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Yankton Area DOT

1996 to Present

Bridge Design, Hydraulics Section

1993 to 1996

Chapter 2 - Staking

- Minimum Staking Requirements
- Reference Points
- Benchmarks
- Common Staking Errors
- Contractor's Responsibilities

Why is good staking needed?

To Avoid Major Construction Errors!

- Piling in wrong location and direction
- Columns not fitting between footing and cap
- Columns in wrong location
- Girders don't fit/ incorrect span length
- Resteel that is wrong length or bend
- Decks that do not match approach pavement
- Decks resulting in a poor ride.
- ??????

Staking preparation

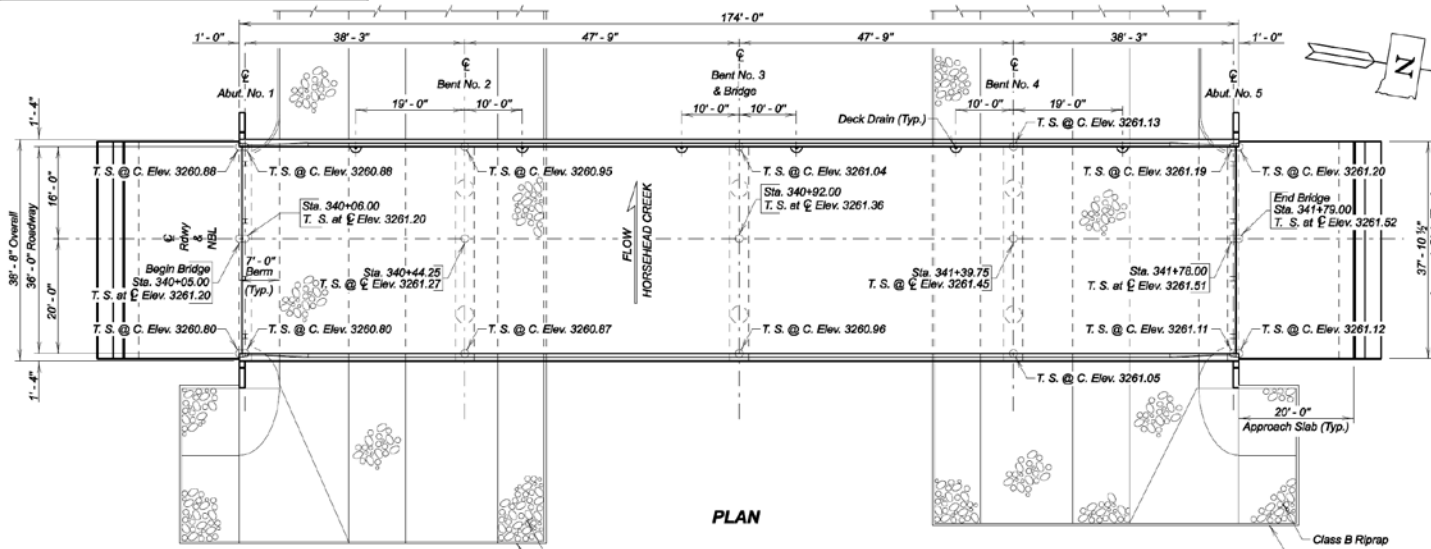
- Good plan review
- Prepare field notes prior to going out into the field.
- Review Check list
 - Structure Training Manual pg 2-10
 - U:\op\Inspection Checklists\Checklist-Staking.doc

Plan review

- Dimensions of the structure
- Check elevations from bottom of footing to finished deck.
- Verify that the roadway profile will match bridge approaches.
- Structure lengths

STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
S.D.	EM 008(15)253	E35	E57

The elevations shown in these plans are based on the National Geodetic Survey (NGS) North American Vertical Datum of 1988 (NAVD88).

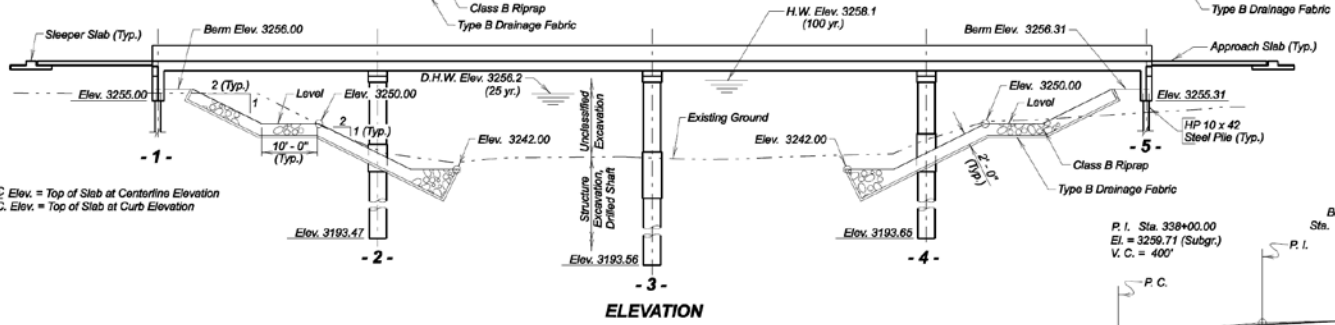


- X020- INDEX OF BRIDGE SHEETS -**
- Sheet No. 1 - General Drawing and Layout
 - Sheet No. 2 - Estimate of Structure Quantities and Notes
 - Sheet No. 3 - Notes (Continued)
 - Sheet No. 4 - Notes (Continued)
 - Sheet No. 5 - Subsurface Investigation, Piling and Drilled Shaft Layout
 - Sheet No. 6 - Riprap Details
 - Sheet No. 7 - Abutment No. 1 Details
 - Sheet No. 8 - Abutment No. 5 Details
 - Sheet No. 9 - Bent Details
 - Sheet No. 10 - Superstructure Details
 - Sheet No. 11 - End Block, Barrier Curb and Deck Drain Details
 - Sheet No. 12 - Details of Bridge End Backfill
 - Sheet No. 13 - Details of Approach Slab Adjacent to Bridge
 - Sheet No. 14 - Approach Slab Joint Details
 - Sheet No. 15 - Compression Steel Joint Details
 - Sheet No. 16 - As-Built Elevation Survey
 - Sheet No. 17 - Details of Standard Plate No's. 460.02 and 460.05
 - Sheet No. 18 - Details of Standard Plate No's. 510.40 and 620.18
 - Sheet No. 19 - Details of Standard Plate No's. 630.92 and No. 680.03.

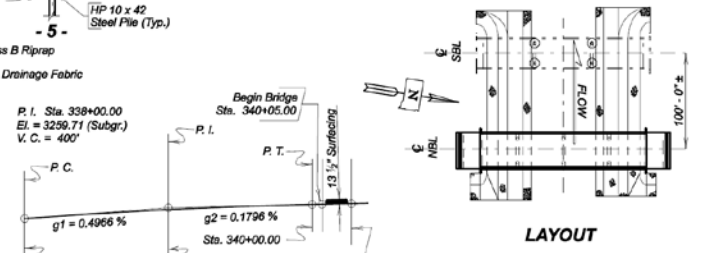
HYDRAULIC DATA

Q_d	4824 cfs
A_d	1419 sq. ft.
V_d	3.4 fps
Q_F	4824 cfs
Q_{100}	8500 cfs
V_{max}	4.6 fps

Q_d = Design discharge for the proposed bridge based on 25 year frequency. El. 3256.2
 Q_{OT} = Overtopping discharge and frequency 100 year recurrence interval. El. 3257.9 Location Sta. 327+00
 Q_F = Designated peak discharge for the basin approaching proposed project based on 25 year frequency.
 Q_{100} = Computed discharge for the basin approaching proposed project based on 100 year frequency. El. 3258.1

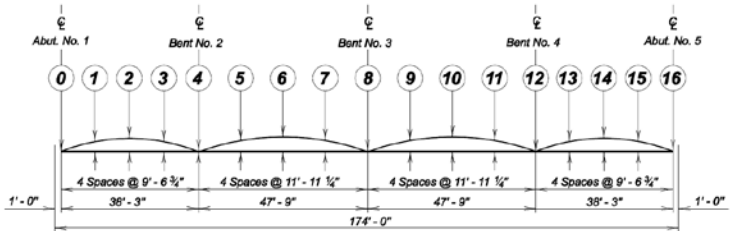


NOTE -
 T.S. @ C. Elev. = Top of Slab at Cantorino Elevation
 T.S. @ C. Elev. = Top of Slab at Curb Elevation



*** TABLE OF ELEVATIONS**

Slab Point	Left Curb	C	Right Curb
0	3260.885	3261.205	3260.805
1	3260.965	3261.285	3260.885
2	3260.993	3261.313	3260.913
3	3260.970	3261.290	3260.890
4	3260.954	3261.274	3260.874
5	3261.029	3261.349	3260.949
6	3261.091	3261.411	3261.011
7	3261.071	3261.391	3260.991
8	3261.039	3261.359	3260.959
9	3261.114	3261.434	3261.034
10	3261.176	3261.496	3261.095
11	3261.158	3261.478	3261.078
12	3261.125	3261.445	3261.045
13	3261.176	3261.496	3261.095
14	3261.234	3261.554	3261.154
15	3261.240	3261.560	3261.160
16	3261.194	3261.514	3261.114



CURB AND CENTERLINE ELEVATION
 (See TABLE OF ELEVATIONS for elevations)

* Camber for Dead Load Deflection plus Plastic Flow, Shown on Superstructure Details, has been included in the elevations shown.

