


10: <b>SUPERSEDED BY EI 97-006          EFFECTIVE 9/25/97</b>	<b>ENGINEERING INSTRUCTION</b> NEW YORK STATE DEPARTMENT OF TRANSPORTATION
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<b>APPROVED:</b>  <u>ARUN M. SHIRGALE, Deputy Chief Engineer (Structures)</u>	<b>Date:</b> <u>3/4/92</u> <b>Supersedes:</b>

An initiative was recently undertaken by the Structures Division to investigate the longitudinal cracking in the concrete decks on adjacent beam - prestressed concrete structures. This cracking, observed during field inspection by Regional and Division personnel, occurs relatively early in the life of the structure and is located in the concrete deck directly over the shear key joints between the beams.

To identify the severity of the problem, a Statewide (Regional) Performance Survey of prestressed concrete structures with shear keys was conducted in December 1990, by the Engineering Research And Development Bureau. 219 structures, constructed from 1985 to 1990, were selected from the Bridge Inventory Computer Data Base for this survey.

The results of this survey are as follows: 101 structures exhibited significant longitudinal cracking in the concrete decks; 86 structures exhibited no deck cracking; 32 structures not accessible for inspection. The longitudinal cracking is located directly above the Shear Key Joints of the beams. The crack length typically extended from end-to-end of beam. The width of crack ranged from 1/32 to 1/16 inch. The number of longitudinal cracks reported were 1 to 4 per structure. The cracks were commonly associated with the crown line but were noted at virtually any longitudinal joint in the cross-section. Water leakage was observed through the shear key joints on 20 of these structures.

The concrete decks of 12 State-owned structures in Region One, greater than 5 years old, were also inspected. Of these decks, 11 exhibited longitudinal deck cracking over the shear key joints, and in 6 of these decks, significant water leakage was observed through these joints. In addition, the inspection included the concrete deck of a 15 year old structure, located on a heavily traveled State Route. This deck exhibited longitudinal cracking over all of the shear key joints and significant deck spalling and water leakage along a portion of these cracks.

We conclude from these surveys, and based on consultation with the Materials Bureau, that cracking occurs over the shear key joints soon after placement of the concrete deck on a majority of these structures and that leakage through these cracks leads to significant deterioration of the structure with time. Based on the field inspection and subsequent model analysis, we believe that the deck cracking resulted from differential rotation of the beams caused by the application of the tendon forces and/or transverse liveload placed near the edge of the beams. This rotation is not restrained by the current shear key configuration. The placement and number of tendons may also contribute to the cracking if they are not adequate to make the entire transverse section act as a "homogeneous" mass.

**Subject:** MODIFICATIONS OF THE CURRENT SHEAR KEY AND TENDON SYSTEM  
FOR ADJACENT BEAM PRESTRESSED CONCRETE STRUCTURES.

The following revisions modify the current shear key and tendon details and shall be incorporated into all adjacent Beam Prestressed Concrete Structures:

- 1.) The current shear key depth be increased. See Attachment No. 1.
- 2.) The number of tendons be increased and placed as follows: (See Attachment Nos. 2, 3, and 4)
  - A.) for span lengths less than 50', 1 tendon placed at the centerline of span, and 1 tendon placed at each end (approximately 2' from Centerline of Bearings) - three tendons total for spans less than 50'.
  - B.) for all spans greater than or equal to 50', 1 tendon placed at the centerline of span, 1 tendon placed at each quarter point, 1 tendon placed at each end (approximately 2' from Centerline of Bearings) - five tendons total for span lengths greater than or equal to 50'.

The post-tensioning force in each tendon shall remain at 30,000 lbs.

Note: The State of Michigan is currently using - with excellent results, a concept similar to the proposed shear key - tendon tie system presented above.

The above revisions to the shear key and increased frequency of tendon locations will reduce and possibly eliminate the longitudinal deck cracking and leakage associated with the current shear key, and ultimately increase the durability of the concrete deck and entire superstructure. The performance of this system will be monitored, and, if needed, future modification will be issued.

