Genesis Structures, Inc.
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Example Slab Demolition Study

Prepared for:

Kansas Department of Transportation

DEMOLITION PLANS

March 21, 2007

GENESIS
STRUCTURES

Mr. Matt Stuart
Project Engineer
APAC-Kansas, Inc. – Kansas City Division
4318 Speaker Road
P.O. Box 6099
Kansas City, Kansas 66106

RE: SEQUENCED DEMOLITION OF THE EXISTING MoDOT BRIDGE K-593

Mr. Stuart:

We have reviewed your proposed phased demolition sequence for the MoDOT K-593 bridge and have evaluated the capacity of the existing structure for three demolition conditions (Phase 1A where the exterior sidewalk and upper curb are removed, Phase 1B where the reinforced concrete deck is removed between Girder Line C and D, Phase 2 where the remaining reinforced concrete deck is removed over Girders A, B and C).

Based on the results of our analysis which was developed using information from the existing 1939 bridge plans, the structural capacity of the over-all structure appears to be sufficient to support the demolition equipment and the phased demolition provided some monitoring of specific areas is maintained.

The following is a summary of our review comments:

1) The existing structure was reviewed assuming three phases of demolition.

    a. Phase 1A Demolition – Remove exterior sidewalk and upper curb

        i. Begin demolition at Bent 1 proceeding along bridge to Bent 15.

        ii. Use Kobelco 200SR with the Allied 785BG Hammer (81,450 lbs with impact) centered between two south exterior girders.

        iii. Outside track will ride on top of lower portion of remaining curb. The suspension system on the Kobelco 200SR has the ability to maneuver over uneven bearing elevations under each track while maintaining uniform distribution of load on the slab surface.

b. Phase 1B Demolition – Remove concrete deck between Girders C and D

   i. Install shims at cross-frames and saw cut existing slab, working from Bent 1 to Bent 15.

   ii. Begin demolition at Bent 15 proceeding back along bridge back to Bent 1.

   iii. Use Kobelco 200SR with the Allied 785BG Hammer (81,450 lbs with impact) centered between two south exterior girders (tracks ride over girders)

   iv. Slab removal does not occur within 10 feet of leading ends of treads.

c. Phase 2 Demolition – Remove remaining concrete over Girders A, B and C

   i. Begin demolition at Bent 1 proceeding along bridge to Bent 15.

   ii. Use Kobelco SK250 with the Allied 785 Hammer (91,800 lbs with impact) centered on Girder B.

   iii. Slab removal does not occur within 10 feet of leading ends of treads.

2) Based on the results of our study for Phase 1A and Phase 1B:

   a. The concrete deck and girders are sufficient to support the track hoe provided the tracks run parallel with the longitudinal axis of the bridge and provided the track hoe is centered between Girder C and D.

      i. Note that the centerline-to-centerline distance of the track hoe treads is approximately the same as the girder spacing, therefore the tracks will ride directly over the girders.

      ii. Note that the cross-frames are critical to the lateral stability of the top flange of the girders. Care must be exercised when removing slab as cross-frames can not be damaged by hammer.

      iii. Centerlines of all cross-frames should be clearly marked with paint on the top surface of the concrete slab.

      iv. Planned travel path @ centerlines of the tracks should be clearly marked with paint on the top surface of the concrete slab.

3) Based on the results of our study for Phase 1A and Phase 1B:

   a. The concrete deck and girders are sufficient to support the track hoe provided the tracks run parallel with the longitudinal axis of the bridge and provided the track hoe is centered on Girder B.

      i. Note that the tracks will ride approximately at midspan of the concrete slab spanning between Girders A and B and Girders B and C.

      ii. Note that the cross-frames are critical to the lateral stability of the top flange of the girders. Care must be exercised when removing slab as cross-frames can not be damaged by hammer.

      iii. Centerlines of all cross-frames should be clearly marked with paint on the top surface of the concrete slab.

      iv. Planned travel path at centerlines of the tracks and/or the centerline of Girder B should be clearly marked with paint on the top surface of the concrete slab.

If you have any questions regarding the information provided, please call John Boschert or myself at (816) 421-1520.

Sincerely,

Genesis Structures, Inc.

David Rogowski P.E.

Cc: File

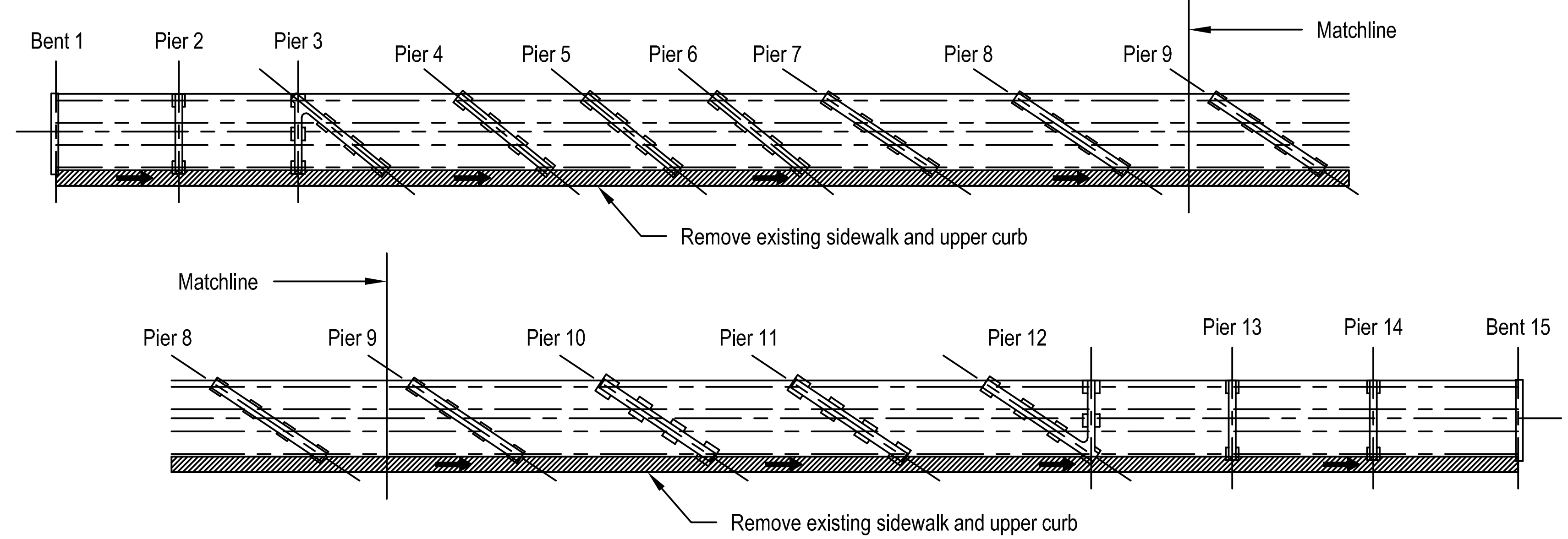
STATE OF MISSOURI

Example PE Seal

PROFESSIONAL

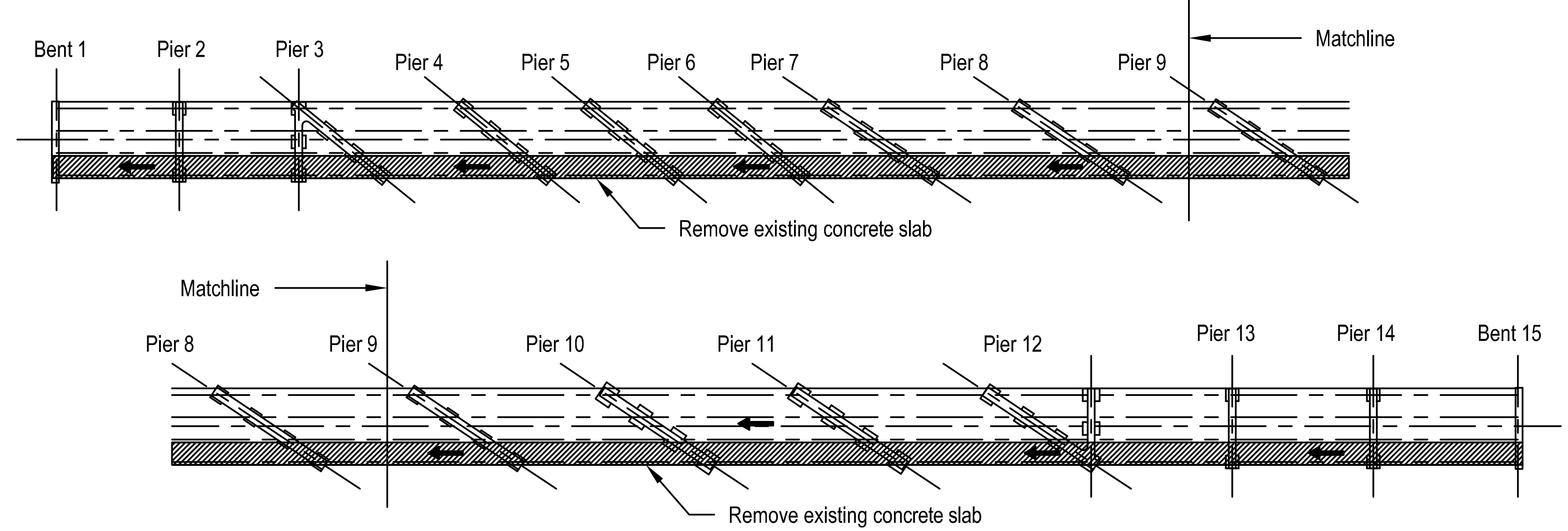
3/21/07

PHASE 1A



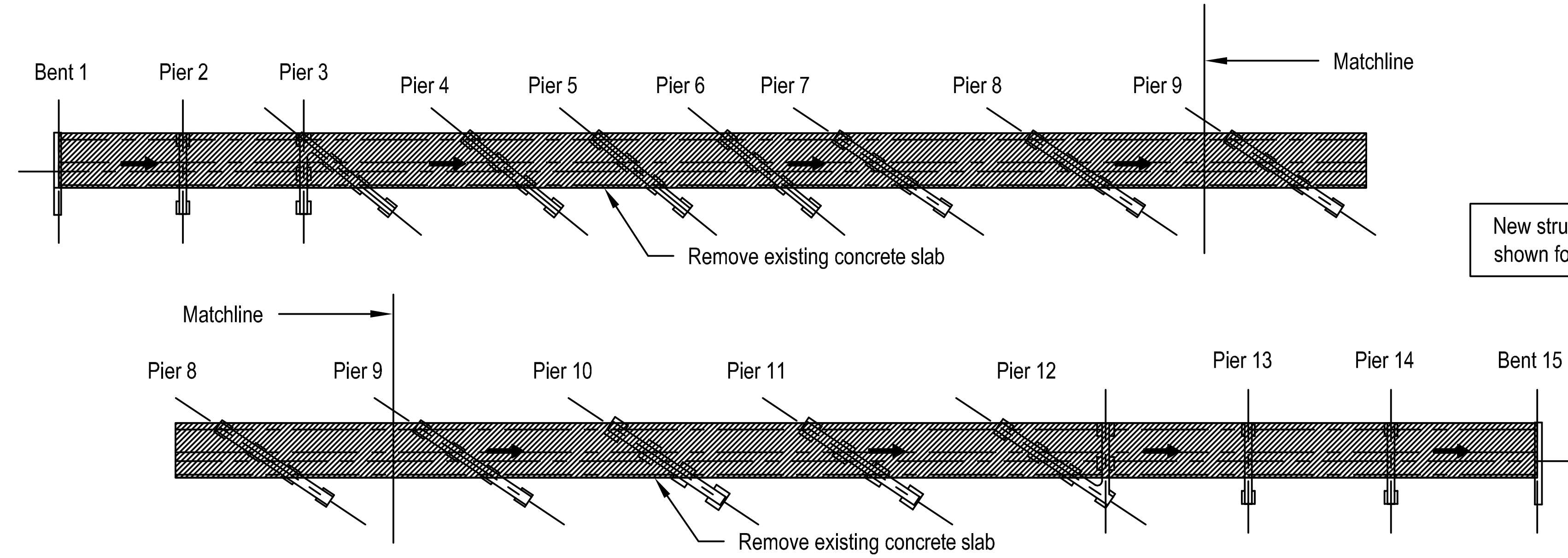
Note:
Positioning of track hoe is critical to performance of structure. Provide painted guide lines along length of bridge indicating centerline of tracks and/or centerline of track hoe.

PHASE 1B



Note:
Positioning of track hoe is critical to performance of structure. Provide painted guide lines along length of bridge indicating centerline of tracks and/or centerline of track hoe.

PHASE 2



New structure not shown for clarity

Note:
Positioning of track hoe is critical to performance of structure. Provide painted guide lines along length of bridge indicating centerline of tracks and/or centerline of track hoe.