GRADELINE DATA

174'-0" CONTINUOUS CONCRETE BRIDGE
 36'-0" ROADWAY
 OVER HORSEHEAD CREEK
 STA. 340 + 05.00 TO 341+79.00
 STR. NO. 24-382-153
 PCN 0008

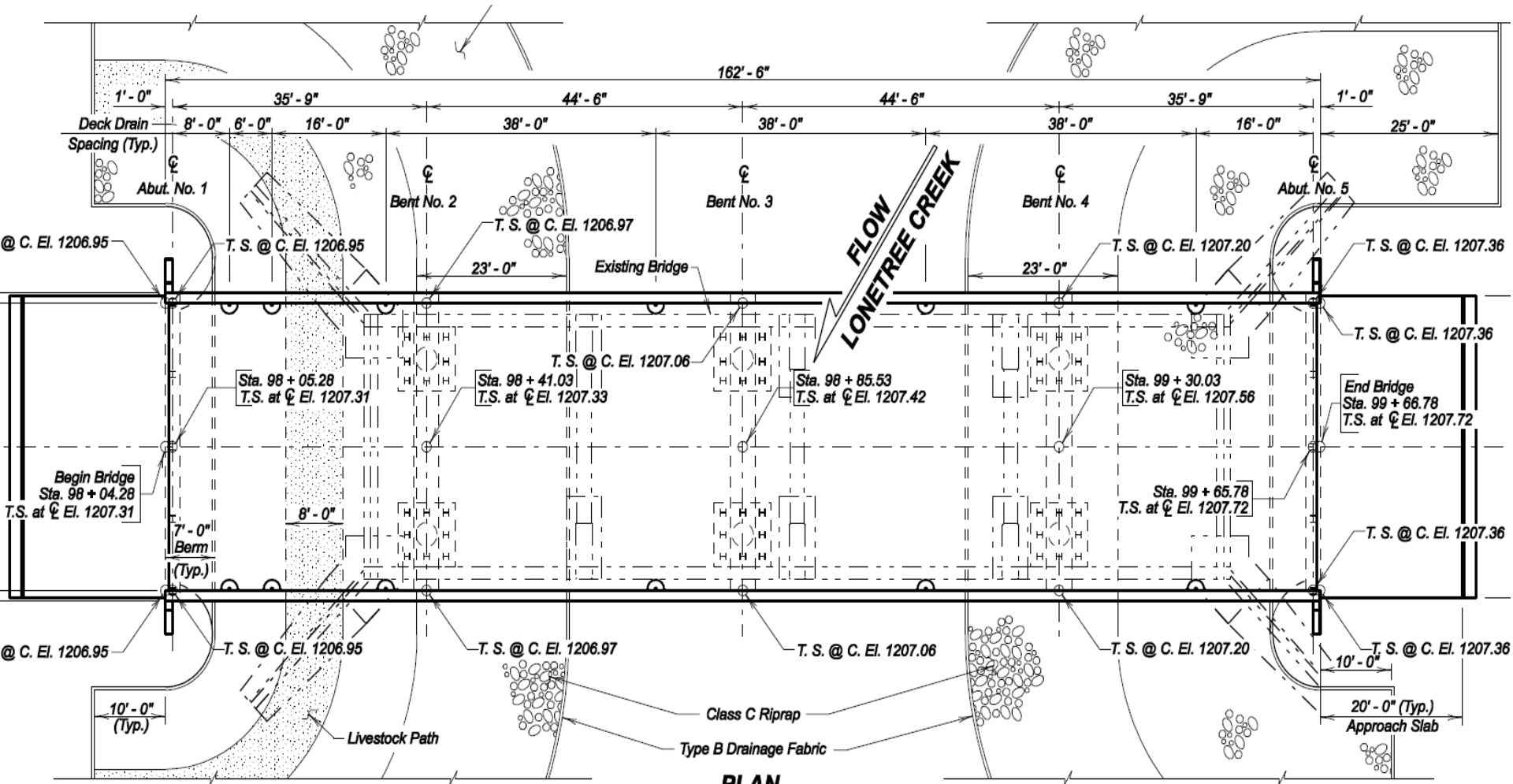
FALL RIVER COUNTY
 S. D. DEPT. OF TRANSPORTATION

FEBRUARY 2009 **1 OF 19**

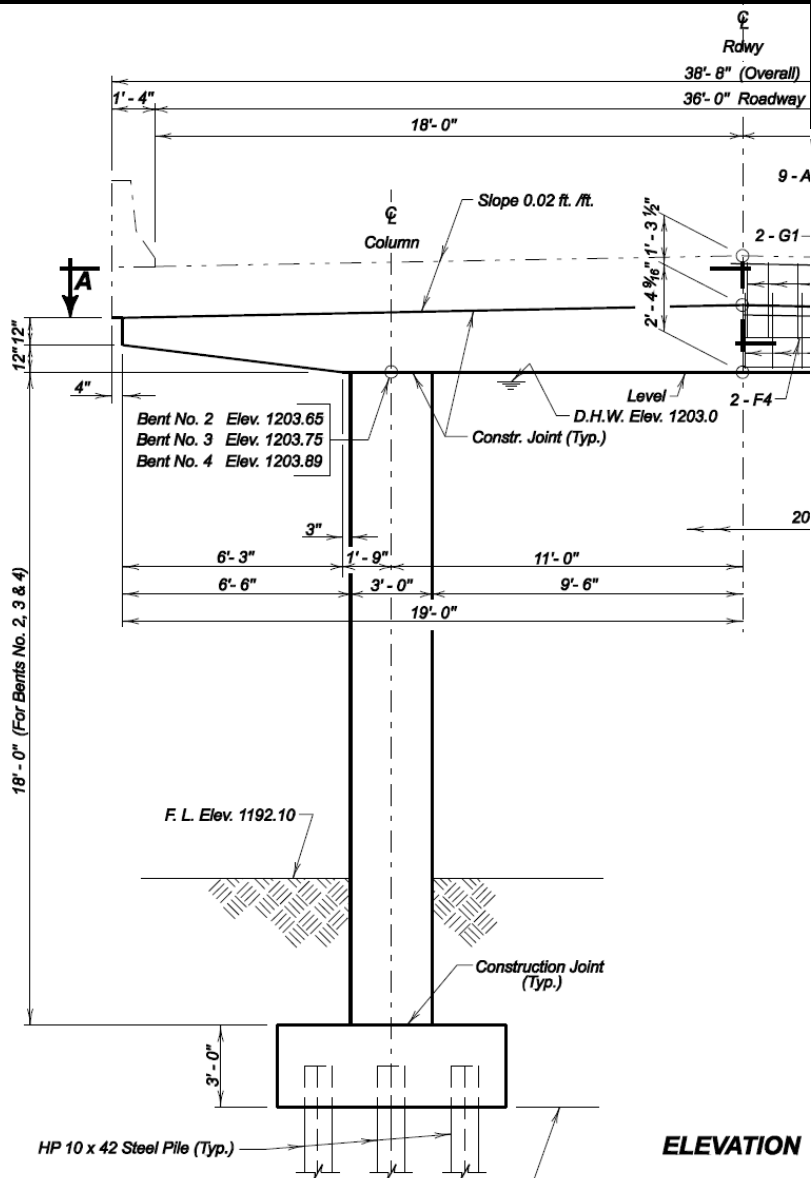
-X020-
 DESIGNED BY: TB/JNH
 DRAWN BY: CW
 CHECKED BY: JMH/TB
 Kevon J. Boeden
 BRIDGE ENGINEER

PLANS BY:
 OFFICE OF BRIDGE DESIGN, SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION