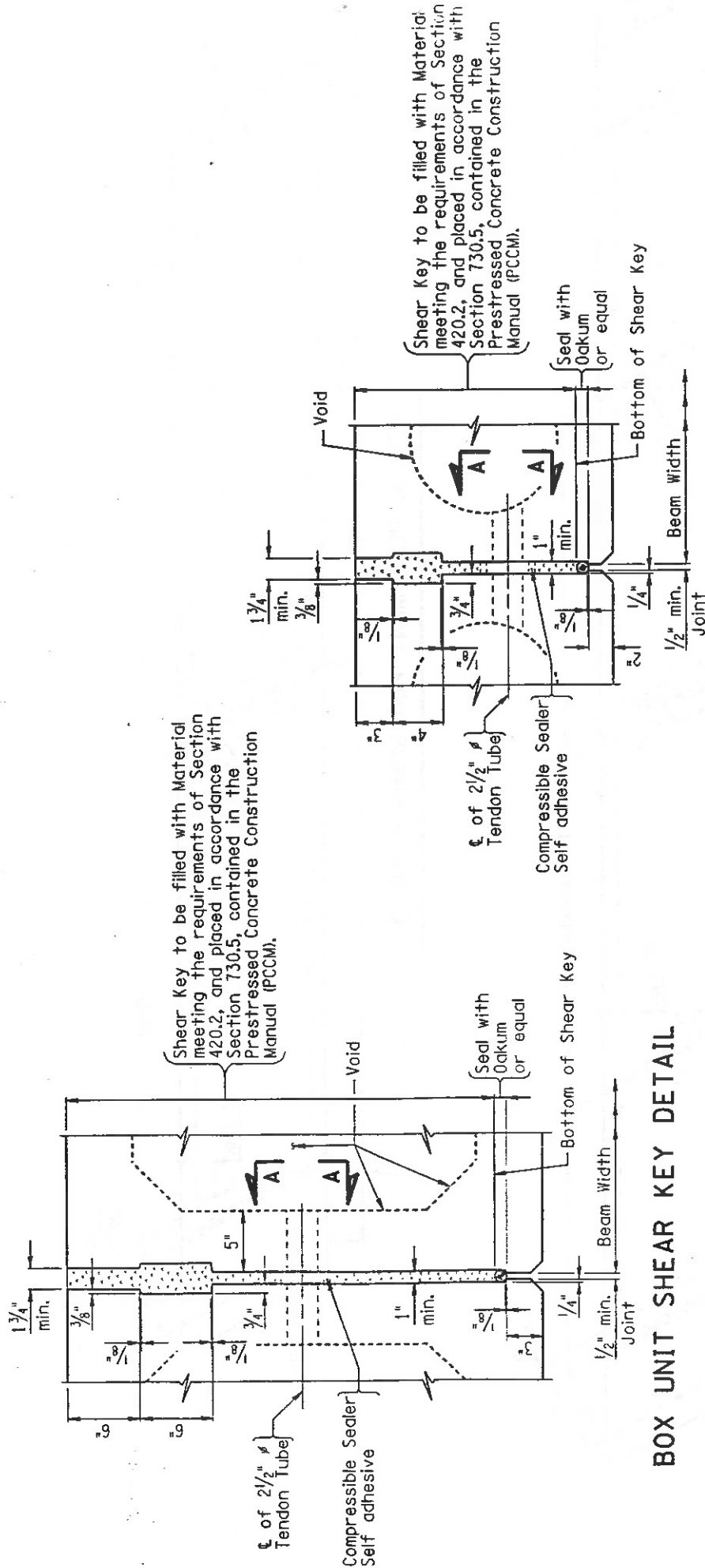
The additional cost associated with the increased shear key depth, based on two recently completed pilot projects using the proposed shear key is minimal, one-half of one percent (0.5%) of the total structure cost. The cost of additional tendons according to various Contractors would also be minimal.

This Engineering Instruction revises the following reference material: Standard Specifications for Highway Bridges, Standard Details for Highway Bridges, Prestressed Concrete Construction Manual, and the applicable Prestressed Concrete Guideline Drawings.