Sheet No. D1

Date: 03-15-07

Date: 03-21-07

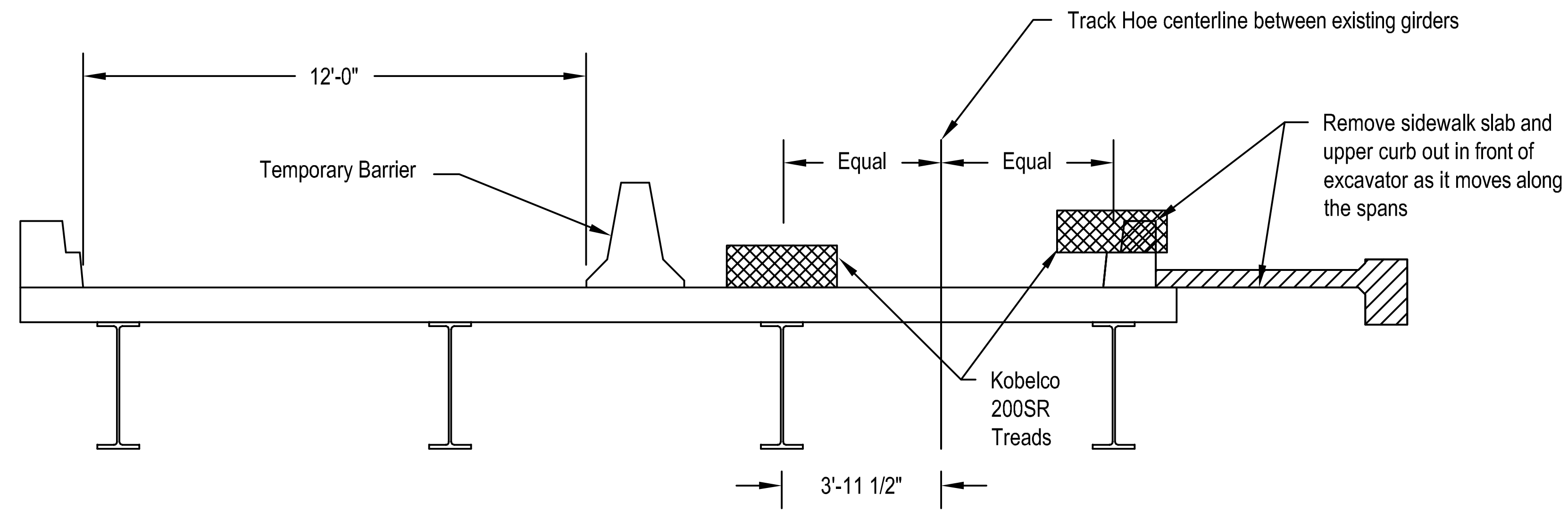
By: JPB

Checked: DMR

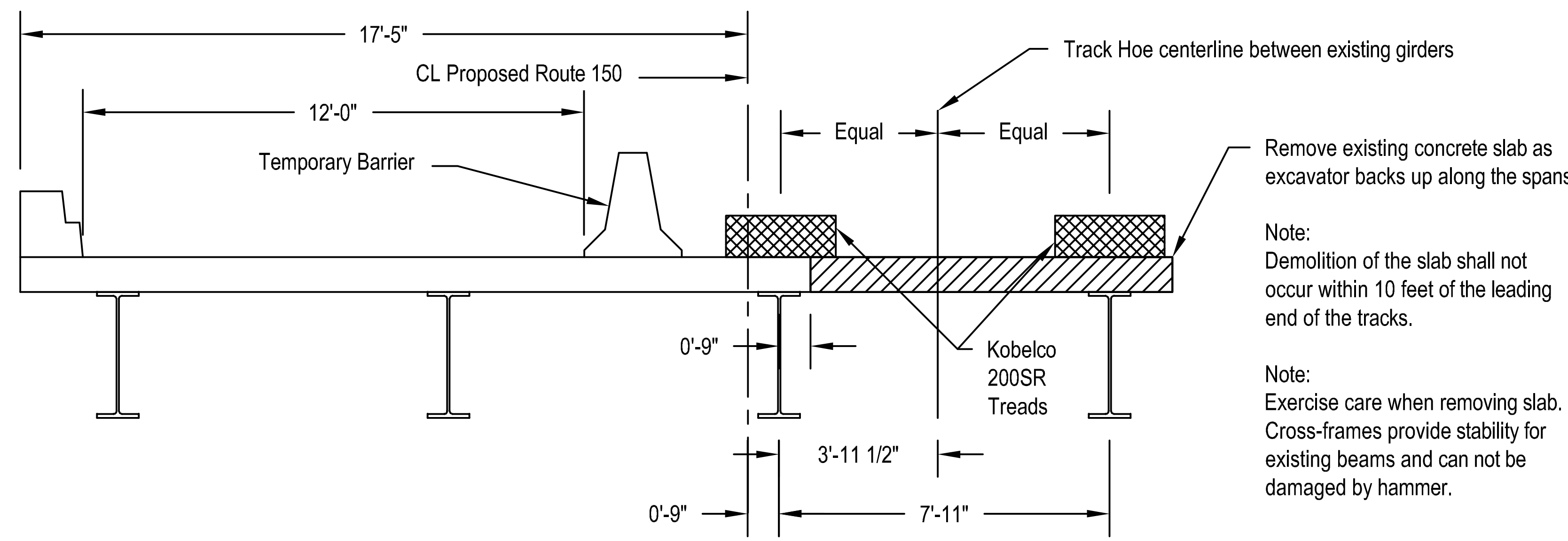
Demolition Phasing - Plan Views

GENESIS STRUCTURES

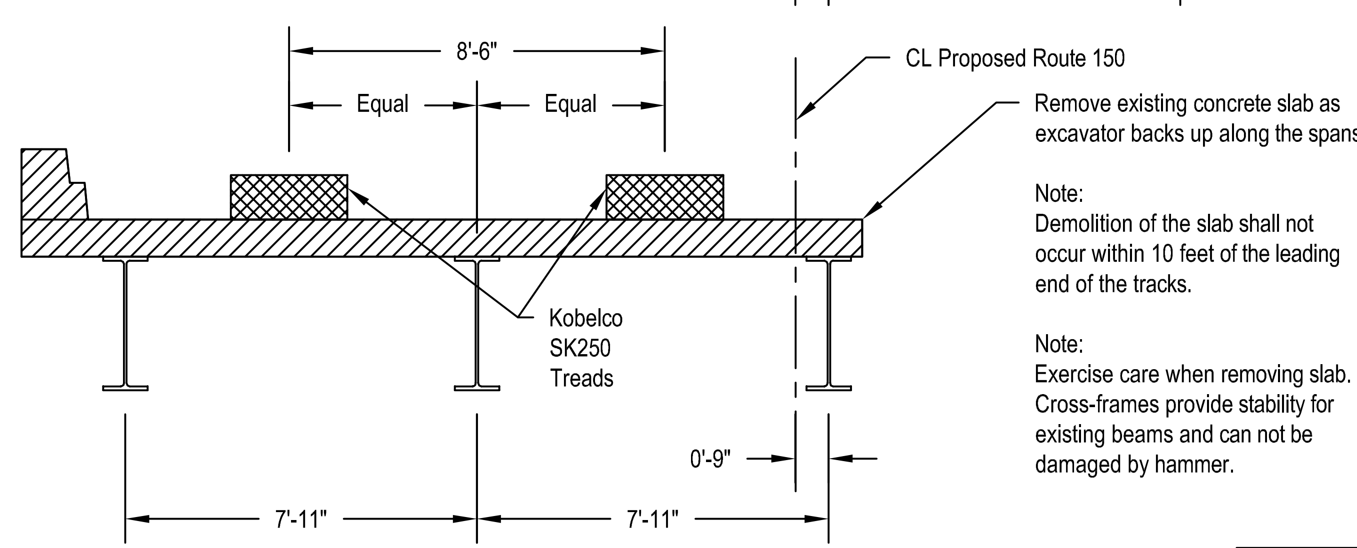
PHASE 1A



PHASE 1B



PHASE 2



Note:
Positioning of track hoe is critical to performance of structure. Provide painted guide lines along length of bridge indicating centerline of tracks and/or centerline of track hoe.

New structure not shown for clarity

Sheet No. D2

Date: 03-15-07

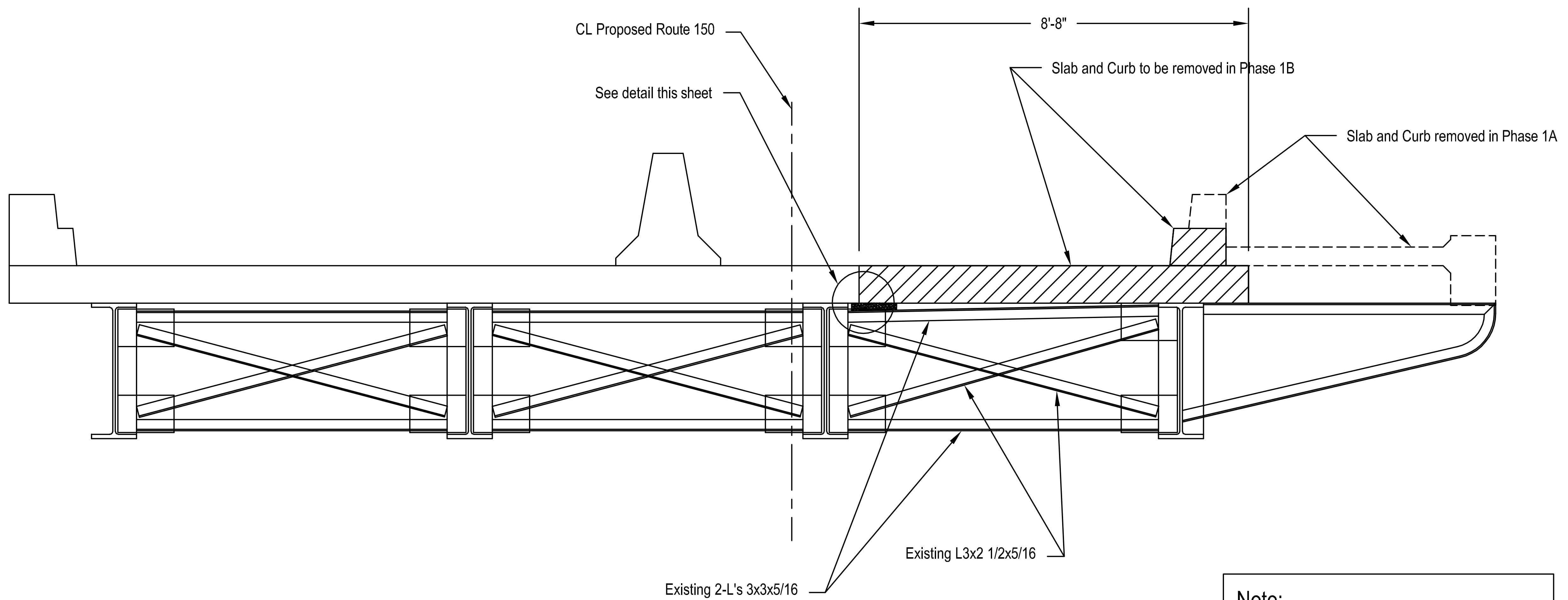
Date: 03-21-07

By: JPB

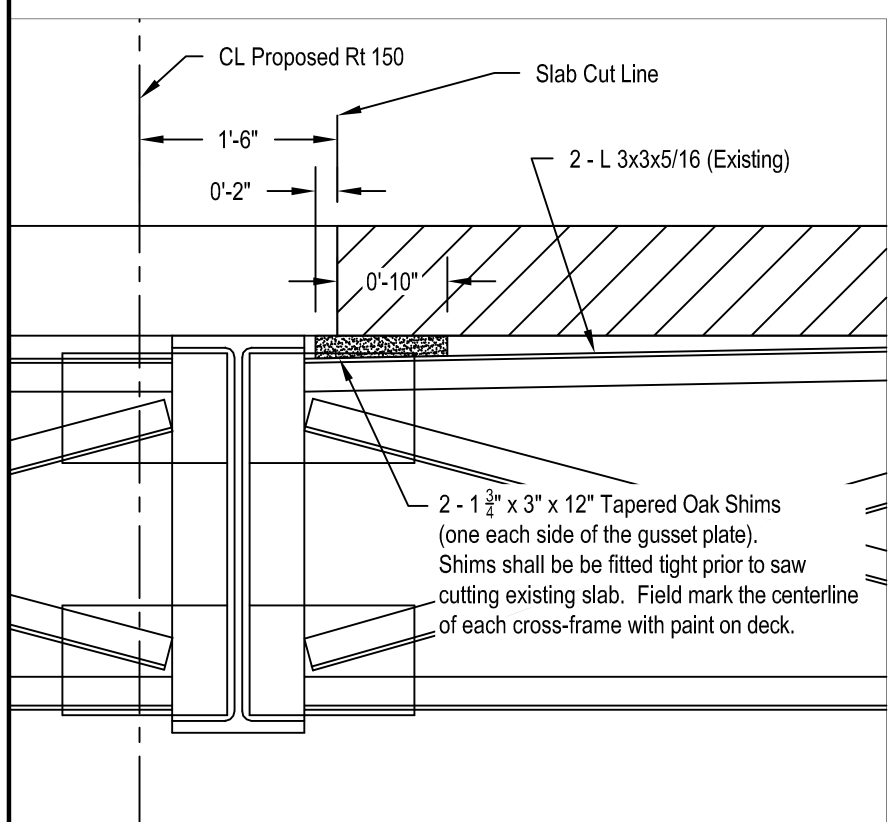
Checked: DMR

Demolition Phasing - Cross Sections

GENESIS STRUCTURES



Note:
Exercise care when removing slab. Cross-frames provide stability for existing beams and can not be damaged by hammer.



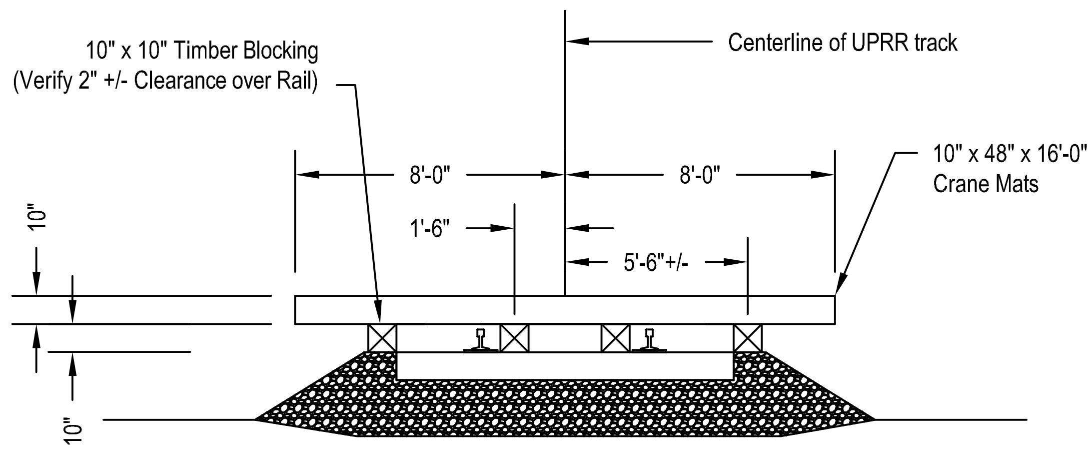
Sheet No. D3

Date: 03-15-07
Date: 03-21-07

By: JPB
Checked: DMR

Demolition Phasing - Temp. Slab Support

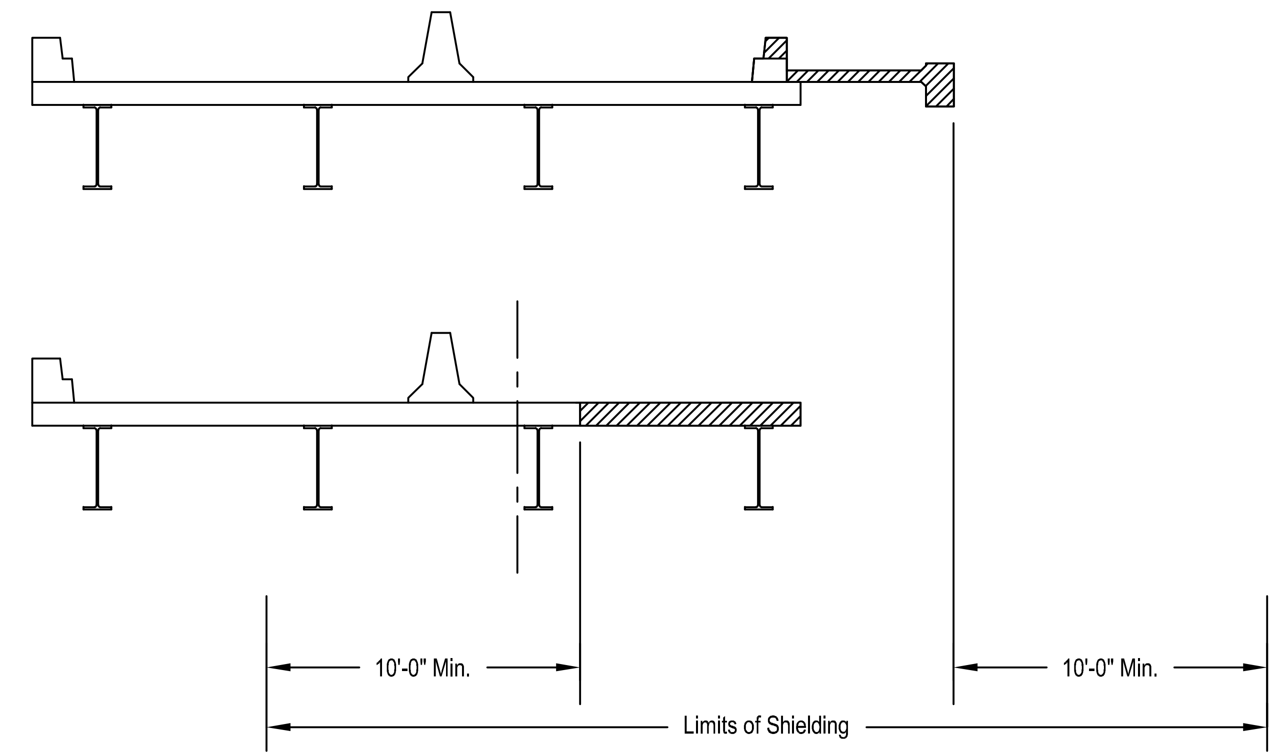
GENESIS STRUCTURES



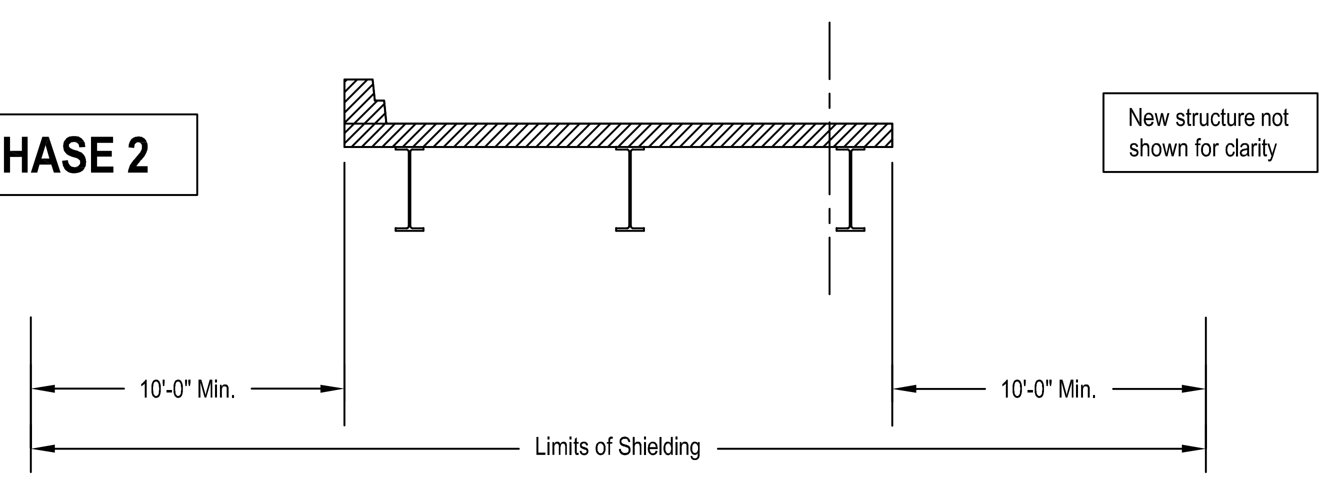
Track Shielding Detail

PHASE 1A

PHASE 1B



PHASE 2



Track Shielding - Typical Sections

By: JPB

Date: 03-15-07

Checked: DMR

Date: 03-21-07

Sheet No. TS1

GENESIS STRUCTURES

DRAFT DEMOLITION PLAN

(DEVELOPED BY CONTRACTOR
PRIOR TO DEMOLITION ENGINEERING)

Bridge Removal Plan

Missouri Highway and Transportation Commission
State Contract I.D. 070223-406
State Job J4U1129
UPRR Mile Post 255.03
City of Greenwood, Jackson County, Route 150

APAC Job No 662488

Removal of Bridge K-593 over Big Creek and Union Pacific Railroad Track

Bridge K-593 is a fourteen span bridge with steel girders and concrete deck with asphalt overlay. Only span 8-9 is over the railroad track. This is a single mainline track. In general all spans will be rubblized with Kobelco 200SR and 250SR excavators with Allied 785 hydraulic hammer from on top of the existing bridge deck proceeding from Bent#1 and progressing to the east. Union Pacific Flagging service will be used when work is is within 25 feet of the track. Enclosed are the stamped results of the structural analysis performed by Genesis Structures for the structural capacity of our proposed removal sequence. A more details description of our operations follows:

PHASE I

1. Spans 1-8 will be rubblized with Kobelco 200SR with Allied 785 hydraulic hammer. Concrete demolition will begin with the removal of the 6' sidewalk and upper curb section on the south side of the structure. Place timber shim blocking under the existing concrete deck and above the steel diaphragm to support the unsupported portion of the concrete slab and allow for concrete sawcutting. Next, one full depth sawcut located at the phased removal line will be completed. Place the Kobelco 200SR with one track located on the outer girder curb above the exterior girder and the other between the temporary safety barrier curb and the

sawcut line and remove the remainder of the concrete slab for this Phase. Once the bridge is rubblized on the ground, the reinforcing steel will be scraped. The reinforcing steel will be hauled to American Compressed Steel. The broken concrete and asphalt will be hauled to an adjacent land owner for crushing and recycling. Some of the crushed concrete may be used in access roads on the site. Structural steel will be removed with a minimum of a 50 ton conventional crawler crane. The girder system is simple span. The south girder line is removed in this phase and recycled at American Compressed Steel.

2. Span 8-9 located over the Union Pacific Railroad will be removed in the same manner as Step 1 with the same Kobelco 200SR excavator with Allied 785 hydraulic hammer. A Kobelco 300 with a barrel dump attachment (See Attached Photo) will be used below the structure and next to the track to catch the concrete debris from up above at a maximum reach of 30 feet. The Kobelco 300 is a track mounted excavator that can swing the attachment away from the tracks when a train is approaching. This machine should retrieve the majority of debris falling from the bridge deck. . In addition, APAC will install shielding that will extend 10' (minimum) from the outside edge of the concrete deck when the deck and parapet is in the process of demolition. Please see attached track shielding calculations for additional details. Structural steel will be removed with a minimum of a 120 ton hydraulic crane to remove the beams.

