contract requirements, nor should the Inspector require the Contractor to furnish more than the contract requires.

The Inspector should not under any circumstances attempt to direct the Contractor's work; otherwise, the Contractor may be relieved of their responsibility under the contract.

Instructions should be given to the Contractor's supervisors, not to their workers.

c. Behavior. There are three relationships that are inevitable parts of an Inspector's work:

1. Fellow Inspectors - The Inspector must maintain a relationship of mutual respect, confidence, and trust with other Inspectors. This is accomplished by being diligent and thorough

in keeping their associates informed of their activities, and in relaying instructions and other information pertinent to the overall inspection activities.

2. Supervisors - The Inspector must similarly maintain a relationship with supervisors. This relationship includes mutual respect, confidence and trust. They must be able to take and execute orders, and accept decisions gracefully. They should be diligent in keeping their supervisors fully informed of the progress of the inspection, and be particularly alert to observe and report to them matters that may be critical in the event of a dispute or claim.

3. Contractors – Use tact when pointing out deficiencies to the Contractor and their staff. An Inspector's behavior can materially help to improve, or disrupt, the relationship between Contractor, inspection personnel and KDOT.

To be successful in their work, the Inspector must merit the respect and confidence of those they work for and of those whose work they inspect. They must be honest and fair, exercising their responsibilities with firmness and good nature. They should work cooperatively with the Contractor, but in such a way as not to prejudice their basic KDOT responsibility.

Personality differences or presumed evaluation of the Contractor by an Inspector should not be permitted to interfere with or affect the Inspector's working relations with the Contractor. An Inspector should not prejudge the Contractor. They must begin on the premise that the Contractor is fair-minded and intends to do a good job.

The Contract Documents require the Contractor to furnish experienced personnel. The same should apply to KDOT's inspection team; it should be staffed with knowledgeable, qualified people.

Criticism, on or off the job, of the Contractor or any of their employees by the Inspector, is unwarranted and should not be tolerated.

If the Inspector has made a wrong decision, they should have the fortitude to admit it. It is recognized that no one is perfect.

When dealing with the public, the Inspector should be courteous and respectful. The resulting good public relations will benefit all concerned.

2.07.03 REMOVAL OF UNACCEPTED AND UNAUTHORIZED WORK

Generally unauthorized work is work performed beyond the limits indicated by the lines and grades shown on the plans or other terms of the contract, or beyond the limits defined by the stakes set, or it is extra work not authorized by written agreements. Such work is not subject to compensation and may at the discretion of the Field Engineer be ordered removed or otherwise corrected by the Contractor at their expense.

Defective work is work which does not conform to the requirements of the contract, or work in which defective materials have been incorporated. Upon written order by the Field Engineer, the Contractor is required to remove and replace, or otherwise satisfactorily correct defective work as directed. Upon failure of the Contractor to comply with such orders, KDOT may cause such defective work to be removed and replaced, or otherwise corrected, and all costs incurred by such actions deducted from any monies due or may be due the Contractor. In some instances of defective work, such as surface courses, base courses, and similar items of work which have minor defects, KDOT has the right to permit such work to be left in place. KDOT may accept the work without any compensation to the Contractor or to make payment to the Contractor at a reduced rate from the contract price, which reflects a commensurate and reasonable value of the work as determined by KDOT.

See Section 105-Control of Work of the Standard Specifications.

2.07.04 PARTIAL AND FINAL ACCEPTANCE

The specifications permit the Engineer to accept and relieve the Contractor of their responsibility for maintenance of completed sections of the project. Give consideration to acceptance of sections when such sections are situated where they can be opened to and advantageously used by traffic or advance the following stage of construction. Partial acceptance, or the acceptance of a portion of a project, relieves the Contractor of their responsibility to KDOT or other governmental agencies responsible for the work accepted. It does not, however, relieve the Contractor of their responsibility for damage by their operations and the remaining work to be accomplished.

Before final inspection is made, all finishing operations, necessary repairs and corrections will be satisfactorily made. As a matter of cooperation with the Contractor, defects to be corrected and special finishing requirements should be called to the Contractor's attention prior to the beginning of their finishing operations, and checked during such operations in order that the completed work will conform to requirements and be in an acceptable condition.

See Section 105-Control of Work of the Standard Specifications.

2.08 CONTROL OF MATERIALS

2.08.01 GENERAL

The specifications provide that only materials conforming to requirements of the contract shall be used, and that the Contractor is responsible for providing materials that meet the specified requirements. See Section 106-Control of Materials of the Standard Specifications.

For assurance that only materials meeting the specifications are used, inspect and test the materials prior to their incorporation into the project. Representative samples of materials for testing are taken at the job site or at the source of supply of material in accordance with proceedings of the governing specifications, or in accordance with standard practices of KDOT.

Sampling and testing is not required for all materials. Some materials are accepted upon certification by the manufacturer that the material complies with the specifications, and a few materials may be accepted upon visual inspection by field personnel. Basis of acceptance of materials is covered in the materials portion of the specifications. Information relative to sampling, inspection and acceptance of materials, and many of the more frequently and generally used procedures in field evaluating, testing and control of materials are included in Part V of Construction Manual. Other procedures or more limited application may be found, herein, under the discussion for a specific item of work.

In supervision of the construction of the project, the Field Engineer will determine that a material has been accepted before permitting its incorporation in the work.

2.08.02 CONTRACTOR QC/QA PROJECTS

The Contractor is required to submit a Quality Control Plan at the Preconstruction Conference. This plan requires the Contractor to provide a list of certified individuals responsible for quality control administration and inspection.

VERIFY these technicians hold the proper certificates for that work. If the verification process identifies technicians whose certifications may expire before the project is scheduled for

completion, notify the Contractor and make note so they are not performing work after their certification expires.

As personnel changes and work progresses, verify technicians hold proper certifications for the work they are performing.

2.09 PROSECUTION AND PROGRESS

2.09.01 SUBCONTRACTING

All requests by the Contractor for permission to sublet any portion of the work shall be submitted on Form No. 259 (Request for Approval of Subcontractor) along with Form No. 260 which stipulates the completion of certain Equal Employment Opportunity requirements. The request shall be submitted to the Field Engineer who shall input the information into CMS and make their recommendations for approval. The District Engineer and the Bureau Chief of Construction and Materials must also approve each subcontractor in CMS.

No work shall be permitted under any proposed subcontract before they are approved. Consent to sublet any portion of the contract shall not relieve the Contractor of any responsibility for fulfillment of the contract. Subcontracts between the prime Contractor and a Subcontractor must be in writing.

See Section 105-Control of Work of the Standard Specifications.

2.09.02 PROSECUTION AND PROGRESS

a. Notice to Proceed. The "Notice to Proceed" will be issued after the Pre-Construction Conference, and will be scheduled to be issued on a date from the Contractor's proposed work schedule. Other considerations may have to be evaluated, such as detours, utility adjustments, traffic considerations, availability of special materials, etc., before issuing the Notice to Proceed. The Notice to Proceed (DOT Form No. 258) is prepared and distributed to the Contractor by the District Office, prior to work starting. The actual Notice to Proceed date should also be entered in CMS on the Contract Information or Contract Information Non C screen. The Notice to Proceed will be issued no later than the "Late Start Date", unless approved by District.

The Notice to Proceed is not required on railroad crossing signal projects or connecting link projects (KLINK).

b. Notice of Work Starting. The Notice of Work Starting should be entered into CMS on the Contract Information or Contract Information Non C screen.

c. Temporary Suspension of Work and Notice of Work Resuming. The District Engineer may authorize the Field Engineer to give the Contractor written permission to suspend the work wholly, or in part, for such period or periods as deemed necessary, or desirable due to conditions beyond their control. These may include unavailability of material, unsuitable weather, inability of the Contractor to perform further work until construction phases involving other Contractors have been completed, or such other conditions of work. The Contractor shall not suspend work without written authority. Reasons such as lack of equipment or work force are not acceptable.

When non-delivery of material is the reason for the delay, the Field Engineer shall ascertain that the Contractor is making all reasonable efforts to obtain the material. The Contractor must provide a record of the prompt placing of orders and documentation of attempts

to find alternate sources of supply before KDOT will consider a work suspension. Reasons due to weather are usually due to the specifications prohibiting some types of work to continue after certain dates. See Section 104-Scope of Work of the Standard Specifications for conditions within the Contractor's control.

If it should become necessary to stop work for an indefinite period, the Contractor should store all materials in such a manner that will not obstruct or impede traffic, or become damaged in any way. Provisions shall be made for suitable drainage on the project and precaution taken to prevent damage or deterioration to work that has been performed. See Section 104.

The Notification of Working Days Charged report for the week in which suspension begins shall carry a note that an authorization for suspension has been given, and that no more reports will be submitted until work is resumed or until counting of working days is resumed.

When work is to be suspended, a Temporary Suspension of Work (DOT Form No. 206) is to be completed and mailed the same day work is suspended. The actual date that work is suspended and the tentative date that work will resume should be entered into CMS on the Contract Information or Contract Information Non C screen. When work resumes, the actual date that work resumes should be entered into CMS on the Contract Information or Contract Information Non C screen.

Addressee:

Federal Aid Projects (except Secondary):

Division Administrator
Federal Highway Administration
3300 South Topeka Boulevard, Suite 1
Topeka, Kansas 66611-2237

All Other projects:

Chief, Bureau of Construction and Materials
Kansas Department of Transportation
Harrison Center, 700 SW Harrison St.
Topeka, Kansas 66603-3754

d. Progress or Network Schedule. It is the general policy to request a "Progress Schedule" or "Network Schedule" from the Contractor. The appropriate time for requesting this information would be when notifying the Contractor of the schedule for the Pre-Construction Conference or during the Pre-Construction Conference. It is essential that the Field Engineer is thoroughly familiar with the Contractor's plan of operation in order to develop an estimate of engineering personnel required.

During construction, if there is a continual lag between the Contractor's progress and the elapsed contract time, and no apparent effort is made to improve the rate of progress, the Field Engineer shall notify the Contractor in writing that progress is unsatisfactory. If the time lag increases to serious proportions, the Field Engineer should request the District Engineer to take appropriate action. In extreme situations, the District Engineer should consider proposing termination of the Contractor's right to proceed, as provided for in the Standard Specifications. Termination may only be taken by the Deputy Secretary of Engineering and State Transportation Engineer.

As work progresses and changes, the Contractor should modify the Schedule accordingly. See Section 108-Prosecution and Progress of the Standard Specifications.

2.09.03 CHARACTER OF WORKERS, METHODS AND EQUIPMENT

The Standard Specifications require the Contractor to, at all times, employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the contract. See Section 105-Control of Work of the Standard Specifications.

Unqualified/inexperienced workforce and inadequate or poor equipment contribute substantially toward poor progress. Unsatisfactory progress quite frequently results in requests for time extensions or claims.

It is important that the Field Engineer keep sufficient daily records on equipment and Contractor's personnel so that complete information will be available should a claim arise, or the Contractor opposes assessment of liquidated damages. Lack of detailed information in many instances has been costly to KDOT.

2.09.04 CONTRACT TIME

KDOT establishes the amount of contract time (number of Working Days or calendar completion date) for each project based upon the volume and type of construction that is required. When the specified contract time expires before all contract work is completed, and KDOT determines a time extension is not justified, the specifications require liquidated damages and in some instances a disincentive assessment be charged. Such changes represent added costs for project administration and inspection, and may include lost use of the facility for the time its completion was delayed. See Section 108-Prosecution and Progress of the Standard Specifications.

2.09.05 CLAIMS AGAINST CONTRACTORS

Frequently, suppliers or subcontractors have reason to file a claim against the prime Contractor on a project for not being paid for materials supplied or work they have completed. As per KSA 68-410, these claims must be handled in a specific manner. They must be in writing and directed to the Secretary of Transportation, the letter must include the amount claimed, copies of invoices or billings must be attached, and the letter must be notarized. Since KDOT does not have a contract with these companies, all KDOT can do is file the claim with the Bonding Company for the Prime Contractor on the project. Claims must be received within 6 months of the Notice of Acceptance for the project. The Secretary has delegated this responsibility to the Bureau of Construction and Materials so the letters need to be addressed as follows:

Secretary of Transportation
Kansas Department of Transportation
Harrison Center, 700 SW Harrison St.
Topeka, Kansas 66603-3754

Attn.:
Change Order Technician
Bureau of Construction and Materials

2.09.06 CONTRACTOR CLAIMS

During the construction of a project, situations may arise that are not completely covered by the contract or specifications, and may, in the opinion of the Contractor, constitute "extra work" for which they demand compensation. Because of KDOT's interpretation of the contract requirements, it may be decided that extra compensation is not due, and the Contractor is directed to proceed under the terms of the existing contract. At this time, the Contractor has the right to put KDOT on notice of a claim for the extra compensation. See Section 105-Control of Work of the Standard Specifications.

Specifications require the Contractor to notify KDOT in writing of their intent to file a claim. When the Contractor does this, it becomes the responsibility of the Field Engineer to maintain accurate records of the labor, equipment and materials that go into the disputed work. Even if written notice is not received and the Contractor has verbally indicated there will or might be a claim, the records should be kept.

If such a claim is filed, it will be reviewed and settled at the lowest possible level in the following order; Field Office, District Office, Bureau of Construction and Materials, Secretary of Transportation or their designee, and then in Court. For this reason, accurate records will be needed. In situations of this type, accurate records and detailed descriptive daily diaries and/or reports will be very valuable in the presentation of KDOT's viewpoint.

2.10 MEASUREMENT AND PAYMENT

2.10.01 GENERAL

The Standard Specifications prescribes, in general, how measurements of quantities shall be made. This section, however, is not intended to be all-inclusive as it makes use of the words "Unless otherwise specified" which refers to the individual construction sections of the Standard Specifications.

Therefore before making any measurement on a project, the Field Engineer should study the Plans, Specifications and Special Provisions to determine first, what is to be measured, and second, how it is to be measured. Make no measurements for payment unless they are specifically provided for in the Contract Documents, or subsequent Change Orders.

2.10.02 EXTRA AND FORCE ACCOUNT WORK

See the Construction Management Systems (CMS) User Manual for detailed information.

2.11 RECORDS AND REPORTS

2.11.01 GENERAL

This section covers the basic records and reports that are essential for each construction project. Additional reports that may be considered necessary for the proper administration of a project shall be prescribed by District Engineers.

2.11.02 CORRESPONDENCE

The Field Engineer shall furnish the District Office with a copy of all outgoing correspondence, and retain a copy in the project office file. Similarly, provide the District Office with a copy of any incoming correspondence that would be of interest to the District Engineer. Any incoming correspondence covering matters outside the authority of the Field Engineer shall be forwarded to the District Office for appropriate action.

2.11.03 PROJECT DIARY

See the Construction Management Systems (CMS) User Manual for detailed information.

2.11.04 FIELD RECORDS

See the Construction Management Systems (CMS) User Manual for detailed information.

2.11.05 CHANGE IN PLANS AND CONSTRUCTION

See the Construction Management Systems (CMS) User Manual for detailed information.

2.12 PAYMENTS

2.12.01 PROGRESS PAYMENTS

See the Construction Management Systems (CMS) User Manual for detailed information.

One essential function of all supporting source documents is to provide positive evidence of the actual performance of the work. This verification is provided by additional entries such as reference to other records, dates and signatures.

In addition to CMS, there are numerous KDOT forms used to document work on the project.

The following details will provide additional information as to how to prepare the source documents:

COMPUTATION SHEETS

Computation sheets shall serve as the source document when the estimated pay quantities are determined from computations based on quantity of completed work, as in the case of concrete pavement, or based on plan dimensions in the case of structures. Structural and reinforcing steel calculation sheets, summaries of asphalt and cement quantities received, on hand, wasted and used are examples of other types of computation sheets.

Regardless of the medium used for these records, whether computation sheets or computations in a notebook, they must be indexed and filed so they are readily available for preparation of other records or audits. All computations should be referenced to the source data, and dated and initialed by the persons making and checking the computations. They should be carefully reviewed by the Field Engineer.

LOAD TICKETS

Summarize the various types of load tickets daily, with a work sheet for an accumulated total as the work progresses.

The field notebooks shall be the source documents when field measurement, count, tally or meter reading represents the pay quantities. It shall also be used as the source document for recorded estimated quantities when the quantities are determined by examination of the Plans by visual approximation of the work performed, as in the case of excavation. It is essential that all measurements, counts, tallies or estimates be dated and signed by the person making the determination.

MATERIAL TEST REPORTS

The quantities of some material will be obtained from material test reports or from calculations furnished by the Bureau of Construction and Materials.

Maintain computation sheets or summary records to account for the quantities received, on hand, wasted and used.

2.12.02 FINAL PAYMENT

See the Construction Management Systems (CMS) User Manual for detailed information.

Provide positive evidence to support payment to the Contractor. Generally, the form in which these records are kept will be left to the Field Engineer following the instructions contained in this Manual, the Construction Form Manual, Documentation Manual and the Construction memoranda.

PLANS AND CHANGE ORDERS

Refer to the back of this section for a listing of items requiring recaps. The Bureau of Construction and Materials will still reserve the right to request any recaps or computations if they are deemed necessary. If the plan quantities are changed during construction, the computation accompanying the Change Order becomes the source document.

Since the computation will be based on field measurements, make a reference on the computation sheet to the appropriate field notebook. The typed copies of the recapitulation and computation sheets shall be signed by the Field Engineer and initialed by the persons making the tabulations, computations or check. Date and sign all check measurements entered in the field notebook.

COMPUTATION SHEETS

Computation sheets will serve as the source documents when the actual pay quantities are determined from computations based on dimension measurements of area or volume made in the field. The individual computing and checking quantities should initial the computation sheets. The Field Engineer should carefully review the completed computation sheets.

LOAD TICKETS

The pay quantities represented by the load tickets will be in units of tons, cubic yards, or M Gallons. Pick up the tickets at the point of delivery and initial at that time. Total and package the tickets for each day's work. File the bundle of tickets with the summary tape.

When the trucks are measured for capacity, record this information in the field notebook, with the signature of the Inspector making the measurements.

In the case of water trucks, which may be calibrated by weighing, record the ticket information in the field notebook and file the ticket.

FIELD NOTEBOOKS

The field notebook will be the same as the source document when the actual field measurement represents the pay quantities. All field measurements shall be dated and signed by the person making the measurement. The field notebook is also the source document when used as a tally book for load deliveries.

At the end of this section there are lists providing additional information on contract units of pay and suggesting field records and source documents. The source documents are not limited to this list. Any document used as a source document must be a part of the permanent project records.

The Documentation Manual illustrates a number of methods that have been used in preparing field records and sources. In all cases, check the Specifications for the required method of measurement.

2.12.03 COMPUTATION OF FINAL QUANTITIES

Final pay quantities will be paid for at the units and measurements specified and will be verified by computations or recap summaries. If final quantity is the same as plan quantity, no recaps are necessary.

2.13 COMPLETED CONSTRUCTION PLANS

2.13.01 GENERAL

Each Field Engineer shall keep on file one extra set of Plans for each grading, paving, or bridge project, or portion of a project, upon which they shall show all changes in the Plans. Use a clean, unused set of prints, and make sketches and notations thereon in permanent black ink showing all major and minor changes in Plans. This set of Plans will be the Completed Construction Plans and should be an exact representation of the finished work. Changes in Plans which require approval shall be shown on this set of prints immediately after the Field Engineer obtains the necessary approval. Changes in Plans which require no preliminary approval shall be shown on the Completed Construction Plans shortly after the change has been adopted. No excuses will be accepted for failure to keep this set of prints up-to-date. Letter all notations placed on the prints as neatly as possible.

This set of plans does not relieve the Contractor responsibility from providing KDOT with a set of As-Built construction plans according to Section 802-Contractor Construction Staking of the Standard Specifications.

The title sheet shall bear the following label placed in some convenient blank space:

COMPLETED-CONSTRUCTION PLANS

_____PROJECT AS CONSTRUCTED

PREPARED BY _____FIELD ENGINEER
(Written Signature)

DATE_____
The purpose of these prints is to show the job as-constructed.

The plans shall show the following information:

(a) Earthwork and Culverts:

- Any change in alignment.
- Changes in grade line.
- Changes in structures, noting elevation of flow line.

- Entrances added or omitted.
- Rock encountered showing class and elevation (show on final cross sections). Locations of springs or definite points of water seepage.
- Limits of any unusual excavation material which required special treatment, and the nature thereof.
- Changes in channels, special ditches or berms showing width and elevations.
- Location of government benchmarks and number on brass plate, also elevations using project level datum.
- New benchmarks established during construction and the elevations thereof.
- Changes in right-of-way lines and distances.
- Locations of right-of-way markers as set.
- Changes in surfacing and any entrances or new areas surfaced from that shown on the Plans.
- Established references on all cornerstones found during construction and list same on Plans.

For each excavation pit and channel change, make a notation on the plan-profile sheet referring to the cross-section sheet or sheets on which the construction cross-sections for the pit or channel are plotted. Show the corrected location of any appreciable errors found in the locations of side roads, section lines or property fences, buildings, roadway structures, or other important landmarks.

All other information of special interest not listed in the preceding instructions.

(b) Bridges:

- Changes in stationing.
- Changes in design of structure, showing dimensions.
- Change in size or type of footings.
- Changes in depth of footings, showing elevations.
- Note the class of material encountered in footings, and show elevation of rock or shale.
- Maximum and minimum lengths and kind of piling driven in each footing (i.e. 16 treated timbers, 27' 3" to 32' 4"), also include bearing of individual piles seated in footing & show sketch of footing with pile.

The Field Engineer shall use this set of Plans in making the final inspection before asking the District Engineer to make their final inspection. When the work has been entirely completed, the Field Engineer shall send the Completed-Construction Plans to the District Engineer for further handling, placing the following information on the outside of the wrapper:

District Number
Project number
Type
Under Project Number, place the following: “Completed-Construction Plans”

Send a letter accompanying each set of Completed-Construction Plans, calling attention to any changes which are not clearly shown on the Plans, and noting the numbers of the Plan sheets on which such changes occur. Clip this letter to the title sheet of the Plans. Enclose all final cross-section sheets with the Plans, being sure to label the cross-section sheets as "Final Cross-Sections". The District Engineer shall forward the Completed-Construction Plans, but not the cross-sections, to the Bureau Chief of Road Design for recording the changes on the original tracings.

After the Bureau of Road Design has transferred all changes noted on the Completed-Construction Plans to their tracings, the Completed Construction Plans will be returned to the District Office for file.

Prepare and submit Completed-Construction Plans on all construction projects including Base and Surfacing projects on the State Highway System. This does not include Contract Maintenance projects such as Asphalt Sealing and Light Type Surfacing, where no plans exist. However, changes in these items should be shown on the Completed-Construction Plans when this work is constructed as a part of the Contract for other types of construction.

Include in the Completed-Construction Plans the Geology sheet for bridges prepared in the Topeka office from the Log of Pile Driving after construction of the bridge.

In lieu of making Completed Construction Plans on county secondary "C" and "U" funded (Urban) projects, a letter may be submitted with the final papers for the project portraying major changes that were made on the project. Forward the original copy of the letter to the Chief, Bureau of Local Projects with copies to the District, the Bureau of Construction and Materials, the State Road Engineer of the Design Department and the County and/or City Engineer.

The letter should contain such items as the following:

(a) Earthwork & Culverts

- A revised list of benchmarks.
- Location of government benchmarks.
- Major changes in alignment.
- Major changes in grade line.
- Established references on cornerstones.
- Major changes in location of drainage structures.
- Major changes in flow line of drainage structures.
- Drainage structures added or deleted.
- Any change of access control.

(b) Bridges

- Changes in stationing.
- Changes in type, size or elevation of footings.
- Changes in grade line.

2.13.02 BENCHMARKS ON COMPLETED PROJECTS

In location and preliminary survey work, the Bureau of Road Design finds that information on benchmarks which have been established on previously completed construction projects may save them much time and expense.

After completion of grading or bridge projects on the State Highway System, submit the following information for all permanent benchmarks on the project:

Benchmark No. Station Elevation Description

Only one copy of the report will be required. It may be in the form of a letter and should be sent to the Bureau Chief of Road Design.

2.14 GPS READINGS FOR ACCESS POINTS

During a construction project, accesses may be added, consolidated, or removed. Those changes need to be reflected in the CANSYS database to keep an accurate record of access to our highways. All highway accesses to our state system, whether to a private home, a city street, or a business, are located by latitude/longitude readings and stored in CANSYS.

When a construction project is complete, the latitude/longitude points for new or consolidated access points need to be collected and submitted to the access database manager at headquarters to be downloaded to the CANSYS database. Contact your Area Utility Coordinator for assistance in collecting the latitude/longitude information. An existing data dictionary in the handheld GPS unit can be used or a new data dictionary can be created. The following basic descriptors are needed for each access:

CANSYS DATA		
DESCRIPTOR	FORMAT	EXAMPLE
District Number	2 placeholders	03
Area Number	2 placeholders	01
Subarea Number	2 placeholders	02
Access Type	1, 2, 3, 4, 5, or 6	5
City	Name	Phillipsburg
County Number	3 placeholders	074
LRS Prefix	K, U	U
LRS Route	5 placeholders	0036
LRS Suffix	1 placeholder (Alt, Bus, or Spur)	B
LRS Unique Identifier	1 placeholder	1
Centerline	Right (R), Left (L), or Both (B)	L
Section	2 placeholders	26
Township	3 placeholders	003
Range	3 placeholders	018
GPS Longitude	Automatically entered by unit	-99.345098765
GPS Latitude	Automatically entered by unit	39.432106789
Project Number	Project that changed or added the access	KA-0871-01
Driveway Surface Type	Asphalt, Turf, Concrete, or Gravel	Concrete
Driveway Surface Width	Numeric	24
Date Collected	Automatically entered by unit	01/15/2011
Location Description	Text field (address/dist from known point)	145 Elm Street
Public Road Intersection	Yes (Y) or No (N)	N
Description of Work	Text field (Residence, field, business, etc.)	Business

Also, notify the Access Database Manager, Bureau of Transportation Planning, of accesses that were removed as part of the project so those accesses may be set to "inactive" and stored for historical reference. (If available, provide the permit number displayed in KGATE for the accesses to be set to inactive in the database. Otherwise, just provide the lat/long and the Project Number that removed it.)

The temporary GPS data email account has been set up. From now on please forward your access point GPS data to the following group in KDOT's Outlook address book:

#GPS_DATA

Please call the Corridor Management Administrator in the Bureau of Transportation Planning with questions or concerns.

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3.00 SURVEYING

3.01 GENERAL

3.01.01 PLAN INFORMATION

To facilitate project scheduling and accurate project staking, the Engineer will provide a staking package of electronic files upon request. A construction staking package can be obtained from the Bureau of Road Design and may contain all or part of the following: project control, cross-section data and GeoPak chain and/or coordinate data.

Obtain R/W point files and a hard copy of R/W plans from the Engineering Section of the Bureau of Right-of-Way.

Obtain preliminary survey information from the Bureau of Road Design.

Project survey information can also be obtained from the following link:
http://kdotapp2.ksdot.org/ProjectLetting/default.aspx

The staking as outlined in this manual is based on a typical project and may be adjusted for types of work, equipment used and terrain over which it was constructed.

Immediately after centerline and R/W are staked, the Construction Engineer and Contractor should review the project with plans in hand for location and alignment of structures and culverts, guardrail and other miscellaneous features. At this time, address discrepancies and adjustments to minimize project delays.

Check the title sheet or the first and last plan and profile sheets for coordinates. These may be state plane coordinates, Lambert adjusted coordinates, or just project coordinates. Whichever they might be, it will be an indication they have used coordinates to design the project. Therefore, the coordinates for all centerline control points, baseline points, section line points, R/W points, horizontal control monuments, (if any were set by the original survey crew) are available through the Bureau of Road Design.

Obtain permission prior to entering any property for the purpose of surveying or locating control points. Never drive a vehicle on a tract of land without prior consent from the owner or manager.

3.01.02 SURVEY ON LOCAL PROJECTS

Keep surveys on Local Projects as complete and accurate as for those on the State System. This is especially important when soundings have been made to determine the geology under the structure or on railroad structures.

3.01.03 STAKES

Use the three standard types of stakes: Type “A”, Type “B”, and Type “C”. The design for each of these three types of stakes is shown on FIGURE No. III-1.

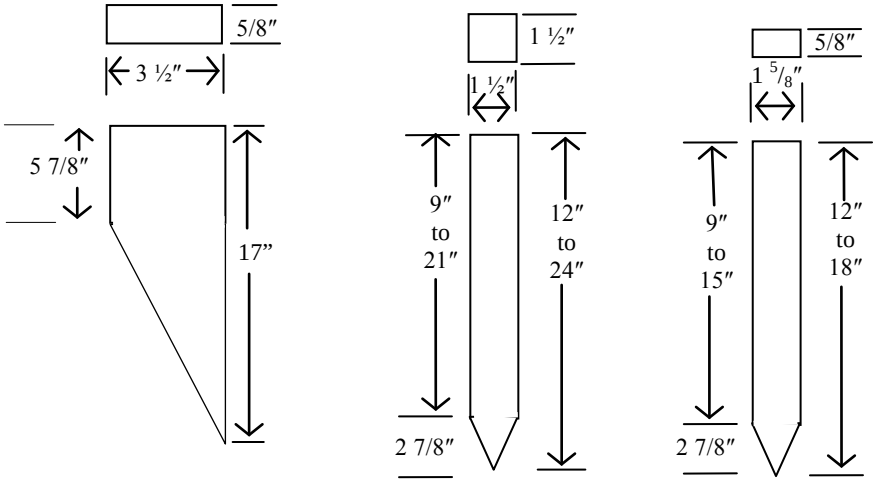
To facilitate identification of construction stakes on a project, a system of color-coding may be used with Type “A” stakes. An example might be to paint right-of-way stakes red, slope stakes white, and structure stakes yellow.

Special stakes may be obtained at times for specific jobs such as the hickory “spoke” stakes. This stake is sometimes used as a finishing stake when the subgrade is very hard. The stake is similar to Type “C” stake, except that the bottom half is turned down to a rounded section.

Use lath, wire flags and flag devices attached to the top of the stake to “mark” or “guard” stakes. Typically, wooden lath is approximately 1½"x ¼"x 48". Laths may also be color coded for easier identification by the use of solid or striped painting, colored cloth, or colored plastic flagging. Colored flags fastened on a wire stem or attached to the top of the stake are also convenient for use as markers or guards.

Finishing grade stakes are normally Type “C” stakes with the tops colored blue; however use other types of stakes if the condition warrants. The color coding blue is universally known and accepted as a finish grade. Do not abuse this traditional acceptance by using the color blue on stakes or by using stakes that have been marked with blue tops for other staking. Never use the blue color-coding on the top of any stake that is not set to grade.

FIGURE No. III-1 - CONSTRUCTION STAKES



TYPE “A”	TYPE “B”	TYPE “C”
Use for slope stake, guide stake, R/W stake or centerline stake.	Use for grade stake, hub stake, reference stake or blue top stake.	Use for blue top stake, if conditions permit. When this type is not suitable, use Type B for blue top stakes.

3.01.04 SIGNALS

Except for short distances, a good system of hand signals between different members of the party makes an efficient means of communication than is possible by word of mouth. The number of signals necessary will depend upon the character of the work and the nature of the terrain. A few of the common signals are given below.

Right or Left: Extend the arm in the direction of the desired movement, the right arm being extended for a movement to the right and the left arm for a movement to the left. A long, slow sweeping motion of the hand indicates a long movement; a short, quick motion indicates a short movement.

Up or Down: Extend the arm upward or downward with wrist straight. When desired movement is nearly completed, the arm is moved towards the horizontal.

All Right: Extend both arms horizontally and the forearms waved vertically.

Plumb the Range Pole or Plumb the Rod: Hold the arm vertically and move in the direction that the range pole or rod is to be plumbed.

Give a Foresight: The instrument person holds one arm vertically above their head.

Establishing a Turning Point or Set a Hub: The instrument person holds one arm vertically above their head, and waves it in a circle.

Give line: The flagger holds the range pole horizontally in both hands above their head, brings it down and turns it to a vertical position. If desired to set a hub, wave the range pole from side to side with one end in the ground.

Turning Point or Benchmark: In profile leveling, the rod person holds the rod horizontally above their head and then brings it down on the point.

Wave the Rod: The leveler holds one arm above their head and moves it from side to side.

Invert Telescope: The flagger holds the range pole in a vertical position and moves the top of the range pole in a circle.

Pick Up the Instrument: Both arms are extended outward and downward, then inward and up, as one would do in grasping the legs of the tripod and shouldering the instrument.

Number signals are as follows:

One: Right arm extended 45° above horizontal
Two: Right arm extended horizontally
Three: Right arm extended 45° below horizontal
Four: Left arm extended 45° above horizontal
Five: Left arm extended horizontally
Six: Left arm extended 45° below horizontal
Seven: Both arms extended 45° above horizontal
Eight: Both arms extended horizontally
Nine: Both arms extended 45° below horizontal
Zero: Both arms forming a 0 over head

Take care to make the signals so they can be understood.

3.02 FIELD NOTES

3.02.01 WRITTEN FIELD NOTES

Keep field notes in standard commercial bound field books, except in cases where loose-leaf notes are approved by the Construction Engineer. Do not keep notes for more than one project in the same book. On large projects, certain notes, such as surveys for documentation of pay quantities, may necessitate separate books for each part of the project.

Reserve a few sheets in the front of the field book to thoroughly index each field book. In ink, in the front of each book, show the section and number of the project, the Construction Engineer's name and address, and the staker's name and address.

Establish a numbering system so that all books for a particular project have a specific number and/or letter designation. It is convenient to establish a referencing system, which is flexible enough to fit all projects so that specific books on all projects carry similar numbers. On the front of the field book, show the project number, book title or contents, and the book designation. With a well-planned reference system of field books, a master list may be kept. This simplifies cross-referencing source documents, and helps to keep account of all field books.

The purpose of keeping field notes is to record the action taken as the survey progresses, document the basic location of the project, and show the action taken in correcting minor discrepancies of the plan alignment.

The condensed form of notes rather than the staggered or loose form is recommended for several reasons. This form is the one most universally used, and therefore most generally understood. It requires less space and for this reason is the preferable form for recording peg-leveling notes for slope stake and grade stake notes, finishing stake notes, pavement form stake notes, and cross-section notes. Make all notes in small letters or figures.

In general, keep notes in separate books as follows:

- Alignment
- Topography
- Benchmark and Adjustments
- Original cross-sections and streambed profiles
- Slope stakes and grade stakes
- Culvert staking
- Bridge staking (each bridge separate book)
- Finishing stakes
- Guardrail and guide posts
- Surfacing staking
- Signing and delineation

On smaller projects, it is not always necessary to break down the books as listed above, since some items may be combined. Combine such items as deemed proper.

At the beginning of each day's work, show the date, weather condition, and the name and duties of the various members of the survey party at the top of the page. Number each page in the upper right-hand corner of the right half of the page. The back side of one sheet and the front side of the adjacent sheet are considered one page. Record field notes with a well-sharpened, hard-lead pencil. Keep notes as clean and neat as possible.

Do not erase. Draw a line through an erroneous notation, and write the correction above or to one side. Include the initials of the party making the correction. Record field notes in the notebook as the work progresses. Do not make field entries of notes on loose paper or in memorandum books.

Many Surveyors make their field notes too brief for clarity and arrange poorly so that it is difficult to interpret the full and correct meaning, though all the necessary information is shown. Keep complete, neatly recorded field notes, logically arranged, so that the correct and complete meaning is readily grasped by any qualified Surveyor.

Use the following adopted abbreviations and symbols in construction field notes:

Point of Curve (horizontal) = P.C.
Point of Tangent (horizontal) = P.T. or P.O.T.
Point of Intersection (alignment tangents) = P.I.
Change from Tangent to Spiral = T.S.
Change from Spiral to Curve = S.C.
Change from Curve to Spiral = C.S.
Change from Spiral to Tangent = S.T.
Horizontal Control Point = H.C.P. (GPS geodetic)
Point on Curve = P.O.C.
Midpoint on Curve = M.O.C.
Point on Curve (vertical) = P.V.C.

Point of Tangent (Vertical) = P.V.T.
Point of Intersection (grade tangents) = P.V.I.
Beginning of Superelevation = B.S.
End of Superelevation = E.S.
Beginning of Maximum Superelevation = B.M.S.
End of Maximum Superelevation = E.M.S.
Guide Stakes = G.S.
Grade Stakes = Gr. S.
Slope Stakes = S.S.
Grade Point or Zero Point = 0.0 Pt.
Cut = C.
Fill = F.
Top of Rock = T.R.
Bottom of Rock = B.R.
Backsight or Plus sight = +S.
Foresight or Minus Sight = -S.
Benchmark = B.M.
Traverse Point = T.P.
Centerline =U
Reference Point = R.P.
Fence = Fc.

Study the Documentation Manual and use as a guide for proper documentation. For additional information on field notes and documentation, see the Standard Specifications and Special Provisions for Contractor Construction Staking.

3.02.02 ELECTRONIC FIELD NOTES

Electronic field notes gathered using data collectors or handheld computers should have the same credibility as field notes taken in a book. Electronic field notes may be substituted for written field notes, if the electronic notes contain all the information specified.

When kept electronically, take field notes compatible with KDOT's system. Contact the District Land Surveyor to check compatibility.

Observe the same care and procedures used with field books as with data collectors. The major advantages of data collection systems are that mistakes in reading and recording measurements in the field are eliminated and the time to process, display, and archive the notes is reduced.

Do not change the information gathered in the collector at any time. Forward copies of all original notes to the District's Land Surveyor for review and approval. Most collectors will not allow editing of the data. However, if editing is allowed, do not modify the original files. If necessary, include sketches in field books if it will help to clarify the notes in the collector. Reference these sketches in the collector and in the book.

Just as with books, include the date, crew, weather, and project description at the start of each file in the collectors, prior to the start of the job. Keep notes in the collector, if they will help in the explanation of the data.

At the end of the day, download the raw data from the collector in binary format into a

computer for editing and processing. At this time, acquire a hard copy of the non-edited file and sign by the survey crew chief. This will help with the legality of the survey should a problem arise. Make a copy of the non-edited file to a disk, and archive both disk and hard copy for future use. Never edit the original file; keep it just like an original field book. If problems or questions arise over the use of the collector, contact the District's Land Surveyor for clarification.

3.03 SURVEYING EQUIPMENT

3.03.01 RECEIPT OF EQUIPMENT

The Construction Engineer may acquire surveying equipment from the District Office. The Construction Engineer will issue a Purchase Authority Continuation Sheet (Form No. 452), transferring equipment to the District or to another Construction Engineer. The District Office will determine responsibility for equipment solely by the receipts on file with the District Office.

The Construction Engineer will be responsible for all missing equipment and for all unreasonable damage to the equipment.

The District Office will purchase all surveying equipment, hand levels, range poles, field notebooks, etc.

3.03.02 ANNUAL INVENTORY

Each year, before the close of the fiscal year, a complete inventory of all audited equipment will be conducted. The District Office will assist the Construction offices with this inventory. The District Office will return one copy of the inventory to the Construction Office.

3.03.03 SERIAL NUMBERS

The District Office will place serial numbers on all new surveying equipment with a purchase price over $5,000.00.

3.03.04 CARE AND USE OF SURVEYING EQUIPMENT

The District Land Surveyor shall establish guidelines for equipment handling and transporting. Handle and use all equipment according to these guidelines. Any damage to equipment resulting from negligence may cause disciplinary action be assessed against any employee responsible for the equipment at the time the damage occurs.

Never leave the equipment unattended.

The District Land Surveyor will inspect all surveying equipment at least once each year, or when damaged. The equipment may be sent to an approved instrument repair shop, for repair, cleaning and adjustments.

Field employees shall keep the external parts of the instruments clean. Field employees shall not take any instrument apart, but may find it necessary to make the simpler adjustments of the instruments from time to time in order to obtain proper results in their fieldwork.

When not in use, keep all surveying instruments in their respective boxes to preserve the condition of the instruments.

Do not expose instruments to rain, snow or rapid changes in temperature. Use a hood in emergencies to protect them from weather until they can be put in their cases. Exercise care to keep the instrument as nearly at a uniform temperature as possible. Do not suddenly move an instrument from outside freezing weather into a heated room.

3.03.05 MAINTENANCE OF SURVEYING INSTRUMENTS

The District Land Surveyor shall provide procedures or training for equipment maintenance. Perform all other maintenance work to instruments according to the manufacturer's recommendations by approved personnel or repair shops designated by the District Engineer.

3.04 SURVEYS FOR EARTHWORK

3.04.01 CHECKING GRADE

Check all grade elevations on the plan-profile sheets before any grade stakes or slope stakes are set. Make a neat set of grade computations when checking plan grade elevations and keep a set on file for future reference. Compute all pluses for which elevations will be required in addition to those points at which elevations are shown on the plans.

In checking grade elevations in vertical curve area, the following formula may be used to compute the mid ordinate for vertical curves:

$$E = \frac{DN}{8}$$

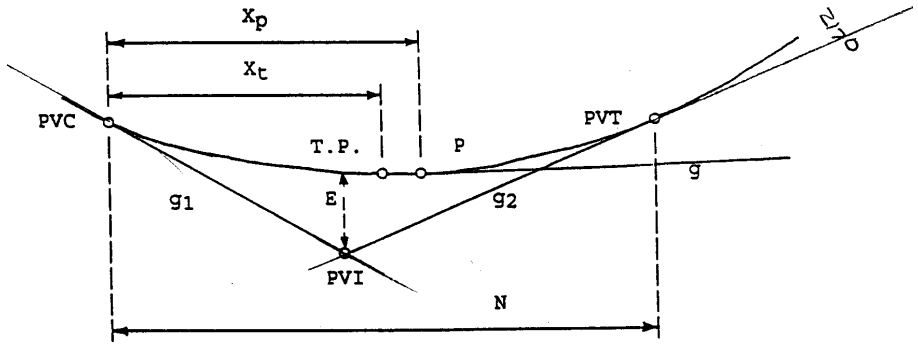
Where E is the mid ordinate, D is the algebraic difference in grades (percent), and N is the length of the vertical curve in stations.

The value of any intermediate vertical ordinate may be determined from the theory of a parabola, namely, that the vertical ordinates will vary as the squares of the distances. For instance, an ordinate 49 feet from the P.V.C. of a 600-foot vertical curve would equal

$$\frac{(49)^2}{(300)^2} \times E$$

To compute plan grade at any point in the vertical curve area, compute the tangent grade at the intermediate point. To obtain the plan grade of the intermediate point, add (for sag vertical curves) or subtract (for crest vertical curves) the value obtained for the ordinate of the intermediate point, as computed above, to the tangent grade.

FIGURE No. III-2 - VERTICAL CURVES



TERMS:

D = Algebraic Difference in grades (g2 – g1)

E = Midordinate of V.C. in feet

N = Length of V.C. in Stations
g_1 = Percent of Tangent grade from PVC to PVI
g_2 = Percent of Tangent grade from PVI to PVT
g = Percent of Tangent of any point on V.C.
P = Any point on V.C.
T.P. = Turning Point (Lowest Point on a sag; highest point on a crest)
Xp = Distance in Sta. from PVC to P.
Xt = Distance in Sta. from PVC to T.P.
r = Rate of Change of Grade (% per Sta.) $= (G_2 - G_1)/ N$
L = N/2

FORMULAS:
Elev. "P" = PVC Elev. + $G_1(Xp) + (r / 2)x^2$
Midordinate E = DN / 8 ; or $E= ½ G_1L + ½ (G_1L + G_2L)$
Any Ordinate = $\frac{(\text{Dist. from PVC})^2}{(N/2)^2} \times E$
Dist. to T.P. = $(G_1N) / (G_1 - G_2)$
Dist. to point where tan. grade is "G"; $Xp = (G – G_1) / r$

3.04.02 EARTHWORK SHRINKAGE AND SETTLEMENT

a.Definitions.

(1) Percent Shrinkage. When the construction does not include earthwork compaction, the percent shrinkage, as determined by earthwork computations based on end areas obtained by plotting the final cross-sections against the construction survey original cross-sections, is not a true percent shrinkage according to the above definition. It is based on a partial shrinkage, since an indefinite time is required for any embankment to obtain its full shrinkage, and the embankment will continue to shrink after the final cross-sections have been taken. However, the percent shrinkage as determined by the earthwork computations based on end areas obtained by plotting the final cross-sections against the original cross-sections is the percent which should be shown on Recapitulation of Earthwork Quantities (Form No. 266) in the column labeled "Computed % Shrinkage of Earth".

(2) Allowance for Earthwork Shrinkage and Settlement. When preparing plans, Design includes calculated lump sum quantities for initial consolidation and settlement in addition to a Volume Multiplication Factor to be applied to the excavation quantities. This is necessary to balance the earthwork quantities.

(3) Initial Consolidation. This is the additional embankment quantity resulting from foundation treatment as shown on the plans, and compaction from general construction activity within the construction limits. This also includes additional quantities resulting from losses in the bottom 6 inches due to compaction in cuts in soil mantle.

(4) Settlement. The vertical distance that the surface of the embankment settles after completion of the construction operations shall be known as the "settlement" of the fill.

Settlement is also the additional embankment quantity resulting from consolidation of soil mantle under embankment sections.

(5) Volume Multiplication Factor (VMF). This factor is used on the plans in lieu of a shrinkage and swell factor. The Volume Multiplication Factor is the quantity of embankment

which can be constructed from 1 cubic yard of excavation. When a balance contains rock as well as common excavation, either the (percent shrinkage) for earth or the Volume Multiplication Factor (percent swell) for rock must be known or assumed before the other can be computed. In this case, assume the percent shrinkage for earth is the same as the percent shrinkage for earth in an adjacent or nearby balance containing no rock excavation, or assume to be equal to the average percent shrinkage for two adjacent balances, or several nearby balances which contain no rock excavation. After determining the percent shrinkage of earth, determine the volumes of earth and rock in the fill.

b. General. The computation of earthwork quantities is not an exact science. This is due in part to the fact that initial consolidation and settlement cannot be measured in the field. However, the combined effect of these three items can be measured by a comparison of the excavation quantities with the embankment quantities as determined from the original final cross-sections.

FIGURE III-3 shows the allowances made for settlement of fills of various depths, built with various types of equipment, with compaction only from the hauling equipment.

The allowance for settlement shown in FIGURE III-3 is not applicable to all conditions. It is a helpful guide to the Engineer in determining the allowable amount of settlement for various types of work. The amount a fill will settle after the construction work is completed depends upon the composition of the fill; that is, the type of soil and the percent of rock. Other factors, such as the weather conditions during construction and the speed or expedition with which the work is prosecuted, have important bearings upon the amount a fill will settle after construction has been completed. These factors cannot be predetermined at the time the slope stakes and grade stakes are set, so make no allowance for them when estimating the amount of allowable settlement when setting slope and grade stakes. In general, make the same allowances for settlement when setting the finishing stakes as were made when setting the slope and grade stakes; and disregard such factors as the weather conditions and the speed of construction.

FIGURE No. III-3 - ALLOWANCE FOR SETTLEMENT OF EARTHWORK
(Without Compaction)

Type of Work	Depth of Fill	Allowance of Settlement
Casting	0'-1'	0.00
	1'-2'	0.2'
	Over 2'	10%
Hauling	0'-1'	0.00
	1'-10'	5%
	Over 10'	0.5'

On sections where compaction of earthwork is specified, set the stakes to plan-grade elevation. The finish grade shall conform to the stakes as set.

When compaction of earthwork is not specified, fills containing a large percent of rock, from 25 to 50%, will probably settle more than fills that do not contain rock. Fills containing

75% or greater rock will probably settle very little, so do not allow for settlement.

Completed earthwork quantities are shown on both the plan-profile and the summary of quantity sheet.

Following is a basic example of a computer printout of end areas and accumulated quantities, which may be included in the plans. The example after indicates a minimal type listing of balance notes and information on plan-profile sheets and earthwork tabulations on summary of quantity sheets. See FIGURE III-4A & III-4B.

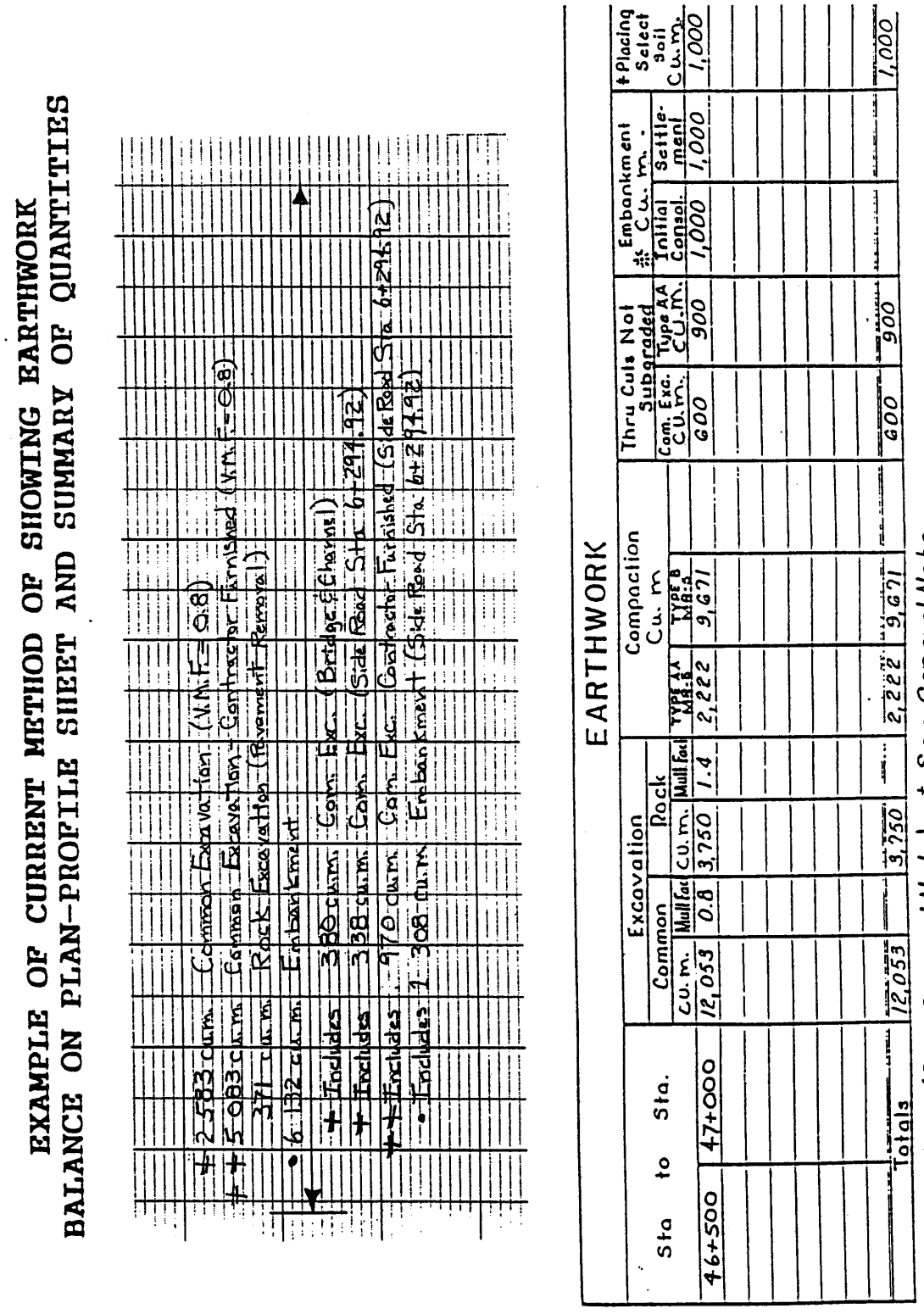
CHANGE AT STA. 465+00 VOLUME MULTIPLICATION FACTOR 'MANTLE' 0.8
MODIFY VOLUMES AT STA. 469+25 'FILL' 1000 $ SETTLEMENT FROM STA. 465+00 TO STA. 470+00
MODIFY VOLUMES AT STA. 469+50 'FILL' 1000 $ INITIAL CONSOLIDATION FROM STA. 465+00 TO STA. 470+00
MODIFY VOLUMES AT STA. 469+75 'FILL' 1000 $ SELECT SOIL FROM STA. 465+00 TO STA. 470+00
FORCE SUMMARY STA. 470+00

BASELINE STA.	MATERIAL NAME	END AREAS	—UNADJUSTED VOLUMES— INCR	FROM BAL	ACCUM	MULT FACTOR	—ADJUSTED VOLUMES— INCR	FROM BAL	ACCUM
465+00	CHG IN MULT FACT								
	FILL	305	0	0	0	1.000	0	0	0
	MANTLE	329	0	0	0	0.800	0	0	0
	ARGT1LSR	400	0	0	0	1.400	0	0	0
469+00	FILL	919	9067	9067	9067	1.000	9067	9067	9067
	MANTLE	72	2970	2970	2970	0.800	2376	2376	2376
	ARGT1LSR	100	3704	3704	3704	1.400	5186	5182	5186
469+25	MODIFY VOLUMES								
	FILL	841	1815	10822	10822	1.000	1815	10882	10882
	MANTLE	124	91	3061	3061	0.800	73	2449	2449
	ARGT1LSR	0	46	3750	3750	1.400	64	5250	5250
469+50	MODIFY VOLUMES								
	FILL	763	1743	12625	12625	1.000	1743	12625	12625
	MANTLE	176	139	3200	3200	0.800	111	2560	2560
469+75	MODIFY VOLUMES								
	FILL	685	1670	14295	14295	1.000	1670	14295	14295
	MANTLE	229	187	3387	3387	0.800	150	2710	2710
470+00	FILL	607	598	14893	14893	1.000	598	14893	14893
	MANTLE	281	236	3623	3623	0.800	189	2899	2899
470+00	FORCED SUMMARY								
	FILL		598	14893	14893	1.000	598	14893	14893
	MANTLE		236	3623	3623	0.800	189	2899	2899
	ARGT1LSR			3750	3750	1.400		5250	5250
	BORROW				8430	0.800		6744	

14,893 Total Emb.
-2,000 Initial Const. & Settlement
12,893
-1,000 Select Soil
11,893 Plan Quantity

FIGURE No. III-4A - END AREA QUANTITIES

FIGURE No. III-4B - EARTHWORK TABULATIONS



3.04.03 CHECKING ALIGNMENT

The Contractor should check alignments, and when possible KDOT should also perform a check. The essential purpose of checking the alignment of the project is to check the angles and the distances as shown on the plans, and to orientate the project to the correct land ties.

The first fieldwork is to check the alignment with the plans, establish any new required control points, reference existing points and check topography. Establish the baseline or centerline as the alignment is checked.

Check these essential items:

- the measured lengths between various control points of the alignment; and
- the interior angle of the intercepting tangents.

See FIGURE No. III-5 for an example of a field book prepared in the office and completed in the field.

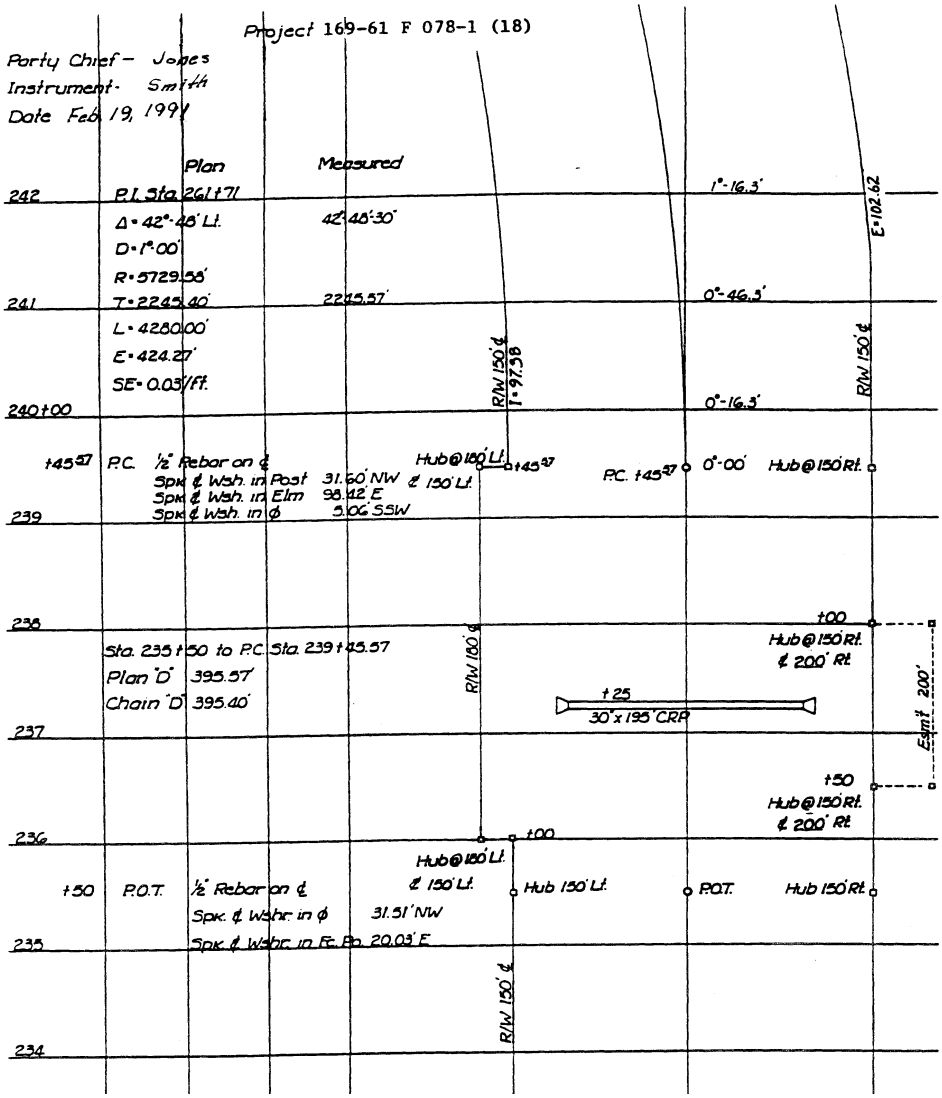
3.04.04 RECOVERING CENTERLINE

Reestablish the centerline of the project. The plan control points shown as P.O.T.'s and P.I.s can be located from the reference data given on the plans. Establish these control points ½ to 1 mile in advance of the centerline survey to provide the instrument person with the necessary control points. It is the intent to follow the points established on the preliminary survey, and make adjustments in stationing and alignment between the nearest P.I.s and P.O.T.'S. From some selected plan control point, designated as the starting point, the centerline of the project may be reestablished.

As the centerline is reestablished, check the distances to the nearest section corner or other public land monument at every opportunity. This can be most readily accomplished by setting a centerline point on the observed section line as the two lines intersect; then measure the distance to the nearest observed section or fractional section corner or radially checking the plan location. The plans should show some reference to local land monuments.

As copies of right-of-way descriptions are received by the construction offices, they can be checked against the measurement shown on the plans, which in turn, have been checked against field observations. If right-of-way descriptions are available at an earlier date, check the plan data against the legal description, prior to beginning construction surveys. Report any discrepancies to the District Land Surveyor.

FIGURE No. III-5 - ALIGNMENT NOTES



3.04.05 STAKING CENTERLINE

Use 40-penny nails with red plastic tied at the top for the centerline markers whether the alignment follows an old roadway or is relocation. The nail affords a definite point from which to make linear measurements.

Mark the centerline or baseline at 100-foot intervals on tangents, flat vertical curves, and horizontal curves with a radius longer than 750 feet. On sharp vertical curves and horizontal curves with a radius of 750 feet or less, set nails on the centerline at 50-foot intervals.

Set a nail on centerline or baseline at all plus stations at which it will be necessary to set grade stakes, so that the grade stakes may be offset with greater facility. Accurately set centerline nails in their true positions at all stations or plus stations where the width of right-of-way changes. Right-of-way stakes at such points may be accurately set by the use of a theodolite or a total station.

3.04.06 CHECKING ANGLES

If an angle does not check with the value shown on the plans, measure it by repetition; measuring the angle with the telescope in direct position a number of times, and an equal number of times with the telescope in the inverted position.

If the mean value of the angle varies from the Delta angle shown on the plans by > 20 seconds, it may be necessary to redesign the curve. Keep in mind that a major change in the design of the curve will also cause the length of the project to be changed. As a further consideration, remember the right-of-way descriptions were written from the same information as that provided on the plans.

Never change the plan alignment without approval from the Construction Engineer and Designer, who can analyze the various factors that might become involved.

3.04.07 CHECKING THE DISTANCES

With the increased use of electronic equipment, the discrepancies between the measured distances and the plan distances should be less than 1:10,000.

When a second check by the survey party indicates that an error exists of more than 1:10,000, it will be necessary to write an equation in the stationing at the nearest control point. Record all equations in the alignment book. Variation in plan stationing may cause the construction quantities to be changed.

Analyze any apparent errors in stationing of control points for an overall adjustment. A control point might be incorrectly stationed on the plans, whereas two equations to correct this error in nomenclature would be superficial and confusing.

Measure all transverse and longitudinal measurements horizontally.

3.04.08 REESTABLISHING THE CENTERLINE REFERENCE AND CONTROL POINTS

a. References and Control Points. At all times, stake the centerline in advance of the construction work so that errors discovered in the Plans may be adjusted without causing delay. In general, it will be necessary to establish the centerline and set the right-of-way stakes for the entire length of the job as early as possible. This will allow that the property owners have ample time to remove obstructions such as fence, power and telephone poles, pipelines, etc., before construction commences on the project.

Do not place centerline control points more than 1,200 feet apart on rural projects and 500 feet apart on urban projects. In case the plan survey party has established them at greater intervals, the construction survey party shall establish new ones, so that the interval between any two adjacent points will meet the required distances noted above. Set additional points at each crest, each side of a bridge or stream crossing, each side road/intersection and other locations that are deemed as favorable prospects for future recovery.

On projects in which conditions exist that hinder, or prohibit, the establishment of the entire project centerline alignment, the following guidelines will be used to monument the basic alignment network of the project:

The beginning centerline alignment monument will be established on the project, along with all subsequent curve points, i.e. P.C., P.I., and P.T., and an ending centerline alignment monument. Offset points shall supplement this basic alignment network in the same manner as described for establishing monuments for an entire centerline alignment in the previous paragraphs.

The alignment monument shall be a ½-inch rebar of sufficient length to remain stable and in true position. It is not necessary to place an identification cap on an alignment point. Monuments shall be placed at a sufficient depth to be preserved during routine maintenance.

The following guidelines are presented for that effort:

Concrete Surfaces	Flush
Asphalt Surfaces	0.25 feet deep.
Pastures/ Other Highway Right of Way locations	0.50 feet deep.
Cultivated Fields	1.50 feet deep.
Crossing Fences Projecting	0.2 feet.

Offset points to be utilized for the alignment control shall be ½-inch rebar of sufficient length so as to remain stable and true in position. A 2-inch aluminum cap, center punched and with the point number stamped upon it, shall be placed on the rebar. These shall be set at a depth to prevent being disturbed by maintenance or farm equipment. Do not leave them flush with the ground line within the right of way.

Place control points so that it will be possible for the instrument person to occupy any one point to see at least 3 feet of a range pole held on either of the adjacent points or on any points along the centerline between the points. It will sometimes be necessary to establish new control points for future use, when the ruling distance or the topography of the ground might not necessitate it. It is also advantageous to establish additional centerline P.O.T.'s near the 0.0 points of deep cuts. Plan P.O.T.'s will be, as a rule, located near the maximum depth of cut. To reestablish P.O.T.'s at the latter mentioned locations often requires considerable work. The new points set near the 0.0 points allows for easy chaining and lining of the reference to the original control points.

