
3.0 TEMPORARY DETOUR BRIDGES

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3.0 TEMPORARY DETOUR BRIDGES

3.1 General

A bridge replacement or substantial repair usually impedes existing traffic patterns. To maintain traffic through or around the bridge site, the options are to (1) detour on other state routes, (2) carry traffic on an offset alignment, (3) carry traffic through the site with stage construction, or (4) construct a shoo-fly. A shoo-fly crossing a stream will require a temporary span bridge if the hydraulic requirements are greater than what pipes can provide.

A temporary span bridge used in a shoo-fly detour will be referred to throughout this chapter as a Detour Bridge. KDOT has an inventory of 14 Detour Bridge spans. When not in use, they are stockpiled at selected storage sites throughout the state. A Detour Bridge has a total deck width of 30'-6" and a roadway of 28'-0". Each Detour Bridge span has a total end to end length of 69'-0". Single span or multiple simple span Detour Bridges may be constructed, depending upon the waterway opening required.

The plan details are developed for Detour Bridges to be placed on tangent alignment and at zero percent grade.

Detour Bridges vary as follows:

- The method of attaching the deck panels.
- The backwall option selected by the Contractor.
- The pile type required.

There are two types of deck panels, the "K" and the "N". Each type has a different method of attaching to the steel rolled beam girders. Steel H-piles are used at the abutments and piers if the piles are driven to point bearing in the underlying geology. Concrete piles are used as friction pile, when point bearing cannot be achieved. The two pile types require different details for constructing the abutments and piers. A multi-span detour bridge may consist of "K" panels and "N" panels. It is possible to use both "K" and "N" panels in a single span, but only if that span has girders for "K" panels. It is recommended that only one panel type be used per span.

3.2 STORAGE SITES:

A storage site is used for the stockpiling of detour bridge parts when a project is completed and the Detour Bridge is dismantled and transported from the construction site. The KDOT Area Engineer from the area in which the project is constructed selects the storage site. Prior to finalizing the design plans, the Area Engineer should inform the Bridge Design Squad Leader of the storage site location. This should be done during or shortly after the field check. Storage site locations have varied from cold mix strips to maintenance yards. Storage site locations are listed in the Transportation Note on the General Notes Sheet and on the Inventory Sheet. If the final storage location changes from the site listed in the plans, notify KDOT Bureau of Design, Attention: Gary Chan.

At the beginning of a project, the Contractor receives the Detour Bridge parts from the storage sites listed in the plans. The Detour Bridge manager selects these sites based upon their proximity to the construction site. More than one receiving site may be listed due to the number of Detour Bridge spans required and the distribution of these spans throughout the various storage sites. These sites are also listed in the Transportation Note on the General Notes Sheet and on the Inventory Sheet.

3.3 BID ITEMS:

The two bid items used in the plans for Detour Bridges are as follows:

- "Erection and Removal of Rolled Beam Detour Bridge".
- "Furnish Rolled Beam Detour Bridge".

The Lump Sum bid item, Erection and Removal of Rolled Beam Detour Bridge is used for every Detour Bridge application. This bid item consists of the following:

- Conducting the pre-construction inventory.
- Loading and unloading the bridge parts from the storage and construction sites to the transporting vehicle.
- Transporting these parts between sites.
- Preparing the Detour Bridge site.
- Erecting or constructing the Detour Bridge.
- Maintaining the bridge during the service life of the project.
- Repairing damaged galvanized coatings as directed by the Engineer.
- Dismantling the bridge upon completion of the project.
- Conducting the post-construction inventory.
- Providing all labor, tools, equipment and incidentals necessary to complete the work.

All replacement parts and other items listed in Column 4 ("Refit Rolled Beam Detour Bridge") of the Inventory Sheet are subsidiary to this bid item. The Lump Sum bid item, "Furnish Rolled Beam Detour Bridge" consists of Contractor furnished Detour Bridge parts. These parts are for one or more complete bridge spans that are required when the need exceeds the existing inventory. The parts furnished are listed in Column No. 5 of the Inventory Sheet.

3.4 INDEX OF PLAN SHEETS with H-Pile:

The sequence of detail sheets as they appear in the plans is:

1. General Notes

2. Construction Layout

a. The Lump Sum Bid Items are listed on this sheet.

3. Geology Sheet

This information is included only if the geological formations at the site vary in thickness, type and elevation. If the formations are uniform and predictable, this sheet is not included and the required pile lengths are based on the geological profile for the mainline bridge replacement.

4. Inventory Sheet

5. Optional Abutment Details

The Contractor can select one of two available methods of constructing the abutment backwall. Most Contractors prefer Option "B".

6. Substructure Details

7. Bearing Device Details

8. Framing Plan and Diaphragm Details

9. K-Connection of Deck Panels

10. N-Connection of Deck Panels

11. Safety Barrier Curb, Precast

3.5 INVENTORY SHEET FOR DETOUR BRIDGES WITH H-PILE:

The Inventory Sheet, as the name implies, is simply a record of the parts required to construct the Detour Bridge. The Design Engineer is responsible for recording all of the information in Columns 2 through 5. After the project is Let, the Construction Engineer is responsible for recording all of the information in Columns 6 through 10. The name of the Construction Engineer who conducts the pre-construction and post-construction inventories, and the date of the post-construction inventory, is to be recorded at the top of the sheet.

The Construction Engineer is required to send a completed copy of the Inventory Sheet, which includes the pre-construction and post-construction inventories, to:

Gary Chan, P.E.

