Performance and Design of Bridge Approach Panels in Wisconsin

Brent Phares, Ph.D., P.E.
Justin Dahlberg, P.E.

Bridge Engineering Center
Iowa State University

WisDOT ID no. 0092-14-04
February 2015

Research & Library Unit

Wisconsin Highway Research Program

WISCONSIN DOT
PUTTING RESEARCH TO WORK

DISCLAIMER

This research was funded through the Wisconsin Highway Research Program by the Wisconsin Department of Transportation and the Federal Highway Administration under Project 0092-14-04. The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views of the Wisconsin Department of Transportation or the Federal Highway Administration at the time of publication.

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof. This report does not constitute a standard, specification or regulation.

The United States Government does not endorse products or manufacturers. Trade and manufacturers' names appear in this report only because they are considered essential to the object of the document.

Technical Report Documentation Page

1. Report No.	2. Government Accession No	3. Recipient's Catalog No
0092-14-04		

4. Title and Subtitle	5. Report Date
Performance and Design of Bridge Approach Panels in Wisconsin	February 2015
	6. Performing Organization Code
7. Authors	**8. Performing Organization Report No.**
Brent Phares and Justin Dahlberg	
9. Performing Organization Name and Address	**10. Work Unit No. (TRAIS)**
Bridge Engineering Center – Iowa State University 2711 S. Loop Dr. Ste. 4700 Ames, IA 50010	11. Contract or Grant No. WisDOT SPR# 0092-14-04
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered**
Wisconsin Department of Transportation Research & Library Unit 4802 Sheboygan Ave. Rm 104 Madison, WI 53707	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Within the recent past, the Wisconsin DOT changed the bridge approach slab design from a system using only one expansion joint to a system using three expansion joints. This change was due primarily to the need to accommodate differential expansion and contraction between the approach pavement and the bridge. Since implementing the new design detail, the Wisconsin DOT has become aware of the detail's difficulty of constructability. As such, a more easily constructed, new standard design with one expansion joint and a sleeper slab was created and has been used more recently. When compared, the designs vary in many ways, and accordingly the question of suitability arises: are three expansion joints needed or is one enough to provide the stress relief and desired performance?

The project objectives were to:

- Review and analyze current approach slab performance
- Review and analyze other states' practices with respect to approach slabs
- Determine what other currently adopted approach slab designs may be applicable to Wisconsin
- Determine if there is a problem with current approach slab performance and, if so, will new designs improve performance
- Determine if three expansion joints are needed to provide thermal expansion/contraction relief or if one joint will be sufficient
- Improve the constructability and performance of approach slabs

As a result of this work, several conclusions and recommendations were made. Generally, these could be grouped into two categories: approach details and backfill/approach support.

17. Key Words	18. Distribution Statement
Bridge approach,	No restriction. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield VA 22161

18. Security Classif.(of this report)	19. Security Classif. (of this page)	20. No. of Pages	21. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Acknowledgements

Thank you to the following sponsors and project participants for their input into the development of this document.

Primary Lead Authors

Justin Dahlberg, Iowa State University, Bridge Engineering Center
Brent Phares, Iowa State University, Bridge Engineering Center
Pavana Vennapusa, Iowa State University Dept. of Civil, Construction, and Environmental Engineering

Funding Sponsors

Wisconsin Highway Research Program, Contract 0092-14-04

Project Team:

Iowa State University Bridge Engineering Center

Project Leaders:

Brent Phares, Iowa State University Bridge Engineering Center
Justin Dahlberg, Iowa State University Bridge Engineering Center
Pavana Vennapusa, Iowa State University Dept. of Civil, Construction, and Environmental Engineering

Committee Members:

Barry Paye, WisDOT Bureau of Technical Services – Materials Lab Supervisor
Aaron Bonk, WisDOT Bureau of Structures – Structures Design Supervisor
Angela Pakes Ahlman, WHRP
Kevin McMullen, Wisconsin Concrete Pavement Association
Ali Soleiman, University of Wisconsin-Platteville
Anthony Allard, WisDOT Northeast Region
Andrea Breen, Lafarge North America Cement
Sam Owusu-Abibio, University of Wisconsin-Platteville
James Schmitt, Schmitt Technical Services
Joe Matchey, Trierweiler Construction
Khaled Al Akhras, Federal Highway Administration
Kimberley Dinkins, WisDOT
Konstantin Sobolev, University of Wisconsin-Milwaukee
David Kopacz, Federal Highway Administration
Keith Lundin, WisDOT
Jed Peters, WisDOT
Steve Cramer, University of Wisconsin-Madison
Tim Bolwerk, OMNNI Associates
Tuncer Edil, University of Wisconsin-Madison

Table of Contents

Table of Figures

Table of Tables

Executive Summary

It is widely recognized that approach slabs/panels play a critical role in the highway system. These panels must provide a smooth transition from mainline pavements to bridges. Beyond being responsible for the majority of roughness typically associated with bridges, these panels must be able to effectively accommodate thermal expansion and contraction of both the bridge and the mainline pavement. Improperly designed/constructed approach panels tend to lead to the formation of a bump at the end of the bridge. The bump is not generally a significant safety problem; rather it can be an expensive maintenance issue. It is very common to attach the approach slab to the bridge via a reinforcing bar extending from the paving notch. By attaching the approach slab to the bridge, one is able to move an expansion joint away from the critical area at the abutment; this promotes drainage of roadway water away from the bridge area. However, one detail that is critical to the long-term, effective performance of approach slabs is that they must allow for free and full expansion and contraction of the surrounding elements. In general, this is accomplished by detailing one or more expansion joints.

Of particular interest to this project was an evaluation of the approach panel details currently in service on Wisconsin highways. Two details, different in numerous ways, have been most commonly used in the State and an assessment of their performance is key to the state of practice moving forward.

To achieve the project goals, the following general tasks were performed:

- Review and analysis of current approach slab performance
- Review and analysis of the national state of the practice with respect to approach slabs
- Determination of applicability to Wisconsin of other currently adopted approach slab designs
- Determination of potential problems with current approach slab construction
- Determination of the need for three expansion joints for thermal expansion/contraction relief or if one joint will be sufficient
- Improvement of the constructability and performance of approach slabs

The following recommendations were developed as a result of this work:

The expansion and contraction requirement does not seem to warrant the use of multiple expansion and contraction joints as seen in SDD 13B2.

The SDD 13B2 is more highly susceptible to inadequacies within the approach supporting materials. If this detail is to perform well in the long-term, it is critical that the materials are prepared well and methods of preservation are built into the system.

For Bridge Standard 12, it is recommended that the slab design is revisited to ensure it is properly sized and reinforced to act as a bridge between the sleeper slab and abutment paving notch in the event that settlement of the backfill and subbase occurs.

The continued use of a sleeper slab at the joint between the mainline pavement and approach slab is recommended.

The continued use of polyethylene sheeting between the approach slab and supporting materials/sleeper slab interface is recommended

It is recommended that all new bridges be profiled and have the gross vertical geometry measured immediately after construction. Additionally, a specification that ensures an acceptable ride quality at the time of construction should be created and adopted by WisDOT.

Following construction, it is recommended that the approach/bridge be profiled at least every 10 years or when it is apparent that the rideability has begun to degrade.

Attention should paid to the abutment backfill and approach support materials to mitigate potential differential settlement through improved compaction, reduced erosion, and/or use of alternative materials.

Consideration should be given to flooding the structural backfill assuming the use of the current materials is maintained to eliminate post-construction collapse of the backfill material.

Water drainage should be an integral part of the bridge and embankment design. It is critical to direct water away from the bridge deck, joints, and embankment in a way that does not create an erosion problem or changes in the soil properties. The following details are generally recommended, some of which may be already in use on some or all new WisDOT structures.

- Full-width approach slabs should be used and have curbs or raised parapets to prevent deck drainage from eroding shoulder support.
- Provide a tiled drainage outlet near the approach slab to pavement joint to prevent water from the bridge flowing onto the embankment.
- Provide surface drainage channels on the embankments with erosions cloth, erosion control mat, or rock to prevent pavement runoff from eroding the embankment.
- Place drainage tile in the embankment that has adequate crushing resistance with respect to the depth of soil placed above the tile.
- Provide a method for water to be drained from the deck prior to reaching the joint between the deck and approach slab.
- Provide a path for water to be drained that does infiltrate approach joints (i.e., bridge to approach, approach to pavement)

Once the bridge is constructed, it is recommended that all drainage be continually checked for debris or other obstructions.

Consideration should be given to alternative backfill materials such as geocomposite drains and/or recycled tire chips.

1 General Information

1.1 Introduction

It is widely recognized that approach slabs/panels play a critical role in the highway system. These panels must provide a smooth transition from mainline pavements to bridges. Beyond being responsible for the majority of roughness typically associated with bridges, these panels must be able to effectively accommodate thermal expansion and contraction of both the bridge and the mainline pavement. Improperly designed/constructed approach panels tend to lead to the formation of a bump at the end of the bridge. The bump is not generally a significant safety problem; rather it can be an expensive maintenance issue. It is very common to attach the approach slab to the bridge via a reinforcing bar extending from the paving notch. By attaching the approach slab to the bridge, one is able to move an expansion joint away from the critical area at the abutment; this promotes drainage of roadway water away from the bridge area. However, one detail that is critical to the long-term, effective performance of approach slabs is that they must allow for free and full expansion and contraction of the surrounding elements. In general, this is accomplished by detailing one or more expansion joints.

1.2 Background

Within the recent past, the Wisconsin DOT changed the bridge approach slab design from a system using only one expansion joint to a system using three expansion joints. This change was due primarily to the need to accommodate differential expansion and contraction between the approach pavement and the bridge. Since implementing the new design detail, the Wisconsin DOT has become aware of the detail's difficulty of constructability. As such, a more easily constructed, new standard design with one expansion joint and a sleeper slab was created and has been used more recently. When compared, the designs vary in many ways, and accordingly the question of suitability arises: are three expansion joints needed or is one enough to provide the stress relief and desired performance?

1.3 Project Objectives

The project objectives were to:

- Review and analyze current approach slab performance
- Review and analyze other states' practices with respect to approach slabs
- Determine what other currently adopted approach slab designs may be applicable to Wisconsin
- Determine if there is a problem with current approach slab performance and, if so, will new designs improve performance
- Determine if three expansion joints are needed to provide thermal expansion/contraction relief or if one joint will be sufficient
- Improve the constructability and performance of approach slabs

It is the research team's opinion that the first five objectives are all questions that must be asked as one strives to reach a conclusion for the sixth and final bullet. Clearly the ultimate goal is to provide information to the Wisconsin DOT that will help improve the usage of approach slabs. It is not surprising that the three-joint slab system is proving more difficult to construct than the single joint system because of the increased complexity of the system; it is both the difficulty associated with construction and field performance that led to the development of this project. Clearly one question to be answered is whether the effort associated with additional expansion joints is worth the (any) improvement in performance.

1.4 Project Scope

A literature review and review of other state approach designs were conducted to find current practices on bridge approach design, construction, and maintenance. An in-depth review of WisDOT bridge approach design and construction practices, both previous and current, was also performed. Twelve bridges were visited as part of a field investigation that included observation of performance and some testing to collect quantitative information on the in-service behavior. Additionally, materials testing was performed on approach subbase and abutment backfill soil samples provided by WisDOT.

1.5 Report Content

Chapter 2 presents the findings of a formal literature review that was focused on the background, use, and evolution of approach slabs. Chapter 3 presents the most recent approach design and construction practices in the State of Wisconsin, with attention given to specific similarities and differences identified when compared to that of other states. The current approach design and construction practices of several states with similar climates are presented in Chapter 4. The in-service approach condition of 12 Wisconsin bridges which were visited as part of this project is presented in Chapter 5. Also in Chapter 5 are the results of the live-load testing completed. Chapter 6 presents the analysis of approach subbase and abutment backfill materials. Chapter 7 summarized the results of this work and presents conclusions and recommendations.

2 General Literature Review

A synthesis report completed by Puppala et al. (2008) titled “Recommendations for Design, Construction, and Maintenance of Bridge Approach Slabs” provides an excellent, in depth resource for a summary of related projects. The reader is directed to this source for an extensive review of previous bridge approach slab studies. Several of the studies reviewed within this source along with others are further described within this chapter.

Hoppe (1999) completed a survey of state DOTs with 81% reply. Among the many questions that were asked, a couple were specific to approach slab dimensions and connection to the bridge.

Fifty percent of respondents indicated they used a common slab length of 20’. The shortest reported was 10’ and the longest 40’. The reported thicknesses varied from 8” for a 15’ long slab and 17” for a 30’ long slab. The common 20’ long slabs were reported to have thicknesses ranging between 9” and 15”, with an average of 12”.

Fifty-seven percent of respondents indicated the use of doweled or tied connections, and 43% use no mechanical attachments for conventional bridges; doweled connections are more commonly used at integral bridges. Seventy-one percent of respondents with integral structures reported using mechanical connections at the approach slab/backwall interface.

Kunin and Alampalli (2000) in their study on integral abutment bridges reported that most transportation agencies used similar approach slab to bridge connections which often involved the slab resting a on a lip or corbel built into the abutment. Differences existed, however, in the method of connection to the bridge. One method was to use reinforcement to connect the approach slab to the bridge deck, which most often was completed by extending longitudinal reinforcement from the deck into the approach. Another method was to use reinforcement extending from the corbel or lip into the bottom of the approach slab, while another method was to not use any connection between the bridge and approach, but rather, simplifying the connection by just resting the approach on corbel or lip.

In the same study, three methods of expansion control were reported: 1) Expansion joints at the far end of the approach slab, 2) Expansion joints at the bridge to approach slab interface, and 3) No expansion joints. The selection criteria were vast, yet two common factors were the bridge length and anticipated movement.

Greimann et al. (2008) investigated the connection between integral bridge abutment and approach slabs. The primary objective was to evaluate the approach slab performance and the impacts the approach slabs have on the bridge. For the sake of comparison, two slab types (one precast and one cast-in-place) were constructed and tied to two integral abutment bridges. Though the joint between the approach slabs and bridge appeared to function quite well, tying the approach slab to the bridge impacted the abutment displacements and girder forces. It was proposed that the source of impact may be the manner in which the approach slab is attached to the mainline pavement. Even more, the impact each slab type had on the bridge was different. It was not clear, however, if the span length (precast longer, cast-in-place shorter) or the type of approach slab was the cause. Strain measurements at the expansion joint between the mainline pavement and approach slab indicated that a force existed and thus should be considered during design. The behavior of the approach slab and bridge tended to follow an annual cyclic pattern, often changing with the seasons.

Mistry (2005) in his discussion of integral abutment bridges recommended several best-practices for approach slab design and construction. These include:

- A decision to install approach slabs should be a collaborative effort between the bridges and structures group and the geotechnical group, with consideration and emphasis on long-term performance and life cycle costs, rather than just initial costs.
- The practice of using sleeper slabs at the end of all approach slabs should be standardized, as cracking and settlement typically develop at the slab to pavement joint.
- Provide well-drained granular backfill to accommodate the imposed expansion and contraction of the bridge.
- Tie approach slabs to abutments with hinge-type reinforcing.
- Provide two layers of polyethylene sheets or fabric under the approach slab to minimize friction against horizontal movement.

Abu-Farsakh and Chen (2014) completed a field demonstration of new bridge approach slab designs for the Louisiana Department of Transportation and Development. The new approach design required increasing the slab flexural rigidity by increasing the slab thickness from 12” to 16”, and using reinforced soil foundations to support the slab and traffic loads at the joint between the roadway pavement and approach slab. The intent behind reinforcing the soil is to increase the soil’s bearing capacity and reduce the embankment settlement. A year and half monitoring program which directly compared two bridges, one with the new design and the other with the traditional design, demonstrated that the new approach slab design performed much better.

Cai et al. (2005) proposed the use of ribbed slab types in lieu of flat approach slabs for longer spans, e.g., 40’ vs 20’). The ribbed approach slab becomes a much more efficient section, that greatly reduces the internal forces and thus the required reinforcement that would otherwise be needed in a flat slab. The ribbed approach slabs were evaluated as both pre-stressed and as regularly reinforced concrete beams with varying rib spacing (12’, 16’, and 32’) for slab lengths of 60’ and 80’. It was determined that the prestressed ribs created an efficient section, but constructability became a big concern. So, rather, the researchers prescribed the most efficient cast-in-place cross-sections.

A finite element analysis of the approach to bridge connection conducted by the researchers found that large stresses occur at the connection when large embankment settlements occur. This led the researchers to suggest the use of an inclined bar between the two elements, which allows rotation of the approach slab, but prevents differential longitudinal movement.

Dupont and Allen (2002) completed a study on the movements and settlements of highway bridge approaches. The study reviewed and discussed practices around the country at that time including approach embankment foundations, the approach embankment, various types of approach slabs, types of abutments and end bents, and drainage around approach embankments and bridge ends. As a result, several recommendations for design and construction practices were provided to improve the performance of bridge approaches. These include:

- Lower the approach slabs to allow for an asphalt overlay riding surface. By designing the approach slab to have an overlay allows for a smoother transition and makes future maintenance easier.

- Require surcharge and settlement periods prior to construction to reduce the amount of primary foundation settlement.
- Design maintenance plans concurrent with construction plans. Many states believe the bump is a bridge issue that cannot be eliminated completely and must be scheduled into the life of the bridge.
- Have specifications that require select fill be placed adjacent to abutments.
- Eliminate erosion near abutments and on approach slopes by designing adequate drainage.
- Implement bridge approach warranties for newly constructed bridges. This could be a difficult approach to sell; however, it could cause better teamwork, better review of drawings and specifications, and more input on design alternatives.
- Reduce the side slope embankments, which are more resistant to settlement and lateral movement of both the foundation and embankment.
- Improve approach slab design by providing longer slabs with stronger reinforcement. By providing longer slabs, the slope of the slab caused by settlement is decreased.

Briaud et al. (1997) completed and extensive survey of state DOTs and summarized causes of poor approach slab performance – specifically, the bump at the end of the bridge. Per the survey, it was estimated that 25% of the bridges in the country were affected by this problem. Three of the main causes reported for this problem are listed below. Those listed and others are illustrated in Figure 2-1.

- Differential settlement between the top of the embankment and the abutment due to the different loads on the natural soil and compression of embankment soils, typically because of insufficient compaction.
- Void development under the pavement due to erosion of embankment fill because of poor drainage.
- Abutment displacement due to pavement growth, embankment slope instability, and temperature cycles on integral abutments.

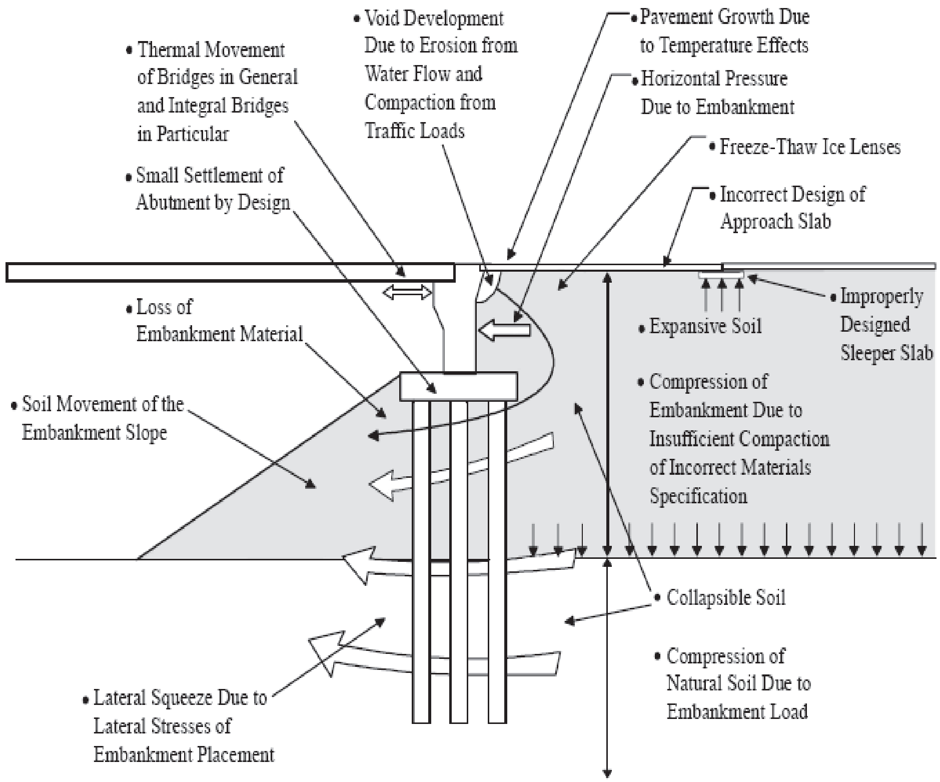


Figure 2-1 Causes for Poor Approach Slab Performance (Briaud et al., 1997)

Briaud prescribed several best practices for reducing bridge approach rideability problems. The report described the state of the practice for the design, construction, and maintenance of bridge approaches at that time to reduce, eliminate, or compensate for settlement at the approach to bridge interface. These best practices include:

- Make the bump a design issue with prevention as the goal.
- Assign the design issue to an engineer.
- Encourage teamwork and open-mindedness between geotechnical, structural, pavement, construction, and maintenance engineers.
- Carry out proper settlement vs. time calculations.
- Design an approach pavement slab for excessive settlement.
- Provide for expansion/contraction between the structure and the approach roadway.
- Design a proper drainage and erosion protection system.
- Use and enforce proper specifications.
- Choose knowledgeable inspectors, particularly on geotechnical aspects.
- Perform inspections including joints, grade specifications, and drainage.

A later project completed by Briaud et al. (2002) investigated a new approach slab that was proposed based on the accumulation and identification of best practices. The proposed approach was a one-span slab on which numerical analysis was performed and model scale simulations were conducted. From the analysis, some of the conclusions formed include:

- The presence of the abutment wall founded on piles creates a difference in settlement between the abutment wall and the embankment.
- The differential settlement is drastically reduced in the absence of the wall.
- The transition zone is about 40’ with 80 percent of the maximum settlement occurring in the first 20’ for a uniform load case.
- The size of the sleeper slab and support slab influences the settlement of the slab when load is applied to the slab. The optimum width of both slabs is about 5’. The height of the embankment is influencing the settlement of the embankment.

A new approach was recommended based on the completed work. The recommendation was to construct a slab at least 20’ long with a single span from the abutment to the sleeper slab that would be able to carry the full traffic load without support beneath the slab except for that provided at the ends by the abutment and sleeper slab.

Phares et al. (2011) in their project specifically aimed at improving Ohio bridge rideability and performance as it relates to approach slabs, provided several recommendations. The recommendations were sub-categorized within multiple categories. Two of the categories were Structural and Geotechnical/Drainage.

Some of the Structural recommendations included:

- Improve the stiffness compatibility between the bridge superstructure, substructure, approach slab, and supporting materials.
- Minimize the frictional resistance between the approach slab and supporting materials by casting the slab on a low-friction material, such as polyethylene sheeting.
- Strive to limit the bridge skew to 30 degrees to minimize the magnitude and lateral eccentricity of the longitudinal forces.
- Design the approach slab with sufficient strength to bridge settlement extending from the bridge abutment to the recommended sleeper slab. Further consider designing the approach slab with stiffness sufficient to minimize any deflection with such settlement.
- Replace the current ODOT approach slab to mainline pavement joint detail with an expansion joint that is sized to accommodate the expected bridge and approach slab expansion and contraction.
- Actively maintain the expansion joint between the approach slab and mainline pavement to prevent the development of high stresses in the approach slab and bridge. Such maintenance activities will ensure that the bridge is free to expand and contract with temperature variations.

Some of the Geotechnical/Drainage recommendations included:

- Develop a lab test protocol to determine the bulking moisture content for granular backfill materials and establish a practice to field-control the moisture content to avoid bulking moisture contents. Compaction curves for cohesionless sands readily show bulking in the range of 3 to 5% moisture content.
- Consider use of alternative backfill materials, such as geosynthetic-reinforced soil, geofoam, or flowable fill, as an alternative to collapsible backfill.
- Improve compaction effort within 5’ of the abutment backfill using thin lifts with a light vibratory compactor. If concerns exist due to compaction equipment imposing high lateral

stresses next to the wall, instrument a wall (or walls of different configurations) to monitor stress development and movement during compaction and during service loading to conclusively determine the impact of compaction loading. In general, vibratory compactors should be used to compact granular backfill materials.

- Water drainage needs to be an integral part of the bridge and embankment design. The bridge and embankment need to be detailed to drain water away from the bridge deck, joints, and embankment without causing erosion or changes in the soil properties. The following are recommended drainage details:
    - Full-width approach slabs should be used and have curbs or raised parapets to prevent deck drainage from eroding shoulder support. If a future asphalt overlay is a possibility, the curbs should be built high enough to compensate for the overlay.
    - Provide a tiled drainage outlet near the approach slab to pavement joint to prevent water from the bridge flowing onto the embankment.
    - Provide surface drainage channels on the embankments with erosion control cloth, erosion control mat, or rock to prevent pavement runoff from eroding the embankment. The water runoff management system should be designed such that water is directed to the channels.
    - Place drainage tile in the embankment that has adequate crushing resistance with respect to the depth of soil placed above the tile.
    - Place concrete gutters at the top of MSE walls and under bridges to direct water away from the embankment to prevent erosion of the embankment materials.
    - Place weep holes in the bridge deck near the approach joint to allow water to be drained prior to reaching the joint.
    - If water infiltrates the joints (bridge-to-approach, approach-to pavement), provide a drainage path for the water to escape the joint.

Additional Geotechnical/Drainage alternative backfill options were provided as advanced methods for improving approach slab performance. The options included:

- Use porous backfill behind the abutment in lieu of granular backfill.
- Placement of geotextile-reinforcing layers to the granular backfill.
- Use a geocomposite vertical drainage system behind the abutment.
- Use a layer of tire chips behind the abutment as an elastic/resilient and drainage fill material.

As part of the project aimed at identifying the best practices for bridge approaches in Iowa, White et al. (2005) described common geotechnical problems with existing approaches, illustrated in Figure 2-2 and listed below.

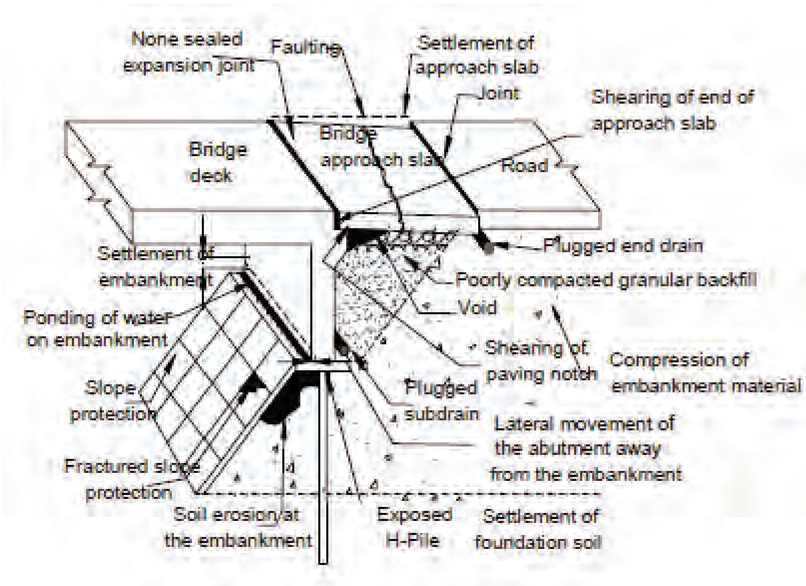


Figure 2-2 Common Bridge Approach Problems (White et al., 2005)

- Backfill materials under poorly performing approach slabs were often loose and undercompacted.
- Settlement of the foundation soil or embankment fill was evidenced at many of the bridges inspected.
- The majority of the bridge approach elevation profiles obtained had slopes higher than 1/200, which is recommended as an acceptable maximum gradient for bridge approaches and a benchmark for initiating maintenance.
- Void development under the bridge approach was commonly observed on bridges within one year of construction, indicating insufficiently compacted and erodible backfill material.
- Inadequate drainage, or otherwise poor water management, was a major problem at most of the bridges inspected. Erosion leads to void development under the approach slab, faulting of the approach slab, and failure of slope protection, and exposes the H-pile supporting the abutments, which can contribute to corrosion.
- A variety of water management designs exist for bridges. Some drainage details perform better than others. Most of the abutment subdrains inspected were not functioning properly.
- Many subdrains were either dry with no evidence of water, blocked with soil fines and debris, or had collapsed.
- Measurements of an expansion joint at one bridge site showed about 1 inch of total movement, much less than the 4-inch design width. This suggests that the design joint width may be overly conservative.
- Most of the expansion joints of the bridges inspected were not sufficiently filled, allowing water to flow into the underlying fill materials. Flexible foam and recycled tire joint fillers were not effective in sealing the expansion joint

Additionally, new bridge approach construction practices and problems were identified. The following findings were reported.

- The granular backfill being used had relatively good compactibility. However, most granular backfill being used as abutment fill at new bridge sites is not being sufficiently compacted.
- Measured moisture content within the bulking moisture content range (i.e., 3% to 7%) was shown to be inhibiting compaction. Backfill materials were being placed at the bulking water content, leaving the material susceptible to collapse upon saturation.
- Several abutment subdrains were observed to be plugged with soil during and after construction. Porous backfill was not used around the subdrain at most bridge sites. On average, 70% of granular backfill particles and 1% of porous backfill materials were smaller than the perforated openings in the subdrain pipe.

Lastly, design changes were recommended.

- Use a combination of porous backfill and geocomposite drainage systems behind the abutment to improve drainage capacity and reduce erosion around the abutment. Several alternative design details are provided for these recommendations and can be implemented on new construction or rehabilitation of existing bridges.
- For bridges with soft foundation or embankment soils, implement practices of improved embankment compaction with moisture control, foundation preloading, ground improvement, soil removal and replacement, or soil reinforcement that reduce time-dependent post construction settlements and possibly lateral squeeze.
- Connect the approach slab to the abutment or the deck of the bridge and eliminate the expansion joint at the bridge end of the approach slab. Support the far end of the approach slab on a sleeper beam with a construction joint of two inches and provide an improved joint sealing system at the CF joint. A rubber V-shaped gland joint sealing system is recommended on a pilot test basis. Replace the #5 vertical reinforcing bars in the abutment wall with #7 reinforcing bars in future nonintegral bridges.

3 Wisconsin Approach Panel Design and Construction State of Practice

The practice of approach panel construction has recently undergone a couple fundamental changes in methodology. First, the Wisconsin DOT changed the bridge approach slab design from a system with one expansion joint to a system with three expansion joints (SDD 13B2). It was believed this change would protect both the pavement and bridge from differential expansion and contractions of both the pavement and the bridge structure. Though the intent for this change was largely realized through improved performance, the constructability of this design proved to be difficult in the field. As such, a new detail would emerge that has been used throughout the United States using a single expansion joint and sleeper slab underlying the joint between the mainline pavement and approach slab (Bridge Standard 12.10, 12.11, 12.12, and 12.13).

The next sections describe the two approach plans, the details of which are fully provided in Appendix A, so that they may be compared with the designs of other Midwestern states which are presented in the following chapter. Here forward, the three-expansion-joint method will be called by its designation SDD 13B2 and the single expansion joint design Bridge Standard 12.

3.1 SDD 13B2

Shown in Figure 3-1 is the approach panel plan for skewed bridges with more than two lanes. Plans for the 12” thick approach panel call out a maximum of 15’-8” between the end of bridge and the first expansion joint with intermediate contraction joints occurring at the same increment within the body of the approach. Between contraction joints the slab length may vary from 6’-0” to 18’-0”. At the expansion joint the approach transitions from 12” thick to that of the adjacent concrete pavement.

The same plans apply aside from minor differences for two lane bridges with skews greater than 30 degrees (see Figure 3-2) and less than 30 degrees (see Figure 3-3).

As shown in Figure 3-4, from the end of bridge to the first expansion or contraction joint, the bottom of the slab is reinforced with #6 bars at 6” o.c. parallel to the roadway centerline and #4 bars at 2’-0” o.c. either parallel to the skew or normal to the centerline. At the top of the slab, the reinforcement consists of 6” x 12” W5.5 x W4 welded wire fabric. Beyond the first expansion or contraction joint the slab is not reinforced. At standard joint spacing, two additional expansion joints are constructed before doweled and sawn contraction joints are re-introduced.

The approach slab rests on a paving notch formed into the abutment wall (see Figure 3-5). No positive connection via reinforcement bars or other means exists between the bridge and approach slab; therefore, the slab has at least a minimal degree of freedom to move independently of the bridge.

The expansion joint shown in Figure 3-6 and enlarged in Figure 3-7 consists of a 1 1/2” joint filled with joint filler and capped with hot poured joint sealant. The joint is spanned by an 18”, 1 1/2” diameter smooth dowel in a dowel socket spaced at 12” o.c. The contraction joints shown in Figure 3-8 consist of a single 1 1/2” diameter dowel embedded in the concrete spanning the joint and a 4” deep sawn joint.

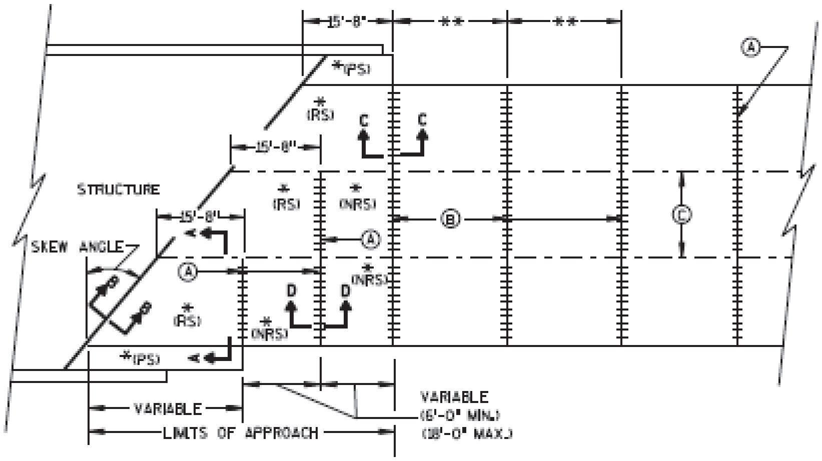


Figure 3-1 Wisconsin Skewed Approach for More than 2 Lanes (WisDOT)

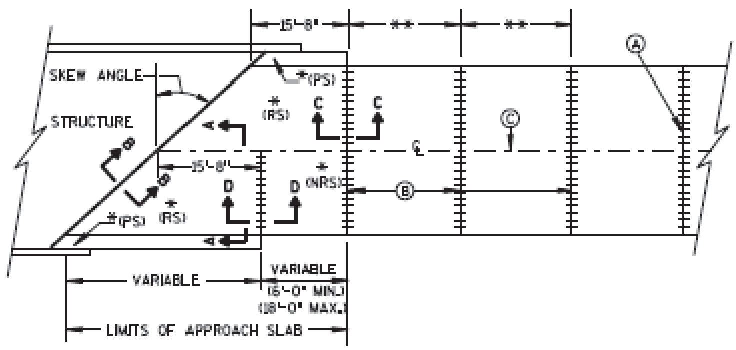


Figure 3-2 Wisconsin Approach Skews Greater than 30 Degrees (WisDOT)

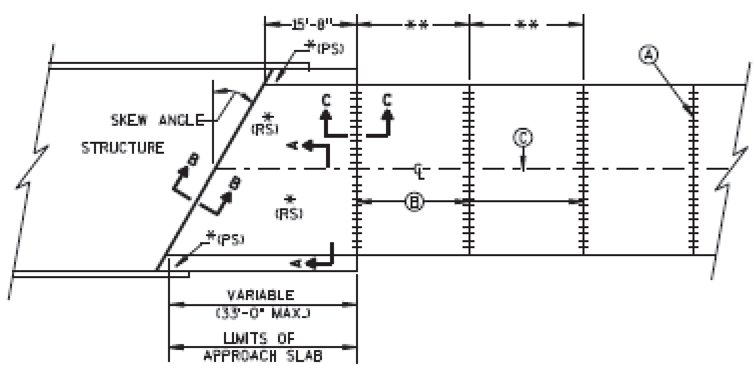


Figure 3-3 Wisconsin Approach Skews Less than 30 Degrees (WisDOT)

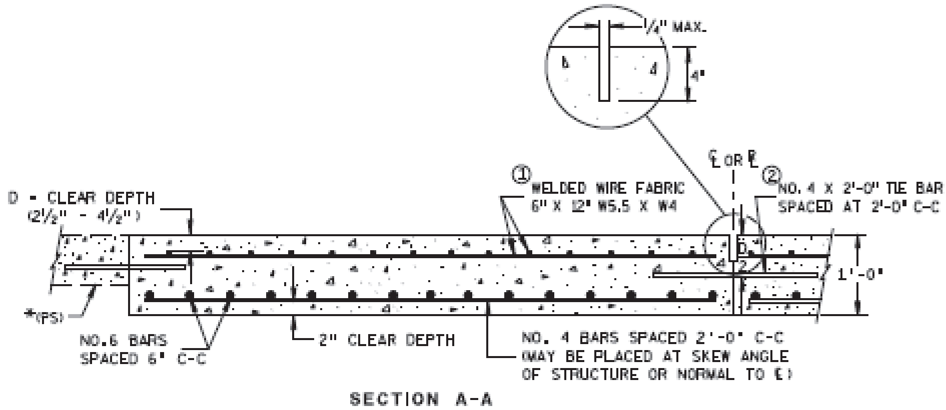


Figure 3-4 Wisconsin Reinforcement Positioning Detail (WisDOT)

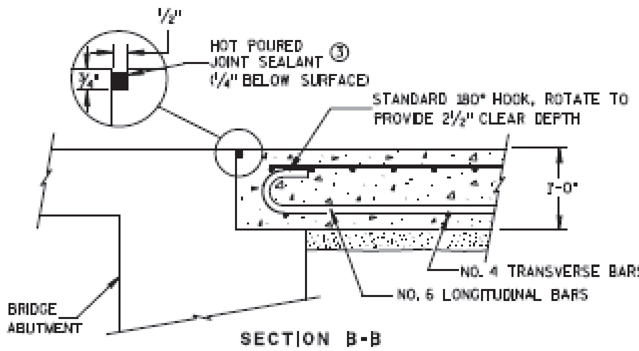


Figure 3-5 Wisconsin Bend Detail Bottom Reinforcement (WisDOT)

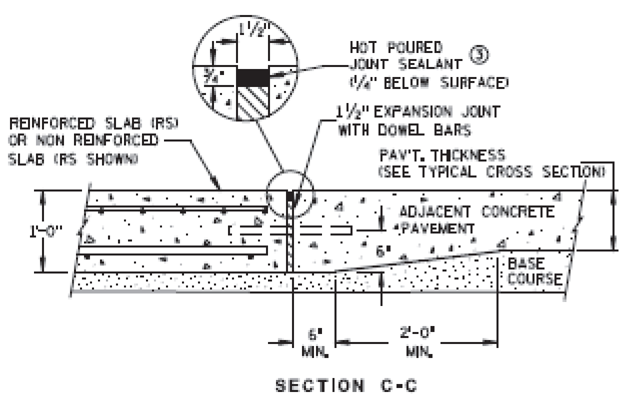


Figure 3-6 Wisconsin Transition Detail Approach to Pavement (WisDOT)

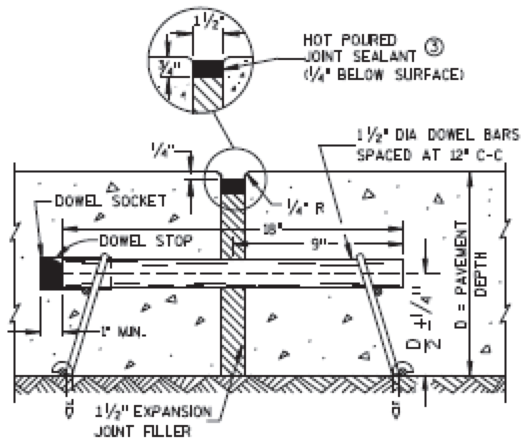


Figure 3-7 Wisconsin Expansion Joint (WisDOT)

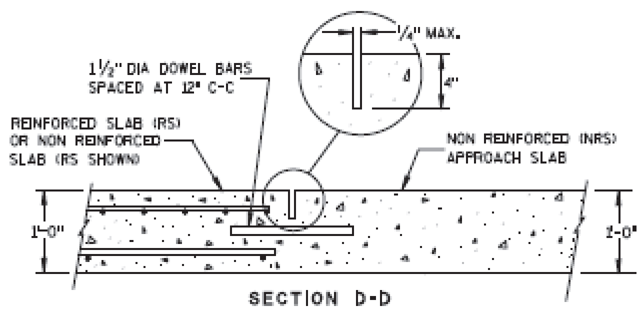


Figure 3-8 Wisconsin Contraction Joint (WisDOT)

3.2 Bridge Standard 12

There are two variations of Bridge Standard 12 dependent upon the type of abutment at which the approach slab would adjoin. Shown in Figure 3-9 is one of two variations which is used at type A1 abutments; that is, semi-integral. The approach plan changes from the three expansion joint method previously used and instead uses a single-span slab that extends from the bridge abutment to a sleeper slab that lies immediately below the approach slab.

The 1’-4” thick slab measures 20’-0” in length invariably, whether adjoining a skewed bridge or not. Between the slab and underlying subbase, multiple layers of polyethylene sheets lie and serve as a bond breaker to aid the sliding of the slab due to expansion and contraction of the bridge and slab itself. The slab is doubly reinforced with a bottom mat of #5 reinforcement bars at 12” o.c. running parallel to the bridge end and #8 reinforcement bars at 7 1/2” o.c. running parallel to the roadway centerline. The top mat consists of #5 reinforcement bars spaced at 12” o.c. each way.

The sleeper slab measures 5’-0” wide, 1’-6” thick and is doubly reinforced with (6)-#8 reinforcement bars top and bottom and #5 stirrups at 1’-0” o.c. The top surface of the sleeper is steel troweled and covered with multiple layers of polyethylene. Additionally, a 3/4” preformed joint filler, 1’-6” wide is placed on top of the sleeper slab under the approach to minimize the friction between the approach and sleeper aiding the ability for the approach to move under expansion and contraction forces. A 1 1/2” expansion joint filler occupies the joint between the mainline pavement and approach panel which also rests on the sleeper slab.

The approach slab footing and structural approach slab is cast upon a base aggregate dense 1 1/4”.

The approach rests on a 1’-0” paving notch formed into the back of the abutment wall and is tied to the abutment with a diagonally placed stainless steel #9 reinforcement bar spaced at 1’-0” o.c. (see Figure 3-10).

The second variation shown in Figure 3-11 and Figure 3-12 is used at Type A3 and A4 abutments; that is, one with an expansion joint between the bridge deck and abutment wall and 1’-0” wide corbel serving as the paving notch. The details otherwise remain the same with respect to the approach slab and sleeper.

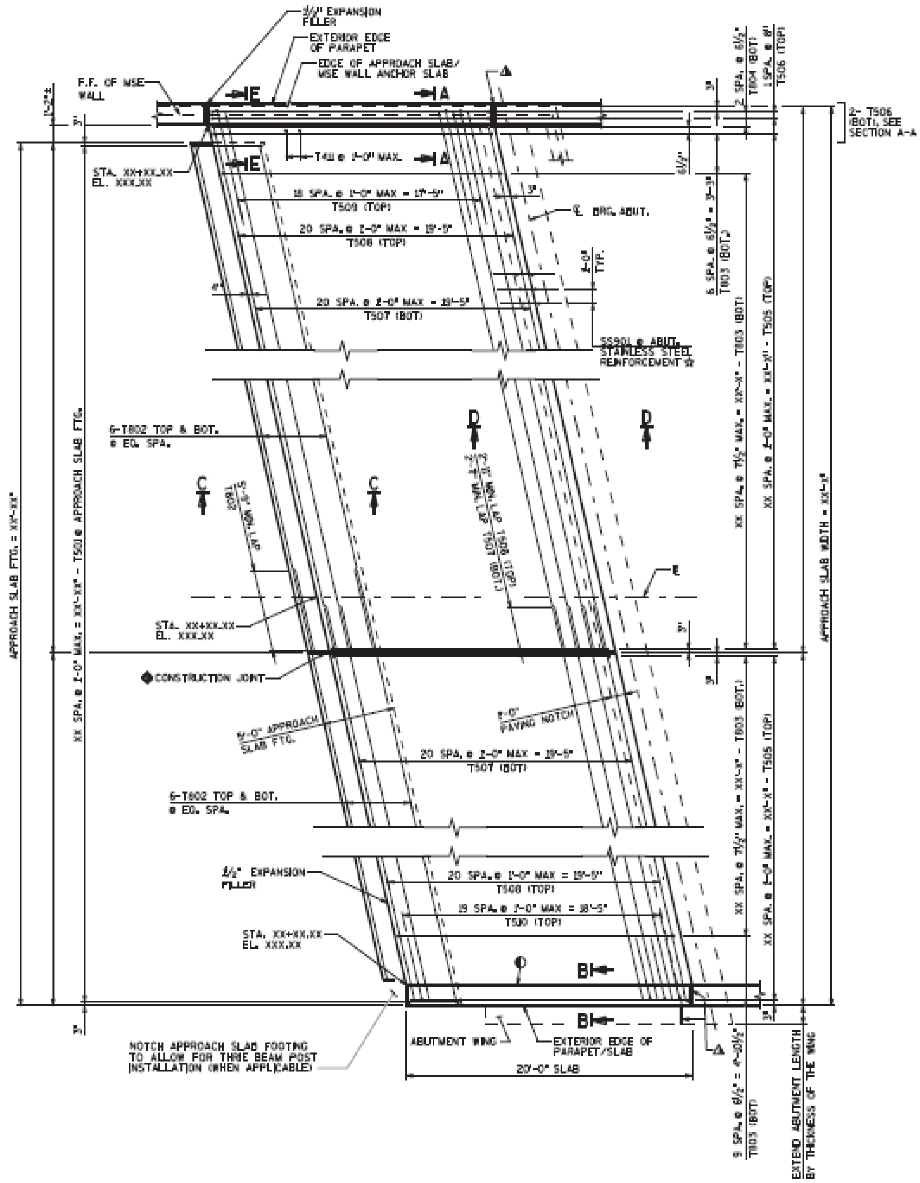


Figure 3-9 Wisconsin Approach Plan at Type A1 Abutments (WisDOT)

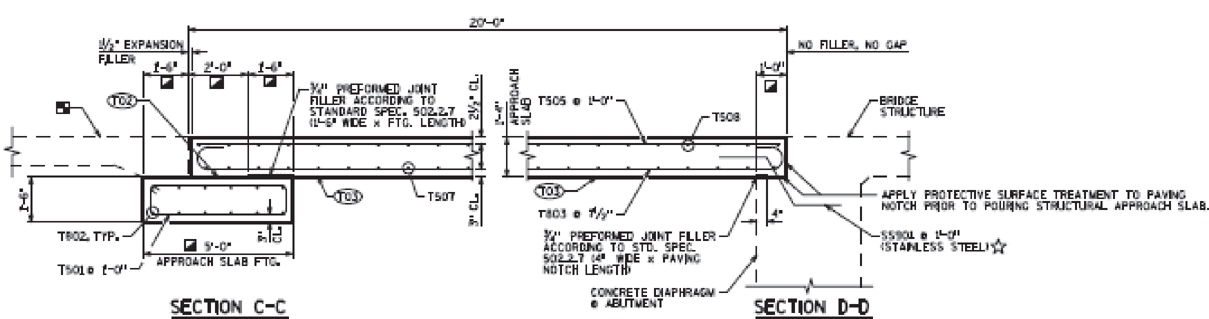


Figure 3-10 Wisconsin Approach Section at Type A1 Abutments (WisDOT)

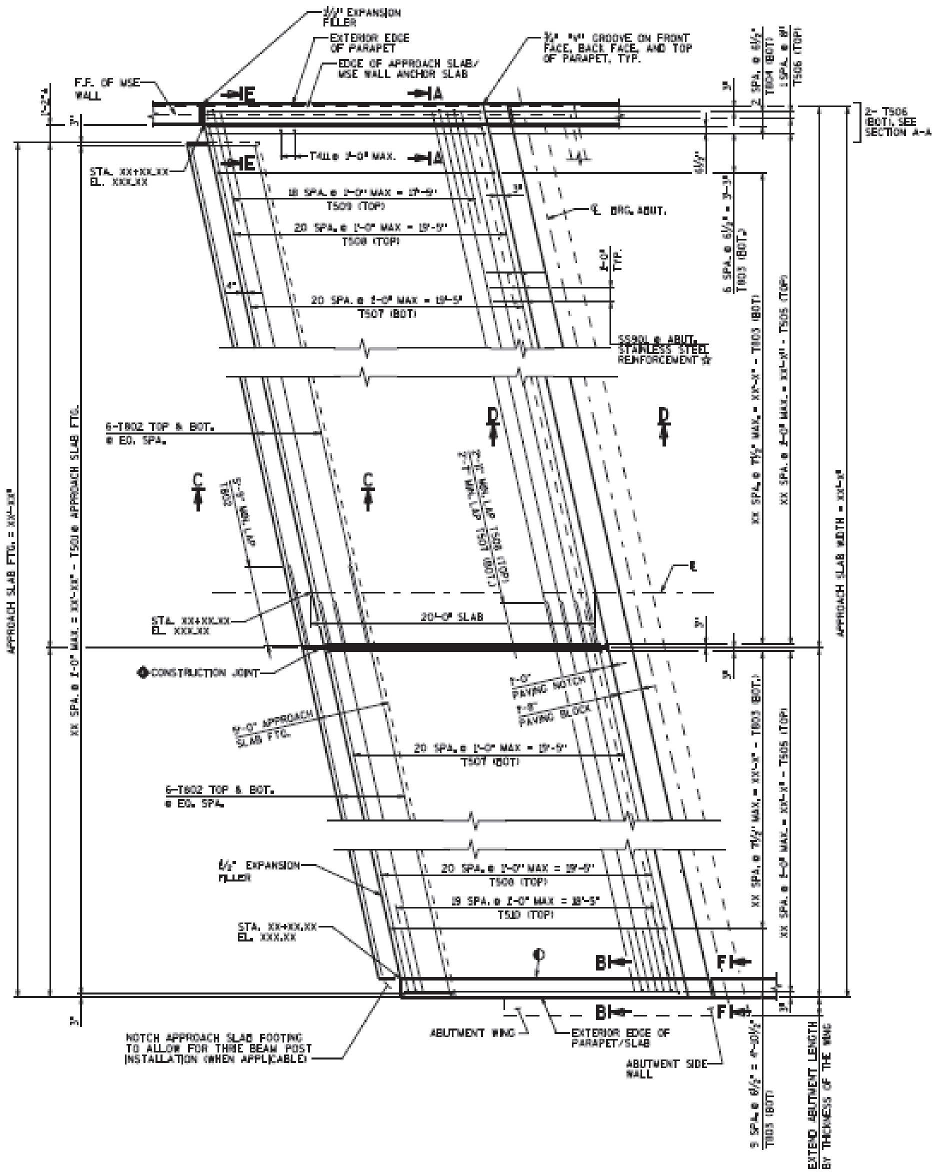


Figure 3-11 Wisconsin Approach Plan at Type A3 and A4 Abutments (WisDOT)

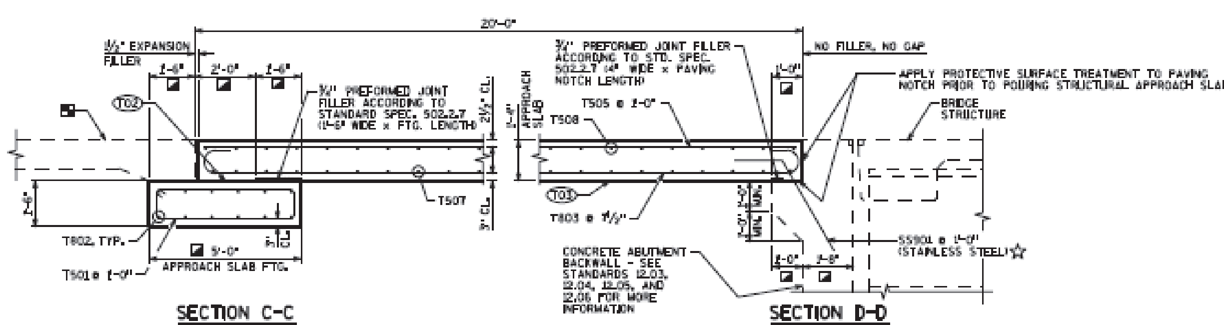


Figure 3-12 Wisconsin Approach Section at Type A3 and A4 Abutments (WisDOT)

3.3 Proposed Alternative

Since the inception of structural slab use (Bridge Standard 12) in Wisconsin, the WisDOT has begun to see contractors requesting an allowance for the approach slabs to be poured concurrently with the bridge deck. This allows for a continuous concrete placement operation from the beginning of the approach slab at the bridge entrance to the end of the approach slab at the bridge exit. Some advantages are that the contractor's efficiency is improved, WisDOT is getting a better product, and a more flexible schedule is created.

Accordingly, WisDOT has developed two versions of a detail accommodating this continuous operation and they have allowed two bridges to be constructed in this manner. The details are shown in Figure 3-13 and Figure 3-14 and continue to be a work in progress.

The details are not intended to supplant those of Bridge Standard 12, but rather provide an alternative for contractors who elect or desire to complete the approach slabs with the bridge deck.

The primary difference between Bridge Standard 12 and the first detail shown in Figure 3-13, is the addition of a continuous bent stainless steel plate at the top of the abutment which forms a bond break between the deck and approach slab. A 2" deep saw cut extends from the top surface of the concrete to the top of the plate, ensuring the joint is formed along the plate.

The second detail shown in Figure 3-14 similarly uses the bent plate along the top of the abutment, but additionally uses a HDPE plate bolted to the stainless steel plate to extend vertically to the pavement surface. This serves to create a bond break between the approach slab and bridge deck in lieu of the saw cut used in the previously mentioned detail.

The use of these details have been limited, yet appear promising to enable a quicker, more efficient operation, while maintaining the same function as those details in Bridge Standard 12.

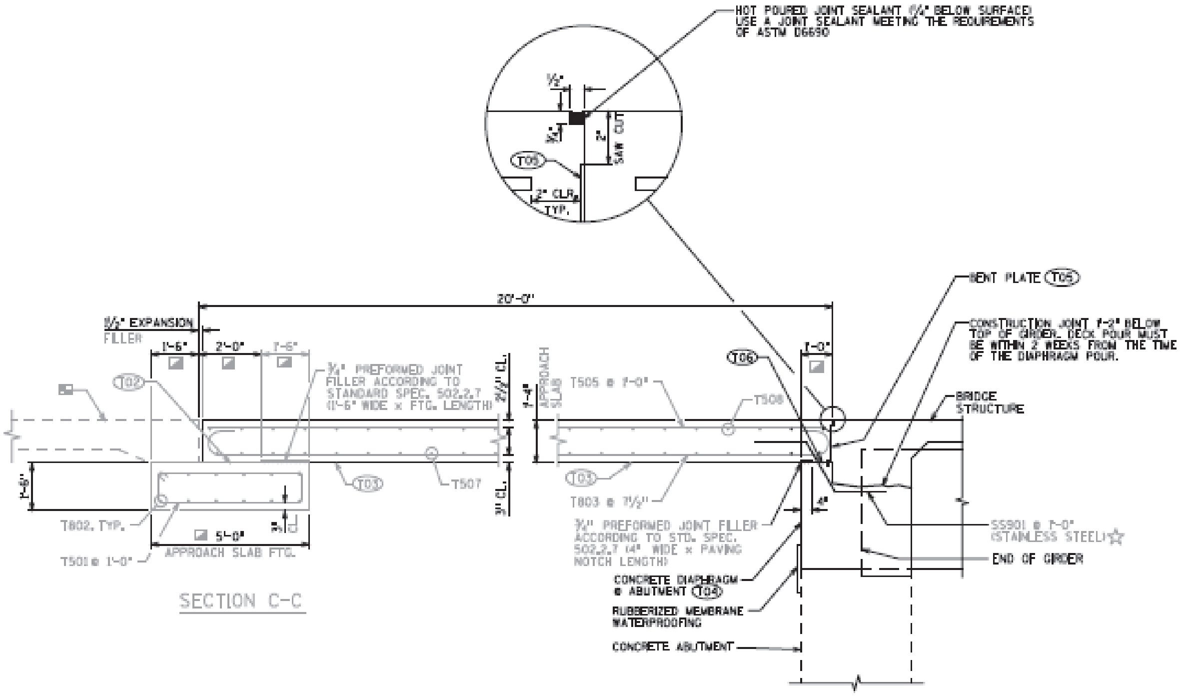


Figure 3-13 Wisconsin Alternative Detail (WisDOT)

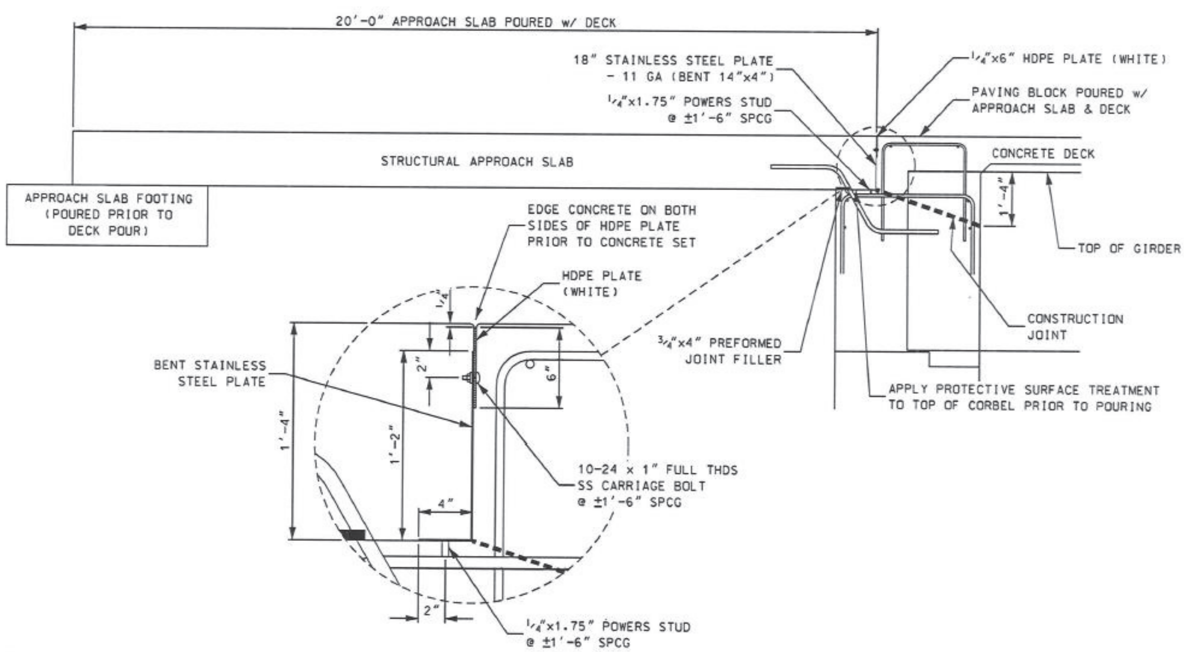


Figure 3-14 Wisconsin Alternative Detail (WisDOT)

3.4 Approach Design and Construction Practices

Section 12.11 of the WisDOT Bridge Manual provides a very good narrative regarding the practices that are likely to improve the performance of the approach slabs. This attention to the design and construction practices of bridge approaches is something not always seen within the manuals of others states. The following excerpts are directly from the manual and touch on many of the key points of emphasis one should be aware of when design and constructing bridge approaches.

> *…Soils, design, construction and maintenance engineers must work together and are jointly responsible for efforts to eliminate rough bridge approaches.*
>
> *Some typical bridge approach problems include:*
>
> - *Settlement of pavement at end of approach slab*
> - *Uplift of approach slab at abutment caused from swelling soils or freezing*
> - *Backfill settlement under flexible pavement*
> - *Approach slab not adequately supported at the abutments*
> - *Erosion due to water infiltration*
>
> *Most bridge approach problems can be minimized during design and construction by considering the following:*
>
> - *Embankment height, material and construction methods*
> - *Subgrade, subbase and base material*
> - *Drainage-runoff from bridge, surface drains and drainage channels*
> - *Special approach slabs allowing for pavement expansion*
>
> *The following construction measures can be used to stabilize foundation materials:*
>
> - *Consolidate the natural material. Allow sufficient time for consolidation under the load of the embankment. When site investigations indicate an excessive length of time is required, other courses of corrective action are available. Use of a surcharge fill is effective where the compressive stratum is relatively thin and sufficient time is available for consolidation.*
> - *Remove the material either completely or partially. This procedure is practical if the foundation depth is less than 15 feet and above the water table.*
> - *Use lightweight embankment materials. Lightweight materials (fly ash, expanded shale and cinders) have been used with apparent success for abutment embankment construction to lessen the load on the foundation materials.*
>
> *Abutment backfill practices that help minimize either settlement or sell include the following:*
>
> - *Use of select materials*
> - *Placement of relatively thin 4- to 6- inch layers*
> - *Strict control of moisture and density*

- *Proper compaction*
- *Installation of moisture barriers*

…Proper drainage needs to be provided to prevent erosion of embankment or subgrade material that could cause settlement of the bridge approach. It is essential to provide for the removal of surface water that leaks into the area behind the abutment by using weepholes and/or drain tile. In addition, water infiltration between the approach slab and abutment body and wings must be prevented.

Even more, the excavation limits and calculations for determining the volume for structure backfill and base aggregate for bridges with a without structural approach slabs are provided. These are shown in Figure 3-16. This step matches or exceeds that of other state's practices.

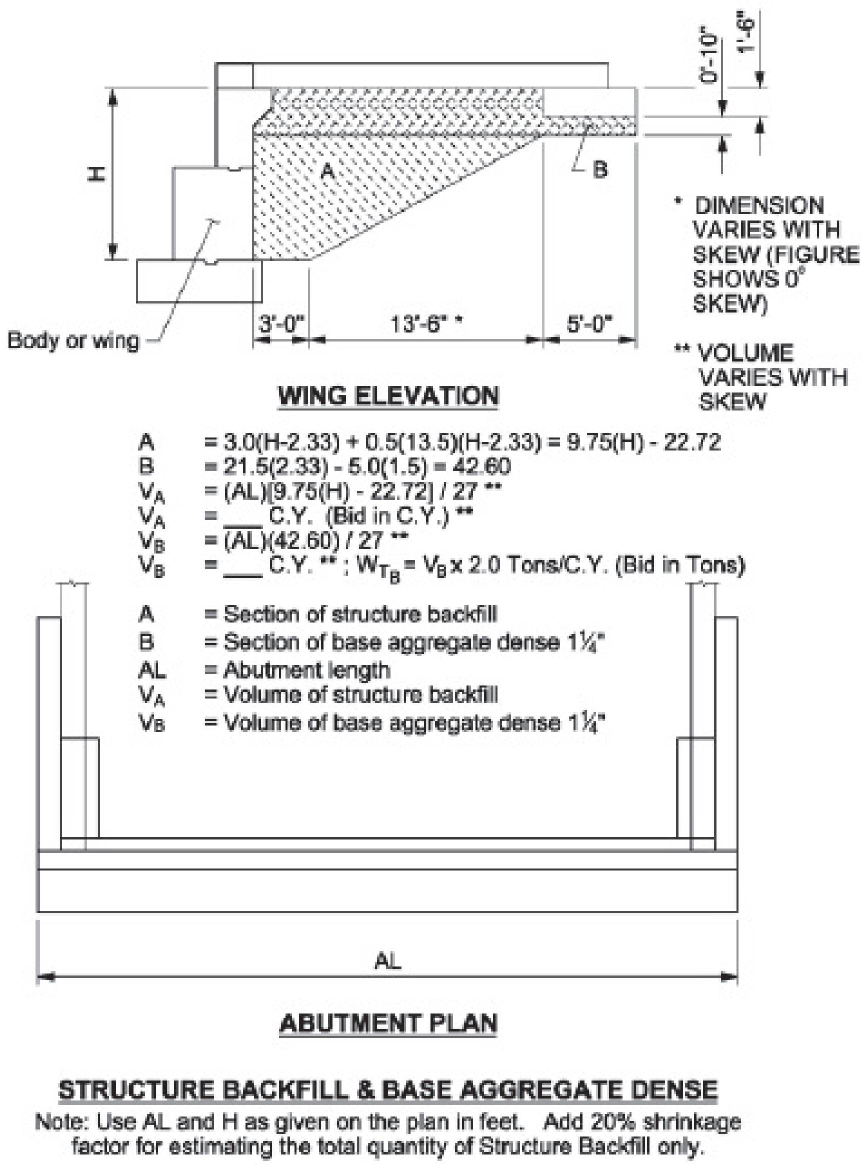
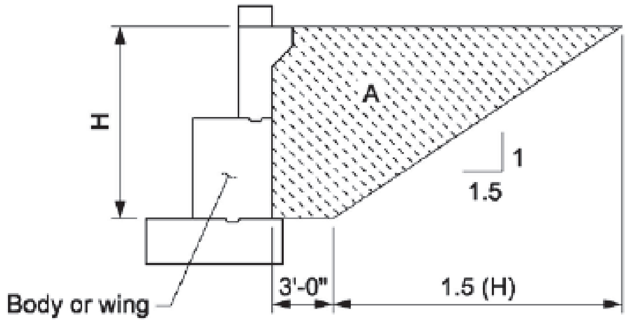


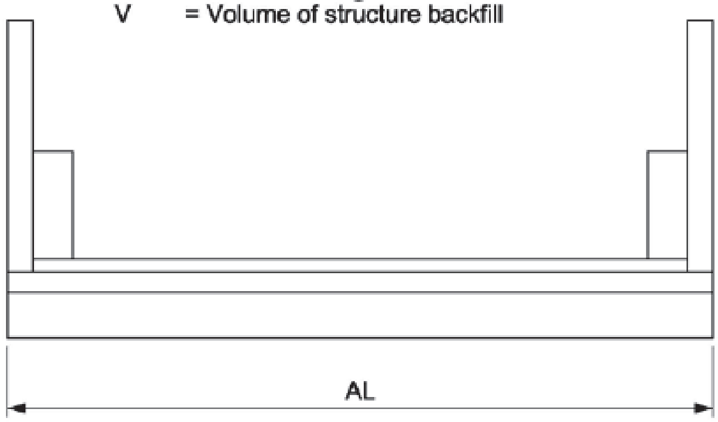
Figure 3-15 Wisconsin Abutment Backfill Calculations with Approach Slab (WisDOT)



WING ELEVATION

A = 3.0(H) + 0.5(H)(1.5H) = 3.0(H) + 0.75(H^2)
V = (AL)[3.0(H) + 0.75(H^2)] / 27
V = ___ C.Y. (Bid in C.Y.)

A = Section of structure backfill
AL = Abutment length
V = Volume of structure backfill



ABUTMENT PLAN

STRUCTURE BACKFILL

Note: Use AL and H as given on the plan in feet.
Add 20% shrinkage factor for estimating the total quantity.

Figure 3-16 Wisconsin Abutment Backfill Calculations (WisDOT)

4 Approach Design and Construction State of Practice of Other States

4.1 Colorado

The Colorado Department of Transportation has developed a few variations of approach slab plans to be used for differing applications. Each variation is provided in its entirety in Appendix A. The example that will be presented here is not fundamentally different than the others, yet this example is specifically intended for where an asphalt pavement will overlay the approach and bridge.

The approach panels are 20'-0" long extending from the 6" paving notch at the bridge abutment to the 3'-0" wide sleeper slab which runs parallel to the end of the bridge as shown in Figure 4-1 and Figure 4-2. At the abutment a 1/2" expansion joint between the approach panel and bridge deck filled with expansion joint material and joint filler separates the two elements (see Figure 4-3). The approach panel is 12" thick with a top reinforcing mat of #5 bars spaced at 12" o.c. running parallel to the end of bridge and #4 bars spaced at 1'-6" o.c. running parallel to the centerline of the bridge, and a bottom reinforcing mat of #5 bars spaced at 12" o.c. running parallel to the end of the bridge and #6 bars spaced at 6" o.c. running parallel to the centerline of the bridge. The slab is tied to the bridge abutment with #5 bars at 12" o.c. The sleeper slab is 1'-0" thick and reinforced with (3) #5 bars top and bottom. Between the sleeper slab and approach panel, a bond breaker made up of 20 gauge galvanized sheet metal exists.

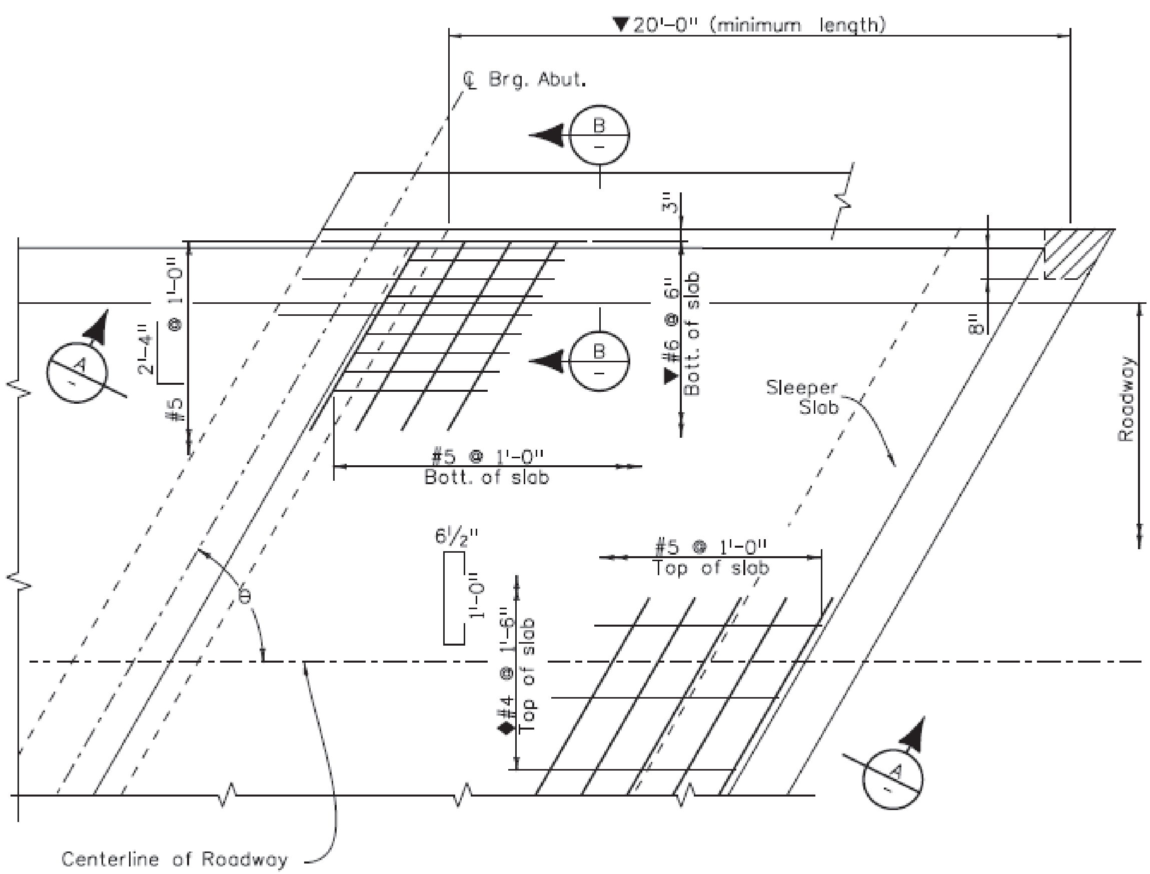


Figure 4-1 Colorado Approach Panel Plan (CDOT)

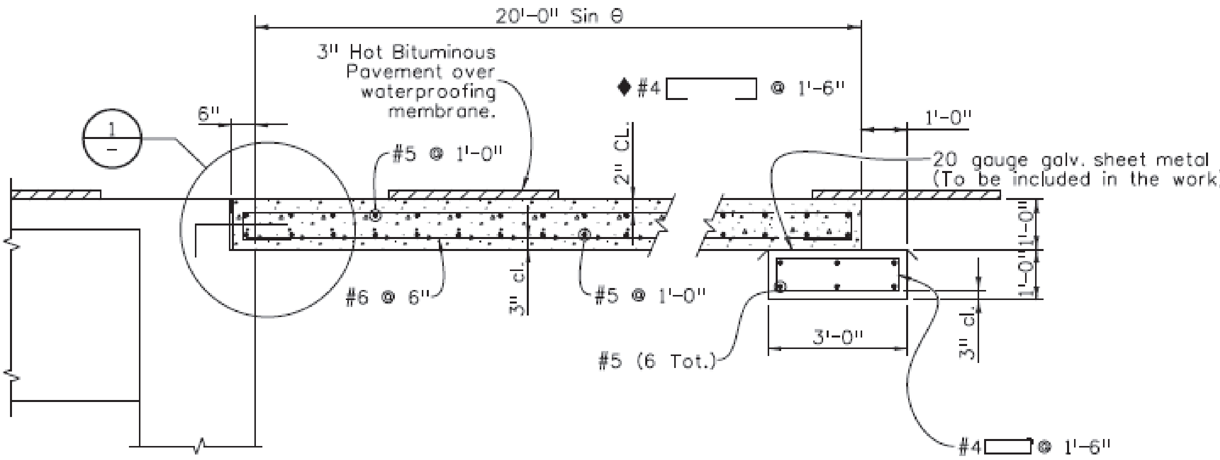


Figure 4-2 Colorado Approach Panel Section (CDOT)

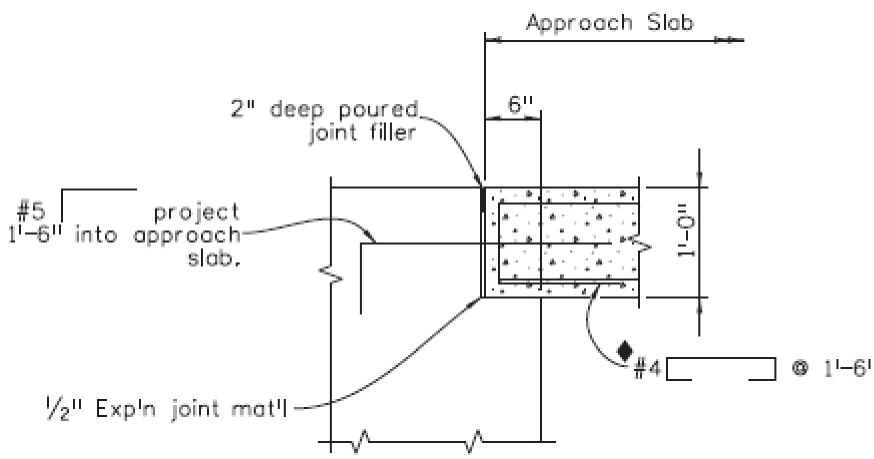


Figure 4-3 Colorado Expansion Joint Detail (CDOT)

4.2 Illinois

The Illinois Department of Transportation approach panel plans are provided in Appendix A. The details presented here forward are specific to approach panels joined by PCC pavement. Other details differ only slightly, primarily at the joint between approach slab and pavement.

The approach panel shown in Figure 4-4 extends from the paving notch at the top side of the abutment 7'-5"over the top of the sleeper slab measuring 30'-0" long. The panel is 1'-3" thick and is reinforced with a double mat of #4 bars at 15" o.c. each way top of slab and #5 bars at 8" o.c. transverse and #9 bars at 5" o.c. longitudinal at the bottom of slab. The approach is tied to the abutment in two ways. First, #5 bars extend vertically from the paving notch into the bottom of the approach slab and second, bars are coupled with the top reinforcing in the deck and extending into the approach slab.

The sleeper slab shown in Figure 4-5 which extends transversely under the bottom of the approach panel measures 10'-0" wide and 10" thick; it is reinforced with #4 bars at 12" o.c. running transversely within the sleeper top and bottom and #5 bars at 6" c.c. running along the length of the sleeper top and bottom. A 10 mil polyethylene bond breaker on a steel troweled finish is used between the sleeper slab and approach panel to aid the sliding ability of the approach panel.

The joint between the approach panel and pavement measures 2-3/4" and is filled with a preformed joint seal as shown in Figure 4-6. Porous granular backfill is placed at the abutment wall and partially under the approach, while the remaining approach is cast upon granular subbase.

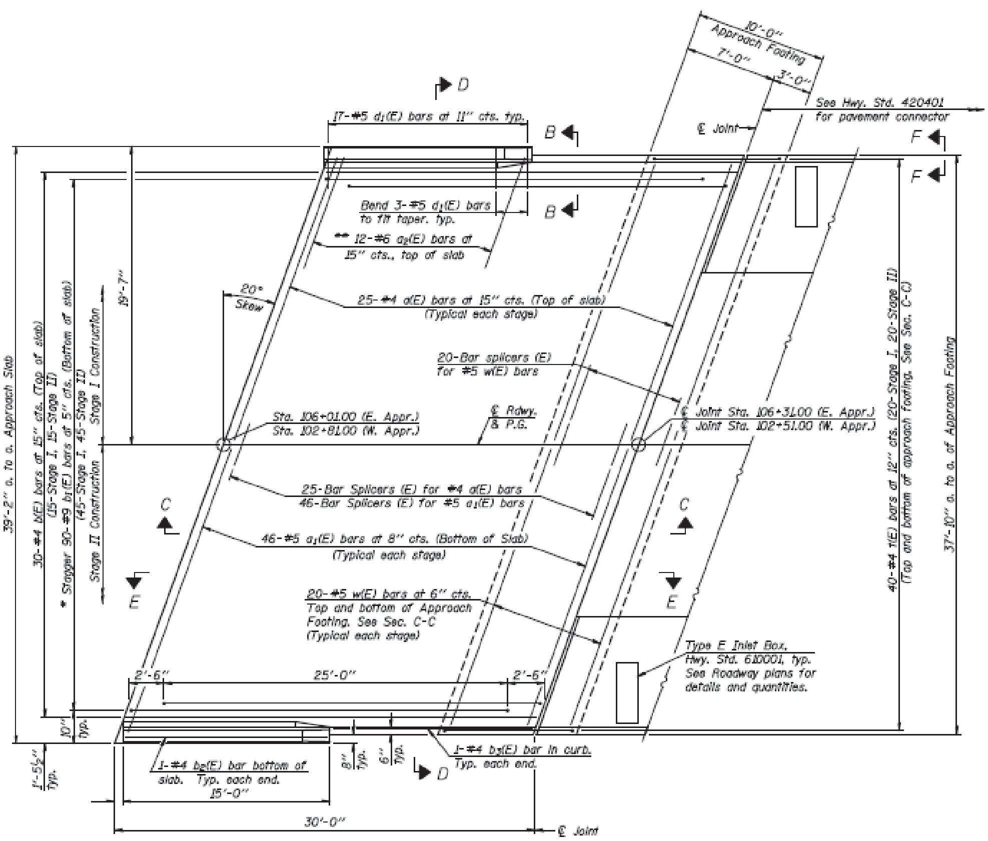


Figure 4-4 Illinois Approach Plan (IDOT)

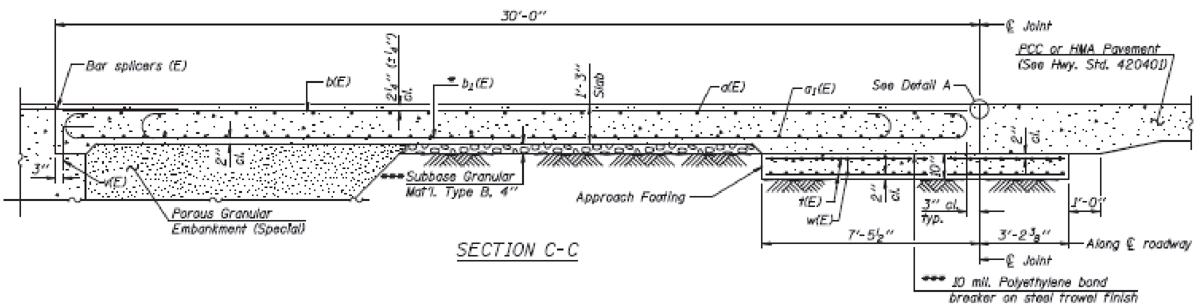


Figure 4-5 Illinois Approach Panel Section (IDOT)

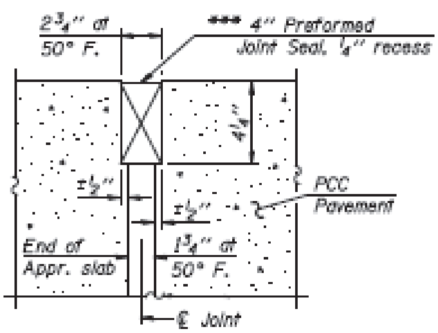


Figure 4-6 Illinois Approach Expansion Joint (IDOT)

4.3 Indiana

The Indiana Department of Transportation uses one of two plans depending if the mainline pavement is asphalt or concrete. Each plan is provided within Appendix A. The following example is that of a reinforced concrete bridge approach for use with concrete mainline pavement.

The approach panel shown in Figure 4-7 measures 6200 mm (20'-4") from the paving notch on the abutment wall to the where it extends over a sleeper slab. The thickness of the panel is 300 mm (11 13/16") and it is reinforced with #4 bars at 300 mm o.c. (11 13/16") each way at the top and #5 bars at 600 mm o.c. (23 5/8") parallel to end of bridge and #5 bars at 150 mm o.c. (5 5/16") longitudinally at the bottom.

As shown in Figure 4-8, the approach panel is cast directly against the bridge deck with expanded polystyrene protecting the bottom edges at the abutment bearing location. The panel is tied to the abutment with a diagonal #5 bar spaced at 300 mm c.c. (11-13/16") creating a hinge-type connection.

Below the panel lies a dense graded subbase which overlays a course aggregate backfill at the abutment wall. Two layers of polyethylene sheeting serve as a bond breaker between the approach panel and subbase.

The sleeper slab shown in Figure 4-9 which supports the end of the approach panel and mainline pavement measures 2500 mm (8'-2 7/16") wide and is reinforced with #5 bars at 460 mm c.c. (18 1/8") top and bottom longitudinally and #5 bars at 150 mm c.c. (5 5/16") transversely.

The joint between the approach panel and approach pavement shown in Figure 4-10 consists of a 600 mm (23 5/8") gap between the approach panel and mainline pavement. This gap is filled with hot mix asphalt to match the elevation of the approach panel and mainline pavement.

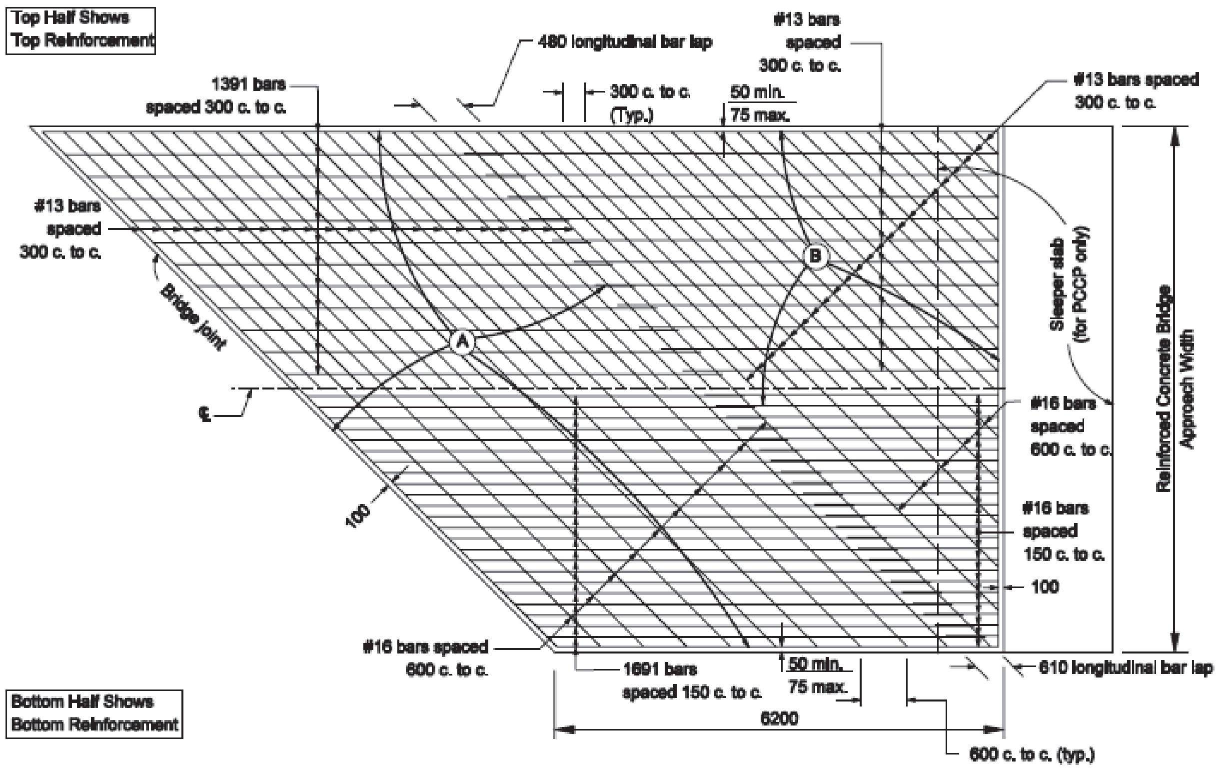


Figure 4-7 Indiana Approach Panel Plan (INDOT)

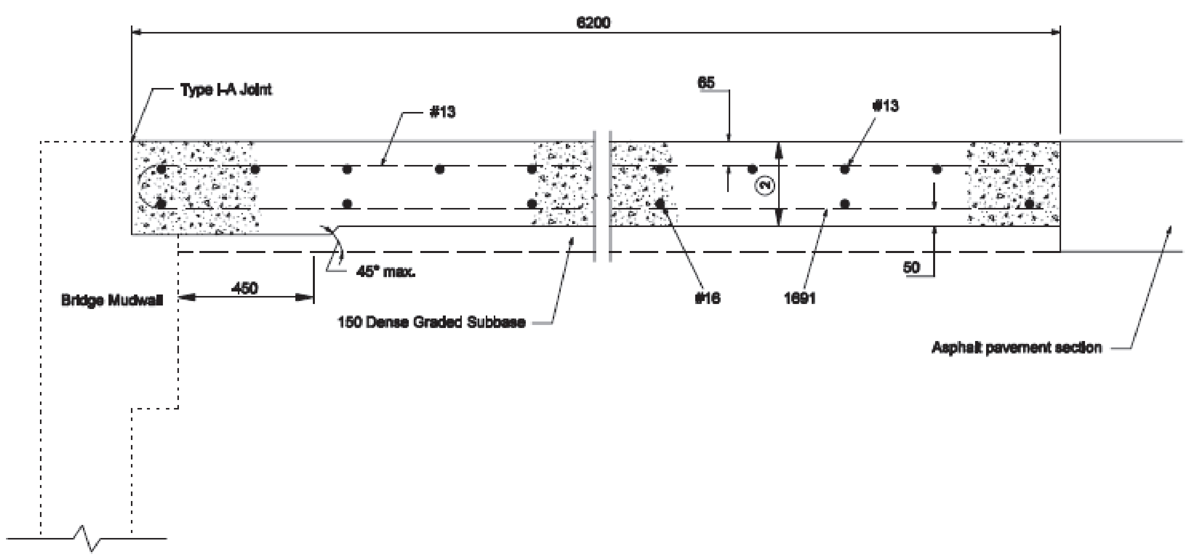


Figure 4-8 Indiana Approach Panel Section (INDOT)

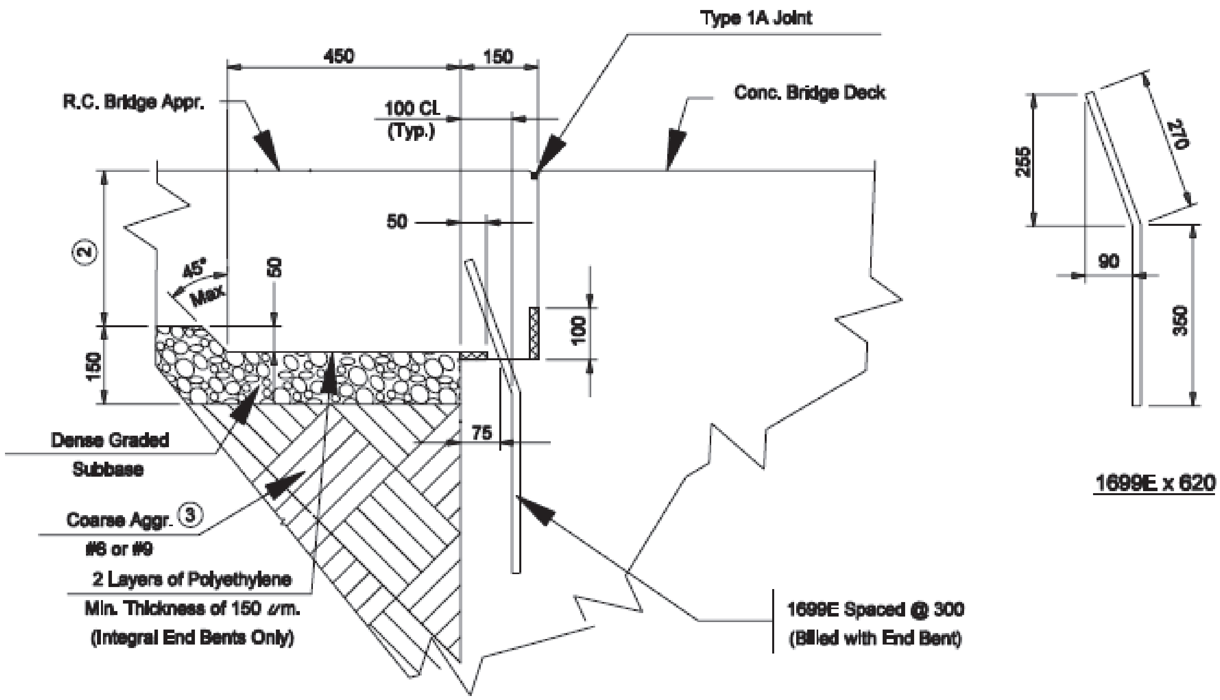


Figure 4-9 Indiana Paving Notch Detail (INDOT)

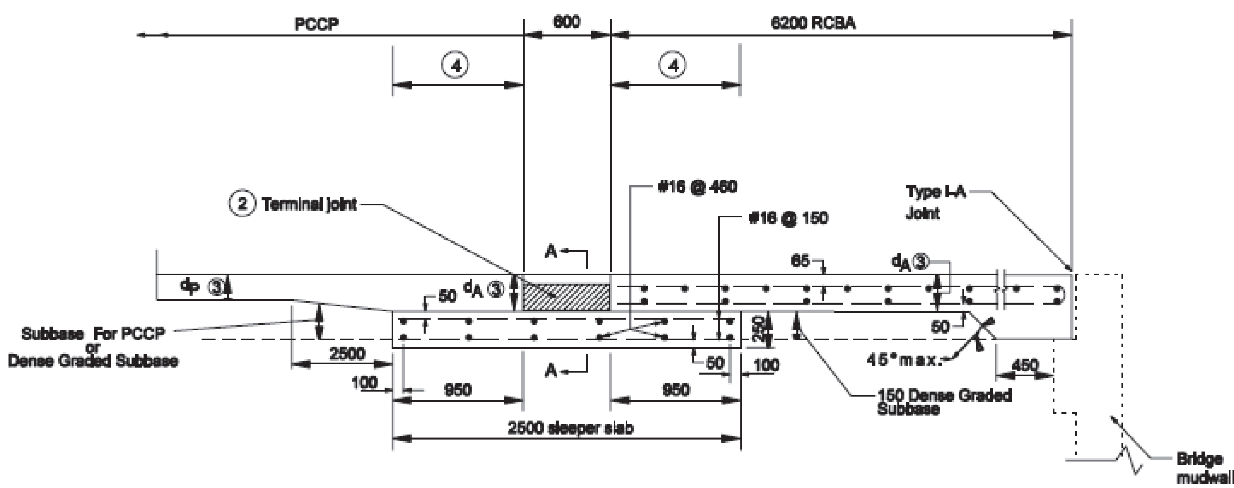


Figure 4-10 Indiana Terminal Joint between Approach and Pavement (INDOT)

4.4 Iowa

The Iowa Department of Transportation has several variations of their approach panel details depending on the exact application; all are provided in Appendix A. Be that as it may, the underlying fundamentals and details remain very similar. The example shown below is for a two-lane approach with abutting PCC pavement. Three distinct sections make up the approach panels and pavement: a reinforced section, non-reinforced section, and approach pavement.

As shown in Figure 4-11, the reinforced section extends a minimum of 20'-0" from the paving notch on the abutment wall at the end of the bridge to the non-reinforced section. The section is 10" thick and reinforced with #5 bars at 12" o.c. transversely and #8 bars at 12" o.c. longitudinally. The non-reinforced section is also 10" thick and extends 10' to 20' from the reinforced section to the mainline pavement. As shown in Figure 4-12, below each section lies a 4" modified subbase and a polymer grid. The section is tied to the abutment using diagonally placed reinforcing bars and an "E joint" is used between the bridge deck and approach slab (see Figure 4-13 and Figure 4-14).

Between the reinforced and non-reinforced section is a doweled contraction joint ("CD joint") shown in Figure 4-15 which includes 1-1/2" diameter, 18" long dowels at 12" o.c. and a 3-1/2" deep saw cut transverse to the roadway centerline. The same joint is used every 20' within the non-reinforced section for up to 300' each way from the end of the reinforced section per the engineer's requirements.

Still within the non-reinforced section, 10' from the mainline pavement, an "EF Joint" shown in Figure 4-16 is used to accommodate movement between the approach and mainline pavement. The joint consists of 1-1/2" diameter, 18" long dowels at 12" o.c. spanning the 3-1/2" joint and flexible foam joint filler capped with joint sealant material.

Between the non-reinforced section and mainline pavement is a "DW joint" shown in Figure 4-17 that includes 30" long, #11 tie bars at 12" o.c. The bars are embedded 15" into the non-reinforced section, while the remaining 15" is left to be cast into the mainline pavement. Below the joint sits a 4" perforated subdrain and porous backfill (see again Figure 4-11).

Included in the standard details are the abutment backfill processes, both in illustrative and narrative forms. These are shown in Figure 4-18 and Figure 4-19, respectively. One noteworthy practice used in Iowa is flooding the backfill. This has been found to be critical to avoid unwanted post-construction collapse in the backfill material, thereby benefitting the overall performance of the approach slabs.

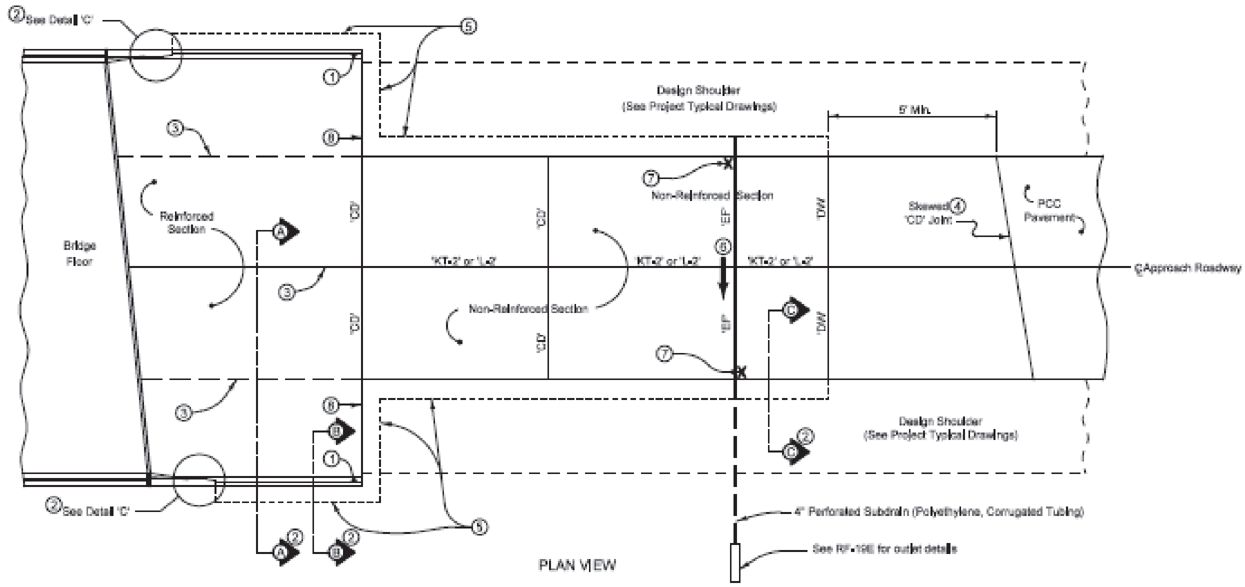


Figure 4-11 Iowa Approach Pavement Plan View (IADOT)

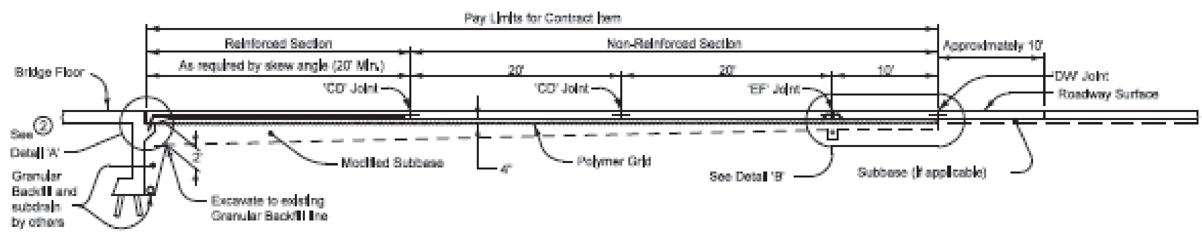


Figure 4-12 Iowa Approach Section through Centerline (IADOT)

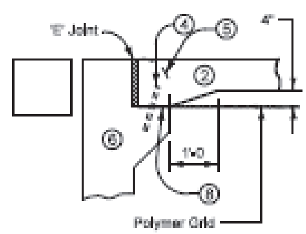


Figure 4-13 Iowa Approach "E" Joint at Bridge Abutment (IADOT)

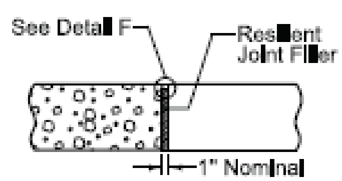


Figure 4-14 Iowa Approach E Joint Detail (IADOT)

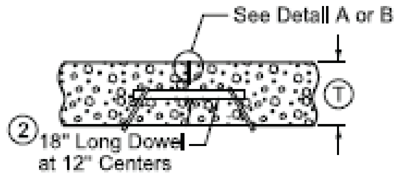


Figure 4-15 Iowa Approach CD Joint (IADOT)

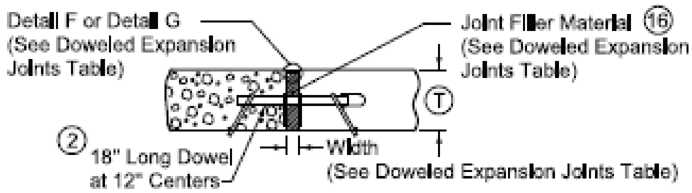


Figure 4-16 Iowa Approach EF Joint (IADOT)

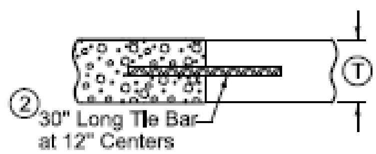


Figure 4-17 Iowa Approach DW Joint (IADOT)

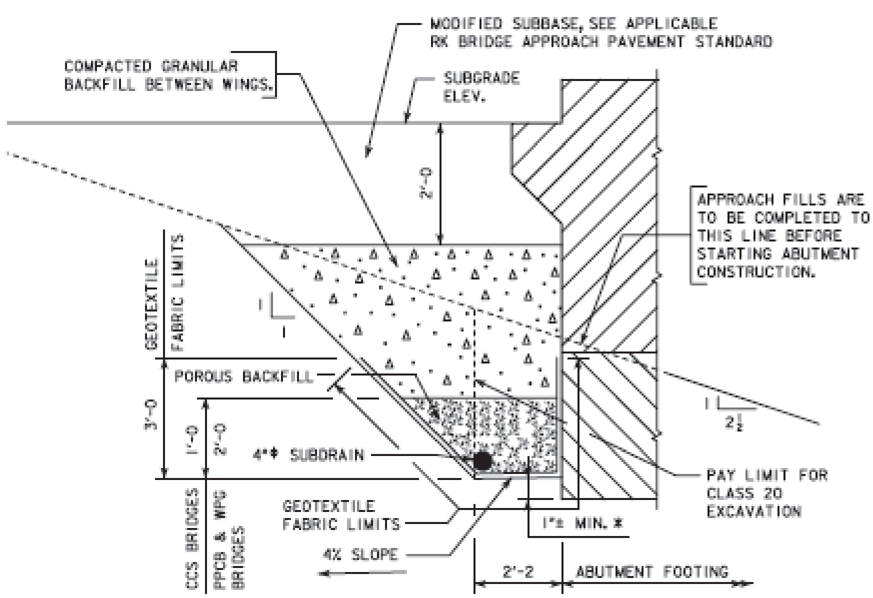


Figure 4-18 Iowa Abutment Backfill Detail (IADOT)

ABUTMENT BACKFILL PROCESS:

THE BASE OF THE EXCAVATION SUBGRADE BEHIND THE ABUTMENT IS TO BE GRADED WITH A 4% SLOPE AWAY FROM THE ABUTMENT FOOTING AND A 2% CROSS SLOPE IN THE DIRECTION OF THE SUBDRAIN OUTLET. THIS EXCAVATION SHAPING IS TO BE DONE PRIOR TO BEGINNING INSTALLATION OF THE GEOTEXTILE AND BACKFILL MATERIAL.