As the centerline is set, establish points on centerline at each culvert location in order to save duplicate set-ups of the instrument.

Establish reference hubs at the P.C., P.T., T.S., S.C., C.S. and S.T. of all curves. If a curve is situated, or so long that it is impossible to stake the entire curve from the P.C. and P.T., establish a reference hub at each P.O.C. at which it is necessary to set up the instrument in staking the next portion of the curve. Tack and reference these.

Set at least two centerline references hubs on each side of each watercourse, on curves and tangents, where a bridge is required. Set these points back 100 - 200 feet from the proposed abutments, so they are not disturbed by bridge construction operations. On horizontal curves, reference hubs can be established at full or half station intervals in the ordinary process of running in the curves.

Drive and tack all hubs set to reference the centerline flush with the ground.

b. Control Points. Carefully reference all control points, if possible, to four suitable points. Check reference points shown on the Plans, and take new reference ties, when necessary. Choose reference points so that the angle determined by any two reference points and the hub shall not be less than 45°. This is necessary to get a definite point of intersection of arcs struck from the reference points. Situate reference points so that horizontal straight-line measurements from such points to the control point can be easily made.

When a steel bar or tacked stake is used for a reference point, drive it flush with the ground surface and the locations indicated by a guide stake marked "R.P." Circle other points, such as a cross in concrete or a drill-hole in a boulder with keel marks to aid in locating them.

Locate the reference points outside or on the right-of-way lines, except in cases where a permanent structure within the right-of-way is available for such use. If possible, locate the reference points on permanent objects. Measure reference ties to the nearest 0.01 foot with a steel tape.

3.04.09 STAKING HORIZONTAL CURVES

a. When instrument is set on the P.C. An expedient method of laying out a simple horizontal curve, after the P.C. and P.T. have been located and set from the computed tangent distant "T", is to set the instrument on the P.C. Place a zero reading on the vernier, and lock the line of sight on the P.I. Turn the telescope in the direction of the curve until the vernier reads the first angle, then set the first point. If the arc length to the first point is 100 feet, the angle of deflection will be D/2, but if arc length of the first point is less than 100 feet, then reduce the angle of D/2 in direct proportion of the length of that arc to the arc of 100 feet. Set all subsequent stations by accumulating the value of D/2 for each arc length of 100 feet. For curves with a "R" of 1900 feet or longer ("D" of 3° or less), the chord length is comparable to the arc length. For sharper curves of a shorter "R" (larger "D"), refer to curve table for a chord correction factor.

b. When instrument is set on the P.T. When the entire curve is visible from the P.T. and the basic curve layout is known to be accurate, it is possible to eliminate one setup by running the curve in with the instrument located at the P.T.

When the instrument is set at the P.T., with the telescope in its normal position, the instrument can be orientated by sighting the P.I., vernier reading Δ 1/2 (Delta), or by sighting on the P.C., vernier reading 00°00'.

With the instrument orientated as noted in the preceding method, the curve notes are the same as when computed for an instrument setup on the P.C.

c. When instrument is set on intermediate Point of Curve. After locating some part of the curve from the P.C., and it is not possible to view the remainder of the curve, move the instrument up to some located point on the curve. There are two methods to orientate the instrument to continue locating the curve.

Method A: Backsight on the P.C. with the scope inverted and the vernier reading 0; invert the scope, release the upper motion and turn until the original computed deflection for the sighted point reads on the vernier. Simply continue the curve using the original computed deflections as determined for the setup at the P.C.

Method B: Backsight on the P.C. with the scope inverted and the vernier reading the total deflection from the P.C. to the occupied point, reset the angle on the opposite side of 0. The scope is then plunged, release the upper motion and turn the vernier to 0, thus locating the local tangent to the occupied point. Re-compute the deflection to the remaining points. This procedure is convenient in locating and laying out a structure that is normal, skewed or rotated to the centerline of the curve.

On highway designs of four lanes or more, the curve data given on the plans will pertain to the centerline of the total roadway and not that of the lanes of travel. Since construction control will require some type of centerline control for each set of traffic lanes or even the right-of-way limits, it is suggested to stake the intrados and extrados of the curve.

An approximate method for staking the two curves is by the two tapes method. After the centerline curve has been established and the points on the offset lines opposite the P.C. and P.T. have been set, set stakes at the points on the offset curve, measure the transverse distance to the offset curve with one tape, and measure the longitudinal distance between the points of the offset curve with the second tape. The chord distance on the offset curves will be greater or less than the distance between the points on the centerline curve in direct proportion to the radii of the two curves.

The following formula is for convenience in calculating the longitudinal distances on the offset curves:

E or I = LR_1/R

E = Extrados

I = Intrados

L = Chord Length

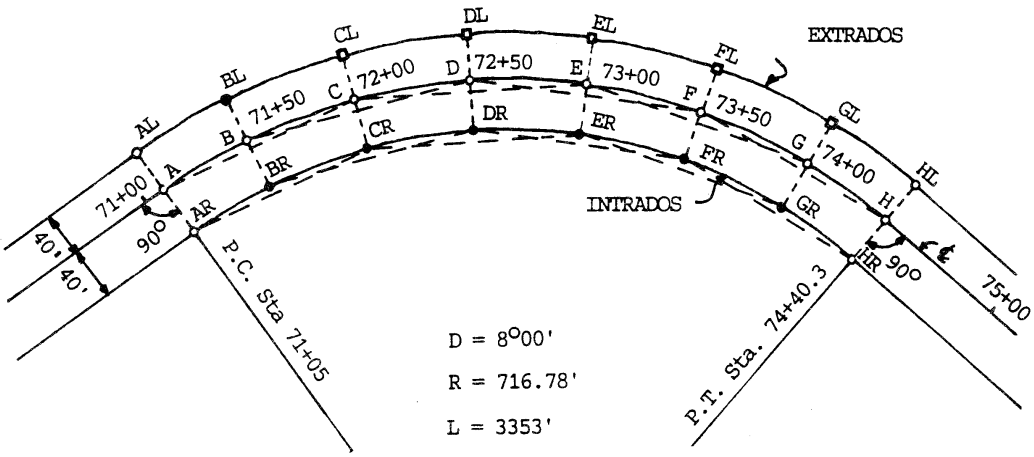
R = Radius of centerline curve

R_1 = R + or - the distance from the centerline curve to the curve being considered.

When setting either the intrados or extrados stakes by the two-tape method, make the longitudinal, or circumferential measurements to and from some definite point on each stake. Transversely or radially draw a pencil or fine keel mark, across the top of each stake at the forward end of the longitudinal tape after the stake has been driven in place. Make the longitudinal measurements from these radial lines.

The original computations, as made up for the centerline curve deflections, will be true for the revised arc length of the offset curves.

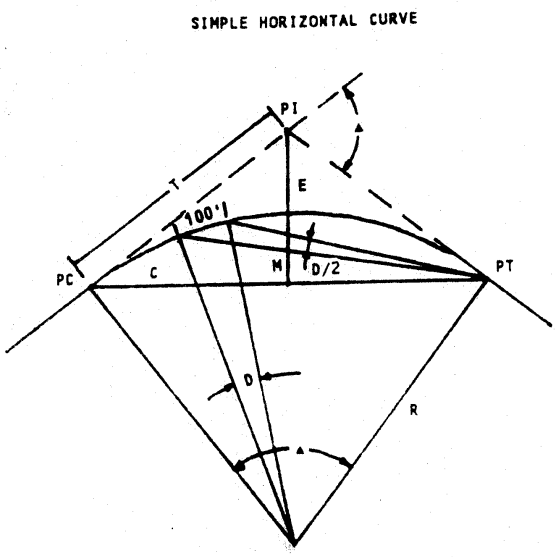
FIGURE No. III-6 - INTRADOS-EXTRADOS



NOTE:

Dotted lines represent linear measurements. – – – – – – –
Rings indicate stakes or nails set with transit and tape.
Solid round dots indicate stakes set using two tapes simultaneously.
Squares indicate stakes set by using one tape and lined in by eye with the center-line stake or nail and the intrados stake.

FIGURE No. III-7 - HORIZONTAL CURVE



D = Angle subtended at center of circle by an arc length of 100'= Degree of Curve
Δ = Central Angle (angle subtended at center of circle by total arc length of curve)
R = Radius of circle
L = Total arc length of curve
T = Tangent length (dist. from Point of Curvature to Point of Intersection)
C = Long Chord length
E = External distance of curve
M = Middle ordinate of curve

CIRCULAR CURVE FORMULAS

$R = \underline{L\ (180)} / \Delta\pi$ or $R = T/\tan(\Delta/2)$ or $R = C/2\ [\sin(\Delta/2)]$
$L = R\ \pi\ \Delta/180$ or if "D" is known $L = 100\Delta/D$ (in stations)
$T = R\ [\tan(\Delta/2)]$
$C = 2\ R\ [\sin(\Delta/2)]$
$E = T\ [\tan(\Delta/4)]$
$M = R\ [1-\cos(\Delta/2)]$

3.04.10 CURVE WITH SPIRAL TRANSITIONS

Curves with spiral transitions are somewhat more complex than simple horizontal curves. With highway curves of one degree or less, there is little need of a transition to start or terminate a horizontal curve. Curves designed with a higher degree of curvature may need a short transition to ease the abruptness of changing from a tangent alignment to a curved configuration and vice versa at the end of a curved section. For this reason, the curve may be designed with a spiral transition to allow the driver time to find the change in steering required to adjust to the circular alignment.

Since a straight line and a circle each have constant curvature and the transition spiral is a curve of uniformly changing curvature, the spiral diverges in angle and offset from the circular curve, for a given distance, at the same rate as from the initial tangent.

The degree of curvature of a spiral (arc definition) varies directly as the distance L from the T.S., being zero at the beginning of the transition and equal to Dc and the S.C. This is a parabolic curvature and follows the equation of $y = ax^2$.

$$D = (L/ Ls) Dc$$

The spiral angle, θs, at the S.C. equals the central angle of the circular curve for a length just half the length of the spiral.

$$\theta_S = Ls \times Dc/200$$

The spiral angle varies as the square of the length of the spiral from the T.S. so that any other point the spiral angle,

$$\theta = (L^2/Ls)\, \theta_S$$

This type of curve may be set out in the field in several ways. One commonly used method of staking a spiral curve requires that the T.S. and S.T. be located at the Ts distance from the P.I. Then using the (Xs) and (Ys) distances, the S.C. and C.S. are located. Another method of locating the S.C. or C.S. is to establish the intersection of the L.T. and S.T. on the tangent line by measuring the L.T. distance from the T.S. or S.T. With the instrument set on this point and the vernier reading zero, sight the P.I. and turn the angle θs and measure the S.T. distance along this line. Using the Xs and Ys distances to locate the C.S. and S.C. is normally preferred over using the L.T. and S.T.

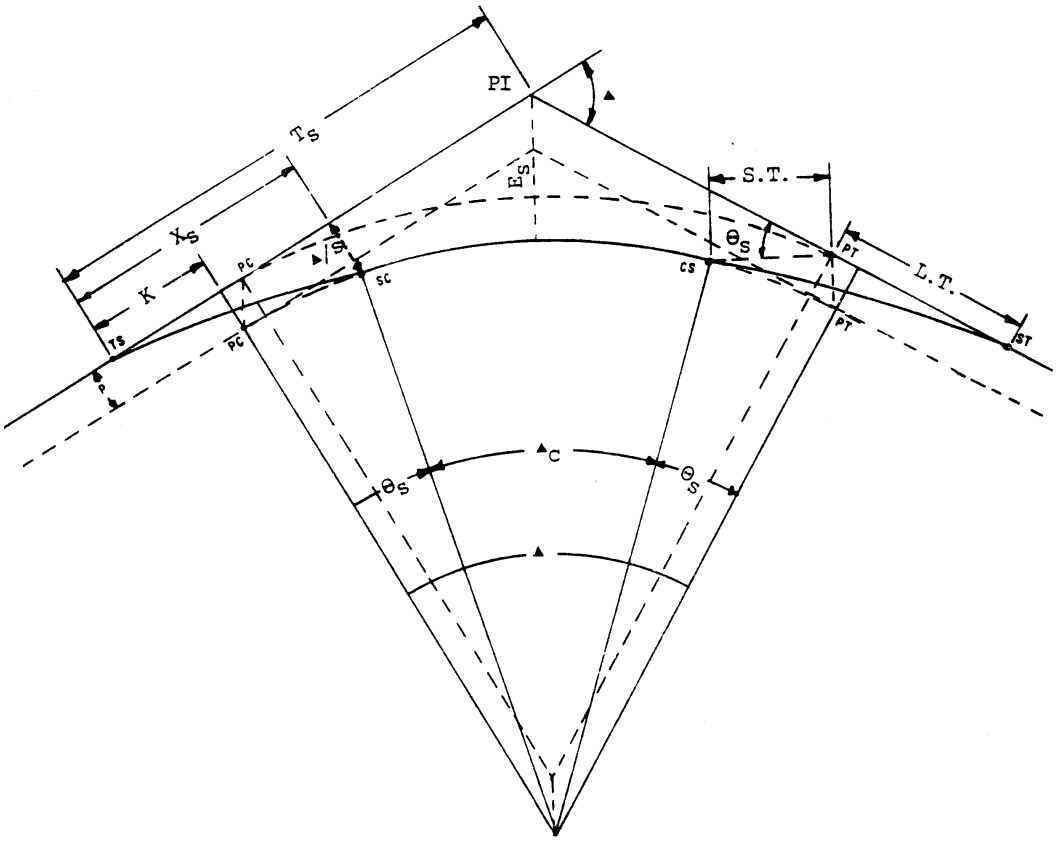
With the T.S. and the S.C. located, set the instrument on the T.S. Set the vernier at zero and sight the P.I. or a point on tangent. The deflection angle, Ø, at a set-up on the T.S. from the tangent to any point on the spiral is the angle whose tangent is x/y. It is unnecessary to compute x and y since the deflection angle is very nearly equal to one-third of the spiral angle, the correction being very small for spiral angle values less than 15°. The deflections from the T.S. to intermediate points on the spiral can be computed by the formula:

$$Ø = (\theta s/3) \times (L^2/ Ls)$$

The total deflection to the S.C. is $\theta s/3$. For values of θ greater than 15° apply a correction.

When the points on the spiral curve have been located, move the instrument to the S.C. The deflection from the T.S. to any point on the spiral equals 1/2 of the deflection from said point back to T.S. In order to orient the instrument to proceed with the simple curve which lies between the two spirals, preset 2/3 θs on the reverse side of the zero. Invert the telescope and sight the T.S. Lock the lower motion on the back sight, invert the scope, and turn the upper motion to zero. An alternate method of orienting the instrument at the S.C. is to set the vernier on zero, invert the scope and sight the intersection of the L.T. and S.T. Return the scope to the normal position and proceed with the simple curve. When the C.S. has been reached, move the instrument to the S.T. for staking of the second spiral. Back in this curve with the same procedures as described in staking the first spiral transition.

FIGURE No.III-8 - SPIRAL CURVE



SPIRAL CURVE FORMULA

$\theta = (L/Ls)^2 \times \theta s$

$\theta s = \blacktriangle - \blacktriangle c/2$ or $Ls \times Dc/200$

$\emptyset = \theta s/3$ = Total spiral deflection from TS or ST

In the event it is necessary to move up on a point "t" on the spiral to complete the staking of the spiral, calculate new deflections. The new deflections may be calculated for a point ahead (or forward) on the spiral (towards the S.C. or C.S.) by the formula:

$$\emptyset A = D/2 \times L_2/100 + (L_2)^2/Ls \times \theta s/3$$

Or (for points ahead)

$$\emptyset A = \theta s\ (3L_1 + L_2)\ L_2$$

The formula can also be used to calculate the deflections from the TS. In this case L_1 and D = 0. To orientate the instruments from point "t" on the spiral, calculate the deflection from point "t" to a previously established point behind (or back) on the spiral. This deflection may be calculated by the formula:

$$Ø\ B = D/2 \times L_2/100 - (L_2)^2/L \times \theta s/3$$

or (For points back)

$$Ø\ B = \theta s/(3Ls)\ 2 \times (3L_1 - L_2)\ L_2$$

If the theodolite is located at the SC or CS, then $L_1 = L_2$. With the deflection from the move-up point to a previously set point on the spiral set on the reverse side of zero, sight the point with an inverted scope. Invert the scope, and turn the vernier to zero. The instrument is now oriented at the move-up point.

Various other methods may be used to stake a spiral curve. These methods and additional information on spiral curves are available in publications listed at the end of this section.

(References are listed in FIGURE No. III-23)

Total spiral deflection from S.C. or C.S. = $2/3\ \theta s$

$Ø = (\theta s/3) \times (L^2/Ls)^2$

$Xs = Ls - [(Ls)^3/40Rc^2]$

$Ys = (Ls)^2/6Rc$

$Ø_A = [\theta s/(3Ls)^2]\ [(3L_1 + L_2)L_2]$ or $[(D/2)(L_2/100)] + [(L_2^2/Ls)(\theta s/3)]$

$Ø_B = [\theta s/(3Ls)^2]\ [(3L_1 - L_2)L_2]$ or $[(D/2)(L_2/100)] - [(L_2^2/Ls)(\theta s/3)]$

SPIRAL CURVE NOMENCLATURE

P.I. Point of intersection of the main tangents.

T.S. Tangent to spiral, common point of tangent and spiral of near transition.

S.C. Spiral to curve, common point of spiral and circular curve of near transition.

C.S. Curve to spiral, common point of circular curve and spiral of far transition.

S.T. Spiral to tangent, common point of spiral and tangent of far transition.

Rc Radius of circular curve.

Ls Length of spiral between T.S. and S.C.

L Length between T.S. and any other point on the spiral.

L_1 Distance from T.S. to move-up point on the spiral.

L_2 Distance from a move-up point on the spiral to any other point on the spiral

Ts Tangent distance between P.I. and T.S. or S.T., tangent distance of the complete curve.

Es External distance from P.I. to center of circular curve portion.

L.T. Long tangent distance of spiral only.

S.T. Short tangent distance of spiral only.

L.C. Straight line chord distance from T.S. to S.C.

P Offset distance from the tangent of P.C. of circular curve produced.

k Distance from T.S. to a point of the tangent opposite the P.C. of the circular curve produced.

▲ Intersection angle between the tangents of the entire curve.

▲c Intersection angle (interior angle) between the tangents at the S.C. and at the C.S. The central angle of the circular curve portion of the curve.

Dc Degree of curvature of the circular curve. The same as the degree of curvature of the spiral at the S.C. (arc definition).

D Degree of curvature of the spiral at any other point on the spiral (arc definition).

θs Spiral angle. The intersection angle between the tangent of the complete curve and the tangent at the S.C.

θ Intersection angle between the tangent of the complete curve and the tangent at any other point on the spiral. The angle at any other point.

øc Deflection angle from the tangent at the T.S. to the S.C.

ø Deflection angle from tangent at any point on the spiral to any other point on the spiral.

øA The spiral deflection angle ahead from an intermediate point on the spiral to any other point on the spiral.

øB The spiral deflection angle back from an intermediate point on the spiral to any other point on the spiral.

Xs Tangent distance for the S.C. or C.S.

Ys Tangent offset of the S.C. or C.S.

X Tangent distance for any other point on the spiral.

Y Tangent offset for any other point on the spiral.

3.04.11 PRELIMINARY STAKING OF RIGHT-OF-WAY

In the early stages of right-of-way acquisition, the Bureau of Right-of-Way will make a property appraisal sometimes called a pre-appraisal. The Bureau of Right-of-way will need a very general type of survey consisting of marking and flagging the outline of the project.

In addition, the utility adjustments cannot begin until acquiring and staking the right-of-way. If the adjustment of utilities is a major item on a particular project, single out the right-of-way in the immediate areas of the utility adjustment for early staking.

Staking right-of-way by coordinate pairs is the preferred method. Place the stakes and drive to an accuracy comparable to the dimension of the end area of the hub stake.

Generally, all stakes should pertain to public right-of-way and property fence lines. These stakes and flags may be strips of cloth or plastic markers attached to a 48" building lath, driven at the approximate limits of the proposed right-of-way.

It is not the intent to reestablish alignment controls with this type of survey, but many existing structures or topographic features can be used to orientate the plan design with the local terrain. Right-of-way breaks and easement limits can be set out with a non-metallic tape. It is not essential to reestablish the centerline point by point, but rather to find and identify points that can be determined from apparent topographic features.

Color-coding can be of great assistance to the appraiser. Since the extent of staking is very limited, it is convenient to differentiate between the centerline, right-of-way and easement limits. Various colors may be assigned to each type of delineation, and the brighter the color the more effective the flagging.

3.04.12 LAND MONUMENTS

Many of the roads in Kansas are located on the section lines of the government land

surveys. It is evident, therefore, that many of these stones or monuments marking the section or fractional-section corners will fall within the lines of the highway right-of-way. These monuments are usually disturbed or covered over during construction operations.

The Bureau of Road Design, is making an effort to locate all existing land monuments and reference the line of survey to them. Therefore, the location of many of them is known before construction begins. In other cases, the actual monuments are not found, but new monuments are established by a resurvey from physical evidence, oral or written testimony of local residents, or by a combination of the above methods. It sometimes happens that after a diligent search for a monument at a section corner, the section line survey party was unable to find it and reestablishes the section corner, when the monument was actually in place. In such cases, the construction operation will often reveal the original or accepted monument, so the construction forces must be on the lookout for them. When a section corner monument is uncovered, immediately notify the Licensed Land Surveyor over staking, who will take proper references. Land Survey Reference Report forms are available for this purpose. Also, notify the District Land Surveyor, the Bureau of Right-of-way, and the Survey Section of the Bureau of Road Design.

In case the reference points for an endangered section corner monument fall within the ROW or an easement, and within 100 feet of the construction limits, re-reference the monuments by a Licensed Land Surveyor over staking. File a Section Corner Endangerment Report at the Kansas State Historical Society (http://www.kshs.org/p/land-survey-records/11325) and forward copies to the Area Engineer. Should reference ties for an endangered corner become destroyed or disturbed during construction, make new ties and re-reference and re-file the endangered corner. At the completion of the project, the Licensed Land Surveyor over staking shall submit a completion of Endangerment Activities Report for each Endangered Corner with permanent ties. FIGURE No. III-9 shows a blank “Land Survey Reference Report”. Of special note are the check boxes in the upper third of the report used to designate what type of reference report applies.

On District designed projects, the responsibility for handling land monuments is on the District Surveyors.

FIGURE No. III-9 – LAND SURVEY REFERENCE REPORT

LAND SURVEY REFERENCE REPORT
State Archives and Library Division
Kansas State Historical Society
6425 SW Sixth Avenue, Topeka, KS 66615-1099
(785) 272-8681 Ext. 322 FAX (785) 272-8682

FOR OFFICIAL USE ONLY

Land Surveyor: _____ **L.S. Reg. Number:** _____
Company: _____ **Project Number:** _____
Street Address: _____ **Telephone Number:** _____
City, State _____ **Date of Survey:** _____
Zip Code: _____ **County of Survey:** _____

This report is filed as a (check only one):

☐ **SURVEY REFERENCE REPORT** (K.S.A. 58-2011a). ☐ **NOTICE OF ENDANGERMENT ACTIVITY** (K.S.A. 58-2011b).
There is a $4.00 per corner filing fee, which must accompany the Survey Reference Report & Notice of Endangerment Activity.

☐ **NOTICE OF COMPLETION OF ENDANGERMENT ACTIVITY AND REPORT OF RESTORATION** (K.S.A. 58-2011c).
This may only be filed after filing a prior Notice of Endangerment Activity. No filing fee for notice of completion.
Endangerment report was filed on_____.

LOCATION CODE OF MARKER IN TOWNSHIP (see illustration below): _____
Legal Description:_____ Section: _____ Township:_____Range: _____
Survey Datum (if known):_____ North: _____ East: _____
Corner Status Prior to Survey: ☐ Existent ☐ Obliterated ☐ Lost ☐ Endangered
Monument Condition: ☐ Found ☐ Set ☐ Reset ☐ Found Record
Detailed Monument Description: _____

REFERENCE MARKS AND MEASUREMENTS: (Please, no symbols or abbreviations.)

NOTE: ALL MEASUREMENTS ARE ☐ HORIZONTAL ☐ SLOPED UNLESS NOTED OTHERWISE.

DETAILED METHOD OF RECOVERY OR ESTABLISHMENT: _____

IDENTIFYING A MARKER

To identify the location of a marker in a township, use the following standard alpha-numeric grid to designate an identifier for a given section corner or intersection.

For Example: The southwest corner of Section 26 would be designated by the identifier **"17V"**. This is the **"LOCATION CODE OF MARKER IN TOWNSHIP"**.

Sec	6	Sec	5	Sec	4	Sec	3	Sec	2	Sec	1
Sec	7	Sec	8	Sec	9	Sec	10	Sec	11	Sec	12
Sec	18	Sec	17	Sec	16	Sec	15	Sec	14	Sec	13
Sec	19	Sec	20	Sec	21	Sec	22	Sec	23	Sec	24
Sec	30	Sec	29	Sec	28	Sec	27	Sec	26	Sec	25
Sec	31	Sec	32	Sec	33	Sec	34	Sec	35	Sec	36

01 03 05 07 09 11 13 15 17 19 21 23 25

A C E G J L N P R T V X Z

The original signature and date shall be across the Land Surveyor's Professional seal.

Surveyor's signature & date

3.05 BENCHMARKS

3.05.01 SETTING NEW BENCHMARKS

Thoroughly check all benchmark elevations before any other level work is started. Peg and document the level prior to running benchmarks.

Check the location of the benchmarks set by the plan-survey party before any check level work is started. In case the plan-survey party has not established benchmarks at the proper intervals, or has established them in places where they will be disturbed by construction operations, or in cases where they have been destroyed prior to any construction activity, set additional or new benchmarks.

The construction survey party shall establish and check new benchmarks near all structures and between benchmarks which are more than 1500 feet. Set at least two benchmarks near each structure. At important bridge sites across streams of considerable width, or which might be difficult to cross, set at least two benchmarks on each side of the stream near each end of the proposed structure. In cases with centerline hubs, benchmarks established near centerline 0.0 points may be convenient.

The new benchmarks established by the construction survey party shall carry the same numerical designation as the supplemental original benchmarks with the suffix A, B, C, etc., dependent on the number of new benchmarks established. For example, three new benchmarks established between B.M. 7 and B.M. 8 on a project will bear the designation 7A, 7B, 7C, etc.

3.05.02 BENCHMARKS AS TURNING POINTS

In running benchmark levels or checking benchmark elevations, use each benchmark as a turning point, even though it will require a short backsight and a short foresight at the set-up between the benchmark and turning point preceding it.

3.05.03 EQUALIZING SIGHTS

In all level work, the leveler shall exercise reasonable care to equalize backsight and foresight shots, to eliminate errors.

3.05.04 DIFFERENCE BETWEEN BENCHMARK ELEVATIONS TO BE COMPARED IN CHECKING

In checking benchmark elevations, it is important to compare the various values of the difference in elevation between any two adjacent benchmarks rather than various elevations obtained for a particular benchmark. Obtain the computed difference in elevation between any two adjacent benchmarks by running two sets of check levels for comparison. If these two differences do not check within the prescribed limits, as hereinafter stated, run one or more additional lines of levels between the two benchmarks until there are two computed differences which check within specified limits. When two such differences are obtained, take the average (computed to the nearest hundredth of a foot) of these two differences as the correct difference in elevation between the two benchmarks. If one benchmark has a greater elevation than the following benchmark, consider the difference between them negative, and vice versa. In this manner, determine the correct difference between each two adjacent benchmarks.

3.05.05 ALLOWABLE VARIATION

When checking benchmark elevations in the manner described above, the allowable variation between differences in elevation of any two adjacent benchmarks shall be a function of the number of instrument setups required in turning from one benchmark to the other. Use the following formula in determining the allowable variation in differences of elevation for any two adjacent benchmarks:

Formula (5): $V = 0.01\sqrt{2N}$

Where V is the allowable variation in feet and N is the number of setups required.

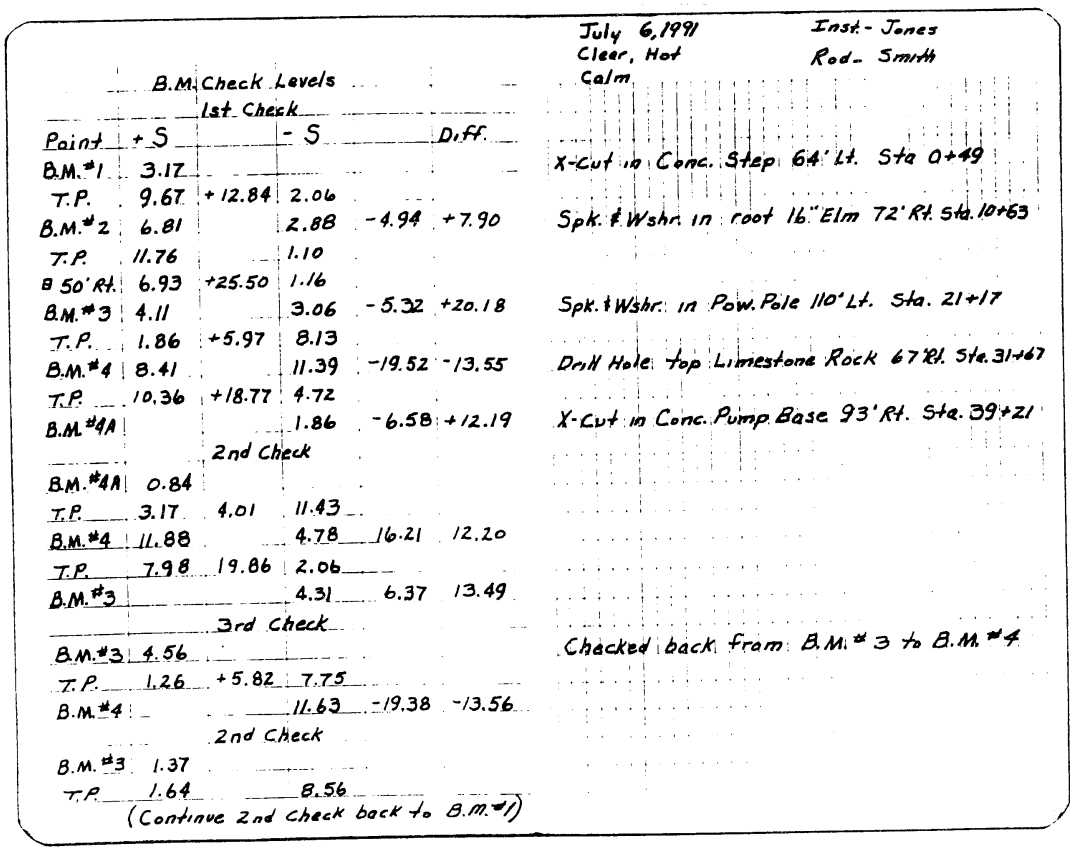
Calculate V to the nearest hundredth of a foot.

3.05.06 NOTES

Keep benchmark notes as illustrated in FIGURE No. III-10.

Compute the difference in elevations between adjacent benchmarks by determining the difference between the total + S (plus sights) and the total - S (minus sights) taken between the two benchmarks. Computing the H.I. (height of instrument) or the elevations of turning points or benchmarks of the benchmark level rerun is not necessary. This procedure eliminates most field computations, thereby speeding up the work and also eliminating duplicate computations of values which are of no use after the final adjustment of the benchmark elevations.

FIGURE No. III-10 - BENCHMARK LEVELS



July 6, 1991
Clear, Hot
Calm

Inst.- Jones
Rod- Smith

B.M. Check Levels

1st Check

Point	+ S		- S	Diff.		
B.M.#1	3.17					X-Cut in Conc. Step 64' Lt. Sta 0+49
T.P.	9.67	+12.84	2.06			
B.M.#2	6.81		2.88	-4.94	+7.90	Spk. & Wshr. in root 16" Elm 72' Rt. Sta. 10+63
T.P.	11.76		1.10			
B 50' Rt.	6.93	+25.50	1.16			
B.M.#3	4.11		3.06	-5.32	+20.18	Spk. & Wshr. in Pow. Pole 110' Lt. Sta. 21+17
T.P.	1.86	+5.97	8.13			
B.M.#4	8.41		11.39	-19.52	-13.55	Drill Hole top Limestone Rock 67 Rt. Sta. 31+67
T.P.	10.36	+18.77	4.72			
B.M.#4A			1.86	-6.58	+12.19	X-Cut in Conc. Pump Base 93' Rt. Sta. 39+21

2nd Check

B.M.#4A	0.84					
T.P.	3.17	4.01	11.43			
B.M.#4	11.88		4.78	16.21	12.20	
T.P.	7.98	19.86	2.06			
B.M.#3			4.31	6.37	13.49	

3rd Check

B.M.#3	4.56					Checked back from B.M.#3 to B.M.#4
T.P.	1.26	+5.82	7.75			
B.M.#4			11.63	-19.38	-13.56	

2nd Check

B.M.#3	1.37					
T.P.	1.64		8.56			

(Continue 2nd Check back to B.M.#1)

3.05.07 ADJUSTMENT OF BENCHMARK ELEVATIONS

Prepare a table for the adjustment of benchmark elevations similar to the one illustrated in FIGURE No. III-11 before going into the field to run the benchmark check levels. In the first column to the left, record the benchmark numbers in alternate horizontal lines.

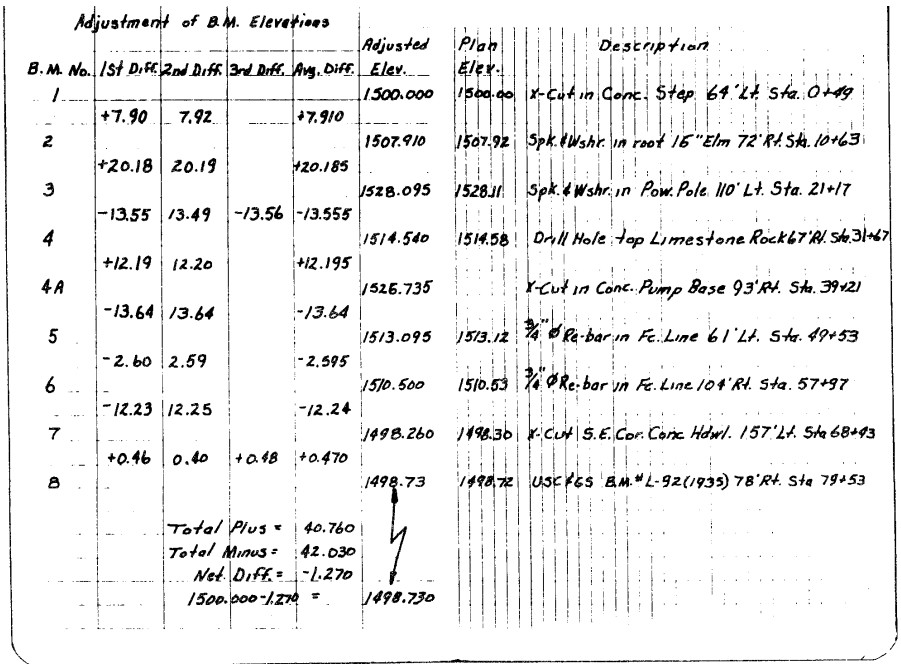
In the second, third and fourth columns, record the differences in elevation between the adjacent benchmarks. Obtain the differences recorded in the second column by carrying the levels from the beginning of the project and proceeding forward with the stationing of the project. The plus and minus signs are indicative of the proper sign to use in computing the difference in elevation. For convenience, make the second check run in reverse order, and reverse the plus and minus signs recorded in the third column.

Use the fourth column if the differences recorded in the preceding two columns indicates that the allowable variation as computed by Formula (5) is exceeded and an additional check is necessary.

In the fifth column, record the average difference, prefixed with the proper plus or minus sign, between any two adjacent benchmarks, which meet the allowable variation required.

In the sixth column, compute the adjusted elevation for each benchmark by adding or subtracting the adjusted differences in order. Beginning with the elevation of the first benchmark, which will usually be an assumed elevation or a known elevation, the difference between it and the next benchmark will be added or subtracted, as the case may be, to obtain the correct elevation of the second benchmark. In like manner, obtain the elevation of the third benchmark by adding to or subtracting the correct difference in elevation between B.M. 2 and B.M. 3 from the correct elevation of B.M. 2. Proceeding in this manner, determine the correct elevations of all the benchmarks along the project.

FIGURE No. III-11 - ADJUSTMENT OF BENCHMARK ELEVATIONS



Adjustment of B.M. Elevations

B.M. No.	1st Diff.	2nd Diff.	3rd Diff.	Avg. Diff.	Adjusted Elev.	Plan Elev.	Description
1					1500.000	1500.00	X-Cut in Conc. Step 69' Lt. Sta. 0+49
	+7.90	7.92		+7.910			
2					1507.910	1507.92	Spk. & Wshr. in root 16" Elm 72' Rt. Sta. 10+63
	+20.18	20.19		+20.185			
3					1528.095	1528.11	Spk. & Wshr. in Pow. Pole 110' Lt. Sta. 21+17
	-13.55	13.49	-13.56	-13.555			
4					1514.540	1514.58	Drill Hole top Limestone Rock 67' Rt. Sta. 31+67
	+12.19	12.20		+12.195			
4A					1526.735		X-Cut in Conc. Pump Base 93' Rt. Sta. 39+21
	-13.64	13.64		-13.64			
5					1513.095	1513.12	3/4" Ø Re-bar in Fc. Line 61' Lt. Sta. 49+53
	-2.60	2.59		-2.595			
6					1510.500	1510.53	3/4" Ø Re-bar in Fc. Line 104' Rt. Sta. 57+97
	-12.23	12.25		-12.24			
7					1498.260	1498.30	X-Cut S.E. Cor. Conc. Hdwl. 157' Lt. Sta. 68+93
	+0.46	0.40	+0.48	+0.470			
8					1498.73	1498.72	USC&GS B.M. "L-92 (1935)" 78' Rt. Sta. 79+53
		Total Plus =		40.760			
		Total Minus =		42.030			
		Net Diff. =		-1.270			
		1500.000 - 1.270 =			1498.730		

On the right-hand page, designate a column to record the plan elevations for the original

benchmarks noted in the plans. The purpose for this information is to provide a means for comparison between the planned and adjusted datum. A consistent variation between the two, indicates an error in the elevation of the initial benchmark from which the adjusted elevations were computed. Correct the datum inspecting all the original benchmarks to determine which ones are undisturbed, and check within the proper tolerance when compared with the adjusted difference as determined by the construction survey party. This inspection and check will verify that the benchmark datum is adjusted to the datum in the plans, and will prevent any sizable variations in earthwork quantities. In other cases, this inspection may reveal a need for incorporating an equation in the benchmark datum to correct an error in the information given in the plans. Do not vary the construction bench-level datum over one hundredth of a foot from the planned datum for any considerable distance. Introduce equations in levels as needed so the datum used on construction follows very closely to that shown on the plans. Exercise care in this procedure to base the equations on undisturbed plan benchmarks.

3.05.08 GOVERNMENT BENCHMARKS

The National Geodetic Survey has established government benchmarks over a large portion of the State of Kansas. Preserve these benchmarks without exception, according to the National Geodetic Survey Procedures, which may be found online:

http://www.ngs.noaa.gov/PUBS_LIB/Benchmark_4_1_2011.pdf

3.06 CROSS-SECTIONS

3.06.01 ORIGINAL CROSS-SECTIONS

The present Standard Specifications provide for Plan Quantity Payment. In this case, the quantities of excavation and embankment shall be the quantities shown on the plans for the various balances, provided the project is constructed essentially to the lines and grades shown on the plans. No allowance will be made for any quantities included as contingencies on the plans.

When the Plans have been altered, or when a disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities in any balance or the entire project, either party can request and cause the quantities involved to be measured for payment. Use the original plan cross-sections plotted on the plans as original field cross-sections. Additional original cross-sections may be interpolated or determined by other approved methods at points where it is necessary to accurately determine the quantities.

If there is doubt as to the accuracy of the original plan cross-sections, or after study of the original plan cross-sections, there is a need for additional original cross-sections, take them as described in this section.

Generally, the plans will not include original cross-sections for channel changes and excavation pits; therefore, when required, take original cross-sections from which to measure quantities in the field, prior to the start of work. Methods of taking these cross-sections are described in this section.

A copy of the original cross-section notes may be requested from the Bureau of Road Design to use as a guide for matching finals and for making sure prior to construction whether extended originals must be taken. If original cross-sections are determined by photogrammetry, computer cross-section listings show all information taken on each section, and are available upon request. On the computer slope stake listing, if the cross-section had to be extended on the slope of the last two original ground shots in order to find the slope stake intercept, an E shows

next to the slope stake distance that fell outside the originals. Take extended originals at these places and recalculate the slope stakes in order to obtain accurate measurements. New original cross-sections are needed frequently, especially on interstate type facilities and on interchanges. Take new originals on ramps and loops if their stationing is going to be used for computing final quantities. There may be cross-sections shown in the plans for the relocated side roads, ramps, loops, channels, and frontage roads, but this does not mean actual originals exist in many cases. Be particularly cautious of new work separated from the actual project roadway, like ramps or frontage roads separated from the new roadway by the two existing lanes. Actual originals are seldom available on the separated new work. This condition frequently occurs when creating four lanes by adding two lanes to the existing lanes.

3.06.02 ROADWAY CROSS-SECTIONS

Field procedure: Take cross-sections every 100 feet and at intermediate points where necessary to obtain an accurate determination of quantities. Keep in mind that a cross-section may be required at certain plus stations though there is no break in the centerline profile. It is just as important to take additional cross-sections at points where the shape of the cross-section changes abruptly as it is to take them at breaks in the centerline profile. In addition to the cross-sections, which will be necessary because of the contour of the original ground surface, take original cross-sections at all points where it will be necessary to take final cross-sections after the construction work is completed.

Before going into the field to take original cross-sections, the Construction Engineer/Manager and Construction Staker shall check over the plans thoroughly and record all the plus stations at which it will be necessary to take original cross-sections due to the design of the improvement. A study of the plans will reveal a number of points at which it will be necessary to take final cross-sections; therefore, it will be necessary to take original cross-sections at the same points. Record the list of plus stations in a small memorandum book. In this book, tabulate the plus stations to the following points:

(a) The P.C. and P.T. of all horizontal curves.

(b) The P.C. and P.T. of sharp vertical curves, and points of vertical intersection where no vertical curve is to be constructed.

(c) Points were superelevation begin and end.

(d) Points where maximum superelevation begin and end.

(e) Points where spiral transitions begin and end.

(f) Points where the shoulder slope changes.

(g) Points where the distance from centerline to either shoulder changes.

(h) Points where the width of side ditches change.

(i) Points where there is a break in ditch grade line.

(j) Points where the back slope, or the road side slope (in case there is a berm) of the ditch changes.

(k) Points where a berm begins or ends.

(1) Points where berm obtains its full width.

(m) Points where the berm ceases to be of full width and starts tapering to a point.

(n) The ends of wing walls of bridges and large culverts.

(o) The back side of bridge abutments.

(p) The back side of the end walls of multiple-box bridges or large culverts.

(q) At all 0.0 points, and any other points where a cross-section is necessary for accurate determination of quantities.

Where rock excavation is anticipated, take both original and final cross-sections at intervals of 50 feet or less, in order to obtain an accurate determination of the quantities.

Take rod and tape readings at all breaks in the ground along the normal line out to the right-of-way line on each side. Since the grade stakes will be driven flush with the ground surface, take the last rod bearing on the grade stake. When held on the grade stake, read the rod to the nearest 0.01 foot. Use grade stakes for turning points. If this system is followed, the point at which any error is introduced can readily be determined. Establish the grade on the grade stake, when the slope stakes are set. The elevations of the grade stakes as determined at the time the original cross-sections are taken, will therefore, serve as a check on the elevations obtained when grading the grade stakes.

In cross-section work, read the tape to the nearest 0.5 foot. Take rod readings for ground elevations to the nearest 0.1 foot.

When taking original cross-sections, take a rod reading at both the upstream and downstream flow line of all culverts and multiple-box bridges, which are to remain in place. Determine the elevations of the tops of the hub guards and the top of the slab for each side of the roadbed. Measure and record the distance between the hub guards. Check this data against corresponding data shown on the plans.

Take special care, at all bridges and miscellaneous structures for which the plans show a pay item of some class of excavation, to get sufficient cross-sections to verify an adequate determination of the excavation quantities.

Cross-section public road intersections that connect to the improvement with the same degree of accuracy as the main part of the improvement. Take the cross-sections at right angles to the centerline of the intersected road and cover the area between property lines. Extend them for a sufficient distance from the centerline of the main road to cover all the proposed work.

3.06.03 NOTES

On the left hand sheet, record the station number and plus at which each section is taken, and the peg leveling notes by which the height of instrument and the elevations of benchmarks and turning points are kept. In the first column to the left, record the station number or the benchmark number.

In the second, third and fourth columns from the left, record the +S, H.I., -S, respectively.

In the fifth column, record the elevations of the turning points and benchmarks as determined by the cross-section peg leveling notes.

In the sixth column, record the correct benchmark elevations.

When the elevation of the benchmark has been determined in the cross-section notes, record the correct or adjusted elevation to the right of it in the sixth column from the left. If two elevations differ by 0.1 foot, run the line of levels back, checking on each grade stake until the error is found, or until the proceeding benchmark is reached. The cross-sections need not be taken again, as the error can be rectified by correcting the H.I. where the error was first introduced, and carrying the correction forward to the benchmark where the error was detected. At each benchmark, correct the peg leveling notes to the correct benchmark elevation; In other words, add the plus sight taken on each benchmark to the correct elevation to determine the height of instrument rather than to the elevation obtained in the cross-section notes.

Record the rod readings and tape readings at cross-section points on the right hand sheet. Show the rod readings above the corresponding tape readings. Record the centerline rod reading at the vertical center of the sheet. Record the other readings in the order from the center toward the edges of the sheet. If all the readings for a particular section cannot be recorded in one horizontal tier, leave one tier blank, record the remaining readings in the third tier below, and list from the outside edges of the sheets towards the center in the order taken.

If it is impossible to take cross-sections for the entire width of the right-of-way from one set up of the instrument, set up the instrument in such a position that the rod can be read when held on one right-of-way line. Take cross-sections from the right-of-way line as far as possible toward the centerline. When all the locations within the range of the instrument have been partially cross-sectioned in this manner, set up the instrument in such a position that part or all of the remaining portions of the cross-sections can be taken. When this procedure is necessary, list each location in the cross-section notes as many times as it is necessary to set up the instrument to complete the cross-section at the location. In other words, do not attempt to block off the cross-section notes and indicate that certain rod readings were taken from one H.I. and others were taken from another H.I. Show the various portions of the cross-sections in different places in the notes.

Use the hand level to complete cross-sections when only a few rod readings cannot be taken with the engineer's level. Exercise extreme care in reducing rod readings taken with a hand level, to the H.I. of the engineer's level.

Record rod readings taken on outcropping ledges of rock at points where cross-sections were taken in the same manner as the rod readings taken on earth, an appropriate notation being made to indicate that the rod reading was taken on the top of rock (T.R.), bottom of rock (B.R.), or some other unusual point. Record rod readings taken on outcrops at points where no cross-sections are taken on the left hand sheet between the peg leveling notes.

Do not crowd cross-section notes; omit two lines between each two successive tiers or rod and tape readings. Keep the notes from the top of the page down.

3.06.04 BORROW AREAS

Cross-section all Borrow Pits before and after the excavation is made. Take cross-sections at least every 50 feet to obtain an accurate determination of excavation quantities. The Contractor shall leave all pits in a neat, well trimmed, and well-cleaned condition so as to facilitate the accurate measurement of the material used. When possible, construct all pits so that they will drain to some natural drainage course. Take final cross-sections for borrow pits as soon as possible after the excavation work has been completed and before the pit is filled with sediment or scoured out by high water or heavy rains. Side excavation pits, or those which are merely an extension of the roadway ditch may be cross-sectioned from the centerline of the project at the same time the roadway cross-sections are taken.

In case an excavation pit is to be cross-sectioned from any baseline other than the centerline of the project, carefully stake and reference the baseline. Keep complete field notes regarding the staking operations. Draw a sketch in the field notes showing the layout of the pit and baseline, and the reference ties to the terminals of the baseline. Keep these notes labeled, "Miscellaneous Field Notes". In case a side pit is located to one side of an alignment curve, it is suggested to establish a straight baseline, either across the pit longitudinally, or on the outside of the pit, and take the cross-sections for that part of the pit which is not included within the

roadway cross-sections from the baseline. This will eliminate the necessity of correcting the computed earthwork quantities for curvature.

There may be cases, however, in which it will be more convenient to cross-section a curved pit from the centerline of the project rather than from a straight baseline. If this is done, make the proper correction for curvature. The method of making this correction is explained in most engineer's handbooks or textbooks on highway or railway curves and earthwork.

Occasionally, it will be necessary to apply the correction for curvature to regular roadway cross-sections, which have not been extended to include an adjoining excavation pit. Where the centers of gravity of the cross-sections taken from a short-radius centerline fall appreciably and uniformly to one side of the centerline, as will usually be the case where a curve is located on a hillside, it is imperative to make this correction.

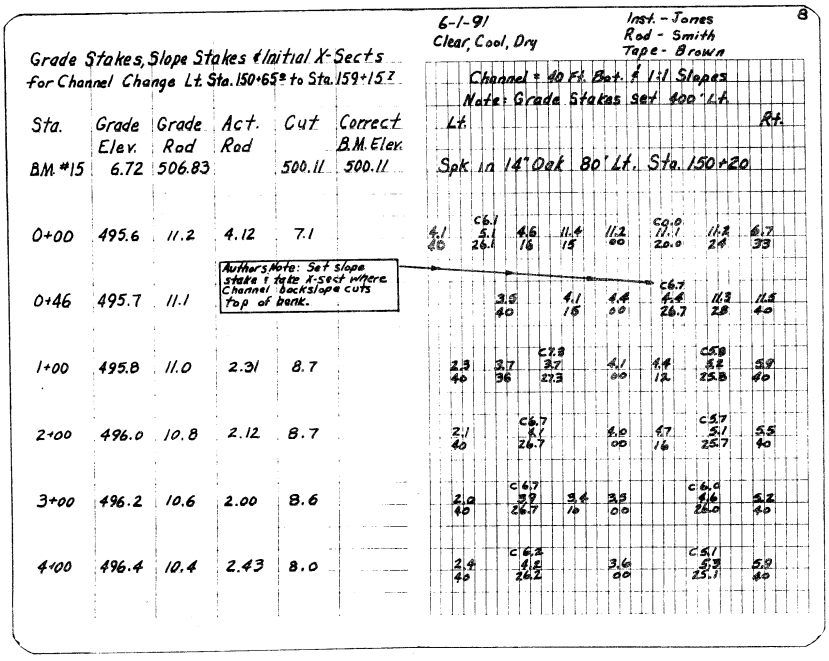
Before any excavation or clearing has been started, check the topography within the limits of the excavation pit.

3.06.05 CHANNEL CHANGES

Take original and final cross-sections, and set slope stakes and grade stakes.

First stake the centerline of the channel change according to the design shown on the plans, or in such a manner that sufficient data will be obtained to enable the Engineer to show on the Completed Construction Plans the exact manner in which the channel change was laid out and constructed. Carefully reference the hubs along the centerline of the channel change to four points by one of the methods described in Section 3.04.11. Tie the centerline of the channel to the centerline of the project by at least one angular and one linear measurement. Measure deflection angles in the centerline of the channel change. After the centerline has been staked and referenced, offset grade stakes at such a distance from the centerline that there will be little danger of their being disturbed by construction operations. The grade on the grade stakes may be established at the same time the slope stakes are set and the original cross-sections are taken. Keep field notes for this three-fold operation according to FIGURE No. III-12.

FIGURE No. III-12 - GRADE STAKES, SLOPE STAKES AND ORIGINAL CROSS-SECTIONS



Before any work on the channel change starts, check the topography within the limits of the construction operations. Carefully check pay items to determine what quantities need to be measured.

When designated for removal, blaze or tag large trees on the side facing the centerline of the channel change.

For all trees to be saved, mark with the standard tag provided for that purpose.

If the grade stakes are still in place at the time the final cross-sections are taken, it will not be necessary to restake the centerline except in cases in which the channel change is cut to a depth of more than 6 or 7 feet below the original ground surface. In such case, reestablish the centerline, in order that the measurements to points within the excavation may be accurately determined. Keep all the field notes pertaining to any one, channel change on successive sheets in the same notebook, and label, “Miscellaneous Field Notes”.

KDOT Field Book No. 1 may be used for setting slope stakes on large channel changes.

Set slope stakes and grade stakes every 100 feet and at all breaks in the grade and points of deflection of the alignment. Also, set slope stakes at all points where the back slope of the channel change intersects the tops of the banks of the original channel.

Take final cross-sections immediately after the channel changes are completed (excavated in a neat and suitable manner) and before silting or scouring in the channel has started.

3.06.06 PLOTTING CROSS-SECTIONS

Employ one of the following methods in plotting cross-sections.

a. Plotting by Elevations Method. In this method, compute the elevation of each point at which a reading is taken. Compute and check these elevations before performing any plotting.

b. Modified H.I. and Rod Reading Method. Add to or subtract a fraction of a foot from

the H. I. to convert it to an elevation of an integral number of feet. Then, add to or subtract the same fraction from all rod readings which were taken from the H.I. Perform all of this addition or subtraction, as the case may be, mentally with no record being made of it in the notes or on the cross-section sheets.

Then, plot the modified H.I. at such a point that the elevations of the heavy horizontal lines will be expressed in integral numbers, which are divisible by the number of feet to the inch on the scale to which the sections are being plotted. Having assumed a line, which represents the modified H.I., plot in the cross-section points, using the scale on the paper, as the reader calls out the modified rod readings.

For example: Assume that the H.I. 127.62, the rod readings at a point 16.5 feet right is 8.9 feet, and the cross-sections are being plotted to a scale of 5 feet to the inch, the same scale being used both horizontally and vertically. The reader should call out the H.I. as being 128.0 feet, mentally adding 0.4 feet to the actual H.I. The plotter should then choose a lightweight horizontal line which is three-fifths inch above one of the heavy horizontal lines, and assume its elevation to be 128.0 feet. The heavy horizontal line directly below will then assume an elevation of 125.0 feet. After the plotter has located this H.I. on the paper, the rod reading shall be called out as 9.3 feet, which is really 0.4 feet greater than the actual rod reading. The plotter shall then plot the point 9.3 feet below the modified H.I. and 16.5 feet to the right of the centerline. After the H.I. bar has been set and the center elevation plotted, the actual road reading between the H.I. and the elevation of the point involved should be read by the plotter. This procedure will prevent the introduction of an error in setting the H.I. bar, the plotting of the elevation of the point or the mental calculation in modifying the rod readings.

After the cross-section points have been plotted and the cross-sections have been drawn by connecting adjoining points with straight lines, check the plotting of each section in a manner as thorough as the method employed in plotting. It is important that the cross-section be completed by drawing the lines between the plotted points before checking in order to verify that all points have been used.

Remember when plotting original cross-sections, the cross-section notes at the 0.0 point are not contained in the regular cross-section notebooks. The notes for the sections at the 0.0 points are recorded in the back of the slope stake and grade stake notebooks. Take care to plot the sections for the 0.0 points in their proper position, in the order of their station numbers.

When plotting original cross-sections for a portion of the project on which slope stakes have not been set, the exact location of the 0.0 points will not be known. By inspecting the plans, the approximate location of the 0.0 points can be determined. Reserve a space, in order, for the plotting of each anticipated zero-point section.

Plot cross-sections to the nearest 0.5 foot on the, horizontal and the nearest 0.1 foot on the vertical scale.

In case a large percentage of the cross-sections of a project or a portion of a project has minor cut or fill sections as compared to the length, as is often the case on a paving or light grading project, plot the cross-section to a larger or a dissimilar scale. When plotting to a larger scale, use two or two and one half feet to the inch, both horizontally and vertically. When using a dissimilar scale, use a larger vertical scale than the horizontal scale. A convenient dissimilar scale is one in which the vertical scale is 2 feet to the inch and the horizontal scale is 5 feet to the inch, 1 square inch on the cross-section sheet will then represent 10 square feet.

c. Computer-generated Cross-section Method. Microstation/Geopak preferred.

3.06.07 DIGITAL TERRAIN MODELING (Three Dimensional Measurements)

With the widespread availability of electronic data collectors, total stations, GPS RTK systems, and computers, it has become a common practice to create a digital terrain model (DTM) of an area rather than manually recording and plotting cross-sections. The DTM is generally constructed by recording coordinates of key points in the data collector. The coordinates may be project coordinates or assumed coordinates. Whichever is used, it is important that the coordinate system is well monumented so that the coordinate system can be replicated at a later time.

Commonly, the information recorded in the data collector for each point includes the northing, easting, elevation, and a point description. The northing, easting, and elevation information tell the computer software where to plot the point. The description information tells the computer what the point represents and whether it is a single point feature or part of a linear feature. The format of the description information will depend on the computer software utilized to create the DTM from the field data.

The computer software will use the recorded points to create a surface model called a **t**riangulated **i**rregular **n**etwork (a *.tin file). It is a faceted surface comprised of adjoining triangular planes. If all of the points are described as contour points with no linear coding, the software simply connects the closest points with a straight line to build a lattice of triangular planes. This type of coding works well for flat to gently rolling terrain. The use of break lines increases the accuracy of the terrain model when the terrain includes definite linear slope changes such as streams, ditches, or berms. The linear coding forces the software to create the lines between the linked points first before linking the closest points. Once the *.tin file is created, the software can be used to plot cross-sections at specified locations or compute volumes between two *.tin files, such as an original and final surface.

3.07 SLOPE STAKES AND GRADE STAKES

3.07.01 GENERAL

The plan grade of the roadbed and ditches are taken to the field and made workable with grade stakes and slope stakes. These stakes are set to establish cut and fill grades for the Contractor and to limit the scope of the Contractor's operations. These are the working stakes, and they are set after the right-of-way is staked. The heavy vegetation, trees and hedges are cleared prior to moving any earthwork.

These stakes may be "flats" or Type "A" stakes for writing the necessary information on a slope stake, and a Type "A" and "B" for the grade control hub and guard stake.

Color coding can be effective in making these stakes prominent and in providing an illustrious background for written information. Establish the grade on the grade stakes and set the slope stakes after the original cross-sections have been taken. Simultaneously perform the setting of the grade stakes and slope stakes.

Since the grade on the grade stakes is established at the same time the slope stakes are set, KDOT Field Book No. 1 has been designed for use in performing these two operations simultaneously. Keep grade stake and slope stake notes as shown in FIGURE No. III-13.

3.07.02 SLOPE STAKES

a. Slope Stakes for Embankments. Set slope stakes for embankment sections at the toe of the slope, and mark to show the vertical distance or fill from the ground at the point where the stake is driven to the finishing grade elevation for the shoulder of the embankment.

Set the slope stake by taking trial readings at right angles to the centerline until a point is found at a distance from the centerline equal to the shoulder slope ratio times the fill from the ground at the point to the plan grade elevation of the shoulder, plus the distance from the centerline to edge of the shoulder.

Mark the fill on the slope stake which is the fill from the ground at the point where the stake is set out to the shoulder finishing grade elevation.

Set embankment slope stakes at a distance from the centerline, which is determined by the shoulder grade elevation, the width of roadway, and the shoulder slope ratio as indicated on the plans. The fill marked on the stakes is a function of the shoulder finishing grade elevation.

b. Slope Stakes for Cuts. Slope stakes for cuts are the stakes set at the point of intersection of the back slope with the natural ground. Mark them to show the vertical distance or cut from the ground at the point where the stake is driven to the grade elevation for the bottom of the ditch.

In determining the point at which to set the slope stake, first determine the point at which the horizontal distance from the centerline to the toe of the back slope, plus the quantity obtained by multiplying the cut by the back-slope ratio is equal to the measured distance from that point to the centerline. Set the slope stake at this point, and mark the cut from this point to the bottom of the ditch on the stake.

Use the above described method of marking for all slope stakes except berm-slope stakes. Where a berm is cut to grade, the cut will begin at the toe of the embankment slope, and the slope ratio of the berm cut will be the same as the embankment slope ratio. Set two slope stakes at the toe of the embankment slope where there is a berm to be cut to grade. Mark an embankment slope stake as described above; mark a berm slope stake indicating the cut from the ground at the stake to the berm-grade elevation. Mark the cut in a horizontal position across the backside of and near the top of the stake. Directly beneath the cut, write the word “Berm” in a vertical position. Mark the station number in a horizontal position across the front side and near the top of the berm-slope stake. Directly below the station number, mark the distance from the centerline of the project to the berm-slope stake in a horizontal position.

c. Marking and Driving Slope Stakes. Mark the cut or fill in a horizontal position across the front side (side facing the centerline) and near the top of the slope stake. Mark the distance from the centerline to slope stake in a horizontal position directly below the cut or fill. Mark the back-slope ratio in a horizontal position immediately below the centerline distance.

Mark the station number in a horizontal position across the backside and near the top of the slope stake.

3.07.03 OFFICE PREPARATION OF NOTES

Record the data, which is to be shown in the first, second, third, eighth, tenth, eleventh, twelfth, fifteenth, nineteenth, twentieth, and twenty-first columns before going into the field. Carefully study the plans to determine at which plus station it will be necessary to set slope

stakes. The location of all of these points can be determined in the office.

If the plans contain plotted cross-sections, the tentative location of the slope stake may be determined. The cross-sections will show the approximate cut or fill and the distance from centerline to the slope stake. It is helpful to make a very light entry in the slope stake book of the cut or fill and distance from the centerline as shown on the section. These figures will probably prove to be incorrect, but they will provide a fast reference for the first trial shot, and often the identical values are determined to fit the field conditions. These trial values provide a check of the fieldwork, because often a wide variation in the trial shot and actual shot is caused by an error in computations or reading the rod.

3.07.04 NOTES FOR STEEP SIDEHILL SECTIONS

If in hilly country, it is impossible to set slope stakes on both sides of the road and grade the grade stakes from one setup of the instrument, set the instrument in such a position that the slope stakes from the downhill side of the road can be set. When the slope stakes have been set on the downhill side at all points within range of the instrument, set the instrument up on higher ground in such a position that the slope stakes for the uphill side can be set. The grade stakes will usually be near one row of slope stakes, and in most cases, may be graded from the same H.I. used in setting the row of slope stakes near the grade stakes. When the above procedure is necessary, list each station in the slope stake and grade stake notes as many times as it is necessary to set up the instrument in setting the slope stakes and grading the grade stakes at the station. When preparing the notes in the office before going to the field, it will be an easy matter to determine from an inspection of the plan cross-sections at which stations or plus stations it will be necessary to set up the instrument more than once in setting the stakes. Reserve a sufficient number of station tiers to provide space for a separate entry of each station for each H.I. used in staking the station. When a few stakes cannot be set from the setup of the engineer's level, use the hand level.

3.08 GRADE STAKES

3.08.01 GENERAL

Use 1½"x1½" stakes (Type "B", See FIGURE No. III-1) varying in length, from 12 to 24 inches, to suit local conditions, for grade stakes. Set grade stakes on both right-of-way lines, on horizontal curves, extremely rough terrain, and at other locations where deemed advisable.