KDOT Bureau of Design

13th Floor - Dwight D. Eisenhower State Office Building

Topeka, KS 66603

3.5.1 COLUMN HEADINGS:

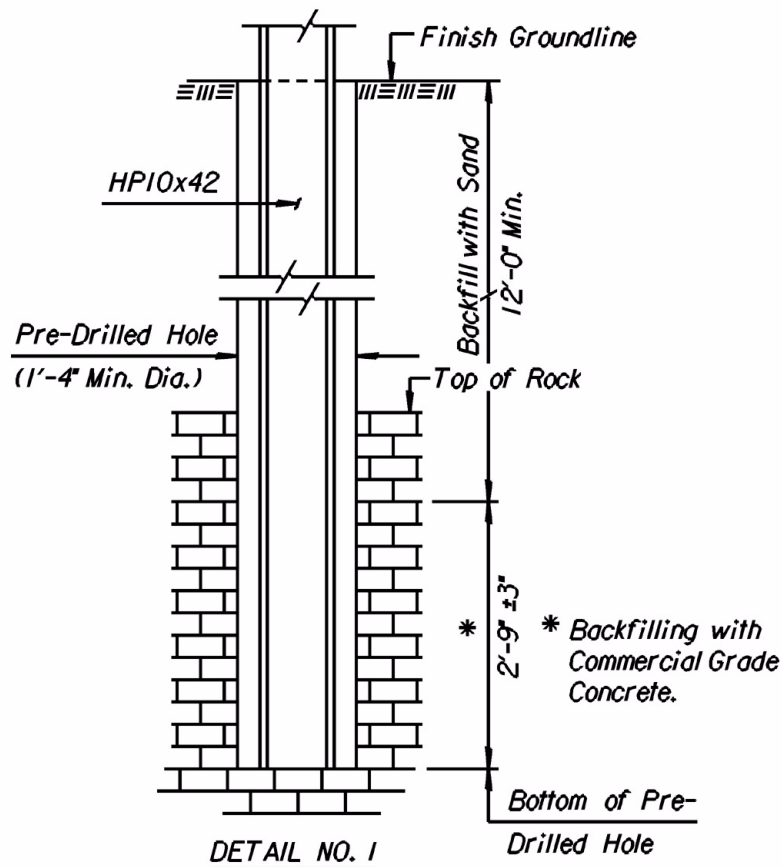
An explanation of the Column Headings is as follows.

3.5.2 LINE ITEMS:

Comments of the Line Items are as follows:

1. Pre-Drilled Pile Holes:

Pre-drilled pile holes are required only when detailed on the Construction Layout and/or Geology Details sheet and listed on the Inventory sheet in Line Item No. 1. They are used only in conjunction with H-pile. (See Detail No. 1) After pre-drilling the hole and inserting the H-pile, the pile will be driven to refusal. Temporary casing may be required to support the hole prior to backfilling. Backfill the bottom 2'-6" +/- 3" of the hole with commercial grade concrete. Backfill the remainder of the hole with sand. The quantity of pre-drilled pile holes, in linear feet, is listed in Column 4, "Refit Rolled Beam Detour Bridge" and is **subsidiary** to the bid item, "Erection and Removal of Rolled Beam Detour Bridges". It includes all drilling or auguring, backfill material, and all labor, tools, equipment and incidentals necessary to complete the work

