SUPERSEDED BY EB 99-024 EFFECTIVE 3/16/99		*New York State Department of Transportation* **ENGINEERING INSTRUCTION**	**EI** **96-035**

Title: Bridge Detail (BD) Sheets IA1 thru IA3, Integral Abutments

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Issuances Affected

This EI supersedes Section 4.18 on Integral Abutments in the Standard Details for Highway Bridges. The material contained in this EI will eventually be incorporated in the Bridge Manual, now under preparation.

Purpose

This Engineering Instruction transmits standard details to be used in the preparation of contract plans for bridges with integral abutments. It also provides guidance for the design of these abutments.

Background

Integral abutments are abutments that are constructed integrally with the deck and primary members of the superstructure. There is no deck expansion joint at the abutment. The abutment is supported on a single row of piles that permit longitudinal movement of the superstructure and rotational movement at the bottom of the abutment stem.

Integral abutments are considerably less expensive to construct than conventional abutments. An important advantage that integral abutments have over conventional abutments is the elimination of the bridge deck expansion joint system. This eliminates the costs associated with the initial installation and continuous maintenance of the joints. Deterioration of the substructure and superstructure caused by a leaking expansion joint is also eliminated.

CRITERIA FOR USE

Hydraulics:

The use of integral abutments in areas where scour is a possibility has been a topic of numerous discussions. Structures subject to reduced freeboard or pressure flow will be subjected to a greater scour potential than structures whose abutments are consistently above Design High Water. Integral Abutments provide fixity between the superstructure and substructure, and provide greater protection against translation and uplift than conventional abutments. The Department does not feel that the integrity of the integral abutment is any more in jeopardy than a conventional abutment when subjected to scour. There is, however, some concern for the integrity of the approach.

To address this concern, certain criteria have been adopted that should be reviewed and evaluated prior to the use of this type of structure where scour potential exists.

1. Stream Velocity:

   For streams with velocities in excess of 1.8 m/s, a visual investigation to assess scour damage and potential at the site should be made. Any history of erosion or scour at the bridge site should be reviewed and a determination made if the new structure will alleviate any problems (alignment, restricted opening etc.) that may contribute to scour.

2. Bank Protection:

   Heavy stone fill is required to provide protection against scour. On all bridges, geotextile bedding shall be used against the front face of the abutment, under the stone fill and down the slope a minimum of 2 m. When required by the Foundation Design Report, the entire slope under the heavy stone fill will be covered by the geotextile bedding.

Skew Angle:

30° maximum for all spans.

Length:

The movement associated with integral abutment design can be largely associated with thermal expansion and contraction of the superstructure. By N.Y.S. definition, the length of an integral abutment structure shall be equal to the abutment center line of bearing to abutment center line of bearing dimension. This also applies to continuous span structures with expansion bearings at the piers. This length of expansion mobilizes the horizontal passive soil pressure.

A bearing at a pier of an integral abutment structure should only be fixed when the length of expansion from the bearing to both abutments is equal. All other cases should use expansion bearings.

1. For bridge lengths 50 m or less, no provision for expansion at the ends of approach slabs will be required unless the highway pavement is rigid concrete.

2. For bridge lengths over 50 m and up to 100 m, provisions shall be made for expansion at the end of each approach slab.

3. For bridge lengths over 100 m and up to 140 m, integral abutments shall be approved by the DCES, on an individual basis. Provision for expansion shall be made at the end of each approach slab.

4. For bridge lengths over 140 m, integral abutments are not recommended at this time.

Expansion Provision:

The purpose of an expansion joint at the end of the approach slab is to prevent stresses building up in the structure due to its restricted movement. The joint should open and close due to thermal expansion and contraction. The longer the span, the greater the opening and closing. When expansion joints are used with asphalt highway pavement, a short sleeper slab with a reinforced concrete end dam section shall be provided. For bridge lengths over 50 m and up to 65 m, the expansion joint at the end dam shall use a silicone sealant. For bridge lengths over 65 m, an armored joint system with a compression seal shall be used at the end dam. For rigid concrete highway pavements, the conventional pressure relief joint on a separate flat sleeper slab shall be used for all bridge lengths.

Approach Slab:

Approach slabs will always be required for integral abutments. Their lengths shall vary from a minimum of 3 m to a maximum of 6 m, based on the intercept of a 1 on 1.5 line from the bottom of the abutment excavation to the top of the highway pavement. This length is measured along the centerline of roadway. Approach slabs used on structures with stage construction shall be a minimum length of 4.5 m to facilitate construction.

The end of the approach slab shall be parallel to the skew. A width from face of rail to face of rail is recommended. Special provisions shall be made to allow free movement of the approach slabs if curbs or safety shape are present. Approach slabs shall always be a separate pour from the superstructure slab.