AFTER THE SUBGRADE HAS BEEN SHAPED THE GEOTEXTILE FABRIC SHALL BE INSTALLED IN ACCORDANCE WITH THE DETAILS SHOWN. THE FABRIC IS INTENDED TO BE INSTALLED IN THE BASE OF THE EXCAVATION AND EXTENDED VERTICALLY UP THE ABUTMENT BACKWALL, ABUTMENT WING WALLS, AND EXCAVATION FACE TO A HEIGHT THAT WILL BE APPROXIMATELY 1 TO 2 FOOT HIGHER THAN THE HEIGHT OF THE POROUS BACKFILL PLACEMENT AS SHOWN IN THE "GRANULAR BACKFILL DETAILS" ON THIS SHEET.
THE STRIPS OF THE FABRIC PLACED SHALL OVERLAP APPROXIMATELY 1 FOOT AND SHALL BE PINNED IN PLACE. THE FABRIC SHALL BE ATTACHED TO THE ABUTMENT BY USING LATH FOLDED IN THE FABRIC AND SECURED TO THE CONCRETE WITH SHALLOW CONCRETE NAILS. THE FABRIC PLACED AGAINST THE EXCAVATION FACE SHALL BE PINNED.

WHEN THE FABRIC IS IN PLACE, THE SUBDRAIN SHALL BE INSTALLED DIRECTLY ON THE FABRIC AT THE TOE OF THE REAR EXCAVATION SLOPE. A SLOT WILL NEED TO CUT IN THE FABRIC AT THE POINT WHERE THE SUBDRAIN EXITS THE FABRIC NEAR THE END OF THE ABUTMENT WING WALL.

POROUS BACKFILL IS THEN PLACED AND LEVELED, NO COMPACTION IS REQUIRED.

THE REMAINING WORK INVOLVES BACKFILLING WITH GRANULAR BACKFILL, SURFACE FLOODING, AND VIBRATORY COMPACTION. THE GRANULAR BACKFILL MATERIAL SHALL HAVE 4% OR LESS PASSING THE #200 SIEVE (I.E. WASHED CONCRETE SAND). THE GRANULAR BACKFILL WILL REQUIRE PLACEMENT IN INDIVIDUAL LIFTS, SURFACE FLOODED, AND THEN FOLLOWED WITH VIBRATORY COMPACTION TO ENSURE FULL CONSOLIDATION. LIMIT THE LOOSE LIFTS TO NO MORE THAN 2 FOOT OF THICKNESS.

TO ENSURE UNIFORM SURFACE FLOODING, WATER RUNNING FULL IN A 2 INCH DIAMETER HOSE FOR 5 MINUTES SHOULD BE SPRAYED ON EACH SAND LIFT AT INCREMENTS NOTED. SURFACE FLOODING IS TO START AT THE HIGH END OF THE SUBDRAIN AND PROGRESS INCREMENTALLY TO THE LOW POINT WHERE THE SUBDRAIN EXITS THE FABRIC. TYPICAL SPACING FOR THE SURFACE FLOODING (5 MINUTE INTERVALS) SHOULD BE APPROXIMATELY AT 6 FOOT TO 8 FOOT INCREMENTS.

LIFT PLACEMENT, FLOODING, AND COMPACTION SHALL PROGRESS UNTIL THE REQUIRED FULL THICKNESS OF THE ABUTMENT BACKFILL HAS BEEN COMPLETED.

SUBDRAINS, POROUS BACKFILL, GRANULAR BACKFILL, GEOTEXTILE FABRIC AND WATER FLOODING REQUIRED AND FURNISHED AT THE BRIDGE ABUTMENTS WILL NOT BE MEASURED SEPARATELY FOR PAYMENT.

THE COST OF SUBDRAINS, POROUS BACKFILL, GRANULAR BACKFILL, GEOTEXTILE FABRIC AND WATER FLOODING REQUIRED AND FURNISHED AT THE BRIDGE ABUTMENTS SHALL BE INCLUDED IN THE CONTRACT UNIT PRICE BID FOR THE STRUCTURAL CONCRETE.

Figure 4-19 Iowa Abutment Backfill Process (IADOT)

4.5 Kansas

The Kansas Department of Transportation approach plans are provided in Appendix A. A portion of the plans is presented below.

The approaches shown in Figure 4-20 and Figure 4-21 are composed of two spans between the mainline pavement and bridge abutment. At the abutment, the approach rests upon a paving notch formed into the abutment and is tied to the abutment with horizontally placed mild reinforcement near the bottom of the approach slab. The 10" thick approach extends 13'-0" from the abutment to a sleeper footing. From there, the approach is divided by an expansion joint measuring 2 1/2" to 4"and then continues to the next sleeper footing where another expansion joint of similar dimension divides the approach from the mainline pavement. The first span is reinforced with #5 bars at 11 1/2" o.c longitudinally and #5 bars at 12" c.c. transversely in the top of the slab; and #6 bars at 6" o.c longitudinally and #5 bars at 18" c.c. in the bottom of the slab. The second span measures 20'-0" and is reinforced with welded wire reinforcement top and bottom. A transverse sawed joint spanned by 2'-6" long, #6 bars is placed at midspan.

The sleeper footings shown in Figure 4-22 each measure 4'-0" wide by 2'-0" deep. They are reinforced by welded wire reinforcement top and bottom. The footings are smooth steel troweled and coated with a curing compound to reduce the friction forces between the approach panels and sleeper footings.

As shown in Figure 4-23, the expansion joints are filled with a Styrofoam filler and a membrane sealant installed with a bonding adhesive continuous through the pavement edge.

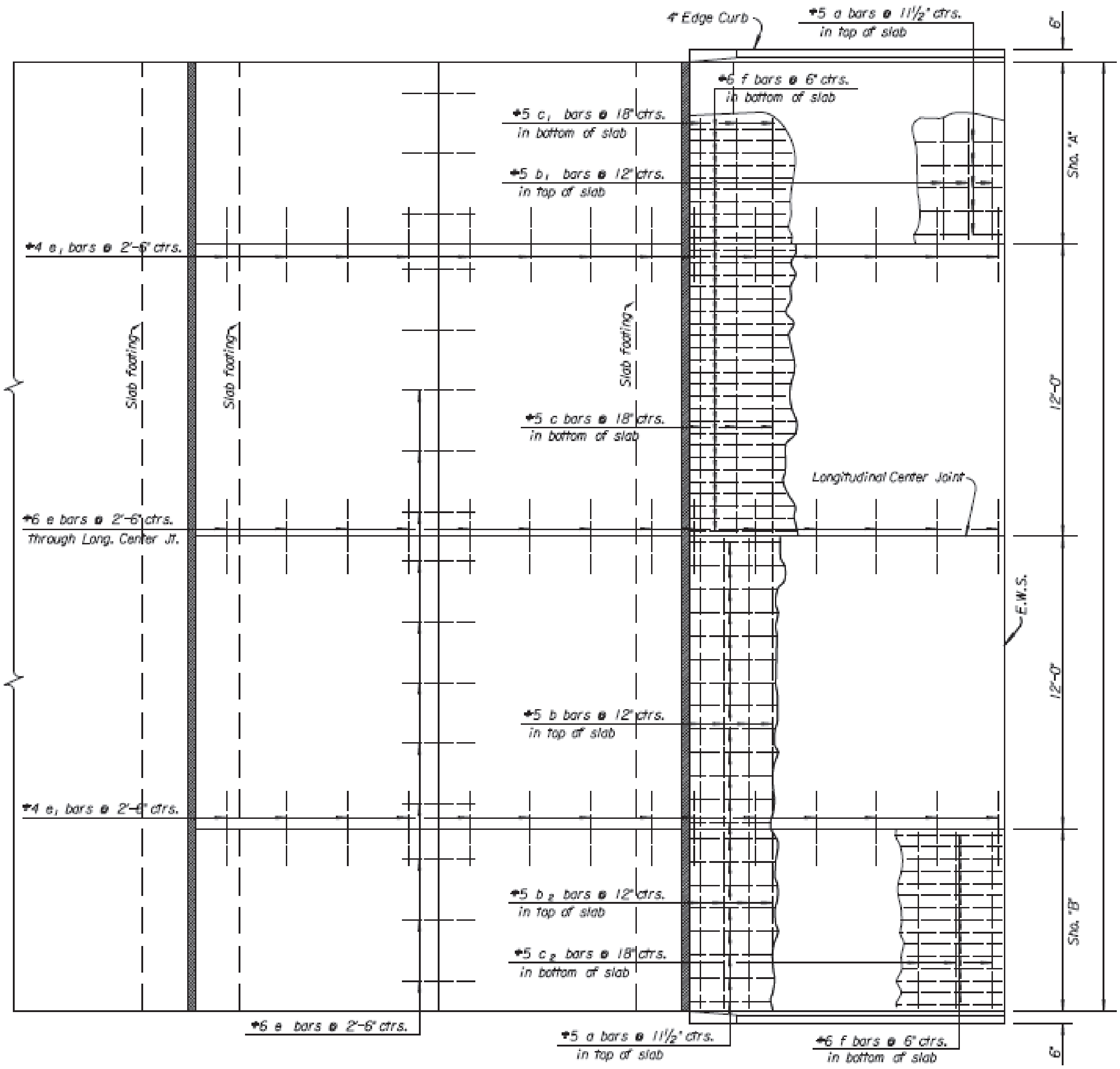


Figure 4-20 Kansas Approach Plan View (KSDOT)

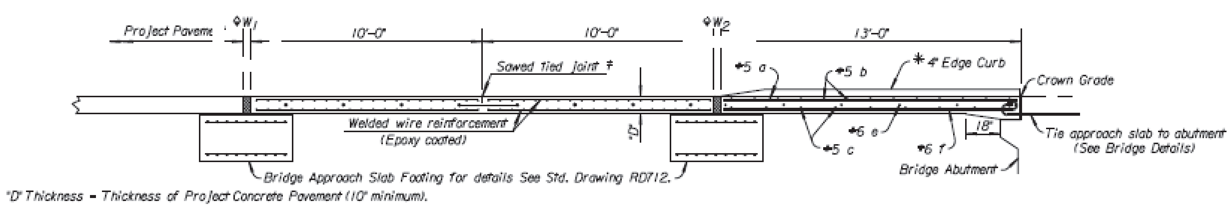


Figure 4-21 Kansas Approach Section View (KSDOT)

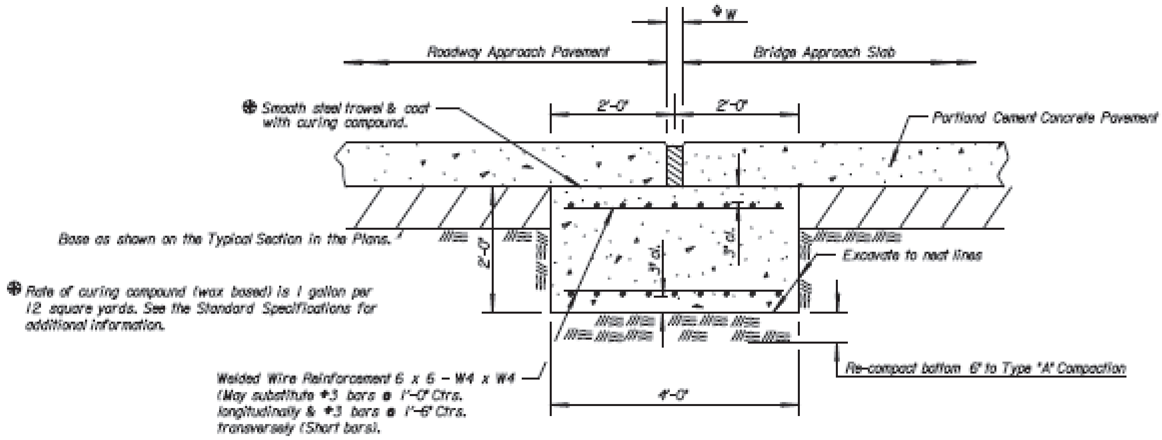


Figure 4-22 Kansas Approach Footing (KSDOT)

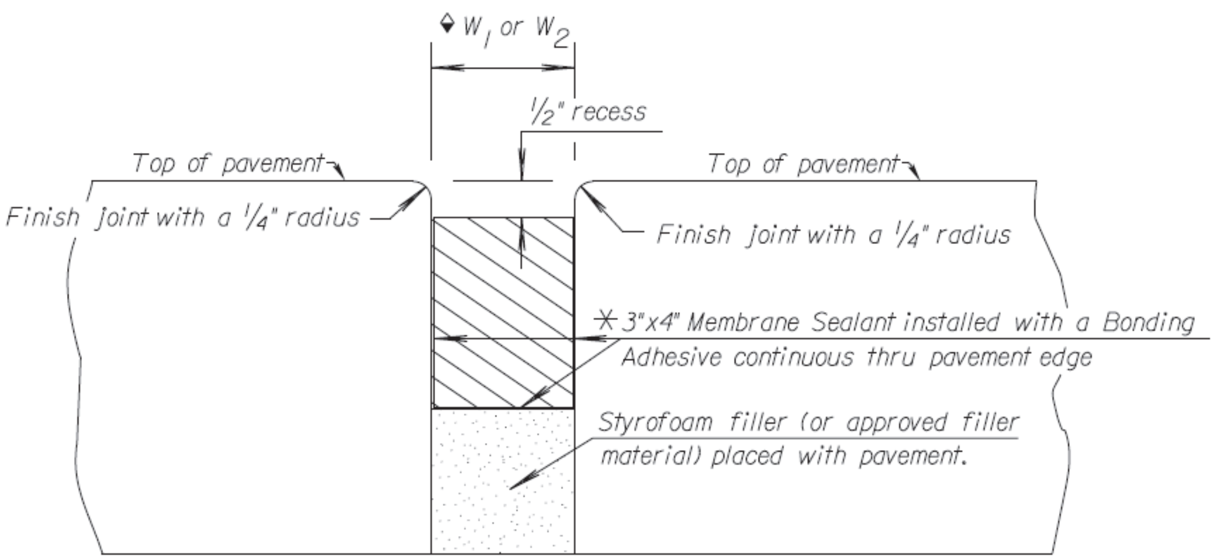


Figure 4-23 Kansas Pressure Relief Joint (KSDOT)

4.6 Kentucky

The approach panel plans used by the Kentucky Department of Transportation are provided in Appendix A. Shown in Figure 4-24, the 1'-5" thick slab extends 25'-0" from the paving notch cast into the abutment to the joint with the mainline pavement. Dowels measuring 1 1/2" in diameter are cast vertically into the paving notch and tie the approach panel to the bridge. Neoprene pads, 1/8" thick, are cast between the approach panel and paving notch. The approach is recessed 12" from the top of the bridge deck, thus the mainline pavement is continuous over the panel to the bridge. The approach is reinforced with #8 bars at 6" o.c. longitudinally and #5 bars at 10" o.c. parallel to the end of bridge at the bottom of the slab. Structural granular backfill and geotextile fabric are used below the approach at a 1 to 1 slope away from the abutment (see Figure 4-25).

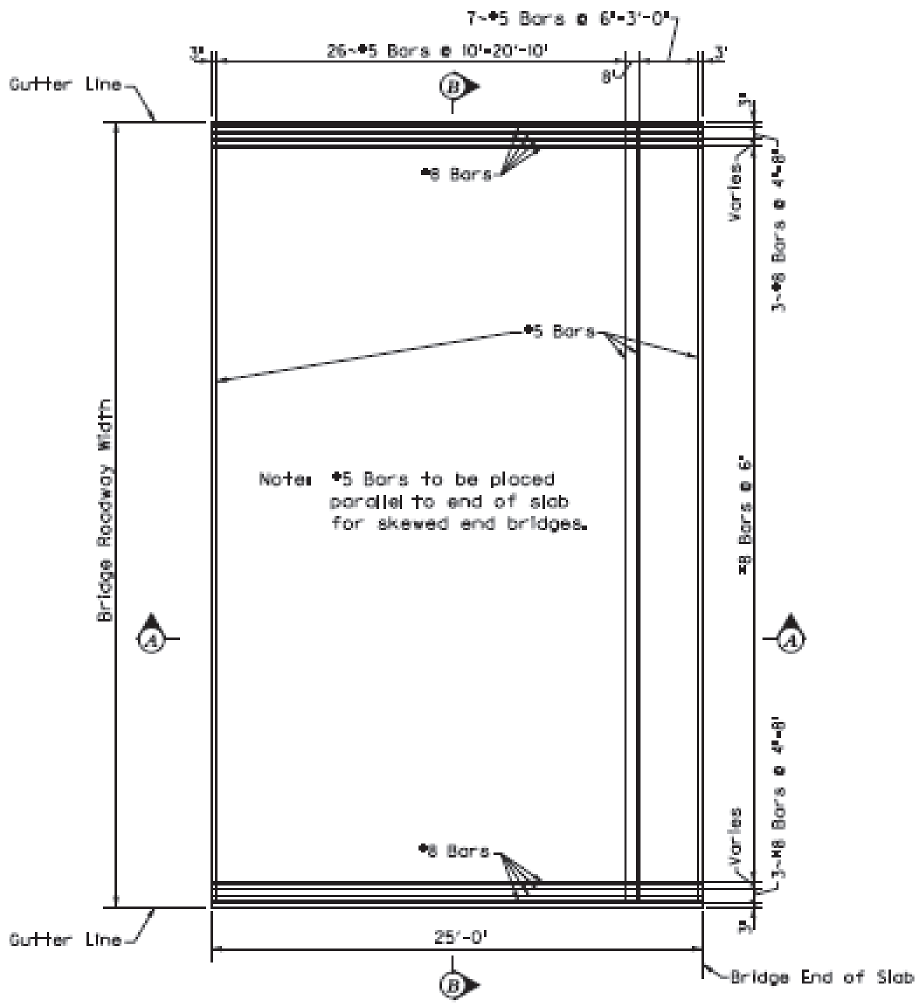


Figure 4-24 Kentucky Approach Plan (KYTC)

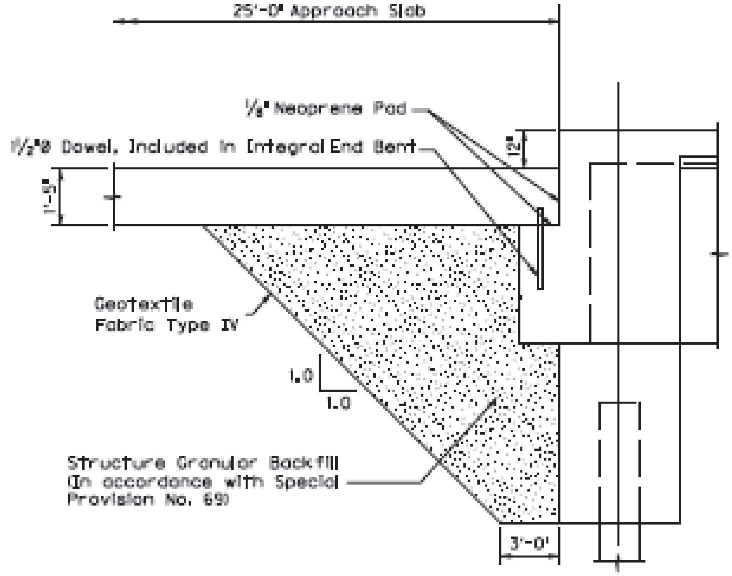


Figure 4-25 Kentucky Approach Detail (KYTC)

4.7 Minnesota

Minnesota's standard plans (see Appendix A for full plans) detail the bridge approach panel layout for various scenarios including bridge skews greater than or less than 10 degrees (see Figure 4-26 and Figure 4-27); barriers on the wingwall or approach panel; and concrete or bituminous mainline pavement.

In each case the approach panel measures 1'-0" thick with the reinforcement within the panel consisting of #4 bars at 12" o.c each way in the top mat and #6 bars at 12" o.c. parallel to roadway and #5 bars at 12" o.c. perpendicular to roadway in the bottom mat. A single diagonal #6 at 12" o.c. is used to join the approach panel to the paving notch at the top of the abutment wall creating a hinge-type connection. Figure 4-28 shows the section view of the approach panel.

For bridges skewed less than 10 degrees, the approach panel measures 20'-0" long from the end of the bridge to where it is supported by a sleeper slab at the opposite end. The sleeper slab measures 4'-0" wide and 1'-6" thick and extends the entire width of the approach panel normal to the bridge centerline and is reinforced with three #5 bars top and bottom. A concrete end block is formed on the sleeper slab (see Figure 4-29) that can be monolithic with the mainline concrete pavement or simply serve as a block at which bituminous mainline pavement can terminate (see Figure 4-30). Between the block and approach panel an E8H, 4" expansion joint exists. This joint is shown in Figure 4-31. Incorporated into concrete mainline pavement are two 12" x 12" keys to help reduce and minimize the horizontal movement of the pavement at the expansion joint.

For bridges skewed at more than 10 degrees, the contraction joints are cut into the approach panel at no greater than 20'-0" increments; 5'-0" long, #6 bars at 12" o.c. extend across the joint. An example of the dowel layout is shown in Figure 4-32. All other details remain the same as for non-skewed bridges.

As shown in Figure 4-33, select granular material is used to backfill behind the abutment wall and under the approach slab. A 12 mil polyethylene sheet is used as a bond breaker between the approach slab and granular material to allow longitudinal movement of the approach panel. Subsurface drain pipe is used at the heel of the abutment wall and either side of the sleeper slab (see again Figure 4-28).

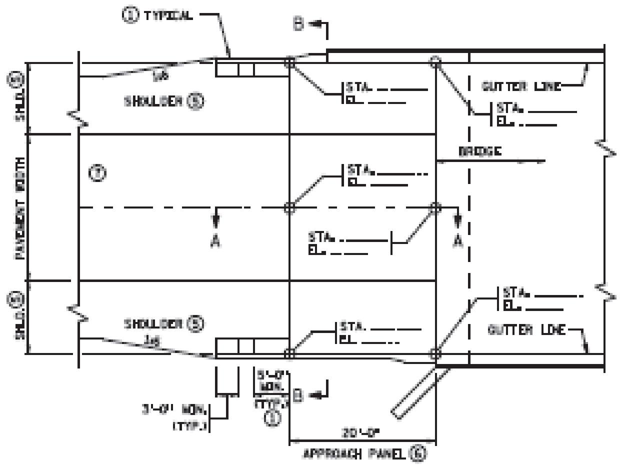


Figure 4-26 Minnesota Approach Panel Plan - No skew (MNDOT)

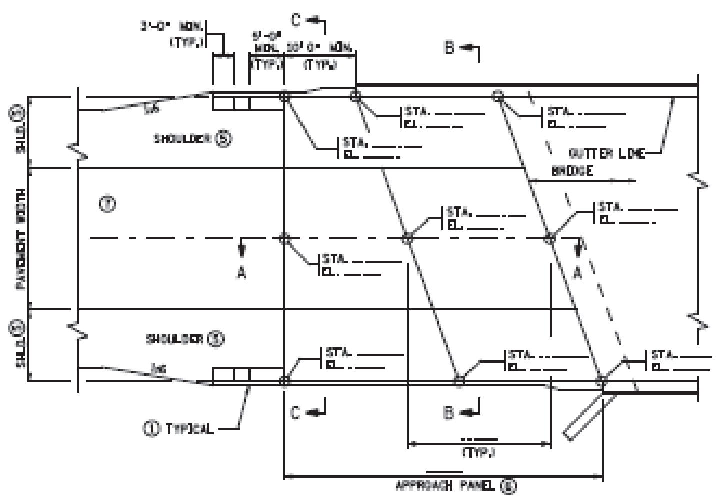


Figure 4-27 Minnesota Approach Panel Plan – Skewed (MNDOT)

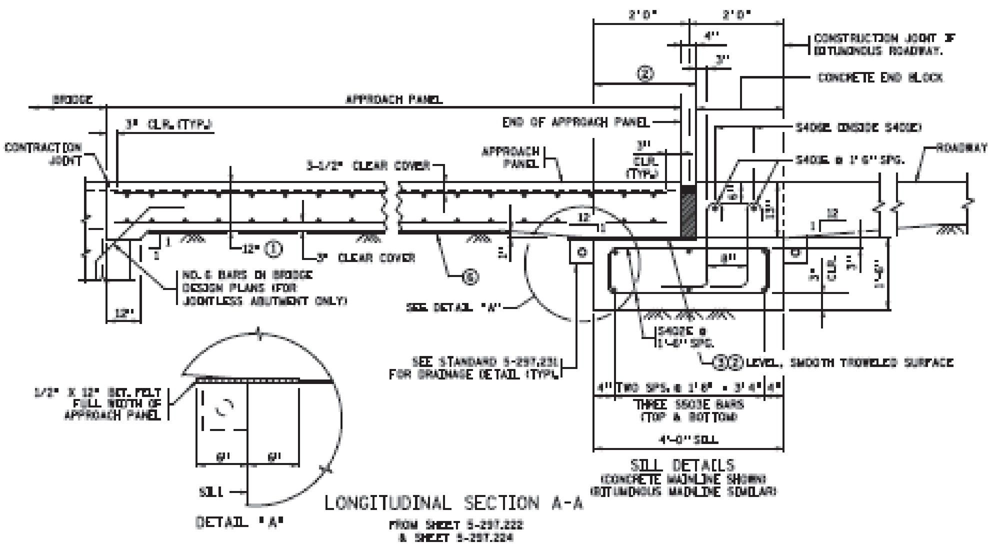


Figure 4-28 Minnesota Approach Panel Section (MNDOT)

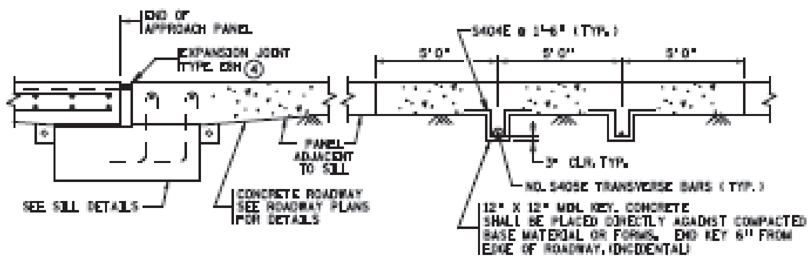


Figure 4-29 Minnesota Approach at Sill and Concrete Mainline (MNDOT)

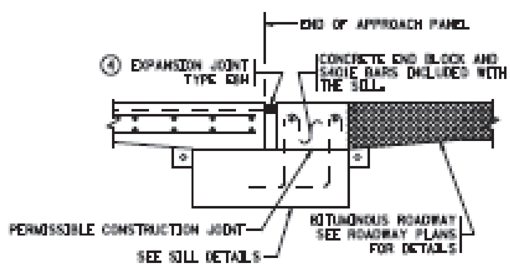


Figure 4-30 Minnesota Approach at Sill and Bituminous Mainline (MNDOT)

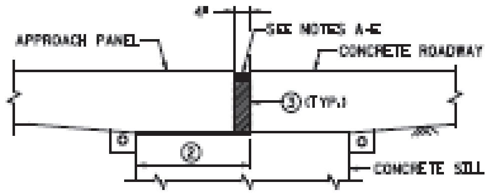


Figure 4-31 Minnesota E8H Expansion Joint (MNDOT)

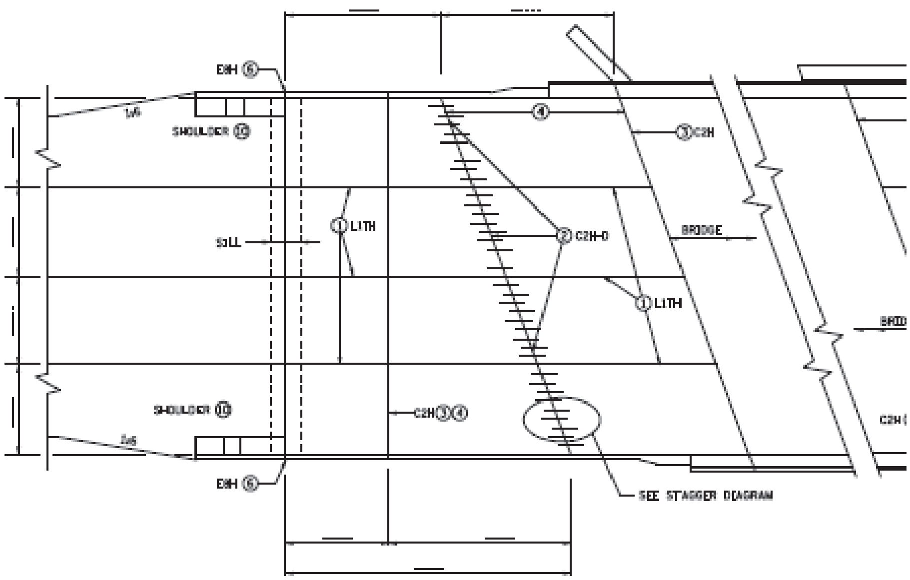


Figure 4-32 Minnesota Skewed Approach Panel Dowel Layout (MNDOT)

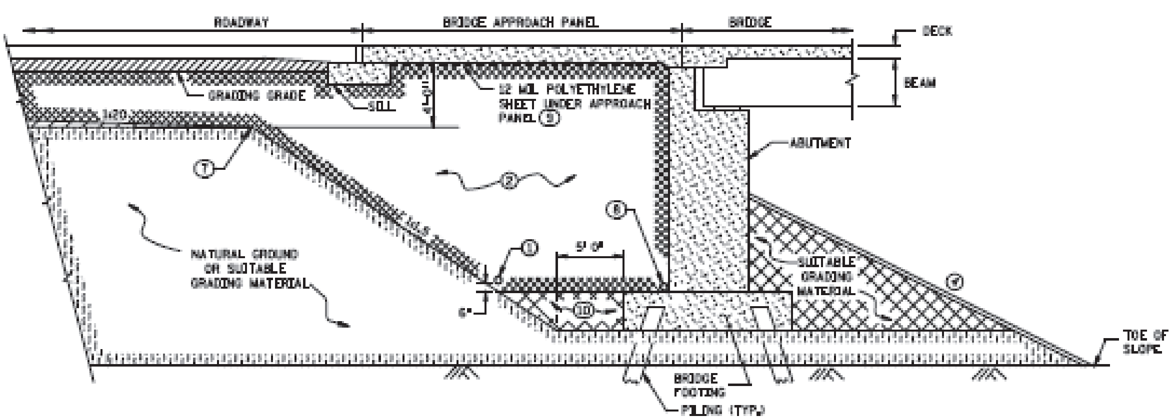


Figure 4-33 Minnesota Approach Panel Finished Grading Section (MNDOT)

4.8 Missouri

The Missouri Department of Transportation bridge approach plans are included in their entirety in Appendix A. The few details provided below give a quick view of the practices employed in Missouri.

The approach panel shown in Figure 4-34, is a minimum of 12" thick (thicker at the crown of the roadway) and is reinforced with #4 bars at 18" o.c. parallel to the bridge end and #7 bars at 12" o.c. parallel to the bridge centerline at the top of the slab. At the bottom of the slab the reinforcement changes to #6 bars at 15"o.c. parallel to the bridge end and #8 bars parallel to the bridge centerline, respectively. The approach spans 25'-0" from the paving notch at the abutment to a sleeper slab. It is tied to the abutment wall with #5 bars at 12" o.c. horizontally placed at mid-depth.

The sleeper slab shown in Figure 4-35 measures 3'-0" wide by 1'-6" tall and is reinforced with (3) #6 bars top and bottom along the length of the slab and #4 transverse stirrups at 12" o.c. Below the sleeper slab lies 2 layers of 4 mil polyethylene sheeting on top of a 4" granular base. At the approach side of the sleeper slab, a perforated drain pipe is installed in an aggregate base to help shed water

A timber header shown in Figure 4-36 is installed at the end of the approach panel. This remains in place until the mainline pavement is placed.

At approximately a 9'-0" by 6'-0" grid (see Figure 4-37), access hole locations are installed to allow visual access to the underside of the approach panel. The holes are 2 3/4" diameter and filled with sand and capped with a 1" thick plug of joint sealing material as shown in Figure 4-38.

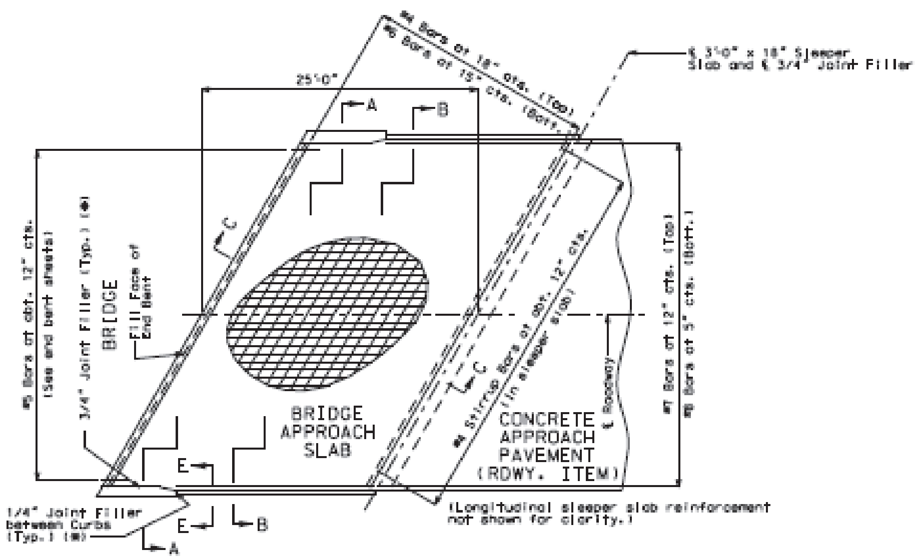


Figure 4-34 Missouri Approach Plan (MODOT)

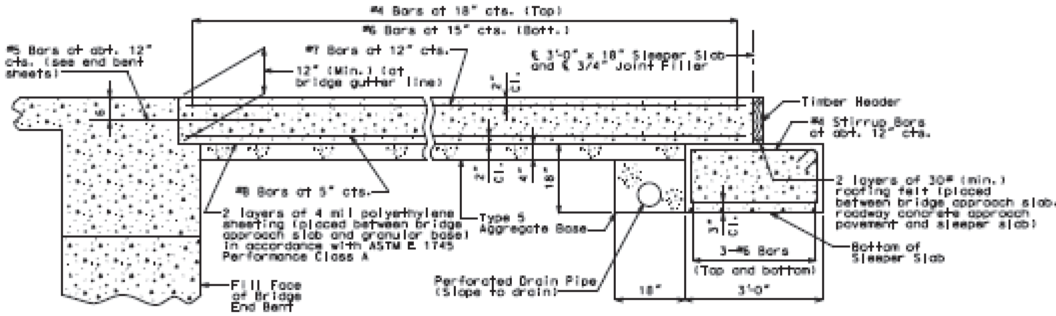


Figure 4-35 Missouri Approach Section (MODOT)

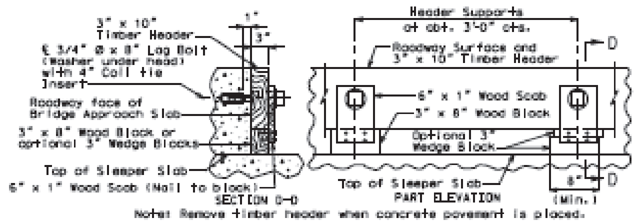


Figure 4-36 Missouri Timber Header Detail (MODOT)

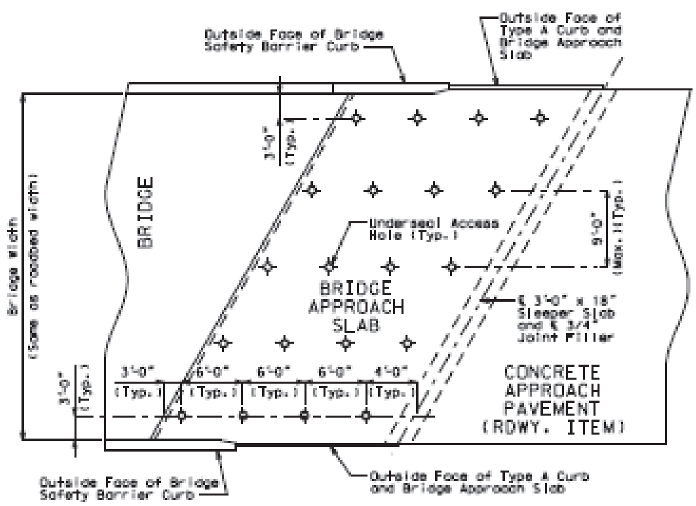


Figure 4-37 Missouri Approach Access Hole Locations (MODOT)

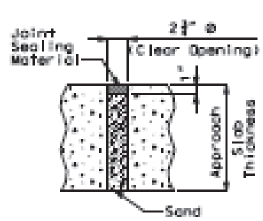


Figure 4-38 Missouri Approach Access Hole Detail (MODOT)

4.9 Nebraska

The approach plans from the Nebraska Department of Transportation are fully provided in Appendix A. Variations of the plans exist for skewed bridges and also for differing mainline pavements. The example provided below is that of a skewed bridge and adjoining concrete mainline pavement. The construction of the approach is similar to many other states except for one very significant difference: the approach is composed on two spans, the common joint being supported by a grade beam on piles.

The approach shown in Figure 4-39 includes two spans, the first measuring 20'-0" from the bridge abutment to the grade beam and the other measuring 30'-0" from the grade beam to the joint with the mainline pavement. Each span is supported along its length by granular backfill.

Each span shown in Figure 4-40 is 1'-2" thick and doubly reinforced with a top mat of #5 bars at 12" o.c. each way and bottom mats of #5 transverse bars at 8" and #8 longitudinal bars at 5"in the 20'-0" span and #5 transverse bars at 12" and #6 longitudinal bars at 6" in the 30'-0" span. The approach is tied to the bridge using diagonal #6 bars and the second span is tied to the grade beam with diagonal #5 bars creating a hinge-type connection in both cases.

The grade beam which supports one end of each span is supported by piles. The 2" joint between the two spans shown in Figure 4-41 is made up of polystyrene and precompressed polyurethane foam. The 3" joint shown in Figure 4-42 between the pavement-adjoining span and pavement is filled with a 3" joint filler and spanned with an 18" long, 1 1/2" diameter smooth tie bar at 12' o.c.

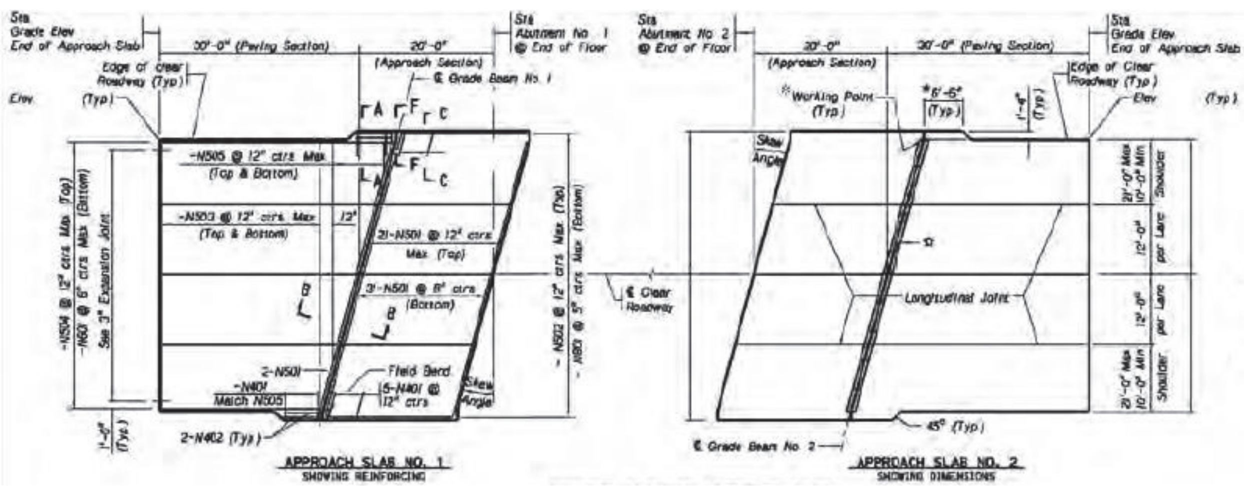


Figure 4-39 Nebraska Approach Plan (NDOR)

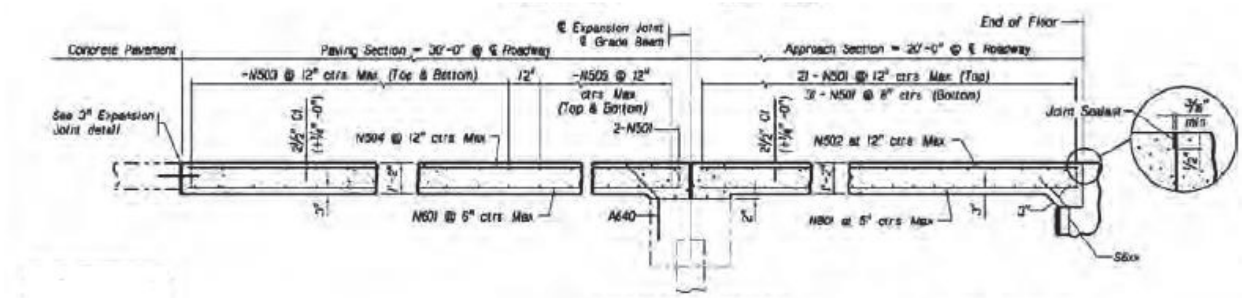


Figure 4-40 Nebraska Approach Section (NDOR)

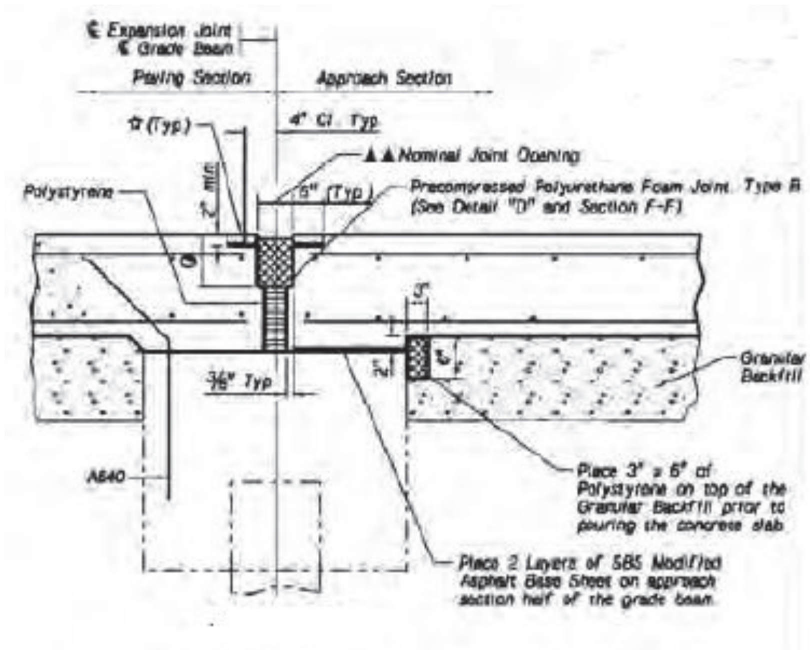


Figure 4-41 Nebraska Approach Expansion Joint (NDOR)

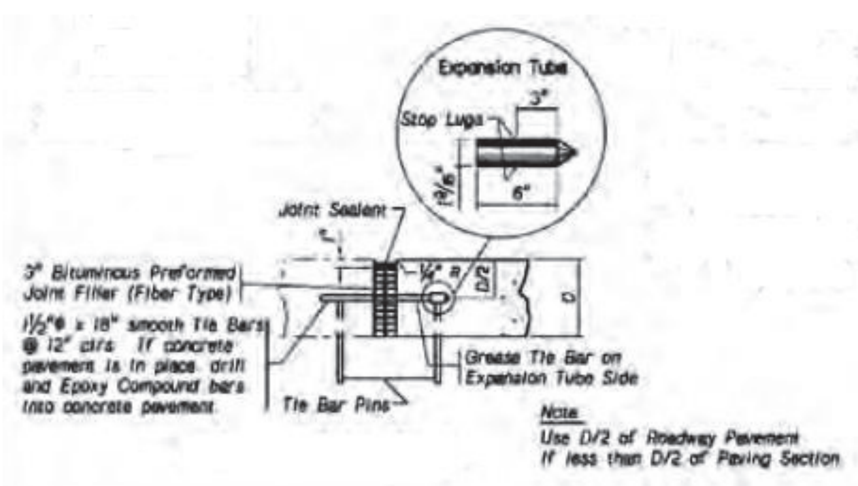


Figure 4-42 Nebraska 3" Expansion Joint (NDOR)

4.10 North Dakota

The approach panel details that the North Dakota Department of Transportation has assembled are limited. They can be found within Appendix A. Though the details are limited, there has been an apparent effort to remove water from below the panels. Shown in Figure 4-43 is the bridge approach slab drainage detail. A turf reinforcement mat is placed beneath the joint between the approach panel and adjoining pavement. The mat measures 11'-0" wide and extends well beyond the roadway limits.

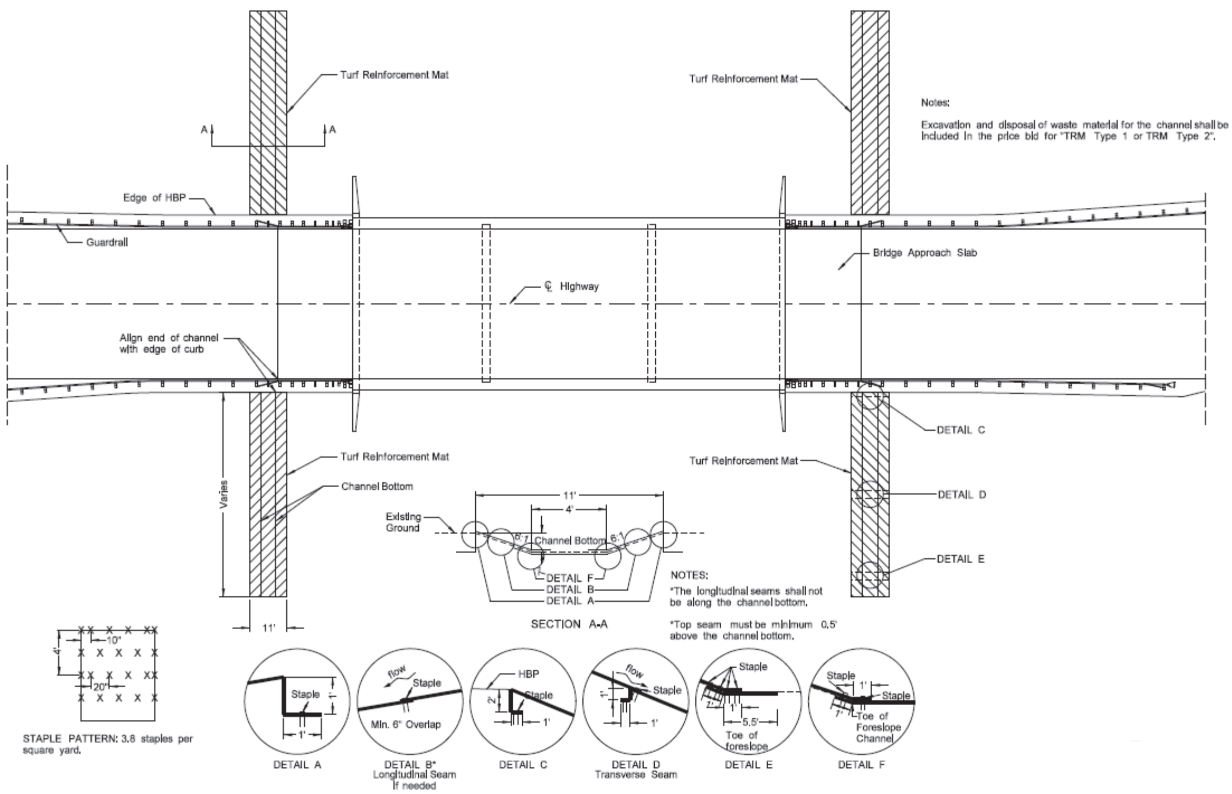


Figure 4-43 North Dakota Approach Drainage Plan (NDDOT)

4.11 Ohio

The Ohio Department of Transportation uses the approach panel plan shown in Figure 4-44. Full plans are provided in Appendix A. The slab can be one of several lengths and thicknesses based upon the factors such as the size and amount of excavation behind the abutments, new or existing embankments and skew of the bridge. The length and corresponding thickness is shown on bridge-specific plans. Regardless of the length and thickness, the detailing remains nearly the same.

As an example, a 20'-0" long approach slab with a 13" thickness is reinforced with #5 bars at 1'-6" o.c. transversely and #5 bars at 1'-6" o.c. longitudinally in the top of the slab, and #5 bars at 8" o.c. transversely and #10 bars at 7 1/2" o.c. longitudinally in the bottom of the slab. The approach rests on the abutment wall and is tied to the bridge with a diagonal #8 reinforcing bars at 1'-6" o.c as is shown in Figure 4-45 creating a hinge-type connection.

The approach is supported along its length by a granular base and supported by a sleeper slab at its end as is common with other states (see Figure 4-46). A bond breaker consisting of two 4'-0" sheets of clear or opaque polyethylene film is centered above the joint between the subbase and the sleeper slab. The sleeper slab is troweled smooth at the top surface and is 8'-0" wide and 9" thick with a single mat of #5 bars at 1'-1" the long direction and at 1'-0" placed parallel with the centerline of the roadway. A pressure relief joint as is shown in Figure 4-47 is constructed between the approach slab and mainline pavement on top of the sleeper slab. The joint is 4'-0" wide and filled with asphalt concrete. Adjacent to the sleeper slab on the mainline pavement side, lies a 6" perforated pipe underdrain that extends beyond the roadway limits.

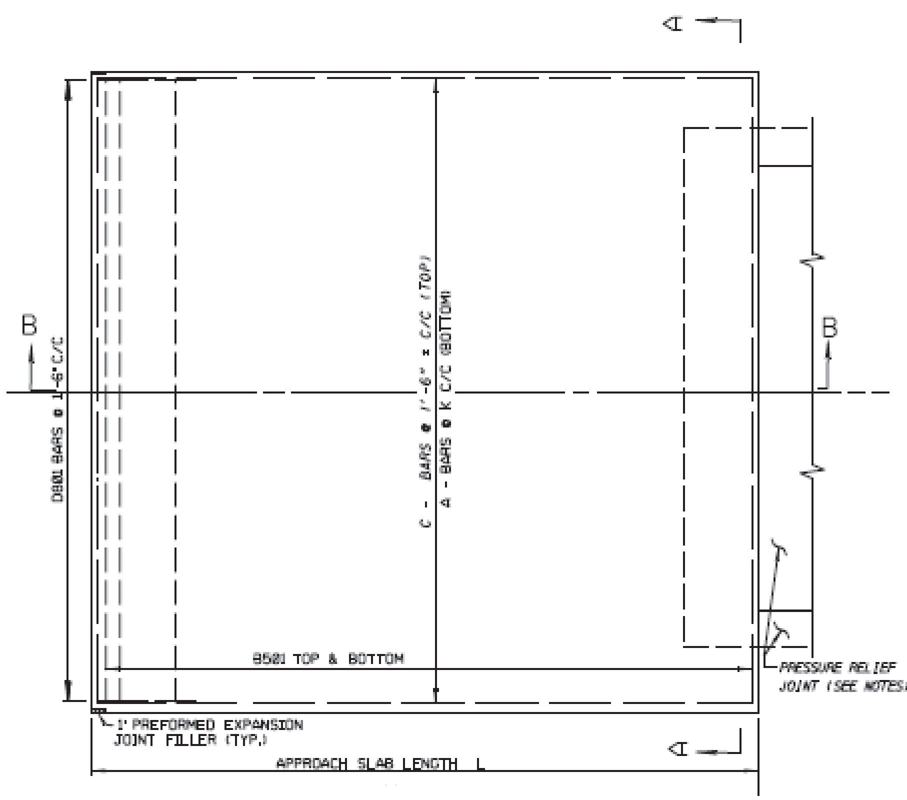


Figure 4-44 Ohio Approach Panel Plan (ODOT)

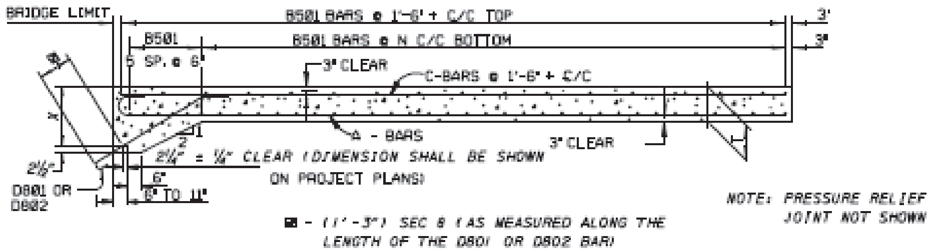


Figure 4-45 Ohio Approach Panel Section (ODOT)

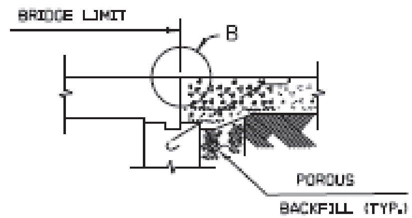


Figure 4-46 Ohio Approach Panel Connection Detail (ODOT)

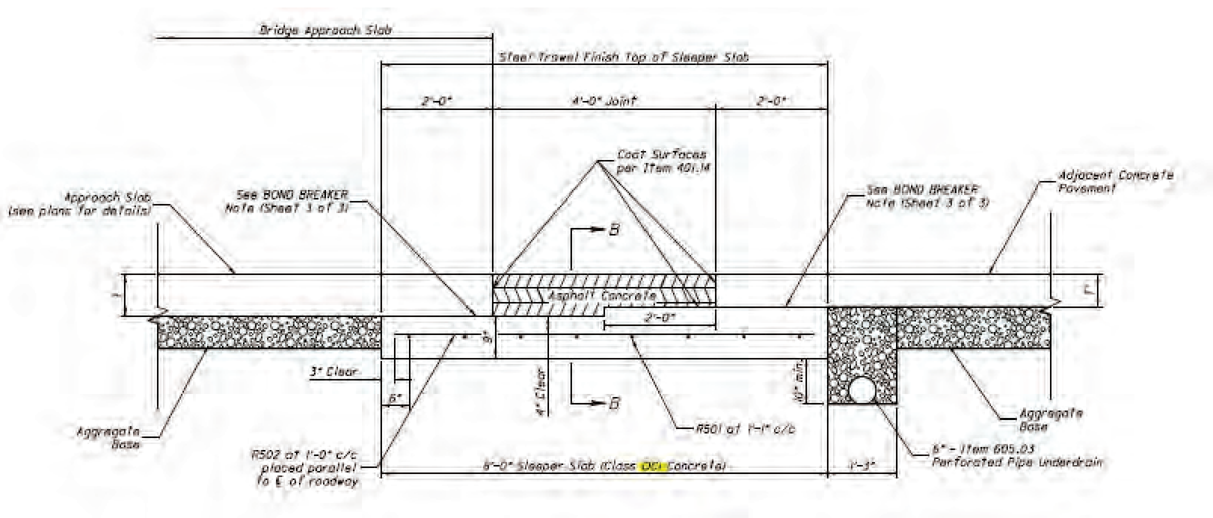


Figure 4-47 Ohio Pressure Relief Detail (ODOT)

4.12 Reported Approach Issues

Though each state highlighted above has similar approach slab detailing in many respects, there have been reported varying levels of desired performance. In a recent survey (Thiagarajan and Gopalaratnam, 2010), several of the states included within this report were asked of any problems, both minor and major, they identified with their respective approach slabs.

For example, Illinois stated they do not have frequent problems with their approach slabs, though occasionally, they have experienced bridge approach slab failures near the interface with the approach seat on bridge abutments. It is believed this problem is a result of the construction methods; the approach slab is not always fully seated on the abutments because the backfill has covered the top of the approach seat. When this backfill eventually migrates from the top of the seat, a gap is left and the connection between the approach slab and bridge deck is overstressed or settlement occurs.

As an additional comment, Illinois indicated that a minor problem is sometimes encountered when approach slabs are used in conjunction with integral abutment bridges. The bridge deck is tied to the approach slab with a series of longitudinal bars and as the bridge approach slab is poured and begins curing, some cracking can occur in the approach slab as a result of the expansion and contraction of the bridge.

Nebraska indicated they have seen cracking in some of their approach slabs, though they would categorize the cracking as being minor. As a result of the cracking, they increased the amount of reinforcing steel in the paving and approach sections as an attempt to alleviate the cracking. As of the time of the survey they had not encountered any major failures.

In Indiana there have been some failures of bridge approach slabs which have been primarily located where approach slabs have been constructed in conjunction with integral abutments. Through researching the cause, they have found the cyclic temperature-induced expansion and contraction of the bridges has caused settlement of the backfill under the approach slabs. As a result, the slab is left unsupported and cracks form. Where the cracks are considered minor, the only maintenance performed is to seal the cracks.

At the time of the survey, Kansas expressed numerous issues with their approach slabs including problems with differential settlement, expansion joint, cracking, and backfill material. The differential settlement problems are believed to be caused by insufficient time for large backfill areas beneath the slab to fully settle prior to the slab being placed on top, the extensive number of freeze-thaw cycles experienced, and improper drainage within the backfill.

Kansas indicated there was difficulty in maintaining water tight joints and thus a problem with improper joint movement. Aggregate problems and insufficient freeze-thaw durability have led to D-cracking. Even more, the backfill material often contains expansive soils which is detrimental to the approach slab.

More recent attempts to mitigate the approach slab problems have included tying the approach slab into the bridge decks and installing abutment strip drains. These revisions have helped significantly.

Prior to the most recent design modifications, Iowa had numerous problems with the bridge approaches. Most notably, they experienced failure of the paving notch on the abutment and failure of the approach slab where it rested on the paving notch. In addition, significant settlement of the approach slab approximately 20' from the end of the bridge was an issue and large cracks in the approach panels was common. It was believed that many of these problems stemmed from the development of voids adjacent to the abutment below the approach slab, some of which had been quite large.

Iowa's approach panel and paving notch designs were modified to address the observed problems. The approach slab adjacent to the bridge was designed to span any voids that might develop over time and the paving notch width was increased. Additionally, a piece of fiber board laps the front 4" of the notch to help protect the corner from load.

Minnesota indicated that maintaining the joint between the approach slab and pavement was one problem they faced. Even more, extensive cracking and settlement were issues. In each case, it was believed to be a result of inadequate drainage and the subsequent formation of voids beneath the slab. Since this survey was completed, Minnesota has revised their approach panel design.

4.13 State Backfill Specifications

The more recent approach slab methodology which aims to create a structural slab that spans between a sleeper slab or grade beam to the bridge abutment is likely a direct reaction to the common problems with the backfill directly adjacent to the bridge abutment. Previously, the abutment backfill would settle or be eroded by water infiltration to point that the approach slab would be left with insufficient support; settlement or cracking of the approach often results. Though with this new design methodology one could argue the backfill requirements are less of an issue, the states included in this study each have a specification for backfill of bridge structures. In general, the materials and methodology used for properly preparing the backfill are similar in many respects though some variances exist. Table 1 provides a summary of the backfill requirements of each state. Full backfill specifications can be found in Appendix B.

The common threads among each of the state specifications include a requirement for structural backfill separate from the embankment materials approaching the bridge, the attention to proper compaction, and provisions for drainage. Similar in many respects, these aspects of backfill preparation aim to reduce after-construction settlement and to shed water from behind the abutment and below the approach slab.

Table 1 Summary of State Backfill Specifications

State	Structure Backfill	Construction Requirements	Drainage Provisions
Colorado	Yes	6" lifts compacted to required density	None
Illinois	Yes	6" lifts compacted to engineer's requirements	Porous granular backfill
Indiana	Yes	12" lifts compacted w/2 passes of at least 17" wide compactor delivering 3,000 to 9,000 lb per blow.	Course aggregate w/drain tile at base of abutment
Iowa	Yes	Flooded and compacted backfill placed over non-compacted porous backfill.	Porous backfill w/drain tile at base of abutment. Subdrain at EF joint.
Kansas	Yes	8" lifts compacted as specified	Granular fill
Kentucky	Yes	6" lifts compacted for soil and rock/soil, 12" lifts compacted for stone	Fabric wrapped drain tile surrounded by course aggregate.
Minnesota	Yes	Compact to specified lift height and density	Select granular backfill. Subsurface drain at top of abutment footing.
Missouri	Yes	6" lifts of backfill consisting of sands, clays, silts, gravels, or a mixture compacted to 95% of maximum density.	Drain tile set in aggregate base laid along sleeper slab and at abutment.
Nebraska	Yes	6" lifts of granular backfill compacted by a single pass of a walk-behind, lightweight compactor. No density requirement.	Drainage matting placed against back of abutment wall and drain tile near base of abutment.
North Dakota	Yes	6" lifts compacted at -2 to +3 optimum moisture content.	Drain tile under approach pavement and at abutment wall surrounded by granular fill.
Ohio	Yes	Granular backfill to be placed according to the plan extents from the near the footing to the underside of approach.	Porous backfill placed adjacent to abutment wall and under approach.

5 In-Service Approach Condition

During the dates of August 10th and 11th, 2014, 12 bridges were visited along the USH 41/STH 29 corridor from Oshkosh to Green Bay; the bridges are listed in Table 2. The condition of the approaches was documented through notes, photography, and videos. Additionally, a cursory review of the overall structure for each bridge was completed and documented. The following sections provide the results of the field investigation. To assess the behavior under the loads of ambient traffic of the Bridge Standards 12.10 and 12.11, the approach apron of one bridge was instrumented with strain and deflection gages. The results of the tests are presented in the respective subsection.

Table 2 Bridges Selected for Field Investigation

Bridge Number	Location
B-05-0604	Brown County – USH 41 SB over Ashwaubenon Creek
B-05-0605	Brown County – USH 41 NB over Ashwaubenon Creek
B-05-0606	Brown County – USH 41 SB over CTH EE
B-05-0607	Brown County – USH 41 NB over CTH EE
B-05-0650	Brown County – STH 29 WB over Duck Creek
B-05-0651	Brown County – STH 29 EB over Duck Creek
B-70-0263	Winnebago County – USH 41 NB over Lake Butte des Morts (South Channel)
B-70-0264	Winnebago County – USH 41 SB over Lake Butte des Morts (South Channel)
B-70-0265	Winnebago County – USH 41 NB over Lake Butte des Morts (Main Channel)
B-70-0266	Winnebago County – USH 41 SB over Lake Butte des Morts (Main Channel)
B-70-0267	Winnebago County – USH 41 NB over Lake Butte des Morts (North Channel)
B-70-0268	Winnebago County – USH 41 SB over Lake Butte des Morts (North Channel)

5.1 B-05-0604

Bridge number B-05-0604 located on southbound US 41 over Ashwaubenon Creek in Brown County, the elevation view of which is shown in Figure 5-1, was constructed in 2013. The single span bridge has a deck width of 67.4', a total length of 94.4', and has a skew angle of 30 degrees.

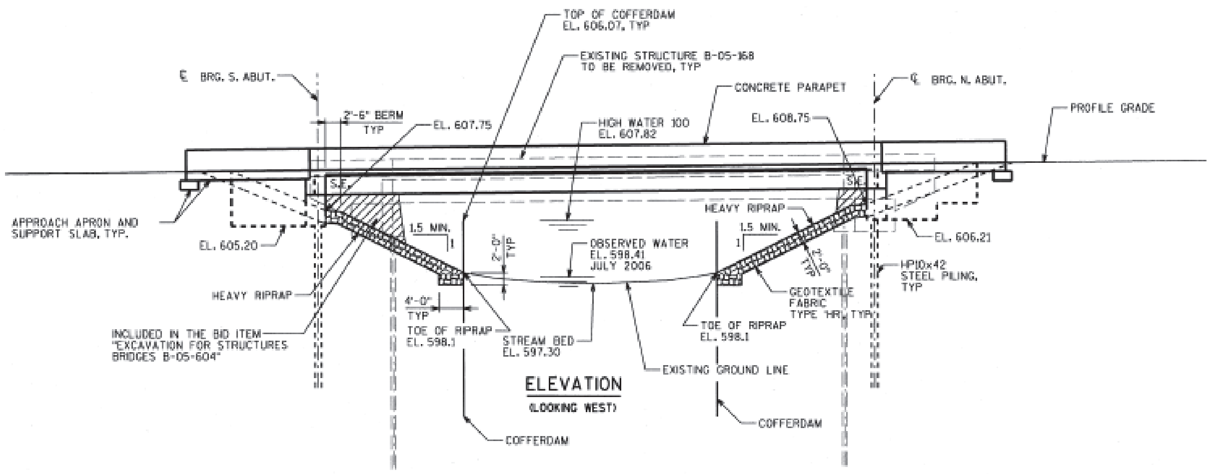


Figure 5-1 B-05-0604 Elevation

The concrete approach apron is detailed according to Bridge Standards 12.10 and 12.11. The 1'-5"thick apron is 20' long extending from the 1'-0" paving notch at the bridge abutment to over the 5'-0" wide sleeper slab. See Figure 5-2.

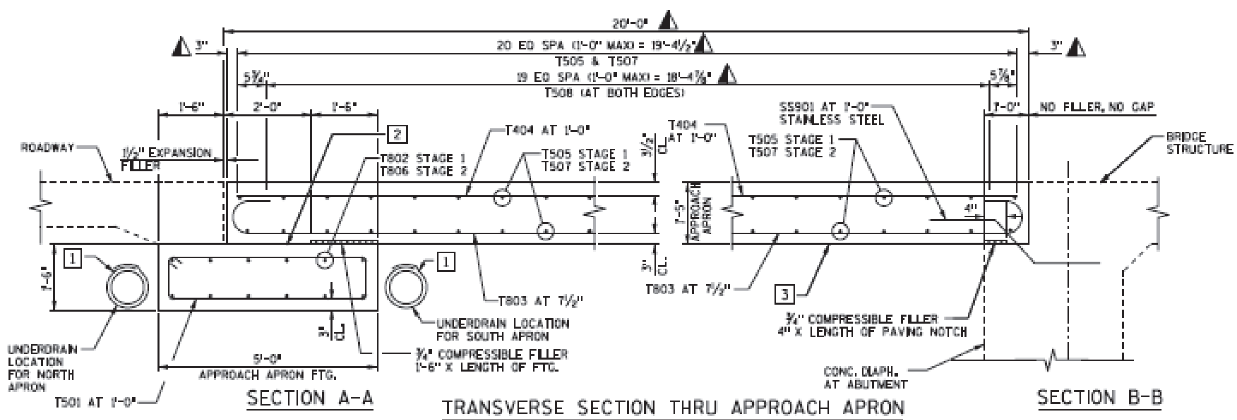


Figure 5-2 B-05-0604 Approach Apron Detail

During the field investigation, some minor cracking (<1/16" wide) in the approaches longitudinal and normal to the skew were observed as shown in Figure 5-3 and Figure 5-4. The cracks primarily permeated from the end of the bridge where additional cracks were observed extending from the end of bridge into the bridge deck. Cracks were more apparent and slightly larger at the bridge exit than the bridge entrance.

As shown in Figure 5-5, there was no apparent differential settlement at the approach apron end joints and the joints appeared to be in good condition, free of debris and adequately filled with expansion filler.

The embankment materials beneath the approach apron were not visible, though the crushed, jagged rock and rip rap outside of the barrier rail appeared to be remaining in place as intended without any noticeable washout or settlement. See Figure 5-6.

As noted previously, some deck cracking was visible extending from the end of bridge into the deck. This cracking was not only visible on the top surface but from below the deck as well especially at the south end as shown in Figure 5-7. Aside from the deck cracking, the bridge (superstructure and substructure) appeared in overall very good condition which was expected due to its recent construction completion.

Figure 5-3 B-05-0604 Approach Apron Cracking

Figure 5-4 B-05-0604 Approach Apron Cracking

Figure 5-5 B-05-0604 Pavement to Approach Expansion Joint

Figure 5-6 B-05-0604 Embankment

Figure 5-7 B-05-0604 Deck Underside Cracking

5.2 B-05-0605

Bridge number B-05-0605 located on northbound US 41 over Ashwaubenon Creek in Brown County, the elevation view of which is shown in Figure 5-8, was constructed in 2013. Like its sister bridge, B-05-0604, the single span bridge has a deck width of 67.4', a total length of 94.4', and has a skew angle of 30 degrees.

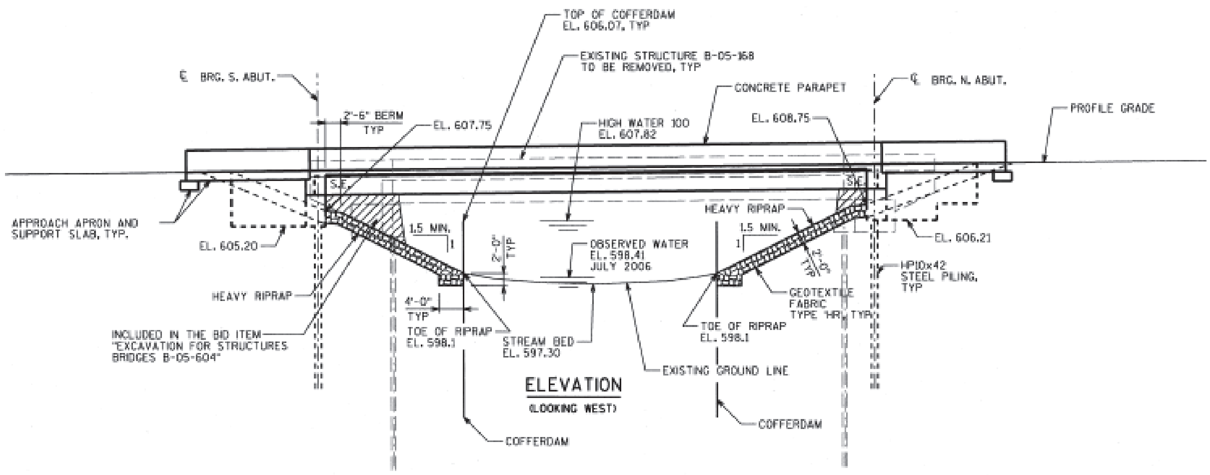


Figure 5-8 B-05-0605 Elevation

The concrete approach apron is detailed according to Bridge Standards 12.10 and 12.11. The 1'-5"thick apron is 20' long extending from the 1'-0" paving notch at the bridge abutment to over the 5'-0" wide sleeper slab. See Figure 5-9.

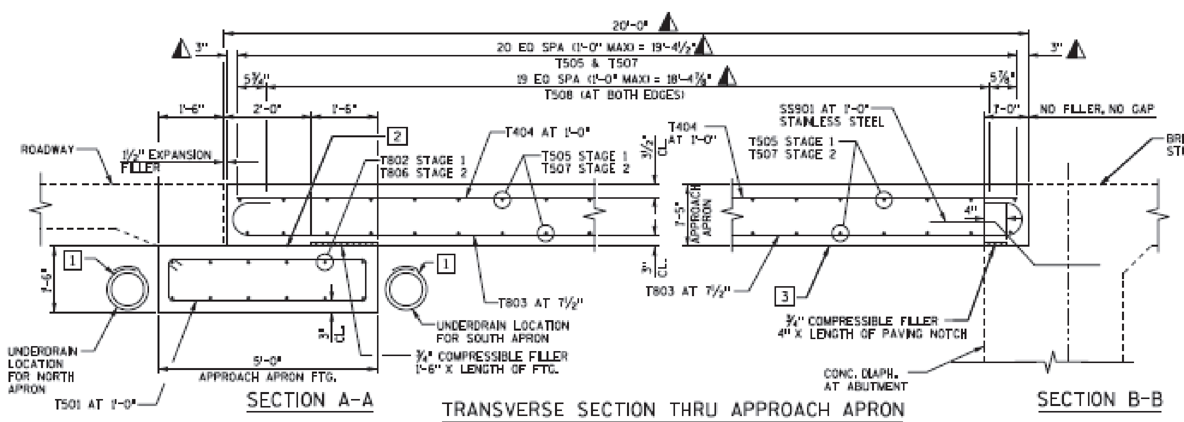


Figure 5-9 B-05-0605 Approach Apron Detail

The approaches appeared generally in overall good condition aside from some diagonal cracking nearly normal to the skew located in the first traffic lane from the right shoulder at the bridge entrance and exit shown in Figure 5-10 and Figure 5-11.

The expansion joints between the approach pavement and approach aprons appeared in good condition with no apparent differential settlement or removal of expansion joint filler. See Figure 5-12.

The material directly below the approach aprons was not visible and therefore could not be assessed for settlement or washout. However, the embankment material outside of the barrier rail could be observed. The material consisting of crushed rock mostly appeared to remain in place, though the bottom of a small portion of the southeast wingwall, shown in Figure 5-13, was exposed, possibly the result of some washout, settlement, or sloughing.

The superstructure and substructure of the bridge appeared in overall good condition, though some diagonal cracking normal to the skew was observed below the deck surface extending from the end of bridge into the deck. An example of this cracking is shown in Figure 5-14.

Figure 5-10 B-05-0605 Approach Cracking at Bridge Entrance

Figure 5-11 B-05-0605 Approach Cracking at Bridge Exit

Figure 5-12 B-05-0605 Pavement to Approach Expansion Joint

Figure 5-13 B-05-0605 Embankment Condition

Figure 5-14 B-05-0605 Deck Underside Cracking

5.2.1 Test Results

An assessment of the behavior of the approach aprons under ambient traffic loads was completed on Bridge B-05-0506. The entrance approach was instrumented with strain gages and deflection gages along the right side of the rightmost travel lane. Shown in Figure 5-15, is the area of instrumentation. Strain data were collected at five individual locations: 1) approach pavement adjacent to expansion joint, 2) approach slab adjacent to expansion joint, 3) mid-span of approach slab, 4) approach slab adjacent to cold joint at end of bridge, and 5) bridge deck adjacent to cold joint at end of bridge. Differential deflection data in both the horizontal and vertical directions were collected at the expansion joint between the approach pavement and approach slab and at the cold joint between the approach slab and bridge deck. Figure 5-16 and Figure 5-17 show the instrumentation setup.

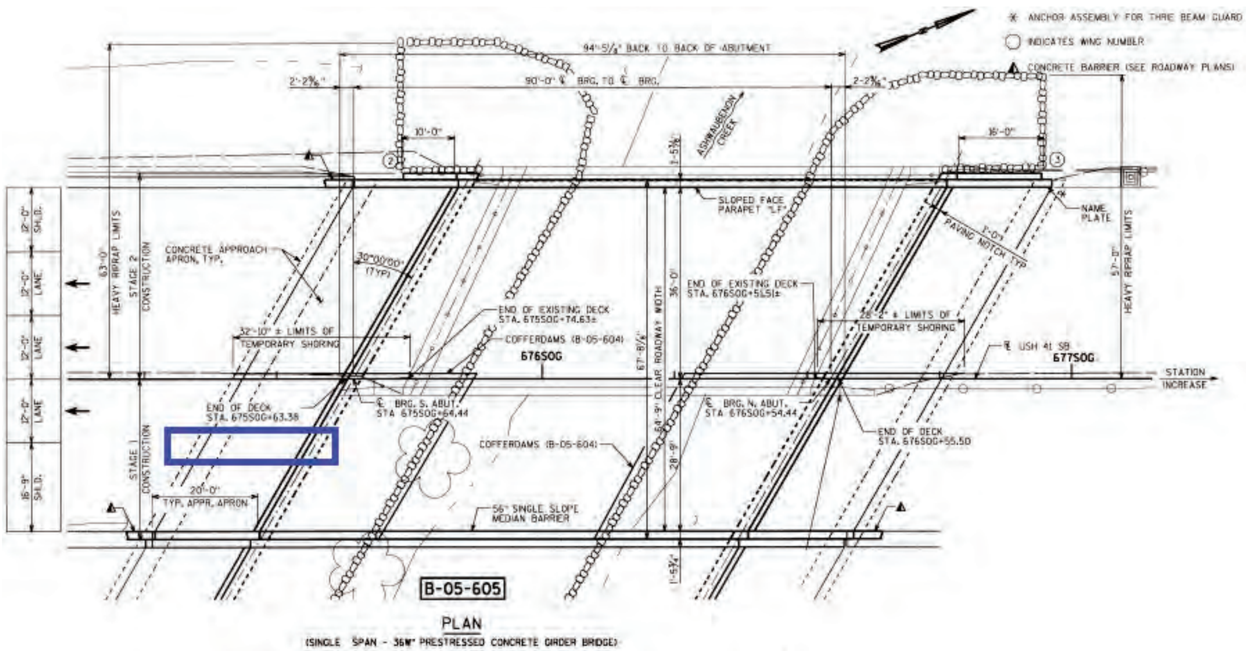


Figure 5-15 B-05-0605 Instrumentation Locations

Figure 5-16 B-05-0605 Instrumentation Setup

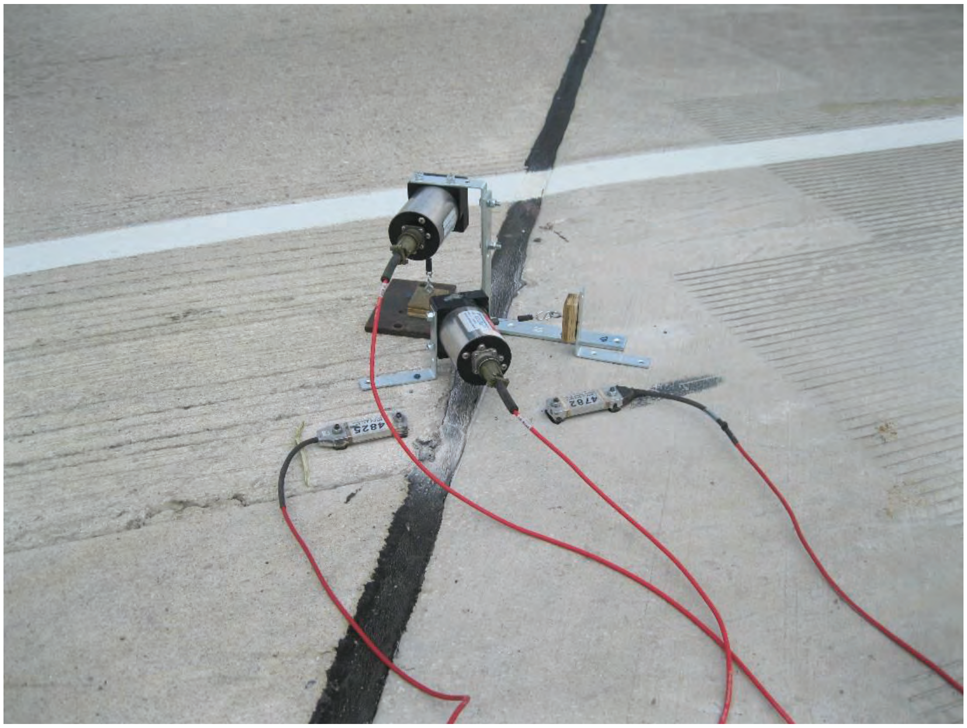


Figure 5-17 B-05-0605 Instrumentation Close-up

Data were collected for ten minutes allowing for numerous vehicles to pass, many of which were large vehicles including semi-trucks, dump trucks, etc.

The data from each strain gage are plotted in Figure 5-18. The maximum tension strain was slightly under 2 microstrain, while the maximum compression strain was slightly under 2.5 microstrain. In every case, though individual vehicles were registered in the data, the magnitude of strain was remarkably small. For a typical 4 ksi concrete mix, these strain data would equate to approximately 9 psi, far below the modulus of rupture (475 psi).

To better differentiate the behavior at each strain gage location, the data were separated in Figure 5-19. Noticeably, the relative strain magnitude near the approach pavement and expansion joint was less than that at the midspan and bridge deck joint locations. Similarly, the strain ranges shown in Figure 5-20, illustrate the smaller ranges at the approach pavement expansion joint and larger ranges at the midspan and bridge deck joint locations.

The differential deflection data collected at each joint of the approach apron provided evidence that under ambient traffic loading the relative movement between the approach pavement and approach slab, and approach slab and bridge deck is effectively zero; the maximum recorded value was 0.0019 in. and was an isolated instance. Given the support conditions at each end (sleeper slab and bridge abutment) and that very little horizontal force was exerted on the approach, it comes as no surprise that the relative movement between each element is effectively zero.

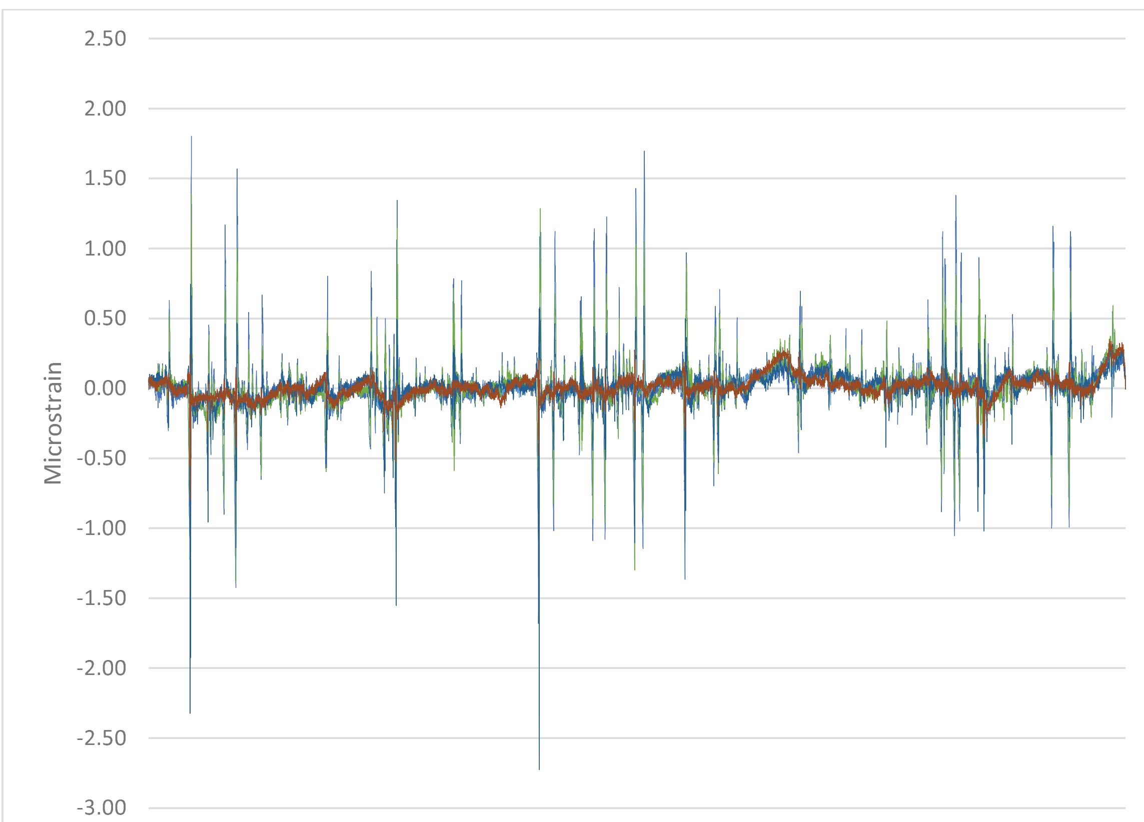


Figure 5-18 B-05-0605 Strain Data

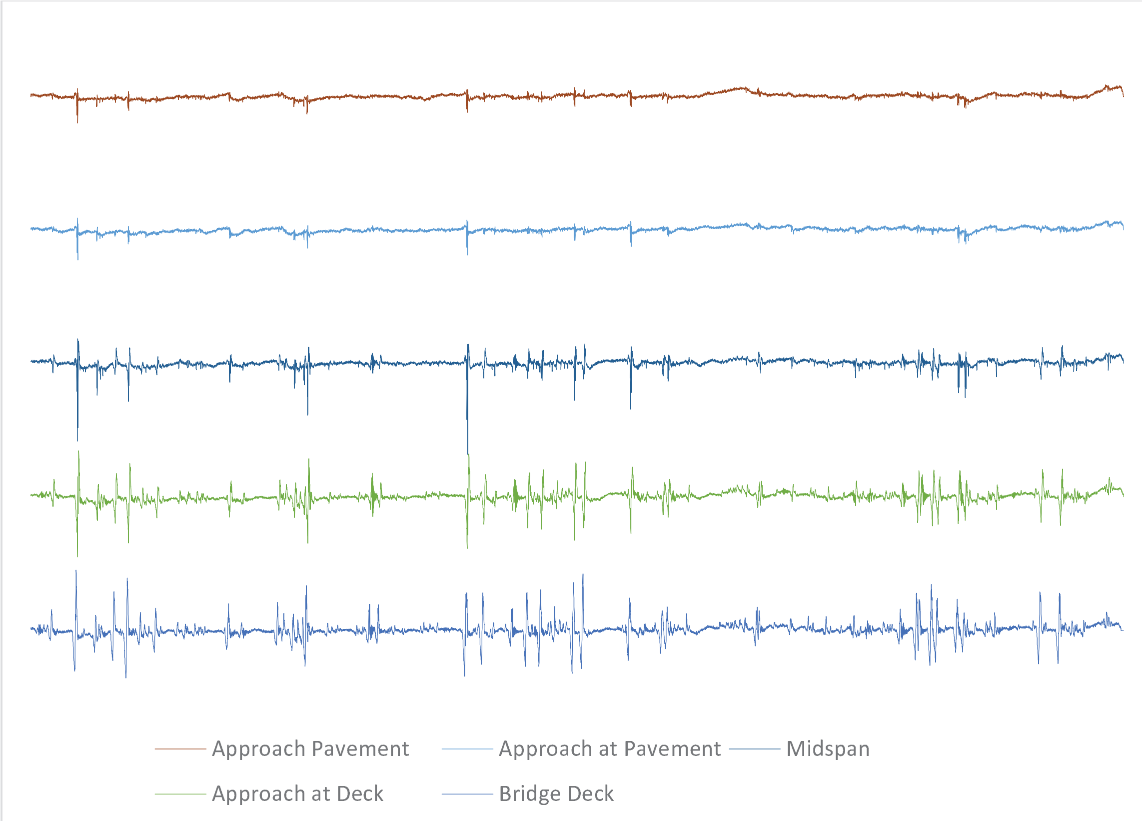


Figure 5-19 B-05-0605 Strain Data Comparison

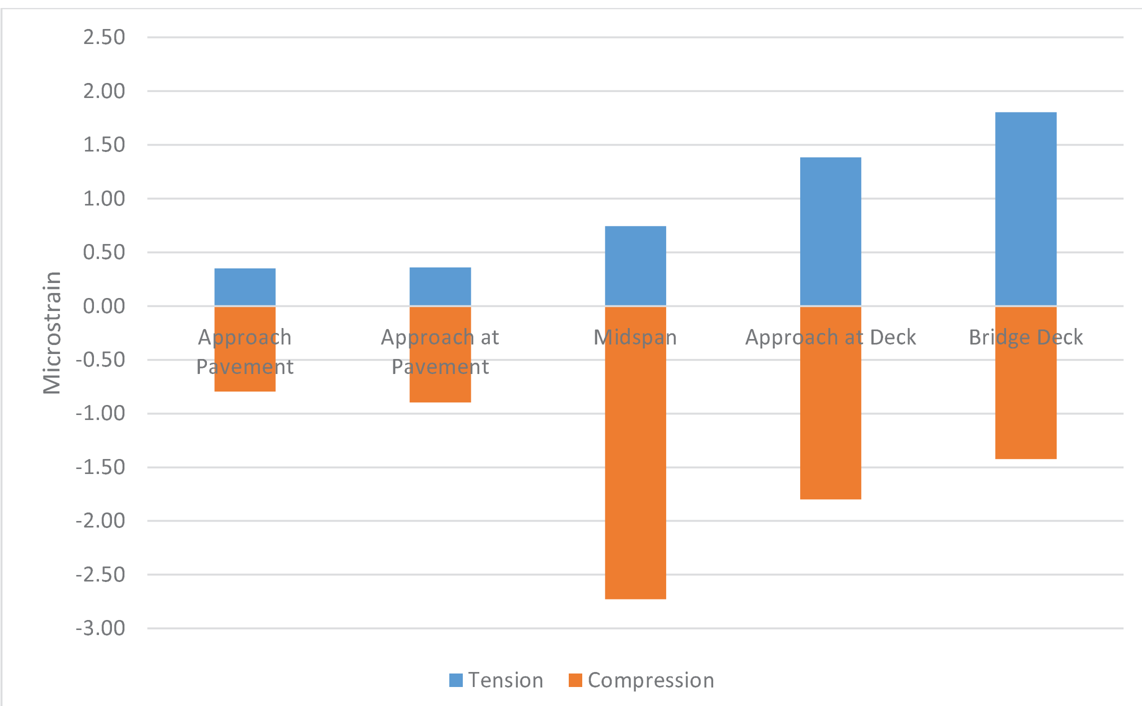


Figure 5-20 B-05-0605 Strain Ranges

5.3 B-05-0606

Bridge number B-05-0605 located on southbound US 41 over County Road EE in Brown County, the elevation view of which is shown in Figure 5-21, was constructed in 2013. The single span bridge has a deck width of 79.7', a total length of 98.2', and has a skew angle of 26 degrees.

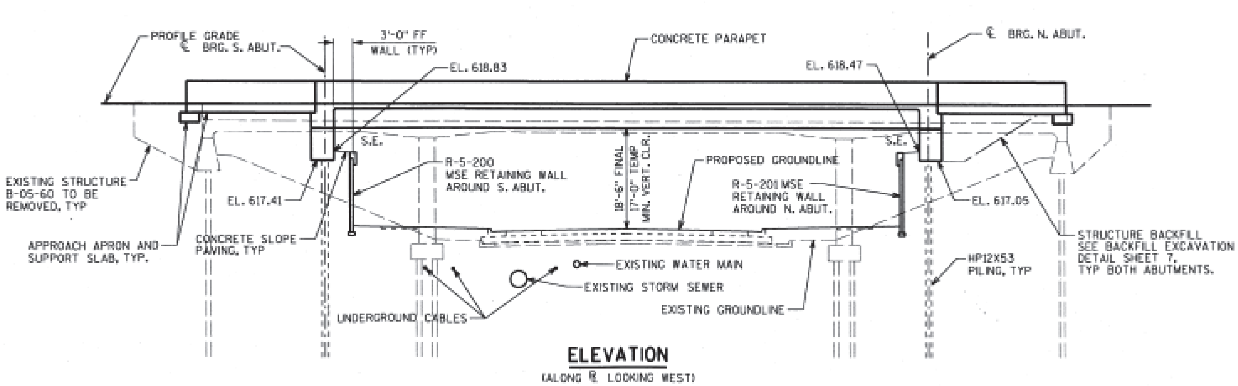


Figure 5-21 B-05-0606 Elevation

The concrete approach is detailed according to Bridge Standards 12.10 and 12.11. The 1'-5"thick slab is 20' long extending from the 1'-0" paving notch at the bridge abutment to over the 5'-0" wide sleeper slab. See Figure 5-22.

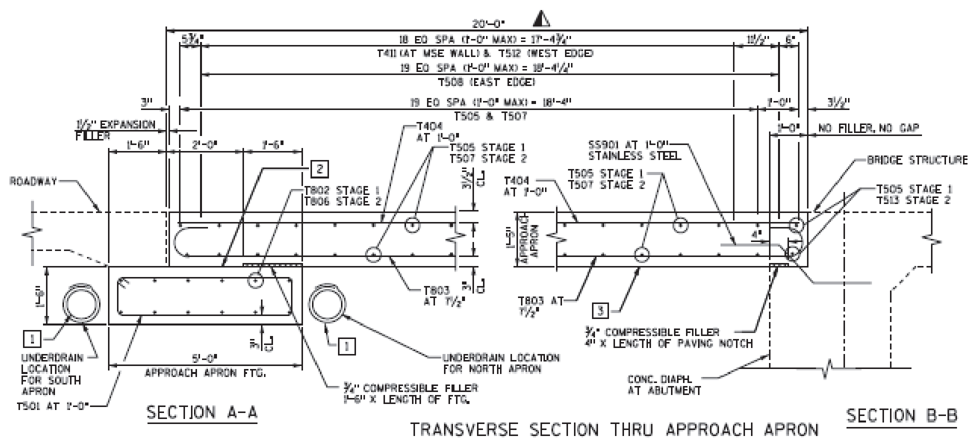


Figure 5-22 B-05-0606 Approach Apron Detail

During the field investigation, several cracks in the approaches longitudinal and normal to the skew were observed as shown in Figure 5-23 and Figure 5-24. The cracks primarily permeated from the end of the bridge where additional cracks were observed extending from the end of bridge into the bridge deck at a similar angle. Cracks were most apparent and slightly larger (approximately 1/16") in the first and second traffic lane from the right shoulder.

As shown in Figure 5-25, there was no apparent differential settlement at the approach apron end joints and the joints appeared to be in good condition, free of debris and adequately filled with expansion filler.

The fill materials beneath the approach apron were not visible, and due to the configuration of the roadway below and the required embankment slopes, the bridge wingwalls extended beyond the approach slabs (see Figure 5-26) thereby retaining the fill material. As such, the condition of the fill could not be assessed.

As noted previously, some deck cracking was visible extending from the end of bridge into the deck. This cracking was not only visible on the top surface but from below the deck also and is shown in Figure 5-27. Aside from the deck cracking, the bridge (superstructure and substructure) appeared in overall very good condition which was expected due to its recent construction completion.

Figure 5-23 B-05-0606 Approach Apron Cracking

Figure 5-24 B-05-0606 Approach Apron Cracking

Figure 5-25 B-05-0606 Pavement to Approach Expansion Joint

Figure 5-26 B-05-0606 Wingwall Extensions

Figure 5-27 B-05-0606 Deck Underside Cracking

5.4 B-05-0607

Bridge B-05-0607, the elevation of which is shown in Figure 5-28, is located on USH 41 southbound over County Hwy EE in Brown County. The single span bridge constructed in 2013 is 98.2' long and 79.4' wide, with a skew angle of 26 degrees.

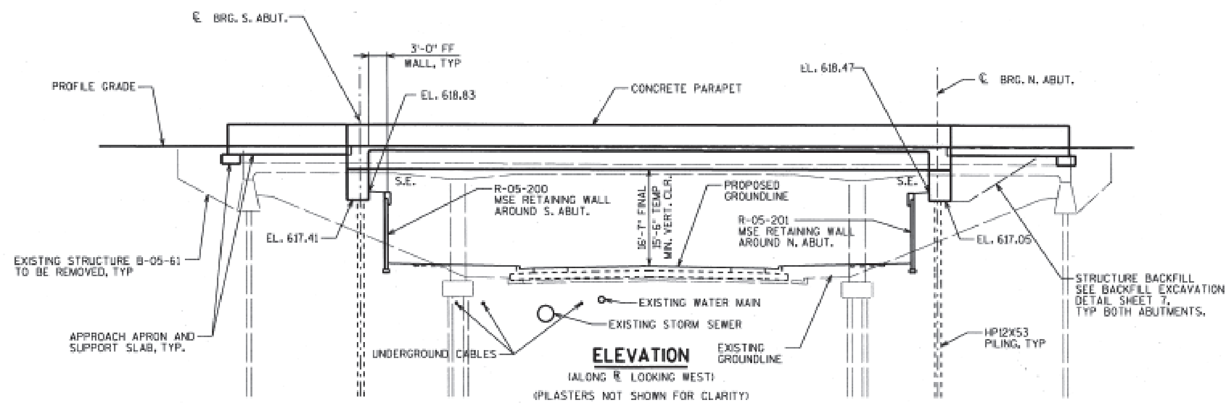


Figure 5-28 B-05-0607 Elevation

The concrete approach apron is detailed according to Bridge Standards 12.10 and 12.11. The 1'-5"thick apron is 20' long extending from the 1'-0" paving notch at the bridge abutment to over the 5'-0" wide sleeper slab. See Figure 5-29.

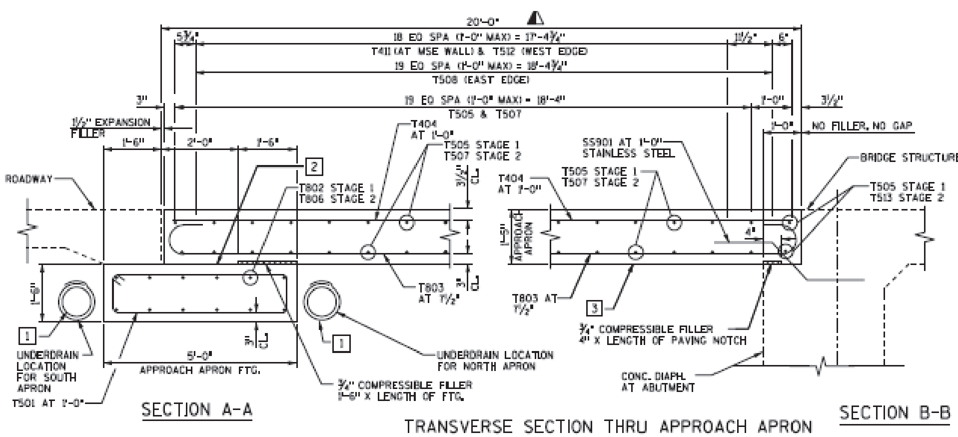


Figure 5-29 B-05-0607 Approach Apron Detail

While documenting the condition of the approach aprons, one larger crack (1/16" to 1/8" wide) was noticed in the second traffic lane from the right shoulder. See Figure 5-30. Additionally, several diagonal cracks starting at the beginning of bridge deck at the bridge entrance and extending toward the centerline were observed both on the deck surface and on the underside of the deck. Examples of these cracks are shown in Figure 5-31 and Figure 5-32.

Some minor scuffing of the bridge deck was observed at the bridge entrance between the approach apron and the bridge deck. This scuffing is likely due to a slight elevation variation in the original placement and subsequent snowplow impacts, rather than any differential displacement between the two structure elements. The scuffing is shown in Figure 5-33.

The fill material below the approach apron was not visible, so a more complete assessment could not be completed during the site visit; the extended wingwalls provide a retaining structure for the abutment backfill and approach apron support material as shown in Figure 5-34. With that said, the embankment material outside of the roadway limits and adjacent to the wingwalls appeared to be in satisfactory condition with little to no settlement or erosion visible.

Figure 5-30 B-05-0607 Approach Apron Cracking

Figure 5-31 B-05-0607 Underside of Deck Cracking

Figure 5-32 B-05-0607 Underside of Deck Cracking

Figure 5-33 B-05-0607 Bridge Deck Scuffing

Figure 5-34 B-05-0607 Wingwall extension and embankment condition

5.5 B-05-0650

Bridge B-05-0650, located on westbound STH 29 over Duck Creek in Brown County, is a two span bridge constructed in 2013 measuring 190.4' in length and 83.2' in width with a skew angle of 30 degrees. The elevation view of the bridge is shown in Figure 5-35.