Check Structure Dimension



Substructure Dimension

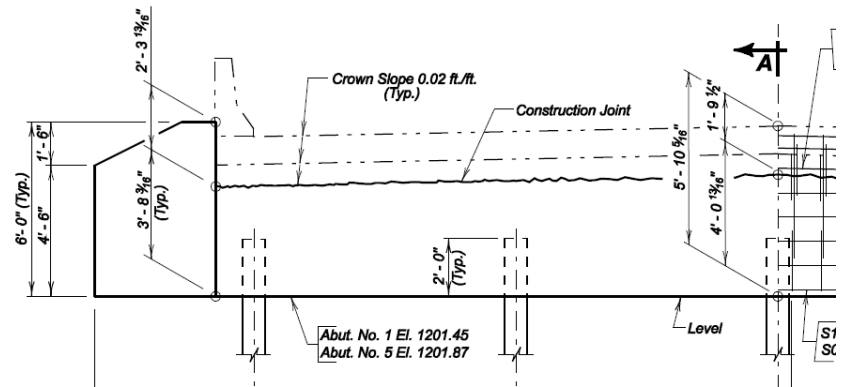


ELEVATION

NOTE:

Substructure shoring shall remain in place until Superstructure shoring is removed.
 F2 bars are to be placed symmetrically between

- Bent No. 2 Elev. 1182.65
- Bent No. 3 Elev. 1182.75
- Bent No. 4 Elev. 1182.89



Field Notes

- Sketch of each unit
- Dimension of each unit
- Distance from bridge Centerline to Centerline of each unit.
- Stationing of each unit
- Skew Angle
- Base & Top of Footing Elevation
- Distance from mainline centerline to bridge centerline
- Benchmark information

Maximum of one Abutment and two Bents per field note sheet.

Page 2-12, Fig 2.1

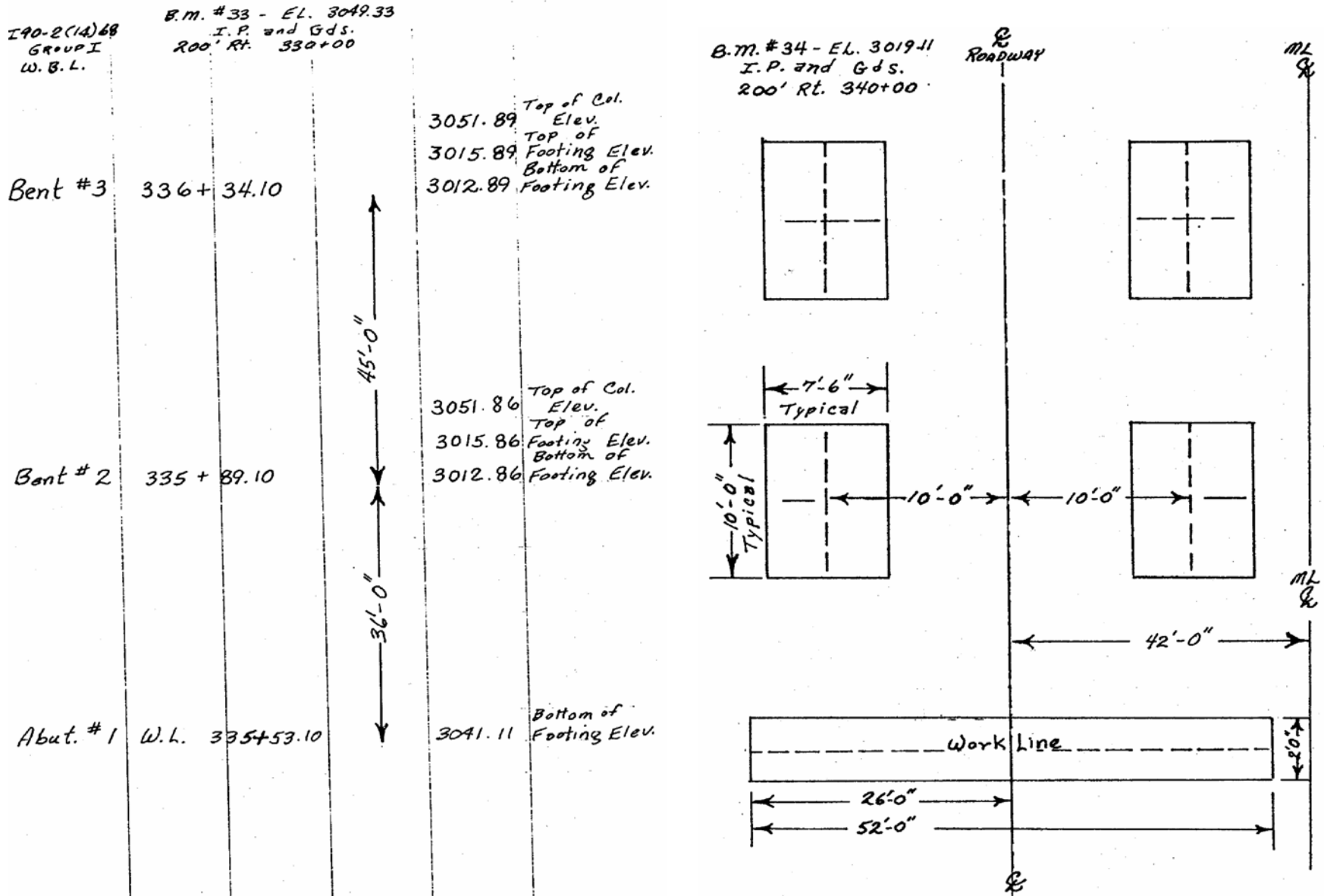


Figure 2.1 Typical Page of Field Notes for Structure Staking

Minimum Staking Requirements

- Bridges - Department to provide stakes to establish elevation, location and alignment for each abutment
- Box Culverts - Department to provide stakes to establish elevation, location, and alignment of both ends of box culvert

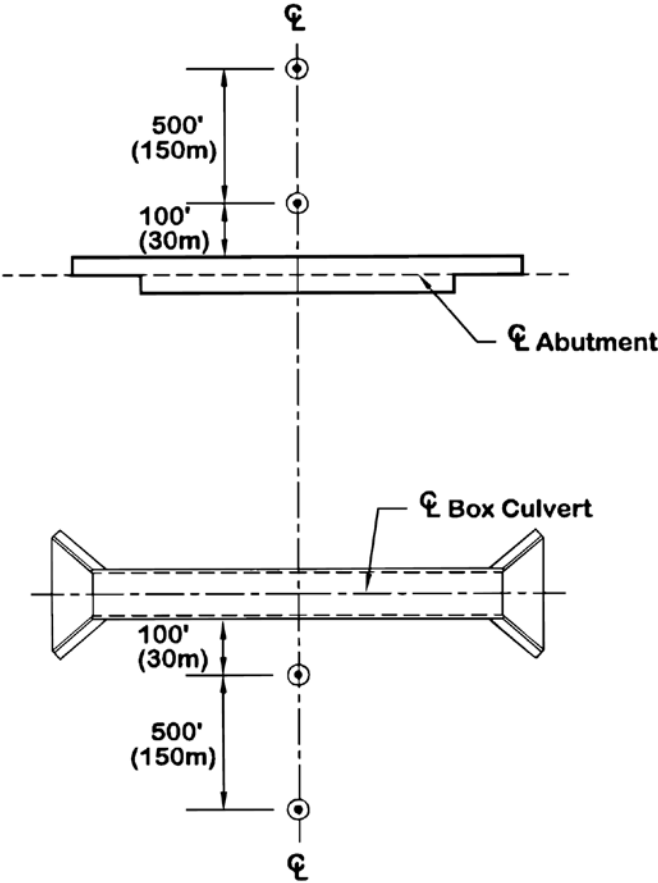
Review Structure Staking with Survey Crew



