# BRIDGE AND CULVERT

## PLAN READING

# QUIZ



Directions:

1. Select the BEST SINGLE answer in each item.

2. Mark ONLY that one answer by placing an X through the letter in front of it. Example:

   The abbreviation ℄ stands for:

   A Construction Line

   B Center Lane

   C Concrete Line

   ~~D~~ Center Line

3. To CHANGE your answer - Mark through your first X clearly and completely. Then X through the letter of your new choice.

4. Some items refer to "Test Sheets". These are attached to the end of the test. They are designated; Test Sheet A , Test Sheet B , etc. Be sure to refer to the correct Test Sheet, when you are asked to do so. Otherwise you cannot answer the item correctly.

1. A culvert described as 10' X 8' would have these dimensions:

   A Height of 10', Span of 8'

   B Height of 8', Span of 10'

   C Length of 10', Span of 8'

   D Length of 8', Span of 10'

2. The culvert part from the parapet to the curtain wall is called the:

   A End Wall

   B Head Wall

   C Barrel

   D Channel

3. No skew means:

   A Parallel to roadway ℄

   B At a 45° angle to roadway ℄

   C Perpendicular to roadway ℄

   D Straight ahead

4. The culvert part from back of parapet to back of parapet is called the:

   A Trough

   B Apron

   C Span

   D Barrel

5. The main difference between a culvert and a flume is:

   A A flume is larger than a culvert

   B A flume is smaller than a culvert

   C A culvert is open across the top and a flume is not

   D A flume is open across the top and a culvert is not

6. A 5tl reinforcing bar has a diameter of:

   A .5 inch

   B .05 foot

   C 5/8 inch

   D 5/6 inch

7. Culvert reinforcing bars in a transverse position are placed in the

   A top or bottom slab, parallel to culvert ℄.

   B top or bottom slab, perpendicular to culvert ℄.

   C wingwall, parallel to wingwall top slope.

   D sidewall, from top slab to bottom slab.

8. Bars to be spaced at 1 foot centers should be

   A parallel, with a 1 foot distance between bar centers.

   B parallel, with a 1 foot distance between outside bar edges.

   C 1 foot apart, all pointing to the center.

   D 1 foot from center line.

9. Refer to Test Sheet A. On this sheet, the number of c bars required for a 4 X 4 culvert on a 45° skew is:

   A 8

   B 9

   C 32

   D 16

10. The culvert flow line elevation is usually the elevation at the

   A height of the expected water line.

   B bottom of the curtain wall.

   C top of the floor, in the trough.

   D mid point between the top and bottom slabs.

11. A bridge with a design number of 1061 is

   A the 1,061st bridge to be designed in the state by the State Highway Commission.

   B a bridge to be built on project No. 1061.

   C the tenth bridge to be built in that survey township in 1961.

   D the tenth bridge in 1961 to be assigned a design number in that county.

12. On the title sheet, the station location given for a bridge refers to a point

    A midway between ℄'s of abutment bearings.

    B at the end of the bridge which has the lowest station number.

    C at the end of the bridge which has the highest station number.

    D at the beginning of the bridge approach slab, back of the bridge.

13. Refer to Test Sheet A. Assume the L distance is 30 feet. The number of a bars needed for a straight Concrete Box Culvert, 4'-0 span, Parallel Wing Walls, is:

    A 60

    B 62

    C 64

    D 32

14. On a bridge with a skew, the skew angle is formed by the meeting of:

    A Bridge ℄ with roadway ℄

    B Pier and abutment ℄'s with bridge ℄

    C Pier and abutment bearing ℄'s with lines perpendicular to ℄ of roadway

    D Pier ℄'s with abutment ℄'s

15. For a bridge described as 60'-0 X 30' the length is:

A 60 feet

B 30 feet

C 1800 feet

D 90 feet

16. When you see revisions listed on the Title Sheet, you should:

A Read them to determine what has been changed and why.

B Turn to the revised sheets to be sure the revisions have been made on each sheet listed.

C Disregard them since these are important only to the designers.

D Read them briefly, so you'll remember what they are in case you need to refer to them.

17. On bridge plans, the situation plan shows:

A The situation at the bridge site, prior to construction

B A top view of the proposed bridge and surrounding area

C The structural steel situation

D A top view of the area below the bridge, where the foundation will be placed

18. Superstructure refers to:

A All parts of the bridge below the bearings

B The structural steel used for the bridge support

C All parts of the bridge above the bearings

D Structural components designed to withstand extreme stress

19. Steel H Piles designated as (10 BP 42)

A are 10" wide and 42' long.

B weigh 42 pounds per foot of pile length and are 10" deep.

C require 42 pounds of pressure for every 10" of length.

D are 10 foot piles which can withstand 42 pounds of bearing pressure per foot.

20. The Sounding Data shows:

A Elevations and types of material found at the test holes

B Expected "soundness" of bridge foundations at specified sites

C Structural steel testing data

D The overall expected strength of the bridge

21. On the plan sheets, the notes which you should read are:

A All notes designated as General Notes

B All notes close to diagrams which you are reading

C All the notes on each sheet

D Notes located in specific places on sheets throughout the plans

22. The bridge seat elevation given for an abutment is the elevation at the

A top of the finished grade, directly above the abutment ℄.

B top of the abutment footing.

C top of the abutment.

D bottom of the abutment footing.

23. Refer to Test Sheet B. The Rear Elevation shows the abutments from the:

A Roadway side

B Bridge side

C Top

D Left side

24. Refer to Test Sheet B. The bridge seat elevation for the South Abutment is:

A 890.65

B 881.11

C 892.74

D 887.91

25. Refer to Test Sheet B. The number of battered piling required for one abutment is:

A 9

B 8

C 5

D 4

26. Refer to Test Sheet B. The piling, as seen from the top, looks most like:

A an O

B an E

C an H

D a T

27. Refer to Test Sheet B. The ℄ of abutment is a line:

A Perpendicular to ℄ of Abutment Bearing, at ℄ of roadway

B Along the length of the bridge seat, midway between the backwall and the front face of footing

C From the midpoint of the piling up to the midpoint of the paving notch

D From side to side, dividing the abutment down the center

28. The major parts of a pier include:

A Pier Cap and Pier Wall

B Pier Wing, Pier Footing and Pier Head

C Pier Cap, Pier Column and Pier Footing

D Pier Backwall, Pier Footing and Paving Notch

29. Refer to Test Sheet C. The distance from the Grade (at ℄ Roadway) to Pier 2 Bridge Seat below is:

A 3'6"

B 5' 1 1/16"

C 2'6"

D 26"

30. Refer to Test Sheet C. The total number of cubic yards of concrete required to construct Pier 2 is:

A 26.8 cubic yards

B 74.5 cubic yards

C 883.05 cubic yards

D 888.16 cubic yards

31. Refer to Test Sheet C. The bars to be placed vertically in the pier column are labeled:

A 11a1

B 10b2

C 10b1

D V-C

32. Refer to Test Sheet C. The elevation at the bottom of the footing on Pier 2 is:

A 882.81

B 888.16

C 300

D 854.56

33. Refer to Test Sheet D. The total anticipated dead load deflection is zero at:

A ℄ pier bearing

B ℄ splice

C ℄ roadway

D Edge of curb

34. Refer to Test Sheet D. On the Total Dead Load Deflection diagram, the encircled numbers show the:

A Depth of concrete, in fractions of a foot

B Expected total "sag" in fraction of an inch

C Fraction of an inch above desired grade elevation, at which the forms must be set

D Deflection expected from the weight of the maximum traffic load

35. Refer to Test Sheet D. The heaviest I beams to be used on this bridge are the:

A Exterior beams

B Interior beams

C Cross beams

D Diagonal beams

36. Refer to Test Sheet D. At the ℄'s of pier bearings, the cross beams

A are perpendicular to roadway ℄.

B are parallel to roadway ℄.

C follow the skew of the pier.

D are not present.

37. Refer to Test Sheet D. The cover plates are placed on

A both sides of each flange at the splice points.

B both sides of the web at the splice points.

C the outsides of the flanges over the pier bearings.

D one side of the web over the pier bearings.

38. Refer to Test Sheet D. Shear Lugs are placed

A on the webs of the cross beams.

B on the tops of the top flanges of the longitudinal beams.

C over the $\mathbb{L}$'s of the pier bearings.

D on the tops of the top splice plates.

39. Refer to Test Sheet D. The nominal depth of the longitudinal beams (interior and exterior) is:

A 36 inches

B Varied

C .1 of the web

D 16.0 inches

40. Refer to Test Sheet D. Shear Lugs are not to be placed on the:

A Top cover plates

B Top splice plates

C Top flange of interior beams

D Top flange of exterior beams

41. Between a pier cap and an I beam there is a:

A Splice plate

B Fixed shoe or rocker

C Connection bolt assembly

D Reinforced concrete connector

42. On an I beam bridge, as well as on many others,

A at each bearing point, the superstructure is securely bolted to the substructure.