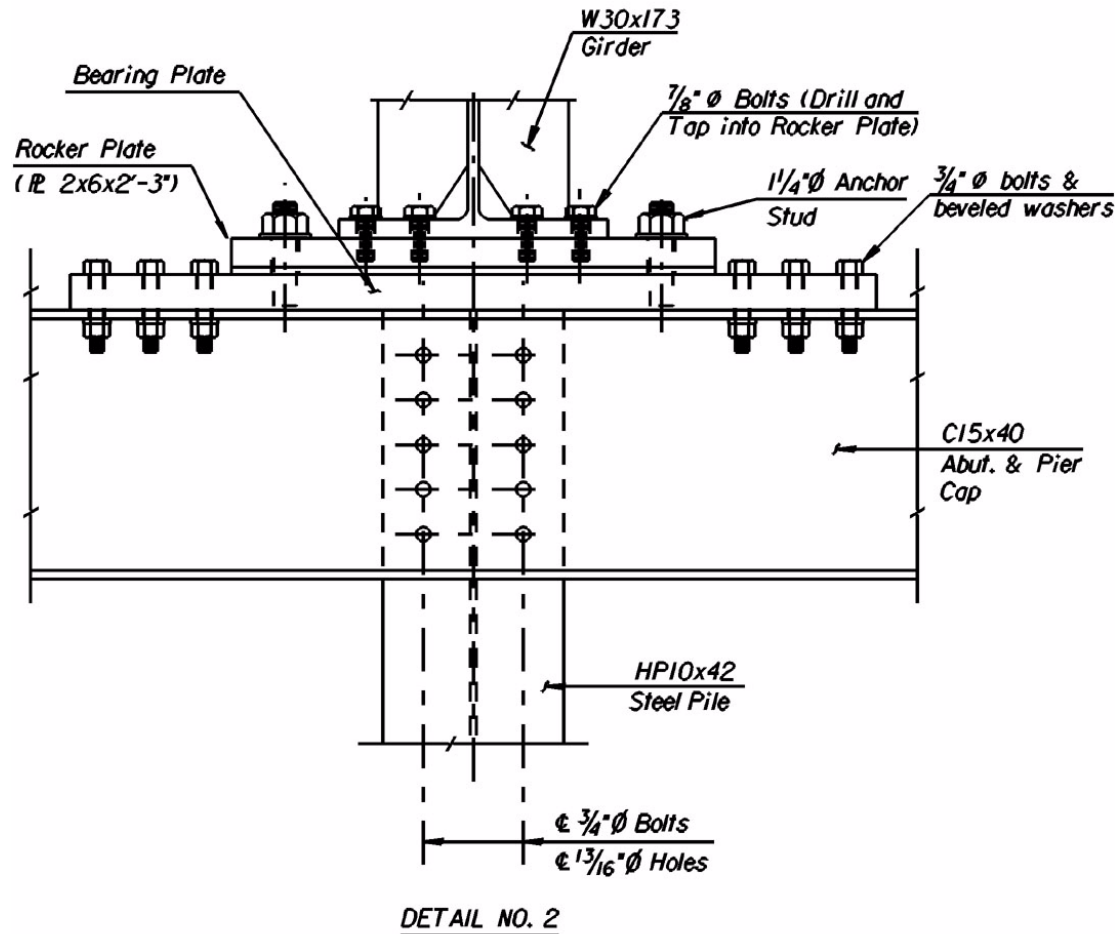


2. Support Bracing:

See the Substructure Details sheet for H-Pile for support bracing requirements. Support bracing of piling at the piers is required to prevent lateral buckling (failure) of the piles about their weak axis. It shall be supplied and installed as required by plan details. The quantity is listed "as required" in Column 4 and is subsidiary to the bid item, "Erect and Remove Rolled Beam Detour Bridge".

3. Steel Pile (HP 10x42):

Drive the steel pile to bearing at the stations detailed on the Construction Layout Sheet. The piles are located directly below the ends of the beams and the bearing devices. There are six pile (six girder lines) at each pier and eight pile (six girder lines and one at each wingwall) at each abutment. The bearing device plates are bolted to pre-drilled steel channel caps which are bolted to the pile flanges. (See Detail No. 2)



Therefore, extra effort must be taken by the Contractor to obtain proper alignment, spacing and relative location of all pile in the abutment and pier pile groups. This may require forcing the tops of the piles in alignment and spacing after the piles have been driven to point bearing.

There is only one pile per wingwall. Wingwall pile are a maximum of 25' long and are not driven to bearing. Their only function is to resist the lateral soil pressures on the wingwalls created by the approach embankments.

Piling remains the property of the Contractor. It may be salvaged by total removal, removed to a minimum of 1' below finished ground line, or removed to a depth as stated in the plans. The required pile lengths are shown on the Construction Layout sheet and listed on the Inventory Sheet. Steel pile quantities are listed in Column 4 and are subsidiary to the bid item "Erect and Remove Rolled Beam Detour Bridge".

4. Abutment Caps and Pier Caps:

The C15x40 channels are the pier and abutment caps, which receive the reactions from the bearing device plates and transfer those reactions to the piling. The channels are fabricated with bolt

holes for attachment of the bearing device plates and for attachment to the pile flanges. (See Detail No. 2) .

Once the channels have been positioned to correct elevation and held firmly in place, field drill bolt holes are through the steel pile flanges. The bolt hole pattern in the channels is used as a template for the field drilling.

KDOT's early Detour Bridges had two steel H-pile at each abutment wingwall. The abutment channel caps from these early bridges have ten bolt hole patterns for attachment to ten abutment piling. However, the current design uses only one pile per wingwall for a total of eight pile per abutment. The first interior bolt hole pattern from each end of an abutment channel that has a total of ten bolt hole patterns should be ignored.

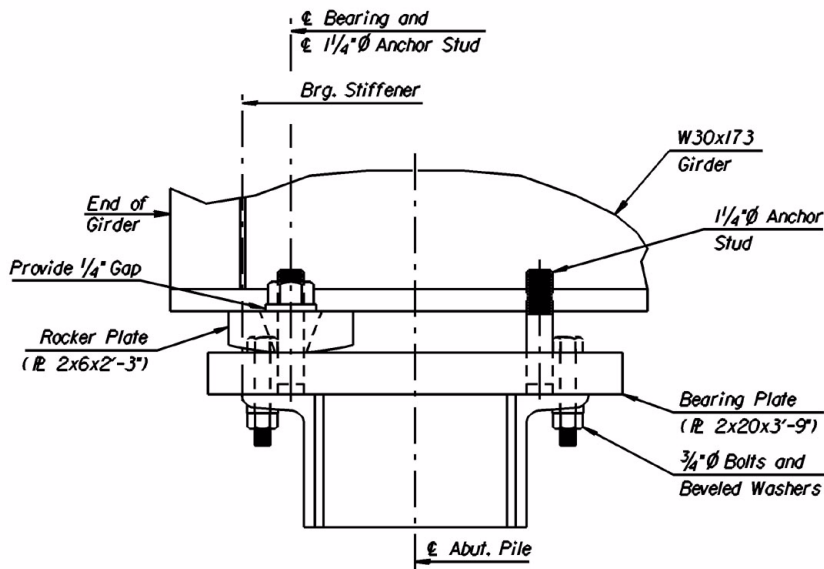
All abutment channels are interchangeable - any abutment channel can be used at either abutment for any bridge. All pier channels are interchangeable - any pier channel can be used at any pier for any bridge.

5. Bearing Plate with Anchor Studs:

The bearing plates are interchangeable. They can be used at the abutments or at the piers. (See Details No. 3 and No.4).