3. Span 9-15 will be removed in the same manner as Step #1.

4. Remove partial substructure concrete to the limits as shown on the plans.

PHASE II

5. Spans 1-8 will be rubblized with Kobelco 250SR with Allied 785 hydraulic hammer. This will include the remainder of the existing concrete bridge deck The reinforcing steel and concrete will be recycled. The reinforcing steel will be hauled

to American Compressed Steel. The broken concrete and asphalt will be hauled to an adjacent land owner for crushing and recycling. Some of the crushed concrete may be used in access roads on the site. Structural steel will be removed with a minimum of a 75 ton conventional crawler crane. The girder system is simple span. The remaining three girder lines are removed in this Phase and disposed of at American Compressed Steel.

6. Span 8-9 located over the Union Pacific Railroad will be removed in the same manner as Step 4 with the same Kobelco 250SR excavator with Allied 785 hydraulic hammer. A Kobelco 300 with a barrel dump attachment (See Attached Photo) will be used below the structure and next to the track to catch the concrete debris from up above at a maximum reach of 30 feet. The Kobelco 300 is a track mounted excavator that can swing the attachment away from the tracks when a train is approaching. This machine should retrieve the majority of debris falling from the bridge deck. . In addition, APAC will install shielding that will extend 10' (minimum) from the outside edge of the concrete deck when the deck and parapet is in the process of demolition. Please see attached track shielding calculations for additional details. Structural steel will be removed with a minimum of a 120 ton hydraulic crane to remove the beams.

7. Span 9-15 will be removed in the same manner as Step #4.

Substructure Removal:

a. Removal of intermediate bents 2-7 and 9-14:

   i. Substructure removal of the concrete piers will be done with a Kobelco 250SR excavator with Allied 785 hydraulic hammer. Piers will be removed to an elevation two feet below finished ground line.

b. Removal of Bent #8 and #9 along Union Pacific Track:

i. Work on this pier will not cause debris to fall within the ballast or track area. Up Flagger will be on sight and advise of trains.

ii. Pier removal will be done down to two feet below existing ground line with a Kobelco 250SR excavator with Allied 785 hydraulic hammer.

c. Removal of Bents #1 and #15 (Abutments):

i. The abutments will be removed to two feet below finish ground line

Reference Information:

Equipment

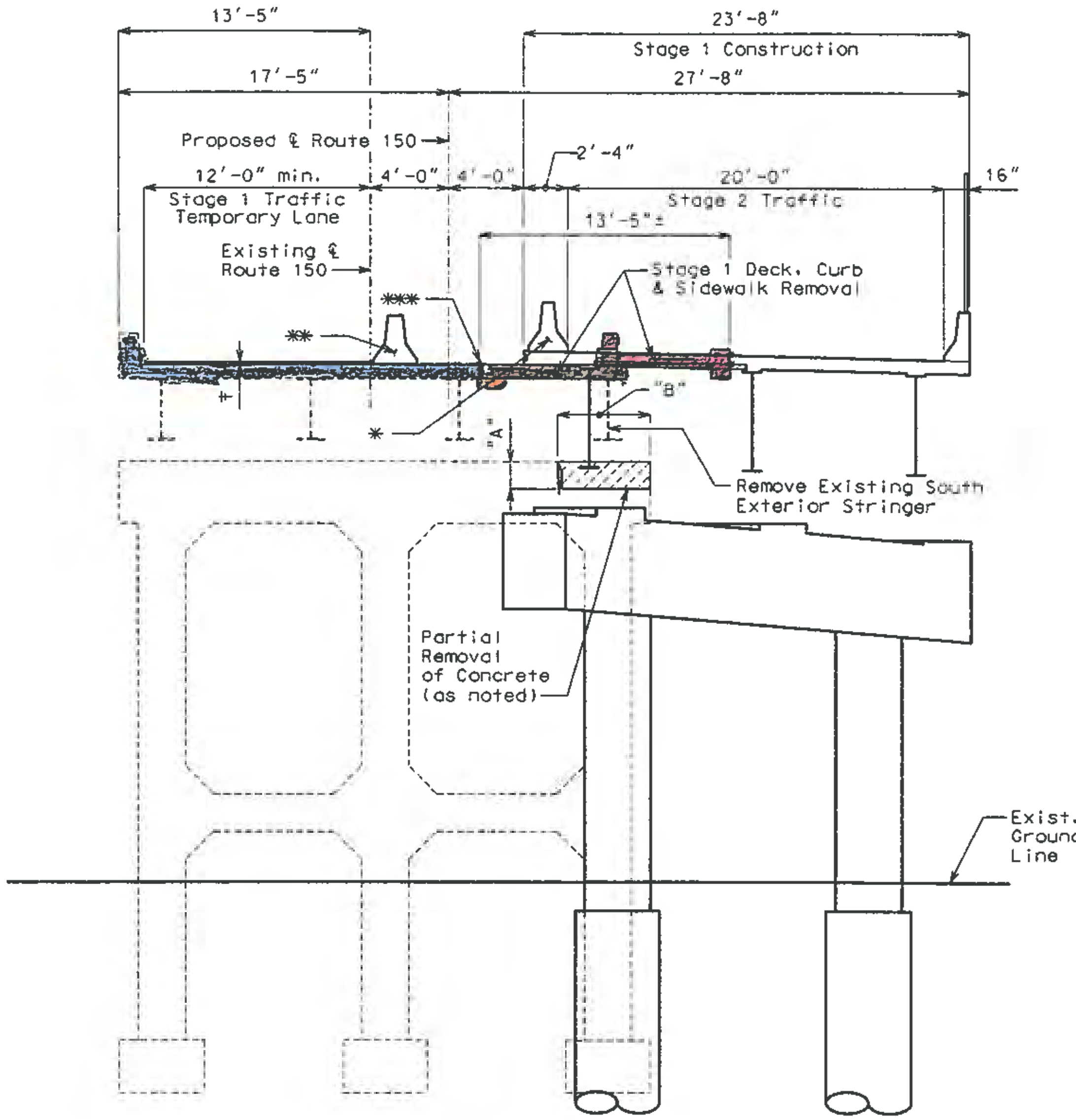
1) Kobelco 200SR Excavator with Allied 785 Hydraulic Hammer.
2) Kobelco 300 Excavator with debris catcher.
3) American 5299 conventional crawler crane (50 ton capacity)
4) Demag AC-160 Hydraulic Crane (180 ton capacity)
5) Kobelco 250SR Excavator with Allied 785 Hydraulic Hammer

Kobelco 300 and cranes NOT on bridge deck

Fire Suppression

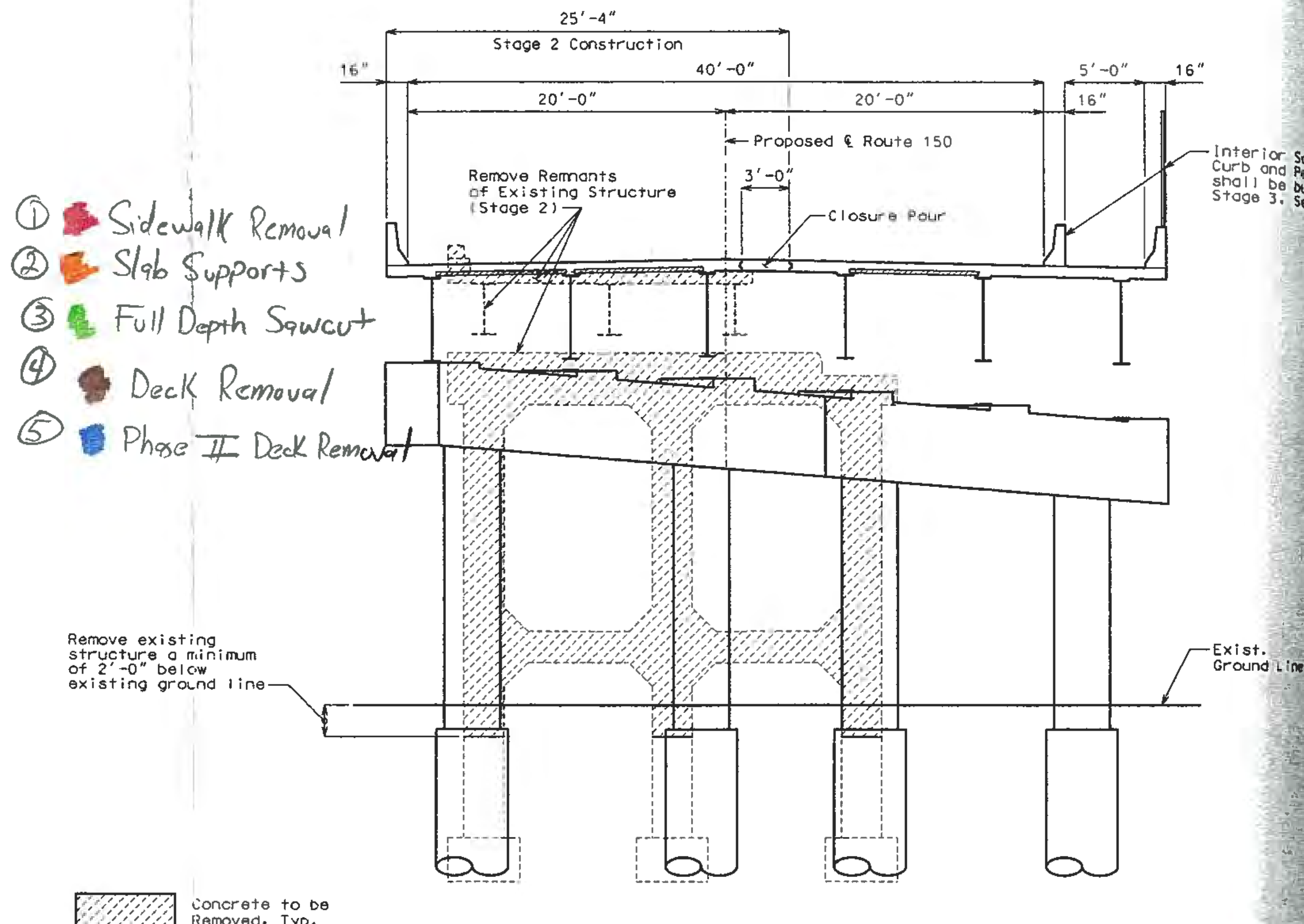
1) 2 Each 300 gal trailer mounted water tanks.
2) ABC fire extinguisher in each piece of equipment and pickup.

State	Proj. No.
MO	



ELEVATION OF STAGE 1 NEAR PROPOSED BENT

(STAGE 1 REMOVAL & CONSTRUCTION, AND STAGE 2 TRAFFIC)



ELEVATION OF STAGE 2 NEAR PROPOSED BENT

(STAGE 2 REMOVAL & CONSTRUCTION)

† 2" Asphalt overlay (Roadway Item) prior to Stage 1 removal of existing Superstructure.

* Type F Temporary Concrete Traffic Barrier (Anchored) (Roadway Item). Method of attachment for the Type F Temporary Concrete Traffic Barrier shall be the Tie-Down Strap method.

** Type F Temporary Concrete Traffic Barrier (Roadway Item)

*** Full depth saw cut through existing deck required prior to Stage 1 removal of existing deck.

Notes:
Existing work is shown in dashed line, proposed work is shown in solid line.

Dimensions shown are normal to ℄ Route 150.

Conflict between Stage I Construction girder erection & the existing bents no. 12, 13, & 14 is probable. The existing bent seat shall be chipped out to form a notch for the new girder. See "Partial Concrete Removal" table for dimensions of removal area.

Removal and partial removal of components of the existing bridge shall be in accordance with Sec 216.

While removing the existing substructure, the contractor shall take the necessary precautions not to disturb the existing box culvert running through the center portal or telephone line running on the northeast side of Existing Bent No. 7.

PARTIAL CONCRETE REMOVAL

BENT	"A"	"B"
12	16"	5'-2"
13	16"	5'-7"
14	16"	5'-7"

Dimension "B" shall be measured from the southern most edge of the existing bent normal to the proposed girder center line.

Any additional partial removal of concrete that may be necessary for the construction of Stage 1 may be done so only with the approval of the engineer.

Cost of partial concrete removal will be considered completely covered by the contract lump sum price for Removal of Bridges.

CONSTRUCTION STAGING

JACKSON COUNTY

g:\KC06\0109\Bridge\150cp01.sht

Designed SEPT. 2006
Detailed SEPT. 2006
12/6/2006

Note: This drawing is not to scale. Follow dimensions.

DEMOLITION MACHINERY DETAILS

Memorandum

Re: Demolition Machines Details
Bridge K-593 on Route 150
Greenwood, MO

By: John Boschert
Dave Rogowski
Genesis Structures

Per correspondence with the contractor, the following demolition machines are proposed for use:

Phase 1:

- Kobelco 200SR Excavator
- Allied 785 hydraulic hammer

Phase 2:

- Kobelco SK250 Excavator
- Allied 785 hydraulic hammer

Machine Weights

See attached product details.

- Kobelco 200SR Excavator = 48500 lbs
- Kobelco SK250 Excavator = 55400 lbs
- Allied 785 hydraulic hammer = 5800 lbs

Operating Weights

- Phase 1 = 48500 + 5800 = 54300 lbs
- Phase 2 = 55400 + 5800 = 61200 lbs

Operational Impact

Apply 50% impact factor based on operation techniques of demolition.

Design weight including impact:

- Phase 1 = 54300 * 1.50 = 81450 lbs
- Phase 2 = 61200 * 1.50 = 91800 lbs

GENESIS STRUCTURES

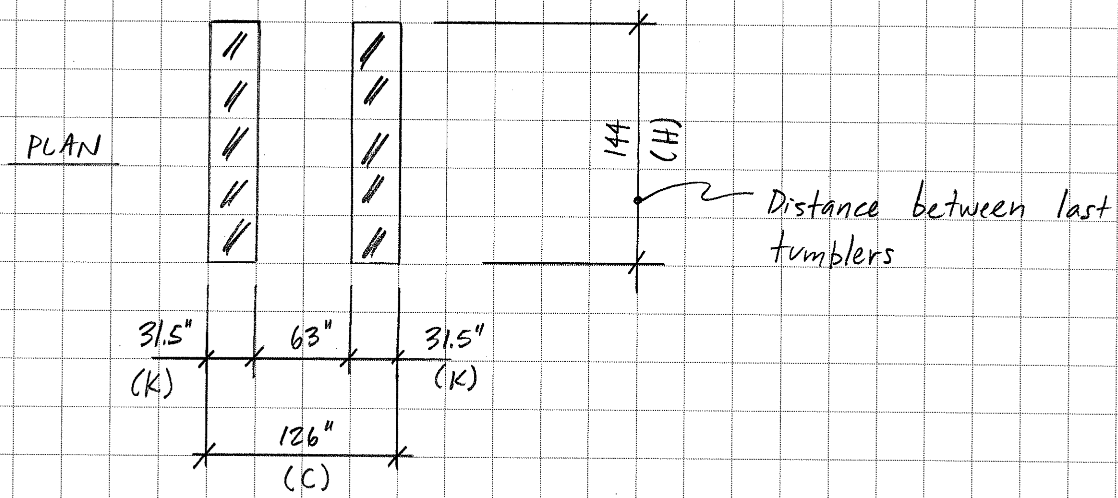
Made By JPB	Date
Checked By	Date
Back checked By	Date

Calculations For: K-593

Job No. 0138 Sheet No.

KOBELCO 200SR TRACK GEOMETRY & LOADING

Track Dimensions (ref Kobelco product literature)



Design weight (includes 50% impact) = 81450 lb

→ See memo for details

Distributed load per tread $= \dfrac{81.45\,k}{(2)(12)\ ft} = 3.39375\ k/ft$

Design pressure $= \dfrac{81.45k}{(2)(144)in\,(31.5)in} = 0.00898\ ksi$

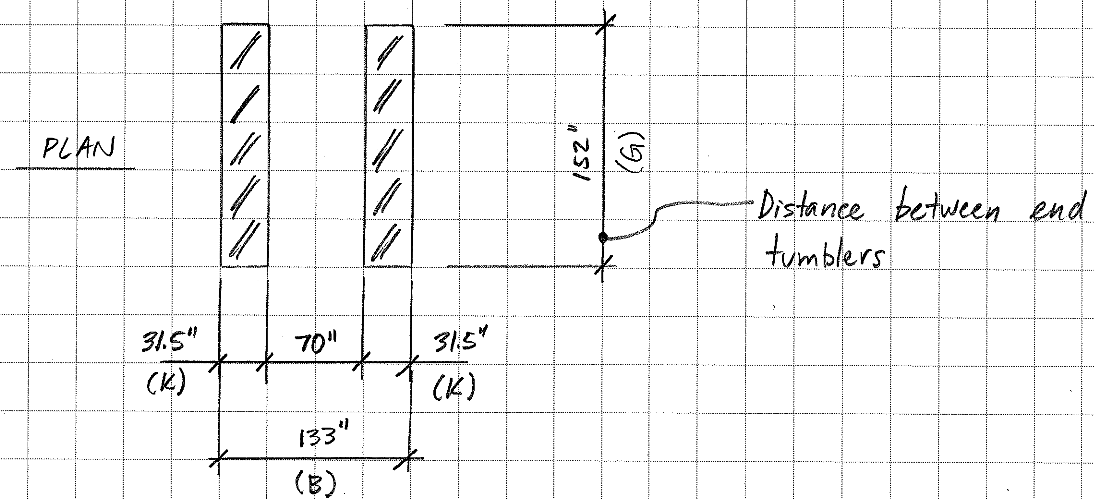
Made By	JPB	Date	
Checked By	DMP	Date	
Back checked By		Date	

Calculations For: K-593

Job No. 0138 Sheet No.

