



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 19-10

September 5, 2019

TO: All Design, Operations, and District Personnel, and Consultants

FROM: /s/ Elizabeth W. Phillips
Elizabeth W. Phillips
Director, Standards and Policy

SUBJECT: Terminal Joints

REVISES: *Indiana Design Manual (IDM) Sections 17-5.09(01), 402-7.02(03) and 409-2.04*

EFFECTIVE: Lettings on or after March 1, 2020

Background

The poor performance of terminal joints continues to be a challenge for INDOT. The practice of providing jointless bridges (integral and semi-integral end bents) addresses deterioration commonly associated with water infiltration at expansion joints. However, integral and semi-integral end bents transfer more of the thermal movement from the bridge to the approach slab (RCBA)/approach pavement interface. This has intensified deterioration of both the HMA in terminal joint and HMA approach pavement without terminal joints, resulting in an increase in repair work by INDOT Maintenance personnel.

Resolution

Revisions to *Standard Specifications* Section 503, PCCP Joints and INDOT *Standard Drawings* series 503-BATJ, Terminal Joints have been approved by the Standards Committee. Contracts let on or after March 1, 2020 that include a terminal joint should include RSP 503-R-692 and RPD 503-R-692d. Note that the design practice has changed. A terminal joint may be required when there is HMA pavement on the approach. See the Design Changes section below.

The referenced *Indiana Design Manual* (IDM) sections have been revised to include additional information on the revised terminal joint details and their application. A summary of changes and IDM revisions are included for reference. IDM revisions will be incorporated into the IDM on-line at a later date.

Questions regarding project-specific terminal joint applications should be discussed with the Pavement Engineering Division, Nick Cosenza at ncosenza@indot.in.gov.

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Summary of Changes

- Pre-compressed foam joint (RSP 724-B-309) replaces 2-ft wide HMA section.
- Consistent subbase and subgrade treatment under RCBA, sleeper slab, and approach pavement.
- Separate details for HMA approach pavement and PCCP approach pavement.
 - HMA approach details use a concrete lug.
 - PCCP approach details use a series of jointed reinforced concrete pavement sections.

Pay Items

Pay Item	Pay Item Description	Unit	Notes
503-12477	TERMINAL JOINT, TYPE HMA	LFT	
503-12478	TERMINAL JOINT, TYPE PCCP	LFT	
503-12475	JCRP, 10" THICKNESS	SYS	Type PCCP only
503-12476	JCRP, 12" THICKNESS	SYS	Type PCCP only
503-12505	JCRP, 14" THICKNESS	SYS	Type PCCP only
503-12479	EXPANSION JOINT WITH LOAD TRANSFER	LFT	Type PCCP only
724-12103	PRECOMPRESSED FOAM JOINT	LFT	

For Type HMA, the 30-ft section of HMA pavement is not included in the LFT terminal joint pay item. It will be paid for separately, either as HMA for Patching, Type__ or, where the approach roadway work consists of full depth reconstruction, as part of the full depth pavement.

Design Changes

A terminal joint is required where there is PCCP pavement on the approach.