B the superstructure rests on the substructure, but is not attached to it at all.

C the superstructure is securely welded to substructure at each bearing point.

D the superstructure is connected to the substructure by rods welded to the rockers or shoes below, and to the bridge floor above.

43. Refer to Test Sheet E. When the temperature at time of setting is 90° F, the D distance of the south abutment expansion assembly should be:

A 1¾ inches

B 2 inches

C 2½ inches

D .90 inches

44. Refer to Test Sheet E. In the + position, the rockers on piers 1, 3 and 4 should:

A Tilt away from pier 2

B Tilt in toward pier 2

C Not tilt

D All tilt toward the north

45. Refer to Test Sheet E. If all rockers are correctly set with no tilt (straight up) the temperature must be:

A 0° F

B 10° F

C 90° F

D 50° F

46. Refer to Test Sheet E. When the temperature rises, the D distance on both abutments:

A Becomes less

B Becomes greater

C Stays the same

D Is unpredictable

47. Refer to Test Sheet F. The crown on the bridge, 12' Lt. and Rt. of Roadway ℄, will be:

A On a tangent cross slope, with a 1½" rate of slope

B Flat

C Parabolic, 1½" in 10 feet

D On a vertical circular curve

48. Refer to Test Sheet F. Masonry plates are to be:

A Set in paint and canvas

B Bolted to the I beams at the flange

C Welded to each bearing point

D Bolted across the I beam webs at splice points

49. Refer to Test Sheet F. The 6 b bars are to be placed:

A Transversely in the top and bottom of the curb

B Longitudinally in the top and bottom of the curb

C Longitudinally in the top and bottom of the slab

D Transversely in the middle of the slab

50. Refer to Test Sheet G. Each rail section must pass through at least:

A 3 posts before being spliced

B 5 posts before being spliced

C 10 posts

D 2 posts

# BILL OF REINFORCING



| SKEW ANGLE | | Φ - 0° | | | | Φ - 15° | | | | Φ - 30° | | | | Φ - 45° | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Position of bars | Mark | Number | Size | Spacing | Length | Number | Size | Spacing | Length | Number | Size | Spacing | Length | Number | Size | Spacing | Length |
| Walls: Vertical | a | 2L+2 | ½"Φ | 1'-0" | H+2A+3" | 2L+2 | ½"Φ | 1'-0" | H+2A+3" | 2L+2 | ½"Φ | 1'-0" | H+2A+3" | 2L+2 | ½"Φ | 1'-0" | H+2A+3" |
| " Horizontal | b | 2H | " | " | M-4" | 2H | " | " | M-4" | 2H | " | " | M-4" | 2H | " | " | M-4" |
| " " ends | b1 | 4H | " | " | Table 1 | 4H | " | " | Table 1 | 4H | " | " | Table 1 | 4H | " | " | Table 1 |
| Wings: Vertical | c | Table-2 | " | " | " 2 | Table 2 | " | " | " 2 | Table 2 | " | " | " 2 | Table 2 | " | " | " 2 |
| Slab: Longitudinal | e | 5 | " | shown | M-4" | 5 | " | shown | M-4" | 5 | " | shown | M-4" | 5 | " | shown | M-4" |
| " " ends | e1 | 10 | " | " | 10'-10" | 10 | " | " | Table 3 | 10 | " | " | Table 3 | 10 | " | " | Table 3 |
| Floor: " | f | 5 | ⅝"Φ | " | M-4" | 5 | ⅝"Φ | " | M-4" | 5 | ⅝"Φ | " | M-4" | 5 | ⅝"Φ | " | M-4" |
| " " ends | f1 | 10 | " | " | Table 4 | 10 | " | " | Table 4 | 10 | " | " | Table 4 | 10 | " | " | Table 4 |
| Parapet: Vertical | i | 8 | ½"Φ | 1'-0" | 1'-9" | 8 | ½"Φ | 1'-0" | 1'-9" | 10 | ½"Φ | 1'-0" | 1'-9" | 12 | ½"Φ | 1'-0" | 1'-9" |
| " Transverse | j | 2 | " | shown | 5'-0" | 2 | " | shown | 5'-2" | 2 | " | shown | 5'-9" | 2 | " | shown | 7'-1" |
| Slab: " | k | | Table 5 | | | | Table 5 | | | | Table 5 | | | | Table 5 | | |
| " " top | k1 | | ½"Φ | 1'-3" | See Detail | | ½"Φ | 1'-3" | See Detail | | ½"Φ | 1'-3" | See Detail | | ½"Φ | 1'-3 | See Detail |
| Floor: " | m | | Table 5 | | 5'-8" | | Table 5 | | 5'-8" | | Table 5 | | 5'-8" | | Table 5 | | 5'-8" |
| Parapet and Curtain | p | | Skews only | | | 8 | ⅝"Φ | 4" | @ 5" | 8 | ⅝"Φ | 4" | 7'-0" | 8 | ⅝"Φ | 4" | 8'-4" |
| Slab: Dowels | r | 10 | ½"Φ | 1'-0" | 4'-0" | 10 | ½"Φ | 1'-0" | 4'-0" | 10 | ½"Φ | 1'-0" | 4'-0" | 10 | ½"Φ | 1'-0" | 4'-0" |
| Wing: Slope | s | 8 | " | 4" | 1.83H+10" | 8 | ½"Φ | 4" | 1.67H+10" | 8 | ½"Φ | 4" | 2.08H+10" | 8 | ½"Φ | 4" | 2.54H+10" |
| Floor: Headwalls | m1 | shown | ½"Φ | 7" | 5'-8" | | ½"Φ | 7" | 5'-8" | | ½"Φ | 7" | 5'-8" | | ½"Φ | 7" | 5'-8" |

## TABLE - 1 b1 BARS TWO EACH LENGTH REQUIRED

| SKEW | 4 x 5 | | | | 4 x 4 | | | | 4 x 3 | | | | 4 x 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Φ - 0° | 12'-9" | 12'-9" | 14'-3" | 14'-3" | 15'-9" | 15'-9" | 17'-3" | 17'-3" | 18'-4" | 18'-4" | 12'-9" | 12'-9" | 14'-3" | 14'-3" | 15'-9" | 15'-9" | 16'-10" | 16'-10" | 12'-9" | 12'-9" | 14'-3" | 14'-3" | 15'-4" | 15'-4" | 12'-9" | 12'-9" | 13'-10" | 13'-10" |
| Φ - 15° | 12'-3" | 13'-7" | 13'-9" | 15'-1" | 15'-4" | 16'-8" | 16'-10" | 18'-2" | 18'-0" | 19'-4" | 12'-3" | 13'-7" | 13'-9" | 15'-1" | 15'-4" | 16'-8" | 16'-5" | 17'-9" | 12'-3" | 13'-7" | 13'-9" | 15'-1" | 14'-11" | 16'-3" | 12'-3" | 13'-7" | 13'-4" | 14'-8" |
| Φ - 30° | 11'-9" | 14'-8" | 13'-6" | 16'-5" | 15'-3" | 16'-2" | 16'-11" | 19'-10" | 18'-2" | 21'-1" | 11'-9" | 14'-8" | 13'-6" | 16'-5" | 15'-3" | 18'-2" | 16'-6" | 19'-5" | 11'-9" | 14'-8" | 13'-6" | 16'-5" | 14'-9" | 17'-8" | 11'-9" | 14'-8" | 13'-0" | 15'-11" |
| Φ - 45° | 11'-3" | 16'-3" | 13'-5" | 18'-5" | 15'-0" | 20'-0" | 17'-8" | 22'-8" | 19'-2" | 24'-2" | 11'-3" | 16'-3" | 13'-5" | 18'-5" | 15'-0" | 20'-0" | 17'-1" | 22'-1" | 11'-3" | 16'-3" | 13'-5" | 18'-5" | 14'-11" | 19'-11" | 11'-3" | 16'-3" | 12'-10" | 17'-10" |