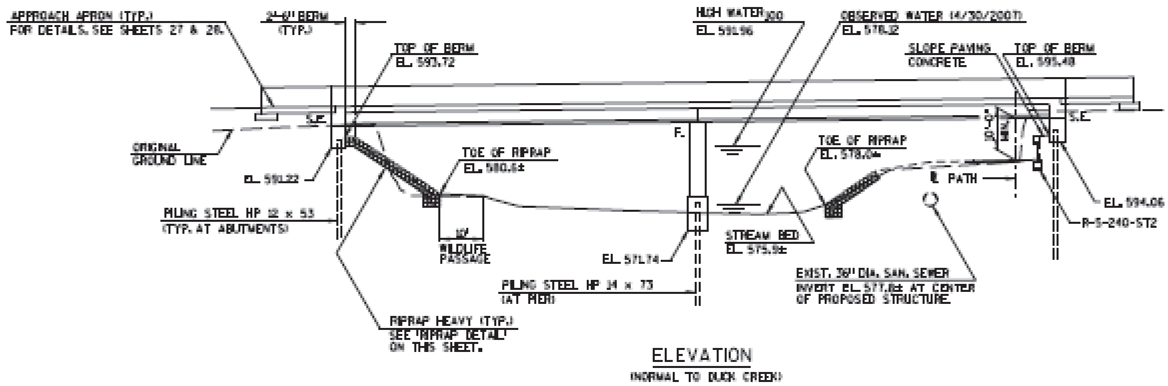


Figure 5-35 B-05-0650 Elevation

The approach apron was constructed per the Bridge Standards 12.10 and 12.11; the section detail is shown in Figure 5-36. The 20' long, 1'-5" thick slab extends from the 1'-0" wide paving notch at the bridge abutment to the 5'-0" wide sleeper slab which carries the approach pavement and approach apron.

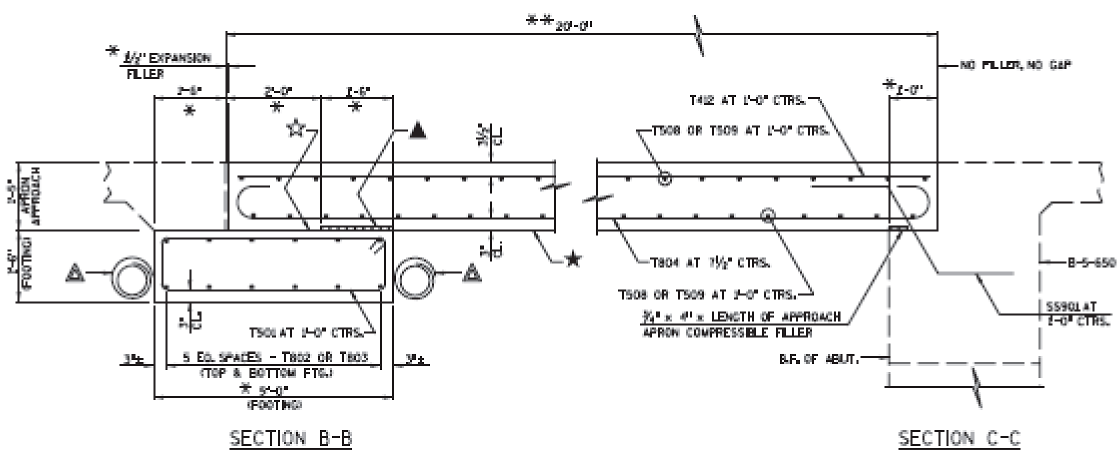


Figure 5-36 B-05-0650 Approach Apron Detail

During observation the approach apron was seen to be in overall very good condition aside from a diagonal crack normal to the skew angle extending the full length of the entrance approach within the right shoulder lane. This crack is shown in Figure 5-37.

The condition of the joints at the beginning and end of the approach aprons were in good condition. As shown in Figure 5-38, the expansion joints were adequately filled and free of debris and the cold joints between the approach and the deck appeared to be performing well.

A cursory observation of the entire structure was completed and the superstructure and substructure were found to be in excellent condition, likely due to its recent construction completion. Even so, the bridge deck was found to have many observable cracks along its entire length diagonal to the longitudinal axis of the bridge; these cracks were observable from above and below the deck. Examples of each are shown in Figure 5-39 and Figure 5-40, respectively.

Though the abutment backfill material and approach apron support material were not visible, the material is largely protected from erosion due to the extended wingwalls acting as a retaining structure. As such, the likelihood exists that the material remains in place, though the possibility of settlement remains. The embankment material outside of the wingwalls gave no indications that excessive settlement or erosion had taken place.

Figure 5-37 B-05-0650 Approach Apron Cracking

Figure 5-38 B-05-0650 Expansion Joint Condition

Figure 5-39 B-05-0650 Bridge Deck Cracks

Figure 5-40 B-05-0650 Bridge Deck Cracks Seen from Below

Figure 5-41 B-05-0650 Embankment Slope Adjacent to Wingwall

5.6 B-05-0651

Bridge B-05-0651, the elevation of which is seen in Figure 5-42, was constructed in 2013 on eastbound STH 29 over Duck Creek in Brown County. The two-span measures 190.4’ long and 84.2’ wide with a skew angle of 30 degrees.

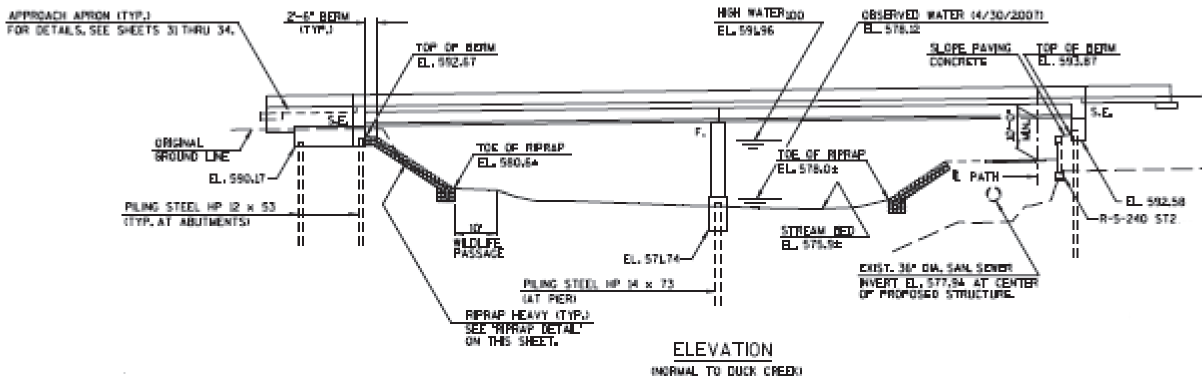


Figure 5-42 B-05-0651 Elevation

The approach aprons constructed per Bridge Standards 12.10 and 12.11 were observed to be in relatively good condition, though diagonal cracks (approx. 4) normal to the skew exist at the exit bridge approach apron. The largest (1/16” to 1/8” wide) was located immediately right of the rightmost mainline traffic lane. See Figure 5-43.

The expansion joints and cold joints at the approach to bridge deck interface were observed to be in good overall condition as shown in Figure 5-44. The expansion joints remained filled with the joint filler and all joints were free of any notable debris. One should note that at each expansion joint the approach pavement lies slightly below the elevation of the approach aprons. This is believed to be a function of the original placement, rather than a symptom of unwanted behavior.

The abutment backfill material and approach apron support material were not visible and thus could not be evaluated. With the extended wingwalls acting as a retaining structure for the backfill and support materials, it is believed that no appreciable erosion has occurred. That is not to say, the material could not have experienced some settlement. The embankment materials outside of the wingwalls did not show any notable erosion or settlement that would indicate a greater problem with the materials below the approach aprons.

Observation of the substructure and superstructure indicated that the condition of each is very good, which was expected given the recent construction completion date. Even so, numerous cracks diagonal to the longitudinal axis of the bridge were found to be present and noticeable on both the top side and bottom side of the bridge deck. Examples of each are shown in Figure 5-45 and Figure 5-46, respectively.

Figure 5-43 B-05-0651 Approach apron cracking

Figure 5-44 B-05-0651 Expansion Joint Condition

Figure 5-45 B-05-0651 Bridge Deck Cracking

Figure 5-46 B-05-0651 Cracking on Underside of Bridge Deck

5.7 B-70-0263

Bridge B-70-0263, the elevation of which is shown in Figure 5-47, crosses the south channel of Lake Butte des Morts on northbound USH 41 in Winnebago County. The two-span bridge, constructed in 2013 measures 219'-10" long and 91'-4" wide. The bridge has no skew.

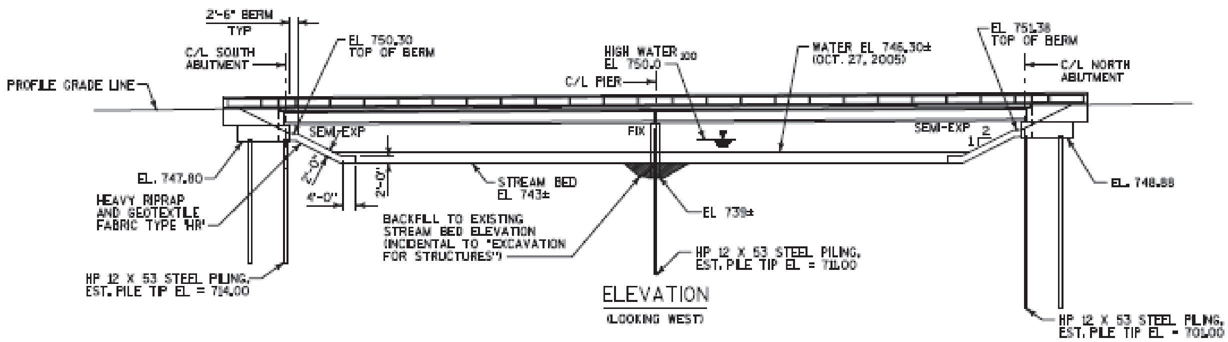


Figure 5-47 B-70-0263 Elevation

The approaches were constructed per SDD 13B2 and were observed to be in very good condition. There was no apparent cracking or differential settlement between joints and the transition to the bridge was smooth as shown in Figure 5-48. The joints appeared to be fully filled with joint sealant with little to know disturbance.

The subbase below the approaches was not visible so a thorough assessment of the supporting materials could not be completed. Nonetheless, the condition of the approaches and the smooth transitions indicate that the subbase is adequately supporting the approaches to this point. Even more, there was no apparent embankment erosion or settlement outside of the roadway limits that would indicate water intrusion below the approaches. The bridge also carries a pedestrian pathway on its eastern side shown in Figure 5-49 whose approach would likely help inhibit subbase material from escaping from below the roadway approaches.

A cursory review of the visible substructure and superstructure indicated the bridge to be in very good condition, which is not surprising given the recent construction completion date. Unlike some of the other bridges completed around the same time and discussed within this document, this bridge did not show any deck cracking.

Figure 5-48 B-70-0263 Expansion Joints

Figure 5-49 B-70-0263 Pedestrian Pathway

5.8 B-70-0264

Bridge B-70-0264, the elevation of which is shown in Figure 5-50, crosses the south channel of Lake Butte des Morts on southbound USH 41 in Winnebago County. The two-span bridge, constructed in 2013 measures 219’-10” long and 91’-4” wide. The bridge has no skew.

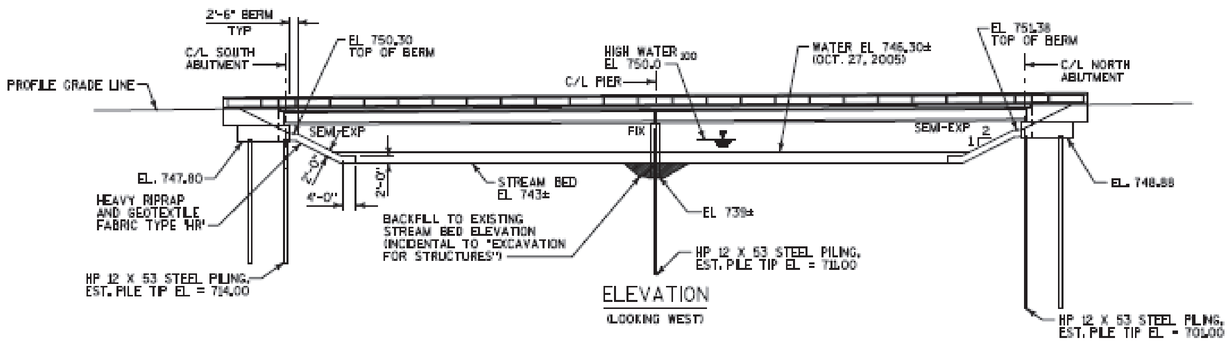


Figure 5-50 B-70-0264 Elevation

The approaches were constructed per the SDD 13B2 plans and, for the most part, each was free of cracking and appeared in good condition. The only exceptions were located at the middle of the three approach panels at the bridge entrance, those being a single transverse crack and patch located in the second travel lane from the right shoulder and longitudinal cracking at the pavement edge of the same panel (see Figure 5-51), and at the third expansion joint from the end of bridge where several large cracks and a patch extend across the first two travel lanes from the right shoulder (see Figure 5-52). Overall, the joints did not show signs of any differential displacement and all were filled with joint sealer.

The subbase material below the approaches was not visible, so a thorough assessment of the supporting material could not be completed. Even so, the material appears to be performing satisfactorily aside from perhaps at the crack locations previously mentioned. The possibility exists that settlement of the material or water intrusion causing washout could have contributed to the approach cracking from loss of support. The embankment material outside of the roadway limits did not show any signs of significant settlement of erosion that might lead one to believe the same could be occurring beneath the approach slabs (see Figure 5-53).

A cursory review of the visible substructure and superstructure was completed and did not reveal any issues. As shown in Figure 5-54, the structure was in very good condition, though one could expect this given its recent completion date.

Figure 5-51 B-70-0264 Approach Patch and Cracking

Figure 5-52 B-70-0264 Approach Cracking

Figure 5-53 Embankment Adjacent to Wingwall

Figure 5-54 B-70-0264 Substructure and Superstructure Review

5.9 B-70-0265

Bridge B-070-0266, the elevation of which is shown in Figure 5-55, crosses over the main channel of Lake Butte des Morts on northbound USH 41 in Winnebago County. The six-span bridge, constructed in 2013, measures 740’-7”, 91’-4” wide, and has no skew.

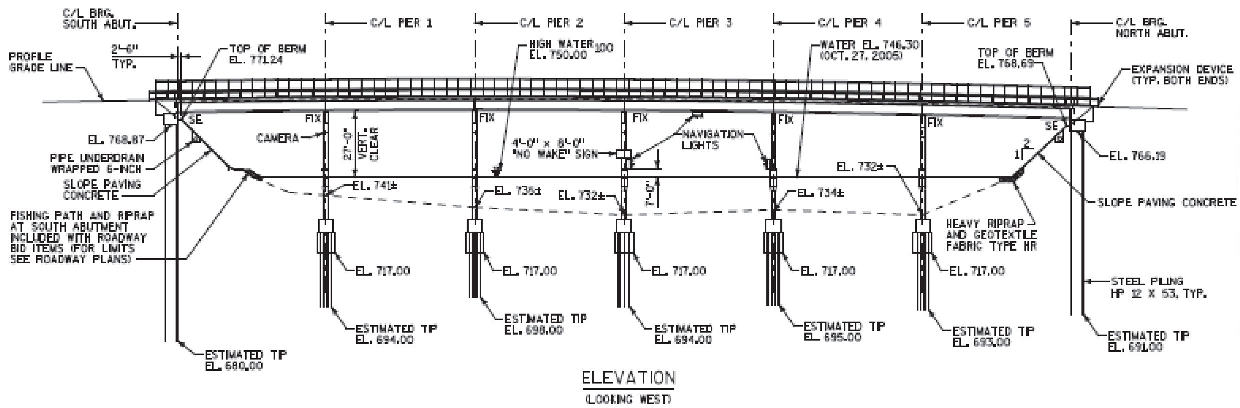


Figure 5-55 B-70-0265 Elevation

The approaches were constructed using a plan very similar to the Bridge Standard 12.10 and 12.11 plans. Slight differences exist, however. For example, a stub equal to the approach slab thickness shown in Figure 5-56 was formed on top of the sleeper slab between the end of the approach slab and mainline pavement, whereas in the Bridge Standard plans the mainline pavement and approach slab are only separated by an expansion joint.

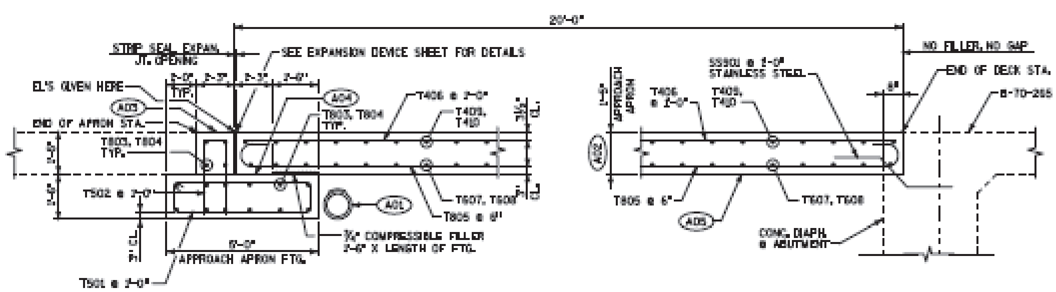


Figure 5-56 B-70-0265 Approach Section

The approaches generally appeared in good condition (see Figure 5-57). The joint between the approach and bridge deck remained tightly joined as shown in Figure 5-58. No cracking was visible except for a longitudinal crack within the first travel lane from the right shoulder and along the barrier rail. These cracks are shown in Figure 5-59 and Figure 5-60, respectively. No apparent elevation differences were observed at the approach joints, providing smooth transitions between the approaches and bridge.

The materials underneath the slab were not visible, so a full assessment of the subbase could not be completed. Even so, the condition of the joints and approaches would indicate that the subbase is performing adequately.

A cursory review of the visible substructure and superstructure was completed. Nothing was noticeable that would indicate poor performance, though the overall good condition was expected due to the recent construction completion date.

Figure 5-57 B-70-0265 Approach Slab

Figure 5-58 B-70-0265 Approach to Deck Joint

Figure 5-59 B-70-0265 Approach Cracking

Figure 5-60 B-70-0265 Approach Cracking

Figure 5-61 B-70-0265 Expansion Joint Debris Build-up

5.10 B-70-0266

Bridge B-070-0266, the elevation of which is shown in Figure 5-62, crosses over the main channel of Lake Butte des Morts on southbound USH 41 in Winnebago County. The six-span bridge, constructed in 2012, measures 740’-7”, 75’-7” wide, and has no skew.

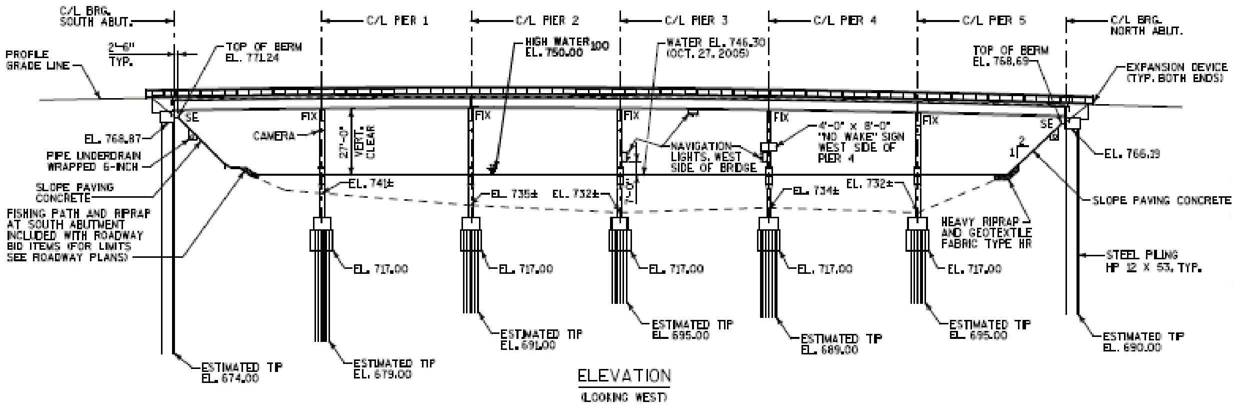


Figure 5-62 B-70-0266 Elevation

The approaches were constructed closely to the Bridge Standard 12.10 and 12.11 plans. Slight differences exist, however. For example, a stub equal to the approach slab thickness was formed on top of the sleeper slab between the end of the approach slab and mainline pavement as shown in Figure 5-63, whereas in the Bridge Standard plans the mainline pavement and approach slab are only separated by an expansion joint.

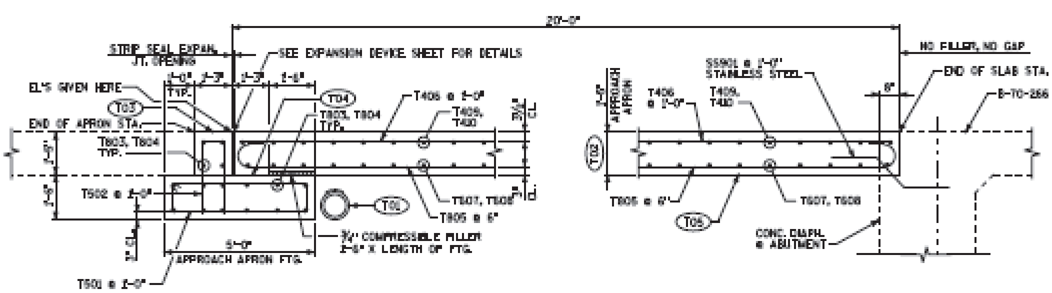


Figure 5-63 B-70-0266 Approach Section

The approaches appeared in overall very good condition, free of cracking at both the bridge entrance and exit. There was no visible differential deflection at any of the joints, yet as shown in Figure 5-64, at several locations the joint filler did not completely fill the expansion joints. Even more, a small area was observed at the bridge entrance where some spalling of the concrete has occurred (see Figure 5-65). The expansion joints at the end of the approach between the approach and the sleeper slab stub was moderately filled with debris which could impose undue forces into the approach panels when the bridge expands. Figure 5-66 shows this debris.

The subbase material below the approach slabs was not visible so an accurate assessment could not be completed. The condition of the approach slabs and, particularly, the joints would indicate that the condition of the subbase remains good. No differential deflection in the joints, cracking in the approaches, or compromised rideability from the approaches to the bridge was observed. Outside of the bridge limits, the embankment material did not appear to have undergone extensive erosion or settlement which might also indicate the same for the subbase below the approaches.

A cursory review of the accessible, visible substructure and superstructure was conducted and it was found to be in great condition as shown in Figure 5-67, likely due to the recent construction completion. As shown in Figure 5-68, the underside of the deck was free of cracking.

Figure 5-64 B-70-0266 Expansion Joint Condition

Figure 5-65 B-70-0266 Bridge Deck Joint Spalling

Figure 5-66 B-70-0266 Approach Expansion Joint

Figure 5-67 B-70-0266 Superstructure Condition

Figure 5-68 B-70-0266 Underside of Deck Condition

5.11 B-70-0267

Bridge B-70-0267, the elevation of which is shown in Figure 5-69, crosses the north channel of Lake Butte des Morts, on northbound USH 41 in Winnebago County. The two-span bridge, constructed in 2013, measures 219’-10” long and 91’-4” wide. The bridge is not skewed.

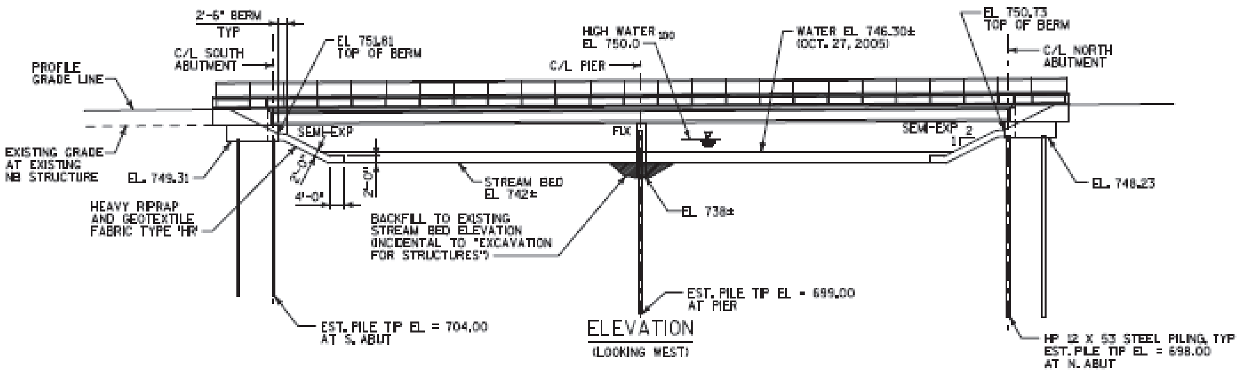


Figure 5-69 B-70-0267 Elevation

The approach panels were constructed per the SDD 13B2 plans and to this point appear in very good condition. As shown in Figure 5-70, no appreciable cracking was visible at both the entrance and exit approaches. The joints between the mainline pavement and approaches, within the body of the approaches, and at the bridge deck remain filled with joint sealant aside from the second joint off the end of the bridge where some sealant appears missing (see Figure 5-71).

The subbase below the approach slabs was not visible, so an accurate assessment could not be made with regards to its settlement or erosion. Even so, the relatively recent construction completion and the lack of any noticeable differential deflection between joints might indicate that the subbase is performing relatively well.

A cursory review of the visible substructure and superstructure was completed and nothing indicating poor performance was observed, which was expected given the recent construction completion of the bridge.

Figure 5-70 B-70-0267 Approach

Figure 5-71 B-70-0267 Missing Joint Sealant

5.12 B-70-0268

Bridge B-70-0268, the elevation of which is shown in Figure 5-72, crosses the north channel of Lake Butte des Morts on southbound USH 41 in Winnebago County. Constructed in 2012, the two-span bridge measures 219’-10” from end to end and 75’-7” wide. The bridge is not skewed.

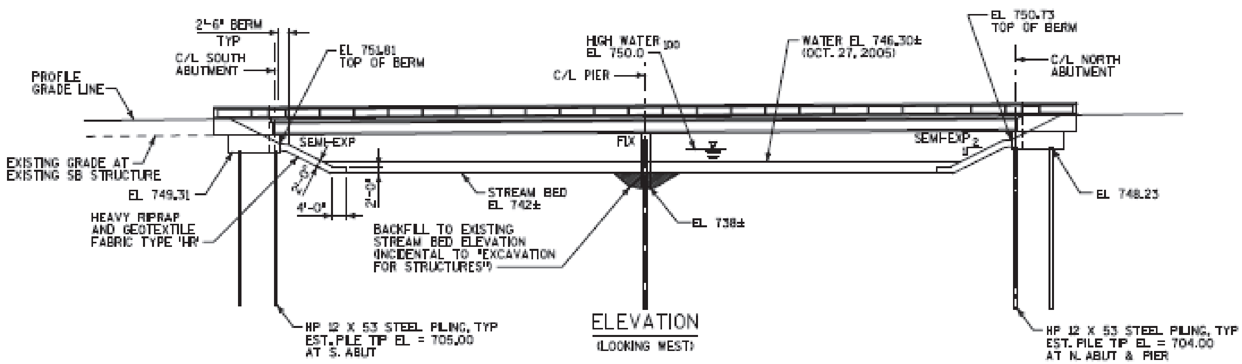


Figure 5-72 B-70-0268 Elevation

The approaches constructed per the three-expansion-joint plans SDD 13B2 was observed to be in good condition as shown in Figure 5-73. All expansion joints appeared to be filled and well-sealed leading up to the bridge with no differential deflection or settlement apparent. No cracking in the three approach spans was visible. As shown in Figure 5-74, some of the joint sealer at the bridge deck to approach joint has been removed. The transition from the approach to the bridge was very smooth.

The subbase below the approach slabs is not visible, though the embankment outside of the roadway limits shown in Figure 5-75 does not show any appreciable settlement or erosion which, along with the good condition of the expansion joints, might indicate that the same is true of the grade below the approach slabs.

A cursory review of the structure condition was completed for the superstructure and visible substructure. Overall, the condition appears in excellent condition which might be expected given its relatively recent construction completion. With that said, there was some hairline deck cracking observed from below the deck. An example of this condition is shown in Figure 5-76.

Figure 5-73 B-70-0268 Bridge Approach

Figure 5-74 B-70-0268 Joint Sealant at Bridge Deck

Figure 5-75 B-70-0268 Embankment

Figure 5-76 B-70-0268 Deck Cracking

5.13 Wisconsin DOT Crack Inspections

Comments and photographs received from WisDOT staff regarding approach apron crack inspections were provided to the researchers. An example of one bridge that was constructed in 2013, but yet had not had traffic, is shown in Figure 5-77 and Figure 5-78. The bridge aprons were constructed per the Bridge Standard 12.10 and 12.11. The comments were as follows:

"Almost all the approach aprons have cracks that form initially and they seem to form around the center or the 1/3 points of the apron. It seems that since these aprons are wide and very skinny, they are cracking like pavement does in large panels. The cracks we have seen are not hair line cracks but open as much as 1/8". This crack formed after the initial crack inspection. These cracks are a similar in size to the ones found at initial crack inspection on all the other aprons."

The comments appear to be similar in many respects to those made regarding the issues indicated in the observation reports of the bridges constructed using the Bridge Standard 12.

Figure 5-77 Wisconsin Approach Cracking

Figure 5-78 Wisconsin Approach Cracking

5.14 Summary of Bridge Distress Conditions

The bridge distress conditions for each of the previously discussed bridges are summarized in Table 3 below; the bridge number, observed distress, the distress location, severity, and extent are provided.

Table 3 Summary of Bridge Distress Conditions

Bridge Number	Observed Distress	Location	Severity	Extent
B-05-0604	Concrete cracking	Normal to skew extending either side of joint between each approach panel and bridge deck. More noticeable at bridge exit in the first traffic lane from the right shoulder.	< 1/16” wide	Full length of approach panel and within approximately 20’ from joint into the bridge deck. Observable hairline cracking from below deck.
B-05-0605	Concrete cracking	Normal to the skew located in the first traffic lane from the right shoulder at the bridge entrance and exit approach panels.	< 1/16” wide	Full length of approach panel and within approximately 20’ from joint into the bridge deck. Observable hairline cracking from below deck.
	Approach support material removal	Southeast wingwall	Minor	Bottom of wingwall exposed possibly the result of some washout, settlement, or sloughing.
B-05-0606	Concrete cracking	At the bridge exit approach panel where additional cracks were observed extending from the end of bridge into the bridge deck at a similar angle. Cracks were most apparent and slightly larger in the first and second traffic lane from the right shoulder.	1/16” to 1/8” wide	3/4 to full length of approach panel and within approximately 20’ from joint into the bridge deck. Observable hairline cracking from below deck.
B-05-0607	Concrete cracking	One more severe crack within the approach panel was noticed in the second traffic lane from the right shoulder and several diagonal cracks starting at the beginning of	1/16” to 1/8” wide (one crack) <1/16” wide (all others)	Full length of approach panel and within approximately 20’ from joint into the bridge deck.

		bridge deck at the bridge entrance and extending toward the centerline were observed both on the deck surface and on the underside of the deck.		Observable hairline cracking from below deck.
B-05-0650	Concrete cracking	Diagonal crack normal to the skew angle at the entrance approach within the right shoulder lane.	< 1/16” wide	Full length of approach panel.
	Concrete cracking	Bridge deck along its entire length diagonal to the longitudinal axis of the bridge	< 1/16” wide	Along entire length of the bridge deck. Hairline cracking is observable from below deck.
B-05-0651	Concrete cracking	Diagonal cracks normal to the skew exist at the bridge exit approach panel. The most noticeable was located immediately right of the rightmost mainline traffic lane.	< 1/16” wide	1/2 length of approach panel
	Concrete cracking	Bridge deck near the joint with the approach panels.	< 1/16” wide	Primarily within approximately 20’ from joint into the bridge deck, though hairline cracking from below deck was observable over the entire length of the deck.
B-70-0263	-	-	-	-
B-70-0264	Concrete cracking	Middle of the three approach panels at the bridge entrance (a single transverse crack and patch located in the second travel lane from the right shoulder and longitudinal cracking at the pavement edge of the same panel) and at the third expansion joint from the end of bridge (several large cracks and	1/8” wide	Isolated to approach panels at bridge entrance.

		a patch extend across the first two travel lanes from the right shoulder).		
B-70-0265	Concrete cracking	Longitudinal crack within the first travel lane from the right shoulder and along the barrier rail.	<1/8” wide	Full length of approach panel.
B-70-0266	Missing joint filler	Expansion joint between approach and mainline sleeper slab stub.	Minor to moderate	Intermediate along entire width of bridge.
	Concrete spalling	Joint between bridge deck and approach panel at bridge entrance.	Minor	Isolated to second travel lane from right shoulder.
	Debris in expansion joint	Expansion joints between sleeper slab stub and approach panels at each end of bridge.	Moderate	Full width of bridge.
B-70-0267	Missing joint filler	Second joint from end of bridge	Minor	Isolated to first travel lane from right shoulder.
B-70-0268	Missing joint filler	At the bridge deck to approach joint at bridge entrance.	Minor to moderate	Intermediate along entire width of bridge.

6 Laboratory Materials Testing

Structural backfill material used on the USH41 project was tested in the laboratory to classify its gradation and compaction properties and determine its collapse potential. The purpose of the compaction tests was to assess the influence of moisture content on the compaction characteristics of the material. The purpose of the collapse tests was to assess how the moisture influences the collapse properties of the material as it relates to settlement of the material in situ. Assessment of collapse of backfill material was found to be critical in previous studies (e.g., White et al. 2005), in developing field compaction specifications to avoid post construction settlement that result in the "bump" at the edge of the bridge. What follows below is a summary of the laboratory test procedures used in this study and results and key findings from the tests.

6.1 Test Procedures

Gradation analysis test was performed in accordance with ASTM C136-06 "*Standard test method for sieve analysis of fine and coarse aggregates*".

Vibratory compaction test was performed to determine maximum and minimum index densities in accordance with ASTM D4253-00 "*Standard test methods for maximum index density and unit weight of soil using a vibratory table*" and D4254 00 "*Standard test methods for minimum index density and unit weight of soils and calculation of relative density*". The standards require testing be conducted on oven-dry material. To assess influence of moisture on the compaction characteristics of the material, vibratory compaction tests were conducted on the material by incrementally increasing the moisture content by 1 to 2% for each test until the material was very wet.

Odometer tests were performed on the material compacted at a target moisture content to a target dry unit weight. Compaction was performed by placing the material in the odometer with a small wooden spacer. Four different moisture contents were selected based on the compaction test results: (1) oven-dry, (2) bulking moisture content, (3) optimum moisture content, (4) wet of optimum moisture content. Tests were conducted by applying a seating pressure of about 1 psi for about 2 min, and applying an overburden stress of 4 psi, 8 psi, and 16 psi to represent approximately 5', 10', and 20' of fill, respectively. After applying the overburden stress till the end of primary consolidation or about 4 min (whichever is longer), water was added to the odometer and the settlement was monitored. The axial strain occurred after adding water was calculated as the collapse strain of the material. The purpose of three applied stress levels was to assess the influence of applied stress on the collapse potential. Pictures of odometer test setup are shown in Figure 6-1.

6.2 Results and Analysis

Gradation test results are presented in Figure 6-2 in comparison with the Wisconsin DOT structural backfill gradation requirements per Section 310 of the Standard Specifications. Results indicated that the material is classified as well graded gravel to silty gravel (GW-GM) according to the Unified Soil Classification System (USCS) and A-1-a according to the AASHTO soil classification system. The material gradation was within the DOT specified limits. The material contained about > 25% passing the No. 4 sieve and <6.4% fines passing the No. 200 sieve, per Section 310 of the specifications. The particle size at 10% passing (D_{10}), 30% passing (D_{30}) and 60% passing (D_{60}), and percentages of gravel, sand, and fines are summarized in Figure 6-2.

Moisture-dry unit weight relationship from vibratory compaction tests are shown in Figure 6-3. Results showed a maximum dry unit weight of 141.3 pcf at 8.4% optimum moisture content. The dry unit weight decreased as the moisture increased from 0 to 3% ("bulking" moisture content) but then increased from 3 to 8%, which is typical for granular materials.

Collapse test results obtained at three different overburden stresses and at four moisture contents are presented in Figure 6-4. Results indicated that increasing overburden stress increased the collapse potential and increasing moisture content decreased the collapse potential. This finding has a practical significance in that having material near saturation at the time of placement (by flooding) is critical to avoid unwanted post-construction collapse in the backfill material.

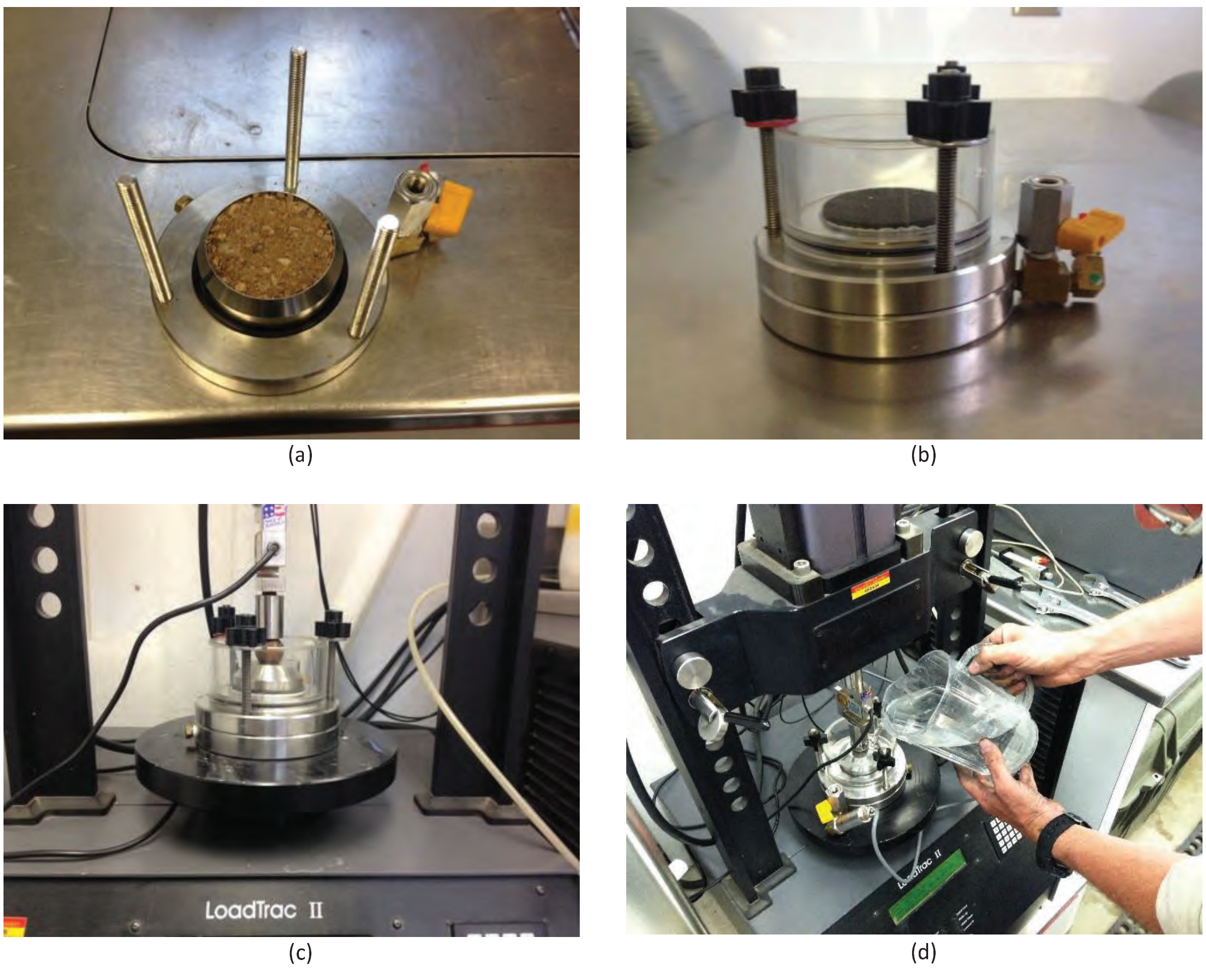
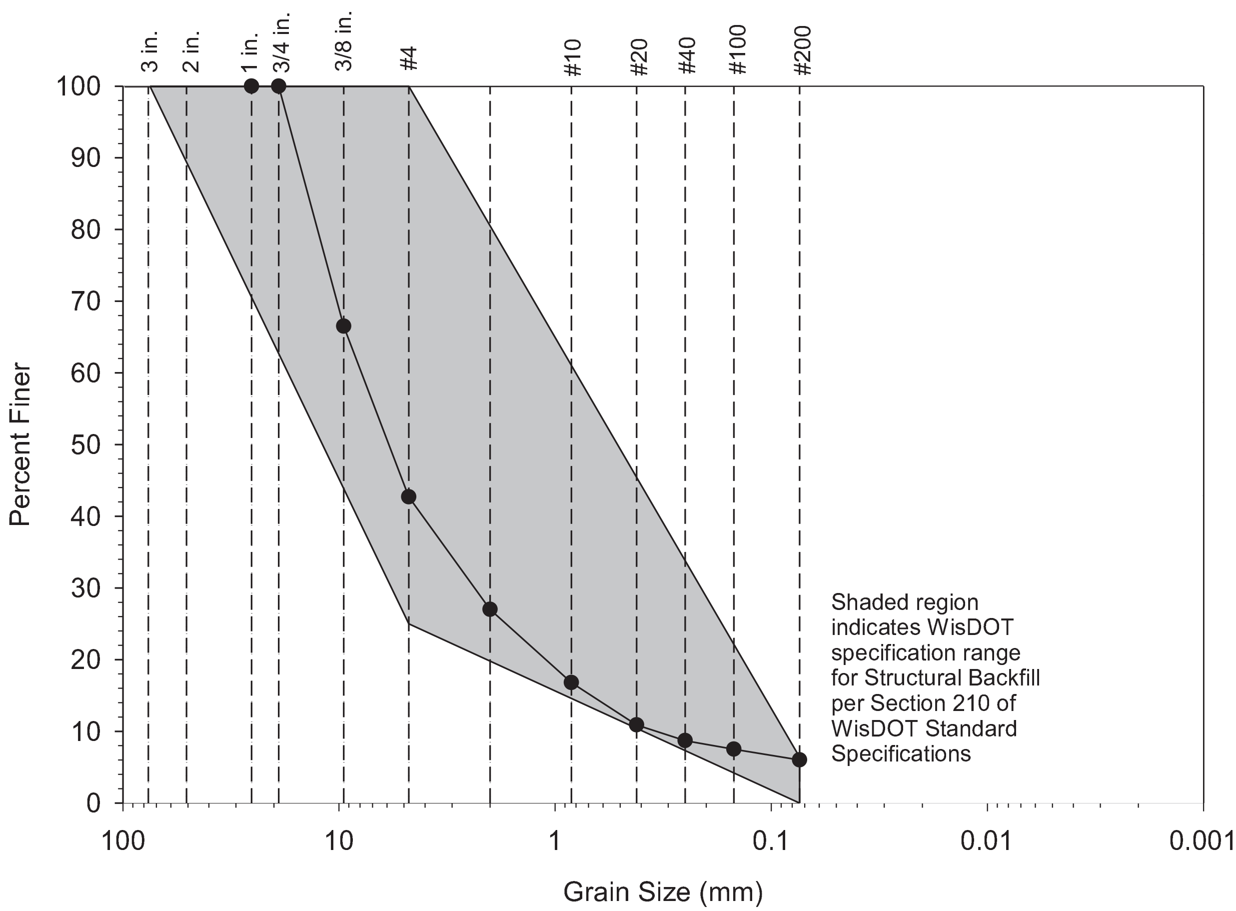


Figure 6-1 Pictures of collapse testing using odometer: (a) sample setup in odometer, (b) sample assembled with porous stone on the top (one-way drainage), (c) sample assembly under loading, and (d) addition of water



% Gravel		% Sand			% Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	57.3	15.7	16.1	4.9	6.0	

Coefficients			Classification	
D_{10} = 0.36	D_{30}= 2.45	D_{60}= 8.31	USCS = GW-GM	AASHTO = A-1-a

Figure 6-2 Results of particle size analysis

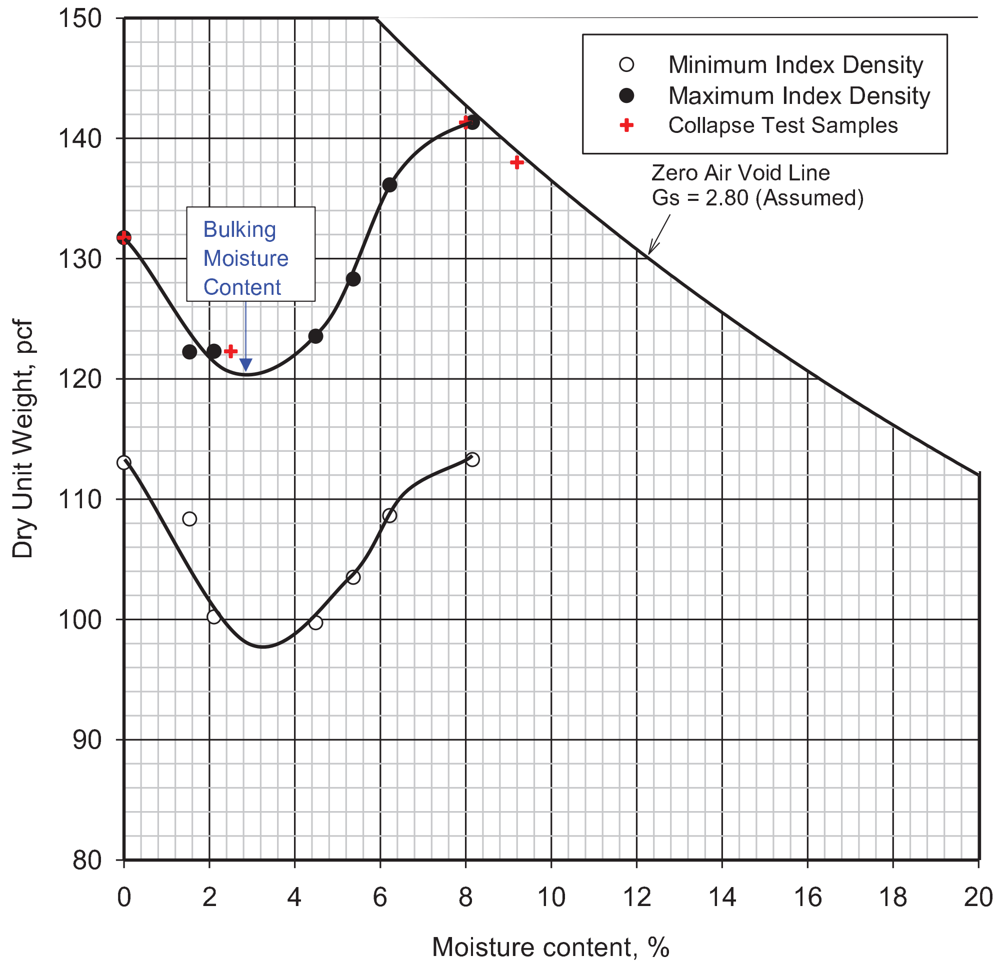


Figure 6-3 Results of vibratory compaction test results

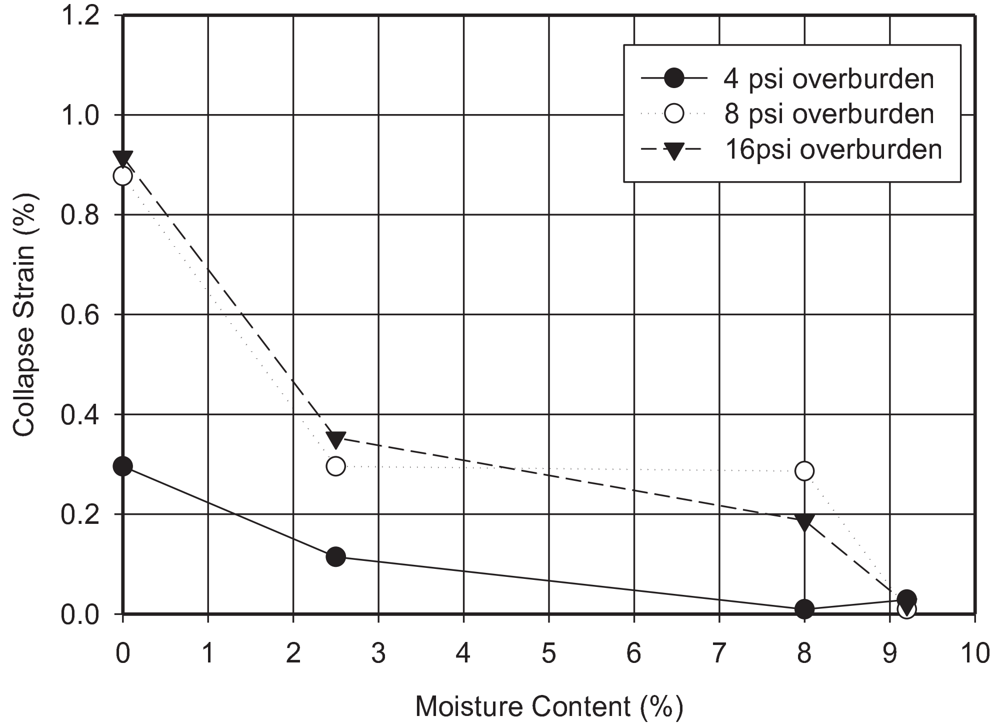


Figure 6-4 Results of collapse tests

7 Summary, Conclusions, and Recommendations

7.1 Summary

The goal of this project was to provide WisDOT with guidance regarding the use of a three-expansion-joint approach detail (SDD 13B2) or a single expansion joint approach detail (Bridge Standard 12.10, 12.11). The constructability of the three-expansion-joint approach was proving to be difficult and costly. Accordingly, a new detail implementing a single expansion joint was devised that would simplify the construction; recently, this detail has been used. An assessment of these approach details was needed to inform the decisions going forward. In total, several project objectives were formulated to complete the assessment and to provide further guidance. The project objectives were as follows:

- Review and analyze current approach slab performance
- Review and analyze other states' practices with respect to approach slabs
- Determine what other currently adopted approach slab designs may be applicable to Wisconsin
- Determine if there is a problem with current approach slab performance and, if so, will new designs improve performance
- Determine if three expansion joints are needed to provide thermal expansion/contraction relief or if one joint will be sufficient
- Improve the constructability and performance of approach slabs

To complete the project objectives the following tasks were performed:

- Literature review of studies completed with respect to approach design and construction
- Review of other state approach design and construction practices
- Review of WisDOT approach design and construction practices
- Field investigation of 12 WisDOT bridges
- Laboratory testing of WisDOT abutment backfill materials

7.2 Conclusions and Findings

The following conclusions and findings were developed from the tasks previously mentioned and detailed in this report.

7.2.1 State Practices

The current approach design and construction practices of numerous states around the Midwest, by and large, are quite similar to the practice of using Bridge Standard 12. Numerous states employ a structural slab which rests within a paving notch cast into the abutment and also on a sleeper slab typically in the range of 20' to 30' from the end of the bridge. Even more, generally speaking, the expansion joints have been moved to between the end of the approach slab and mainline pavement. Measures to reduce the friction forces between the approach slab and subbase have been taken in many cases; typically, polyethylene sheeting is used. Also, the sleeper slabs are often troweled smooth and polyethylene sheeting laid over the top to form a bond break between it and the approach slab.

The details appear to mostly differ in at least one of a couple areas including subbase/backfill drainage and required reinforcement. Several states do not have specific drainage details for below the approach, at the joints, or adjoining the abutment. If water intrusion occurs, either through cracks or at the joints, the soils become wet thereby changing the properties. If large amounts of water pass beneath the approach, it is likely that soil loss will occur. In either case, the approach slab support can be compromised possibly leading rider discomfort and/or required maintenance. The reinforcement sizes, spacing, and quantities in similarly sized approach slabs varied considerably from state to state. This leads one to believe that maybe not all slabs are being designed to bridge the span between the sleeper slab and abutment, which seemingly defeats one of the primary purposes of constructing a structural slab in the first place.

7.2.2 SDD 13B2

The three-expansion-joint detail (SDD 13B2) appears to be performing well at the observed locations. There was no apparent differential deflection or uneven settlement. The detailing at the paving notch (no positive connection) and the inclusion of multiple expansion/contraction joints tends to limit the cracking that might otherwise occur if the approach was restrained from movement from expansion and contraction of the bridge and/or approach itself.

The overall performance, however, greatly hinges on the subbase preparation and condition. This detail, more than the other (Bridge Standard 12), requires particular attention to the backfill materials and placement. Any settlement or erosion could be reflected in the approach panels, thereby potentially causing cracking and/or differential settlement at the joints which affects the rideability and increases required maintenance activities.

All of the observed bridges with the three-expansion-joint detail have been constructed within the last couple of years. It is difficult to determine if the long term performance of the associated approaches will continue to be quite good or if, over time, they will be subject to subbase settlement and/or erosion.

The difficult constructability of this approach has already been documented both in this document and by the Wisconsin DOT. If an effective, more easily constructed alternative will be or has been developed, it would be reasonable to eliminate or reduce the use of this plan going forward.

7.2.3 Bridge Standard 12

The single expansion joint detail (Bridge Standard 12.10, 12.11) looked to be performing well with respect to rideability. Differential deflection at the approach joints was not detected, nor was it evident through traffic observation (vehicles bouncing across the bridge). The joints mostly remained in overall good condition, without loss of sealant and/or debris buildup. However, cracking of the approach slab and/or the bridge deck adjacent to the slab seemed to be prevalent at those bridges visited.

Cracks appeared to initiate at the approach to bridge deck joint and propagate at an angle approximately normal to the skew. Six bridges (those in Brown County) are a small percentage of the total population of bridges constructed using this detail, though it is noteworthy that all of those bridges had very similar cracking issues and each of these bridges were skewed at an angle no less than 26 degrees and no more than 30 degrees. The bridges using a detail very similar to Bridge Standard 12 (B-70-0264, B-70-0265 – Winnebago County) were not skewed and did not show cracking to the extent of those skewed (Brown County), especially cracking propagating into the deck.

Studies have been completed that specifically aim to identify the causes of deck cracking at the ends of skewed bridges. In one particular study (Fu et al, 2007), the researchers concluded that the decks of skewed bridges may develop much higher stresses than their straight counterparts and that early cracking in skewed bridge decks is primarily caused by thermal and shrinkage loading in concrete hydration. One could argue the same constraints are present in the approach slab at the joint abutting the bridge deck thereby causing similar cracking to occur. The researcher's recommended practices to reduce the strain and stress in the concrete during the strength development stage included the following:

- Reduce or relax the constraint at the deck end by reducing or eliminating the composite nature of the deck.
- Optimize the ingredients in the concrete mix to reduce the potential of cracking by reducing the heat generated shortly after placement and the tendency for shrinkage.
- Increase the amount of steel reinforcement in the acute angle corner areas and the end areas of skewed decks.

It seems improbable that these actions will eliminate all cracking in the deck. In fact, the researchers of this project have concluded through other recently completed studies that the cracking at the end of skewed decks is almost a certainty, particularly for bridges with integral or semi-integral abutments, regardless of the preventative actions taken, short of completely reforming the traditional methods of construction. It was found that the differential temperatures between the abutment and deck create non-uniform expansion and contraction between the two elements, and since they share a common fixity at the shared joint, the forces imposed by this discontinuity are expressed through deck cracking. Even so, attempts to reduce the number and severity of cracks could pay dividends in the future when considering potential maintenance activities.

The potential exists on skewed bridges that, if the approach panel becomes locked in place via limited slip resistance between the slab and subbase or from sufficient expansion to close the expansion joint, a horizontal force could be developed along the skewed joint between the end of deck and approach panel. It is believed that this horizontal force could potentially help propagate the cracking at the joint or in extreme cases be the cause thereof.

Through the findings of the aforementioned studies as well as others, it is concluded that the cracking in the bridge deck is not due to the approach slab detailing but, because of the detailing (positive connection to the abutment), the approach slab is subject to the same mechanisms that cause the cracking in the deck, thus likely to realize cracking.

The primary function of the approach slab is to provide a smooth transition from the mainline pavement to the bridge, and in that respect the detail is performing the function for which it was intended.

The details indicate the approach slab is doubly reinforced. Even so, it is not clear if the slabs have been designed to fully span between the sleeper slab and paving notch in the absence of any support provided by the subbase. In the event of consolidation and/or settlement the approach slab would require this strength to avoid premature failure. Due to the results obtained while testing the approach slab under ambient live load conditions, it is concluded that when the supporting soil structure remains in contact with the bottom side of the approach, the forces developed in the slab are quite minimal.

7.2.4 Materials Testing

The materials used for structural backfill on the USH 41 project were provided to the researchers by WisDOT. Two material was tested to classify its gradation and compaction properties and determine its collapse potential. The purpose of the compaction tests was to assess the influence of moisture content on the compaction characteristics of the material. The purpose of the collapse tests was to assess how the moisture influences the collapse properties of the material as it relates to settlement of the material in situ. Assessment of collapse of backfill material was found to be critical in previous studies (e.g., White et al. 2002), in developing field compaction specifications to avoid post construction settlement that result in the "bump" at the edge of the bridge.

Results indicated that the material is classified as well graded gravel to silty gravel (GW-GM) according to the Unified Soil Classification System (USCS) and A-1-a according to the AASHTO soil classification system. The material gradation was within the DOT specified limits.

The results from the collapse test indicated that increasing overburden stress increased the collapse potential and increasing moisture content decreased the collapse potential. This finding has a practical significance in that ensuring the material is near saturation at the time of placement (by flooding) is critical to avoid unwanted post-construction collapse in the backfill material.

7.3 Recommendations

7.3.1 Approach Details

The expansion and contraction requirement does not warrant the use of multiple expansion and contraction joints as seen in SDD 13B2. Even so, it should be noted that the size of expansion joint shown within the Bridge Standard 12 plans does not vary with respect to the length of bridge, type of bridge, or temperature at placement like those used in Kansas (see Appendix A). Attention should be paid to this detail to ensure the joint has been properly sized for the bridge at which it will be used.

The SDD 13B2 is more highly susceptible to inadequacies within the approach supporting materials. If this detail is to perform well in the long-term, it is critical that the materials are prepared well and methods of preservation are built into the system. Specific methods to complete this task are discussed within the next section.

For Bridge Standard 12, it is recommended that the slab design is revisited to ensure it is properly sized and reinforced to act as a bridge between the sleeper slab and abutment paving notch in the event that settlement of the backfill and subbase occurs.

The continued use of a sleeper slab at the joint between the mainline pavement and approach slab is recommended. Particular attention should be paid to the proper compaction and preparation of the soils supporting the sleeper slab. Any movement of the sleeper slab will be directly reflected at the joint above and change the slope of the approach slab potentially creating the "bump" at the end of the bridge. More than that, the joint between the deck and approach slab will also change with a changing slope.

The continued use of polyethylene sheeting between the approach slab and supporting materials/sleeper slab interface is recommended. It is known that considerable friction forces remain despite the use of this material, but those forces are reduced on account of the sheeting which directly impacts the forces being imposed on the bridge structure.

It is recommended that all new bridges be profiled and have the gross vertical geometry measured immediately after construction. This establishes a baseline that can be used for evaluating future performance. Additionally, a specification that ensures an acceptable ride quality at the time of construction should be created and adopted by WisDOT. It is suggested that the specification should contain two parts: a maximum global roughness and maximum local roughness.

Following construction, it is recommended that the approach/bridge be profiled at least every 10 years or when it is apparent that the rideability has begun to degrade (Phares et al, 2011). The comparison afforded between years can provide a quantitative assessment of the changing condition of the approach/bridge.

7.3.2 Backfill and Approach Support

Attention paid to the abutment backfill and approach support materials to mitigate potential differential settlement through improved compaction, reduced erosion, and/or use of alternative materials can prove to be time well spent, especially in the absence of a structural slab meant to span between a sleeper slab and the abutment.

Appropriate consideration for the backfill materials should be made. To a great extent, WisDOT has paid due diligence to this critical element in the design phase. Still, ensuring that the construction is completed as intended is of the utmost importance. Proper placement and compaction of the backfill and base materials can mean the difference between a long-lived approach and one that perpetually requires maintenance.

Consideration should be given to flooding the structural backfill assuming the use of the current materials is maintained to eliminate post-construction collapse of the backfill material.

Water drainage should be an integral part of the bridge and embankment design. It is critical to direct water away from the bridge deck, joints, and embankment in a way that does not create an erosion problem or changes in the soil properties. The following details are generally recommended, some of which may be already in use on some or all new WisDOT structures.

- Full-width approach slabs should be used and have curbs or raised parapets to prevent deck drainage from eroding shoulder support.
- Provide a tiled drainage outlet near the approach slab to pavement joint to prevent water from the bridge flowing onto the embankment.
- Provide surface drainage channels on the embankments with erosions cloth, erosion control mat, or rock to prevent pavement runoff from eroding the embankment.
- Place drainage tile in the embankment that has adequate crushing resistance with respect to the depth of soil placed above the tile.
- Provide a method for water to be drained from the deck prior to reaching the joint between the deck and approach slab.
- Provide a path for water to be drained that does infiltrate approach joints (i.e., bridge to approach, approach to pavement)

If drains and other drainage measures become plugged during or after construction, the purpose for which they were intended becomes nullified. Once the bridge is constructed, it is recommended that all drainage be continually checked for debris or other obstructions.

Simple tasks, such as cleaning plugged surface drains, replacing compressible joint filler, and placing a curb and gutter on the approach, can be very effective at minimizing water infiltration below the slab. If extensive erosion and loss of support has taken place, more drastic measures, such as removing the approach slab, installing a drainage system, and replacing soil and approach slab, may be required.

Consideration should be given to alternative backfill materials such as geocomposite drains and/or recycled tire chips. These products have been found to significantly increase drainage capacity, prevent void formation, and reduce settlement (White et al., 2005).

8 References

Abu-Farsakh, M.Y., and Chen, Q. (2014). “Field Demonstration of New Bridge Approach Slab Designs and Performance.” *Report No. FHWA/LA.13/520.* Louisiana Transportation Research Center. Baton Rouge, LA.

Briaud, J.L., James, R.W., and Hoffman, S.B. (1997). NCHRP synthesis 234: Settlement of Bridge Approaches (the bump at the end of the bridge), Transportation Research Board, National Research Council, Washington D.C. pp. 75.

Briaud, J.L., Seo, J. and Hunsoo, H., (2002). “Investigation of Settlement at Bridge Approach Slab Expansion Joint: Numerical Simulations and Model Tests.” *Report No. FHWA/TX-03/0-4147-2*, Texas Transportation Institute, Texas A&M, College Station, TX.

Cai, C.S., Voyiadjis, G.Z., and Xiaomin, S. (2005). “Determination of Interaction between Bridges, Concrete Approach Slab, and Embankment Settlement.” Department of Civil Engineering, Louisiana State University, Baton Rouge, LA.

Colorado Department of Transportation (CDOT). 2014. Staff Bridge Worksheets. Bridge Design and Management. http://www.coloradodot.info/library/bridge/design-standards/structural-worksheets-pdfs/b-600

Dupont, B. and Allen, D. (2002). “Movements and Settlements of Highway Bridge Approaches.” *Rep. No. KTC-02-18/SPR-220-00-1F*, Kentucky Transportation Center Report, Lexington, KY.

Fu, G., Feng, J., Dimaria J., and Zhuang, Y. (2007) “Bridge Deck Corner Cracking on Skewed Structures.” Rep. No. RC-1490, Center for Advanced Bridge Engineering, Wayne State University, Detroit, MI.

Greimann, L., Phares, B., Faris, A., and Bigelow, J. (2008). “Integral Bridge Abutment-to-Approach Slab Connection. Center for Transportation Research and Education. *CTRE Project 05-197*. I*owa Highway Research Board (IHRB) Project TR-530.* Iowa State University, Ames, IA.

Hoppe, E.J., (1999). “Guidelines for the Use, Design, and Construction of Bridge Approach Slabs.” *VTRC 00-R4.* Virginia Transportation Research Council, University of Virginia, Charlottesville, VA.

Illinois Department of Transportation (IDOT). 2012. Division of Highways – Bridges and Structures. http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Manuals-Guides-&-Handbooks/Highways/Bridges/CADD/Bridge-Cell-Libraries/superstructure.pdf

Indiana Department of Transportation (INDOT). 2012. Standard Drawings. Division of Bridges. http://www.in.gov/dot/div/contracts/standards/drawings/sep13/e/sep600.htm

Iowa Department of Transportation (IADOT). 2011. Standard Road Plans. Office of Design. http://www.iowadot.gov/design/SRP/CurrentBook/Sections/erk_section.pdf

Kansas Department of Transportation (KSDOT). 2014. Bridge Design Manual. Bridge Office. http://www.ksdot.org/Assets/wwwksdotorg/bureaus/burDesign/bridge/rd71252609.pdf

Kentucky Transportation Cabinet (KYTC). 2011 Standard Drawings. Division of Structural Design. http://transportation.ky.gov/highway-design/standard%20drawings%20%20sepias%20pdfs%202012/ebgx017.pdf

Kunin , J., and Alampalli, S., (2000). "Integral Abutment Bridges: Current Practice in United States and Canada." *Journal of Performance of Constructed Facilities*. Vol. 14. No. 3: 1014-111.

Minnesota Department of Transportation (MNDOT). 2011. 2012 Standard Drawings. Bridge Office. http://standardplans.dot.state.mn.us/StdPlan.aspx

Missouri Department of Transportation (MODOT). 2014. Bridge Standard Drawings – Approach Slabs. State Bridge Office. http://www.modot.org/business/standard_drawings2/approachslab_new_title_block.htm

Mistry, Vasant C. (2005). "Integral Abutment and Jointless Bridges." Paper presented at FHWA Conference: Integral Abutment and Jointless Bridges (IAJB 2005). FHWA. University of West Virginia, March 16-18, 2005.

Nebraska Department of Roads (NDOR). 2014. Bridge Office Policies and Procedures. Bridge Division. http://www.transportation.nebraska.gov/design/bridge/bopp/BOPP-Manual.pdf

North Dakota Department of Transportation (NDDOT). 2014. Standard Drawings. Bridge Division. http://www.dot.nd.gov/divisions/design/docs/standards/D255-01.pdf

Ohio Department of Transportation (ODOT). 2013. English Standard Drawings. Office of Structural Engineering. http://www.dot.state.oh.us/Divisions/Engineering/Structures/standard/Bridges/Standard%20Drawings/as181_01-18-13.pdf

Phares, B., White, D., Bigelow, J., Berns, M., and Zhang, J. (2011). "Identification and Evaluation of Pavement-Bridge Interface Ride Quality Improvement and Corrective Strategies.*" Rep. No. FHWA/OH-2011/1. State Job No. 134375,* Iowa State University, Ames, IA.

Puppala, A.J., Saride, S., Archeewa, E., Hoyos, L.R., and Nazarian, S., (2008). "Recommendations for Design, Construction, and Maintenance of Bridge Approach Slabs: Synthesis Report." *Report No. FHWA/TX-09/0-6022-1.* Department of Civil Engineering. The University of Texas at Arlington, Arlington, TX. The University of Texas at El Paso, El Paso, TX.

Thiagarajan, G., and Gopalaratham, V. (2010). "Alternative and Cost-Effective Bridge Approach Slabs." *Rep. No. NUTC R240 & R241.* Center for Transportation Infrastructure and Safety. Missouri University of Science and Technology, Rolla, MO.

Wisconsin Department of Transportation (WisDOT). 2014. WisDOT Bridge Manual – Chapter 12. Bureau of Structures. http://on.dot.wi.gov/dtid_bos/extranet/structures/LRFD/BridgeManual/Ch-12.pdf

Wisconsin Department of Transportation (WisDOT). 2014. Standard Detail Drawings. Bureau of Structures. http://on.dot.wi.gov/dtid_bos/extranet/structures/LRFD/standards.htm

Wisconsin Department of Transportation (WisDOT). 2014. Standard Detail Drawings. Bureau of Structures. http://on.dot.wi.gov/dtid_bos/extranet/structures/LRFD/standards/chap12.pdf

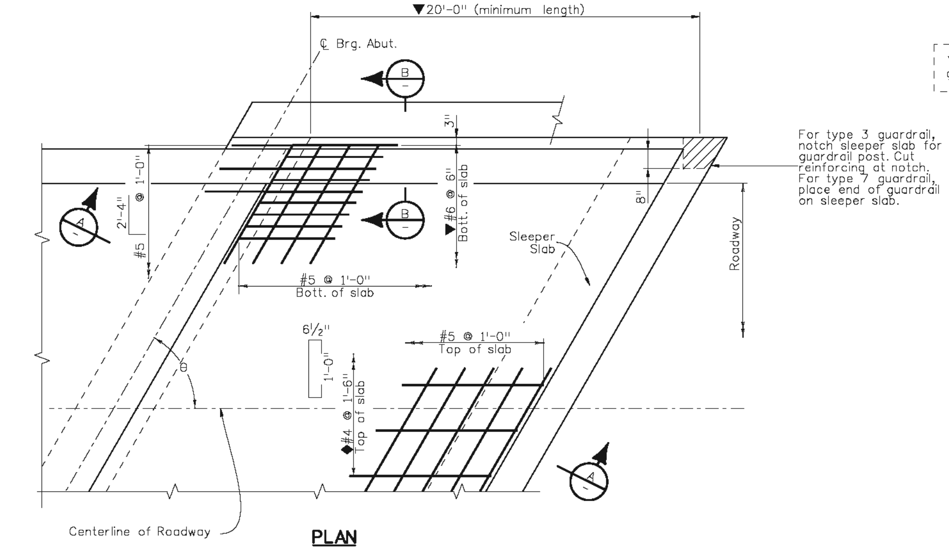
Wisconsin Department of Transportation (WisDOT). 2014. Facilities Development Manual. http://roadwaystandards.dot.wi.gov/standards/fdm/SDD/13b02.pdf

White, D., Sritharan, S., Suleiman, M., Mohamed M., and Sudhar, C. (2005). "Identification of the Best Practices for Design, Construction, and Repair of Bridge Approaches." *CTRE. Project 02-118*, Iowa State University, Ames, IA.

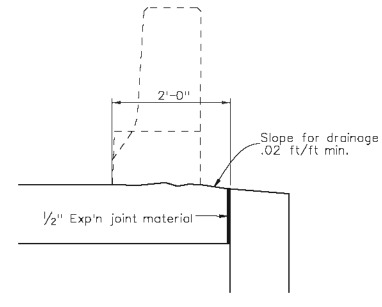
A. Appendices

Colorado

▼Designer: Use #9 for approach slabs greater than 20' and less than 31' long.

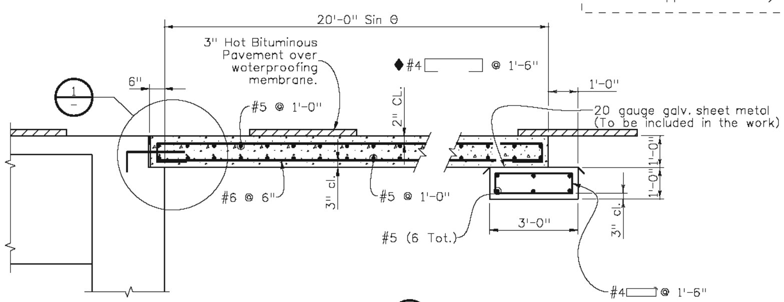


PLAN



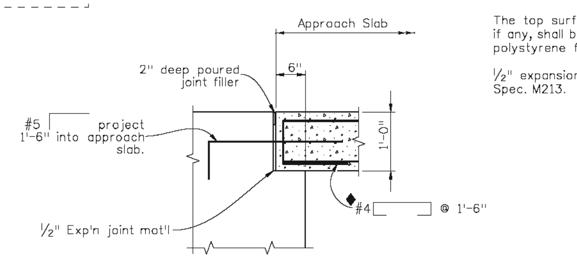
SECTION B

Designer: Do not use this sheet when the bridge length exceeds 250' on bridges with integral abutments, nor when the approach roadway is concrete.



SECTION A

With asphalt roadway



◆Contractor may use 7" 1'-0"

DETAIL 1

NOTES:

Concrete Class D (Bridge) shall be used for approach slabs.

Approach slab concrete shall be cured in accordance with the Specifications for Bridge Deck Concrete in Subsection 601.

The top surface of the post-tensioning block, if any, shall be covered with 1" of low density polystyrene foam. See Dwg. No. B_______.

½" expansion joint material shall meet AASHTO Spec. M213.

Print Date: $DATE$	
File Name: Sheet_B-601-1.dgn	
Horiz. Scale: NTS	Vert. Scale: As Noted
Staff Bridge Branch - Unit 022X	Unit Leader Initials

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
4201 East Arkansas Avenue
Room 107
Denver, CO 80222
Phone: 303-757-9309 FAX: 303-757-9197
Staff Bridge Branch — Initials

As Constructed
No Revisions:
Revised:
Void:

APPROACH SLAB DETAILS
ASPHALT W/ SLEEPER

Designer:	XXXXXXXX	Structure Numbers	X-XX-XX
Detailer:	XXXXXXXX		X-XX-XX
Sheet Subset:	BRIDGE	Subset Sheets:	BXX of XXX

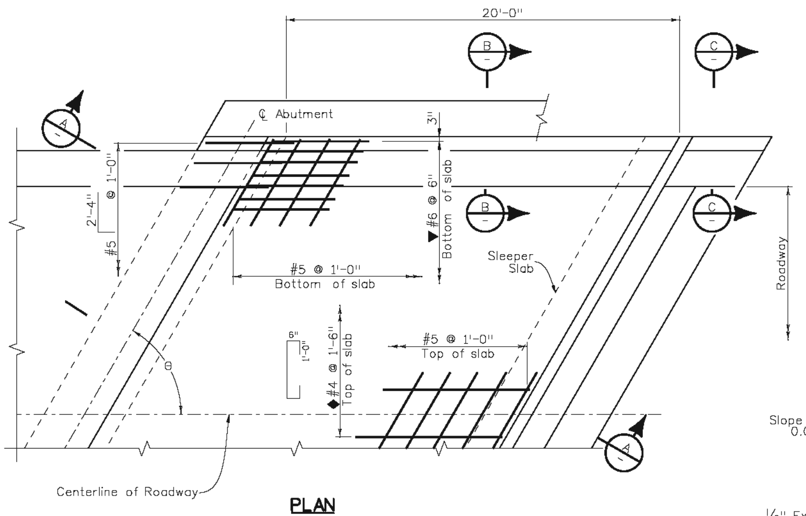
Project No./Code
Project Number
Code
Sheet Number

Revision Dates	8/95	3/99	11/99	5/00	4/02	6/04	3/07	10/13

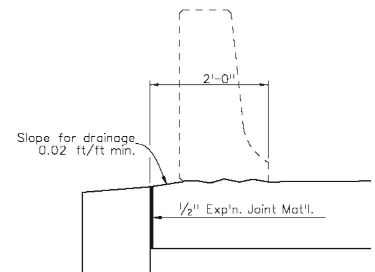
(Preliminary Stage Only)

	Designed By / Checked By	INITIAL	DATE
Design		XXX	MM/YY
Detail	Detailed By / Checked By	XXX	MM/YY
Quantities	Quantities By / Checked By	XXX	MM/YY

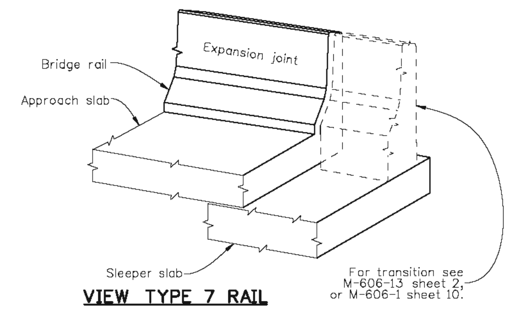
$PLOT_INFO$



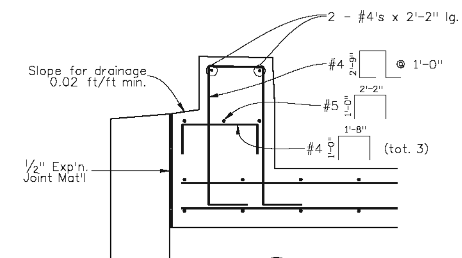
PLAN



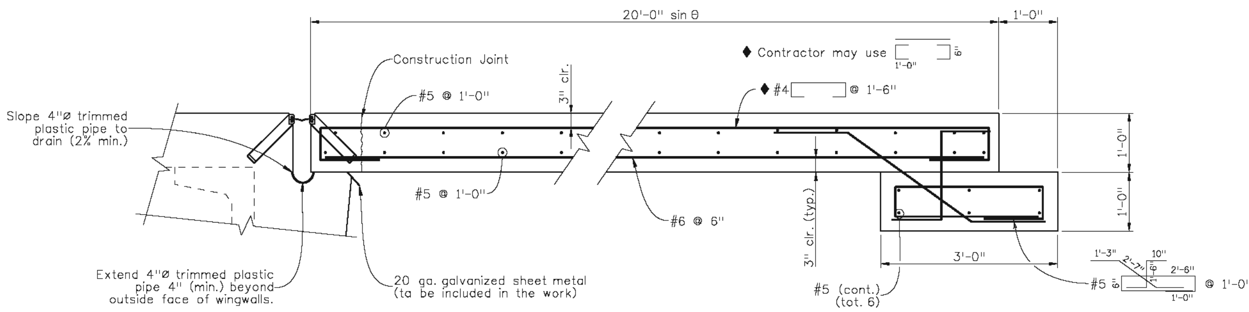
SECTION B



VIEW TYPE 7 RAIL



SECTION C



SECTION A

NOTES:

Concrete Class D (Bridge) shall be used for approach slabs.

½" expansion joint material shall meet AASHTO Spec. M213.

For expansion device details see Dwg. No. B___.

For curb and rail details see Dwg. No. B___.

Approach slab concrete shall be cured in accordance with the Specifications for Bridge Deck Concrete in Subsection 601.

The top surface of the post-tensioning block, if any, shall be covered with 1" of low density polystyrene foam. See Dwg. No. B___.

Revision Dates (Preliminary Stage Only): 6/04, 3/07, 10/13

		INITIAL	DATE
Design	Designed By	XXX	MM/YY
	Checked By	XXX	MM/YY
Detail	Detailed By	XXX	MM/YY
	Checked By	XXX	MM/YY
Quantities	Quantities By	XXX	MM/YY
	Checked By	XXX	MM/YY

Print Date: $DATE$
File Name: Sheet_B-601-1BF.dgn
Horiz. Scale: NTS Vert. Scale: As Noted
Staff Bridge Branch - Unit 022X Unit Leader Initials

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
4201 East Arkansas Avenue
Room 107
Denver, CO 80222
Phone: 303-757-9309 FAX: 303-757-9197
Staff Bridge Branch Initials

As Constructed
No Revisions:
Revised:
Void:

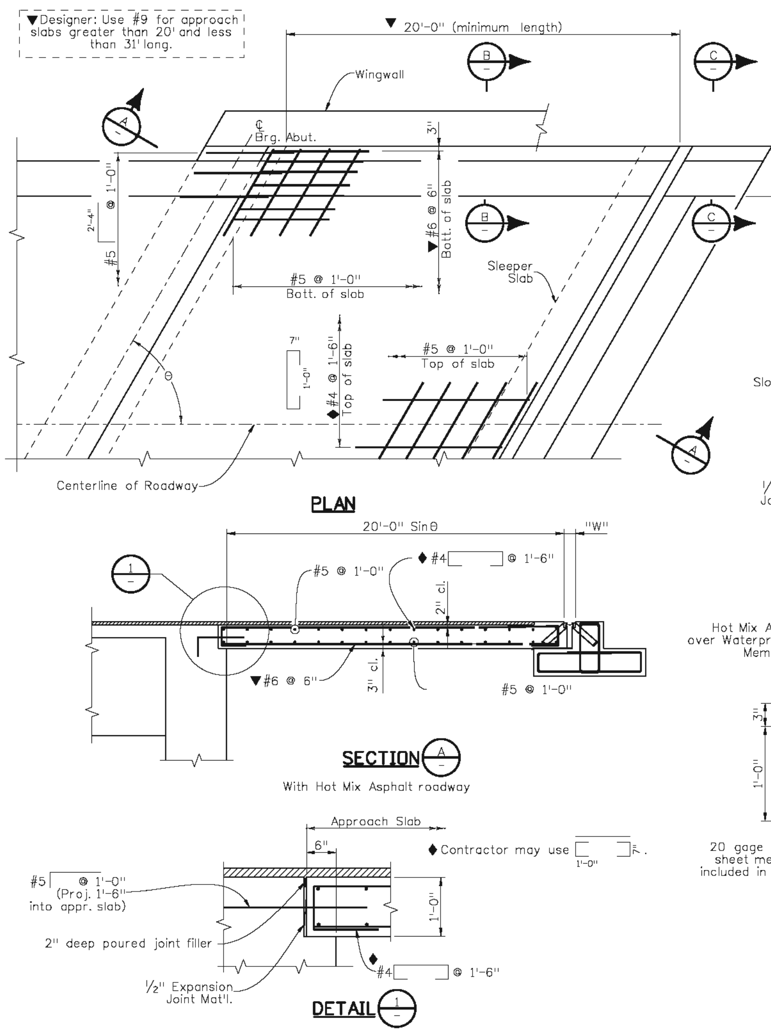
APPROACH SLAB DETAILS
CONCRETE W/ 0"-4" AT ABUTMENT

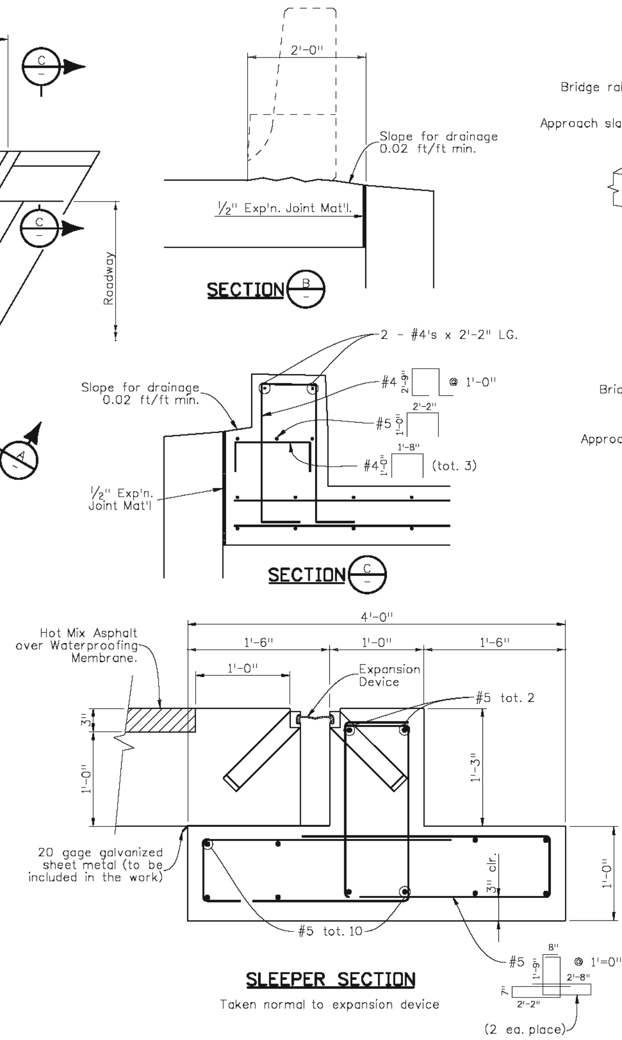
Designer:	XXXXXXXX	Structure Numbers	X-XX-XX
Detailer:	XXXXXXXX		X-XX-XX
Sheet Subset:	BRIDGE	Subset Sheets:	BXX of XXX

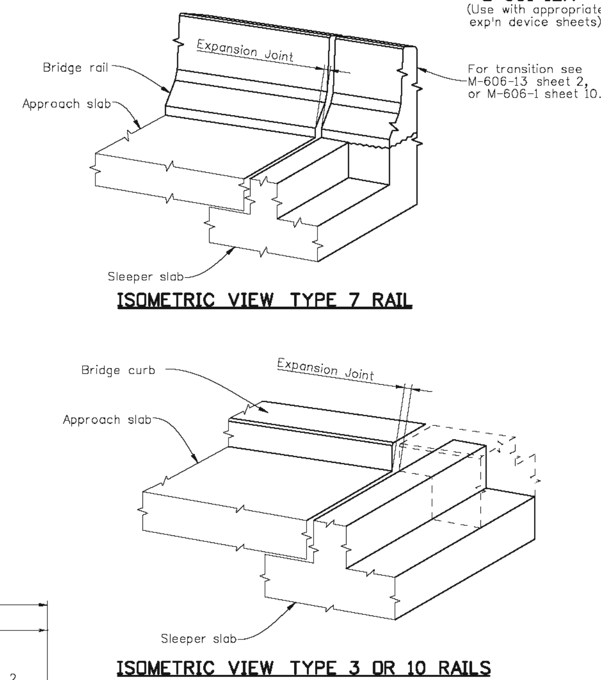
Project No./Code
Project Number
Code
Sheet Number XXX

$PLOT_INFO$

B-601-1EA
(Use with appropriate exp'n device sheets)







NOTES:

Concrete Class D (Bridge) shall be used for approach slabs.

½" expansion joint material shall meet AASHTO Spec. M213.

For expansion device details see Dwg. No. B___.

For curb and rail details see Dwg. No. B___.

Approach slab concrete shall be cured in accordance with the Specifications for Bridge Deck Concrete in Subsection 601.

The top surface of the post-tensioning block, if any, shall be covered with 1" of low density polystyrene foam. See Dwg. No. B___.

Revision Dates (Preliminary Stage Only)							
3/99	11/99	5/00	4/02	9/02	6/04	3/07	10/13

	INITIAL	DATE
Quantities By / Checked By	XXX / XXX	MM/YY / MM/YY
Detailed By / Checked By	XXX / XXX	MM/YY / MM/YY
Designed By / Checked By	XXX / XXX	MM/YY / MM/YY

Print Date: $DATE$
File Name: Sheet_B-601-1EA.dgn
Horiz. Scale: NTS Vert. Scale: As Noted
Staff Bridge Branch - Unit 022X Unit Leader Initials

Sheet Revisions		
Date:	Comments	Init.

Calorado Department of Transportation
4201 East Arkansas Avenue
Room 107
Denver, CO 80222
Phone: 303-757-9309 FAX: 303-757-9197
Staff Bridge Branch Initials

As Constructed
No Revisions:
Revised:
Void:

APPROACH SLAB DETAILS
ASPHALT W/ 0"-4" JOINT

Designer:	XXXXXXXX	Structure Numbers	X-XX-XX
Detailer:	XXXXXXXX		X-XX-XX
Sheet Subset:	BRIDGE	Subset Sheets:	BXX of XXX

Project No./Code
Project Number
Code
Sheet Number

$PLOT_INFO$

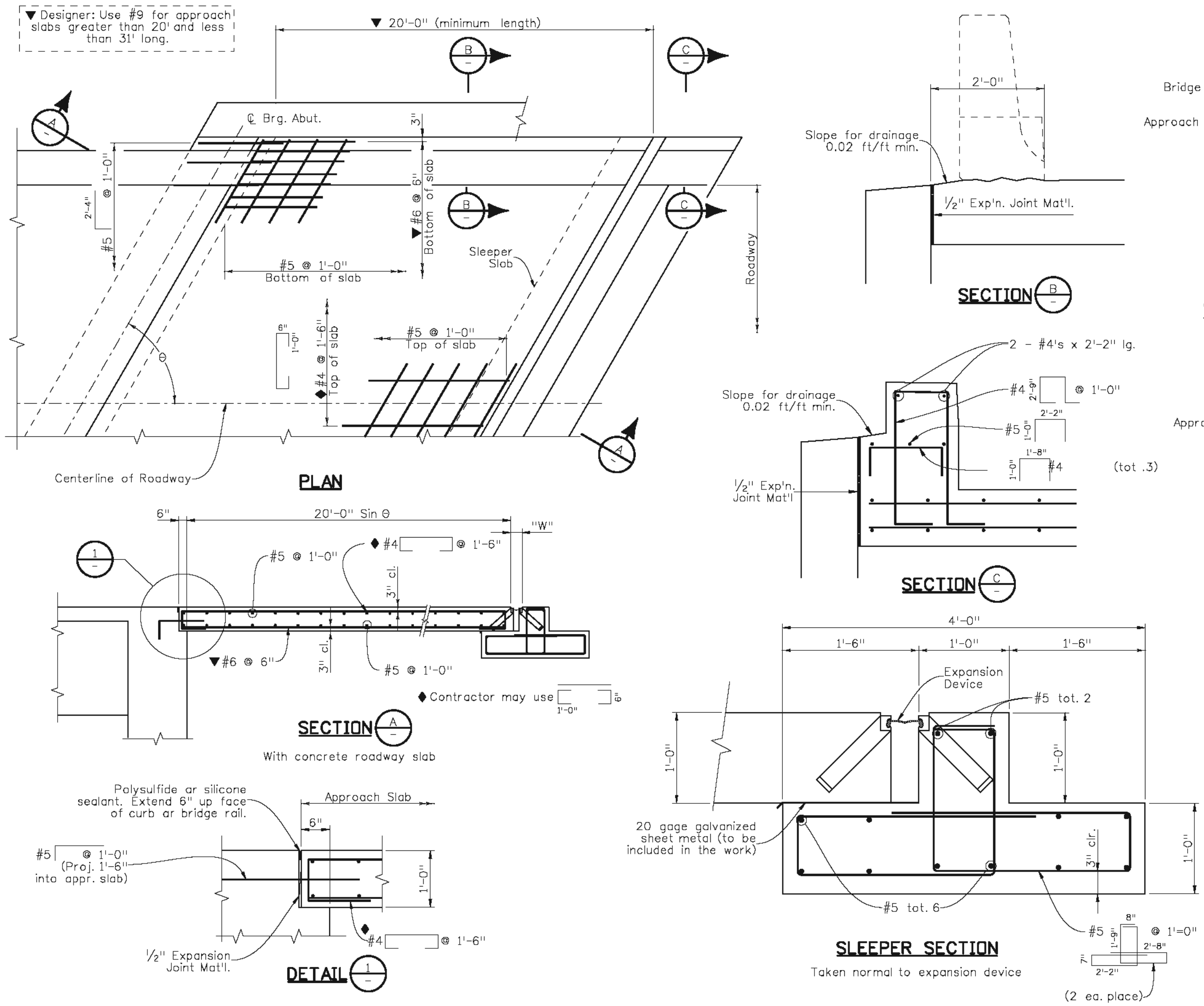
Revision Dates (Preliminary Stage Only): 3/99, 11/99, 5/00, 4/02, 9/02, 6/04, 3/07, 10/13

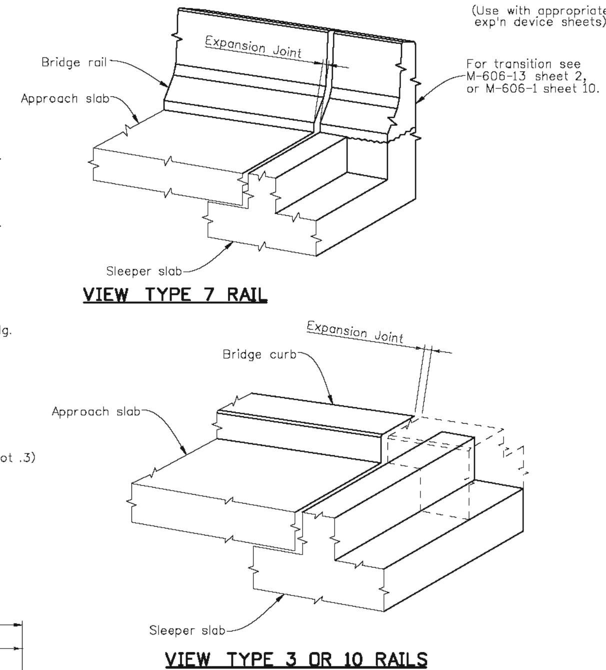
	Designed By	Checked By	Detailed By	Checked By	Quantities By	Checked By
INITIAL	XXX	XXX	XXX	XXX	XXX	XXX
DATE	MM/YY	MM/YY	MM/YY	MM/YY	MM/YY	MM/YY

Design / Detail / Quantities

B-601-1EC

(Use with appropriate exp'n device sheets)





NOTES:

Concrete Class D (Bridge) shall be used for approach slabs.

½" expansion joint material shall meet AASHTO Spec. M213.

For expansion device details see Dwg. No. B___.

For curb and rail details see Dwg. No. B___.

Approach slab concrete shall be cured in accordance with the Specifications for Bridge Deck Concrete in Subsection 601.

The top surface of the post-tensioning block, if any, shall be covered with 1" of low density polystyrene foam. See Dwg. No. B___.

Print Date: $DATE$
File Name: Sheet_B-601-1EC.dgn
Horiz. Scale: NTS Vert. Scale: As Noted
Staff Bridge Branch - Unit 022X Unit Leader Initials

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
4201 East Arkansas Avenue
Room 107
Denver, CO 80222
Phone: 303-757-9309 FAX: 303-757-9197
Staff Bridge Branch Initials

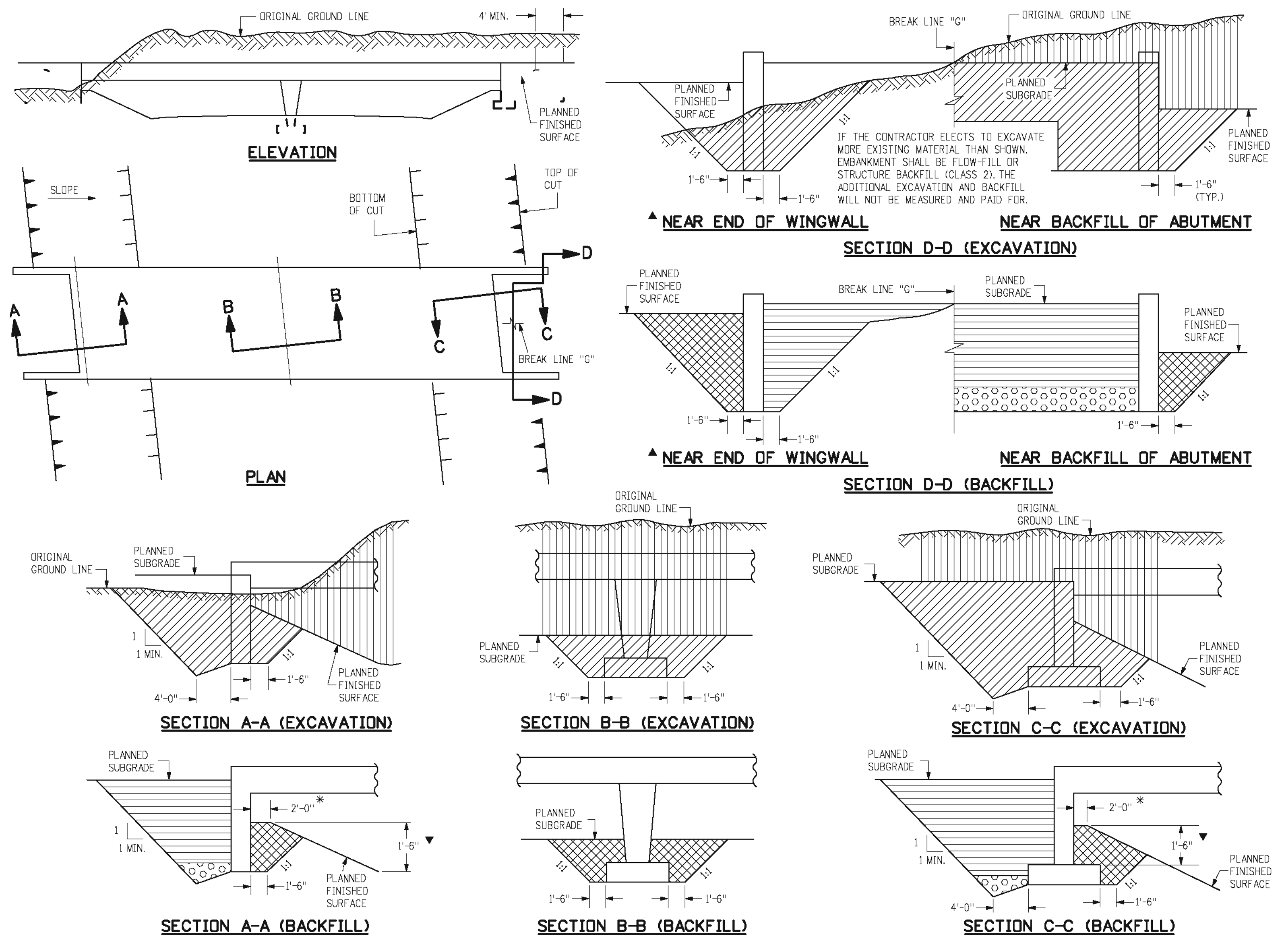
As Constructed
No Revisions:
Revised:
Void:

APPROACH SLAB DETAILS
CONCRETE W/ 0"-4" JOINT

Designer:	XXXXXXXX	Structure Numbers	X-XX-XX
Detailer:	XXXXXXXX		X-XX-XX
Sheet Subset:	BRIDGE	Subset Sheets:	BXX of XXX

Project No./Code
Project Number
Code
Sheet Number

$PLOT_INFO$



GENERAL NOTES

1. EXCAVATION AND BACKFILL PATTERNS DIFFERENT FROM THOSE INDICATED ON THIS SHEET WILL BE SHOWN ON THE PLANS.
2. STRUCTURE FOOTINGS WHICH ARE LOCATED IN ROCK SHALL BE POURED OUT TO UNDISTURBED ROCK WITHOUT FORMING, IN CONFORMANCE WITH SUBSECTION 601.09(b).
3. STRUCTURE EXCAVATION FOR SLOPE PAVING NOT SHOWN.

LEGEND

UNCLASSIFIED EXCAVATION

STRUCTURE EXCAVATION

STRUCTURE BACKFILL (FLOW-FILL), OR STRUCTURE BACKFILL (CLASS 1) WITH MECHANICAL REINFORCEMENT AS SHOWN ON THE PLANS

STRUCTURE BACKFILL CLASS 1

FILTER MATERIAL

▲ FOR PURPOSES OF QUANTITY CALCULATIONS THIS TEMPLATE APPLIES TO END OF WINGWALL.

* MINIMUM BERM DIMENSION

▼ MINIMUM EMBEDMENT OF ABUTMENT, IN STRUCTURE BACKFILL

Computer File Information		Sheet Revisions	
Creation Date: 07/04/06 Initials: SJR		Date:	Comments
Last Modification Date: 07/04/06 Initials: LTA	(R-X)		
Full Path: www.dot.state.co.us/DesignSupport/	(R-X)		
Drawing File Name: 206020102.dgn	(R-X)		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)		

Colorado Department of Transportation
4201 East Arkansas Avenue
Denver, Colorado 80222
Phone: (303) 757-9083
Fax: (303) 757-9820
Project Development Branch SRJ/LTA

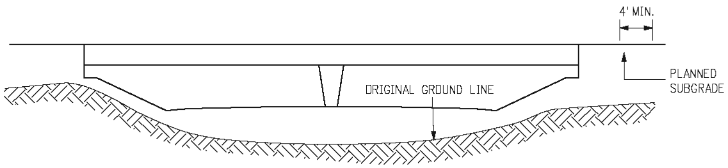
EXCAVATION AND BACKFILL FOR BRIDGES

Issued By: Project Development Branch July 04, 2006

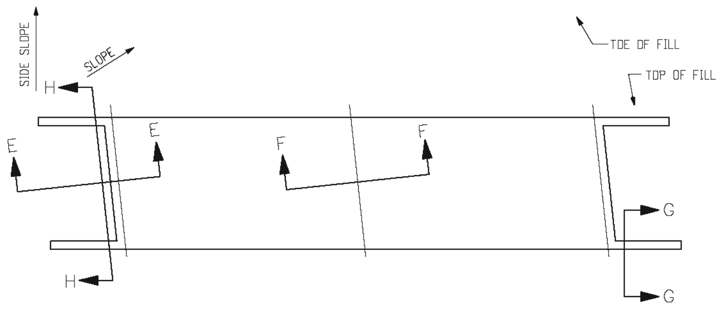
STANDARD PLAN NO.