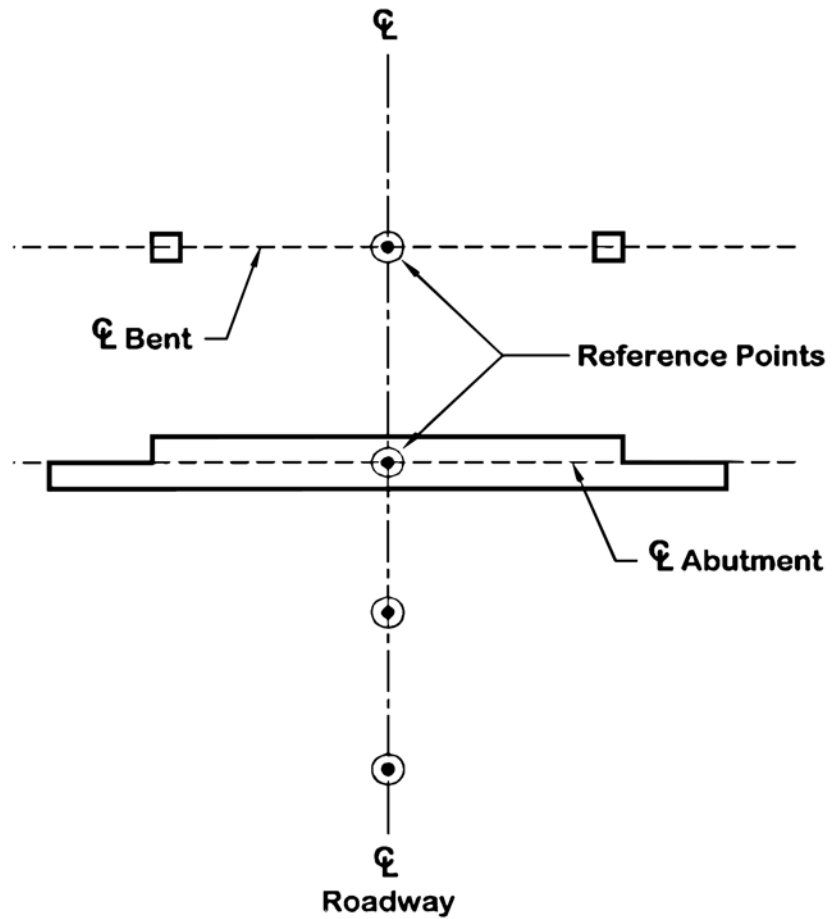
Reference Points

- Permanent points set beyond work activities
- Minimum of 2 points on each end (100' and 500')
- Offset points set to reestablish reference points if needed
- Set at centerline of each abutment and bent
- Set along skew if skewed bridge

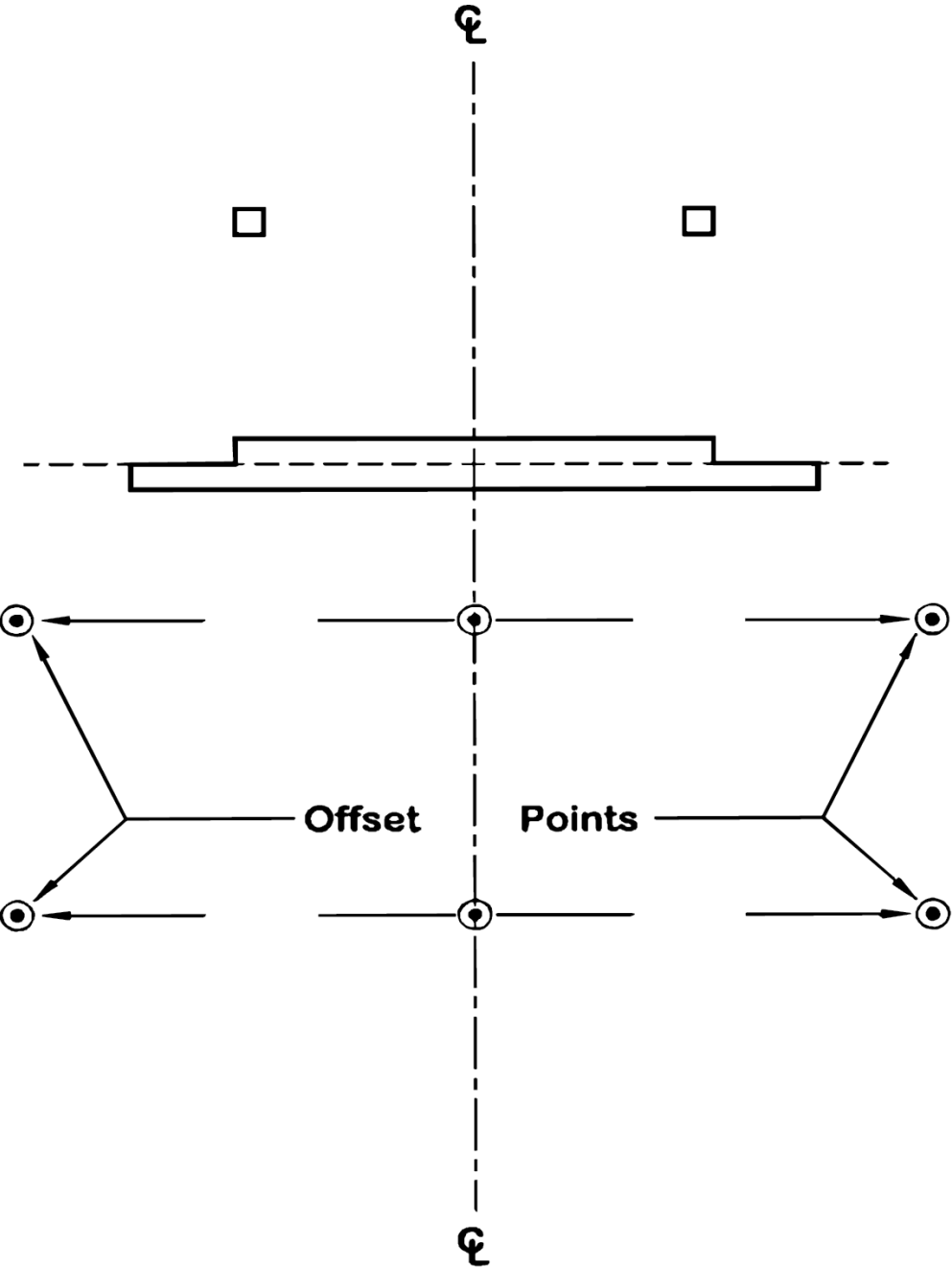
Figure 2.2 Permanent Points for Bridge and Box Culvert Staking