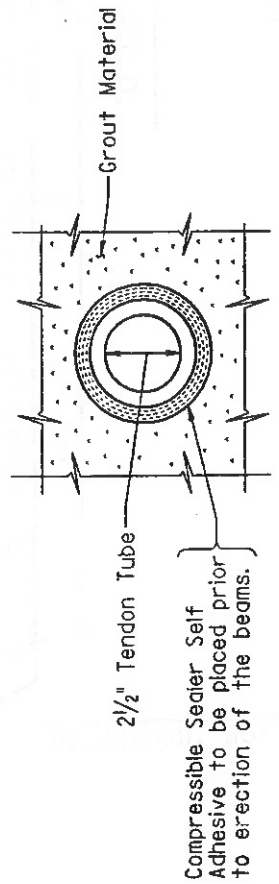
Questions regarding this E.I. may be directed to the Structures Division, Main Office at (518) 457-4534.

This Engineering Instruction is approved for immediate use. All Contracts Let on or after May 28, 1992 (PS&E March 5, 1992) shall comply with the requirements of this E.I.

NAP:GD  
17.19  
Attachments



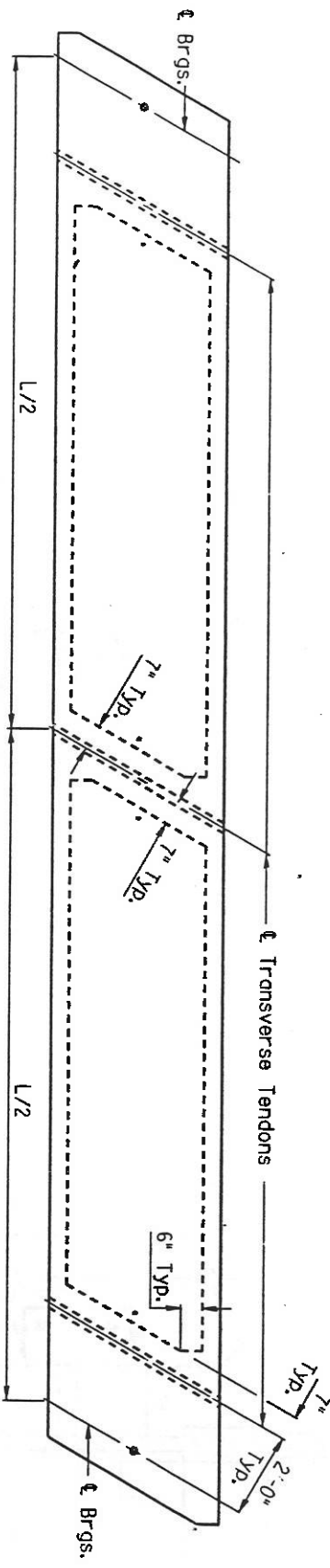
BOX UNIT SHEAR KEY DETAIL