M-206-2

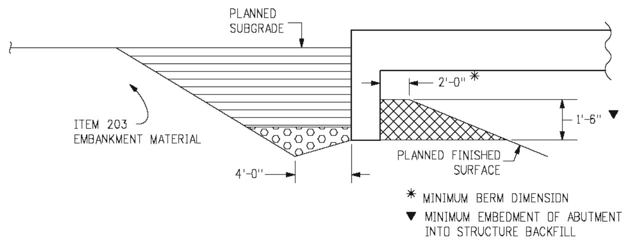
Sheet No. 1 of 2



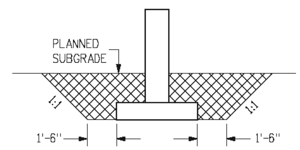
ELEVATION



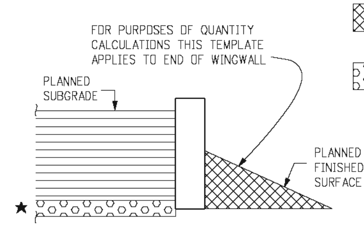
PLAN



SECTION E-E (BACKFILL)



SECTION F-F (BACKFILL)



SECTION G-G (BACKFILL)

★ FILTER MATERIAL IS ONLY USED IN AREA NEAR THE ABUTMENT AND NOT AT THE END OF THE WINGWALL

GENERAL NOTES

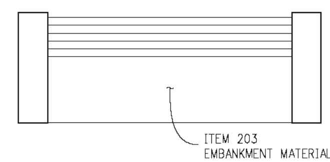
1. EXCAVATION AND BACKFILL PATTERNS DIFFERENT FROM THOSE INDICATED ON THIS SHEET WILL BE SHOWN ELSEWHERE ON THE PLANS.
2. STRUCTURE FOOTINGS WHICH ARE LOCATED IN ROCK SHALL BE POURED OUT TO UNDISTURBED ROCK WITHOUT FORMING IN CONFORMANCE WITH SUBSECTION 601.09.
3. STRUCTURE EXCAVATION FOR SLOPE PAVING NOT SHOWN.

LEGEND

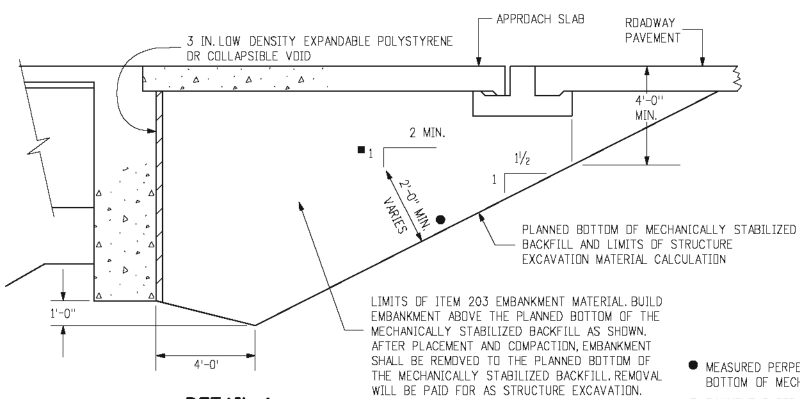
STRUCTURE BACKFILL (FLOW-FILL), OR STRUCTURE BACKFILL (CLASS 1) WITH MECHANICAL REINFORCEMENT AS SHOWN ON THE PLANS

STRUCTURE BACKFILL CLASS 2 (ON-SITE CLASS 2 MATERIALS MUST MEET CLASS 1 REQUIREMENTS)

FILTER MATERIAL



SECTION H-H (BACKFILL)

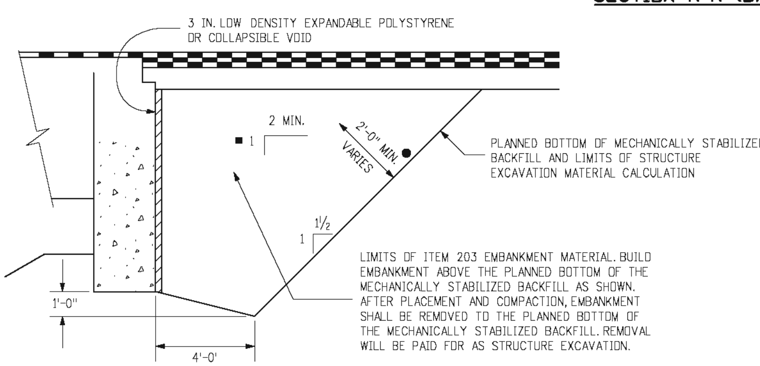


DETAIL 1

(WITH APPROACH SLAB)

● MEASURED PERPENDICULAR TO PLANNED BOTTOM OF MECHANICALLY STABILIZED BACKFILL.

■ PAYMENT BASED ON 2:1 SLOPE. ADDITIONAL QUANTITIES SHALL BE INCLUDED IN THE WORK.



DETAIL 2

(WITHOUT APPROACH SLAB)

Computer File Information		Sheet Revisions	
Creation Date: 07/04/06 Initials: SJR		Date:	Comments
Last Modification Date: 07/04/06 Initials: LTA	(R-X)		
Full Path: www.dot.state.co.us/DesignSupport/	(R-X)		
Drawing File Name: 206020202.dgn	(R-X)		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)		

Colorado Department of Transportation
4201 East Arkansas Avenue
Denver, Colorado 80222
Phone: (303) 757-9083
Fax: (303) 757-9820
Project Development Branch SRJ/LTA

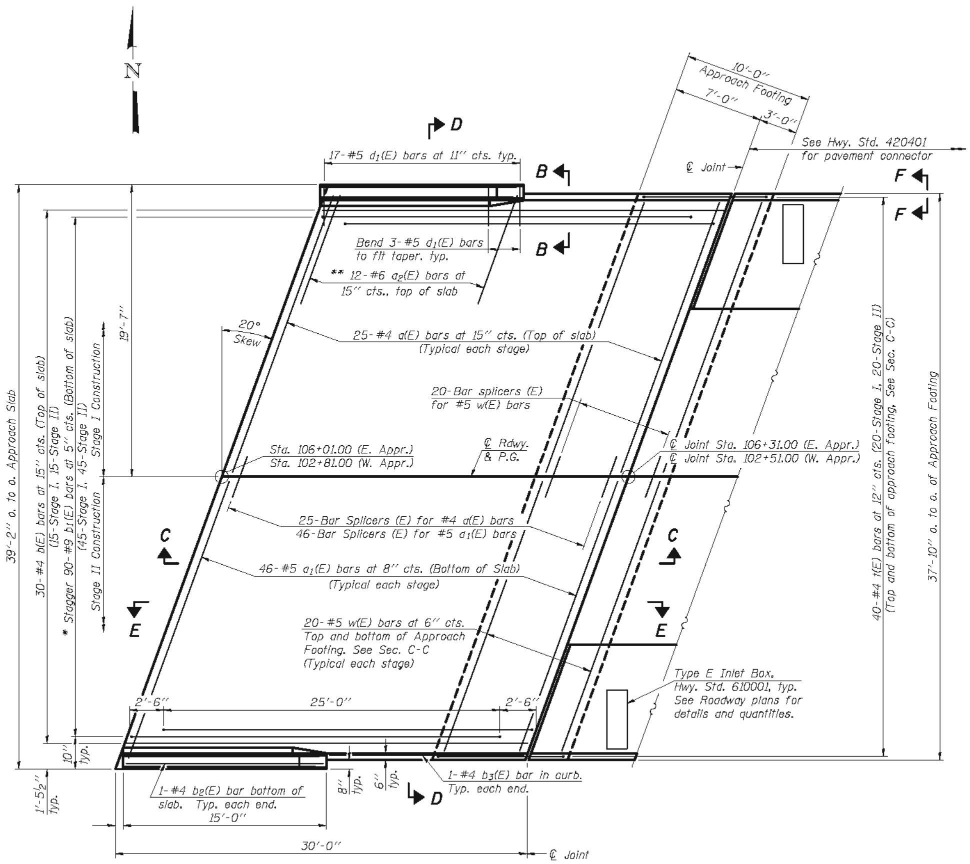
EXCAVATION AND BACKFILL FOR BRIDGES

Issued By: Project Development Branch July 04, 2006

STANDARD PLAN NO.
M-206-2

Illinois

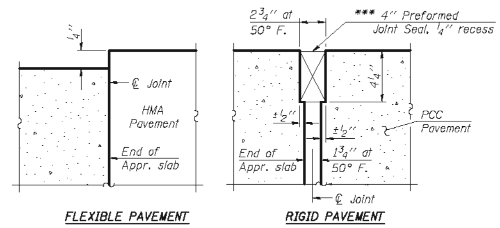
Notes:
See sheet 38 of 38 for Sections C-C & D-D and View E-E.
$a(E)$ and $a_1(E)$ bar spacings measured along ℄ Rdwy.



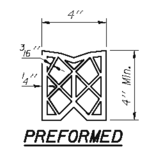
PLAN

* Tilt #9 $b_1(E)$ bars as required to maintain clearance.
** Space between $a(E)$ bars, typ. each parapet.

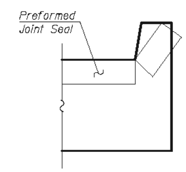
*** Cost included with Concrete Superstructure.



DETAIL A

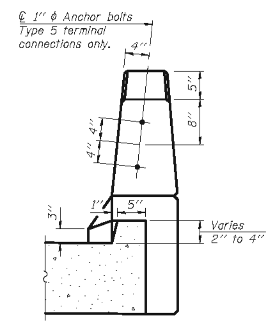


PREFORMED JOINT SEAL



VIEW F-F

Angle Preformed Joint Seal at 45° at curbs when req'd for drainage.

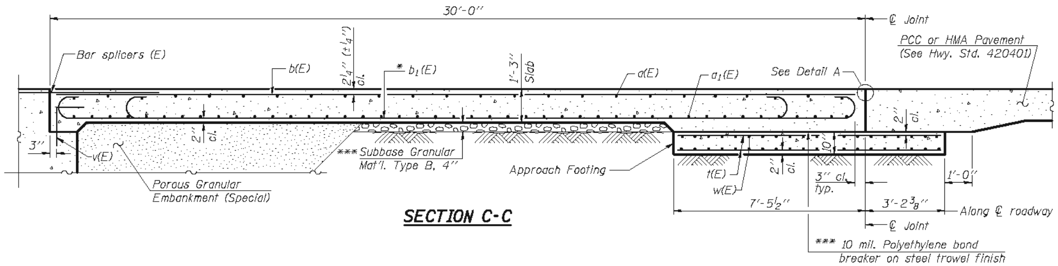


VIEW B-B

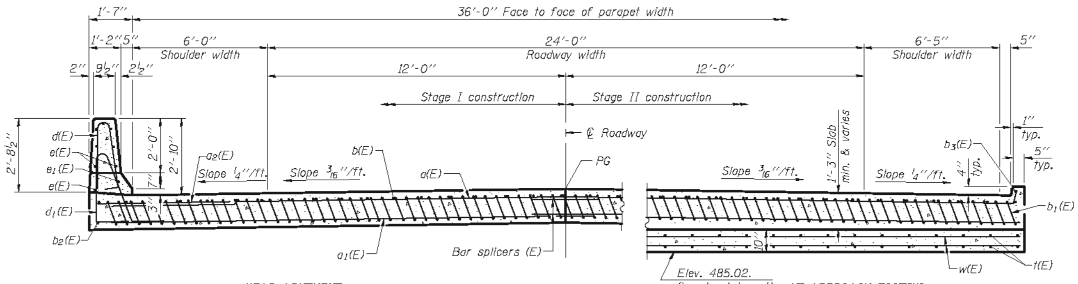
(Sheet 1 of 2)

FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.
		CHECKED -	REVISED -		
	PLOT SCALE =	DRAWN -	REVISED -		
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 37 OF 38 SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
CONTRACT NO.				
ILLINOIS FED. AID PROJECT				



SECTION C-C

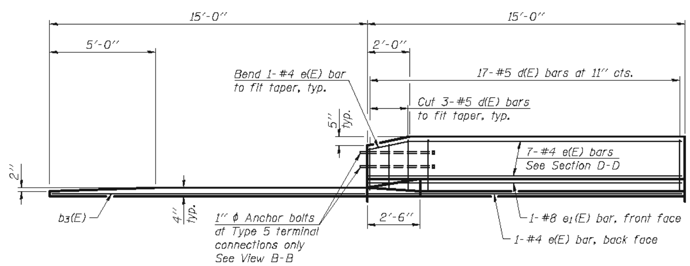


NEAR ABUTMENT

AT APPROACH FOOTING

SECTION D-D

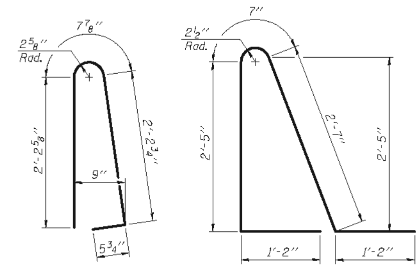
(See Plan for dimensions not shown)



VIEW E-E

Notes:

See sheet 37 of 38 for Detail A and View B-B.
Approach slab and parapet concrete shall be paid for as Concrete Superstructure.
Approach footing concrete shall be paid for as Concrete Structures.
Reinforcement shall be paid for as Reinforcement Bars, Epoxy Coated.
For v(E) bar details, see sheet 17 of 38.
The approach footing maximum applied service bearing pressure (Qmax) = 2.0 ksf.
For bar splicer details, see sheet 36 of 38.
Cost of excavation for approach footing included with Concrete Structures.
For Porous Granular Embankment (Special) and drainage treatment details, see sheet 2 of 38.
For additional parapet details, see sheet 15 of 38.

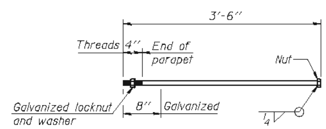


BAR d(E)

BAR d_1(E)

* Tilt #9 b_1(E) bars as required to maintain clearance.

*** Cost included with Concrete Superstructure.

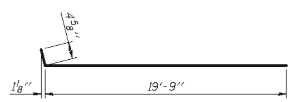


1"ϕ ANCHOR BOLT

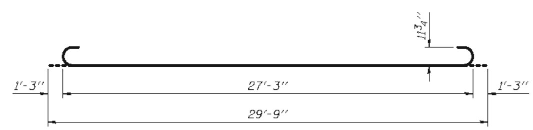
(Cost included with Concrete Superstructure)

TWO APPROACHES BILL OF MATERIAL

Bar	No.	Size	Length	Shape
a(E)	100	#4	20'-4"	
a_1(E)	184	#5	19'-10"	
a_2(E)	48	#6	6'-6"	
b(E)	60	#4	29'-8"	
b_1(E)	180	#9	29'-9"	
b_2(E)	4	#4	14'-8"	
b_3(E)	4	#4	14'-4"	
d(E)	68	#5	5'-7"	
d_1(E)	68	#5	7'-11"	
e(E)	32	#4	14'-8"	
e_1(E)	4	#8	14'-8"	
f(E)	160	#4	10'-3"	
w(E)	160	#5	20'-5"	
Concrete Superstructure			Cu. Yd.	117.6
Concrete Structures			Cu. Yd.	23.4
Reinforcement Bars, Epoxy Coated			Pound	31,040



BAR a(E)

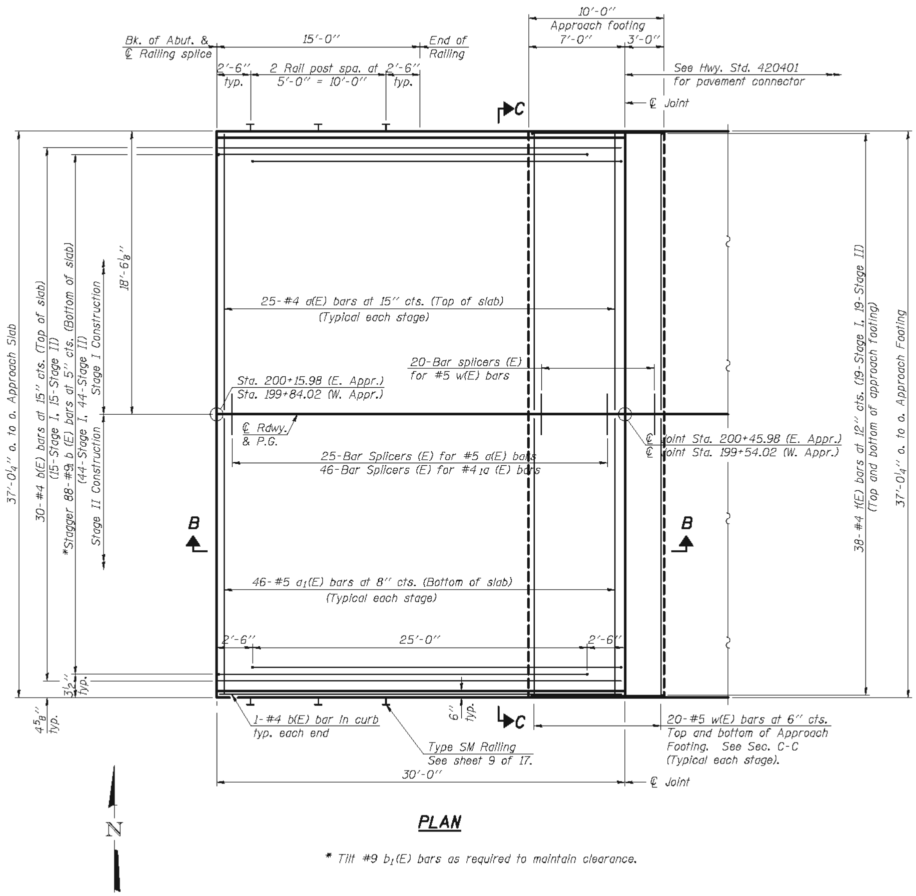


BAR b_1(E)

(Sheet 2 of 2)

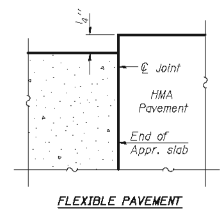
FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.	F.A. RTE. / SECTION / COUNTY / TOTAL SHEETS / SHEET NO.
		CHECKED -	REVISED -			
	PLOT SCALE =	DRAWN -	REVISED -			CONTRACT NO.
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 38 OF 38 SHEETS	ILLINOIS FED. AID PROJECT

Notes:
See sheet 17 of 17 for Sections B-B & C-C.
See sheet 10 of 17 for Railing, Railing Connection, and Curb details.
a(E) and a_1(E) bar spacings measured along ℄ Rdwy.



PLAN

* Tilt #9 b_1(E) bars as required to maintain clearance.

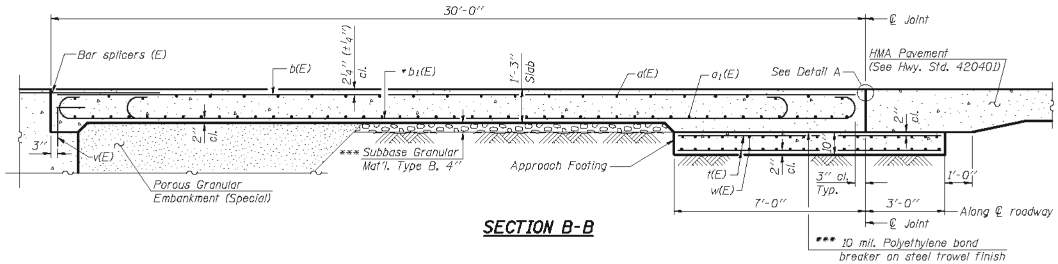


FLEXIBLE PAVEMENT

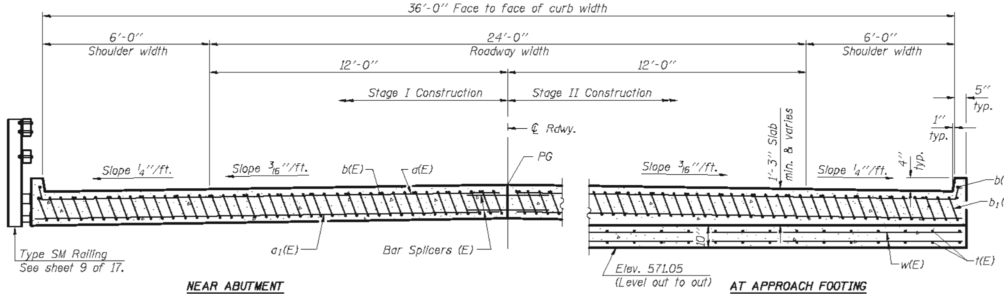
DETAIL A

(Sheet 1 of 2)

FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.	F.A. RTE. / SECTION / COUNTY / TOTAL SHEETS / SHEET NO.
		CHECKED -	REVISED -			CONTRACT NO.
	PLOT SCALE =	DRAWN -	REVISED -			
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 16 OF 17 SHEETS	ILLINOIS FED. AID PROJECT



SECTION B-B



SECTION C-C

(See Plan for dimensions not shown)

Notes:

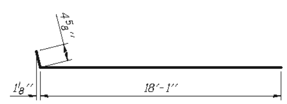
See sheet 16 of 17 for Detail A.
Approach Slab shall be paid for as Concrete Superstructure.
Approach Footing concrete shall be paid for as Concrete Structures.
Reinforcement shall be paid for as Reinforcement Bars, Epoxy Coated.
For v(E) bar details, see sheet 14 of 17.
The Approach Footing maximum applied service bearing pressure (Qmax) = 2.0 ksf.
For Bar Splicer details, see sheet 15 of 17.
Cost of excavation for Approach Footing included with Concrete Structures.
For Porous Granular Embankment (Special) and drainage treatment details see sheet 2 of 17.

* Tilt #9 b_1(E) bars as required to maintain clearance.

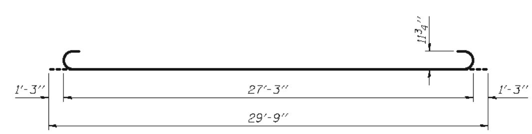
*** Cost included with Concrete Superstructure.

TWO APPROACHES BILL OF MATERIAL

Bar	No.	Size	Length	Shape
a(E)	100	#4	18'-6"	
a_1(E)	184	#5	18'-2"	
b(E)	64	#4	29'-8"	
b_1(E)	176	#9	29'-9"	
f(E)	154	#4	9'-8"	
w(E)	160	#5	18'-2"	
Concrete Superstructure			Cu. Yd.	107.0
Concrete Structures			Cu. Yd.	22.8
Reinforcement Bars, Epoxy Coated			Pound	27,820



BAR a(E)



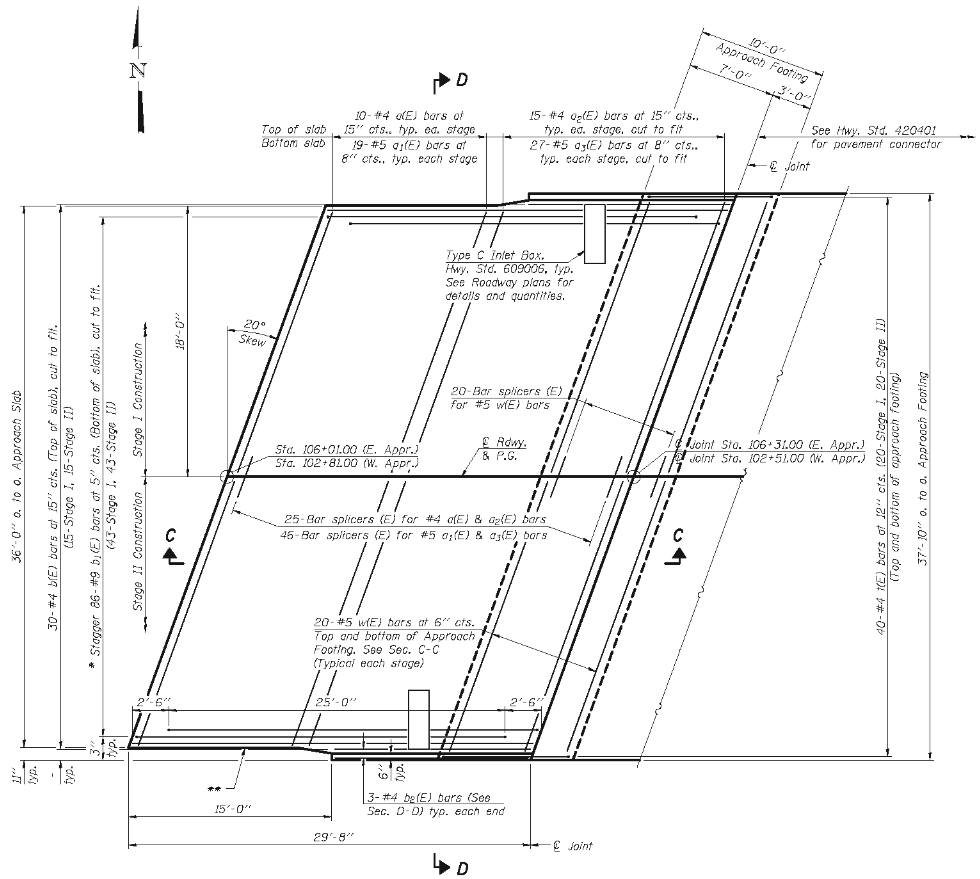
BAR b_1(E)

(Sheet 2 of 2)

FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.
		CHECKED -	REVISED -		
	PLOT SCALE =	DRAWN -	REVISED -		
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 16 OF 17 SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
CONTRACT NO.				
ILLINOIS FED. AID PROJECT				

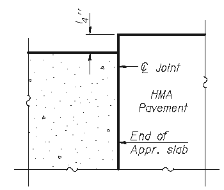
Notes:
See sheet 38 of 38 for Sections C-C & D-D.
Order a(E), a_1(E), b(E) and b_1(E) bars full length. Cut in field to fit Type C Inlet Box, Hwy. Standard 609006.
a(E), a_1(E), a_2(E) and a_3(E) bar spacings measured along ℄ Roadway.



PLAN

* Tilt #9 b_1(E) bars as required to maintain clearance.

** Closed cell joint filler according to Article 1051.08 of the Std. Specifications; full depth of slab, full length of parapet. Typ. each parapet.



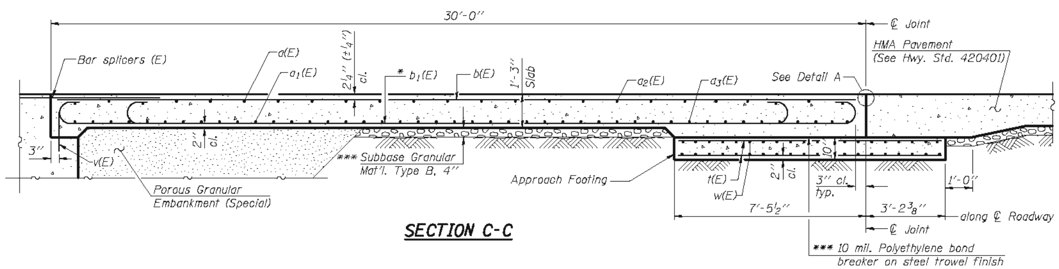
FLEXIBLE PAVEMENT

DETAIL A

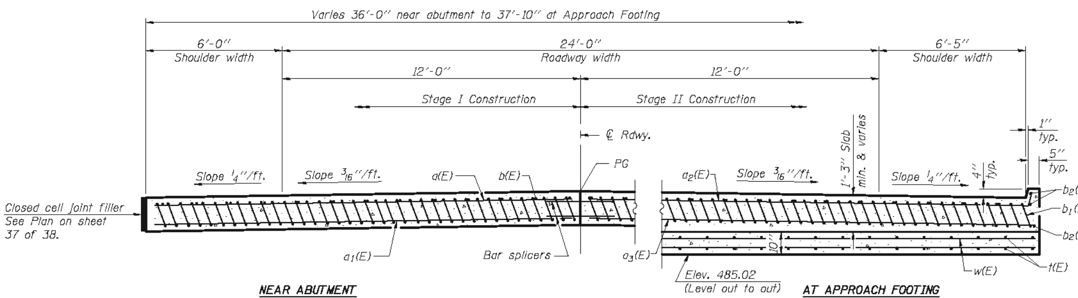
(Sheet 1 of 2)

FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.	F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CHECKED -	REVISED -							
	PLOT SCALE =	DRAWN -	REVISED -			CONTRACT NO.				
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 37 OF 38 SHEETS	ILLINOIS FED. AID PROJECT				

Notes:
See sheet 37 of 38 for Detail A.
Approach Slab shall be paid for as Concrete Superstructure.
Approach Footing concrete shall be paid for as Concrete Structures.
Reinforcement shall be paid for as Reinforcement Bars, Epoxy Coated.
For v(E) bar details, see sheet 17 of 38.
The Approach Footing maximum applied service bearing pressure (Qmax) = 2.0 ksf.
For Bar Splicer details, see sheet 36 of 38.
Cost of excavation for Approach Footing included with Concrete Structures.
For Porous Granular Embankment (Special) and drainage treatment details see sheet 2 of 38.



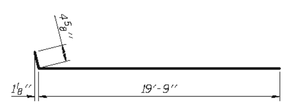
SECTION C-C



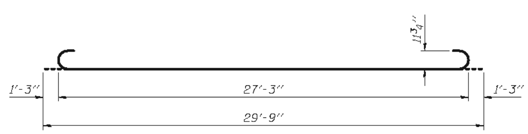
SECTION D-D
(See Plan for dimensions not shown)

* Tilt #9 b_1(E) bars as required to maintain clearance.

*** Cost included with Concrete Superstructure.



BAR a_2(E)



BAR b_1(E)

TWO APPROACHES BILL OF MATERIAL

Bar	No.	Size	Length	Shape
a(E)	40	#4	19'-1"	———
a_1(E)	76	#5	19'-1"	———
a_2(E)	60	#4	20'-2"	⌞——
a_3(E)	108	#5	19'-10"	———
b(E)	60	#4	29'-8"	———
b_1(E)	172	#9	29'-9"	⊂—⊃
b_2(E)	12	#4	14'-4"	———
t(E)	160	#4	10'-3"	———
w(E)	160	#5	20'-5"	———
Concrete Superstructure		Cu. Yd.	106.6	
Concrete Structures		Cu. Yd.	23.4	
Reinforcement Bars, Epoxy Coated		Pound	28,270	

(Sheet 2 of 2)

FILE NAME =	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	BRIDGE APPROACH SLAB DETAILS STRUCTURE NO.
		CHECKED -	REVISED -		
	PLOT SCALE =	DRAWN -	REVISED -		
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. 38 OF 38 SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
CONTRACT NO.				
ILLINOIS FED. AID PROJECT				

Indiana

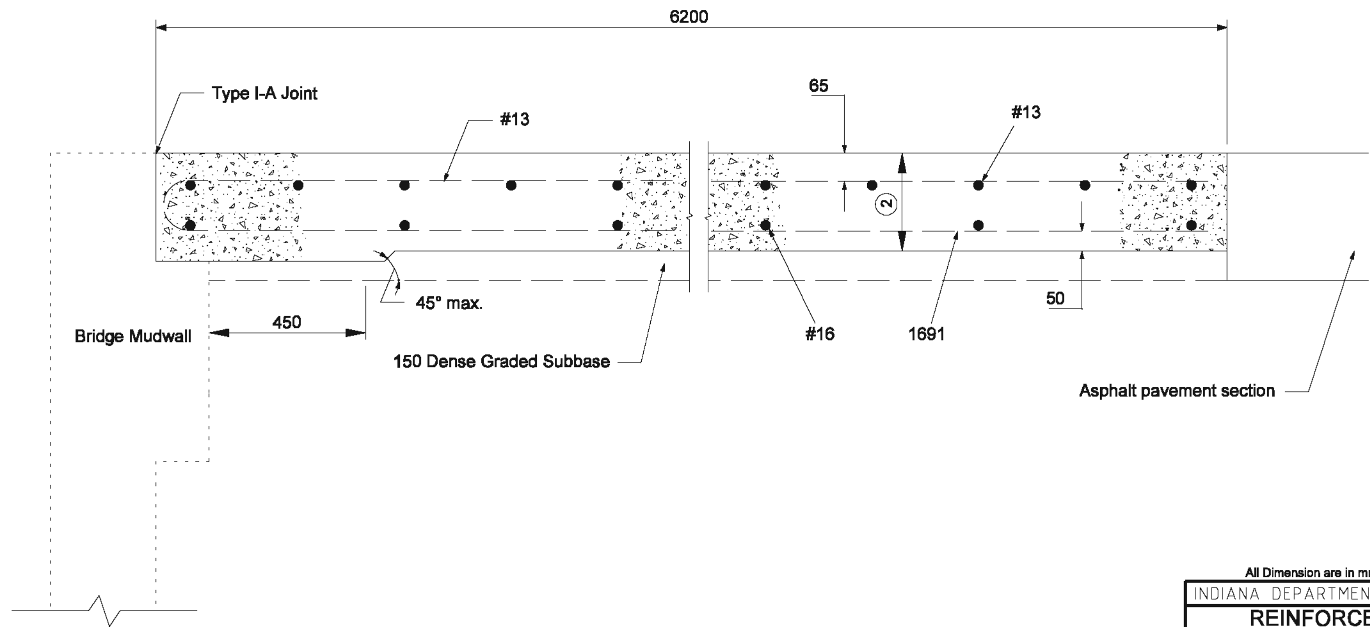
NOTES

1. For reinforcement details, see Standard Drawing 609-RCBA-03 for square RCBAs and Standard Drawing 609-RCBA-04 for skewed RCBAs.

2. 250 if design year AADT < 1000
   300 if design year AADT ≥ 1000

3. All reinforcing bars shall be epoxy coated.

4. See Standard Drawings 609-RCBA-07 and 609-BRJT-01 for details of Type I-A Joint.



All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH FOR USE WITH ASPHALT PVMT.

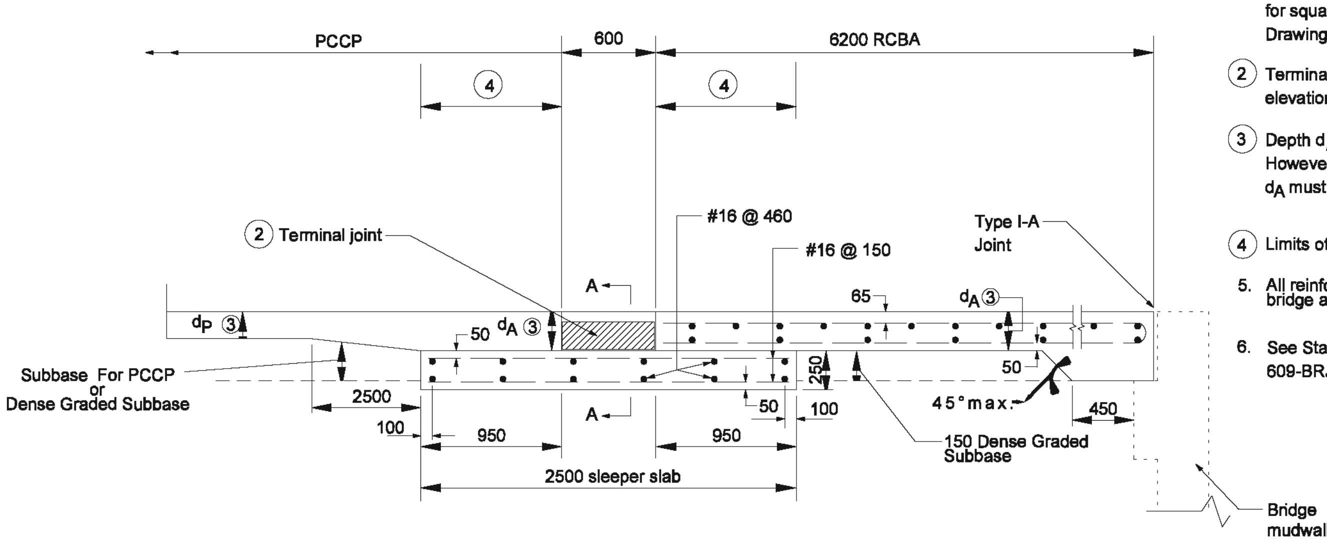
SEPTEMBER 2005

STANDARD DRAWING NO. 609-RCBA-01

RICHARD L. VanCLEAVE
REGISTERED
No. 9750
STATE OF INDIANA
PROFESSIONAL ENGINEER

DESIGN STANDARDS ENGINEER

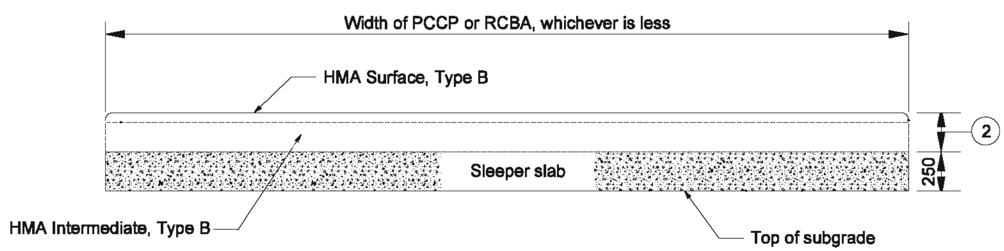
/s/ Richard L. VanCleave	9-01-05
DESIGN STANDARDS ENGINEER	DATE
/s/ Richard K. Smutzer	9-01-05
CHIEF HIGHWAY ENGINEER	DATE



TERMINAL JOINT FOR PCCP AT BRIDGE STRUCTURE

GENERAL NOTES

1. For reinforcement details, see Standard Drawing 609-RCBA-03 for square RCBAs and Standard Drawing 609-RCBA-04 for skewed RCBAs.
2. Terminal joint elevation shall match elevation of adjacent PCCP and RCBA.
3. Depth d_A must equal d_P. However, if d_P s less than 300, d_A must be 300.
4. Limits of polyethylene bond breaker.
5. All reinforcing bars in the reinforced concrete bridge approach shall be epoxy coated.
6. See Standard Drawing 609-RCBA-07 and 609-BRJT-01 for details of Type I-A Joint



SECTION A-A

All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH AND TERMINAL JOINT FOR USE WITH PCCP

SEPTEMBER 2005

STANDARD DRAWING NO. 609-RCBA-02

RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

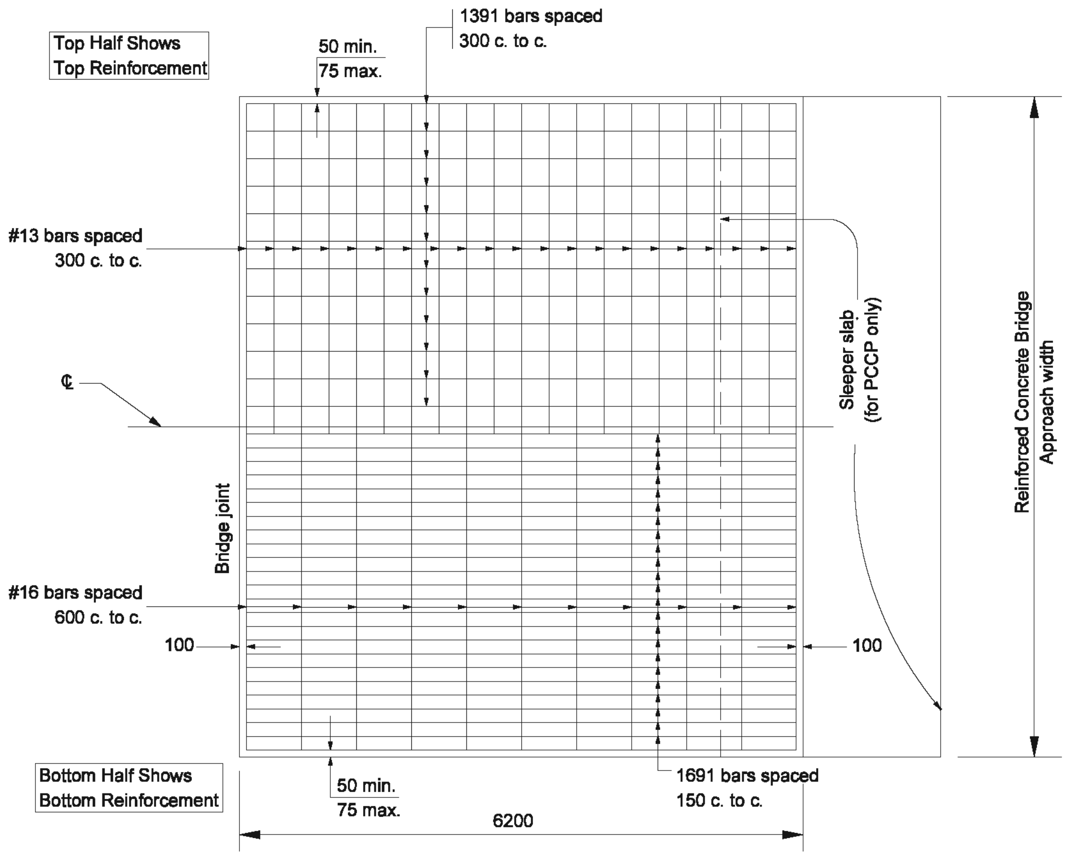
DESIGN STANDARDS ENGINEER

/s/ Richard L.VanCleave	9-01-05
DESIGN STANDARDS ENGINEER	DATE
/s/ Richard K.Smutzer	9-01-05
CHIEF HIGHWAY ENGINEER	DATE

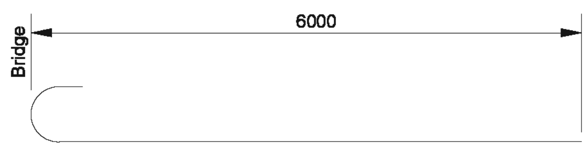
NOTE

1. See Standard Drawing 609-RCBA-05 for Bill of Materials.

2. All reinforcing bars shall be epoxy coated.



REINFORCEMENT DETAIL FOR SQUARE APPROACH



1391 x 6160
1691 x 6180

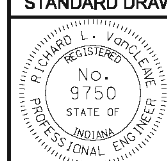
All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH

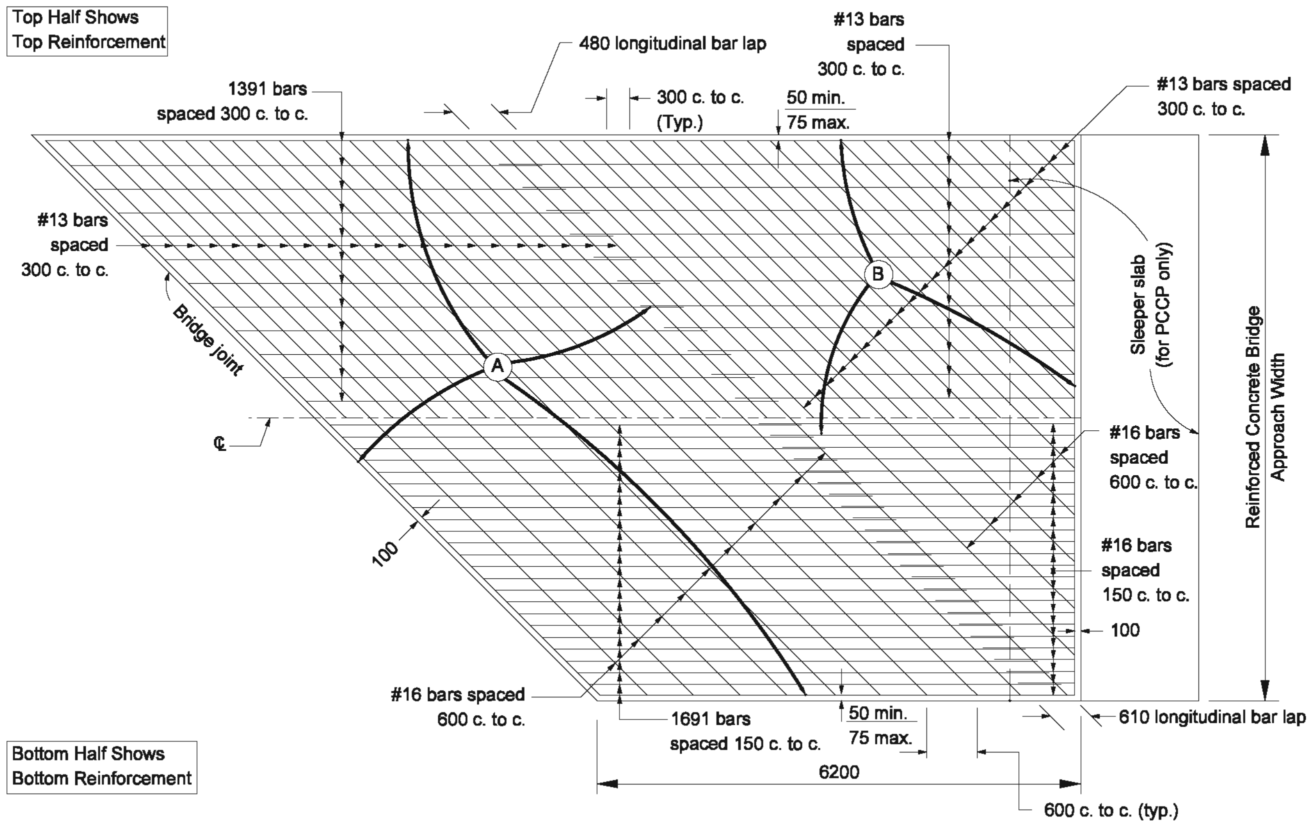
MARCH 2004

STANDARD DRAWING NO. 609-RCBA-03



DESIGN STANDARDS ENGINEER

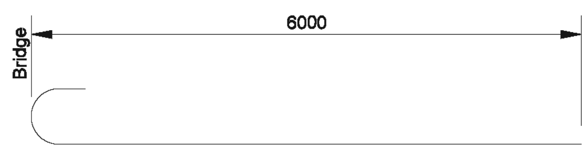
/s/ Richard L. VanCleave	3-01-04
DESIGN STANDARDS ENGINEER	DATE
/s/ Richard K. Smutzer	3-01-04
CHIEF HIGHWAY ENGINEER	DATE



REINFORCEMENT DETAIL FOR SKEWED APPROACH

NOTES

1. Area Ⓐ includes all bars of equal length.
2. Area Ⓑ includes all bars of unequal length.
3. See Standard Drawing 609-RCBA-06 for Bill of Materials.
4. All reinforcing bars shall be epoxy coated.



1391 x 6260
1691 x 6280

All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH

MARCH 2004

STANDARD DRAWING NO. 609-RCBA-04

RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

DESIGN STANDARDS ENGINEER

/s/ Richard L.VanCleave 03-01-04
DESIGN STANDARDS ENGINEER DATE

/s/ Richard K.Smutzer 3-01-04
CHIEF HIGHWAY ENGINEER DATE

BILL OF MATERIALS

SQUARE STRUCTURES - ONE SLAB

BRIDGE APPROACH WIDTH	EPOXY COATED REINFORCING BARS					REINFORCED CONCRETE BRIDGE APPROACH AREA m^2
	LONGIT. BARS		TRANSV. BARS		TOTAL MASS, kg	
	NO.	SIZE x LGTH. OR MARK	NO.	SIZE x LGTH.		
7200	24	1391	21	#13 x 7100	877	44.6
	48	1691	11	#16 x 7100		
7600	26	1391	21	#13 x 7500	933	47.1
	51	1691	11	#16 x 7500		
7800	26	1391	21	#13 x 7700	947	48.4
	52	1691	11	#16 x 7700		
8200	28	1391	21	#13 x 8100	1006	50.8
	55	1691	11	#16 x 8100		
8800	30	1391	21	#13 x 8700	1080	54.6
	59	1691	11	#16 x 8700		
9400	32	1391	21	#13 x 9300	1153	58.3
	63	1691	11	#16 x 9300		
10000	34	1391	21	#13 x 9900	1226	62.0
	67	1691	11	#16 x 9900		
10600	36	1391	21	#13 x 10500	1300	65.7
	71	1691	11	#16 x 10500		
11200	38	1391	21	#13 x 11100	1373	69.4
	75	1691	11	#16 x 11100		
11800	40	1391	21	#13 x 11700	1447	73.2
	79	1691	11	#16 x 11700		
12100	41	1391	21	#13 x 12000	1483	75.0
	81	1691	11	#16 x 12000		
12400	42	1391	42	#13 x 6400 *	1542	76.9
	83	1691	22	#16 x 6500 **		
13600	46	1391	42	#13 x 7000 *	1659	84.3
	91	1691	22	#16 x 7100 **		

* Bars lapped 480 at centerline of roadway. ** Bars lapped 610 at centerline of roadway.

NOTES

1. The Bill of Materials shall be used to determine the bar lengths, total mass of steel, and bridge approach area for square structures.

2. For details, see Standard Drawing 609-RCBA-03.

All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH

MARCH 2004

STANDARD DRAWING NO. 609-RCBA-05

RICHARD L. VanCLEAVE
REGISTERED
No. 9750
STATE OF INDIANA
PROFESSIONAL ENGINEER

DESIGN STANDARDS ENGINEER

/s/ Richard L. VanCleave 3-01-04
DESIGN STANDARDS ENGINEER DATE

/s/ Richard K. Smutzer 3-01-04
CHIEF HIGHWAY ENGINEER DATE

BILL OF MATERIALS
SKEWED STRUCTURES - ONE SLAB

BRIDGE APPROACH WIDTH	EPOXY COATED REINFORCING BARS			
	LONGIT. BARS, AREA (A)		TRANSV. BARS. AREA (A)	
	NO.	SIZE x LGTH. OR MARK	NO.	SIZE
7200	24	1391	21	#13
	48	1691	11	#16
7600	26	1391	21	#13
	51	1691	11	#16
7800	26	1391	21	#13
	52	1691	11	#16
8200	28	1391	21	#13
	55	1691	11	#16
8800	30	1391	21	#13
	59	1691	11	#16
9400	32	1391	21	#13
	63	1691	11	#16
10000	34	1391	21	#13
	67	1691	11	#16
10600	36	1391	21	#13
	71	1691	11	#16
11200	38	1391	21	#13
	75	1691	11	#16
11800	40	1391	21	#13
	79	1691	11	#16
12100	41	1391	21	#13
	81	1691	11	#16
12400	42	1391	42	#13 *
	83	1691	22	#16 **
13600	46	1391	42	#13 *
	91	1691	22	#16 **

* Bars lapped 480 at centerline of roadway if bar exceeds 12000.
** Bars lapped 610 at centerline of roadway if bar exceeds 12000.

NOTES

1. The Bill of Materials shall be used to determine the longitudinal bar requirements in Area (A) shown on Standard Drawing 609-RCBA-04 for skewed structures.
2. See the plans for longitudinal bars required in Area (B), all transverse bars, total mass of steel and bridge approach area for skewed structures.
3. All reinforcing bars shall be epoxy coated.

All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH

MARCH 2004

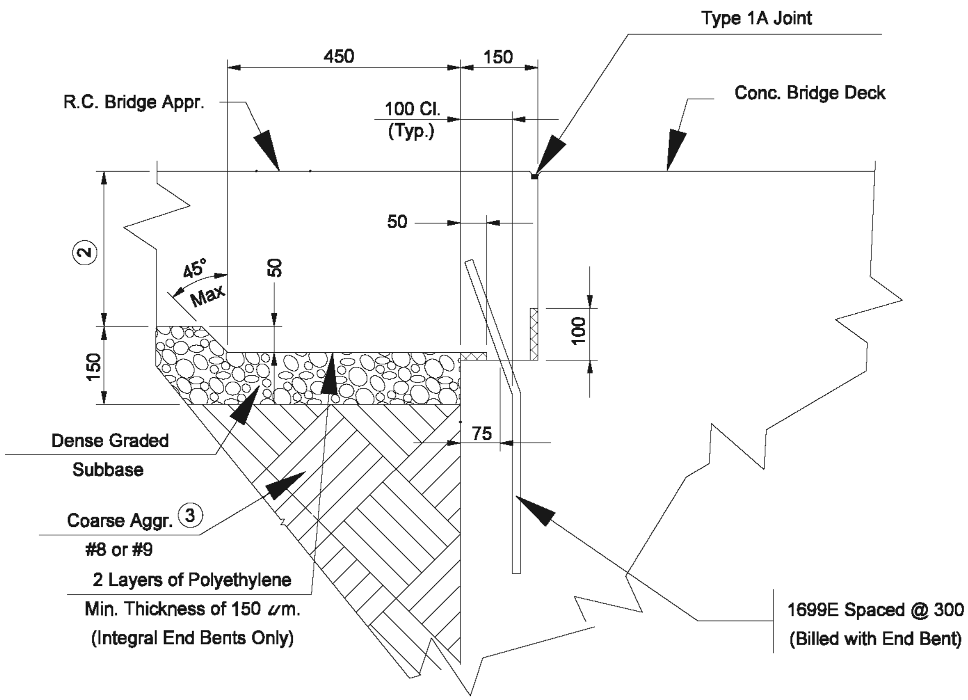
STANDARD DRAWING NO. 609-RCBA-06

RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

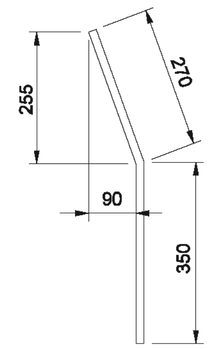
DESIGN STANDARDS ENGINEER

/s/ Richard L.VanCleave 3-01-04
DESIGN STANDARDS ENGINEER DATE

/s/ Richard K.Smutzer 3-01-04
CHIEF HIGHWAY ENGINEER DATE



PAVEMENT LEDGE DETAIL



1699E x 620

NOTES:

1. See Standard Drawing 609-BRJT-01 for Type 1A joint details.

(2.) 250 if design year AADT< 1000
300 if design year AADT ≥ 1000
or match thickness of concrete
approach pavement if thicker than 300

(3.) Flowable backfill if slab bridge.

LEGEND

13 mm Expanded Polystyrene

All Dimension are in mm unless otherwise specfied

INDIANA DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE BRIDGE APPROACH PAVEMENT LEDGE DETAIL
MARCH 2004

STANDARD DRAWING NO. 609-RCBA-07

RICHARD L. VanCLEAVE REGISTERED No. 9750 STATE OF INDIANA PROFESSIONAL ENGINEER

DESIGN STANDARDS ENGINEER

/s/ Richard L. VanCleave	3-01-04
DESIGN STANDARDS ENGINEER	DATE
/s/ Richard K.Smutzer	3-01-04
CHIEF HIGHWAY ENGINEER	DATE

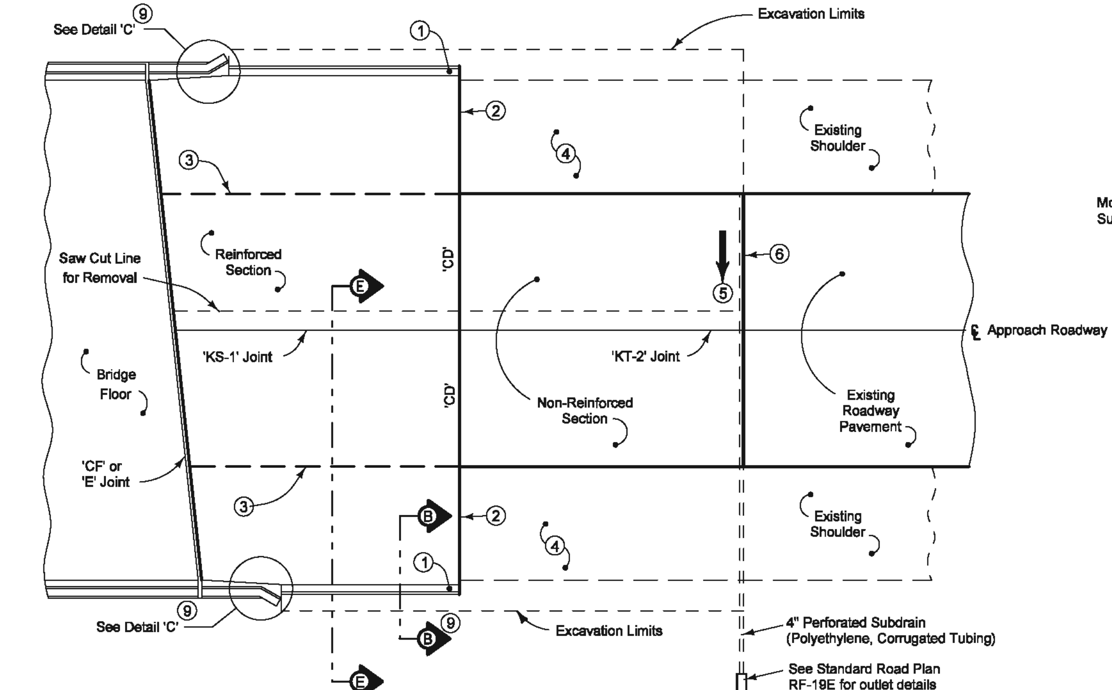
Iowa

Bridge Approach Pavement

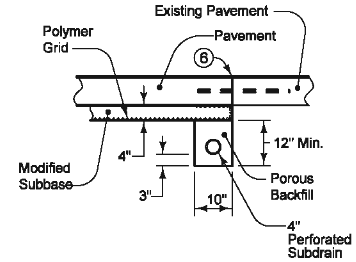
RK

Bridge Approach Pavement

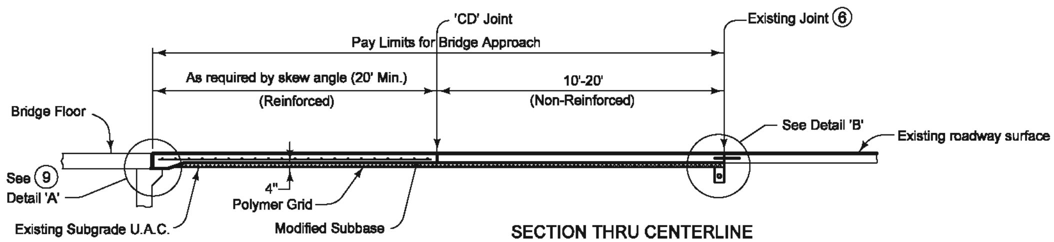
NO.	DATE	TITLE
RK-16	10-16-12	Bridge Approach Details (in Conjunction with Bridge Deck Overlay)
RK-17	04-19-11	PCC Overlay of Reinforced Bridge Approach Section
RK-18	10-15-13	Bridge Approach Details (Secondary Roads)
RK-19A	04-16-13	Bridge Approach Section (General Details)
RK-19B	10-16-12	Bridge Approach Section (Two-Lane, Abutting PCC Pavement)
RK-19C	10-16-12	Bridge Approach Section (Two Lane for Bridge Reconstruction, PCC Pavement)
RK-19F	10-16-12	Bridge Approach Section (at Existing Bridges, PCC Pavement)
RK-19G	10-16-12	Bridge Approach Section (Two Lane, HMA Pavement)
RK-19H	10-16-12	Bridge Approach Section (Two Lane for Bridge Reconstruction, HMA Pavement)
RK-19J	10-16-12	Bridge Approach Section (at Existing Bridges, HMA Pavement)
RK-20	04-16-13	Double Reinforced 12" Approach
RK-21	10-16-12	Bridge Approach (abutting PCC or Composite Pavement)
RK-22	10-16-12	Bridge Approach (abutting HMA Pavement)
RK-23	10-16-12	Bridge Approach (Multi-Lane, Curbed Roadway)
RK-25	04-16-13	Double Reinforced 10" Approach
RK-26	04-16-13	Double Reinforced 10" Approach with Variable Depth Paving Notch
RK-27	04-16-13	Double Reinforced 12" Approach with Variable Depth Paving Notch
RK-30	04-19-11	Bridge Approach (Abutting Pavement)



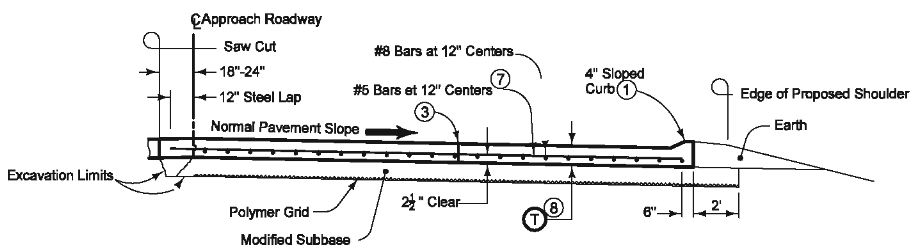
PLAN VIEW



DETAIL 'B'



SECTION THRU CENTERLINE



SECTION E-E

Maintian traffic in adjacent lanes.

For joint details, see PV-101.

If an existing 'CF' joint is located approximately 60 feet from the new 'B' or 'RT' joint, the joint is to be recut to a width of 4" and new form joint material installed. If no 'CF' exists, construct a new 'CF' joint approximately 60 feet from the new 'B' or 'RT' joint.

Modified Subbase under paved shoulder panels adjacent to the bridge approach is incidental to "Paved Shoulder, P.C. Concrete", unless measured and paid for elsewhere on the project plans.

1. Build 4" Sloped Curb to end of Reinfoced Bridge Approach Section. See Curb Location Details (Section B-B).
2. Place 'RD' joint if P.C. Shoulder; 'B' joint otherwise.
3. Optional 'KS-1' joint.
4. See Typical Paving Cross-Sections.
5. Slope Subdrain to drain.
6. Place 'RT' joint if existing pavement is P.C., 'B' joint otherwise.
7. If bridge is skewed, place additional #5 bar parallel to skewed face.
8. T=10".
9. See Standard Road Plan RK-19A.

Possible Contract Items:

Bridge Approach, RK-19
Paved Shoulder, P.C. Concrete

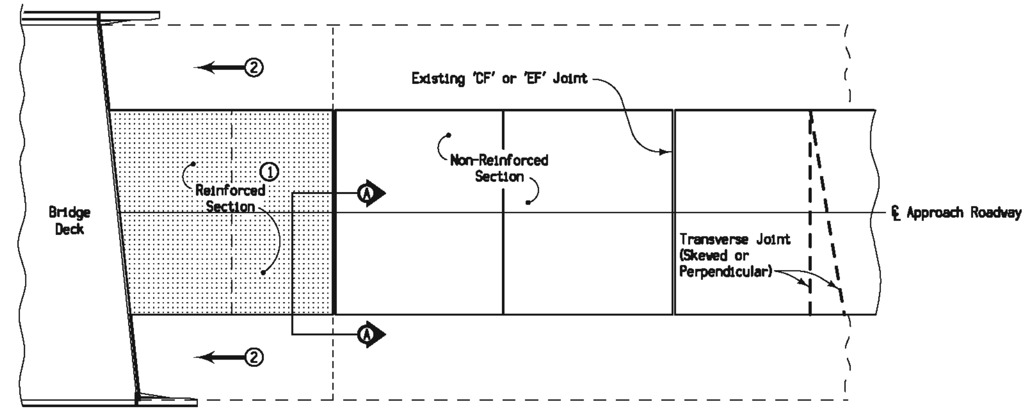
PossibleTabulation: 112-6

Iowa Department of Transportation	REVISION
	21 10-16-12
STANDARD ROAD PLAN	RK-16
	SHEET 1 of 1

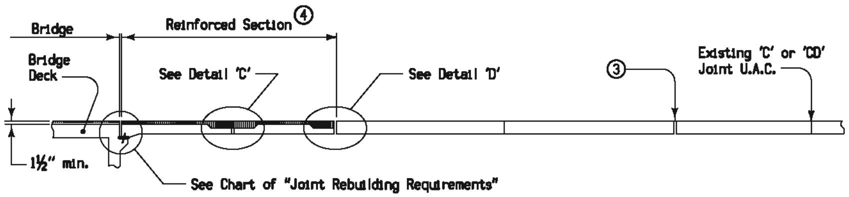
REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars. Added circle note 9.

Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

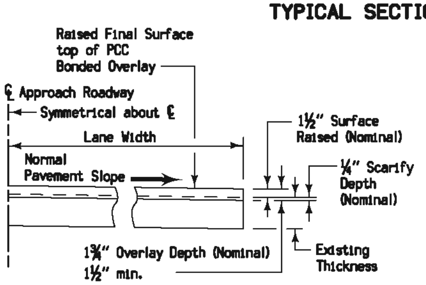
BRIDGE APPROACH DETAILS (IN CONJUNCTION WITH BRIDGE DECK OVERLAY)



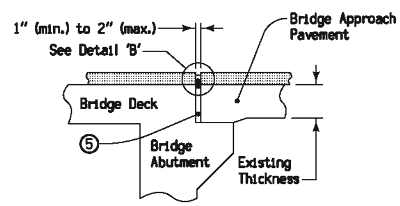
TYPICAL PLAN VIEW



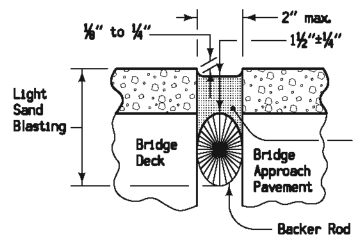
TYPICAL SECTION THRU CENTERLINE



SECTION A-A

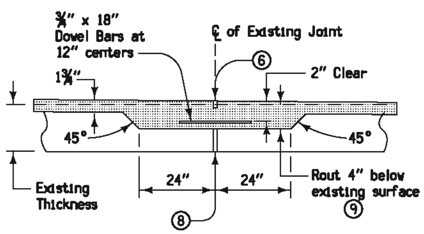


DETAIL 'A'

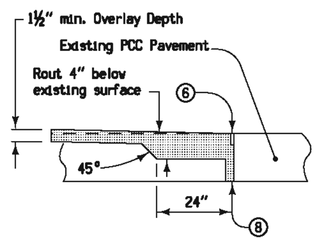


DETAIL 'B'

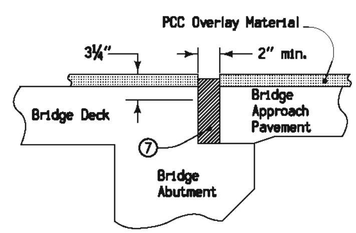
JOINT REBUILDING REQUIREMENTS	
EXISTING JOINT WIDTH	CONSTRUCTION METHOD REQUIRED
0 to 1"	Cut to 1½" width See Detail 'A'
1" to 2"	See Detail 'A'
Greater than 2"	See Detail 'E'



DETAIL 'C'



DETAIL 'D'



DETAIL 'E'

Where Existing Joint is greater than 2"

1. Remove HMA Resurfacing if present. The cost of removal is considered incidental to "Bridge Floor Overlay" as detailed hereon.
2. Existing shoulder elevation to be raised to match new pavement grade.
3. At first existing 'CF' joint beyond PCC Overlay area, clean joint, trim to $3\frac{3}{4}" \pm \frac{1}{2}"$ and install preformed joint material $4\frac{1}{2}" \pm \frac{1}{8}"$ wide times pavement thickness minus 1 inch deep with lubricant adhesive. See Materials I.M. 436.05 for list of approved materials.
4. Reinforced bridge approach section overlay "Runout" slope not to exceed 1 inch in 50 feet from profile grade.
5. Existing joint, remove all expansion material and clean joint area (not to be overlaid and saw cut).
6. Saw and seal over existing joint; refer to Detail 'C' on PV-101.
7. Tire buffings. Refer to Joint Standards.
8. Existing joint, remove all expansion material and fill with overlay material.
9. Applicable only if a transverse crack in the reinforced section exists.

This plan shows construction details of a PCC Overlay on a bridge approach section to match the thickness of the bridge deck overlay.

After undersealing (by others), work is to proceed in the following sequence and in accordance with traffic control plans:

1. Rout out existing joints as detailed in the plans.

2. Scarify to the minimum depth of $\frac{1}{4}"$ the existing PCC surfaca of the reinforced bridge approach section. Scarify deep enough to provide a minimum overlay thickness of 1½ inches.

3. Overlay the scarified approach pavement with PCC in compliance with Section 2413. The existing joint at the bridge end is not to be overlaid and cut out by saw. Use a method approved by the Engineer.

4. Install sealed joint at the bridge end and at the locations of overlaid existing joints as detailed on this sheet.

5. Trim the first existing 'CF' joint beyond the resurfaced area to a uniform $3\frac{3}{4}" \pm \frac{1}{2}"$ width, clean joint and install new preformed joint material with lubricant adhesive.

Routing at joints will be measured and paid for as "Class A Deck Repair" in compliance with section 2413.

Overlaying of the bridge approach pavement with PCC will be paid for at the contract unit price for "Deck Overlay" as specified in Section 2413. Scarification to the depth required is incidental to "Deck Overlay".

Sealed joints installed at locations of existing joints will not be paid for separately, but are incidental to "Deck Overlay".

For raising HMA shoulder to match the PCC overlay of the bridge approach pavement, Class II compaction is required as specified in Section 2303. Asphalt binder and tack coat are incidental.

Construct "Grenular Shoulders, Type B" according to Section 2121 when other than paved shoulders exist.

For joint details, refer to PV-101.

Iowa Department of Transportation

STANDARD ROAD PLAN

REVISION	
10	04-19-11

RK-17

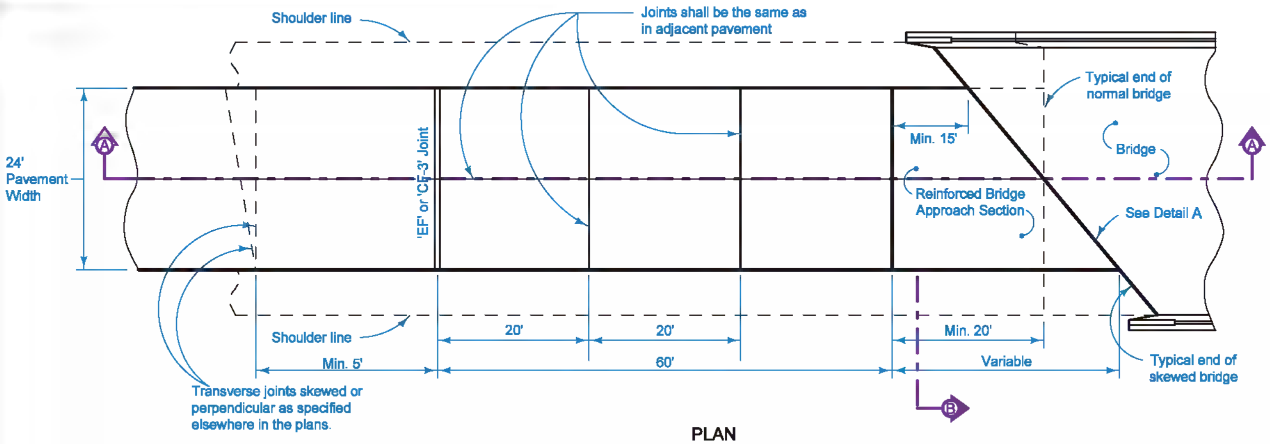
SHEET 1 of 1

REVISIONS: Updated references to renamed standards. Deleted duplicate note.

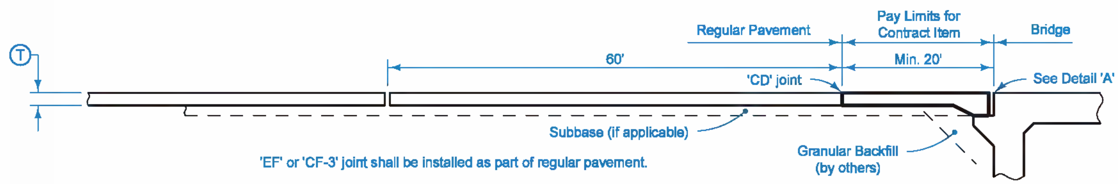
Deanna Maifield

APPROVED BY DESIGN METHODS ENGINEER

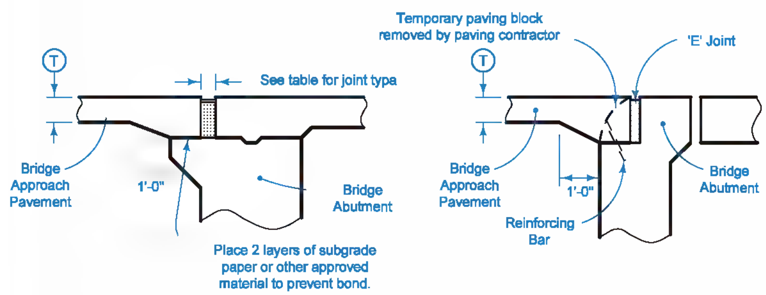
PCC OVERLAY OF REINFORCED BRIDGE APPROACH SECTION



PLAN



SECTION A-A

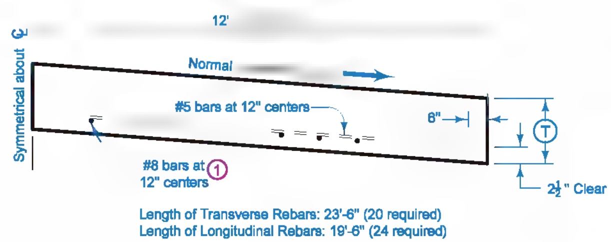


MOVABLE ABUTMENT BRIDGE

FIXED ABUTMENT BRIDGE

DETAIL 'A'

'T' is same thickness as is required for remainder of project pavement.



TYPICAL HALF SECTION B

Use the same concrete for the bridge approach section as that used for remainder of project pavement.

For joint details, see PV-101.

(1) If bridge is skewed, place additional #5 bar parallel to skewed face.

Quantity for 20' long approach section for 24' pavement is 53.33 sq. yds. of "Bridge Approach."

JOINT TYPE FOR MOVABLE ABUTMENT BRIDGES

Joint	Concrete Beam Maximum Bridge Length	Steel Girder Maximum Bridge Length
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

Possible Contract Items:
Bridge Approach, RK-18
Standard or Slip-Form PCC Pavement

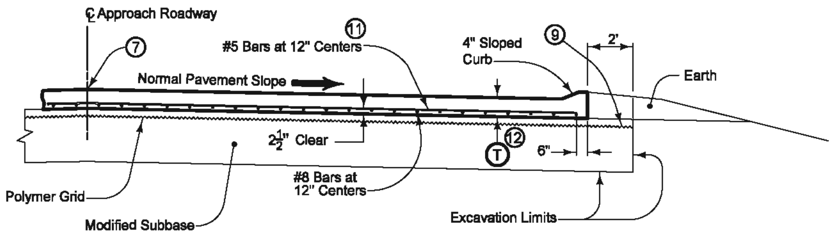
Possible Tabulation:
112-6

Iowa Department of

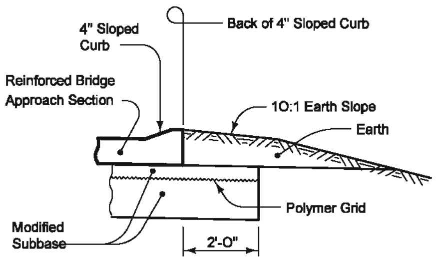
STANDARD ROAD PLAN

RK-18

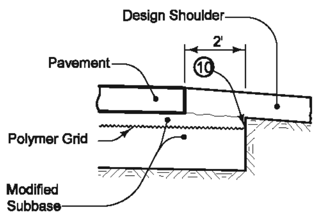
BRIDGE APPROACH DETAILS (SECONDARY ROADS)



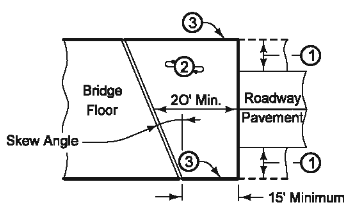
SECTION A-A



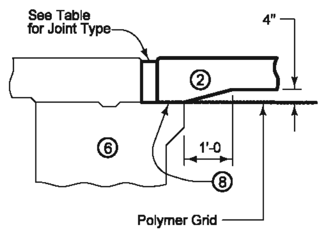
SECTION B-B



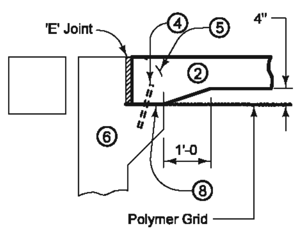
SECTION C-C



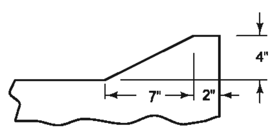
TWO LANE APPROACH PAVEMENT
LAYOUT AT A SKEW



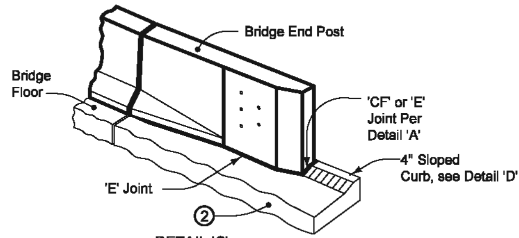
DETAIL 'A'
Movable Abutment Bridge



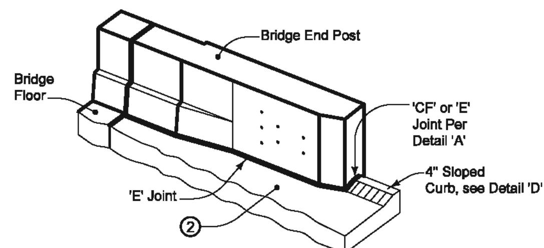
DETAIL 'A'
Fixed Abutment Bridge



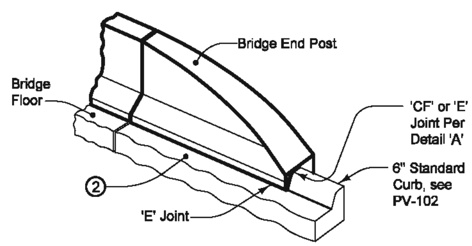
DETAIL 'D'
4" Sloped Curb



DETAIL 'C'
Five Hole Bridge End Post



DETAIL 'C'
Retrofit Bridge End Post



DETAIL 'C'
Low Speed Bridge End Post

CURB ALIGNMENT and
JOINT PLACEMENT

Sections and details apply to Standard Road Plans RK-16 and RK-19B through RK-19J.

1. Design Shoulder width.
2. Reinforced Bridge Approach Section.
3. Build curb. See Detail C.
4. Reinforcing Bar.
5. Temporary paving block removed by paving contractor.
6. Bridge Abutment.
7. Longitudinal Joint: (PV-101)

   Single pour - Saw cut joint per Detail B.
   Two pours - Use 'KS-1' joint.
8. Secure polymer grid on top of paving notch.
9. Extend polymer grid to 2' outside edge of pavement.
10. Trim fabric to edge of excavation.
11. If bridge is skewed, place additional #5 bar parallel to skewed face.
12. T = 10 inches.

JOINT TYPE FOR MOVABLE ABUTMENT BRIDGES

Joint	Concrete Beam Maximum Bridge Length	Steel Girder Maximum Bridge Length
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

Possible Contract Item:
Bridge Approach, RK-19

Possible Tabulation:
112-6

Iowa Department of Transportation

STANDARD ROAD PLAN

REVISION	
19	04-16-13

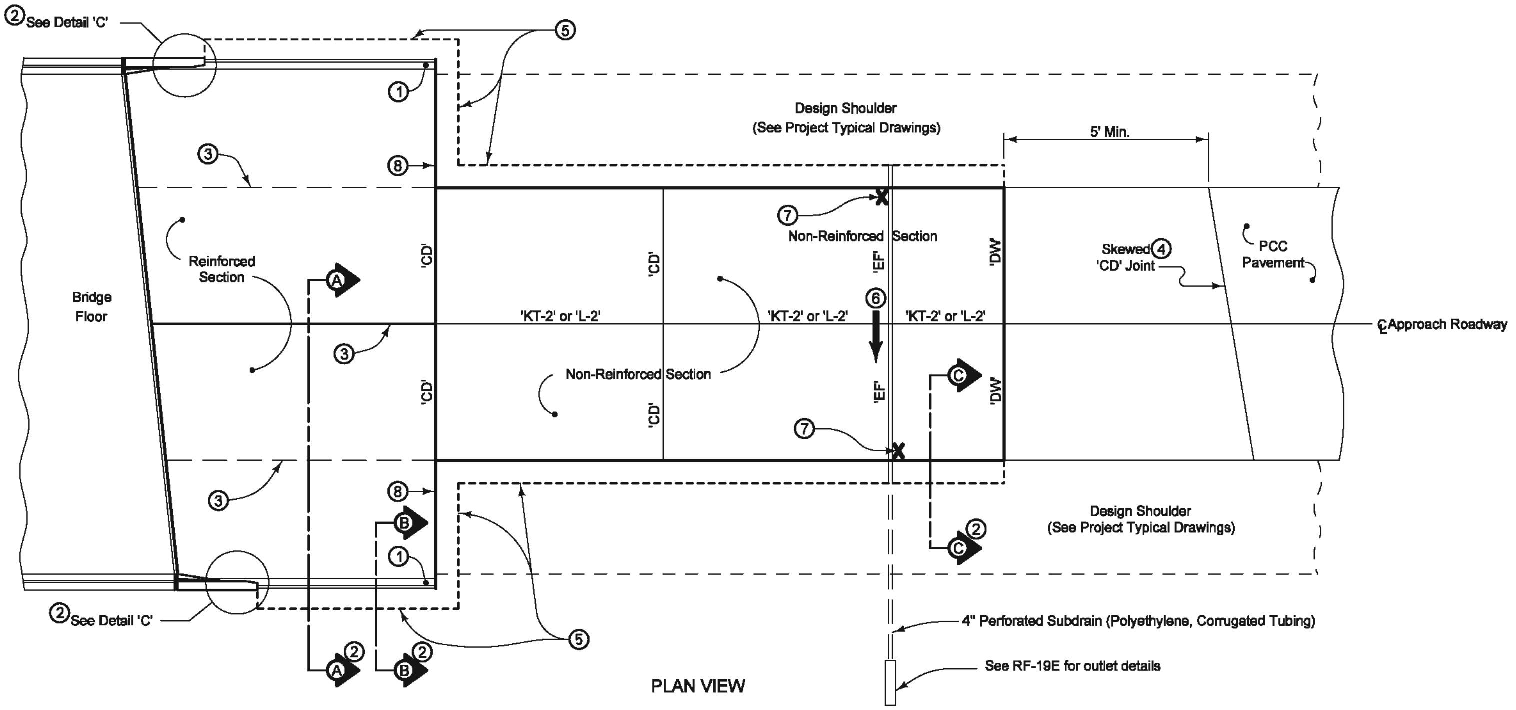
RK-19A

SHEET 1 of 1

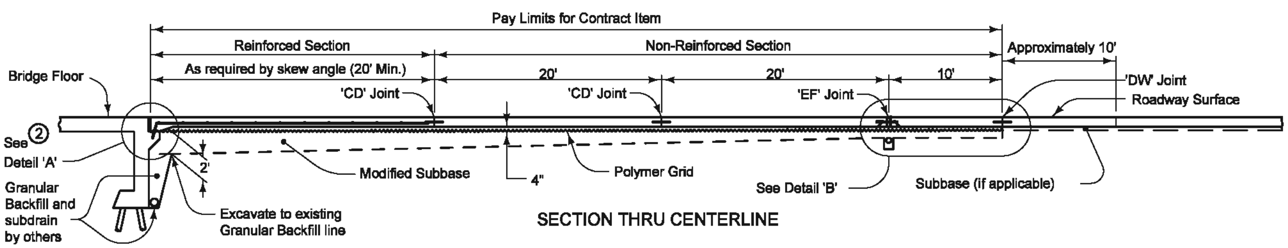
REVISIONS: Added Detail 'D' and reference to PV-102. Removed Flared Bridge End Post detail.

Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

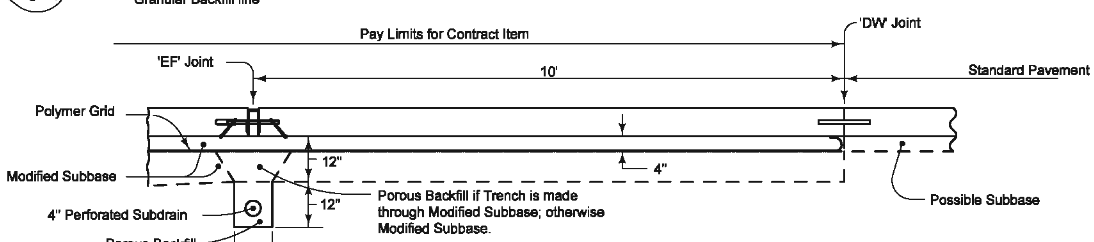
BRIDGE APPROACH SECTION
(GENERAL DETAILS)



PLAN VIEW



SECTION THRU CENTERLINE



DETAIL 'B'
Doweled PCC Pavement

For joint details, see PV-101.

1. Build 4 inch Sloped Curb to end of Reinforced Bridge Approach Section. See Curb Location Details (Section B-B).
2. See RK-19A.
3. Longitudinal Joint: (PV-101)
   Single Pour - Saw cut joint per Detail "B."
   Two Pours - Use "KS-1" joint.
4. 'CD' Joints required up to 300' each way from end of Reinforced Bridge Approach Section.
5. Excavation limits of Modified Subbase 2' outside of pavement edge, see RK-19A.
6. Slope subdrain to drain.
7. Place an "X" in the plastic concrete near the 'EF' Joint at the outside edge of pavement.
8. Place 'RD' Joint where PCC shoulder, 'B' Joint otherwise.

Possible Contract Item:
Bridge Approach, RK-19

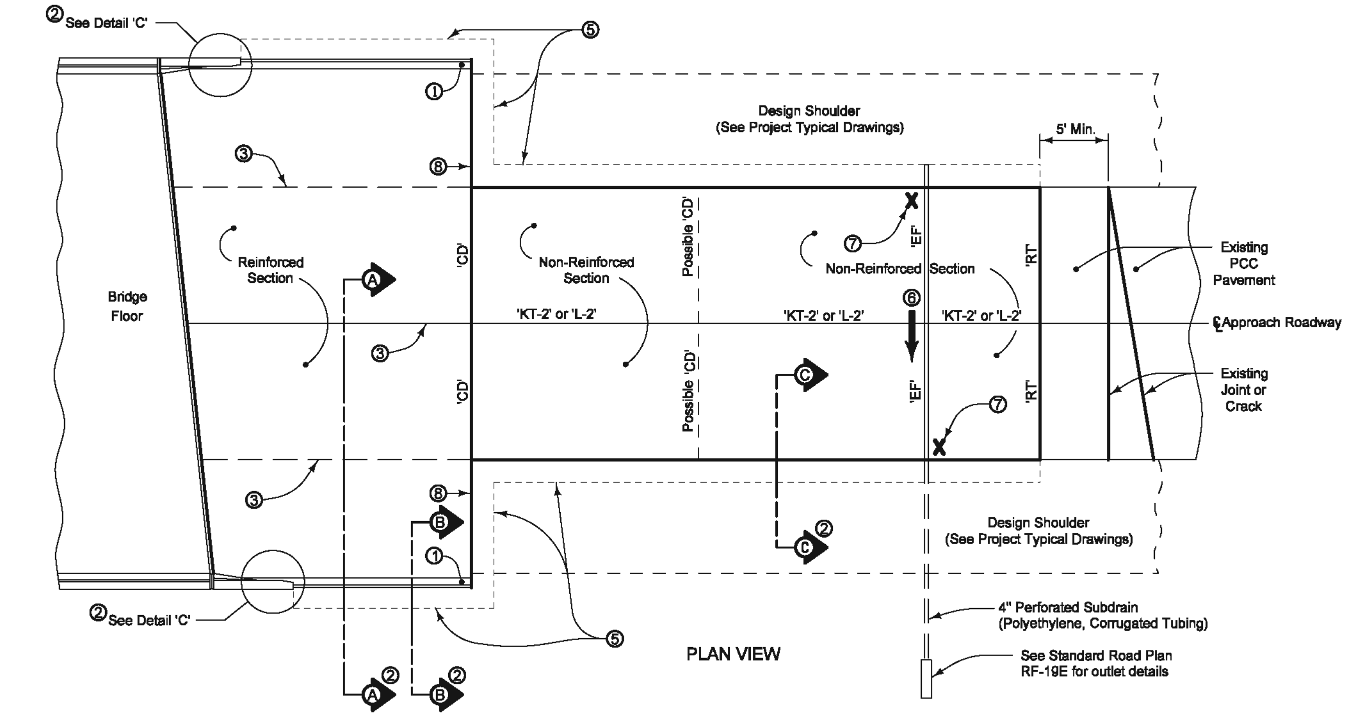
Iowa Department of Transportation	REVISION	
	18	10-16-12
STANDARD ROAD PLAN	RK-19B	
	SHEET 1 of 1	

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

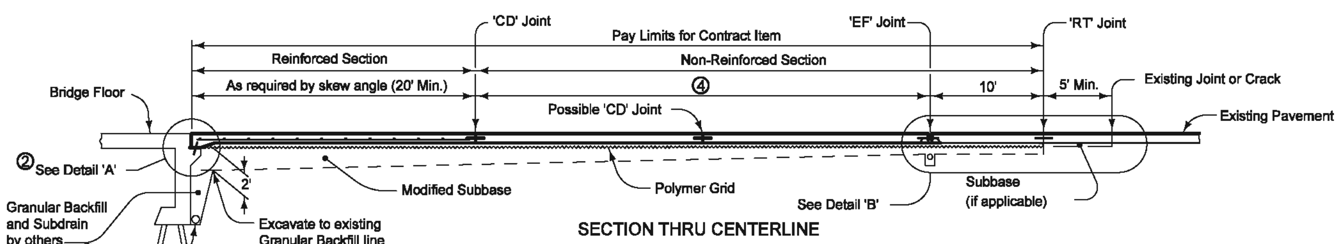
Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

BRIDGE APPROACH SECTION (TWO-LANE, ABUTTING PCC PAVEMENT)

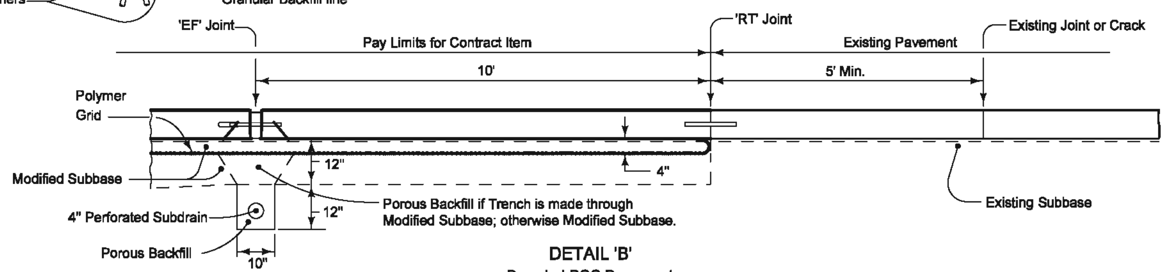
For joint details, see PV-101.



1. ① Build 4 inch Sloped Curb to end of Reinforced Bridge Approach Section.See Curb Location Details (Section B-B).
2. ② See Standard Road Plan RK-19A.
3. ③ Longitudinal Joint: (Standard Road Plan PV-101)
   Single Pour - Saw cut joint per detail B.
   Two Pours - Use 'KS-1' joint.
4. ④ Minimum 1 panel, maximum 3 panels; 15' minimum 20' maximum panel length, use 'CD' Joints.
5. ⑤ Excavation limits of Modified Subbase 2' outside of pavement edge, see Standard Road Plan RK-19A.
6. ⑥ Slope subdrain to drain.
7. ⑦ Place an "X" in the plastic concrete near the 'EF' Joint at the outside edge of pavement.
8. ⑧ Place 'RD' Joint where PCC shoulder, 'B' Joint otherwise.



SECTION THRU CENTERLINE



DETAIL 'B'
Doweled PCC Pavement

Iowa Department of Transportation

STANDARD ROAD PLAN

REVISION	
18	10-16-12

RK-19C

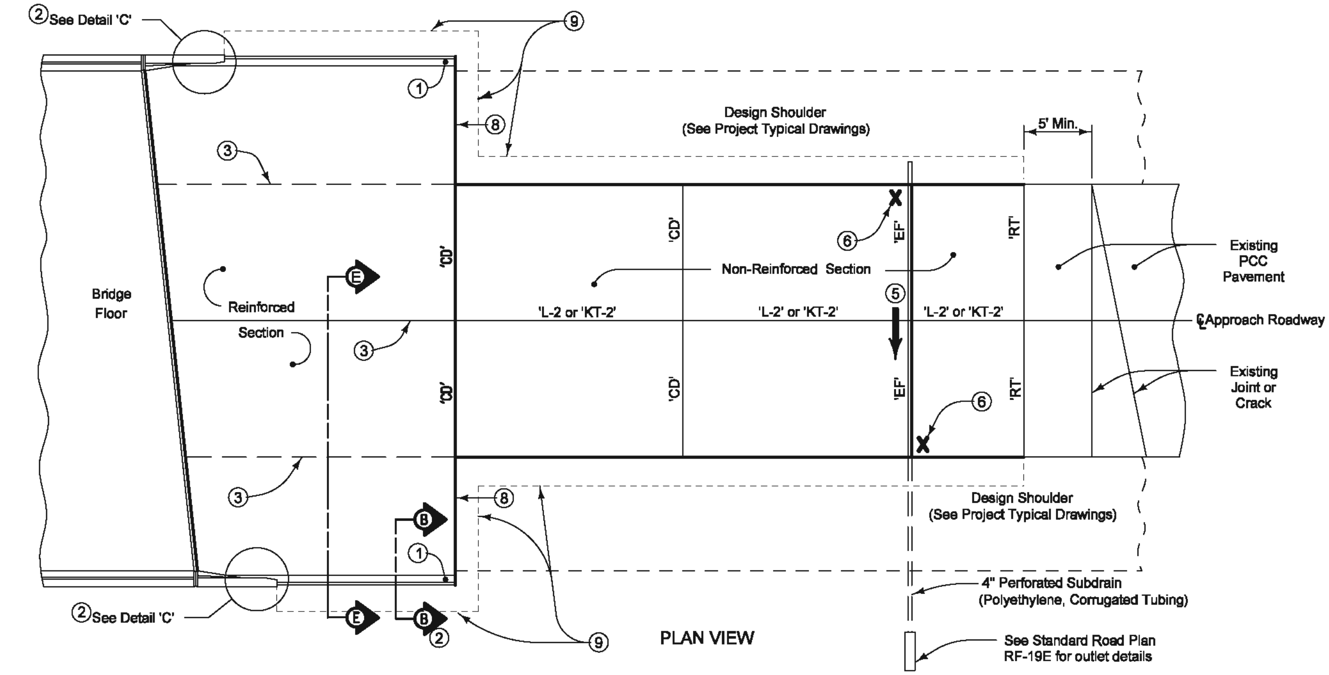
SHEET 1 of 1

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

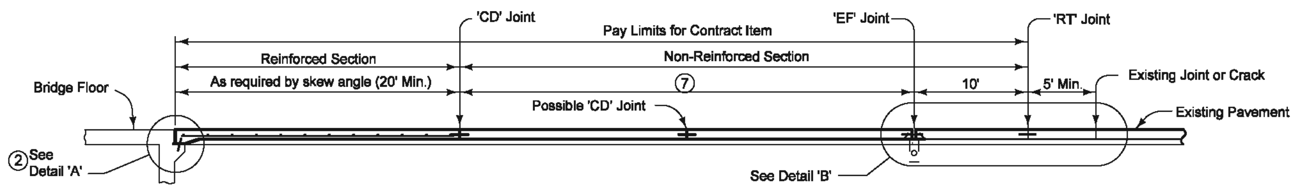
Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

BRIDGE APPROACH SECTION (TWO-LANE FOR BRIDGE RECONSTUCTION, PCC PAVEMENT)

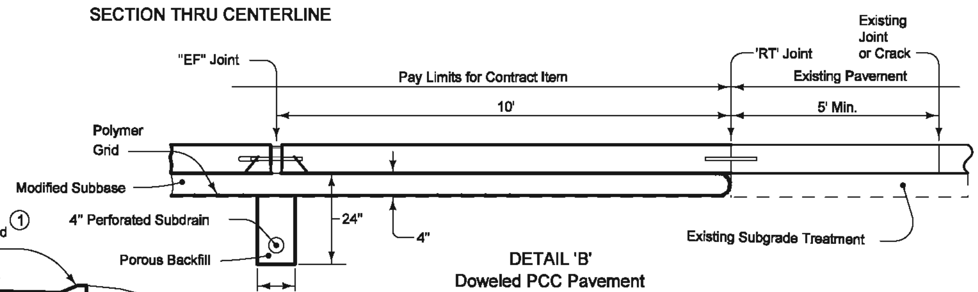
For joint details, see PV-101.



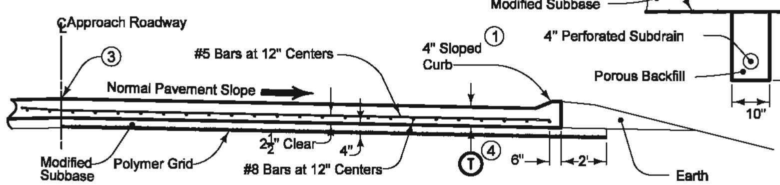
PLAN VIEW



SECTION THRU CENTERLINE



DETAIL 'B'
Doweled PCC Pavement



SECTION E-E

1. Build 4 inch Sloped Curb to end of Reinforced Bridge Approach Section. See Curb Location Details (Section B-B).
2. See Standard Road Plan RK-19A.
3. Longitudinal Joint: (PV-101)
   Single Pour - Saw cut joint per detail B.
   Two Pours - Use 'KS-1' joint.
4. T = 10 inches.
5. Slope subdrain to drain.
6. Place an "X" in the plastic concrete near the 'EF' Joint at the outside edge of pavement.
7. Minimum 1 panel, maximum 3 panels; 15' minimum 20' maximum panel length, use 'CD' Joints.
8. Place 'RD' Joint where PCC shoulder, 'B' Joint otherwise
9. Excavation limits of Modified Subbase 2' outside of pavement edge, see RK-19A.

Iowa Department of Transportation

STANDARD ROAD PLAN

REVISION	
18	10-16-12

RK-19F

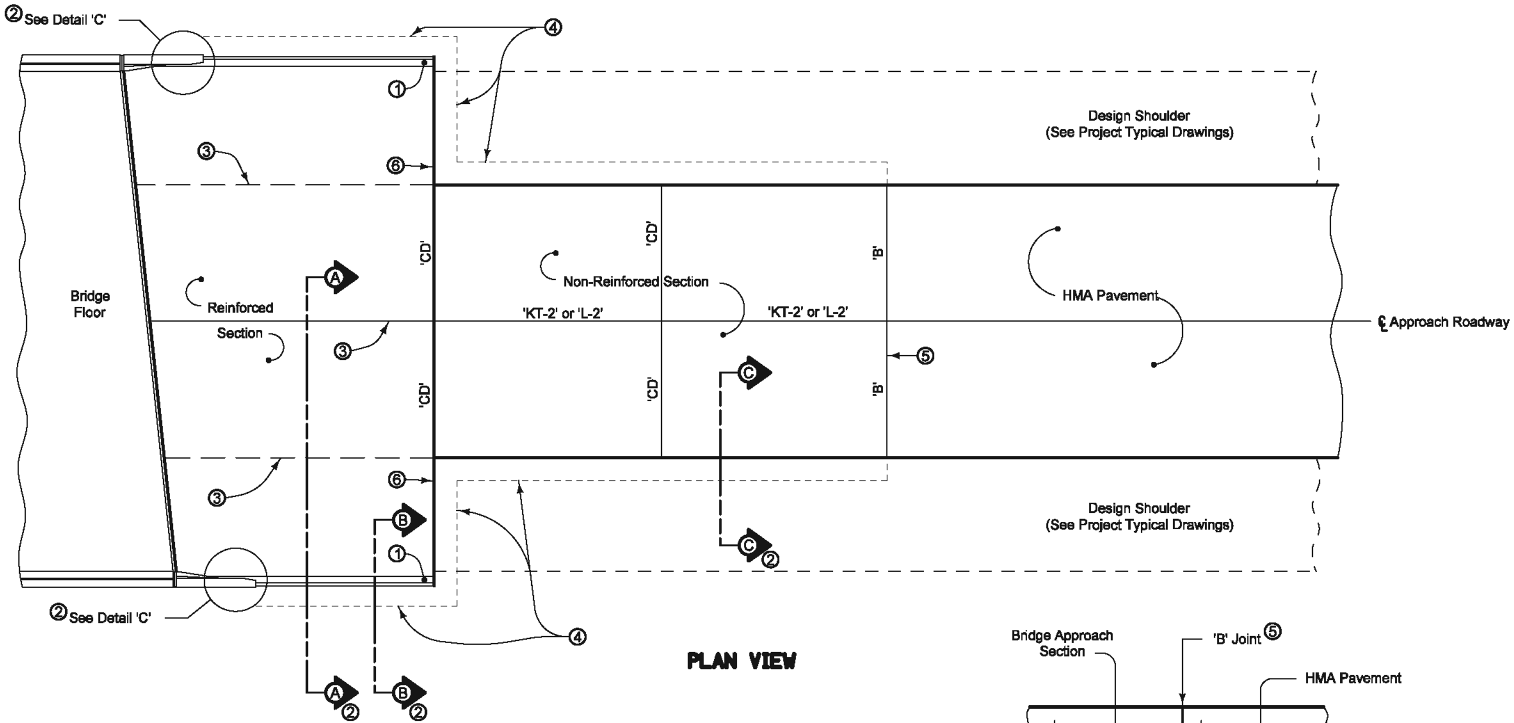
SHEET 1 of 1

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

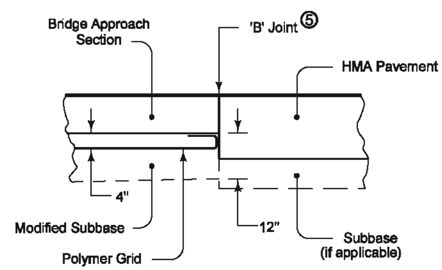
BRIDGE APPROACH SECTION
(AT EXISTING BRIDGES, PCC PAVEMENT)

For joint details, see PV-101.