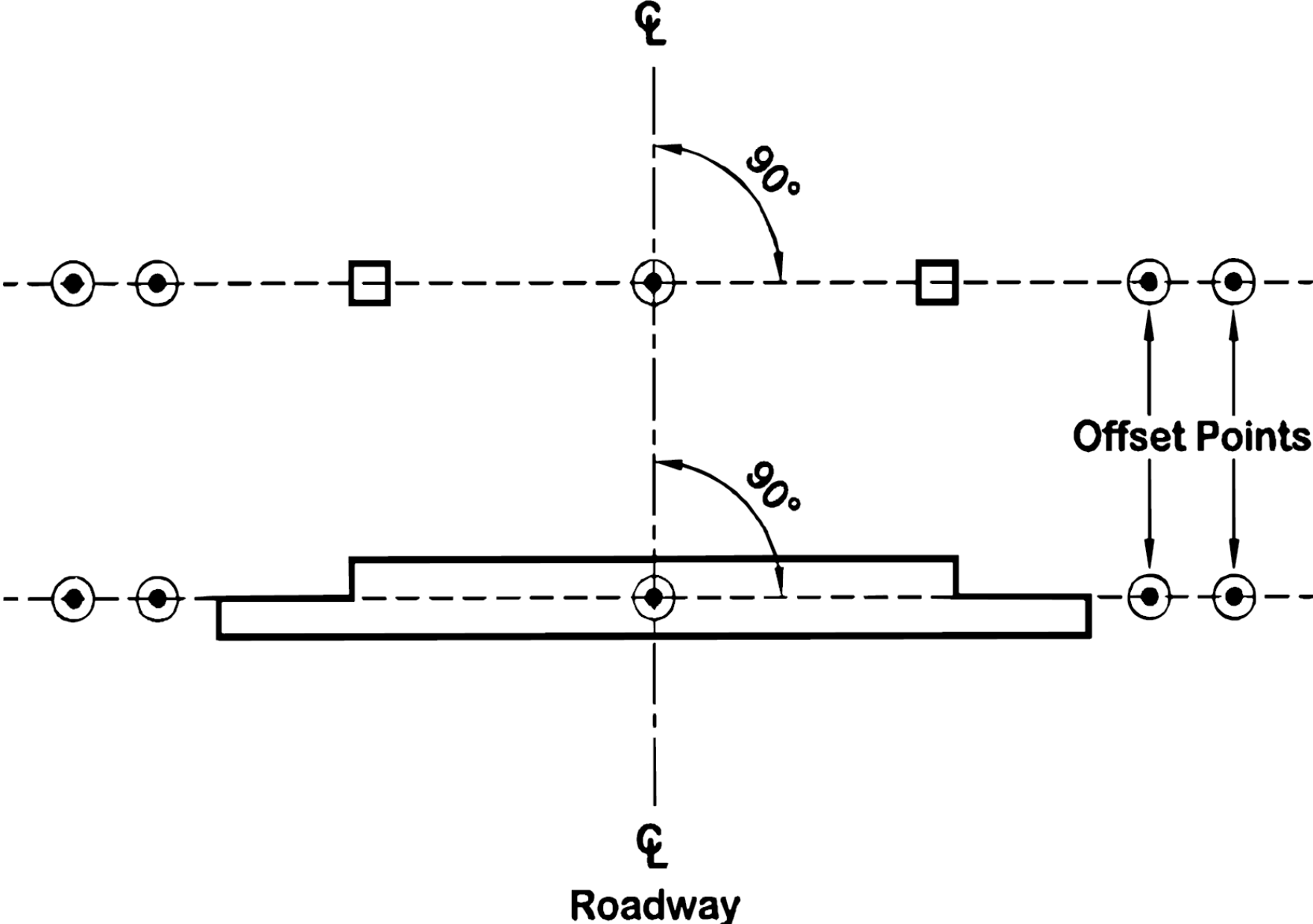
Page 2-15, Fig 2.4: Reference Points



OFFSET POINTS



Offset Points on 0 Degree Skewed Bridge

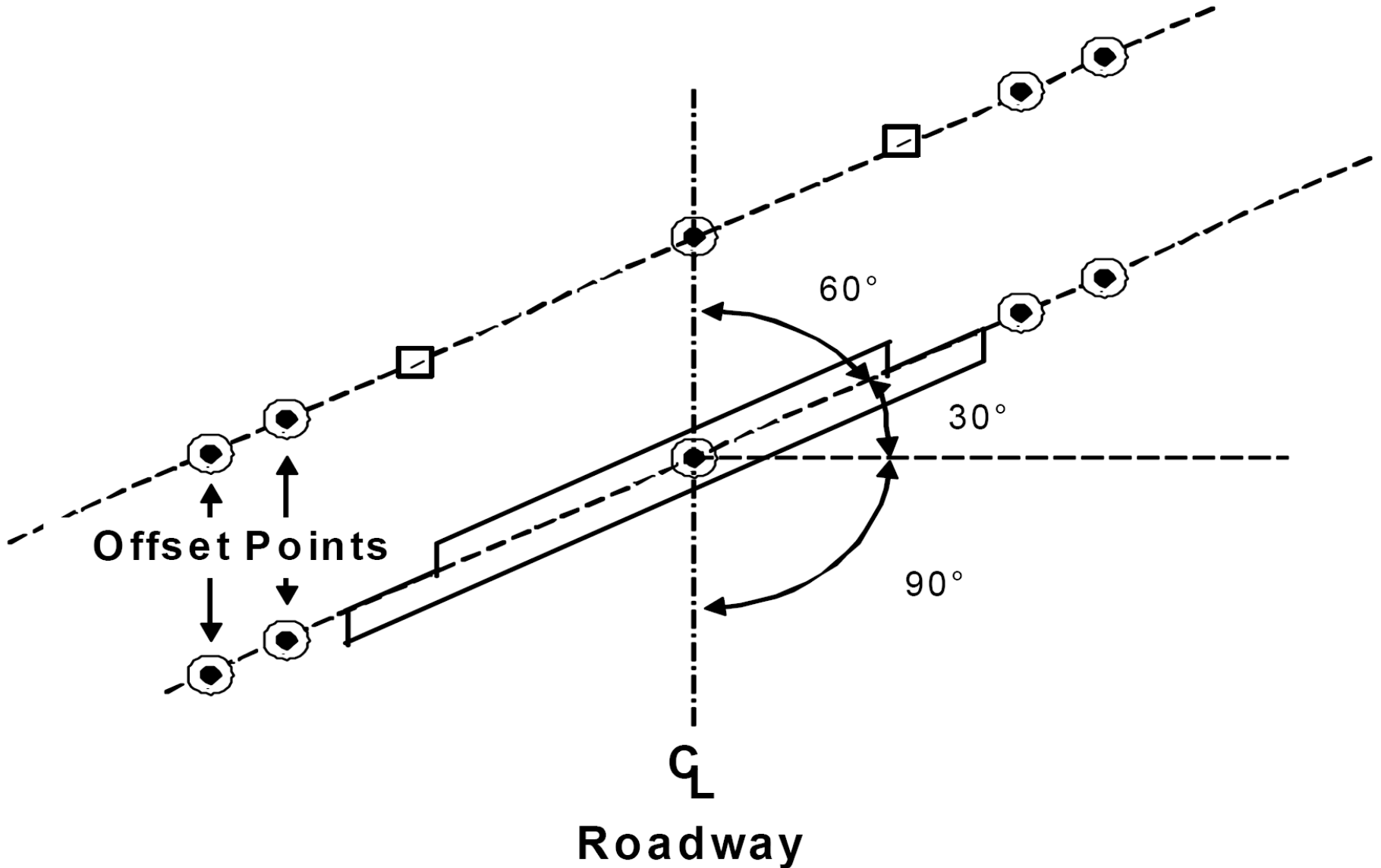




Place all
stakes
on solid
ground!