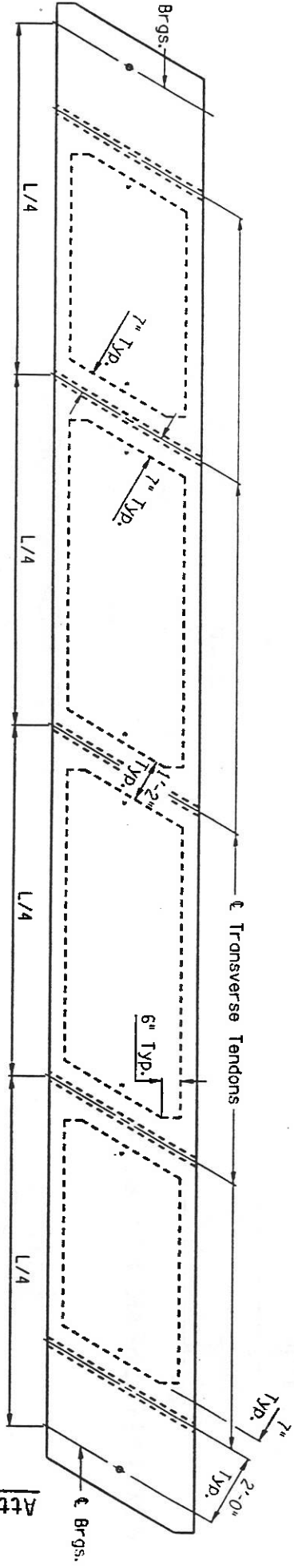
SLAB UNIT SHEAR KEY DETAIL

Details shown-NOT TO SCALE

SECTION A-A

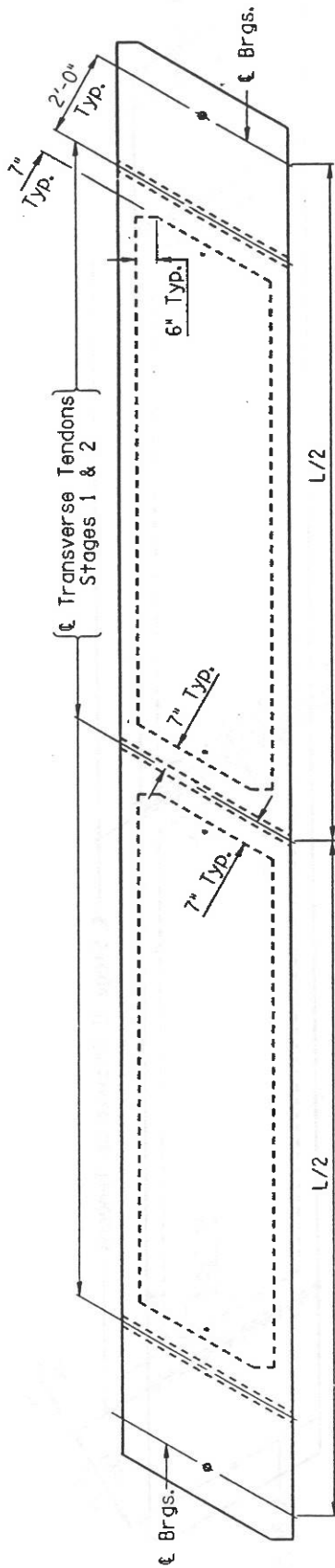


TENDON PLACEMENT FOR SPANS < 50'-0"

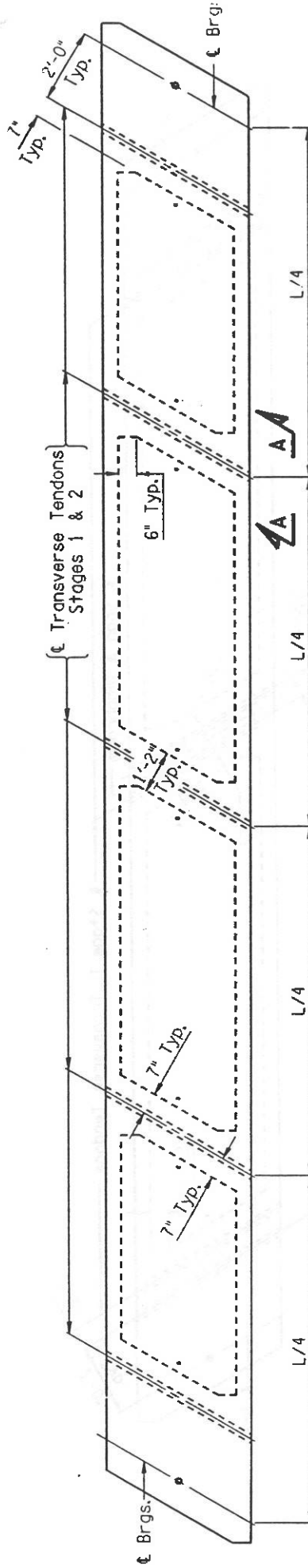


TENDON PLACEMENT FOR SPANS > 50'-0"

NO STAGE CONSTRUCTION

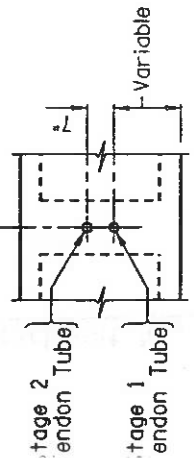


TENDON PLACEMENT FOR SPANS < 50'-0"



TENDON PLACEMENT FOR SPANS ≥ 50'-0"