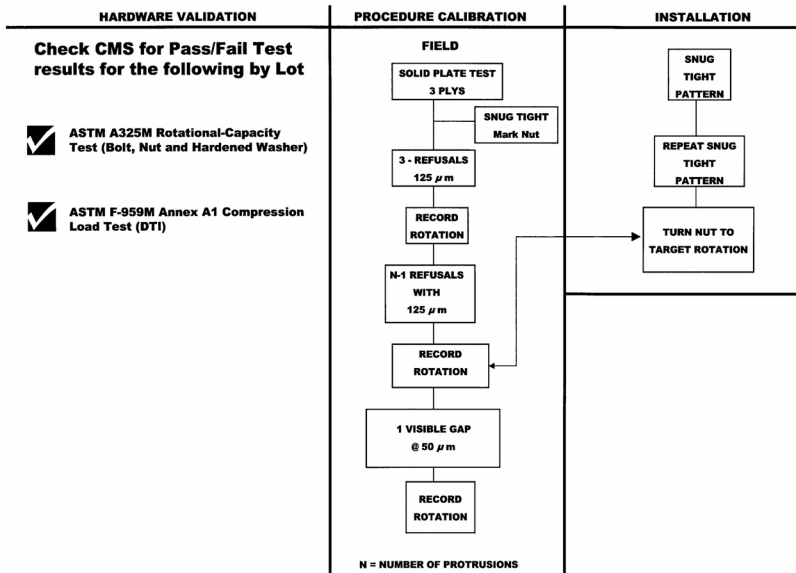
6. Rocker Plates:

The rocker plates are interchangeable. They can be used at the abutments or at the piers. The rocker plates are not to be removed from the rolled beams when the Detour Bridge is disassembled at the end of a project. They are stockpiled at a storage site still attached to the beams with the drill and tap bolts. (See Detail No. 3 and 4)



DETAIL NO. 3

Bolting Operation Flow Chart
(EXAMPLE FOR A325M M24 BOLTS)



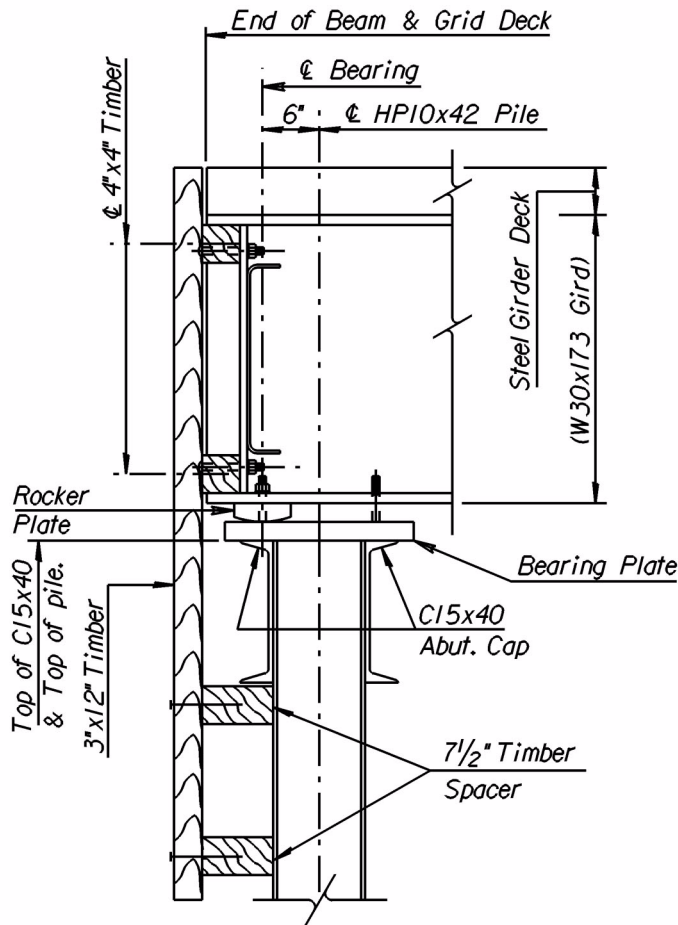
7. Timber:

Timber is used in construction of the abutment backwalls. The timber supplied by the Contractor shall be full size but is not required to be treated. The timber shall remain the property of the

Contractor after the project is completed. Timber listed in column 1 of the Inventory sheet is for both abutment backwalls.

8. Options A and B:

The required number of timber items, which are listed in Column 2 of the Inventory sheet, are based on abutment option B, which seems to be the preference of the Contractors. (See Detail No. 5).



DETAIL NO. 5

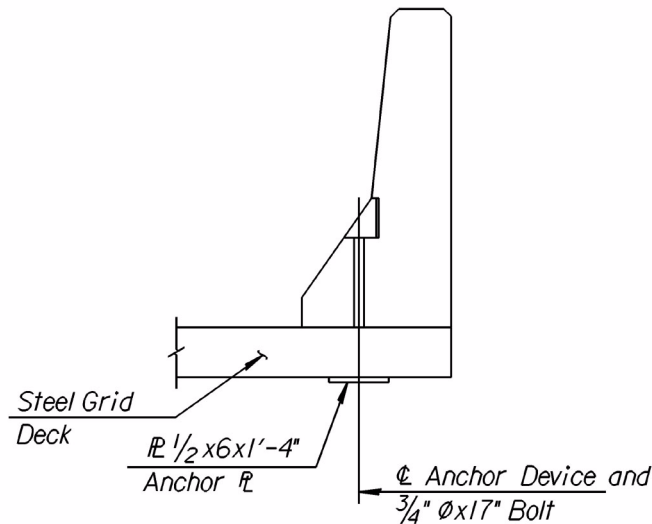
8. Precast Concrete Safety Barriers, Interior and End Units:

Eighteen units are required per span, nine on each side of the bridge. Four end units are required per bridge. The plan details show a left-handed end unit. (When viewing the front or roadway side of the unit, the bolt holes for the guard fence attachment are at the left end of the unit). Every detour bridge requires two left-handed end units and two right-handed end units. It is the Engineer's responsibility to see that one extra of each end unit and a minimum of two extra interior units are stored at the construction site at all times for immediate replacement of damaged units.