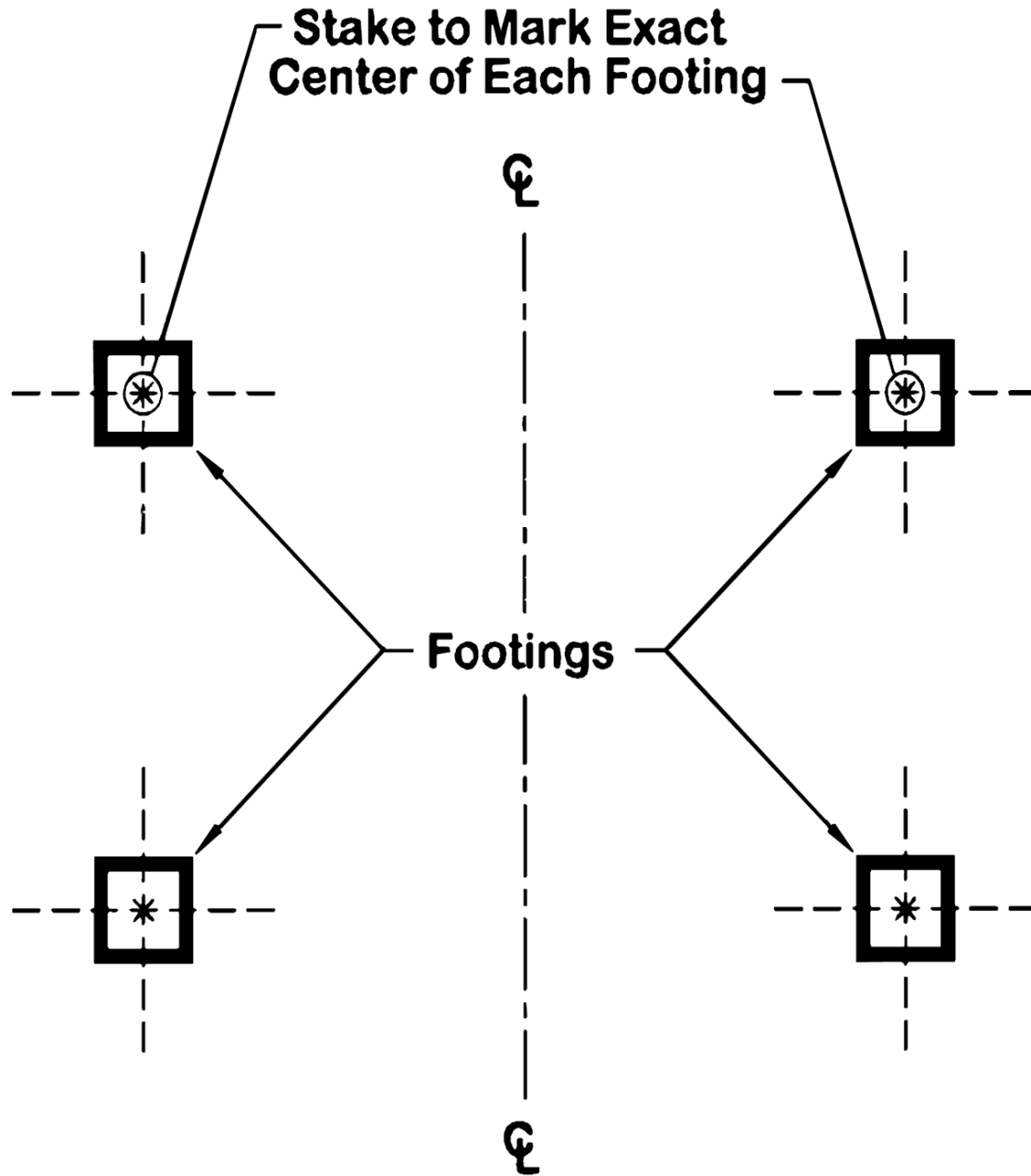
Offset Points on Skewed Bridge

Structure on Skew 30° R.H.F

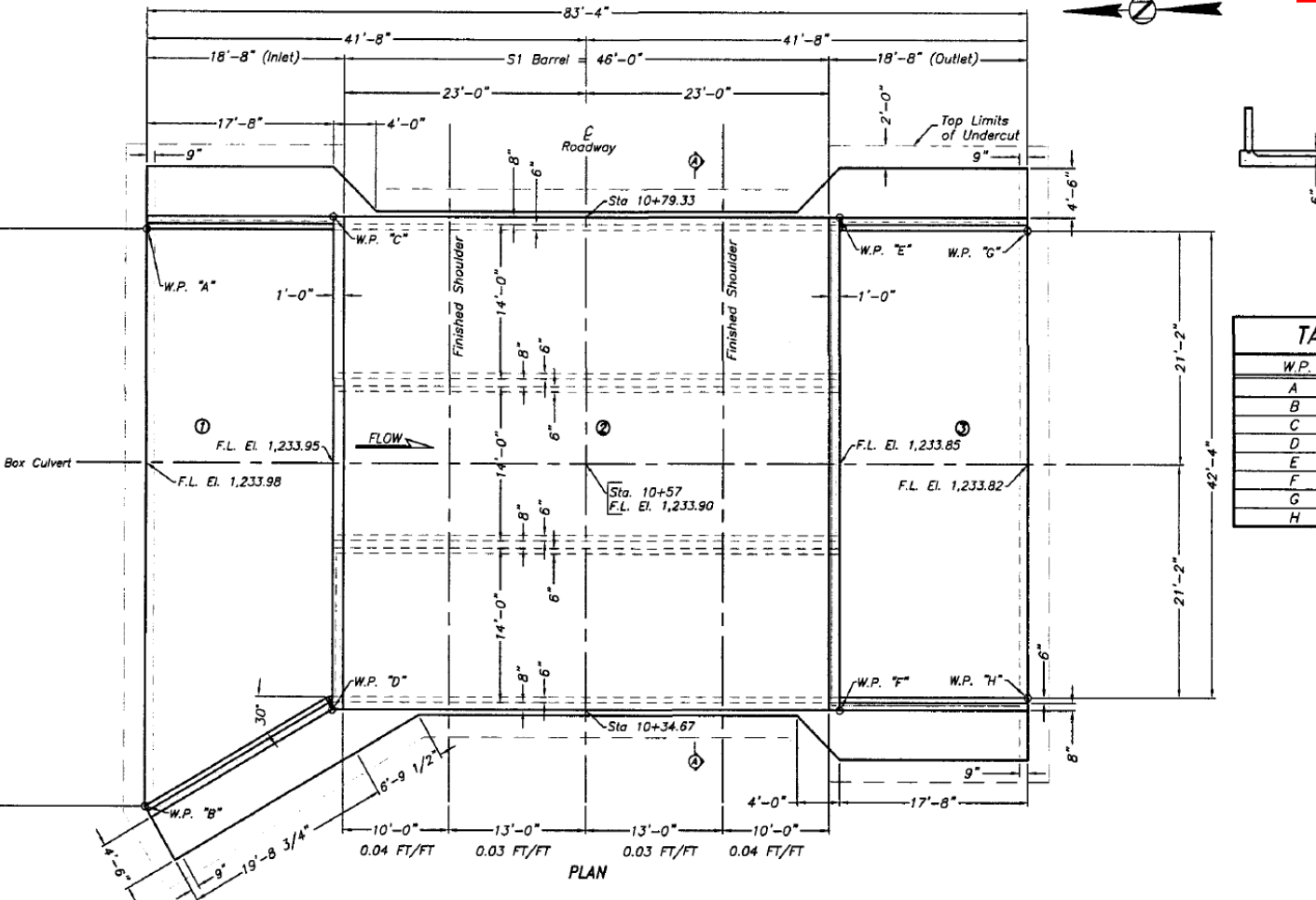




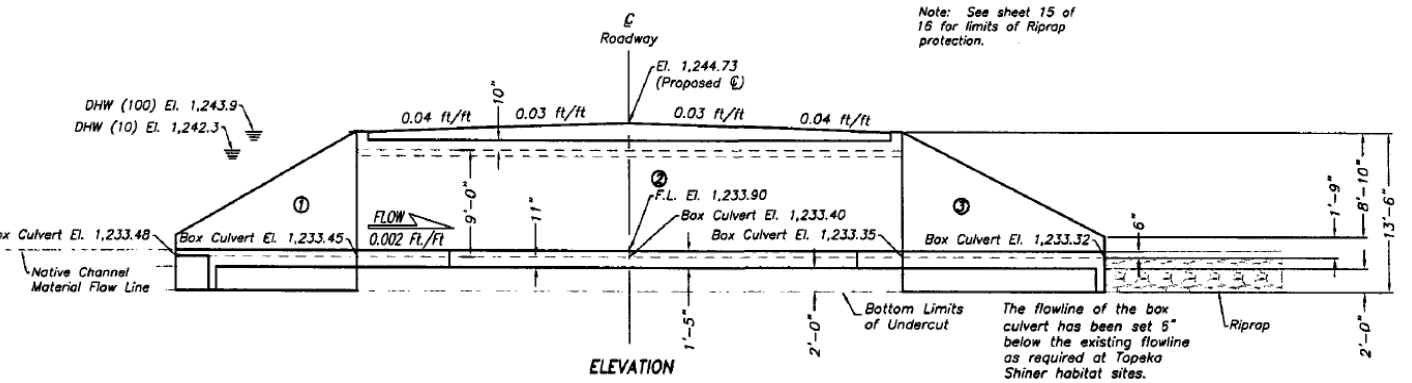
Reference Points for Footings



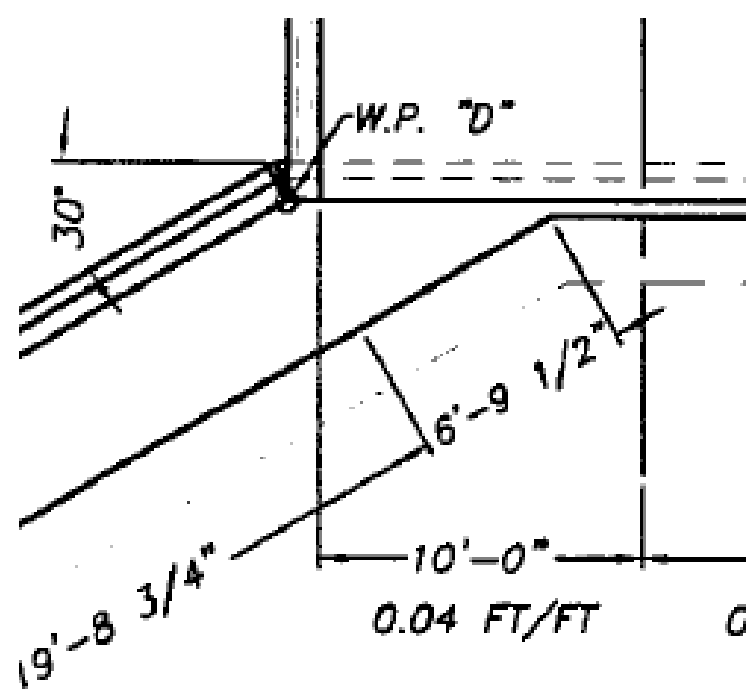
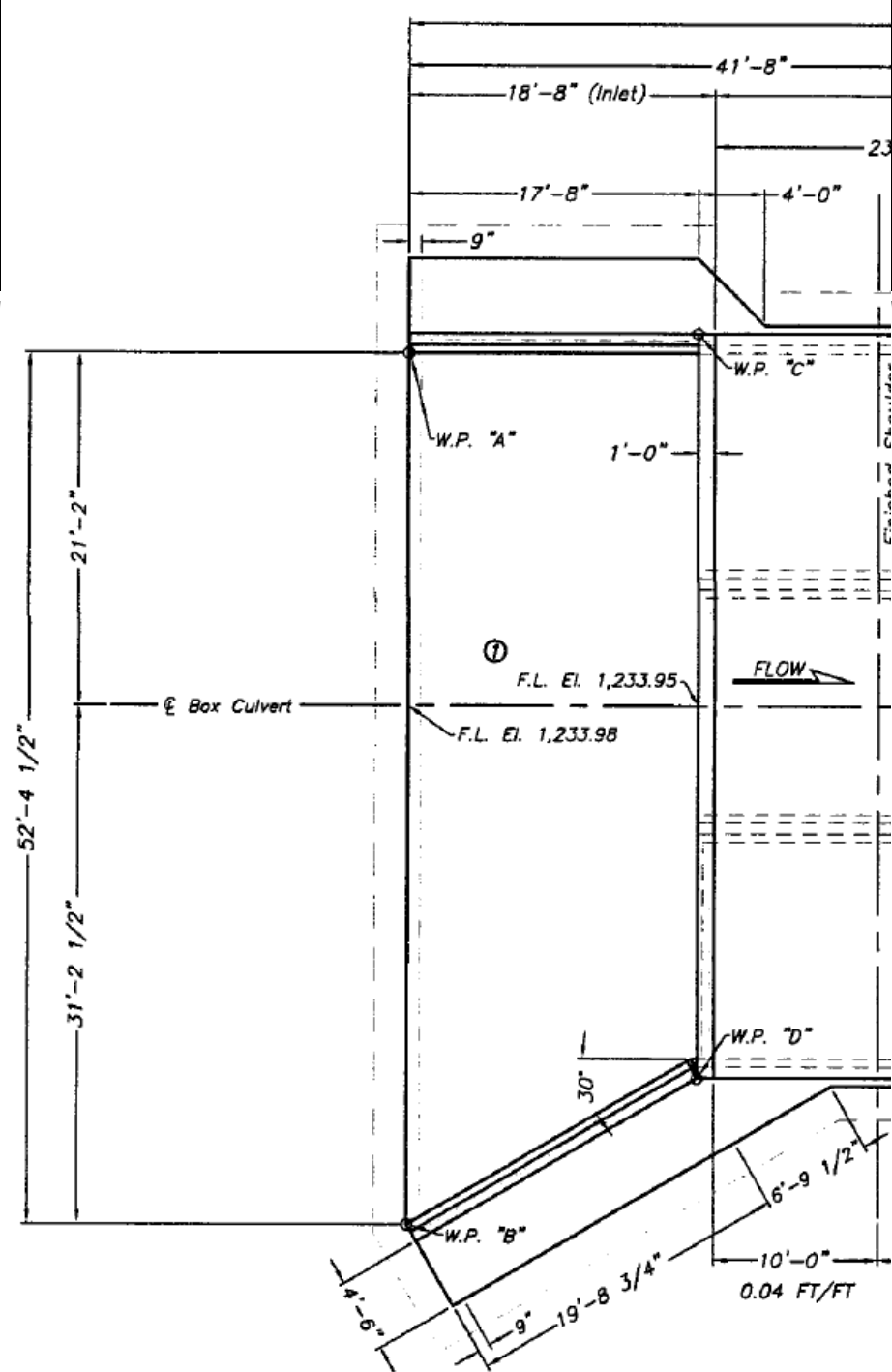
Working Points on a RCBC