Where grade stakes are set only on one right-of-way line, if practicable, set them on the same side of centerline throughout the project. Locate grade stakes to minimize the danger of disturbance during construction, without placing them too far away from the centerline of the project.

Drive grade stakes flush with the ground surface. Place a Type "A" guard stake (See FIGURE No. III-1) beside the grade stake. The right-of-way (or R/W) stake will very often meet the required condition of the grade stake. Since this R/W hub is driven flush with the ground, and it is located in an area accessible to the project but clear of construction, designate them as the grade control stakes.

At locations of interchanges, where the R/W widens to a substantial distance from the project centerline or in city sections where the R/W is often existing property lines of irregular distances, set grade stakes at the most reasonable position convenient to the needs.

Set grade stakes at every 100 feet on tangents, flat vertical curves, and on horizontal

curves with a radius longer than 750 feet. Set them at every 50 feet on horizontal curves with a radius of 750 feet or less. Also set grade stakes opposite the P.C. and P.T. of horizontal curves, at points where superelevation begins and ends, at points where maximum superelevation begins and ends (usually the P.C. and P.T., respectively), and at the beginning and end of all spiral transitions.

Mark the distance from the centerline to the grade stake in a horizontal position on the back of the guard stake. Later, mark the cut or fill from the grade hub to the centerline finish grade on the front side of the guard stake directly below the station number.

Take the rod readings on the grade stakes and record to the nearest 0.01 foot. Record the fill or cut on the guard stakes to the nearest 0.1 foot. With elevations determined to the 0.01 foot, each stake becomes somewhat of an intermediate benchmark, which can be used for checking purposes. Compare the elevations obtained when establishing grade on the grading stakes with those obtained at the time the original cross-sections were taken.

In rough country, it is important to offset the grade stakes in their true position at right angles to the centerline. Employ some method more exact than estimating by eye the angle of offset.

Grade stakes may be offset on curves by the method explained in Section 3.04.09 and illustrated on FIGURE No. III-6. The method of accurately offsetting grade stakes from a tangent is very similar to that of offsetting from a curve.

When staking the centerline, use the surveying instrument to offset the grade stake on a normal line opposite each P.O.T. In case the surveying instrument is not set up at both the P.C. and P.T. of the horizontal curve during the operation of running the curve, set up these points to offset the grade stakes. Offset right-of-way stakes in this manner on the side opposite the grade stakes at each P.C. and P.T.

With these correct, offset grade or R/W stakes as beginning points and control points. Offset the intermediate stakes as follows:

Using two tapes, one stretched along the right-of-way line on the offset line to measure the longitudinal distance between stakes, and the other, stretched from the centerline point transversely to the forward end of the longitudinal tape, set a stake at, or vertically below, the point where the outside end of the transverse tape and the forward end of the longitudinal tape meet. Draw both tapes tight and hold in a horizontal position.

Make longitudinal measurements between grade and R/W stakes from definite points on the stakes. Draw a pencil or fine keel mark transversely across the top of each stake at the forward end of the longitudinal tape after the stake has been driven in place. Make longitudinal measurements to succeeding stakes from these transverse marks.

Proceeding in this manner, set the grade or R/W stake until the next control point is reached. At this point, check the accuracy of the longitudinal measurements.

Another method which may be used in offsetting grade stakes from tangents with a fair degree of accuracy is using the right-angle triangle. Lay out the triangle with the right angle at the station from which the stake is to be offset. Lay out the triangle with the tape measuring the sides out in the ratio of six, eight, and ten with the base of the triangle on the centerline. To use this method, provide a backsight or foresight.

In flat country and when narrow right-of-way is provided, it is permissible to offset grade stakes from the tangents and long-radius horizontal curves by using one tape to make the offset measurement and estimating by eye the direction of the normal. Employ the procedure outlined

above for rough country in offsetting grade stakes on all horizontal curves, with radius of 750 feet or less.

3.08.02 FIELD NOTES FOR SLOPE STAKES AND GRADE STAKES

Use the standard form for slope staking and grade stake field notes, provided in the KDOT Field Book No. 1. FIGURE No. III-13 is a reproduction of the standard form and contains illustrating field notes. The following comments will aid in a ready comprehension of its use.

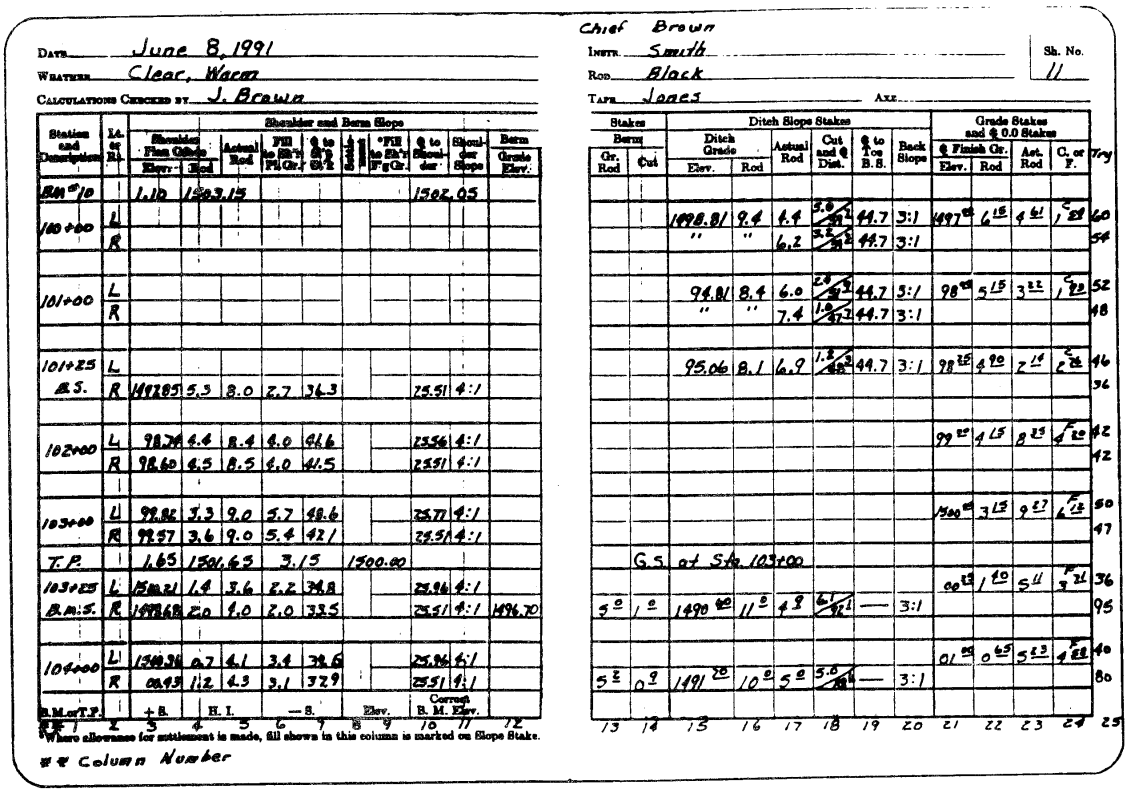
The notes which pertain to each station or plus station at which a grade stake or slope stake is set shall occupy two horizontal lines, and will be designated as a double depth station tier. Always record the data for the left hand side of the road above the data for the right hand side. Record the peg leveling notes by which the height of instrument is kept on the left half of the form in the single depth horizontal tiers, which are located between the double depth station tiers. Show the benchmark number or the turning point designation, the plus sight, the height of instrument, the minus sight, the elevation of the benchmark or turning point as determined by these peg leveling notes, and the correct or adjusted benchmark elevation in the vertical columns so labeled at the bottom of the sheet. The column headings at the top of the form refer only to the rectangular spaces formed by the intersection of the columns with the double depth station tiers; while the column labels at the bottom of the form refer only to the rectangular spaces formed by the intersection of the columns with the single depth horizontal tiers.

The description of the turning points may be shown in the single depth tiers on the right half of the form.

The uses of the rectangular spaces formed by the intersection of the vertical columns, which are labeled at the top of the form with the double depth station tiers are explained below.

For convenience, these spaces are referred to according to the column in which they are located. The columns are designated by numbers, the numbers beginning at the extreme left-hand side of the form and increasing to the right. The first column to the left side of the form is designated as column number 1; the next column going to the right is referred to as column number 2, etc.

FIGURE No. III-13 - SLOPE STAKES AND GRADE CONTROL STAKES



(a) The double depth spaces in column number 1, labeled “Station and Description”, are large enough for recording the station numbers, and indicating whether or not a P.C., P.T., B.S. (Beginning of Superelevation), E.M.S. (End of Maximum Superelevation), or any other similar point is located at the station indicated.

(b) In the second column, always record the letter “L” indicating “left” above the letter “R” indicating “right”. Record the data in the other columns to the right in the same order.

(c) In the third column, record the shoulder plan grade elevation for both the left and right shoulders.

(d) In the fourth column, record the shoulder plan-grade rod, which will be the difference between the H.I. and the shoulder plan-grade elevation.

(e) In the fifth column, record the actual rod reading when the rod is held on the point at which the embankment-slope stake is to be set. Determine the fill from the point on the ground at the stake to the shoulder plan-grade elevation by subtracting the shoulder plan-grade rod from the actual rod reading. When the planned grade elevation is above the H.I., record a plus grade rod. The fill is equal to the sum of the grade rod and the actual rod.

(f) In the sixth column, record the fill to the plan-grade elevation of the shoulder.

(g) In the seventh column, record the distance from the centerline to the slope stake. Determine this distance as indicated before.

(h) In the eighth column, record the allowance for settlement. FIGURE III-3 shows the allowed percentages of settlement for fills of various heights. Base the calculations of the allowance for settlement upon the fill at the centerline of the project. Figure the allowance for settlement to the nearest 0.1 foot.

(i) In the ninth column, record the fill to the shoulder finishing-grade elevation. Determine this fill by adding the allowance for settlement to the fill for the shoulder plan-grade elevation, as recorded in the sixth column. Where allowance is made for settlement of the embankment, mark the fill shown in the ninth column on the face of the slope stake. If no settlement is anticipated, mark the fill shown in the sixth column on the slope stake.

(j) In the tenth column, record the distance from the centerline to the edge of the shoulder.

(k) In the eleventh column, record the shoulder-slope ratio. If the shoulder-slope ratio at one location is 3:1 and at the next location is 1½: 1, determine the shoulder-slope ratio for any intermediate point by interpolation. For example, if the distance between the two shoulder slopes mentioned above is 300 feet, then the slope ratio would be 2 ½: 1 at a point 100 feet from the first station toward the station at which the slope ratio is 1:1 ½.

(1) In the twelfth column, when a berm is to be cut to grade, record the berm grade elevation.

(m) In the thirteenth column, record the berm grade rod, determined by subtracting the berm grade elevation from the H.I.

(n) In the fourteenth column, record the berm cut, determined by subtracting the actual rod recorded in the fifth column from the grade rod in the thirteenth column.

(o) In the fifteenth column, record the ditch grade elevation.

(p) In the sixteenth column, record the ditch grade rod, determined by subtracting the ditch grade elevation from the H.I.

(q) In the seventeenth column, record the actual rod reading taken at the point on the ground where the ditch slope stake is set.

(r) In the eighteenth column, record the cut from the ground, at the point where the slope stake is set to the bottom of the ditch. Also, record the distance from the centerline to the slope stake, in this column. Record the cut above the centerline distance, a horizontal or sloping line being drawn between the two numbers. Determine the cut by subtracting the actual rod reading from the ditch-grade rod. Determine the distance from the centerline to the cut slope stake as indicated herein before.

(s) In the nineteenth column, record the computed distance from the centerline to the toe of the back slope. This distance will usually be a constant.

(t) In the twentieth column, record the ditch back slope ratio. If the back slope ratio at one location is 2:1 and at the next station 1:1, determine the back slope ratio for any intermediate point by interpolation. For example, in the case mentioned above the back slope ratio at a point midway between the two locations would be 1 ½: 1.

(u) In the twenty-first column, record the centerline finishing grade elevation.

(v) In the twenty-second column, record the centerline finishing grade rod. Determine this rod by subtracting the centerline finishing-grade elevation from the H.I.

(w) In the twenty-third column, record the actual rod reading which is taken on top of the grade stake. Record this rod reading to the nearest 0.01 foot.

(x) In the twenty-fourth column, record the cut or fill from the top of the grade stake to the centerline finishing-grade elevation. The cut or fill will be equal to the differences between the actual rod and the centerline finishing-grade rod. Mark the cut or fill on the guard stake to the nearest 0.1 foot, and drive beside the grade stake.

(y) A twenty-fifth column, when desired, include as an aid to slope staking. Label this column “Try”. Determine this distance from the centerline to the slope stake from the cross-

sections. This distance may be entered when the slope stake book is made up in the office.

3.09 FINISHING STAKES

3.09.01 FINISHING STAKES

Set finishing stakes on all work which has been graded to a reasonable conformity with the plans. The number of finishing stakes required will depend on the type of finishing equipment used. The use of automatic equipment operating off of a stringline requires considerably less stakes than conventional blade finishing. The Contractor should keep their work finished as close as possible to the rough grading.

Set finishing stakes for both line and grade. They may be set on both shoulder lines and driven to shoulder finish grade elevation. Finish the roadbed in both cut and fill as indicated by the plan cross-sections. The finished roadbed shall conform with the line of the finishing stakes as well as to the elevations of the tops of the stakes. Set at least one set of finishing stakes over the entire length of each grading project.

Do not set stakes until the Grade Inspector has checked the grade, checked the roadbed for width, and inspected the shoulder for alignment and slope. In other words, obtain a fair job of rough grading before setting the finishing stakes so one set of finishing stakes will probably be sufficient to obtain a good finished roadway. When necessary, however, two or more sets of finishing stakes may be set over the entire project or portions of the project.

Finish bridge approach fills to plan grade elevation near the ends of the bridge. Start the grade approaching the bridge at a sufficient distance from the end of the bridge wearing surface to produce a smooth-riding approach.

Finishing stakes may be set at 100 feet intervals on tangents, flat vertical curves, and horizontal curves with a radius longer than 750 feet. They may be set at 50-foot intervals on sharp vertical curves and on horizontal curves with a radius of 750 feet or less. Finishing stakes may also be set opposite the P.T. and P.C. of horizontal curves, at all points where the width of the roadbed changes, at all points where superelevation begins and ends, at all points where maximum superelevation begins and ends, and at the P.C. and P.T. of sharp vertical curves.

Calculate the shoulder finishing-grade elevation to drive the finishing stakes, to the nearest 0.01 foot. Drive finishing stakes to within 0.02 foot of the finishing-grade elevation.

On tangents, one shoulder line may be established with the surveying instrument and chain, setting a Type “C” stake each station, or at breaks in shoulder grade or alignment. The opposite shoulder line may be offset from the line of stakes established with the surveying instrument. The normal line may be established by eye, or by placing the stakes on a line between the right-of-way stakes.

On curves, reestablish the centerline with the surveying instrument and chain before setting the shoulder stakes. After establishing the centerline, offset the finishing stakes onto the shoulder lines, the normal or radial directions being estimated by eye. Where a short-radius horizontal curve is on a steep grade, however, it may be advisable to accurately offset the shoulder finishing stakes. When this is necessary, the stakes may be offset on the shoulder lines in a manner similar to that explained above. When the finishing stakes have been set, drive them to grade.

3.09.02 FINISHING STAKE NOTES

Use DOT Field Book No. 4 for blue top staking or finish staking. See FIGURE No. III-14

showing one type of four-lane construction blue-topped for finishing.

Four-lane highway type construction requires a field book allowing for seven or more finishing stakes across the roadbed at any one point.

Do not set finishing stakes until the roadbed is nearly to finish grade so most of the stakes can be set to finishing grade elevation.

Record the peg-leveling notes by which the height of instrument is kept, in the single-depth horizontal tiers, which are located between the double-depth station tiers. Record the benchmark number or the turning-point designation, the plus sight, the H.I., the minus sight, the elevation of the benchmark or turning point as determined by these peg-leveling notes, and the correct or adjusted benchmark elevation in the vertical columns so labeled at the bottom of the book. The column headings at the top of the form refer only to the rectangular spaces formed by the intersection of the columns with the double-depth station tiers. The column labels at the bottom of the form refer only to the rectangular spaces formed by the intersection of the columns with the single depth tiers.

Each point to be graded will require the use of both decks of the double-deck rectangular blocks. Enter the distance from the alignment control in the upper left block, the finish elevation in the upper right block, and finally the grade rod in the lower right block as computed in the field.

On single lane roadbeds, use the centerline column and adjoining left and right columns, as required. Some columns may not be needed, as the stationing will be carried in the left column in all cases.

The item "Theo. Rod" is the actual grade rod required to place the finishing stake at the required elevation. Determine this reading in the field by subtracting the elevation of the finished grade from the elevation of the instrument or H.I.

Set finishing stakes to the nearest 0.02 foot, and record all notes to the nearest 0.01 foot.

Drive the stake to grade, true and plumb.

When it is impossible to drive the finishing stake to the finishing grade elevation, write the amount of cut or fill from the top of the stake to the shoulder finishing grade elevation on the front side of the stake. There will be an occasional stake, however, on which cut or fill must be indicated. When this is necessary, do not blue the top of the stakes, and drive the stakes solid with the cut or fill necessary written on the stakes.

3.09.03 OFFICE PREPARATION OF NOTES

The finish grade staking notes may be partially completed prior to going to the field. Take the station, the distance the stake will be set from the alignment control and the relative elevation of each stake from the plans.

Compute the grade rod of theoretical rod reading only after the instrument is set up and the H.I. determined.

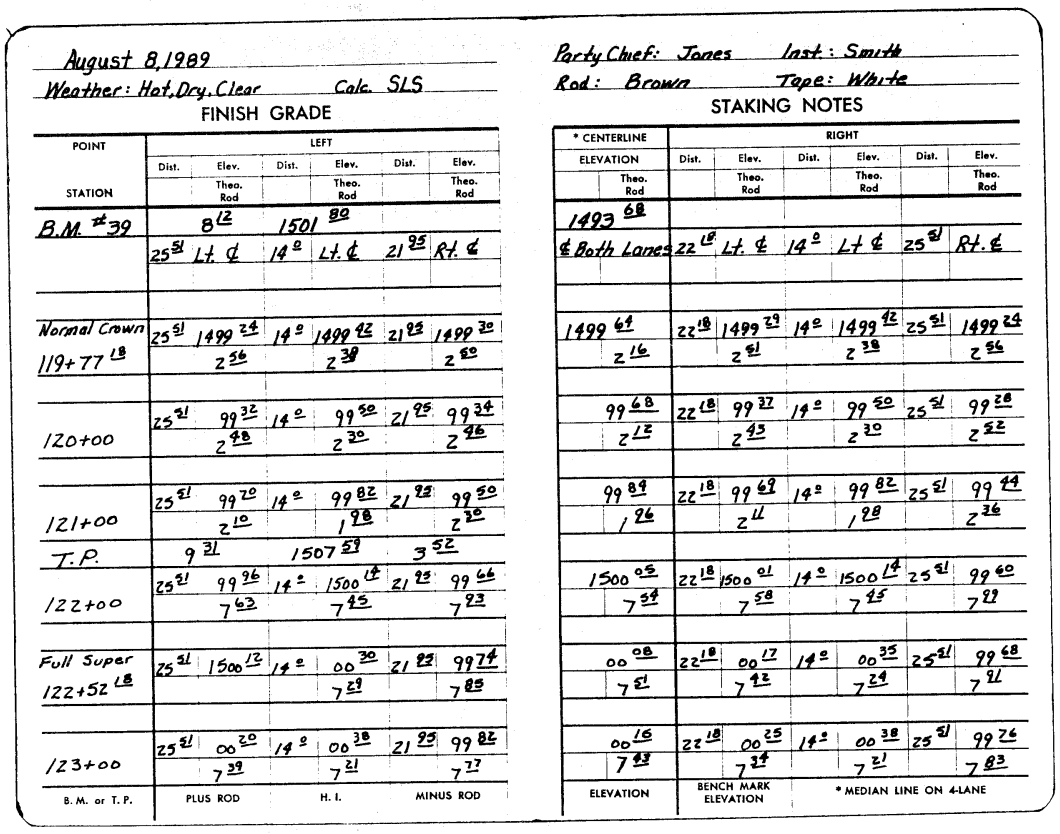
3.10 FINAL CROSS-SECTIONS AND COMPUTATIONS

3.10.01 GENERAL

When both the Engineer and the Contractor accept Plan Quantities as the basis of final payment, no final cross-sections will be required. However, if the plans have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities in any balance or the entire project, either party shall have the right to request and

cause the quantities to be measured in accordance with measured quantities. When quantities are measured, take final cross-sections after the grading work is completed. Compute the actual volume as determined from the original and final cross-sections and use this volume or measured volume as the basis for final payment. Take original cross-sections according to Section 3.06.

FIGURE No. III-14 - FINISH GRADE STAKING NOTES



August 8, 1989
Weather: Hot, Dry, Clear Calc. SLS
Party Chief: Jones Inst.: Smith
Rod: Brown Tape: White

FINISH GRADE

POINT / STATION	LEFT Dist.	LEFT Elev. Theo. Rod	LEFT Dist.	LEFT Elev. Theo. Rod	RIGHT Dist.	RIGHT Elev. Theo. Rod
B.M. #39		8.12		1501.80		
	25.51 Lt. ℄		14.0 Lt. ℄		21.95 Rt. ℄	
Normal Crown	25.51	1499.24	14.0	1499.42	21.95	1499.30
119+77.18		2.56		2.38		2.50
120+00	25.51	99.32	14.0	99.50	21.95	99.34
		2.48		2.30		2.46
121+00	25.51	99.20	14.0	99.82	21.95	99.50
		2.10		1.88		2.30
T.P.		9.31		1507.58		3.52
122+00	25.51	99.96	14.0	1500.14	21.95	99.66
		7.63		7.45		7.93
Full Super	25.51	1500.12	14.0	00.30	21.95	99.74
122+52.18				7.29		7.85
123+00	25.51	00.20	14.0	00.38	21.95	99.82
		7.39		7.21		7.77
B.M. or T.P.	PLUS ROD		H.I.		MINUS ROD	

STAKING NOTES

* CENTERLINE ELEVATION Theo. Rod	RIGHT Dist.	RIGHT Elev. Theo. Rod	RIGHT Dist.	RIGHT Elev. Theo. Rod	RIGHT Dist.	RIGHT Elev. Theo. Rod
1493.68						
℄ Both Lanes	22.18 Lt. ℄		14.0 Lt. ℄		25.51 Rt. ℄	
1499.64	22.18	1499.29	14.0	1499.42	25.51	1499.24
2.16		2.51		2.38		2.56
99.68	22.18	99.37	14.0	99.50	25.51	99.28
2.12		2.43		2.30		2.52
99.89	22.18	99.69	14.0	99.82	25.51	99.44
1.96		2.11		1.88		2.36
1500.05	22.18	1500.01	14.0	1500.14	25.51	99.60
7.54		7.58		7.45		7.89
00.08	22.18	00.17	14.0	00.35	25.51	99.68
7.51		7.42		7.24		7.91
00.16	22.18	00.25	14.0	00.38	25.51	99.76
7.43		7.34		7.21		7.83
ELEVATION	BENCH MARK ELEVATION		* MEDIAN LINE ON 4-LANE			

3.10.02 FIELD NOTES

Write large and clear. Leave ample space between rod shots and sections.

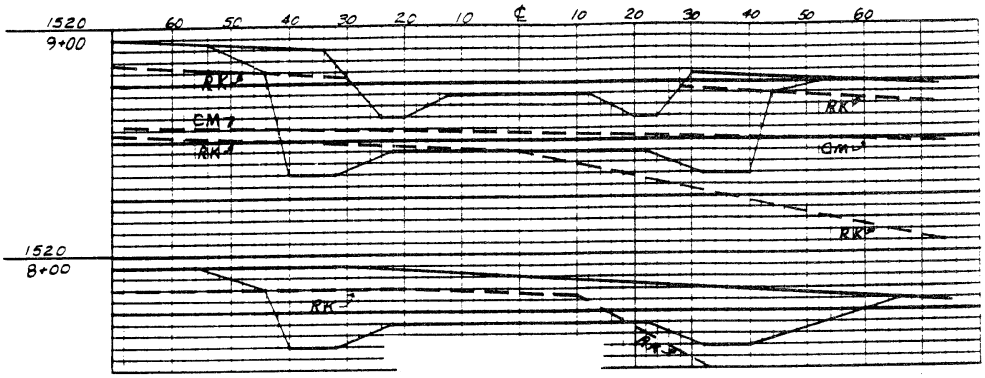
Record the complete H.I. elevation on each turn as 1225.10 instead of just 25.10.

If there is a deviation from standard field note practice, indicate left and right for that section when facing in the direction of increasing stationing. When recording a reverse station, mark it as “Reverse Section”. Make these notations, whenever a deviation occurs, on all sections whether originals or finals.

There must be a final section for all 0.0 subgrade and 0.00 rock sections. If rock layers exist, and the 0.0 section left is different from the 0.0 section right, take a final section at each location.

Originals must be available for all final stations. The computer can make straight line interpolations between stations to provide the extra originals needed. If there is ever a case when this type of interpolation is incorrect, the additional originals needed must accompany the final notes.

FIGURE No. III-15 - LAYER CROSS-SECTIONS



The Finals for these sections would be recorded as follows:

FINAL SECTIONS

Sta.	H.I.											
8+00	1520.00	OG 50	TR 6° 24	16° 40	16° 32	12° 22	12° ℄	12° 22	16° 32	16° 40	OG 60	
9+00	1520.00	OG 54	TR 8° 24	BR TR 18° 20° 42 41	26° 40	26° 32	22° 22	22° ℄	22° 22	22° 33	22° 40	BR TR 32° 12° 42 44

In addition to the final section, the layer sections must be recorded separately beginning with the lowest layer and working up as follows:

(℄ must be indicated but no rod is needed unless the layer breaks at that point.)

LAYER SECTIONS

Sta.	H.I.	Label										
8+00	1520.00	RK				6° 44	6° 20	℄	8° 10	12° 18		
9+00	1520.00	RK				20° 41	22° ℄			26° 18		
9+00	1520.00	CM				18° 42	℄			32° 42		
9+00	1520.00	RK	8° 24	0° 30	16° 24	16° 20	16° 12	℄	12° 10	16° 32	12° 24	10° 28	12° 22

If rock is involved on the project, follow the directions for recording rock layers shown in this section. In FIGURE III-15 both stations create a problem because the rock information taken with the final cross-section is not complete enough to calculate the rock. Station 8+00 shows one rock shot in the left backslope, but it cannot be determined where it goes from there. At station 9+00, incomplete information exists for the first rock layer on the right side, but seems to be all right otherwise. However, the top rock layer, if connected from TR to TR, would slice across the old roadbed and would give an additional rock volume of that amount. Separate the rock information and record it by itself, as shown, to determine the correct quantity. The illustration shows rod and distance, but elevations and distance may also be used as long as the complete elevation is shown.

For all required sections, record layer sections as shown above.

In order to compute the Rock and Common quantities accurately, we must have an original section and a final section wherever you wish to have the rock zero out on one side or the other or on both sides at once. This applies to the beginning and ending of subgrade sections. To get accurate quantities for rock excavation, take original and final cross-sections at intervals of 50 feet or less. This will normally give sections close enough to use as zero rock sections. To get accurate quantities for other excavation, take original and final cross-sections at intervals of 100 feet or less, and at break points.

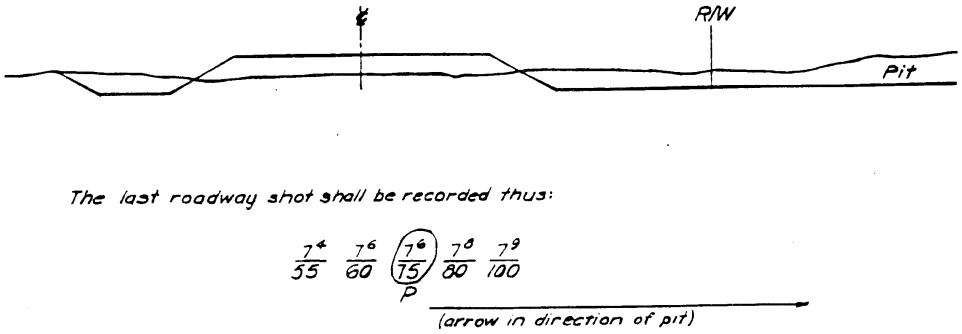
It is necessary to take a section at all equations. Note, along with the section, the equation as it appears on the plans, such as: Station 238+00 = 95+66.

Label and group the notes so all original and final notes for the roadway are grouped together, all side roads labeled and grouped, all borrow area information, all channel information, rock layer information, etc. Order each group in the natural sequence of stationing as they appear on the plans. Split H.I. sections or extensions should indicate where to find the rest of that section. Clearly reference each pit location, side road, etc., to the roadway stationing.

Treat each beginning and ending rod shot of a final section as original ground at 0.1 foot further out. Also, indicate original ground by O.G. and distance, and tie to the original ground at that distance. Original ground may be used within a section as long as an ending O.G. and beginning O.G. are indicated next to each other. If these are left and right of centerline, show the centerline between them without a rod shot. The centerline indication is the only thing that can be between the intermediate original ground shots.

If a borrow pit parallels the roadway and the pit sections are taken as a continuation of the roadway section, record and circle a rod shot at the R/W line where the roadway and pit join. Show a "P" under the distance and an arrow in the direction of the pit as shown in the illustration in FIGURE III-16.

FIGURE No. III-16 - BORROW PIT



In the letter of transmittal that accompanies the cross-section notes, indicate which sections are to be computed in the field.

Carefully plan how to handle the final section on interchanges. Make a thorough study of the interchange, and the original sections that cover the area where it is to be located. Often interchanges lack coverage as well as needing additional sections. In many cases, it will save much time and trouble if new originals, taken through interchanges wide enough and at the correct stationing, will be available for the finals. Determine the cut-off limits and carry all sections out to those limits. These cut-off limits could be laid out in the field with the use of a surveying instrument.

This method is suggested because design originals are taken from centerline of project and at right angles.

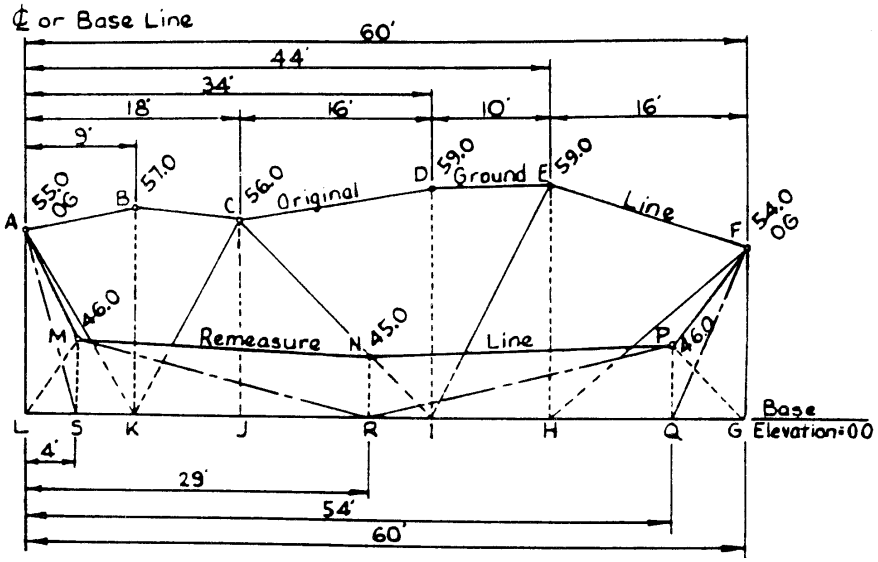
3.10.03 DETERMINATION OF END AREAS

After plotting the cross-sections, it is necessary to determine the end area in square feet of the excavation and/or the embankment shown on the cross-section. Determine this measurement by a method ordinarily referred to as "stripping". In stripping, the area to be measured is divided into trapezoids having uniform bases, usually one to five scaled feet depending on the size of the

area. Then measure the mid-ordinate of the trapezoids by the use of a piece of paper, generally a section of adding machine paper. The edge of the paper is laid along the mid-ordinate of the trapezoid and a pencil mark made at each end of the ordinate. Use the end mark of the previous mid-ordinate as the beginning of next measurement, determine an accumulative total measurement by laying the strip of paper on the cross-section paper in the same direction the ordinates were measured, and then read the total scaled length. This length multiplied by the uniform base gives the area of total figure. Check each area by a second person. While the determined areas will not be the same, they should be within reasonable tolerance, generally less than 3%. When two determinations are within tolerance, average them to obtain the final end area for the section.

An alternate method for determining the end area is the Crisscross Methods For Determining The Area of Any Prism as detailed in FIGURE No. III-17.

FIGURE No. III-17 - CRISSCROSS METHODS FOR DETERMINING THE AREA OF ANY PRISM



The above figure may represent a cross-section of a roadway, a cross-section of a borrow area or a prism on a horizontal plane in each case the area of the prism being desired. It has been divided into triangles to explain the procedure in the method of computation. There are two methods that can be used:

Method 1: Compute gross area from common ordinates and abscissas and deduct areas outside the area being measured;

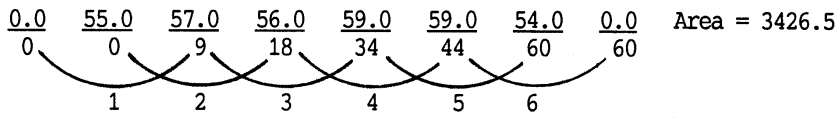
Method 2: Rotate calculation around the limits of the area being measured.

Both of the following methods are predicated on the figure shown as being a borrow cross-section, on which the original ground line and remeasure line are shown by elevations.

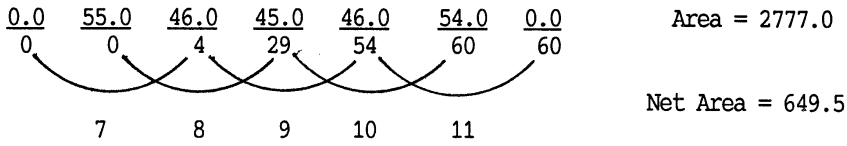
Method 1: In this problem the ordinate lies through one extreme point of the borrow section, A, and the abscissa is a horizontal line, or base elevation, which is common to both the original section and remeasure section. Subtract the area of the remeasured prism from the area

of the original prism, and represent in the field notes in the following manner:

Original Ground



Remeasure



This can be explained by the following combination of triangles, the net value of which must be divided by 2 since no recognition has been given in the computations to the formula for the area of a triangle or bh/2.

Original Ground

Triangles AKL	No. 1	55.0 x (9- 0)	= 495
Triangles ABK & BCK	2	57.0 x (18- 0)	= 1026
Triangles KCJ & JCI	3	56.0 x (34- 9)	= 1400
Triangles CDI & DEI	4	59.0 x (44- 18)	= 1534
Triangles IEH & EHF	5	59.0 x (60- 34)	= 1534
Triangles HFG	6	54.0 x (60- 44)	= 864
		Total	= 6853

6853.0 / 2= 3426.5 Area in Sq. Ft.

Remeasure

Triangles AML	No. 7	55.0 x (4- 0)	= 220
Triangles LMS & SMR	8	46.0 x (29- 0)	= 1334
Triangles MNR & RNP	9	45.0 x (54- 4)	= 2250
Triangles RPQ & PQG	10	46.0 x (60- 29)	= 1426
Triangles GPF	11	54.0 x (60- 54)	= 324
		Total	= 5554

554.0 / 2= 2777.0 Area in Sq. Ft.

Net Area = 649.5 Sq. Ft.

As illustrated, the area of the prism bounded by the original ground, the two extreme ordinates and the base elevation or abscissa is computed from which is deducted the prism bounded by the remeasure line, the two extreme ordinates and the base elevation.

As illustrated, deduct the area of the prism bounded by the remeasure line, the two extreme ordinates and the base elevation from the area of the prism bounded by the original ground, the two extreme ordinate and the base elevation or abscissa. In order to include all of the

area in each case, indicate the horizontal distance from the extreme elevation to the base elevation, or zero. In the field notes above, this is represented by 0.0 and 0.0.
0 60

The ordinates and abscissas may be located in any convenient position as long as all elevations or distances are normal to them.

This method may also be used for computing volumes of borrow pits; first by computing the volume above an assumed plane; and later by computing and subtracting the remeasured volume above that plane. By computing volumes in this manner, it is not mandatory to take intermediate points of remeasure at the same points or sections as the originals.

When using this method, remember that the extremities of a plane figure or the horizontal boundaries of a borrow pit must be identical, both for the original measure and for the remeasure, interpolation in some instances being required.

Method 2: The ordinate and abscissa may be established the same as for Method 1. In this method, however, the original and remeasure elevations are combined into a single step in the determination of the area. The extremities of the section may have to be interpolated if original ground elevations were not taken at those points. Record field notes as follows for this method:

Original Ground	55.0	57.0	56.0	59.0	59.0	54.0
	0	9	18	34	44	60
	9	1	2	3	4	5
Remeasure	46.0		45.0		46.0	
	4		29		54	
	8		7		6	

This is explained by the following combination of triangles, whose net value must be divided by 2, as explained in Method 1.

Triangles ABK & BCK	No. 1	57.0 x (18- 0)	(plus)	= +1026.0
Triangles KCJ & CJI	2	56.0 x (34- 9)	(plus)	= +1400.0
Triangles CDI & DEI	3	59.0 x (44- 18)	(plus)	= +1543.0
Triangles IEH & EFH	4	59.0 x (60- 34)	(plus)	= +1543.0
Triangles HFQ	5	54.0 x (54- 44)	(plus)	= +540.0
Triangles QPF & RPQ	6	46.0 x (60- 29)	(Minus)	= -1426.0
Triangles MNR & RNP	7	45.0 x (54- 4)	(Minus)	= -2250.0
Triangles SMR & AMS	8	46.0 x (29- 0)	(Minus)	= -1334.0
Triangles AKS	9	55.0 x (9- 4)	(Plus)	= +275.0
			Total	= 1299
		1299.0 / 2 = 649.5 Area in Sq. Ft.		

In computing the area of a prism by Method 2, observe the following rules:

1. Be sure to supply the original ground readings at the outer terminals of the original elevations and rule out any other original elevations beyond these outer terminals.

2. Record all of the remeasure elevations inside of the outer terminal points directly below the original elevations.

3. Go entirely around the section to form a complete closure; that is, use every elevation in the complete section as a base for the computation of the triangles once, and only once.

4. When the baseline, or centerline, lies at or outside of an outer terminal point, begin the computations at the point of least recorded distance. Proceed in the direction the distances are increasing, and go completely around the section in that direction. As the distances are increasingly larger, the product of the base and altitudes will be additive, and when the distances are decreasing, that product will be subtractive.

5. When the baseline, or centerline, lies within the area involved, commence at the centerline elevation of the original elevations which will be additive, proceed in one direction from centerline and around the section in that direction until the centerline distance on the remeasure elevations has been reached. Continue the computations from the centerline of the original elevations in the other direction and around the side of the section until reaching the remeasure centerline. Complete the closure of the section across centerline of the remeasure elevation, which is a subtractive computation. Excepting for the first computation across centerline of the original elevations, and the closing computation across the remeasure centerline, the rule in each direction from the starting point remains the same, that is, when the distances are increasing, the product of the base and altitudes will be additive, and when the distances are decreasing, that product will be subtractive.

3.10.04 COMPUTATIONS

Make earthwork computations on the Earthwork Computation Sheet (Form No. 101). Record rock excavation computations on a separate sheet in the same manner. Determine the volume of each class of excavation for each balance. Use the same station limits of balances as those shown on the plans or modified plans. Carefully check all computations before attempting to balance the quantities.

Along with the earthwork computation sheets, fill out Recapitulation of Earthwork Quantities (Form No. 266). List individual quantities for excavation, embankment and compaction separately under the proper column on the face of the form. Make an entry for the quantity of each item, which enters into the total for the balance. Describe as a pit, channel, roadway, side roads, entrances, etc., and show the stationing involved. Use one line for each separate pit, channel, entrance, side road, or the roadway as it appears on the Earthwork Computation Sheet (Form No. 101). Total the various entries to reflect the balance totals.

Reserve the last column of this form for remarks. Record any necessary remarks or explanation concerning the totals for a balance in this column. In case a particular balance shows an abnormal shrinkage of earth or swell of rock, check the computations, and correct any errors. If after checking the computations, the percent shrinkage or swell is unreasonably high or low, record in the remarks column any known information which might explain the apparent irregularity.

In the ninth column, indicate the volume of rock taken from stone fences and placed in the fill, the quantity of wasted material, etc.

In case the final quantities for a particular balance do not check reasonably close,

generally less than 3%, with the plan quantities, record in the remarks column any known information which might explain the underrun or overrun.

After plotting and checking final cross-sections, compare them with the slope stake notes to determine whether the finish lines conform to those lines indicated by the construction stakes. In cases where the Contractor has gone beyond reasonable construction limits in the excavation or embankment sections, compute the excess quantities and deduct from final pay quantities.

On all Federal Aid projects, except County Secondary projects, prepare a Recapitulation of Earthwork Quantities (Form No. 266) showing the location of the State owned borrow areas, plan volume shown to come from the areas, adjusted quantity (if appropriate) and the actual volume excavated.

Submit the Recapitulation of Earthwork Quantities (Form No. 266) with the Final Papers for the project. The form is to notify Fiscal Management of the volume removed from the borrow areas. This information is used for billing the Federal Highway Administration for a proportionate share of the borrow cost. See the Form Manual for instructions on preparing the form.

3.11 MISCELLANEOUS NOTES AND STAKING

3.11.01 STAKES FOR GUARDRAIL AND GUIDEPOSTS

Do not set stakes for guardrail or guideposts until the roadbed and shoulders have been satisfactorily finished to the grade line and slope indicated by the finishing stakes and slope stakes.

Keep field notes for guardrail and guideposts stakes in the miscellaneous items field book. Locate the alignment notes for a particular section of guardrail or guideposts immediately before the grade stake notes. Prepare notes as completely as possible before going to the field.

When installing guideposts and guardrail posts on horizontal curves, set a tacked line stake a uniform and convenient distance inside of each post location. When the guardrail or guide posts are to be installed on an alignment tangent, set tacked line stakes at intervals of 50 feet or less. Since the posts often vary in depth, set the inside face of the post an even distance from the tack point. Setting the posts in this manner will result in a straight or uniformly curved line on the inside face of the guardrail, with any irregularity in the depth of the posts being thrown to the outside face of the fence.

Use type “B” stakes for line stakes.

On curves, set the guideposts on the inside, or intrados shoulder, slightly less than the designated intervals, and set those on the outside, or extrados shoulder, at slightly greater than the designated intervals, so that the intrados post and the extrados post at a given station or plus station will both be on the radial line passing through the centerline point. Offset stakes on curves in this manner even though guideposts are to be set on only one side.

On all vertical and horizontal curves, set a Type “C” stake to grade for each post. When the location of the proposed guardrail or guideposts is on a grade tangent as well as an alignment tangent it will be sufficient to set a grade stake beside each alignment stake, which may be at intervals of 50 feet or less. Set the grade stake so that the top is 24 inches below the elevation to which the top of the guidepost is to be set, or in other words, 6 inches above the shoulder finishing grade elevation. Also, set so the top is a uniform determined distance below the bolthole in the guardrail posts. On projects where driving stakes is not possible, such as a project with stabilized shoulders, drive a concrete nail into the roadway surface for alignment. Grade the

top of the nail, and write the fill to a predetermined point on the post on a guide stake or on the shoulder material itself if practicable.

3.11.02 RIGHT-OF-WAY MONUMENTS

Set right-of-way monuments on the right-of-way lines at all deflections in alignment, including each P.C., P.T., and P.C.C. on horizontal curves, at all points where the width of right-of-way changes, and at points not greater than one quarter mile apart where the right-of-way line is straight or on a continuous horizontal curve of constant radius.

Show the locations of all right-of-way monuments on the Completed-Construction Plans. Do not set right-of-way monuments on County Secondary Projects.

See Standard Specification and Special Provisions for Contractor Construction Staking for more information on Right-Of-Way Monuments.

3.12 HORIZONTAL AND VERTICAL CONTROL FOR CONSTRUCTION PROJECTS

Check the plans to see if the original survey crew set any permanent control monuments. If set by KDOT crews, they will probably show on plans as a standard KDOT disk set in concrete and stamped with letters and numbers such as HCP-JO 202, etc. If set by a consulting firm, they may be stamped with the firms initials and a set of numbers such as T3, T4, T5, etc. If any of these monuments exist, you have a controlled survey and can proceed accordingly.

Request the coordinate data from the KDOT squad leader shown.

If permanent monuments exist, you may find that they have been set a mile or more apart as they were only set as needed to gather information to design plans for the project. You will need to set additional monuments for construction layout and permanent R/W points. In some cases, you may find the actual centerline of project or portions thereof may never have been laid out on the ground. All information for the plans may have been taken from an offset baseline or from the horizontal control traverse line. In this case, and when there are no control points within ½ mile of each other, set control points within ½ mile or closer.

Before starting to set construction control monuments, consult the Volume II Coordinating Section Survey Manual, developed by the Bureau of Road Design. It contains information on horizontal control surveys and monuments.

When selecting locations for construction control monuments, visualize what the project will look like at various stages of construction. Keep in mind how high the fills will be, how deep the cuts, keep away from railroad as much as possible. Try to set enough monuments that when occupying one, you can see two others and be able to reset all centerline and R/W points for that portion of the project. When setting control points, keep a record of the location, approximate distance Rt. or Lt. of centerline, approximate station and some short ties to fence corners and a short description of the monument and location.

3.13 SURVEYS FOR ASPHALT OVERLAYS AND REFERENCE STRINGLINES

The Standard Specifications require the use of a reference stringline on some types of asphalt bases and overlays. The Construction Staker will make the survey required to establish a reference stringline.

3.14 FENCING

Generally, the right-of-way stakes will be sufficient staking for the construction of

fencing when the fence follows the right-of-way line. On locations where the fence does not follow the right-of-way and is within the right-of-way, stake the beginning, all the corners, and the ending, as well as alignment stakes every 100 feet or less on the straight runs. Provide the necessary stake for special fencing details.

3.15 SIGNING AND DELINEATION

On signing projects, it is necessary to establish the centerline stationing as all signs and delineators are located by the stationing.

After receiving the signing plans, set a temporary stake at the location of each sign so that the location may be checked in the field. After the Engineer approves the final location, set the center of the posts as shown on the plans. Since the center points will be destroyed during construction, use temporary nails or stakes on these points. Set offset hubs or reference points outside of the construction area to maintain the alignment of the sign. If the final grade has been completed at the sign location, take actual field elevations to determine the footing elevations and the lengths of the posts. Because all elevations are relative to the edge of the pavement, it is not necessary to establish benchmarks and carry an H.I. Determine the elevation of the off-set hubs and mark the cut or fill to the adjacent footing on the flat. If the grading or shouldering is not complete, these elevations and post lengths may be determined from the typical section. It is generally sufficient to indicate the location of delineators, because the elevation is determined from the existing shoulder.

3.16 CONTROL FOR AERIAL PHOTOGRAPHY

On some projects, it will expedite the calculation of final payment quantities by requesting the Bureau of Road Design, Survey Section, to fly the project for final earthwork quantities. From aerial photographs, they can determine the final sections and compute the final excavation and embankment quantities. This aerial survey requires a field survey party to place a specific ground control. The specific details of this control are contained in the Volume II Coordinating Section Survey Manual. Contact the Survey Coordinator in the Bureau of Road Design for information and targets needed. This may save you considerable work in accomplishing aerial control.

3.17 ROADSIDE IMPROVEMENTS

The construction surveys for roadside improvements are quite varied. Stake each item to meet the circumstances.

3.18 ELECTRIC LIGHTING

The construction surveys for electric lighting are quite varied. Stake each item to meet the circumstances.

3.19 EROSION CONTROL

Before staking wash checks or ditch lining, shape the ditch or channel to the dimensions shown on the plans or as revised. The existing ditch or channel is then the control for both alignment and elevation of the wash checks or ditch lining. Generally, one hub offset from each end of the wash check on the highest side with cuts to the flowline will be adequate. Stake the ends and each break in grade or width of ditch lining with a hub offset on each side. Show a cut

and distance to the edge of the liner, and a cut and distance to the flowline of the liner. Do not set these stakes over 25 feet apart along the length of the lining.

The construction of riprap on berms and slopes may require the setting of blue tops to the subgrade elevation and later to the finish elevation in order to maintain uniform slopes and transitions. The limits of the riprap may be outlined with reference stakes.

3.20 SEEDING

Generally, the only staking required on a seeding project will be the limits of mulch areas.

3.21 TERRACES

Generally, the only staking required is a stake or plastic flag on a wire placed every 100 feet along the flowline of the proposed terrace. The local Soil Conservation Service office will supply information as to the percent of grade used in terraces in their area and will provide advice as to their location. Terraces are normally used only in borrow pits.

3.22 HIGH WATER MARKS

In the interests of obtaining information and in developing a file of flood marks for use by all interested parties, the Kansas Water Office (KWO) initiated a statewide high water marking program.

Use the following summary of the procedures in establishing high water marks, as recommended by the KWO.

There are at present two types of markings acceptable to the KWO.

Use an aluminum disc, obtainable from the KWO. Nail them to objects, preferably two to six feet above the ground.

Paint a stripe on concrete, steel or rock ledge. The bottom edge should indicate the high water level.

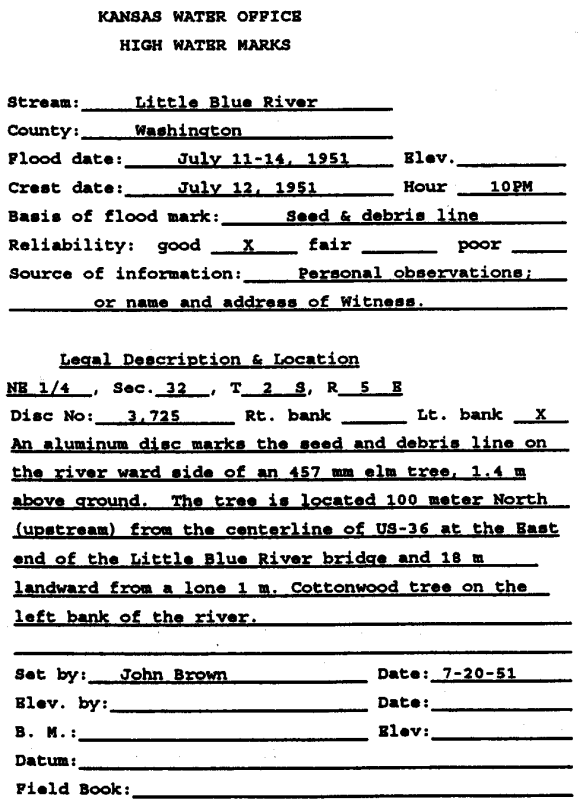
Place all markings to protect them from malicious damages. Set these marks in relatively straight portions of the stream and in areas free of obstructions.

Do not set these marks in areas of high stream velocity, where the body of water is large enough to permit wind waves, and in sites of heavy drift deposits. Avoid major obstructions, bends in the stream, where heavy debris might accumulate, and the upstream and downstream sides of trees, bridges, and other obstructions in the main channel area.

The high water mark may be determined by the remains of seed or mud lines on trees, posts, and other objects; by debris left in the fields or on roadsides and by the testimony of local residents who observed the depth of the water or the extreme edge of the high water. These elevations may be transferred to suitable locations through the careful use of a hand level.

The number of flood marks to be set is up to the discretion of the individual. Usually one good flood mark per mile of stream will be adequate. However, set several marks at a dam, fill or structure that tends to cause abrupt changes in flood profile. Set at 100, 200, and 300 yards above and below the obstruction. At embankments crossing the valley or where several structures are located in the flood plain, set high water marks of flood which cause flooding of bottomlands even if the flood is lower than others that have been recorded. High water marks of several floods at the same location are very useful for comparative purposes. Decide if marks should be set on both sides of the stream.

FIGURE No. III-18 - KANSAS WATER OFFICE – HIGH WATER MARKS



KANSAS WATER OFFICE
HIGH WATER MARKS

Stream: Little Blue River
County: Washington
Flood date: July 11-14, 1951 Elev.
Crest date: July 12, 1951 Hour 10PM
Basis of flood mark: Seed & debris line
Reliability: good X fair poor
Source of information: Personal observations;
or name and address of Witness.

Legal Description & Location

NE 1/4, Sec. 32, T 2 S, R 5 E
Disc No: 3,725 Rt. bank Lt. bank X
An aluminum disc marks the seed and debris line on the river ward side of an 457 mm elm tree, 1.4 m above ground. The tree is located 100 meter North (upstream) from the centerline of US-36 at the East end of the Little Blue River bridge and 18 m landward from a lone 1 m. Cottonwood tree on the left bank of the river.

Set by: John Brown Date: 7-20-51
Elev. by: Date:
B. M.: Elev:
Datum:
Field Book:

Mail the forms to:
Kansas Water Office
901 S. Kansas Ave.
Suite 300
Topeka, Kansas 66612-1249

Copy to:
Kansas Department of Transportation
Bureau of Design
Harrison Center, 700 SW Harrison St.
Topeka, Kansas 66603-3754

Information to be collected: when the marker is set, the date of the flood crest, if known, or stamp the approximate date on the disc with a die set, or mark on the disc with a sharp edge (month-day-year as mm-dd-yy).

The Kansas Water Office provides a standard form with the aluminum discs which serves as a guide in locating and describing marks left by floods on streams. Complete this form in detail to provide information for the level party to later find and identify the high water mark preparatory to determining its elevation. Fill out the postcard forms with all information possible at the time the markers are installed. It is not necessary to determine the elevations at the time of installation of the markers. Use the previous illustration as an example for completing the forms.

3.23 SURVEYS FOR STRUCTURES

3.23.01 GENERAL

In staking out structures, set all lines and measurements absolutely correct. Keep in mind a mental picture of the completed structure, and the manner in which it should fit the stream and

roadbed. Use all possible refinements in the work, and thoroughly check the staking. When practicable, another person should check the work in order to avoid any possible errors.

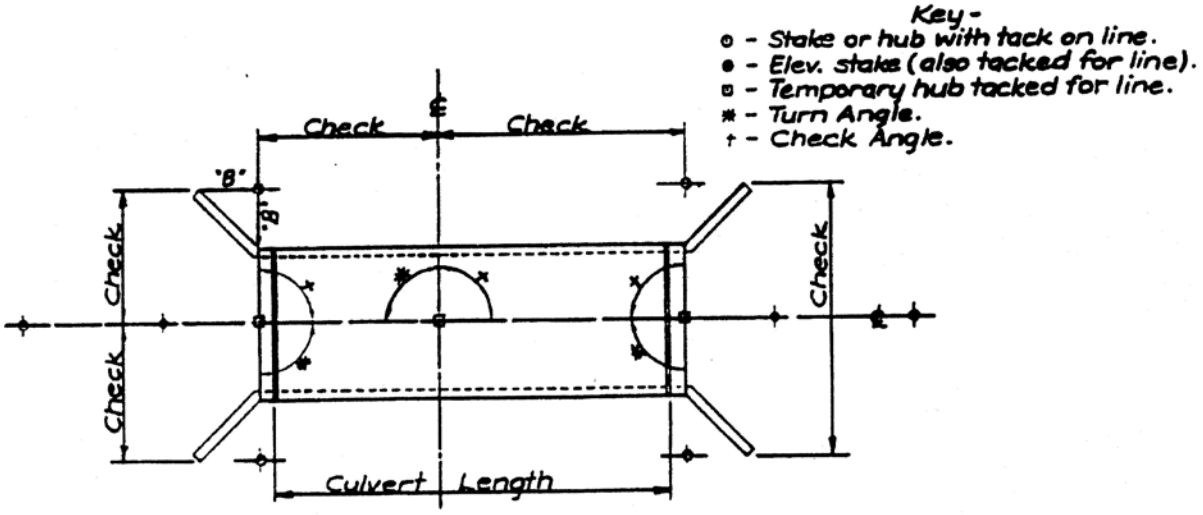
See FIGURES III-19 & 20 for the methods of staking various types of structures. Not all possible cases are covered, but the general method is illustrated.

When possible, completely stake out the entire structure before structure construction begins. Additionally, it may be required that an independent re-survey be performed by a different "qualified" surveyor to verify critical bridge locations and elevations. See Standard Specifications and Special Provisions on Contractor Construction Staking.

Stake the line on the outside of all culverts and multiple-box bridges, and offset the stakes a distance sufficient to clear the excavation.

Convey the system of staking each pier and abutment to all parties involved in the structure construction. Pay particular attention to the fact that the transverse centerlines of the piers are staked, but that the stakes for the abutments which are usually set on the centerline of bearing may be set on the centerline of piling or centerline of abutment.

FIGURE No. III-19 - EXAMPLE-CULVERT STAKING



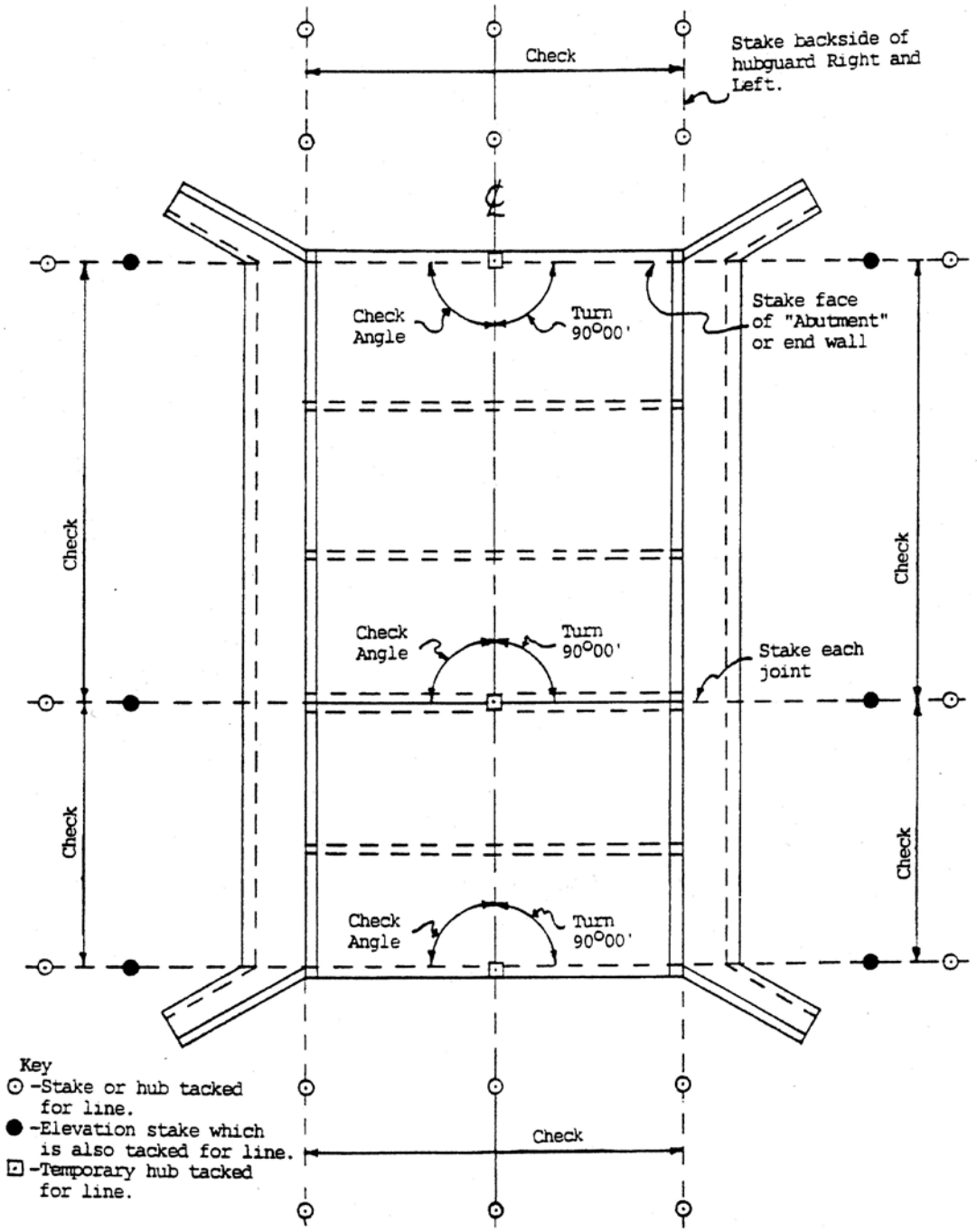
Set stakes on the outside of the hubguard on the "B" distance from the side of the culvert. In all cases, set stakes to clear the channel excavation.

Note: Set the vernier at 0°0' to check angle.

Indicate on the Elevation stakes the cut to F.L. elevation on the end of the culvert on which the stakes are set.

Stakes on the centerline of the culvert are optional and in some locations their removal is necessary.

FIGURE No. III-20 - EXAMPLE-MULTIPLE BOX BRIDGE STAKING



Note: In all cases, take linear and angular check measurements as indicated. Check all distances at least once in addition to check measurements indicated.
Set the vernier at 0°00' to check angles.
Indicate on the Elevation stakes the cut to flow line elevation on the side on which the stakes are set.

Pay particular attention to the centerline of the structure. On multi-lane roadways, centerline of the lanes and centerline of structures may not coincide due to the different width of shoulders on inside and outside of the lanes. In this case, convey the appropriate line to all parties involved.

Several methods of determining size of structures are in use. The Federal Highway Administration has derived a series of charts, nomographs, and tables for use in designing culverts. This information is available from the Bureau of Road Design for use in checking and designing culverts.

3.23.02 ALIGNMENT AND STATIONING

As set out in Section 3.22, set hubs on each side of each bridge and culvert at the time the centerline is reestablished. Set these hubs in their true position and tack for line. Set one hub on the centerline of the project on each side of each culvert and in the immediate vicinity thereof.

Set at least two hubs on centerline back of each bridge abutment. It is not always possible to see from one side of the stream to the other along the centerline during the period of construction due to obstructions such as equipment or materials. For this reason, it is desirable to have the centerline independently established on each side of the stream. Two stakes on each side should be sufficient for this purpose. On large bridges, which may be under construction for over a year, it is good policy to set a third stake 100 feet back from the abutment to preserve the centerline. Once the work has started, do not alter the location.

Take care to see that all measurements are accurate enough to locate the bridge as shown on the plans. Any appreciable error may place the bridge on foundations different in character from those designed. Frequently check the spacing of the abutments and piers. Check by different methods to verify that they are properly located.

It is very important that the spacing of piers and abutments be correct on all structures, and particularly critical in the case of steel or concrete girders and arch structures. The use of Electronic Distance Measuring Equipment may be very beneficial and recommended in various situations and conditions. For accurate measurement of distances, it is necessary to set the atmospheric pressure and temperature settings on an EMD or Total Station before taking a measurement.

When measuring over a bank or bluff at the edge of a stream, do not determine the horizontal distance by using a tape and plumb bob. Instead, set a stake on top of the bank and another on the lower level, and determine the difference in elevation between the two stakes. If this difference is too large to determine in one set-up, determine the vertical angle from the top of one stake to the top of the other. Then, measure the distance between the two stakes along the slope with the tape held in a taut position from the top of one stake to the top of the other. Calculate the correct horizontal distance between the two points from the sloping distance, and the vertical angle or difference in elevation. Distance computed from a vertical triangle may be checked quickly by laying off a perpendicular baseline and computing the distance from a horizontal triangle.