KOBELCO SK250LC TRACK GEOMETRY & LOADING

Track Dimensions (ref Kobelco product literature)



Design weight (includes 50% impact) = 91800 lbs

→ See memo for details

Distributed load per tread = $\frac{91.80\ k}{(2)(12.67)\ ft}$ = 3.6237 k/ft

Design pressure = $\frac{91.80\ k}{(2)(152)\ in\ (31.5)\ in}$ = 0.00959 ksi

KOBELCO®

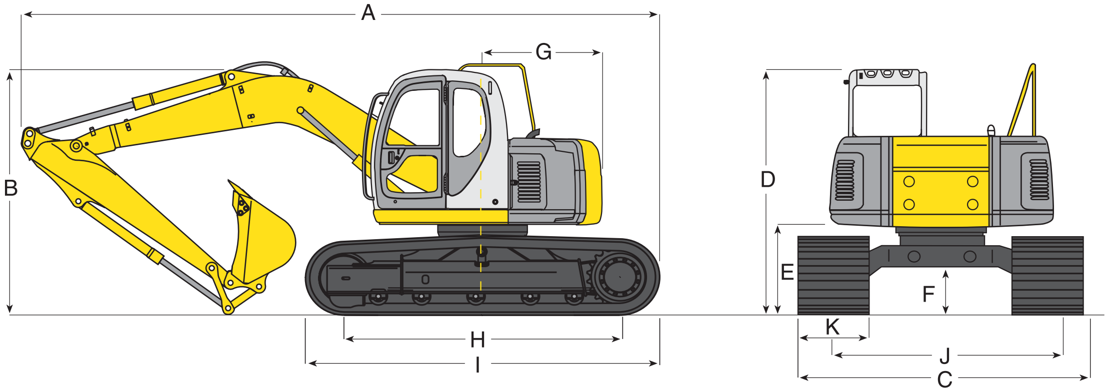
Your competitive edge.

200SRLC	
WT	*48,500 lb.*
HP	*123 SAE NET*
BKT CAP	*.88~.1.25 cu yd*

SHORT RADIUS Hydraulic Excavator

SPECS 200SR LC

WEIGHTS & DIMENSIONS



WEIGHTS

Overall Width ft-in (m)	10' 6" (3.19)
Ground pressure psi (kPa)*	4.93 (34)
Operating weight lb (kg)	48,500 (22,000)

* Ground pressure with standard (800 mm) shoes.

HYDRAULIC SYSTEM

Pumps	2 variable displacement
Max discharge flow	2 x 46.5 + 5 US gal/min (2 x 176 + 19 lit/min)
Max discharge pressures:	
Boom, arm & bucket	4,980 psi (34.3 MPa)
Power boost	5,470 psi (37.8 MPa)
Travel circuit	5,190 psi (35.8 MPa)
Control circuit	710 psi (5.0 MPa)
Swing pressure	4,060 psi (28.0 MPa)
Control valves	6 spool

DIMENSIONS

Unit ft-in (m)

ARM LENGTH		8' 6"	(2.6)	9' 10"	(3.0)
A	Overall length	26' 11"	(8.20)	26' 10"	(8.18)
B	Overall height (to top of boom)	10' 0"	(3.05)	9' 9"	(2.98)
C	Overall width	10' 6"	(3.19)	10' 6"	(3.19)
D	Overall height (to top of cab)*	10' 0"	(3.06)	10' 0"	(3.06)
E	Ground clearance of rear end*	3' 5"	(1.03)	3' 5"	(1.03)
F	Ground clearance*	17.7"	(450 mm)	17.7"	(450 mm)
G	Tail swing radius	5' 6"	(1.68)	5' 6"	(1.68)
H	Tumbler distance	12' 0"	(3.66)	12' 0"	(3.66)
I	Overall length of crawler	14' 7"	(4.45)	14' 7"	(4.45)
J	Track gauge	7' 10"	(2.39)	7' 10"	(2.39)
K	Shoe width	31.5"	(800 mm)	31.5"	(800 mm)

*Excludes height of grouser bar.

BUCKET SELECTION CHART

Bucket Duty	Capacity (SAE) Cubic Yard (m³)		Width Inches (m)		Weight lb (kg)		Arm ft-in (mm) 8' 6" (2.6m)	9' 10" (3.0)
General Purpose	0.88	(.672)	24"	(.609)	1,165	(528)	H	H
	0.91	(.695)	30"	(.762)	1,325	(601)	H	H
	1.14	(.871)	36"	(.914)	1,450	(658)	H	M
	1.25	(.960)	42"	(1.066)	1,651	(749)	M	L
Heavy Duty	0.68	(.519)	24"	(.609)	1,250	(567)	H	H
	0.91	(.695)	30"	(.762)	1,420	(644)	H	M
	1.14	(.871)	36"	(.914)	1,560	(708)	M	L
	1.25	(.960)	42"	(1.066)	1,730	(785)	L	X
Severe Duty	0.63	(.481)	26"	(.660)	1,455	(660)	H	H
	0.75	(.573)	31"	(.787)	1,590	(721)	H	H
	0.88	(.672)	37"	(.939)	1,790	(812)	M	M
	1.13	(.871)	43"	(1.092)	2,000	(907)	L	X

H Used with material weight up to 3,000 lbs per cubic yard.
M Used with material weight up to 2,500 lbs per cubic yard.
L Used with material weight up to 2,000 lbs per cubic yard.
X Not recommended.

KOBELCO®

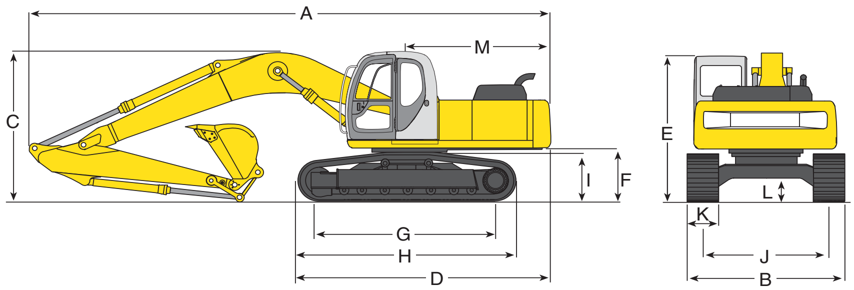
Your competitive edge.

SK250LC	
WT	55,400 lb
HP	176 @ 2,100 RPM
BKT CAP	.75-2.25 cu yd

Dynamic Acera Hydraulic Excavator

SPECS

SK250LC



DIMENSIONS

Unit ft-in (m)

	ARM LENGTH	9' 9" (2.98)	12' 0" (3.66)
A	Overall length	33' 1" (10.08)	33' 1" (10.07)
B	Overall width (with 800mm shoe)	11' 1" (3.39)	11' 1" (3.39)
C	Overall height (to top of boom)	10' 0" (3.05)	10' 5" (3.16)
D	Basic machine length	17' 3" (5.27)	17' 3" (5.27)
E	Overall height (to top of cab)*	9' 8" (2.94)	9' 8" (2.94)
F	Ground clearance of rear end*	3' 6" (1.06)	3' 6" (1.06)
G	Center distance of tumblers	12' 8" (3.85)	12' 8" (3.85)
H	Overall length of crawler	15' 3" (4.66)	15' 3" (4.66)
I	Crawler height at tumbler center*	38.2" (970 mm)	38.2" (970 mm)
J	Track gauge	8' 6" (2.59)	8' 6" (2.59)
K	Width of crawler shoe	31.5" (800 mm)	31.5" (800 mm)
L	Ground clearance of undercarriage*	17.7" (460 mm)	17.7" (460 mm)
M	Tail swing radius	9' 9" (2.98)	9' 9" (2.98)

*Excludes height of grouser bar.

WEIGHTS

Bucket weight: 1,720 lbs (780 kg)

Shoe width	in (mm)	27.6" (700)	31.5" (800)
Machine overall width ft-in (mm)		10' 10" (3.29)	11' 1" (3.39)
Ground pressure	psi (cm²)	6.06 (0.43)	5.40 (0.38)
Operating weight	lb (kg)	54,500 (24,720)	55,400 (25,130)

HYDRAULIC SYSTEM

Pump	2 variable displacement	
Max discharge flow	2 x 63.4 US gal/min (2 x 240 L/min)	
Operating pressure:		
Implement	4,980 psi	(34.3 MPa)
Travel	4,980 psi	(34.3 MPa)
Swing	4,270 psi	(29.4 MPa)
Power Boost/Heavy lift	5,470 psi	(37.8 MPa)
Pilot control circuit	710 psi	(4.9 MPa)
Control valves	6 spool	

BUCKET SELECTION CHART

Bucket Duty	Capacity (SAE) Cubic Yard (m³)	Width Inches (m)	Bucket Weight lb (kg)	Arm ft-in (m) 9' 9" (2.98)	12' 0" (3.66)
General Purpose	0.875 (.669)	24 (.609)	1,560 (708)	H	H
	1.125 (.860)	30 (.762)	1,710 (776)	H	H
	1.375 (1.051)	36 (.914)	1,860 (844)	H	M
	1.625 (1.243)	42 (1.066)	2,060 (934)	M	L
	1.71 (1.31)	48 (1,219)	2,539 (1,176)	M	X
	2.0 (1.53)	54 (1.371)	3,065 (1,390)	L	X
	2.25 (1.72)	54 (1.371)	3,331 (1,511)	L	X
Heavy Duty	0.875 (.669)	30 (.762)	1,840 (834)	H	H
	1.125 (.860)	36 (.914)	2,000 (907)	H	M
	1.375 (1.051)	42 (1.066)	2,215 (1,004)	M	L
	1.625 (1.242)	48 (1.219)	2,335 (1,059)	L	X
Severe Duty	0.75 (.573)	27 (.685)	2,205 (1,000)	H	M
	1.00 (.764)	30 (.762)	2,450 (1,111)	M	X
	1.125 (.860)	36 (.914)	2,545 (1,154)	X	X

H - Used with material weight up to 3,000 lbs/cu yd (1,780 kg/m³)
M - Used with material weight up to 2,500 lbs/cu yd (1,483 kg/m³)
L - Used with material weight up to 2,000 lbs/cu yd (1,186 kg/m³)
X - Not recommended

Allied 785 Hammer

ALLIED Construction Products, LLC
3900 Kelley Avenue, Cleveland, Ohio 44114
Tel: 216-431-2600 Fax: 216-431-2601
e-mail: Sales@AlliedCP.com
website: http://www.AlliedCP.com

Model		**735**	**745**	**755B**	**755B G**
AEM Measured Values					
Energy Rating **	ft. lbs	792	1,045	1,998	1,998
	(joules)	1,074	1,417	2,709	2,709
Frequency	bpm	995	819	657	657
Hydraulic Flow	gpm	25.5	32.0	36.9	36.9
	(lpm)	97	121	140	140
Supply Pressure	psi	2,323	2,593	2,607	2,607
	(bar)	160	179	180	180
Operating Ranges					
Recommended Carrier Weight (Backhoe)	lbs.	14,000-25,000	20,000-25,000	N/A	N/A
Recommended Carrier Weight (Excavator)	lbs.	15,000-30,000	25,000-45,000	33,000-60,000	33,000-60,0000
Frequency	bpm	600-1,000	350-800	350-680	350-680
Hydraulic Flow Required	gpm	16-26	18-32	27-37	27-37
	(lpm)	(60-100)	(70-120)	(100-140)	(100-140)
Hydraulic Pressure	psi	1,600-2,300	1,750-2,600	2,200-2,600	2,200-2,600
	(bar)	(110-160)	(120-180)	(150-180)	(150-180)
Working Weight	lbs.	1,250	2,200	2,900	2,990
	(kg)	568	1,000	1,315	1,356
Overall Length	in.	75	84	100	100
	(cm)	191	214	254	254
Tool Diameter	in.	3.54	3.94	4.72	4.72
	(mm)	90	100	120	120

Model		**775B**	**775B G**	**785B**	**785B G**
AEM Measured Values					
Energy Rating **	ft. lbs.	2,638	2,638	3,528	3,528
	(joules)	3,577	3,577	4,784	4,784
Frequency	bpm	643	643	538	538
Hydraulic Flow	gpm	42.2	42.2	47.8	47.8
	(lpm)	160	160	181	181
Supply Pressure	psi	2,611	2,611	2,484	2,484
	(bar)	180	180	171	171
Operating Ranges					
Recommended Carrier Weight (Excavator)	lbs.	44,000-76,000	44,000-76,000	55,000-80,000	55,000-80,000
Frequency	bpm	360-600	360-600	280-550	280-550
Hydraulic Flow Required	gpm	34-42	34-42	37-48	37-48
	(lpm)	(130-160)	(130-160)	(140-180)	(140-180)
Hydraulic Pressure	psi	2,300-2,600	2,300-2,600	2,300-2,600	2,300-2,600
	(bar)	(160-180)	(160-180)	(160-180)	(160-180)
Working Weight	lbs.	3,900	4,000	5,560	5,800
	(kg)	1,770	1,815	2,525	2,630
Overall Length	in.	112	112	126	126
	(cm)	284	284	320	320

Tool Diameter	in.	5.51	5.51	5.91	5.91	
	(mm)	140	140	150	150	
Model		**797B**	**797B G**	**805B**	**805B G**	**905B G**
AEM Measured Values						
Energy Rating **	ft. lbs.	4,955	4,955	5,834	5,834	10,247
	(joules)	6,719	6,719	7,910	7,910	13,895
Frequency	bpm	708	708	500	500	449
Hydraulic Flow	gpm	78.7	78.7	74.6	74.6	126.0
	(lpm)	298	298	282	282	477
Supply Pressure	psi	2,604	2,604	2,595	2,595	2,736
	(bar)	180	180	179	179	189
Operating Ranges						
Recommended Carrier Weight (Excavator)	lbs.	74,000-110,000	74,000-110,000	90,000-150,000	90,000-150,000	145,000+
Frequency	bpm	320-600	320-600	240-530	240-530	330-470
Hydraulic Flow Required	gpm	64-79	64-79	66-85	66-85	105-127
	(lpm)	(240-300)	(240-300)	(250-320)	(250-320)	(400-480)
Hydraulic Pressure	psi	2,300-2,600	2,300-2,600	2,300-2,600	2,300-2,600	2,300-2,750
	(bar)	(160-180)	(160-180)	(160-180)	(160-180)	(160-190)
Working Weight	lbs.	7,200	7,315	9,410	9,820	16,500
	(kg)	3,265	3,320	4,270	4,455	7,485
Overall Length	in.	141	141	142	142	164
	(cm)	358	358	361	361	417
Tool Diameter	in.	6.50	6.50	7.09	7.09	8.27
	(mm)	165	165	180	180	210
(**) The hammer energy rating is in accordance with the Certified AEM (Formerly CIMA) Tool Energy Rating Method.						

Updated:
Questions? Contact Us
Equipment descriptions and specifications are subject to change without notice.

MATERIAL PROPERTIES

Memorandum

Re: Material Properties for Evaluation Calculations
Bridge K-593 on Route 150
Greenwood, MO

By: John Boschert
Dave Rogowski
Genesis Structures

The General Notes from the existing bridge plans indicate the following ALLOWABLE stresses for the materials:

- Structural steel: 18000 psi
- Reinforcing steel: 18000 psi
- Reinforced Concrete: 900 psi

Demolition adequacy evaluations are performed in the strength limit state, so determine equivalent strength data.

<u>Structural Steel</u>

Per AASHTO 17th Edition Table 10.32.1A, the baseline allowable stress for structural steel is 0.55Fy.

Fy = Fa / 0.55 = 18000 / 0.55 = 33000 psi

<u>Reinforcing Steel</u>

Per AASHTO 17th Edition Section 8.15.2.2, the allowable stress for Grade 40 reinforcing steel = 20000 psi.

Ratio Fy for reinforcing steel based on this criteria.

Fy = (18000 / 20000) * 40000 = 36000 psi

<u>Reinforced Concrete:</u>

Per AASHTO 17th Edition Section 8.15.2.1, the allowable stress for compression in concrete = 0.40f'c.

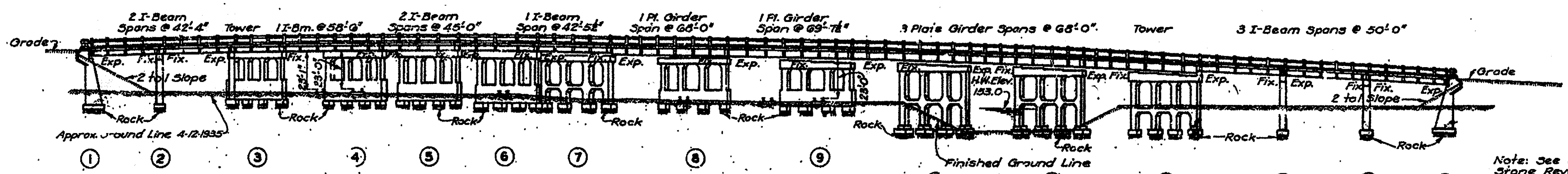
f'c = 900 / 0.40 = 2250 psi

MISSOURI STATE HIGHWAY DEPARTMENT

B82

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	FAGM 816A(1)	19		

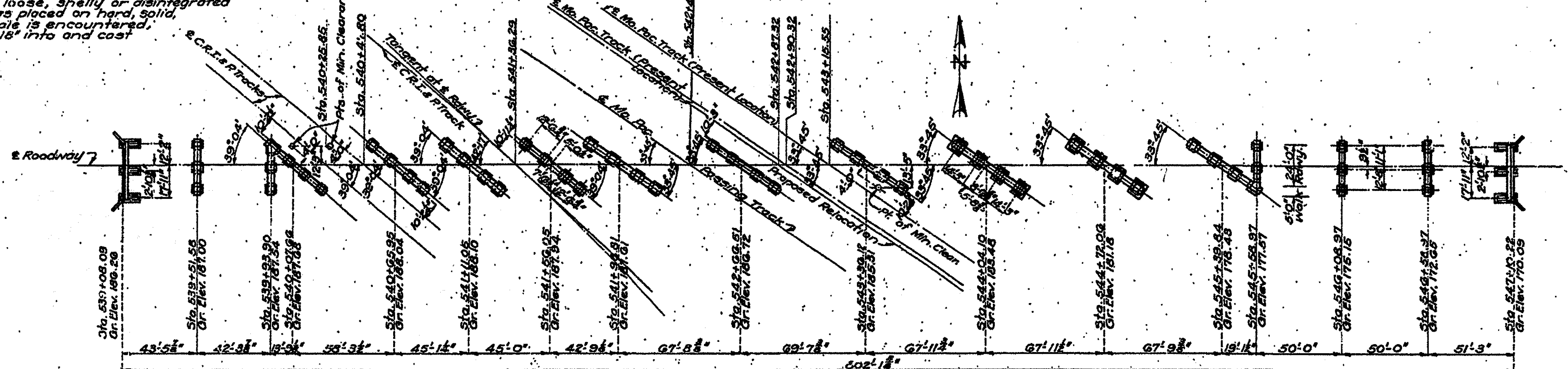
FINAL PLANS



GENERAL ELEVATION

Note: See Sheet No. 5 for sketch of Heavy Stone Revetment on south side of Bent No. 15.