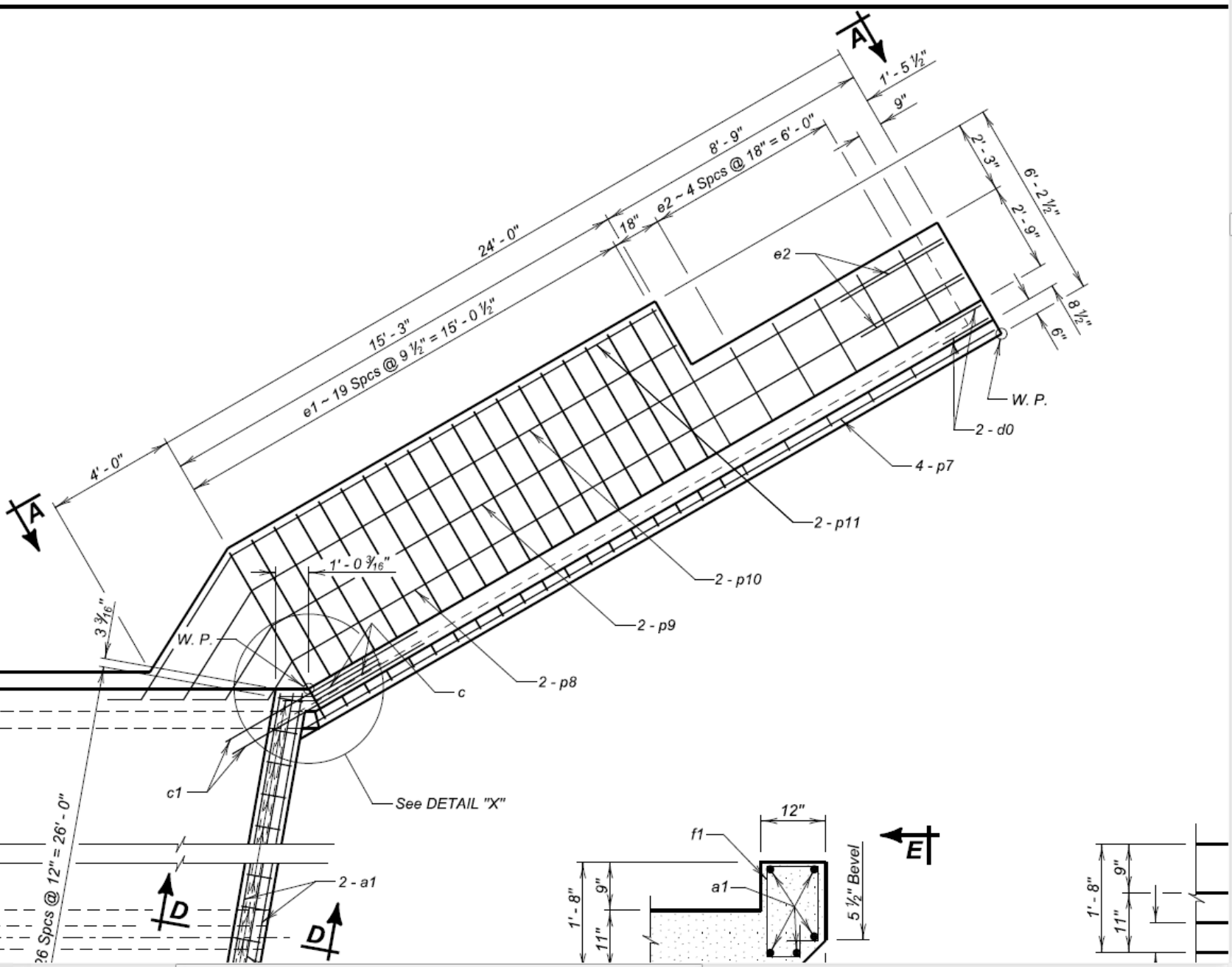


TA	
W.P.	
A	
B	
C	
D	
E	
F	
G	
H	



Note: See sheet 15 of 16 for limits of Riprap protection.





Reference Stakes



Fig 2.8, Page 2-17

Page 2-17, Fig 2.9



Benchmarks

- Set two benchmarks
- One for higher elevations - bent columns, bent caps, bearings, girders, etc.
- One for lower elevations - footings, piling, abutments, etc.