3.23.03 TURNING ANGLES FOR PIERS AND ABUTMENTS

When the instrument is set up on the centerline of a project, to laying off the angle for the face or back of an abutment, or the transverse centerline of a pier, exercise extreme care to see that the angle is turned off accurately and in the right direction. Turn all angles from a foresight,

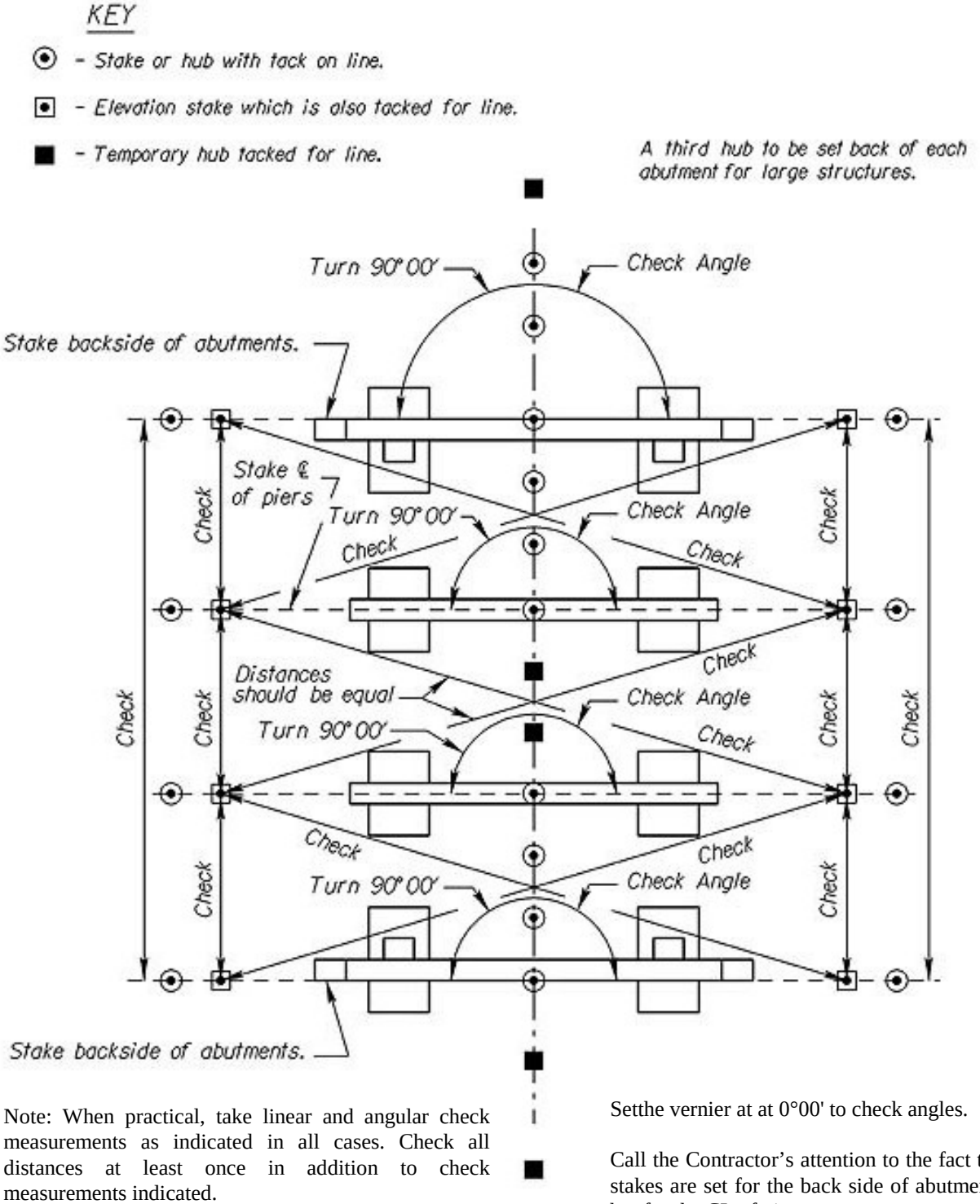
thus eliminating the necessity of reversing the telescope. After an angle has been turned off, and the stakes set along the line of sight, set the horizontal vernier at 0°00" or at any random reading, and measure the supplemental angle as a check on the angle laid off a structure is to be built on a skew. Exercise extreme care to set the stakes with proper skew direction and accurate skew angle. Line all handrail posts for structure, and set to grade with an instrument. Check the alignment and elevation of the forms for posts before placing concrete.

3.23.04 TRIANGULATION

In case a stream is so wide that the water cannot be spanned with a 200-foot tape, and Electronic Distance Measuring Equipment is not available, set a tacked stake on centerline on each side of the stream at a safe distance back of each proposed abutment. Determine the distance between the stakes by triangulation.

To determine the distance between the two stakes by triangulation, lay off a baseline on one bank of the stream. If possible, this baseline should be perpendicular to the centerline, to simplify computations. The baseline should be of such length that the triangle determined by it and segment of the centerline will have no angle smaller than 30°. If the location is on rough ground, set stakes at 50-foot intervals, and determine the elevation of each stake. Determine the sloping distance from the top of each stake to the succeeding stake, and calculate the horizontal distance between stakes.

FIGURE No. III-21 - BRIDGE CONSTRUCTION STAKING DIAGRAM



Note: When practical, take linear and angular check measurements as indicated in all cases. Check all distances at least once in addition to check measurements indicated.

Setthe vernier at at 0°00' to check angles.

Call the Contractor’s attention to the fact that stakes are set for the back side of abutments, but for the CL of piers

For accurate measurement of distances, corrections in chained distances are necessary; therefore, determine the calibrated tension and temperature for the chain.

Use a calibrated steel tape with tension scales to determine the length of the baseline for triangulation work pertaining to structures.

In triangulation work, measure the angles by repetition; measure each angle of the triangle or other figure at least twice with the telescope in direct position, and an equal number of times with the telescope in reverse position. When measuring angles by this method, record the first value of the angle with the telescope in direct position as a check against the mean angle. The mean angle is determined by dividing the final reading by the number of observations. Record three angular values: The first reading with the telescope in direct position, the final reading resulting from three repetitions, and the mean value of the angle. Using a surveying instrument with a vernier reading to minutes, check the mean value of the angles at least within 30" of the first value of the angle. If this check is not obtained, the indications are that either the instrument is not in proper adjustment, or some error has been made in measuring the angle. Measure the angle again. For another check upon the accuracy of the measured angles, add together the mean values of the angles of each figure to ascertain whether or not the figure closes. Adjust the figure to eliminate any angular error of closure before any computations are made.

3.23.05 ELEVATIONS

Set at least two benchmarks near each structure. For large bridges across wide or otherwise difficult streams, set at least two benchmarks on each side of the stream near the ends of the structure. Thoroughly check all the benchmarks according to Section 3.05 before grading any construction stakes. For level work, always sight at least two benchmarks each time the instrument is set up for leveling work. When closing level work, take the last rod reading on a benchmark.

Check the elevation of the streambed, the low-water elevation, and the high-water elevation. The elevation of the natural ground surface on either side of the stream or the elevation of the existing roadbed may also be checked.

In cases where a railroad bridge is near the site of the proposed bridge, check the clearance elevation of the railroad structure. Before staking a grade-separation structure, whether it is an overpass or underpass, check the elevations of the tops or bases of the rails.

When determined, carefully compare all of these elevations with the corresponding elevations shown on the plans, to detect any errors on the plans or in the fieldwork before the staking the structure. Exercise extreme care to see that each structure is built to the relative elevations with respect to the designed streambed, etc. Prior to placing concrete, set molding and check for elevation. Also check for elevation after the concrete is placed, and just before starting the finishing operations.

3.23.06 STAKES

When staking bridges or culverts, the minimum dimensions for elevation and line stakes used is 1½" x 1½" x 12". On large structures with longer duration of construction, it may be advisable to use heavier stakes. Drive all stakes flush with the ground surface in locations where they will not be covered or disturbed. Flag each stake, and use a substantial guard. Since the grade and line stakes are flush, mark the cut or fill, the distance to centerline, and any other data on the guard stake or a separate guide stake driven in place for that purpose. Where large, smooth

finished wooden guard stakes are used, show any data referring to the grade or line stake on the guard stake. If a steel bar is used as a guard, drive a Type "A" guide stake (see FIGURE No. III-1) in place and record the data thereon. Show the distance from the line stakes to the centerline of the project, to the face of the structure, or to some other similar line or point on the guide or guard stake, and record in the field notes as an aid in finding stakes, which might become covered.

Locate culverts or multiple boxes at the station shown on the plans, unless there is a definite reason for changing the location. This will avoid overruns and underruns in culvert excavation and backfill.

3.23.07 CROSS-SECTIONS FOR BRIDGES AND CULVERTS

See the Contract Documents to determine what excavation quantities need calculated for payment.

To determine the excavation for channels through structures and excavation for bridges and miscellaneous structures, take accurate and complete cross-sections at each structure site prior to construction. In most cases, take the cross-sections when staking out the structure.

Take cross-sections:

(a) at right angles to the centerline of the structure;

(b) at the critical points indicated by irregularities in the surface of the ground;

(c) at points of change in the excavation limits; and

(d) at points where there is a change in the flow-line grade.

Record the cross-sections on the page following the staking notes for each structure. Plot these field notes using the same method as that employed on regular roadway sections.

Determine and plot the excavation limits for each section, and run the end areas. Compute the excavation volume for the barrel and wings, using the regular Earthwork Computation Sheet (Form No. 101), with a separate calculation for the toe-wall excavation.

For information on the classification of excavation requiring payment, see Excavation and Backfill for Structure in the Standard Specifications and Special Provisions.

Take adequate and accurate cross-sections at all locations before beginning excavation.

Although no classification is made of the various classes of material, such as gravel, shale, rock, etc., and no differentiation is made between wet and dry excavation, take and record the water elevation and the elevation of the various classes of material for permanent record, and place on the Completed Construction Plans.

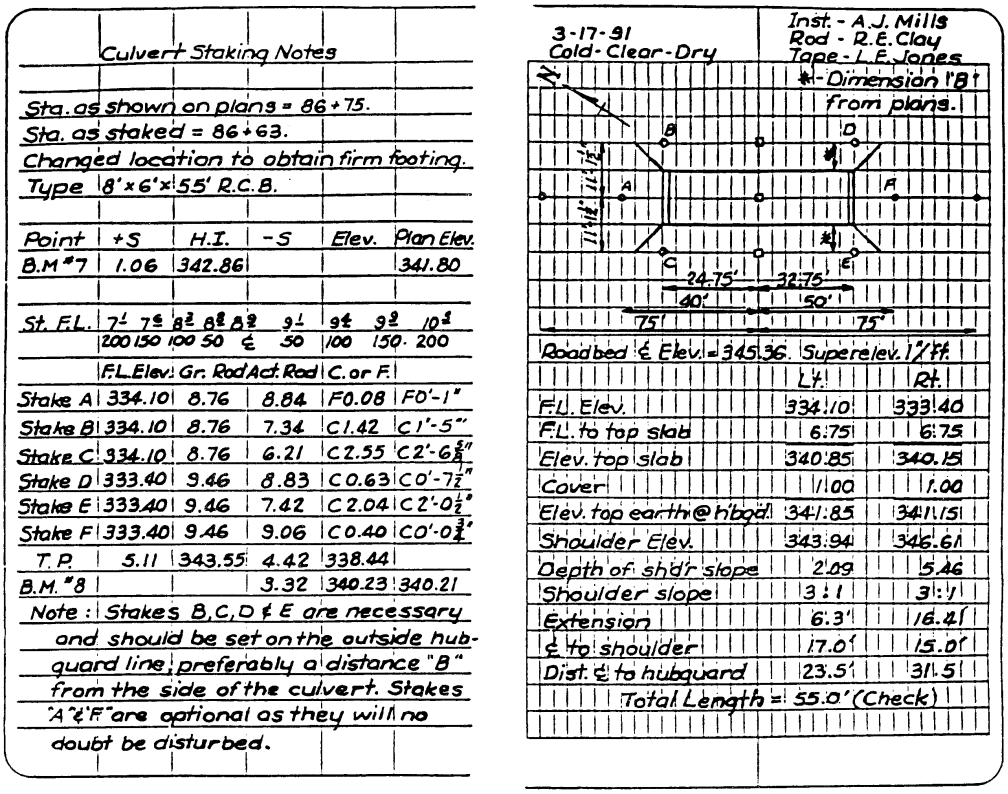
3.23.08 NOTES

Keep the field notes for a large bridge in a separate field book. Show all the sketches and notes pertaining to the staking, cross-section notes, and all other notes pertaining to the structure. Keep field notes for every field operation, including checking operations. Supplement notes with neat sketches to aid in recording or interpreting the notes.

In the case of small bridges, keep the complete notes for several such structures on the same project in the same field book, unless they are under construction at the same time.

Thoroughly index each notebook when making field entries.

FIGURE No. III-22 - CULVERT STAKING NOTES



Culvert Staking Notes

Sta. as shown on plans = 86+75.
Sta. as staked = 86+63.
Changed location to obtain firm footing.
Type 8'x6'x55' R.C.B.

Point	+S	H.I.	-S	Elev.	Plan Elev.
B.M. "7	1.06	342.86			341.80

St. F.L.	7'	7½	8'	8½	8½	9'	9½	9½	10'
	200	150	100	50	℄	50	100	150	200

	F.L. Elev.	Gr. Rod	Act. Rod	C. or F.	
Stake A	334.10	8.76	8.84	F0.08	F0'-1"
Stake B	334.10	8.76	7.34	C1.42	C1'-5"
Stake C	334.10	8.76	6.21	C2.55	C2'-6⅝"
Stake D	333.40	9.46	8.83	C0.63	C0'-7½"
Stake E	333.40	9.46	7.42	C2.04	C2'-0½"
Stake F	333.40	9.46	9.06	C0.40	C0'-0¾"
T.P.	5.11	343.55	4.42	338.44	
B.M. "8			3.32	340.23	340.21

Note: Stakes B, C, D ℄ E are necessary and should be set on the outside hub-guard line; preferably a distance "B" from the side of the culvert. Stakes "A" ℄ "F" are optional as they will no doubt be disturbed.

3-17-91
Cold - Clear - Dry

Inst. - A.J. Mills
Rod - R.E. Clay
Tape - L.E. Jones

*- Dimension "B" from plans.

24.75' 32.75'
40' 50'
75' 75'

Roadbed ℄ Elev. = 345.36. Superelev. 1"/Ft.

		Lt.	Rt.
F.L. Elev.		334.10	333.40
F.L. to top slab		6.75	6.75
Elev. top slab		340.85	340.15
Cover		1.00	1.00
Elev. top earth @ h'bgd.		341.85	341.15
Shoulder Elev.		343.94	346.61
Depth of shd'r slope		2.09	5.46
Shoulder slope		3:1	3:1
Extension		6.3'	16.4'
℄ to shoulder		17.0'	15.0'
Dist. ℄ to hubguard		23.5'	31.5'
Total Length = 55.0' (Check)			

Keep culvert field notes, including construction records, in a separate field book. Keep a complete record of all staking operations and all level work pertaining to culverts. See FIGURE No. III-22 for an example of culvert staking.

Immediately following the staking and field notes, record the cross-section notes. Reserve two or three blank sheets immediately following the staking and cross-section notes for construction records for each culvert.

3.24 SURVEYS FOR PAVEMENTS

3.24.01 GENERAL

These surveys may be of three types:

(a) Staking for base control
(b) paving stakes
(c) staking for drainage

3.24.02 PAVING GRADE AND LINE STAKES

There are two basic types of paving: Concrete and hot mix asphalt (HMA).

a. Concrete. Set a line of type "B" stakes (hubs) on each side of the pavement subgrade at an offset of two to four feet from the form liner. In all cases, tack one line of hubs, or otherwise permanently marked for line. The second line of hubs need not be tacked.

Set paving grade stakes at 50-foot intervals on tangents and flat, vertical and horizontal curves. In the case of an exceptionally sharp curve, it may be necessary to set graded hubs at

intervals of 25 feet or less.

In addition, set graded hubs on all necessary points in transitions to super-elevation, according to the transition diagram shown on the plans. Place graded hubs at all points of beginning or ending or pavement widening. Never move or disturb hubs after tacking. See Section 3.23.05 and 3.23.06 for establishing offset line.

There are three common methods of setting graded hubs for concrete paving forms. Discuss and agree upon the actual method to be used with the Contractor and Engineer. Each method has some advantages and disadvantages.

Method No. 1: After placing the hubs on line, drive them to the edge of pavement grade. This is also the top of form grade. The form setter simply sets the form line by leveling off the paving hub.

Method No. 2: Set all grade stakes at some agreed fill (such as 0.50' to 0.75'), but this is a condition and all parties should be advised. In this method, grade hubs before tacking for line. It may be faster and convenient to use surveying instrument and level at the same time.

Method No. 3: By this method, drive the hubs on line and tack before grading. After tacking the hubs shoot with a level, and compute an individual cut or fill to top of form line for each hub. This method of staking is quicker.

b. HMA. The most common method is to place grade stakes on centerline of each pair of lanes throughout the length of the project. On horizontal curves with superelevation, set grade stakes for the outside edge of pavement and offset in the same manner as concrete pavement stakes.

All grade stakes are usually driven flush with the bottom of pavement grade.

The interval for grade stakes will have the same measurements as previously stated for concrete paving stakes.

Set an offset alignment control so centerline may be reestablished for succeeding lifts of the HMA.

3.24.03 STAKING FOR GUTTERS

When staking edge curbs and gutters, the method of paving hubs is usually applicable. Establish grade to top of form line. Take care to maintain at least 0.2 feet drop per 100 feet, whenever possible. When constructing the gutter after placing the pavement, a stake at the beginning and the end may be sufficient.

When setting inlets in vertical curves, take care to find the low point on the pavement edge. Often, it will be a few feet from the point shown on the plans.

3.24.04 OFF-SETTING STAKES FROM ALIGNMENT TANGENT

For all types of pavement staking, reference control points such as P.O.T.’s, P.T.’s, P.C.’s, etc., by setting a stake at right angle to the control point on each offset line. Set these stakes with a surveying instrument and tack for line and offset distance. Then run the offset line with a surveying instrument and steel tape.

3.24.05 OFF-SETTING ON HORIZONTAL CURVES

When off-setting form stakes on a horizontal curve, the centerline may first be established. The form stakes may be offset by using two tapes in a manner similar to that

explained in Section 3.04.12. It is also practical to set the instrument on an offset control point, then chain in the offset line using the intrados corrections. Set stakes at intervals of 50 feet or less (centerline distance), and shorten to 25 feet for short radius curves.

Offset all other types of stakes by similar methods.

3.24.06 NOTES

Base and pavement grade notes may be kept in KDOT Field Book No. 4.

3.25 COMPLETED CONSTRUCTION PLANS

3.25.01 GENERAL

Prepare completed (As-built) construction plans for all grading, paving and bridge projects. See Contractor Construction Staking Standard Specifications and Special Provisions. Include in the as-built plans, major and minor changes in plans, project alignment, land monuments, project control and benchmarks.

3.25.02 PROJECT CONTROL

Recover, reset and verify project control centerline or baseline with 3 reference ties as stated in Sections 3.04.08 and 3.04.12.

FIGURE No. III-23 - ADDITIONAL REFERENCES

The references listed below are included as sources of additional information and procedure on construction surveys. Since it is impossible to cover all aspects of surveying in the Construction Manual, consult the following references for computational details, formulas, tables, care of equipment, etc.:

(a) Searles, W. H., Ives, H. C., & Kissam, P., Area Construction Engineering, John Wiley & Sons, Inc., New York.

(b) Breed, C. B., Hosmer, G. L., Bone, A. J. Elementary Surveying, John Wiley & Sons, Inc., New York

(c) Hickerson, T. F. Route Location and Design, McGraw-Hill Book Co., Inc., New York.

(d) Barnett, J., Transition Curves for Highways, United States Government Printing Office, Washington, D.C.

(e) Solar Ephemeris for 19-- and Surveying Instrument Manual, Keuffel & Esser Co., New York.

(f) Operating manuals as issued with instruments.

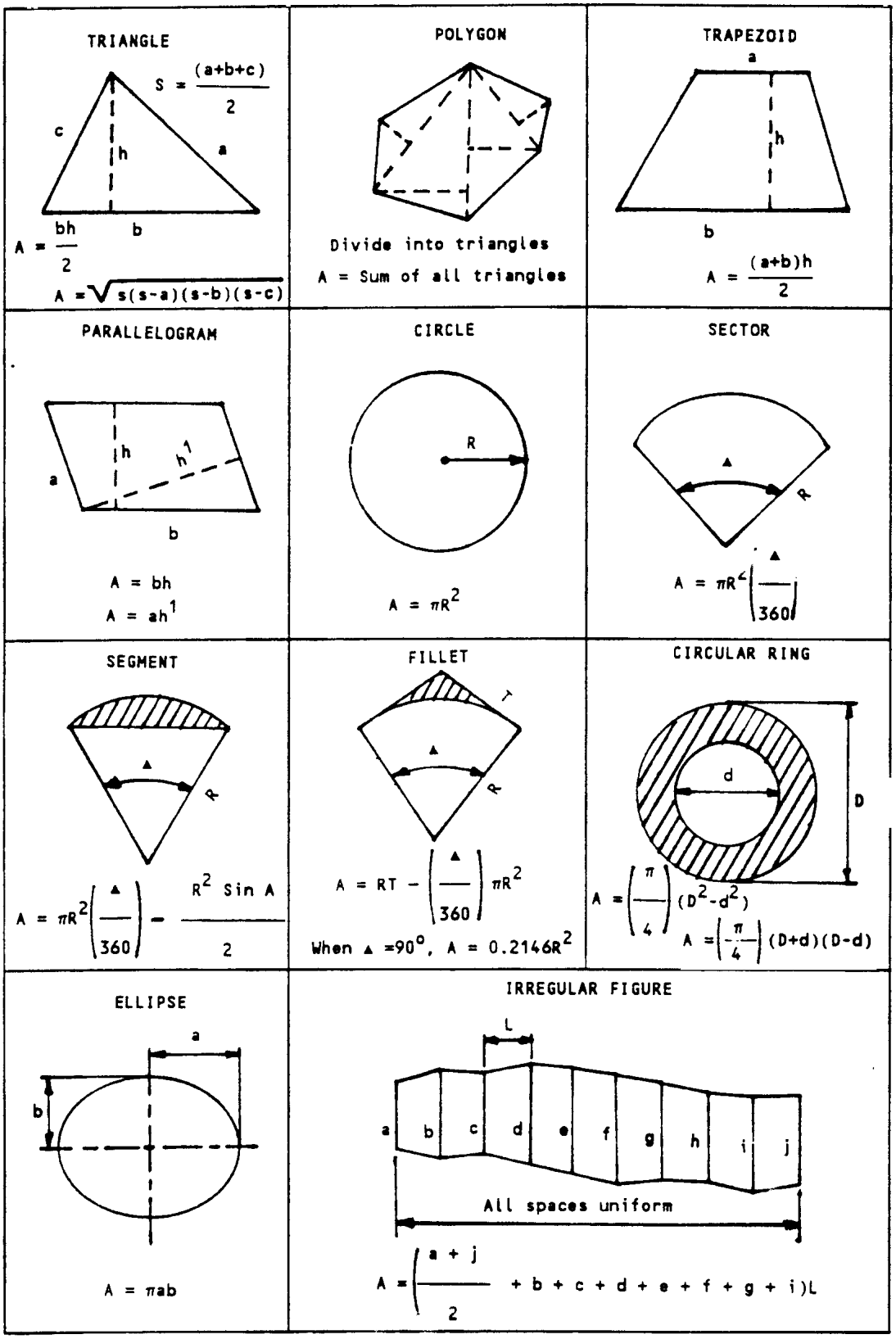
FIGURE No. III-24 - CONVERSION FACTORS

Multiply	**by**	**To Obtain**
Acres (ac)	4046.87300000	Square meters (m^2)
Acres (ac)	0.40468730	Hectares (ha)
Acres (ac)	43560.00000000	square feet ($ft^{2)}$
Acres (ac)	0.00156200	square miles (mi^2)
board foot	0.00235974	cubic meters (m^3)
bushels	2150.40000000	cubic inches (in^3)
bushels (U.S.)	0000.0.523907	cubic meters (m^3)
Centimeters (cm)	0.39370000	Inches (in)
Centimeters (cm)	0.03281000	Feet (ft)
Cubic Feet (ft^3)	0.02831685	Cubic meters (m^3)
Cubic Feet (ft^3)	28.31685000	Liters (L)
cubic inches (in^3)	0.00001639	cubic meters (m^3)
cubic meters (m^3)	35.31466247	cubic feet (ft^3)
cubic meters (m^3)	1.30795055	cubic yards (yd^3)
cubic meters (m^3)	1000.00000000	Liters (L)
cubic meters (m^3)	264.17203728	Gallons (gal)
cubic meters (m^3)	0.26417200	1000 gallons (M gal)
cubic yards (yd^3)	0.76455490	cubic meters (m^3)
cubic yard/mile (yd^3/mi)	0.47507150	cubic meter/kilometer (m^3/km)
degree celsius (°C)	(°Cx1.8)+32	degree fahrenheit (°F)
degree celsius (°C)	°C+273.15	Kelvin (K)
degree fahrenheit (°F)	(°F-32)/1.8	degree celsius (°C)
degree fahrenheit (°F)	(°F+459.67)/1.8	Kelvin (K)
Feet (ft)	0.30480000	Meters (m)
Feet (ft)	0.00018940	miles (mi)
feet/second (ft/sec)	0.68180000	miles/hour (mi/hr)
feet/second (ft/sec)	1.09728000	kilometer/hour (km/hr)
foot-pound force (ft-lbf)	1.35581800	Joule (J)
gallons (gal)	3.78530000	Liters (L)
gallons (gal)	0.00378541	cubic meters (m^3)
1000 gallons (M gal)	3.37854126	cubic meters (m^3)
1000 gallons (M gal)	3785.41260000	Liters (L)
gallons/square yards (gal/yd^2)	4.52731774	liters/square meter (L/ (m^2)
gallons/minute (gal/min)	0.63090200	liters/second (L/sec)
Hectares (ha)	2.47100000	Acres
Hectares (ha)	1000.00000000	square meter (m^2)
Inches (in)	25.40000000	Millimeters (mm)
Inches (in)	2.54000000	Centimeters (cm)
Joule (J)	0.73756212	Foot-pound force (ft-lbf)
Kilograms (kg)	2.20460000	pounds (lb)

Multiply	by	To Obtain
Kilograms (kg)	0.23453430	sacks of cement (94 lbs)
Kilograms (kg)	0.00100000	Megagram (Mg)
Kilograms (kg)	9.80665000	Newton (N)
kilogram/cubic meter (kg/m^3)	0.06242797	pound/cubic foot (lb/ft^3)
kilogram/cubic meter (kg/m^3)	1.68555500	pound/cubic yard (lb/yd^3)
Kilometer (km)	3280.83989500	Feet (ft)
Kilometer (km)	0.62140000	Miles (mi)
Kilometer (km)	32.80839895	station (100 ft)
kilometer/hour (km/hr)	0.91134440	feet/second (ft/sec)
kilonewton (kN)	0.22480892	Kip
kilopascal (kPa)	0.14503774	pounds/square inch (psi)
Kip	1.44822200	kilonewton (kN)
kip/square inch (ksi)	6894.75700000	kilopascal (kPa)
Liters (L)	0.00100000	cubic meter (m^3)
Liters (L)	0.26420000	gallons (U.S.) (gal)
liter/square meter (L/m^2)	0.22088144	gallon/square yard (gal/yd^2)
Meters (m)	39.37007800	Inches (in)
Meters (m)	3.28080000	Feet (ft)
Meters (m)	0.00062140	Miles (mi)
Meters (m)	1.09360000	Yards (yd)
Megagram (Mg)	0.98420000	tons (long)
Megagram (Mg)	1.10230000	tons (short)
Miles (mi)	1.60930000	Kilometers (km)
Miles (mi)	5280.00000000	Feet (ft)
miles/hour (mi/h)	88.00000000	feet/minute
miles/hour (mi/h)	1.60934700	kilometer/hour (km/h)
Millimeters (mm)	0.03940000	Inches (in)
Newton (N)	1.00000000	kilogram meter/sq second ($kg\ m/s^2$)
Newton (N)	0.22480892	pound force (lbf)
pascal (Pa)	1.00000000	newton/square meter (N/m)
pounds-force (lbf)	4.44822200	Newtons (N)
pounds-mass (lbm)	0.45335924	Kilograms (kg)
pounds/foot (lb/ft)	14.59390000	newton/meter (N/m)
pounds/cubic foot (lb/ft^3)	16.01846000	kilogram/cubic meter (kg/m^3)
pounds/cubic yard (lb/yd^3)	0.59327640	kilogram/cubic meter (kg/m^3)
pounds/square foot (lb/ft^2)	4.88242800	kilogram/square meter (kg/m^2)
pounds/square foot (lb/ft^2)	47.88092600	pascal (Pa)
pounds/square foot/hour ($lb/ft^2/hr$)	4.88242800	kilogram/square meter/hour ($kg/m^2/hr$)
pounds/square inch (psi)	6.89475700	kilopascal (kPa)
Pounds (lb)	16.00000000	Ounces (oz)
Quart (qt)	0.00094635	cubic meter (m^3)

Multiply	by	To Obtain
Quart (gt)	0.94630000	Liters (L)
Radians	57.30000000	Degrees
rods	5.02900000	Meters (m)
rods	16.50000000	Feet (ft)
sacks of cement (94 lb)	42.63768560	Kilogram (kg)
square inches (in^2)	0.00064516	Square meters (m^2)
square feet (ft^2)	0.09290000	Square meters (m^2)
square kilometers (km^2)	0.38610000	square miles (mi^2)
Square meters (m^2)	10.76390000	square feet (ft^2)
Square meters (m^2)	1.19600000	square yards (yd^2)
Square meters (m^2)	0.00024710	Acres (ac)
Square meters (m^2)	0.00010000	Hectares (ha)
square miles (mi^2)	2.59000000	square kilometers (km^2)
square yards (yd^2)	0.83610000	Square meters (m^2)
station (100 ft)	0.03048000	Kilometer (km)
ton (long 2240 lb)	1016.04700000	Kilogram (kg)
ton (long 2240 lb)	1.01600000	Megagram (Mg)
ton (short 2000 lb)	907.18470000	Kilogram (kg)
ton (short 2000 lb)	0.90720000	Megagram (Mg)
tons (long)	2240.00000000	Pounds (lb)
tons (short)	2000.00000000	Pounds (lb)
Megagram (Mg)	1000.00000000	Kilogram (kg)
Megagram (Mg)	0.98420640	ton (long 2240 lb)
Megagram (Mg)	1.10231136	ton (short 2000 lb)
Megagram (Mg)	2204.62248000	Pounds (lb)
Yards (yd)	0.91440000	Meters (m)
Yards (yd)	0.00056820	Miles (mi)

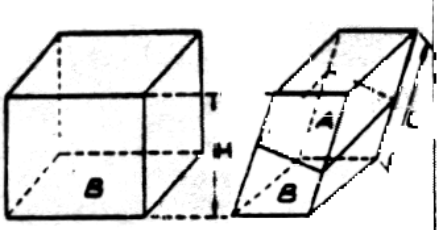
FIGURE No. III-25 - SURFACES AND VOLUMES OF SOLIDS



SYMBOLS

S = Lateral Surface Area
V = Volume
A = Area of Setion Perpendicular to Sides
B = Area of Base
P = Perimeter of Base
P_A = Perimeter of Section Perpendiculer to Sides
R = Radius of Shers or Circle
L = Slant Height of Lateral Length
H = Perpendicular Height
C = Circumference of Circle of Sphers

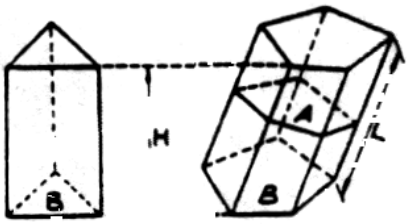
PARALLELEPIPED



S = PH S = P_AL

V = BH = AL

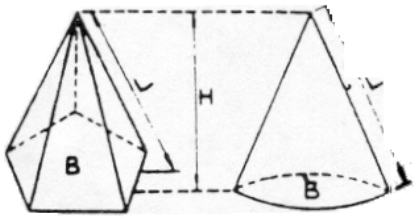
PRISM, RIGHT OR OBLIQUE, REGULAR OR IRREGULAR



S = PH S = P_AL

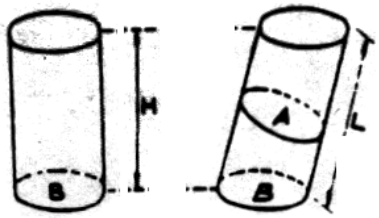
V = BH = AL

PYRAMID OR CONE, RIGHT AND REGULAR



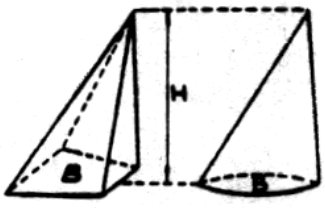
S = ½ PL V = ⅓ BH

CYLINDER, RIGHT OR OBLIQUE, CIRCULAR OR ELLIPTIC



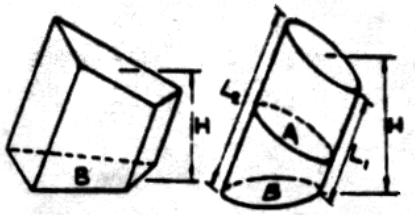
S = PH = P_AL
V = BH = AL

PYRAMID OR CONE, RIGHT OR OBLIQUE, REGULAR OR IRREGULAR



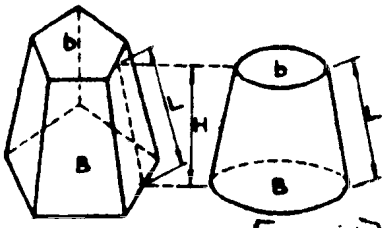
V = ⅓ BH

FRUSTUM OF ANY PRISM OR CYLINDER



V = BH V = ½ A (L + L_1) for cylinder

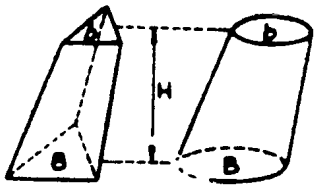
FRUSTUM OF PYRAMID OR CONE RIGHT AND REGULAR, PARALLEL ENDS



$S = \frac{1}{2} L (P + p)$ $V = \frac{1}{3} H \left[B + b + \sqrt{Bb} \right]$

(p = perimeter of top base)
(b = area of top base)

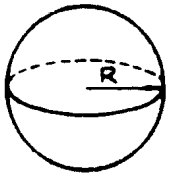
FRUSTUM OF ANY PYRAMID OR CONE. PARALLEL ENDS



$V = \frac{1}{3} H (B + b + \sqrt{Bb})$

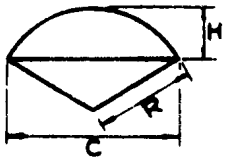
b = Area of top base

SPHERE



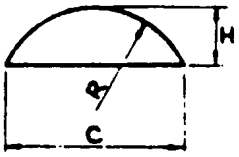
$S = 4 \pi R^2$ $V = 4/3 \pi R^3$

SPHERICAL SECTOR



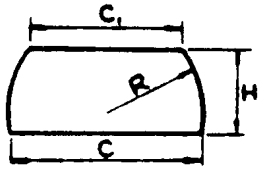
$S = 1/2 \pi R (4H + C)$ $V = 2/3 \pi R^2 H$

SPHERICAL SEGMENT



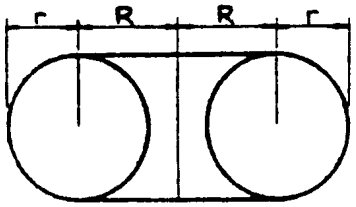
$S = 2 \pi RH = 1/4 \pi (4H^2 + C^2)$ $V = 1/3 \pi H^2 (3R - H)$

SPHERICAL ZONE



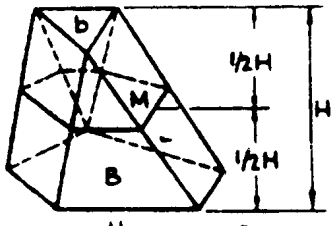
$S = 2 \pi RH$ $V = 1/24 \pi H (3C_1^2 + 3C^2 + 4H^2)$

CIRCULAR RING



$S = 4 \pi^2 Rr$ $V = 2 \pi^2 Rr^2$

PRISMOIDAL FORMULA

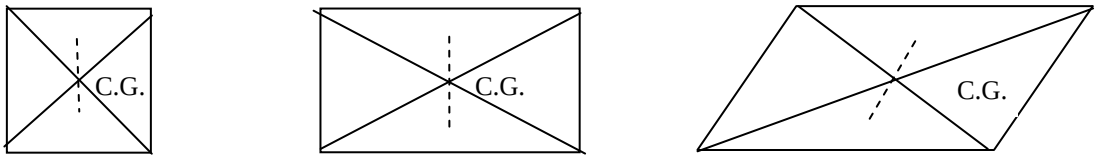


$V = \frac{H}{6} (B + b + 4M)$

M = Area of Section Parallel to Bases, Midway between them.

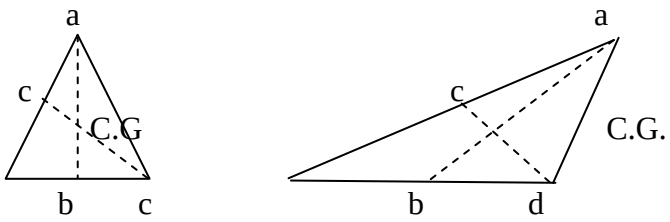
FIGURE No. III-26 - CENTERS OF GRAVITY OF ORDINARY PLANE FIGURES

Squares, Retangles & Paralleograms



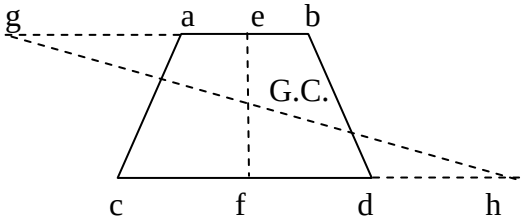
Center of gravity is at the intersection of the diagonals or midway between the bases on a line drawn between the centers of those bases.

Triangles



Center of gravity is at the intersection of the medial lines a b and c d: a medial line is a line drawn from any apex to the middle of the opposite side. The distance b (C.G.) = 1/3 a b: that is, the center of gravity is on the medial line 1/3 of the distance from the base to the apex.

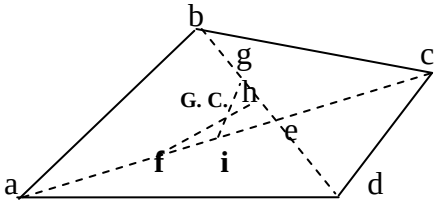
Trapezoid



Graphic Method. Prolong b a to g, making a g = c d. Prolong c d to h, making d h = a b. Connect g h. Bisect a b at e. Bisect c d at f. Connect e f: the intersection of g h and e f is the center of gravity

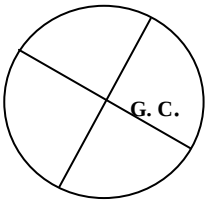
$$\text{The distance f (C.G.)} = \frac{ef}{3} \times \frac{2ab+cd}{ab+cd}$$

Any Quadrilateral



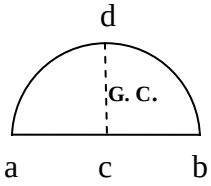
Graphic Method. Drawn the diagonals ac and bd intersecting at e. Lay off a f = e c. Lay off b d = e d. Bisect e g at h; bisect e f at i. The intersection of f h and g i is the center of gravity of the figure.

Circles



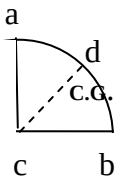
Center of gravity at the center

Semicircle



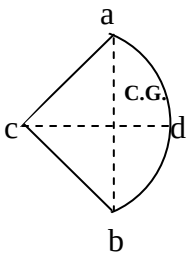
The center of gravity lies on the radius perpendicular to the diameter. The distance c (G. C.) = radius x 0.4244

Quadrant



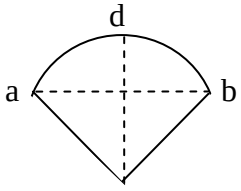
The center of gravity lies on the radius which bisects the ∟acb. The distance c (C.G. = radius x 0.6002

Sector



The center of gravity lies on the radius bisecting the ∟acb. The distance c (C.G.) = 2/3 radius x $\frac{\text{cord ab}}{\text{arc adb}} = \frac{\text{radius x chord}}{3 \text{ x area}}$

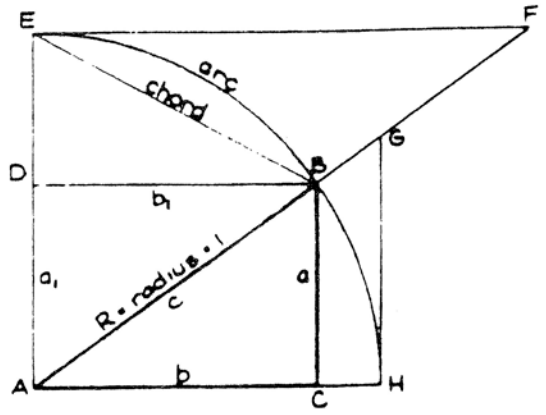
Segment



The center of gravity lies on the perpendicular erected at the center of the chord ab.

The distance c (C.G.) = $\frac{\text{Chord ab3}}{12 \text{ x area of segment}}$

FIGURE No. III-27 - TRIGONOMETRIC FUNCTIONS



$\tan \angle BAC = GH = (\tan \angle BAC)R = a/b = \cot \angle ABC$

$\sin \angle BAC = BC = (\sin \angle BAC)R = a/c = \cos \angle ABC = \sqrt{c^2 - b^2}$

$\cos \angle BAC = AC = (\cos \angle BAC)R = b/c = \sin \angle ABC = \sqrt{c^2 - a^2}$

$\sin \angle ABD = AD = (\sin \angle ABD)R = a/c = \cos \angle DAB$

$\cos \angle ABD = BD = (\cos \angle ABD)R = b/c = \sin \angle DAB$

$\text{Sec} \angle BAC = AG = \left(\frac{1}{\cos \angle BAC}\right)R = c/b = \text{cosec} \angle ABC$

$\text{cosec} \angle BAC = AF = \left(\frac{1}{\sin \angle BAC}\right)R = c/a = \sec \angle ABC$

$\cot \angle BAC = EF = \left(\frac{1}{\tan \angle BAC}\right)R = b/a = \tan \angle ABC$

$\text{exsec} \angle BAC = BG = \left(\frac{1}{\cos \angle BAC} - 1\right)R = \frac{c-b}{b} = \text{coexsec} \angle ABC$

$\text{vers} \angle BAC = CH = (1 - \cos \angle BAC)R = \frac{c-b}{c} = \text{covers} \angle ABC$

$\text{coexsec} \angle BAC = BF = \left(\frac{1}{\sin \angle BAC} - 1\right)R = \frac{c-a}{a} = \text{exsec} \angle ABC$

$\text{covers} \angle BAC = DE = (1 - \sin \angle BAC)R = \frac{c-a}{c} = \text{vers} \angle ABC$

$\text{Chord of } EB = \left(\sin \frac{\angle EAB}{2}\right)2R = \sqrt{ED^2 + DB^2}$

$\text{Arc of } EB = \frac{100(\angle EAB)(R)}{5729.58}$

$\text{Length of } R = AB = \frac{a}{\sin \angle BAC} = \frac{b}{\cos \angle BAC} = \sqrt{a^2 + b^2}$

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PART IV

4.00 CONSTRUCTION INSPECTION

The addition of QC/QA to KDOT construction projects, does not in any way relieve the responsibility of KDOT personnel from inspecting work on the construction projects.

4.01 GENERAL - PRIOR TO CONSTRUCTION

4.01.01 CONTRACT DOCUMENTS

Carefully examine and check the plans, prior to starting the work, and check all notes on the Plans against physical features on the project.

Examine the standard specifications, special provisions, any project special provisions, exploratory work documents, addenda, etc.

4.01.02 PRECONSTRUCTION CONFERENCE

Follow the format of DOT Form 205 and discuss all applicable items found in the outline. This form can be found at: https://k2prodas.ksdot.org/scm/Default.aspx. More information on the preconstruction conference can be found in Section 2.06.

4.01.03 CONSTRUCTION LIMITS

The Inspector and the Contractor's Superintendent should field check the project before any work is done.

Make sure the construction limits are properly defined.

4.01.04 ARCHEALOGICAL CLEARANCE

Make sure the Contractor has received all clearances according to the Contract Documents.

4.01.05 UTILITIES

Check the status of utilities to make sure all utilities have been properly relocated.

4.01.06 ENVIRONMENTAL PACKET

Check to see if the project inlcudes an environmental packet. There may be unusual wildlife habitats, restrictions on timing of construction activities and water pollution controls.

4.01.07 NOTIFICATION

Make sure the Contractor has notified all property owners that will be affected by construction.

4.01.08 CONTRACTOR EQUAL EMPLOYMENT OPPORTUNITY SIGNS

Verify the Contractor has erected all required identification signs and posters in a conspicuous location. See contract required provision 11-15-96, latest revision. A further description of required posters can be found at:

http://www.ksdot.org/divadmin/civilrights/pdf/BulletinBoard/Post-ins.pdf.

Additionally, a check list sheet can be accessed at:

http://www.ksdot.org/divadmin/civilrights/pdf/BulletinBoard/PostChek-sht.pdf.

Also, see Section 1.10.

4.01.09 SURVEYING

Make sure the Survey Crew has arranged to save, relocate or reference all important land monuments, survey points, bench marks, etc.

If the Contractor is using GPS, thoroughly understand which items can be staked with GPS.

See Section 802-Contractor Construction Staking of the Standard Specifications.

4.01.10 SAFETY

The Inspector should keep well informed as to the safety and the environmental protection practices that are required during any construction work. Be alert to any possible danger to KDOT and Contractor personnel, the public and the environment. Following is a partial list of items that the Inspector should be familiar with for the safe completion of any construction project:

- Be familiar with the plans as to the location of underground facilities such as water mains, gas lines, communication lines, etc.
- Be familiar with safety practices while working around the various kinds of construction equipment to include an observation of overhead clearances to prevent damage to power lines, telephone lines, etc.
- Be familiar with the safety precautions involved in the various construction methods and practices, such as cofferdam construction, movement and storage of material, steel erection, concreting operations, demolition and dismantling of structures, etc.
- Observe that adequate traffic control devices are used in conformance with the traffic control plan, and verify that the plan meets the field conditions.
- Make sure the Contractor does not swing any equipment or materials over the travelling public.
- Be familiar with any environmental requirements.
- Be alert to any hazardous materials that may be in the area.

4.01.11 TRAFFIC CONTROL

Verify that adequate traffic control devices are used in conformance with the traffic control plan and the Contract Documents.

4.01.12 MATERIALS-TEST REPORTS

Prior to their use in the work, inspect and approved all materials. Most materials, particularly large quantities, are inspected at their point of storage or manufacture. Usually the test report is received in the Construction Engineer's Office before the materials arrive on the job site. In this instance, it is necessary to check the material markings, such as lot number or tag number, against the test report and also to visually inspect the material between time of test and time of use. In some instances, it is possible for the project personnel to make visual inspections.

Occasionally, materials arrive on the job site prior to testing. In this instance, take samples and forward to the central laboratory for testing. The procedures for this sampling are covered in Part V of this Manual and the Standard Specifications.

No material is to be incorporated in the work, unless it has been tested and accepted or visually accepted on the job by the Engineer or assigned representative.

4.01.13 EXTRA WORK

Whenever issues arise that differ from the Contract Documents, such as extra work, differing site conditions, etc., consult the Standard Specifications and Construction Manual for direction.

4.01.14 SCHEDULES

When required, has the Contractor submitted the appropriate schedules. See Section 2.09.02 and Section 108-Prosecution and Progress of the Standard Specifications.

4.01.15 CHARGING OF TIME (WORKING DAY CONTRACTS)

At the preconstruction conference or at least 10 business days prior to work commencing, obtain a project schedule to be used for the determination of the Controlling Item of Work (CIOW). Begin charging working days on the Notice to Proceed date and continue to charge either a working day or cleanup day for every day that qualifies under Section 108-Prosecution and Progress of the Standard Specifications until the project work is complete. Also charge appropriate liquidated damages, once contract time has been exhausted as detailed Section 108. Keep a record of working days charged, as well as liquidated damages if applicable, in the project diary.

4.01.16 CHARGING OF TIME (CALENDAR DAY CONTRACTS)

Issue the Notice to proceed on the date the Contractor begins work or the date specified in the Contract Documents. The Secretary can change the calendar completion date if one of the reasons detailed in Section 108-Prosecution and Progress of the Standard is met. When the calendar completion date special provision has separate sections or milestones ("Once closed, access to County Road C must be restored within 45 calendar days.") a record of these separate sections or milestones needs to be tracked and recorded in the project diary.

4.01.17 ERODIBLE SURFACE

Unless approved in writing by the Engineer, do not exceed 750,000 square feet of surface area of erodible earth material per equipment spread at one time. The Engineer will limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations. Limit the exposed erodible earth material according to the capability and progress and in keeping with the approved schedule. Upon completion of an area, seed, mulch and install erosion control devices according to the Contract Documents. See Section 4.03 of this manual for more detail.

4.01.18 CHECKLISTS

Checklists can be found on KDOT's website. They have been created for all types of construction activities.

4.02 GRADING - EXCAVATION AND EMBANKMENT

4.02.01 CLEARING AND GRUBBING

Clearing and grubbing, often performed simultaneously with installation of erosion control devices, must be completed prior to grading operations. Clearing involves just that, clearing the ground of trees, trash debris. Grubbing follows and involves additional clearing of stumps, roots, bushes and undergrowth.

The limits of the areas to be cleared and grubbed are to be staked or satisfactorily delineated by other means acceptable to the Engineer. Usually, the slope stakes are the outside limits of any clearing. Dead and dying trees within the right-of-way but outside of the specified limits for clearing should also be removed to improve the appearance of the finished project.

Before beginning work, meet with the Contractor to point out all areas where grass and trees are to be preserved and determine the limits of grubbing. The Contractor should also be asked to preserve as much top soil as possible during grubbing.

Also, the plans may identify some trees that are to be removed. This is not to be interpreted as an all inclusive list. There may be some trees not specifically identified in the Contract Documents that are in conflict with the new construction, and that also need removed. These items should be paid for under the Contractor's bid price of Clearing and Grubbing, and would **not** be considered Extra Work. See Section 201-Clearing and Grubbing of the Standard Specifications.

In the interest of beautification of highways, preserve suitable trees, shrubs and ground cover within the right-of-way, but situated outside the limits of construction operations that could enhance beauty and break the uniformity of the conventional lines of clearing. Identify and mark any trees or shrubs within the right-of-way that are designated to be preserved for shade or roadside aesthetics. Attach a suitable placard or tag bearing the words "SPARE THIS TREE", where readily visible. The Contractor will be required to replace or repair any damage done to trees or shrubs designated to remain if damage is due to negligence.

Check the trees that are to be saved to determine if their locations would be considered a safety hazard in accordance with the latest safety standards. Essentially, anything inside the clear zone that presents an obstacle to traffic should be removed.

The Contractor may employ a variety of methods to affect the clearing and grubbing of the project, although the use of bulldozers and power saws are among the most common. At locations where the embankment will be 3 feet or less in height, all trees and stumps will be grubbed. At locations where the embankment will exceed 3 feet in height, the trees and stumps need not be grubbed if cut off within 6 inches of the ground.

All methods of disposal shall be accomplished in accordance with all applicable Federal, State and Local ordinances.

When burning of the debris resulting from clearing and grubbing is permitted, it is the Contractor's responsibility to burn the debris and to control the burning to preclude any damage to property or injury to trees that are to be preserved. Burning sites within the right-of-way should be located on areas cleared and grubbed where the fire can be kept under control and trees are sufficiently away to be protected from injury by the heat. Contractors must exercise caution to prevent damage to private property during clearing and grubbing operations.

Clearing and grubbing should be satisfactorily completed before permitting grading operations in a given area to start. Generally, grubbing of all large roots and stumps is performed wherever clearing is required, except that grubbing is not required under embankments of 3 feet or more in height.

4.02.02 REMOVAL OF EXISTING STRUCTURES

Since this item is measured by the Lump Sum, it may be helpful to get a breakdown of the price from the Contractor as a basis to determine intermediate payment amounts when numerous structures are to be removed.

Also, the plans identify some structures, but that may not be a complete list of items that require removal. There may be items not specifically identified in the Contract Documents that

are in conflict with the new construction that also need removed. These items should be paid for under the Contractor's bid price, and are **not** considered Extra Work. See Section 202-Removal of Existing Structures of the Standard Specifications. Additionally, the summary of quantities sheet often includes a list of items to be removed. That table is typically labeled, "for information only" which further supports that it may not be an allinclusive list of items to remove.

4.02.03 GRADING-GENERAL

Discuss the following items with the Contractor:

- Strip and stockpile the existing topsoil from within the construction limits to use to cap the finished embankment and cut slopes.
- How will items be measured and paid? Provided the Contractor and KDOT agree that the contract quantities are accurate, no measurements or computations are needed. Otherwise, quantities must be measured. See Section 205-Excavation and Embankment for Highways of the Standard Specifications.
- Will any borrow/waste sites off the project be used, and has the Contractor obtained and provided copies of the proper permits? And, will a SWPPP be required?
- If contract quantities are not accepted and the Contractor requests that quantities be measured and computed, be sure the Contractor knows the responsibility to obtain initial cross sections falls on them. KDOT is responsible for the final cross-sections.
- Any unusual, difficult or special items.
- The locations of all utilities and especially any buried utilities.
- Temporary erosion and pollution control, see Section 4.03 this manual and Section 901-Temporary Erosion and Pollution Control of the Standard Specifications.
- What method of staking will be used? Will they be using GPS?

The Inspector responsible for inspecting the grading operations should become familiar with the staking procedures that will be used on the project. Work closely with the survey crew so that all necessary field measurements may be made with a minimum of inconvenience to all concerned, remembering that earthwork is measured by average end area and not load count or other means. Have a thorough understanding of the limits of the balance points as well as the cross-sections. Be familiar with the planned drainage and all material sources. Know the bounds of the right-of-way and borrow sites as well as any conditions imposed by the deeds or agreements.

Before start of the grading operations, review the project for special features relative to grading. Observe the drainage of the adjacent lands and determine that required intercepting embankments and flumes have been staked at their proper locations to permit their construction during the proper sequence of the grading operations. Be familiar with the Contractor's schedule for installing temporary project water pollution control devices. See Section 4.03 of this manual and Section 901-Temporary Erosion and Pollution Control of the Standard Specifications.

Preparing the roadway foundation includes the removal of objectionable material from cut and fill sections, and the work required to provide a satisfactory foundation treatment, 6 inch scarification for embankments. Where excavated materials are to be used in roadway embankments, heavy sod and other unstable soils should first be removed from the area to be excavated. If the material excavated is suitable to support vegetation, it should be stockpiled to spread on the slopes when finished. If not suitable to support vegetative growth or if more is

available than is needed to cover the finished slopes, the excess can be disposed of outside of the roadbed foundation.

Rigid control of embankment compaction is critical. Due to accelerated rates of construction, it is increasingly important that the Inspector keep a continual visual inspection of these operations. Proper placement and compaction is critical to the longevity of the pavement placed on any embankment or cut section. Inadequate compaction can create problems that can reflect up to the surface causing movement and irregularities that are virtually impossible to fix without reconstructing the embankment.

As soon as possible, the Project Manager should reconcile preliminary quantity calculations and shrinkage and swell factors with actual quantities and factors. Deviations may require wasting, adjustments in haul, or adjustments in grade or alignment.

It is the intent of the Standard Specifications that the graded roadway, in respect to the finished grade and section, will conform closely to the plan requirements. Unless designated by the Contract Documents, prior authorization is required to excavate areas of the right-of-way outside of the roadway grading limits, or to change the grade of the roadway to balance quantities of excavation or for other justifiable purposes. Minor adjustments of slopes may be made as required to meet existing conditions or to provide an improvement in general appearance.

4.02.04 EMBANKMENTS

Embankments should be constructed and maintained in such condition that in the event of rain, the work will be well drained at all times. If rain appears imminent, the embankment can be rolled and tight bladed with a motor grader to seal the surface and deter the absorption of water. Water should be drained away by temporary drainage facilities. In loam and clay soils, the problem of stability and density are compounded when the moisture of the soil is above optimum. Keeping the grade smooth and slightly higher in the center for quick runoff of rain water and maintaining ditches open for free drainage helps to prevent saturated subgrades.

After a heavy rain or after setting through the winter season, the soil may have to be manipulated to dry and stabilize it, then recompacted, prior to beginning normal grading operations.

Verify appropriate temporary erosion and pollution control devices are properly installed and maintained. See Section 4.03 of this manual and Section 901-Temporary Erosion and Pollution Control of the Standard Specifications.

When tests are not specified as a basis for determining the acceptability of earthwork compaction, use experience and judgment to determine when satisfactory compaction has been obtained. If the Standard Specifications require that certain equipment be used, inspect and approve it prior to its use. Document this information in the appropriate field book.

Give particular attention toward maintaining proper loose layer thickness, proper moisture content and adequate coverage with the specified rollers. If the specified roller is suitable for the materials being used and is of the proper weight, embankments constructed in relatively thin layers at optimum moisture content will normally possess the required stability, and neither settlement nor swellage due to improper consolidation will be a serious problem.

When the moisture of the embankment material is at or near the optimum, the Contractor should have little difficulty in obtaining satisfactory density with adequate compactive effort. With modern, heavy earthmoving equipment, compaction is often attained by the hauling units alone, if the spread covers a large area, the material is placed in thin layers, and the units break track for maximum compactive coverage. A common problem occurs when many units are hauling a short distance to a small embankment area. Either supplemental compaction and/or

blading equipment must be added or the number of hauling units reduced to attain a balanced operation. Have an understanding with the roller operators and the Contractor's Foreman of a suitable rolling, blading and dumping pattern. Regularly discuss this pattern with the personnel involved to obtain uniform and complete coverage of the fill areas. It is required on earth fills that a motor grader be operated continuously while embankment is being placed. This grading work must be done with the rolling and blading operations to prepare the grade.

Whenever the density tests indicate the specified density has not been met, immediately advise the Contractor of the test results. Do not allow the succeeding layer to be placed until the Specification requirement is met.

The decision as to what corrective work is to be done is left up to the Contractor. However, from the test results and observations, the Inspector should recognize the reason for the low density and may suggest appropriate action such as discing and drying wet soil, adding water to a dry soil, or simply doing more rolling if moisture is not a problem.

For many types of soil, the top of the layer being compacted remains loose until it has been confined by placement of the succeeding layer. For that reason, it is important that the loose surface be scraped away before the density test is taken.

4.02.04 GRADE POINTS

Many times roughness in the base and surface courses of a roadbed appears at the transition between a sizeable excavation and embankment section. This is likely the result of a lack of attention to proper foundation preparation in these critical areas. This situation is comparable to the junction of a side hill excavation and its laterally adjacent embankment. Under these conditions, "benches" are cut into the existing ground slope as each succeeding layer of embankment is placed. Benching shall be of sufficient width to permit operations of placing and compacting equipment. This bench area should be compacted with this layer of embankment, and then covered with the next lift of loose embankment material. As a result of the manipulation and compaction that follows, the embankment lift is "keyed" into the adjacent natural ground. This procedure, with the "benched" cut running parallel to the intersection of the fill section and the cut section, can be advantageous in reducing subsurface movement where these grade points occur.

4.02.05 COMPACTION AT STRUCTURES

When compacting embankments in the vicinity of structures, extreme care shall be exercised to prevent damage to the structures, due to contact with the roller. This is of particular importance at structure wing walls. Compaction is specified adjacent to structures, and shall be performed according to the Contract Documents. The Inspector shall require that the lifts be placed, and the compaction accomplished on both sides to approximately the same elevation at the same time to avoid tipping or in an extreme case, overturning of the structure. Structures are designed to withstand the lateral pressure of the compacted embankment with the possible exception of long wing walls. Particular care shall be exercised at these locations to see that all debris and soft, wet material is removed from the embankment foundation, that the embankment is started on stable soil, and the compaction is obtained on each lift over the entire area and for the full depth of the embankment. A slight easing of this requirement may be necessary against wing walls to prevent overturning or cracking of the wing. This exception should apply only for a slight distance back of the wing, and the degree of compaction should be lessened only enough to prevent tipping or cracking the wing. The Inspector shall require the use of mechanical tampers

or hand tampers in accordance with the Standard Specifications to obtain compaction in areas inaccessible to rollers or other equipment.

4.02.06 ROCK EMBANKMENTS

Rock fills should be constructed to preclude or minimize future settlement. The rock should not be dumped in its final position, but should be deposited slightly aside and manipulated or otherwise shoved into position in such manner that the various sizes of rock are uniformly distributed, and to the extent possible, all voids are filled with fine material.

The construction methods for placing embankment material consisting principally of rock will usually depend upon the size of the rocks and the amount of rock present. Ordinarily, rock embankments are constructed in layers extending over the full width of the roadway, with the layer thickness conforming to the requirements of the governing specifications. By exercising skill in handling, the coarse and fine materials can usually be distributed so that the interstices in the various size stones will be filled with small stones and earth to make the embankment as dense and compact as possible. The rock fill shall be shaped and constructed so that the fill will drain at all times. Oversized rocks not suitable for placement in a layer should be broken down to the proper dimensions.

4.02.07 SURPLUS MATERIAL

Surplus material that is suitable for embankment should be used to flatten the fill slopes and fill low areas between embankment and right-of-way line, or in loops and gores of the interchanges if such areas are available. The Project Manager should select disposal areas, where possible, which will not interfere with drainage, will benefit future development, and will improve the appearance and stability of the facility. If the quantity of surplus material is large, the low grade areas should be investigated for a possible grade raise. This is the most advantageous use of surplus suitable material.

Unsuitable material should be wasted as shown in the Plans, or if it is not shown on Plans, wasted as directed by the Project Manager. This material should not be used on the embankments except to flatten the slopes. It can also be used to fill low areas in the right-of-way. When the surplus or unsuitable material is disposed of in an area as outlined above, special consideration should be given by the Project Manager and Inspector to the drainage, both from the roadway and also from the adjacent property. A toe or slope ditch may be required to allow proper drainage from the roadway ditch or from the adjacent property as may be required.

4.02.08 MOISTURE CONTROL

The amount of water in a soil or soil mixture, shown as a percentage of the dry weight, is called the moisture content. Moisture control is as important as compaction. Each soil or soil mixture compacts most easily, and to its highest density at some definite moisture content. This is called the optimum moisture content. A mixture of granular material and a sticky material, such as clay or silt, compacts most easily when the moisture content is within a narrow range. The range of moisture depends on the type of material and the method used to compact it. For very fine materials, such as silt or clay, the moisture content must be maintained close to the optimum to be fully compacted.