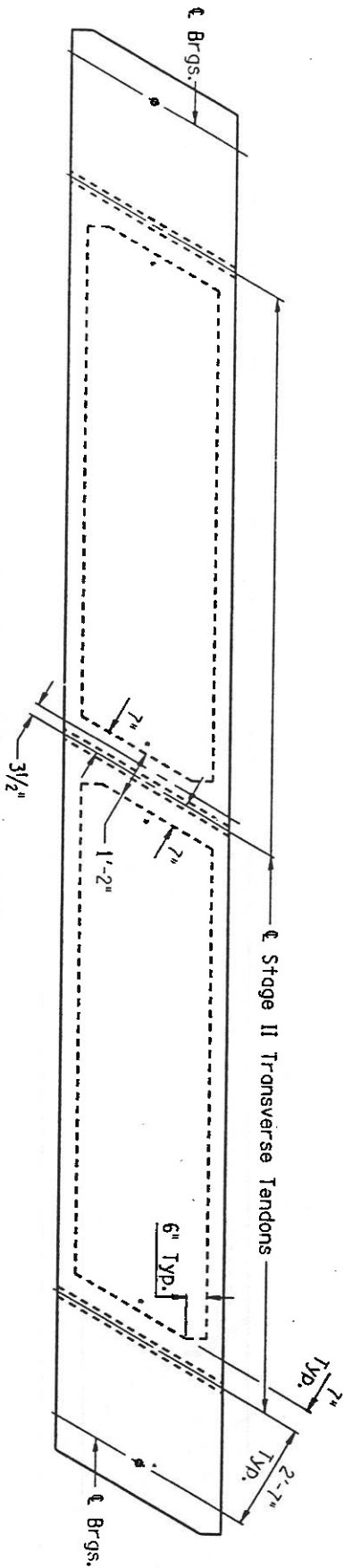
Transverse Tendons



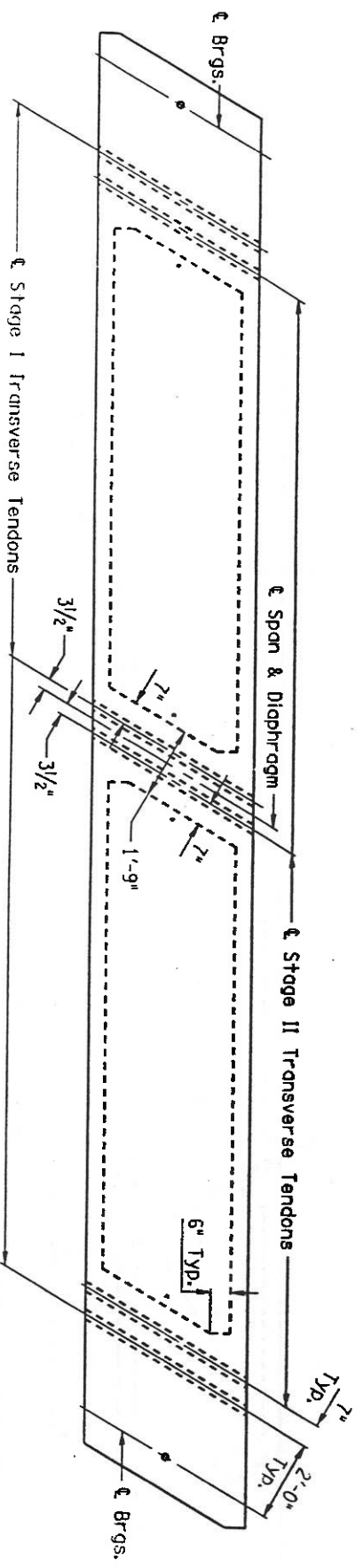
SECTION A-A (TYP.)

STAGE CONSTRUCTION (OPTION 1)

Note: Two Stage construction shown.



STAGE II CONSTRUCTION  
TENDON PLACEMENT FOR SPANS < 50'-0"



STAGE I CONSTRUCTION  
TENDON PLACEMENT FOR SPANS < 50'-0"

Note: Two Stage construction shown.

STAGE CONSTRUCTION (OPTION 2)

For Spans > 50'-0", Add quarter point tendons