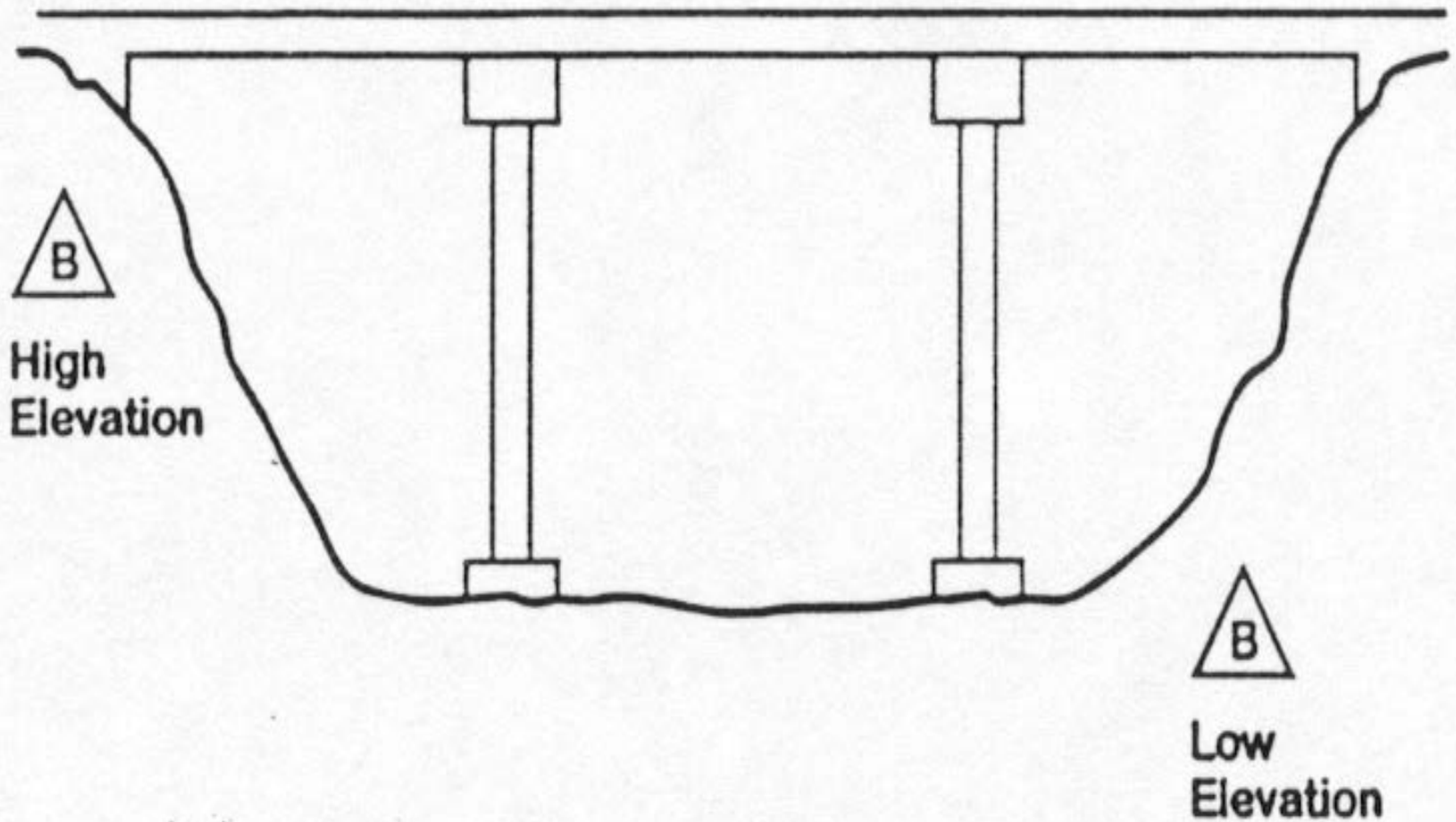


Fig. 2.10 – Bridge Benchmark Locations

BENCHMARK



FORE SIGHT

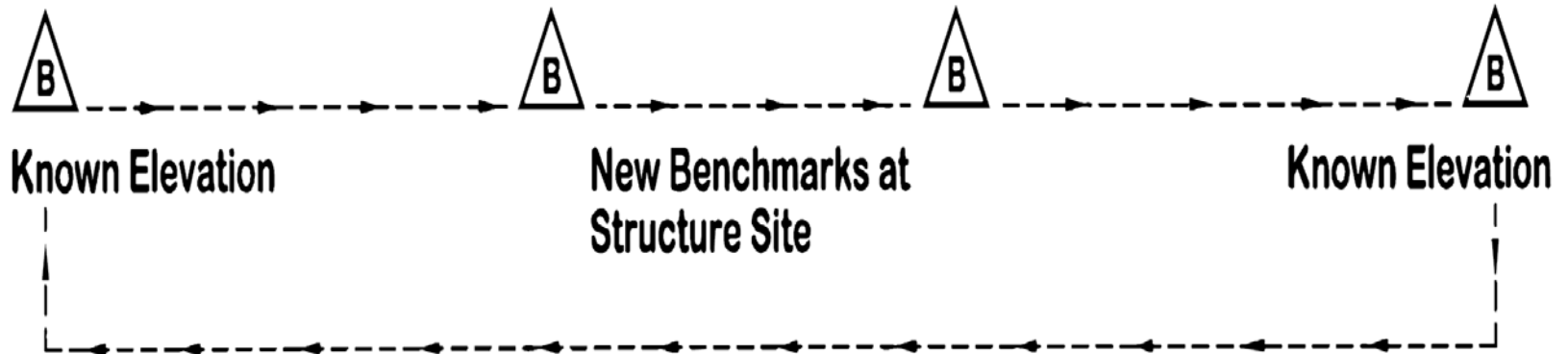


CHECKING/TYING BENCHMARKS

Page 2-18, Fig 2.11

Figure 2.11 Checking/Tying Benchmarks

Carry Elevations Through to Insure Accuracy



Common Staking Errors

- NOT Verifying benchmarks set before use
- Turning wrong skew angle
- Errors in measuring distances, lengths
- Using wrong working points and lines
- Centerline of bridge is not always centerline of road
- Never assume stakes or benchmarks haven't been moved
- Not tying into a 2nd BM when checking/setting elevations.

Contractor's Responsibilities

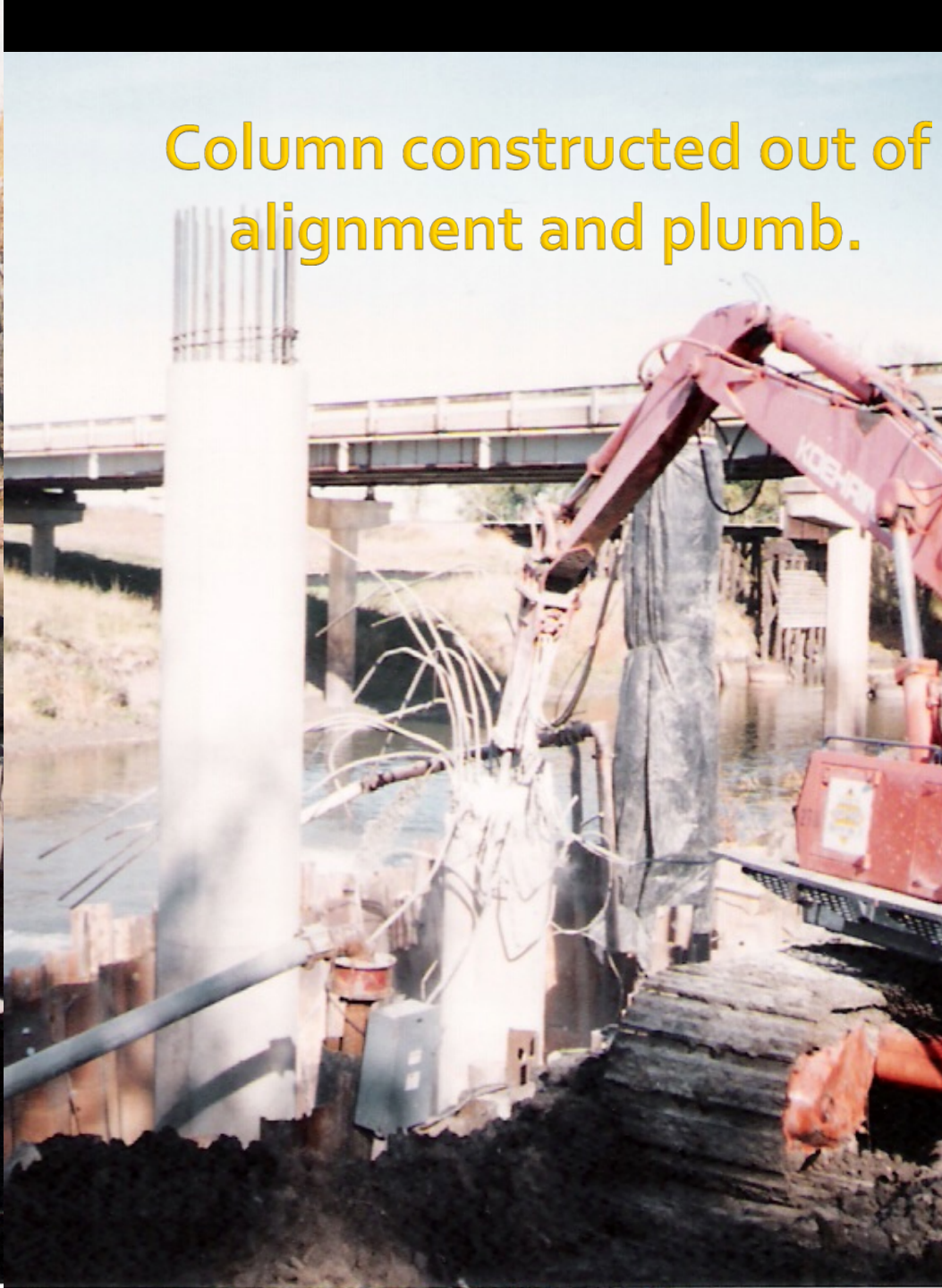
- Contractor's responsibility to provide all other stakes required to successfully complete the construction of bridge or box culvert
- Department does initial staking of abutments and box culvert centerlines
- Should always be checking each other

Check!, Check!, Check!, Check!

- Check Contractor Staking
 - Equipment Problems
 - Contractor misread plans
 - Reference Points disturbed
- Verify Grades
 - Damaged Equipment
 - Misread level road
 - Calculation errors
 - Numbers transposed incorrectly in field book
 - Etc.







Column constructed out of alignment and plumb.



BREAKTIME: 10 MINUTES!!