## TABLE - 2 c BARS FOUR EACH LENGTH REQUIRED

| 4 x 5 | | | | 4 x 4 | | | | 4 x 3 | | | | 4 x 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Φ - 0° | Φ - 15° | Φ - 30° | Φ - 45° | Φ - 0° | Φ - 15° | Φ - 30° | Φ - 45° | Φ - 0° | Φ - 15° | Φ - 30° | Φ - 45° | Φ - 0° | Φ - 15° | Φ - 30° | Φ - 45° |
| 7'-10" | 7'-10" | 7'-10" | 7'-10" | @ 10" | @ 10" | @ 10" | @ 10" | 5'-10" | 5'-10" | 5'-10" | 5'-10" | 4'-10" | 4'-10" | 4'-10" | 4'-10" |
| 7'-2" | 7'-2" | 7'-3" | 7'-4" | @ 2" | @ 2" | @ 3" | @ 4" | 5'-2" | 5'-2" | 5'-3" | 5'-4" | 4'-2" | 4'-2" | 4'-3" | 4'-4" |
| @ 6" | @ 6" | @ 8" | @ 11" | 5'-@" | 5'-@" | 5'-8" | 5'-11" | 4'-@" | 4'-@" | 4'-8" | 4'-11" | 3'-@" | 3'-@" | 3'-8" | 3'-11" |
| 5'-10" | 5'-11" | @'-1" | @'-5" | 4'-10" | 4'-11" | 5'-1" | 5'-5" | 3'-10" | 3'-11" | 4'-1" | 4'-5" | | | | 3'-5" |
| 5'-2" | 5'-3" | 5'-@" | @'-0" | 4'-2" | 4'-3" | 4'-@" | 5'-0" | 3'-2" | 3'-3" | 3'-@" | 4'-0" | | | | |
| 4'-@" | 4'-7" | 4'-11" | 5'-@" | 3'-@" | 3'-7" | 3'-11" | 4'-@" | | | | 3'-@" | | | | |
| 3'-10" | 3'-11" | 4'-4" | 5'-0" | | | 3'-4" | 4'-0" | | | | | | | | |
| 3'-2" | 3'-4" | 3'-9" | 4'-7" | | | | 3'-7" | | | | | | | | |
| | | 3'-2" | 4'-1" | | | | | | | | | | | | |
| | | | 3'-7" | | | | | | | | | | | | |
| | | | 3'-2" | | | | | | | | | | | | |

## TABLE - 3 e1 BARS ALL HEIGHTS TWO EACH LENGTH REQUIRED

| Φ - 0° | Φ - 15° | Φ - 30° | Φ - 45° |
|---|---|---|---|
| 10'-10" | 10'-3" | 9'-8" | 8'-10" |
| " | 10'-@" | 10'-4" | 9'-11" |
| " | 10'-10" | 10'-11" | 11'-0" |
| " | 11'-2" | 11'-6" | 12'-1" |
| " | 11'-5" | 12'-2" | 13'-2" |

## TABLE - 4 f1 BARS TWO EACH LENGTH REQUIRED

| SKEW | 4 x 5 | | | | | 4 x 4 | | | | | 4 x 3 | | | | | 4 x 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Φ - 0° | 21'-0" | 21'-0" | 21'-0" | 21'-0" | 21'-0" | 19'-0" | 19'-0" | 19'-0" | 19'-0" | 19'-0" | 17'-0" | 17'-0" | 17'-0" | 17'-0" | 17'-0" | 15'-0" | 15'-0" | 15'-0" | 15'-0" | 15'-0" |
| Φ - 15° | 21'-11" | 21'-7" | 21'-3" | 20'-11" | 20'-7" | 19'-11" | 19'-7" | 19'-3" | 18'-11" | 18'-7" | 17'-10" | 17'-6" | 17'-2" | @'-10" | @'-6" | 15'-9" | 15'-5" | 15'-1" | 14'-8" | 14'-5" |
| Φ - 30° | 23'-8" | 22'-10" | 22'-3" | 21'-8" | 20'-10" | 21'-5" | 20'-7" | 20'-0" | 19'-5" | 18'-7" | 19'-2" | 18'-4" | 17'-9" | 17'-2" | @'-4" | 16'-11" | @'-1" | 15'-@" | 14'-11" | 14'-1" |
| Φ - 45° | 26'-9" | 25'-4" | 24'-3" | 23'-2" | 21'-9" | 24'-2" | 22'-9" | 21'-8" | 20'-7" | 19'-2" | 21'-6" | 20'-1" | 19'-0" | 17'-11" | @'-6" | 18'-11" | 17'-6" | @'-5" | 15'-4" | 15'-1" |

## TABLE 5 DIMENSIONS AND QUANTITIES FOR BARREL SECTIONS

| DIMENSIONS | | | | k AND m BARS | | LENGTH OF BARS | | QUANTITIES PER FOOT OF BARREL | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 4x5 | | 4x4 | | 4x3 | | 4x2 | |
| FILL | A | E | G | Size | Spacing | k | m | Concrete | Steel | Concrete | Steel | Concrete | Steel | Concrete | Steel |
| 0' | 8" | 6" | 4'-3" | ⅝"Φ | 5" c's | 5'-11" | 5'-8" | .551 C.Y. | 58.32 # | .514 C.Y. | 55.65 # | .477 C.Y. | 52.98 # | .440 C.Y. | 49.77 # |
| 1' | 7" | " | 4'-4" | ½"Φ | 6" c's | 5'-8" | " | .517 C.Y. | 44.24 # | .480 C.Y. | 41.57 # | .443 C.Y. | 38.90 # | .406 C.Y. | 35.69 # |
| 2' | 6" | " | " | " | 5½" c's | " | " | .483 C.Y. | 45.40 # | .446 C.Y. | 42.73 # | .409 C.Y. | 40.06 # | .372 C.Y. | 36.85 # |
| 3'-6' | 6" | " | " | " | 7" c's | " | " | " " | 41.86 # | " " | 39.19 # | " " | 36.52 # | " " | 33.31 # |
| 7'-8' | 6" | " | " | " | 6" c's | " | " | " " | 44.02 # | " " | 41.35 # | " " | 38.68 # | " " | 35.47 # |
| 9'-10' | 6" | " | " | ½"Φ | 5" c's | 5'-8" | " | " " | 47.06 # | " " | 44.38 # | " " | 41.71 # | " " | 38.51 # |
| 11'-12' | 7" | " | 4'-3" | ⅝"Φ | 8" c's | 5'-11" | " | .517 C.Y. | 47.23 # | .480 C.Y. | 44.56 # | .443 C.Y. | 41.88 # | .406 C.Y. | 38.68 # |
| 13'-14' | 7" | " | " | " | 7" c's | " | " | " " | 49.81 # | " " | 47.14 # | " " | 44.46 # | " " | 41.26 # |
| 15'-16' | 7" | " | " | " | 6" c's | " | " | " " | 53.26 # | " " | 50.59 # | " " | 47.91 # | " " | 44.71 # |
| 17'-20' | 8" | 6" | 4'-3" | ⅝"Φ | 6" c's | 5'-11" | 5'-8" | .551 C.Y. | 53.48 # | .514 C.Y. | 50.81 # | .477 C.Y. | 48.14 # | .440 C.Y. | 44.93 # |

## QUANTITIES IN TWO HEADWALLS

| SKEW ANGLE | 4x5 | | 4x4 | | 4x3 | | 4x2 | |
|---|---|---|---|---|---|---|---|---|
| | Concrete | Steel | Concrete | Steel | Concrete | Steel | Concrete | Steel |
| Φ - 0° | 7.87 C.Y. | 514 # | @.14 C.Y. | 410 # | 4.57 C.Y. | 314 # | 3.13 C.Y. | 226 # |
| Φ - 15° | 8.15 C.Y. | 572 # | 6.39 C.Y. | 465 # | 4.73 C.Y. | 366 # | 3.24 C.Y. | 275 # |
| Φ - 30° | 9.09 C.Y. | 629 # | 7.09 C.Y. | 512 # | 5.26 C.Y. | 396 # | 3.61 C.Y. | 297 # |
| Φ - 45° | 11.13 C.Y. | 753 # | 8.68 C.Y. | 607 # | @.46 C.Y. | 470 # | 4.43 C.Y. | 355 # |

Headwalls constant for all fills.

Bars r at end construction joints are included in headwall quantities.

To obtain total quantities add quantities of barrel section to those given for two headwalls.