Foundation Type:

All integral abutments shall be supported on a single row of piles. Cast-in-place (C.I.P.) or steel H piles may be used for structures with span lengths of 50 m or less. Only steel H piles should be used for structures with span lengths over 50 m. When steel H piles are used, the web of the piles shall be perpendicular to the centerline of the beams regardless of the skew, so that bending takes place about the weak axis of the pile.

To handle expansion, for bridge lengths of 30 m or more, each pile at each abutment shall be inserted into a pre-excavated hole that extends 2.5 m below the bottom of the stem. The cost of pre-excavating these holes, casings and cushion sand shall be included in the Unit Price Bid for the pile item. All details and notes required by the FDR shall be placed on the plans. For bridge lengths under 30 m, no special provisions are required for expansion purposes.

If CIP Piles are used, they must be pipe casings conforming to ASTM A252, Grade 2 with a minimum wall thickness of 6 mm. This shall be noted on the plans.

All piles shall be driven to minimum penetration of 6 m. This is to avoid a stilt type effect, provide for scour protection and to provide sufficient lateral support to the pile particularly since the top 2.5 m may be excavated and backfilled with cushion sand.

A pile bent configuration will be used for the integral abutment detail. For steel superstructure bridges, a minimum of one pile per girder shall be used. Steel superstructures shall have their girders directly attached to the piles through the use of welded load plates as shown on BD-IA3.

Abutment:

A minimum width of 900 mm for steel superstructures and 1125 mm for prestressed concrete superstructures shall be required. Wingwalls may be tapered to a minimum of 450 mm at their ends to reduce vertical dead load, if pile spacing and edge distances permit. The abutments shall be parallel to each other.

Wingwall Configuration:

In-Line wingwalls cantilevered off the abutment are the preferred arrangement. Flared walls cantilevered off of the abutment may be considered by the designer on a case by case basis. The use of flared wingwalls should generally only be considered at stream crossings where the alignment and velocity of the stream would make an in-line wall vulnerable to scour. Piles shall not be placed under any flared walls that are integral with the abutment stem. Generally, the controlling design parameter is the horizontal bending in the wingwall at the fascia stringer caused by the large passive pressure behind the wingwalls. Wingwall lengths in excess of 4 m should be avoided. The 4 m dimension is measured parallel to the centerline of bearings for in-line walls.

Wingwalls in excess of 4 m should be supported on their own foundation independent of the integral abutment system. In this case, a flexible joint must be provided between the wingwalls and the backwall as shown on BD-IA2.

U-walls cantilevered off the abutment stem shall be allowed only if in-line or flared walls cannot be used because of right-of-way or wetlands encroachment. The U-walls shall not measure more than 2 m from the rear face of the abutment stem. No piles shall be placed under the U-walls. This would inhibit the abutments ability to translate and would cause internal stresses.

The distance between the approach slab and the rear face of the U-wall should preferably be a minimum of 1.2 m. If the approach slab must extend to the U-wall, they shall be separated by a 50 mm joint filled with Premoulded Resilient Joint Filler, material subsection 705-07.

Superstructure Type:

Steel or prestressed concrete superstructures may be used, however, because of past performance considerations, preference to a steel superstructure shall be given when site conditions make this possible. All beams shall be parallel to each other.

Horizontal Alignment:

Only straight beams will be allowed. Structures on curved alignments will be allowed provided the beams are straight.

Grade:

The maximum grade between abutments shall be 5%.

Stage Construction:

Stage Construction is allowed.

DESIGN PROCEDURE GUIDELINES

1. The superstructure is designed in the normal manner assuming simple supports at the abutments. Any fixity developed as a result of connection details at the abutments shall not be considered.

2. Abutments shall be designed for passive pressure developed against the back of stem and wingwalls. Passive pressure values will be provided in the "Foundation Design Report."

3. Horizontal reinforcement in the abutment stem shall be designed by considering the stem to be continuous between piles. The horizontal reinforcement in the front face of the stem should be designed to withstand the positive moments between the beams caused by passive soil pressure. The horizontal reinforcement in the rear face should be designed to withstand the negative moments at the beams caused by passive soil pressure. Vertical steel in the stem is usually controlled by shear considerations. If the ratio of the abutment stem depth to the spacing between the pile supports is 1:1 or greater, deep beam considerations should be included in the design.

4. Wingwalls integral with the abutment stem shall be designed as cantilevers from the outer pile and/or the fascia girder. Wingwalls separate from the main abutment stem shall be designed separately.

5. Piles shall be designed for normal vertical loads ignoring any fixity developed between the superstructure and the pile top.

6. Pile Loads can be determined by assuming the uniform distribution to each pile of the vertical reaction from the superstructure and the dead load of the abutment.

CONTACT PERSON:

Questions concerning this EI should be directed to Arthur Yannotti of the Structures Division's Design Standards Unit at 518-485-1148.

EFFECTIVE DATE:

This EI will be effective with the letting of 1/9/97.