Check the moisture content of the excavation and borrow material in advance of the Contractor's operations. Notify the Contractor of the results in a timely manner. Discuss the Contractor's plan for controlling the moisture content. This will include the drying or moistening of the excavated material, depending on the natural moisture present. The Contractor will be

better able to plan operations effectively if the condition of the material to be excavated is known, and whether it must be dried or moistened.

If the moisture content is too high, it must be reduced to the specified limit by some method of drying, typically aerating. If the moisture content is too low, it must be increased to the specified limit by adding water. This may be done by sprinkling the material with water, using equipment specified in the Standard Specifications, as it is being placed in the embankment. It will be necessary to do some mixing by blading or discing to uniformly distribute the moisture in the soil before compaction.

4.02.09 PRE-WATERING

The moisture content in the soil may be increased by "pre-watering" the excavation areas by either ponding or sprinkler irrigation. The "pre-watering" method has been found to be quite satisfactory for most soils provided proper inspection and control of the operation is maintained. It is necessary and important to determine the approximate natural moisture content in the soil from the excavation or borrow areas, the approximate quantities of water required, and to control the quantities of water applied.

It is preferable to preserve the natural vegetation growth of each excavation area until the watering has been completed to reduce evaporation. If the vegetation is removed prior to watering, or the type, slope or condition of the soil warrants, the area should be ripped on the contour of the ground to a depth of 2 feet on approximately 4 feet centers to facilitate penetration of the water and to minimize runoff. Runoff should be avoided by adjusting the application rate and the construction of dikes.

Ponding or sprinkler irrigation in the excavation areas may require more water and more preliminary work than wetting the soil as it is placed in the embankment. However, the moisture will be more uniformly distributed, the moisture content is more easily controlled, and dust is practically eliminated. The Contractor will obtain soil samples both prior to and during the water application, in areas that are pre-watered. The Engineer will run moisture tests. Based on the results, the Contractor will determine water application rates. The water application rate is determined using the natural moisture content and natural in-place dry density of the soil to be excavated.

The areas watered will require a curing period to permit the water to move downward and become uniform in the soils. This time will vary with soil types and condition of the soils. This determination will be made by the Project Manager by sampling the soil at intervals throughout the curing period.

4.02.10 EXCAVATION

The roadbed and ditches should be maintained in such a manner that the work will be well drained at all times. Check the ditch sections and roadway slopes as they are being constructed to verify that the cross-section is according to plan and slope stakes. Check the drainage outlets before constructing the ditches to confirm the direction of flow. Outlet ditches and channels should be excavated before starting other items of roadway excavation or drainage structures. This procedure very often prevents flooding of other operations allowing the work to proceed more efficiently. Wherever it is practical and the excavated material is suitable, it should be used in the construction of the roadway.

Frequent inspections will be necessary during excavation operations to determine that:

- the roadway, intersections, approaches, ditches and channels are excavated to the required grade, width and slope;

- rock in the roadbed is properly subgraded; and
- proper disposal is made of any unsuitable material.

Unless the Contract Documents show the material to be wasted, all suitable excavated material shall be used in the construction of embankments. In order to utilize all desirable material, intersections and entrances should be graded at the time the roadway excavation is made.

Unstable material is material that would otherwise be suitable, but due to high moisture content is unstable. This material can be manipulated in some way to reduce the moisture content and used in the embankment. Unsuitable material is material that is not acceptable for use in the embankment for reasons other than the moisture content.

In cuts where unsuitable soil is encountered at final grade, the area should be undercut until a solid base is encountered (or for approximately 3 feet, if solid material is not found) and replaced with suitable material. The Inspector should notify the Project Manager of these locations. If not designated for an underdrain, it would be advisable to have geology investigate the area for possible subsurface water problems. This should be accomplished promptly to avoid delays in the completion of the project.

The end sections of all cuts shall be turned out and down the slope for better appearance. This turning out of the ends of cuts and the rounding at the top of the slope greatly improves the appearance of the finished highway section. Rounding of the tops and ends of excavation slopes and sloping is most economically done as the excavation progresses because of ready access for suitable equipment. Spot checks of cut and fill slopes should be made as the grading progresses.

When a borrow pit is located adjacent to the right-of-way and the roadway is in a cut section, it often provides a more pleasing appearance if the area between the two is graded to eliminate the ridge.

4.02.11 ROCK EXCAVATION

It is the intent of the Contract Documents that rock be excavated closely to the designated limits with minimal overbreakage. If either KDOT or Contractor wants to measure and compute quantities, cross-sections for determining rock quantities should be taken as soon as the overburden has been removed.

Blasting operations should be performed in a manner to minimize overbreakage. Blasting operations should always be conducted under careful, competent supervision to prevent damage to adjacent property and injury to persons. The location of the area in which blasting is to be done will determine to a great extent, the procedure to be used. Both the size of the area to be shot at one time and the strength of the charges set therein should be determined by this factor.

As a general rule, blasting charges should be as light as possible, yet of sufficient strength to adequately break up the material being shot. In restricted or urban areas where the hazard to surrounding life and property is greatest, it may be necessary to load fewer and more closely spaced holes with lighter charges to break the material, while holding the possibility of damage to a minimum. Blasting areas must be properly signed to inform all persons of potential hazard and to instruct that all mobile radio units be turned off when in the immediate vicinity of explosive charges. All explosives must be stored in a secure manner in compliance with local, State and Federal laws and pertinent safety regulations.

Pre-split lines should be staked to reduce drilling errors and to allow the best opportunity to produce ditch elevations at the proper grade and distance from centerline. The Contractor

should give the grade Inspector ample notice on a daily basis when blasting operations will be commencing. The Inspector should constantly check the rock excavation operations.

4.02.12 CLASSIFICATION

Keep in close touch with the work at all times, in order to classify the excavated material intelligently. To classify material properly is a difficult task and requires careful study of the work as well as experience and judgment. The Project Manager and the Contractor should agree on the classification of material as it is uncovered.

If differences of opinion arise between the Project Manager and the Contractor regarding the classification of material, the Construction Engineer should confer with the District Construction and Materials/Assistant District Engineer regarding the classification. The District Construction and Materials/Assistant District Engineer, the Construction Engineer, the Project Manager and the Contractor should discuss the classification together, and if possible, arrive at some agreement. If agreement cannot be reached regarding the classification of excavation or any doubt remains in border-line cases, the District Construction and Materials/Assistant District Engineer should secure the advice of the geologist. Construction Engineers should contact the geologist only after discussion with, and the recommendation of the District Construction and Materials/Assistant District Engineer.

Excavation for a roadway may be classified or unclassified as provided for in the Contract Documents. When classified, each class of excavation shall be determined during the excavation, and the necessary measurements taken to compute the quantity.

4.02.13 FINISH GRADING

All of the embankment and excavated areas shall be finished in reasonably close conformity to the Contract Documents, or as directed by the Engineer. Before finish grading begins, slope stakes should be in place and legible so that slopes and grades can be checked. The roadbed surface should be finished to the bluetop stakes set for final earth grade. Check to confirm that the subgrade is being trimmed to the elevation of the stakes and make random checks on the bluetop stakes themselves to verify that they were placed accurately and have not been disturbed. This check of the bluetop can be made with visual alignment with other stakes, and a check of actual to theoretical difference in elevation. If drainage is critical, grade stakes should be set for ditches and borrow pits to prevent any ponding.

While a Contractor can place temporary seed on areas that have only been roughed in, it is to everyone’s advantage to finish earthwork as work progresses and timely seed the finished slopes and ditches. Ideally, this will be performed before equipment moves to the next area to be worked. Even if there is insufficient moisture to establish temporary grass, the stabilization provided by mulching can significantly reduce the amount of erosion.

Before the Contractor begins finish grading operations, point out any corrections and/or clean-up work that needs to be done. It is a recommended practice to give the Contractor a written list of features that must be corrected during finish grading. Perform a complete inspection of the work as soon as rough grading is completed to prepare the list for the Contractor. This inspection should include the Contractor’s representative and include discussion regarding the schedule to stabilize the exposed ground.

Continual checking is required during finish operations to determine that the work is done satisfactorily. Take level readings as necessary to check compliance with grade stakes and to obtain proper drainage of all areas concerned. Document the grade checks in the field book.

Economic considerations usually make it impractical to trim rock slopes to the exact cross-section; however, any dangerous or objectionable appearing projections should be removed. The finished slope should have a uniform appearance.

4.02.14 GRADING RECORDS

Give particular attention to the keeping of accurate, up-to-date records of all the work. Some of the more important items which should be documented and made a part of the project records are:

- Locations of actual balance points and notes concerning cross-haul that may have occurred, including reasons for the cross-hauling and the quantities involved.
- Measurements and notes made to substantiate the classification and quantity of the various materials encountered in the excavation. Reporting earthwork quantities will require thoughtful preparation. Vehicle measure and load count should generally be avoided. However, if other methods are impractical, it may be used within the limits of the plan quantities for the separate balances to make intermediate payments. In no case will the final quantities be adjusted based on load counts.
- Design quantities can be off, particularly if building demolition work has been done in these areas, as initial cross-sections do not take into consideration the basement excavations. Estimates should reflect any known changes in conditions.
- Records of dimensions, weights and calibrations which may be required by the Standard Specifications for water distribution and rolling equipment.
- Measurements of excavation below grade necessary for the removal of unstable or other undesirable materials.
- Daily record of events, including limits in which work was performed during the day, type and number of pieces of equipment used, number and classifications of labor used, and notes regarding discussions of any unusual nature with the Contractor's representative and which may lead to the issuance of specific recommendations or instructions to the Contractor. Weather conditions, for the purpose of determining a working day. List all District, Headquarters or FHWA visitors.
- A complete record of all density tests made to determine the acceptability of embankment, with remarks included which explain the corrective action taken at locations where failing test results were obtained and reasons for not making the required tests at other locations. The results of proof rolling should also be recorded.
- Notes regarding damage to private property caused by the Contractor's equipment and/or operations should be noted and action taken recorded.
- Record of final disposition of salvageable materials.
- Document grade checks in the field book.

4.03 TEMPORARY EROSION AND POLLUTION CONTROL

4.03.01 STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REVIEW

On KDOT projects with one acre or more of disturbed area, the Contractor shall submit copies of the project Storm Water Pollution Prevention Plan (SWPPP) to the Area/Metro Engineer for approval. The Engineer shall review the SWPPP for completeness, compliance with the requirements of the NPDES permit, and following the points in KDOT form 248 (KDOT's checklist for Contractor's Storm Water Pollution Prevention Plan). The SWPPP must be approved by the Area/Metro Engineer before any construction activities other than surveying

may begin. Document approval on KDOT form 219. The Area/Metro Engineer shall submit the approved SWPPP to KDHE according to the instructions on KDOT form 219.

4.03.02 STORM WATER PRECONSTRUCTION CONFERENCE

Hold a Storm Water Erosion Control preconstruction conference before beginning construction activities. This conference is separate from the project preconstruction conference and must be attended by the Area/Metro Engineer, the Contractor's Water Pollution Control Manager, Certified Environmental Inspectors for the project from both KDOT and the Contractor, and any erosion control subcontractors for the project. Attendance and minutes will be kept and added to the SWPPP notebook, and a copy sent to KDOT's Storm Water Compliance Engineer. The conference should at a minimum cover the following: inspection schedule, procedures, contact information, discussion of responsibility for installation, inspection, and maintenance of devices, how the erosion and sediment control will progress with the project schedule, and the SWPPP site plan and process for updating and modifying it.

4.03.03 CONSTRUCTION/INSTALLATION INSPECTION

At a minimum, perimeter control devices to protect water sources and prevent sediment from leaving the project should be in place for an area before any type of soil disturbance is allowed in that area. As devices are being installed, the Inspector should check that the devices are installed in accordance with the information provided in the Contractor's SWPPP, regarding both location and installation practice. The as-built site map for the project should also be updated daily as devices are installed and removed. As the project progresses, the Inspectors should look at the performance of devices and other practices to make sure the desired results are being achieved. Inspectors should also see that areas are stabilized as soon as possible and that sediment control devices are removed when they are no longer necessary, as leaving them in longer than needed can be detrimental to the project.

4.03.04 STORM WATER INSPECTIONS AND REPORTS

Storm water inspections are required to be conducted from the beginning of the project until the notice of termination is issued for the permit, once 70% permanent vegetation coverage is attained. Inspections are to be conducted jointly by both KDOT and Contractor certified environmental inspectors from the beginning of the project until the Notice of Acceptance. Once the NOA for the project has been issued, the Contractor is relieved of the responsibilities and the inspections will be conducted by KDOT's certified environmental inspector until the notice of termination is received. Reports are required to be submitted after each inspection. The inspections and reports should be conducted according to and meet the requirements laid out in KDOT's SWPPP Inspection Procedures and Form 247 Instructions.

4.03.05 PROJECT MAINTENANCE

The Contractor is responsible for installing and maintaining the erosion and sediment control for the project from the beginning of construction until the notice of acceptance at which point the maintenance of the project falls on KDOT's maintenance crews until the permit is terminated. Thus, it is very important that project is in the best shape possible in regards to erosion and sediment control before the NOA is issued. Shortly before the final walk through to develop the final punch list, conduct a storm water inspection to develop a list of items that need to be addressed before the project is accepted. Make sure that all unnecessary devices are

removed, all remaining devices are in good working order and that all open areas have been properly stabilized.

4.03.06 PERMIT TERMINATION

Permit termination requires that all vegetated areas on the entire project are stabilized with perennial, permanent vegetation with a density of at least 70% of the density of undisturbed areas at or near the site. Taking pictures of the area prior to construction is a good practice and can be helpful in making this determination. Additional assistance may be requested by contacting the Stormwater Compliance Engineer or the Environmental Services Section. Any remaining temporary sediment control devices shall be removed from the project prior to termination. Once the project is fully stabilized and all devices removed, termination may be requested by email to the Stormwater Compliance Engineer. The Stormwater Compliance Engineer shall complete the Notice of Termination and provide a copy to the Area Engineer for inclusion with the SWPPP documentation. All SWPPP related documents are to be retained in accordance with the storm water permit or as otherwise directed by the Stormwater Compliance Engineer.

4.03.07 PROJECTS WITH LESS THAN 1 ACRE DISTURBED

On projects with less than one acre of disturbed ground a NPDES permit, formal SWPPP and SWPPP inspections are not required. The Contractor should still follow best management practices as described in the specifications to prevent storm water pollution. The Inspector should help make sure we are good neighbors to adjacent landowners and stewards of the environment. In addition to good erosion and sediment control practices such as proper perimeter control and prompt stabilization of inactive work areas, particular attention should be paid to material storage areas (including soil stockpiles), construction entrances, stream crossings and other potential sources of storm water pollution.

4.03.08 LOCAL PROJECTS

On city and county projects the Local Public Authority is the responsible party and submits the Notice of Intent on projects with one acre or more of disturbed area. While the LPA is ultimately responsible, the SWPPP must be approved by KDOT's Area/Metro Engineer. As on KDOT projects, the Contractor shall submit copies of the project Storm Water Pollution Prevention Plan (SWPPP) to the Area/Metro Engineer for approval. The Engineer shall review the SWPPP for completeness, compliance with the requirements of the NPDES permit, and following the points in KDOT form 248 (KDOT's checklist for Contractor's Storm Water Pollution Prevention Plan). The SWPPP must be approved by the Area/Metro Engineer before any construction activities other than surveying may begin. Document approval on KDOT form 219. The Area/Metro Engineer shall submit the approved SWPPP to KDHE according to the instructions on KDOT Form 219.

The LPA's Inspector has the same responsibilities as the KDOT Inspector does on KDOT projects. They are responsible for conducting environmental inspections and verifying that the SWPPP is implemented and the requirements of the permit are being met. They must conduct the environmental inspections jointly with the Contractor, verify devices are being installed and maintained correctly, and verify that stabilization measures are promptly implemented as portions of the work are completed.

The role of the KDOT Inspector is oversight just like any other aspect of LPA projects. If a KDOT Inspector sees an issue they should bring it to the attention of the Project Inspector and possibly the Area/Metro Engineer so that it can be corrected.

4.04 BASE COURSES AND SUB-BASES

4.04.01 GENERAL

Base Courses and Sub-bases are primarily the foundations or subgrade for the various types of surfaces. They may include subgrade modification, treated subgrade, all types of aggregate binder base courses, portland cement treated base courses, road mix asphalt base course or plant mix asphalt base course. The specific type shall be constructed as specified in the Contract Documents. The construction procedures are common to most types of bases and the following instructions apply in general to the various types of base courses and sub-bases.

The Project Manager should study the available soil investigation reports. These reports describe the various soils, and contain moisture-density curves.

If the material is paid for by the cubic yard, the volume can be determined by the method described above, or by developing a conversion factor from weight to volume and weighing each load. Whenever the quantity is based upon a weight, the loads are to be weighed by a bonded scale operator according to the Contract Documents. Care should be exercised to account for material that is produced but is not paid for.

4.04.02 EQUIPMENT

The equipment for the specific type of base course is listed in the Standard Specifications. Prior to starting the work, check each piece of equipment for compliance with the Standard Specifications, and record the check in the project records. Measure the material according to the Standard Specifications. When the material is paid for by the cubic yard, accurately measured each truck, and compute the level volume. Record these measurements and computations to the nearest 0.25 cubic yard in the project records. Be alert for any changes in sideboards or other conditions that would affect the volume of the vehicle load.

When windrow eveners are required, they will be capable of shaping separate windrows of material to a uniform cross-section. If material is paid for by the ton, the weighing equipment shall be in accordance with the Standard Specifications. The Contractor shall have the scales checked, adjusted and certified by an approved testing firm prior to use. The calibration report is to be issued to the Construction Office, prior to weighing any material.

4.04.03 SUBGRADE PREPARATION

The subgrade shall be prepared as shown in the Contract Documents for the different type bases or sub-bases. If the plans do not indicate any specific preparation of subgrade, the Standard Specifications require that the Contractor prepare the roadbed by sprinkling, blading, rolling and lightly scarifying, if necessary, to eliminate ruts and minor irregularities and to provide proper crown.

Regardless of the procedure used in preparing the subgrade, the Inspector should carefully check the subgrade at frequent intervals for crown grade and alignment. Also, check subgrade density, if definite density requirements are specified. In all types of subgrade preparation, the surface should be hard and firm, with a minimum amount of loose material remaining on the surface. If, in the opinion of the Inspector, the condition of the subgrade, after the work specified is completed, will produce an unsatisfactory surface on which to place the base or subbase, the

Construction Engineer should be notified so arrangements may be made for adequate subgrade preparation.

After the subgrade is satisfactorily prepared, it is the Contractor's sole responsibility to preserve it in that condition. Any damage to the subgrade caused by weather conditions, hauling operations or any other reason shall be repaired immediately.

4.04.04 PRODUCTION AND DELIVERY OF MATERIAL

Before production of material begins, the Project Manager shall obtain all available aggregate reports. If a material survey report is not available, or a survey has not been made for each source of material, a survey should be conducted to determine the quality and quantity of the material at each location.

Uniformity is an essential part of the construction of satisfactory base courses and shall receive the strict attention of the inspection forces as well as the Contractor's forces, during all the phases of production, placing, blending and mixing of the materials. It is the Contractor's responsibility to show that the materials submitted for acceptance are within tolerances. Therefore, the Contractor's process control test results are to be submitted to the construction office prior to any acceptance tests being performed.

4.04.05 ROAD MIXING METHODS

After every effort has been made to obtain uniformity in the production of the material, some unavoidable variations will remain. This non-uniformity may be reduced through the proper placing of the material on the road. The Inspector should make sure that each load is dumped in the distance allotted, and that no overlapping of the distance allotted to each load is permitted. Tables showing the length of spread for each weight or volume of load shall be calculated ahead of time for use during hauling operations.

Aggregates that constitute a large portion or all of the final mixture will usually not be placed in a single windrow for each lift. It is far easier to equalize several small windrows than to equalize a large one. Each individual windrow should be thoroughly evened before combining the separate windrows of material.

Individual aggregate, such as filler material, binder soil or crushed rock for sweetening, which constitute less than ¼ of the mix, may usually be placed in one windrow. The percentage used will not influence the uniformity of the total mix to any great extent, providing they are properly equalized before combining with the other material. Under no circumstances shall the various windrows be combined until each is properly evened. Nor, shall the windrows be dumped so close together that before evening, they become intermingled in any manner. The final windrow of combined aggregates shall be closely observed to see that uniformity is maintained during subsequent mixing operations.

Some materials are used in the construction of base courses and sub-base which require pulverizing. The Contract Documents give definite requirements for pulverization of most aggregates. Pulverization is usually accomplished with far less effort for an individual aggregate than after they have been combined with the other material. Pulverization should be accomplished as the material dries on the road by the use of tillers, disks, rollers, etc. No material shall be incorporated into the final windrow until it has been properly pulverized. Material not properly pulverized can produce an actual gradation and plasticity of the material in the windrow far different than the gradation and plasticity represented by the laboratory test.

The Contract Documents require a percentage of finer particles, and an overall gradation and plasticity which produces maximum density and stability. The lack of pulverization can

greatly decrease the strength of the base, produce a condition which will make specific compaction difficult to achieve and lead to other deficiencies and difficulties. It is important that the material which constitutes the base or sub-base be pulverized, as nearly as possible, so it will represent the laboratory samples and meet all the requirements of the Contract Documents.

Mixing of the combined aggregate with the various binding and cementing agents may be performed either with blades, tillers, disks, harrows, etc. or by traveling plants.

When blade-mix methods are used to incorporate the water and/or asphalt with the aggregate, a sufficient number of blades, disks, harrows, tillers and distributors shall be provided to obtaim the rapid completion of the mixing operations. Prolonged periods of mixing with an inadequate amount of equipment only results in excessive evaporation of the water, and when asphalt is used, the loss of the original temperature and volatiles from the asphalt increases the amount of manipulation necessary to coat the aggregate particles and to obtain complete mixing.

After the various windrows of individual materials have been mixed and blended together, water may be added by spreading shallow lifts of material on the subgrade and watering each lift. The watered material is then moved across the roadbed and placed in another windrow on the opposite shoulder. It is important that the water be applied uniformly with pressure distributors and that mixing continue until a uniform moisture content is obtained. Considerable mixing can be eliminated, if the watered material is left in a windrow overnight to produce a more uniform moisture content. Sufficient water should be added to the material to obtain adequate compaction, allowing some additional moisture to compensate for that lost through evaporation during the laying and rolling procedure. Moisture shall be added as the material is laid to achieve thorough bonding of the various lifts and to compensate for any undue loss through evaporation.

4.04.06 TRAVELING PLANT MIX METHODS

In general, there are 2 types of traveling plants in use. One type elevates the aggregate into a hopper. The aggregate rate is then automatically controlled into a pug-mill by the speed of the machine. The liquids are controlled by the aggregate rate by a cascade controller. With the second type, the rate at which the aggregate enters the pug-mill depends upon the size of the windrow and the speed of the machine. The rate at which the liquids enter the pug-mill is automatically controlled by the speed of the machine, not the rate of aggregate. This can result in a varying liquid content.

It is obvious that the traveling plants which are able to control the rate of aggregate as well as the rate of liquid into the pug-mill can produce a more uniform mixture. However, it is important that an operation record be kept, and the actual proportions checked at regular intervals. The gate settings shall be adjusted to produce the desired mixture which may change due to the moisture content of the aggregates, their gradations, etc. Traveling plants should be operated with the "pick-up shoes" properly adjusted so that the material from the windrow is elevated into the bin without gouging the subgrade. Closely observe the resulting mixture to obtain as near complete mixing as is practicable.

The mixing time for a traveling plant depends on the charge and discharge rates of the pug-mill. The mixing time and the volume of material in the pug-mill may be controlled to some extent by raising or lowering the discharge end of the pug-mill. In order to secure the most efficient mixing, the pug-mill should operate with the discharge end raised so that the material fills the pug-mill. If incomplete mixing is obtained when the pug-mill is raised so that its full capacity is being utilized, then the amount of material being fed into the pug-mill is too great and should be decreased (slow forward speed of the machine or reduce the size of the windrow),

thereby increasing the mixing time. Regardless of the type of traveling plant used, complete mixing is seldom, if ever, accomplished by the plant. It is necessary to complete the mixing with blade-mix methods even though a traveling plant is used.

Plants which depend on a uniform forward speed and a uniform windrow to proportion the mixture properly, present more variables in operation, which must be given close consideration if satisfactory mixtures are to be obtained. It is absolutely necessary that uniform windrows of material be provided as the plant passes over the windrow. The volume of material shall be controlled by restricting the size of windrow which will permit the plant to mix adequately without decreasing its forward speed. No appreciable amount of dry material shall be left on the subgrade. No slippage of the tracks of the tractor shall be tolerated.

A sufficient number of mixing paddles shall be reversed to retard the flow of material through the mixing chamber to obtain as near complete mixing as is practical. On down-grade it is usually necessary to have fewer paddles reversed to retard the flow, and on upgrades more retard paddles should be used than are normally used on level grades. When down-grades are encountered, the position of the retard paddles should be changed at the first sign of track slippage or reduction of forward speed. Likewise on up-grades, the position of the retard paddles should be changed as soon as an incomplete mixture is detected.

After the plant has been calibrated and is operated satisfactorily to give the desired proportions, the forward speed shall be measured. The forward speed shall then be checked frequently to detect any variations and adjustments made to maintain a constant, uniform speed. The evening of the windrow ahead of this type of plant is of utmost importance. Equalizing should closely precede the mixer in order to rectify any variations due to rainfall and subsequent drying operations. An operation log shall be kept, and the actual proportions checked and documented frequently to verify that proper proportioning is being obtained at all times. As previously stated, traveling plants do not produce a complete mixture and mixing must be completed with blade-mix methods.

4.04.07 CENTRAL PLANT MIX METHODS

Specific types of base courses will require a central mixing plant capable of combining aggregate, water and cement, flyash or calcium chloride, if required. Water shall be added during the mixing operation in the amount necessary to provide the approximate moisture content as determined by the Engineer for compaction. The Contract Documents show the method of measurement and basis of payment for water.

If more than one aggregate is combined, the individual gates on the feeders must be calibrated to obtain the proper percentage of each aggregate.

When calcium chloride is specified, a great deal of effort is needed to keep the required pounds per ton ratio. A definite system of checks correlating sack count of calcium chloride to scale weights should be established and maintained. Calibrated metering systems should be encouraged, but must be checked against the weights of material delivered and used each day. When using dry calcium chloride, special care must be taken to monitor the gate settings because they are influenced by the relative humidity conditions which typically change throughout the day.

Maintain a daily record of the amount of calcium chloride, cement, flyash and water. Compute the percentage of calcium chloride, cement and water on a daily and an accumulated basis. Water is not paid for separately on Cement Treated Base, but subsidiary.

4.04.08 AERATION

Typically, aeration is only required for material which is mixed in a windrow. Base courses which contain MC or RC asphalt may become tacky through loss of volatiles before laying is started. A certain amount of the volatiles originally contained in the oil must be removed before the mixture will bond together and lay satisfactorily without rutting and shoving.

Over aeration will result in a mixture that will be difficult to roll into a smooth mat. Aeration is accomplished by continued mixing with blades and tillers. The amount of aeration desired will vary with asphalt from different sources and it is intended that the specification limits cover this range of aeration. It is important that for each type of asphalt, sufficient aeration shall be attained to prevent rutting and shoving of the laid material, and at the same time to guard against over aeration which will produce a dry, brittle base.

4.04.09 LAYING AND COMPACTING

Laying, compacting and finishing shall be completed according to the Contract Documents for the base material being used.

Perform and record appropriate aggregate, moisture, compaction, etc. tests.

Keep in mind that the finished surface of the base course in many cases affects the riding surfaces; the final surface of the project depends on quality of base obtained. Sub-bases and underlying lifts of the base course need not present excellent riding qualities but when constructed properly and finished to their proper crown and grade, add appreciably to the final qualities of the project. Be alert to detect any faulty alignment, crown or other defects which will impair the riding qualities or appearance of the finished surface. Laxity in laying any lift will result in a concentrated effort on the final lift to overcome all deficiencies and will only lead to mediocre work. Diligently check the crown, grade and alignment when laying the final lift.

The edges of the base may be cut to line by means of specially constructed shoes, conforming to the edge slope of the base on the angle at which the blade will be operated, or if the slope is flat enough, the edge slope may be cut with the heel of the blade.

If each step in the laying and finishing of bases and sub-bases is properly considered by the Inspector and the Contractor, there will be little need of wasting material to obtain the specified line, grade, crown and riding surface on the finished base course.

4.04.10 CURING AND MAINTENANCE

Curing is an extremely important factor in the satisfactory construction of a base course or sub-base; especially those of the waterbound type on which an asphalt surface is to be constructed. The specifications for curing are based on the retained moisture content for most types of bases. Others are based upon the time required for the chemical reaction (curing) to take place. Note that cool temperatures slow the reaction rate, and thus require a longer curing period. See the specifications for appropriate curing requirements.

While the maximum moisture content at the time of priming for waterbound bases is specified, it is desired to decrease the moisture content of the base as much below the maximum specified as is possible under existing conditions. Base courses or sub-bases which are to be primed with asphalt material should be primed before serious raveling takes place. The prime coat, if applied when the base or sub-base is adequately cured, will prevent the penetration of surface moisture into the base and will also prevent severe pitting and raveling of the surface.

4.04.11 SHOULDERS, ENTRANCES AND SIDEROADS

Shoulders, entrances and sideroads shall be constructed to comply with the details shown in the Contract Documents. If the Contract Documents do not require any shouldering, the slope shall be bladed uniform from the ditch bottom to the top of base. It is desirable to complete the entrances and sideroads with the same surface as the adjoining roadway.

Entrances and sideroads should slope away from the base and be of such radius to allow traffic to enter and exit safely. It may be advisable to recommend some adjustment in quantities to properly complete these items.

4.05 STRUCTURES

The information contained in the section is general in nature. Refer to the Bridge Construction Manual for greater detail regarding structure construction. The manual is posted on KDOT's website, currently at this link:

http://www.ksdot.org/burStructGeotech/constructionmanual/bcm.asp

4.05.01 GENERAL

Review structure plans for possible errors in quantities and elevations. Most common errors are in the number of reinforcing bars. Check for conformance between dimensions given and elevations shown.

Inspect the structure site, and determine if conditions are as depicted on the plans or whether some changes may have taken place since the original survey was made. This investigation may indicate that the structure should be shifted slightly from the exact stationing shown on the plans to better fit existing conditions. There may be no latitude for such a shift in position in the case of a grade separation structure, but there is sometimes considerable opportunity to shift drainage structures. Contact the State Bridge Office before relocating any structure.

On all structures where falsework is required, see Section 708-Falsework and Form Construction of the Standard Specifications.

4.05.02 LOCATION

The Project Manager should see that the structures are located in such a position as to provide for the most efficient drainage. In some cases, it may be advisable to change the location of culverts to obtain proper drainage. The life of a road depends to a large extent upon proper drainage. Take care to see that the drainage system is properly planned and constructed in every detail.

Whenever possible, the Project Manager should verify the previous high water levels at each structure site before the structure is staked. If investigation shows that the structure is not designed for the proper high water level, or is not of sufficient length to accommodate the stream, the Construction Engineer or Project Manager should notify the District Construction and Materials/Assistant District Engineer at once.

If the culvert, as indicated on the plans, appears to be improperly located, inadequate or excessive in size, or if it is definitely not adapted to the location specified, contact the District Construction and Materials/Assistant District Engineer.

Entrance culverts should be of ample size and placed to drain the side ditches completely, so that no water will be impounded. Culverts under cross roads should be set as far back from the center line of the main line of the roadway as is consistent with efficient drainage, and placed at such a grade that the side ditches will be completely drained.

A properly constructed culvert should have a flow-line grade equal to or steeper than that of the channel in which it is built. The elevation of the inlet end of the culvert should be slightly higher than the existing flow-line of the watercourse. It is also advisable to raise the outlet end of the culvert slightly above the existing flow line of the watercourse in cases where the flow-line grade of the stream bed is not sufficiently steep to prevent silting at the lower end of the culvert.

Failure to observe these precautions may result in silting up at both ends of the culvert. The practice of constructing culverts on a flat grade with a high drop at the lower end is not recommended. All culverts should be constructed so that they will completely drain after the flow of surface water has ceased, except in cases where the plans indicate that the floor is to be placed below the flow-line elevation in order to provide protection against frost action.

When staking an abutment, the survey crew may have staked the centerline of bearing, centerline of abutment, or front or back face, depending on which line the unit is dimensioned from the plans. The Inspector should understand which line has been staked. The centerline of a pier is many times different from the centerline of bearing. This should always be checked with the survey crew. To prevent errors due to misunderstanding which lines are staked, the Inspector should confer with the survey crew in the layout of the bridges.

Every structure that is staked must be checked thoroughly to prevent staking errors. Different methods of staking should be used to give a check on the accuracy. Verify that the Contractor has performed the appropriate checks according to Section 802-Contractor Construction Staking of the Standard Specifications.

4.05.03 INSPECTION

The Construction Engineer or Project Manager shall see that the construction work on each structure or portion of the structure is thoroughly inspected. The Inspector should check all the forms for line, elevation, plumbness, spacing, quality of lumber, bracing, strength, placement of reinforcing steel, etc. before any concrete is placed.

4.05.04 EXCAVATION

Before the structure excavation has begun, adequate elevations or cross-sections of the site must be obtained. This is needed so that the quantity of "Excavation for Structures" can be accurately determined; however, prior to taking such elevations or sections, review the plans to determine the limits for the structure excavation.

Normally, the excavation should be carried to the elevation of the footing shown on the plans. A possible exception would be in the event that a satisfactory foundation in rock can be secured at a higher elevation. It is imperative on a stream crossing that the footing be keyed into the rock or shale. If it appears that the footing elevation can be raised, maintain a keyed depth of 6 inches in rock and 12 inches in shale as a minimum. Contact the Bureau of Structures and Geotechnical Services prior to adjusting any footing elevations.

Always compare the material encountered at the footing elevation with that shown on the plans and the geology report. If the foundation material is not equivalent to that shown on the plans, and thus on which the design was based, it may be necessary to revise the footing elevation, increase the footing size, or redesign the unit. Assistance is readily available from the Bureau of Structures and Geotechnical Services. Do not hesitate to consult the District Construction and Materials/Assistant District Engineer for needed assistance.

If satisfactory material is not obtained at the plan elevation, first determine the nature and extent of the material below that level. This can usually be done by hand boring, rod sounding or digging a test hole, but in extreme cases, arrangements can be made to have one of the KDOT's

boring rigs brought in. If satisfactory foundation material is found at a reasonable depth below plan elevation, lowering the footings will probably be the best solution; if not, a redesign may be required. All but nominal changes from plan elevations should be authorized in advance by the District Office. Consult the Bureau of Structures and Geotechnical Services before making any substantial changes.

If it becomes necessary to excavate between 2 to 6 feet below the plan elevation for the footing, the Standard Specifications list the basis of payment. Excavation below the 6 foot limit will become extra work, and an agreement must be reached in accordance with the Standard Specifications.

NOTE: Foundation Stabiliation (Set Price) should **only** be authorized for paid use in the construction of culverts, boxes and pipes. When shown in the Contract as a bid item, Foundation Stabilization at the Contractor's bid price may either be used, or underrun when deemed unnecessary. See Section 204-Excavation and Backfill of Structure in the Standard Specifications.

4.05.05 CULVERT FOUNDATION

The Inspector must keep records of all conditions that are found in the construction of any structure. If different from that shown on the plans, always show the actual elevation of the footing or base and the type of material encountered.

Culverts should never be placed on uncompacted earth fills.

The foundation for the base of the culvert shall be stable enough to provide a firm work area for the workers. If after the excavation is completed the foundation is deemed unstable, the Project Manager should require the addition of foundation stabilization material to the unstable material. The stability of the culvert foundation should be carefully inspected to determine if the material encountered is unstable in its natural state, or if the Contractor's methods of excavation has caused the material to become unstable.

The type of material to be used must meet with the approval of the Project Manager. Make sure the wings have stable foundation material, too. Crushed stone is an excellent material to use for foundation stabilization.

When specified or approved, the Contractor shall place gravel or other available material which can be readily compacted in the subgrade and thoroughly compacted to produce a firm foundation for the structure.

Pumping that permits water flowing in contact with the fresh unset concrete is prohibited. The sump from which water is pumped should be outside the footing forms.

KDOT will **not** pay for foundation stabilization material used to provide a work platform for the Contractor. Only foundation stabilization and concrete seal courses authorized by the Project Manager will be paid for their set contract price, and those shown in the Contract Documents will be paid for at the contract unit price.

4.05.06 BEARING PILES

Before starting driving of piling, the excavation shall be complete. In embankment areas, the embankment shall be completed to the bottom of substructure concrete elevation. Proper elevation of fill or cut is especially critical in cases where battered piles are being constructed. On certain wall-type abutments, an error in grade could easily result in the piling being too close to or possibly outside the wall forms. After the Contractor completes the actual pile layout, it should be thoroughly checked by the Inspector.

To the extent practicable, all pile driving within a substructure unit should be completed before any concrete is placed in that unit. Should it become necessary to drive piling within a minimum of 15 feet from the previously placed concrete, such operations should be delayed until the concrete has attained the minimum age of 7 days.

Before using any piling, it is the Inspector's responsibility to make certain that the material has been tested and that the test reports are on file. Even though piling is accompanied by the proper test report or certification, they may be damaged in shipment or may have defects that had been overlooked during inspection, and therefore, are subject to rejection at the job site. Thoroughly inspect all piling before being placed in the leads for driving. Conspicuously mark any rejected piles.

Check the bid item to determine the type of piling that is required for the structure. Most of the bid items designate the type of piling required but in some cases there is an option available.

If integral abutments are shown on the Plans, pay extra attention to any notes on plans, or special provisions regarding the driving of piling.

For all types of piling, the Contractor is required to submit a completed "Pile and Driving Equipment Data" sheet to the Engineer, a minimum of 3 weeks before the scheduled date of driving piling. When Test Pile (Special) is a bid item in the contract, forward this information to the Bureau of Structures and Geotechnical Services.

a. Pile Lengths. Plans for structures involving piles generally give a pile layout for each foundation that will meet the design requirements, if no unforeseen conditions are encountered, and soil bearing proves to be equal to what was anticipated. The number and length of piles shown on the plans were calculated as a result of studies of soil-borings and soundings made at the bridge site, and are used as the Contractor's Order List.

Delivery of ordered lengths of piling, for timber and precast concrete piles, will be in a single piece, unless otherwise provided in the contract.

Delivery of ordered lengths of steel shells for cast-in-place concrete piling and of steel piling will be in one or more pieces in accordance with the Contract Documents.

b. Test Pile. Test pilings are to provide Bureau of Structures and Geotechnical Services with additional information. Usually one or more test piles are driven at each substructure unit, however, in a small structure, 1 or 2 test piles may be all that is required and shown on the plans.

During driving of the test pile, and beginning after the pile has penetrated the upper few feet of any soft or loose soil, measurements are to be taken and recorded to the rate of penetration of the pile at each foot interval for the total depth of penetration. The rate of penetration is the distance in inches that the pile penetrates the soil per blow of the hammer, and it is equal to 12 divided by the number of blows per foot interval. In the case of a test pile, it shall be determined by counting the number of blows of the hammer for each foot interval of penetration of the pile and computing the rate as the average for the foot interval. When driving a test piling, if 1 foot intervals are first marked on the pile and the 5 and 10 foot intervals designated, count of blows per foot interval may be made as the foot mark passes a fixed object and determination of the depth of penetration may be made by observing the foot interval mark at the ground level.

c. Test Pile (Special). When these are specified in the contract, the Engineer will use a Pile Driving Analyzer (PDA) to monitor the driving of the test piles (special). In order to mobilize the PDA, coordinate with the Contractor so the Engineer has a minimum of 5 working

days' notice before driving the test pile (special). Make sure the Contractor knows the Bureau of Structures and Geotechnical Services will need ~1 ½ hours to prepare the pile.

d. Log of Continuous Pile Driving for Abutment and Pier Footings. Record a Continuous Pile Driving Record for a representative pile on each abutment and pier footing on a structure. The record should be inclusive from the beginning of the drive to the final bearing of the pile.

The Log of Continuous Pile Driving Records is the same record used for test piles. Therefore, additional records are not required if one was already created for the test piles.

e. Pile Driving Hammers. The Standard Specifications provide what the minimum weight of a gravity hammer must be and the energy rating an air, steam or diesel hammer must have for driving a pile to designated bearing. One purpose of this is to provide sufficient energy for driving the pile to the required bearing without incurring a set or penetration per blow that is so small, that when it is used in the formula for determining the bearing power of the pile, it may give unreliable results.

Each manufacturer of air, steam or diesel type pile driving hammers designate each size of each type of their hammers by a number and the rated energy output of the hammer. This designated energy rating is usually the maximum energy that the hammer is capable of producing as determined by the manufacturer by the use of formulae or by measurement of the energy developed.

The pile hammer data is included as a matter of information for the Inspector and includes the maximum rated energy in foot-pounds, the length of stroke, the weight of the ram (striking part), the number of blows per minute that the hammer must operate to give the rated energy, and other information relative to the operation of the hammer. For information see http://www.apevibro.com/asp/specs.asp "American Piledriving Equipment". Pile hammers may exist that are not included on this list and new hammers may have been developed since this list was last updated. For these hammers refer to the manufacturer's data for the hammer provided by the Contractor.

Check that the leads are of sufficient length to allow them to be spiked into the ground at the onset of driving.

f. Driving Piling. After a pile has been placed in position for driving, a check should be made to determine that it is plumb or has the correct batter, and is not rotating or twisting. Determination should be made during the driving so that the pile is retained in its correct position. Checking the batter of a pile may be made with a spirit level attached to a board which has one edge cut to the required pile batter.

Upon completion of one unit and prior to driving operation in the next unit, it is advisable, whenever possible, to measure the distance between the units to verify that the location of the unit as originally staked is correct.

The chance of piling being heaved up during the driving of adjacent piling is the greatest when driving timber or treated timber piling through wet cohesive soils. This is due to the heaving tendency of this type of soil and because timber and treated timber piling are generally closer spaced than other types. The Contractor shall re-drive any heaved piles and remove any upheaved material at his own expense. Treated timber piling shall be handled with care so as not to damage the treated surface. The use of tongs, cant hooks and pike poles is not allowed.

Verify that the Contractor brushes paint on cuts or holes, according to the Standard Specifications.

When using the gravity hammer, care should be taken to see that there is no undue friction in the drums and no excess kinking or tangling in the cable which will cause an excessive retardation of the fall of the hammer. When checking the penetration per blow, make sure that the operator does not cushion the blow by applying the brakes to the drum. The hammer should drop freely, and the cable should slap or show evidence of being slack when the hammer hits the pile cap.

When short piles are driven to a stratum which is known to be impenetrable and of considerable thickness, special care should be taken to avoid injury to the piling by overdriving. It may be necessary to reduce the fall of the hammer.

It may also be possible to observe during the driving that the penetration is considerably less than that which indicates required resistance in which case no further test would be necessary, and no further driving of the pile should be attempted. In this case it is important that all piling be reseated after all piling in the footing are driven as there is a tendency in driving additional piles, to raise those pile already in place. The Inspector be confident that all piling are driven down to positive contact with the impenetrable stratum before allowing the piles to be cut off.

When making the test blows, there should be little or no bouncing of the hammer. If the hammer bounces to any considerable extent, either the fall is too great, the pile has struck a solid obstacle, or the hammer is too light. When bouncing occurs, careful trials and discriminating judgment are required to determine the cause. Decreasing the height of fall will sometimes decrease the bouncing and increase the effect of the blow. If the pile has struck an impenetrable stratum or boulder, and the driving is continued, it is probable that there will be a small and continuous apparent penetration due to the brooming or a failure of the pile. In hard driving, there is likely to be a small rebound of the hammer due to the elastic compression of the pile. The penetration to be used in the formulas should not be taken until it has attained a reasonably uniform or uniformly decreasing rate.

If the piling cannot be driven to the minimum penetration elevation shown on the plans by ordinary driving methods, the Inspector may require the Contractor to follow the restrike procedure according to the Section 704-Piling in the Standard Specifications.

If the piles are too short to obtain minimum bearing resistance, the driving of piling should be suspended until it can be determined whether:

- longer piling should be obtained;
- the piles should be spliced; or
- the design should be revised by increasing the number of piling or lowering the footing to enable the shorter piling to be used.

Immediately consult the District Construction and Materials/Assistant District Engineer if any of these changes seem necessary.

If frequent obstructions are encountered which deflect the course of the pile or render it impossible to drive. Driving should be discontinued when it is apparent that the pile is brooming or failing. Piles are damaged and rendered ineffective by continued driving after they have been driven to required resistance.

The driving of piling, after specified penetration has been obtained, to bearing values that are greatly in excess of plan requirements for the purpose of using up ordered lengths is prohibited.

4.05.07 DRILLED SHAFTS

Refer to Section 703-Drilled Shafts of the Standard Specifications for details on constructing drilled shafts. Make sure the Contractor follows the additional requirements for drilled shafts equal to or greater than 72 inches in diameter founded in shale, or as required in the Bridge Foundation Geology Report.

Prior to constructing drilled shafts, complete adjacent excavation of the entire pier.

4.05.08 SUPERSTRUCTURES

a. Falsework Construction. For normal structural steel, prestressed concrete girder and RCB construction, falsework or formwork details for deck construction are not required. However, the Engineer may request such details to verify the structural capacity and requirements for bracing of slab overhangs, needlebeams and formwork support.

b. Structural Steel Construction. The Standard Specifications require that the Contractor provide written notification of the name and location of the steel fabricator to the State Bridge Engineer and the Bureau Chief of Construction and Materials within 10 days after the Contract is signed. Prior to the fabrication of any structural steel or castings, the Contractor or fabricator is to submit shop drawings to the Engineer for approval. The Contractor shall also give enough advance notice to the Engineer prior to the beginning of the fabrication work so inspection can be provided.

All structural steel is to be handled in such a manner to keep it clean and prevent damage and distortion. It is to be stored above the ground on such supports necessary to keep it free of dirt, grease, corrosion and other foreign matter. Girders and beams shall be supported to prevent change in design camber or warping.

The Contractor is required to submit detail plans for the erection of the structural steel. The plans shall include shop details, camber diagrams, shipping statements and lists of field bolts and parts.

When the structural steel is to be bolted, the Inspector shall observe the installation to determine that the proper procedure is used and that all connections are tightened according to the Contract Documents. When setting the anchor units and expansion joints, close attention shall be paid to the design temperature for the steel, and the corrections to be made for the difference in design temperature and the ambient temperature at the time of erection.

c. Structure Construction. Forms for concrete may be metal or wood and shall be mortar tight and rigid enough to prevent distortion due to the placement of concrete or other loads on the structure. The forms shall be capable of being removed without causing injury to the concrete. Forms shall be handled and stored in such a manner to prevent warping and shrinkage. Metal forms shall be kept free of rust, grease or other foreign matter. Aluminum forms, floats, chutes etc. are prohibited.

The Inspector should check the forms and reinforcing steel for spacing, clearance and cleanliness prior to the placement of the concrete. Anchor bolt locations should be checked prior to placement of concrete so as not to drill into the reinforcing steel. Notify the Contractor of any required repairs.

Concrete mixes that include supplemental cementitious materials may have different requirements. See Section 710-Concrete Structure Construction of the Standard Specifications.

Concrete shall be placed in such a manner to avoid segregation of the materials and displacement of the reinforcing steel. The concrete shall not be allowed to fall more than 5 feet without the use of closed chutes or pipes.

Placement of concrete in any floor slab shall be one continuous operation, unless joints are provided on the plans or authorized by the Engineer. The Contractor may submit an alternate placement sequence for review. The alternate sequence shall include the proposed rate of concrete placement in cubic yards per hour, the plant capacity, a description of the equipment used in placing the concrete, proposed admixtures and the quantity of concrete in each placing sequence. Approval of the alternate sequence is required prior to placement of the concrete.

Consolidation of concrete for bridge decks shall be accomplished by the use of internal (spud or tube type) vibrators. The vibrators shall be mounted on a mechanical device capable of being operated so that vibrator insertions are made on a maximum of 12 inch centers over the entire surface of the deck. The vibration time per insertion shall be between 3 to 15 seconds. Hand held vibrators will be required in inaccessible and confined areas.

The Contractor should always position the finish machine over the entire area of the bridge deck to verify the proper positioning of the machine and reinforcing steel prior to placing concrete.

Make sure the Contractor covers all concrete surfaces with saturated burlap within the specified time.

The Contractor shall texture or groove the finished surfaces according to the Contract Documents.

Initial curing of bridge decks shall be according to Section 710 of the Standard Specifications. Curing membrane shall be sprayed in 2 coats while the surface is wet but no free moisture is present. The spraying equipment shall be capable of maintaining a constant and uniform pressure.

Unless shown otherwise, handrail should not be placed until the falsework has been struck or removed. As a rule of thumb, approximately one half of the camber will come out of the bridge deck once the falsework has been removed; therefore the handrail should be constructed using only about one half of the camber shown for the bridge deck.

d. Form Removal. The Contractor shall remove forms according to Section 710-Concrete Structure Construction of the Standard Specifications.

4.06 PORTLAND CEMENT CONCRETE PAVEMENT

4.06.01 GENERAL

The Inspector assigned to a paving project is responsible for the quality of the work. A Contractor with modern equipment and a good organization can pave more than a mile per day. With this speed of operation, the Project Manager and personnel must be on top of the situation at all times. Problems that arise must be taken care of immediately by the Project Manager. The inspection personnel working in the many areas of a paving operation must be familiar with the plans, Standard Specifications, and Special Provisions, as they apply to their area of responsibility. Above all, the inspection personnel and the Contractor's personnel on the project must keep the lines of communication open at all times. Throughout the project the "Concrete Pavement Construction Checklist" should be utilized as a guideline for the construction and inspection of Portland Cement Concrete Pavement operations.

4.06.02 CONCRETE PAVEMENT METHODS

a. Fixed Form Method. This is the method that has been used for many years, and consists primarily of setting metal side forms to proper line and grade, with the paving train using the forms as tracks. The placement of transverse joints (baskets) should be made prior to starting concrete placement, unless specified as plain pavement. The equipment in the paving train consists of some type of spreading device, a machine which vibrates and strikes off the fresh concrete followed by a burlap drag, tining and then curing.

b. Slip Form Method. This method is quite similar to the Fixed Form Method; however, in lieu of setting the side forms, the "Slip form paver" extrudes the final product. The slip form paver does the following operations; spreads the concrete, consolidates through vibration and tamping, shapes, extrudes, finishes, controls width, thickness and riding surface. When the depth is controlled by the paver in the free floating method, it is extremely important to check the subgrade for plan elevation and a smooth surface. Most of the other equipment in the paving train is quite similar to the fixed form method in function.

4.06.03 ORGANIZATION OF PORTLAND CEMENT CONCRETE PAVEMENT PROJECT

The Construction Engineer immediately supervises the following personnel, who shall be responsible for the proper control of the various phases of the work:

- **Project Manager:** The Project Manager will be the field coordinator for all work done by KDOT personnel assigned to the project, and will have the authority to act in the Construction Engineer's absence.
- **Survey Party Chief** (if staking is done by KDOT): The Survey Party Chief shall be responsible for staking out the work to the proper line and grade as indicated in the Contract Documents.
- **Concrete Plant Inspector:** The Inspector shall verify that all Contractors' operations at the concrete plant are in accordance with current Standard Specifications.
- **The Slab Inspector:** The Inspector shall verify that the Contractor satisfactorily places and cures the properly proportioned concrete along the lines and grade established by the Contractor.

The above noted personnel must inter-act between themselves and the Contractor's key field personnel. It is extremely important that KDOT personnel be familiar with the entire organization of the Contractor, and the authority of each member of the organization. Prior to starting the actual operation, the key personnel for the KDOT and the Contractor should hold a field meeting in order to arrive at the plan of operation. (NOTE: This should not be done at the pre-construction conference, but held separately). This plan will become the operating schedule for the concrete pavement and should be written up as the plan schedule.

4.06.04 DUTIES AND RESPONSIBILITIES OF THE PROJECT ENGINEER OR PROJECT MANAGER

The first duty of the Project Manager on a concrete paving job is to be completely familiar with all details of construction and plant inspection. The manager must address if it is a QC/QA project or non-QC/QA project to determine the correct inspection procedures and material testing requirements. The Project Manager must instruct assistants, explain their duties and be sure they fully understand their responsibilities. The Project Manager must coordinate the work of the personnel assigned to the project and must check their work frequently to see that

they are performing their duties. The Project Manager is responsible for both the performance and the quality of the inspection performed by the personnel assigned to him.

The Project Manager must also see to it that the Contractor accomplishes the work according to the Standard Specifications. The Contractor must have the equipment calibrated as required by the Standard Specifications in the presence of the Inspector and the Contractor or his representative. The Project Manager should make sure that the Contractor plans to use enough qualified personnel and that the Contractor's equipment meets requirements. The Project Manager should review with the Contractor's Superintendent, the Contractor's plans in order to prepare for day to day changes in the schedule of operation. It is imparative the Project Manager to see that the project progresses smoothly, to anticipate problems, and to eliminate as many as possible.

On QC/QA projects, the Project Manager should also verify that the Contractor's personnel performing the test holds the proper certification according to the Policy and Procedures Manual for The Certified Inspection and Testing Program.

4.06.05 DUTIES AND RESPONSIBILITIES OF THE CONCRETE PLANT INSPECTOR

a. General. The Inspector shall verify that the Contractor maintains proper control of materials and batching operations. The Inspector should be familiar with the requirements of the specifications for the type of testing needed; QC/QA or non-QC/QA. Duties will start at the time materials are being accumulated and continue until final records for the project are complete. Materials will be field tested at the concrete plant, which is a function of the Inspector. Be familiar with the source and type of aggregate intended for use, mix proportions, moisture content, method of determining scale weights, batching equipment, tests and reports. The Inspector should be familiar with the manufacturer's manual and the batching equipment to understand its operation. The Contractor will normally have this information; if not, it may be obtained from the manufacturer's representative. The Inspector should know what the certification requirements are for all parts of the batch plant operation, types of haul vehicles and other equipment used on the project. The ready mix plant whether it be a permanent or mobile plant shall have a plant inspection completed and on file before any concrete batching is allowed.

b. Batching Plant and Equipment. Be familiar with specifications regarding the requirements of all equipment. See subsection 154-Concrete Pavement and Concrete Structure Equipment of the Standard Specifications. Prior to the start of batching operations, the Inspector must thoroughly check, verify calibrations, and verify that all equipment is of an approved design, and complies with the Standard Specifications. Hoppers or bins should be set level and loaded for at least 24 hours prior to calibration. The scales shall be inspected and calibrated by an approved scale company. Initial and periodic calibration of each weighing device shall be accurate to within 0.25 % throughout the range of use. The Contractor shall have the scales checked, adjusted and certified by an approved testing firm or a qualified manufacturer's representative at:

- a maximum of 6 month intervals;
- at each plant set up, except for small units such as three sack mixers which are moved frequently, etc;
- when scales are repaired, and;
- any other time deemed necessary by the Engineer. The Contractor shall have available, not less than 500 pounds of weights for calibration and verification of the

scales. The Inspector may check the calibration with the weights at any time that it is deemed necessary during the operation.

Each mixer shall have attached, in a prominent place, a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Bins for batching aggregates or bulk cement and/or fly ash, should be tight and constructed in such a manner that there is a free flow of material with no accumulation in the corners, and should be loaded in a way to avoid segregation, contamination or coning against bottom of bin, and should be constructed to empty completely. Cement and/or fly ash shall be weighed in a separate hopper from the aggregates.

All working parts, such as knife edges, shackles and weighing arms should be in good condition, free from avoidable friction, and readily accessible for inspection and cleaning, as well as being protected from falling or adhering material. There should be no attachments to scales or weighing hoppers which might restrict the free movement of any part of the weighing equipment. Cement and/or fly ash hoppers should be vented to permit escape of air, and should be sealed to prevent loss of cement and/or fly ash during discharge. There should be a periodic check of the amount of cement and/or fly ash actually used, by comparing the total amount received to the theoretical amount used, taking into account the amount remaining on hand and amount wasted. This check should be made daily, if possible. Before concrete construction operations are started, the facilities for the batching and mixing of concrete should be inspected to determine that the plant meets all specification requirements, and that the plant has the capability for producing concrete of the required uniformity and quality. In some instances, detailed plant requirements may not be spelled out in the specification, and it will be necessary to evaluate the plant on the basis of standards commonly accepted. Two things can be accomplished by the use of a guide or check list in the inspection of a batch plant; first, inspection of all details required by the check list will indicate whether the materials, plant and operating procedures meet all requirements of the Standard Specifications, and whether they conform to the normally accepted standards; second, this detailed inspection using the check list for a guide will familiarize the Inspector with all features of the plant, from the aggregate storage facilities up to final mixing operations and will alert him to the existence of equipment and procedures of marginal quality which will require close supervision during operation.

NOTE: These check lists can be reproduced in a form to fit the type of mixing operation and should be referred to frequently.

NOTE: Storage of aggregates should be controlled so that the materials are kept as uniform as possible in both grading and moisture content, and protected from contamination. Standard Specifications require uniformity of grading at the time of batching, therefore, excessive segregation and breakage should be avoided in stockpiling aggregates. Conveyors are commonly used in materials handling, and it is an important part of inspection to see that materials are not allowed to fall from heights such that large or small particles are separated, nor should aggregates be allowed to run down the slope of the pile. Baffles may be necessary to break the fall and prevent excessive segregation.

Operation of Plant: (as to accuracy)

When changing scale weights for batch correction in the aggregates, be sure that set screws holding the counterweights in position on the beam arms, are firmly tightened by the operator. Constant vibration around the plant tends to move these weights causing an incorrect amount of aggregate to enter the batch. (NOTE: The position of the weights should be checked frequently).

Since many central mix plants are controlled from a central control console location, some additional checks are required. Some of these additional items are included in the PCCP Checklists.

It will be found that automatic plant operation will require considerably more documentation and pre-construction inspection, however, if everything is pre-planned and checked before starting, less work is required during operation.

c. Inspection of Trucks. The delivery of the concrete from the plant to the paver is a very important part of the overall operation of concrete paving. Depending on the Contractor's operation, there may be a number of ways this can be done.

(1) Non-agitating Delivery Trucks. Non-agitating units shall have interior surfaces that are smooth and water tight, having gates or other means to control the concrete discharge. The interiors shall be free from excessive accumulations of hardened concrete and from other obstructions or deterioration sufficient to interfere with the proper discharge of concrete. The interiors shall be free of any foreign materials which may contaminate fresh concrete.

(2) Agitator Delivery Trucks. Everything mentioned above for non-agitating units applies to agitating units. The paddles or blades should not have a build up of mortar or concrete, nor be worn to excess.

(3) Ready Mix Trucks. See the PCCP Checklists.

d. Control of Concrete Mix. Accurate proportioning of aggregate and cement and/or fly ash.

The Contractor will make free moisture tests at least twice daily (minimum of one in A.M. and one in P.M.) and more frequently if in the judgment of the Inspector there has been a change in moisture content. All tests will be recorded in a bound book and become property of KDOT upon completion of the project. The Inspector will observe the testing procedures. These tests are required so that batch weights may be adjusted, and to verify that the maximum water-cement and/or fly ash ratio is not being exceeded.

If rain comes at any time while the aggregate bins are loaded, the water will collect in the material at the bottom of the bins. Two or three truck loads of each size aggregate should be taken from the bins and hauled back into the stockpiles before batching begins. When this is not done, the moisture content of the first few batches will be excessive and sloppy concrete will result. Many Contractors allow the bins to empty at the end of the day for the above reason. The proper control of the moisture and proper changes in the mix will result in uniform and consistent concrete. Therefore, the mixes must be regularly corrected for aggregate moisture changes.

NOTE: Uniformity of mixture is probably the most important point that should be made, and stockpiling can measurably improve this condition and help provide a consistent slump. The Slab Inspector must be advised immediately of any change in the mix due to moisture correction.

It shall also be the responsibility of the Concrete Plant Inspector to:

- Care for and test beam specimens (see Part V of the Construction Manual for Testing Procedures).
- Keep records of materials received, used and on hand.

4.06.06 DUTIES AND RESPONSIBILITIES OF THE SLAB INSPECTOR

a. General. The Inspector shall verify that the Contractor places concrete in a satisfactory manner to the line and grade shown on the plans. The Inspector should be familiar

with the Contract Documents, plan sheets and all specifications that pertain to each phase of the operations.

Each operation consists of a number of small steps and the Inspector must check every detail of each step. The quality of the pavement depends largely on the amount of attention the Inspector pays to the details of the work.

Some of the more important points of concrete pavement construction are listed here.

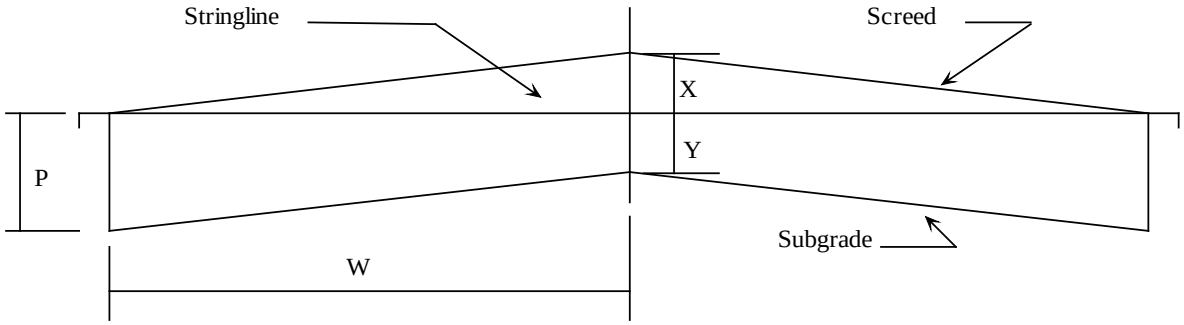
b. Inspecting Subgrade for Conformance. A subgrade that was once compacted to specification density, but which has lost density, must be brought to required moisture content and density. Any loose material added to fill low spots must be compacted by rolling with the specified rollers until those parts of the subgrade are brought to a uniform density, meeting the specification requirements.

Before any subbase material is placed, the subgrade must be checked for grade, cross-section and drainage. It is especially important that there be no ruts or depressions that will hold water. Material in any soft or yielding spots should be removed and replaced with good subgrade material.

On many of the projects, lime treated subgrade will be a part of the contract. In these cases, the subgrade material must be in the proper cross-section so that adequate depth of material is placed. This lime treated area then becomes the final subgrade. After proper curing time and recompaction of the lime subgrade, the subgrade must be trimmed to the final cross-section. Lower areas are generally filled in with the trimmings of the higher areas, and some waste should be expected due to the normal expansion of the material.

If any soft areas show up, the unstable material should be removed. The new material used to repair the soft area should meet the Standard Specifications for subgrade material up to the level of the bottom of the subbase and for subbase material above that level. All the material should be moist enough to be easily compacted. It must be put back in layers and each layer must be compacted. When the area has been filled, the subbase should be given some extra rolling to make sure that it is firm and that all the soft material has been completely removed. If the subbase material has been compacted properly and the density has not been lost, it will give firm, uniform support. If the subbase material becomes contaminated from any cause, such as by mud tracked on by trucks or washed onto the subbase during a rain, the contaminated material must be removed and replaced with material which meets the specification requirements.