STANDARD DESIGN

# CONCRETE BOX CULVERTS

## 4'-0 SPAN

## PARALLEL WING WALLS

IOWA STATE HIGHWAY COMMISSION

APRIL 1932

APPROVED BY T. R. Mitts CHIEF ENGINEER

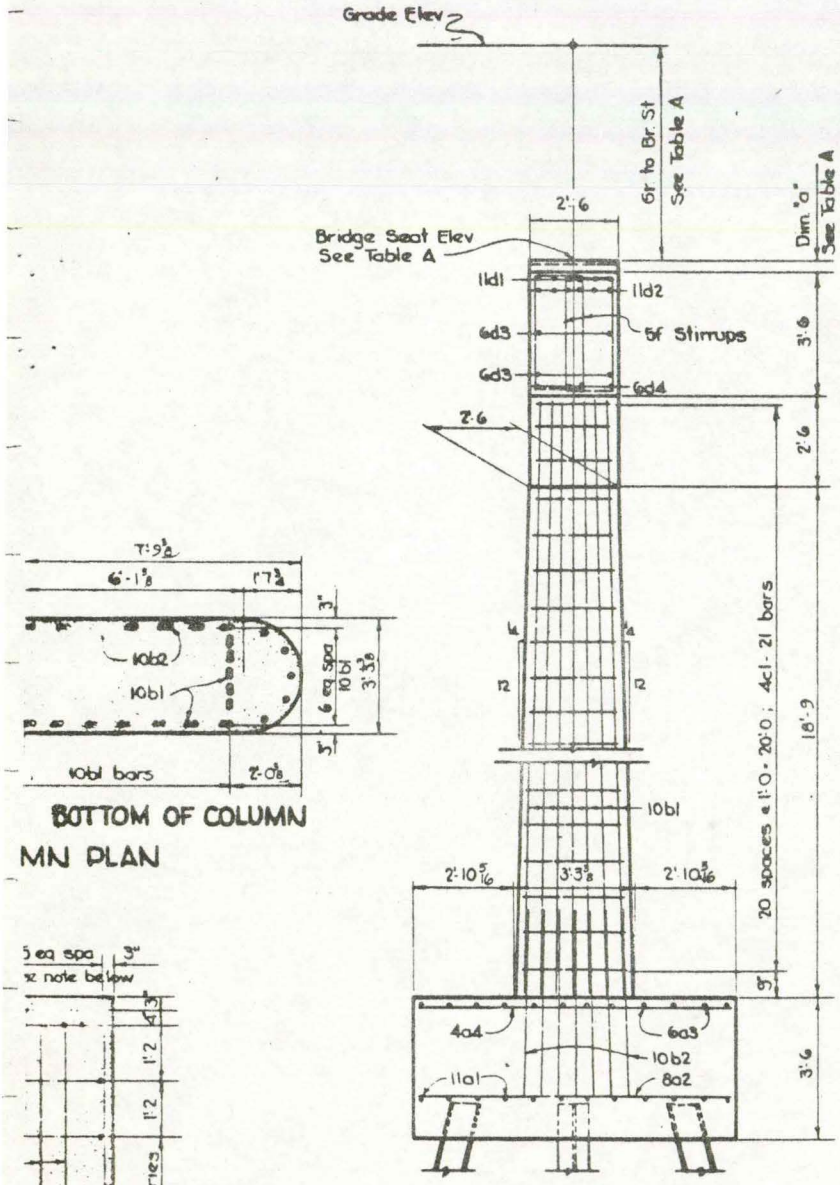
C 4 P

REVISED JUNE 1944

TEST SHEET A

4'-3
30'-0 Roadway
4'-3
Point "A"
Abut Elev 885.79
Abut Elev 892.52
1'-10
1¼
℄ Roadway
Point "C"
N. Abut Elev. 884.99
S. Abut Elev. 891.66
Level
N. Abut. Elev. 883.86
S. Abut. Elev. 890.65
4g3
6f2
4g1
4f1
4f5 (Typ.)
Low Step El. 887.66
6f4
4g2
5b1 (Typ.)
South Abutment
Br. St. Elev = 887.91
8a1
1'-8 Typ. top 8a1
Low step El 880.91
* Note: G
and c
REAR ELEVATION
North Abutment Steps
Br. St. Elev = 881.11
Bott ftg Elev
N. Abut 876.9
S. Abut 883.6
B
4'-3
3'-0½
16'-0¾
3 Beam spaces @ 10'-0⅛" = 30'-0¼
10'-0
15°
℄ Abutment
6 7/16
Gutter line
15'-0
5a
Point "A"
4c
6f4
5m
30°
Point "C"
℄ Abut Brg
31'-0¾ Out to out of paving notch
Point "B"
R-6
PLAN
30'-0 Roadway
1'-10
5'-0
30°
2'-9⅝
℄ 2'-0
4g2
F.O. 1'-0 Typical
5b1
4f3
4g1
4g3
4f5
15 spaces @ 2'-0 = 30'-0, 16-4f1 bars Backwall F.F
30 spaces @ 1'-0 = 30'-0, 31-4f5 bars Paving notch ties
61 spaces @ 0'-6" = 30'-6, 62-6f2 bars Backwall B.F
15 spaces @ 2'-0 = 30'-0, 16-4f6 bars Paving notch dowels
4f6
5@0'-6"=2'-6
6-6f4 B.F
℄ Roadway
4 spaces @ 4'-6" = 18'-0
℄ Abutment
4 spaces @ 4'-6" = 18'-0
FOOTING PLAN
℄ Abut Brg
℄ Piles
PILE PLAN
Scale ⅛"-1'-0
NOTE:
9-18' piles required for South Abut.
9-45' piles required for North Abut.
Note: All dimensions are at the bottom of the footing.
Batter piles 1/4 in the direction shown
TEST SHEET B

Bench Mark No. 9: Sta 194+77 350' Rt. R.R. Spike in base of double cottonwood ● N. Bank Elev = 873.27




END ELEVATION



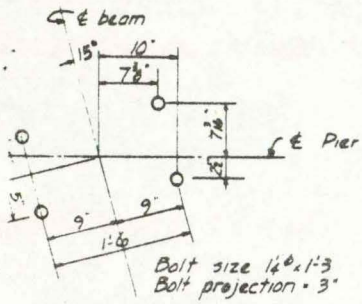

BOTTOM OF COLUMN

MN PLAN

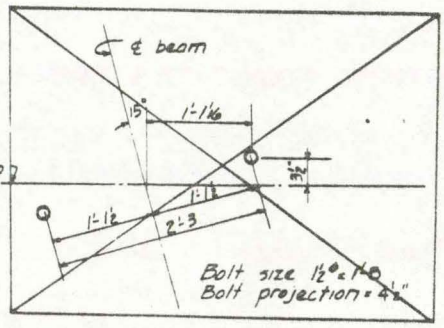



TION A-A

bars as necessary to reset anchor bolts.




FIXED SHOE
Pier 2



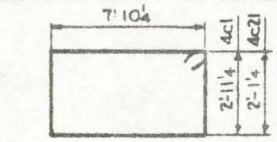

ROCKER
Pier 1

ANCHOR BOLT LOCATION

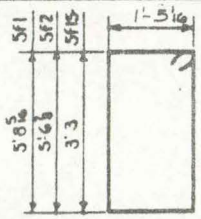
## REINFORCING STEEL - ONE PIER

| Bar | Location | Shape | № | Length | Weight |
|---|---|---|---|---|---|
| 11a1 | Footing longitud. bottom | —— | 12 | 24'2 | 1541 |
| 8a2 | " transv. " | —— | 25 | 8'8 | 579 |
| 6a3 | " longitud. top | —— | 12 | 24'2 | 436 |
| 4a4 | " transv. top | —— | 25 | 8'8 | 145 |
| 10b2 | Column dowels | —— | 46 | 5'0 | 980 |
| 10b1 | " vertical | —— | 36 | 21'-9 | 3892 |
| 4c1-21 | " ties | □ | 42 | Varies | 598 |
| 11d1 | Cap longitud. top | —— | 6 | 34'8 | 1105 |
| 11d2 | " " " | —— | 6 | 26'2 | 834 |
| 6d3 | " " center | —— | 4 | 34'8 | 208 |
| 6d4 | " " bottom | ⌣ | 4 | 35'2 | 211 |
| 5f1 | " stirrups | □ | 26 | 14'11 | 405 |
| 5f2-15 | " " | □ | 56 | Varies | 722 |
| | | | | | 11066 |

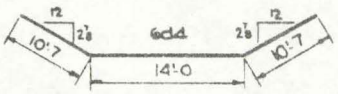
## BENT BAR DETAILS




4c1-21




5f1-15




Note: All dimensions are out to out.

## CONCRETE PLACEMENT QUANT. - ONE PIER

| | |
|---|---|
| Footing | 28.6 c.y. |
| Column | 28.4 c.y. |
| Cap | 17.5 c.y. |
| | |
| Total ONE | 74.5 c.y. |

## TOTAL ESTIMATED QUANT. - ~~TWO~~ PIERS

| Item | | |
|---|---|---|
| Concrete | | 74.5 ~~149.0~~ c.y. |
| Reinforcing Steel | | 11066 ~~22132~~ lbs. |
| 10 BP 42 Steel | Furnish | 960 ~~1200~~ L.F. |
| Bearing Piling ~~24@10'~~, 24@40' | Drive | 960 ~~1200~~ L.F. |
| Class 20 Excavation | | 60 ~~164~~ c.y. |
| Class 21 Excavation | | 100 ~~173~~ c.y. |

## TABLE A

| Pier | Dim "a" | Dim "b" | Dim "c" | Grade Elev | Gr. to Br. St | Br. St Elev | Low Step Elev | Bot. Ftg Elev | Pile Length |
|---|---|---|---|---|---|---|---|---|---|
| ~~1~~ | ~~2 5/16"~~ | ~~3"~~ | ~~2 3/16"~~ | ~~890.07~~ | ~~5'-0 15/16"~~ | ~~884.96~~ | ~~884.71~~ | ~~856.46~~ | ~~10'~~ |
| 2 | 2¾" | 1" | 1¼" | 888.16 | 5'-1 1/16 | 883.05 | 882.81 | 854.56 | 40' |

## PIER NOTES:

All exposed corners of 90° or sharper shall be filleted with a ¾" dressed and beveled strip.