These extra units are not included in Columns 2 through 4. If there are not enough units at the stockpile site, the Contractor is required to fabricate and supply the additional units.

9. Anchor Plates:

Anchor plates are located at the bottom of the deck panels and used as washer plates for the 17" bolts that hold the barrier units in place. Two anchor plates are required for each barrier unit. (See Detail No. 6).

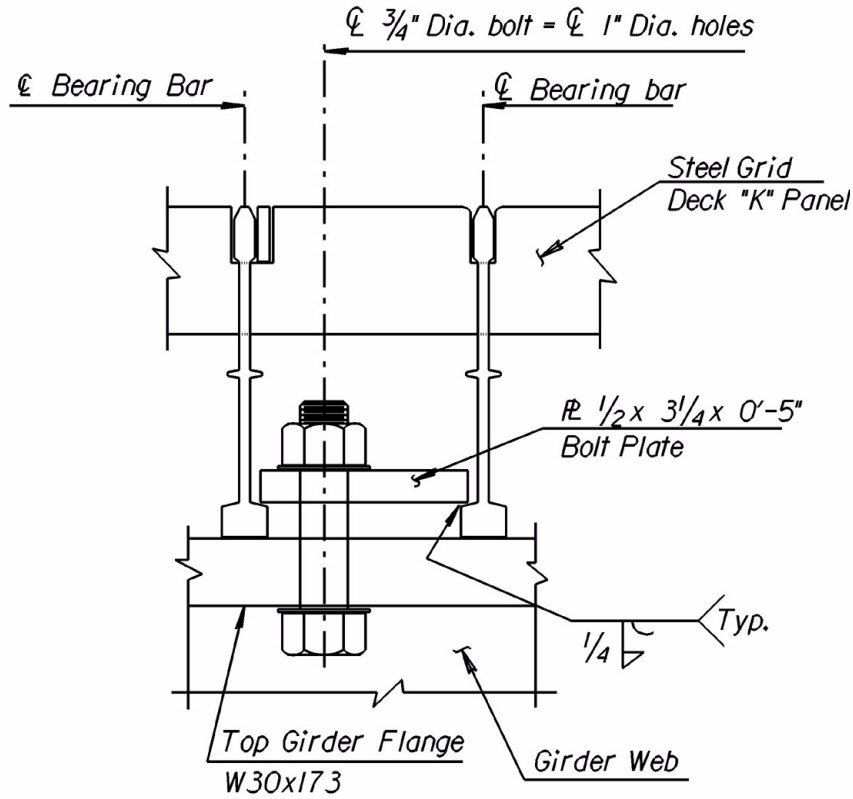


DETAIL NO. 6

10. Steel Grid Deck Panels:

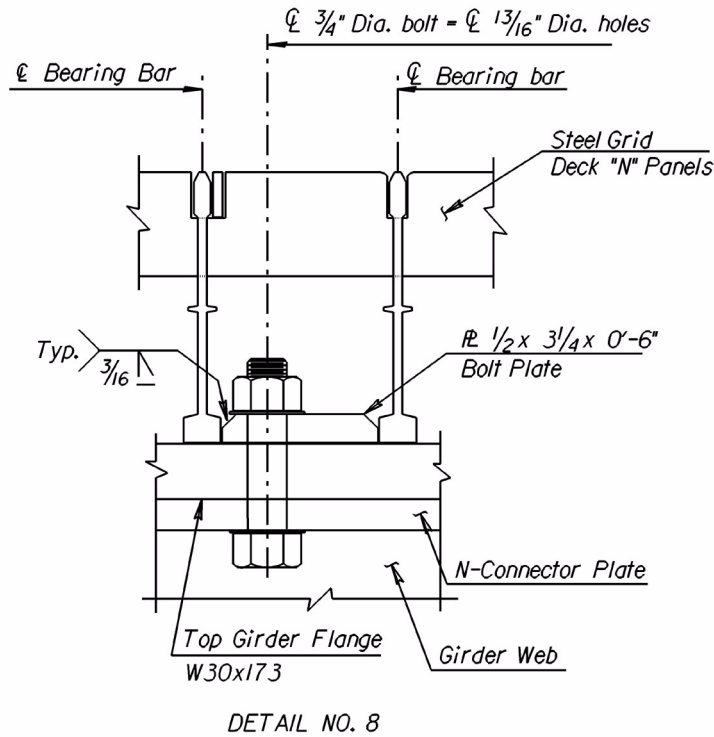
KDOT owns two different panel types, the "K" panel and the "N" panel as mentioned above. The "K" panel was the first type used by KDOT and therefore, the "K" stands for Kansas. Due to inherent construction problems, the "N" panels were added to our inventory. They are a copy of a design used by Nebraska.

Each panel has a nominal width of 7'-8" and a length of 30'-6". Nine panels are required per bridge span with the length (30'-6") being placed perpendicular to the roadway centerline. See the Panel Layout detail in the plans. "N" panels can be easily identified from "K" panels when they are stockpiled at a storage site. Note No. 6 on the Inventory sheet states that "All 'N' type deck panels are identified by the painted RED end of a bearing bar. 'K' type deck panels do not have painted bearing bar ends." The location of the painted bearing bar end is in the middle of the short side of the panel. Another way of identifying the panels is to look at the bolt plates that are welded into the bottom of the panel grids. The "K" panel bolt plates are welded to and sit on top of the bottom flanges of the bearing bars. When these panels are in final position, the bolt plates are not in contact with the top flange of the rolled beams. (See Detail No. 7).