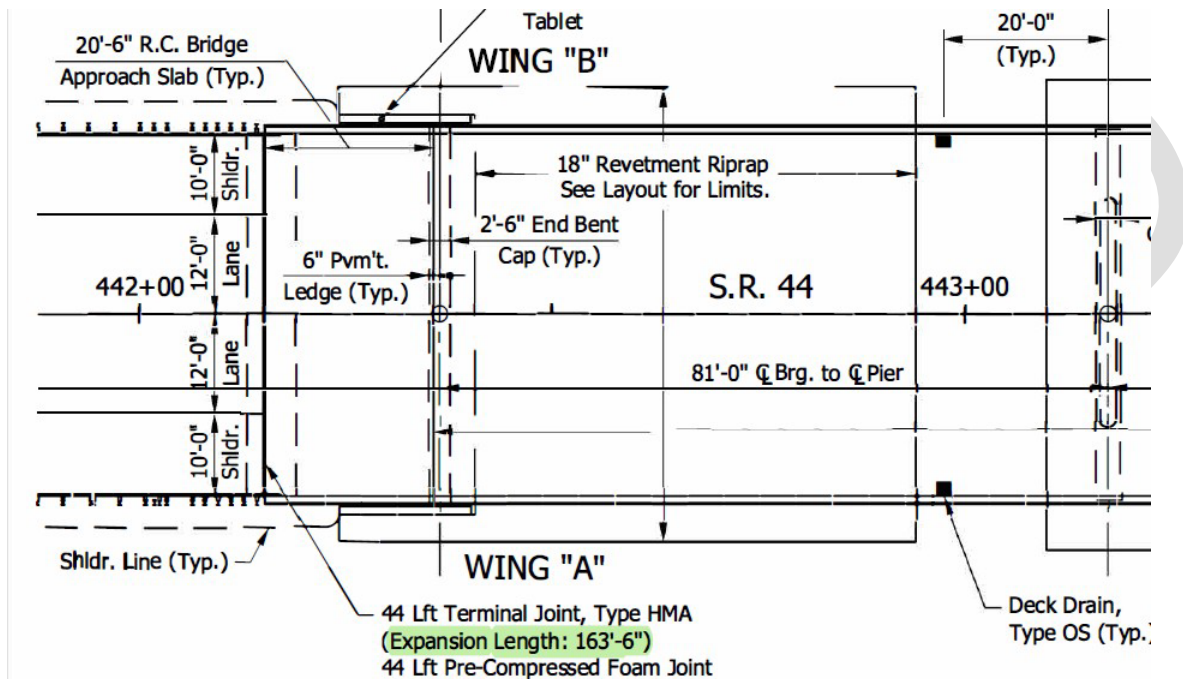
A terminal joint is required where there is HMA pavement on the approach when the following exist

- The bridge has an integral or semi-integral end bent, and
- The bridge expansion > 1/4 in. but not greater than 4 in. 1/4 in. expansion approximately equates to an expansion length equal to 100 ft for concrete and 50 ft for steel.
 - Expansion < 1/4 in. does not require a terminal joint
 - Expansion > 4 in. cannot be accommodated by the terminal joint. A special detail is required.

RCBA details have been revised for consistency with the subgrade and subbase changes associated with the terminal joint. See RSP 609-B-310 and RPD 609-B-310d.

Expansion Length Plan Requirements

Expansion lengths are measured from fixed support to bridge end adjacent to terminal joint and should be shown in plans as shown highlighted below.



IDM Revisions

[Quantities]

17-5.09 Reinforced Concrete Bridge Approach (RCBA) [Rev. July 2012, Apr. 2016, Sep. 2019]

17-5.09(01) Miscellaneous Requirements [Rev. July 2012, Apr. 2016, Sep. 2019]

The designer should provide complete RCBA details on the bridge plans.

1. Dimensions. The RCBA length, width, skew, thickness, and bill of materials should be determined and shown on the plans. The length and width should be also shown on the General Plan sheet. INDOT *Standard Drawings* Series E 609-RCBA contains information on the spacing of reinforcement and connection to the bridge deck. The *Standard Drawings* are intended for new construction. The RCBA width should equal the bridge clear-roadway width and RCBA extensions utilized as needed.

2. Anchoring. The RCBA should be anchored to the end of the superstructure where integral end bent construction is used. Where a bridge deck expansion joint is used at the end of the superstructure, an alternate anchoring detail should be utilized.
3. Polyethylene Fabric. Two layers of polyethylene fabric, each of minimum thickness 0.02 in., should be placed between the RCBA and the dense-graded subbase where the RCBA is anchored to the superstructure.
4. Terminal Joint. The need for a terminal joint considers the type of end bent, expansion length, and type of approach pavement. See Section 409-2.04(01) for terminal joint criteria. See RPD 503-R-692d for terminal joint details until such time as the detail are incorporated into INDOT *Standard Drawings* Series E 503-BATJ. Separate details have been created for HMA and PCCP approach pavement types.
 - a. Terminal Joint, Type HMA, requires 30 feet of a thickened full depth HMA pavement. The pavement section will be provided in the approved pavement design should be shown on the plans. The need for a terminal joint should be noted in the pavement design request. In general, where the roadway work consists of full depth reconstruction, the HMA base layer can be increased as needed to obtain the thickness shown in the notes on the drawing. Where there is only HMA overlay and transition milling, then HMA for Patching, Type__ (based on roadway traffic) will be used. See IDM Figure 304-15B. The pre-compressed foam joint is paid for by the linear foot.
 - b. Terminal Joint, Type PCCP requires a series of jointed reinforced concrete pavement (JRCP) sections. The JRCP is paid for by the square yard for the thickness required. Reinforcing bars are included in the cost of JCRP. The pre-compressed foam joint, D-1 contraction joint and the expansion joint with load transfer are paid for by the linear foot.