Minimum clear distance from face of concrete to near reinforcing bar shall be 2" unless otherwise noted or shown.

Anchor bolts shall be preset. Weight of anchor bolts is included in superstructure structural steel estimate.

~~Piles for Pier 1 are to be driven to refusal in limestone. Number of piles is based on a 37 Ton bearing capacity per pile.~~ Piles for Pier 2 are to be driven to full penetration if practicable, but in no case, less than 37 Ton bearing capacity per pile.

Design: A.A.S.H.O. Series of 1961.

Construction: Standard Specifications of I.S.H.C. Series 1960, plus current special provisions and supplemental specifications.

Design for 15° Skew

# 410' x 30' CONTINUOUS I-BEAM BRIDGE

70'-0 End Spans — Concrete floor and substructure

90'-0 Center Spans — Tubular Rail

## PIER 1, 2 DETAILS

Station 196+29.00

Project F-1112(1)

## WINNESHIEK COUNTY

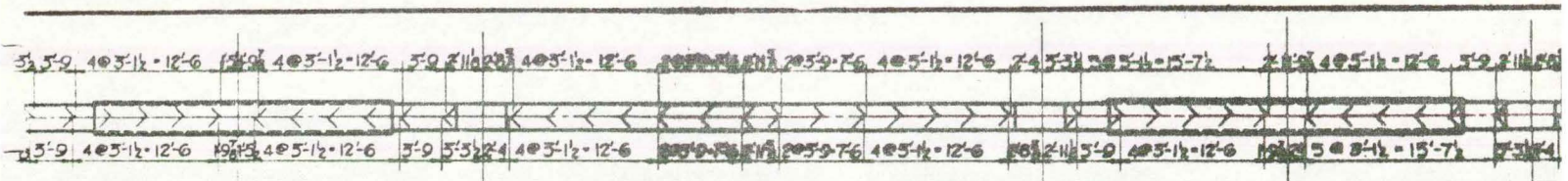
Iowa State Highway Commission

ed (10-24-62): This sheet void for Pier 1. See Sheet 4A

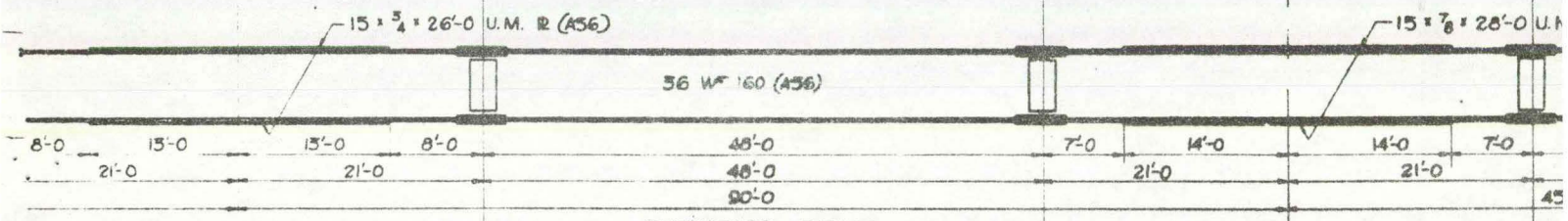
**TEST SHEET C**

ber, 1961 — Sheet 4 of 10

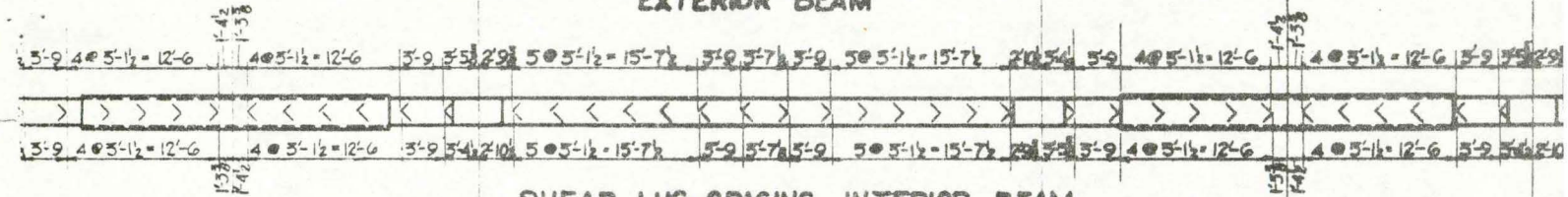
gn No. 1161 — Winneshiek Co. — File No. 21058