Note: Footings for Bents No. 10 & 11 shall be carried at least 18" into and cast against vertical faces of hard, solid, undisturbed rock at elevations not above those specified on the plans.
At footings for all other bents all loose, shelly or disintegrated rock shall be removed and the footings placed on hard, solid, undisturbed rock. If soft rock or shale is encountered, the footings shall be carried at least 18" into and cast against vertical faces of same.



GENERAL PLAN

GENERAL NOTES:

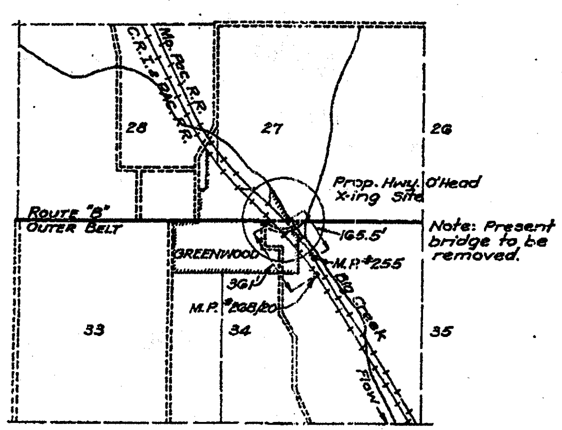
Design Specifications: A.A.S.H.O.-1935
Loading H-20 A.A.S.H.O.
Structural Steel Stress 18,000#/□"
Reinforcing Steel Stress 18,000#/□"
Concrete Class "B" 900#/□"
All concrete shall be Class "B".
Exposed edges shall be beveled ¾" where no other bevel is noted.
Bar supports and spacers will be required for reinforcing steel in sidewalk slab. See Standard C110RI.
Bar truss supports will be required for reinforcing steel in roadway slabs. See Sheet No. 3
Floor slab for each span shall be constructed full length and width at one operation. No longitudinal or transverse construction joints will be permitted except as shown.
Where rubber compound is specified on plans for use in partition or expansion joints, the premoulded joint shall be securely stitched to one face of concrete with copper wire.
All concrete shall be proportioned by the weight proportioning method.
Excavation for structure shall be in accordance with Specification I of Standard and Supplemental Specifications.
Detail shop drawings for all structural steel, wrought iron, cast steel and all other metal items shall be submitted to the State Highway Department in duplicate and shall be approved before material is ordered or work started.
Beam flanges shall be squared up at all points of bearing.
Qualification of all welding operators and electrodes will be required in accordance with specifications.
The welding symbols used on these plans are the 1937 symbols of the American Welding Society.
Rivets ¾"φ, holes 13/16"φ, except in handrail where rivets shall be ⅝"φ, holes 11/16"φ. Field connections for handrail shall be ⅝"φ button head bolts with hexagonal nuts. All other field connections riveted except as noted.
Paint: Shop, surfaces inaccessible after erection three coats of red lead, all other surfaces one coat of red lead: Field, All exposed surfaces, second coat red lead tinted brown, third coat aluminum tinted, fourth coat aluminum. See Special Provisions relative to required sandblasting, cleaning and painting.
A minimum vertical clearance of 22'-0" from top of rails and a minimum lateral clearance of 8'-6" from centerline of tracks shall be maintained over railroad tracks during construction.
See Special Provisions relative to required shoring of excavation for Tower 3 and Bents No. 4, 5, 6, 8 and 9.
Drainage Area 9 Sq. Miles - Rolling.

FINAL PLAN QUANTITIES				
Item		Substr.	Superstr.	Total
Class 1 Excavation for Structures	Cu.Yds.	1339.5		1339.5
Class 2 Excavation for Structures	Cu.Yds.	184.5		184.5
Class "B" Concrete	Cu.Yds.	1075.6	877.0	1952.6
Fabricated Structural Steel (Gird.Sps.)	Lbs.		397810	397810
Fabricated Structural Steel (I-Bm. Sps.)	Lbs.		398560	398560
Steel Castings	Lbs.		13100	13100
Fabr. Struct.Steel (Brg.Pls., Pins etc.)	Lbs.		15030	15030
Wrought Iron Blast Plates	Lbs.		29060	29060
Bridge Drainage System	Lump Sum		1	1
Corrugated Metal Pipe (12" Diam.)	Lin.Ft.	92		92
Reinforcing Steel	Lbs.	99550	223150	322700
22" Structural Steel Handrail	Lin.Ft.		800	800
32" Structural Steel Handrail	Lin.Ft.		800	800

Excavation for bridge made above Elev. 141.0 will be paid for as Class 1 Excavation for Structures.
Excavation for bridge made below Elev. 141.0 will be paid for as Class 2 Excavation for Structure.

FINAL PLAN QUANTITIES				
Item	Substr	Superstr	Total	
Spec. Concrete Prot. Gr. A c.y.	384.3		384.3	
" " " Gr. B c.y.	0		0	
" " " Gr. C c.y.	89.8		89.8	
Temporary Bridge Lin. Ft.			58	
Removal of (1) Existing Struct. (Lump Sum)			1	
Contingent Items				
Test holes in Footing Fndtns (Lin. Ft.)	182		182	
45° Elbo for 12" C.M.P.			1	
Left over 12" C.M. Pipe 54' Long			54	
Painting Expansive Grout Under Hndrl Posts			1	
Cl. 1 Exc. at contract price plus 25% - C.Y.	35.0		35.0	Specifications
Cl. 2 Exc. at contract price plus 50% - C.Y.	3.0		3.0	Specifications

Sheet No. 14



LOCATION SKETCH

Note: Present bridge to be removed.

FOR INFORMATION ONLY

U.S.G.S. B.M. Elev. 16… Sta. 539+00.
Add 754.573 for U.S.G.S. datum.

BRIDGE OVER R.R. TRACKS AND BIG CREEK

STATE ROAD FROM ROUTE 35 TO ROUTE 7

IN GREENWOOD

PROJECT NO. FAGM 816A(1) (SB) STA. 539+08.09

JACKSON COUNTY

SUBMITTED BY N. R. Sack DATE 6/2/1939 BRIDGE ENGINEER

APPROVED BY C. W. Brown DATE 6/2/1939 CHIEF ENGINEER

STD. C110RI

K-593

Drawn May 1939 by R.A.-D.K.M.
Traced May 1939 by G.W.
Checked May 1939 by H.D.

FINAL PLANS

DEAD LOADS AND DEMOLITION PHASING

Made By JPB	Date 3-15-07
Checked By [initials]	Date
Back checked By	Date

Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Evaluate Dead Loads

1. Slab: Varies from 9" @ curb to 10" @ ℄ Bridge.

→ Use 155 pcf & thickness = 10" for engineering calcs. (DC's)

2. Asphalt Overlay: 2" overlay. Assume 135 lb/ft^3

3. Steel details: Assume 20% additional for details

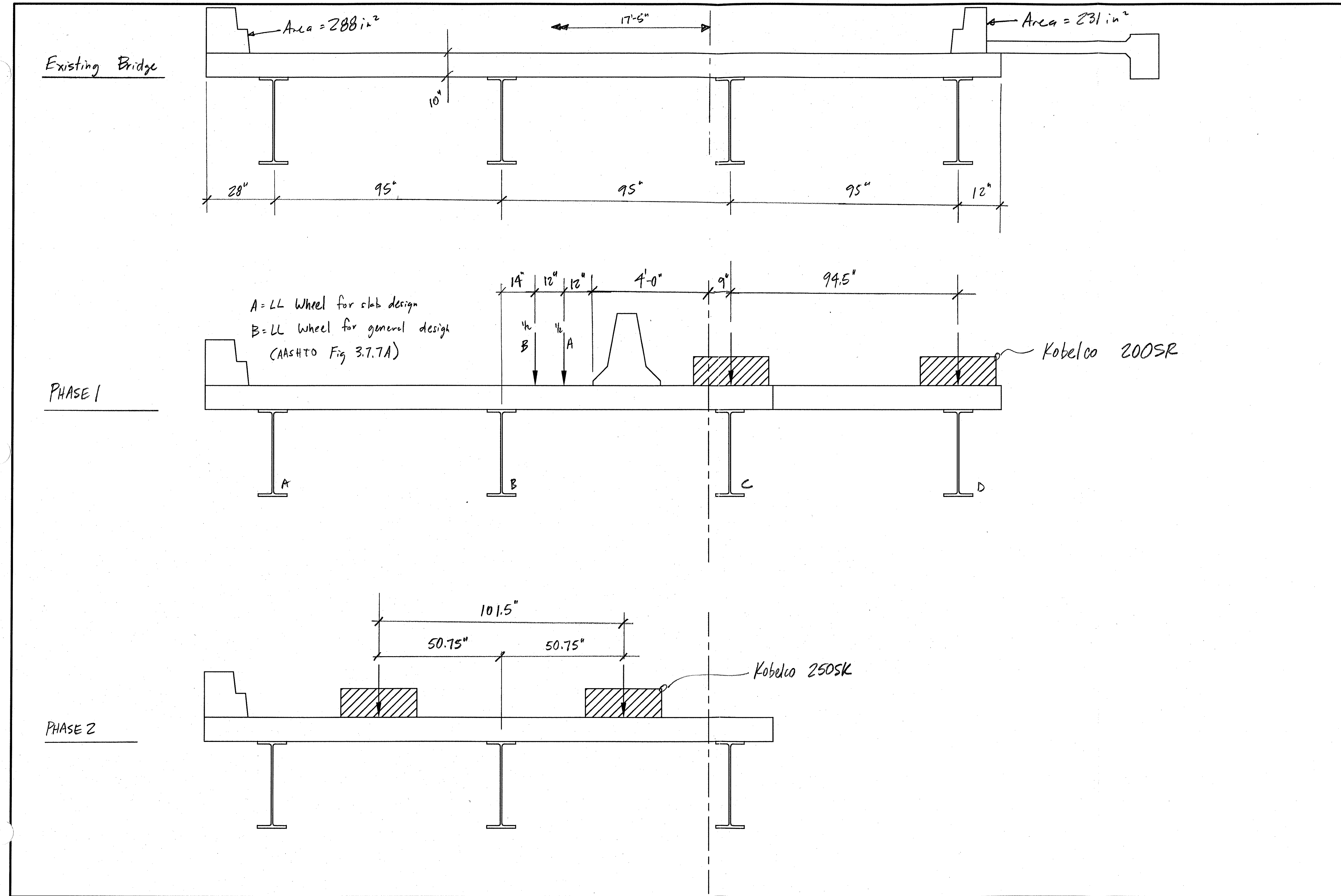
4. Barrier:

1. Permanent DC → Assume 350 lb/ft
2. Temporary DC → Assume 350 lb/ft

Permanent: Average area $= \frac{231+288}{2} = 259.5\ in^2$

$w = 260\ in^2 * 0.150\ \frac{k}{ft^3} * \frac{1\ ft^2}{144\ in^2} = 270\ lb/ft$

→ Use 350 lb/ft



Sheet No.

Date: 03-15-07

Date:

By: JPB

Checked:

Demolition Phasing

GENESIS STRUCTURES

PHASE 1 STEEL SUPERSTRUCTURE

EVALUATION CALCULATIONS

Steel superstructure Evaluation.

PHASE I

A. Rolled Beam spans

The south edge girder (D) is typically a larger section and the loading demand is clearly critical @ Girder C (1st South interior). So, check only girder C.

Dead loads:

A. Slab – Assume weight of slab south of saw cut is taken by girder C

└→ tributary width = 95"

$$w_{slab} = \frac{0.155\ k}{ft^3} * 10\ in * 95\ in * \frac{1 ft^2}{144 in^2} = 1.023\ k/ft$$

B. Overlay

$$w_{over} = \frac{0.135\ (2)(95)}{144} = 0.178\ k/ft$$

C. Barriers – Assume BDL (shared among 3 remaining)

$$w = \frac{2(350)}{3} = 233\ lb/ft \quad \text{Phase I}$$

$$= 350/3 = 116.5\ lb/ft \quad \text{Phase II}$$

D. Steel Details → Add 20% Additional for details.

Steel Superstructure (cont)

PHASE 1 - Cont.

E. HS LL → Say HS20

Find % HS20 lane to be taken by beam C. See Phasing Diagram for sketch

$C = \frac{1}{2}(14/95) = 0.074 *$ HS20 Lane or Truck Load.

→ Use AASHTO S.S. HS20 LL tables to get LL per spanlength.
(simple-span)

Design Cases:

1. Span 12 → 41'-6" span, W36x150 ← Does not control
2. Span 34 → 57'-8" span, W36x230
3. Span 45 → 44'-2" span, W36x150
4. Span 67 → 38'-8 3/16" span, W36x150 ← Does not control.

Case 2: Span 34, spanlength = 57'-8", W36x230
l_b = 9'-9" (Diaphragm spacing)

HS20 LL for 58' span = 770.8 k-ft (truck), 60.4^k (truck)
$*$ DF = 0.074

M_{LL} = 57.0 k-ft
V_{LL} = 4.5^k

LOADING—HS 20-44 (MS18)

TABLE OF MAXIMUM MOMENTS, SHEARS, AND REACTIONS—SIMPLE SPANS, ONE LANE

Spans in feet; moments in thousands of foot-pounds; shears and reactions in thousands of pounds.

These values are subject to specification reduction for loading of multiple lanes.

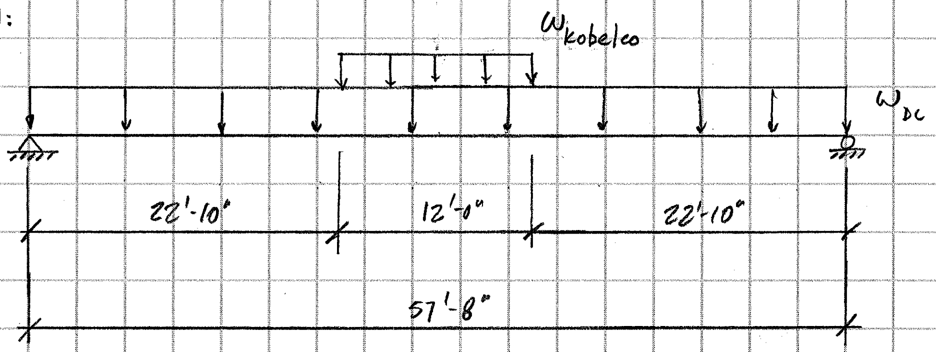
Impact not included.

Span	Moment	End shear and end reaction (a)	Span	Moment	End shear and end reaction (a)
1	8.0(b)	32.0(b)	42	485.3(b)	56.0(b)
2	16.0(b)	32.0(b)	44	520.9(b)	56.7(b)
3	24.0(b)	32.0(b)	46	556.5(b)	57.3(b)
4	32.0(b)	32.0(b)	48	592.1(b)	58.0(b)
5	40.0(b)	32.0(b)	50	627.9(b)	58.5(b)
6	48.0(b)	32.0(b)	52	663.6(b)	59.1(b)
7	56.0(b)	32.0(b)	54	699.3(b)	59.6(b)
8	64.0(b)	32.0(b)	56	735.1(b)	60.0(b)
9	72.0(b)	32.0(b)	58	770.8(b)	60.4(b)
10	80.0(b)	32.0(b)	60	806.5(b)	60.8(b)
11	88.0(b)	32.0(b)	62	842.4(b)	61.2(b)
12	96.0(b)	32.0(b)	64	878.1(b)	61.5(b)
13	104.0(b)	32.0(b)	66	914.0(b)	61.9(b)
14	112.0(b)	32.0(b)	68	949.7(b)	62.1(b)
15	120.0(b)	34.1(b)	70	985.6(b)	62.4(b)
16	128.0(b)	36.0(b)	75	1,075.1(b)	63.1(b)
17	136.0(b)	37.7(b)	80	1,164.9(b)	63.6(b)
18	144.0(b)	39.1(b)	85	1,254.7(b)	64.1(b)
19	152.0(b)	40.4(b)	90	1,344.4(b)	64.5(b)
20	160.0(b)	41.6(b)	95	1,434.1(b)	64.9(b)
21	168.0(b)	42.7(b)	100	1,524.0(b)	65.3(b)
22	176.0(b)	43.6(b)	110	1,703.6(b)	65.9(b)
23	184.0(b)	44.5(b)	120	1,883.3(b)	66.4(b)
24	192.7(b)	45.3(b)	130	2,063.1(b)	67.6
25	207.4(b)	46.1(b)	140	2,242.8(b)	70.8
26	222.2(b)	46.8(b)	150	2,475.1	74.0
27	237.0(b)	47.4(b)	160	2,768.0	77.2
28	252.0(b)	48.0(b)	170	3,077.1	80.4
29	267.0(b)	48.8(b)	180	3,402.1	83.6
30	282.1(b)	49.6(b)	190	3,743.1	86.8
31	297.3(b)	50.3(b)	200	4,100.0	90.0
32	312.5(b)	51.0(b)	220	4,862.0	96.4
33	327.8(b)	51.6(b)	240	5,688.0	102.8
34	343.5(b)	52.2(b)	260	6,578.0	109.2
35	361.2(b)	52.8(b)	280	7,532.0	115.6
36	378.9(b)	53.3(b)	300	8,550.0	122.0
37	396.6(b)	53.8(b)			
38	414.3(b)	54.3(b)			
39	432.1(b)	54.8(b)			
40	449.8(b)	55.2(b)			

(a) Concentrated load is considered placed at the support. Loads used are those stipulated for shear.
(b) Maximum value determined by Standard Truck Loading. Otherwise the Standard Lane Loading governs.