[Structure Size and Type]

402-7.02(03) Integral End Bent [Rev. Sep 2019]

The integral end bent eliminates the deck joint between the superstructure and the end bent by the structural integration of the two. The vertical dimension of the cap beam can be minimized as the mudwall becomes a composite part thereof.

Components of the deep foundation should be flexible to accommodate the longitudinal movement of the pile bent. Such flexibility can be provided with steel H-piles or steel-encased-concrete piles.

The reinforced concrete bridge approach (RCBA) should be attached to the end bent. The longitudinal bridge movements should be accommodated at the outer end of the RCBA by using a terminal joint. See Section 409-2.04(01) for terminal joint criteria.

The *LRFD Specifications* encourages minimizing the number of deck joints. This end-bent type satisfies that requirement. If the superstructure is fully continuous, no deck joints remain.

[Abutment, Bent, Pier, and Bearing]

409-2.04(01) General Requirements [Rev. Oct. 2012, Apr. 2016, May 2019, Sep. 2019]

The following requirements must be satisfied.

1. Backfill. Each integral end bent for a beam- or girder-type superstructure should be backfilled with aggregate for end bent backfill. Each end bent for a reinforced concrete slab bridge should be backfilled with removable flowable backfill. The INDOT *Standard Drawings* series E 211-BFIL provides backfill details for both concrete slab, beam, and girder structures.
2. Reinforced Concrete Bridge Approach (RCBA). A reinforced concrete bridge approach is utilized to span over the backfill placed behind a newly constructed end bent or mudwall. The RCBA should be anchored to the end bent with epoxy coated #5 threaded tie bar assemblies, spaced at 2'-0" centers. Two layers of polyethylene sheeting is placed between the reinforced-concrete bridge approach and the subgrade. INDOT *Standard Drawings* series E 609-RBCA provides additional details.

Where an expansion joint or mudwall is used, the threaded tie bar anchoring system may not be practical and an alternate connection may be considered.

3. Terminal Joint. A terminal joint is placed at the end of the RCBA to absorb the thermal expansion of the bridge and transfer the load from the approach pavement to the RCBA. See *Standard Drawing* series E 503-BATJ for terminal joint details.

The application of the terminal joint details as follows. The approach pavement is based on pavement visible on the surface, except HMA over CRCP.

The Bridge has an...	Approach Pavement is...	Terminal Joint Requirement
integral or semi integral end bent AND expansion $\leq 1/4$ in. * * $\leq 1/4$ in. expansion approximately equates to an expansion length ≤ 100 ft for concrete and ≤ 50 ft for steel.	HMA	Not Required
	PCCP	Terminal Joint, Type PCCP
integral or semi integral end bent AND has an expansion length > 100 ft ≤ 400 . (concrete) or expansion length > 50 ft ≤ 400 . (steel)	HMA	Terminal Joint, Type HMA
	PCCP	Terminal Joint, Type PCCP
integral or semi integral end bent AND has an expansion length > 400 ft.	HMA or PCCP	Special Detail Required
integral or semi integral end bent AND any expansion length	CRCP or HMA over CRCP	Special Detail Required

A steel finger plate expansion joint is required for an integral structure with an expansion length greater than 400 ft. The steel finger plate details should be designed in accordance with the *LRFD* and a sleeper slab should be incorporated.