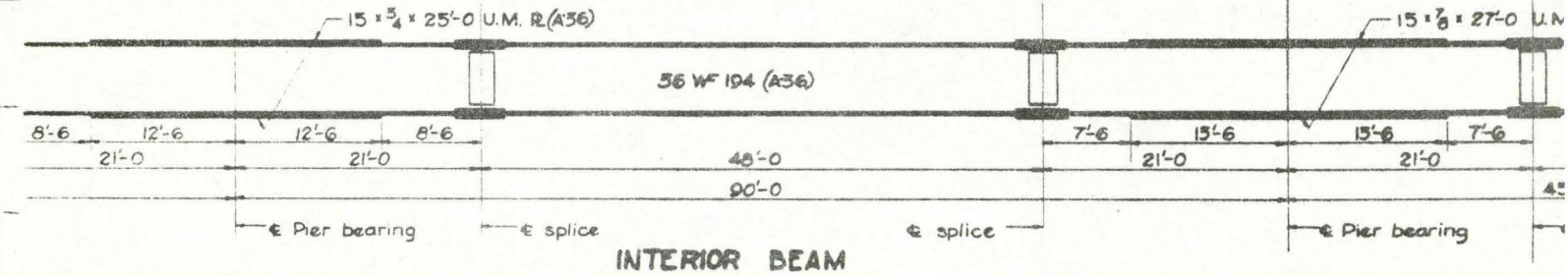
SHEAR LUG SPACING EXTERIOR BEAM



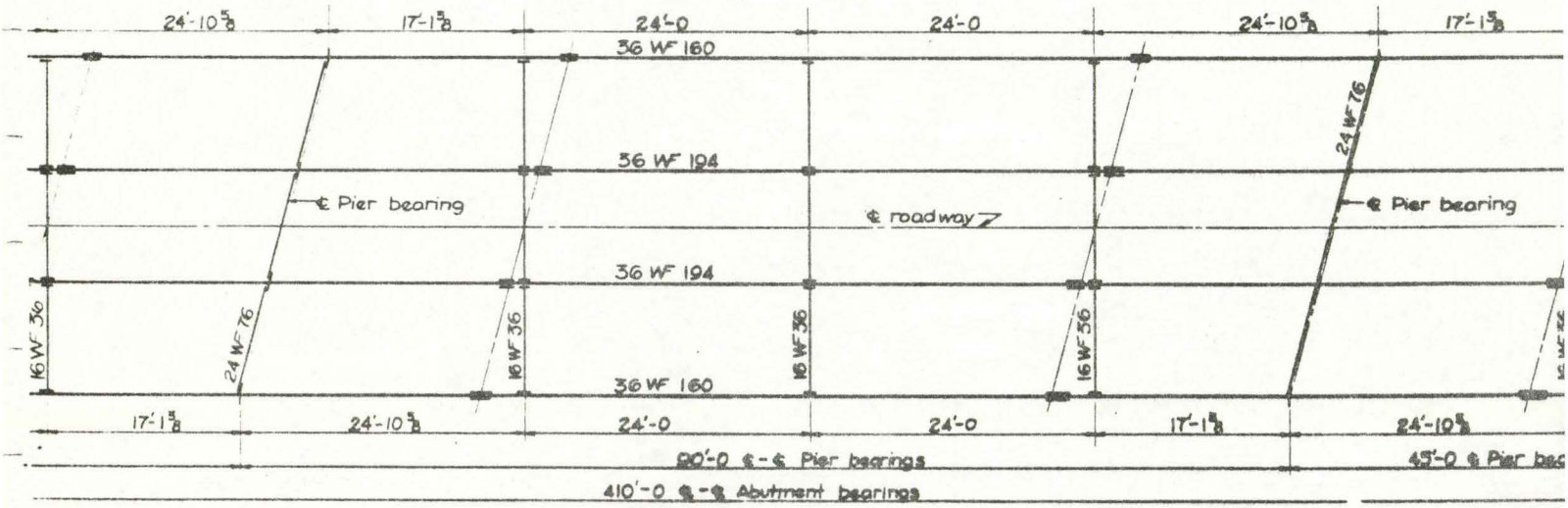

EXTERIOR BEAM



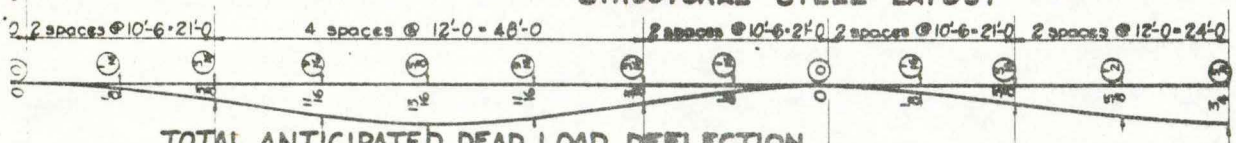
SHEAR LUG SPACING INTERIOR BEAM




INTERIOR BEAM

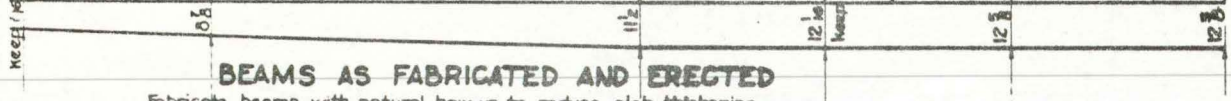



STRUCTURAL STEEL LAYOUT



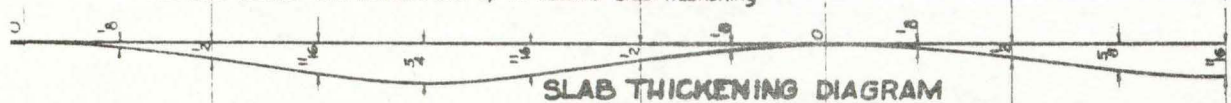

TOTAL ANTICIPATED DEAD LOAD DEFLECTION

Encircled figures indicate deflection due to concrete alone. Use for grade line correction. Straight line between abutments.



BEAMS AS FABRICATED AND ERECTED

Fabricate beams with natural bow up to reduce slab thickening

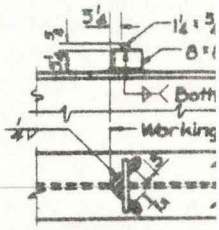


SLAB THICKENING DIAGRAM

For estimating purposes only.

℄ splice ℄ splice ℄ splice ℄ bridge

TEST SHEET D



SHEAR LUG DE

Wt. = 10.64# ea. 480

Revised 12-10-62: 16 splices elimin
to contractor's desire. See sheet
new splice locations and resu

## T AND REACTION TABLE

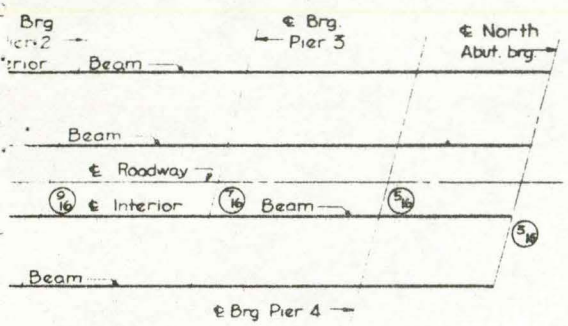
Moments in foot-kips
Reactions in kips

| Pos. M End Span | | Neg. M Pier 1 & 4 | | Pos. M 2nd Span | | Neg. M Pier 2 & 3 | | Pos. M Center Span | | Abut. Reaction | | Reaction Pier 1 & 4 | | Reaction Pier 2 & 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. | Int. | Ext. | Int. | Ext. | Int. | Ext. | Int. | Ext. | Int. | Ext. | Int. | Ext. | Int. | Ext. | Int. |
| 237.1 | 374.1 | * 552.3 | * 871.4 | 225.2 | 355.3 | ** 574.8 | ** 906.8 | 214.0 | 337.6 | 19.4 | 30.5 | 70.2 | 110.6 | 70.3 | 111.0 |
| 195.1 | 35.0 | 384.0 | 66.7 | 208.1 | 36.1 | 400.7 | 69.6 | 199.7 | 34.7 | 15.3 | 2.7 | 52.8 | 9.2 | 53.6 | 9.3 |
| ——— | ——— | 323.9 | 434.6 | ——— | ——— | 363.5 | 487.7 | ——— | ——— | ——— | ——— | 40.7 | 54.6 | 45.2 | 58.0 |
| ——— | ——— | 169.9 | 227.9 | ——— | ——— | 178.9 | 240.0 | ——— | ——— | ——— | ——— | 17.0 | 22.9 | 17.0 | 22.9 |
| 564.0 | 756.9 | ——— | ——— | 553.4 | 742.6 | ——— | ——— | 558.9 | 750.1 | 39.5 | 53.0 | ——— | ——— | ——— | ——— |
| 144.6 | 194.1 | 120.4 | 161.6 | 128.7 | 172.7 | 126.2 | 169.3 | 130.0 | 174.5 | 10.1 | 13.6 | 14.1 | 18.9 | 14.0 | 18.8 |
| ——— | ——— | 1550.5 | 1762.2 | ——— | ——— | 1644.1 | 1873.4 | ——— | ——— | 84.3 | 99.8 | 194.8 | 216.2 | 198.1 | 220.0 |

* 9.5% Increase

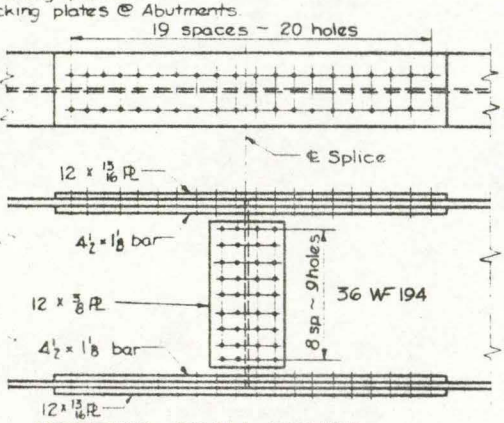
** 9.2% Increase

ncentrated live moment and the



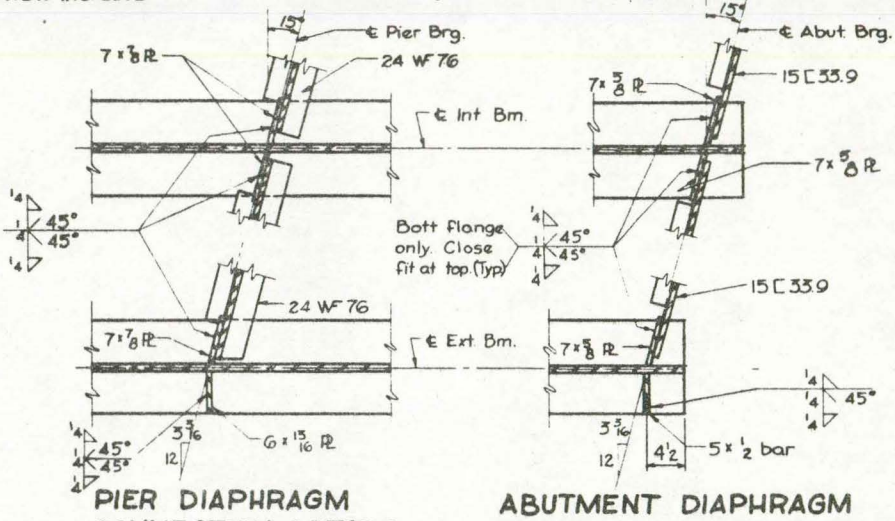

## LATE THICKNESSES

x t blocking plates @ Piers
x t blocking plates @ Abutments




INTERIOR BEAM SPLICE DETAILS

tes are to be A 36 steel.




PIER DIAPHRAGM CONNECTION DETAILS

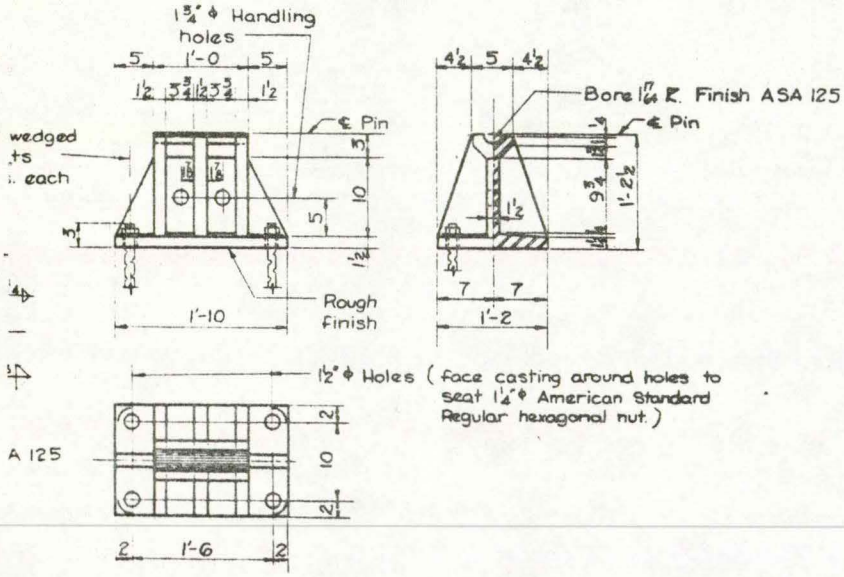
ABUTMENT DIAPHRAGM CONNECTION DETAILS

## ROCKER AND EXPANSION PLATE SETTING

| | S. Abut. | Pier 1 | Pier 2 | Pier 3 | Pier 4 | N. Abut. |
|---|---|---|---|---|---|---|
| Temperature at time of setting | *D | t | | t | t | *D |
| 10° F | 3 | -¼ | — | -¼ | -9/16 | 3¼ |
| 50° F | 2½ | 0 | — | 0 | 0 | 2½ |
| 90° F | 2 | +¼ | — | +¼ | +9/16 | 1¾ |

* Normal to Expansion Plate.