Steel Superstructure - Phase I (cont)

Max M:



w_{kob} = 3.39375 k/ft (200SR, see demo machines calcs)

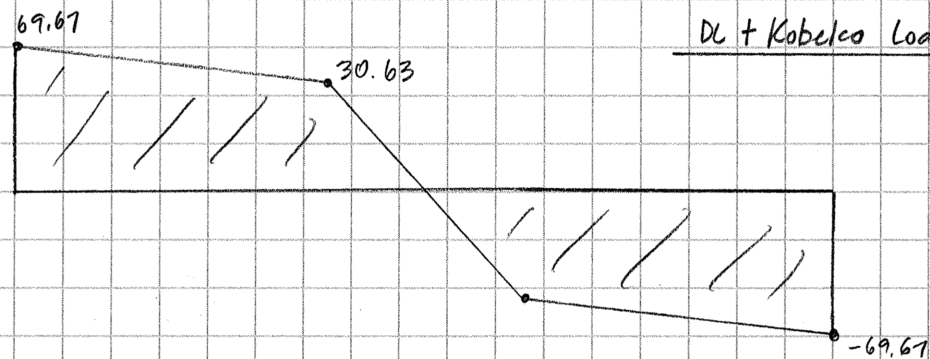
w_{DC}:

1.023	Slab
0.178	Overlay
0.233	Barriers
0.230	S.W.
0.046	Details
1.710 k/ft	

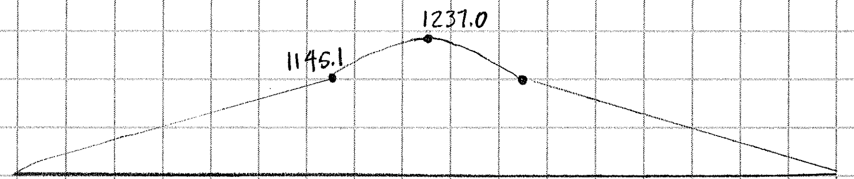
Rxn = ½(1.710)(57.667) + ½(3.39375)(12) = 69.67^k

DL + Kobelco Load Condition

VD (k)



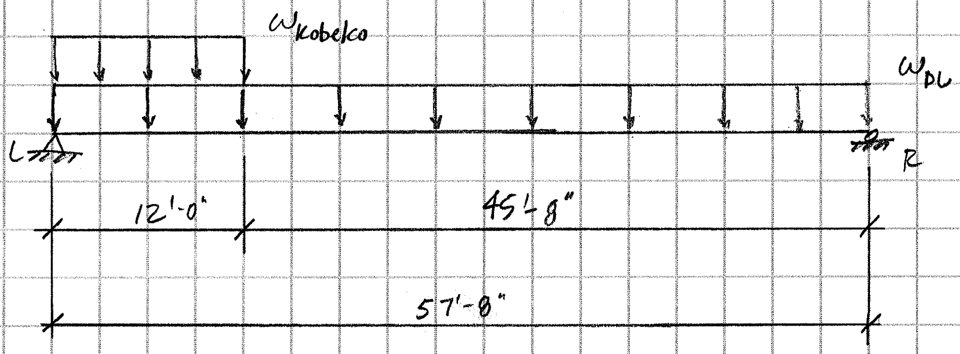
MD (k-ft)



M_{Tot} = 1237.0 + 57.0 = 1294 k-ft
(LL)

Steel Superstructure – Phase I (cont)

Max Shear:



$\Sigma M_L = 3.39375(12)(6) + 1.710(57.667)^2(0.5) - 57.667 R_R = 0$

$R_R = 53.54^k$

$R_L = 3.39375(12) + 1.710(57.667) - 53.54 = 85.79$

$V_{max} = 85.79 + 4.5 = 90.3^k$

SEE SPREADSHEET FOR EVALUATION

$f_b = 1294.0(12) / 837 = 18.55$ ksi

$f_v = \dfrac{90.3}{35.90(0.160)} = 3.31$ ksi

Allow 25% overstress for temporary condition.

LR for flexure $= \dfrac{18.55}{0.55(33)} = 1.02 < 1.25$ OK

shear $= \dfrac{3.31}{11.0} = 0.30 < 1.25$ OK

	By:	JPB	Date:	3/19/07	Job No.
	Chkd By:		Date:		
	Bckchk By:		Date:		Sht. No.

PLATE GIRDER - SECTION PROPERTIES: **Built-Up Section** **W36x230**

Girder Properties:

	TF		WEB		BF
bf =	16.470	d =	33.380	bf =	16.470
tf =	1.260	tw =	0.760	tf =	1.260

	BFP
bf =	0.000
tf =	0.000

Steel Section Properties: (inches from top of web)

Area =	66.9	Iz steel =	14811.6	Iy =	939.4	in^4
y =	-16.690	rz =	14.882	ry =	3.748	in.
Detail % =	20%	S top =	825.2	Dc =	16.690	in.
Weight =	0.228	Sbot =	825.2	Iyc top =	469.1	in^4
Details =	0.046			Iyc bot =	469.1	in^4
Total =	0.273 k/ft			J =	26.8	in^4
				Ix =	26.8	in^4

Allowable Strength

Bending

$Fy_{Top\ Flange}$ =	33000	psi
$Fy_{Bot\ Flange}$ =	33000	psi
Cb =	1.000	
lb =	117.000	
Fb_{top} =	18150.0	psi
Fb_{bot} =	18150.0	psi
	(AASHTO 10.32)	
$M_{allow\text{-}top}$ =	14976.7	k-in
$M_{allow\text{-}bot}$ =	14976.7	k-in

Shear

Fy_{Web} =	33000	psi
Fv =	11000.0	psi (AASHTO 10.34.4)
V_{allow} =	279.1	kips

NOTE: Bending strength based on top flange compressive strength ONLY

GENESIS STRUCTURES

Made By JPB	Date 3-16-07
Checked By	Date
Back checked By	Date

Calculations For: APAC Demo K 593

Job No. ______ Sheet No. ______

Steel Superstructure - PHase I (cont)

Case 3: Span 45, spanlength = 44'-2", W36x150

l_b = 9'-0" (Diaphragm spacing)

HS20LL for 44' span = 520.9 k-ft (truck)

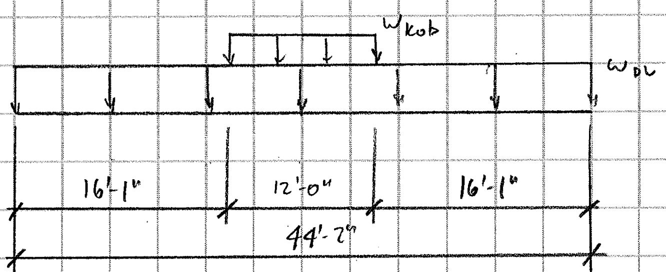
= 56.7 k (truck)

* DF = 0.074

M_{LL} = 38.5 k-ft

V_{LL} = 4.2 k

Max M:



$w_{kobelco}$ = 3.39375 k/ft

w_{DL} = 1.023 Slab

0.178 Overlay

0.150 SW

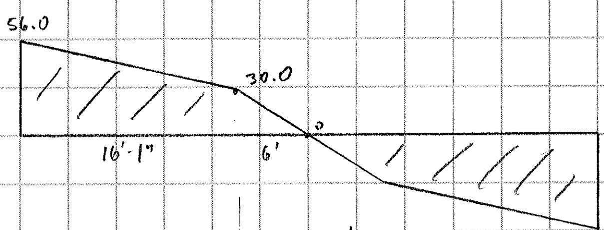
0.030 Details

0.233 Barriers

1.614 k/ft

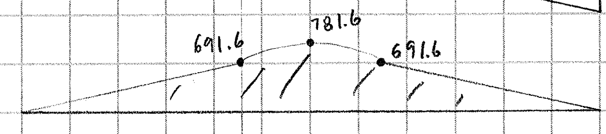
Rxn = ½(3.39375)(12) + ½(1.614)(44.167) = 56.0k

VD (k)



DL + Kobelco

MD (k-ft)



Steel Superstructure – Phase I (cont)

$M_{max} = 781.6 + 38.5 = 820.1$ k-ft

$V_{max} = \frac{1}{2}(1.614)(44.167) + 81.45/2 + 4.2 = 80.7^k$

DL + Kob + LL

See spreadsheet for evaluation.

$f_b = \frac{820.1\,(12)}{504} = 19.53$ ksi

$f_v = \frac{80.7}{(35.85)(0.625)} = 3.60$ ksi

Allow 25% overstress for temporary condition.

C.R. for flexure $= \frac{19.53}{18.15} = 1.08 < 1.25$ **ok**

CR for shear $= \frac{3.60}{11.0} = 0.33 < 1.25$ **ok**

	By:	JPB	Date:	3/16/07	Job No.	
	Chkd By:		Date:			
	Bckchk By:		Date:		Sht. No.	

PLATE GIRDER - SECTION PROPERTIES: **Built-Up Section** **W36x150**

Girder Properties:

	TF		WEB		BF
bf =	11.975	d =	33.970	bf =	11.975
tf =	0.940	tw =	0.625	tf =	0.940

	BFP
bf =	0.000
tf =	0.000

Steel Section Properties: (inches from top of web)

Area =	43.7	Iz steel =	8902.5	Iy =	269.7	in^4
y =	-16.985	rz =	14.266	ry =	2.483	in.
Detail % =	20%	S top =	496.7	Dc =	16.985	in.
Weight =	0.149	Sbot =	496.7	Iyc top =	134.5	in^4
Details =	0.030			Iyc bot =	134.5	in^4
Total =	0.179 k/ft			J =	9.4	in^4
				Ix =	9.4	in^4

Allowable Strength

Bending

$Fy_{Top\ Flange}$ =	33000	psi
$Fy_{Bot\ Flange}$ =	33000	psi
Cb =	1.000	
lb =	108.000	
Fb_{top} =	18150.0	psi
Fb_{bot} =	18150.0	psi
	(AASHTO 10.32)	
$M_{allow\text{-}top}$ =	9014.3	k-in
$M_{allow\text{-}bot}$ =	9014.3	k-in

Shear

Fy_{Web} =	33000	psi
Fv =	11000.0	psi (AASHTO 10.34.4)
V_{allow} =	233.5	kips

NOTE: Bending strength based on top flange compressive strength ONLY

Made By JPB	Date 3-16-07
Checked By	Date
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Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

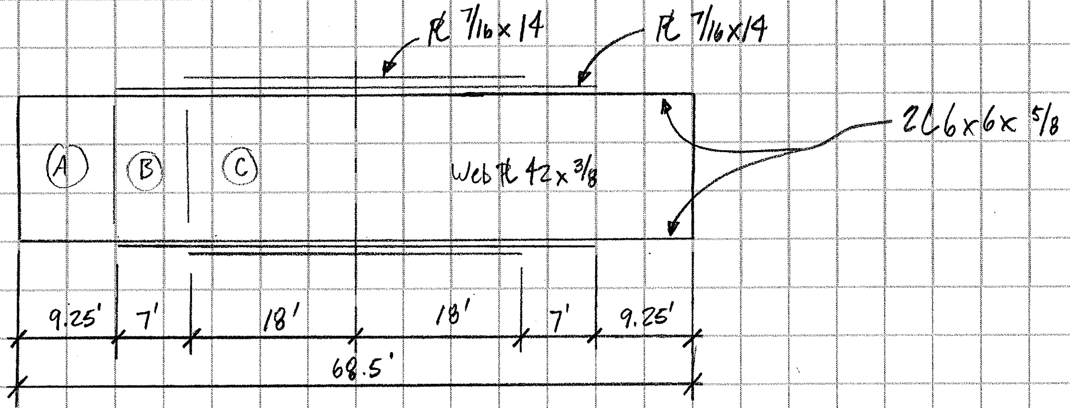
Steel Superstructure - Phase I (cont)

B. Plate Girder spans

Again, Girder D is larger because it carried the sidewalk, so focus on and analyze only Girder C for Phase I.

Analyse the longest span with the smallest section to envelope the solution.

Span 89 = 68'-3 1/8" → Say 68.5'



42.5" back-to-back of L6x6 members.

See attached schedule of section properties for regions A, B, C.

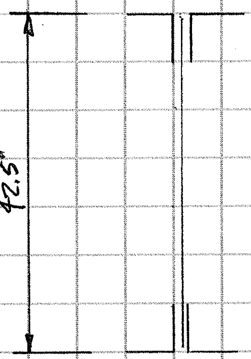
Made By JPB	Date 3-16-07
Checked By [initials]	Date
Back checked By	Date

Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Steel Superstructure - Phase I (cont)

Handcalc section properties for w/o cover PL's.



(A)

$A_x = 14.2(2) + 0.375(42) = 44.15\ in^2$

$I = \left[48.3 + 14.2\,(0.5 \times 42.5 - 1.73)^2\right]2$

$+ \ 1/12\,(0.375)(42)^3 = 13233\ in^4$

$S_x = 13233 / (0.5 \times 42.5) = 622.7\ in^3$

Section (B)

$A_x = 44.15 + (7/16)(14)(2) = 56.4\ in^2$

$I_x = 13233 + 2\left[\frac{1}{12}(14)(7/16)^3 + (7/16)(14)(0.5 \times 42.5 + 7/16 \times 0.5)^2\right]$

$= 18879.3\ in^4$

$S_x = 18879.3 / (0.5 \times 42.5 + 7/16) = 870.5\ in^3$

Section @ (C)

$A_x = 44.15 + (7/8)(14)(2) = 68.65\ in^2$

$I_x = 13233 + 2\left[\frac{1}{12}(14)(7/8)^3 + (7/8)(14)(0.5 \times 42.5 + 7/8 \times 0.5)^2\right]$

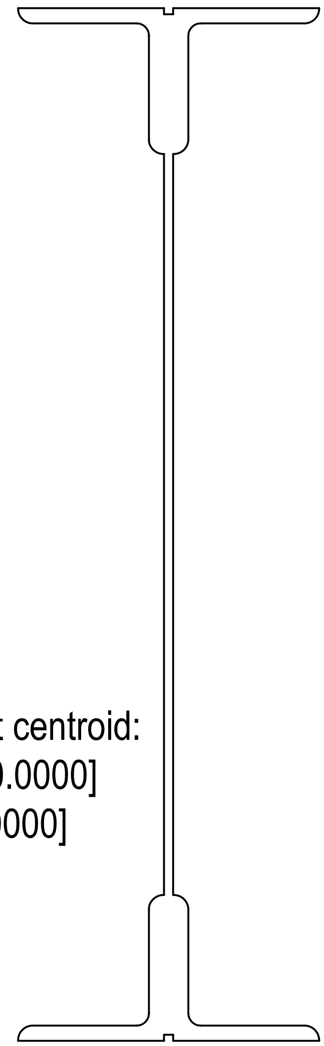
$= 24758.1\ in^4$

$S_x = 24758.1 / (0.5 \times 42.5 + 7/8) = 1119.0\ in^3$

By:	Date:	Checked:	Date:

---------------- REGIONS ----------------

Area: 43.7840
Perimeter: 131.8314
Bounding box: X: -6.1875 -- 6.1875
Y: -21.2500 -- 21.2500
Centroid: X: 0.0000
Y: 0.0000
Moments of inertia: X: 13131.3314
Y: 190.0946
Product of inertia: XY: 0.0000
Radii of gyration: X: 17.3179
Y: 2.0837
Principal moments and X-Y directions about centroid:
I: 13131.3314 along [1.0000 0.0000]
J: 190.0946 along [0.0000 1.0000]



A

GENESIS STRUCTURES

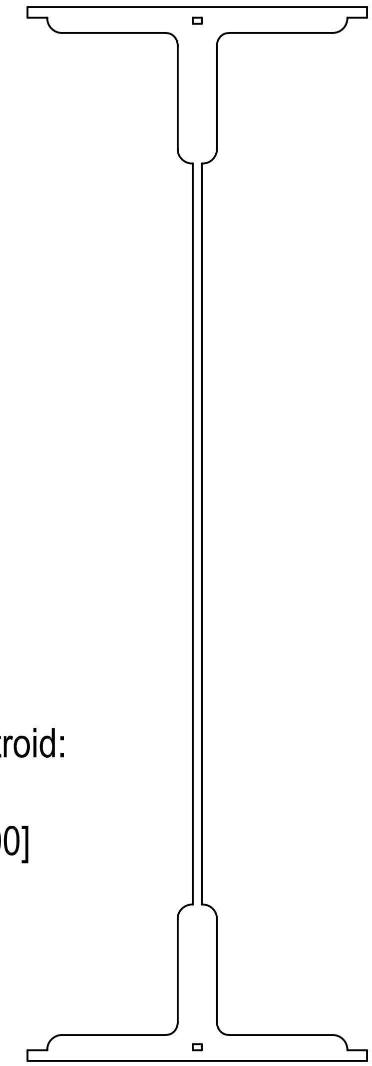
Plate Girder Section Properties

Sheet No.