DETAIL NO. 7

The welded "N" panel bolt plates are flush with the bottom of the bearing bars. When these panels are in final position, the bolt plates are in contact with the top flange of the rolled beams. (See Detail No. 8)

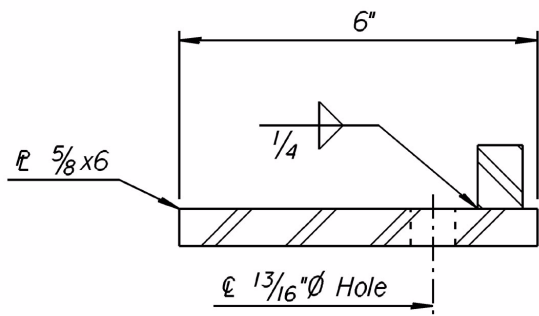


Panel identification by bolt plates is slightly complicated in that "N" panels have both "N" and "K" bolt plates. For the first "N" panels ordered, the "K" bolt plates were intended to be a backup system if the "N-Connectors" slipped under traffic loads. The inherent problems of "K" panels are as follows.

- a. The "K" panels bolt directly to the top flange of the rolled beams. Therefore, the bolt holes in the panel bolt plates must align directly above the bolt holes in the beam flanges. Due to warpage of the panels caused by weld shrinkage during fabrication, many holes do not properly align. The Contractor is then required to force the panels into alignment.
- b. As stated above, the bolt plates are not in contact with the flanges when the panels are in their final position. Therefore, the high strength bolts cannot be tightened to their full capacity without bending the bolt plates. Service live load vibrations tend to loosen these bolted connections. The Maintenance Note of the General Notes sheet states that the Contractor is responsible for periodic inspection to assure that the bolted connections remain tight. The Contractor may elect to use self-locking nuts, double nuts or burr the threads to prevent the nuts from becoming loose. Inspection is required regardless of the nut type used.

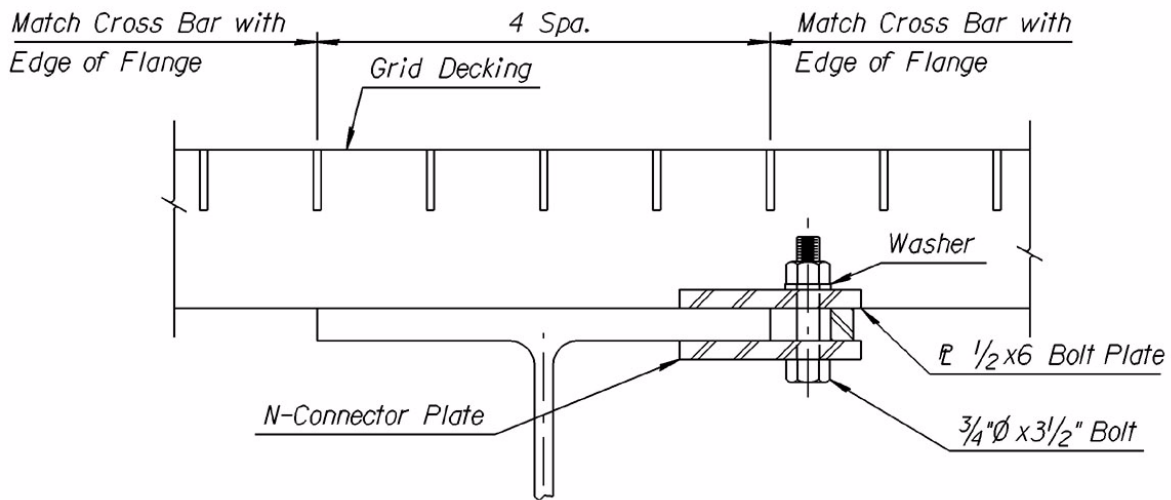
11. N-Connector Plates:

"N" Panels are held in place by frictional clamping forces. These frictional forces are produced from the clamping effect of the panel bolt plates and the N-Connector plates on the top flange of the rolled beams. These clamping plates are staggered on both sides of the flanges. The high strength bolts are tightened by the turn-of-the-nut method in accordance with KDOT Specifications to develop the required clamping forces. (See Detail No. 9 and No. 10).



N-CONNECTOR PLATE

DETAIL NO. 9



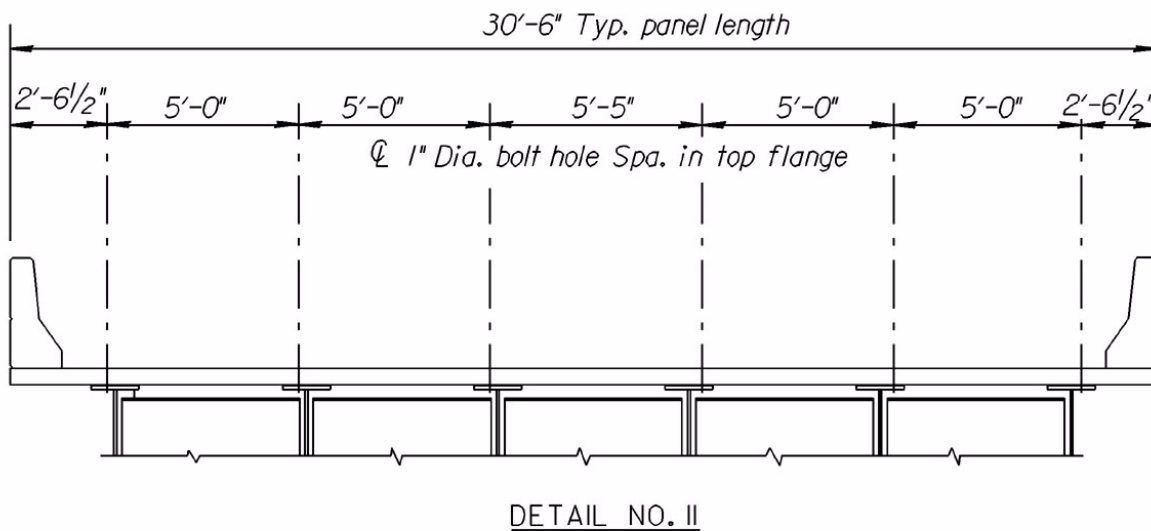
DETAIL NO. 10

12. Steel Spacer Plates:

These plates are used in the wingwalls between the timber backwall and the steel H-pile. Four plates are required per abutment. Nominal 2x10 timbers may be substituted.