Note. Settings for other temperatures are proportional to those shown for a 40° temperature change.




FIXED SHOE S3

Wt. = 349 lbs.

Design For 15° Skew

# 410'-0 x 30' CONTINUOUS I-BEAM BRIDGE

70'-0 End Spans
Concrete Floor & Substructure

90'-0 Interior Spans
Tubular Rail

## SUPERSTRUCTURE DETAILS

Station 196+29.00

Project No. F-1112(1)

## WINNESHIEK COUNTY

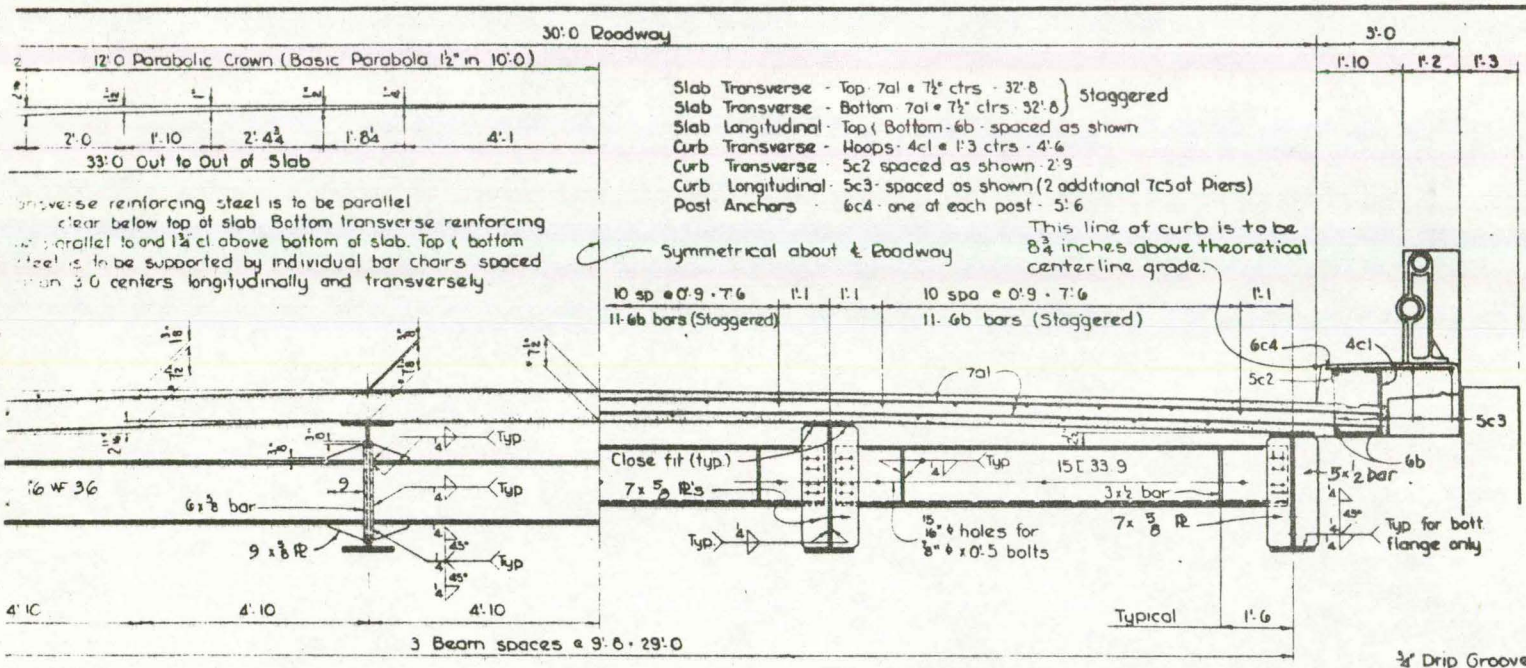
Iowa State Highway Commission

October 1961

Sheet 8 of 10

Design No. 1161 Winneshiek County File No. 21058

TEST SHEET E



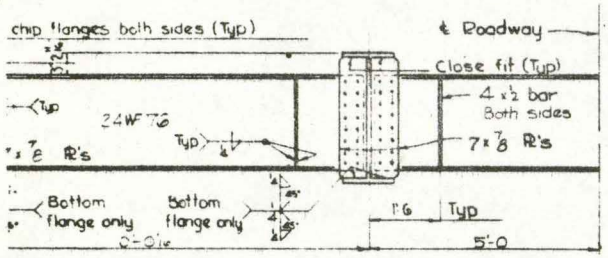

## INTERMEDIATE SECTION

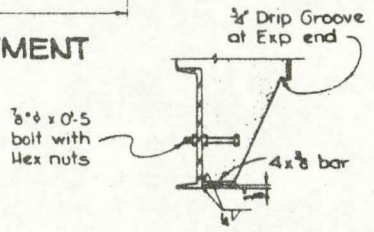
## HALF SECTION NEAR ABUTMENT

Scale ½" = 1'-0

Note The bottom of the slab is to be a flat surface between the top of the top flanges of adjacent beams

* Indicates nominal dimensions

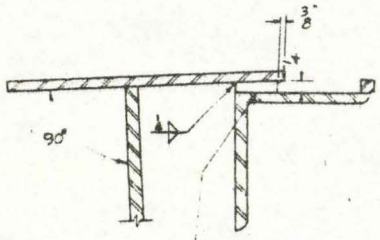


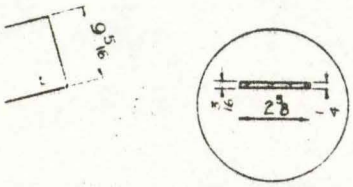




## SECTION THROUGH ABUTMENT DIAPHRAGM

## PIER DIAPHRAGM DETAILS

for 50° F for North & South Abutments
for North Abutment
for North Abutment
ed for other temperatures




## SHIM DETAIL

South Abutment Only

Shim to be fabricated in sections to fit between ⅛" plate and ⅜" ±

## SUPERSTRUCTURE NOTES:

This bridge is designed for H20 S16 loading plus 19#/sq.ft of roadway for future wearing surface.

The floor slab, as shown, includes ½" of wearing surface.

Field connections may be riveted or bolted, except as noted or shown. Splice connections, if bolted, will require "High Tensile Strength Bolts". Structural Steel weights have been computed using "High Tensile Strength Bolts"

All open holes are to be 15/16" ϕ unless otherwise noted

All rivets and bolts are to be ⅞" ϕ unless otherwise noted

Bottom flanges of beams are to be perpendicular to webs at reaction points.

Beam splices are to be subpunched and reamed. Before reaming, all beams are to be assembled to proper camber as shown on Sheet 6, "Beams as Fabricated and Erected," for inspection. After inspection, holes are to be reamed and all parts match marked.

Masonry plates are to be set in paint & canvas

Bearing surfaces of unfinished masonry plates are to be flat and true

Shop coat of paint is to be omitted on tops of top flanges of beams and on other steel surfaces in contact with concrete.

Parts inaccessible after erection are to be given three coats of paint in the shop.

Forms for the slab and curb are to be supported by the beams

Cost of all preformed joint filler to be included in price bid for concrete.

Main beams, cover plates and splice plates shall conform to the A.S.T.M. Specifications for A36 Carbon Steel. All other Structural Steel shall conform to the A.S.T.M. Specifications for A-7 Steel, except as noted on sheet #8.

## SPECIFICATIONS:

Design AASHO 1961

Construction Iowa State Highway Commission Standard Specifications Series of 1960, plus current special provisions, and supplemental specifications.