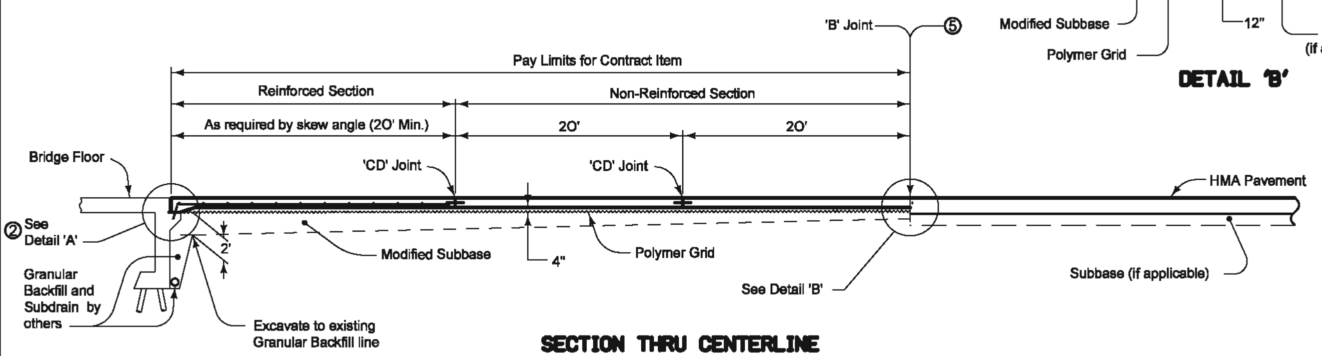


PLAN VIEW

1. Build 4" Sloped Curb to end of Reinforeced Bridge Approach. See curb location details (Section B-B).
2. See Standard Road Plan RK-19A.
3. Longitudinal Joints: (PV-101)
   Single Pour - Saw cut joint per detail B.
   Two Pours - Use 'KS-1' Joint.
4. Excavation limits of Modified Subbase 2' outside of pavement edge, see Standard Road Plan RK-19A.
5. The contractor may be required to saw cut the HMA pavement full depth to accommodate the 'B' joint.
6. Place 'RD' joint where PCC shoulder, 'B' joint otherwise.



DETAIL 'B'



SECTION THRU CENTERLINE

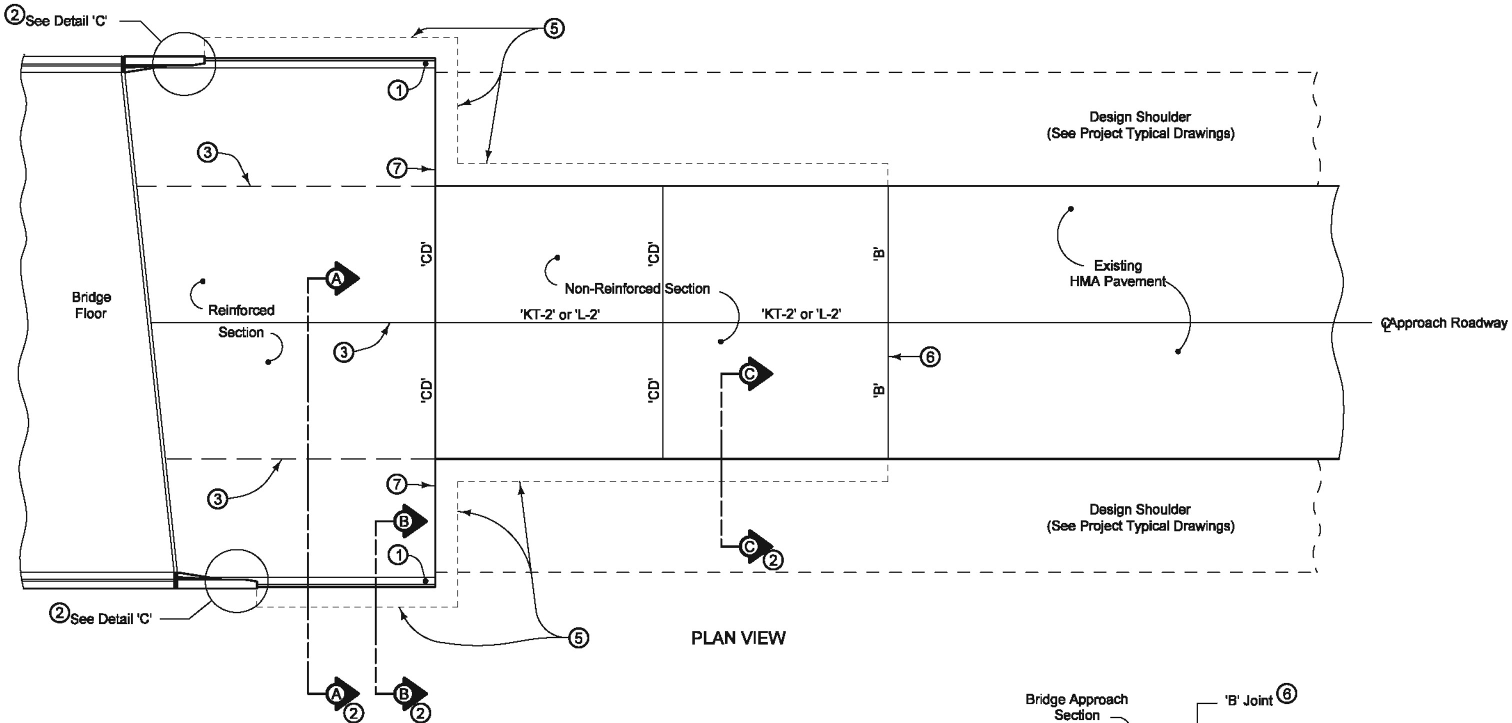
Iowa Department of Transportation	REVISION
STANDARD ROAD PLAN	18 · 10-16-12
	RK-19G
	SHEET 1 of 1

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

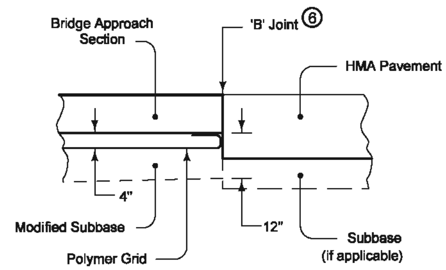
BRIDGE APPROACH SECTION (TWO-LANE, HMA PAVEMENT)

For joint details, see PV-101.

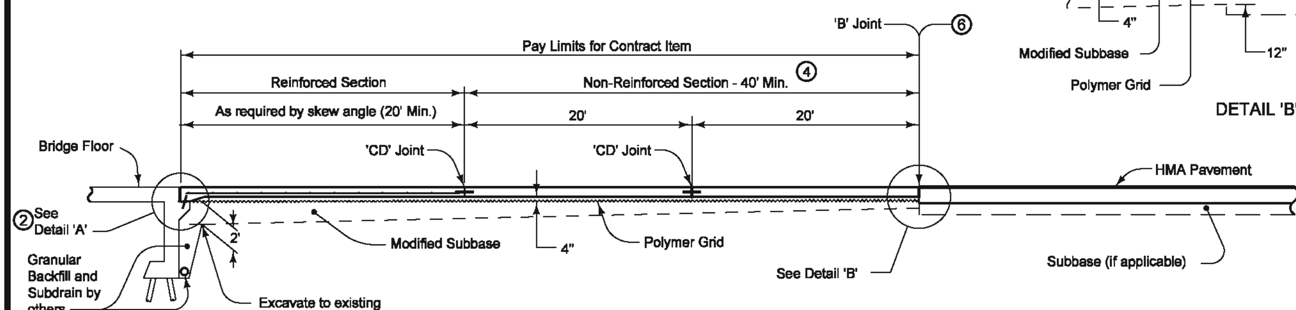


PLAN VIEW

1. Build 4" Sloped Curb to end of Reinforced Bridge Approach Section. See Curb Location Details (Section B-B).
2. See Standard Road Plan RK-19A.
3. Longitudinal Joint: (PV-101)
   Single Pour - Saw cut joint per Detail B.
   Two Pours - Use 'KS-1' Joint.
4. Minimum 2 panels, maximum 3 panels; 20' panel length, use 'CD' Joints.
5. Excavation limits of Modified Subbase 2' outside of pavement edge, see RK-19A.
6. The contractor may be required to saw cut the HMA pavement full depth to accommodate the 'B' joints.
7. Place 'RD' joint where PCC shoulder, 'B' joint otherwise.



DETAIL 'B'



SECTION THRU CENTERLINE

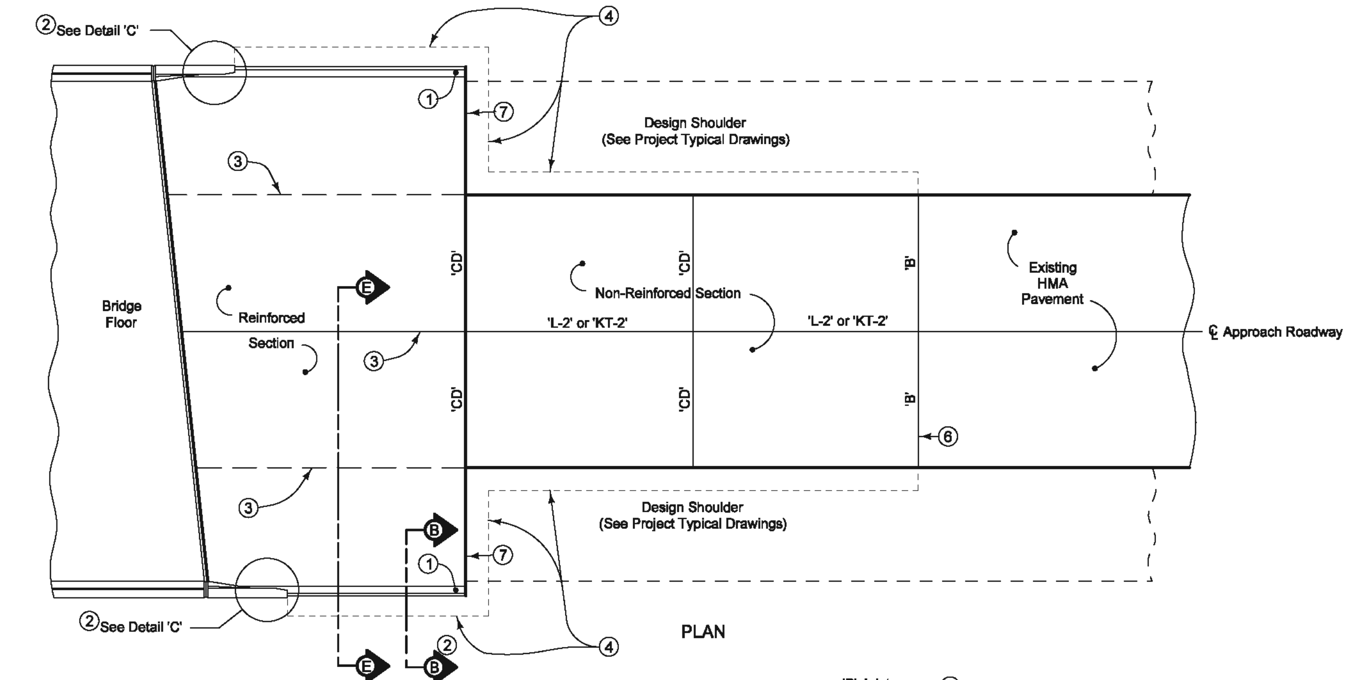
Iowa Department of Transportation	REVISION: 18 — 10-16-12
STANDARD ROAD PLAN	RK-19H — SHEET 1 of 1

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

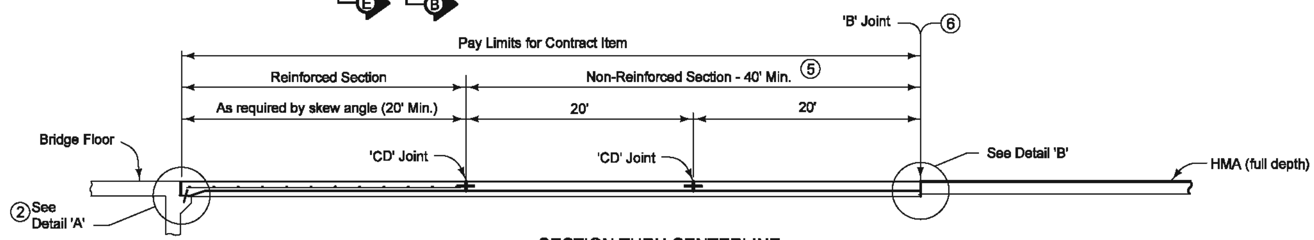
Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

BRIDGE APPROACH SECTION
(TWO-LANE FOR BRIDGE RECONSTRUCTION, HMA PAVEMENT)

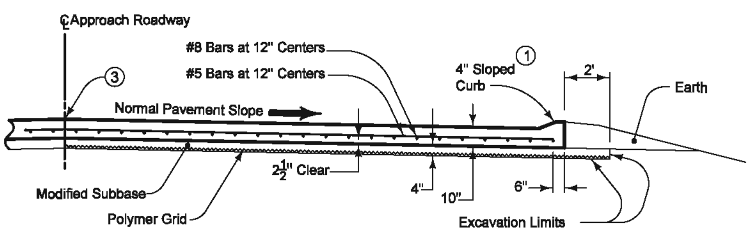
For joint details see PV-101.



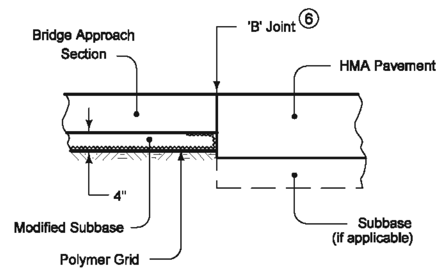
PLAN



SECTION THRU CENTERLINE



SECTION E-E



DETAIL 'B'

1. Build 4" Sloped Curb to end of Reinforced Bridge Approach Sections. See Curb Location Details (Section B-B).
2. See RK-19A.
3. Longitudinal Joints: (PV-101)
   Single Pour - Saw cut joint per detail B.
   Two Pours - Use 'KS-1' Joint.
4. Excavation limits of Modified Subbase 2' outside of pavement edge; see RK-19A.
5. Minimum 2 panels, maximum 3 panels; 20' panel length, use 'CD' Joints.
6. The contractor may be required to saw cut the HMA pavement full depth to accommodate the 'B' joint.
7. Place 'RD' joint where PCC shoulder, 'B' joint otherwise.

Possible Contract Item:
Bridge Approach, RK-19

Iowa Department of Transportation

STANDARD ROAD PLAN

REVISION	
20	10-16-12

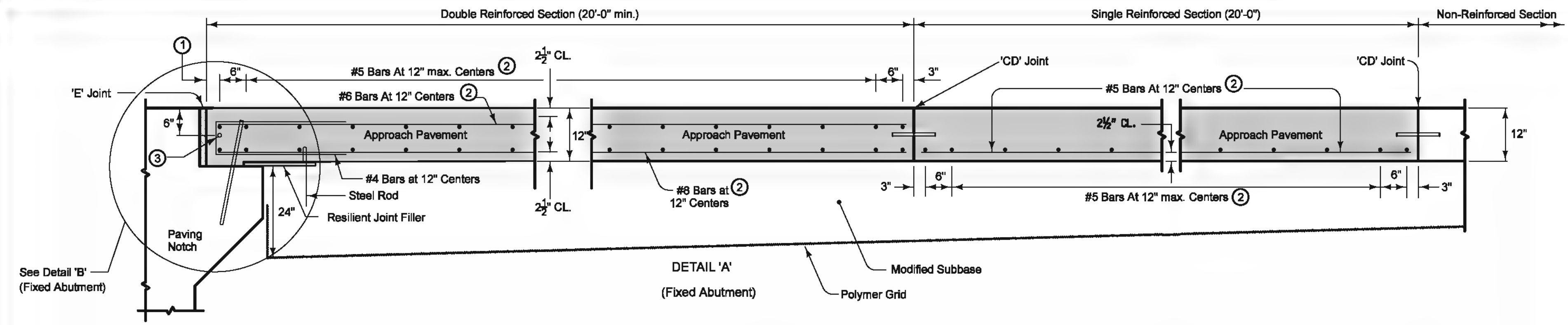
RK-19J

SHEET 1 of 1

REVISIONS: Redrew reinforcing mat to place #5 bars on top of #8 bars.

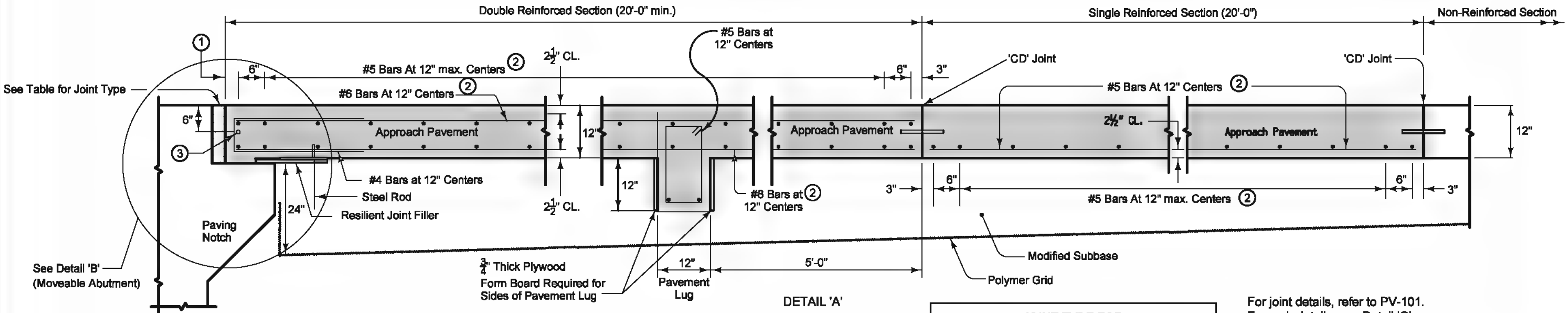
Deanna Maifield
APPROVED BY DESIGN METHODS ENGINEER

BRIDGE APPROACH SECTION
(AT EXISTING BRIDGES, HMA PAVEMENT)



DETAIL 'A'

(Fixed Abutment)



DETAIL 'A'

(Moveable Abutment)

JOINT TYPE FOR MOVEABLE ABUTMENT BRIDGES		
	Maximum Bridge Length	
Joint	Concrete Beam or Slab	Steel Girder
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

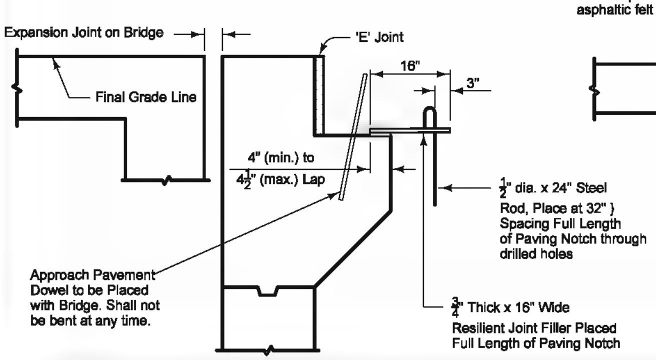
For joint details, refer to PV-101.
For curb details, see Detail 'G'.

All transverse bars are #5.

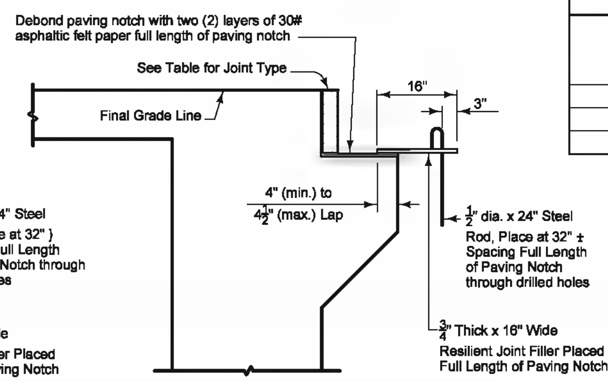
Possible Contract Item:

Bridge Approach, RK-20

Possible Tabulation: 112-6



DETAIL 'B' (Fixed Abutment)



DETAIL 'B' (Moveable Abutment)

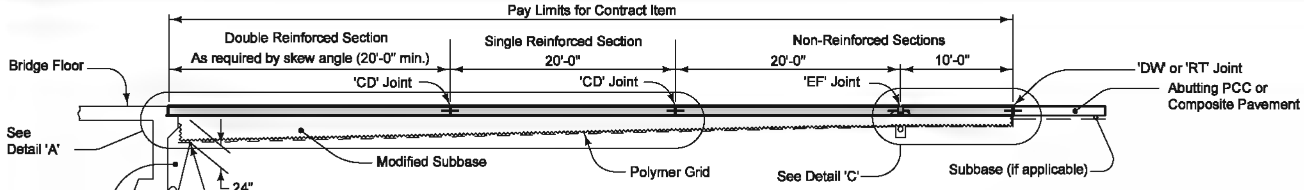
1. 2" min. to 2 1/2" max. clear to bent bar.
2. Minimum lap length: #5 Bars - 18"
   #6 Bars - 27"
   #8 Bars - 48"
3. If bridge is skewed, place additional #5 bar parallel to skewed face.

Iowa Department of

STANDARD ROAD PLAN

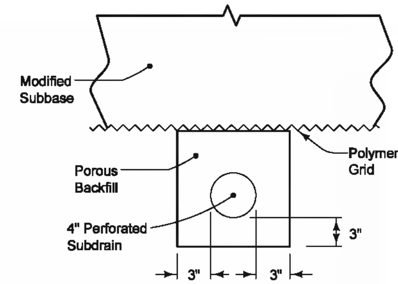
RK-20

DOUBLE REINFORCED 12" APPROACH

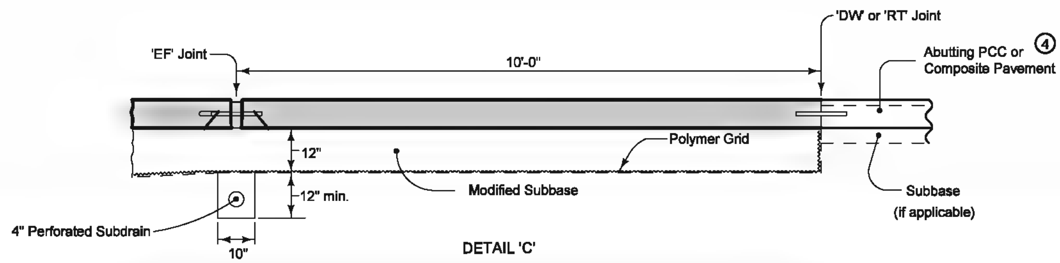


SECTION THRU CENTERLINE

(Abutting PCC or Composite Pavement)

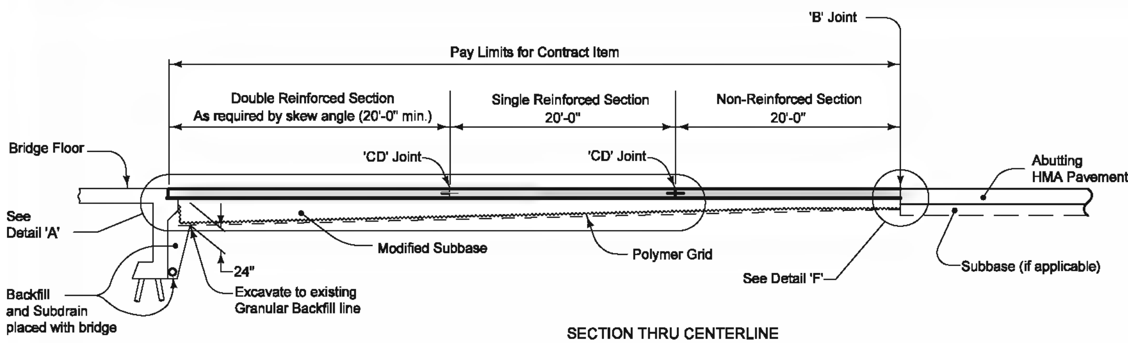


4" SUBDRAIN LOCATION



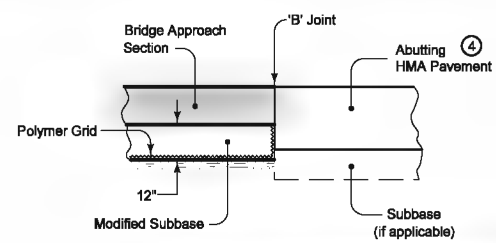
DETAIL 'C'

(Doweled PCC Pavement)



SECTION THRU CENTERLINE

(Abutting HMA Pavement)



DETAIL 'F'

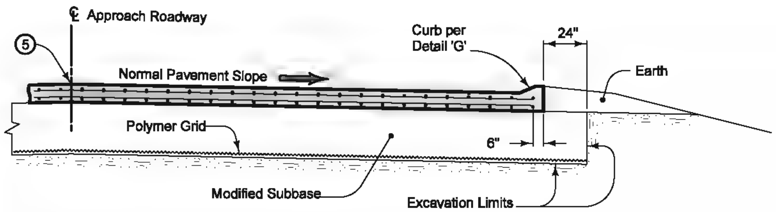
4 If abutting pavement (PCC or HMA) is not in place, refer to RK-30.

Iowa Department of

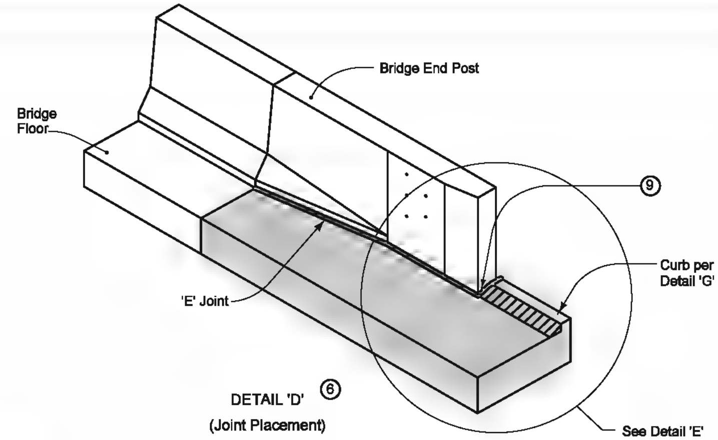
STANDARD ROAD PLAN

RK-20

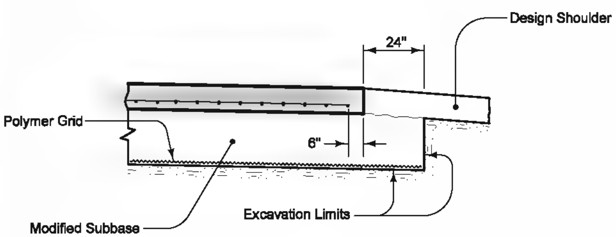
DOUBLE REINFORCED 12" APPROACH



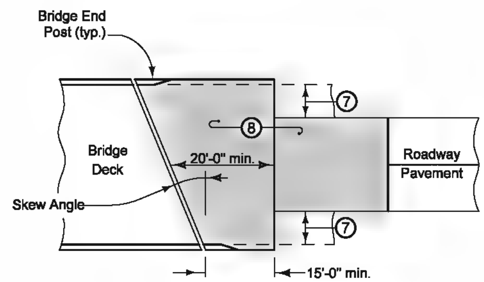
SECTION A-A 6



DETAIL 'D' 6
(Joint Placement)



SECTION B-B 6

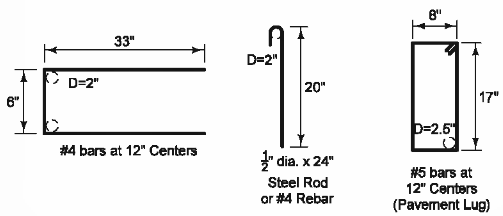


APPROACH PAVEMENT LAYOUT AT A SKEW

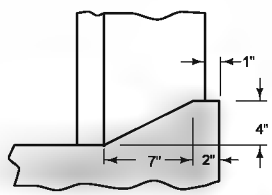
5. Longitudinal Joint: (PV-101)
   Single pour - Saw cut joint per Detail B.
   Two pours - Use 'KS-2' Joint
6. Refer to RK-21, RK-22, or RK-23.
7. Design shoulder width.
8. Reinforced bridge approach section.
9. Expansion joint at end of bridge end post: Place joint filler the full depth of the bridge approach pavement. In areas with curb, place full depth of pavement plus curb and shape material to fit the shape of the curb per Section B-B of PV-101. Seal joint per Detail F of PV-101.

   - Fixed Abutment Bridges:Type 'E' Joint

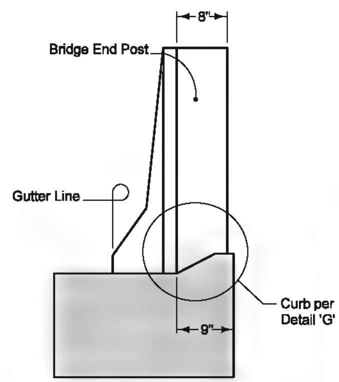
   - Moveable Abutment Bridges: Flexible Foam Expansion Joint Filler in accordance with Specification Section 4136. Minimum filler width is the abutment 'CF' joint width. Joint length as required to completely fill from back side of curb to front face of bridge wing.



BENT BAR SHAPES



DETAIL 'G'



DETAIL 'E'
(Back of Curb Placement)

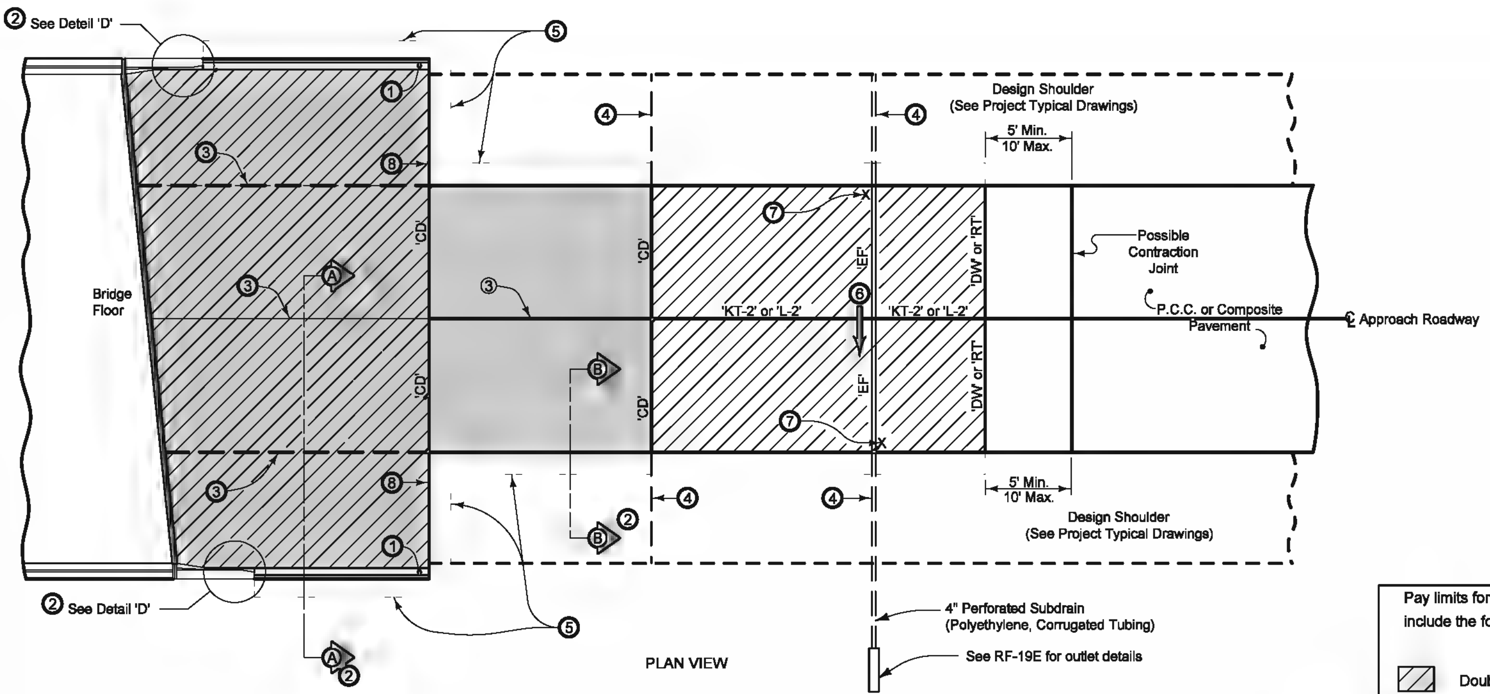
Iowa Department of Transportation

STANDARD ROAD PLAN

RK-20

DOUBLE REINFORCED 12" APPROACH

For joint details, see PV-101.



Pay limits for contract item include the following areas:

- Double Reinforced Section
- Single Reinforced Section
- Non-Reinforced Section

1. Build 4 inch Sloped Curb to end of Double Reinforced Section.
2. See Standard Road Plan RK-20, RK-25, RK-26, or RK-27.
3. Longitudinal Joint: (See PV-101)
   Single Pour - Saw cut joint per detail B
   Two Pours - Use 'KS-2' Joint (Double Reinforced Section).
   Use 'KS-1' Joint (Single Reinforced Section).
4. Extend 'CD' and 'EF' Joints where PCC Shoulder.
5. Polymer Grid and excavation limits of Modified Subbase 2' outside of pavement edge. See Standard Road Plan RK-20, RK-25, RK-26, or RK-27.
6. Slope Subdrain to drain.
7. Place an "X" in the plastic concrete near the 'EF' Joint at the outside edge of pavement.
8. Place 'RD' Joint where PCC shoulder, 'B' Joint otherwise.

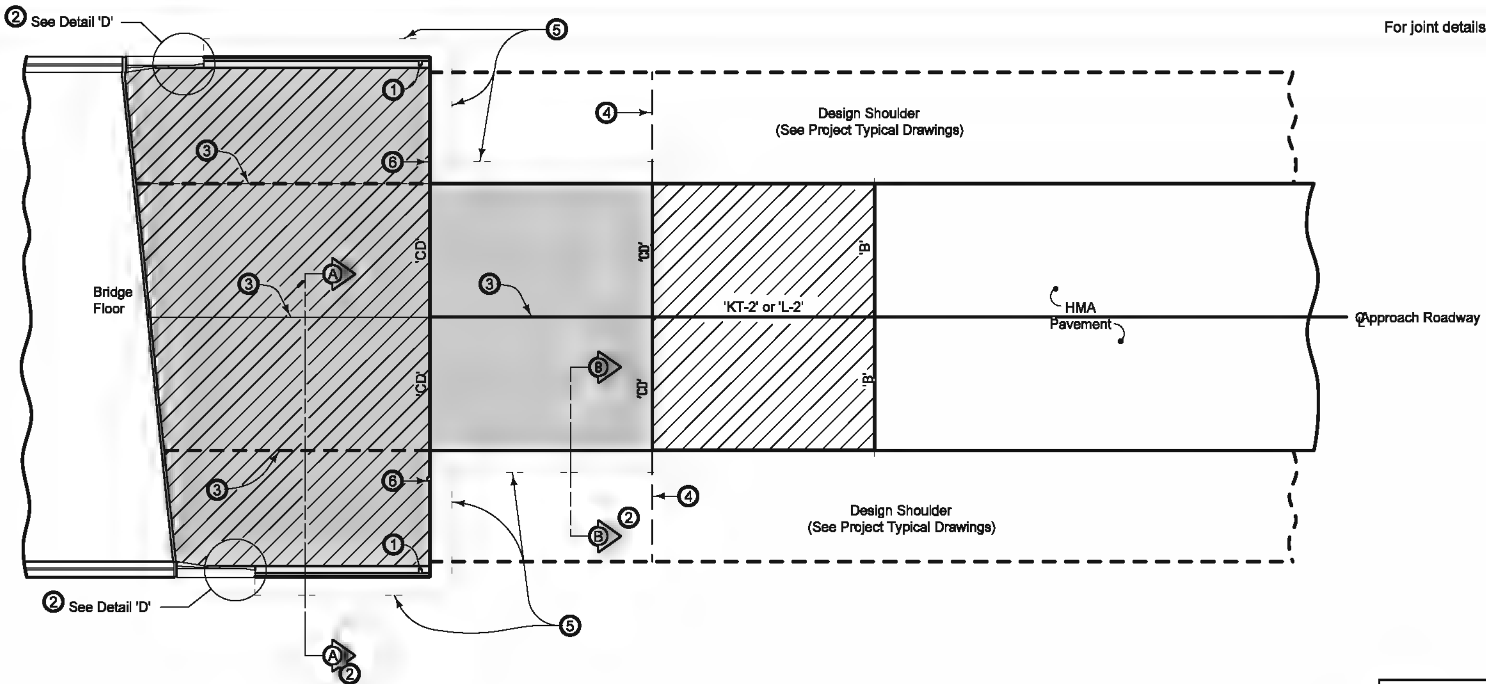
Iowa Department of

STANDARD ROAD PLAN

RK-21

BRIDGE APPROACH
(ABUTTING PCC OR
COMPOSITE PAVEMENT)

For joint details, see PV-101



PLAN VIEW

Pay limits for contract item include the following areas:	
	Double Reinforced Section
	Single Reinforced Section
	Non-Reinforced Section

1. Build 4" Sloped Curb to end of Double Reinforced Section.
2. See RK-20, RK-25, RK-26, or RK-27.
3. Longitudinal Joint: (See PV-101)
   Single Pour - Saw cut joint per detail B
   Two Pours - Use 'KS-2' Joint (Double Reinforced Section).
   Use 'KS-1' Joint (Single Reinforced Section).
4. Extend 'CD' Joints where PCC Shoulder.
5. Polymer Grid and excavation limits of Modified Subbase 2' outside of pavement edge. See RK-20, RK-25, RK-26, or RK-27.
6. Place 'RD' joint where PCC shoulder, 'B' joint otherwise.

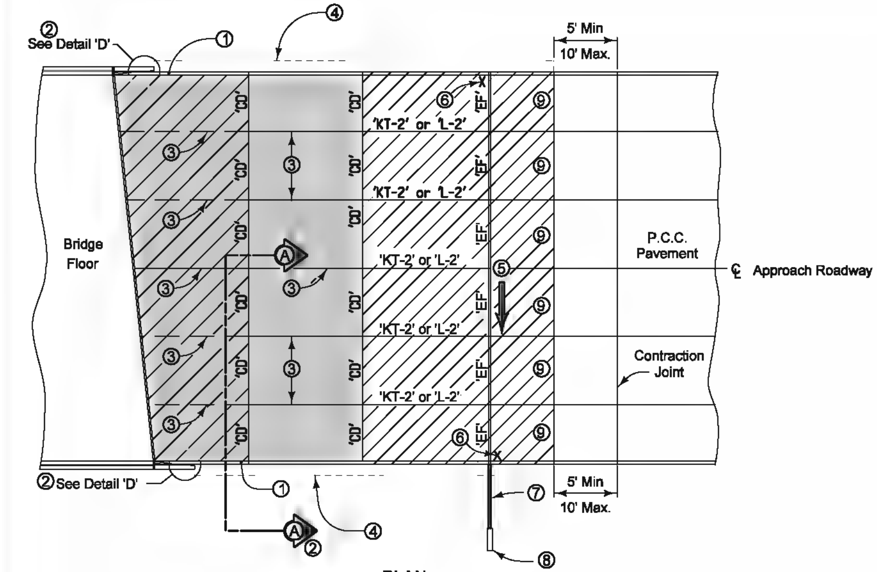
Iowa Department of

STANDARD ROAD PLAN

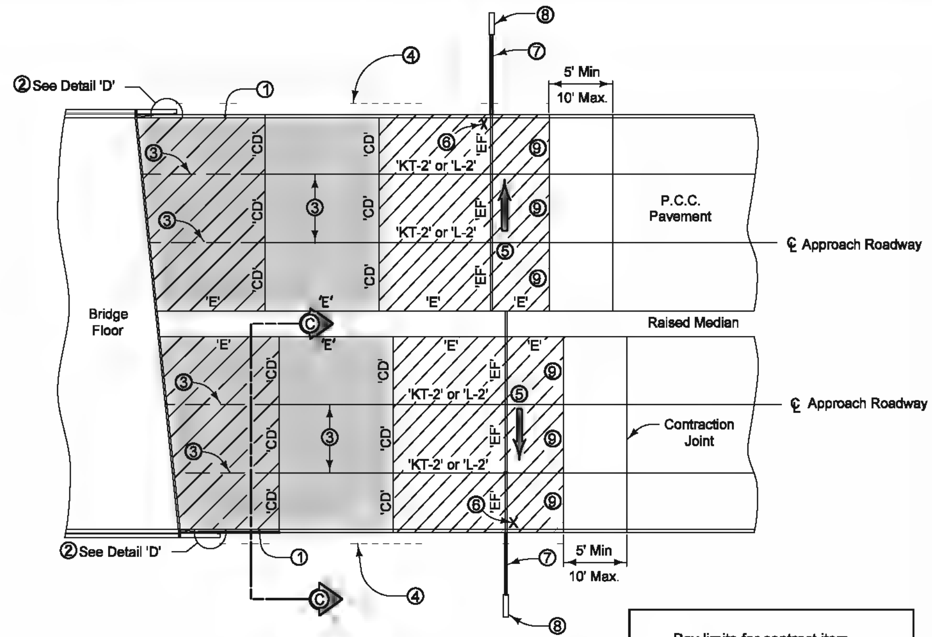
RK-22

BRIDGE APPROACH
(ABUTTING HMA PAVEMENT)

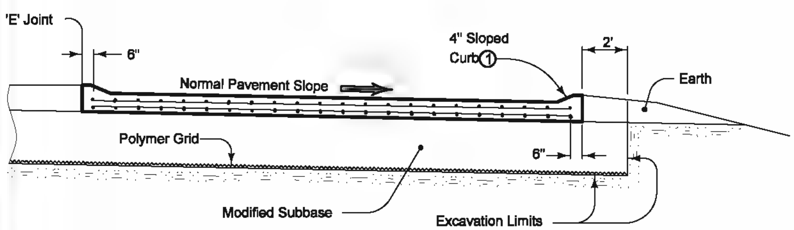
For joint details, see PV-101.



PLAN



PLAN



SECTION C-C

Pay limits for contract item include the following areas:

- Double Reinforced Section
- Single Reinforced Section
- Non-Reinforced Section

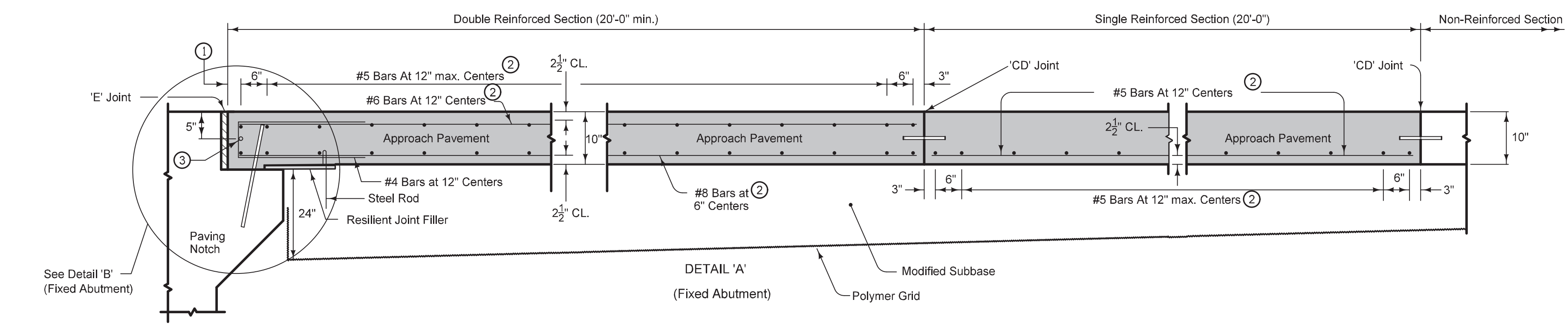
1. Build 4 inch Sloped Curb, unless noted otherwise in the plans.
2. See RK-20, RK-25, RK-26 or RK-27.
3. Longitudinal joint: (PV-101)
   Single Pour - Saw cut joint per detail B.
   Two Pours - Use 'KS-2' Joint (Double Reinforced Section).
   Use 'KS-1' Joint (Single Reinforced Section).
4. Polymer grid and excavation limits of Modified Subbase 2' outside of pavement edge. See RK-20, RK-25, RK-26 or RK-27.
5. Slope subdrain to drain.
6. Place an "X" in the plastic concrete near the 'EF' joint at the outside edge of pavement.
7. 4 inch perforated subdrain (polyethylene, corrugated tubing).
8. See RF-19C or RF-19E for outlet details.
9. 'DW' or 'RT' Joint.

Iowa Department of Transportation

STANDARD ROAD PLAN

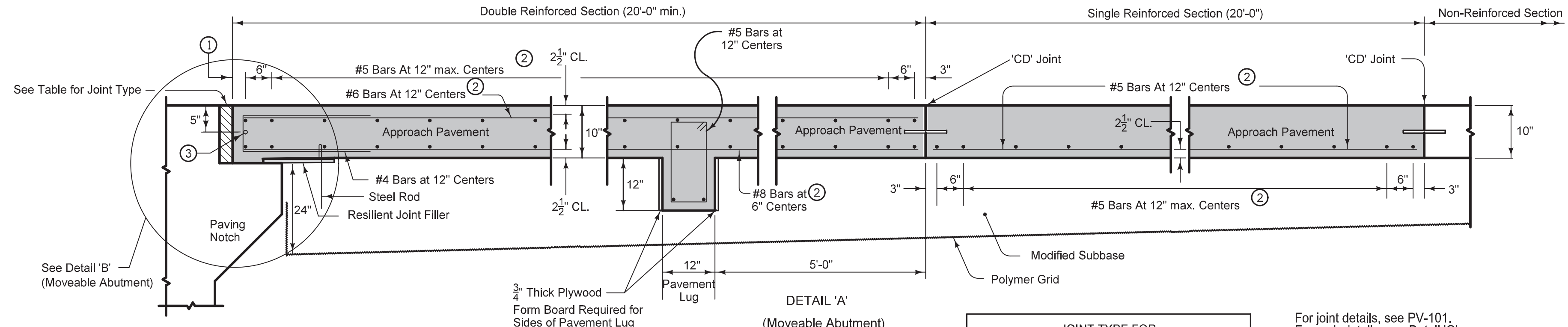
RK-23

BRIDGE APPROACH
(MULTI-LANE, CURBED ROADWAY)



DETAIL 'A'

(Fixed Abutment)



DETAIL 'A'

(Moveable Abutment)

JOINT TYPE FOR MOVEABLE ABUTMENT BRIDGES		
Joint	Maximum Bridge Length	
	Concrete Beam or Slab	Steel Girder
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

For joint details, see PV-101.
For curb details, see Detail 'G'.

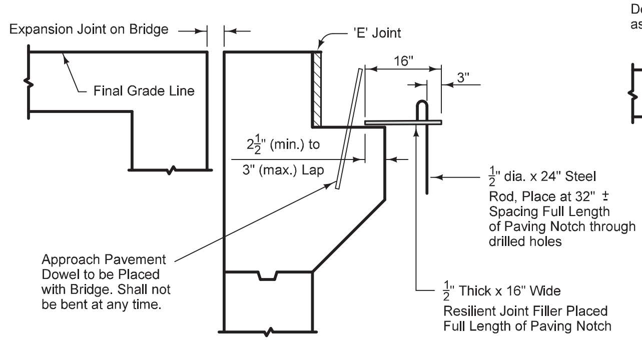
All transverse bars are #5.

Possible Contract Item:

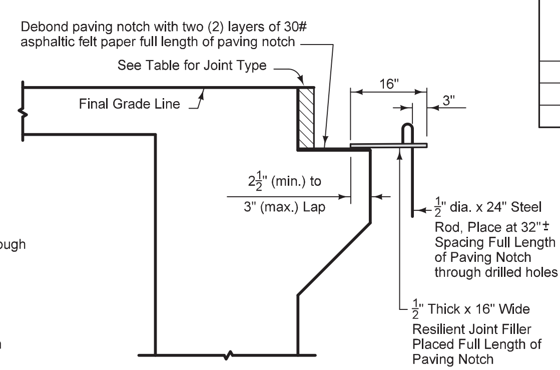
Bridge Approach, RK-25

Possible Tabulation:

112-6



DETAIL 'B' (Fixed Abutment)



DETAIL 'B' (Moveable Abutment)

① 2" min. to 2 1/2" max. clear to bent bar.

② Minimum lap length: #5 Bars - 18"
#6 Bars - 27"
#8 Bars - 48"

③ If bridge is skewed, place additional #5 bar parallel to skewed face.

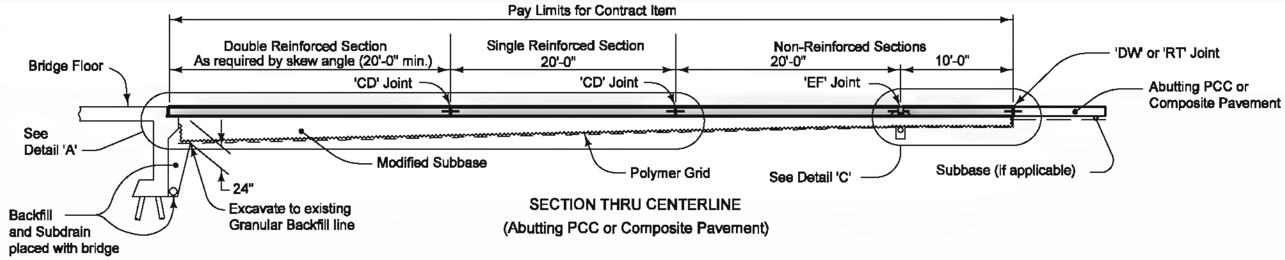
Iowa Department of Transportation	REVISION	
	11	04-16-13
STANDARD ROAD PLAN	RK-25	
	SHEET 1 of 3	

REVISIONS: Modified notes to change reference from PV-102 to Detail 'G'.

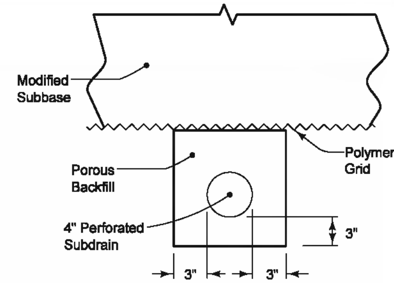
Deanna Maifield

APPROVED BY DESIGN METHODS ENGINEER

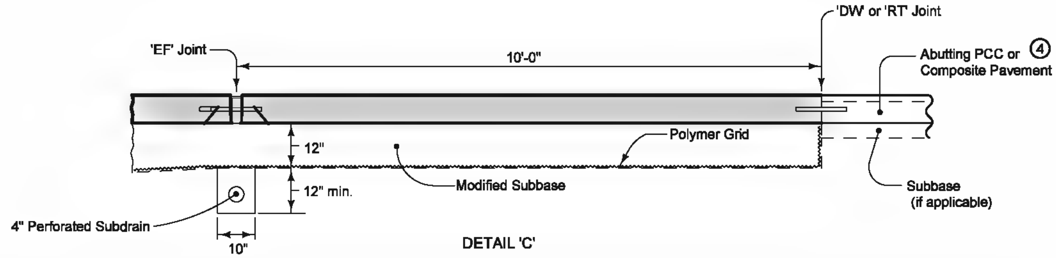
DOUBLE REINFORCED 10" APPROACH



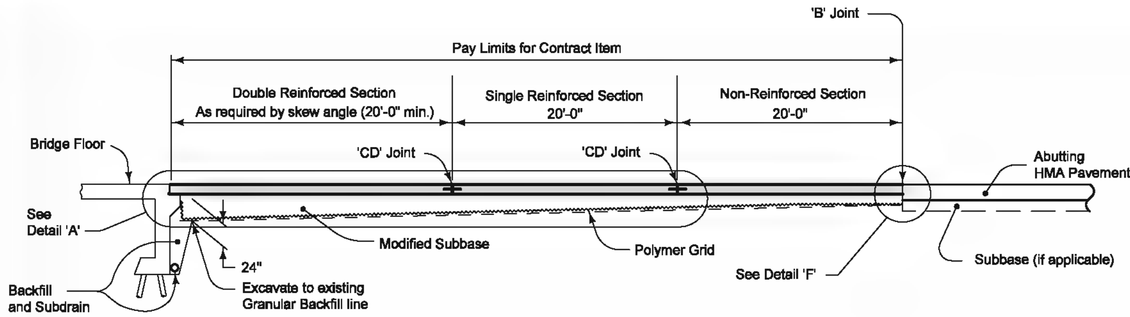
SECTION THRU CENTERLINE
(Abutting PCC or Composite Pavement)



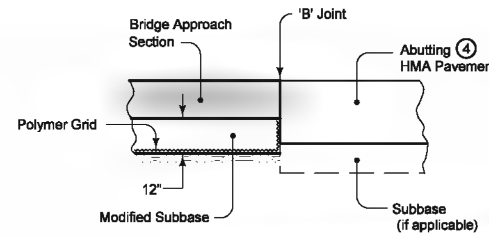
4" SUBDRAIN LOCATION



DETAIL 'C'
(Doweled PCC Pavement)



SECTION THRU CENTERLINE
(Abutting HMA Pavement)



DETAIL 'F'

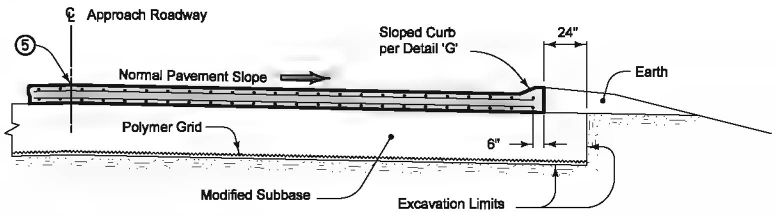
④ If abutting pavement (PCC or HMA) is not in place, see RK-30.

Iowa Department of

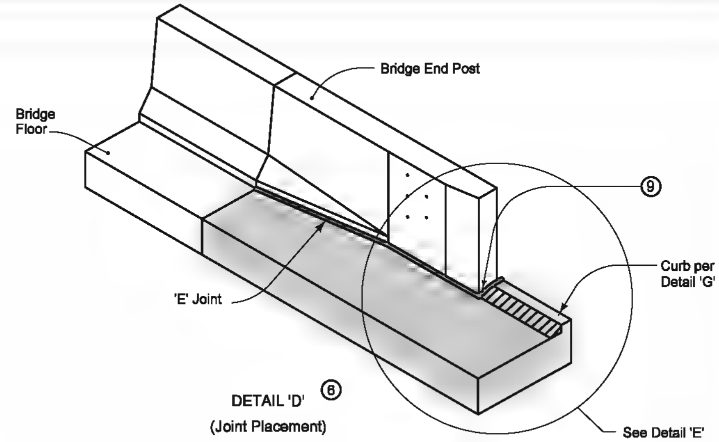
STANDARD ROAD PLAN

RK-25

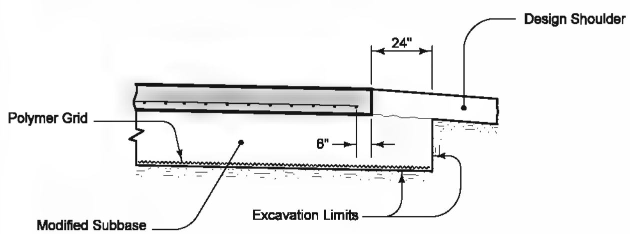
DOUBLE REINFORCED 10" APPROACH



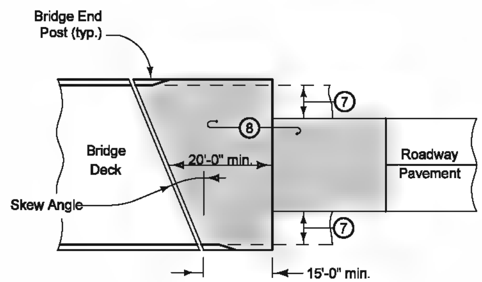
SECTION A-A ⑥



DETAIL 'D' ⑥
(Joint Placement)



SECTION B-B ⑥



APPROACH PAVEMENT
LAYOUT AT A SKEW

⑤ Longitudinal Joint: (PV-101)
Single pour — Saw cut joint per Detail B.
Two pours — Use 'KS-2' Joint

⑥ See RK-21, RK-22, or RK-23.

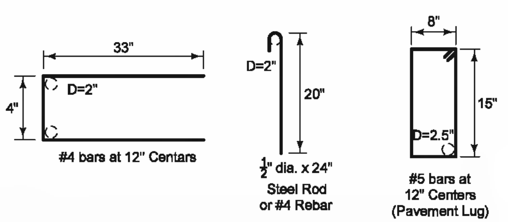
⑦ Design shoulder width.

⑧ Reinforced bridge approach section.

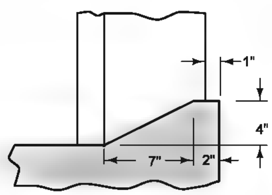
⑨ Expansion joint at end of bridge end post: Place joint filler the full depth of the bridge approach pavement. In areas with curb, place full depth of pavement plus curb and shape material to fit the shape of the curb per Section B-B of PV-101. Seal joint per Detail F of PV-101.

- Fixed Abutment Bridges:Type 'E' Joint

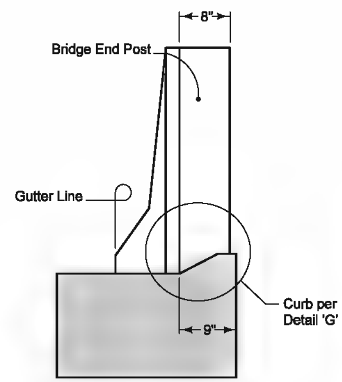
- Moveable Abutment Bridges: Flexible Foam Expansion Joint Filler in accordance with Specification Section 4136. Minimum filler width is the abutment 'CF' joint width. Joint length as required to completely fill from back side of curb to front face of bridge wing.



BENT BAR SHAPES



DETAIL 'G'



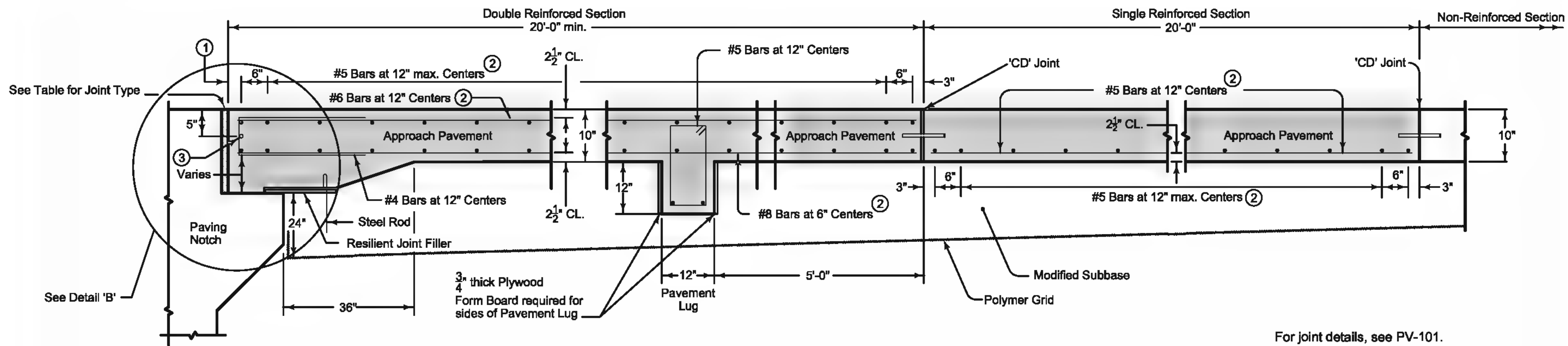
DETAIL 'E'
(Back of Curb Placement)

Iowa Department
of

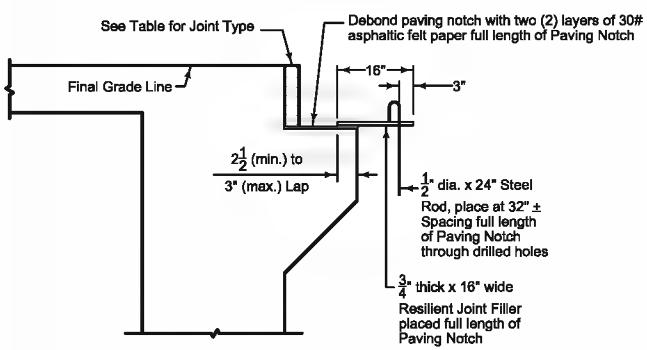
STANDARD ROAD PLAN

RK-25

DOUBLE REINFORCED 10" APPROACH



DETAIL 'A'



DETAIL 'B'

For joint details, see PV-101.
For curb details, see Detail 'G'.

All Transverse Bars are #5.

See RK-21 or RK-22 for shoulders.

① 2" to $2\frac{1}{2}$" clear to bent bar.

② Minimum lap length: #5 bars - 18 inches
#6 bars - 27 inches
#8 bars - 48 inches

③ If bridge is skewed, place additional #5 bar parallel to skewed face.

Possible Contract Item:
Bridge Approach, RK-26

Possible Tabulation:
112-6

JOINT TYPE FOR MOVEABLE ABUTMENT BRIDGES

Joint	Maximum Bridge Length	
	Concrete Beam or Slab	Steel Girder
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

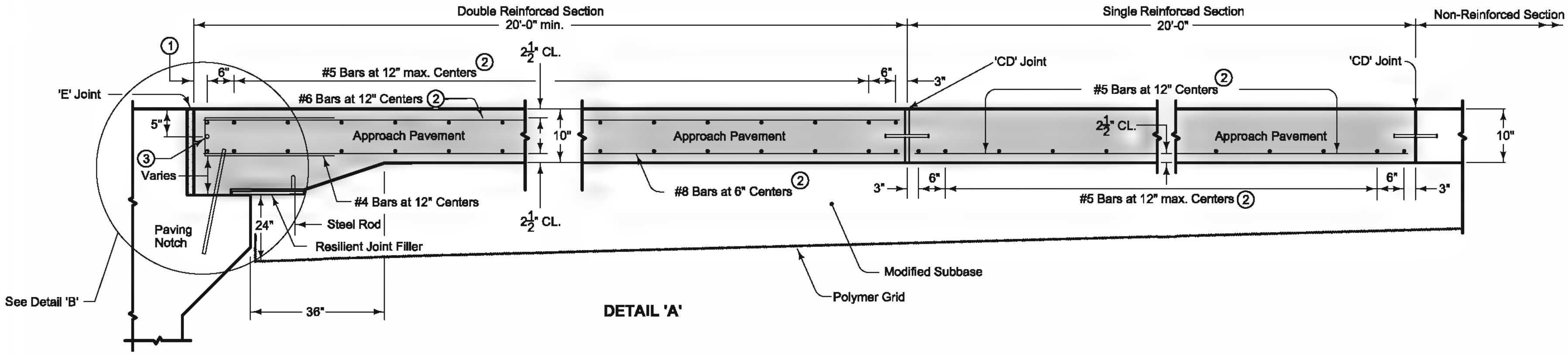
MOVEABLE ABUTMENT

Iowa Department of

STANDARD ROAD PLAN

RK-26

DOUBLE REINFORCED 10" APPROACH WITH VARIABLE DEPTH PAVING NOTCH

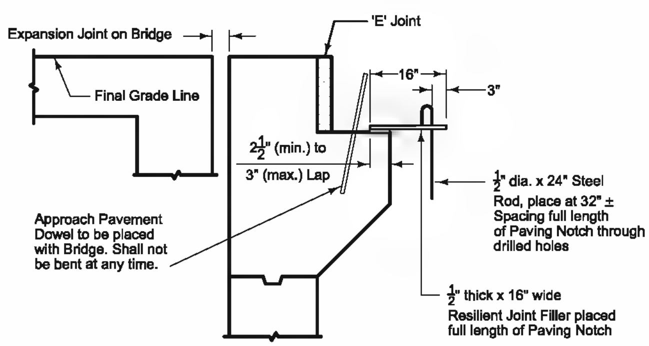


DETAIL 'A'

① 2" to 2½" clear to bent bar.

② Minimum lap length: #5 bars - 18 inches
#6 bars - 27 inches
#8 bars - 48 inches

③ If bridge is skewed, place additional #5 bar parallel to skewed face.



DETAIL 'B'

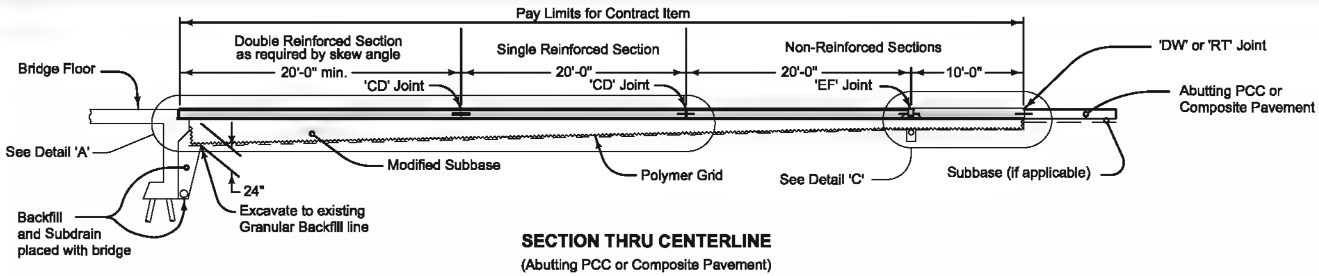
FIXED ABUTMENT

Iowa Department of

STANDARD ROAD PLAN

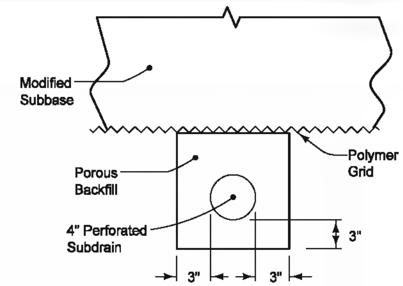
RK-26

DOUBLE REINFORCED 10" APPROACH WITH VARIABLE DEPTH PAVING NOTCH

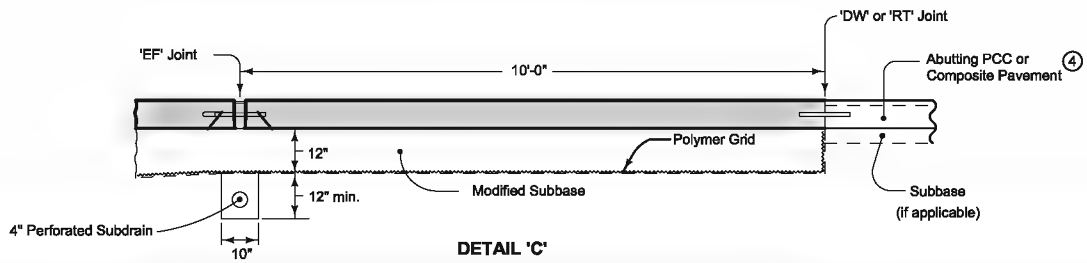


SECTION THRU CENTERLINE

(Abutting PCC or Composite Pavement)

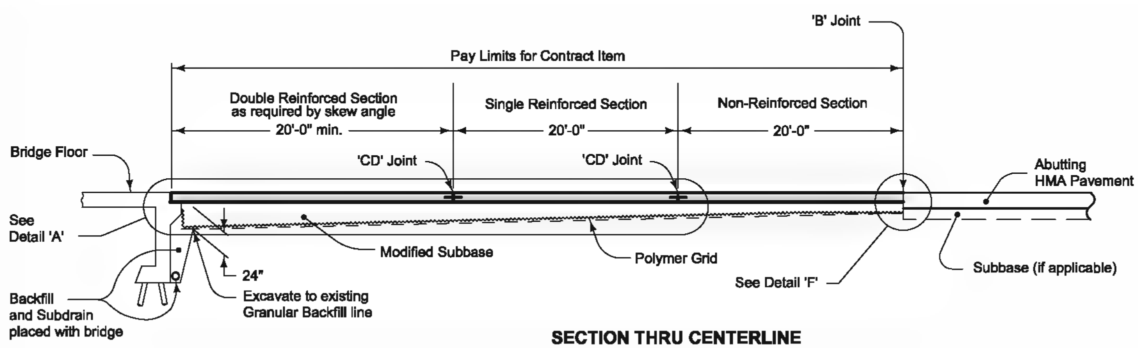


4" SUBDRAIN LOCATION



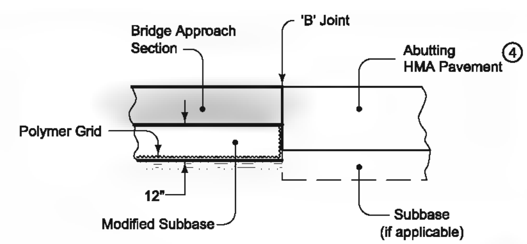
DETAIL 'C'

(Doweled PCC Pavement)



SECTION THRU CENTERLINE

(Abutting HMA Pavement)



DETAIL 'F'

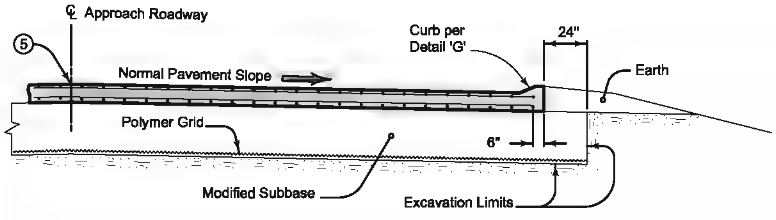
④ If abutting pavement (PCC or HMA) is not in place, see RK-30.

Iowa Department of [illegible]

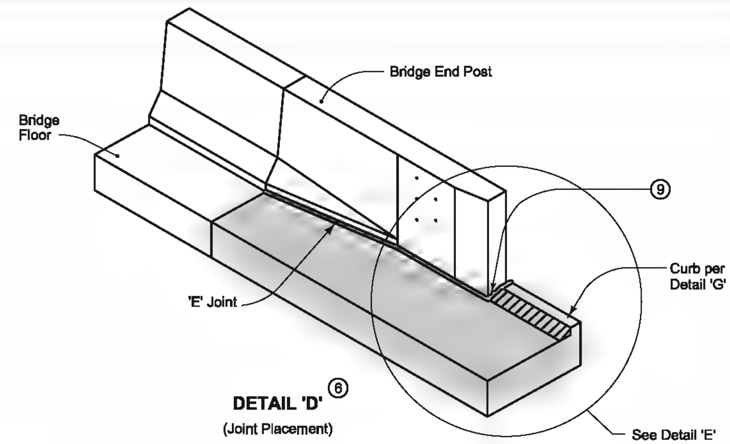
STANDARD ROAD PLAN

RK-26

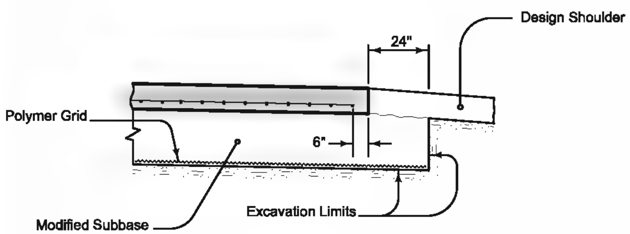
DOUBLE REINFORCED 10" APPROACH WITH VARIABLE DEPTH PAVING NOTCH



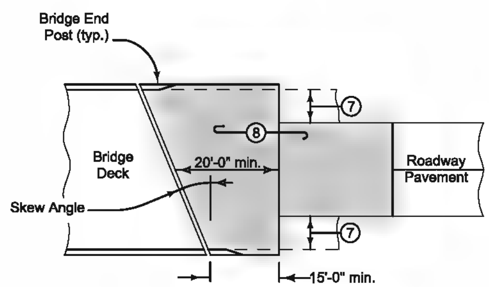
SECTION A-A ⑥



DETAIL 'D' ⑥
(Joint Placement)



SECTION B-B ⑥



APPROACH PAVEMENT LAYOUT AT A SKEW

⑤ Longitudinal Joint: (PV-101)
Single pour - Saw cut joint per Detail B
Two pours - use 'KS-2' Joint

⑥ See RK-21, RK-22, or RK-23.

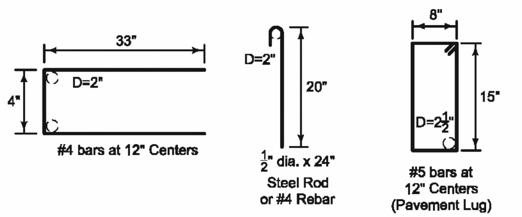
⑦ Design shoulder width.

⑧ Reinforced bridge approach section.

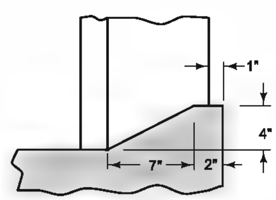
⑨ Expansion joint at end of bridge end post: Place joint filler the full depth of the bridge approach pavement. In areas with curb, place full depth of pavement plus curb and shape material to fit the shape of the curb per Section B-B of PV-101. Seal joint per Detail F of PV-101.

- Fixed Abutment Bridges:Type 'E' Joint

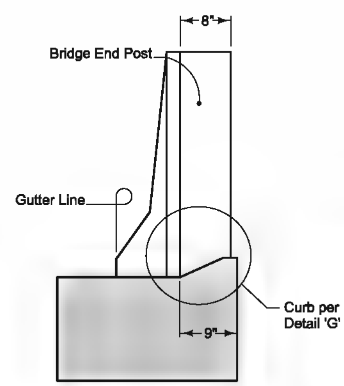
- Moveable Abutment Bridges: Flexible Foam Expansion Joint Filler in accordance with Specification Section 4136. Minimum filler width is the abutment 'CF' joint width. Joint length as required to completely fill from back side of curb to front face of bridge wing.



BENT BAR SHAPES



DETAIL 'G'



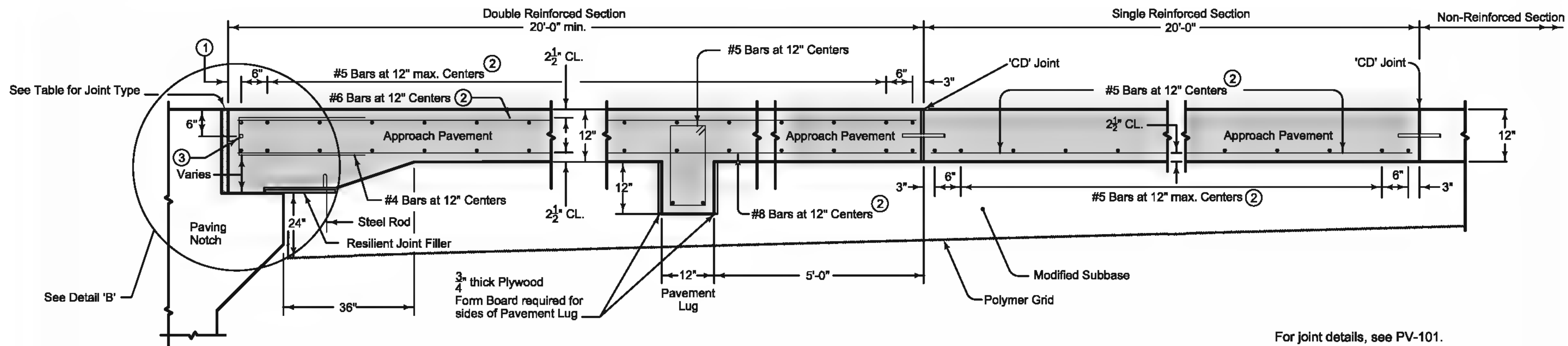
DETAIL 'E'
(Back of Curb Placement)

Iowa Department of Transportation

STANDARD ROAD PLAN

RK-26

DOUBLE REINFORCED 10" APPROACH WITH VARIABLE DEPTH PAVING NOTCH



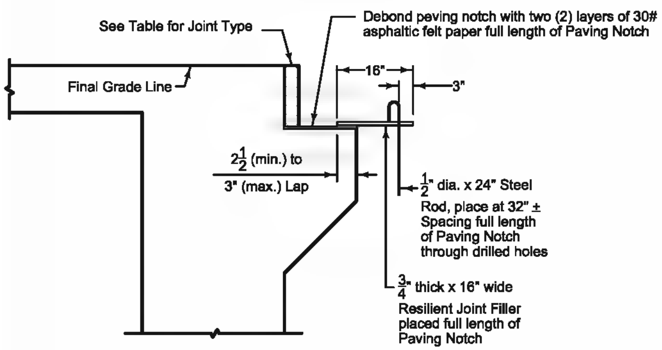
DETAIL 'A'

For joint details, see PV-101.
For curb details, see Detail 'G'.

All Transverse Bars are #5.

See RK-21 or RK-22 for shoulders.

1. 2" to $2\frac{1}{2}$" clear to bent bar.
2. Minimum lap length: #5 bars - 18 inches; #8 bars - 27 inches; #8 bars - 48 inches
3. If bridge is skewed, place additional #5 bar parallel to skewed face.



DETAIL 'B'

JOINT TYPE FOR MOVEABLE ABUTMENT BRIDGES		
Joint	Maximum Bridge Length	
	Concrete Beam or Slab	Steel Girder
CF-1	370'	250'
CF-2	465'	320'
CF-3	575'	400'

Possible Contract Item:
Bridge Approach, RK-27

Possible Tabulation:
112-6

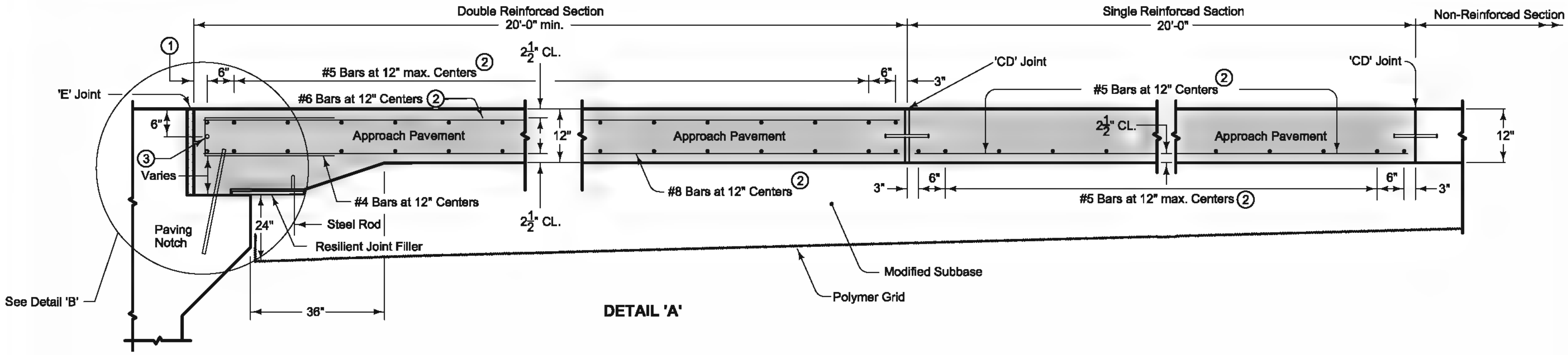
MOVEABLE ABUTMENT

Iowa Department of

STANDARD ROAD PLAN

RK-27

DOUBLE REINFORCED 12" APPROACH WITH VARIABLE DEPTH PAVING NOTCH

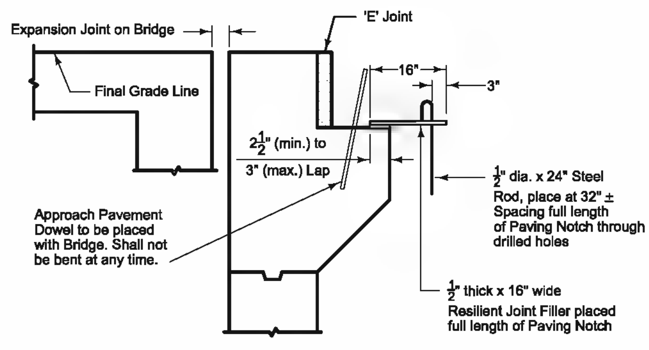


DETAIL 'A'

① 2" to $2\frac{1}{2}$" clear to bent bar.

② Minimum lap length: #5 bars - 18 inches
#6 bars - 27 inches
#8 bars - 48 inches

③ If bridge is skewed, place additional #5 bar parallel to skewed face.



DETAIL 'B'

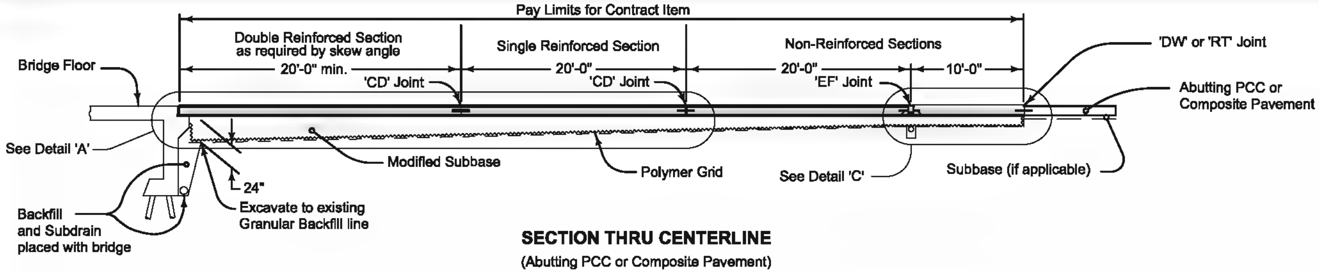
FIXED ABUTMENT

Iowa Department of

STANDARD ROAD PLAN

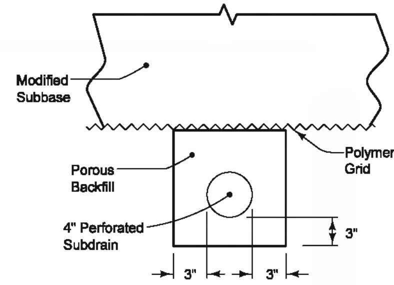
RK-27

DOUBLE REINFORCED 12" APPROACH WITH VARIABLE DEPTH PAVING NOTCH

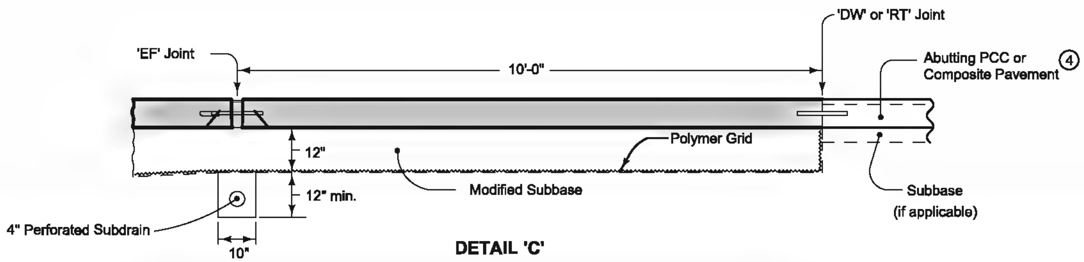


SECTION THRU CENTERLINE

(Abutting PCC or Composite Pavement)

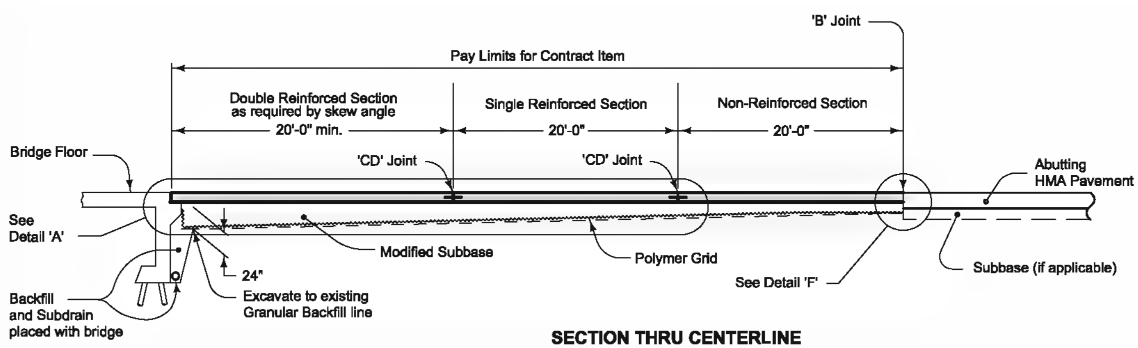


4" SUBDRAIN LOCATION



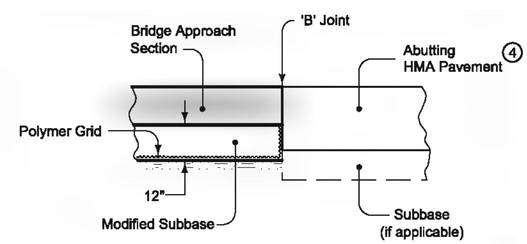
DETAIL 'C'

(Doweled PCC Pavement)



SECTION THRU CENTERLINE

(Abutting HMA Pavement)



DETAIL 'F'

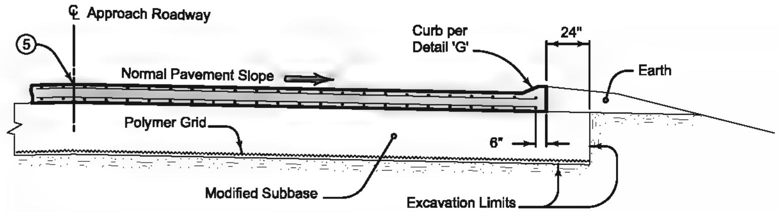
④ If abutting pavement (PCC or HMA) is not in place, see RK-30.

Iowa Department of

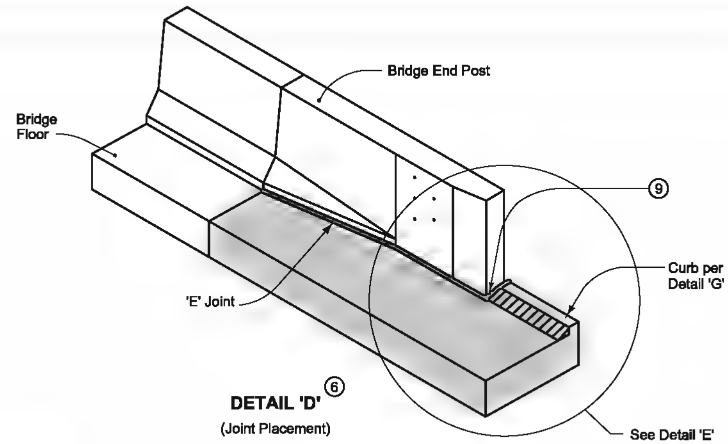
STANDARD ROAD PLAN

RK-27

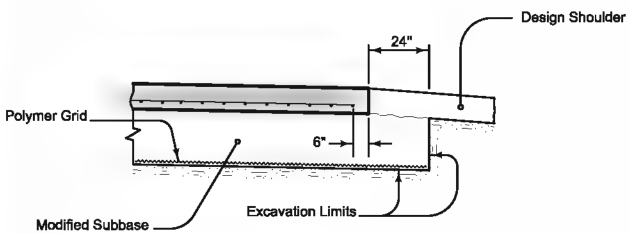
DOUBLE REINFORCED 12" APPROACH WITH VARIABLE DEPTH PAVING NOTCH



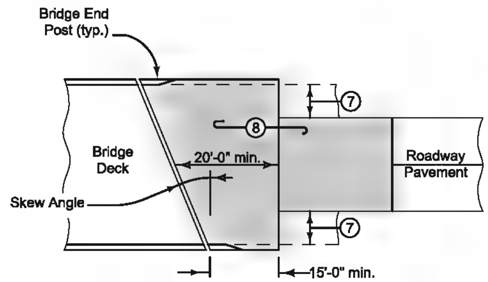
SECTION A-A ⑥



DETAIL 'D' ⑥
(Joint Placement)



SECTION B-B ⑥



APPROACH PAVEMENT LAYOUT AT A SKEW

⑤ Longitudinal Joint: (PV-101)
Single pour - Saw cut joint per Detail B
Two pours - use 'KS-2' Joint

⑥ See RK-21, RK-22, or RK-23.

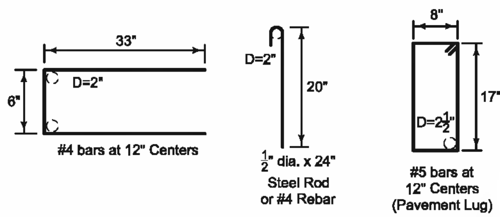
⑦ Design shoulder width.

⑧ Reinforced bridge approach section.

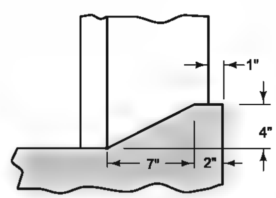
⑨ Expansion joint at end of bridge end post: Place joint filler the full depth of the bridge approach pavement. In areas with curb, place full depth of pavement plus curb and shape material to fit the shape of the curb per Section B-B of PV-101. Seal joint per Detail F of PV-101.

- Fixed Abutment Bridges:Type 'E' Joint

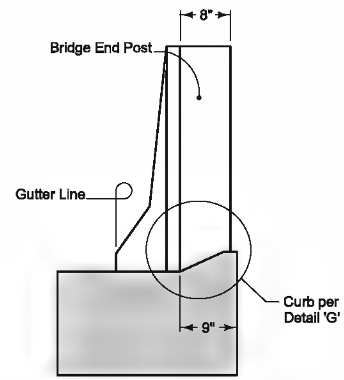
- Moveable Abutment Bridges: Flexible Foam Expansion Joint Filler in accordance with Specification Section 4136. Minimum filler width is the abutment 'CF' joint width. Joint length as required to completely fill from back side of curb to front face of bridge wing.



BENT BAR SHAPES



DETAIL 'G'



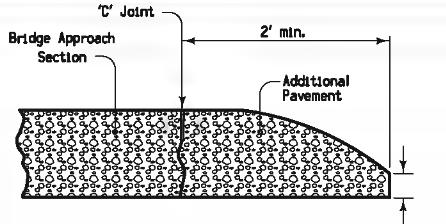
DETAIL 'E'
(Back of Curb Placement)

Iowa Department of Transportation

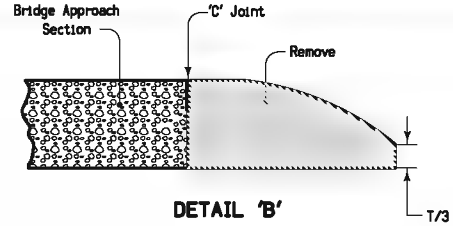
STANDARD ROAD PLAN

RK-27

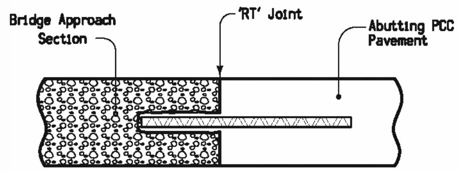
DOUBLE REINFORCED 12" APPROACH WITH VARIABLE DEPTH PAVING NOTCH



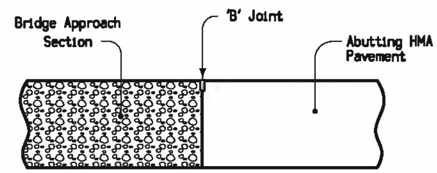
DETAIL 'A'
SECTION A-A



DETAIL 'B'
SECTION A-A



(For Abutting PCC Pavement)
DETAIL 'C'
SECTION A-A



(For Abutting HMA Pavement)
DETAIL 'C'
SECTION A-A

If abutting pavement (PCC or HMA) is not in place when bridge approach pavement is constructed, the following procedure should apply:

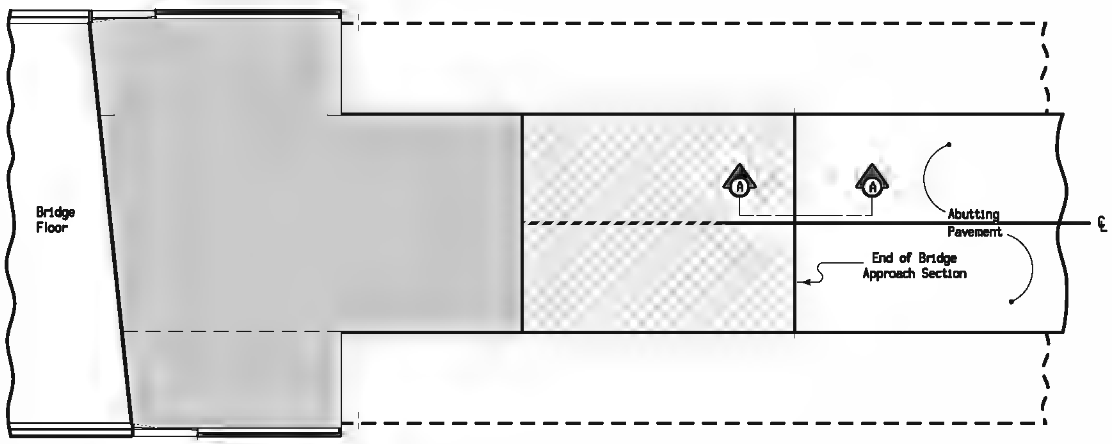
Detail A: Paving contractor (of bridge approach pavement) to pave additional pavement (as shown) and construct 'C' Joint at end of bridge approach section. Leave in this state.

Detail B: Paving contractor (of abutting pavement) to saw cut full depth at 'C' Joint and remove additional pavement, then

Detail C: Pave abutting pavement and construct 'RT' joint or 'B' Joint, accordingly.

This work will be considered incidental to one of the following:

Bridge Approach, RK-20 (Detail 'A')
Standard or Slip Form PCC Pavement (Detail 'B' and 'C')
Hot Mix Asphalt Mixture (Detail 'B' and 'C')



PLAN VIEW

▭ (shaded)	Reinforced Section
▭	Non-Reinforced Section

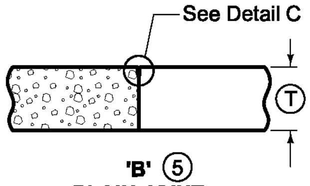
For joint details, see PV-101.

Iowa Department of

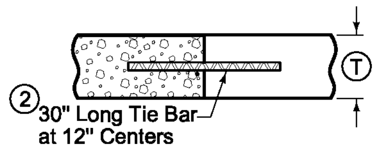
STANDARD ROAD PLAN

RK-30

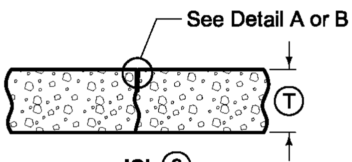
BRIDGE APPROACH
(ABUTTING PAVEMENT)



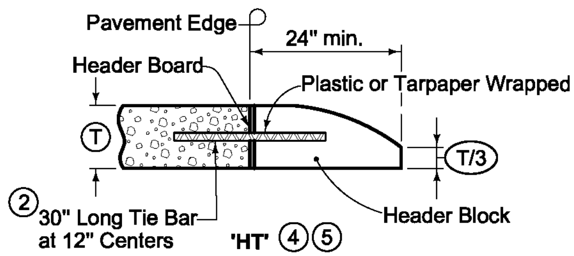
'B' 5
PLAIN JOINT
(Abutting Pavement Slabs)



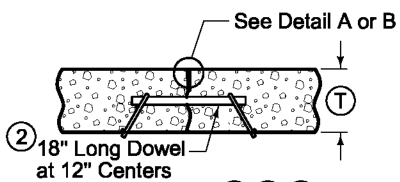
'DW' 3 4 7
DAY'S WORK JOINT(Non-working)



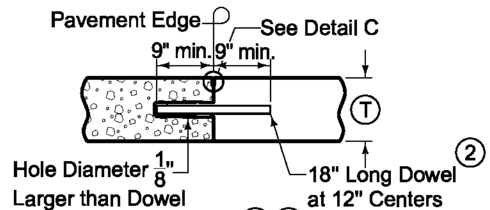
'C' 6
CONTRACTION JOINT



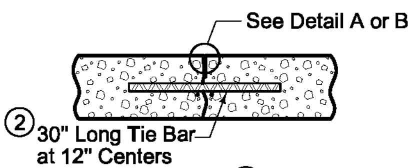
'HT' 4 5
HEADER JOINT
(End Rigid Pavement)



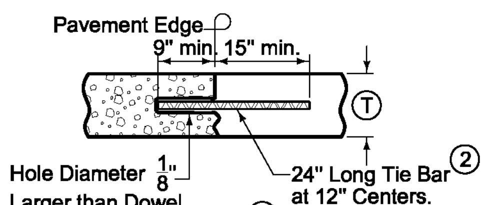
'CD' 1 4 6
DOWELED CONTRACTION JOINT



'RD' 4 5
ABUTTING PAVEMENT JOINT



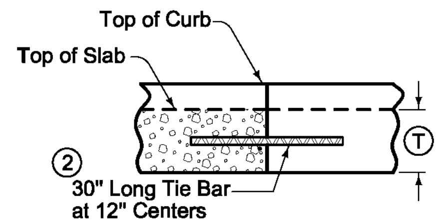
'CT' 4
TIED CONTRACTION JOINT



'RT' 4
ABUTTING PAVEMENT JOINT
RIGID TIE

TRANSVERSE CONTRACTION

1. See dowel assemblies for fabrication details.
2. See Bar Size Table.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw. Remove header block and board when second slab is placed.
6. Unless otherwise specified, use 'CD' transverse contraction joints in mainline pavement when T is greater or equal to 8 inches. Use 'C' joints when T is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



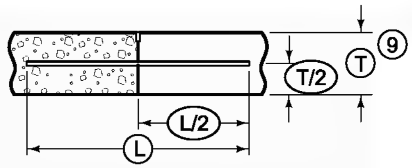
'DW - CG' 3 4
DAY'S WORK JOINT
CURB AND GUTTER UNIT

SUDAS	IOWADOT	REVISION 4 10-21-14
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101 SHEET 1 of 8

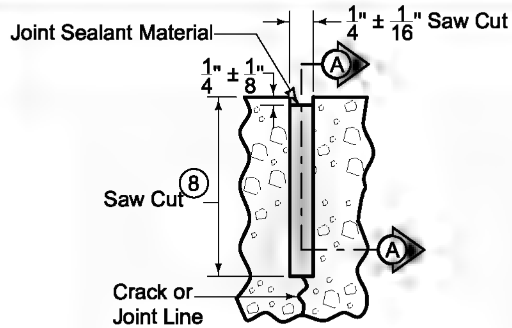
REVISIONS: Changed the 'DW-CG' Joint on sheet 1 to reference the Bar Size Table rather than a #5 bar.