13. Steel Girders for "K" Panels:

The steel girders are W30x173 rolled beams. There are six beams per span and their alignment and spacing is shown in the Framing Plan. The top flanges have 1" diameter bolt holes spaced the length of the beams. These bolt holes are located on only one side of the web and are used to attach the "K" panels. Position the beams are to be positioned such that the bolt hole lines are furthest away from the centerline of the bridge. (See Detail No. 11).



14. Steel Girders for "N" Panels:

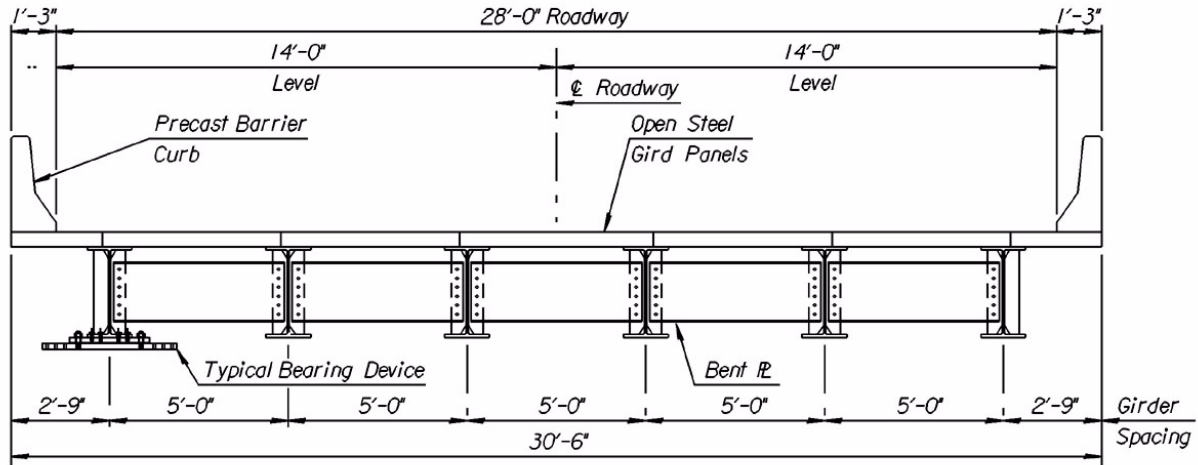
These girders are the same size and have the same framing plan as the girders for the "K" panels. "N" panels do not require girders with the 1" diameter bolt holes in the top flange since they are attached by clamping plates, not direct bolting. However, eighteen girders (three spans) supplied for "N" panels were fabricated with these bolt holes so that they would be interchangeable with "K" panels. Twelve beams (two spans) supplied for "N" panels were fabricated with these bolt holes only at the ends of the beams. There are enough bolt holes at each end to bolt a panel directly to the beams. It was not intended that these end panels are to be directly bolted with K-Connections. It was not known how well panels would remain in position under clamping friction only, so this provision was made for the end panels.

15. Bent Plate Diaphragms:

There are twenty bent plate diaphragms per span. See the Framing Plan in the Detour Bridge Plans for their locations. They bolt to the girder's intermediate and bearing stiffener plates.

16. Bolts:

The only bolts that are to be saved and stored at a stockpile site are the 17" long bolts, nuts and washers which attach the concrete barrier units to the deck panels and the drill and tap bolts used to attach the rocker plate to the beam flange. The drill and tap bolts do not require separate storage since the rocker plates are not to be removed from the flanges at the end of a job. 17" long bolts, nuts and washers are to be stored in open containers that have holes in the bottom to provide drainage. The tops of the containers are to be left open to eliminate the formation of condensation. All other bolts and lag screws will remain the property of the Contractor and are to be removed from the site.



TYPICAL SECTION OF DETOUR BRIDGE SUPERSTRUCTURE

EXAMPLE - Construction of a Temporary Detour Bridge:



SLIDE #1

- * Looking along the centerline of a single span detour bridge.
- * All detour bridges have been placed on tangent at 0.0 profile grade.
- * Guard fence had not yet been attached when this picture was taken.

**SLIDE #2**

- * Side view of a single span detour bridge.
- * Shows 9 units of the Safety Barrier Curbs.
- * There are six 69' simple span Steel Rolled Beams.

**SLIDE #3**

- * View at the Abutment.
- * Single steel H-pile at the wingwall.
- * Timber wingwall.
- * ThrieBeam guard fence connection bolt holes in the end unit of the barrier curb.
- * Steel channel caps bolted to the H-pile.
- * Edge of the open grid deck below the barrier curbs.

**SLIDE #4**

- * Abutment wingwall with 2 H-pile. Currently, only the outermost pile is used.
- * Steel channel caps bolted to the H-pile.
- * Timber Backwall consists of two horizontal 4"x6" timber and vertical 3"x12" planks.
- * Note the 1 1/2" steel spacer plates between the H-pile and the 4"x6" timber.