Design for 15° Skew

# 410'-0 x 30' CONTINUOUS I-BEAM BRIDGE

70'-0 End Spans
Concrete Floor & Substructure

90'-0 Interior Spans
Tubular Rail

## SUPERSTRUCTURE DETAILS

Station 196+29.00

Project № F-1112(1)

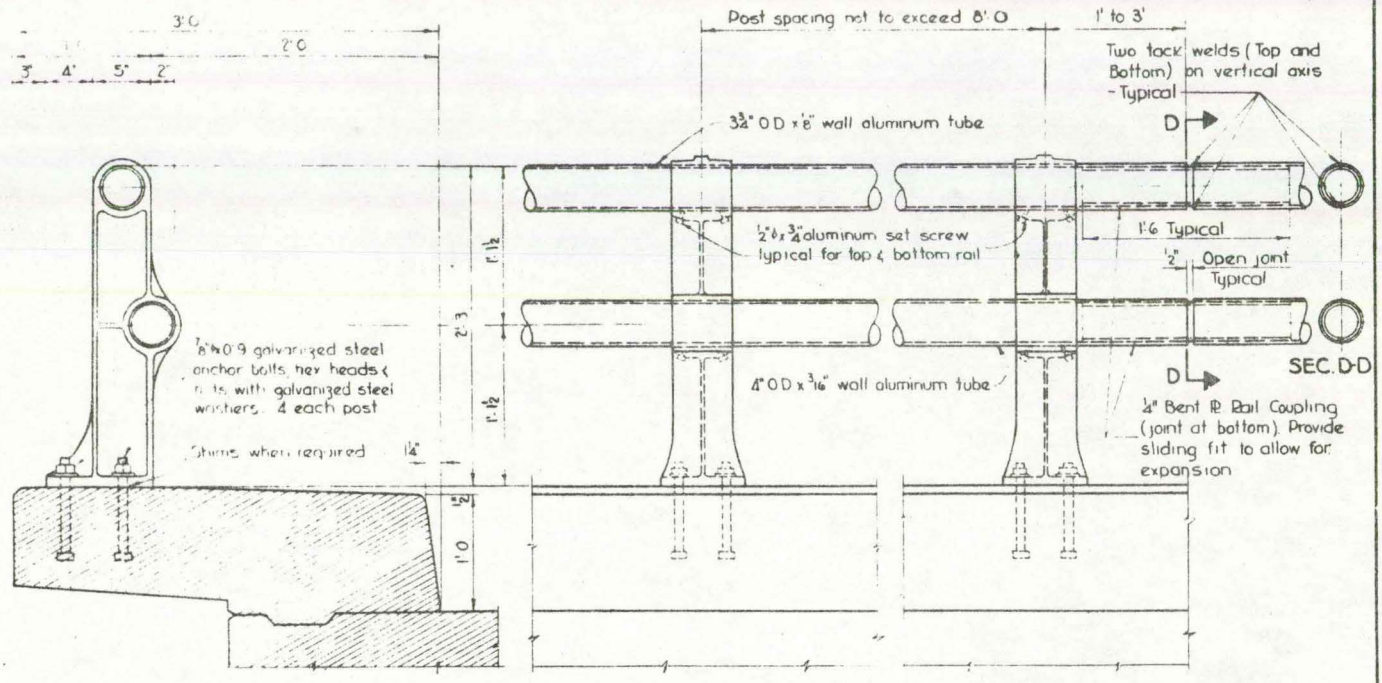
WINNESHIEK COUNTY

Iowa State Highway Commission

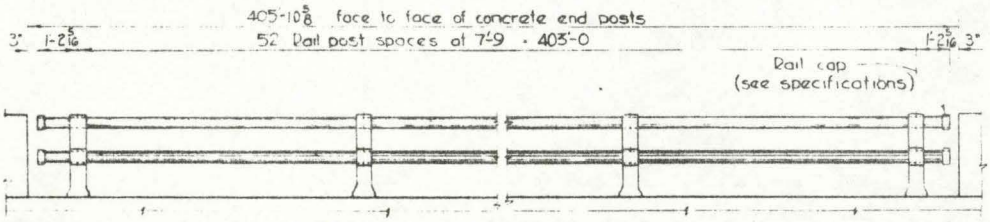
Sheet 9 of 10

TEST SHEET F

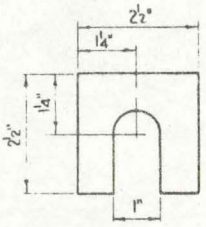
Winneshiek Co. File № 21058




## SECTION THRU CURB




## RAIL POST LAYOUT




## ALUMINUM SHIM DETAIL

Note Provide 4-1/16" thick shims at each post

## SPECIFICATIONS:

**1. DESCRIPTION OF BID ITEM**

A. Aluminum handrail is to be bid on a linear foot basis measured from center to center of end posts. The price bid for "Aluminum Handrail" shall consist of furnishing, fabricating, erecting, and cleaning all metal handrail and shall include the furnishing and installation of anchor bolts and all other incidental items in accordance with these plans and specifications.

**2. COMPONENT PARTS AND MATERIALS**

A. Aluminum Bridge Rail Tubing

1. Aluminum tubing shall comply with the A.S.T.M. Specification B 235- * alloy 6511A condition T6 (commercial designation 6061-T6). The rail tubing is to be fabricated from random length tubing and joined as indicated. Each rail section must pass thru at least three posts before being spliced.
2. The aluminum rail tubing shall be closed at the ends next to the concrete end posts as detailed, by means of cast caps or plugs or by means of welded end plates. The cast caps or plugs shall comply with the material specifications as outlined for post castings or with A.S.T.M. Spec. B 26 alloy 55A condition F.

B. Aluminum Rail Post Castings

1. Aluminum post castings shall comply with:
   (a) The A.S.T.M. Specification B108- * alloy SG70B condition T6 for aluminum alloy permanent mold castings (commercial designation - A356-T6)
2. The post castings shall have smooth and even surfaces, free from shrinkage cracks, oxide inclusions, and other defects.
3. The post castings shall follow the outlines and dimensions as detailed. Minor changes, such as draft angles and radii for fillets and corners, shall be permitted. Draft on front and back face of post may be omitted providing minimum wall thicknesses as detailed are maintained. Shop drawings for post castings must be submitted and approved by the Engineer before castings are made.
4. The ⅜" parting strip is to be finished with a 120 grit finish or an approved equal. ~~All other surfaces are to have a uniformly polished or burnished finish.~~
5. Before setting posts, the entire base of the post casting shall be coated with an aluminum impregnated caulking compound ⅛" thick. The caulking compound shall comply with Federal Specifications TT-C-598 for knife grade to which shall be added aluminum paste complying with Paragraph 4181.02 in proportion to one pound of aluminum to 5 pound of caulking compound.

C. Aluminum Set Screws for Posts

1. Aluminum set screws shall comply with the A.S.T.M. Specification B211 * alloy C6 42 A (commercial designation 2024-T4 with N° 205 alumilite finish). The finished set screws shall be supplied in the T-4 temper and shall be given an anodic coating at least 0.0002" in thickness and chromate sealed. The set screws shall have a hexagon socket head and oval point.

D. Aluminum Shims

1. Aluminum shims shall comply with the A.S.T.M. Specification B-209 * alloy 990A condition O (commercial designation - 1100-O).

* Current tentative A.S.T.M. Standard Specifications.

**3. CONSTRUCTION**

A. The specifications for construction shall be the Standard Specifications of the Iowa State Highway Commission, Series of 1960, plus current Special Provisions with the added provisions:

1. The anchor bolts for the aluminum posts shall be set at the line and elevations shown on the plans. They shall be firmly held in place by suitable templates that will assure their correct position during the placement of concrete. Aluminum shims, as detailed, shall be used if necessary to insure the correct elevation of the rails.
2. The cast aluminum posts and the aluminum tube rails shall be carefully handled during their unloading, handling, and erection. Members that are marred, disfigured or damaged to the extent that they impair their usefulness or appearance shall be rejected and replaced at the contractor's expense.
3. The aluminum handrail shall be stored above ground upon suitable platforms and kept free from dirt, grease, and contact with dissimilar metals. The stored aluminum handrail shall be protected from moisture as far as practical.
4. After anchor bolts have been tightened, the excess caulking compound shall be removed and all openings around the base of the post pointed full and flush with caulking compound.
5. After erection, rails and posts and the concrete around the post bases shall be thoroughly cleaned of all dirt, grease, caulking compound and other foreign material by an approved means as directed by the Engineer.
6. Set screws are to be tightened to prevent rails from rattling, but they are not to be tightened so as to prevent movement due to rail expansion.

| ALUMINUM HANDRAIL QUANTITIES | | |
|---|---|---|
| Aluminum Handrail (℄ ℄ End Posts) | 806.0 | lin. ft. |

Design for 15° Skew

## 410'-0 x 30' CONTINUOUS I-BEAM BRIDGE

70'-0 End Spans — 90'-0 Interior Spans
Concrete Floor & Substructure — Tubular Rail

## ALUMINUM HANDRAIL DETAILS

Station 196 + 29.00 — Proj N° F-1112(1)

## WINNESHIEK COUNTY

Iowa · State Highway Commission

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sign No. 1161 — Winneshiek County — File No. 21058

TEST SHEET G

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