Paul D. Wiegand — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

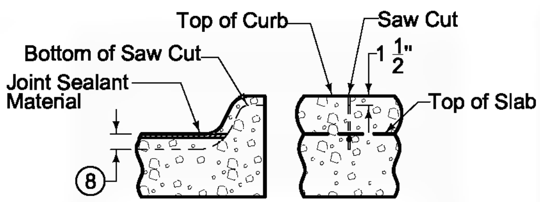
JOINTS



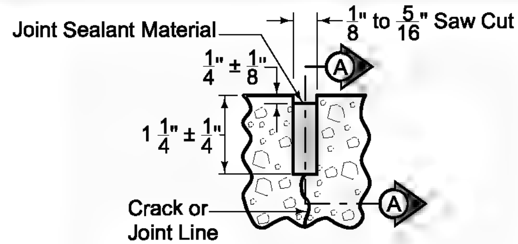
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



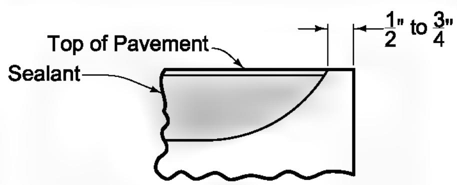
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)



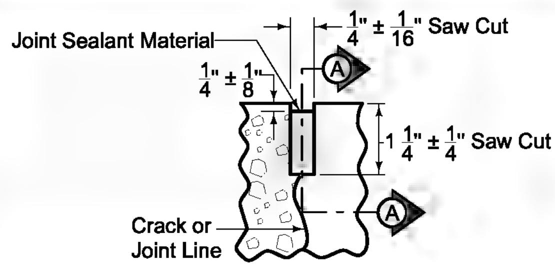
'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)



DETAIL B
(Saw cut formed by approved early concrete sawing equipment.)



SECTION A-A
(Detail at Edge of Pavement)



DETAIL C

TRANSVERSE CONTRACTION

(8) Saw 'CD' joint to a depth of T/3 ± 1/4"; saw 'C' joint to a depth of T/4 ± 1/4".

(9) When tying into old pavement, (T) represents the depth of sound PCC.

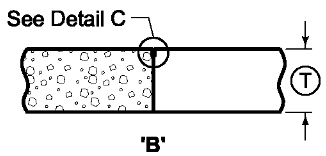
BAR SIZE TABLE		
(T)	Dowel Diameter	Tie Bar Size
< 8"	3/4"	#6
≥ 8" but < 10"	1 1/4"	#10
≥ 10"	1 1/2"	#11

SUDAS IOWADOT

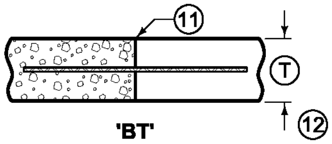
FIGURE 7010.101 STANDARD ROAD PLAN

PV-101

JOINTS

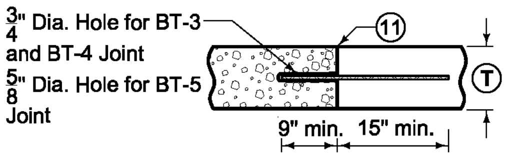


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



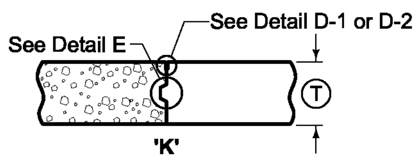
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
≥ 8"	'BT-2'	#5	36" Long at 30" Centers

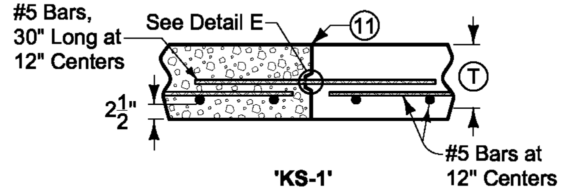


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

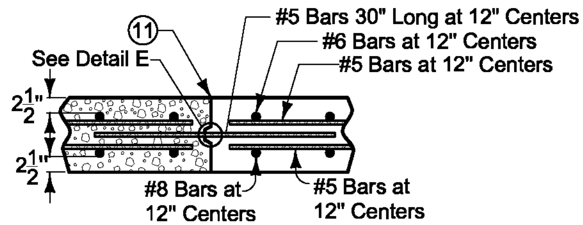
T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



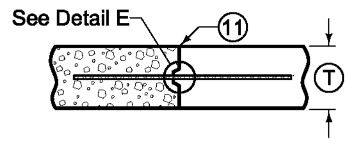
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



'KS-1'
[Single Reinforced Pavement (Bridge Approach)]



'KS-2'
[Double Reinforced Pavement (Bridge Approach)]



10 12

'KT'
ABUTTING PAVEMENT JOINT - KEYWAY TIE

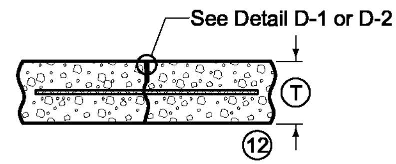
T	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

LONGITUDINAL CONTRACTION

10 Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

11 Sawing or sealing of joint not required.

12 The following joints are interchangeable, subject to the pouring sequence:
'BT-1', 'L-1', and 'KT-1'
'KT-2' and 'L-2'
'KT-3' and 'L-3'



'L'
CONTRACTION JOINT

T	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers

SUDAS | IOWADOT | REVISION 4 10-21-14

FIGURE 7010.101 | STANDARD ROAD PLAN | **PV-101** SHEET 3 of 8

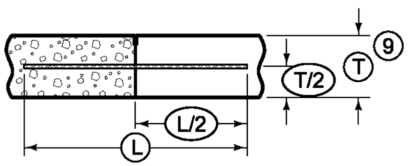
REVISIONS: Changed the 'DW-CG' Joint on sheet 1 to reference the Bar Size Table rather than a #5 bar.

SUDAS DIRECTOR — DESIGN METHODS ENGINEER

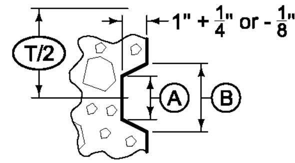
JOINTS

9 When tying into old pavement, T represents the depth of sound PCC.

13 Sealant or cleaning not required.

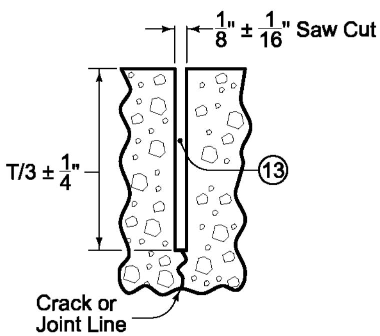


TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)

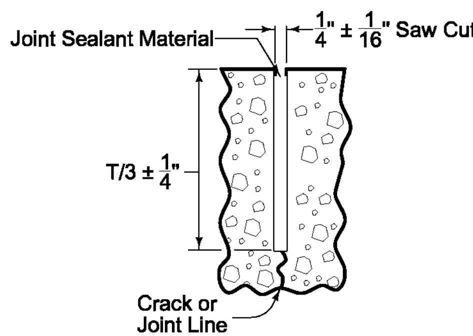


DETAIL E

KEYWAY DIMENSIONS			
Keyway Type	Pavement Thickness T	A	B
Standard	8" or greater	$1\frac{3}{4}$"	$2\frac{3}{4}$"
Narrow	Less than 8"	1"	2"



DETAIL D-1
(Required when the Department of Transportation is the Contracting Authority, or when specified in the contract documents.)



DETAIL D-2
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)

LONGITUDINAL CONTRACTION

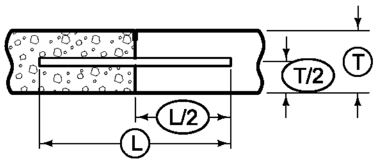
FIGURE 7010.101 SHEET 4 OF 8

SUDAS	IOWADOT	REVISION 4 10-21-14
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101 SHEET 4 of 8

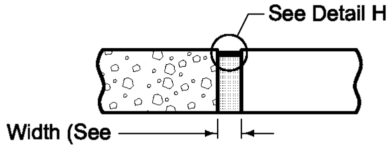
REVISIONS: Changed the 'DW-CG' Joint on sheet 1 to reference the Bar Size Table rather than a #5 bar.

Paul D. Wiegand — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

JOINTS

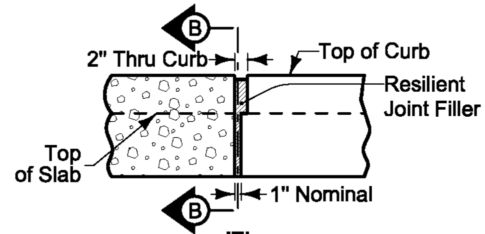


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

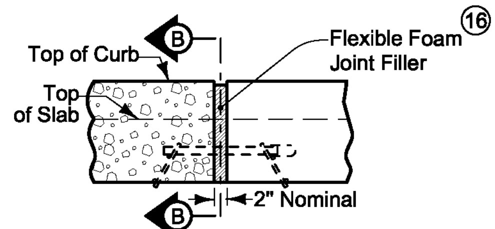


'CF' JOINT

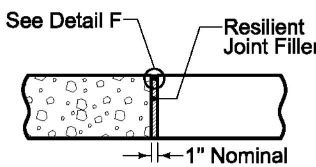
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



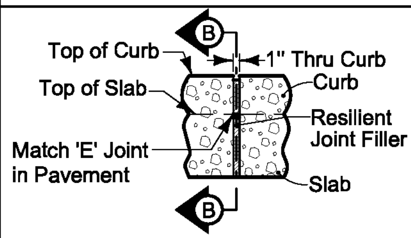
'E'
JOINT IN CURB
(View at Back of Curb)



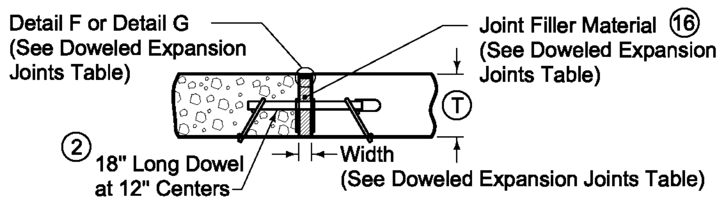
'EE'
JOINT IN CURB
(View at Back of Curb)



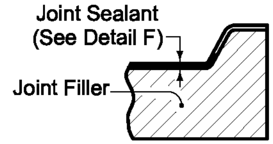
'E'
1" EXPANSION JOINT



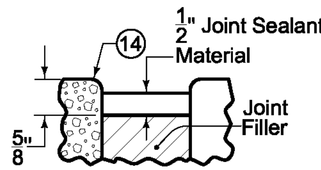
'ES'
JOINT IN CURB
(View at Back of Curb)



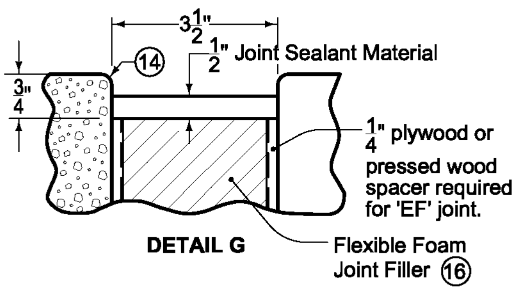
'ED', 'EE', 'EF' 15
DOWELED EXPANSION JOINT



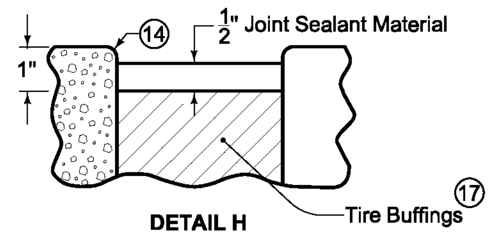
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

2. See Bar Size Table.
14. Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.
15. See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.
16. Predrill or preform holes in joint material for appropriate dowel size.
17. Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS		
TYPE	WIDTH	FILLER MATERIAL 16
ED	1"	Resilient (Detail F)
EE	2"	Flexible Foam (Detail F)
EF	$3\frac{1}{2}$"	Flexible Foam (Detail G)

BAR SIZE TABLE			
T	< 8"	≥ 8" but < 10"	≥ 10"
Dowel Diameter	$\frac{3}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{2}$"

SUDAS | IOWADOT

REVISION	
4	10-21-14

FIGURE 7010.101 | STANDARD ROAD PLAN | **PV-101**

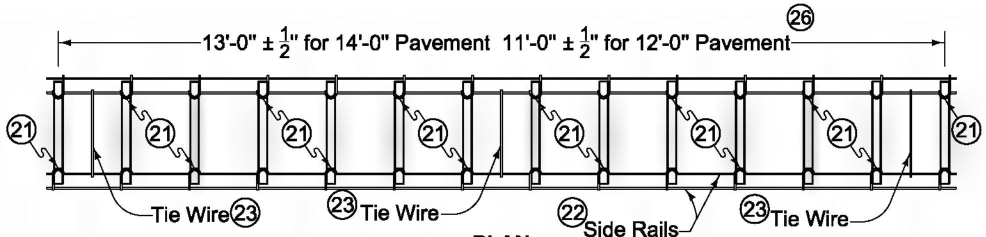
SHEET 5 of 8

REVISIONS: Changed the 'DW-CG' Joint on sheet 1 to reference the Bar Size Table rather than a #5 bar.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

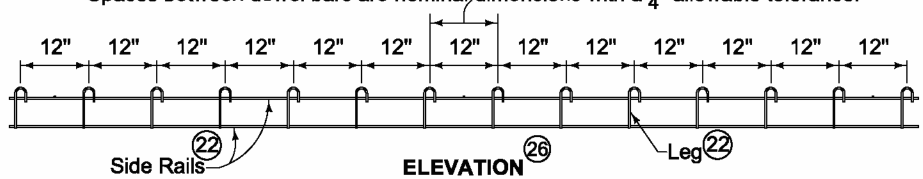
JOINTS

CONTRACTION JOINTS

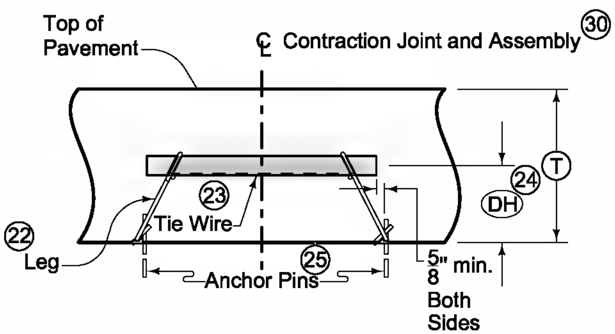


PLAN

Spaces between dowel bars are nominal dimensions with a 1/4" allowable tolerance.



ELEVATION 26



LONGITUDINAL SECTION

DOWEL ASSEMBLIES 18 19 20

18. Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

19. Wire sizes shown are the minimum required. Use wires with a minimum tensile strength of 50 ksi.

20. Details apply to both transverse contraction and expansion joints.

21. Weld alternately throughout.

22. #1/0 gauge (0.306 inch diameter) wire.

23. #10 gauge (0.135 inch diameter) wire, welded or friction fit to upper side rail, both sides.

24. Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

25. Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

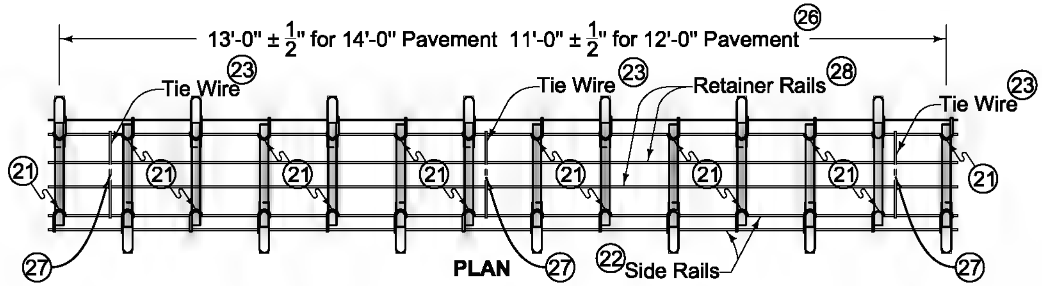
26. If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

30. Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

DOWEL HEIGHT AND DIAMETER		
T	DH 24	Diameter
7" to 7$\frac{1}{2}$"	3$\frac{1}{2}$"	$\frac{3}{4}$"
8" to 9$\frac{1}{2}$"	4$\frac{1}{4}$"	1$\frac{1}{4}$"
10" to 11$\frac{1}{2}$"	5$\frac{1}{4}$"	1$\frac{1}{2}$"
12" to 13"	6$\frac{1}{4}$"	1$\frac{1}{2}$"

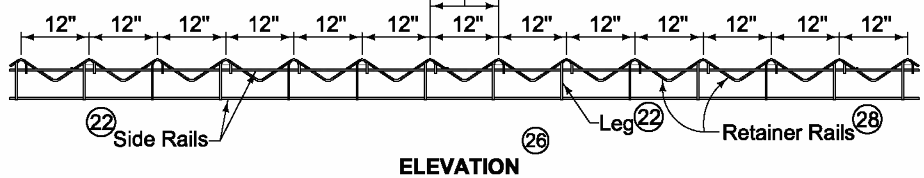
SUDAS IOWADOT
FIGURE 7010.101 STANDARD ROAD PLAN
PV-101
JOINTS

EXPANSION JOINTS

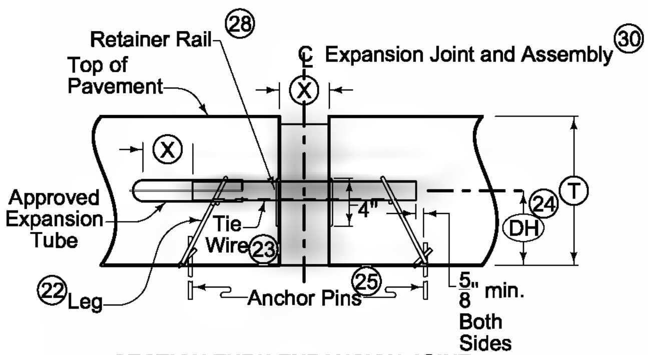


PLAN

Spaces between dowel bars are nominal dimensions with a 1/4" allowable tolerance.



ELEVATION 26



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION		
Joint Type	X	Minimum Tube Length
"ED"	1"	6"
"EE"	2"	7"
"EF"	3 1/2"	9"

DOWEL HEIGHT AND DIAMETER		
T	DH 24	Diameter
7" to 7 1/2"	3 1/2"	3/4"
8" to 9 1/2"	4 1/4"	1 1/4"
10" to 11 1/2"	5 1/4"	1 1/2"
12" to 13"	6 1/4"	1 1/2"

DOWEL ASSEMBLIES 18 19 20

18 Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

19 Wire sizes shown are the minimum required. Use wires with a minimum tensile strength of 50 ksi.

20 Details apply to both transverse contraction and expansion joints.

21 Weld alternately throughout.

22 #1/0 gauge (0.306 inch diameter) wire.

23 #10 gauge (0.135 inch diameter) wire, welded or friction fit to upper side rail, both sides.

24 Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

25 Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

26 If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

27 Clip and remove center portion of tie during field assembly.

28 1/4 inch diameter wire.

30 Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

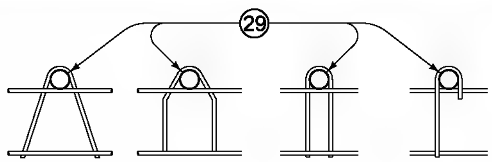
1. ⑱ Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

⑲ Wire sizes shown are the minimum required. Use wires with a minimum tensile strength of 50 ksi.

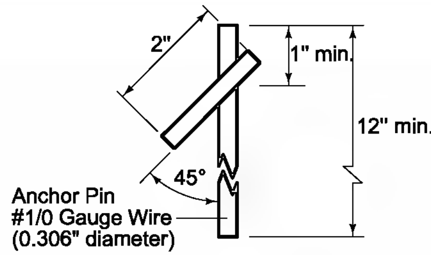
⑳ Details apply to both transverse contraction and expansion joints.

㉙ Diameter of bend around dowel is dowel diameter + 1/8 to 3/16 inches.

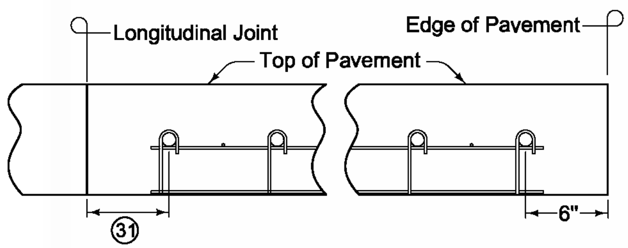
㉛ For uniform lane widths: 3" - 6". For taper and variable width pavements: 3" - 12".



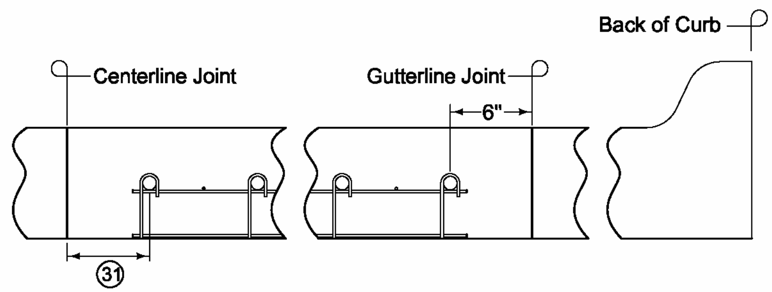
OPTIONAL LEG SHAPES



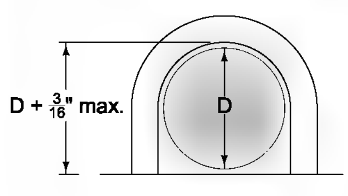
ANCHOR PIN



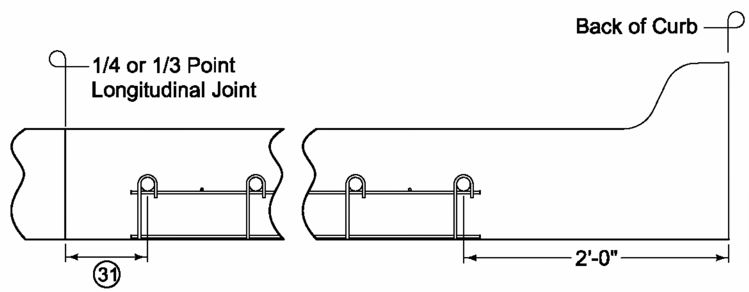
PLACEMENT LIMITS
(Rural Section)



PLACEMENT LIMITS
(Curb and Gutter - Gutterline Jointing)



BEND AROUND DOWEL ㉙



PLACEMENT LIMITS
(Curb and Gutter - 1/4 or 1/3 Point Jointing)

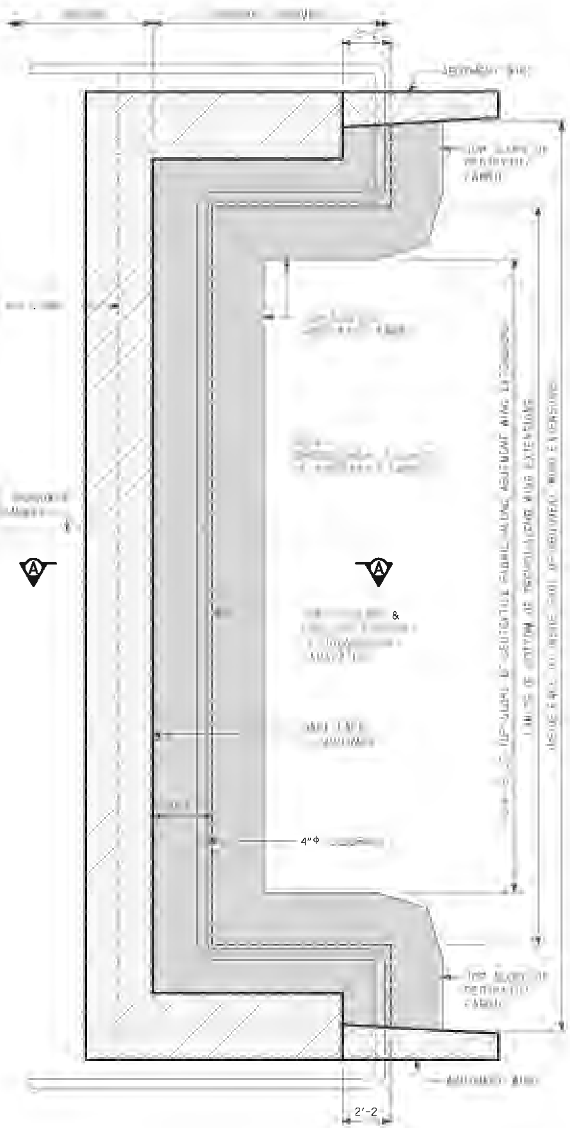
DOWEL ASSEMBLIES ⑱⑲⑳

SUDAS	IOWADOT	PV-101
FIGURE 7010.101	STANDARD ROAD PLAN	

JOINTS

FIGURE 7010.101

SHEET 8 OF 8

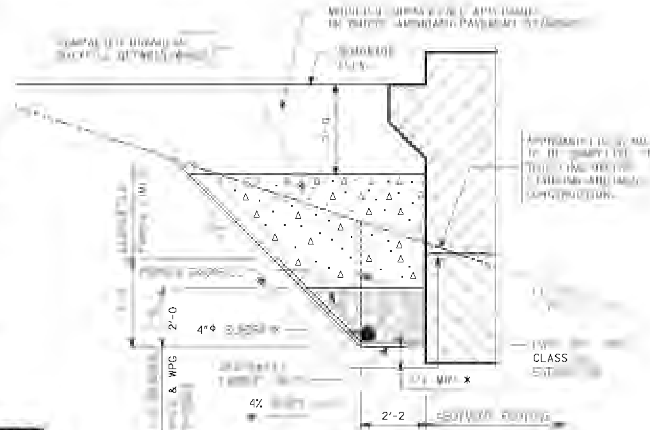


ABUTMENT PLAN WITH WING EXTENSIONS

ABUTMENT BACKFILL PROCESS:

TECHNICAL DATA INFORMATION - GEOTEXTILE FABRIC

[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	ASTM D4595	[illegible]	[illegible]	[illegible]
[illegible]	ASTM D4491	[illegible]	0.038	
[illegible]	ASTM D4491	[illegible]	[illegible]	
[illegible]	ASTM D4355	% STRENGTH RETAINED	70	



SECTION A-A

GRANULAR BACKFILL DETAILS

ABUTMENT BACKFILL DETAILS

IOWA

ENGLISHFORESLOPEPROTECTIONBRIDGES.DGN 1007E THIS SHEET ISSUED ???

07-JUN-2007 10:15 tsorens W:\Highway\Bridge\NewStandards\New_GranularBackfill\EnglishForeslopeProtectionBridges.dgn 1007E \\NTPPRTSVR2\BrgPDF

Kansas

Figure 3.14.2.1-1 Bridge Approach

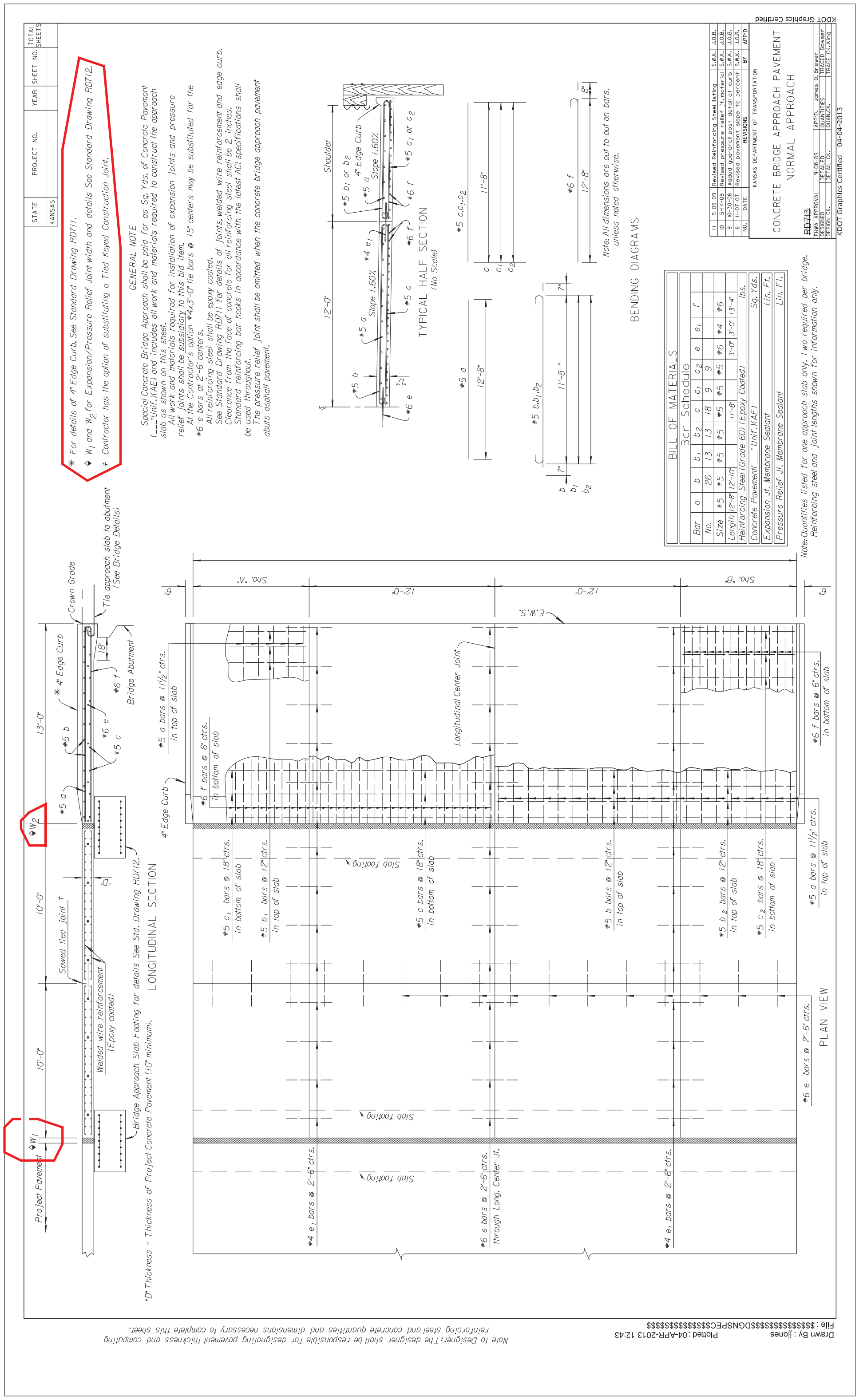


Figure 3.14.2.1-2 Approach Slab Joint Table for Steel Bridges

GAP SIZING AT APPROACH JOINT FOR STEEL SUPERSTRUCTURES

Thermal Coefficient:	6.50E-06	
Minimum Gap:	1.5	*in*
Minimum Gap Temperature:	120	*°F*

	Expansion Length (ft)										
Temp (°F)	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**
120	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
110	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 3/4"	1 3/4"	1 3/4"	1 3/4"	1 3/4"
100	1 5/8"	1 3/4"	1 3/4"	1 3/4"	1 3/4"	1 7/8"	1 7/8"	1 7/8"	2"	2"	2"
90	1 3/4"	1 3/4"	1 7/8"	1 7/8"	2"	2"	2 1/8"	2 1/8"	2 1/4"	2 1/4"	2 3/8"
80	1 3/4"	1 7/8"	2"	2"	2 1/8"	2 1/4"	2 1/4"	2 3/8"	2 3/8"	2 1/2"	2 5/8"
70	1 7/8"	2"	2 1/8"	2 1/8"	2 1/4"	2 3/8"	2 1/2"	2 5/8"	2 5/8"	2 3/4"	2 7/8"
60	2"	2 1/8"	2 1/4"	2 3/8"	2 3/8"	2 1/2"	2 5/8"	2 3/4"	2 7/8"	3"	3 1/8"
50	2"	2 1/8"	2 3/8"	2 1/2"	2 5/8"	2 3/4"	2 7/8"	3"	3 1/8"	3 1/4"	3 3/8"
40	2 1/8"	2 1/4"	2 3/8"	2 5/8"	2 3/4"	2 7/8"	3"	3 1/4"	3 3/8"	3 1/2"	3 5/8"
30	2 1/4"	2 3/8"	2 1/2"	2 3/4"	2 7/8"	3 1/8"	3 1/4"	3 3/8"	3 5/8"	3 3/4"	4"
20	2 1/4"	2 1/2"	2 5/8"	2 7/8"	3"	3 1/4"	3 1/2"	3 5/8"	3 7/8"	4"	4 1/4"
10	2 3/8"	2 5/8"	2 3/4"	3"	3 1/4"	3 3/8"	3 5/8"	3 7/8"	4 1/8"	4 1/4"	4 1/2"
0	2 3/8"	2 5/8"	2 7/8"	3 1/8"	3 3/8"	3 5/8"	3 7/8"	4 1/8"	4 1/4"	4 1/2"	4 3/4"
-10	2 1/2"	2 3/4"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"
-20	2 5/8"	2 7/8"	3 1/8"	3 3/8"	3 5/8"	4"	4 1/4"	4 1/2"	4 3/4"	5"	5 3/8"
-30	2 5/8"	3"	3 1/4"	3 1/2"	3 7/8"	4 1/8"	4 3/8"	4 3/4"	5"	5 1/4"	5 5/8"

Design Temperature Range

Typical Construction Temperature Range

Figure 3.14.2.1-3 Approach Slab Joint Table for Concrete Bridges

GAP SIZING AT APPROACH JOINT FOR CONCRETE SUPERSTRUCTURES

Thermal Coefficient:	6.00E-06	
Minimum Gap:	1.5	*in*
Minimum Gap Temperature:	90	*°F*

	Expansion Length (ft)												
Temp (°F)	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**
120	1 1/4"	1 1/4"	1 1/8"	1 1/8"	1 1/8"	1"	1"	7/8"	7/8"	3/4"	3/4"	3/4"	5/8"
110	1 3/8"	1 3/8"	1 1/4"	1 1/4"	1 1/4"	1 1/8"	1 1/8"	1 1/8"	1 1/8"	1"	1"	1"	7/8"
100	1 3/8"	1 3/8"	1 3/8"	1 3/8"	1 3/8"	1 3/8"	1 3/8"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"
90	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
80	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"	1 3/4"	1 3/4"	1 3/4"	1 3/4"	1 3/4"	1 3/4"
70	1 5/8"	1 5/8"	1 3/4"	1 3/4"	1 3/4"	1 7/8"	1 7/8"	1 7/8"	1 7/8"	2"	2"	2"	2 1/8"
60	1 3/4"	1 3/4"	1 7/8"	1 7/8"	1 7/8"	2"	2"	2 1/8"	2 1/8"	2 1/4"	2 1/4"	2 1/4"	2 3/8"
50	1 3/4"	1 7/8"	1 7/8"	2"	2 1/8"	2 1/8"	2 1/4"	2 1/4"	2 3/8"	2 3/8"	2 1/2"	2 5/8"	2 5/8"
40	1 7/8"	2"	2"	2 1/8"	2 1/4"	2 1/4"	2 3/8"	2 1/2"	2 5/8"	2 5/8"	2 3/4"	2 7/8"	3"
30	1 7/8"	2"	2 1/8"	2 1/4"	2 3/8"	2 1/2"	2 5/8"	2 3/4"	2 3/4"	2 7/8"	3"	3 1/8"	3 1/4"
20	2"	2 1/8"	2 1/4"	2 3/8"	2 1/2"	2 5/8"	2 3/4"	2 7/8"	3"	3 1/8"	3 1/4"	3 3/8"	3 1/2"
10	2 1/8"	2 1/4"	2 3/8"	2 1/2"	2 5/8"	2 3/4"	3"	3 1/8"	3 1/4"	3 3/8"	3 1/2"	3 5/8"	3 3/4"
0	2 1/8"	2 1/4"	2 1/2"	2 5/8"	2 3/4"	3"	3 1/8"	3 1/4"	3 1/2"	3 5/8"	3 3/4"	3 7/8"	4 1/8"
-10	2 1/4"	2 3/8"	2 5/8"	2 3/4"	3"	3 1/8"	3 1/4"	3 1/2"	3 5/8"	3 7/8"	4"	4 1/4"	4 3/8"
-20	2 1/4"	2 1/2"	2 3/4"	2 7/8"	3 1/8"	3 1/4"	3 1/2"	3 5/8"	3 7/8"	4 1/8"	4 1/4"	4 1/2"	4 5/8"
-30	2 3/8"	2 5/8"	2 3/4"	3"	3 1/4"	3 1/2"	3 5/8"	3 7/8"	4 1/8"	4 1/4"	4 1/2"	4 3/4"	5"

Design Temperature Range

Typical Construction Temperature Range

Figure 3.14.2.1-4 Membrane Sealant

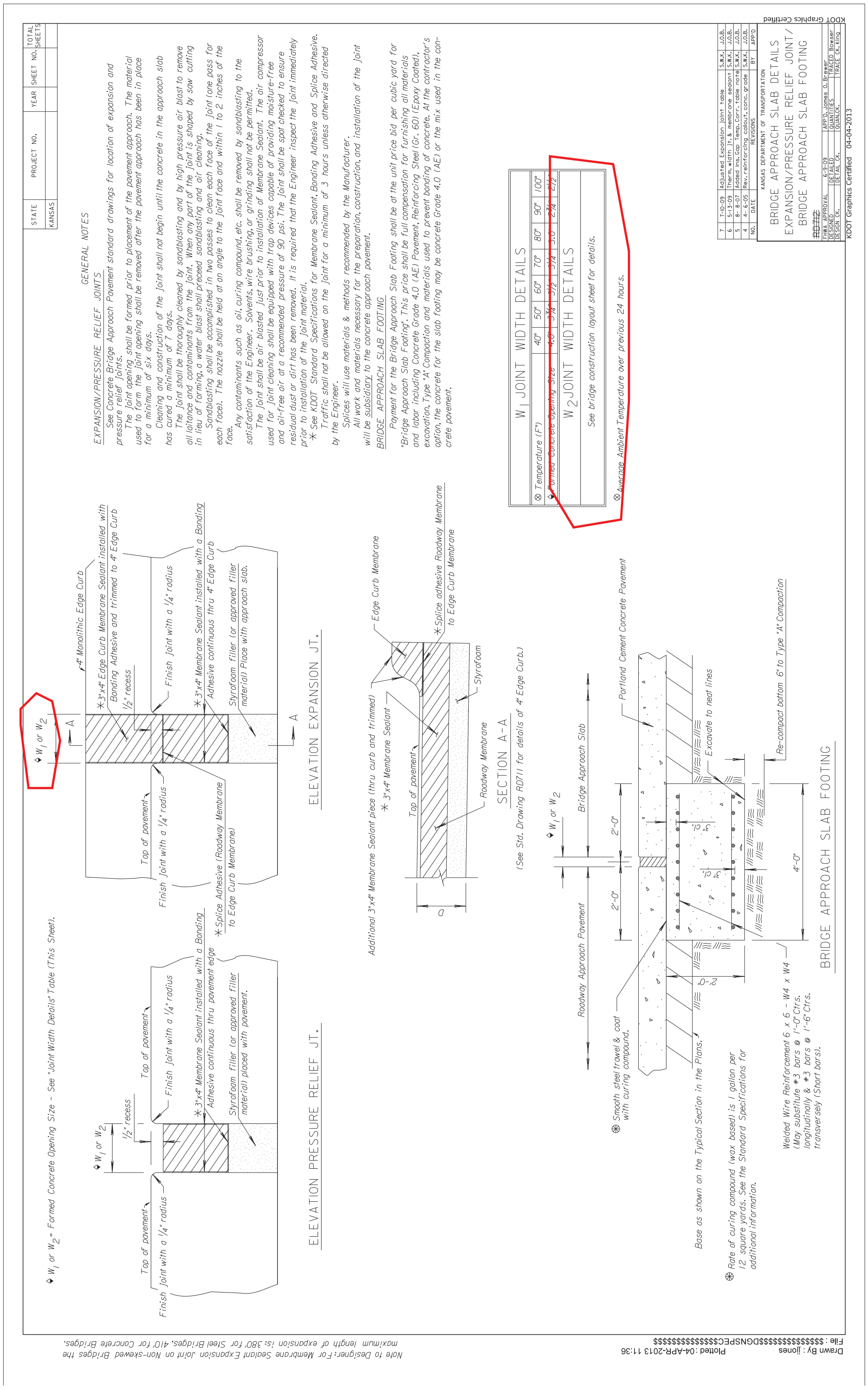
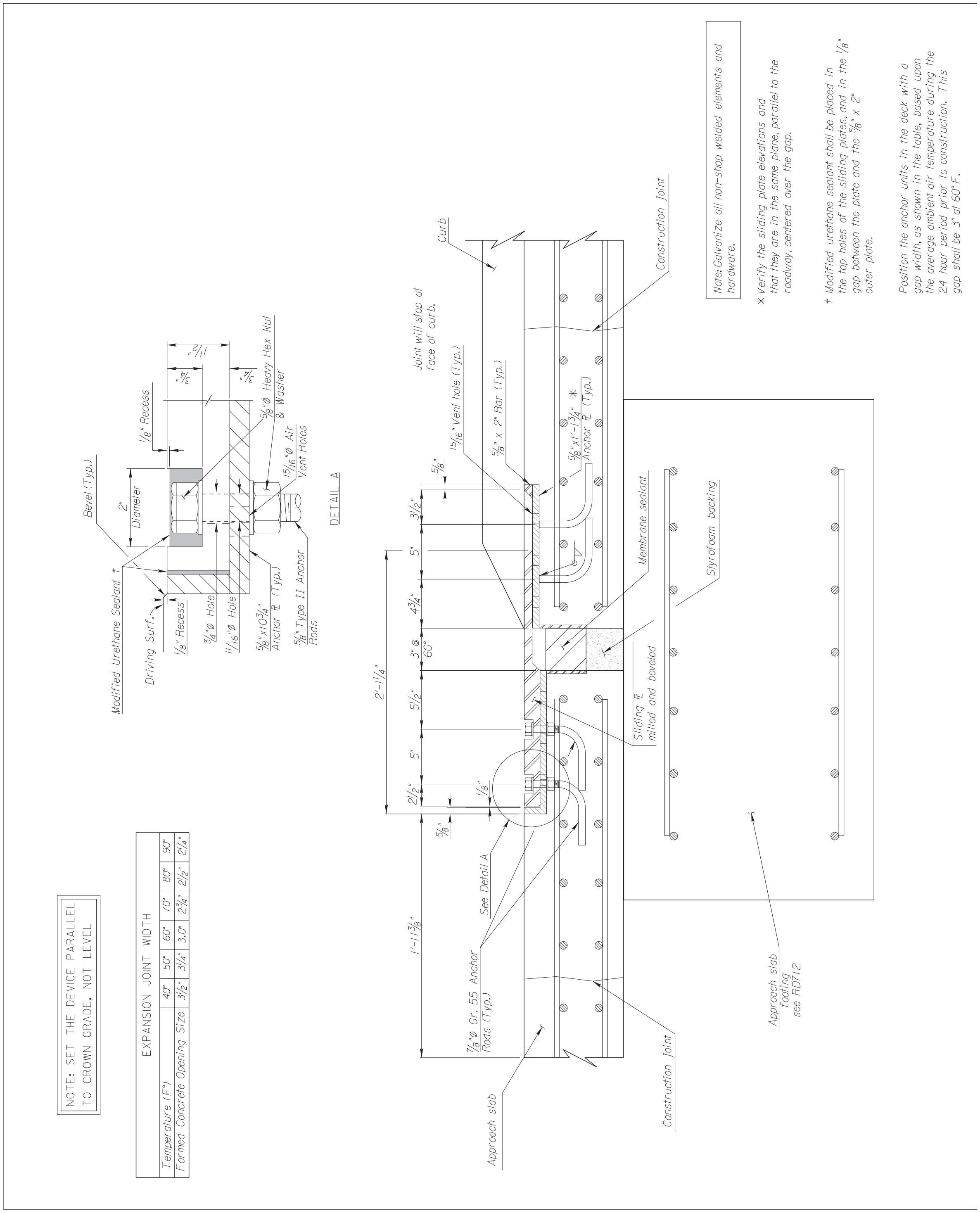


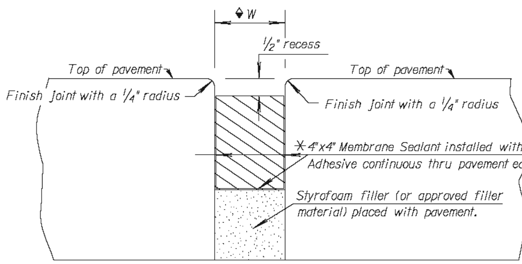
Figure 3.14.2.1-5 Hybrid Joint



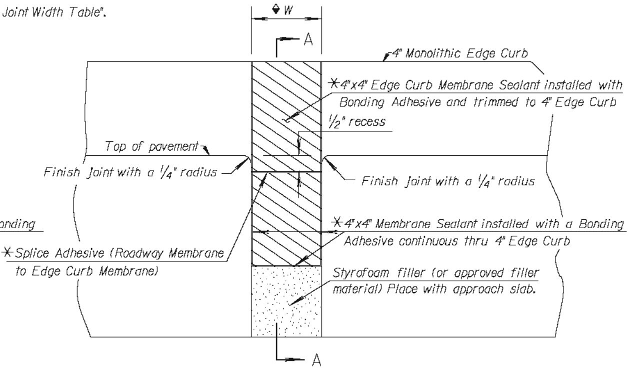
STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
KANSAS				

Note to Designer: For Membrane Sealant Expansion Joint on Non-skewed Bridges the maximum length of expansion is: 380' for Steel Bridges, 410' for Concrete Bridges.

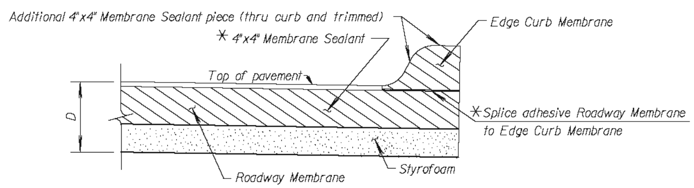
♦ W= Formed Concrete Opening Size - See "Temperature Expansion/Pressure Relief Joint Width Table".



ELEVATION PRESSURE RELIEF JT.

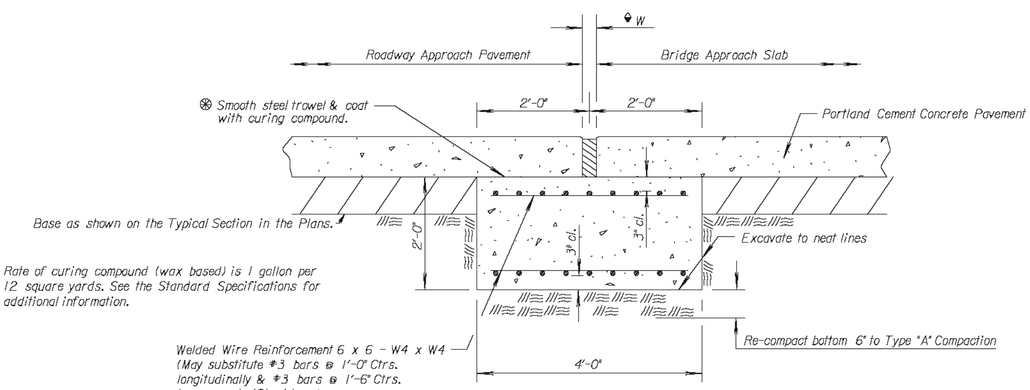


ELEVATION EXPANSION JT.



SECTION A-A

(See Std. Drawing RD711 for details of 4" Edge Curb.)



⊛ Rate of curing compound (wax based) is 1 gallon per 12 square yards. See the Standard Specifications for additional information.

BRIDGE APPROACH SLAB FOOTING

GENERAL NOTES

EXPANSION/PRESSURE RELIEF JOINTS

See Concrete Bridge Approach Pavement standard drawings for location of expansion and pressure relief joints.

The joint opening shall be formed prior to placement of the pavement approach. The material used to form the joint opening shall be removed after the pavement approach has been in place for a minimum of six days.

Cleaning and construction of the joint shall not begin until the concrete in the approach slab has cured a minimum of 7 days.

The joint shall be thoroughly cleaned by sandblasting and by high pressure air blast to remove all laitance and contaminants from the joint. When any part of the joint is shaped by saw cutting in lieu of forming, a water blast shall preceed sandblasting and air cleaning.

Sandblasting shall be accomplished in two passes to clean each face of the joint (one pass for each face). The nozzle shall be held at an angle to the joint face and within 1 to 2 inches of the face.

Any contaminants such as oil, curing compound, etc. shall be removed by sandblasting to the satisfaction of the Engineer. Solvents, wire brushing, or grinding shall not be permitted.

The joint shall be air blasted just prior to installation of Membrane Sealant. The air compressor used for joint cleaning shall be equipped with trap devices capable of providing moisture-free and oil-free air at a recommended pressure of 90 psi. The joint shall be spot checked to insure residual dust or dirt has been removed. It is required that the Engineer inspect the joint immediately prior to installation of the joint material.

✱ See KDOT Standard Specifications for Membrane Sealant, Bonding Adhesive and Splice Adhesive.

Traffic shall not be allowed on the joint for a minimum of 3 hours unless otherwise directed by the Engineer.

Splices will use materials & methods recommended by the Manufacturer.

All work and materials necessary for the preparation, construction, and installation of the joint will be subsidiary to the concrete approach pavement.

BRIDGE APPROACH SLAB FOOTING

Payment for the Bridge Approach Slab Footing shall be at the unit price bid per cubic yard for "Bridge Approach Slab Footing". This price shall be full compensation for furnishing all materials and labor including Concrete Grade 4.0 (AE) Pavement, Reinforcing Steel (Gr. 60) (Epoxy Coated), excavation, Type "A" Compaction and materials used to prevent bonding of concrete. At the contractor's option, the concrete for the slab footing may be concrete Grade 4.0 (AE) or the mix used in the concrete pavement.

EXPANSION JOINT WIDTH

⊗ Temperature (F°)	40°	50°	60°	70°	80°	90°	100°
♦ Formed Concrete Opening Size	2 3/4"	2 1/2"	2 1/4"	1 7/8"	1 5/8"	1 1/4"	1"

⊗ Average Ambient Temperature over previous 24 hours.

NO.	DATE	REVISIONS	BY	APP'D
6	5-13-09	Therm. width jt. & membrane sealant	S.W.K.	J.O.B.
5	8-8-07	Added Ins. Gap Temp. Corr. table note	S.W.K.	J.O.B.
4	4-6-05	Rev. reinforcing callout, conc. grade	S.W.K.	J.O.B.

KANSAS DEPARTMENT OF TRANSPORTATION

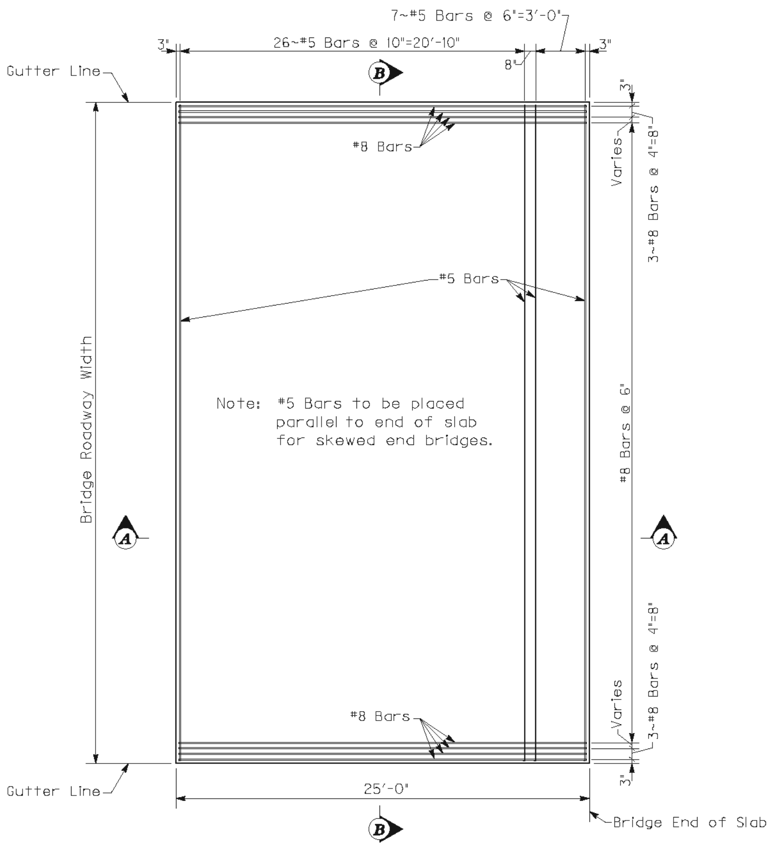
BRIDGE APPROACH SLAB DETAILS
EXPANSION/PRESSURE RELIEF JOINT/
BRIDGE APPROACH SLAB FOOTING

RD712

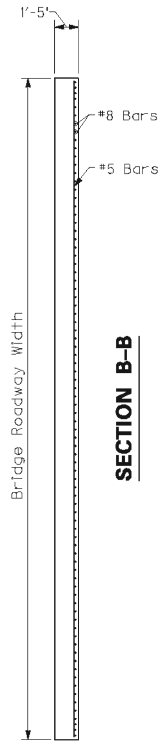
FHWA APPROVAL		APP'D. James O. Brewer	
DESIGNED	DETAILED	QUANTITIES	TRACED Bowser
DESIGN CK.	DETAIL CK.	QUAN.CK.	TRACE CK. King

Drawn By: jjones
File: rd712.dgn (rd712)
Plotted: 26-MAY-2009 11:37

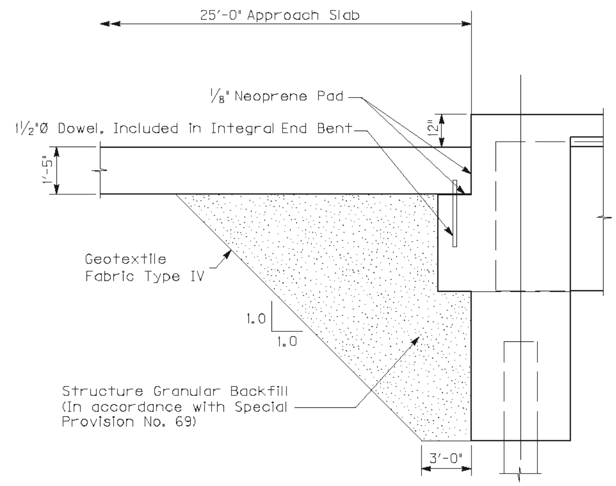
Kentucky



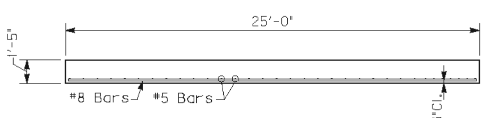
PLAN



SECTION B–B



TYPICAL SECTION BRIDGE END



SECTION A–A

GENERAL NOTES

CROWN: Crown shall conform to the rate of crown at the approach pavement and bridge deck. If the rate of crown at the bridge deck differs from that of approach pavement, a smooth transition shall be provided within the limits of the approach slab.

CONCRETE: Concrete shall be Class "AA".

REINFORCEMENT: All steel reinforcement shall be Grade 60 and epoxy coated.

PAYMENT: Include the cost of Class "AA" Concrete, epoxy-coated steel reinforcement, and all labor and materials required to construct the approach slab in the bid item for Approach Slab.

KENTUCKY
DEPARTMENT OF HIGHWAYS

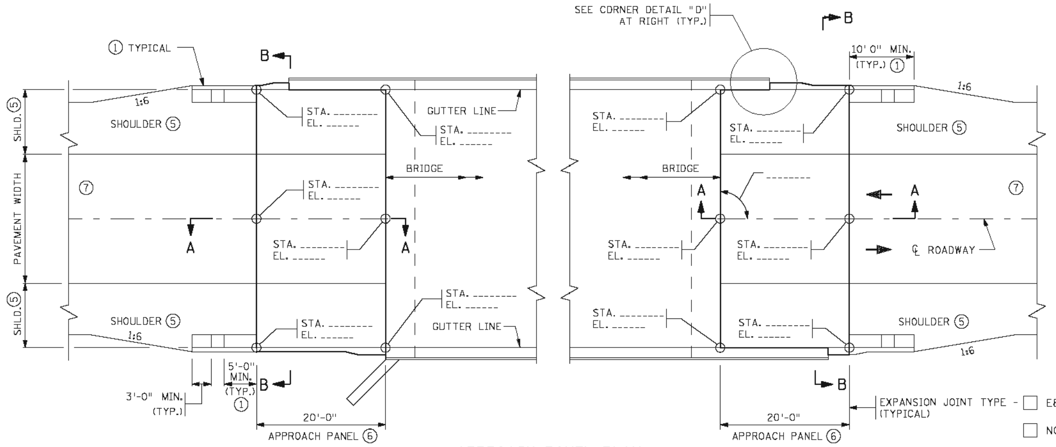
APPROACH SLAB

STANDARD DRAWING NO. BGX-017-01

SUBMITTED ____ DIRECTOR DIVISION OF STRUCTURAL DESIGN — 12-02-11 DATE

APPROVED ____ STATE HIGHWAY ENGINEER — 12-02-11 DATE

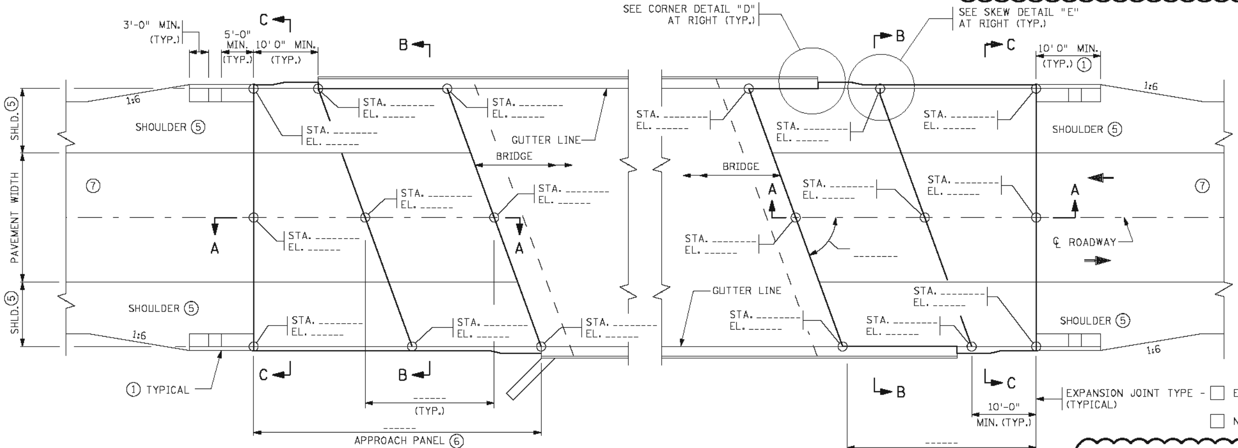
Minnesota



APPROACH PANEL PLAN

SQUARE TO 10° SKEW, BARRIER ON WINGWALL

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
PLACE AN "X" IN THE APPROPRIATE BOX TO INDICATE THE EXPANSION JOINT TYPE.



APPROACH PANEL PLAN

OVER 10° SKEW, BARRIER ON WINGWALL

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
APPROACH PANEL PLAN VIEW SHOULD BE MODIFIED/MIRRORED TO SHOW ACTUAL SKEW ORIENTATION, WINGWALL AND CURB TRANSITION CONFIGURATION, AND TRAFFIC DIRECTION ARROWS.

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
PLACE AN "X" IN THE APPROPRIATE BOX TO INDICATE THE EXPANSION JOINT TYPE.

NOTES:

① SEE STANDARD PLAN 5-297.231 FOR DRAINAGE DETAILS AND ADDITIONAL REQUIREMENTS.

② B4 CURB DESIGN SHOWN. SEE STANDARD PLATES FOR CURB DETAILS.

③ E8H QUANTITY SHALL BE PAID FOR SEPARATELY, MEASURED FROM BACK OF CURB TO BACK OF CURB.

④ WHEN SKEW IS OVER 45°, THE JOINT SHALL BE PERPENDICULAR TO GUTTER FOR 1' (TYP.).

⑤ SEE GRADING PLANS FOR PAVEMENT AND SHOULDER WIDTHS AND CONFIGURATION.

⑥ PANEL SIZE AND REQUIREMENTS FOR TRANSVERSE AND LONGITUDINAL JOINTS ARE SHOWN ON STANDARD PLANS 5-297.228 AND 5-297.229.

⑦ FOR CONCRETE PAVEMENT, SEE STANDARD PLAN 5-297.227 FOR LUG REQUIREMENTS.

GENERAL NOTES:

SECTION A-A IS SHOWN ON STANDARD PLAN 5-297.227. SECTIONS B-B AND C-C ARE SHOWN ON STANDARD 5-297.223 AND SHOW THE STATION AND ELEVATION AT END LOCATIONS ON THE APPROACH PANEL.

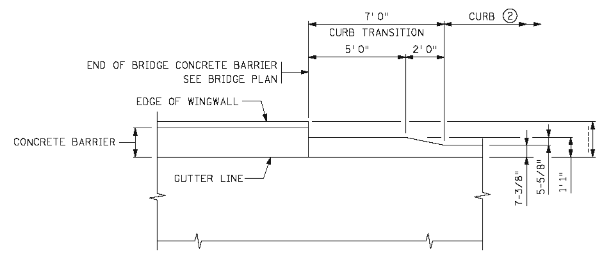
A CONCRETE SILL IS REQUIRED BENEATH EXPANSION JOINT TYPE E8H. EXTEND THE EXPANSION JOINT AND THE SILL ALONG THE FULL WIDTH OF THE TRAFFIC LANES, SHOULDERS AND CURB. ENSURE THAT SILL DOES NOT INTERFERE WITH GUARDRAIL POST PLACEMENT. CONCRETE SILL AND CURBING, IF REQUIRED, ARE INCLUDED IN THE APPROACH PANEL PAY ITEM.

AT THE END OF THE CONCRETE BARRIER, TRANSITION FACE OF 4-INCH CURB INTO PROFILE OF CONCRETE BARRIER. SEE CURB TRANSITION DETAILS ON STANDARD PLAN 5-297.227. IF THERE IS NO ROADWAY CURB AT THE END OF THE APPROACH PANEL, TRANSITION THE APPROACH PANEL CURB HEIGHT FROM 4 INCH TO 0 INCH IN THE LAST 3'-4" SECTION (1:10 OR FLATTER SLOPE).

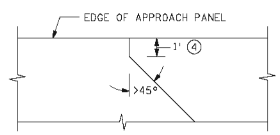
GENERAL DRAINAGE DETAILS ARE SHOWN ON BRIDGE APPROACH PANEL DRAINAGE DETAILS, STANDARD PLAN 5-297.231. ADDITIONAL CATCH BASIN DETAILS ARE SHOWN ON DRAINAGE PLAN SHEETS.

CONCRETE MIX SHALL BE 3A42 FOR APPROACH PANEL AND SILL.

REFER TO MNDOT SPEC. 2406 FOR ADDITIONAL INFORMATION.



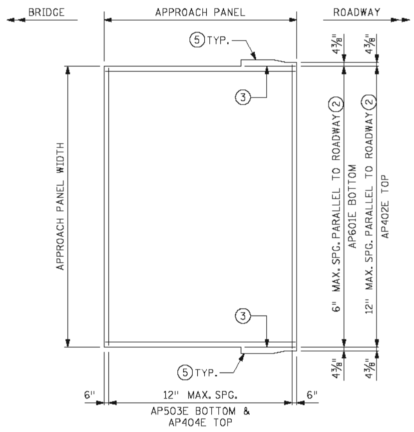
CORNER DETAIL "D"
(PLAN VIEW)



SKEW DETAIL "E"
(PLAN VIEW)

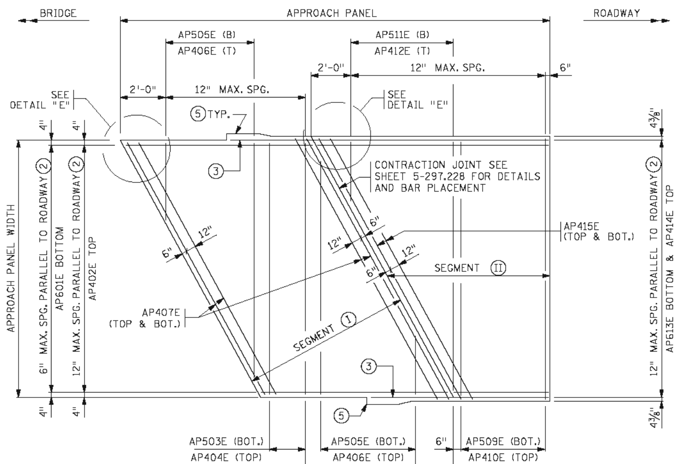
BRIDGE NO. _____

CERTIFIED BY ______ LICENSED PROFESSIONAL ENGINEER ______ DATE	STANDARD PLAN SHEET NO. 5-297.222	TITLE: BRIDGE APPROACH PANEL LAYOUT (CONCRETE BARRIER ON WINGWALL)
PRINTED NAME: LIC. NO.	STANDARD APPROVED: MARCH 23, 2011	
	STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS



APPROACH PANEL REINFORCEMENT

SQUARE TO 10° SKEWS



APPROACH PANEL REINFORCEMENT

OVER 10° SKEWS

ESTIMATED REINFORCEMENT QUANTITY FOR BRIDGE APPROACH PANELS

TYPE	LOCATION	ESTIMATIED WEIGHT
PANEL (SQ. TO 10°)	BRIDGE TO END OF APPROACH PANEL	48.5 LB./SQ. YD.
PANEL SEGMENT I (OVER 10°)	BRIDGE TO CONTRACTION JOINT	48.5 LB./SQ. YD.
PANEL SEGMENT II (OVER 10°)	CONTRACTION JOINT TO END OF APPROACH PANEL	35.0 LBS/SQ. YD.
CURB	7.0 FT. CURB TRANSITION	19.0 LBS/EACH
SILL	SILL (IF REQUIRED)	14.0 LBS/LIN FT.

NOTES:

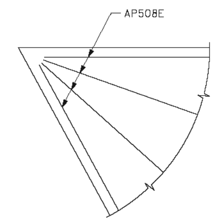
TRANSVERSE BARS IN BOTH PANEL SEGMENTS ARE PERPENDICULAR TO ROADWAY CENTERLINE EXCEPT AP407E ARE PARALLEL TO SKEW IN SEGMENT I AND AP415E ARE PARRALLEL TO SKEW IN SEGMENT II.

LONGITUDINAL BARS IN BOTH PANEL SEGMENTS ARE PARALLEL TO ROADWAY CENTERLINE.

BILL OF REINFORCEMENT FOR BRIDGE APPROACH PANELS

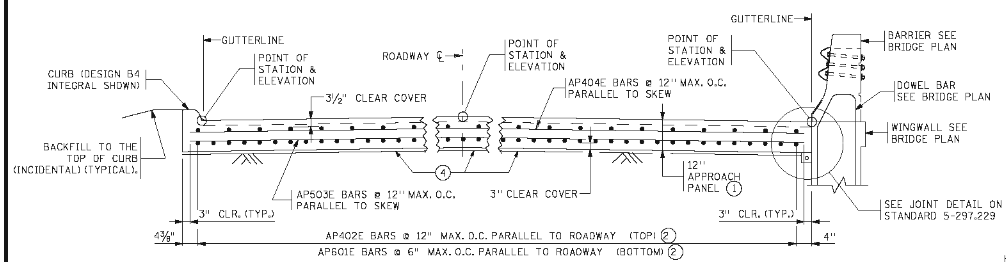
CONTRACTOR IS REQUIRED TO COMPLETE THE BILL OF REINFORCEMENT TABLE AND PREPARE SHOP DRAWINGS AND SUBMIT THEM TO THE PROJECT ENGINEER AT LEAST 3 WEEKS BEFORE REBAR FABRICATION.

BAR	NO.	LENGTH	SHAPE	LOCATION
AP601E		'-	——	BOTTOM LONGITUDINAL
AP402E		'-	——	TOP LONGITUDINAL
AP503E		'-	——	BOTTOM TRANSVERSE
AP404E		'-	——	TOP TRANSVERSE
AP505E	SER. OF	'- TO '-	——	BOTTOM TRANSVERSE
AP406E	SER. OF	'- TO '-	——	TOP TRANSVERSE
AP407E		'-	——	TOP & BOTTOM EDGE
AP508E		8'-0	——	TOP CORNER - FAN
AP509E		'-	——	BOTTOM TRANSVERSE
AP410E		'-	——	TOP TRANSVERSE
AP511E	SER. OF	'- TO '-	——	BOTTOM TRANSVERSE
AP412E	SER. OF	'- TO '-	——	TOP TRANSVERSE
AP613E	SER. OF	'- TO '-	——	BOTTOM LONGITUDINAL
AP414E	SER. OF	'- TO '-	——	TOP LONGITUDINAL
AP415E		'-	——	TOP & BOTTOM EDGE
AP616E		5'-0	——	C2H-D JOINT



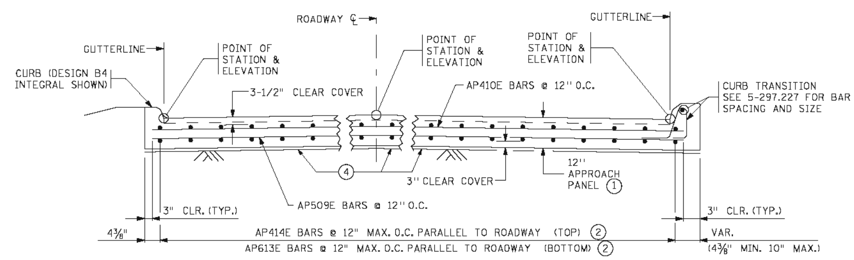
DETAIL "E"

FAN 4-AP508E BARS AS SHOWN IN ACUTE CORNERS FOR SKEWS OVER 30°.



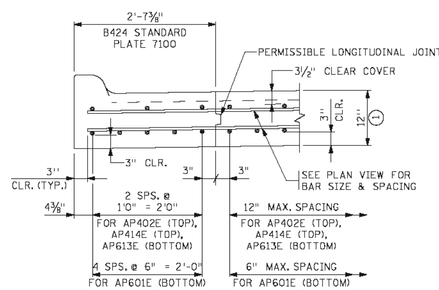
TRANSVERSE SECTION B-B

FROM STANDARD PLAN 5-297.222



TRANSVERSE SECTION C-C

FROM STANDARD PLAN 5-297.222



CURB DETAIL

(B424 CURB AND GUTTER SHOWN)

GENERAL NOTES:

AS PER MNDOT SPEC. 3301, USE EPOXY COATED GRADE 60 REINFORCEMENT BARS IN APPROACH PANEL, CONCRETE SILL AND CURB TRANSITION.

BARS MARKED WITH THE SUFFIX "E" SHALL BE EPOXY COATED IN ACCORDANCE WITH Mn/DOT SPEC. 3301.

FOR VARIABLE ROADWAY WIDTHS, VARY THE LAP LENGTH OF THE REINFORCEMENT.

MINIMUM REINFORCEMENT LAP LENGTHS ARE AS FOLLOWS: NO. 4 BAR = 1'-8", NO. 5 BAR = 2'-1", NO. 6 BAR = 2'-6".

ALL LAP SPLICES SHALL BE STAGGERED SUCH THAT NO MORE THAN 50% OF REBAR IS SPLICED AT THE SAME LOCATION.

1. APPROACH SLAB THICKNESS IS 12" (12" MONOLITHIC OR 10" SLAB + 2" WEARING COURSE). CHECK BRIDGE PLANS FOR CONCRETE WEARING COURSE, WHICH IS INCLUDED IN BRIDGE PLAN QUANTITIES.
2. SPACING ONLY FOR B4 INTEGRANT CURB. SEE CURB DETAIL FOR SPACING FOR USING B424 CURB AND GUTTER.
3. EXTEND AND/OR CUT REINFORCING AS NECESSARY TO ACCOMMODATE CURB TRANSITION IF PRESENT. REINFORCEMENT MUST EXTEND INTO CURB AS SHOWN IN TRANSVERSE SECTIONS B-B AND C-C.
4. IF THE APPROACH PANEL IS TIED TO THE BRIDGE ABUTMENT WITH REINFORCEMENT BARS, PLACE 12 MIL POLYETHYLENE SHEETING (OR 2 LAYERS OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCLUDED IN THE APPROACH PANEL PAY ITEM.
5. SEE STANDARD PLAN 5-297.222 FOR CURB TRANSITION LOCATION.

STANDARD PLAN SHEET NO. 5-297.223	TITLE: BRIDGE APPROACH PANEL REINFORCEMENT DETAILS (CONCRETE BARRIER ON WINGWALL)
STANDARD APPROVED: DECEMBER 20, 2011	

REVISION DATE 3-22-2013

STATE PROJ. NO. (TH) SHEET NO. OF SHEETS

NOTES:

1. SEE STANDARD PLAN 5-297.231 FOR DRAINAGE DETAILS AND ADDITIONAL REQUIREMENTS.
2. B4 CURB DESIGN SHOWN. SEE STANDARD PLATES FOR CURB DETAILS.
3. E8H QUANTITY SHALL BE PAID FOR SEPARATELY, MEASURED FROM BACK OF CURB TO BACK OF CURB.
4. TO ACCOMMODATE GUARDRAIL CONNECTION AND CRASH TEST REQUIREMENTS THE CONCRETE BARRIER MUST EXTEND 7'-0" MINIMUM ONTO THE APPROACH PANEL. FOR PARALLEL WINGWALLS THE BARRIER MUST EXTEND 7'-0" MINIMUM ON TO THE APPROACH PANEL OR TO THE END OF THE WINGWALL, WHICH EVER IS LONGER. REFER TO BRIDGE PLAN FOR BARRIER REINFORCEMENT AND PAYMENT.
5. SEE GRADING PLANS FOR PAVEMENT AND SHOULDER WIDTHS AND CONFIGURATION.
6. WHEN SKEW IS OVER 45°, THE JOINT SHALL BE PERPENDICULAR TO GUTTER FOR 1' (TYP.).
7. PANEL SIZE AND REQUIREMENTS FOR TRANSVERSE AND LONGITUDINAL JOINTS ARE SHOWN ON STANDARD PLANS 5-297.228 AND 5-297.229.
8. FOR CONCRETE PAVEMENT, SEE STANDARD PLAN 5-297.227 FOR LUG REQUIREMENTS.

GENERAL NOTES:

SECTION A-A IS SHOWN ON STANDARD PLAN 5-297.227. SECTIONS B-B AND C-C ARE SHOWN ON STANDARD PLAN 5-297.225 AND SHOW THE STATION AND ELEVATION AT END LOCATIONS ON THE APPROACH PANEL.

A CONCRETE SILL IS REQUIRED BENEATH EXPANSION JOINT TYPE E8H. EXTEND THE EXPANSION JOINT AND THE SILL ALONG THE FULL WIDTH OF THE TRAFFIC LANES, SHOULDERS AND CURB. ENSURE THAT SILL DOES NOT INTERFERE WITH GUARDRAIL POST PLACEMENT. CONCRETE SILL AND CURBING, IF REQUIRED, ARE INCLUDED IN THE APPROACH PANEL PAY ITEM.

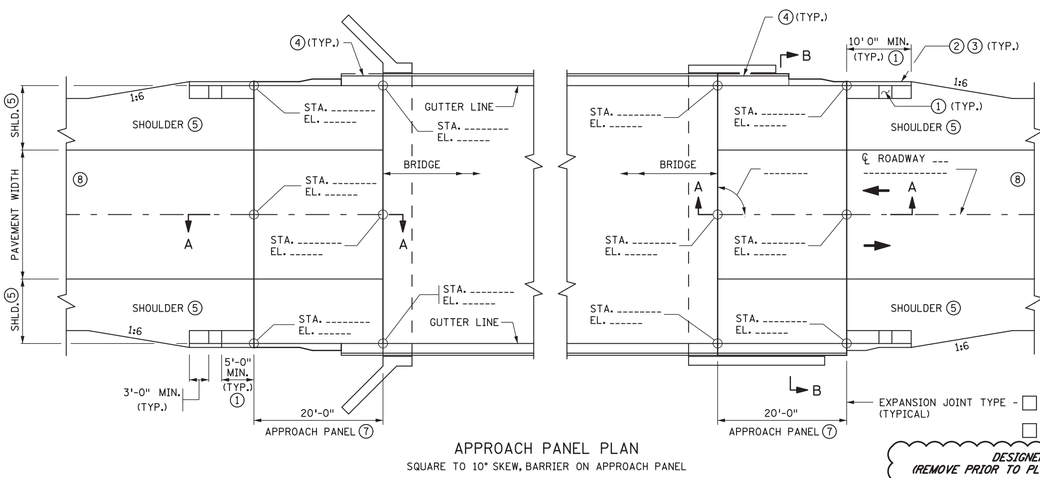
AT THE END OF THE CONCRETE BARRIER, TRANSITION FACE OF 4-INCH CURB INTO PROFILE OF CONCRETE BARRIER. SEE CURB TRANSITION DETAILS ON STANDARD PLAN 5-297.227 IF THERE IS NO ROADWAY CURB AT THE END OF THE APPROACH PANEL, APPROACH PANEL CURB HEIGHT FROM 4 INCH TO 0 INCH IN THE LAST 3'-4" SECTION (1:10 OR FLATTER SLOPE).

GENERAL DRAINAGE DETAILS ARE SHOWN ON BRIDGE APPROACH PANEL DRAINAGE DETAILS, STANDARD PLAN 5-297.231. ADDITIONAL CATCH BASIN DETAILS ARE SHOWN ON DRAINAGE PLAN SHEETS.

CONCRETE MIX SHALL BE 3A42 FOR APPROACH PANEL AND SILL.

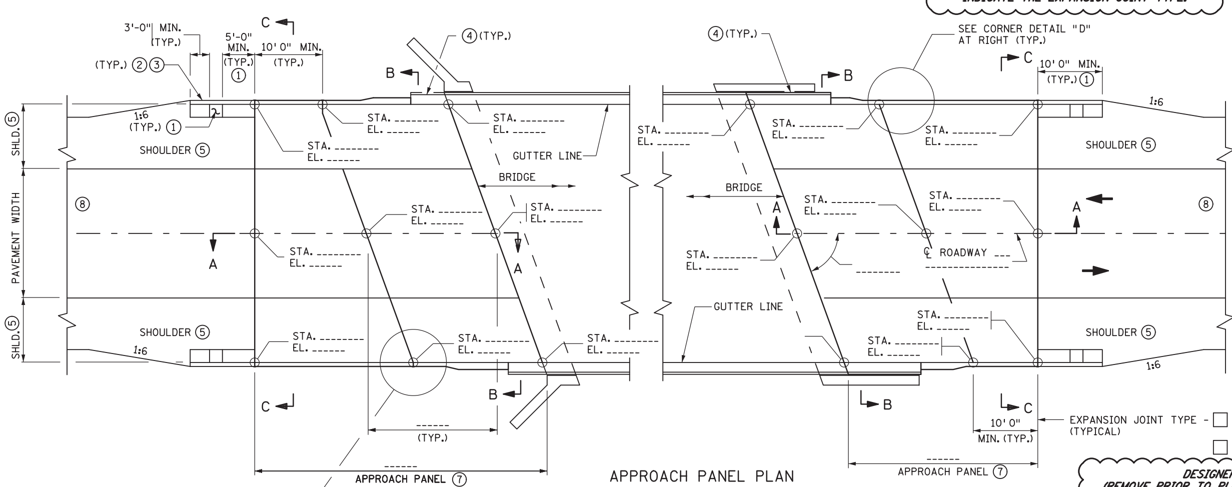
REFER TO MNDOT SPEC. 2406 FOR ADDITIONAL INFORMATION.

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
SEE NOTE 4 AND COORDINATE BARRIER LENGTH WITH BRIDGE DESIGNER. 7'-0" MINIMUM LENGTH IS FOR TL-4 BARRIER. TL-5 BARRIER REQUIRES SPECIAL DESIGN, CONTACT THE BRIDGE DESIGNER.



APPROACH PANEL PLAN
SQUARE TO 10° SKEW, BARRIER ON APPROACH PANEL

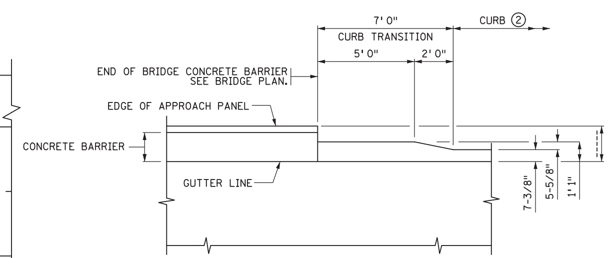
DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
PLACE AN "X" IN THE APPROPRIATE BOX TO INDICATE THE EXPANSION JOINT TYPE.



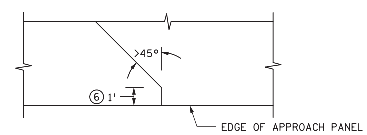
APPROACH PANEL PLAN
OVER 10° SKEW, BARRIER ON APPROACH PANEL

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
APPROACH PANEL PLAN VIEW SHOULD BE MODIFIED/MIRRORED TO SHOW ACTUAL SKEW ORIENTATION, BARRIER LENGTH, WINGWALL AND CURB TRANSITION CONFIGURATION AND TRAFFIC DIRECTION ARROWS.

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
PLACE AN "X" IN THE APPROPRIATE BOX TO INDICATE THE EXPANSION JOINT TYPE.



CORNER DETAIL "D"
(PLAN VIEW)

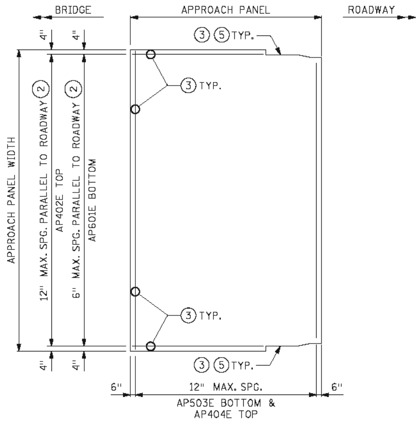


(PLAN VIEW)
SKEW DETAIL "E"

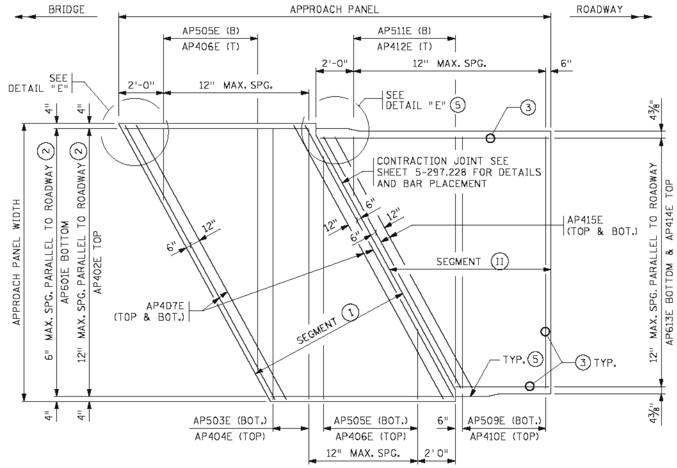
BRIDGE NO. _____

CERTIFIED BY ______ LICENSED PROFESSIONAL ENGINEER ______ DATE	STANDARD PLAN SHEET NO. 5-297.224	TITLE: BRIDGE APPROACH PANEL LAYOUT (CONCRETE BARRIER ON APPROACH PANEL)
PRINTED NAME: LIC. NO.	STANDARD APPROVED: DECEMBER 20, 2011	
	STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS

DECEMBER 20, 2011 5-297.224



APPROACH PANEL REINFORCEMENT
SQUARE TO 10° SKEWS



APPROACH PANEL REINFORCEMENT
OVER 10° SKEWS

ESTIMATED REINFORCEMENT QUANTITY FOR BRIDGE APPROACH PANELS

TYPE	LOCATION	ESTIMATED WEIGHT
PANEL (SQ. TO 10°)	BRIDGE TO END OF APPROACH PANEL	48.5 LB./SQ. YD.
PANEL SEGMENT Ⅰ (OVER 10°)	BRIDGE TO CONTRACTION JOINT	48.5 LB./SQ. YD.
PANEL SEGMENT Ⅱ (OVER 10°)	CONTRACTION JOINT TO END OF APPROACH PANEL	35.0 LBS/SQ. YD
CURB	7.0 FT. CURB TRANSITION	19.0 LBS/EACH
SILL	SILL (IF REQUIRED)	14.0 LBS/LIN FT.

NOTES:

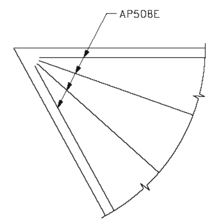
TRANSVERSE BARS IN BOTH PANEL SEGMENTS ARE PERPENDICULAR TO ROADWAY CENTERLINE EXCEPT AP407E ARE PARALLEL TO SKEW IN SEGMENT Ⅰ AND AP415E ARE PARRALLEL TO SKEW IN SEGMENT Ⅱ.

LONGITUDINAL BARS IN BOTH PANEL SEGMENTS ARE PARALLEL TO ROADWAY CENTERLINE.

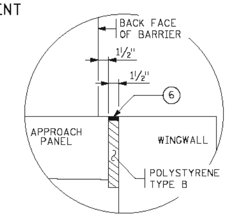
BILL OF REINFORCEMENT FOR BRIDGE APPROACH PANELS

CONTRACTOR IS REQUIRED TO COMPLETE THE BILL OF REINFORCEMENT TABLE AND PREPARE SHOP DRAWINGS AND SUBMIT THEM TO THE PROJECT ENGINEER AT LEAST 3 WEEKS BEFORE REBAR FABRICATION.

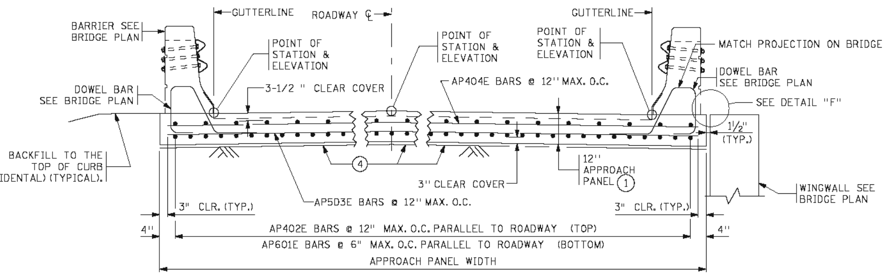
BAR	NO.	LENGTH	SHAPE	LOCATION
AP601E		'-	——	BOTTOM LONGITUDINAL
AP402E		'-	——	TOP LONGITUDINAL
AP503E		'-	——	BOTTOM TRANSVERSE
AP404E		'-	——	TOP TRANSVERSE
AP505E	SER. OF	'- TO '-	——	BOTTOM TRANSVERSE
AP406E	SER. OF	'- TO '-	——	TOP TRANSVERSE
AP407E		'-	——	TOP & BOTTOM EDGE
AP508E		8'-0	——	TOP CORNER - FAN
AP509E		'-	——	BOTTOM TRANSVERSE
AP410E		'-	——	TOP TRANSVERSE
AP511E	SER. OF	'- TO '-	——	BOTTOM TRANSVERSE
AP412E	SER. OF	'- TO '-	——	TOP TRANSVERSE
AP613E	SER. OF	'- TO '-	——	BOTTOM LONGITUDINAL
AP414E	SER. OF	'- TO '-	——	TOP LONGITUDINAL
AP415E		'-	——	TOP & BOTTOM EDGE
AP616E		5'-0	——	C2H-D JOINT



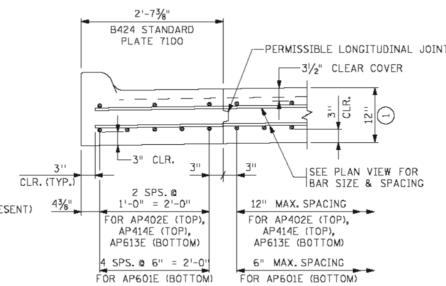
DETAIL "E"
FAN 4-AP508E BARS AS SHOWN
IN ACUTE CORNERS FOR SKEWS OVER 30°.



DETAIL "F"



TRANSVERSE SECTION B-B
FROM STANDARD PLAN 5-297.224
CONCRETE BARRIERS ARE SHOWN, BUT MAY NOT BE PRESENT.
REFER TO BRIDGE PLANS FOR END OF BARRIER LOCATIONS.



CURB DETAIL
(B424 CURB AND GUTTER SHOWN)

GENERAL NOTES:

AS PER MNDOT SPEC. 3301, USE EPOXY COATED GRADE 60 REINFORCEMENT BARS IN APPROACH PANEL, CONCRETE SILL AND CURB TRANSITION.

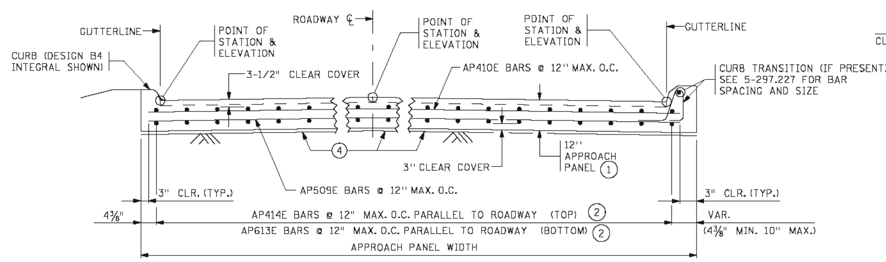
BARS MARKED WITH THE SUFFIX "E" SHALL BE EPOXY COATED IN ACCORDANCE WITH MnDOT SPEC. 3301.

FOR VARIABLE ROADWAY WIDTHS, VARY THE LAP LENGTH OF THE REINFORCEMENT.

MINIMUM REINFORCEMENT LAP LENGTHS ARE AS FOLLOWS: NO. 4 BAR = 1'-8", NO. 5 BAR = 2'-1", NO. 6 BAR = 2'-6".

ALL LAP SPLICES SHALL BE STAGGERED SUCH THAT NO MORE THAN 50% OF REBAR IS SPLICED AT THE SAME LOCATION.

1. APPROACH SLAB THICKNESS IS 12" (12" MONOLITHIC OR 10" SLAB + 2" WEARING COURSE). CHECK BRIDGE PLANS FOR CONCRETE WEARING COURSE, WHICH IS INCLUDED IN BRIDGE PLAN QUANTITIES.
2. SPACING ONLY FOR B4 INTEGRANT CURB. SEE CURB DETAIL FOR SPACING FOR USING B424 CURB AND GUTTER.
3. EXTEND AND/OR CUT REINFORCING AS NECESSARY TO ACCOMMODATE CURB TRANSITION IF PRESENT. REINFORCEMENT MUST EXTEND INTO CURB AS SHOWN IN TRANSVERSE SECTIONS B-B AND C-C.
4. IF THE APPROACH PANEL IS TIED TO THE BRIDGE ABUTMENT WITH REINFORCEMENT BARS, PLACE 12 MIL POLYETHYLENE SHEETING (OR 2 LAYERS OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCLUDED IN THE APPROACH PANEL PAY ITEM.
5. SEE STANDARD PLAN 5-297.224 FOR CURB TRANSITION LOCATION.
6. SEAL WITH SELF-LEVELING SILICONE PER MNDOT 3722.

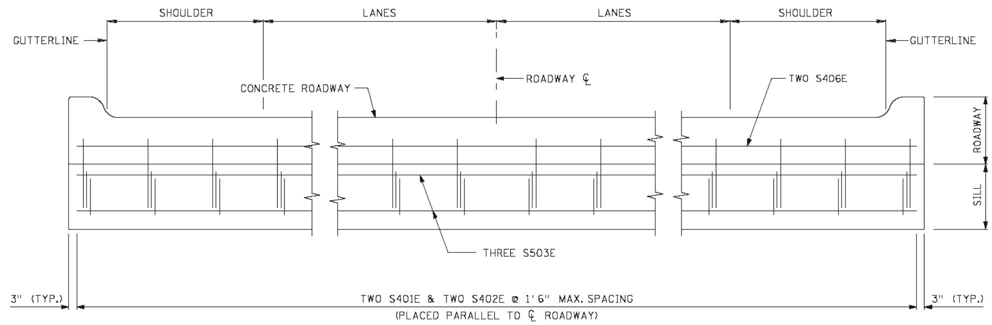


TRANSVERSE SECTION C-C
FROM STANDARD PLAN 5-297.224

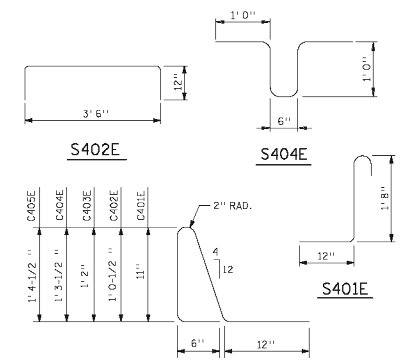
REVISION DATE
3-22-2013

STANDARD PLAN SHEET NO. 5-297.225	TITLE: BRIDGE APPROACH PANEL REINFORCEMENT DETAILS (CONCRETE BARRIER ON APPROACH PANEL)
STANDARD APPROVED: DECEMBER 20, 2011	

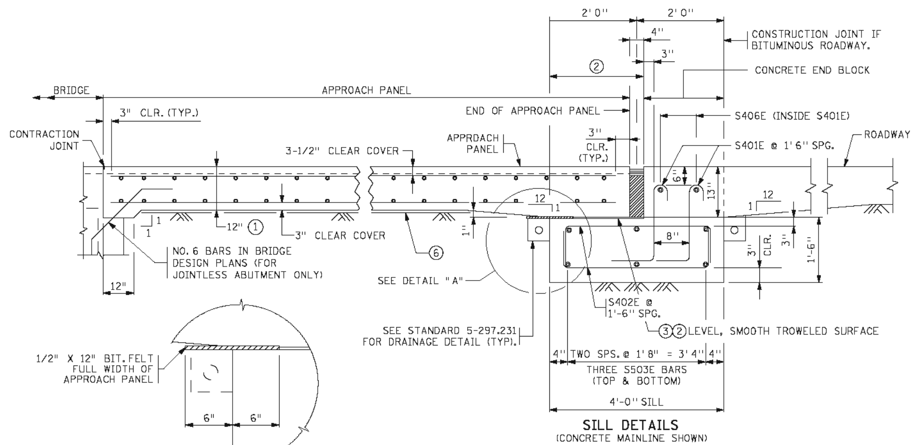
STATE PROJ. NO. (TH) SHEET NO. OF SHEETS



SILL ELEVATION
(REINFORCEMENT IN PAVEMENT NOT SHOWN)



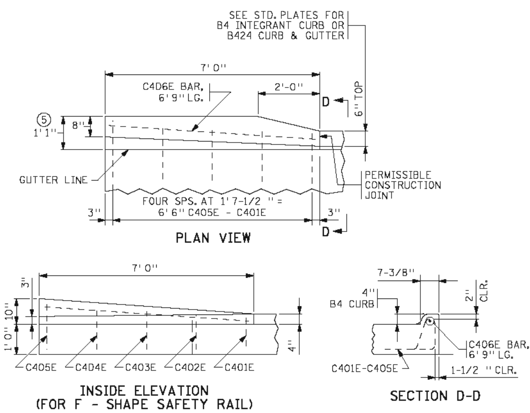
C401E - C405E



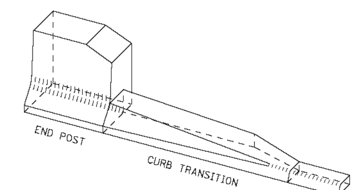
DETAIL "A"

LONGITUDINAL SECTION A-A
FROM SHEET 5-297.222 & SHEET 5-297.224

SILL DETAILS
(CONCRETE MAINLINE SHOWN)
(BITUMINOUS MAINLINE SIMILAR)



CURB TRANSITION DETAILS
F-SHAPE SAFETY BARRIER TO B4 CURB WITH W-BEAM GUARDRAIL BARRIER



ISOMETRIC VIEW

BILL OF REINFORCEMENT FOR CONCRETE SILL

CONTRACTOR IS REQUIRED TO COMPLETE THE BILL OF REINFORCEMENT TABLE AND PREPARE SHOP DRAWINGS AND SUBMIT THEM TO THE PROJECT ENGINEER AT LEAST 3 WEEKS BEFORE REBAR FABRICATION.

	BAR	NO.	LENGTH	SHAPE	LOCATION
	S401E		3' 2"		SILL VERTICAL
	S402E		5' 6"		SILL TIE
✱	S503E		'-		SILL HORIZONTAL
	S404E		4' 6"		KEY TIE
✱	S405E		' "		KEY HORIZONTAL
✱	S406E		' "		END BLOCK HORIZONTAL

✱ MINIMUM REINFORCEMENT LAP LENGTHS ARE AS FOLLOWS: NO. 4 BAR = 1'-8", NO. 5 BAR = 2'-1".

BILL OF REINFORCEMENT FOR CURB TRANSITION

CONTRACTOR IS REQUIRED TO COMPLETE THE BILL OF REINFORCEMENT TABLE AND PREPARE SHOP DRAWINGS AND SUBMIT THEM TO THE PROJECT ENGINEER AT LEAST 3 WEEKS BEFORE REBAR FABRICATION.

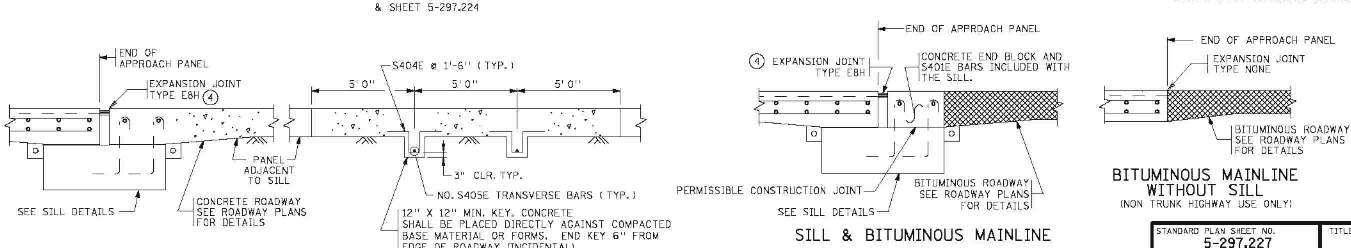
BAR	NO.	LENGTH	SHAPE	LOCATION
C401E		3' 6"		CURB VERTICAL
C402E		3' 9"		CURB VERTICAL
C403E		4' 0"		CURB VERTICAL
C404E		4' 3"		CURB VERTICAL
C405E		4' 5"		CURB VERTICAL
C406E		6' 9"		CURB LONGITUDINAL

NOTES:

AS PER MNDOT 3301, USE EPOXY COATED GRADE 60 REINFORCEMENT BARS.

ENSURE THAT SILL DOES NOT INTERFERE WITH GUARDRAIL POST PLACEMENT.

1. APPROACH SLAB THICKNESS IS 12" (12" MONOLITHIC OR 10" SLAB + 2" WEARING COURSE). CHECK BRIDGE PLANS FOR CONCRETE WEARING COURSE, WHICH IS INCLUDED IN BRIDGE PLAN QUANTITIES.
2. PLACE PLASTIC SHEETING (MNDOT 3756) AS APPROVED BY THE ENGINEER TO BREAK BOND. COVER AREA SHOWN IN DETAIL. (SHEETING IS INCLUDED IN THE APPROACH PANEL PAY ITEM).
3. REQUIRED CONSTRUCTION JOINT.
4. SEE STANDARD PLANS 5-297.222 & 5-297.224 FOR TYPE OF EXPANSION JOINT. DETAILS OF EXPANSION JOINT TYPE E8H ARE SHOWN ON STANDARD PLAN 5-297.229.
5. FROM BACK SIDE OF CURB TRANSITION TO GUTTERLINE.
6. IF THE APPROACH PANEL IS TIED TO THE BRIDGE ABUTMENT WITH REINFORCEMENT BARS, PLACE 12 MIL POLYETHYLENE SHEETING (OR 2 LAYERS OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCLUDED IN THE APPROACH PANEL PAY ITEM.