FIGURE IV-1
MEASUREMENTS FOR CHECKING SCREED AND SUBGRADE ON UNIFORM PAVEMENT FROM A STRING STRETCHED ACROSS TOPS OF FORMS



$X = (W - H)(S)$
$Y = P - X$

WHERE DIMENSION:
S = Slope per Foot in Inches
P = Pavement Thickness in Inches
W = Width of Pavement from Centerline to Edge in Feet
H = Horizontal Distance from Centerline to Check Point in Feet
X = Vertical Distance from Stringline up to Screed in Inches
Y = Vertical Distance from Stringline down to Subgrade in Inches

e. Forms and Form Setting. Forms are not the normal for long stretches of paving. They are mostly used for approaches, hand finish areas and other irregular areas of work. Forms are a continual source of trouble because they serve as tracks for all of the paving equipment in addition to serving as forms for the concrete. Since developments in paving equipment have given us more and heavier equipment, the forms play an increasingly important role in the construction of smooth pavements. The forms should be continually inspected to see that they comply with the requirements of the Standard Specifications. Verify that the forms have the proper dimensions and that they are straight and true. Also, check that the connecting devices and wedges function properly, and that the form pins are of sufficient length to result in rigid forms. It is extremely important that forms be set in such a manner as to prevent the forms from settling.

The first time the forms are set on a project they should be straightedged and inspected individually. Forms which are distorted more than specification allowances shall be rejected. Forms which are rejected should be marked conspicuously and removed from the work so that there will be no chance of moving them ahead and using them again. With the heavy equipment in use, all forms must be in perfect condition. This is a continuing job of inspecting forms, not just once at the beginning of the job.

Forms should be thoroughly cleaned and oiled each time they are used.

Care should be exercised in cutting the trench for the forms. The trench should be cut slightly shallow and trimmed to the required grade rather than cut below grade and filled with loose material. Blocking up the forms with loose material, bricks, blocks, etc., is not allowed. If it is necessary to use loose material to bring the trench up to the required elevation, the loose material shall be moistened and thoroughly compacted before the forms are placed.

Under present paving methods, the forms must support heavy loads, and are also subject to lateral forces imparted by the finishing equipment. It is therefore important that the foundation is thoroughly compacted, and uniform support is provided for the full length and width of the form base. After the forms have been set, the material under the forms must be thoroughly tamped, either with a mechanical tamper or a suitable hand tamper, under the face and back of the form. Sufficient subbase material should be available at the tampers to obtain compaction. Probing with a steel pin readily discloses how effectively this has been done. Guard against excessive tamping in one spot, as this has a tendency to raise the form above the true grade. The principal point of inspection is to see that the subbase material is not excessively loosened under the form-line, as form setters much prefer to shovel loose material under the form rather than the harder work of cutting out the compacted material.

The foundation under forms which were placed prior to rain, should be checked for stability. Careful probing underneath the forms will disclose whether the material is firm enough to prevent settlement under the heavy equipment. Instances of deficient depth pavement have been attributed to this condition.

Use stringlines to establish a smooth grade on approaches to bridges, railroad grade crossings or adjacent pavements. Approximately 20 to 25 feet of the approach nearest the structure or crossing to be met, should be on the same plane as the structure to obtain a smooth riding approach. When setting forms for pavement underneath a structure, the required vertical clearance above the pavement should be checked. The grade of the forms must be checked by eye to see that there are no humps or dips. The Inspector must determine if humps in the forms are due to a high place in the grade or low places on each side of the hump. Do not allow forms to be raised if the high form is due to a hump in the form grade. The high spot should be cut down.

A stringline should be stretched across a gap in the forms and the subbase fine graded with compacted material to reset the form to the proper grade.

Finally, check to see that all form pins are driven below the top rail elevation, and that the locks are tight on all stake pockets. Forms shall be staked into place with not less than 3 pins for each 10 foot section. A pin shall be placed at each side of every joint. A smooth riding job starts with a smooth and secure form-line.

f. Checking Forms for Alignment and Grade. After the forms are set, the Inspector must check them. They must be plumb and to line and grade on both sides of the lane. Line can be checked by measurement of the offset distance from the fine grade stakes and by sighting along the forms. Then, the distance between opposite forms must be measured with a steel tape. The elevation of the top of the forms should be checked to make sure that it is the same as the grade staked. The forms should also be checked with a straight-edge across joints.

The checking of the forms is a most important part of the construction inspection of Paving by the fixed form method. The pavement cannot be built to the proper line and grade unless the forms are set right.

g. Transverse Expansion Joints. Expansion joints are used at bridge approaches and as specified in urban construction. A great many types of expansion joints have been used in the past and their spacing and the methods of installation have varied greatly. Plans will need to be checked for each project to determine type of expansion joint and filler to be used. All expansion joint assemblies shall be set and checked before placing of the concrete.

The purpose of a load-transfer device is to reinforce the joint, which is the weakest part of a pavement, and at the same time permit movement to take place due to expansion and contraction of the slab. It is essential that all dowel bars be parallel to the center line of the pavement and also parallel to the surface of the concrete. One end of the dowel bar shall be coated as specified and thoroughly, but not excessively, greased to break the bond between the bar and the concrete. NOTE: Greasing should be complete and include the end of the rod. Greasing the dowel bars after they are in place usually results in a coating of grease on the joint assembly each side of the dowel bar. This decreases bond between the concrete and the dowel bars, and weakens the pavement adjacent to the joint. This defect may be eliminated by greasing the bars immediately before they are inserted into the installation device. The expansion caps should be placed on the greased end of the bars. Be sure that the caps are not driven past the stop which will allow ample room for expansion. The joint assembly must be held firmly in place and be at right angles to the forms or reference line (along the radius when on a curve). Sufficient metal stakes must be provided to stake the joint assembly securely to the subgrade.

h. Transverse Contraction Joints. Transverse contraction joints spacing are to be as shown on the plans. Contraction joints are installed in nearly the same way as transverse expansion joints. One end of each dowel must be greased. Nose caps are not required but there must not be any burrs on the coated end of the dowel.

The exact location of each dowel assembly must be carefully marked for each contraction joint so that the saw cut is made across the center of the dowel bars.

i. Checking Alignment of Transverse Joints.

(1) Fixed Form Method. An easy way to find if a joint has been installed at a right angle (or on a true radius if on a curve) is shown in Figure IV-2.

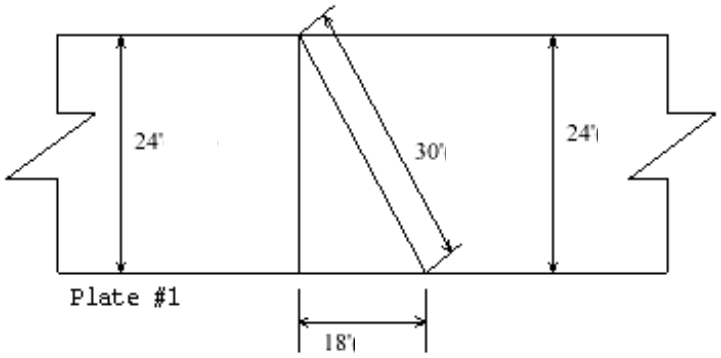
(2) Slip Form Method. Joint alignment using the slip form method may be checked as in the form method by using the reference string line in lieu of the form line.

j. Longitudinal Joints. Requirements for longitudinal joints are given in the Standard Specifications, and details of construction are shown on the Plans.

Longitudinal tie bars should either be placed mechanically or supported securely with bar chairs driven into the subgrade. When bar chairs are used it may be necessary to use 3 chairs for each bar instead of two. When the bars are placed mechanically, they should be placed at the proper spacing and to the proper depth, after the first pass of the concrete spreader and before the mesh reinforcement is placed. Care should be taken to see that the tie bars remain in their proper position during subsequent placing of the mesh and the remaining course of concrete.

All tie bars and dowel bars, unless mechanically placed, shall be placed prior to placing the concrete. Continuous vigilance on the part of the Inspector is necessary to see that the steel is properly placed and remains in place as the paving operations proceed.

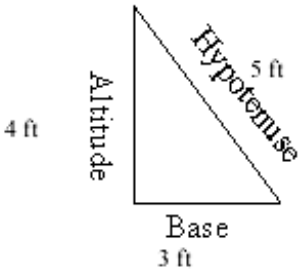
FIGURE IV-2

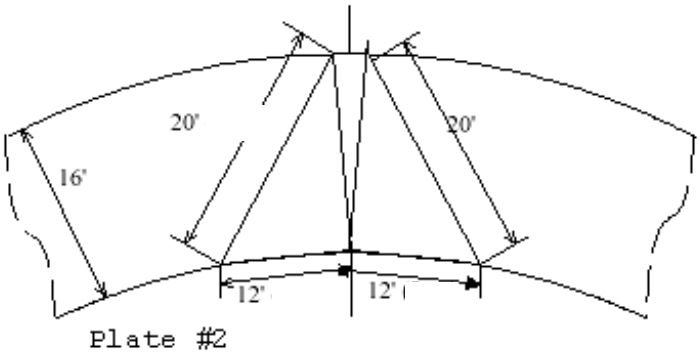


With the paving form on a tangent, a good method of squaring baskets is shown in Plate #1.
Using the right angle triangle dimensions of 4 feet , 3 feet & 5 feet, divide the roadway width by the altitude 4 feet. The results are multiplied by the base 3 feet and the hypotenuse 5 feet.

Example:

24 ft ÷ 4 ft or Altitude (a) = 6
6 x 3 ft or Base (b) = 18 ft
6 x 5 ft or Hypotenuse (h) = 30 ft





With the paving forms on a curve, a good method of squaring the basket is shown in Plate #2.
In this case, the right angle triangle is projected in both directions. The difference between the vertex of the two right angle triangles is split to find the true right angle.

k. Reinforcement for Approach Slabs to Structures.

(1) Fixed Form Method. Additional reinforcement is required for the pavement or approach slabs, next to bridges and other rigid structures. Details are shown on the Plans. The reinforcing steel must be clean and tightly fastened together by wire ties so they will not move when the concrete is placed. The reinforcing bar assembly should be held at the proper elevations by steel supports or bolsters. Sometimes it is necessary to true up the subgrade, reset some forms, and place the steel and joints after the paver has moved from the shoulder of the road to the bridge floor. This creates a confused and congested condition which is conducive to poor workmanship. The Inspector should insist that the subgrade at these locations be properly reshaped that the double reinforcement be placed at the proper elevation both above the subgrade and below the surface, and that it is properly spaced and tied, and the joints are properly constructed. Bar chairs and spacers are necessary to hold the double bar reinforcement in place and shall be placed in its proper position before the concrete is placed. When properly

constructed, this type of approach should eliminate a large amount of maintenance at these locations.

(2) Slip Form Method. On Slip Form projects, the approach slab is usually constructed using the Fixed Form Method. However, with proper ramps and stringline control, slip form pavers can pave approach slabs.

l. Control of the Mixed Concrete. In the QC/QA method of controlling the concrete mix, the Contractor has most of the control of the consistency, but the Inspector still has to test the concrete to verify it meets the Standard Specifications. The Inspector shall see that the concrete has the proper consistency within the limits set by the Contract Documents. They shall run frequent slump tests as per Part V appendix A or B, or as necessary to check the mix. Notify the Contractor of test results. When necessary, the Contractor may find it necessary to adjust the mix. The total water in the mix allowed by the Contract Documents includes the water in the aggregate. The consistency of the concrete is extremely important as the strength and durability are greatly reduced by the use of excess water. Concrete of proper consistency and uniform throughout the day's run will do more to secure a smooth, durable surface than any other factor entering into the construction. The consistency is measured by the slump test and is reported in inches of slump. The maximum allowable slump is noted in the Contract Documents.

The Contract Documents may require the use of an admixture to produce air-entrained concrete. Variations in concrete temperature, aggregate gradation, consistency, mixing equipment and other factors, can cause fluctuations in the air content. The Inspector must run frequent air tests on the concrete to maintain uniformity. Constant surveillance of all operations is necessary to maintain proper air content throughout the entire depth of concrete.

When the concrete is delivered from a central mixer or a transit mixer, the final acceptance or rejection lies at the paver. With Slip Form paving, a slump of 1 inch or less usually works best and will hold a good edge.

m. Spreading Concrete.

(1) Fixed Form Method**.** The spreader distributes and strikes off the correct amount of concrete so that the pavement reinforcement can be placed at the proper elevation. The screed must be adjustable so that it can be raised over the prepositioned load transfer baskets, when required, so that they are not disturbed. The speed of the machine is adjusted to the amount of concrete placed.

The concrete spreader, which will spread the concrete between the forms, should be inspected to make sure that the gauges, which show the elevations of the spreading device and the strike-off, read zero when the lower edge of the strike-off plate, immediately behind the spreading device, is at the level of the top of the forms. This can be checked by means of a wire or string-line stretched across the tops of opposite forms.

The Standard Specifications require that spreading of concrete be accomplished with a mechanical spreader. The screeds or strike-off of the spreader should be set to conform with the approximate cross-section of the crown, and to feed enough concrete under the strike-off to furnish material for the finishing operations.

A uniform pattern of distribution in discharging concrete on the subgrade ahead of the spreading equipment is essential for efficient spreading. The paver's spreader bucket is best discharged while in motion, resulting in a partial spread of the concrete. Dumping in piles results in uneven consolidation, differential subsidence, and affects spreading efficiency. The distribution pattern should be shifted on super-elevated sections so that a greater amount of

concrete is placed at the higher side of the section. From all standpoints other than workability, too much water is detrimental to the concrete. If a particularly wet batch is being discharged from the truck into the spreader bucket, there is a tendency for the mortar to flow to the sides of the discharge chute with the coarse aggregate in the center, resulting in an accumulation of the larger stones on one side of the concrete bucket. Such wet batches should be rejected and the Contractor should not be allowed to place it within the forms, not even on the bottom, as the excess water will bleed up through the slab and cause eventual subsidence.

The Inspector should see that the spreader operator spreads the concrete out uniformly to a depth a little greater than the required depth. The concrete should not be dumped in a high pile and then spread. When a hopper type spreader is used, the hopper should be partially filled at all times for its full width, as it moves ahead to spread the concrete. Windrowing or piling of the concrete is not permitted.

On the first pass of the spreader, the concrete should be struck off at the elevation of the mesh, and the vibrators should be used to consolidate the concrete. The setting of this elevation is very important as it is on this pass that the concrete is struck off to provide a bed for the paving mesh. If necessary, a second pass on this lift shall be made to fill all low places to give support to the mesh over its entire area. No voids or pockets should be permitted in this layer so as to leave a pocket to be bridged over by the reinforcing. The second pass of the spreader should strike off the concrete to the proper crown and at an elevation to allow for the consolidation and finishing of the concrete.

Special care is required in spreading concrete over and across transverse joints to be sure that the joint is not disturbed. The strike-off should be lifted well above the joint for some distance on each side. This makes a certain amount of hand leveling and vibrating at the joint necessary to get the mesh on each side of the joint is in its proper position. Consolidation against and along the full length and on both sides of all joint assemblies shall be attained by hand operated spud type internal vibrators inserted in the concrete.

When the spud vibrator is used, a worker should leave the spud in one place between 5 to 15 seconds. If vibrated over 15 seconds in one place, the concrete will become so liquid that the large stones will sink to the bottom. There will be too much mortar on top, which will create a weak area in the pavement. The mortar shrinks more than the rest of the concrete, and this uneven shrinkage may cause a crack. Vibrators are to be used only to consolidate the concrete; they must never be used to move or spread concrete.

Extreme care is necessary in placing the concrete at the joints so that the joints will not be disturbed. The concrete shall be carefully hand vibrated at the joints, and when a joint is found to be disturbed, the concrete around the joint shall be removed. The joint shall be straightened or reset to its true position and the concrete carefully replaced. It is particularly important that uniform concrete with no segregation be placed on both sides of each joint assembly. This operation must be inspected carefully to make sure the dowels are not moved, and the dowel caps at the expansion joints are not knocked off or damaged. The operator should never dump the batch where it will run against a joint. The bucket shall be brought to a stop over the joint to deposit the concrete on each side of the joint simultaneously. If any method of discharging the bucket causes distortion of any joints, the concrete shall be dumped away from the joint and shoveled against the joint in a manner to prevent distortion.

(2) Slip Form Method. See Division 150 of the Standard Specifications for equipment requirements. See Division 500 of the Standard Specifications for allowed paving widths.

The concrete spreader must be self-propelled with an adjustable strike-off capable of placing the required thickness of concrete and adjustable slip-forms for placing the required width of pavement. The spreader will use the same string-line that was used for subgrade trimming as a guide for the depth of concrete and alignment of the pavement. The spreader should uniformly distribute the concrete over the subgrade, and the concrete should be free of cavities and pockets.

The paver should be operated continuously, stopping only when absolutely necessary. If the forward motion of the paver is stopped, the Contractor should immediately stop the vibrator and tamping elements.

The concrete should be deposited on the grade in successive batches to minimize re-handling. The concrete should be placed over and against any joint assemblies so the joint assembly is retained in its correct position. The Contractor should spread the concrete using approved mechanical spreaders to prevent segregation and separation of the materials.

After striking the concrete off with the spreader, they should leave sufficient concrete in place to allow the final shaping by the use of screeds, templates and pans, depending on make, model and type of machines approved for use in the paving train.

n. Placing Wire Mesh and Dowel Bars. The reinforcement must be fully supported over its entire area. This pass of the spreader should continue for a distance well past the end of the sheet of mesh. The mesh is then placed, lapped and tied as noted in the Contract Documents. Frequent checks on the depth of the mesh behind the finishing operations may require adjustments in the depth of the strike off. These checks may be made with a rule measuring from the surface of the concrete to the top of the mesh at intervals across the crown of the pavement, and recorded in the project records.

(1) Single Lift Method. Approximately 1 inch more concrete than called for on the plans, should be placed on the subbase with the spreader as described above. The paving mesh, when required, is placed on the fresh concrete, lapped and tied, then depressed into the fresh concrete to the depth indicated on the plans. This is done mechanically just ahead of the Slip Form paver. Care is required to place and maintain the mesh in the proper location.

(2) Two Lift Method. Approximately one half the thickness, plus or minus 1 inch, of fresh concrete is placed on the subbase using the spreader described above. Paving mesh is then placed on the concrete. Care must be taken when placing the mesh for alignment and joints. A second spreader placing the remaining thickness on the previously placed fresh concrete and wire mesh is then used. The tying of the paving mesh is done just prior to placing the second lift of concrete. Both spreaders are controlled off the same string-line as used for trimming the subbase. Note the string-line is used for alignment only, and depth is controlled from the top of the subbase.

Paving Mesh and Dowel Bars (both methods). Care must be taken in placing wire mesh and dowel bars. Mesh generally is placed and secured manually. Mesh shall be placed in accordance with the Contract Documents. Care must be taken to avoid walking on dowel and/or tie bars while placing the mesh.

When mechanical mesh installers are used, the reinforcing mesh is placed on the concrete after it has been struck off to its approximate final position. It is pressed into the concrete to the required depth by a tamping or vibratory action exerted by a grid or a system of parallel bars acting on tied reinforcing mesh. Care must be taken to avoid any movement of this mesh. The mesh placer has a tendency to move the mesh forward over the center of the next contraction

joint. Verify that the mesh does not creep ahead during the finishing operations. Never allow the mesh to extend through a transverse joint.

Dowel bars (for transverse joints) must be placed manually ahead of concrete placement and must be secured in place. Tie bars (for longitudinal joints) may be either placed manually (on "p" stakes) or by a mechanical attachment to the paver.

Correct location of both the tie bars and dowel bars is vitally important for the pavement and joints to work properly and as designed. Standard plan sheets show the deviations allowed in placement of the bars. Any variations from these limits should not be allowed.

Verification of the location of the bars should be made and documented during concrete placement and also after the concrete is hardened. Probing the concrete to verify depth and using a pachometer on the hardened concrete are two methods that can be used.

o. Consolidation and Machine Finishing.

(1) Fixed Form Method.

(a) Finishing Machines. Finishing machines are used to give the final cross-section and finish to a pavement, and by the action of its screeds to compact and consolidate the concrete. It is the Contractor's obligation to maintain paving equipment in a condition suitable to produce work which meets specification requirements. The Inspector's job is to see that the equipment is adequate and in condition to produce satisfactory work. Regardless of how recently the equipment was used on other work, the Inspector should verify that it is in a condition to perform satisfactorily and to produce the quality of work required by the Standard Specifications.

After paving is underway, more adjusting may be required. By knowing what the settings were initially, much of the guesswork can be eliminated in subsequent adjustments.

The sections of a screed which slide across the forms during its transverse motion are subject to a great amount of wear. They should be examined carefully prior to paving and if worn excessively, should be replaced or reversed prior to any screed adjustments. As paving progresses they should be checked for wear periodically and replaced when distortion of the pavement cross-section-occurs.

The final pass with a machine using a transverse screed should be delayed as long as practicable to permit some settlement in the concrete to take place. Unless every batch is uniform, the settlement in concrete is non-uniform and early finishing results in irregular settlement, which causes poor riding qualities in the pavement.

If the screed adjustments have been carefully made as explained previously, each screed should carry forward a smaller quantity ("roll") of concrete than the one preceding. Due to the mix which is being used, the initial adjustments may not produce the desired results and more adjusting may be required to fit the mix.

The relation of forward speeds with the action of the transverse screed is important. With stiff mixes, the screed speed should be fairly rapid and lengthy, and the forward speed should be relatively slow. With more workable mixes, the screed action should be decreased in both speed and length, and the forward speed increased accordingly. Any machine which is incapable of being adjusted to overcome a forward motion that is jerky and hesitant and causes excess racking of the forms should not be approved.

(b) Longitudinal Finishing. The longitudinal finisher has a screed or float set parallel to the pavement which operates across the slab as the machine is moving forward. When operating properly, the float should carry a slight roll of mortar which diminishes toward the rear. If it cuts, or if additional concrete is required to be added, it means that some machine in the finishing train is out of adjustment or is being improperly operated and corrections should be made. It may be

the finishing machine, the longitudinal finisher or both that need adjusting. A sloppy laitance carried by the finisher is an indication that the operation is being performed too early. Precise control and attention to varying conditions are necessary if acceptable riding surfaces are to be obtained. The time at which the longitudinal finishing is done is very important. Because of loss of water and air, the concrete is continually settling until it has started to harden. If it is finished too soon, more settlement will take place. Since this settlement is never uniform, an uneven riding surface will result.

Two types of float finishers are presently in use. One has a screed and a float pan and is attached to and towed by a finishing machine. The satisfactory performance of this machine depends largely on the action of the finishing machine. For best results, it must move forward at a steady uniform speed. The second type is a self-propelled unit equipped with a conventional screed in front with a screed and float pan in the rear. In each case, the rear screed and float pan is suspended from the frame and has no contact with the forms. The suspended screed shapes the final surface, and the float pan irons out minor irregularities. A very precise correlation in adjustment is required. A slight roll should be carried by the screed, and the float pan should rest on the surface with just enough pressure to iron the surface without cutting. The timing of this operation, as with the longitudinal finisher, should be closely controlled.

In case of equipment breakdowns or unavoidable delays when the finishing is hampered, the addition of a slight amount of water above the surface as an aid in finishing is permissible. If used, the spray shall be applied above the surface in a fog spray. The use of the spray is not considered as good practice, but is the lesser of two evils when difficult conditions exist, and is to be used sparingly and only when absolutely necessary.

The Inspector should check the crown behind the longitudinal finisher at frequent intervals to verify that the proper crown is being maintained. Constant coordination in the operation and adjustments of the spreader, finishing machine and longitudinal finisher is necessary to see that each one may carry a roll of material ahead of its screeds, to produce the proper cross-section and riding surface of the slab, without undue waste of material. On some occasions, such as on curves and transitions, and in some cases on crowned sections, the concrete will have a tendency to slump against or away from the forms, causing either a ridge or depression or both. If this condition cannot be corrected by adjusting the slump of the concrete, the longitudinal finisher shall be operated only one way (uphill) or only from the form line to the center. Frequent checks of the crown of the pavement, whether on tangents, transitions or curves, should be made to verify that the surface is finished to the correct section and free from ridges or depressions caused by slumping of the concrete.

(c) Mechanical Finishing of Transitions. Curve transitions shall be laid out, formed and finished to the lines, grade and cross-section indicated in the Contract Documents, or as indicated by the best engineering practice. The amount of superelevation will be shown in the Contract Documents.

All finishing machines and longitudinal finishers have a mechanical device for bringing the screeds to a plane surface from the crowned surface. These adjusting devices operate on the principle of dividing the portion of the transition, in which it is necessary to eliminate the crown into an even number of increments, and to eliminate the crown in the same number of adjustments of the machine. Different machines have slightly different procedures for eliminating crown through transitions. The instruction manual for each should be consulted. The proper operation of the longitudinal finisher through these areas is of utmost importance in producing good riding surfaces.

The Contract Documents will indicate a plane surface on all curves that are super-elevated. Experience has proven that more satisfactory results are obtained if approximately ¼ inch crown is retained at the time of finishing. Slight slumping of the concrete on surfaces finished to a plane will cause minor depressions and ridges adjacent to the forms and on curves with slight superelevation, water may be impounded. Retaining a slight crown usually eliminates this condition without materially affecting the riding surface.

(d) Consolidation. In the construction of portland cement concrete pavement, the settlement and consolidation of the concrete is usually accomplished by the use of mechanical equipment as shown in Division 150 of the Standard Specifications.

The vibratory equipment for general consolidation of the pavement concrete is of the internal spud type or the surface pan type. When used on the top course of reinforced pavement, the angle of the vibrator with the surface plane of the pavement should be small enough to prevent contact with the mesh reinforcement. The hand operated internal spud vibrator can be used to good advantage in consolidating the concrete at locations where the use of the finishing machine is restricted, such as connections to a bridge deck, around manholes, at transverse joint dowels assemblies or along forms. Honeycombed concrete is objectionable at these locations, and the proper and judicious use of a vibrator can help to secure thorough consolidation at these points.

(2) Slip Form Method. A slip form paver is a self-propelled machine with trailing forms which move with the paver. The following operations are done through the machine: laying and shaping, consolidating through vibrating and tamping, forming and controlling width, thickness, alignment and riding surfaces. These operations are all done simultaneously and continuously throughout the time the paver is in operation. The paver is controlled for alignment by the same stringline used for the trimming. The final depth of finished concrete is controlled by the top of the subgrade, making the checking of the subgrade one of the most important operations of the slip form paving.

p. Straightedging and Hand Floating. After the mechanical finishing is completed, but while the concrete is still plastic, minor irregularities and score marks may be removed with the straightedge and wasted over the forms. The straightedges should be rigid enough to scrape off high spots, if necessary, instead of merely riding over the surface. The straightedge shall be operated parallel to the pavement centerline starting at the center and progressing outward. Advancement shall be made in successive stages of not more than ½ the length of the straightedge. At the Contractor's option, this requirement may be waived when smoothness is to be determined by the profilograph. Straightedges should be periodically checked for trueness. Long handled floats may occasionally be necessary to close opened textured areas, but their use should be discouraged. If opened textured areas persist, it is an indication that deficiencies exist in the mix proportions and an effort should be made to correct it. Finishers must not be allowed to throw water on the surface of the pavement to make their work easier. Addition of water causes scaling and very rapid eroding of the surface under traffic. Very frequently, small air voids appear on the surface. In an effort to remove them, the surface is over-manipulated which is more detrimental to the concrete surface than the air voids.

(1) Tube Finisher. This machine consists of a metal hollow tube, and cannot be constructed out of aluminum; it may have a fog moisture bar attachment, and a burlap drag bar.

This machine is mounted on wheels capable of either manual or automatic steering by sensors, and is a self-propelled machine. This machine is guided from the same stringline as the other pieces in the paving train.

This machine acts as a large trowel and as a straight-edge.

Prior to lowering the tube upon the slab surface, it must be positioned at an angle across the slab.

When the tube has been positioned at the desired angle to the slab, it is then lowered while the machine is moving forward at moderate speed. This prevents marking the slab surface when the tube is lowered. Care should be taken when the tube is lowered for the initial pass over the slab, and a specific section of the slab should be completely worked before moving to a new section. The condition of the slab should be noted to determine the length of the section to be worked.

The slab must be finished while the surface grout is fluid enough to be moved over the slab by the tube.

Tube angle should be reversed each time machine direction is changed. The number of passes will depend on the initial condition of the slab surface. On the final pass in the forward direction, the burlap drag bar shall be lowered, and the tube placed at such an angle that the tube end extends approximately 6 inches over the edge of the slab. This permits any residue remaining on the slab surface to be discharged over the edge of the pavement.

The tube finisher may be operated with two 20 foot floating tubes for crowned surfaces. One tube is located forward of the other so that the tubes overlap approximately 2 feet at the center of the machine.

These tubes ride upon the surface of the slab under their own weight.

On the last forward pass, a burlap drag or other roughing material, (attached to the back of the tube float) will be lowered to apply the final finish prior to the transverse grooving operation as shown in the Contract Documents.

(2) Miscellaneous Items of concern.

(a) Hand Finishing. The only occasions that hand finishing methods may be employed are to complete finishing at the construction joint, when mechanical equipment breaks down, or when constructing irregular sections or narrow widths, where mechanical methods cannot be used.

Intersections and other irregular areas do not lend themselves to most types of mechanical equipment. To obtain proper thickness of the slab, adequate drainage, crown, etc., steel stakes should be set and graded to the surface of the slab at approximately 10 foot intervals on the control lines. Usually, these stakes are set on the center line, on radial lines and in the flow line of the gutters. Forms shall be properly staked, aligned and graded to the surface of the slab. From these forms and stakes, stringlines may be stretched, and these along with straightedges, may be used to prepare the subgrade, strike the concrete to the steel elevation and to finish the surface. Gutters should be checked with a straightedge and spirit level to make sure they drain, and the crown should be checked for flat spots which impair drainage or riding qualities. It is essential that the same degree of accuracy be obtained in the placement and finishing of concrete at these locations, as though machine methods were being used.

On narrow, regular sections, such as widening, short screeds should be constructed by the Contractor for cutting the fine grade, striking off the concrete at the mesh elevation, and for shaping the surface. These screeds should be pulled by hand or by a mechanical device. Longitudinal finishing may be done by hand. The accuracy and the steps in the construction of pavement in this manner should be the same as outlined for mechanical finishing.

(b) Joints. All expansion, contraction and longitudinal joints shall conform to the details shown on the plans for the joint required. Where alternate types are included in the design, the

Contractor may choose the type to be used. The joints shall be installed at the spacing and location shown in the Contract Documents.

For obvious reasons, the joints are the weakest part of the pavement as is evidenced by corner breaks, spalled joints, rough joints, etc. They are responsible for a large portion of the maintenance cost of concrete pavement. For these reasons, it is essential that the utmost care be taken in the installation of joints to see that they are properly installed, well consolidated, straightedged for riding qualities, edged, cleaned and filled.

(c) Expansion Joints. The expansion joint assembly was discussed previously, and the importance of its proper installation ahead of concreting operations was stressed. Care should be exercised in passing the finishing equipment over the joint, so that its various parts will remain in their exact position. Careful placing of the concrete is necessary around the joint to properly consolidate the concrete around the dowel bars and installation device and to eliminate honeycombing. The concrete around expansion joints shall be vibrated with an internal spud vibrator.

After the longitudinal finisher has passed over the joint, and when the concrete has stiffened sufficiently to prevent slumping, the concrete over the joint filler board shall be removed and the joint edged. The plans call for a relatively short radius on the edge of the joints. The Inspector should check the edgers to see that the proper radius is used. The longer the radius of the edger, the wider is the joint, and wide joints detract from the riding qualities of the pavement. If other types of expansion joints are specified or permitted, they shall receive the same careful attention and installation as the one herein discussed.

(d) Longitudinal Joints. Longitudinal joints shall be sawed, cleaned and sealed in the same manner as will be described for contraction joints. It will be necessary that the tie bars, when required, be securely staked to the subgrade in their proper position, by the use of bar chairs before the concrete is placed, or the bars may be placed in the fresh concrete mechanically. When bar chairs are used, they shall be stable and shall be oriented in a manner to achieve maximum bracing against the direction of machine travel.

(e) Contraction Joints. The location of all contraction joints shall be plainly marked in the fresh concrete after finishing operations are completed. No mesh shall extend through the contraction joints. When sawing the contraction joints, the Inspector’s chief concern is to be sure that they are cut at the proper angle to centerline, have the proper depth, are vertical and true to line, and are cut before premature, erratic cracking occurs. This will require close inspection, but with the use of abrasive blades, these joints may be cut early enough that uncontrolled erratic cracking will be prevented.

(f) Construction Joints. Construction joints shall be made perpendicular to the centerline of the pavement in accordance with the Contract Documents whenever paving operations are discontinued for the day or for any other reason. The joint shall be formed by placing a header board in a vertical position across the slab and finishing the concrete to the board, or at the option of the Contractor, may "pave by" the joint location and saw the construction joint when the concrete has hardened.

(g) Edge Curb. The back forms for edge curb constructed monolithically with concrete pavement, shall be of steel. They shall fasten securely to the pavement form, shall be of the proper dimension, and shall be brought to the proper alignment. The concrete shall be placed and consolidated, and then shaped with a steel tool to the section shown in the Contract Documents.

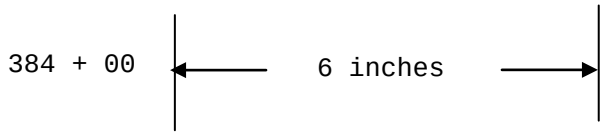
In order to obtain the best bond between the pavement and the curb, the forms should be set, and the edge curb constructed as soon as possible after the pavement finishing operations

have been completed. The pavement area to be covered shall be cleaned of all laitance and thoroughly roughened before placing the concrete for the curb. If the Inspector finds that the placing of the concrete for the monolithic curb is delayed excessively, a keyway should be constructed in the pavement at the front toe of the curb and vertical tie bars inserted in the pavement. This construction requires constant inspection to verify the maximum bond between the pavement and the curb.

The curb shall be shaped to its proper contour and finished with a steel trowel. The Inspector should closely check the lines being obtained by the finishers to obtain well-shaped curbs free from bulges, depressed tops and unsightly lines. After the curb has been finished, the glaze should be removed by lightly brushing the surface with a soft, damp brush.

(h) Stationing. Survey station numbers shall be marked in the pavement surface while the concrete is plastic. These station numbers shall be at 500 foot intervals, and shall be placed in a transverse position about 6 inches from the right edge of the pavement, as indicated in the following diagram:

FIGURE IV-3



Special dies are furnished for this purpose and are available through the District Office. An aligning device should be used so the marking will produce a neat appearance. Stakes shall be set at the even fifth and tenth stations throughout the project and the Construction Engineer's forces shall place the marker. This applies to all pavement projects.

q. Protection and Curing.

(1) Curing. Curing is essentially the process whereby the amount of water necessary for the proper hydration of the concrete is prevented from evaporating. It is an important element in the production of durable concrete. The hydration process continues for an indefinite time, but the critical period falls within 96 hours after placing. When concrete sets, it has many very small holes and channels which are filled with the mixing water. If it is kept moist, the water acts on the cement to form a jelly-like substance called "gel", which partly fills these holes and channels, and binds the pieces of aggregate together. Any delay in starting curing, especially in hot, dry, and/or windy weather, can cause surface cracking of the concrete. Curing will normally be accomplished by either the "Damp Burlap Cure" or the "Membrane Cure."

(a) Damp Burlap Cure. As soon as the finished pavement can be covered without detrimental marring, damp burlap shall be placed on the surface and kept saturated during the curing period as required by the Standard Specifications.

The correct time for covering can usually be determined by lightly touching the concrete surface with the finger tips. If the concrete sticks to the finger tips and a definite depression is made, the concrete is a little too fresh to cover. If, on touching the concrete lightly, the surface shows no depression of consequence and only a light stain of cement and dampness shows on the finger tips, the slab shall be covered immediately. The burlap should be damp when it is applied. Placing dry burlap on the surface would draw moisture from the concrete and defeat the purpose of its application. Damp burlap also is much easier to place while the wind is blowing. After the damp burlap has been placed, it should be kept wet for the entire specified curing period.

Because curing is of great importance in obtaining high quality concrete (both durable and strong), the Inspector should check this operation at least once an hour during the day.

Periodic checks should be made to determine if proper curing is maintained throughout the night, as it is possible that the burlap could dry out during the night. Periodic early morning checks would determine if adequate curing is maintained.

The curing must always take first priority. If there is not enough labor or enough water to take care of both the paving and the curing, the paving must be stopped until the curing is addressed. Arrangements must be made so that the curing is continued on holidays, or at any other time when paving is interrupted.

Methods are described in the Standard Specifications. In any case, the objective is to put as nearly an air-tight seal as possible over the exposed surfaces of the concrete, and to prevent the escape of water vapor. During the curing period, the concrete will gain strength rapidly if it is kept moist.

(b) Membrane Cure. See Section 154 of the Standard Specifications for equipment requirements. When membrane curing is used, the entire covering should completely seal in the water vapor. The membrane material contains a solvent which evaporates quickly, and the type used for highway work contains a white colored pigment. The white color reflects the rays of the sun and reduces heating of the concrete. This reflection lowers the curing temperature and helps to prevent the escape of water vapor.

Before paving operations start, the Inspector should calculate the coverage of membrane material from a 45 gallon drum (be sure to include the edges of slab in calculation).

The surface of the concrete should be moist, but free from standing water when the membrane material is applied. If the surface is too dry, the solvent will be absorbed, and a tight membrane will not be formed. Membrane material must be applied uniformly, and at the rate called for by the Standard Specifications. The area covered by each drum of material should be measured to make sure that the proper amount is being used. For highway work, the material usually is applied by mechanical spraying machines in one application. When a hand sprayer is permitted, the curing material shall be applied at the same rate as with the mechanical spraying machines.

Check all nozzles on the sprayer frequently, and maintain a uniform spray across the entire slab surface and vertical edges. This spraying operation can proceed as soon as the free moisture has left the slab. If the slab is left exposed to the elements too long before spraying with curing membrane, hairline cracks will develop. If this occurs, cracks must be closed with a wood float or other approved methods, prior to spraying the curing membrane.

The white pigment in the curing compound remains in suspension for a relatively short time. To obtain a uniform coating of the desired reflecting qualities is provided, the material must be thoroughly agitated just prior to use and kept agitated during its application. When applied at the specified rate, the surface should present a uniformly white appearance without alternately light and dark bands. Frequent checks should be made to verify that the rate of application and coverage is satisfactory.

In any case, the membrane material must be applied evenly, and must form a continuous film that leaves no part of the concrete exposed. Apply the compound in 1 application at a minimum rate of 1 gallon per 150 square feet of surface. The sides of the slabs shall be sprayed with hand sprayers as soon as the forms have been removed and any honeycomb areas repaired. Care must be taken to cover the entire area.

After a satisfactory coating of membrane has been applied, it must be protected. Walking on the membrane, operating equipment on it, or doing anything else that might scrape or wear off the membrane, will break the film and let water vapor escape. Any area where the membrane has

been damaged by rain, has been scuffed off or has pinholes, must be resprayed. A continuous film must be maintained at all times.

During the curing and aging period, traffic will not be permitted on the pavement, except as necessary for sawing the joints. Areas of the membrane disturbed during joint sawing operations, must be resprayed immediately.

r. Cold Weather Protection. Heat hastens and cold delays the hardening and strength gain of concrete. Therefore, Division 400 of the Standard Specifications stipulates the weather limitations. To protect and cure the concrete, an approved moisture barrier must first be placed in intimate contact with the surface of the concrete. On top of the moisture barrier, a blanketing material, such as straw, should be placed as an insulation to maintain temperature or higher as required by the Standard Specifications. The Inspector must make regular checks of the temperature of the concrete as measured on the surface to ascertain that proper curing temperatures are being maintained.

If it becomes necessary reasons to continue paving operations when air temperatures are below the specified minimum, and written permission has been obtained, the provisions of the Standard Specifications cover the procedure in detail. The Construction Engineer shall see that the materials are heated correctly, and that the desired temperature of the concrete is rigidly controlled and maintained throughout the curing period.

s. Final Stages.

(1) Removal of Forms. The Standard Specifications require the side forms remain in place at least 12 hours after the concrete has been placed. The forms protect the green concrete and prevent the escape of moisture from the edges of the pavement during the important first part of the curing period. Form pins should not be removed, and forms should not be "loosened" until the end of the specified period.

When the forms are being removed, care must be taken to never pry against the slab or to throw pins, or sections of the forms, onto the new concrete. Form pins should be pulled with equipment that works outside the forms and does not put pressure on the edges of the slab. If forms have been properly cleaned and oiled, they should be easy to remove. In all cases, the forms must be pulled away from the edge of the slab without prying against the concrete.

(2) Surface Trueness. The smoothness of the pavement will be determined by using a 10 foot straightedge or by the profilograph test. Requirements for Pavement Trueness are described in Division 500 of the Standard Specifications.

Any rough areas of pavement that do not comply with specification tolerances, shall be corrected by the Contractor. Grinding or removal and replacement may be required to correct deficiencies.

(3) Joint Sawing. All joints shall be wet sawed and constructed as shown in the Contract Documents. Sawing of the joints shall be accomplished in two stages. The first stage shall be a relief cut approximately ⅛ inch wide and to the full joint depth at the proper location. Alternate methods for the first stage sawing are listed in the Standard Specifications. The second stage is widening of the relief joints. Contraction joints are to be sawed to the depth required for the full width of the slab in one continuous pass.

Longitudinal joints shall be sawed in as continuous an operation as practicable. A re-start usually causes irregularities in the saw cut.

Immediately after sawing the joint, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure, and by the use of other tools as necessary.

(4) Sealing Joints. Check Contract Documents and specifications for correct procedures and to determine if joints are to be sealed. Joints, sawed or formed, must be clean and the surface dry at the time of sealing. Sealing of joints with approved material, should be done prior to opening to any traffic.

Immediately prior to sealing, all joints are to be thoroughly cleaned and filled with approved material in accordance with the Contract Documents. It is extremely essential that the joints be clean and dry prior to filling.

(a) Poured Joint. If heated joint-sealing material is used, it shall be agitated to avoid localized overheating, and the temperature continually checked to verify compliance with manufacturer's recommended temperatures. Pouring of joints shall be done in such a manner that the material will not be spilled on the exposed surface of the concrete.

Artificial heating is prohibited, if cold-poured joint compound is used. Field heating of this material will cause serious damage. Difficulty in handling this material because of too low a temperature is encountered only in the late fall and early spring. In case higher pouring temperatures are required, the material should be placed in a heated storage room and delivered to the project as needed.

(b) Preformed Elastomeric Compression Joint seals. These are to be installed according to the Contract Documents and Manufacturer's instructions.

(c) Pressure Relief Joints. Openings for the joint material should be formed or sawed as shown on the plans. The lubricant adhesive shall be used as recommended by the manufacturer.

Immediately prior to installation of the joint material, the joint shall be cleaned by sandblasting followed by an air blast to clean the joint faces.

The Engineer may approve pre-positioning of the 2 inch material if adequate means are taken to obtain proper placement and retention, and if deformation of the material does not occur when the fresh concrete is placed against it.

The Contractor will use a foam spacer block beneath the 4 inch joint filler material to maintain the grade shown on the plans. The spacer block will be an easily compressed foam material shown on the plans and cut to fill the void beneath the joint filler as shown on the plans.

4.06.07 CORING PORTLAND CEMENT CONCRETE PAVEMENT OR BASE COURSE

Coring of newly constructed concrete pavement is required to determine that the construction conforms to the specified thickness. When possible, the coring should be complete prior to the opening of traffic. If KDOT is to do the coring, the District Construction and Materials/Assistant District Engineer should be notified that the project will be ready for coring approximately 2 weeks before the completion of the project.

On projects where the Contractor is to core the pavement, make arrangements to complete the coring prior to opening to traffic.

All cores shall be submitted to the Materials and Research Center.

4.07 FLEXIBLE PAVEMENT

4.07.01 HOT MIX ASPHALT (HMA)

a. General. Hot mix asphalt (HMA) is also known as plant mix, and asphalt mix. HMA is most often used to overlay existing roadways. It can also be used to construct a new section of

pavement. HMA is generally placed in lifts of 1 to 4 inches thick. It can be used on both low and high volume traffic routes.

The primary ingredients in HMA are the aggregates, which comprise approximately 95% of the mix by weight and the asphalt binder, which is the glue that holds the mix together. Typical aggregates used in Kansas are crushed limestone, crushed gravels, sand, sand-gravels, quartzite, chat, limestone screenings, manufactured sand, granite, and crushed steel slag. Some mixes may incorporate mineral fillers such as cement, lime, volcanic ash, fly ash, and silt.

The asphalt binders are typically designated as performance graded binders. The binder name includes a temperature range in which they are expected to function. For instance a PG 64-22 should perform at temperatures between 64°C and -22°C (147°F and -8°F).

In addition to aggregates and asphalt binders, a few other materials may be used in a mix. The most common is Reclaimed Asphalt Pavement (RAP). Recycled Asphalt Singles (RAS) can also be added to a mix. In certain mixes such as a Stone Mastic Asphalt (SMA), fibers may be added to the mix. A couple of materials that may be added to the asphalt binder include an anti-strip agent and a warm mix additive. When a warm mix additive is added to a binder, the general name is changed from Hot Mix Asphalt (HMA) to Warm Mix Asphalt (WMA).

Aggregates used in a mix must have an Official Quality (OFQ) showing that the aggregates meet Division 1100. The asphalt binder used in the mix must be on the prequalified list (PQL). PQL 4.1 is the current list for asphalt materials.

Other mixes used by KDOT include ultrathin bonded asphalt surface (UBAS) and reflective crack interlayer (RCI). The UBAS is exclusively used as a surface course with a nominal thickness of 5/8 to ¾ inch. The RCI is placed directly on a concrete pavement with a nominal thickness of 1 inch. This mix will always have additional HMA lifts above it.

b. Mix Design. The Mix design process is detailed in Division 600. The Contractor must submit a mix design to the District Lab at least 10 working days prior to production. When the District Construction and Materials/Assistant District Engineer approves the mix design, copies are sent to both the Construction Office and the Contractor. Only material components on the mix design may be used in the mix, unless specifically approved by the District Construction and Materials/Assistant District Engineer.

c. HMA Plant Operations. In order to combine the aggregates with the asphalt binder into a usable paving material, the mix must be produced between temperatures of 280°F to 340°F so that the asphalt binder can properly coat the aggregates. Note that WMA may be produced at lower temperatures. In addition, the aggregates must be dry prior to being mixed with the asphalt binder or the binder will not adhere to the aggregates.

This drying of the aggregates and the subsequent mixing with the asphalt binder is accomplished in a Drum Mix Plant (Division 150). The drum will also have a collar where the RAP is added. The Contractor is required to provide and calibrate a HMA plant that meets Division 150 to the satisfaction of Inspector. Checklists are available to verify the calibration of the plant.

Aggregates are stockpiled at the plant. Verify that only material approved for use in the mix design are designated for the mix being made. Aggregate OFQ's pertain to the Producer ID as well as the ledge from which it was mined. If unsure if the stockpiled aggregate is the correct material, contact the District Construction and Materials/Assistant District Engineer. Delivery vehicles and loaders should never drive onto stockpiles. If the stockpile is contaminated with mud, etc., reject the material until the contamination is removed.

The Plant Inspector should verify that the percentage of components going into the mix correlate with the current job mix formula (JMF). The Contractor may make adjustments to the JMF during production in order to meet the volumetric properties. The Contractor must inform the Inspector of changes to the JMF prior to making the change.

Although many aspects of the plant operation must function correctly to produce a satisfactory mix, one common problem in HMA is excessive mud balls on the road. When this is reported, the source of the contamination must be identified and addressed. Often a smaller scalping screen is required to remove mud balls. Other times, the flights inside the drum need to be cleaned by the Contractor. In other cases the stockpile is too contaminated and will need to be reprocessed to remove the contamination.

d. Laydown Operations.

(1) Make sure the Contractor cleans the roadway, usually by brooming. HMA will not bond to the underlying pavement if the surface is not cleaned.

(2) Unless a spray paver is being used to place the HMA, a tack coat (emulsified asphalt) is first applied to the roadway. Verify the rate at which the tack is placed and do not permit paving on the roadway until the tack has broken (turned black). This is the point where the water in the emulsified asphalt has evaporated. The cooler the temperatures, the longer it will take for the tack to break.

(3) Most mixes require the use of a material transfer device. This machine remixes the HMA prior to being placed in the paver. This is one of KDOT's best defenses against segregation. Segregation is where fine aggregates or coarse aggregates conglomerate in a section of the roadway resulting in a mix that is susceptible to moisture related damage. An excellent document for identifying points where segregation most often occurs is technical advisory 603.02 located at:

https://dmsweb01.ksdot.org/idmws/doccontent.dll?Library=PublicDocs^dt00mx38&ID=003693259

(4) The Paver. Keep it moving. When the paver is operated at a fast speed for a few minutes and then forced to wait for trucks, the working parts of the paver cool-off and the remaining mix in the machine becomes stiff, and related problems arise. When the paver resumes operation with the next load of material, all of the resisting forces have increased, and the paver must overcome these forces before it can settle down to a smooth spread again. An intermittent operation will cause the mix trucks to bunch up at the plant. This results in erratic operation at the plant as well as the paver. To minimize such disorderly operations, it is necessary for the paver to be operated at a speed in balance with the plant production. It is true that all stops cannot be avoided, however when plant and paver output are in balance, a large portion of the interruptions are eliminated and stops are held to a minimum.

Keep the augers running continuously. Adjust the speed of the augers so the flow of material is slow, reducing the potential from segregation. Fast moving augers often cause deficient material in the center of the mat resulting in a crack in the center of the mat within a couple of years.

Preheat the screed to prevent tearing of the mat.

The screed vibrators should be turned on. Eighty-five percent of the compaction of a mix can occur at the screed provided the vibrators are turned on.

(5) Rolling Operations. Rolling patterns are initially evaluated with 3 rollers. If plant is operating at 275 tons per hour or more, then 4 rollers are required for initial evaluation.

Temperature of the mat is key to obtaining density.

Do not crush the aggregate.

Only static rollers are permitted when the mat reaches 175°F (165°F if using WMA)

Rollers should be operated with frequencies turned up and amplitude turned down. Division 150 provides a chart for the speed of vibratory rollers given the frequency of the vibrators. Increased speeds must be accompanied by increased vibrator frequency to provide not less than 10 impacts per lineal foot.

(6) Density Checks using the nuclear density gauge:

- Used for density pay adjustment on the roadway;
- Used for joint density checks;
- Used for segregation profile checks.

e. Miscellaneous. Haul trucks should be discussed in regard to the number to be used, size of each, covering to be provided, method of cleaning and need for insulation when low temperatures and long hauls are expected. The use of petroleum derivatives for coating the truck beds is prohibited. Division 150 of the Standard Specifications explains the requirements for hauling equipment.

The spreading operation should be discussed in great detail. The Contract Documents' construction requirements for each type of pavement should be familiar to both Contractor and KDOT personnel. The laydown requirements for all kinds of mixtures are similar, and are discussed in Division 600 of the Standard Specifications. There should be an understanding as to the temperatures at which spreading will not be permitted. Temperature, both air and road surface and weather limitations are discussed in Division 600 of the Standard Specifications. All rolling shall be achieved before the asphalt mixture cools to the specified temperature. The number of lifts in which the pavement is to be constructed should be discussed so as to stay within the requirements of the Contract Documents.

The offset of the longitudinal joint between successive lifts should be discussed and understood. The construction joints are discussed in Division 600 of the Standard Specifications.

The method by which the mix is weighed for payment should be discussed. The Standard Specifications provide for payment of aggregate by the wet ton.

The procedure in rejecting a batch or load of mixture should be discussed. The relationship between operators and inspectors will remain at a high level if this detail is discussed and understood beforehand.

Any widening operation shown in the Contract Documents should be discussed to account for the handling of traffic. Widening should be placed well ahead of the paving operation to allow ample time for sufficient rolling and time for cooling.

4.07.02 ASPHALT PAVEMENT SMOOTHNESS

a. Equipment. Refer to PQL 44.

- Requires annual calibration through Bureau of Research
- California type profilograph
  - Truss type systems
  - Pushed along pavement
- Inertial Profilers
  - High Speed – Usually a van
  - Lightweight – Utility vehicle

b. Procedure for Contractors.

- Follow KT-46.
  - Segments are 0.1 mile for each lane.
- May use 10-foot straightedge.
- If asphalt smoothness pay adjustment, then profile within 24 hours of final rolling.
- If no asphalt smoothness pay adjustment, then profile within 72 hours of final rolling.

c. Corrective actions.

- Diamond grind final surface.
- Micro-milling, if next layer is an asphalt seal or microsurfacing.
- Milling, if layer is covered by another action.
- Corrective measure is full lane width.

4.07.03 COLD RECYCLED ASPHALT CONSTRUCTION (CIR)

a. General. This work consists of in-place recycling of reclaimed asphalt pavement (RAP) by milling, sizing of RAP, adding additive(s), mixing, laydown and compaction of the reclaimed mixture. The primary benefit is to arrest the transverse cracking so that they do not reflect into the new overlay. The CIR layer is a pavement base course and must have sufficient HMA above it to protect the layer from rutting due to truck traffic. The cold recycle train is pulled by a large rotomill which mills 3 or 4 inches deep by 12.5 feet or more width in one pass. The rate of production averages about 2 lane-miles per day.

The cold recycle train consists of a double deck screen and crusher, with all oversize material being continuously rerun until it goes through the proper size screen, and a pug-mill where a liquid additive is added by weight derived from belt scales electronically connected to a computer and a positive displacement variable speed additive pump.

The mix is then deposited in a windrow behind the train where it is picked up by a windrow pickup machine on the front of a conventional asphalt paver which lays the mixture. Irregular windrows require that some mix be moved before it is loaded into the paver hopper, unless the hopper is of sufficient capacity, and the amount of mix in the hopper is adequate to accommodate the irregularities. This may require that the paver be stopped temporarily, while a loader or other equipment is used to even the windrow. The equipment shall be available at all times to be used as specified.

Compaction is by both pneumatic and steel rollers.

b. Materials. The sized RAP may be combined with a variety of materials including emulsified asphalt, rejuvenating agents, water, lime and/or aggregate. The liquid or slurry materials are added at the front of the pug-mill while the aggregates are usually placed in a sized windrow on the pavement ahead of the milling machine and mixed with the RAP at the time of milling.

c. Design. The mix design procedures for CIR are found in Part V of the Construction Manual, Section 5.3.4. The Contractor is required to obtain cores from the roadway and meet the design requirements.

The District Construction and Materials/Assistant District Engineer must approve the mix design prior to the start of the project.

d. Pre-work conference. The following items should be discussed in detail at a pre-work conference so the Contractor knows what you expect, and you fully understand and approve of the Contractors methods:

(1) Milling and mixing. A uniform windrow is important to obtaining a smooth laydown. The windrow size is a function of the cross-sectional area being milled. The most uniform windrow and smoothest laydown is obtained by milling a uniform depth the full width of the milling machine and letting the milled cross slope vary.

Water is added at the milling head for cooling purposes, however, it also aids in mixing and compacting. The amount of water is normally controlled by the rotomill operator; however, it can also be controlled by a person on the ground. It has no precision control and very seldom needs to be a concern, except to be sure it is turned off immediately when the milling machine is stopped to avoid saturating the RAP and causing an unstable spot in the cold recycled pavement. Normally, the amount of water at laydown is 2 to 4% except when using flyash, then extra water will be required, usually in the 10 to 12% range.

When the weather is clear and hot, and the temperature of the mix behind the pugmill reaches the softening point of the asphalt on the RAP (usually between 104°F and 115°F) the mixture becomes very sticky. This usually occurs in the late afternoon and can be helped by adding more water and keeping the paver close behind the recycle train. It can become so sticky that the pickup attachment and paver cannot handle the mix. When this happens, the operation must be shut down for the day, and the mix should be laid with a motorgrader before nightfall. The next morning, the area can be remilled and put through the train with very little or no additional additive, and laid in the normal manner with the paver.

Asphalt emulsion is normally added at a rate between 2.0% and 3.0%. Lime (either hydrated or pebble quick) is added for stability usually at a typical rate of 1.5%. It is possible to visually estimate the correct additive content, if the Inspector has had previous training and experience with cold recycling. Similar to hot mix, too much asphalt will result in rutting of the pavement, so if the amount of emulsion is incorrect, it is better to error on the lean side than too rich. The lime can also be adjusted to increase the stability of the CIR.

(2) Paving. The distance between the train and paver should be kept to the minimum distance that will allow the paver operator to anticipate any windrow size changes. Excessive distance between the paver and train allows the windrow to settle and dry on the outside, allows more potential for rain damage, and in the case of a paver breakdown, creates a situation where the mix will need to be laid by any reasonable means to allow traffic on the road overnight. A maximum reasonable distance should be established, and the train stopped if it reaches or exceeds that distance. A suggested rule of thumb is 500 feet; however, project specific conditions dictate that the distance should be established by the Inspector. If rain is eminent, the distance should be decreased to the absolute minimum possible.

Segregation is undesirable and is difficult to eliminate. The segregation can be lessened by one or all of the following methods:

- Changing the position of baffles below the pug-mill outlet.
- Adding baffles if there are none.
- Changing the depth of the mix around the paver augers.
- Changing the depth of feed from the hopper.
- Changing the distance between the augers and the front of the screed.

One operation that is almost certain to cause segregation is to run the hopper from near full down, to near empty, which causes the coarse pieces of RAP near the sides of the hopper to be fed to the screed at one time.

Proper crown and cross slope should be maintained by the paver screed even though the depth of the mix may not be uniform from side to side. The screed vibrator shall be used as specified. If the screed is pulling and causing a non-uniform surface, adding more water at the milling head will help. Decreasing the distance between the auger and front of the screed may also help. The shorter the distance between the train and paver, the less water will be evaporated resulting in better mix workability.

(3) Compaction and density. Contract Documents require the use of a minimum of one double drum vibratory steel roller and one pneumatic tired roller. The vibratory roller may be used in the static mode.

The mix temperature at the time of compaction has a great influence on the density which can be obtained. It is extremely advantageous to have the mix temperature higher than the specified minimum, when obtaining the minimum density. The best possible condition to obtain the highest density is in the mid to late afternoon on a clear, warm day. As a general rule, the mix temperature will exceed the mid-afternoon ambient temperature by approximately (15°F to 20 °F under these conditions. Due to the large number of passes required and depending on the skill of the roller operators, it may take up to 3 days to obtain the target density. The number of passes over the same spot may be up to 15 for the pneumatic and 10 for the steel vibratory. The pneumatic roller is to be used for breakdown. The steel roller may precede the pneumatic roller, provided the minimum density is attained. Determination of the density will be by nuclear meter in accordance with the latest Kansas Test Methods. The rate of turnout at the end of each pass should be very gradual to prevent ridges. These ridges are very difficult and in some cases impossible to remove.

(4) Traffic Control. The physical size of the train necessitates traffic control at intersections with other routes and railroads. Railroad schedules must be obtained and notice given prior to crossing railroad tracks. When the project is on a 2 lane road with no or very narrow shoulders, the Bureau of Transportation Safety and Technology should be notified prior to beginning the work and requested to restrict over-width loads on that particular route, during the project.

(5) Miscellaneous. The surface of cold recycle is more likely to allow water to enter prior to having traffic on the surface; however, it will usually take some moisture any time prior to being sealed or overlaid. The specification requires the CIR material have 2.0% moisture prior to a subsequent course being laid; however, this does not take into account that porous aggregate in the original pavement will have absorption. Satisfactory results have been obtained by interpreting the 2.0% moisture content of the recycled mixture as the difference between the moisture before milling and the recycled pavement at lay down; thus not taking into account any absorption of the aggregate. The time necessary for the moisture to return to below 2.0% may vary from 1 to 10 days depending on weather conditions.

The additive pump should be calibrated on the first project of the season. Thereafter, the accuracy can be verified by contacting KDOT personnel from the previous project. On-the-job checks should be made on each tanker load. Rough checks can be made by comparing the indicated amount of additive with that calculated from the theoretical volume of existing pavement each 500 feet. A daily check should be made of the belt scale accuracy each morning preceding use. The electronic digital readouts vary by manufacturer, so it is important that the Inspector asks for an explanation from Contractor personnel and/or review the operator's manual.

4.07.04 SURFACE RECYCLED ASPHALT CONSTRUCTION

This work consists of in-place recycling by heating the existing pavement, scarifying and/or hot milling the existing surface, adding a rejuvenating agent, mixing, spreading, leveling and compacting the recycled material. The primary benefit is to remove cracks and other surface defects while restoring flexibility to the asphalt material.

The HIR layer is predominantly a pavement base course with a seal or a HMA overlay placed above it. The depth of the HIR is typically between 1 and 2 inches. The deeper the HIR, the more heaters are required to heat the existing pavement. A 1-inch SR can be accomplished using a single mill or scarifier unit. When more than 1 inch of depth is required, each mill can remove a maximum of ¾ inch. Thus, a 2-inch SR will require 3 milling units. The rate of production averages about 3 lane-miles per day.

The HIR train consists of several heater units with milling units placed behind specific heaters to remove the existing pavement. Each time the material is hot milled, a method must be employed by the Contractor to provide heat to the next section of roadway without overheating the material already removed from the roadway. This is most frequently accomplished by using a tunnel heater that shields the windrowed material from the heat source to avoid overheating of the already milled material. When the final lift of material is hot milled from the roadway, the rejuvenating agent is added uniformly to the material usually through a pug mill, but may also be added to the final milling heads provided a uniform product is obtained. The material is then placed by an asphalt paver.

Temperature, depth, density, and cross slope are the four predominant properties that the Inspector must monitor to obtain a quality product. Of course several other items of interest include the speed of the HIR train, the amount of asphalt rejuvenating agent being applied to the mix, the depth of each mill, the proximity of each heater/heater-miller unit to each as well as to the paver. Material that is allowed to cool or material that gets overheated (over 500°F) is detrimental to the HIR process. Make sure you have a temperature gun to monitor the temperature. You will also need a level to verify the cross slope of the road.

Temperature should be checked behind the screed for both uniformity throughout the width of the screed as well as maintaining a temperature between 190ºF and 300ºF. A minimum of two steel wheeled rollers are required to obtain density prior to the mat cooling to 160°F.

Density is checked with a nuclear density gauge and is compared with the maximum density obtained from the initial approved rolling procedure.

Depth is checked by methods described in KT-47. The rod and level is the most common and most accurate method for determining depth. The stab stick may be used as a quick check once it's been calibrated to the rod and level, but unless the stab stick is engraved with depth marks, we can only determine if the depth meets or does not meet specifications. The weigh method will also work; however, this method must be calibrated to the rod and level at least twice a day.

When using a rod and level, take 5 shots across the width of the roadway. Take the shots before and after the HIR train has passed that section. Remove the loose material down to the existing roadbed for the second set of readings at the same location where the first set of readings were taken. The difference in heights between the first and second readings is the depth of cut for the HIR. Average these depths for the depth for that test.

4.07.05 MICROSURFACING

a. General. This work shall consist of the application of microsurfacing to an existing surface. The microsurfacing shall consist of a mixture of modified emulsified asphalt, mineral

aggregate, mineral filler and additives, properly proportioned, mixed and spread on the existing surface in accordance with the Contract Documents and as directed by the Engineer.

b. Equipment. Apart from the slurry machine, only a small amount of supporting equipment is required for a complete microsurfacing project. Usually a sweeper front-end loader combination, water truck, asphalt tanker, nurse trucks and various hand tools are all that are necessary. Occasionally, a roller may be required for some special applications.