By: Date: Checked: Date:

---------------- REGIONS ----------------

Area: 56.0340
Perimeter: 141.5814
Bounding box: X: -7.0000 -- 7.0000
Y: -21.6875 -- 21.6875
Centroid: X: 0.0000
Y: 0.0000
Moments of inertia: X: 18777.6403
Y: 390.1780
Product of inertia: XY: 0.0000
Radii of gyration: X: 18.3060
Y: 2.6388
Principal moments and X-Y directions about centroid:
I: 390.1780 along [0.0000 -1.0000]
J: 18777.6403 along [1.0000 0.0000]



B

GENESIS STRUCTURES

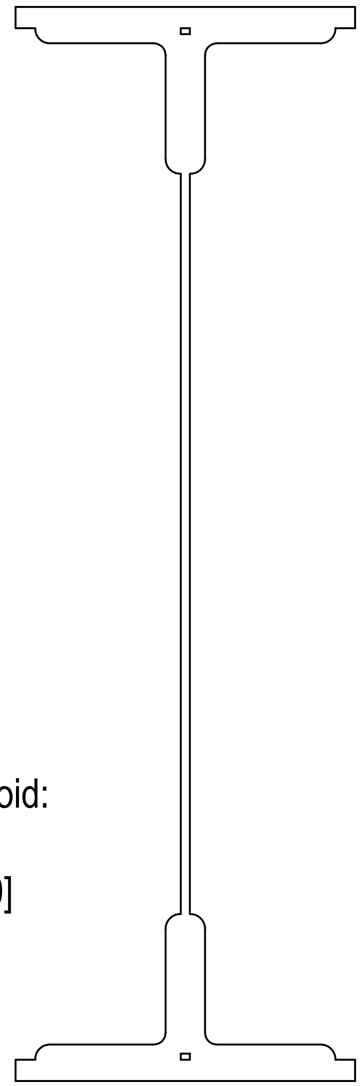
Plate Girder Section Properties

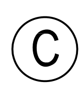
Sheet No.

By:	Date:	Checked:	Date:

---------------- REGIONS ----------------

Area: 68.2840
Perimeter: 143.3314
Bounding box: X: -7.0000 -- 7.0000
Y: -22.1250 -- 22.1250
Centroid: X: 0.0000
Y: 0.0000
Moments of inertia: X: 24656.4121
Y: 590.2613
Product of inertia: XY: 0.0000
Radii of gyration: X: 19.0023
Y: 2.9401
Principal moments and X-Y directions about centroid:
I: 590.2613 along [0.0000 -1.0000]
J: 24656.4121 along [1.0000 0.0000]





GENESIS STRUCTURES

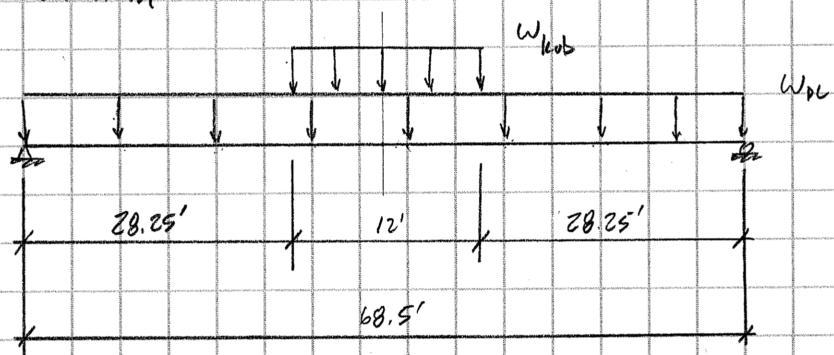
Plate Girder Section Properties

Sheet No.

Steel Superstructure – Phase I (cont)

B. Plate Girders spans (cont)

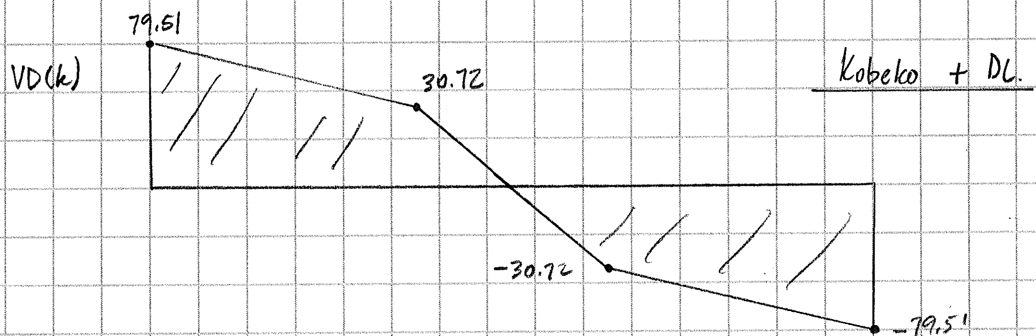
Check maximum M

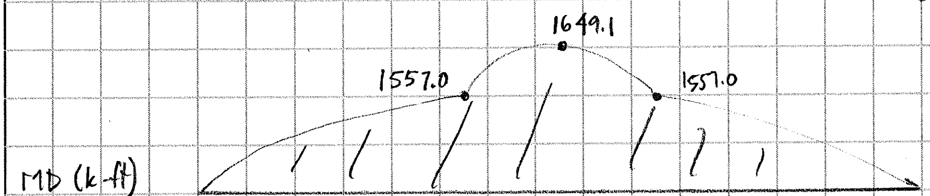


w_{kob} = 3.39375 k/ft

w_{DL}	=	1.023 k/ft	Slab	
	=	0.178 k/ft	Overlay	
	=	0.233 k/ft	Barriers	
	=	0.234 k/ft	S.W. (use Sect C)	$= 68.65\,in^2 * 0.490\,\frac{k}{ft^3} * \frac{1ft^2}{144 in^2} = 0.234$ k/ft
	=	0.059 k/ft	Details (25%)	
		1.727 k/ft		

$R_{xn} = \frac{1}{2}(1.727)(68.5) + \frac{1}{2}(3.39375)(12) = 79.51^k$





GENESIS STRUCTURES

Made By JPB	Date 3-16-07
Checked By DWB	Date
Back checked By	Date

Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Steel Superstructure - Phase I (cont)

HS20 LL for span = 68' = 949.7 k-ft (truck)
= 62.1 k (truck)
→ DF = 0.074

M = 70.3 k-ft
V = 4.6 k

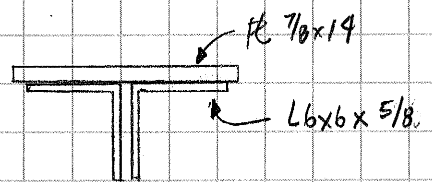
M_{TOT} = 1649.1 + 70.3 = 1719.4 k-ft

V_{TOT} = (1/2)(1.727)(68.5) + 1/2(81.45) + 4.6 = 104.5^k
DL Kob LL

Flexure: Section C → $f_b = \frac{1719.4(12)}{1119.0}$ = 18.4 ksi

Shear: $f_v = \frac{104.5}{42(0.375)}$ = 6.6 ksi

See spreadsheet Evaluation @ Section C:



→ Say Equiv flange =

Width = 12"

Area = 7/8(14) + 12(.625) = 19.75 in^2

t_{eff} = 19.75 / 12 = 1.646 in

	By:	JPB	Date:	3/16/07	Job No.	
	Chkd By:		Date:			
	Bckchk By:		Date:		Sht. No.	

PLATE GIRDER - SECTION PROPERTIES: **Built-Up Section** **Plate Girder**

Girder Properties:

TF		WEB		BF	
bf =	12.000	d =	42.000	bf =	12.000
tf =	1.646	tw =	0.375	tf =	1.646

BFP	
bf =	0.000
tf =	0.000

Steel Section Properties: (inches from top of web)

Area =	55.3		Iz steel =	21137.7	Iy =	474.2	in^4
y =	-21.000		rz =	19.559	ry =	2.930	in.
Detail % =	20%		S top =	933.4	Dc =	21.000	in.
Weight =	0.188		Sbot =	933.4	Iyc top =	237.0	in^4
Details =	0.038				Iyc bot =	237.0	in^4
Total =	0.226	k/ft			J =	36.4	in^4
					Ix =	36.4	in^4

Allowable Strength

Bending

$Fy_{Top\ Flange}$ =	33000	psi
$Fy_{Bot\ Flange}$ =	33000	psi
Cb =	1.000	
lb =	108.000	
Fb_{top} =	18150.0	psi
Fb_{bot} =	18150.0	psi
	(AASHTO 10.32)	
$M_{allow\text{-}top}$ =	16941.1	k-in
$M_{allow\text{-}bot}$ =	16941.1	k-in

Shear

Fy_{Web} =	33000	psi
Fv =	5843.4	psi (AASHTO 10.34.4)
V_{allow} =	92.0	kips

NOTE: Bending strength based on top flange compressive strength ONLY

Steel Superstructure - Phase I (cont)

L.R. for flexure: Section C → $\frac{18.4}{18.15}$ = 1.01 < 1.25 OK

Allow 25% overstress for temporary condition.

PHASE 2 STEEL SUPERSTRUCTURE

EVALUATION CALCULATIONS

Steel Superstructure - Phase II

For Phase II, the heavier machine (Kobelco 250SK) will be used instead of the Kobelco 200SR.

By inspection, Girder B is critical. → Take ½ of Kobelco 250SK weight.

Girders B & are identical, and Girder C was checked for Phase I.

So, compare loading between Phase 1 and Phase 2... may be able to eliminate the analysis of Phase 2.

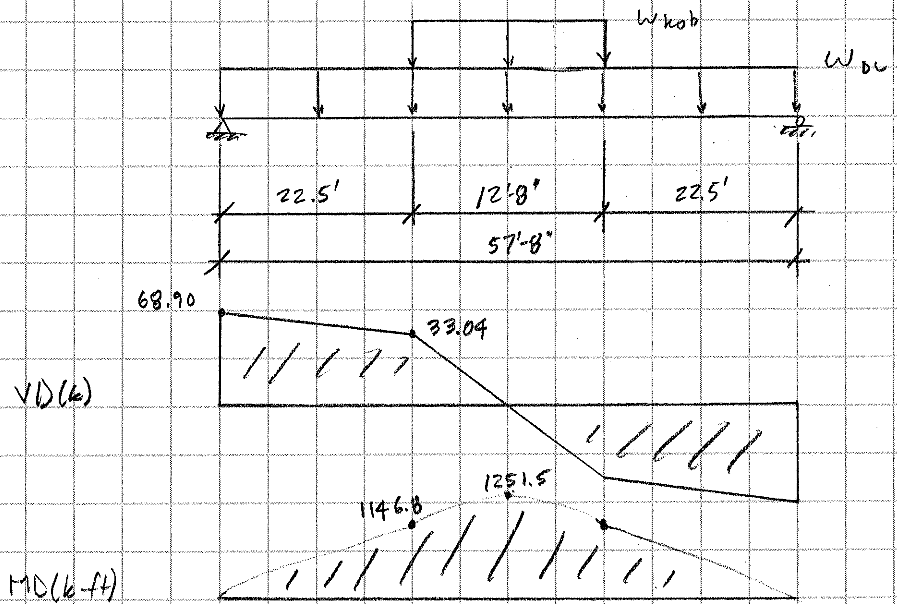
A. Rolled beam spans

Case 2: $w_{kob} = \frac{91.8(0.5)}{12.67} = 3.6227$ k/ft @ L = 12'-8"

w_{DC}

1.023	Slab
0.178	Overlay
0.117	Barriers
0.230	SW
0.046	Details
1.594	k/ft.

LL = 0



$R_{xn} = ½(1.594)(57.667) + ½(3.6227)(12.67) = 68.90^k$

Made By JPB	Date 3-16-07
Checked By [initials]	Date
Back checked By	Date

Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Steel Superstructure – Phase II (cont)

M_{max} = 1251.5 + 0 = 1251.5 k ft < Phase I ok

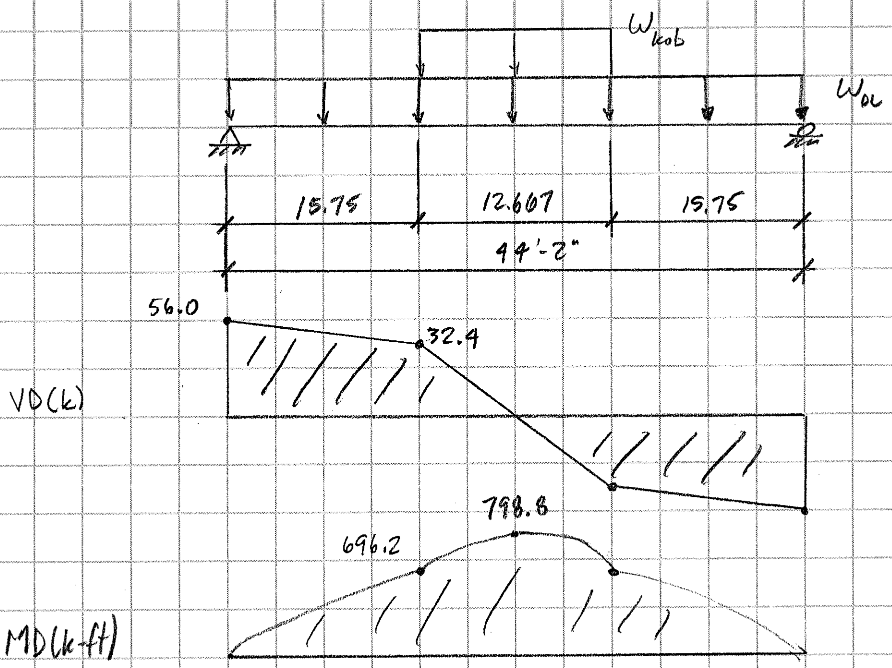
V_{max} = ½(1.594)(57.67) + ½(91.80) = 91.9k ≅ Phase I ok (LR ≅ 0.3)

Case 3:

w_{kob} = 3.6227 k/ft @ L = 12'-8"

w_{DL} = 1.023 Slab
0.178 Overlay
0.150 SW
0.030 Details
0.117 Barriers
1.498 k/ft

Rxn = ½(1.498)(44.16) + ½(3.6227)(12.67)
= 56.03k



M_{max} = 798.8 k-ft < Phase I ok

V_{max} = ½(1.498)(44.167) + ½(91.8) = 79.0k ≅ Phase I ok

Made By JPB	Date 3-16-07
Checked By [initials]	Date
Back checked By	Date

Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Steel Superstructure - Phase II (cont)

B. Plate girder spans

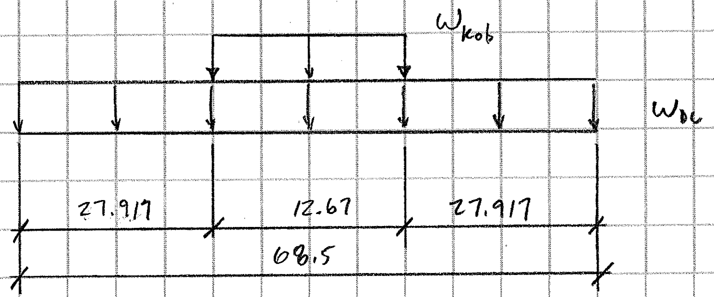
$w_{kob} = 3.6227$ k/ft

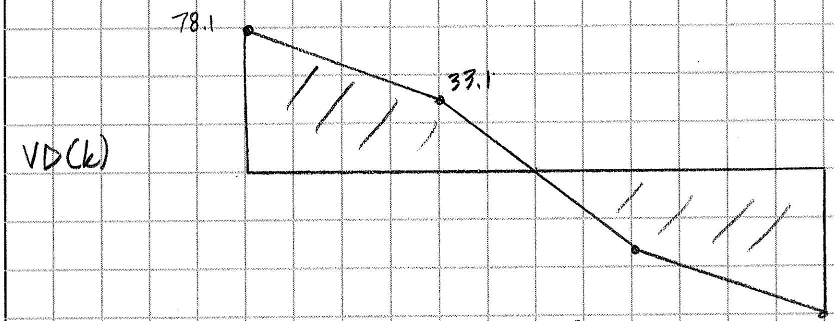
w_{DL}:

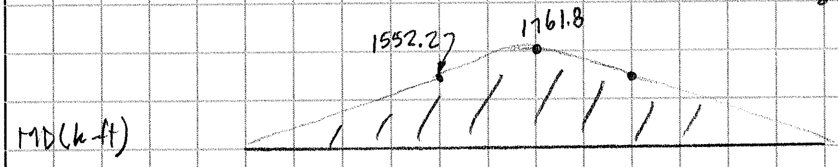
1.023	slab
0.178	Overlay
0.117	Barriers
0.234	SW
0.059	Details
1.611 k/ft	

$R_{xn} = \frac{1}{2}(1.611)(68.5) + \frac{1}{2}(3.6227)(12.67)$

$= 78.12^k$







$M_{max} = 1761.8$ k-ft

$V_{max} = \frac{1}{2}(1.611)(68.5) + \frac{1}{2}(91.8) = 101.1^k$ < Phase I ok

$f_b = \frac{1761.8(12)}{1119} = 18.9$ ksi → $LR = \frac{18.9}{18.15} = 1.04 < 1.25$ ok

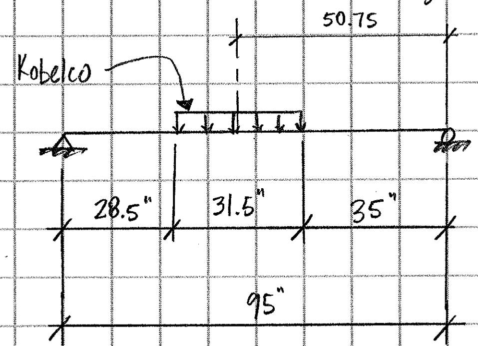
CONCRETE DECK EVALUATION CALCULATIONS

Slab Check

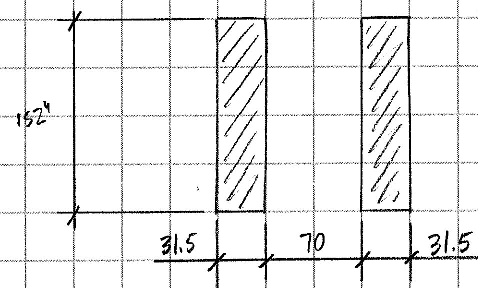
The critical case for slab loading is clearly Phase 2 because the heavier Kobelco excavator is positioned between the girders.

So, check only Phase 2.

Kobelco 250SK is centered on Girder B. Disregard continuity @ slab over Girder B... check simple-span scenario @ either span AB or BC (same geometry).