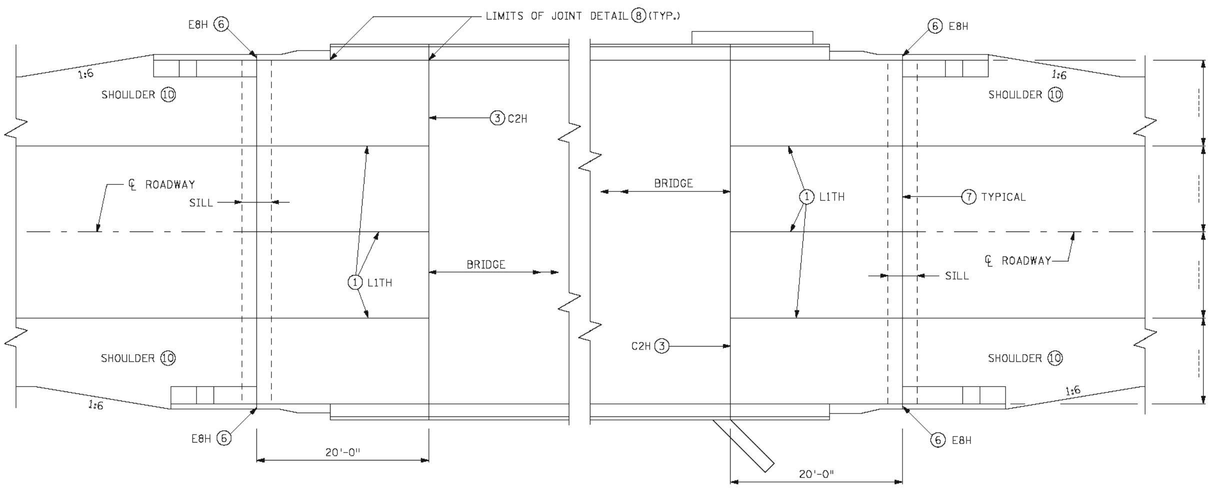


END OF APPROACH PANEL

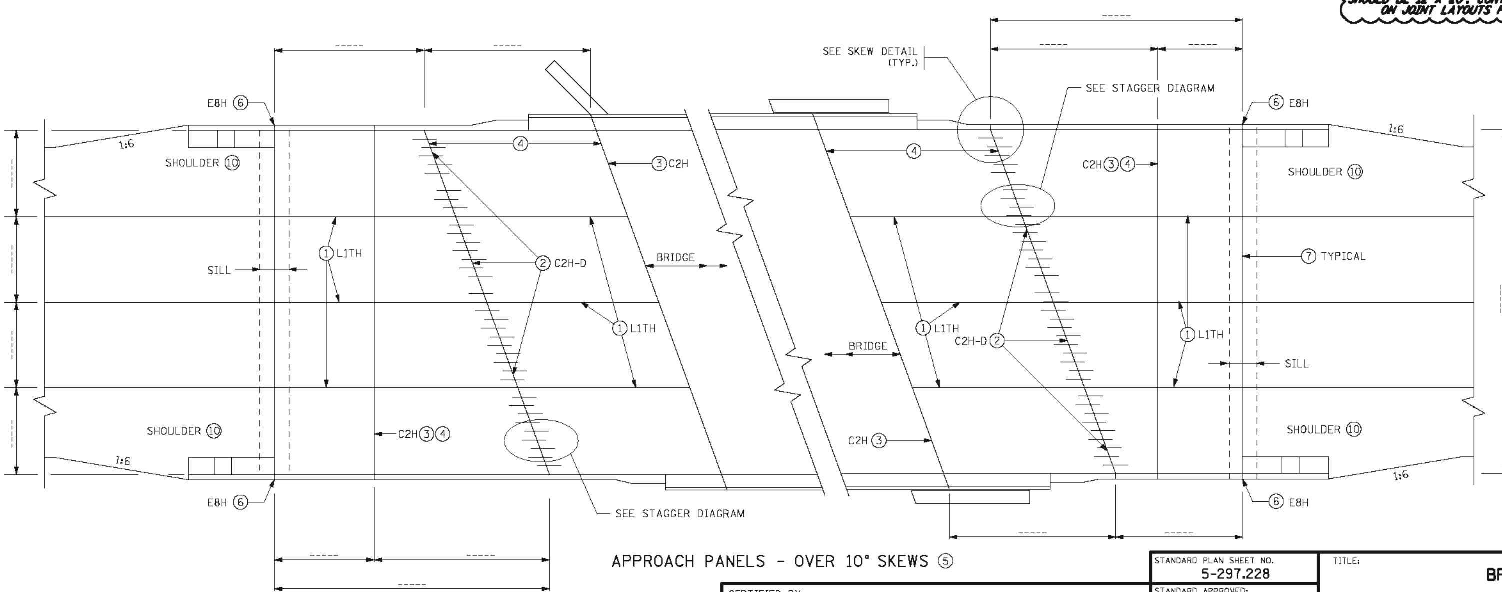
REVISION DATE 3-22-2013

STANDARD PLAN SHEET NO.	TITLE:
5-297.227	BRIDGE APPROACH PANEL MISCELLANEOUS DETAILS
STANDARD APPROVED: DECEMBER 20, 2011	

STATE PROJ. NO. (TH) SHEET NO. OF SHEETS



APPROACH PANELS - SQUARE TO 10° SKEWS (5)



APPROACH PANELS - OVER 10° SKEWS (5)

APPROACH PANEL JOINT LAYOUT NOTES:

(1) L1TH LONGITUDINAL JOINT. SEE STANDARD PLAN 5-297.229 FOR REINFORCEMENT LAP LENGTH REQUIREMENTS FOR STAGED CONSTRUCTION.

(2) PERMISSIBLE CONSTRUCTION JOINT. USE JOINT TYPE C2H-D WITH AP616E BARS AT 12-INCH SPACING AT MID DEPTH OF THE SLAB, PARALLEL TO THE CENTERLINE OF THE ROADWAY. AP616E BARS ARE 5'-0" LONG. PLACE THE BAR WITH 2'-0" ON ONE SIDE OF THE JOINT AND 3'-0" ON THE OPPOSITE SIDE OF THE JOINT. ALTERNATE THE 2'-0" AND 3'-0" DIMENSIONS AS SHOWN ON THE PLAN. THE C2H-D JOINT AND AP616E BARS ARE REQUIRED ON ALL PANELS WITH A SKEW OVER 10 DEGREES.

(3) C2H CONTRACTION JOINT.

(4) MAXIMUM PANEL LENGTH OF 20'-0" FOR UP TO 40° SKEWS, 15'-0" FOR SKEWS OVER 40°.

(5) ALL JOINTS SHALL BE SAWCUT. SAWCUTS SHALL BE MADE WHILE THE CONCRETE IS STILL GREEN. WHEN A CONCRETE WEARING COURSE IS SPECIFIED, THE JOINTS SHALL BE SAWN THROUGH BOTH THE WEARING COURSE AND THE UNDERLYING APPROACH SLAB IN A SINGLE OPERATION.

(6) E8H JOINT REQUIRED IN CURB ADJACENT TO E8H JOINT. E8H QUANTITY SHALL BE PAID FOR SEPARATELY, MEASURED FROM BACK OF CURB TO BACK OF CURB.

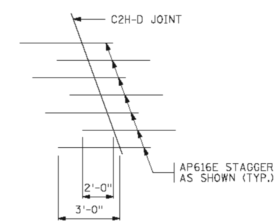
(7) SEE STANDARD PLANS 5-297.222 OR 5-297.224 FOR TYPE OF EXPANSION JOINT.

(8) SEE STANDARD PLANS 5-297.229 OR 5-297.231 FOR JOINT DETAIL FOR CONCRETE BARRIER ON WINGWALL.

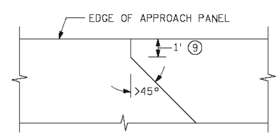
(9) WHEN SKEW IS OVER 45°. THE JOINT SHALL BE PERPENDICULAR TO GUTTER FOR 1' (TYP).

(10) SEE GRADING PLAN FOR PAVEMENT AND SHOULDER WIDTHS AND CONFIGURATION.

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLANS)
THIS SHEET IS INTENDED AS A TEMPLATE FOR APPROACH PANEL JOINT LAYOUT. DESIGNERS SHOULD MAKE CHANGES AS NEEDED TO MATCH THE SKEW, DIMENSIONS, ETC OF A PARTICULAR BRIDGE. THE MAXIMUM SIZE CONCRETE PANEL BETWEEN JOINTS OR SAWCUTS SHOULD BE 12' X 20'. CONTACT THE CONCRETE ENGINEERING UNIT FOR ASSISTANCE ON JOINT LAYOUTS FOR WIDE BRIDGES OR BRIDGES WITH LARGE SKEWS.



STAGGER DIAGRAM



SKEW DETAIL
(PLAN VIEW)

BRIDGE NO. _____

REVISION DATE 3-22-2013

CERTIFIED BY ______ LICENSED PROFESSIONAL ENGINEER ______ DATE

PRINTED NAME: ______ LIC. NO. ______

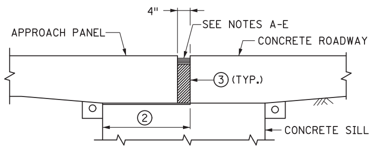
STANDARD PLAN SHEET NO. 5-297.228

STANDARD APPROVED: MARCH 23, 2011

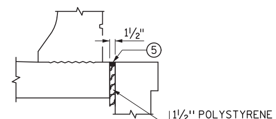
TITLE: BRIDGE APPROACH PANEL JOINT LAYOUT

STATE PROJ. NO. (TH) SHEET NO. OF SHEETS

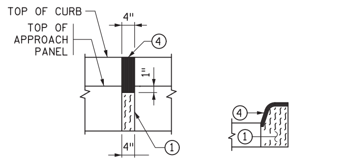
EXPANSION JOINTS



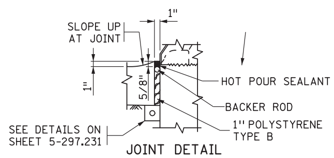
E8H JOINT DETAIL AT PAVEMENT



JOINT DETAIL
(CONCRETE BARRIER ON APPROACH PANEL)



E8H JOINT AT CURB



JOINT DETAIL
(CONCRETE BARRIER ON WINGWALL)

EXPANSION JOINT NOTES:

① PREFORMED JOINT FILLER MATERIAL, SPEC. 3702.

② PLACE PLASTIC SHEETING SPEC. 3756 AS APPROVED BY THE ENGINEER TO BREAK BOND. COVER AREA SHOWN IN DETAIL. SEE SILL DETAILS ON STANDARD PLAN 5-297.227.

③ THE JOINT FACES SHALL BE CLEANED AND DRIED BY SANDBLASTING AND AIR BLASTING PRIOR TO SEALING THE JOINT.

④ HOT POUR JOINT SEALER SPEC. 3725. TOP OF SEALER FLUSH TO 1/8 INCH BELOW TOP OF PAVEMENT SURFACE. MAKE TOP OF SEALER FOR CURB SECTION E8H JOINTS FLUSH WITH SURFACE (+ 1/8 INCH OR - 1/8 INCH).

⑤ SEAL WITH SELF-LEVELING SILICONE PER MNDOT 3722.

E8H PRESSURE RELIEF JOINT MATERIAL INSTALLATION INSTRUCTIONS:

SEE MNDOT APPROVED/QUALIFIED PRODUCTS LIST.

FURNISH AND INSTALL JOINT MATERIAL IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND THE FOLLOWING:

(A) EXPANSION JOINT FILLER MATERIALS USED FOR A 4 INCH PRESSURE RELIEF JOINT CONSISTS OF A PREFORMED FOAM PRODUCT HAVING MINIMUM DIMENSIONS OF 4.5 INCHES IN WIDTH (MAY BE LAMINATED) AND 8 INCHES IN DEPTH, AND A MINIMUM LENGTH OF 10 FEET. WHEN THE CONCRETE DEPTH IS GREATER THAN THE DEPTH OF THE PRESSURE RELIEF MATERIAL, FILL THE VOID BELOW THE MATERIAL WITH POLYSTYRENE. FURNISH AND INSTALL THE JOINT MATERIAL UNDER COMPRESSION WITH A LUBRICANT ADHESIVE APPLIED TO THE CONCRETE CONTACT SURFACES.

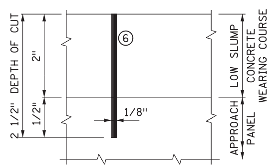
(B) SAW OR FORM THE JOINTS 4 INCHES WIDE BY THE FULL-DEPTH OF THE PANEL. INSPECT TO ASSURE THAT THE INSIDE WALLS OF THE JOINT HAVE BEEN SANDBLASTED, ARE DRY, SMOOTH AND FREE OF DEBRIS AND LOOSE PARTICLES. APPLY TAPE TO THE TOP 1 INCH OF THE INSIDE WALLS TO PREVENT THE LUBRICANT ADHESIVE FROM CONTAMINATING THE CONCRETE BONDING SURFACES OF THE SUBSEQUENTLY PLACED HOT POUR JOINT SEALER.

(C) PAINT THE INSIDE WALLS OF THE JOINT WITH LUBRICANT ADHESIVE AT THE RATE OF 1 GALLON PER 50 LINEAL FEET OF JOINT.

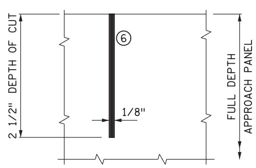
(D) PINCH THE BOTTOM OF THE MATERIAL TOGETHER AND PUSH IT DOWN INTO THE JOINT. WALK THE MATERIAL DOWN INTO THE JOINT; USE A SLEDGEHAMMER AND A 2 X 4 IF NECESSARY. APPLY LUBRICANT ADHESIVE TO THE ENDS OF THE PREFORMED FOAM MATERIAL WHEN BUTTING TWO PIECES TOGETHER.

(E) FURNISH AND INSTALL THE FOAM RELIEF JOINT MATERIAL TO A DEPTH OF APPROXIMATELY 7/8 INCH BELOW THE FINISHED CONCRETE SURFACE. AFTER INSTALLATION, REMOVE THE TAPE AND FILL THE VOID ON TOP OF THE FOAM MATERIAL WITH APPROXIMATELY 1/2 INCH OF HOT POUR JOINT SEALER (MNDOT 3723 OR 3725) TO A LEVEL OF 3/8 INCH +/- 1/4 INCH BELOW THE FINISHED CONCRETE SURFACE. THE HOT POUR JOINT SEALER SHOULD ONLY SLIGHTLY MELT INTO THE FOAM JOINT MATERIAL (TO PREVENT EXCESSIVE MELTING OF THE JOINT MATERIAL, PLACE THE HOT POUR SEALER AT THE LOWER END OF THE TEMPERATURE SPECIFICATION). CHECK FOR CORRECT TEMPERATURE BY PLACING HOT POUR SEALER ON A SAMPLE OF WASTE FOAM MATERIAL.

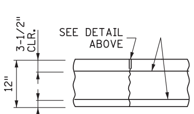
JOINT DETAILS



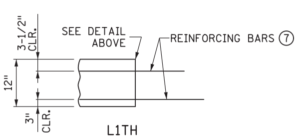
C2H & L1TH WITH CONCRETE WEARING COURSE ⑥
(SAWED & SEALED PER SPEC. 3725)



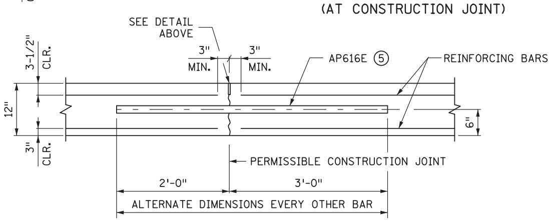
C2H & L1TH WITHOUT CONCRETE WEARING COURSE ⑥
(SAWED & SEALED PER SPEC. 3725)



L1TH



L1TH
(AT CONSTRUCTION JOINT)



SECTION AT C2H-D JOINT ⑤

JOINT NOTES:

⑤ PERMISSIBLE CONSTRUCTION JOINT. AP616E BARS AT 12-INCH SPACING AT MID DEPTH OF SLAB, PARALLEL TO THE CENTERLINE OF THE ROADWAY. AP616E BARS ARE 5'-0" LONG. PLACE THE BAR WITH 2'-0" ON ONE SIDE OF THE JOINT AND 3'-0" ON THE OPPOSITE SIDE OF THE JOINT. ALTERNATE THE 2'-0" AND 3'-0" DIMENSION AS SHOWN ON THE PLAN.

⑥ CLEAN AND DRY FULLY CURED JOINT FACES BY SANDBLASTING PRIOR TO SEALING THE JOINT.

⑦ WHEN CONSTRUCTING A L1TH JOINT UNDER STAGED CONSTRUCTION, EXTEND NO. 4 BARS 1'-8" AND NO. 5 BARS 2'-1" PAST THE EDGE OF THE FIRST CONCRETE POUR. CONSTRUCT L1TH JOINT ACCORDING TO DETAIL SHOWN AFTER ADJACENT POUR IS COMPLETE.

SIDEWALK COVER PLATE

GENERAL NOTES:

GALVANIZE STRUCTURAL STEEL AFTER FABRICATION PER Mn/DOT SPEC. 3394
GALVANIZE FASTENERS PER Mn/DOT SPEC. 3392.

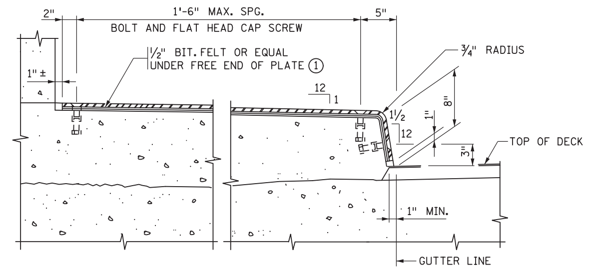
STRUCTURAL STEEL SHALL COMPLY WITH Mn/DOT SPEC. 3306 OR Mn/DOT SPEC. 3309.

SHOP DRAWING SUBMITTALS REQUIRED PER Mn/DOT SPEC. 2471.

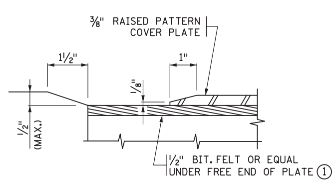
CAP SCREWS SHALL BE COUNTERSUNK 1/16" BELOW TOP OF PLATE.

FURNISHING AND INSTALLING SIDEWALK COVER PLATE IS INCIDENTAL.

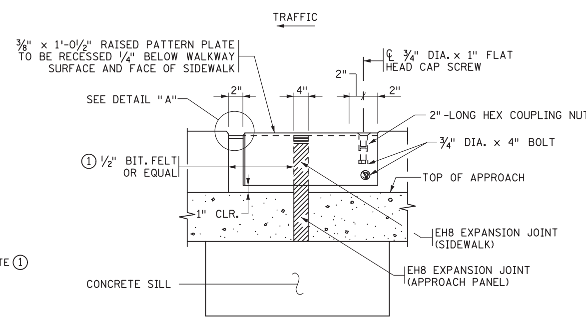
① USE LARGEST SINGLE PIECE POSSIBLE. USE OF SMALL PIECES OR SCRAPS SECURED TOGETHER IS PROHIBITED.



SECTION THROUGH SIDEWALK



DETAIL "A"



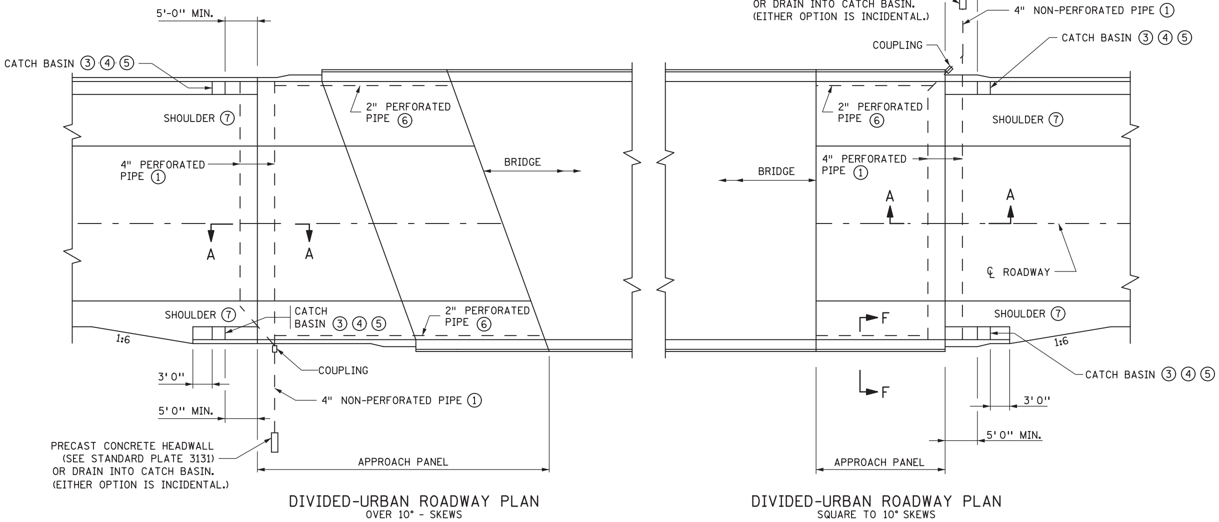
SIDEWALK ELEVATION

STANDARD PLAN SHEET NO. 5-297.229	TITLE: BRIDGE APPROACH PANEL JOINT DETAILS
STANDARD APPROVED: DECEMBER 20, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS

REVISION DATE 3-22-2013

DECEMBER 20, 2011 5-297.229

DESIGNER NOTE
(REMOVE PRIOR TO PLOTTING FINAL PLAN):
WHEN DETERMINING THE LENGTH AND LOCATION OF THE CURB & GUTTER AND CATCH BASIN, BE SURE TO TAKE INTO CONSIDERATION THE LOCATION AND SPACING OF THE GUARDRAIL POSTS TO AVOID HITTING THE OUTLET PIPES.



DIVIDED-URBAN ROADWAY PLAN
OVER 10° - SKEWS

DIVIDED-URBAN ROADWAY PLAN
SQUARE TO 10° SKEWS

NOTES:

① 4-INCH NOMINAL DIAMETER THERMOPLASTIC PIPE, AS PER ASTM D1785M, SCHEDULE 40. SLOPE PIPE TO DITCH. WRAP PERFORATED PIPE WITH GEOTEXTILE AS PER SPEC. 3733. 1/8 INCH PER 12 INCH MINIMUM SLOPE. FURNISHING AND INSTALLING THE DRAIN SYSTEM IS INCIDENTAL.

② BACKFILL WITH FINE AGGREGATE (MNDOT 3149) MODIFIED TO 0-3% PASSING A NO. 200 SIEVE (INCIDENTAL).

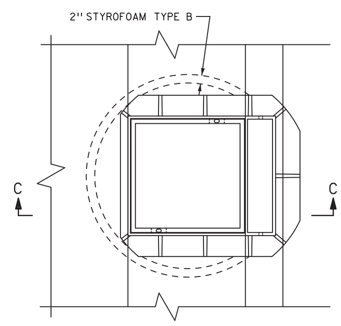
③ SEE ROADWAY PLAN FOR ADDITIONAL CATCH BASIN DETAILS.

④ LOCATE BETWEEN GUARDRAIL POST OR AS DETERMINED BY THE DESIGNER.

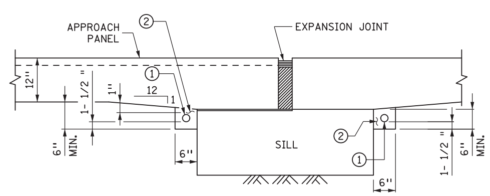
⑤ REFER TO THE DRAINAGE PLAN TO DETERMINE WHETHER A FLUME OR A CATCH BASIN REQUIRED.

⑥ 2-INCH NOMINAL DIAMETER THERMOPLASTIC PIPE, AS PER ASTM D1785M, SCHEDULE 40. SLOPE PIPE TO DITCH. WRAP PERFORATED PIPE WITH GEOTEXTILE AS PER SPEC. 3733. 1/8 INCH PER 12 INCH MINIMUM SLOPE. FURNISHING AND INSTALLING THE DRAIN SYSTEM IS INCIDENTAL.

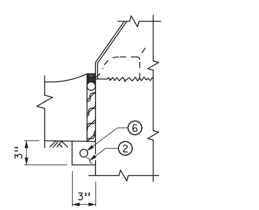
⑦ SEE GRADING PLANS FOR PAVEMENT AND SHOULDER WIDTHS AND CONFIGURATION.



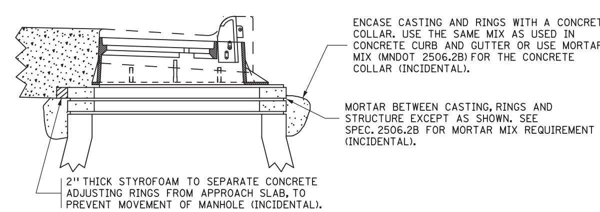
PLAN VIEW OF C.B. CASTING
(GRATE NOT SHOWN)



SECTION A-A
DRAINAGE AT EXPANSION JOINT DETAIL

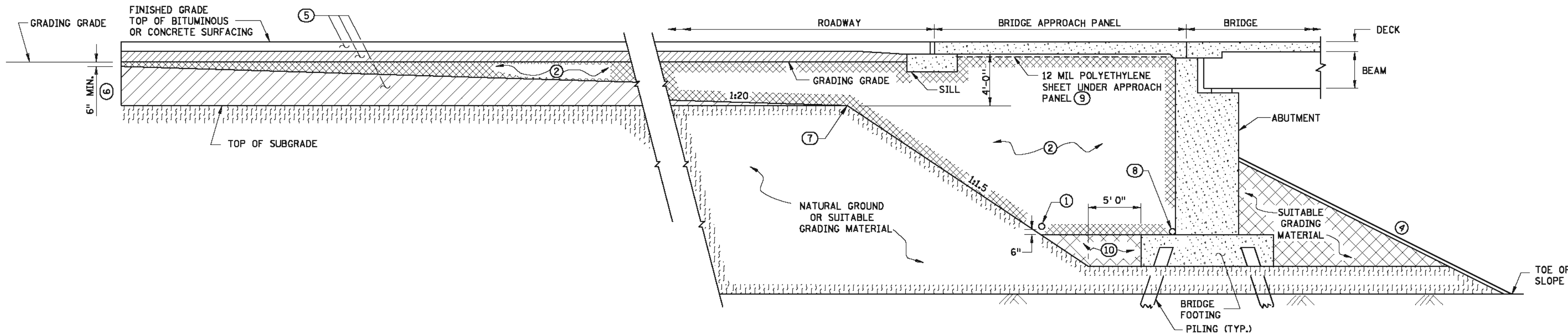


SECTION F-F
DRAINAGE AT PANEL EDGE OF JOINT
(THIS DETAIL IS USED IF THE CONCRETE BARRIER IS MOUNTED ON THE WINGWALL. DO NOT USE THIS DETAIL IF THE BARRIER IS MOUNTED ON THE APPROACH PANEL).



SECTION C-C

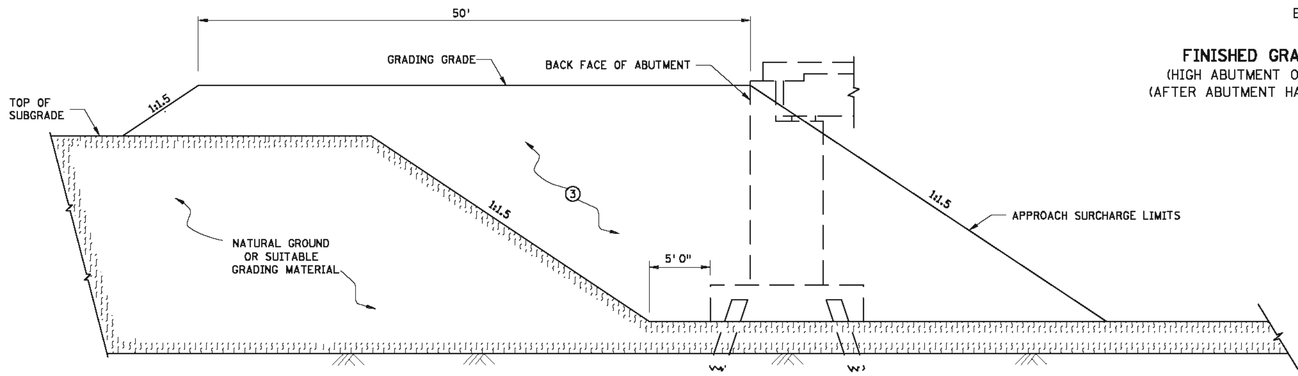
STANDARD PLAN SHEET NO. 5-297.231	TITLE: BRIDGE APPROACH PANEL DRAINAGE DETAILS
STANDARD APPROVED: MARCH 23, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS



ELEVATION

FINISHED GRADING SECTION

(HIGH ABUTMENT ON PILING SHOWN)
(AFTER ABUTMENT HAS BEEN CONSTRUCTED)



ELEVATION

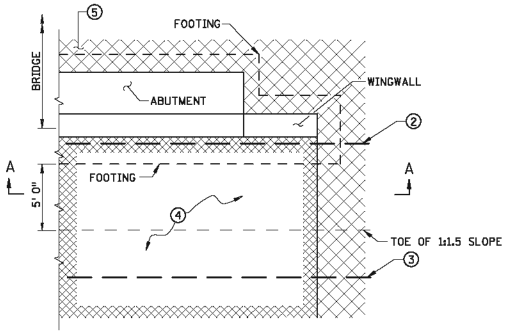
ROUGH GRADING SECTION

(PRIOR TO ABUTMENT CONSTRUCTION)

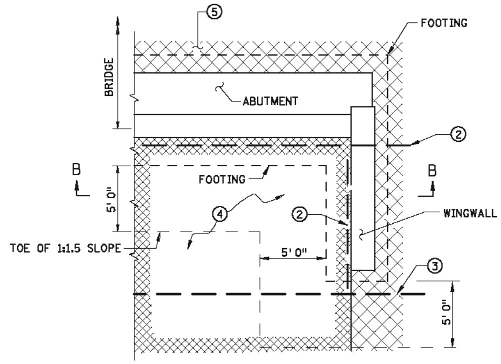
NOTES:

1. SUBSURFACE PIPE DRAIN. SEE GRADING PLAN FOR DETAILS. FURNISH AND INSTALL IF SHOWN IN GRADING PLAN.
2. QUANTITY OF SELECT GRANULAR MATERIAL MODIFIED 10% IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SELECT GRANULAR MATERIAL MODIFIED 10% SHALL COMPLY WITH SPEC. 3149.2B2, MODIFIED TO 10% OR LESS PASSING THE NUMBER 200 SIEVE. SEE GRADING PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES SHALL BE CONSIDERED INCIDENTAL.
3. PLACE ABUTMENT APPROACH SURCHARGE MATERIAL PRIOR TO ABUTMENT CONSTRUCTION. AFTER COMPLETION OF SURCHARGE WAITING PERIOD, REMOVE SURCHARGE AND EXISTING NATURAL GROUND OR SUITABLE GRADING MATERIAL TO THE LIMITS SHOWN IN "ROUGH GRADING SECTION" ABOVE, PRIOR TO ABUTMENT CONSTRUCTION. SEE BRIDGE PLANS AND SPECIAL PROVISIONS FOR ABUTMENT APPROACH SURCHARGE REQUIREMENT AND PAYMENTS.
4. SEE BRIDGE PLANS FOR SLOPE AND SLOPE PROTECTION.
5. SEE GRADING PLANS FOR TYPE OF MATERIAL.
6. GRADING TO BE SQUARED OFF ON SKEWED BRIDGES.
7. TOP OF 1:1.5 SLOPE (FORMS A LINE PARALLEL TO END OF BRIDGE).
8. SUBSURFACE PIPE DRAIN. FURNISH AND INSTALL AT TOP OF BRIDGE FOOTING IF BRIDGE DETAIL B910 IS INCLUDED ON BRIDGE PLAN.
9. IF THE APPROACH PANEL IS TIED TO THE ABUTMENT WITH REINFORCEMENT BARS, PLACE 12 MIL POLYETHYLENE SHEETING (OR TWO LAYERS OF OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCIDENTAL.
10. SUITABLE GRADING MATERIAL SHALL HAVE SUITABLE MOISTURE CONTENT DURING PLACEMENT AND SHALL BE COMPACTED PER SPEC. 2105. SELECT GRANULAR MATERIAL MODIFIED 10% MAY BE USED IN LIEU OF SUITABLE GRADING MATERIAL.

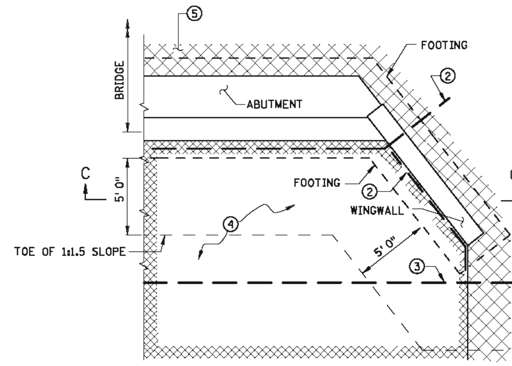
STANDARD SHEET NO. 5-297.233 (1 OF 2)	TITLE: BRIDGE ABUTMENT APPROACH TREATMENT FOR ABUTMENT ON FOOTING
STANDARD APPROVED: AUGUST 1, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS



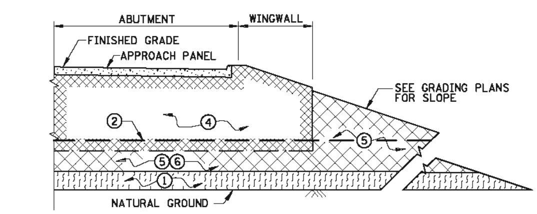
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT 180°) (FINISHED GRADING)



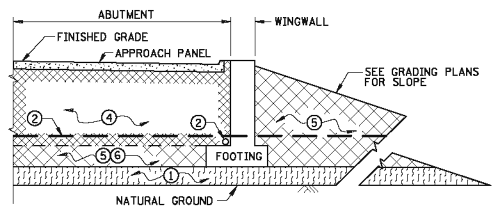
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT 90°) (FINISHED GRADING)



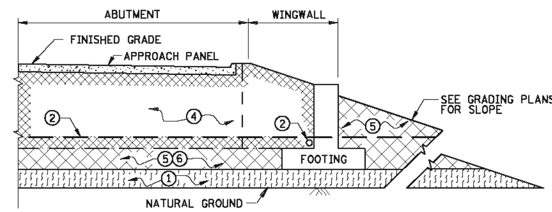
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT ANY OTHER ANGLE) (FINISHED GRADING)



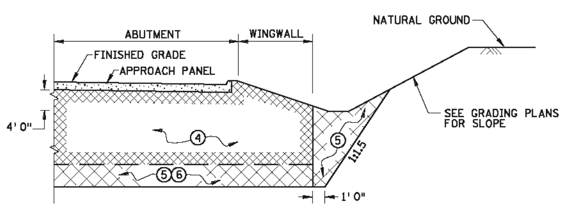
FINISHED GRADING SECTION A-A
(FILL SECTION)



FINISHED GRADING SECTION B-B
(FILL SECTION)



FINISHED GRADING SECTION C-C
(FILL SECTION)



FINISHED GRADING SECTION A-A
(CUT SECTION)
(BRIDGE DETAIL B910 DRAIN NOT SHOWN)

NOTES:

1 NATURAL GROUND OR SUITABLE GRADING MATERIAL.

2 SUBSURFACE PIPE DRAIN, FURNISH AND INSTALL AT TOP OF BRIDGE FOOTING IF BRIDGE DETAIL B910 IS INCLUDED ON BRIDGE PLAN.

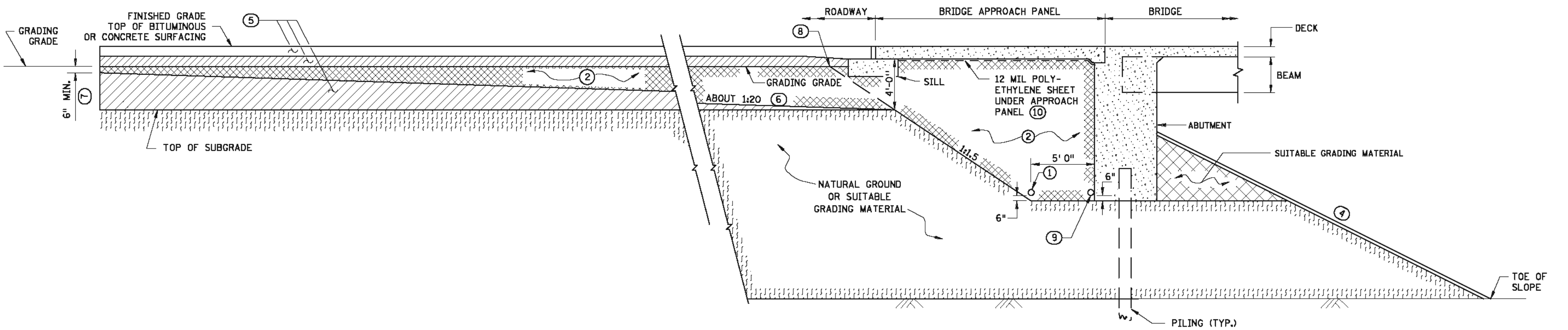
3 SUBSURFACE PIPE DRAIN. SEE GRADING PLAN FOR DETAILS. FURNISH AND INSTALL IF SHOWN IN GRADING PLAN.

4 SELECT GRANULAR MATERIAL MODIFIED 10% SHALL COMPLY WITH SPEC. 3149.2B2, MODIFIED TO 10% OR LESS PASSING THE NUMBER 200 SIEVE. QUANTITY OF SELECT GRANULAR MATERIAL MODIFIED 10% IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SEE GRADING PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES SHALL BE CONSIDERED INCIDENTAL.

5 SUITABLE GRADING MATERIAL.

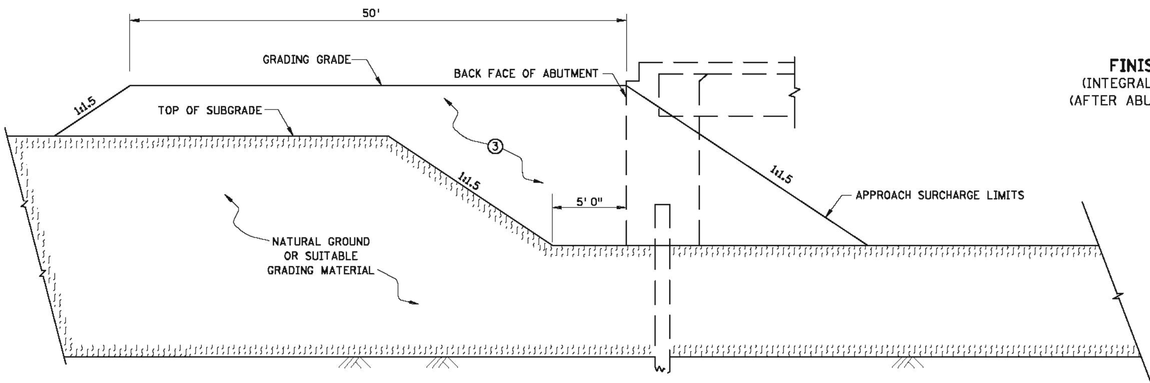
6 MATERIAL SHALL HAVE SUITABLE MOISTURE CONTENT DURING PLACEMENT AND SHALL BE COMPACTED PER SPEC. 2105. SELECT GRANULAR MATERIAL MODIFIED 10% MAY BE USED IN LIEU OF SUITABLE GRADING MATERIAL.

STANDARD SHEET NO. 5-297.233 (2 OF 2)	TITLE: BRIDGE ABUTMENT APPROACH TREATMENT FOR ABUTMENT ON FOOTING
STANDARD APPROVED: AUGUST 1, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS



ELEVATION

FINISHED GRADING SECTION
(INTEGRAL ABUTMENT ON PILING SHOWN)
(AFTER ABUTMENT HAS BEEN CONSTRUCTED)



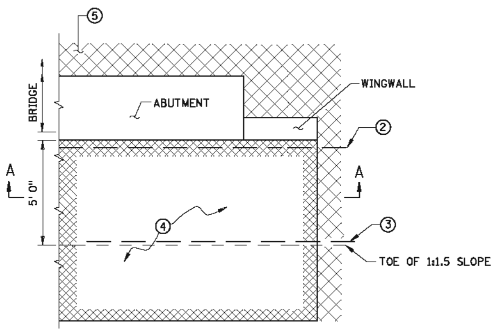
ELEVATION

ROUGH GRADING SECTION
(PRIOR TO ABUTMENT CONSTRUCTION)

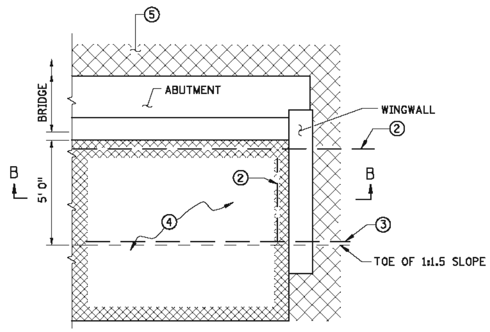
NOTES:

1. SUBSURFACE PIPE DRAIN. SEE GRADING PLAN FOR DETAILS. FURNISH AND INSTALL IF SHOWN IN GRADING PLAN.
2. QUANTITY OF SELECT GRANULAR MATERIAL MODIFIED 10% IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SELECT GRANULAR MATERIAL MODIFIED 10% SHALL COMPLY WITH SPEC. 3149.2B2, MODIFIED TO 10% OR LESS PASSING THE NUMBER 200 SIEVE. SEE GRADING PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES SHALL BE CONSIDERED INCIDENTAL.
3. PLACE ABUTMENT APPROACH SURCHARGE MATERIAL PRIOR TO ABUTMENT CONSTRUCTION. AFTER COMPLETION OF SURCHARGE WAITING PERIOD, REMOVE SURCHARGE AND EXISTING NATURAL GROUND OR SUITABLE GRADING MATERIAL TO THE LIMITS SHOWN IN "ROUGH GRADING SECTION" ABOVE, PRIOR TO ABUTMENT CONSTRUCTION. SEE BRIDGE PLANS AND SPECIAL PROVISIONS FOR ABUTMENT APPROACH SURCHARGE REQUIREMENT AND PAYMENTS.
4. SEE BRIDGE PLANS FOR SLOPE AND SLOPE PROTECTION.
5. SEE GRADING PLANS FOR TYPE OF MATERIAL.
6. START 1:20 TAPER AT END OF APPROACH PANEL. 1:20 VARIES WHEN APPROACH PANEL IS SKEWED.
7. GRADING TO BE SQUARED OFF ON SKEWED BRIDGES.
8. TOP OF 1:1.5 SLOPE (FORMS A LINE PARALLEL TO END OF BRIDGE).
9. SUBSURFACE PIPE DRAIN. SEE BRIDGE PLAN FOR STANDARD DETAIL B910 FOR DETAILS.
10. PLACE 12 MIL POLYETHYLENE SHEETING (OR TWO LAYERS OF OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCIDENTAL.

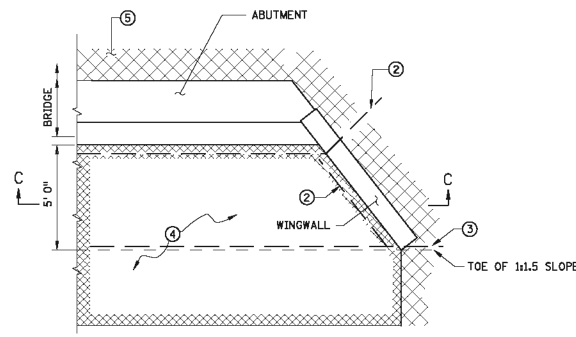
STANDARD SHEET NO. 5-297.234 (1 OF 2)	TITLE: **BRIDGE ABUTMENT APPROACH TREATMENT** FOR INTEGRAL ABUTMENTS
STANDARD APPROVED: AUGUST 1, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS



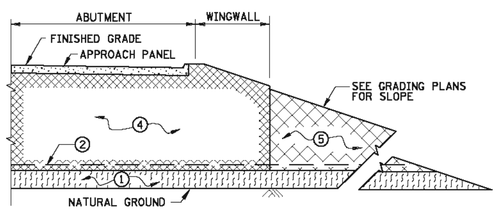
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT 180°) (FINISHED GRADING)



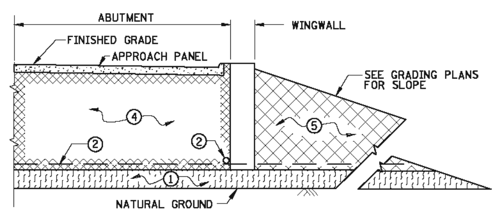
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT 90°) (FINISHED GRADING)



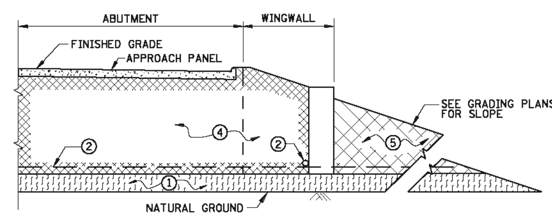
PARTIAL PLAN VIEW AT ABUTMENT
(WINGWALL AT ANY OTHER ANGLE) (FINISHED GRADING)



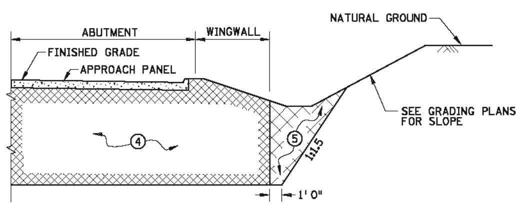
FINISHED GRADING SECTION A-A
(FILL SECTION)



FINISHED GRADING SECTION B-B
(FILL SECTION)



FINISHED GRADING SECTION C-C
(FILL SECTION)



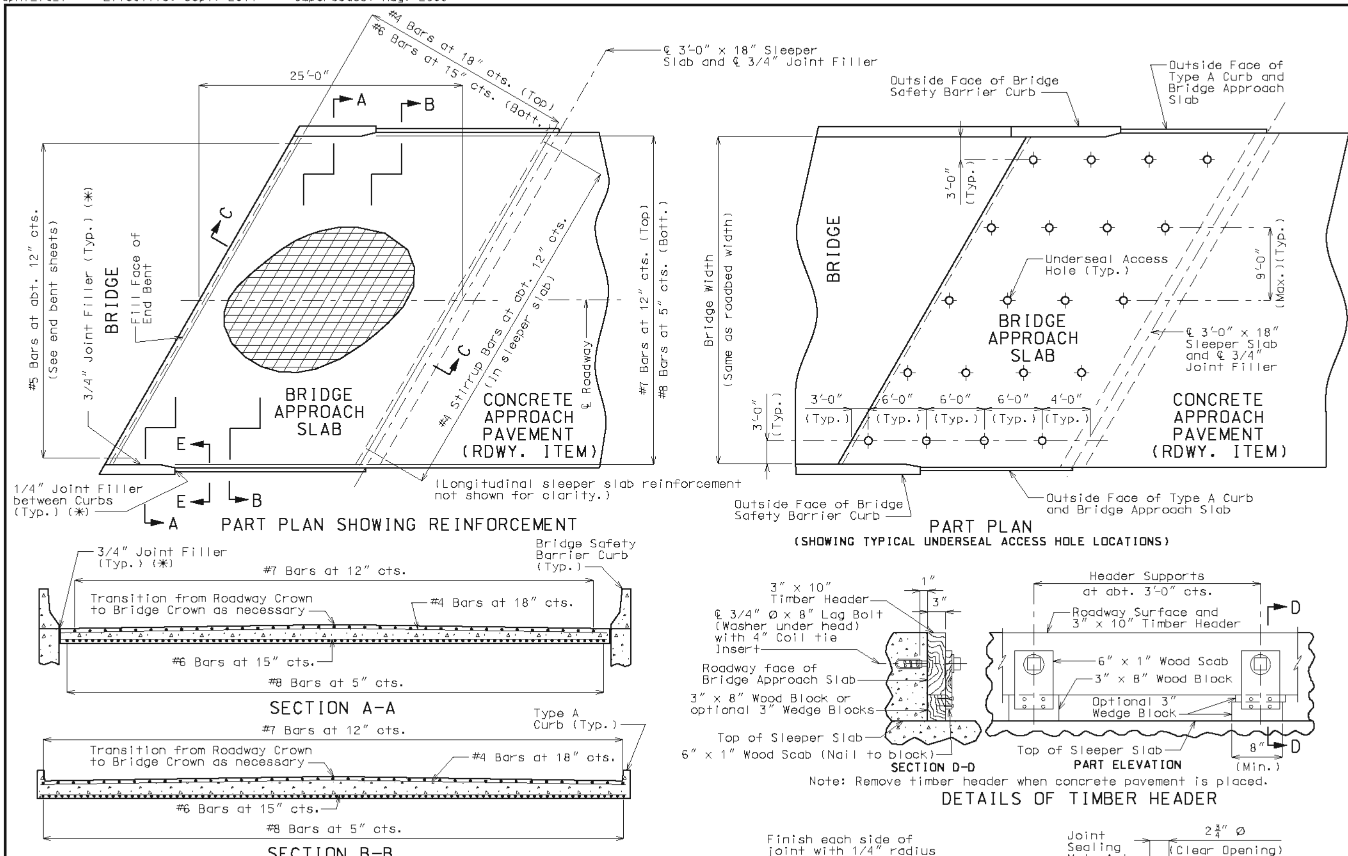
FINISHED GRADING SECTION A-A
(CUT SECTION)
(BRIDGE DETAIL B910 DRAIN NOT SHOWN)

NOTES:

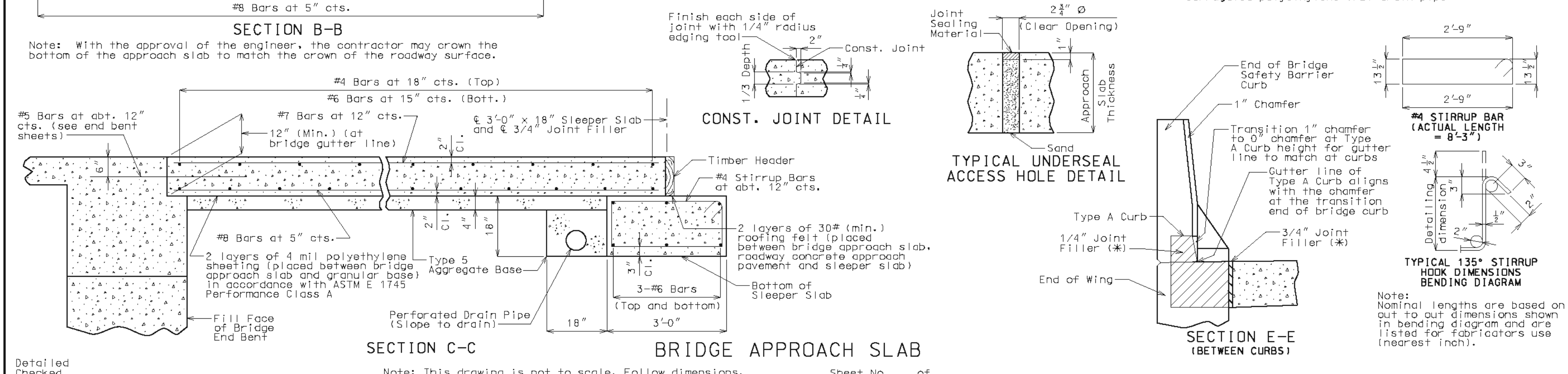
1. NATURAL GROUND OR SUITABLE GRADING MATERIAL.
2. SUBSURFACE PIPE DRAIN. SEE BRIDGE PLAN FOR STANDARD DETAIL B910 FOR DETAILS.
3. SUBSURFACE PIPE DRAIN. SEE GRADING PLAN FOR DETAILS. FURNISH AND INSTALL IF SHOWN IN GRADING PLAN.
4. QUANTITY OF SELECT GRANULAR MATERIAL MODIFIED 10% IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SELECT GRANULAR MATERIAL MODIFIED 10% SHALL COMPLY WITH SPEC. 3149.2B2, MODIFIED TO 10% OR LESS PASSING THE NUMBER 200 SIEVE. SEE GRADING PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES SHALL BE CONSIDERED INCIDENTAL.
5. SUITABLE GRADING MATERIAL.

STANDARD SHEET NO. 5-297.234 (2 OF 2)	TITLE: BRIDGE ABUTMENT APPROACH TREATMENT FOR INTEGRAL ABUTMENTS
STANDARD APPROVED: AUGUST 1, 2011	
STATE PROJ. NO.	(TH) SHEET NO. OF SHEETS

Missouri



Note: With the approval of the engineer, the contractor may crown the bottom of the approach slab to match the crown of the roadway surface.



Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).

BRIDGE APPROACH SLAB

Note: This drawing is not to scale. Follow dimensions.

Detailed
Checked

Sheet No. of

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✳) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

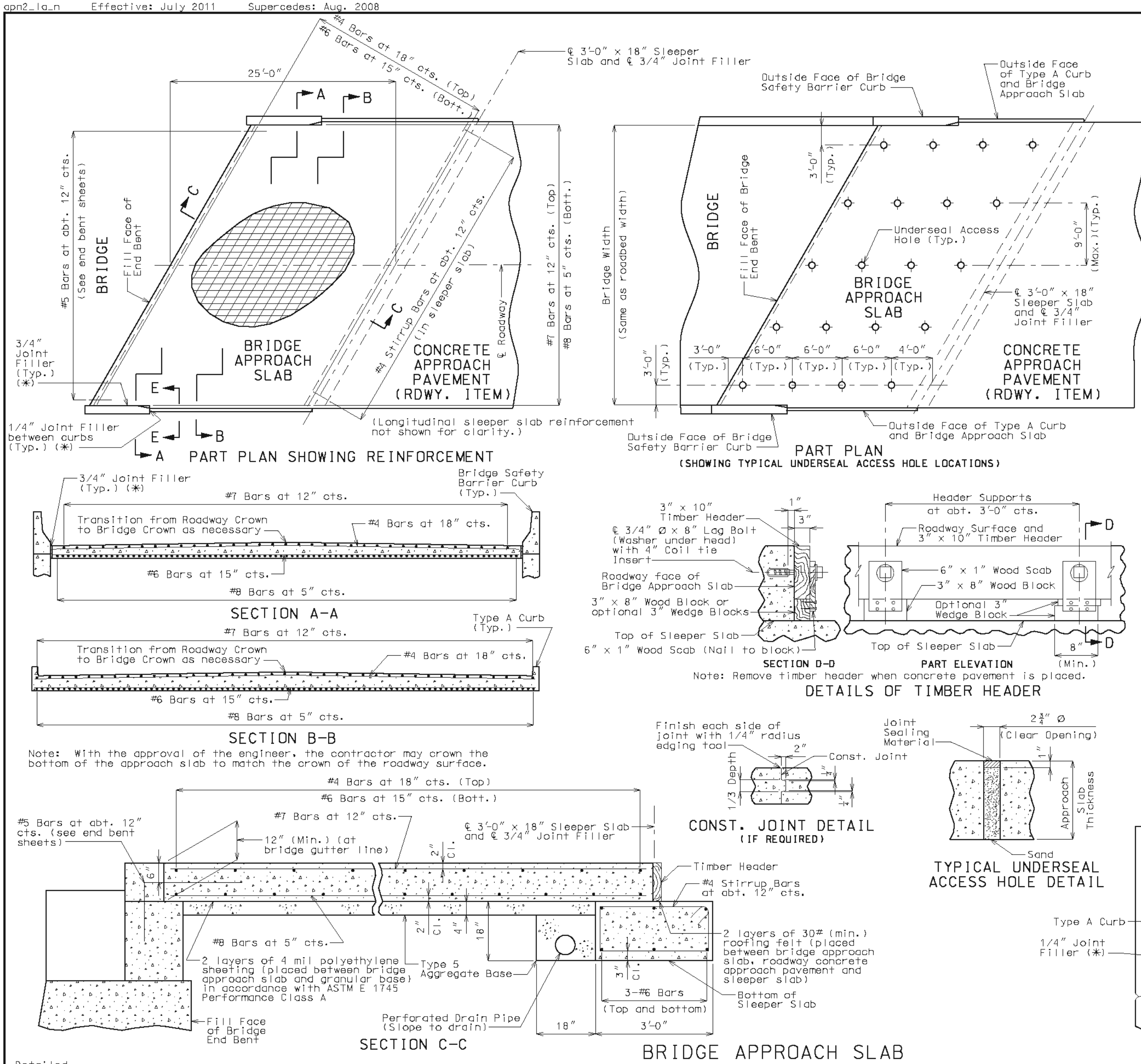
When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.

DATE PREPARED 9/30/2011
ROUTE ✳ STATE MO
DISTRICT BR SHEET NO. ✳
COUNTY ✳
JOB NO. ✳
CONTRACT ID.
PROJECT NO.
BRIDGE NO. APN 1

DESCRIPTION
DATE
REV.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)



GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✱) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

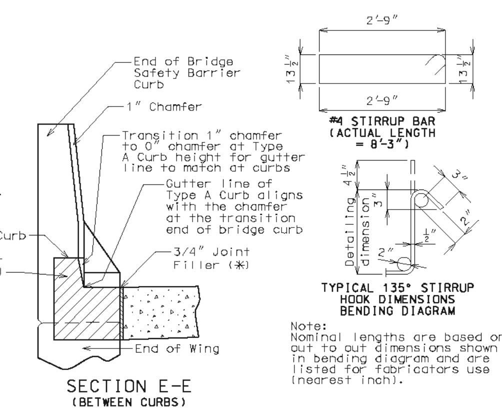
For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	9/30/2011
ROUTE ✱	STATE MO
DISTRICT BR	SHEET NO. ✱
COUNTY	✱
JOB NO.	✱
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN 2

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

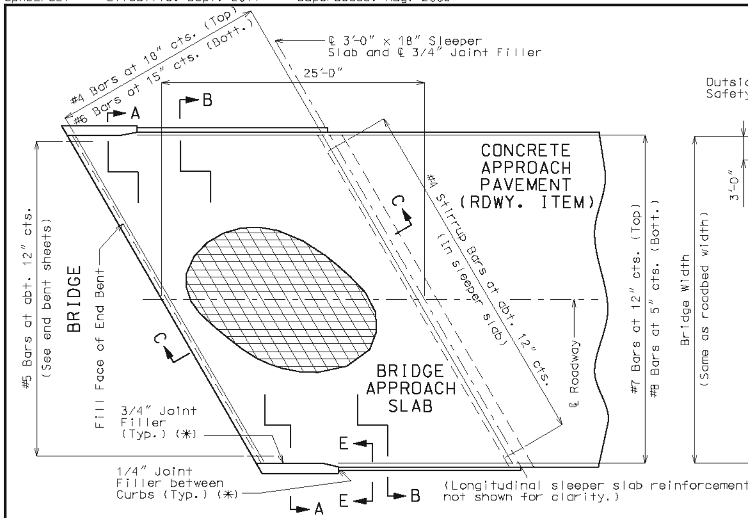
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

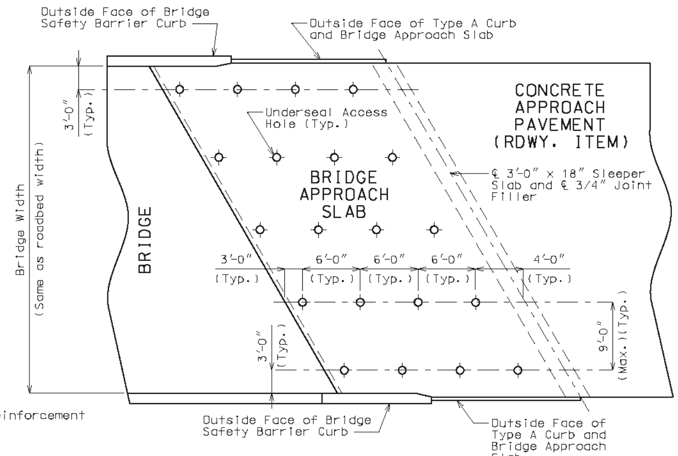
REV.

Detailed
Checked

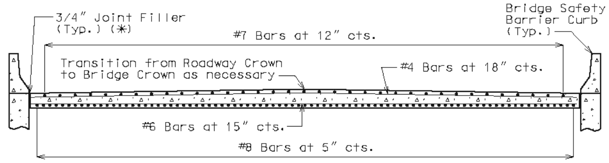
Note: This drawing is not to scale. Follow dimensions.



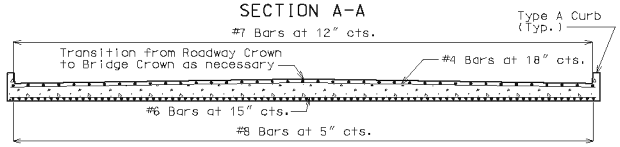
PART PLAN SHOWING REINFORCEMENT



PART PLAN
(SHOWING TYPICAL UNDERSEAL ACCESS HOLE LOCATIONS)

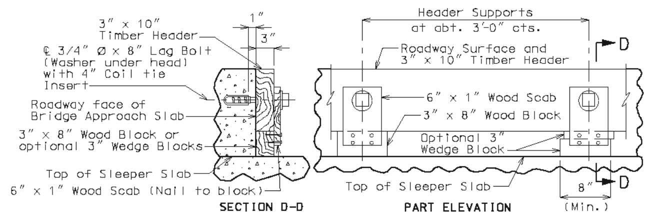


SECTION A-A



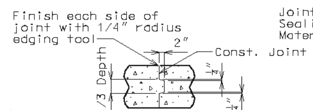
SECTION B-B

Note: With the approval of the engineer, the contractor may crown the bottom of the approach slab to match the crown of the roadway surface.

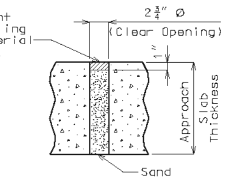


Note: Remove timber header when concrete pavement is placed.

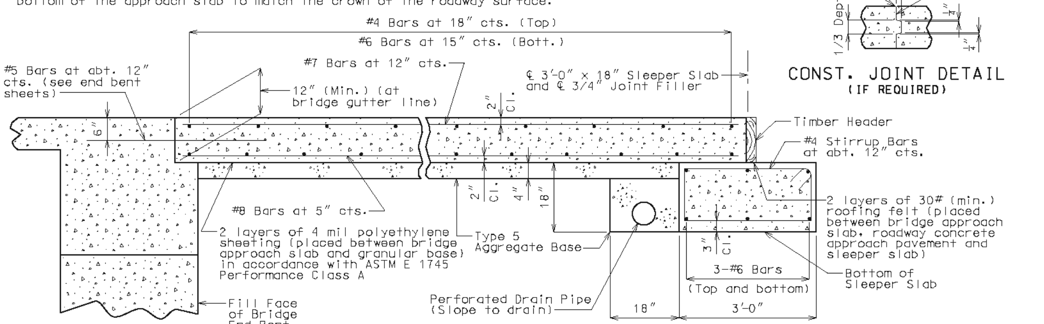
DETAILS OF TIMBER HEADER



CONST. JOINT DETAIL
(IF REQUIRED)



TYPICAL UNDERSEAL ACCESS HOLE DETAIL



SECTION C-C

BRIDGE APPROACH SLAB

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✳) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

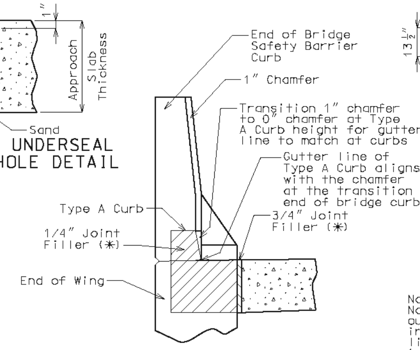
For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

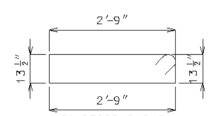
At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

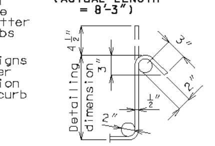
Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



SECTION E-E
(BETWEEN CURBS)



#4 STIRRUP BAR
(ACTUAL LENGTH = 8'-3")



TYPICAL 135° STIRRUP HOOK DIMENSIONS BENDING DIAGRAM

Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	9/30/2011
ROUTE ✳	STATE MO
DISTRICT BR	SHEET NO. ✳
COUNTY	✳
JOB NO.	✳
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN 3

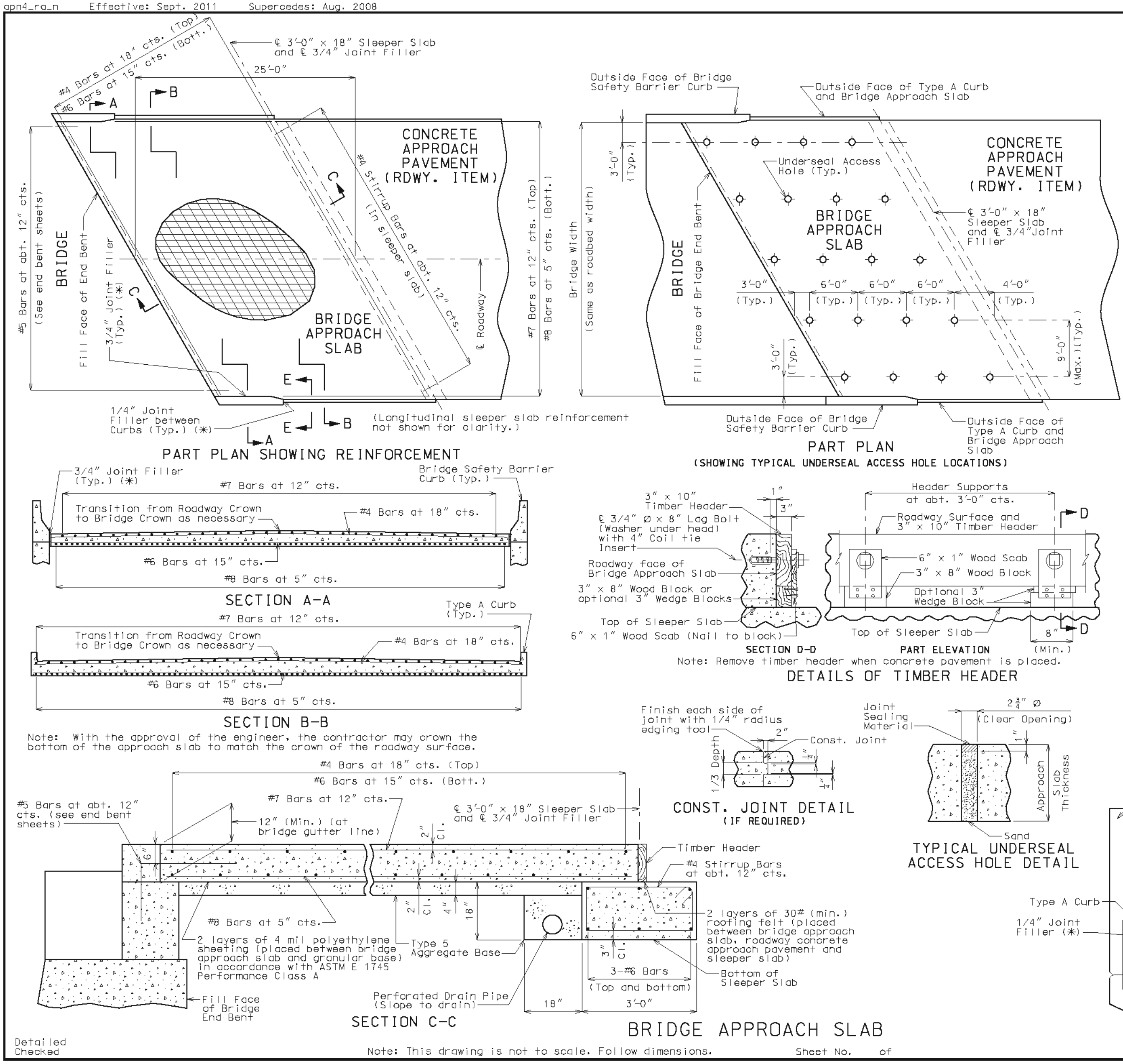
DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

Detailed
Checked

Note: This drawing is not to scale. Follow dimensions. Sheet No. of



GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✱) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

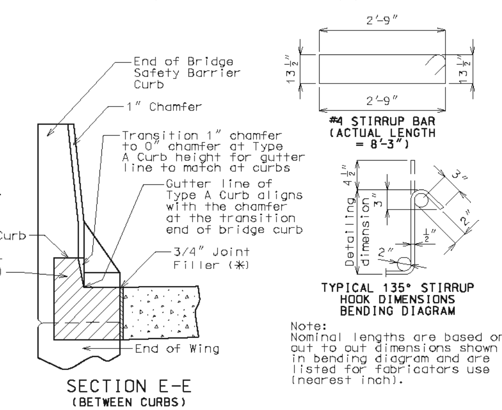
For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	9/30/2011
ROUTE ✱	STATE MO
DISTRICT BR	SHEET NO. ✱
COUNTY	✱
JOB NO.	✱
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN 4

DESCRIPTION DATE

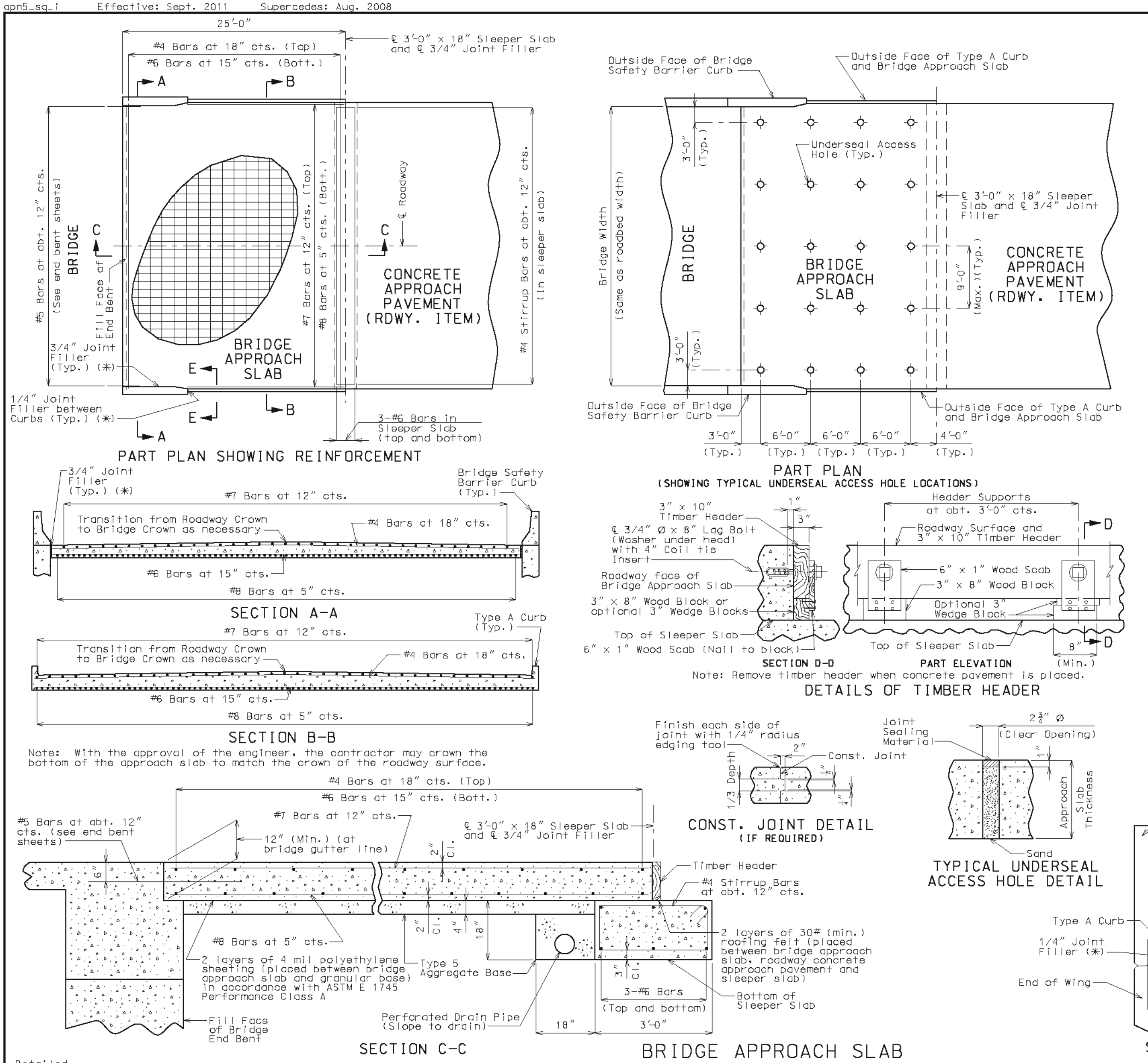
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL JEFFERSON CITY, MO 65102 1-888-ASK-MODOT (1-888-275-6636)

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

Detailed
Checked

Note: This drawing is not to scale. Follow dimensions. Sheet No. of



BRIDGE APPROACH SLAB

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✱) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

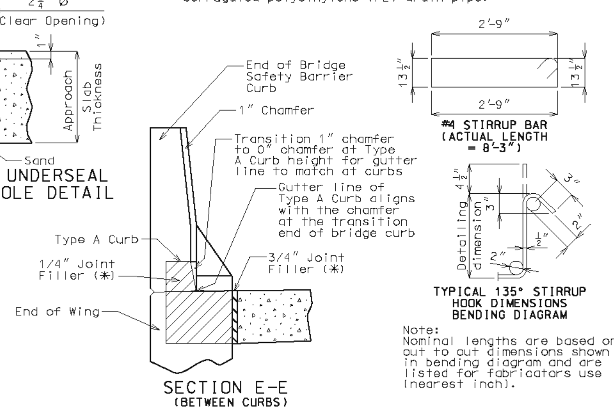
For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	9/30/2011
ROUTE ✱	STATE MO
DISTRICT BR	SHEET NO. ✱
COUNTY	✱
JOB NO.	✱
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN 5

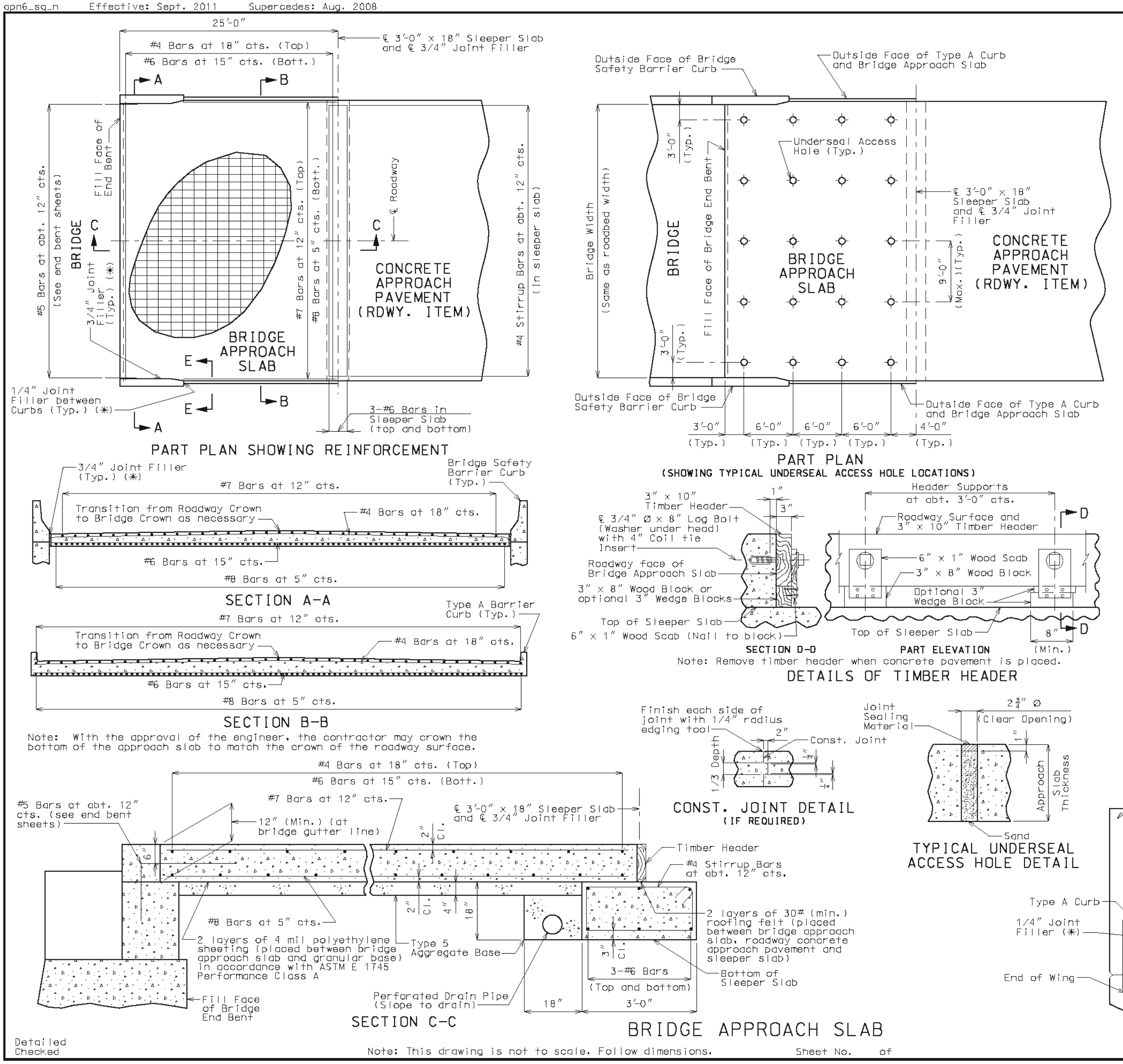
DATE DESCRIPTION

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

Detailed
Checked

Note: This drawing is not to scale. Follow dimensions.



BRIDGE APPROACH SLAB

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✱) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

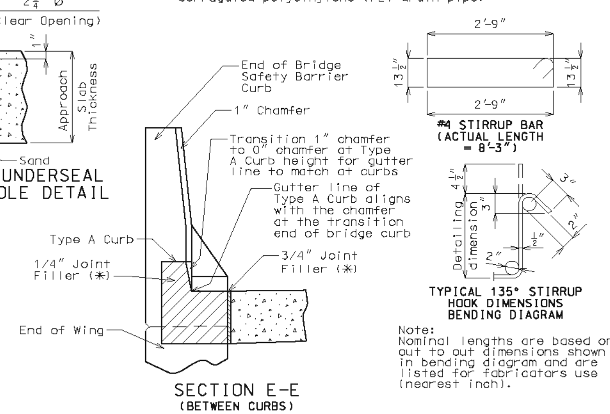
For Concrete Approach Pavement details, see roadway plans.

See Missouri Standard Plans Drawing 609.00 for details of Type A Curb.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	9/30/2011
ROUTE ✱	STATE MO
DISTRICT BR	SHEET NO. ✱
COUNTY	✱
JOB NO.	✱
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN 6

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

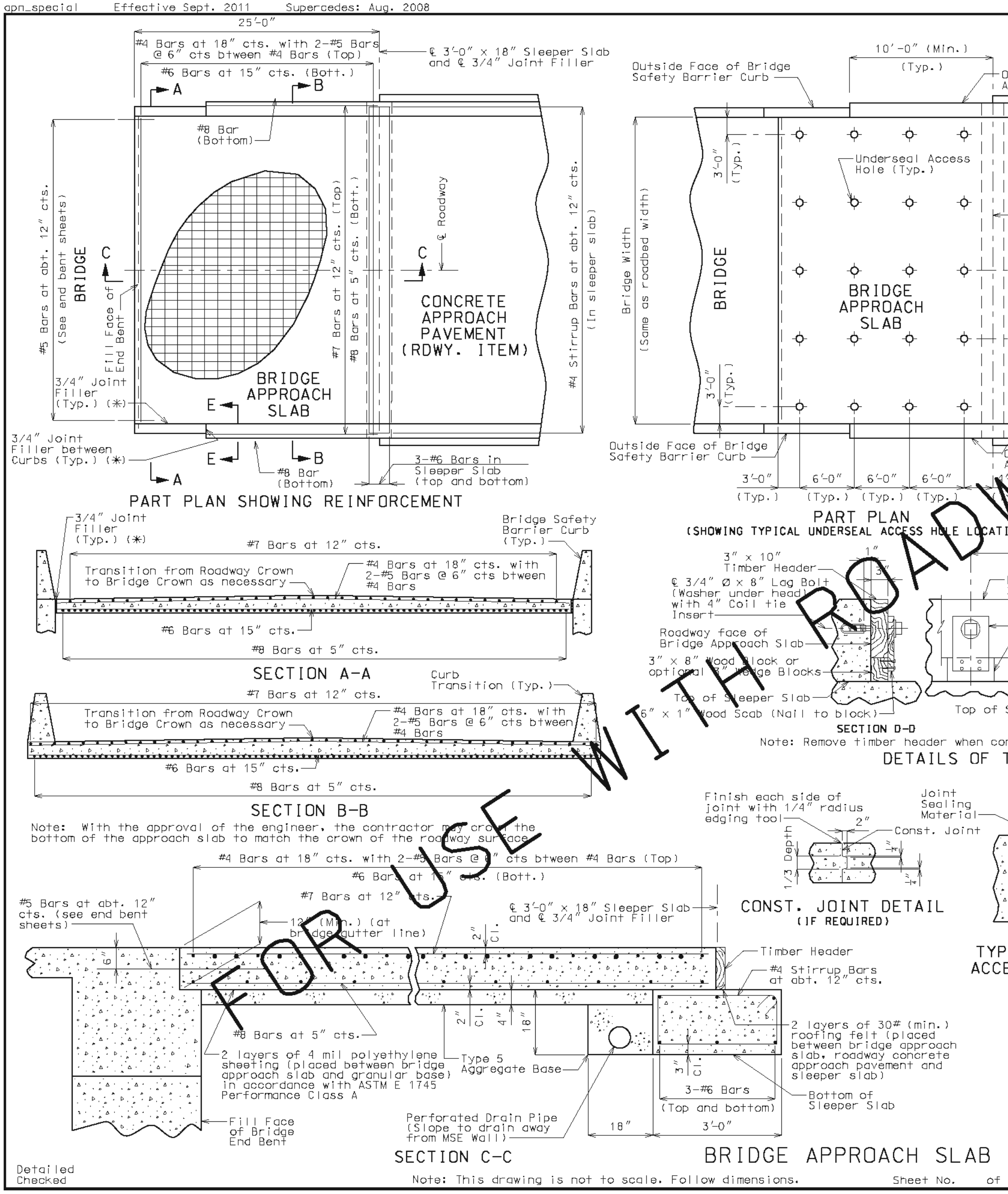
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

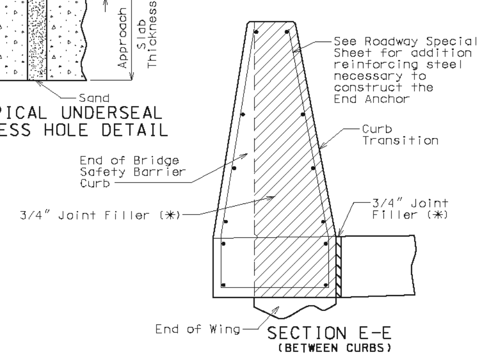
IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

Detailed
Checked

Note: This drawing is not to scale. Follow dimensions.

Sheet No. of





BRIDGE APPROACH SLAB

Note: This drawing is not to scale. Follow dimensions.

GENERAL NOTES:

All concrete for the bridge approach slab and sleeper slab shall be in accordance with Sec 503 (f'c = 4,000 psi).

All joint filler shall be in accordance with Sec 1057 for preformed fiber expansion joint filler, except as noted.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be epoxy coated Grade 60 with Fy = 60,000 psi.

Minimum clearance to reinforcing steel shall be 1 1/2", unless otherwise shown.

The reinforcing steel in the bridge approach slab and the sleeper slab shall be continuous. The transverse reinforcing steel may be made continuous by lap splicing the #4 & #6 bars 18" and 2'-2", respectively.

Mechanical bar splices shall be in accordance with Sec 706.

(✱) Seal joint between vertical face of approach slab and wing with "Silicone Joint Sealant for Saw Cut and Formed Joints" in accordance with Sec 717.

Hooks and bends shall be in accordance with the CRSI Manual of Standard Practice for Detailing Reinforced Concrete Structures, Stirrup and Tie Dimensions.

The contractor shall pour and satisfactorily finish the bridge or semi-deep slab before pouring the bridge approach slabs.

Longitudinal construction joints in approach slab and sleeper slab shall be aligned with longitudinal construction joints in bridge or semi-deep slab.

Payment for furnishing all materials, labor and excavation necessary to construct the approach slab, including the timber header, sleeper slab, underdrain, Type 5 aggregate base, joint filler and all other appurtenances and incidental work as shown on this sheet, complete in place, will be considered completely covered by the contract unit price for Bridge Approach Slab (Bridge) per square yard.

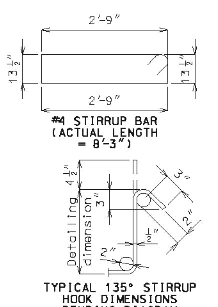
For Concrete Approach Pavement details, see roadway plans.

See Roadway Special Sheet for Permanent Concrete Traffic Barrier Atop MSE Wall.

At the contractor's option, Grade 40 reinforcement may be substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment. No additional payment will be made for this substitution.

When Grade 40 reinforcement is substituted for the Grade 60 #5 dowel bars connecting the bridge approach slab to the bridge abutment, the reinforcement may be bent up to 90 degrees with a 2" minimum radius near the abutment to allow compaction of the backfill material near the abutment. Damage to epoxy coating shall be repaired in accordance with Sec 710.

Drain pipe may be either 6" diameter corrugated metallic-coated pipe underdrain, 4" diameter corrugated polyvinyl chloride (PVC) drain pipe, or 4" diameter corrugated polyethylene (PE) drain pipe.



Note:
Nominal lengths are based on out to out dimensions shown in bending diagram and are listed for fabricators use (nearest inch).

DATE PREPARED	9/30/2011
ROUTE ✱	STATE MO
DISTRICT BR	SHEET NO. ✱
COUNTY	✱
JOB NO.	✱
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	APN SP

DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

Detailed
Checked

Sheet No. of

Nebraska

2.2.4 – Approach Slab Policy

General Design

Approach slabs will be required on all State projects. Plans and elevation views of approach sections should be shown on the General Plan and Elevation Sheet of Bridge Plans.

For bridges that are to be widened, the existing bridge and location should be investigated to determine any deviations from the standard approach layout.

Design Criteria

Approach Section

The approach section length shall be 20 ft. from the end of the bridge floor to CL grade beam; see Grade Beam Policy for more information. The approach section reinforcing details shall be as shown in Section 6 (6.12 thru 6.14), Approach Slab Base Sheets. The depth of the approach section shall be 14 in. and placed above the abutment wing; see Wing Policy for more information.

Paving Section

The paving section length shall be 30 ft. from CL grade beam to the road pavement along CL clear roadway. The joint between the paving section and the roadway shall be perpendicular to CL roadway. For wide bridges and/or large skew angles, Designers shall consult with the Assisant Bridge Engineer on a case-by-case basis.

The thickness of the paving section shall be 14 in. The reinforcing details shall be as shown in Section 6 (6.12 thru 6.14), Approach Slab Base Sheets.

If abutment wings extend beyond the grade beam, changing paving section layouts is not recommended.

Designers shall show elevations of the end of pavement sections at left edge, center and right edge.

Reinforcement Layout

Longitudinal bar spacing is always measured perpendicular to CL roadway and placement is parallel to the CL roadway. Designers should check longitudinal bar lengths to verify if the skew dictates a shorter bar. Field personnel indicated that omission of these slight skew adjustments have caused problems for joint installation. Transverse bar spacing is always measured parallel to CL roadway. Placement may be perpendicular to CL roadway or skewed.

Roadway Joint

When the roadway is concrete pavement, use 3 in. joint filler (Fiber Type) topped with ½ in. joint sealant and 1 ½ in. x 18 in. smooth tie bars at 12 in. centers. When the roadway is asphalt, no joint is required.

Expansion Joint

Joint systems will be placed between the approach section and paving section in the approach slab. For information on approved expansion joint systems, see Section 3.1.7, Expansion Device Policy.

One layer of SBS Modified Asphaltic Base Sheet placed on a steel troweled smooth surface will provide a bond breaker for bridge expansion between the approach section and the grade beam.

Longitudinal Joints

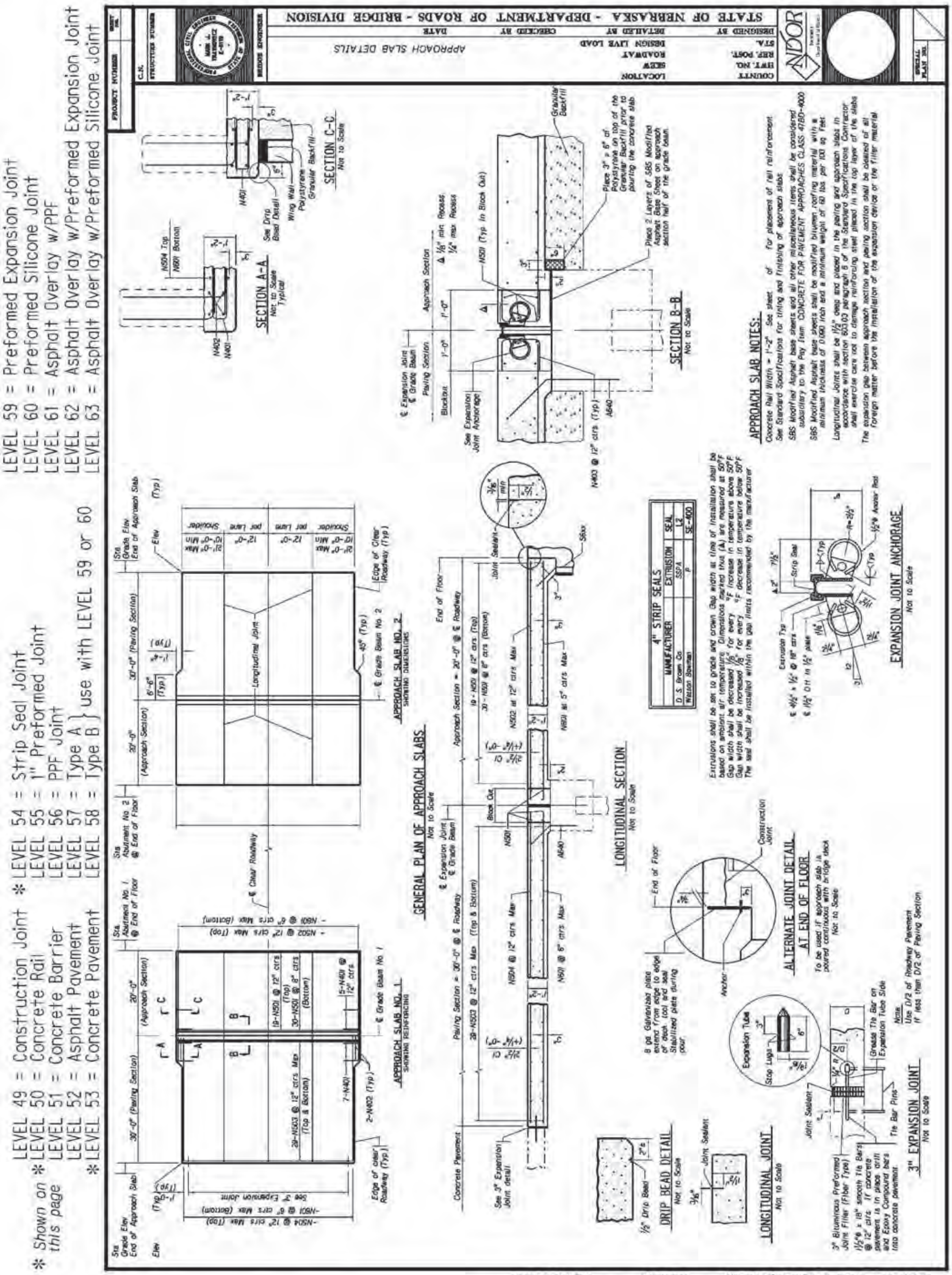
Longitudinal joints shall be placed in the approach and paving sections. Wide paving sections should have additional joints placed at the edge of the traffic lanes. Bridge Designers should check with the Roadway Designer for the exact location of the traffic lanes. The perpendicular distance between joints will not exceed 12 ft.

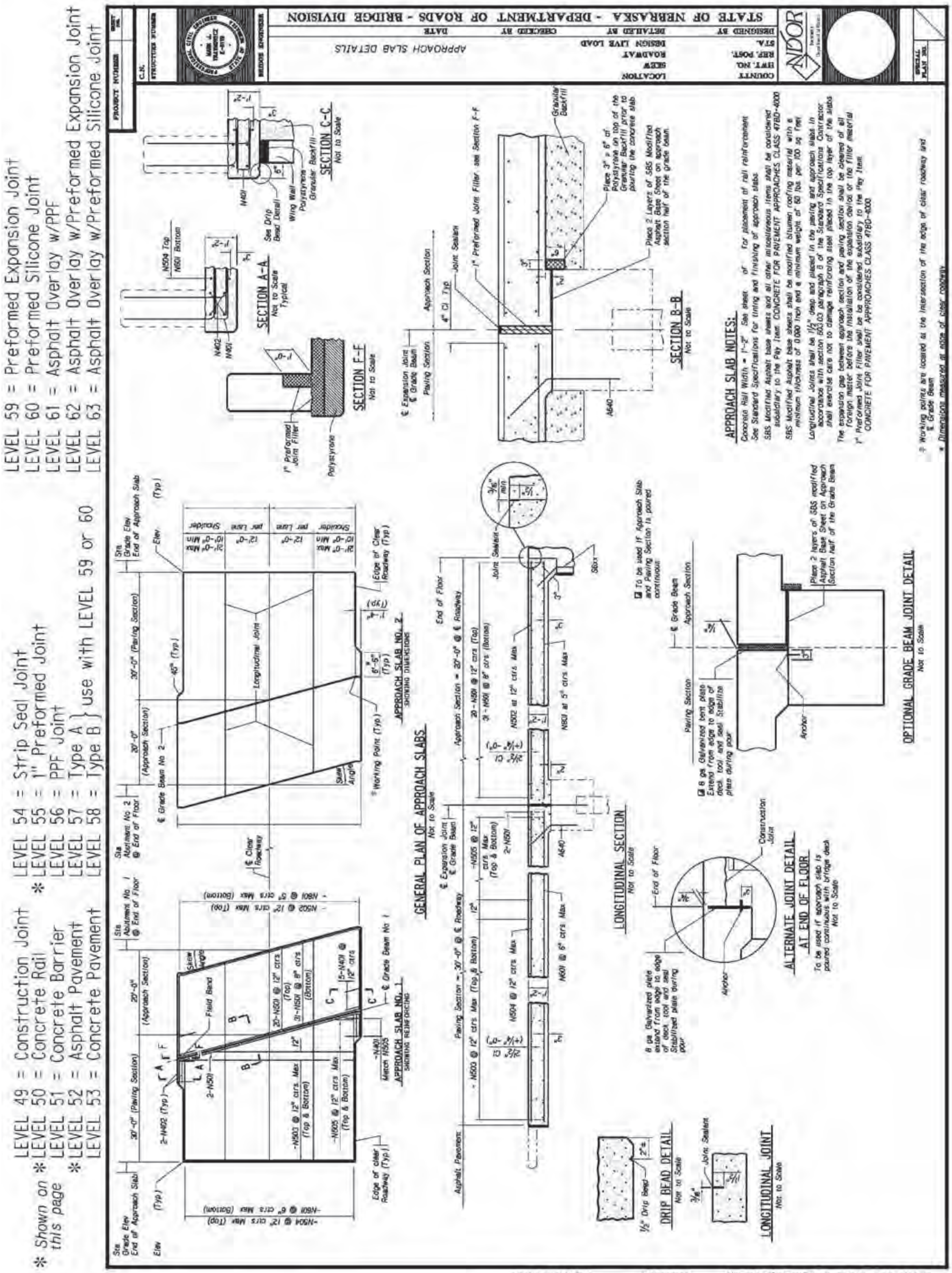
Payment

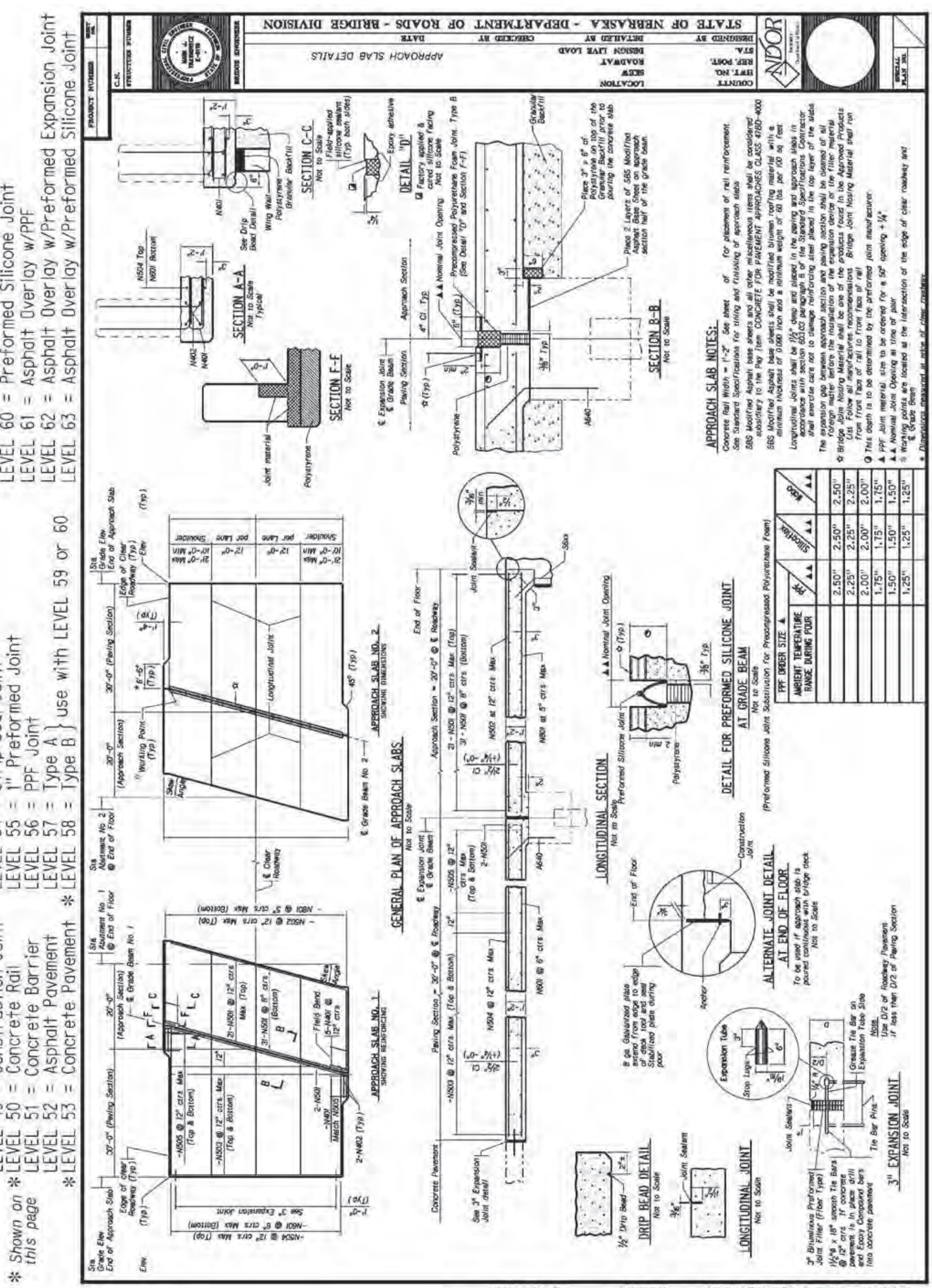
The Pay Items **“Concrete for Pavement Approaches Class 47BD-4000”** (CY) and **“Epoxy Coated Reinforcing Steel for Pavement Approaches”** (LB) includes all concrete and steel for placement of the paving and approach sections, and all rail attached to the approaches.