(1) Microsurfacing Machine. Microsurfacing Machines are equipped to carry all materials necessary for producing asphalt microsurfacing on the job site, and to mix the different ingredients proportionally in a special mixer. The finished slurry is discharged into a spreader box that spreads the slurry on the pavement as the box is pulled behind the slurry machine. The machine shall be operated continuously while loading to eliminate unnecessary construction joints.

All machines have separate water and emulsion tanks, and the size of these tanks varies with the machine. The tanks can be filled through hatches on top of the equipment and through bottom loading attachments. The emulsion tank should be inspected regularly to prevent excess build-up of asphalt. The screen in the bottom of the tank should be inspected to prevent hardened asphalt from accumulating and entering the lines. All water lines, filters and screens should be kept clean. The emulsion tank should be filled from the bottom in order to minimize foaming and/or disturbing any hardened asphalt materials which may be in the tank.

The aggregate is fed from the bin by a belt or auger system through a controlled gate opening. The bin is generally charged with any standard front-end loader.

The mixer should be cleaned after each day's operation. The Inspector should make certain the mixer is clean before use, and should also examine the mixing compartment and blades to verify there is no excessive wear which would cause poor mixing.

(2) Spreader Box. The spreader box is designed to apply the slurry evenly over the pavement. The box has steel front and side parts, and either a steel or flexible squeegee screed. The slurry is fed directly from the mixer to the box.

The box is usually extendible from 8 to 13 feet at any desired increment. It is raised into a carry position by means of electric, hydraulic or hand controls depending on the machine. Lateral movement is made by hand or hydraulic controls. The box should be hinged in the center to allow for crown adjustment.

Located on the rear squeegee are adjustment screws which help control the thickness of the slurry. The thickness of the slurry is chiefly governed by the maximum size aggregate being used, the consistency of the mix, and surface texture of the old pavement.

The spreader should be kept reasonably clean while in use, and thoroughly cleaned after each day's operation. Any material left on the spreader can cause a poor quality product and an unsightly appearance in the final pavement.

The machine moves as fast as the slurry can be produced and placed. If the slurry becomes low in the box, the operator signals the driver to slow down until the rate of production can catch up to the spreading rate. This usually takes some adjustment at the start of each new project, but as time progresses the rate of speed and the rate of production become uniform.

c. Materials.

(1) Aggregate: The Project Manager is responsible for seeing that aggregate for acceptance tests is sampled at the point of usage and that proper test reports are on hand prior to starting the work and that the aggregate is as called for in the Contract Documents.

(2) Mineral Filler: This material will be as specified by the Contract Documents.

(3) Emulsified Asphalt: A mixture of water, asphalt and an emulsifier is referred to as emulsified asphalt. In this process the emulsifier is the agent that permits the mixing of 2 normally immiscible materials.

(4) Water: Water is the major factor in controlling the consistency of the finished product. By weight, it normally composes from 4 to 12 % of the dry aggregate. A set amount of aggregate and a set amount of asphalt emulsion are introduced into the slurry machine mixer. To obtain the proper working consistency of the finished product, the water is increased or decreased. The water coats the aggregate particles before the emulsion does, thus reducing the frictional resistance of the aggregate and allowing the emulsion to more easily coat the aggregate particles. Water shall meet the requirements of Division 2400 of the Standard Specifications.

d. Construction.

(1) Surface Preparation: Prior to application of the slurry, the entire surface will be cleaned of all foreign materials. Following the cleaning and immediately prior to the application of the slurry, the surface should be given a light application of water. This application must be uniform and light enough that it does not cause puddles of water to stand on the pavement surface. In the event that small depressions do result in surface puddles, these wet areas should be hand broomed or squeegeed to remove the excess water.

(2) Slurry Placement: It is very important in the actual laying procedure for the Inspector to keep a close watch on the spreader box itself. The homogeneous slurry should roll in one continuous mass. The "roll" will ordinarily be about 12 inches wide. The operator keeps the box in the desired lateral position by hand or hydraulic controls. It is, of course, the responsibility of the driver to drive as straight a line as possible. This is accomplished by a chain that is attached to the front bumper of the truck, and allows the driver to know the approximate location of the edge of the box. Make sure any ruts or depressions are filled prior to placing the final surface.

When coming to the end of a pass, the operator should cut the machine off in order to have as little slurry left in the mixer as possible, and none left in the spreader. This, of course, is a judgment factor and depends on a good operator. The operator should cut off the materials for making the slurry in the same order that they were turned on. The slurry should be evenly distributed over the box, clear to the end of the pass. At times, this may require extra help from someone. If slurry is left in the mixer, the operator should cut the mixer off as soon as possible to prevent over-mixing. If slurry is left in the spreader box, the operator should be sure that there are people to handle the slurry when the spreader box is raised. At the end of the pass, the operator cuts off the spray bars and raises the spreader into a carry position. It is very important that anytime the operator stops the truck, the spray bars are cut off, and just as important that they be restarted when the operation proceeds.

(3) Handwork: Another important part of the slurry operation is handwork. Good handwork is just one of the many things that can make what would have been a satisfactory job a superior job. Handwork can look as good as work done by the machine if it is done properly. It is best to do as much handwork ahead of the machine as possible. This is particularly true in those areas which require a great amount of handwork. Sometimes, slurry is left in a pile for handwork to be done, while the machine is laying close by.

The best way to tell if the slurry is in a homogeneous mass is by handwork. This is because the slurry is hard to move around with a hand squeegee, if settling or separation has taken place. Normally, 24 to 36 inch rubber hand squeegees are used. Generally, a burlap drag is used after the hand squeegee as a finishing tool. The person operating the squeegee should

rapidly move the slurry in place. The area should have been previously dampened with the hand hose of the slurry machine.

e. Joints. In this work, as in all asphalt sealing, the work should be conducted in such a manner that all lane widths and longitudinal joints will conform to the existing traffic lanes.

(1) Transverse Joints: One of the most important operations in getting a good seal and appearance on a job is by making a good joint. Transverse joints are just as important as longitudinal joints, but oftentimes do not receive as much attention due to their short length. When the machine runs out of material, the operator will open the mixer gate, completely emptying the mixer. The slurry is spread out over the pavement, and it does not have to come out in a straight line, since the new pass will start over it. However, since some of this slurry may have been in the mixer for some time, it could be over-mixed. It is advisable that in making the new joint, the driver back the machine 10 to 15 feet prior to continuing the pass.

There are normally two ideal times for making a joint. One is when the slurry is still in a completely uncured, semi-fluid condition. The other is when the slurry is completely cured. The time between these two periods is when the most trouble develops as most of the water is out of the emulsion, but the asphalt is still not firmly attached to the aggregate. In this state, the slurry can be easily scarred by any type of heavy object that may run over it, leaving a poor appearance. If this is the case, the operator should lightly wet the area that the spreader will touch by using the hand hose, and then start the procedure as previously described in the actual laying operation.

(2) Longitudinal Joints. Longitudinal joints are much more critical, especially to the eye, than the transverse joints. This is because of the very nature of their length along the pavement. As mentioned in the preceding paragraph, the ideal time to make any joint is either when the microsurfacing is completely uncured or when it is totally cured. If it is in the intermediate state, the spray bars and sometimes hand hose should be used to help semi-wet the joint as the box is being dragged over it. Also, in this case, the use of a drag is often helpful. The drag (burlap or some form of carpeting) is pulled along the joint seam and will cause the fresh slurry from the spreader box to evenly distribute itself over the joint. The joint can be just as good as a Contractor wants it to be, or just as bad as the Inspector allows it to be.

(3) Curing: There are several factors that are involved in the curing of slurry. For anionic type slurry, the water must evaporate from the surface before the slurry is cured. This depends on several factors, one of which is the thickness of the slurry. The thicker the slurry is, the longer the curing period. It is also characteristic of an anionic type emulsion to cure from the top downwards. Thus, a crust can form on the surface and give a cured appearance, while the slurry underneath will not be cured. The Inspector should watch for this type of scumming, and not allow any traffic over the surface until the microsurfacing is completely cured.

For a cationic type slurry, the break of the slurry is chiefly by chemical reaction, although the above mentioned factors would still have some bearing on the curing. The cationic emulsion normally breaks from the bottom of the pavement up, and therefore, does not give a false break. Here again, be sure that the slurry is completely cured before the area is opened to traffic.

Another variable factor of slurry curing is climatic conditions, the most important factor being the wind. Wind moving hot air gives a favorable curing condition, and wind moving hot, dry air affords the best.

Normal curing periods range anywhere from ½ to 6 hours, but the average is from 2 to 4 hours. In any case, the application of the slurry seal shall be suspended early enough each day to permit traffic to safely travel over the completed work before sunset.

f. Special Problems. The following are considered special problems for various slurry applications.

(1) Over-mixing. As previously discussed, one of the main objectives of the continuous mix slurry machine is to proportion, mix and lay the slurry in rapid order. The slurry is over-mixed when the asphalt attaches itself to the aggregate but does not readily attach the slurry to the old surface. Over-mixing can occur in a continuous mix machine, if at the end of a pass the operator fails to shut the mixer off while slurry is still inside. Over-mixing traps air into the system. This, along with over-beating the asphalt emulsion, causes a puffy malt-like appearance. The slurry also loses its luster and will oftentimes leave a discolored spot on the pavement. Constantly be on the watch for over-mixing, because over-mixed slurry, with special handling, can be satisfactorily placed on the pavement.

(2) Lumps in the Mix. At times, a ball of aggregate will go through the mixer and not break-down before reaching the spreader box. This is especially true if the aggregate has a high percentage of clay-like particles. These particles tend to ball up in lumps when they become wet, and oftentimes will pass through the mixer unmixed. The best way to eliminate lumps in the slurry is to control the aggregates. Normally, the material will not have clay balls: however, if the amount of clay is minor, and if the aggregate must be used, there are several ways to eliminate this condition. First, reduce the size of the mixer gate opening. The gate of the mixer controls the mixing time of the slurry. If the mixer gate is open wide, the mixing time is less, and if it has a smaller opening the mixing time is more. Therefore, to increase the mixing time and break up the lumps, the gate opening should be smaller. Another method being used is placing a ½ inch screen over the spreader box where the slurry passes from the diverter through the screen and into the box. The screen will catch the lumps which can be later removed. If the lumps are left in the spreader box, they will pass out under the back squeegee, leaving streaks in the finished slurry and a discolored surface.

(3) Oversized Aggregate. The best way to prevent oversized aggregate in slurry is to be sure the material does not contain any. This is much easier said than done, since many times the loader will accidentally dig too deep in the stockpile and pick up some of the existing material that was already on the ground. This condition can be overcome by locating the stockpile on a paved surface or in an area where the loader will not pick up foreign material. Oversized aggregate will pass through the mixer, and in turn through the spreader box, but will catch under the back squeegee and leave streaks in the pavement. This situation can often be overcome by placing a ½ to ¾ inch screen over the spreader box where the slurry from the mixer passes through the screen before entering the spreader box. The screen will catch the oversized rock, yet permit the slurry to pass through. The rocks can be disposed of later. Another problem of oversized rocks is that they can get caught between the blades of the mixer and the sides of the mixer walls, thus causing the mixer shear pin to break, resulting in an unwarranted breakdown of the slurry operation.

The techniques described above would be considered as preventative measures for elimination of oversized materials. However, there may be specific restrictions set out in the Contract Documents concerning this matter, and no statement made above should be taken as relieving the Contractor of the responsibilities for providing the specified equipment and material.

(4) High Crowns and Superelevated Curves. A special problem that may arise when laying slurry in areas of high crowns and superelevated curves is the difficulty in distributing the slurry evenly in the spreader box. The thin consistency of the slurry will, of course, cause it to move to the low side of the box. The operator should divert the slurry constantly to the high side,

as the low side of the box will fill itself by gravity. Sometimes an extra person is required to distribute the slurry in the spreader box by a shovel when coming to the end of a pass and all materials have been shut off.

(5) Steep Grades. Laying slurry on grades of 8% or more presents several new problems. It has been found through experience, it is best to lay the slurry going uphill whenever possible, although some Contractors prefer just the opposite. Regardless of the method chosen, each has its advantages as well as its disadvantages.

In laying slurry uphill, it is usually easier to hold the slurry in the spreader box since the direction of movement of the machine forces the slurry to go through 2 sets of squeegees before leaving the spreader box. Oftentimes in a downhill operation, the slurry will overflow and/or push out under the front squeegee and get ahead of the machine.

An uphill operation will usually move at a more rapid pace, since there is no necessary worry of overflowing the front part of the spreader box. An uphill operation will usually require a somewhat thinner (more fluid) slurry to prevent laying too thick an application caused by the pressure of the slurry against the strike-off squeegee. For the downhill operation, the mix should be somewhat thicker to prevent excessive run-off of the slurry under the front squeegee. An uphill operation requires a more powerful truck to pull the heavy load uphill at a slow speed, while downhill operations will be harder on the truck brakes.

(6) Gutters. It is desirable to keep any type of paving from getting out of bounds. The slurry spreader box is designed to completely contain the slurry. This is accomplished by side and end squeegees which overlap and completely hold the slurry in the box. The small opening between the side and back rubber is to allow a little slurry to run outside the box to help make joints or work adjacent to curbs. This is a nominal amount and should not cause any runoff in the gutter.

(7) Clean-up. All areas which have been a part of the project will be restored to an acceptable condition. The Inspector should check the stockpile, storage and loading areas to determine that all excess materials have been satisfactorily disposed of and that no corrective action is required. Also inspect the roadway area to verify that all spillages, excess materials and signs of poor workmanship or damage are corrected.

4.07.06 ASPHALT SEALING

a. General. Asphalt sealing is described as an application of asphalt material followed by an application of cover material. The asphalt material used may be a cutback asphalt, an asphalt cement or an emulsified asphalt. The cover material may be any of the several grades shown in the Contract Documents. Specific types for a particular project are stipulated in the Contract.

b. Design. In order to determine the rates of application of the asphalt and cover material, a standard method of computation is used. The design approach utilizes the median particle size (M.P.S.) of the aggregate from results of sieve analysis tests, traffic count and roadway surface condition. Division 600 of the Standard Specifications lists the emulsion type and estimated application rates of the asphalt and cover material.

When graded aggregates are used, theoretical computations of the rates of application can only be used as an indication of the relation of the average particle size of the aggregate and the quantity of asphalt required, which when applied to this type of aggregate means very little.

For clarification, practically all the material of single sized aggregates is retained on 2 consecutive sieves. The quantity of both asphalt and cover material, when computed from the

average particle size of graded aggregates will prove to be unsatisfactory. The average particle size of these aggregates will indicate a rate of asphalt application which will be sufficient to cover the smaller sizes of aggregate, but will be insufficient to hold the larger sizes of aggregate. If the larger sizes of aggregate, which in most cases is the premium material, are to be retained in the seal coat rather than be whipped off the road by traffic, the indicated rate of application of asphalt must exceed the calculated amount. Since in all probability, a black rather slick surface will result when using this type of aggregate, the asphalt is usually increased from the calculated rate by trial and error to a rate which will retain the larger sizes of aggregate without excessively covering the average sized aggregate.

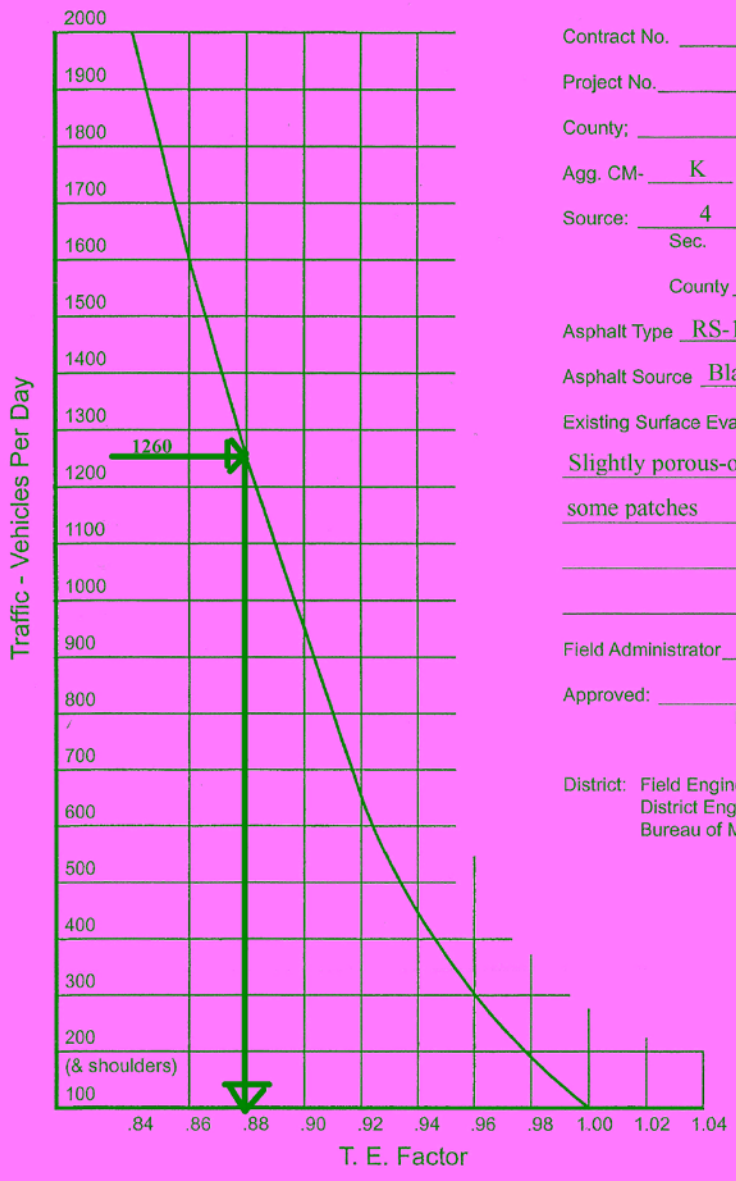
When using single-sized aggregate for cover material, it is expected that light-colored granular surfaces be obtained. This can be accomplished only by rigid control of the rates of application of the asphalt and cover material. When using single-sized aggregates, it is possible and practical to predetermine the rates of application of the asphalt and cover material.

In general, the computations will give accurate results for asphalt and aggregate quantities when one-sized or nearly one-sized aggregates are used. However, for graded aggregates the computed quantity of asphalt will probably need to be increased since the average particle size will not provide enough asphalt to hold the larger particles in place.

The theoretical rates of application of cover material and asphalt may be computed as shown in the following example:

FIGURE IV-4

KANSAS DEPARTMENT OF TRANSPORTATION
BITUMINOUS SEALING DESIGN



Contract No. 503076295

Project No. 160-4 K 9298-01

County; Barber

Agg. CM- K Qual. No. 90-8261

Source: 4 (Sec.) 17S (Twp.) 21E (Range)

County Seton

Asphalt Type RS-1H

Asphalt Source Black Gold, Inc.

Existing Surface Evaluation:

Slightly porous-oxidized,

some patches

Field Administrator

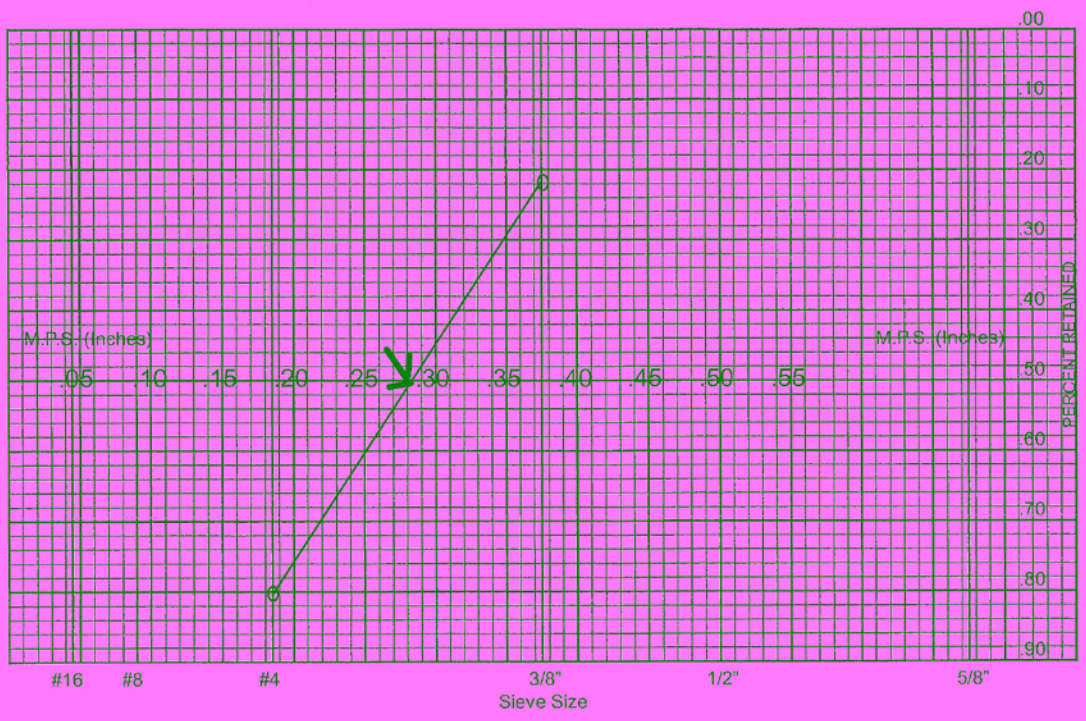
Approved:

District Materials Engineer

District: Field Engineer
District Engineer
Bureau of Materials & Research

Rev. 10-02

D.O.T. Form No. 683



Median Particle Size (M.P.S.) = 0.285 " Traffic Count 1260 V.P.D.

T.E. Factor X 0.88 (From Graph) (For traffic over 2,000 V.P.D., the T.E. Factor = 0.84)

Basic Residue Rate = 0.251 Gals. / Sq. yd.

Pavement Condition Adjust. = +0.02 Gals. / Sq. yd. (See Below)

Revised Application Rate, R_a = 0.271 Gals. / Sq. yd. (Residue)

Revised Application Rate, $R_e = \frac{R_a}{\%\ \text{Residue}} = \frac{0.271}{0.68} =$ 0.40 Gals. / Sq. yd. (Bitumen)

Aggregate Rate $A_{base} = \frac{36}{M.P.S.} = \frac{36}{0.285} =$ 126.3 Sq. yd. / Cu. yd.

Theo. Max. Aggregate Rate, $A_a = A_{base}$ X (Factor) = 126.3 X 0.90

A_a = 113.7 Sq. yd. / Cu. yd.

CM-	Factor
A	0.70
D	0.90
E	0.94
K	0.90
L	0.90

Pavement Condition	Adjustment	
Flushed Asphalt Surface	– 0.03	Gals. / Sq. yd.
Smooth, Non-porous Surface	0.00	Gals. / Sq. yd.
Slightly Porous, Oxidized Surface	+ 0.02	Gals. / Sq. yd.
Slightly Pocked, Porous Surface	+ 0.04	Gals. / Sq. yd.
Badly Pocked, Porous, Oxidized Surface	+ 0.06	Gals. / Sq. yd.

It must be remembered that these design values are based on the premise that the particles of aggregate have approximately the same height as their length and width.

The use of excessively flat or elongated aggregate particles may necessitate a modification of the theoretical rates of application of both the cover material and the asphalt. The presence of an excessive amount of flat particles in the cover material would decrease the effective median particle size to some thickness below the theoretical, which would indicate a decrease in the rate of application of cover material and asphalt. If it can be assumed that the flat particles of cover material assume a flat position under rolling, it can be seen that the application of more cover material than the calculated quantity would only result in placing one particle of cover material upon another, and with the corresponding decrease in the rate of application of asphalt, the relationship of asphalt, aggregate and embedment would be out of balance, and the quantities calculated would probably not give satisfactory results.

The calculated rate of application in the outlined procedure indicates the quantity of asphalt that is necessary to be permanently retained around the aggregate particles and above the existing surface to give satisfactory results. If cutback or emulsified asphalt is used, the calculated rate of application must be increased an amount equal to the diluent content of the cutback asphalt or the water content of the emulsified asphalt. The rate of application also must be adjusted to compensate for the old roadway surface condition. The recommended adjustments for pavement condition are shown on DOT Form No. 683.

The exact quantity of asphalt may need to be adjusted based on observation of trial rates of applications on selected test sections.

c. Preparation of Road Surfaces. Prior to any application of asphalt material, the roadway must be cleared of all foreign material. This can be done with power brooms, small blades, hand tools or other approved methods. The surface of the road must be dry at the time any asphalt material is applied. A good rule of thumb is to wait after a rain until the soil adjacent to the roadway has dried down 0.25 inch. At this time, the checks and cracks are probably dry enough to eliminate any trouble from moisture.

d. Application of Asphalt Material. Examine the distributor to see that it conforms to the Standard Specifications and contains the calibration certificate. Also check at least once each year to determine if recalibration is necessary.

It is very important that the distributor is traveling at proper speed when application starts. This will reduce any unsightly heavy areas at the beginning of each shot. The truck should never have to shift gears on hills. The bar should always be shut off before it "blows" or pump air at the end of each shot. Special care should be taken to obtain the proper center lap. This will differ with nozzle spacing and distribution. If the center lap is too great, an unsightly black streak or bleeding will develop on the centerline. If it is not enough, the aggregate will ravel or strip off at the center. It is also important to get the center covered as soon as possible so the entire width will be uniform in texture.

e. The Do's and Don'ts of Asphalt Application.

- Do turn nozzles so that fans are at proper angle to spray bar (Approximately 300). Sprays should not touch or merge -- this causes puddling. Check this at least once each day.
- Do check bar height at start of each shot for manufacturer's recommended ground to nozzle distance over the entire bar length. Distributor manufacturer's label should

give a height at which their nozzle design and positioning will give the smooth overlapped spray pattern. Any departure from this recommended distance will cause a streaking. The use of snubbers to hold constant height despite load variation, have been successful.

- Do check the spraying pressures so as to give straight edged spray fan. If pressure is too high, spray will fog and distort. If pressure is too low, spray fan will sag with heavy edges and decided longitudinal streaking. (Use highest possible pump pressure or speed.)
- Do heat the bitumen to upper part of spraying temperature range to eliminate as nearly as possible the heavy edge that is characteristic of all fan type sprays.
- Do keep material clean at spray bars by regularly cleaning and inspecting strainers. Clean each night. Small pieces of coke or carbon will clog the nozzles. Sections of the spray bar may be starved for material, due to foreign obstructions. Cleanliness of distributor usually means good work.
- Do have an accurate calibration of the distributor tank.
- Do make check on first shots, and apply correction to application charts. Viscosity of materials on jobs will differ from that used by manufacturer in calibration.
- Do embed the cover material into the asphalt membrane as soon as possible so it drops in place while asphalt is expanded by air, water or volatile.
- Do roll immediately and thoroughly to give good bonding.
- Don't use nozzles which have burrs or mechanical imperfections; the nozzle should spray a balanced spray.
- Don't use material too hot. If too fluid, the spray pattern will not be uniform and the fans will overrun one another.
- Don't use material too cold. Material too viscous will narrow the spray fan causing heavy application directly under the nozzle and material will not knit together.
- Don't try to seal a dusty or wet surface.
- Don't expect to obtain satisfactory results if air, wind or surface are too cold. Any one or all three of these chill a thin layer of material before it can knit together, either by gravity or cohesion, into a smooth surface.
- Don't make shots too long before applying cover material.

f. Application of Aggregate. Standard Specifications require a self-propelled spreader for the spreading of cover material. The careful operation of the spreader and hauling equipment is essential to obtaining a uniform surface. The trucks should never cross the uncovered asphalt at the center joint without first covering with cover material. All operators should use extreme care in clutching so wheel slippage does not occur.

A general fault is to use too much cover material. A good procedure to follow is to reduce the application of cover material until "picking up" is just starting. Then, increase the spread one notch. Normally, some black staining (not flushing) of the asphalt is expected in the wheel paths.

Occasionally, foreign material will get in the cover material from careless loading from the stockpile. This will plug up the spreader box and cause streaking which cannot be tolerated. If the spreader box tends to place the cover material in corrugations, usually slowing down the

truck will eliminate this problem. However, carrying more air in the tires on the spreader box may permit higher speeds of application and still eliminate corrugation in the cover material.

The aggregate spreader should cover to within a specified distance of the inside edge of the first shot. If any aggregate overlaps this joint, it must be cleaned back or an unsightly overlap will develop on the next pass. It is the responsibility of the Inspector and the Contractor to have enough aggregate to cover the next shot before allowing the distributor to commence.

An improper transverse joint will stand out as a defect for years. Building paper shall be used in making proper transverse joints. The front edge of the paper should be placed on the aggregate where the asphalt application is uniform. A square blade shovel should be used to scrape off all excess material in front of the paper. If this is done carefully, it will make a neat straight joint that will seldom be noticed.

When bids are taken by the cubic yard, each truck should be accurately measured and the level full volume computed. These measurements and computations should be recorded in the project records, and the full load (to the nearest ¼ cubic yard) plainly marked on the truck bed. The Inspector should be alert for any changes in sideboards or other conditions that would affect the volume of the vehicle.

It is necessary to review the current Contract Documents. List the specific requirements for hauling, heating and compacting equipment, and document these checks.

g. Immediately following the application of cover material, it shall be embedded by pneumatic rolling. A sufficient number of pneumatic rollers shall be furnished so the initial complete roller coverage is completed within 15 minutes after the application of the cover material. For hard aggregate CM-A, B, or E, the Inspector may require the use of a steel roller for one of the coverages, provided that excessive crushing of the cover material does not occur.

It is necessary that vehicle speeds be controlled in the fresh sealed areas to avoid flying particles and tearing the aggregate from the surface. It should be understood with the Contractor that this speed limit applies to hauling equipment as well as the traveling public.

h. Field Notes. It is necessary to keep a complete record of the asphalt and aggregate application. Random checks of rate of application of aggregate may be made by occasionally checking the distance covered by one truck with a complete record made of aggregate used per mile.

FIGURE IV-5

DISTRIBUTOR	NOZZLE SIZE	NOZZLE SPACING (INCHES)	NOZZLE SLOT ANGLE (DEGREES)	NOZZLE HEIGHT ABOVE ROAD (INCHES)	PUMP DISCHARGE GAL./MINUTE OR PUMP SPEED	PUMP PRESSURE (P.S.I.)	APPLICATION RATE GAL. PER SQ. YD.	COVERAGE
CHAUSSE	1/16 IN.	4	45 WITH	6 TO 15	95 GPM AT	5 TO 15	VARIES WITH SIZE OF BAR	4 IN. TRIPLE LAP
		6	SPRAY BAR		420 RMP		AND SPEED OF TRUCK	6 IN DOUBLE LAP
	1/8 IN.	4	45 WITH	6 TO 15	95 GPM AT	5 TO 15	VARIES WITH SIZE OF BAR	4 IN. TRIPLE LAP
		6	SPRAY BAR		420 RMP		AND SPEED OF TRUCK	6 IN DOUBLE LAP
	3/32 IN.	4	45 WITH	6 TO 15	45 GPM AT	5 TO 15	VARIES WITH SIZE OF BAR	4 IN. TRIPLE LAP
		6	SPRAY BAR		420 RMP		AND SPEED OF TRUCK	6 IN DOUBLE LAP
	3/16 IN	4	45 WITH	6 TO 15	45 GPM AT	5 TO 15	VARIES WITH SIZE OF BAR	4 IN. TRIPLE LAP
		6	SPRAY BAR		420 RMP		AND SPEED OF TRUCK	6 IN DOUBLE LAP
ETNYRE	1/16 IN.	4	30 WITH	12	5-7 GAL. PER	--------	0.3 TO 3.0 GALS	TRIPLE LAP
			SPRAY BAR		FOOT OF BAR			
	1/8 IN.	4	30 WITH	12	10-15 GAL. PER	--------	0.3 TO 3.0 GALS	TRIPLE LAP
			SPRAY BAR		FOOT OF BAR			
	3/32 IN.	4	30 WITH	12	7-10 GAL. PER	--------	0.3 TO 3.0 GALS	TRIPLE LAP
			SPRAY BAR		FOOT OF BAR			
	3/16 IN	4	30 WITH	12	12-20 GAL. PER	--------	0.3 TO 3.0 GALS	TRIPLE LAP
			SPRAY BAR		FOOT OF BAR			
	S36-5	4	30 WITH	12	10-15 GAL. PER	--------	0.6 TO 3.0 GALS	QUADRUPLE LAP
			SPRAY BAR		FOOT OF BAR			
GRACE	1/16 IN.	6	60 WITH	11	100 GPM	35	0.05 TO 1.0 GALS.	DOUBLE LAP
200 SERIES			SPRAY BAR					
	1/8 IN.	6	60 WITH	9	325 GPM	35	0.05 TO 1.0 GALS.	TRIPLE LAP
			SPRAY BAR					
	3/32 IN.	6	60 WITH	11	100 GPM	35	0.05 TO 1.0 GALS.	DOUBLE LAP
			SPRAY BAR					
	3/16 IN	6	60 WITH	9	325 GPM	35	0.05 TO 1.0 GALS.	TRIPLE LAP
			SPRAY BAR					
LITTLEFORD	1/8 IN.	4	15 WITH	10 IN. MIN.	12.5 GAL.PER	--------	0.05 TO 3.3 GALS.	TRIPLE LAP
	SQ. SLOT		SPRAY BAR	12 IN. MAX.	FOOT OF BAR			
	1/8 IN.	4	15 WITH	10 IN. MIN.	12.5 GAL.PER	--------	0.05 TO 3.3 GALS.	TRIPLE LAP
	"V" SLOT		SPRAY BAR	12 IN. MAX.	FOOT OF BAR			
ROSCO	NO. 0	4	25 WITH	10	--------	10 TO 50	0.05 TO 2.0 GALS	TRIPLE LAP
			SPRAY BAR					
	NO.1	4	25 WITH	10	--------	10 TO 50	0.05 TO 2.0 GALS	TRIPLE LAP
			SPRAY BAR					
	NO. 2	4	25 WITH	10	--------	10 TO 50	0.05 TO 2.0 GALS	TRIPLE LAP
			SPRAY BAR					
SEAMAN -	1/8 IN.	4	15 WITH	9	375 GPM AT	--------	0.1 TO 3.0 GALS	TRIPLE LAP
GUMMISON			SPRAY BAR		375 RPM			
	3/16 IN	4	15 WITH	9	375 GPM AT	--------	0.1 TO 3.0 GALS	TRIPLE LAP
			SPRAY BAR		375 RPM			
SOUTH BEND	1/16 IN.	4	22 WITH	9 IN. MIN.	90 TO 375 GPM	20 TO 40	0.1 TO 3.0 GALS	TRIPLE LAP
(MUNICIPAL)		6	SPRAY BAR	11 IN. MAX.				
	1/8 IN.	4	22 WITH	9 IN. MIN.	90 TO 375 GPM	20 TO 40	0.1 TO 3.0 GALS	TRIPLE LAP
		6	SPRAY BAR	11 IN. MAX.				
	3/16 IN.	4	22 WITH	9 IN. MIN.	90 TO 375 GPM	20 TO 40	0.1 TO 3.0 GALS	TRIPLE LAP
		6	SPRAY BAR	11 IN. MAX.				
STANDARD	1/16 IN.	4	45 WITH	9	375 GPM AT	50	0.1 TO 1.0 GALS.	TRIPLE LAP
			SPRAY BAR		675 RPM			
	5/32 IN.	4	45 WITH	9	375 GPM AT	50	0.1 TO 1.0 GALS.	TRIPLE LAP
			SPRAY BAR					

The asphalt rate should be computed for each shot with the record being kept in a bound field book and filed with the project records. A typical example for a shot record is shown in the documentation manual. It is important to measure the stab while the distributor is in a level position to obtain a correct stab.

4.07.07 ASPHALT PRIME COAT

a. General. This work is the application of a cutback asphalt to a rock, sand or dirt base to obtain a surface so additional applications of asphalt material can be applied. It may also be used as the surface treatment for completed asphalt bases. The equipment and material shall be in accordance with the Contract Documents.

b. Preparation of Road Surfaces. It is essential that the road surface be hard, smooth and uniform. The loose material must be bladed and cleaned with mechanical sweepers or blowers. It is impossible for a blade to get the surface clean enough without brooming. After the surface is broomed, it is usually necessary to give it a light application of water approximately 15 minutes in advance of the asphalt application. This cuts the dust film and makes for better penetration of the asphalt.

c. Weather Conditions. The Contract Documents gives the temperature and seasonal limitations. In order to obtain good penetration, it is necessary for the base to be warm. If the base is cool, the cutback asphalt will chill as it contacts the surface and will not completely penetrate the surface. When this happens, the desired penetration is not obtained and the excess asphalt will have to be blotted, causing additional work and expense.

d. Application of Prime Coat. The rate of asphalt shall be determined by the Project Manager. It is necessary to apply as much cutback asphalt as the base will absorb, but not so much that it will require excess blotting. Dense AB-2 bases and most existing gravel surfaces will require from 0.3 to 0.4 gallons per square yard of asphalt while generally the dense, flushed and glazed surfaces of AB-3 bases will absorb no more than 0.2 to 0.25 gallons per square yard of asphalt. Good judgment based on past experience plays an important part in determining the rate of application.

It is desirable to allow the prime to set at least 48 hours before blotting; however, on minor secondary roads, local traffic is usually maintained through construction. The only practical way this can be done is to apply the asphalt on one side in the morning, apply enough blot to allow local traffic through, then complete the other side. This will allow at least 4 hours prior to blotting. This should only be done in the areas where the road cannot be completely barricaded. Where prime coat is applied to the completed asphalt base, it is mandatory that this be done after the final rolling and before traffic is allowed on the base. Extreme care should be taken to keep from obtaining a slick surface which is a traffic hazard.

e. Maintenance of Prime Coat. It is the Contractor's responsibility to maintain, protect and repair any damaged prime coat. It normally takes at least 72 hours before the prime cures out enough to apply additional asphalt surfaces. During this period it may be necessary for the Contractor to blot, drag and maintain the completed prime coat.

Blotting material to be used should be determined in advance. If available, fine sand is considered most satisfactory.

4.08 ROADSIDE IMPROVEMENT

4.08.01 GENERAL

The Construction Engineer shall be in overall charge of the project, and will see that the project is completed in accordance with the Contract Documents. The Construction Engineer will work with Environmental Services Section, Landscape Unit in all items concerning the location and acceptability of all roadside improvement items.

4.08.02 DELIVERY OF PLANT MATERIALS

The Construction Engineer with guidance from Environmental Services Section, may inspect and recommend acceptance or rejection of all plants, topsoil, mulch and miscellaneous materials for roadside improvement projects. It is the Contractor's responsibility to notify the Inspector 24 hours in advance of delivery so arrangements can be made for inspection. The proper procedures for protection of "bare-root" materials shall be established for each type of plant by the Environmental Services Section. The instructions given for "heel in," "puddling," etc., shall be carried out by the Contractor. Weather conditions will dictate the degree of protection necessary to properly protect the material prior to planting.

The Inspector shall keep a complete record of the plants delivered, the number accepted and planted or rejected. A positive procedure should be established to see that none of the rejected materials are returned to the project. It is expected that during the progress of large projects, the Inspector may request inspection of the plants as they arrive and are planted. This requires close contact between the Environmental Services Section, Construction Engineer and the Inspector to solve any questions that may arise and to see that no inferior plants are planted. If the exact species of plant shown on the plans is not available, the Contractor may obtain approval for substitution by submitting a letter from three competent sources to this effect noting unavailability of item specified and proposed substitution. The substitution will normally be a similar variety of plant at no additional cost to the KDOT.

4.08.03 WORK PREPARATORY TO PLANTING

The Construction Engineer and the Inspector may work together in staking out the project. On large projects, the Contractor will normally have a crew digging holes far ahead of the planting. It is therefore necessary to stake each individual tree or shrub as many will have different hole sizes. The Contract Documents require a hole size for each item; therefore, each hole must be checked for diameter and depth prior to filling with topsoil or planting. When topsoil is shown on the plans, it must be approved in advance.

The method of measurement must be agreed upon by the Inspector and the Contractor. Normally, there are two approved methods, the first being to measure the truck and issue cubic yard tickets as the soil is delivered to the tree holes. If this is done, the Inspector must be verified that the paid volume is not wasted, washed away or used except to fill the hole. The other method is to use the measured hole for the paid volume. The latter method will usually cost the Contractor extra topsoil, but may be an advantage due to less restrictions in hauling and stockpiling of topsoil.

When peat moss is specified, the method of mixing shall be established at the Pre-Construction Conference. One procedure is to place the specified quantity of peat moss on the given area, till it to the depth of existing soil that will give the required mixture and use the mixture to backfill the pits.

4.08.04 PLANTING TREES, SHRUBS AND OTHER PLANTS

The Contract Documents give the requirements for handling and planting the accepted plants. The Inspector should frequently inspect the planting operations and advise the Contractor of any changes in procedure necessary for the proper establishment of the plants.

Trees, vine and shrub pits shall be backfilled to the proper planting depth and firmed by trampling or with tamping tools. This operation is necessary to remove air pockets around the

roots and should not be overlooked. It is necessary to study the terrain of the land to determine the proper planting depth. Deep planting is a common fault of inexperienced planters and is one cause for many transplants dying. In heavy soils or poorly drained areas, it is often advisable to provide a mound instead of a depression around the plants. Care should be taken to spread the roots of plants while backfilling and to firm the soil around the roots. The handling of balled and burlapped (B & B) plants is outlined in the Contract Documents. The Inspector should reject any plants that have been damaged by careless handling. This would show up as trees that are loose in the ball, broken or crushed balls, or any other damage that would decrease the chance of making a satisfactory plant. Many B & B plants are now tied with plastic twine. Be sure that this twine is cut from around the main stem of the plant. This should be done after the plant has been set in the hole and partially backfilled. Wire baskets used on large balled trees may be partially removed after planting.

It is considered good practice to water the plant when the backfill is ¾ complete and as often thereafter as necessary. Cultivating an area outside the pit, providing a cup or depression, fertilizing, mulching, staking and wrapping trees as provided in the Contract Documents shall be carefully supervised by the Inspector. When staking bare root trees, it is desirable to place the stake prior to planting the tree. This will prevent the stake from damaging the roots. The Inspector shall check the acceptability of methods and workmanship, and advise the Contractor of any changes in operation to improve the quality of protection of the plant.

4.08.05 PLANTING SODS AND SEEDS

Sods shall be laid on prepared soils and properly maintained. It is the Inspector's responsibility to see that this work is performed in a satisfactory manner. Dry soils should be watered prior to laying sods. The edges of sods shall be covered with soil to prevent drying. Proper grade lines shall be provided before laying the sod. Sods shall be in good growing condition at the end of the 20-day maintenance period to be acceptable.

Soil preparations for seeding shall provide for good seed soil contact. Seeding on poorly prepared seedbeds increases the chance of failure. When seeding is done on a newly graded roadside, the soil shall be properly disked and harrowed to eliminate all existing weeds and grassy growth. Normally, seeding shall be done with an appropriate drill for grass seed, a fertilizer box or attachment may be utilized to drill fertilizer as grass seed is planted.

Fertilizer may be drilled with the seed or broadcast. All seed shall be drilled, except on small or rough areas where a drill cannot operate. In urban areas such as lawns, drop seeders, cyclone seeders, etc., may be used. The area will require light raking to provide cover for the seed.

It is not necessary to till the soil to bare ground in all seeding operations. When temporary cover has no erosion, the soil is highly erodible, stable slope areas or over-seeding a previous seeded area, seeding may be done with a no-till drill. This equipment is designed to drill seed into existing cover without tilling. Minimal damage is done to existing cover.

On all seeding projects, the drill rows shall run perpendicular to the slope when possible. This will help prevent rivulets of erosion down the slope. Small seed such as bluegrass, lovegrass and dropseed shall be planted shallow. When seeds are broadcast, cover shall be provided by hand raking, harrowing, cultipacking or dragging.

The use of a hydroseeder may be used on a project only if approved by the Construction Engineer. Generally, hydroseeding will not be approved, unless circumstances warrant its use.

Many projects include wildflower seed in the native grass areas. Wildflower seed shall be drilled with a no-till drill along with the grass seed in a separate box. Minimal cover of wildflower seed is desirable.

4.08.06 MULCH

Mulch requires firming or tying in some manner as described in the Contract Documents. Where a mulch punch cannot operate, some other suitable method shall be used to "stabilize" the mulching material. Do not pay for areas of mulch not properly firmed or stabilized.

Mulch quantity may be reduced or eliminated on projects seeded with a no-till drill. The extent of existing cover will dictate the use of mulch. A tackifier may also be used to tack the mulch down.

The Inspector shall see that the Contractor places the mulching material soon after seeding. If rains prevent completion of mulching a slope or given area until soils dry, the mulching should be continued as soon as is possible. After a delay of 7 to 8 days, partial germination may occur. Mulching operations shall cease on the area where seedling grasses and legumes are emerging. The mulch would smother the seedlings that have emerged. If the Contractor keeps up with the mulching operations as the Contract Documents require, there will be few instances where mulch will have to be deleted.

4.08.07 PARK STRUCTURES

The Plans generally list the work to be done, such as site grading, materials to be used, lumber requirements, painting and many other details. The notes on the plans are usually detailed. Special effort must be made by the Inspector to verify that the details are not overlooked. Some Contractors may be careless about earthwork such as compacting earth under concrete slabs, backfilling around structures and other related items. Specific compaction requirements may not be specified; however, good construction practices should be followed.

The fill areas should not contain excessive amounts of vegetation. The fill under and around concrete structures should be discussed in advance of construction, and a method agreed upon that will give the desired quality of work. The plans should be carefully followed on waste stabilization pond (lagoon) construction. These plans have been reviewed and approved by the Department of Health & Environment. Any changes from the plans should be reviewed with Environmental Services Section, Landscape Unit. Prior approval of changes in plans must be received. When lagoon construction is completed, notify the Construction Engineer so that arrangements for final inspection by the Department of Health & Environment may be made.

4.08.08 ACCEPTING MATERIALS

Items such as seed and fertilizer that require a materials test report or certification shall not be used or planted until the Inspector receives a test report or Certification showing that said items have been tested and accepted in accordance with Contract Documents. Many roadside improvement and general building project items are not covered by specific detailed Standard Specifications. Commercial grade items normally used for the use intended on the project are acceptable. All materials, equipment and fabrication items shall have catalog cuts, setting drawings, schedules, etc., submitted for approval by Environmental Services Section, Landscape Unit. A letter of transmittal shall accompany all submissions. No items shall be installed without approval.

Visual inspection will be made of most types of plant materials, mulch, sod, guideposts, topsoil, etc. Trees, shrubs, vines and sod often appear to be in good condition when delivered and planted, but are in poor condition when final inspection is made. A number of conditions might contribute to such items being in an acceptable or unacceptable condition. The Inspector shall advise the Contractor to give such care or attention to the various plants that will keep them in a satisfactory condition. Plants that are definitely in a dead, or in a dying and unsatisfactory condition shall be removed and replaced with good live plants by the Contractor.

If deemed necessary, the Inspector, the Construction Engineer and the Environmental Services Section shall examine the plants and items of work on the project at the end of the establishment period specified in the contract. Inspection shall be made of the quality of work performed and the condition of the plant materials. Items that are in a dying condition shall be replaced with good quality plants. In case it is so late in the season that transplanting is not advisable, the items rejected shall be replaced during the following planting season. A list of items to be replaced and a description of the remaining work to be done to put the project in an acceptable condition shall be completed by the Inspector and furnished to the Contractor.

The final inspection and acceptance of a project will be made by the District Construction and Materials/Assistant District Engineer.

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
	DIVISION 100						
07-01007	Highway Construction Trainees	Highway Construction Trainees (Set Price)	Hours		Hour		Hour
	DIVISION 200						
201	Clearing & Grubbing	Clearing & Grubbing	Lump Sum		Lump Sum		Lump Sum
202	Removal of Existing Structures	Removal of Existing Structures	Lump Sum		Lump Sum		Lump Sum
		Removal and Reconstruction of Existing Structures	Lump Sum		Lump Sum		Lump Sum
203	Resetting Existing Culverts	Resetting End Section	Each		Each		Each
		Resetting Pipe Culvert	LNFT		LNFT		LNFT
204	Excavation & Backfill for Structures	Class * Excavation	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Concrete (Grade**) (***)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Concrete for Seal Course (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Foundation Stabilization	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Foundation Stabilization (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Granular Backfill	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Granular Backfill (Wingwalls) (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Water (Grading)(Set Price)	MGAL		0.1 MGAL		MGAL
205	Excavation & Embankment for Highways	Common Excavation	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Common Excavation (Contractor-Furnished)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Rock Excavation	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Rock Excavation (Non-Durable Shale)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Unclassified Excavation	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Common Excavation (Unstable)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Common Excavation (Unsuitable)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Compaction of Earthwork (Type *) (MR-**)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Embankment	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Embankment (Contractor-Furnished)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Eradication of Traveled Way	STA		0.1 STA		0.1 STA
		Water (Grading) (Set Price)	MGAL		0.1 MGAL		MGAL
206	Select Soil	Select Soil	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Select Soil (Contractor-Furnished)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
207	Overhaul	Overhaul	CUYD/STA	X	0.1 FT/0.1 STA	0.1 CUYD/0.1 STA	CUYD/STA
208	Linear Grading	Linear Grading (*) (**)	STA		0.1 STA		0.1 STA
		Water (Grading) (Set Price)	MGAL		0.1 MGAL		MGAL
07-02002	Salvaging, Stockpiling and Placing Topsoil	Salvaged Topsoil	SQYD	X	0.1 FT	0.1 SQYD	SQYD

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
	DIVISION 300						
301	Subgrade Modification	Manipulation for Aggregate Subgrade Modification (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Manipulation for In-Place Material Subgrade Modification (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Aggregate for Subgrade Modification (*)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Calcium Chloride	Ton		20 LBS or 0.01 Ton^		TON
		Cement	Ton		20 LBS or 0.01 Ton^		TON
		Fly Ash	Ton		20 LBS or 0.01 Ton^		TON
		Water (Subgrade Modification) (Set Price)	MGAL		0.1 MGAL		MGAL
302	Lime Treated Subgrade	Lime	Ton		20 LBS or 0.01 Ton^		TON
		Manipulation (Lime Treated Subgrade)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Water (Lime Treated Subgrade) (Set Price)	MGAL		0.1 MGAL		MGAL
303	Cement or Fly Ash Treated Subgrade	Cement	Ton		20 LBS or 0.01 Ton^		TON
		Fly Ash	Ton		20 LBS or 0.01 Ton^		TON
		Manipulation for Treated Subgrade (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Water (Treated Subgrade) (Set Price)	MGAL		0.1 MGAL		MGAL
304	Crushed Stone Subgrade	Crushed Stone Subgrade (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Water (Crushed Stone Subgrade) (Set Price)	MGAL		0.1 MGAL		MGAL
305	Aggregate Base and Aggregate Shoulders	Aggregate Base (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Aggregate Shoulder (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Calcium Chloride	Ton		20 LBS or 0.01 Ton^		TON
		Water (Aggregate Base) (Set Price)	MGAL		0.1 MGAL		MGAL
		Water (Aggregate Shoulders) (Set Price)	MGAL		0.1 MGAL		MGAL
306	Cement Treated Base	Cement Treated Base	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Quality Control Testing (CTB)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
307	Granular Base	Granular Base (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Water (Granular Base) (Set Price)	MGAL		0.1 MGAL		MGAL
	DIVISION 500						
501	Portland Cement Concrete Pavement (QC/QA)	Concrete Pavement (*Uniform) (AE) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Pavement (*Variable) (AE) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Early Strength Concrete Pavement (*Uniform) (AE)(**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Early Strength Concrete Pavement (*Variable) (AE)(**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Quality Control Testing (PCCP)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Core (Set Price)	Each		Each		Each

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
502	Portland Cement Concrete Pavement (NON-QC/QA)	Concrete Pavement (*Uniform) (AE) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Pavement (*Variable) (AE) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Early Strength Concrete Pavement (*Uniform) (AE)(**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Early Strength Concrete Pavement (*Variable) (AE)(**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
503	Portland Cement Concrete Pavement Smoothness	Concrete Pavement Smoothness	Lump Sum	X	$0.01		$0.01
07-05004	Portland Cement Concrete Pavement Bonded Inlay or Overlay Over Hot Mix Asphalt (HMA)	Milling	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Placement	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Bonded Concrete Pavement (* Uniform)(AE)(**)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
Future	Portland Cement Concrete Pavement Bonded Inlay or Overlay Over Portland Cement Concrete Pavement (PCCP)	Milling	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Surface Preparation	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Placement	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Bonded Concrete Pavement (* Uniform)(AE)(**)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Saw Cuts	LNFT		0.1 LNFT		0.1 LNFT
	DIVISION 600						
602	Hot Mix Asphalt (HMA) Construction (QC/QA)	HMA Base (*) (**) (***)	Ton		20 LBS or 0.01 Ton^		Ton
		HMA Surface (*) (**) (***)	Ton		20 LBS or 0.01 Ton^		Ton
		HMA Overlay (*) (**) (***)	Ton		20 LBS or 0.01 Ton^		Ton
		HMA Pavement (#) (##)	SQYD	X	1/4 inch	0.1 SQYD	SQYD
		HMA Pavement (#) Shoulder	SQYD	X	1/4 inch	0.1 SQYD	SQYD
		Emulsified Asphalt (****)	Ton		10 Gallons	.1 Ton	Ton
		Asphalt Core (Set Price)	Each		Each		Each
		Material for HMA Patching (Set Price)	Ton		20 LBS or 0.01 Ton^		Ton
		Quality Control Testing (HMA)	Ton		20 LBS or 0.01 Ton^		Ton
603	Asphalt Pavement Smoothness	Asphalt Pavement Smoothness	Lump Sum	X	$0.01		$0.01
604	Cold Recycle Asphalt Construction (CIR)	Cold Recycled Asphalt Material	STA		0.1 STA		0.1 STA
		Lime (Hydrated) (Slurry)	Ton		20 LBS or 0.01 Ton^		TON
		Emulsified Asphalt (CSS) (Special)	Ton		10 Gallons	.1 Ton	Ton
		Emulsified Asphalt (CSS-1H or SS-1H) Cure (Set Price)	Ton		10 Gallons	.1 Ton	Ton
		Blotter Sand (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
605	Surface Recycled Asphalt Construction	Surface Recycling (*)	STA		0.1 STA		0.1 STA
		Asphalt Rejuvenating Agent	Ton		100 LBS		Ton
606	Microsurfacing	Aggregate for Microsurfacing	Ton		20 LBS or 0.01 Ton^		Ton
		Emulsified Asphalt (*) (Modified)	Ton		10 Gallons	.1 Ton	Ton
		Mineral Filler	Ton		.01 Ton or nearest		Ton

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
607	Asphalt Prime Coat	Emulsified Asphalt (*)	Ton		10 Gallons	.1 Ton	Ton
		Cutback Asphalt (*)	Ton		10 Gallons	.1 Ton	Ton
608	Asphalt Sealing	Cover Material (*)	CUYD	X	0.25 CU YD		CUYD
609	Single Asphalt Surface Treatment	Cutback Asphalt (*)	Ton		10 Gallons	.1 Ton	Ton
		Emulsified Asphalt (*)	Ton		10 Gallons	.1 Ton	Ton
610	Double Asphalt Surface Treatment	Asphalt Cement (*)	Ton		10 Gallons	.1 Ton	Ton
		Water (Flexible Pavement) (Set Price)	MGAL		0.1 MGAL		MGAL
		Manipulation (Asphalt Seal)	STA		0.1 STA		0.1 STA
		Manipulation (*.A.S.T.)	STA		0.1 STA		0.1 STA
611	Hot Mix Asphalt (HMA) - Commercial Grade	HMA - Commercial Grade (Class *)	Ton		20 LBS or 0.01 Ton^		Ton
		HMA - Commercial Grade (Class *) (Patching)	Ton		20 LBS or 0.01 Ton^		Ton
612	Milling	Milling	SQYD	X	0.1 FT	0.1 SQYD	SQYD
			Ton		20 LBS or 0.01 Ton^		Ton
613	Ultrathin Bonded Asphalt Surface	HMA Surface (Ultrathin Bonded) (*) (**)	Ton		20 LBS or 0.01 Ton^		Ton
614	Plant Mix Asphalt Construction	Aggregate for Asphalt Surface Course (*)	Ton		20 LBS or 0.01 Ton^		Ton
07-06001	(BM-Mixes)	Aggregate for Asphalt Base Course (*)	Ton		20 LBS or 0.01 Ton^		Ton
		Aggregate for Asphalt Surface Course (*) (Shoulders)	Ton		20 LBS or 0.01 Ton^		Ton
		Aggregate for Asphalt Base Course (*) (Shoulders)	Ton		20 LBS or 0.01 Ton^		Ton
		Asphalt Cement (**)	Ton		10 Gallons	.1 Ton	Ton
		Cutback Asphalt (**)	Ton		10 Gallons	.1 Ton	Ton
		Asphalt Core (Set Price)	Each		Each		Each
		Material for Asphalt Patching (Set Price) (***)	Ton		20 LBS or 0.01 Ton^		Ton
07-06002	Plant Mix Asphalt Construction - Commercial Grade (BM-Mixes)	Plant Mix Asphalt Mixture - Commercial Grade	Ton		20 LBS or 0.01 Ton^		Ton
		Plant Mix Asphalt Mixture - Commercial Grade (Patching)	Ton		20 LBS or 0.01 Ton^		Ton
07-06004	Asphalt Pavement - UGWC/KC/Kansas	Plant Mix Asphalt Mixture - Wyandotte County (*)	Ton		20 LBS or 0.01 Ton^		Ton
07-06010	HMA Base (Reflective Crack Interlayer (RCI))	HMA Base (RCI) (*)	Ton		20 LBS or 0.01 Ton^		Ton
		Quality Control Testing (HMA)	Ton		20 LBS or 0.01 Ton^		Ton
	DIVISION 700						
701	Temporary Shoring	Temporary Shoring	Lump Sum		Lump Sum		Lump Sum
702	Corrugated Metal Sheet Piling	* Corrugated Metal Sheet Piling	LNFT		0.1 LNFT		LNFT
703	Drilled Shafts	Drilled Shaft (*) (**)	LNFT		0.1 LNFT		LNFT
		Permanent Casing (*) (Set Price)	LNFT		0.1 LNFT		LNFT
		Sonic Test (Drilled Shaft) (Set Price)	Each		Each		Each
		Core Hole (Investigative)	LNFT		0.1 LNFT		LNFT

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
704	Piling	Piles (*) (**)	LNFT		0.1 LNFT		0.1 LNFT
		Test Piles (*) (**)	LNFT		0.1 LNFT		0.1 LNFT
		Test Piles (Special) (*) (**)	LNFT		0.1 LNFT		0.1 LNFT
		Cast Steel Pile Points	Each		Each		Each
		Pre-Drilled Pile Holes	LNFT		0.1 LNFT		0.1 LNFT
706	Bearings and Pads for Structures	Elastomeric Bearing Pad (**)	Each		Each		Each
		Bearing (*) (**)	Each		Each		Each
707	Finger Plate and Modular Expansion Devise	Expansion Device (Finger Plate)	LNFT		0.1 LNFT		LNFT
		Expansion Device (Modular)	LNFT		0.1 LNFT		LNFT
708	Falsework and Form Construction	Falsework Inspection	Lump Sum		Lump Sum		Lump Sum
710	Concrete Structure Construction	Concrete (*) (**) (***)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
711	Reinforcing Steel	Reinforcing Steel (*) (**)	LBS	X	0.1 FT	1 LB	10 LBS
		Reinforcing Steel (Repair) (*) (**) (Set Price)	LBS	X	0.1 FT	1 LB	10 LBS
712	Structural Steel Construction	Structural Steel (*) (**) (***)	LBS		LB		LB
		Structural Steel (Merchant Quality)	LBS		LB		LB
		Welded Stud Shear Connectors	Each		Each		Each
		Bridge Drainage System	Lump Sum		Lump Sum		Lump Sum
			LNFT		0.1 LNFT		LNFT
			Each		Each		Each
			LBS		LB		LB
714	Painting Structural Steel	Bridge Painting (*)	Lump Sum		Lump Sum		Lump Sum
		Environmental Protection	Lump Sum		Lump Sum		Lump Sum
		Power Wash	Lump Sum		Lump Sum		Lump Sum
715	Prestressed Concrete Members	Prestressed Concrete Beams (*) (**)	LNFT		0.1 LNFT		LNFT
		Prestressed Concrete Panels	SQFT	X	0.1 FT	0.1 SQFT	SQFT
716	Post - Tensioning (Haunched Slab Bridges)	Post - Tensioning for Slab Bridge	LBS	X	LB		LB
717	Silica Fume Overlay	Silica Fume Overlay (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Material for Silica Fume Overlay (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
719	Expansion Joint (Strip Seal Assembly)Preformed Elastomeric (Neoprene & Compression & Other)	Expansion Joint (*)	LNFT		0.1 LNFT		LNFT
721	Handrail for Bridges & Other Uses	Bridge Handrail (*) (**)	LNFT		0.1 LNFT		LNFT
		Handrail (*) (**)	LNFT		0.1 LNFT		LNFT
722	Sign Structures & Bridge Mounted Sign Attachments	Bridge Mounted Sign Attachment (*)(**)	Each		Each		Each
		Butterfly Overhead Sign Structure(*)(**)	Each		Each		Each
		Cantilever Sign Structure(*)(**)	Each		Each		Each
		Overhead Sign Structure(*)(**)	Each		Each		Each
		Overhead Sign Structure (Mast Arm Type)(*)(**)	Each		Each		Each

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
722	Sign Structures & Bridge Mounted Sign Attachments (cont.)	Overhead Sign Structure (Single Tapered Tube)(*)(**)	Each		Each		Each
		Remove and Reset Sign Structure (***)	Each		Each		Each
		Reset Sign Structure (***)	Each		Each		Each
		Sign Structural Modification (***)	Each		Each		Each
723	Substructure Waterproofing Membrane	Substructure Waterproofing Membrane	SQYD	X	0.1 FT	0.1 SQYD	SQYD
724	Bridge Backwall Protection System	Bridge Backwall Protection System	SQYD	X	0.1 FT	0.1 SQYD	SQYD
725	Abutment Drainage Systems	Abutment Strip Drain	SQYD	X	0.1 FT	0.1 SQYD	SQYD
726	Concrete Masonry Coating	Concrete Masonry Coating	SQYD	X	0.1 FT	0.1 SQYD	SQYD
727	Repair (Structure)	Bridge Repair	Lump Sum		Lump Sum		Lump Sum
		Jacking of Existing Structure	Lump Sum		Lump Sum		Lump Sum
		Raise Expansion Device	Each		Each		Each
		Remove and Reset Expansion Device	Each		Each		Each
		Reset Existing Bearing	Each		Each		Each
728	Bridge Curb Repair	Bridge Curb Repair	LNFT		0.1 LNFT		LNFT
729	Multi-Layer Polymer Concrete Overlay	Multi-Layer Polymer Concrete Overlay	SQYD	X	0.1 FT	0.1 SQYD	SQYD
730	Epoxy Resin Crack Repair	Epoxy Resin Crack Repair	LNFT		0.1 LNFT		LNFT
731	Area Prepared for Patching (Existing Concrete Bridge Decks)	Area Prepared for Patching	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Area Prepared for Patching (Full Depth)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Area Prepared for Patching (Poured with Overlay)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Reinforcing Steel (Repair) (*) (**) (Set Price)	LBS	X	0.1 FT	1 LB	10 LBS
732	Machine Preparation (Existing Concrete Bridge Decks)	Machine Preparation (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
733	Hydrodemolition	Hydrodemolition	SQYD	X	0.1 FT	0.1 SQYD	SQYD
734	Structural Plate Structures	(*) Structural Plate Pipe (**) (***)	LNFT		0.1 LNFT		LNFT
		(*) Structural Plate Pipe Arch (**) (***)	LNFT		0.1 LNFT		LNFT
		(*) Structural Plate Arch (**) (***)	LNFT		0.1 LNFT		LNFT
735	Precast Reinforced Concrete Box	Reinforced Concrete Box (*) (Precast)	LNFT		0.1 LNFT		LNFT
07-07001	Bridge Project Marker	Bridge Project Marker	Each		Each		Each
07-07003	Heat Straightening (In-Place) of Damaged Structural Steel	Heat Straightening Repair	LNFT		0.1 LNFT		LNFT
07-07012	Expansion Joint (Membrane Sealant)	Expansion Joint (Membrane Sealant *)	LNFT		0.1 LNFT		LNFT
07-07018	Rolled Beam Detour Bridge	Erect and Remove Rolled Beam Detour Bridge	Lump Sum		Lump Sum		Lump Sum
		Furnish Rolled Beam Detour Bridge	Lump Sum		Lump Sum		Lump Sum