**SLIDE #5**

- * Installing 3"x12" timber planks with 1/2" diameter lag screws. The lag screws screw into 4"x4" and 4"x6" horizontal timber.
- * Note the wingwall H-pile on the left side of the picture.
- * Note the abutment channel caps bolted to the wingwall pile.
- * Note the exterior girder end with the bearing stiffener.
- * Note the horizontal timber members bolted to the bearing stiffener.

**SLIDE #6**

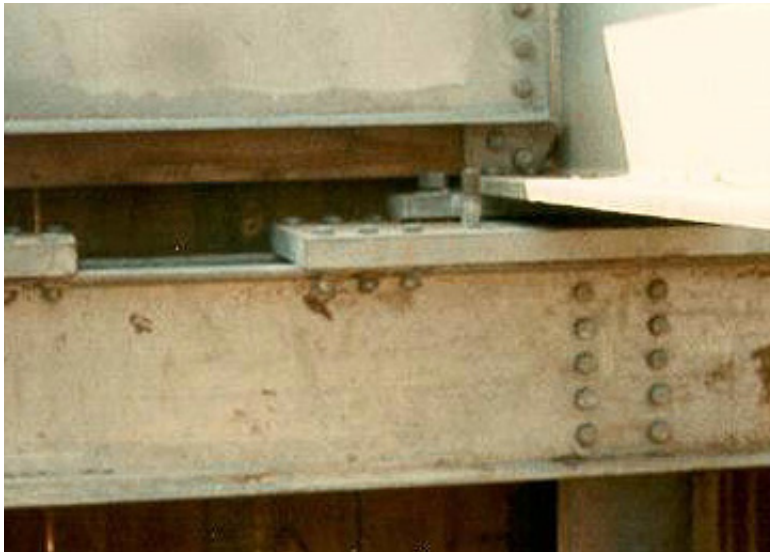
- * Completed timber backwall prior to backfilling.

**SLIDE #7**

- * Exterior girder and bearing rocker plate at the abutment.
- * The wingwall is located to the left of the girder.
- * The lower 4"x6" timber requires 2 notches at the exterior beam.
- * All girders are interchangeable. If this girder was an interior girder, the bolt holes in the bearing stiffener plate would be used for attachment of a diaphragm.
- * Note rocker plate and rocker plate bolt (1 1/4" Anchor Stud). The nut should have a 1/4" gap to the top of rocker to allow the rocker to move under beam live load deflections.
- * Note the bolt heads at the top of the beam flange. These are the drill and tap bolts that are not to be removed.

**SLIDE #8**

- * Another look at an exterior girder at the abutment.
- * Note the bolts attaching the bearing plate to the top flanges of the channel caps.
- * All bearing plates are interchangeable - they must be used at piers or abutments. Note the 1 1/4" anchor stud. This stud would hold a second rocker plate if this bearing plate was used at a pier.
- * Note the bolts attaching the channel cap to the pile.

**SLIDE #9**

- * Bearing plates attached to channel caps at the abutment.
- * Note the bolts attaching the channel cap to the pile.
- * Note the 1 1/4" anchor stud on the first interior bearing plate.

**SLIDE #10**

- * A look at the abutment in an interior bay prior to construction of the earth berm.
- * Note the timber backwall on the opposite side of the channels.
- * Note the H-pile and the channel bolted to the pile.
- * Girders are spaced at 5 foot centers.

**SLIDE #11**

- * Typical pier construction.
- * Note the diagonal bracing.
- * Typical detour bridge layout attempts to avoid placing a pier in the flowline of a stream channel.



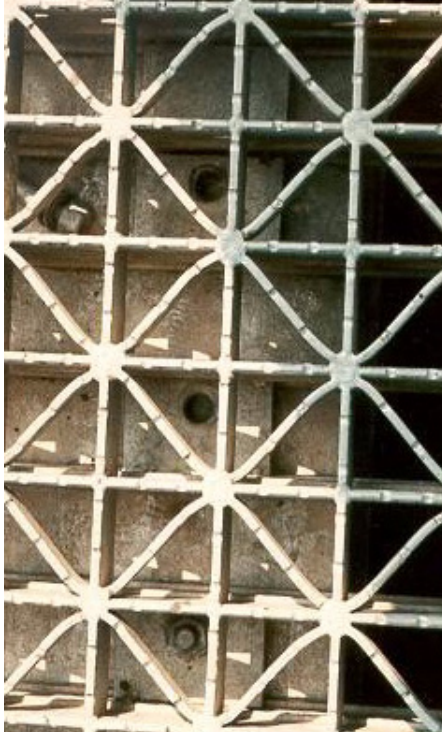
SLIDE #12

* Shows typical warpage of deck panels.



SLIDE #13

* Shows typical warpage of deck panels.



SLIDE #14

- * Looking through a steel grid deck panel at the bolt holes in the bolt plates for a K-Connection.
- * Note the top flange of the girder.



SLIDE #15

- * Typical method of tightening the bolts from above.



SLIDE #16

- * End view of a Steel Grid Deck with K-Connections.
- * Note that the bolt plate is not in contact with the top girder flange.



SLIDE #17

- * Side view of detour bridge showing safety barrier units.
- * Note the steel grid deck below the barrier units.



SLIDE #18

- * Two barrier units butted end-to-end.
- * 17 inch long bolts are used to attach the barrier units to the steel grid deck.



SLIDE #19

- * Anchor plates serve as washer plates for the 17" bolts attaching the barrier units to the steel grid deck.



SLIDE #20

* An end barrier unit showing bolt hole pattern for three beam guard fence.