Kobelco 250SK loading: Total Wt (+ Impact) = 91.8k



$$P = \frac{91.8 \text{ k}}{(2)(31.5)(152) \text{ in}^2}$$

$$= 9.5865E-3 \text{ ksi}$$

$$* \frac{144 \text{ in}^2}{1 \text{ ft}^2} * \frac{1000 \text{ lb}}{1 \text{k}}$$

$$= 1380.5 \text{ lb/ft}^2$$

GENESIS STRUCTURES

Made By JPB	Date 3-18-07
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Back checked By	Date

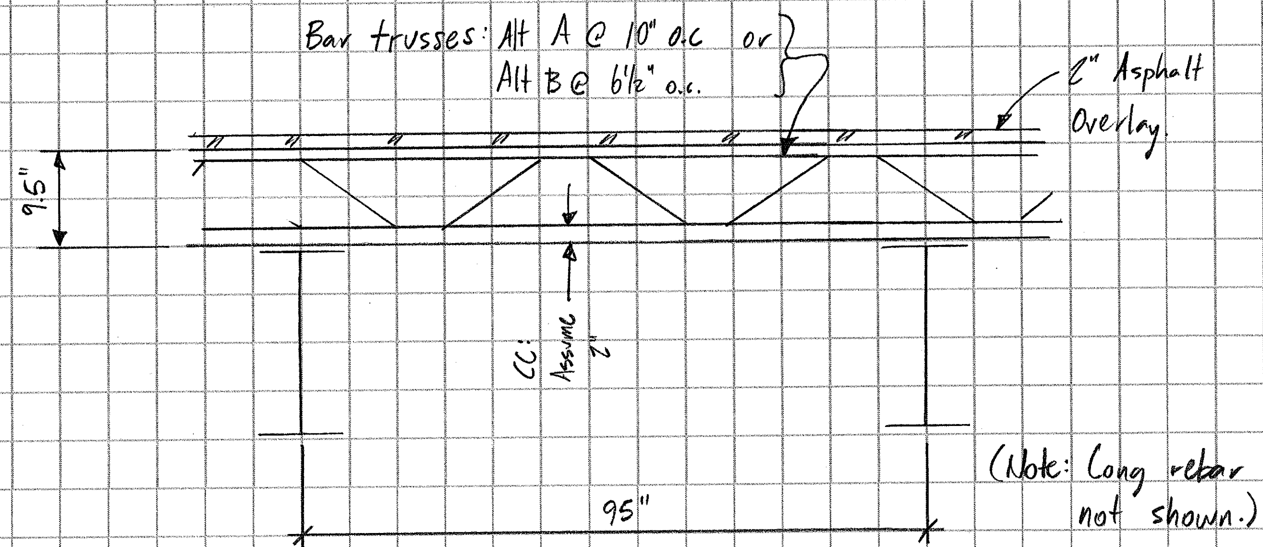
Calculations For: APAC Demo K593

Job No. ______ Sheet No. ______

Slab Check (cont)

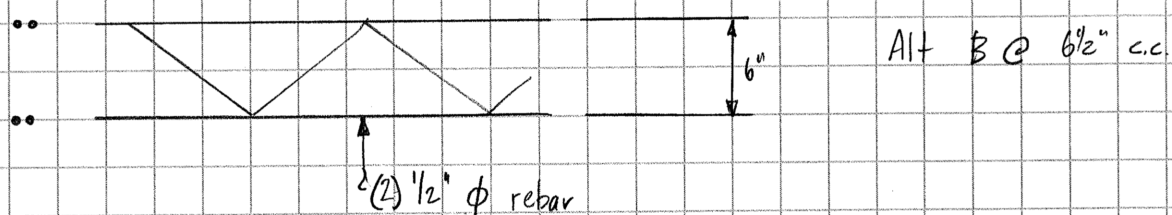
Slab Design & Reinforcing:

- Slab thickness varies between 9" & 10".
  - → Use t = 9½" for capacity evaluation.



- Clear cover not noted... assume 2"

- Bar truss detail (Ref Sheet 3)



→ Alt A is not detailed... Assume Alt A is equivalent rebar, so check design based on Alt B shown above.

Note: 2" c.c. is consistent with 6" bar truss height.

f'_c = 2250 psi
$f_{y,rebar}$ = 36000 psi
} See material properties memo.

Slab Checks (cont)

Loading:

DL → $p_{slab} = \left(\frac{9.5}{12}\right) ft\ (150) \frac{lb}{ft^3} = 118.75\ lb/ft^2$

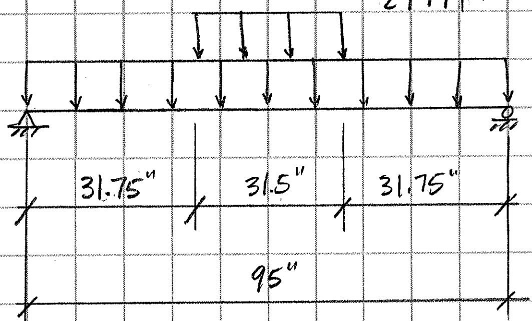
$p_{overlay} = \left(\frac{2}{12}\right) ft\ (135) \frac{lb}{ft^3} = 22.5\ lb/ft^2$

Ultimate DL = $1.3[118.75 + 22.5] = 183.625\ lb/ft^2$

Ultimate LL = $1.3(1.67)(1380.5) = 2997.1\ lb/ft^2$

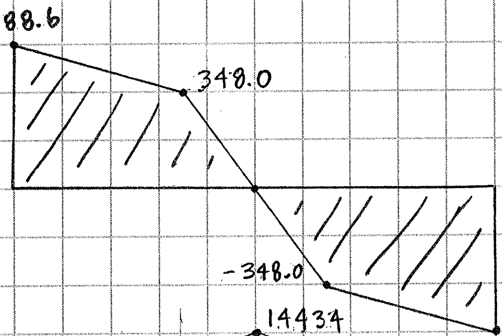
$2997\ psf = 20.81\ lb/in^2$

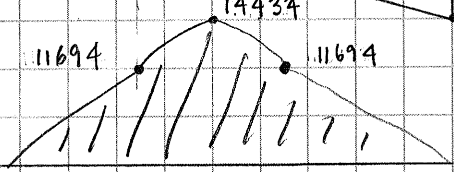
$183.6\ psf = 1.28\ lb/in^2$



(Center TH load... Assume that the operator will not exactly be @ ℄)

$R_{xn} = \frac{1}{2}(1.28)\frac{lb}{in^2}(95)in + \frac{1}{2}(20.81)\frac{lb}{in^2}(31.5)in = 388.6\ lb/in$





Made By JPB	Date 3-18-07
Checked By	Date
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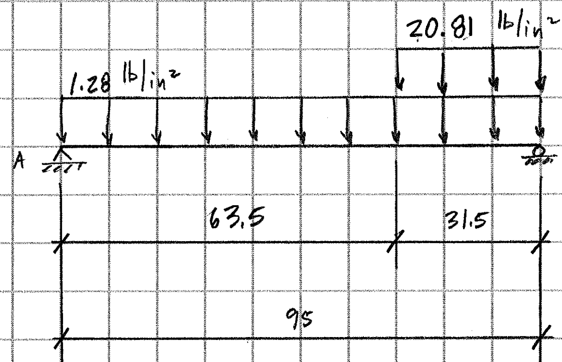
Calculations For: APAC K593 Demo

Job No. ______ Sheet No. ______

Slab Check (cont)

Check max shear by assuming track hoe operator gets off alignment.



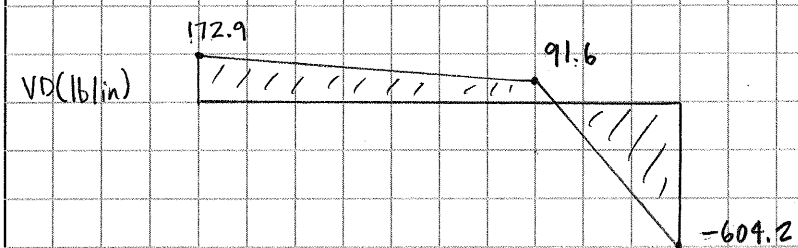
$$\Sigma M_A = 1.28 \frac{lb}{in^2} (95)^2 in^2 (0.5) + 20.81 \frac{lb}{in^2} (31.5) in \left(63 + \tfrac{1}{2} * 31.5\right) in - 95 B = 0$$

$$57398\ lb = 95 B$$

$$604.2 \frac{lb}{in} = B$$

$$\uparrow \Sigma F = A + 604.2 - 1.28(95) - 20.81(31.5)$$

$$A = 172.9\ lb/inch$$



Made By JPB	Date 3-18-07
Checked By DWP	Date
Back checked By	Date

Calculations For: APAC K593 Demo

Job No. ______ Sheet No. ______

Slab Check (cont)

Slab Design Check:

Select $b = 12''$

$d = 9.5 - 2 - \frac{1}{2}(\frac{1}{2}) = 7.25$ inch

$f'_c = 2250$ psi

$f_y = 36000$ psi

Reinforcing: Physically, (2) 1/2" ϕ bars @ 6 1/2" o.c.
Spreadsheet: #4 rebar @ 3.25" o.c.

$M_u = 14434 \frac{lb\text{-}in}{in} * 12\ in * \frac{1k}{1000\ lb} = 173.2$ k-in

$V_u = 604.2 \frac{lb}{in} * 12\ in * \frac{1k}{1000\ lb} = 7.3$ k

See spreadsheet evaluation:

CR for flexure = 1.14 < Allowable 1.25 OK

CR for shear = 1.22 < Allowable 1.25 OK

APAC Bridge K593 Demo

One-Way Slab Design

Value	*Units*	*Item*	*Comment*
	inch	--	Total slab width
12.0	inch	b	Assumed width
Load Factors			
1.4	--	$\gamma_{D,1}$	D Factor for LC 9-1 (ACI 318-02)
1.2	--	$\gamma_{D,2}$	D Factor for LC 9-2 (ACI 318-02)
1.6	--	$\gamma_{L,2}$	L Factor for LC 9-2 (ACI 318-02)
Factored Loads			
	kip -inch	M_1	Factored moment LC 9-1, per foot width
	kip -inch	M_2	Factored moment LC 9-2, per foot width
173	kip -inch	M_u	Factored moment for design
	kips	V_1	Factored shear LC 9-1, per foot width
	kips	V_2	Factored shear LC 9-2, per foot width
7.3	kips	V_u	Factored shear for design
Material Specification			
2250	psi	f'c	Seal slab concrete strength
36000	psi	fy	Reinforcing yield strength
0.85	--	β_1	
Seal Slab Geometry Data			
9.5	inch	t_{slab}	Slab thickness
2.25	inch	cc	Clear cover to reinforcing
Provided Reinforcing			
4	--	--	Bottom rebar size
3.25	inch	--	Bottom rebar spacing
0.74	in^2 / ft	A_s	As-built flexural steel
7.00	inch	d	Flexural "d"
0.008791	--	$\rho_{provided}$	Provided reinforcing ratio
Flexural Reinforcing Requirements			
0.327	ksi	R_n	
0.010027	--	$\rho_{required}$	Required reinforcing ratio
0.004126	--	$\rho_{minimum}$	Minimum reinforcing ratio
0.023955	--	$\rho_{maximum}$	Maximum reinforcing ratio
1.14	--	LR	Flexure Load Ratio
SAY OK	--	OK?	Flexural reinforcing OK?
Shear Strength Check			
116	psi	v_u / ϕ	Ultimate shear stress in concrete
95	psi	v_c	Shear strength of concrete
1.22	--	LR	Shear Load Ratio
SAY OK	--	OK?	Shear stress OK?

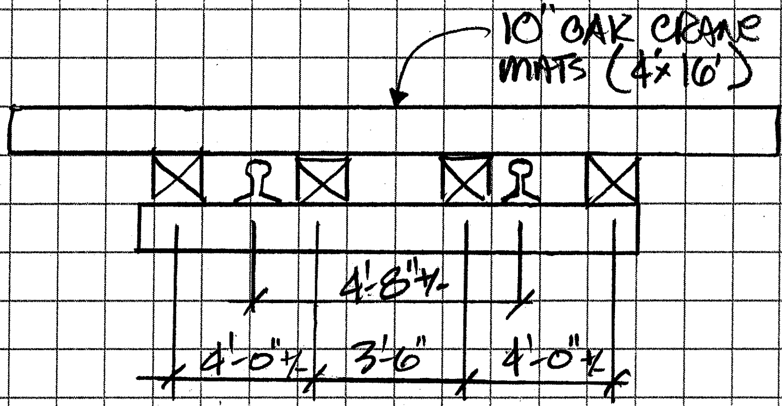
SAY OK: Load ratio < 1.25

Allow 25% overstress due to temporary condition.

TRACK SHIELDING DESIGN CALCULATIONS

DESIGN RAIL FALL PROTECTION

* FOLLOW U.P. GUIDELINES FOR TRACK SHIELDING.



* OAK PROPERTIES (mixed)

$f_b = 925$
$f_v = 170$
$f_{c\perp} = 800$
$\gamma = 48$ pcf
$E = 900{,}000$

* SECTION PROPERTIES

	SMALL PIECES OF DEBRIS (12")	LARGER PIECES OF DEBRIS (48")
	$S = 1/6(12)(10^2)$	$S = 1/6(48)(10^2)$
	$S_x = 200\ in^3$	$S_x = 800\ in^3$
	$A = 120\ in^2$	$A = 480\ in^2$

STATE OF MISSOURI
Example PE Seal
...TERED PROFESSIONAL ENG...

3/21/07

2/3

Table 4A (Cont.) Base Design Values for Visually Graded Dimension Lumber (2"-4" thick)[1,2]

(All species except Southern Pine — see Table 4B) (Tabulated design values are for normal load duration and dry service conditions. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4A ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)						Grading Rules Agency
		Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain F_c	Modulus of Elasticity E	
MIXED MAPLE								
Select Structural	2" & wider	1000	600	195	620	875	1,300,000	NELMA
No.1		725	425	195	620	700	1,200,000	
No.2		700	425	195	620	550	1,100,000	
No.3		400	250	195	620	325	1,000,000	
Stud	2" & wider	550	325	195	620	350	1,000,000	
Construction	2"-4" wide	800	475	195	620	725	1,100,000	
Standard		450	275	195	620	575	1,000,000	
Utility		225	125	195	620	375	900,000	
MIXED OAK								
Select Structural	2" & wider	1150	675	170	800	1000	1,100,000	NELMA
No.1		825	500	170	800	825	1,000,000	
No.2		800	475	170	800	625	900,000	
No.3		475	275	170	800	375	800,000	
Stud	2" & wider	625	375	170	800	400	800,000	
Construction	2"-4" wide	925	550	170	800	850	900,000	
Standard		525	300	170	800	650	800,000	
Utility		250	150	170	800	425	800,000	
NORTHERN RED OAK								
Select Structural	2" & wider	1400	800	220	885	1150	1,400,000	NELMA
No.1		1000	575	220	885	925	1,400,000	
No.2		975	575	220	885	725	1,300,000	
No.3		550	325	220	885	425	1,200,000	
Stud	2" & wider	750	450	220	885	450	1,200,000	
Construction	2"-4" wide	1100	650	220	885	975	1,200,000	
Standard		625	350	220	885	750	1,100,000	
Utility		300	175	220	885	500	1,000,000	
NORTHERN SPECIES								
Select Structural	2" & wider	1000	450	110	350	1100	1,100,000	NLGA
No.1/No.2		600	275	110	350	850	1,100,000	
No.3		350	150	110	350	500	1,000,000	
Stud	2" & wider	475	225	110	350	550	1,000,000	
Construction	2"-4" wide	700	300	110	350	1050	1,000,000	
Standard		400	175	110	350	875	900,000	
Utility		175	75	110	350	575	900,000	
NORTHERN WHITE CEDAR								
Select Structural	2" & wider	775	450	120	370	750	800,000	NELMA
No.1		575	325	120	370	600	700,000	
No.2		550	325	120	370	475	700,000	
No.3		325	175	120	370	275	600,000	
Stud	2" & wider	425	250	120	370	300	600,000	
Construction	2"-4" wide	625	375	120	370	625	700,000	
Standard		350	200	120	370	475	600,000	
Utility		175	100	120	370	325	600,000	
RED MAPLE								
Select Structural	2" & wider	1300	750	210	615	1100	1,700,000	NELMA
No.1		925	550	210	615	900	1,600,000	
No.2		900	525	210	615	700	1,500,000	
No.3		525	300	210	615	400	1,300,000	
Stud	2" & wider	700	425	210	615	450	1,300,000	
Construction	2"-4" wide	1050	600	210	615	925	1,400,000	
Standard		575	325	210	615	725	1,300,000	
Utility		275	150	210	615	475	1,200,000	

* SECTION CAPACITIES.

	SMALL PIECES OF DEBRIS (12")	LARGER PIECES OF DEBRIS (48")
V_{MAX} →	$120(170)(\frac{2}{3}) = 13{,}606^{\#}$	$480(170)(\frac{2}{3}) = 54{,}400^{\#}$
BRG_{MAX} →	$36(800) = 28{,}800^{\#}$ (Assume 6"x6" IMPACT AREA)	$144(800) = 115{,}200^{\#}$ (Assume 12"x12" IMPACT AREA)
P_{MAX} →	$15{,}416^{\#}$	$61{,}666^{\#}$

Assume simple span:

$$M = P\ell/4 = P(4/4) = 1.0\,P$$

$$M = F_b S = 925(S_x)$$

$$\therefore P = \frac{925(S_x)}{12}$$

* BY INSPECTION THE 10" OAK CRANE MATS WILL PROTECT THE RAILS FROM MISC/ERRANT DEBRIS (i.e. SMALL PIECES OF CONC RUBBLIZED w/ THE HOE RAM)

* IF AN IMPACT FACTOR OF 2.0 IS ASSIGNED TO THE FALLING DEBRIS, A CRANE MAT 48" WIDE WILL PROTECT THE RAIL FROM A PIECE OF DEBRIS WEIGHING APPROXIMATELY 27,200# (POINT LOAD)

CONC VOLUME = $\sqrt[3]{27{,}200/150} = 5.66\,ft^3$

– 10" SLAB THICKNESS AREA = $27200/150(10/12) = 218\,ft^2$

NOTE: A 48" WIDE CRANE MATT COULD PROTECT THE TRACK FROM A ERRANT FALLING SLAB PIECE WITH AN AREA = 218 ft^2 SAY ✓ OK