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
	DIVISION 800						
801	Mobilization	Mobilization	Lump Sum		Lump Sum		Lump Sum
		Mobilization (DBE)	Lump Sum		Lump Sum		Lump Sum
802	Contractor Construction Staking	Contractor Construction Staking	Lump Sum		Lump Sum		Lump Sum
		Right-of-Way Survey Monument	Each		Each		Each
		Benchmark Monument (Concrete Cylinder)	Each		Each		Each
		Monument Box	Each		Each		Each
803	Field Office and Laboratory	Field Office	Each		Each		Each
		Field Office & Laboratory (*)	Each		Each		Each
804 07-08031	Maintenance and Restoration of Haul Roads	Maintenance and Restoration of Haul Roads (Set Price)	Lump Sum		Lump Sum		Lump Sum
805	Work Zone Traffic Control & Safety	Work Zone Signs (0 to 9.25 SQFT)	EADA		EADA		EADA
		Work Zone Signs (9.26 to 16.25 SQFT)	EADA		EADA		EADA
		Work Zone Signs (16.26 SQFT and over)	EADA		EADA		EADA
		Work Zone Signs (Special) (**)	Each		Each		Each
		Work Zone Barricades (Type III - 4 to 12 LNFT)	EADA		EADA		EADA
		Arrow Display	EADA		EADA		EADA
		Portable Changeable Message Sign	EADA		EADA		EADA
		Channelizer (Fixed)	EADA		EADA		EADA
		Channelizer (Portable)	EADA		EADA		EADA
		Work Zone Warning Light (Type "A" Low Intensity)	EADA		EADA		EADA
		Work Zone Warning Light (Red Type "B" Low Intensity)	EADA		EADA		EADA
		Pavement Marking (Temporary) 4" Broken (8.2 ft) (*Tape)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) 4" Solid (*Tape)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) 4" Broken (3.3 ft) (*Tape)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) 4" Broken (Raised Pavement Marker)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) 4" Dotted Extension (*Tape)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) Broken (Line Masking Tape)	STAL		0.01 STAL		0.1 STAL
		Pavement Marking (Temporary) Solid (Line Masking Tape)	STAL		0.01 STAL		0.1 STAL
		Flagger (Set Price)	Hour		Hour		Hour
		Traffic Signal Installation (Temporary)	Lump Sum		Lump Sum		Lump Sum

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
805	Work Zone Traffic Control & Safety	Temporary Raised Pavement Marker (*)	Each		Each		Each
	(cont.)	Traffic Control	Lump Sum		Lump Sum		Lump Sum
		Traffic Control (Initial Set Up)	Lump Sum		Lump Sum		Lump Sum
07-08030		Barricade (Type III) (Fixed)	Each		Each		Each
806	Durable Pavement Marking	Pavement Marking (*) (**) (***) (*****)	LNFT		0.1 FT		LNFT
07-08024		Pavement Marking (Plowable Raised Pavement Marker) (**)	Each		Each		Each
		Pavement Marking Symbol (*) (**) (****) (*****)	Each		Each		Each
807	Painted Pavement Marking	Pavement Marking (Paint) (*) (**)	LNFT		0.1 FT		LNFT
		Pavement Marking Symbol (Paint) (*) (***)	Each		Each		Each
808	Removal of Existing Pavement	Pavement Marking Removal	LNFT		0.1 FT		LNFT
07-08025	Marking	Pavement Marking Removal (Plowable Raised Marker)	Each		Each		Each
809	Concrete Safety Barrier	Concrete Safety Barrier (*)	LNFT		0.1 FT		LNFT
		Concrete Safety Barrier (*) (Temporary)	LNFT		0.1 FT		LNFT
		Concrete Safety Barrier (*) (Temporary - Installation Only)	LNFT		0.1 FT		LNFT
		Concrete Safety Barrier (*) (Temporary - Relocate)	LNFT		0.1 FT		LNFT
810	Inertial Barrier System	Inertial Barrier System	Each		Each		Each
		Replacement Modules (*)	Each		Each		Each
811	Impact Attenuator	Impact Attenuator (*)	Each		Each		Each
		Impact Attenuator (Temporary)	Each		Each		Each
07-08034		Replacement Module	Each		Each		Each
812	Permanent Signing	Sign (*1) (High Performance)	SQFT	X	0.01 FT	0.01 SQFT	0.01 SQFT
		Sign Post (4" x 6" Wood) (*2)	LNFT		0.1 FT		LNFT
		Sign Post (*3 Steel Beam)	LNFT		0.1 FT		LNFT
		Sign Post (*4 U Steel)	LNFT		0.1 FT		LNFT
		Sign Post (*5 Perforated Square Steel Tube)	LNFT		0.1 FT		LNFT
		Sign Post (4" x 6" Structural Steel)	LNFT		0.1 FT		LNFT
		Sign Post (3 I 2.25 Aluminum)	LNFT		0.1 FT		LNFT
		Sign Post Stub and Breakaway Base Plate (*3)	Each		Each		Each
		Sign Post Breakaway Base Plate (*3)	Each		Each		Each
		Sign Post Footing (*6 Concrete)	LNFT		0.1 FT		LNFT
		Sign Post Footing (*5 Perforated Square Steel Tube)	Each		Each		Each
		Signing Object Marker (*7)	Each		Each		Each
		Signing Delineator (*8) (*9 Rigid, "U" Post)	Each		Each		Each

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
812	Permanent Signing (cont.)	Signing Delineator (*8) (*9 Flexible) (*10 Anchor)	Each		Each		Each
		Signing Delineator (*8) (*9 Bracket)	Each		Each		Each
		Sign (Remove and Reset)	Lump Sum		Lump Sum		Lump Sum
07-08022		Sign Post Square Coupler (*)	Each		Each		Each
		Sign Post Footing (Sign Post Square Coupler) (*)	Each		Each		Each
813	Rumble Strips (Milled) and	Rumble Strips (Milled) (*)	STA		0.1 STA		0.1 STA
07-08029	Rumble Strips (Milled) (Centerline)	Rumble Strips (Milled) (*) (Centerline)	STA		0.1 STA		0.1 STA
		Rumble Strips (Milled) (*) (Edgeline)	STA		0.1 STA		0.1 STA
814	Electrical Lighting Systems and Traffic Signals	Electric Lighting System	Lump Sum		Lump Sum		Lump Sum
		Electric Conduit (*) (**)	LNFT		0.1 LNFT		LNFT
		Electric Service Box	Each		Each		Each
		Traffic Signal	Lump Sum		Lump Sum		Lump Sum
		Traffic Signal Interconnect	Lump Sum		Lump Sum		Lump Sum
		Emergency Vehicle System	Lump Sum		Lump Sum		Lump Sum
815	Catch Basins, Inlets, Outlets, Manholes, Junction Boxes & Other Existing Structures	Catch Basin *	Each		Each		Each
		Inlet *	Each		Each		Each
		Outlet *	Each		Each		Each
		Manhole *	Each		Each		Each
		Junction Box	Each		Each		Each
816	Adjustment of Inlets, Manholes & Other Existing Structures	Adjustment of Catch Basins	Each		Each		Each
		Adjustment of Curb Inlets	Each		Each		Each
		Adjustment of Manholes	Each		Each		Each
		Structural Steel	LBS		LB		LB
		Cast Steel	LBS		LB		LB
		Cast Iron	LBS		LB		LB
817	Pipe Culverts, Erosion Pipe, Storm	Entrance Pipe (*) (**) (+) (++) (^) (^^)	LNFT		0.1 FT		LNFT
07-08023	Sewers, Sanitary Sewers & End Sections	Cross Road Pipe (*) (**) (+) (++) (^) (^^)	LNFT		0.1 FT		LNFT
		Erosion Pipe (*) (**) (+) (++) (^) (^^)	LNFT		0.1 FT		LNFT
		Liner Pipe (*) (**)	LNFT		0.1 FT		LNFT
		Storm Sewer (*) (**) (^) (^^)	LNFT		0.1 FT		LNFT
		Sanitary Sewer (*) (**)	LNFT		0.1 FT		LNFT
		End Section (*) (**) (+) (++)	Each		Each		Each
		Concrete Headwall	Each		Each		Each
		Fly Ash Slurry Grout (xx)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
818	Encasement Pipe	Encasement Pipe (*) (**) (***)	LNFT		0.1 FT		LNFT
819	Bored, Jacked or Tunneled Pipe	* (Bored, Jacked or Tunneled)	LNFT		0.1 FT		LNFT
820	Flume Inlets & Slope Drains	Flume Inlet (*)	Each		Each		Each
		Slope Drain (*)	LNFT		0.1 FT		LNFT
		Slope Drain (Special)	LNFT		0.1 FT		LNFT

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
821	Flapgates	(*) Flapgates	Each		Each		Each
822	Underdrains	* Pipe Underdrains (Type **)	LNFT		0.1 FT		LNFT
		Aggregate for Blanket Underdrains	Ton		20 LBS or 0.01 Ton*		Ton
			CUYD	X	0.1 FT	0.1 CUYD	CUYD
823	Prefabricated Interception Devices	Prefabricated Interception Device (*)	Each		Each		Each
	& Slotted Drains	Slotted Drain (**)	LNFT		0.1 FT		LNFT
824	Concrete Sidewalk, Steps and	Sidewalk Construction (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
	Ramps	Sidewalk Ramp	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Grade 3.0 Concrete (Misc.)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Reinforcing Steel	LBS	X	0.1 FT	1 LB	10 LBS
825	Curb & Gutter	Curb, Edge (*) (**)	LNFT		0.1 FT		LNFT
		Curb, Header (**)	LNFT		0.1 FT		LNFT
		Curb & Gutter, Combined (**)	LNFT		0.1 FT		LNFT
		Gutters (**)	LNFT		0.1 FT		LNFT
		Curb, Protection (*) (**)	LNFT		0.1 FT		LNFT
		Curb, Asphaltic Concrete	LNFT		0.1 FT		LNFT
		Gutters, Asphaltic Concrete	LNFT		0.1 FT		LNFT
		Curb & Gutters, Asphaltic Concrete	LNFT		0.1 FT		LNFT
		Curb Repair	LNFT		0.1 FT		LNFT
826	Shot - Crete Concrete	Shot - Crete	*				
07-08019	Concrete Surface Repair	Concrete Surface Repair	SQFT	X	0.1 FT	0.1 SQFT	SQFT
827	Guardrail & Guideposts	Guardrail, Steel Plate	LNFT		0.1 FT		LNFT
		Guardrail, Cable	LNFT		0.1 FT		LNFT
		Guardrail, Removal of Steel Plate	LNFT		0.1 FT		LNFT
		Guardrail, Removal of Cable	LNFT		0.1 FT		LNFT
		Guardrail, Removal of Timber	LNFT		0.1 FT		LNFT
		Guardrail, Reconstruction of Steel Plate	LNFT		0.1 FT		LNFT
		Guardrail, Reconstruction of Cable	LNFT		0.1 FT		LNFT
		Guardrail, Removal & Reconstruction of Steel Plate	LNFT		0.1 FT		LNFT
		Guardrail, Removal & Reconstruction of Cable	LNFT		0.1 FT		LNFT
		Guideposts	Each		Each		Each
		Guideposts, Removal of	Each		Each		Each
		Guideposts, Resetting of	Each		Each		Each
		Guideposts, Removal & Resetting of	Each		Each		Each
		Guardrail Posts	Each		Each		Each
		Guardrail End Terminals (*)	Each		Each		Each
828	Fencing	Fence (*) (**) (***)	LNFT		0.1 FT		LNFT
		Fence (*) (Temporary)	LNFT		0.1 FT		LNFT
		Fence (*) (Removal & Resetting)	LNFT		0.1 FT		LNFT

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
828	Fencing (Cont.)	Fence (*) (Removal of Existing)	LNFT		0.1 FT		LNFT
		Gate (*) (**)	Each		Each		Each
		Posts (Corner) (*)	Each		Each		Each
		Posts (End) (*)	Each		Each		Each
		Posts (Pull) (*)	Each		Each		Each
		Floodgates	Each		Each		Each
829	Riprap	Riprap (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
830	Slope Protection	Bedding for Slope Protection	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Slope Protection (*) (**) (***)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Slope Protection (Gabion)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Slope Protection (Special)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Geotextile Fabric	SQYD	X	0.1 FT	0.1 SQYD	SQYD
831	Ditch Lining	Aggregate Ditch Lining (*)	Ton		20 LBS or 0.01 Ton^		Ton
		Aggregate Backslope Ditch Lining	Ton		20 LBS or 0.01 Ton^		Ton
		Concrete Ditch Lining	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Concrete Backslope Ditch Lining	SQYD	X	0.1 FT	0.1 SQYD	SQYD
832	Gabions	Gabions	CUYD	X	0.1 FT	0.1 CUYD	CUYD
			SQYD	X	0.1 FT	0.1 SQYD	SQYD
833	Pavement Patching	Asphalt Pavement Patching	Ton		100 LBS		Ton
		PCCP Patching (*) (**) (***)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		PCCP Edge Joint Patching (***)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		PCCP Joint Patching (Full Depth)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		PCCP Joint & Crack Patching (***)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Extra Work Saw Cuts (Set Price)	LNFT		0.1 FT		LNFT
834	Undersealing	Fly Ash (Undersealing)	Ton		20 LBS or 0.01 Ton^		TON
		Injection Holes	Each		Each		Each
835	Resealing Joints & Sealing Cracks in Existing PCCP & HMA Pavements	Sealing PCCP Joints (Longitudinal)	LNFT		0.1 FT		LNFT
		Sealing PCCP Joints (Transverse)	LNFT		0.1 FT		LNFT
		Sealing PCCP Cracks (>1/8"<2")	LNFT		0.1 FT		LNFT
		Sealing Spalled PCCP Joints & Cracks (>2"≤3")	LNFT		0.1 FT		LNFT
		Sealing Spalled PCCP Joints & Cracks, Type A or B (>2"≤3")	LNFT		0.1 FT		LNFT
		Sealing Asphalt Cracks (>1/8"≤1/2")	LNFT		0.1 FT		LNFT
		Sealing Asphalt Cracks (>1/2"<1/2")	LNFT		0.1 FT		LNFT
		Sealing Longitudinal Asphalt Shoulder Joint	LNFT		0.1 FT		LNFT
836	Surfacing for Side Roads & Entrances	Surfacing Material (*)	Ton		20 LBS or 0.01 Ton^		Ton

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
837	Pavement Widening, Shouldering	Shoulders (Earth) (HMA Widening)	STA		0.1 STA		0.1 STA
07-08033	& Pavement Edge Wedge	Shoulders (Aggregate) (HMA Widening)	STA		0.1 STA		0.1 STA
		Pavement Edge Wedge (Earth)	STA		0.1 STA		0.1 STA
		Pavement Edge Wedge (Rock)	Ton		20 LBS or 0.01 Ton^		Ton
		Aggregate for Shoulders (AS-1)	Ton		20 LBS or 0.01 Ton^		Ton
		Common Excavation (Contractor-Furnished)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Water for Earthwork Compaction (Set Price)	MGAL		0.1 MGAL		MGAL
838	Grinding Rehab Concrete						
07-08032	Pavement	Grinding Concrete Surface	SQYD	X	0.1 FT	0.1 SQYD	SQYD
839	Rubbilizing Portland Cement	Crushed Stone for Backfill	CUYD	X	0.1 FT	0.1 CUYD	CUYD
	Concrete Pavement	Removal of Asphaltic Material	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Rubbilized Concrete	SQYD	X	0.1 FT	0.1 SQYD	SQYD
840	Temporary Surfacing	Temporary Surfacing Material (Aggregate) (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Temporary Surfacing Material (HMA) (Set Price)	Ton		20 LBS or 0.01 Ton^		Ton
841	Light Type Surfacing	Light Type Surfacing (*)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
842	Drilling & Grouting	Drilling & Grouting	Each		Each		Each
		Drilling & Grouting (Repair) (Set Price)	Each		Each		Each
843	Flowable Fill	Flowable Fill (*)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
844	Slurry Grout	Slurry Grout (*)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
845	Cleaning Existing Structures &	Cleaning Existing Structures	Lump Sum		Lump Sum		Lump Sum
	Underdrains	Cleaning Existing Underdrains	LNFT		0.1 FT		LNFT
846	Transporting Salvageable Material	Transporting Salvageable Material	*				
			Ton		20 LBS or 0.01 Ton^		Ton
			Lump Sum		Lump Sum		Lump Sum
847	Mailbox Installation	Mailbox Installation (Set Price)	Each		Each		Each
07-08003	Dowel Bar Retrofit (Existing Portland Cement Concrete Pavement)	Dowel Bar Retrofit (*)	Each		Each		Each
07-08004	Bridge Approach Slab Footing	Bridge Approach Slab Footing	CUYD	X	0.1 FT	0.1 CUYD	CUYD
07-08005	Retaining Wall System	Retaining Wall (*)	SQFT	X	0.1 FT	0.1 SQFT	SQFT
07-08006	Tie Bar Insertion	Tie Bar Insertion	Each		Each		Each
07-08007	Adjustment of Meter and Valve	Adjustment of Meter Box (*)	Each		Each		Each
	Boxes	Adjustment of Valve Box (*)	Each		Each		Each
07-08008	Solid Interlocking Paving Units (Paving Bricks)	Paving Brick	SQYD	X	0.1 FT	0.1 SQYD	SQYD
07-08009	Loop Detector Replacement	Loop Detector Replacement (Set Price)	LNFT		0.1 FT		LNFT
07-08010	Pavement Waterproofing Membrane	Pavement Waterproofing Membrane	LNFT		0.1 FT		LNFT
07-08012	Sanitary Sewer System	Sanitary Sewer System	Lump Sum		Lump Sum		Lump Sum

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
07-08013	Plugging Wells	Plugging (*) Wells	Each		Each		Each
07-08014	Compaction Grouting	Compaction Grouting	LNFT		0.1 FT		LNFT
		Compaction Grout	CUYD	X	0.1 FT	0.1 CUYD	CUYD
07-08015	Prefabricated Vertical Drain	Prefabricated Vertical Drain	LNFT		0.1 FT		LNFT
07-08016	Granular Drainage Blanket	Granular Drainage Blanket (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
07-08017	Separation Geotextile	Separation Geotextile	SQYD	X	0.1 FT	0.1 SQYD	SQYD
07-08018	Landscape Retaining Wall System	Landscape Retaining Wall	SQFT	X	0.1 FT	0.1 SQFT	SQFT
07-08020	Courtesy Towing	Towing (Courtesy) (Set Price)	Each		Each		Each
07-08021	Adjustment of Existing Structure	Adjustment of Existing Structure	Lump Sum		Lump Sum		Lump Sum
07-08028	Railroad Signing & Protective	Reflectorized Advance-Warning Signs	Each		Each		Each
	Liability Insurance	Reflectorized Railroad Crossing Signs	Each		Each		Each
		Railroad Protective Liability Insurance	Lump Sum		Lump Sum		Lump Sum
	DIVISION 900						
901	Temporary Erosion & Pollution	Temporary Berm	LNFT		0.1 FT		LNFT
	Control	Temporary Slope Drain	LNFT		0.1 FT		LNFT
		Temporary Slope Barrier (Set Price)	LNFT		0.1 FT		LNFT
		Temporary Ditch Check	LNFT		0.1 FT		LNFT
		Temporary Ditch Check (Rock) (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Temporary Inlet Sediment Barrier	Each	Field Book	Each		Each
		Temporary Sediment Basin	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Temporary Steam Crossing	Each	Field Book	Each		Each
		Sediment Removal (Set Price)	CUYD	X	0.1 FT	0.1 CUYD	CUYD
		Temporary Fertilizer (**)	LBS		LB		LB
		Temporary Seed (****)	LBS		LB		LB
		Soil Erosion Mix	LBS		LB		LB
		Temporary Seeding	Lump Sum		Lump Sum		Lump Sum
		Erosion Control (*)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
		Mulching (Temporary)	ACRE	X	1 FT	0.01 Acre	0.1 Acre
		Mobilization (Emergency Erosion Control) (Set Price)	Each		Each		Each
07-09002		Curb Inlet Protection	LNFT		0.1 FT		LNFT
902	Fertilizer, Agricultural Limestone &	Fertilizer (*-**-***)	LBS		LB		LB
	Peat Moss	Agricultural Limestone	Ton		20 LBS or 0.01 Ton^		Ton
		Peat Moss	Ton		20 LBS or 0.01 Ton^		Ton
903	Seeding	Seed (*)	LBS		LB		LB
		Seed (Hydro) (*)	LBS		LB		LB
		Seeding	Lump Sum		Lump Sum		Lump Sum
904	Mulching	Mulching (Temporary)	ACRE	X	1 FT	0.01 Acre	0.1 Acre
		Mulching (Permanent) (Set Price)	ACRE	X	1 FT	0.01 Acre	0.1 Acre
		Mulching Tacking Slurry	ACRE	X	1 FT	0.01 Acre	0.1 Acre
		Mulching (Hydro)	SQYD	X	0.1 FT	0.1 SQYD	SQYD

Section	Section Title	Pay Item	Unit	Comps	Minimum Measure to Nearest	Minimum Compute to Nearest	Minimum Pay to Nearest
905	Topsoil	Topsoil	CUYD	X	0.1 FT	0.1 CUYD	CUYD
906	Sodding	Sod (*) (**)	SQYD	X	0.1 FT	0.1 SQYD	SQYD
907	Trees, Shrubs & Other Plans	Furnishing & Planting Plant Materials	Lump Sum		Lump Sum		Lump Sum
		Transplanting Existing Plants	Lump Sum		Lump Sum		Lump Sum
908	Mowing	Mowing	PMPS		0.1 PMPS		0.1 PMPS
910	Stone Masonry Tree Wells	Stone Masonry for Tree Wells	CUYD	X	0.1 FT	0.1 CUYD	CUYD
911	Park Structures	Bench	Each		Each		Each
		Grill	Each		Each		Each
		Table (*)	Each		Each		Each
		Table Shade (**)	Each		Each		Each
		Waste Receptacle	Each		Each		Each
		Comfort Station (***)	Each		Each		Each
		Comfort Station (Modification)	Each		Each		Each
912	Water Systems	Water System	Lump Sum		Lump Sum		Lump Sum

^Platform scales nearest 20 lbs, overhead bins 0.01 ton

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
	DIVISION 100					
07-01007	Highway Construction Trainees	Highway Construction Trainees (Set Price)	Hours	Field Book	Training Reports	Field Book - Training Reports
	DIVISION 200					
201	Clearing & Grubbing	Clearing & Grubbing	Lump Sum	Field Book	Field Book	Field Book
202	Removal of Existing Structures	Removal of Existing Structures	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities - Field Book
		Removal and Reconstruction of Existing Structures	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities - Field Book
203	Resetting Existing Culverts	Resetting End Section	Each	Field Book	Field Book	Field Book-Plans
		Resetting Pipe Culvert	LNFT	Field Book	Field Book	Field Book-Plans
204	Excavation & Backfill for Structures					Plan Summary of Quantities or Change
		Class * Excavation	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Concrete (Grade**) (***)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Concrete for Seal Course (Set Price)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Foundation Stabilization	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Foundation Stabilization (Set Price)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Granular Backfill	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Granular Backfill (Wingwalls) (Set Price)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
					Load Tickets or Water Meter	
		Water (Grading)(Set Price)	MGAL	Field Book	Reading	Load Tickets or Water Meter Reading
205	Excavation & Embankment for Highways					Plan Summary of Quantities or Change
		Common Excavation	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
		Common Excavation (Contractor-Furnished)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
						Plan Summary of Quantities or Change
		Rock Excavation	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Rock Excavation (Non-Durable Shale)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Unclassified Excavation	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Common Excavation (Unstable)	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Common Excavation (Unsuitable)	CUYD	Field Book	Computation Sheets	Order Computation Sheets
		Compaction of Earthwork (Type *) (MR-**)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
						Plan Summary of Quantities or Change
		Embankment	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Embankment (Contractor-Furnished)	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
205	Excavation & Embankment for Highways (Cont.)	Eradication of Traveled Way	STA	Field Book	Field Book	Field Book
		Water (Grading) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
206	Select Soil	Select Soil	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Select Soil (Contractor-Furnished)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
207	Overhaul	Overhaul	CUYD/STA	Field Book	Field Book	Computation Sheets
208	Linear Grading	Linear Grading (*) (**)	STA	Field Book	Field Book	Field Book
		Water (Grading) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
07-02002	Salvaging, Stockpiling and Placing Topsoil	Salvaged Topsoil	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
	DIVISION 300					
301	Subgrade Modification	Manipulation for Aggregate Subgrade Modification (*) (**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Manipulation for In-Place Material Subgrade Modification (**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Aggregate for Subgrade Modification (*)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Calcium Chloride	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Cement	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Fly Ash	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Water (Subgrade Modification) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
302	Lime Treated Subgrade	Lime	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Manipulation (Lime Treated Subgrade)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Water (Lime Treated Subgrade) (Set Price)	MGAL	Field Book	Field Book	Load Tickets or Water Meter Reading
303	Cement or Fly Ash Treated Subgrade	Cement	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Fly Ash	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Manipulation for Treated Subgrade (*)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Water (Treated Subgrade) (Set Price)	MGAL	Field Book	Field Book	Load Tickets or Water Meter Reading

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
304	Crushed Stone Subgrade					Plan Summary of Quantities or Change Order Computation Sheets
		Crushed Stone Subgrade (*)	SQYD	Field Book & Plans	Computation Sheets	
		Water (Crushed Stone Subgrade) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
305	Aggregate Base and Aggregate Shoulders					Plan Summary of Quantities or Change Order Computation Sheets
		Aggregate Base (*) (**)	SQYD	Field Book & Plans	Computation Sheets	
						Plan Summary of Quantities or Change Order Computation Sheets
		Aggregate Shoulder (*) (**)	SQYD	Field Book & Plans	Computation Sheets	
		Calcium Chloride	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Water (Aggregate Base) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
		Water (Aggregate Shoulders) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
306	Cement Treated Base					Plan Summary of Quantities or Change Order Computation Sheets
		Cement Treated Base	SQYD	Field Book & Plans	Computation Sheets	
						Plan Summary of Quantities or Change Order Computation Sheets
		Quality Control Testing (CTB)	SQYD	Field Book & Plans	Computation Sheets	
307	Granular Base					Plan Summary of Quantities or Change Order Computation Sheets
		Granular Base (*)	SQYD	Field Book & Plans	Computation Sheets	
		Water (Granular Base) (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
	DIVISION 500					
501	Portland Cement Concrete Pavement (QC/QA) and NON-QC/QA	Concrete Pavement (*Uniform) (AE) (**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
502	Portland Cement Concrete Pavement (NON-QC/QA)	Concrete Pavement (*Variable) (AE) (**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Early Strength Concrete Pavement (*Uniform) (AE)(**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Early Strength Concrete Pavement (*Variable) (AE)(**)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Quality Control Testing (PCCP)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Concrete Core (Set Price)	Each	Field Book	Field Book	Field Book
503	Portland Cement Concrete Pavement Smoothness	Concrete Pavement Smoothness	Lump Sum	Spreadsheet/Field Book	Spreadsheet/Field Book	Spreadsheet/Field Book
07-05004	Portland Cement Concrete Pavement Bonded Inlay or Overlay Over Hot Mix Asphalt (HMA)	Milling	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Concrete Placement	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Bonded Concrete Pavement (* Uniform)(AE)(**)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
Future	Portland Cement Concrete Pavement Bonded Inlay or Overlay Over Portland Cement Concrete Pavement (PCCP)	Milling	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Surface Preparation	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Concrete Placement	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Bonded Concrete Pavement (* Uniform)(AE)(**)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Saw Cuts	LNFT	Field Book	Field Book	Field Book-Plans
	DIVISION 600					
602	Hot Mix Asphalt (HMA) Construction (QC/QA)	HMA Base (*) (**) (***)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		HMA Surface (*) (**) (***)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		HMA Overlay (*) (**) (***)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		HMA Pavement (#) (##)	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		HMA Pavement (#) Shoulder	SQYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Emulsified Asphalt (****)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Asphalt Core (Set Price)	Each	Field Book	Field Book	Field Book
		Material for HMA Patching (Set Price)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Quality Control Testing (HMA)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
603	Asphalt Pavement Smoothness	Asphalt Pavement Smoothness	Lump Sum	Spreadsheet/Field Book	Spreadsheet/Field Book	Spreadsheet/Field Book
604	Cold Recycle Asphalt Construction (CIR)	Cold Recycled Asphalt Material	STA	Field Book	Field Book	Field Book
		Lime (Hydrated) (Slurry)	Ton	Scale Tickets & Field Book	Bag Tally, Scale Tickets, in Field Book	Bag Tally, Scale Tickets, Recap in Field Book
		Emulsified Asphalt (CSS) (Special)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Emulsified Asphalt (CSS-1H or SS-1H) Cure (Set Price)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Blotter Sand (Set Price)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
605	Surface Recycled Asphalt Construction	Surface Recycling (*)	STA	Field Book	Field Book	Field Book
		Asphalt Rejuvenating Agent	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
606	Microsurfacing			Scale Tickets & Field		
		Aggregate for Microsurfacing	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field		
		Emulsified Asphalt (*) (Modified)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field	Bag Tally, Scale Tickets, in	Bag Tally, Scale Tickets, Recap in Field
		Mineral Filler	Ton	Book	Field Book	Book
607	Asphalt Prime Coat			Scale Tickets & Field		
		Emulsified Asphalt (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field		
		Cutback Asphalt (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
608	Asphalt Sealing, Single/Double					Plan Summary of Quantities or Change
	Asphalt Surface Treatment	Cover Material (*)	CUYD	Field Book	Load Tickets	Order Computation Sheets
609	Single Asphalt Surface Treatment			Scale Tickets & Field		
		Cutback Asphalt (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
610	Double Asphalt Surface Treatment			Scale Tickets & Field		
		Emulsified Asphalt (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field		
		Asphalt Cement (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
					Load Tickets or Water Meter	
		Water (Flexible Pavement) (Set Price)	MGAL	Field Book	Reading	Load Tickets or Water Meter Reading
		Manipulation (Asphalt Seal)	STA	Field Book	Field Book	Field Book
		Manipulation (*.A.S.T.)				
611	Hot Mix Asphalt (HMA) -			Scale Tickets & Field		
	Commercial Grade	HMA - Commercial Grade (Class *)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		HMA - Commercial Grade (Class *)		Scale Tickets & Field		
		(Patching)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
612	Milling					Plan Summary of Quantities or Change
		Milling	SQYD	Field Book	Computation Sheets	Order Computation Sheets
				Scale Tickets & Field		
			Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
613	Ultrathin Bonded Asphalt Surface			Scale Tickets & Field		
		HMA Surface (Ultrathin Bonded) (*) (**)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
614	Plant Mix Asphalt Construction (BM-			Scale Tickets & Field		
	Mixes)	Aggregate for Asphalt Surface Course (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
07-06001				Scale Tickets & Field		
		Aggregate for Asphalt Base Course (*)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Aggregate for Asphalt Surface Course (*)		Scale Tickets & Field		
		(Shoulders)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Aggregate for Asphalt Base Course (*)		Scale Tickets & Field		
		(Shoulders)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field		
		Asphalt Cement (**)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
				Scale Tickets & Field		
		Cutback Asphalt (**)	Ton	Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Asphalt Core (Set Price)	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
614	Plant Mix Asphalt Construction (BM-Mixes) (Cont.)	Material for Asphalt Patching (Set Price) (***)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
07-06002	Plant Mix Asphalt Construction - Commercial Grade (BM-Mixes)	Plant Mix Asphalt Mixture - Commercial Grade	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Plant Mix Asphalt Mixture - Commercial Grade (Patching)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
07-06004	Asphalt Pavement - UGWC/KC/Kansas	Plant Mix Asphalt Mixture - Wyandotte County (*)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
07-06010	HMA Base (Reflective Crack Interlayer (RCI))	HMA Base (RCI) (*)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
		Quality Control Testing (HMA)	Ton	Scale Tickets & Field Book	Scale Tickets, in Field Book	Scale Tickets, Recap in Field Book
	DIVISION 700					
701	Temporary Shoring	Temporary Shoring	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
702	Corrugated Metal Sheet Piling	* Corrugated Metal Sheet Piling	LNFT	Field Book	Field Book	Field Book
703	Drilled Shafts	Drilled Shaft (*) (**)	LNFT	Field Book	Field Book	Field Book
		Permanent Casing (*) (Set Price)	LNFT	Field Book	Field Book	Field Book
		Sonic Test (Drilled Shaft) (Set Price)	Each	Field Book	Field Book	Field Book
		Core Hole (Investigative)	LNFT	Field Book	Field Book	Field Book
704	Piling	Piles (*) (**)	LNFT	Field Book	Field Book and Log of Pile Driving	Log of Pile Driving
		Test Piles (*) (**)	LNFT	Field Book	Field Book and Log of Pile Driving	Log of Pile Driving
		Test Piles (Special) (*) (**)	LNFT	Field Book	Field Book and Log of Pile Driving	Log of Pile Driving
		Cast Steel Pile Points	Each	Field Book	Field Book and Log of Pile Driving	Log of Pile Driving
		Pre-Drilled Pile Holes	LNFT	Field Book	Field Book and Log of Pile Driving	Log of Pile Driving
706	Bearings and Pads for Structures	Elastomeric Bearing Pad (**)	Each	Field Book	Field Book	Field Book
		Bearing (*) (**)	Each	Field Book	Field Book	Field Book
707	Finger Plate and Modular Expansion Devise	Expansion Device (Finger Plate)	LNFT	Field Book	Field Book	Field Book
		Expansion Device (Modular)	LNFT	Field Book	Field Book	Field Book
708	Falsework and Form Construction	Falsework Inspection	Lump Sum	Field Book	Invoices	Invoices
710	Concrete Structure Construction	Concrete (*) (**) (***)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
711	Reinforcing Steel	Reinforcing Steel (*) (**)	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Reinforcing Steel (Repair) (*) (**) (Set Price)	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
712	Structural Steel Construction	Structural Steel (*) (**) (***)	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Structural Steel (Merchant Quality)	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
712	Structural Steel Construction Cont.)	Welded Stud Shear Connectors	Each	Field Book	Field Book	Field Book
		Bridge Drainage System	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
			LNFT	Field Book	Field Book	Field Book
			LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
714	Painting Structural Steel	Bridge Painting (*)	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Environmental Protection	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Power Wash	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
715	Prestressed Concrete Members	Prestressed Concrete Beams (*) (**)	LNFT	Field Book & Plans	Field Book & Plans	Field Book & Plans
		Prestressed Concrete Panels	SQFT	Field Book & Plans	Field Book & Plans	Plan Summary of Quantities or Change Order Computation Sheets
716	Post - Tensioning (Haunched Slab Bridges)	Post - Tensioning for Slab Bridge	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
717	Silica Fume Overlay	Silica Fume Overlay (*) (**)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Material for Silica Fume Overlay (Set Price)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
719	Expansion Joint (Strip Seal Assembly) Preformed Elastomeric (Neoprene & Compression & Other)	Expansion Joint (*)	LNFT	Field Book	Field Book	Field Book
721	Handrail for Bridges & Other Uses	Bridge Handrail (*) (**)	LNFT	Field Book	Field Book	Field Book
		Handrail (*) (**)	LNFT	Field Book	Field Book	Field Book
722	Sign Structures & Bridge Mounted Sign Attachments	Bridge Mounted Sign Attachment (*)(**)	Each	Field Book	Field Book	Field Book
		Butterfly Overhead Sign Structure(*)(**)	Each	Field Book	Field Book	Field Book
		Cantilever Sign Structure(*)(**)	Each	Field Book	Field Book	Field Book
		Overhead Sign Structure(*)(**)	Each	Field Book	Field Book	Field Book
		Overhead Sign Structure (Mast Arm Type)(*)(**)	Each	Field Book	Field Book	Field Book
		Overhead Sign Structure (Single Tapered Tube)(*)(**)	Each	Field Book	Field Book	Field Book
		Remove and Reset Sign Structure (***)	Each	Field Book	Field Book	Field Book
		Reset Sign Structure (***)	Each	Field Book	Field Book	Field Book
		Sign Structural Modification (***)	Each	Field Book	Field Book	Field Book
723	Substructure Waterproofing Membrane	Substructure Waterproofing Membrane	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
724	Bridge Backwall Protection System	Bridge Backwall Protection System	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
725	Abutment Drainage Systems	Abutment Strip Drain	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
726	Concrete Masonry Coating	Concrete Masonry Coating	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
727	Repair (Structure)	Bridge Repair	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Jacking of Existing Structure	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Raise Expansion Device	Each	Field Book	Field Book	Field Book
		Remove and Reset Expansion Device	Each	Field Book	Field Book	Field Book
		Reset Existing Bearing	Each	Field Book	Field Book	Field Book
728	Bridge Curb Repair	Bridge Curb Repair	LNFT	Field Book	Field Book	Field Book
729	Multi-Layer Polymer Concrete Overlay	Multi-Layer Polymer Concrete Overlay	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
730	Epoxy Resin Crack Repair	Epoxy Resin Crack Repair	LNFT	Field Book	Field Book	Field Book
731	Area Prepared for Patching (Existing Concrete Bridge Decks)	Area Prepared for Patching	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Area Prepared for Patching (Full Depth)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Area Prepared for Patching (Poured with Overlay)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Reinforcing Steel (Repair) (*) (**) (Set Price)	LBS	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
732	Machine Preparation (Existing Concrete Bridge Decks)	Machine Preparation (*)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
733	Hydrodemolition	Hydrodemolition	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
734	Structural Plate Structures	(*) Structural Plate Pipe (**) (***)	LNFT	Field Book	Field Book	Field Book
		(*) Structural Plate Pipe Arch (**) (***)	LNFT	Field Book	Field Book	Field Book
		(*) Structural Plate Arch (**) (***)	LNFT	Field Book	Field Book	Field Book
735	Precast Reinforced Concrete Box	Reinforced Concrete Box (*) (Precast)	LNFT	Field Book	Field Book	Field Book
07-07001	Bridge Project Marker	Bridge Project Marker	Each	Field Book	Field Book	Field Book
07-07003	Heat Straightening (In-Place) of Damaged Structural Steel	Heat Straightening Repair	LNFT	Field Book	Field Book	Field Book
07-07012	Expansion Joint (Membrane Sealant)	Expansion Joint (Membrane Sealant *)	LNFT	Field Book	Field Book	Field Book
07-07018	Rolled Beam Detour Bridge	Erect and Remove Rolled Beam Detour Bridge	Lump Sum	Field Book	Field Book	Field Book
		Furnish Rolled Beam Detour Bridge	Lump Sum	Field Book	Field Book	Field Book
	DIVISION 800					
801	Mobilization	Mobilization	Lump Sum	Field Book & Plans	Field Book	Field book
		Mobilization (DBE)	Lump Sum	Field Book & Plans	Field Book	Field Book
802	Contractor Construction Staking	Contractor Construction Staking	Lump Sum	Field Book & Plans	Field Book	Field Book
		Right-of-Way Survey Monument	Each	Field Book	Field Book	Field Book
		Benchmark Monument (Concrete Cylinder)	Each	Field Book	Field Book	Field Book
		Monument Box	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
803	Field Office and Laboratory	Field Office	Each	Field Book	Field Book	Field Book
		Field Office & Laboratory (*)	Each	Field Book	Field Book	Field Book
804	Maintenance and Restoration of	Maintenance and Restoration of Haul				
07-08031	Haul Roads	Roads (Set Price)	Lump Sum	Field Book	Field Book	Field Book
805	Work Zone Traffic Control & Safety	Work Zone Signs (0 to 9.25 SQFT)	EADA	Field Book	Field Book	Field Book
		Work Zone Signs (9.26 to 16.25 SQFT)	EADA	Field Book	Field Book	Field Book
		Work Zone Signs (16.26 SQFT and over)	EADA	Field Book	Field Book	Field Book
		Work Zone Signs (Special) (**)	Each	Field Book	Field Book	Field Book
		Work Zone Barricades (Type III - 4 to 12 LNFT)	EADA	Field Book	Field Book	Field Book
		Arrow Display	EADA	Field Book	Field Book	Field Book
		Portable Changeable Message Sign	EADA	Field Book	Field Book	Field Book
		Channelizer (Fixed)	EADA	Field Book	Field Book	Field Book
		Channelizer (Portable)	EADA	Field Book	Field Book	Field Book
		Work Zone Warning Light (Type "A" Low Intensity)	EADA	Field Book	Field Book	Field Book
		Work Zone Warning Light (Red Type "B" Low Intensity)	EADA	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) 4" Broken (8.2 ft) (*Tape)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) 4" Solid (*Tape)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) 4" Broken (3.3 ft) (*Tape)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) 4" Broken (Raised Pavement Marker)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) 4" Dotted Extension (*Tape)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) Broken (Line Masking Tape)	STAL	Field Book	Field Book	Field Book
		Pavement Marking (Temporary) Solid (Line Masking Tape)	STAL	Field Book	Field Book	Field Book
		Flagger (Set Price)	Hour	Field Book	Field Book	Field Book
		Traffic Signal Installation (Temporary)	Lump Sum	Field Book	Field Book	Field Book
		Temporary Raised Pavement Marker (*)	Each	Field Book	Field Book	Field Book
		Traffic Control	Lump Sum	Field Book	Field Book	Field Book
		Traffic Control (Initial Set Up)	Lump Sum	Field Book	Field Book	Field Book
07-08030		Barricade (Type III) (Fixed)	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
806	Durable Pavement Marking	Pavement Marking (*) (**) (***) (*****)	LNFT	Field Book	Field Book	Field Book
07-08024		Pavement Marking (Plowable Raised Pavement Marker) (**)	Each	Field Book	Field Book	Field Book
		Pavement Marking Symbol (*) (**) (****) (*****)	Each	Field Book	Field Book	Field Book
807	Painted Pavement Marking	Pavement Marking (Paint) (*) (**)	LNFT	Field Book	Field Book	Field Book
		Pavement Marking Symbol (Paint) (*) (***)	Each	Field Book	Field Book	Field Book
808	Removal of Existing Pavement Marking	Pavement Marking Removal	LNFT	Field Book	Field Book	Field Book
07-08025		Pavement Marking Removal (Plowable Raised Marker)	Each	Field Book	Field Book	Field Book
809	Concrete Safety Barrier	Concrete Safety Barrier (*)	LNFT	Field Book	Field Book	Field Book
		Concrete Safety Barrier (*) (Temporary)	LNFT	Field Book	Field Book	Field Book
		Concrete Safety Barrier (*) (Temporary - Installation Only)	LNFT	Field Book	Field Book	Field Book
		Concrete Safety Barrier (*) (Temporary - Relocate)	LNFT	Field Book	Field Book	Field Book
810	Inertial Barrier System	Inertial Barrier System	Each	Field Book	Field Book	Field Book
		Replacement Modules (*)	Each	Field Book	Field Book	Field Book
811	Impact Attenuator	Impact Attenuator (*)	Each	Field Book	Field Book	Field Book
		Impact Attenuator (Temporary)	Each	Field Book	Field Book	Field Book
07-08034		Replacement Module	Each	Field Book	Field Book	Field Book
812	Permanent Signing					Plan Summary of Quantities or Change Order Computation Sheets
		Sign (*1) (High Performance)	SQFT	Field Book & Plans	Field Book	Field Book
		Sign Post (4" x 6" Wood) (*2)	LNFT	Field Book	Field Book	Field Book
		Sign Post (*3 Steel Beam)	LNFT	Field Book	Field Book	Field Book
		Sign Post (*4 U Steel)	LNFT	Field Book	Field Book	Field Book
		Sign Post (*5 Perforated Square Steel Tube)	LNFT	Field Book	Field Book	Field Book
		Sign Post (4" x 6" Structural Steel)	LNFT	Field Book	Field Book	Field Book
		Sign Post (3 I 2.25 Aluminum)	LNFT	Field Book	Field Book	Field Book
		Sign Post Stub and Breakaway Base Plate (*3)	Each	Field Book	Field Book	Field Book
		Sign Post Breakaway Base Plate (*3)	Each	Field Book	Field Book	Field Book
		Sign Post Footing (*6 Concrete)	LNFT	Field Book	Field Book	Field Book
		Sign Post Footing (*5 Perforated Square Steel Tube)	Each	Field Book	Field Book	Field Book
		Signing Object Marker (*7)	Each	Field Book	Field Book	Field Book
		Signing Delineator (*8) (*9 Rigid, "U" Post)	Each	Field Book	Field Book	Field Book
		Signing Delineator (*8) (*9 Flexible) (*10 Anchor)	Each	Field Book	Field Book	Field Book
		Signing Delineator (*8) (*9 Bracket)	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
812	Permanent Signing (Cont.)	Sign (Remove and Reset)	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
07-08022		Sign Post Square Coupler (*)	Each	Field Book	Field Book	Field Book
		Sign Post Footing (Sign Post Square Coupler) (*)	Each	Field Book	Field Book	Field Book
813	Rumble Strips (Milled) and	Rumble Strips (Milled) (*)	STA	Field Book	Field Book	Field Book
07-08029	Rumble Strips (Milled) (Centerline)					
		Rumble Strips (Milled) (*) (Centerline)	STA	Field Book	Field Book	Field Book
		Rumble Strips (Milled) (*) (Edgeline)	STA	Field Book	Field Book	Field Book
814	Electrical Lighting Systems and	Electric Lighting System	Lump Sum	Field Book & Plans	Field Book	Plan Summary of Quantities
	Traffic Signals	Electric Conduit (*) (**)	LNFT	Field Book	Field Book	Field Book
		Electric Service Box	Each	Field Book	Field Book	Field Book
		Traffic Signal	Lump Sum	Field Book & Plans	Field Book	Plan Summary of Quantities
		Traffic Signal Interconnect	Lump Sum	Field Book & Plans	Field Book	Plan Summary of Quantities
		Emergency Vehicle System	Lump Sum	Field Book & Plans	Field Book	Plan Summary of Quantities
815	Catch Basins, Inlets, Outlets,	Catch Basin *	Each	Field Book	Field Book	Field Book
	Manholes, Junction Boxes & Other	Inlet *	Each	Field Book	Field Book	Field Book
	Existing Structures	Outlet *	Each	Field Book	Field Book	Field Book
		Manhole *	Each	Field Book	Field Book	Field Book
		Junction Box	Each	Field Book	Field Book	Field Book
816	Adjustment of Inlets, Manholes &	Adjustment of Catch Basins	Each	Field Book	Field Book	Field Book
	Other Existing Structures	Adjustment of Curb Inlets	Each	Field Book	Field Book	Field Book
		Adjustment of Manholes	Each	Field Book	Field Book	Field Book
		Structural Steel	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Cast Steel	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Cast Iron	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
817	Pipe Culverts, Erosion Pipe, Storm	Entrance Pipe (*) (**) (+) (++) (^) (^^)	LNFT	Field Book	Field Book	Field Book
07-08023	Sewers, Sanitary Sewers & End					
	Sections	Cross Road Pipe (*) (**) (+) (++) (^) (^^)	LNFT	Field Book	Field Book	Field Book
		Erosion Pipe (*) (**) (+) (++) (^) (^^)	LNFT	Field Book	Field Book	Field Book
		Liner Pipe (*) (**)	LNFT	Field Book	Field Book	Field Book
		Storm Sewer (*) (**) (^) (^^)	LNFT	Field Book	Field Book	Field Book
		Sanitary Sewer (*) (**)	LNFT	Field Book	Field Book	Field Book
		End Section (*) (**) (+) (++)	Each	Field Book	Field Book	Field Book
		Concrete Headwall	Each	Field Book	Field Book	Field Book
		Fly Ash Slurry Grout (xx)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
818	Encasement Pipe	Encasement Pipe (*) (**) (***)	LNFT	Field Book	Field Book	Field Book
819	Bored, Jacked or Tunneled Pipe	* (Bored, Jacked or Tunneled)	LNFT	Field Book	Field Book	Field Book
820	Flume Inlets & Slope Drains	Flume Inlet (*)	Each	Field Book	Field Book	Field Book
		Slope Drain (*)	LNFT	Field Book	Field Book	Field Book
		Slope Drain (Special)	LNFT	Field Book	Field Book	Field Book
821	Flapgates	(*) Flapgates	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
822	Underdrains	* Pipe Underdrains (Type **)	LNFT	Field Book	Field Book	Field Book
		Aggregate for Blanket Underdrains	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
			CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
823	Prefabricated Interception Devices & Slotted Drains	Prefabricated Interception Device (*)	Each	Field Book	Field Book	Field Book
		Slotted Drain (**)	LNFT	Field Book	Field Book	Field Book
824	Concrete Sidewalk, Steps and Ramps					Plan Summary of Quantities or Change Order Computation Sheets
		Sidewalk Construction (*) (**)	SQYD	Field Book	Computation Sheets	
		Sidewalk Ramp	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Grade 3.0 Concrete (Misc.)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Reinforcing Steel	LBS	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
825	Curb & Gutter	Curb, Edge (*) (**)	LNFT	Field Book	Field Book	Field Book
		Curb, Header (**)	LNFT	Field Book	Field Book	Field Book
		Curb & Gutter, Combined (**)	LNFT	Field Book	Field Book	Field Book
		Gutters (**)	LNFT	Field Book	Field Book	Field Book
		Curb, Protection (*) (**)	LNFT	Field Book	Field Book	Field Book
		Curb, Asphaltic Concrete	LNFT	Field Book	Field Book	Field Book
		Gutters, Asphaltic Concrete	LNFT	Field Book	Field Book	Field Book
		Curb & Gutters, Asphaltic Concrete	LNFT	Field Book	Field Book	Field Book
		Curb Repair	LNFT	Field Book	Field Book	Field Book
826	Shot - Crete Concrete	Shot - Crete	*			
07-08019	Concrete Surface Repair					Plan Summary of Quantities or Change Order Computation Sheets
		Concrete Surface Repair	SQFT	Field Book	Computation Sheets	
827	Guardrail & Guideposts	Guardrail, Steel Plate	LNFT	Field Book	Field Book	Field Book
		Guardrail, Cable	LNFT	Field Book	Field Book	Field Book
		Guardrail, Removal of Steel Plate	LNFT	Field Book	Field Book	Field Book
		Guardrail, Removal of Cable	LNFT	Field Book	Field Book	Field Book
		Guardrail, Removal of Timber	LNFT	Field Book	Field Book	Field Book
		Guardrail, Reconstruction of Steel Plate	LNFT	Field Book	Field Book	Field Book
		Guardrail, Reconstruction of Cable	LNFT	Field Book	Field Book	Field Book
		Guardrail, Removal & Reconstruction of Steel Plate	LNFT	Field Book	Field Book	Field Book
		Guardrail, Removal & Reconstruction of Cable	LNFT	Field Book	Field Book	Field Book
		Guideposts	Each	Field Book	Field Book	Field Book
		Guideposts, Removal of	Each	Field Book	Field Book	Field Book
		Guideposts, Resetting of	Each	Field Book	Field Book	Field Book
		Guideposts, Removal & Resetting of	Each	Field Book	Field Book	Field Book
		Guardrail Posts	Each	Field Book	Field Book	Field Book
		Guardrail End Terminals (*)	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
828	Fencing	Fence (*) (**) (***)	LNFT	Field Book	Field Book	Field Book
		Fence (*) (Temporary)	LNFT	Field Book	Field Book	Field Book
		Fence (*) (Removal & Resetting)	LNFT	Field Book	Field Book	Field Book
		Fence (*) (Removal of Existing)	LNFT	Field Book	Field Book	Field Book
		Gate (*) (**)	Each	Field Book	Field Book	Field Book
		Posts (Corner) (*)	Each	Field Book	Field Book	Field Book
		Posts (End) (*)	Each	Field Book	Field Book	Field Book
		Posts (Pull) (*)	Each	Field Book	Field Book	Field Book
		Floodgates	Each	Field Book	Field Book	Field Book
829	Riprap					Plan Summary of Quantities or Change
		Riprap (*) (**)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
830	Slope Protection					Plan Summary of Quantities or Change
		Bedding for Slope Protection	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Slope Protection (*) (**) (***)	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Slope Protection (Gabion)	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Slope Protection (Special)	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Geotextile Fabric	SQYD	Field Book	Computation Sheets	Order Computation Sheets
831	Ditch Lining			Load Tickets & Field	Load or Scale Tickets, in Field	Load Tickets or Scale Tickets, Recap in
		Aggregate Ditch Lining (*)	Ton	Book	Book	Field Book
				Load Tickets & Field	Load or Scale Tickets, in Field	Load Tickets or Scale Tickets, Recap in
		Aggregate Backslope Ditch Lining	Ton	Book	Book	Field Book
						Plan Summary of Quantities or Change
		Concrete Ditch Lining	SQYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Concrete Backslope Ditch Lining	SQYD	Field Book	Computation Sheets	Order Computation Sheets
832	Gabions					Plan Summary of Quantities or Change
		Gabions	CUYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
			SQYD	Field Book	Computation Sheets	Order Computation Sheets
833	Pavement Patching			Load Tickets & Field	Load or Scale Tickets, in Field	Load Tickets or Scale Tickets, Recap in
		Asphalt Pavement Patching	Ton	Book	Book	Field Book
						Plan Summary of Quantities or Change
		PCCP Patching (*) (**) (***)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		PCCP Edge Joint Patching (***)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		PCCP Joint Patching (Full Depth)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		PCCP Joint & Crack Patching (***)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
		Extra Work Saw Cuts (Set Price)	LNFT	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
834	Undersealing			Load Tickets & Field	Bag Tally, Load or Scale	Bag Tally, Load Tickets or Scale Tickets,
		Fly Ash (Undersealing)	Ton	Book	Tickets, in Field Book	Recap in Field Book
		Injection Holes	Each	Field Book	Field Book	Field Book
835	Resealing Joints & Sealing Cracks in Existing PCCP & HMA Pavements	Sealing PCCP Joints (Longitudinal)	LNFT	Field Book	Field Book	Field Book
		Sealing PCCP Joints (Transverse)	LNFT	Field Book	Field Book	Field Book
		Sealing PCCP Cracks (>1/8"<2")	LNFT	Field Book	Field Book	Field Book
		Sealing Spalled PCCP Joints & Cracks (>2"≤3")	LNFT	Field Book	Field Book	Field Book
		Sealing Spalled PCCP Joints & Cracks, Type A or B (>2"≤3")	LNFT	Field Book	Field Book	Field Book
		Sealing Asphalt Cracks (>1/8"≤1/2")	LNFT	Field Book	Field Book	Field Book
		Sealing Asphalt Cracks (>1/2"<1/2")	LNFT	Field Book	Field Book	Field Book
		Sealing Longitudinal Asphalt Shoulder Joint	LNFT	Field Book	Field Book	Field Book
836	Surfacing for Side Roads & Entrances			Load Tickets & Field	Load or Scale Tickets, in Field	Load Tickets or Scale Tickets, Recap in
		Surfacing Material (*)	Ton	Book	Book	Field Book
837 07-08033	Pavement Widening, Shouldering & Pavement Edge Wedge	Shoulders (Earth) (HMA Widening)	STA	Field Book	Field Book	Field Book
		Shoulders (Aggregate) (HMA Widening)	STA	Field Book	Field Book	Field Book
		Pavement Edge Wedge (Earth)	STA	Field Book	Field Book	Field Book
		Pavement Edge Wedge (Rock)	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
		Aggregate for Shoulders (AS-1)	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
		Common Excavation (Contractor-Furnished)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Water for Earthwork Compaction (Set Price)	MGAL	Field Book	Load Tickets or Water Meter Reading	Load Tickets or Water Meter Reading
838 07-08032	Grinding Rehab Concrete Pavement	Grinding Concrete Surface	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
839	Rubbilizing Portland Cement Concrete Pavement	Crushed Stone for Backfill	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Removal of Asphaltic Material	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Rubbilized Concrete	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
840	Temporary Surfacing	Temporary Surfacing Material (Aggregate) (Set Price)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Temporary Surfacing Material (HMA) (Set Price)	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
841	Light Type Surfacing	Light Type Surfacing (*)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
842	Drilling & Grouting	Drilling & Grouting	Each	Field Book	Field Book	Field Book
		Drilling & Grouting (Repair) (Set Price)	Each	Field Book	Field Book	Field Book

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
843	Flowable Fill	Flowable Fill (*)	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
844	Slurry Grout	Slurry Grout (*)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
845	Cleaning Existing Structures & Underdrains	Cleaning Existing Structures	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Cleaning Existing Underdrains	LNFT	Field Book	Field Book	Field Book
846	Transporting Salvageable Material	Transporting Salvageable Material	*			
				Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
			Ton			
			Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
847	Mailbox Installation	Mailbox Installation (Set Price)	Each	Field Book	Field Book	Field Book
07-08003	Dowel Bar Retrofit (Existing Portland Cement Concrete Pavement)	Dowel Bar Retrofit (*)	Each	Field Book	Field Book	Field Book
07-08004	Bridge Approach Slab Footing	Bridge Approach Slab Footing	CUYD	Field Book & Plans	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08005	Retaining Wall System	Retaining Wall (*)	SQFT	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08006	Tie Bar Insertion	Tie Bar Insertion	Each	Field Book	Field Book	Field Book
07-08007	Adjustment of Meter and Valve Boxes	Adjustment of Meter Box (*)	Each	Field Book	Field Book	Field Book
		Adjustment of Valve Box (*)	Each	Field Book	Field Book	Field Book
07-08008	Solid Interlocking Paving Units (Paving Bricks)	Paving Brick	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08009	Loop Detector Replacement	Loop Detector Replacement (Set Price)	LNFT	Field Book	Field Book	Field Book
07-08010	Pavement Waterproofing Membrane	Pavement Waterproofing Membrane	LNFT	Field Book	Field Book	Field Book
07-08012	Sanitary Sewer System	Sanitary Sewer System	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
07-08013	Plugging Wells	Plugging (*) Wells	Each	Field Book	Field Book	Field Book
07-08014	Compaction Grouting	Compaction Grouting	LNFT	Field Book	Field Book	Field Book
		Compaction Grout	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08015	Prefabricated Vertical Drain	Prefabricated Vertical Drain	LNFT	Field Book	Field Book	Field Book
07-08016	Granular Drainage Blanket	Granular Drainage Blanket (*)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08017	Separation Geotextile	Separation Geotextile	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08018	Landscape Retaining Wall System	Landscape Retaining Wall	SQFT	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
07-08020	Courtesy Towing	Towing (Courtesy) (Set Price)	Each	Field Book	Field Book	Field Book
07-08021	Adjustment of Existing Structure	Adjustment of Existing Structure	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
07-08028	Railroad Signing & Protective Liability Insurance	Reflectorized Advance-Warning Signs	Each	Field Book	Field Book	Field Book
		Reflectorized Railroad Crossing Signs	Each	Field Book	Field Book	Field Book
		Railroad Protective Liability Insurance	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
	DIVISION 900					
901	Temporary Erosion & Pollution Control	Temporary Berm	LNFT	Field Book	Field Book	Field Book
		Temporary Slope Drain	LNFT	Field Book	Field Book	Field Book
		Temporary Slope Barrier (Set Price)	LNFT	Field Book	Field Book	Field Book
		Temporary Ditch Check	LNFT	Field Book	Field Book	Field Book
		Temporary Ditch Check (Rock) (Set Price)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Temporary Inlet Sediment Barrier	Each	Field Book	Field Book	Field Book
		Temporary Sediment Basin	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Temporary Steam Crossing	Each	Field Book	Field Book	Field Book
		Sediment Removal (Set Price)	CUYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Temporary Fertilizer (**)	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Temporary Seed (****)	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Soil Erosion Mix	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Temporary Seeding	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Erosion Control (*)	SQYD	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Mulching (Temporary)	ACRE	Field Book	Computation Sheets	Plan Summary of Quantities or Change Order Computation Sheets
		Mobilization (Emergency Erosion Control) (Set Price)	Each	Field Book	Field Book	Field Book
07-09002		Curb Inlet Protection	LNFT	Field Book	Field Book	Field Book
902	Fertilizer, Agricultural Limestone & Peat Moss	Fertilizer (*-**-***)	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Agricultural Limestone	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
		Peat Moss	Ton	Load Tickets & Field Book	Load or Scale Tickets, in Field Book	Load Tickets or Scale Tickets, Recap in Field Book
903	Seeding	Seed (*)	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Seed (Hydro) (*)	LBS	Load Tickets & Field Book	Bag Tally, Load or Scale Tickets, in Field Book	Bag Tally, Load Tickets or Scale Tickets, Recap in Field Book
		Seeding	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities

Section	Section Title	Pay Item	Unit	Field Record	Source Documents for Intermediate Pay Quantities	Source Documents for Final Pay Quantities
904	Mulching					Plan Summary of Quantities or Change
		Mulching (Temporary)	ACRE	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Mulching (Permanent) (Set Price)	ACRE	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Mulching Tacking Slurry	ACRE	Field Book	Computation Sheets	Order Computation Sheets
						Plan Summary of Quantities or Change
		Mulching (Hydro)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
905	Topsoil					Plan Summary of Quantities or Change
		Topsoil	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
906	Sodding					Plan Summary of Quantities or Change
		Sod (*) (**)	SQYD	Field Book	Computation Sheets	Order Computation Sheets
907	Trees, Shrubs & Other Plans	Furnishing & Planting Plant Materials	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
		Transplanting Existing Plants	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities
908	Mowing	Mowing	PMPS	Field Book	Field Book	Field Book
910	Stone Masonry Tree Wells					Plan Summary of Quantities or Change
		Stone Masonry for Tree Wells	CUYD	Field Book & Plans	Computation Sheets	Order Computation Sheets
911	Park Structures	Bench	Each	Field Book	Field Book	Field Book
		Grill	Each	Field Book	Field Book	Field Book
		Table (*)	Each	Field Book	Field Book	Field Book
		Table Shade (**)	Each	Field Book	Field Book	Field Book
		Waste Receptacle	Each	Field Book	Field Book	Field Book
		Comfort Station (***)	Each	Field Book	Field Book	Field Book
		Comfort Station (Modification)	Each	Field Book	Field Book	Field Book
912	Water Systems	Water System	Lump Sum	Field Book & Plans	Computation Sheets	Plan Summary of Quantities