Bridge Base Sheets

There is one reference file available for the approaches; (see Section 6). Zero, RHB, and LHB skews are shown on Sheets A, B, and C, respectively (Section 6.12 thru 6.14).


* Shown on this page
* LEVEL 49 = Construction Joint
* LEVEL 50 = Concrete Rail
LEVEL 51 = Concrete Barrier
LEVEL 52 = Asphalt Pavement
* LEVEL 53 = Concrete Pavement
* LEVEL 54 = Strip Seal Joint
LEVEL 55 = 1" Preformed Joint
LEVEL 56 = PPF Joint
LEVEL 57 = Type A
LEVEL 58 = Type B
use with LEVEL 59 or 60
LEVEL 59 = Preformed Expansion Joint
LEVEL 60 = Preformed Silicone Joint
LEVEL 61 = Asphalt Overlay w/PPF
LEVEL 62 = Asphalt Overlay w/Preformed Expansion Joint
LEVEL 63 = Asphalt Overlay w/Preformed Silicone Joint
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION
APPROACH SLAB DETAILS
GENERAL PLAN OF APPROACH SLABS
APPROACH SLAB NO. 1
APPROACH SLAB NO. 2
LONGITUDINAL SECTION
SECTION A-A
SECTION B-B
SECTION C-C
APPROACH SLAB NOTES:
DRIP BEAD DETAIL
LONGITUDINAL JOINT
3" EXPANSION JOINT
ALTERNATE JOINT DETAIL AT END OF FLOOR
EXPANSION JOINT ANCHORAGE
4" STRIP SEALS

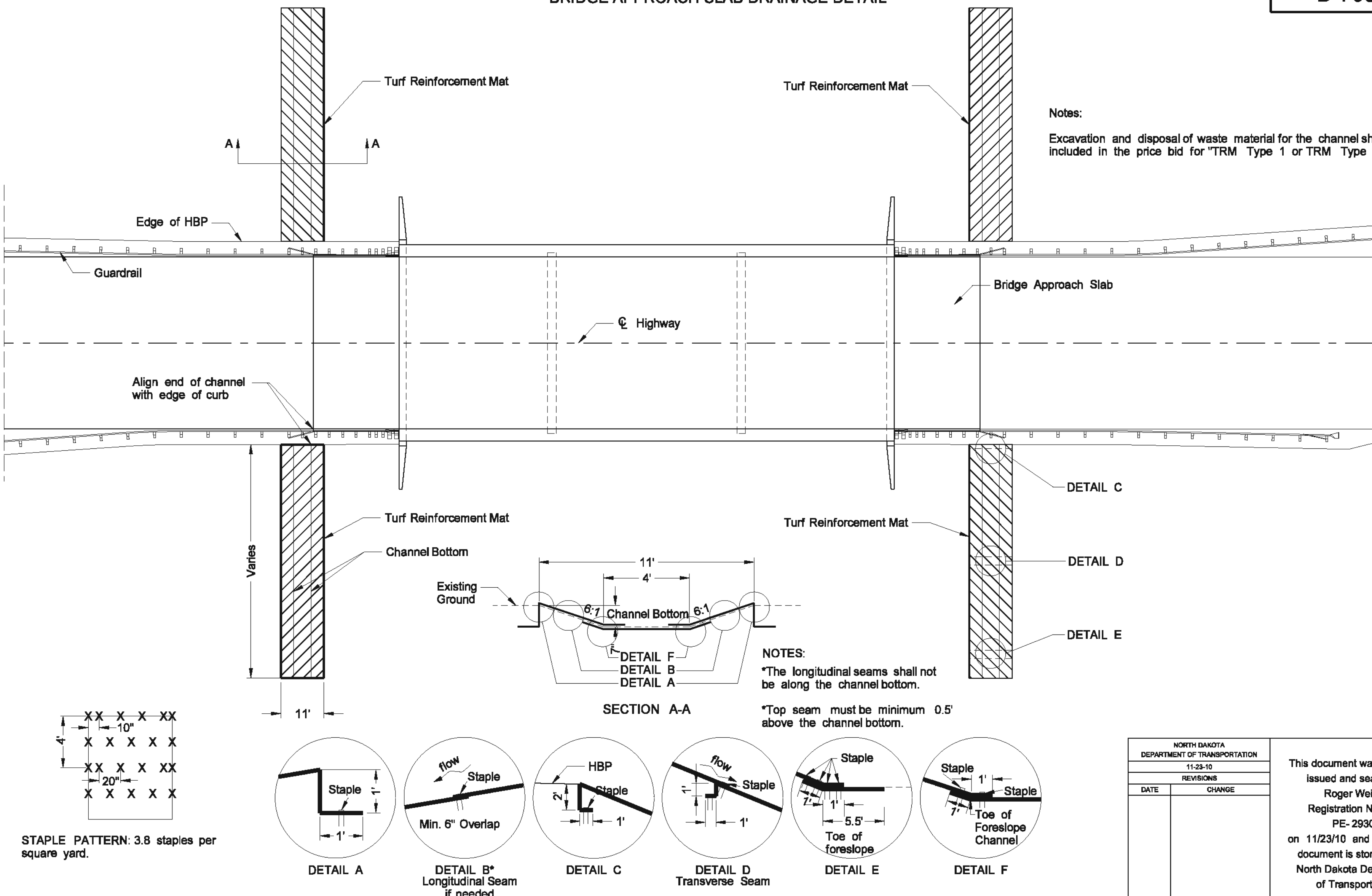

LEVEL 49 = Construction Joint
* LEVEL 50 = Concrete Rail
LEVEL 51 = Concrete Barrier
* LEVEL 52 = Asphalt Pavement
LEVEL 53 = Concrete Pavement
LEVEL 54 = Strip Seal Joint
* LEVEL 55 = 1" Preformed Joint
LEVEL 56 = PPF Joint
LEVEL 57 = Type A
LEVEL 58 = Type B } use with LEVEL 59 or 60
LEVEL 59 = Preformed Expansion Joint
LEVEL 60 = Preformed Silicone Joint
LEVEL 61 = Asphalt Overlay w/PPF
LEVEL 62 = Asphalt Overlay w/Preformed Expansion Joint
LEVEL 63 = Asphalt Overlay w/Preformed Silicone Joint
* Shown on this page
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION
APPROACH SLAB DETAILS
GENERAL PLAN OF APPROACH SLABS
APPROACH SLAB NO. 1
APPROACH SLAB NO. 2
LONGITUDINAL SECTION
ALTERNATE JOINT DETAIL AT END OF FLOOR
OPTIONAL GRADE BEAM JOINT DETAIL
DRIP BEAD DETAIL
LONGITUDINAL JOINT
SECTION A-A
SECTION B-B
SECTION C-C
SECTION F-F
APPROACH SLAB NOTES:


* Shown on this page
LEVEL 49 = Construction Joint
* LEVEL 50 = Concrete Rail
* LEVEL 51 = Concrete Barrier
LEVEL 52 = Asphalt Pavement
* LEVEL 53 = Concrete Pavement
LEVEL 54 = Strip Seal Joint
LEVEL 55 = 1" Preformed Joint
LEVEL 56 = PPF Joint
LEVEL 57 = Type A
* LEVEL 58 = Type B
use with LEVEL 59 or 60
* LEVEL 59 = Preformed Expansion Joint
LEVEL 60 = Preformed Silicone Joint
LEVEL 61 = Asphalt Overlay W/PPF
LEVEL 62 = Asphalt Overlay W/Preformed Expansion Joint
LEVEL 63 = Asphalt Overlay W/Preformed Silicone Joint
APPROACH SLAB DETAILS
STATE OF NEBRASKA - DEPARTMENT OF ROADS - BRIDGE DIVISION

North Dakota

BRIDGE APPROACH SLAB DRAINAGE DETAIL

D-708-4



Notes:

Excavation and disposal of waste material for the channel shall be included in the price bid for "TRM Type 1 or TRM Type 2".

NOTES:

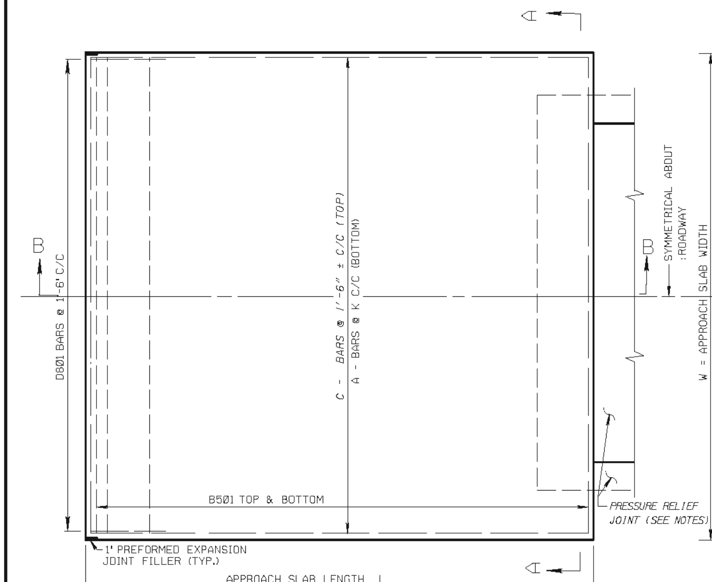
*The longitudinal seams shall not be along the channel bottom.

*Top seam must be minimum 0.5' above the channel bottom.

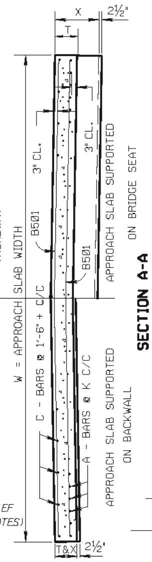
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION	
11-23-10	
REVISIONS	
DATE	CHANGE

This document was originally issued and sealed by Roger Weigel Registration Number PE-2930, on 11/23/10 and the original document is stored at the North Dakota Department of Transportation

Ohio

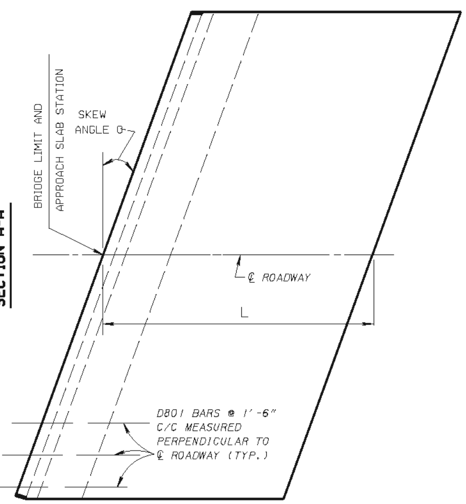


PLAN

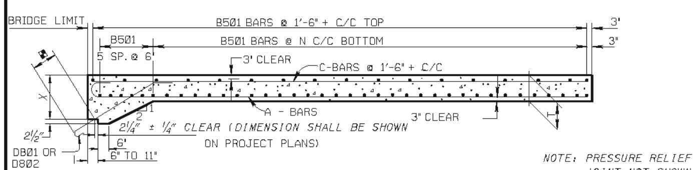


SECTION A-A

NOTE: X SHALL NEVER BE LESS THAN T



APPROACH SLAB FOR SKEWED STRUCTURE



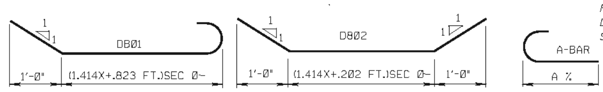
■ = (1'-3") SEC θ (AS MEASURED ALONG THE LENGTH OF THE D801 OR D802 BAR)

SECTION B-B

REINFORCING STEEL (FOR ONE APPROACH SLAB)

LENGTH L	THICK-NESS T	A-BARS SP'C'G K	A-BARS MARK	A-BARS LENGTH	A-BARS DIMENSION A	A-BARS NO. REQ'D.	B501 (BOTTOM) * LENGTH	B501 (BOTTOM) SP'C'G N	B501 (BOTTOM) NO. REQ'D.	B501 (TOP) * LENGTH	B501 (TOP) NO. REQ'D.	C-BARS MARK	C-BARS LENGTH	C-BARS NO. REQ'D.	D801 OR D802 NO. REQ'D.
15'-0"	12"	10"	A1001	15'-11"	14'-6"	$\frac{(W-0.5)\,12}{K}+1$	(W-0.5)sec θ	9"	22	(W-0.5)sec θ	11	C501	14'-6"	$\frac{(W-0.5)\,12}{18}+1$	$\frac{(W-0.5)\,12}{18}+1$
20'-0"	13"	7½"	A1002	20'-11"	19'-6"			8"	31		14	C502	19'-6"		
25'-0"	15"	7"	A1003	25'-11"	24'-6"			8"	39		18	C503	24'-6"		
30'-0"	17"	6½"	A1004	30'-11"	29'-6"			8½"	44		21	C504	29'-6"		

W = APPROACH SLAB WIDTH, OUT TO OUT, IN FEET
θ = ANGLE OF SKEW
K = A-BAR SPACING IN INCHES
N = B-BAR SPACING IN INCHES
X = APPROACH SLAB THICKNESS AT ABUTMENT END IN FEET
% = OUT TO OUT



GENERAL: THIS DRAWING PROVIDES DESIGN AND GENERAL CONSTRUCTION DETAILS. THE PROJECT PLANS WILL SHOW LENGTH, SKEW, CURBS (IF ANY), ESTIMATED QUANTITY (SQUARE YARDS), AND SPECIAL NOTES AND DETAILS WHERE NECESSARY. FOR CONDITIONS OTHER THAN THOSE INDICATED HEREON, THE APPROACH SLAB SHALL BE ADAPTED TO FIT THE ENDS OF THE BRIDGE AND THE APPROACH PAVEMENT.

THE D801 OR D802 ANCHOR BARS SHALL BE DIMENSIONED IN THE CONTRACT PLANS AND INCLUDED WITH ITEM 509 FOR PAYMENT FOR EACH SPECIFIC BRIDGE. D801 BARS CANNOT BE USED AS SHOWN IF APPROACH SLABS ARE SUPPORTED ON BACKWALLS LESS THAN 14 INCHES THICK. D802 BARS SHALL BE USED ON PRESTRESSED CONCRETE BOX BEAM BRIDGES WITH APPROACH SLABS SUPPORTED ON BACKWALLS 11 INCHES THICK.

D801 BARS CANNOT BE USED AS SHOWN WHERE APPROACH SLABS ARE SUPPORTED ON BACKWALLS LESS THAN 14 INCHES THICK. D802 BARS SHALL BE USED ON PRESTRESSED CONCRETE BOX BEAM BRIDGES WHERE THE APPROACH SLAB IS SUPPORTED ON AN 11 INCH THICK BACKWALL.

* AT THE OPTION OF THE CONTRACTOR AND AT NO ADDITIONAL COST TO THE STATE, B501 BARS MAY BE LAPPED 2'-6" MINIMUM AT THE CENTERLINE OF ROADWAY, OR WHERE REQUIRED FOR LONGITUDINAL CONSTRUCTION JOINTS, IN LIEU OF PROVIDING FULL LENGTH BARS AS SHOWN.

DESIGN SPECIFICATIONS: THIS STANDARD DRAWING CONFORMS TO "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES" ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, 1996, INCLUDING THE 1997, 1998 & 1999 INTERIM SPECIFICATIONS AND THE ODOT BRIDGE DESIGN MANUAL.

DESIGN DATA:
DESIGN LOADING: DEAD LOAD - 60 LB/FT^2 (F.W.S.)
LIVE LOAD - HS25 AND THE ALTERNATE MILITARY LOADING.

CONCRETE - COMPRESSIVE STRENGTH = 4500 PSI.

REINFORCING STEEL - MIN. YIELD STRENGTH = 60,000 PSI.

REINFORCING STEEL FOR SKEWED BRIDGES: THE A AND C BARS SHALL BE PLACED PARALLEL TO THE CENTER LINE OF ROADWAY AND THE B BARS SHALL BE PLACED PARALLEL TO THE ABUTMENTS.

LONGITUDINAL CONSTRUCTION JOINTS REQUIRED FOR STAGE CONSTRUCTION SHALL BE ACCORDING TO 511.

CURBS, BRIDGES WITH SIDEWALKS : FOR BRIDGES CONSTRUCTED WITH RAISED SIDEWALKS, DEFLECTOR PARAPETS OR OTHER TYPES OF CONSTRUCTION WHICH RETAIN ROADWAY SURFACE DRAINAGE, THE APPROACH SLABS SHALL EITHER INCLUDE INTEGRAL CURBS OR BE CONSTRUCTED IN CONJUNCTION WITH BRIDGE CURBS. CURB HEIGHT SHALL BE TRANSITIONED UNIFORMILY BETWEEN BRIDGE CURB HEIGHT AND ROADWAY CURB HEIGHT IN A LENGTH AS FOLLOWS: WHERE WINGWALL EXTENDS BEYOND END OF APPROACH SLAB, USE A MINIMUM LENGTH OF 10 FEET BEYOND END OF WINGWALL. WHERE THE APPROACH SLAB EXTENDS BEYOND THE END OF WINGWALL,TRANSITION IN THIS LENGTH. HOWEVER, THE TRANSITION LENGTH SHALL NOT BE LESS THAN 10 FEET AND THE TRANSITION SHALL EXTEND BEYOND THE END OF APPROACH SLAB IF NECESSARY.

APPROACH SLAB WIDTH (W): APPROACH SLABS SHALL BE THE SAME WIDTH AS THE BRIDGE ROADWAY.

APPROACH SLAB LENGTH (L): THE LENGTH SHOULD BE BASED ON FACTORS SUCH AS THE SIZE AND AMOUNT OF EXCAVATION BEHIND THE ABUTMENTS, NEW OR EXISTING EMBANKMENTS AND SKEW OF THE BRIDGE. THE LENGTH SHALL BE SHOWN ON THE PROJECT PLANS.

DECK CROWN AND SLOPE: THE LOCATION OF THE CROWN POINT AND THE RATE OF CROSS SLOPE ON THE APPROACH SLAB SHALL CONFORM TO THAT OF THE BRIDGE DECK AND APPROACH PAVEMENT. IF THE RATE OF CROSS SLOPE OF THE BRIDGE DECK DIFFERS FROM THAT OF THE APPROACH PAVEMENT, A SMOOTH TRANSITION SHALL BE PROVIDED WITHIN THE LIMITS OF THE APPROACH SLAB WHENEVER POSSIBLE.

WEARING SURFACE: GENERALLY APPROACH SLABS SHALL HAVE AN ASPHALT CONCRETE WEARING SURFACE ONLY WHEN BOTH THE APPROACH PAVEMENT SURFACE AND THE BRIDGE WEARING SURFACE ARE ASPHALT CONCRETE.

PRESSURE RELIEF JOINTS: RELIEF JOINTS, TYPE A, ARE TO BE PROVIDED REGARDLESS OF ABUTMENT DESIGN AT ALL BRIDGE APPROACHES WHERE APPROACH PAVEMENT IS RIGID, OR COMPOSITE CONSISTING OF A RIGID BASE. SEE STANDARD CONSTRUCTION DRAWING BP-2.3 FOR DETAILS

BASIS OF PAYMENT: IN ADDITION TO THE INCIDENTAL ITEMS LISTED IN 526.08, THE DEPARTMENT WILL INCLUDE THE FOLLOWING ITEMS FOR PAYMENT: THE PREFORMED EXPANSION JOINT FILLER AND JOINT SEALER AT THE CORNERS AND SIDES OF THE APPROACH SLAB; AND THE TYPE "A" WATERPROOFING AND THE PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL AT THE BRIDGE LIMIT END OF THE APPROACH SLAB.

THE DEPARTMENT WILL PAY FOR THE PRESSURE RELIEF JOINTS AND ANCHOR BARS (D801 OR D802) SEPARATELY.

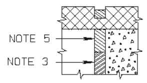
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
ENGINEER OF BRIDGES
10-25-94
DATE

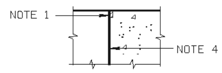
REVIEWED LMW
CHECKED JAM
DESIGNED JFF
DRAWN JFF
REVISIONS 09-15-94 04-20-01 07-19-02 01-18-13

AS-1-81

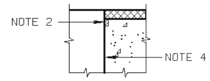
STANDARD
REINFORCED CONCRETE APPROACH SLAB



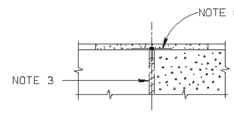
DETAIL A



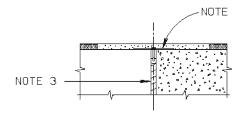
DETAIL B



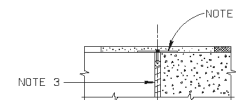
DETAIL C



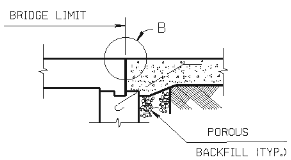
DETAIL D



DETAIL E

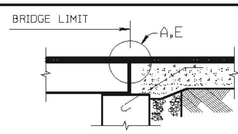


DETAIL F

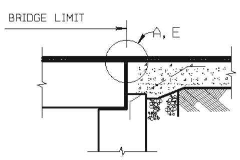


ON SLAB BRIDGES

CONCRETE WEARING SURFACE ON BRIDGE DECK AND APPROACH SLAB

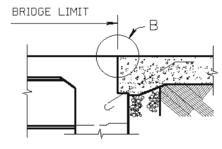


ON PRESTRESSED CONCRETE BOX BEAM BRIDGES ●

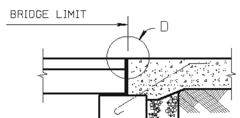


APPROACH SLAB SUPPORTED ON ABUTMENT BACKWALL

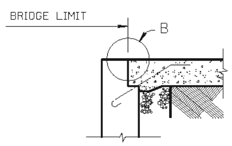
ASPHALT CONCRETE WEARING SURFACE ON BRIDGE DECK AND APPROACH SLAB



ON BRIDGES WITH INTEGRAL CONSTRUCTION
(SEMI-INTEGRAL SIMILAR)

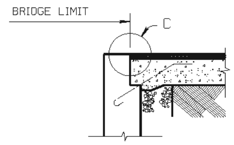


ON PRESTRESSED CONCRETE BOX BEAM BRIDGES ●

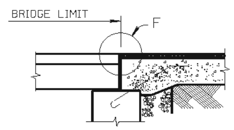


APPROACH SLAB SUPPORTED ON ABUTMENT BACKWALL

CONCRETE WEARING SURFACE ON BRIDGE DECK AND APPROACH SLAB



APPROACH SLAB SUPPORTED ON ABUTMENT BACKWALL



ON PRESTRESSED CONCRETE BOX BEAM BRIDGES ●

CONCRETE WEARING SURFACE ON BRIDGE DECK ONLY

● - THE APPROACH SLAB SEAT FOR THIS PRESTRESSED CONCRETE BOX BEAM BRIDGE IS SHOWN AT THE SAME ELEVATION AS THE BEAM SEAT. HOWEVER, IT MAY ACTUALLY BE HIGHER OR LOWER THAN THE BEAM SEAT DEPENDING ON THE BOX BEAM DEPTH.

NOTE 1: PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL, 705.11 (1¼" WIDE FOR A ½" WIDE GROOVE) PLACED IN ½" x 2¼" GROOVE.

NOTE 2: PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL, 705.11 (1¼" WIDE FOR A ½" WIDE GROOVE) PLACED IN ½" x 2⅛" GROOVE.

NOTE 3: 1" PREFORMED EXPANSION JOINT FILLER, 705.03.

NOTE 4: TYPE "A" WATERPROOFING.

NOTE 5: SEE PLAN INSERT SHEET, "ABUTMENT JOINTS IN BITUMINOUS CONCRETE, BOX BEAM BRIDGES."

NOTE 6: SEE PLAN INSERT SHEET, "POLYMER MODIFIED ASPHALT EXPANSION JOINT SYSTEM."

TYPE "A" WATERPROOFING SHALL NOT EXTEND ABOVE THE BOTTOM OF THE GROOVE INTO WHICH THE PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL IS TO BE PLACED. IT SHALL BE APPLIED TO THE ENTIRE AREA OF THE ABUTMENT OR SUPERSTRUCTURE WHICH COMES INTO CONTACT WITH THE APPROACH SLAB.

FOR PRESTRESSED CONCRETE BOX BEAM BRIDGES WITH ASPHALT CONCRETE ON BOTH BRIDGE DECK AND APPROACH SLAB, THE TOP OF APPROACH SLAB AT THE BRIDGE END SHALL BE CONSTRUCTED TO THE LEVEL OF THE TOP OF THE BEAMS TO FACILITATE WATERPROOFING OF THE JOINT. THE THICKNESS OF ASPHALT CONCRETE AT THE APPROACH END OF THE SLAB SHALL BE THE THICKNESS OF ASPHALT CONCRETE USED ON THE ROADWAY PAVEMENT. THE THICKNESS OF ASPHALT CONCRETE SHALL VARY UNIFORMLY, IF NECESSARY, IN THE LENGTH OF THE APPROACH SLAB. THE SUBGRADE (SUBBASE) SHALL BE GRADED TO PERMIT THE BOTTOM OF THE APPROACH SLAB TO BE PARALLEL TO THE TOP.

FOR STRUCTURES WITHOUT STRIP SEAL, COMPRESSION SEAL OR POLYMER MODIFIED ASPHALT EXPANSION JOINTS, THAT HAVE AN ASPHALT CONCRETE WEARING SURFACE ON BOTH THE BRIDGE DECK AND APPROACH SLAB, EXTEND THE DECK WATERPROOFING 2'-0" BEYOND THE BRIDGE LIMITS. FOR STRUCTURES WITH STRIP SEAL AND COMPRESSION SEAL EXPANSION JOINTS, END THE DECK WATERPROOFING AT THE PRESTRESSED BOX BEAM NOTCH. FOR STRUCTURES WITH POLYMER MODIFIED ASPHALT EXPANSION JOINTS, EXTEND THE DECK WATERPROOFING TO THE CENTERLINE OF THE JOINT.

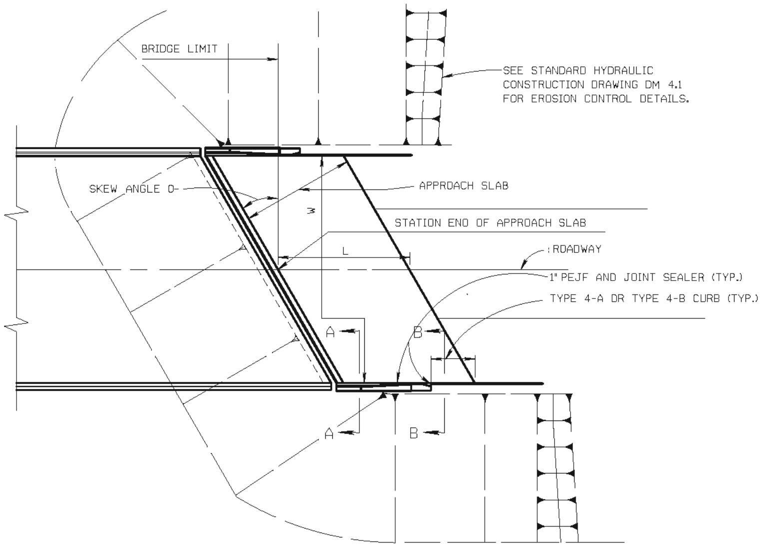
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
ENGINEER OF BRIDGES
10-25-94
DATE

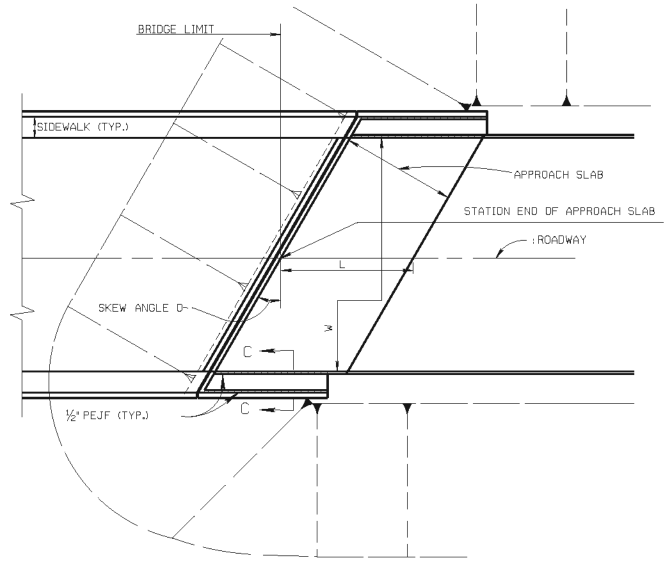
REVIEWED LMW
CHECKED JAM
DESIGNED JFF
DRAWN JFF
AS-1-81

REVISIONS
09-15-94
04-20-01
07-19-02
01-18-13

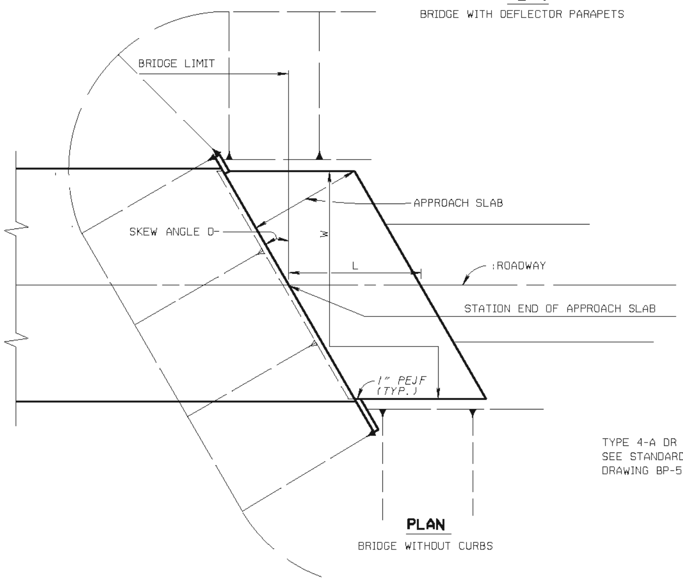
STANDARD
REINFORCED CONCRETE APPROACH SLAB



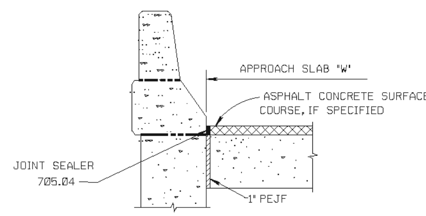
PLAN
BRIDGE WITH DEFLECTOR PARAPETS



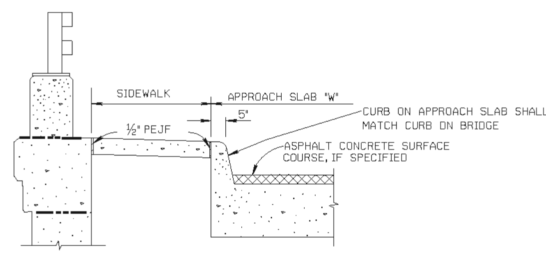
PLAN
BRIDGE WITH SIDEWALKS



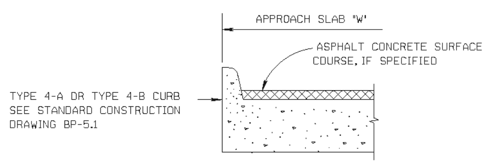
PLAN
BRIDGE WITHOUT CURBS



SECTION A-A



SECTION C-C



SECTION B-B

LEGEND

W= APPROACH SLAB WIDTH, OUT TO OUT, IN FEET.

L= APPROACH SLAB LENGTH.

PEJF = PREFORMED EXPANSION JOINT FILLER.

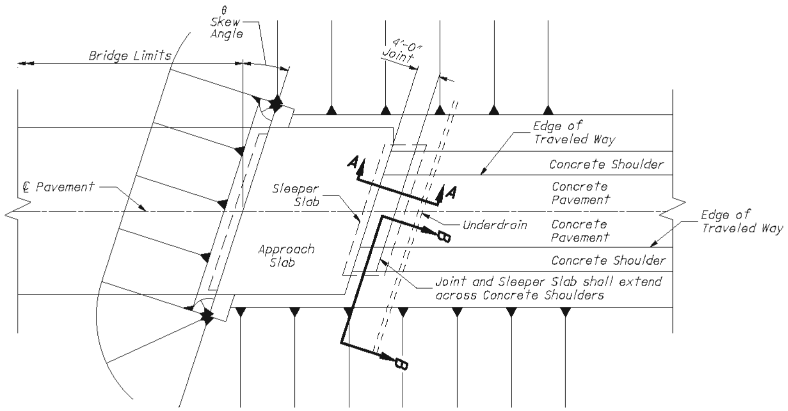
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
ENGINEER OF BRIDGES
10-25-94
DATE

REVIEWED LMW
CHECKED JAM
DESIGNED JFF
DRAWN JFF
AS-1-81

REVISIONS
09-15-94
04-20-01
07-19-02
01-18-13

STANDARD
REINFORCED CONCRETE APPROACH SLAB



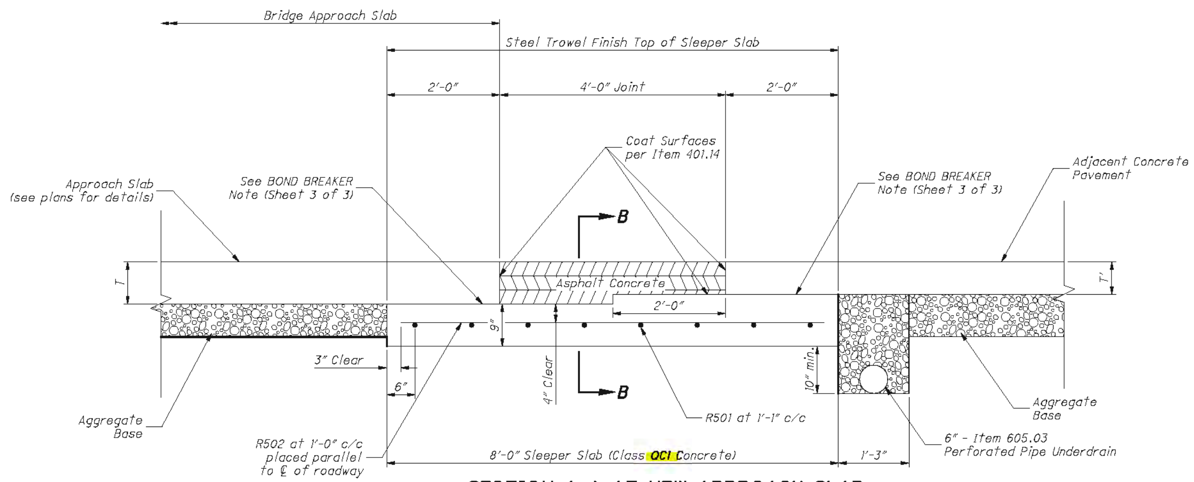
PLAN VIEW
PRESSURE RELIEF JOINT - TYPE A
AT NEW APPROACH SLAB

(Concrete Shoulders shown)

REINFORCING STEEL LIST			
Mark	**Shape**	**Number**	**Length**
R501 [1]	Straight	8	S - 0.5'
R502	Straight	$N = \frac{S}{1'}$	$\frac{8'}{\cos\theta}$

S = Length of sleeper slab in feet

[1] R501 bars may be furnished in segments with a 1'-7" bar lap between segments.



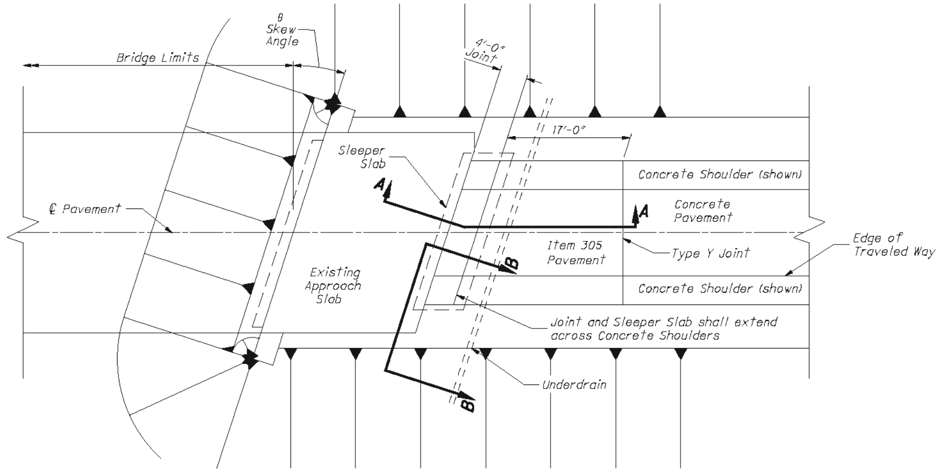
T = Thickness of Approach Slab as Shown in the Plans

T' = Design Pavement Thickness as Shown in The Plans.

SECTION A-A AT NEW APPROACH SLAB

THIS DRAWING REPLACES BP-2.3 DATED 7-16-04.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
ADMINISTRATOR
7-19-2013
DATE
STDS. ENGINEER D. MILLER
OFFICE OF PAVEMENT ENGINEERING
STANDARD ROADWAY CONSTRUCTION DRAWING
PRESSURE RELIEF JOINT TYPE A (at New Approach Slab)
SCD NUMBER
BP-2.3



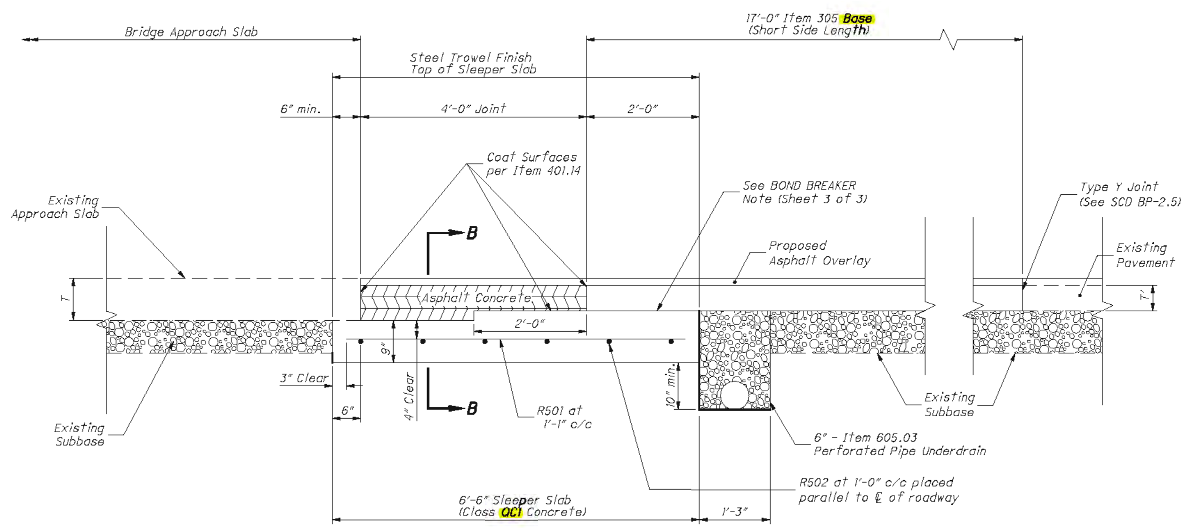
PLAN VIEW
PRESSURE RELIEF JOINT - TYPE A
AT EXISTING APPROACH SLAB
(Concrete Shoulders shown)

REINFORCING STEEL LIST

Mark	Shape	Number	Length
R501 [1]	Straight	6	S - 0.5'
R502	Straight	$N = \frac{S}{1'}$	$\frac{6'}{\cos\theta}$

S = Length of sleeper slab in feet

[1] R501 bars may be furnished in segments with a 1'-7" bar lap between segments.



SECTION A-A AT EXISTING APPROACH SLAB

T = Thickness of Approach Slab as Shown in the Plans

T' = Design Pavement Thickness as Shown in The Plans.

THIS DRAWING REPLACES BP-2.3 DATED 7-16-04.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

7-19-2013
DATE

ADMINISTRATOR

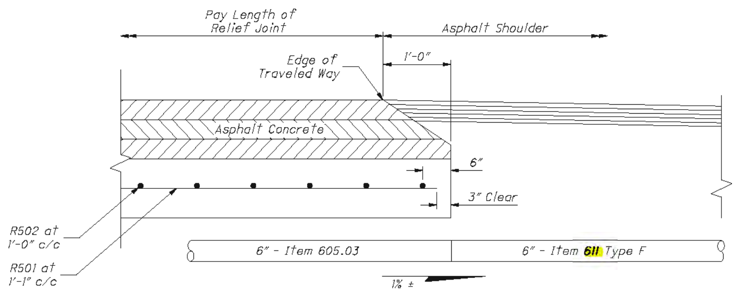
STDS. ENGINEER D. MILLER

OFFICE OF PAVEMENT ENGINEERING

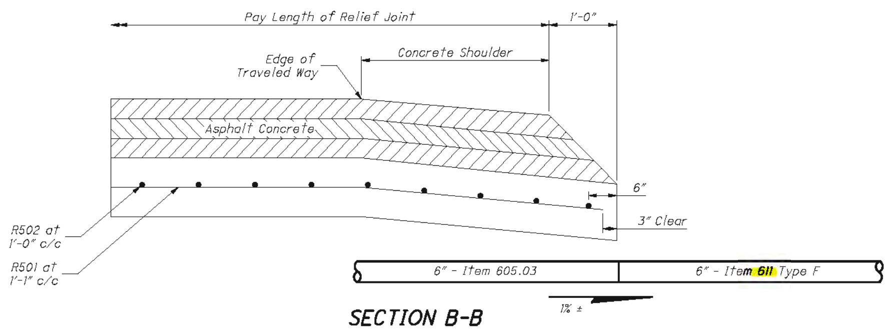
STANDARD ROADWAY CONSTRUCTION DRAWING

PRESSURE RELIEF JOINT TYPE A (at Existing Approach Slab)

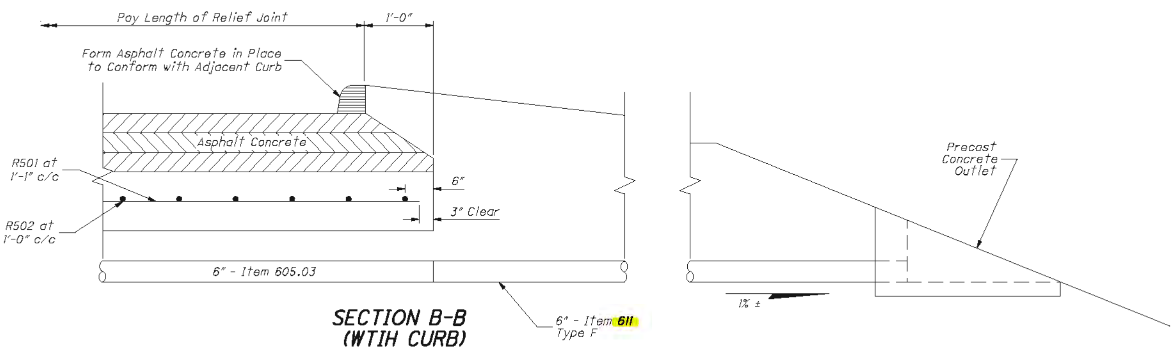
SCD NUMBER **BP-2.3**



SECTION B-B
(WITH ASPHALT SHOULDERS)



SECTION B-B
(WITH CONCRETE SHOULDERS)



SECTION B-B
(WTIH CURB)

(Showing an Underdrain Outlet Through the Embankment)

NOTES

APPROACH SLAB PRESSURE RELIEF JOINTS: Relief joints are to be provided regardless of abutment design at all bridge approaches where approach pavement is rigid, or composite consisting of a rigid base.

ASPHALT CONCRETE: Item 448 - Asphalt Concrete Intermediate Course, Type 2 PG 64-22 shall be compacted in equal lifts not exceeding 3" with compaction equipment as approved by the Engineer.

ITEM 305 BASE: Shall be constructed in accordance with **SCD BP-2.1 & BP-2.2**. Longitudinal joints shall be placed in the same location and in the same alignment as the longitudinal joints in the existing pavement.

BOND BREAKER: A bond breaker consisting of two 4' sheets of clear or opaque polyethylene film, Item 705.06, shall be centered above the joint between the subbase and the sleeper slab. Care shall be taken in the area beneath the polyethylene film to ensure the surface of the subbase is finished smooth and is flush with or slightly higher than the surface of the sleeper slab. The film shall have a nominal thickness of 4 mils.

UNDERDRAIN: A perforated underdrain shall be placed as shown. It shall extend from edge to edge of the sleeper slab and be outletted as shown on the plan, either to a longitudinal underdrain, a catch basin, or through the embankment or ditch foreslope. For additional information, see **SCD DM-1.2.**

PAYMENT: Measurement of the pressure relief joint for payment purposes shall be along the centerline of the Sleeper Slab 1) between the outside edges of concrete shoulders, 2) between the backs of curb, and 3) between the **edges of the traveled way** when asphalt shoulders are used. Payment shall be per Linear Foot of **Item Special - Pressure Relief Joint, Type A** and shall include saw cutting & removal of existing pavement, Items 305 & 448, and all labor, materials and incidentals needed to construct the joint as shown, except for the pipe underdrain. The underdrains shall be paid for per Linear Foot of **Item 605 - 6" Shallow Pipe Underdrain**, Item **707.31** Type CP, or 707.41. The outlet pipe shall be paid for per Linear Foot **Item 611 - 6" Conduit, Type F for Underdrain Outlets. The precast concrete outlet shall be paid for per each of Item 611 - Precast Reinforced Concrete Outlet.**

THIS DRAWING REPLACES BP-2.3 DATED 7-16-04.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
ADMINISTRATOR
7-19-2013
DATE

STDS. ENGINEER D. MILLER

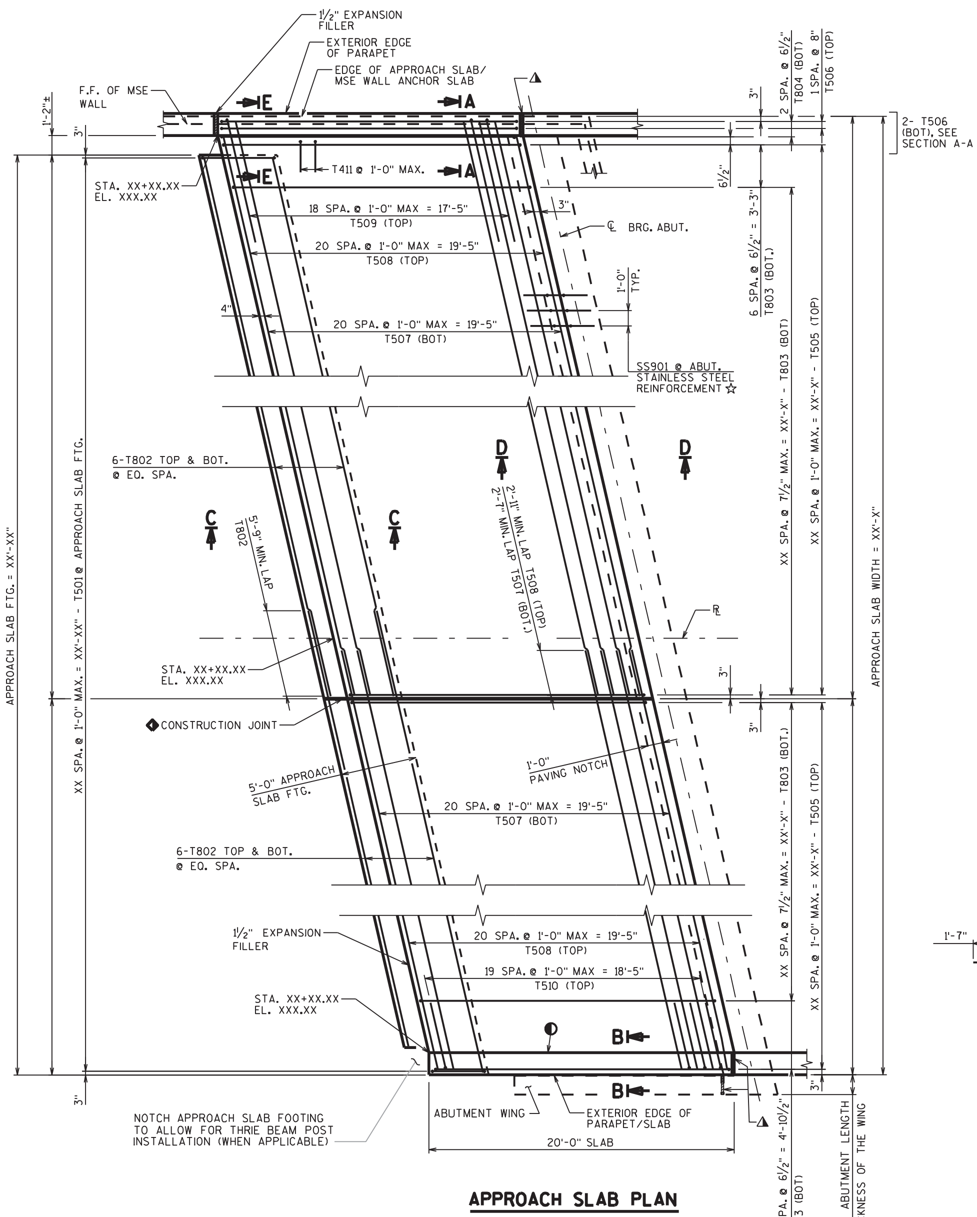
OFFICE OF PAVEMENT ENGINEERING

STANDARD ROADWAY CONSTRUCTION DRAWING

PRESSURE RELIEF JOINT TYPE A
(Notes and Section B-B)

SCD NUMBER
BP-2.3

Wisconsin



APPROACH SLAB PLAN

DESIGNER NOTES

STRUCTURAL APPROACH SLABS AND PARAPETS SHALL BE USED ON ALL I.H. BRIDGES AND U.S.H. BRIDGES. OTHER LOCATIONS CAN BE CONSIDERED WITH THE APPROVAL OF THE CHIEF STRUCTURAL DESIGN ENGINEER.

STRUCTURAL APPROACH SLABS TO BE PART OF THE BRIDGE PLAN. BID ITEMS ARE CONCRETE MASONRY BRIDGES, BAR STEEL REINFORCEMENT HS COATED BRIDGES, ETC. POLYETHYLENE SHEETS SHALL BE INCIDENTAL TO CONCRETE MASONRY BRIDGES.

QUANTITIES FOR APPROACH SLABS SHALL BE SHOWN IN A SEPARATE COLUMN WITHIN THE TOTAL ESTIMATED QUANTITIES TABLE IN THE FINAL PLANS.

◆ CONSTRUCTION JOINT REQUIRED WHEN WIDTH OF SUPERSTRUCTURE EXCEEDS 90'. RUN REINFORCEMENT THROUGH THE JOINT.

LONGITUDINAL APPROACH SLAB REINFORCEMENT SHALL BE PLACED PARALLEL TO THE APPROACH (I.E., NOT NORMAL TO THE ℄ ABUTMENT WITH SKEWED STRUCTURES).

STRUCTURE APPROACH SLABS TO BE DETAILED TO MATCH THE BRIDGE DECK (I.E., PROTECTIVE SURFACE TREATMENT, STAINLESS STEEL REINFORCEMENT, LONGITUDINAL GROOVING, ETC.). WHERE HIGH PERFORMANCE CONCRETE IS USED AT THE BRIDGE DECK, HPC SHALL BE USED FOR THE APPROACH SLAB ONLY (I.E., HPC IS NOT REQUIRED FOR APPROACH SLAB FOOTING).

☆ THE BID ITEM FOR SS901 BARS SHALL BE SPECIAL PROVISION "BAR STEEL REINFORCEMENT HS STAINLESS BRIDGES".

DESIGNER TO COORDINATE LOCATION OF SURFACE DRAINS, INLETS, AND/OR FLUMES WITH ROADWAY DESIGNER AND FDM SDD 8D2 OR 8D3.

LEGEND

△ SEAL ALL EXPOSED HORIZONTAL AND VERTICAL SURFACES OF ½" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD ⅛" BELOW SURFACE OF CONCRETE). EXTEND SEALER 3" BELOW GUTTER LINE AT INSIDE FACE.

◐ SEE PARAPET STANDARD DETAILS FOR LOCATION OF NAME PLATE AND BENCH MARK WITH RESPECT TO THE END OF PARAPET.

DESIGN DATA

CONCRETE STRENGTH, f'c: 4,000 P.S.I.
BAR STEEL REINFORCEMENT, GRADE 60, fy: 60,000 P.S.I.
ALLOWABLE SOIL BEARING PRESSURE: 2,000 P.S.F.

NOTE:
FOR NEW STRUCTURES ON NEW ALIGNMENTS, BASE AGGREGATE DENSE 1-1/4 INCH AS PER FDM 14-5 AND BRIDGE MANUAL FIGURE 12.6-2 SHALL BE UTILIZED. FOR REPLACEMENT STRUCTURES ON EXISTING ALIGNMENTS, THE EXISTING SOIL MAY REMAIN IN PLACE IF THE REGION SOILS ENGINEER DETERMINES THAT THE EXISTING SOIL BEARING PRESSURE MEETS THE REQUIREMENT ABOVE.

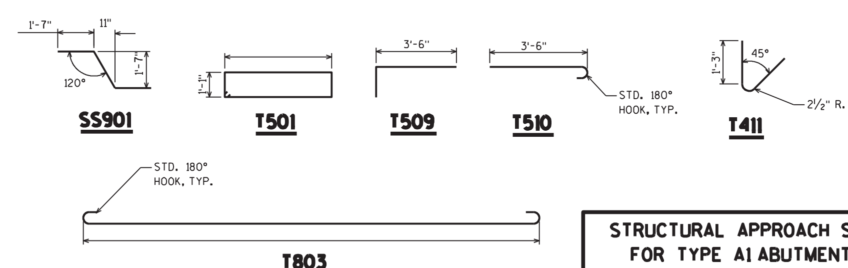
BILL OF BARS

NOTE: THE FIRST OR FIRST TWO DIGITS OF THE BAR MARK SIGNIFIES THE BAR SIZE.

STAINLESS STEEL →

BAR MARK	COAT	NO. REQ'D.	LENGTH	BENT	BAR SERIES	LOCATION
SS901			5'-0"	X		CONC. ABUT. DIAPH. TO APPROACH SLAB

BAR MARK	COAT	NO. REQ'D.	LENGTH	BENT	BAR SERIES	LOCATION
T501	X			X		APPROACH SLAB FTG. - STIRRUP
T802	X					APPROACH SLAB FTG. - TRANS.
T803	X			X		APPROACH SLAB - LONG. - BOT.
T804	X					APPROACH SLAB - LONG. - BOT. - WALL
T505	X					APPROACH SLAB - LONG - TOP.
T506	X					APPROACH SLAB - LONG. - WALL
T507	X					APPROACH SLAB - TRANS. - BOT.
T508	X					APPROACH SLAB - TRANS - TOP.
T509	X		4'-3"	X		APPROACH SLAB - TRANS. - TOP - WALL
T510	X		4'-1"	X		APPROACH SLAB - TRANS. - TOP - WING
T411	X		3'-0"	X		APPROACH SLAB - TRANS. - WALL

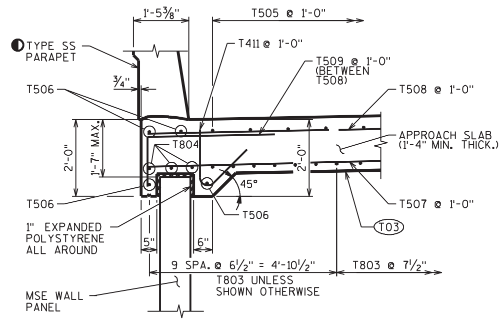


SECTIONS A-A THRU E-E ARE SHOWN ON STANDARD 12.11

STRUCTURAL APPROACH SLAB FOR TYPE A1 ABUTMENTS

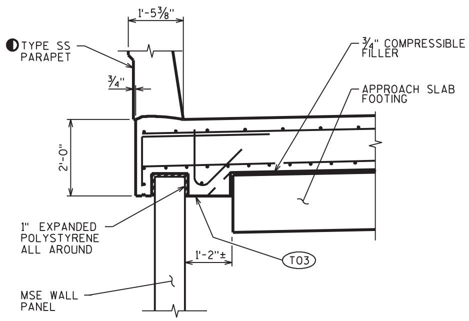
STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION
STRUCTURES DEVELOPMENT SECTION

APPROVED: Bill Oliva | DATE: 1-14



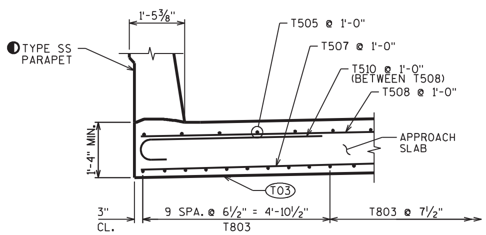
SECTION A-A

(AT MSE WINGWALLS)



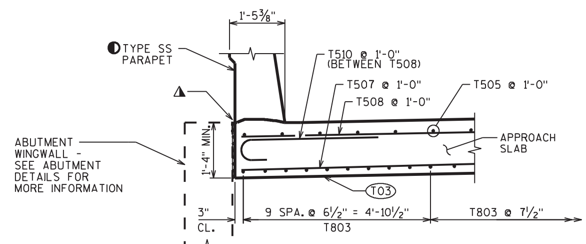
SECTION E-E

(AT MSE WINGWALLS)



SECTION B-B

(AT WINGWALLS PERP. TO BRIDGE)



SECTION B-B

(AT WINGWALLS PARALLEL TO BRIDGE)

LEGEND

- (T02) STEEL TROWEL TOP SURFACE OF FOOTING AND PLACE MULTIPLE LAYERS (0.03" MIN. TOTAL THK.) OF POLYETHYLENE SHEETS OVER THE ENTIRE TOP OF FOOTING.
- (T03) PLACE MULTIPLE LAYERS (0.03" MIN. TOTAL THK.) OF POLYETHYLENE SHEETS OVER THE ENTIRE TOP OF SUBGRADE BENEATH SLAB.
- ▲ SEAL ALL EXPOSED HORIZONTAL AND VERTICAL SURFACES OF ½" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD ⅛" BELOW SURFACE OF CONCRETE). EXTEND SEALER 3" BELOW GUTTER LINE AT INSIDE FACE.

DESIGNER NOTES

STRUCTURAL APPROACH SLABS AND PARAPETS SHALL BE USED ON ALL I.H. BRIDGES AND U.S.H. BRIDGES. OTHER LOCATIONS CAN BE CONSIDERED WITH THE APPROVAL OF THE CHIEF STRUCTURAL DESIGN ENGINEER.

STRUCTURAL APPROACH SLABS TO BE PART OF THE BRIDGE PLAN. BID ITEMS ARE CONCRETE MASONRY BRIDGES, BAR STEEL REINFORCEMENT HS COATED BRIDGES, ETC. POLYETHYLENE SHEETS SHALL BE INCIDENTAL TO CONCRETE MASONRY BRIDGES.

QUANTITIES FOR APPROACH SLABS SHALL BE SHOWN IN A SEPARATE COLUMN WITHIN THE TOTAL ESTIMATED QUANTITIES TABLE IN THE FINAL PLANS.

LONGITUDINAL APPROACH SLAB REINFORCEMENT SHALL BE PLACED PARALLEL TO THE APPROACH (I.E., NOT NORMAL TO THE ℄ ABUTMENT WITH SKEWED STRUCTURES).

STRUCTURE APPROACH SLABS TO BE DETAILED TO MATCH THE BRIDGE DECK (I.E., PROTECTIVE SURFACE TREATMENT, STAINLESS STEEL REINFORCEMENT, LONGITUDINAL GROOVING, ETC.). WHERE HIGH PERFORMANCE CONCRETE IS USED AT THE BRIDGE DECK, HPC SHALL BE USED FOR THE APPROACH SLAB ONLY (I.E., HPC IS NOT REQUIRED FOR APPROACH SLAB FOOTING).

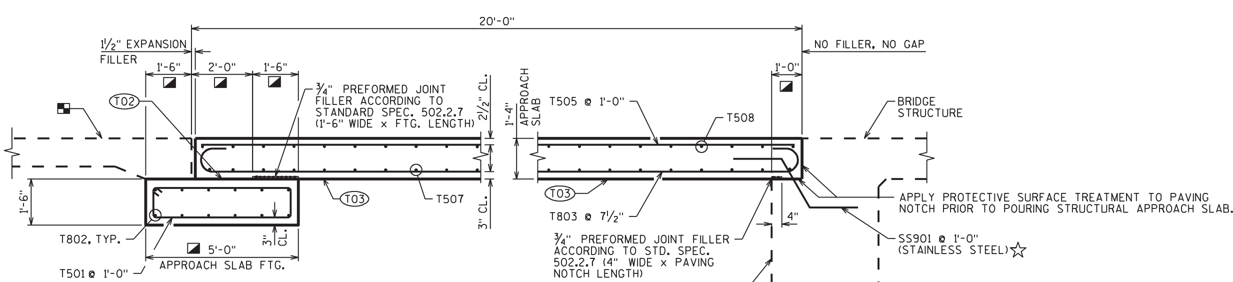
☆ THE BID ITEM FOR SS901 BARS SHALL BE SPECIAL PROVISION "BAR STEEL REINFORCEMENT HS STAINLESS BRIDGES".

DESIGNER TO COORDINATE LOCATION OF SURFACE DRAINS, INLETS, AND/OR FLUMES WITH ROADWAY DESIGNER AND FDM SDD 8D2 OR 8D3.

◐ SEE PARAPET STANDARD DETAILS FOR REINFORCEMENT, LOCATION OF NAME PLATE AND BENCH MARK WITH RESPECT TO THE END OF PARAPET, ETC.

BELOW THE APPROACH SLAB FOOTING AND STRUCTURAL APPROACH SLAB, SHOW BASE AGGREGATE DENSE 1-1/4 INCH AS PER FDM 14-5 AND BRIDGE MANUAL FIGURE 12.6-2.

▣ FOLLOW FDM 14-10-15 REQUIREMENTS FOR ROADWAY APPROACH PAVEMENT.



SECTION C-C

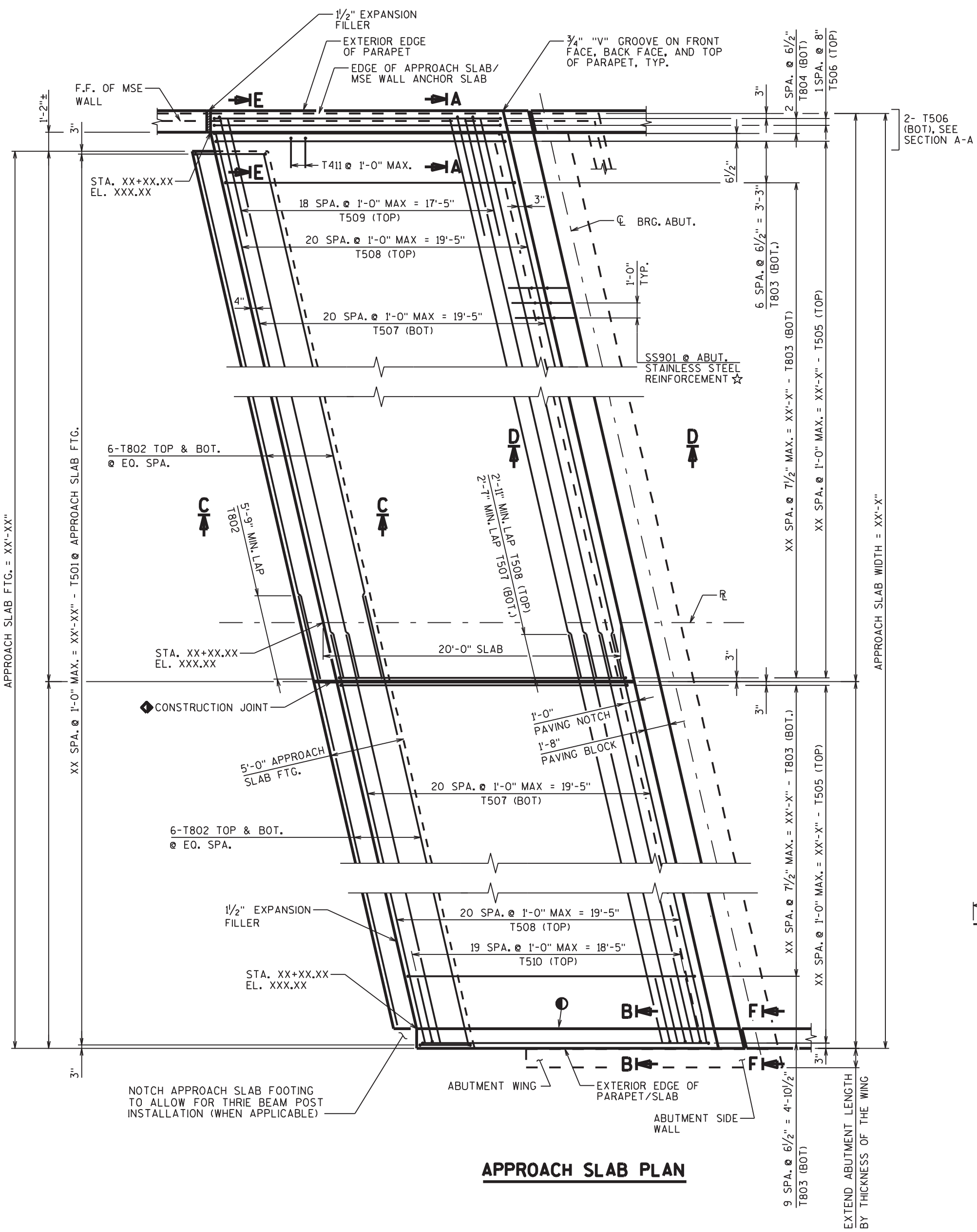
SECTION D-D

SECTION THRU APPROACH SLAB

◪ MEASURED NORMAL TO ABUTMENT

SECTIONS SHOWN HERE ARE FROM STANDARD 12.10

STRUCTURAL APPROACH SLAB DETAILS FOR TYPE A1 ABUTMENTS	
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION STRUCTURES DEVELOPMENT SECTION	
APPROVED: Bill Oliva	DATE: 1-14



APPROACH SLAB PLAN

DESIGNER NOTES

STRUCTURAL APPROACH SLABS AND PARAPETS SHALL BE USED ON ALL I.H. BRIDGES AND U.S.H. BRIDGES. OTHER LOCATIONS CAN BE CONSIDERED WITH THE APPROVAL OF THE CHIEF STRUCTURAL DESIGN ENGINEER.

STRUCTURAL APPROACH SLABS TO BE PART OF THE BRIDGE PLAN. BID ITEMS ARE CONCRETE MASONRY BRIDGES, BAR STEEL REINFORCEMENT HS COATED BRIDGES, ETC. POLYETHYLENE SHEETS SHALL BE INCIDENTAL TO CONCRETE MASONRY BRIDGES.

QUANTITIES FOR APPROACH SLABS SHALL BE SHOWN IN A SEPARATE COLUMN WITHIN THE TOTAL ESTIMATED QUANTITIES TABLE IN THE FINAL PLANS.

◆ CONSTRUCTION JOINT REQUIRED WHEN WIDTH OF SUPERSTRUCTURE EXCEEDS 90'. RUN REINFORCEMENT THROUGH THE JOINT.

LONGITUDINAL APPROACH SLAB REINFORCEMENT SHALL BE PLACED PARALLEL TO THE APPROACH (I.E., NOT NORMAL TO THE ℄ ABUTMENT WITH SKEWED STRUCTURES).

STRUCTURE APPROACH SLABS TO BE DETAILED TO MATCH THE BRIDGE DECK (I.E., PROTECTIVE SURFACE TREATMENT, STAINLESS STEEL REINFORCEMENT, LONGITUDINAL GROOVING, ETC.). WHERE HIGH PERFORMANCE CONCRETE IS USED AT THE BRIDGE DECK, HPC SHALL BE USED FOR THE APPROACH SLAB ONLY (I.E., HPC IS NOT REQUIRED FOR APPROACH SLAB FOOTING).

☆ THE BID ITEM FOR SS901 BARS SHALL BE SPECIAL PROVISION "BAR STEEL REINFORCEMENT HS STAINLESS BRIDGES".

DESIGNER TO COORDINATE LOCATION OF SURFACE DRAINS, INLETS, AND/OR FLUMES WITH ROADWAY DESIGNER AND FDM SDD 8D2 OR 8D3.

LEGEND

△ SEAL ALL EXPOSED HORIZONTAL AND VERTICAL SURFACES OF ½" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD ⅛" BELOW SURFACE OF CONCRETE). EXTEND SEALER 3" BELOW GUTTER LINE AT INSIDE FACE.

◐ SEE PARAPET STANDARD DETAILS FOR LOCATION OF NAME PLATE AND BENCH MARK WITH RESPECT TO THE END OF PARAPET.

DESIGN DATA

CONCRETE STRENGTH, f'c: 4,000 P.S.I.
BAR STEEL REINFORCEMENT, GRADE 60, fy: 60,000 P.S.I.
ALLOWABLE SOIL BEARING PRESSURE: 2,000 P.S.F.

NOTE:
FOR NEW STRUCTURES ON NEW ALIGNMENTS, BASE AGGREGATE DENSE 1-1/4 INCH AS PER FDM 14-5 AND BRIDGE MANUAL FIGURE 12.6-2 SHALL BE UTILIZED. FOR REPLACEMENT STRUCTURES ON EXISTING ALIGNMENTS, THE EXISTING SOIL MAY REMAIN IN PLACE IF THE REGION SOILS ENGINEER DETERMINES THAT THE EXISTING SOIL BEARING PRESSURE MEETS THE REQUIREMENT ABOVE.

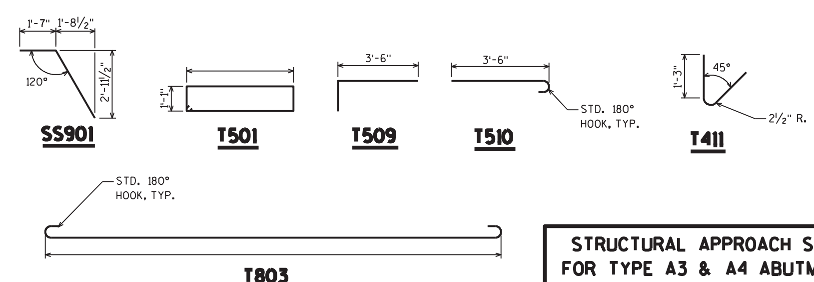
BILL OF BARS

NOTE: THE FIRST OR FIRST TWO DIGITS OF THE BAR MARK SIGNIFIES THE BAR SIZE.

STAINLESS STEEL

BAR MARK	COAT	NO. REQ'D.	LENGTH	BENT	BAR SERIES	LOCATION
SS901			5'-0"	X		CONC. BACKWALL TO APPROACH SLAB

BAR MARK	COAT	NO. REQ'D.	LENGTH	BENT	BAR SERIES	LOCATION
T501	X			X		APPROACH SLAB FTG. - STIRRUP
T802	X					APPROACH SLAB FTG. - TRANS.
T803	X			X		APPROACH SLAB - LONG. - BOT.
T804	X					APPROACH SLAB - LONG. - BOT. - WALL
T505	X					APPROACH SLAB - LONG - TOP.
T506	X					APPROACH SLAB - LONG. - WALL
T507	X					APPROACH SLAB - TRANS. - BOT.
T508	X					APPROACH SLAB - TRANS - TOP.
T509	X		4'-3"	X		APPROACH SLAB - TRANS. - TOP - WALL
T510	X		4'-1"	X		APPROACH SLAB - TRANS. - TOP - WING
T411	X		3'-0"	X		APPROACH SLAB - TRANS. - WALL



SECTIONS A-A THRU F-F ARE DETAILED ON STANDARD 12.13

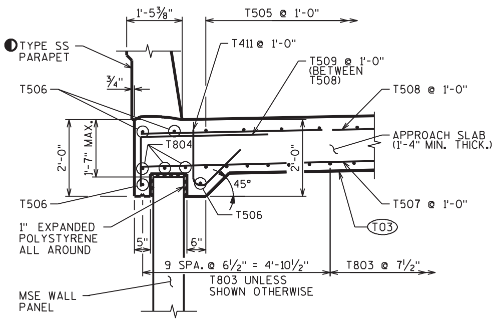
STRUCTURAL APPROACH SLAB FOR TYPE A3 & A4 ABUTMENTS

STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION
STRUCTURES DEVELOPMENT SECTION

APPROVED: Bill Oliva

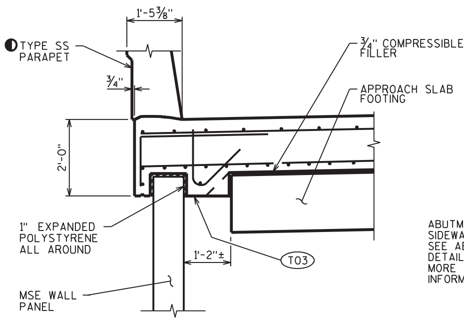
DATE: 1-14

STANDARD 12.12



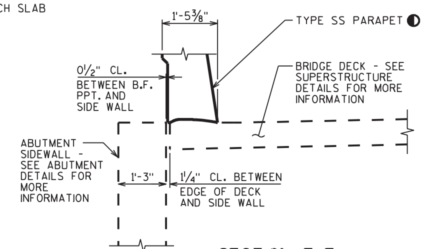
SECTION A-A

(AT MSE WINGWALLS)



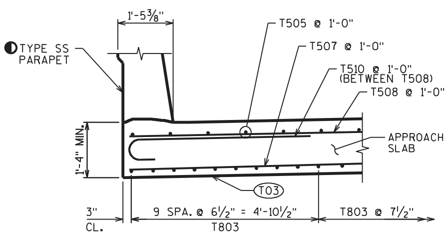
SECTION E-E

(AT MSE WINGWALLS)



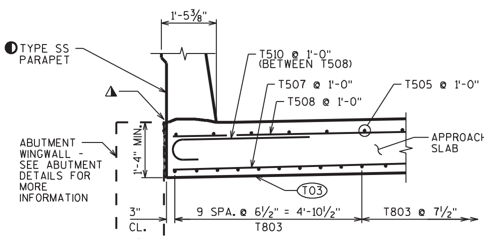
SECTION F-F

(AT WINGWALLS PARALLEL TO BRIDGE)



SECTION B-B

(AT WINGWALLS PERP. TO BRIDGE)



SECTION B-B

(AT WINGWALLS PARALLEL TO BRIDGE)

LEGEND

(T02) STEEL TROWEL TOP SURFACE OF FOOTING AND PLACE MULTIPLE LAYERS (0.03" MIN. TOTAL THK.) OF POLYETHYLENE SHEETS OVER THE ENTIRE TOP OF FOOTING.

(T03) PLACE MULTIPLE LAYERS (0.03" MIN. TOTAL THK.) OF POLYETHLENE SHEETS OVER THE ENTIRE TOP OF SUBGRADE.

▲ SEAL ALL EXPOSED HORIZONTAL AND VERTICAL SURFACES OF ½" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD ⅛" BELOW SURFACE OF CONCRETE). EXTEND SEALER 3" BELOW GUTTER LINE AT INSIDE FACE.

DESIGNER NOTES

STRUCTURAL APPROACH SLABS AND PARAPETS SHALL BE USED ON ALL I.H. BRIDGES AND U.S.H. BRIDGES. OTHER LOCATIONS CAN BE CONSIDERED WITH THE APPROVAL OF THE CHIEF STRUCTURAL DESIGN ENGINEER.

STRUCTURAL APPROACH SLABS TO BE PART OF THE BRIDGE PLAN. BID ITEMS ARE CONCRETE MASONRY BRIDGES, BAR STEEL REINFORCEMENT HS COATED BRIDGES, ETC. POLYETHYLENE SHEETS SHALL BE INCIDENTAL TO CONCRETE MASONRY BRIDGES.

QUANTITIES FOR APPROACH SLABS SHALL BE SHOWN IN A SEPARATE COLUMN WITHIN THE TOTAL ESTIMATED QUANTITIES TABLE IN THE FINAL PLANS.

LONGITUDINAL APPROACH SLAB REINFORCEMENT SHALL BE PLACED PARALLEL TO THE APPROACH (I.E., NOT NORMAL TO THE ℄ ABUTMENT WITH SKEWED STRUCTURES).

STRUCTURE APPROACH SLABS TO BE DETAILED TO MATCH THE BRIDGE DECK (I.E., PROTECTIVE SURFACE TREATMENT, STAINLESS STEEL REINFORCEMENT, LONGITUDINAL GROOVING, ETC.). WHERE HIGH PERFORMANCE CONCRETE IS USED AT THE BRIDGE DECK, HPC SHALL BE USED FOR THE APPROACH SLAB ONLY (I.E., HPC IS NOT REQUIRED FOR APPROACH SLAB FOOTING).

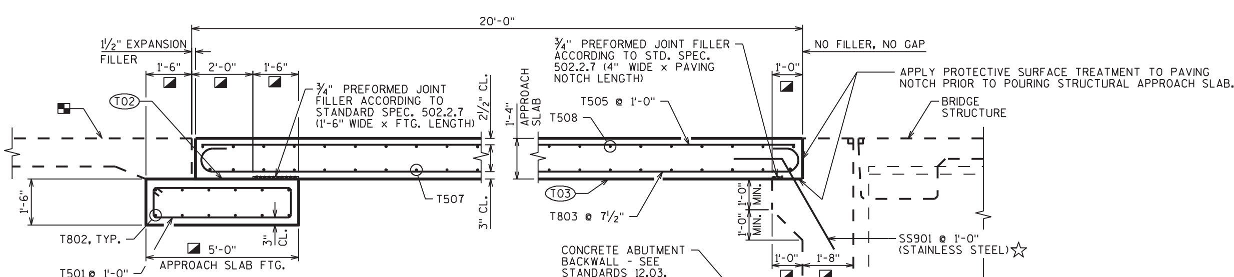
☆ THE BID ITEM FOR SS901 BARS SHALL BE SPECIAL PROVISION "BAR STEEL REINFORCEMENT HS STAINLESS BRIDGES".

DESIGNER TO COORDINATE LOCATION OF SURFACE DRAINS, INLETS, AND/OR FLUMES WITH ROADWAY DESIGNER AND FDM SDD 8D2 OR 8D3.

◐ SEE PARAPET STANDARD DETAILS FOR REINFORCEMENT, LOCATION OF NAME PLATE AND BENCH MARK WITH RESPECT TO THE END OF PARAPET, ETC.

BELOW THE APPROACH SLAB FOOTING AND STRUCTURAL APPROACH SLAB, SHOW BASE AGGREGATE DENSE 1-1/4 INCH AS PER FDM 14-5 AND BRIDGE MANUAL FIGURE 12.6-2.

FOLLOW FDM 14-10-15 REQUIREMENTS FOR ROADWAY APPROACH PAVEMENT.



SECTION C-C

SECTION D-D

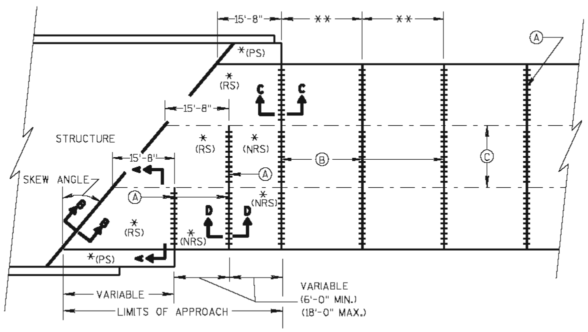
SECTION THRU APPROACH SLAB

◪ MEASURED NORMAL TO ABUTMENT

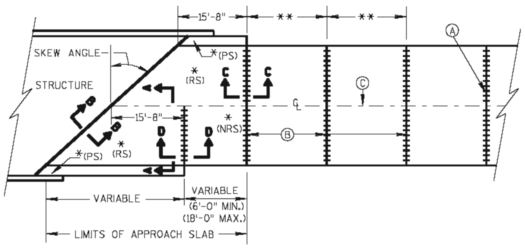
SECTIONS SHOWN HERE ARE CUT ON STANDARD 12.12

STRUCTURAL APPROACH SLAB DETAILS FOR TYPE A3 & A4 ABUTMENTS	
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION STRUCTURES DEVELOPMENT SECTION	
APPROVED: Bill Oliva	DATE: 1-14

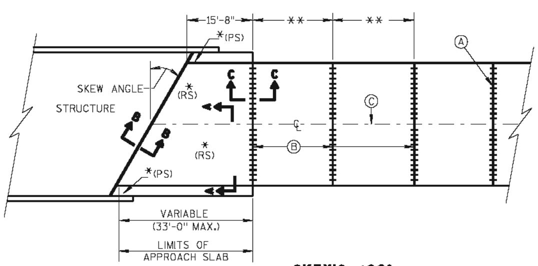
STANDARD 12.13



SKEWED APPROACH
(PAVEMENT MORE THAN 2 LANES)



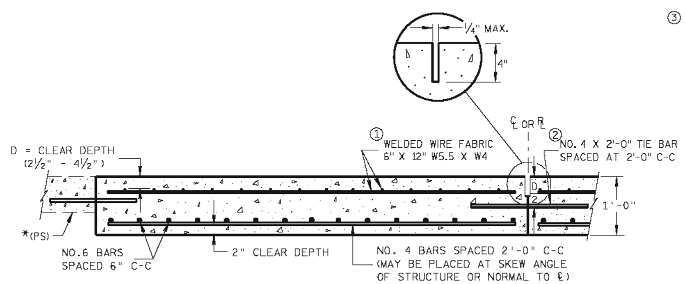
SKEWS >30°
(PAVEMENT WIDTH ≤30')



SKEWS ≤30°
(PAVEMENT WIDTH ≤30')

APPROACH SLAB AND ADJACENT PAVEMENT

*(RS) = REINFORCED CONCRETE SLAB
*(PS) = PAVED CONCRETE SHOULDER: CONCRETE PAVEMENT, OR CONCRETE SURFACE DRAIN (SEE DETAILS ELSEWHERE IN THE PLAN)
*(NRS) = NON-REINFORCED CONCRETE SLAB
**STANDARD TRANSVERSE JOINT SPACING (SEE SDD 13C4, SDD 13C11, & SDD 13C13)
Ⓐ STANDARD CONTRACTION JOINT NORMAL TO ℞ OR ℄
Ⓑ 1 1/2" EXPANSION JOINT WITH DOWEL BARS NORMAL TO ℞ OR ℄
Ⓒ STANDARD LONGITUDINAL JOINT AND TIE BARS.



SECTION A-A
REINFORCEMENT POSITIONING DETAIL

GENERAL NOTES

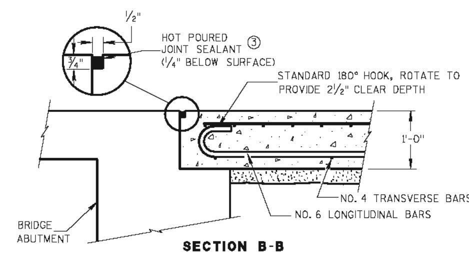
APPROACH SLABS ABUTTING AN HMA PAVEMENT OVER BASE COURSE DO NOT NEED TO BE DOWELED.

THE CONTRACTOR MAY SPLICE NO. 6 BARS IN THE APPROACH SLAB FOR SKEWED STRUCTURES ONLY. STAGGER SPLICES WITH A MAXIMUM OF ONE SPLICE PER BAR. THE LENGTH OF LAP IS 20 INCHES.

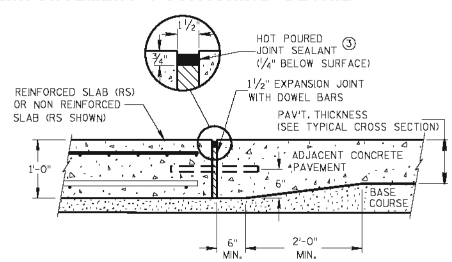
① THE CONTRACTOR MAY USE NO. 4 BARS SPACED AT 2'-0" C-C IN BOTH THE LONGITUDINAL AND TRANSVERSE DIRECTIONS FOR TOP REINFORCEMENT AS AN ALTERNATIVE TO THE WELDED WIRE FABRIC.

② THE CONTRACTOR MAY OMIT TIE BARS BETWEEN REINFORCED SLABS WHERE SLAB REINFORCEMENT BARS EXTEND ACROSS THE CENTERLINE OR REFERENCE LINE.

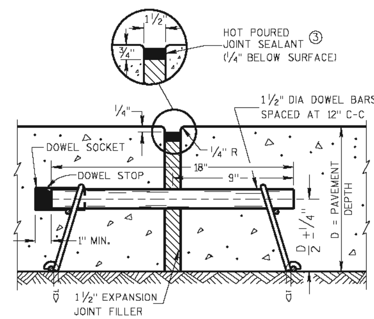
③ USE A JOINT SEALANT MEETING THE REQUIREMENTS OF ASTM D6690.



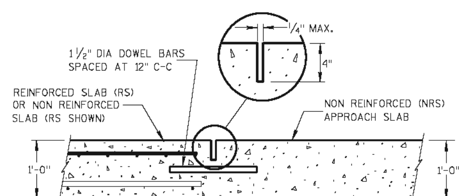
SECTION B-B
BEND DETAIL
BOTTOM REINFORCEMENT



SECTION C-C
TRANSITION DETAIL
APPROACH SLAB TO ADJACENT PAVEMENT

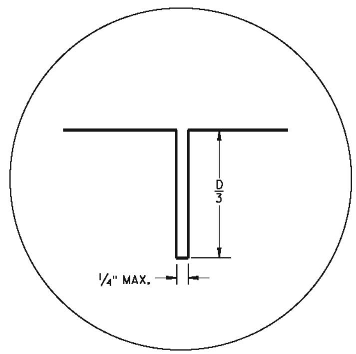


EXPANSION JOINT

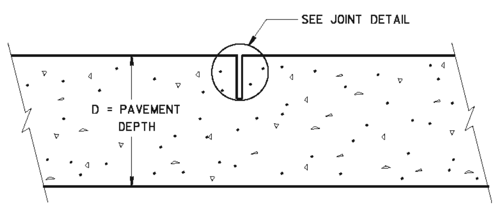


SECTION D-D
CONTRACTION JOINT

CONCRETE PAVEMENT APPROACH SLAB
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION
APPROVED 12/11/2009 DATE — /S/ Deb Bischoff PAVEMENT POLICY & DESIGN ENGINEER — FHWA



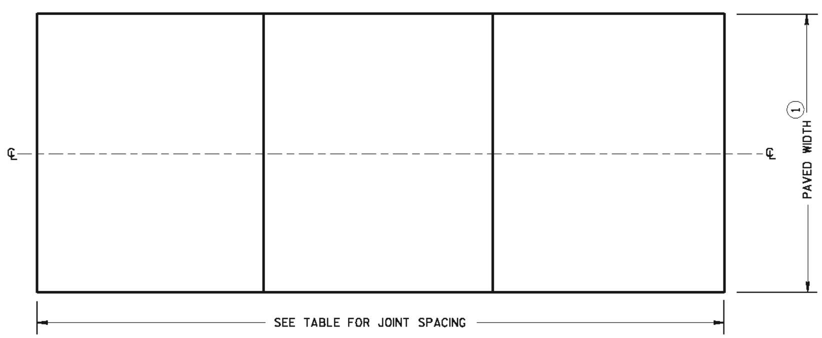
JOINT DETAIL



CONTRACTION JOINT

PAVEMENT DEPTH AND JOINT SPACING TABLE

PAVEMENT DEPTH (D)	CONTRACTION JOINT SPACING
6", 6 1/2"	12'
7", 7 1/2"	14'
8" & ABOVE	15'



CONTRACTION JOINT LOCATIONS

GENERAL NOTES

CONTRACTION JOINTS

CONSTRUCT TRANSVERSE CONTRACTION JOINTS NORMAL TO THE CENTERLINE.

LOCATE AND ORIENT CONTRACTION JOINTS THROUGH INTERSECTIONS AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

DO NOT SEAL OR FILL CONTRACTION JOINTS.

CONSTRUCTION JOINTS

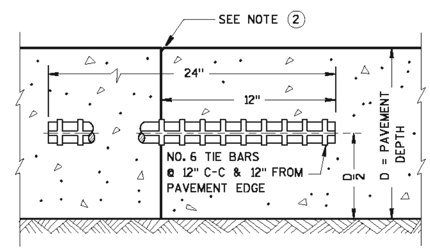
LOCATE CONSTRUCTION JOINTS A MINIMUM OF 6 FEET FROM THE NEAREST CONTRACTION JOINT AND ALIGN PARALLEL TO THE CONTRACTION JOINTS.

FORM OR SAW CONSTRUCTION JOINTS.

THE CONTRACTOR MAY INSERT TIE BARS THROUGH THE HEADER BOARD AFTER THE CONCRETE HAS BEEN PLACED.

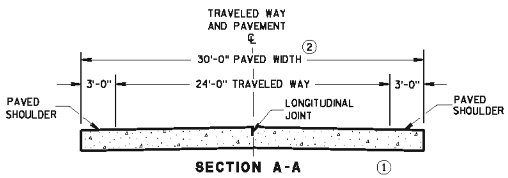
(1) REFER TO TYPICAL CROSS SECTIONS FOR PAVED WIDTH AND LOCATION OF LONGITUDINAL JOINTS.

(2) PROVIDE A SMOOTH VERTICAL FACE FOR THE ENTIRE DEPTH OF THE PAVEMENT WHEN FORMING CONSTRUCTION JOINTS. PROVIDE A 1/4-INCH RADIUS AT FORMED JOINTS.

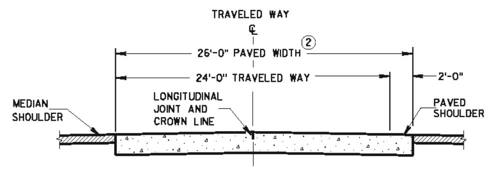


TIED TRANSVERSE CONSTRUCTION JOINT

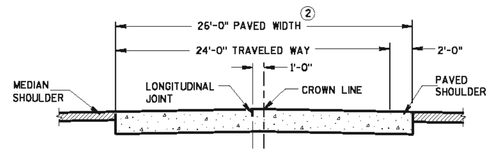
URBAN NON-DOWELED CONCRETE PAVEMENT
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION
APPROVED 5/3/2013 DATE /S/ Deb Bischoff PAVEMENT POLICY & DESIGN ENGINEER FHWA



SECTION A-A
TWO-LANE TWO-WAY HIGHWAY



SECTION B-B



ALTERNATIVE SECTION B-B
1
DIVIDED HIGHWAY

GENERAL NOTES

CONTRACTION JOINTS

CONSTRUCT TRANSVERSE CONTRACTION JOINTS NORMAL TO THE CENTERLINE. SHOW THE LOCATION OF CONTRACTION JOINTS THROUGH INTERSECTIONS ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

DO NOT SEAL OR FILL CONTRACTION JOINTS.

INSTALL DOWEL BARS PARALLEL TO THE PAVEMENT CENTERLINE AND PAVEMENT SURFACE.

FOR PAVEMENT SLABS OF VARYING WIDTHS, LOCATE THE OUTER MOST DOWEL BAR SO THAT THE CENTER OF THE BAR IS A MINIMUM OF 6 INCHES AND A MAXIMUM OF 18 INCHES FROM THE FREE EDGE OF PAVEMENT.

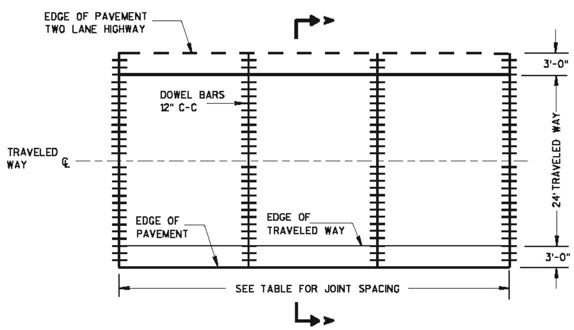
CONSTRUCTION JOINTS

LOCATE CONSTRUCTION JOINTS A MINIMUM OF 6 FEET FROM THE NEAREST CONTRACTION JOINT AND ALIGN PARALLEL TO CONTRACTION JOINTS.

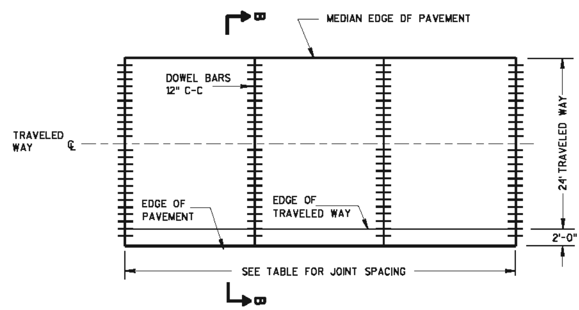
1. REFER TO TYPICAL CROSS SECTIONS FOR ADDITIONAL DETAILS.
2. MEASURE THE ENTIRE PAVED WIDTH INCLUDING THE PORTION(S) LABELED PAVED SHOULDER AS CONCRETE PAVEMENT.

PAVEMENT DEPTH, DOWEL BAR SIZE AND JOINT SPACING TABLE

PAVEMENT DEPTH (D)	DOWEL BAR DIAMETER	CONTRACTION JOINT SPACING
5 1/2", 6", 6 1/2"	NONE	12'
7", 7 1/2"	1"	14'
8", 8 1/2"	1 1/4"	15'
9", 9 1/2"	1 1/4"	15'
10" & ABOVE	1 1/2"	15'



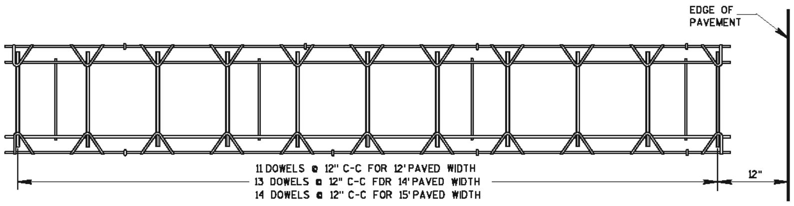
CONTRACTION JOINT LAYOUT
FOR TWO-LANE TWO-WAY HIGHWAY



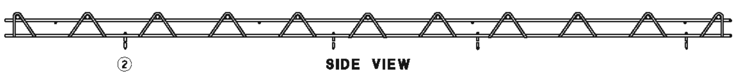
CONTRACTION JOINT LAYOUT
FOR DIVIDED HIGHWAY

RURAL DOWELED
CONCRETE PAVEMENT

STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION

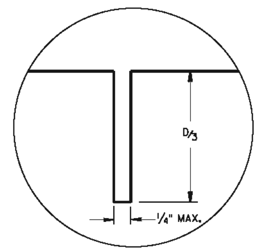


PLAN VIEW

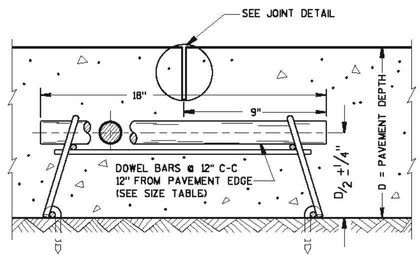


SIDE VIEW
(NORMAL TO CENTERLINE)

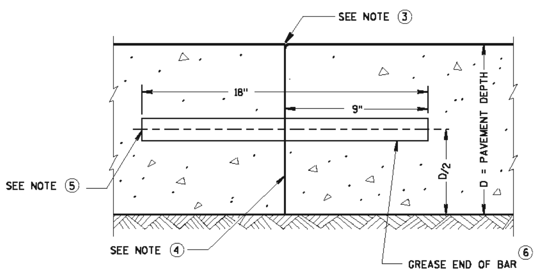
CONTRACTION JOINT DOWEL ASSEMBLY (1)



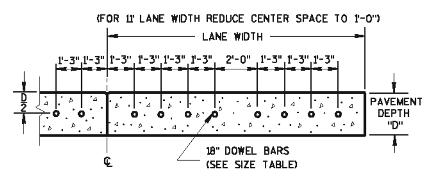
JOINT DETAIL



DOWELED CONTRACTION JOINT



TRANSVERSE CONSTRUCTION JOINT



DRILLED DOWEL BAR CONSTRUCTION JOINT (7)

GENERAL NOTES

(1) OBTAIN THE ENGINEER'S APPROVAL FOR THE USE OF ALTERNATIVE DESIGNS OF THE DOWEL ASSEMBLY. USE MECHANICAL DOWEL BAR INSERTERS OR DOWEL ASSEMBLIES WHEN CONSTRUCTING CONTRACTION JOINTS.

(2) SECURE BASKETS WITH ANCHORS TO HOLD DOWEL BARS IN THE CORRECT POSITION AND ALIGNMENT. TYPE, LOCATION, NUMBER AND LENGTH OF ANCHORS ARE DEPENDENT UPON FIELD CONDITIONS.

(3) FORM OR SAW CONSTRUCTION JOINTS. PROVIDE A 1/4-INCH RADIUS AT FORMED JOINTS.

(4) PROVIDE A SMOOTH VERTICAL FACE FOR THE ENTIRE DEPTH OF THE PAVEMENT WHEN FORMING CONSTRUCTION JOINTS.

(5) INSTALL DOWEL BARS AT CONSTRUCTION JOINTS BY FORMING OR DRILLING. INSTALL FORMED DOWEL BARS 12 INCHES C-C AND 12 INCHES FROM PAVEMENT EDGE. REMOVE EXCESS CONCRETE FROM THE FREE END OF THE DOWEL BAR IF DOWEL BARS ARE FORMED THROUGH A HEADER BOARD. INSTALL DRILLED DOWEL BARS ACCORDING TO *DRILLED DOWEL BAR CONSTRUCTION JOINT* DETAIL.

(6) APPLY A THIN UNIFORM COATING OF SURFACE TREATMENT TO THE FREE END OF DOWEL BARS TO PREVENT BONDING.

(7) ANCHOR DOWEL BARS INTO DRILLED HOLES WITH AN EPOXY. MAXIMUM DRILLED HOLE SIZE IS 1/8-INCH GREATER THAN DOWEL BAR DIAMETER, 9 INCHES IN LENGTH.

6

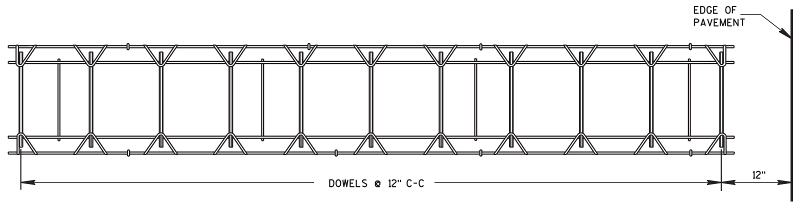
6

RURAL DOWELED CONCRETE PAVEMENT

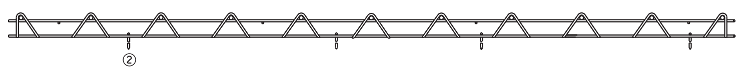
STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION

APPROVED
5/3/2013 DATE
/S/ Deb Bischoff
PAVEMENT POLICY & DESIGN ENGINEER
FHWA

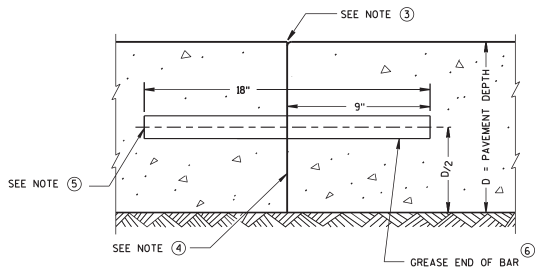
S.D.D. 13 C 11-11b



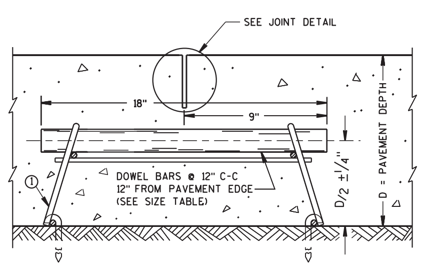
PLAN VIEW



SIDE VIEW
CONTRACTION JOINT DOWEL ASSEMBLY ①



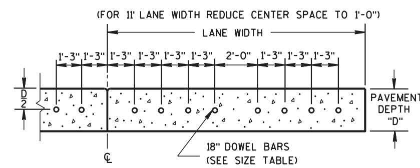
TRANSVERSE CONSTRUCTION JOINT



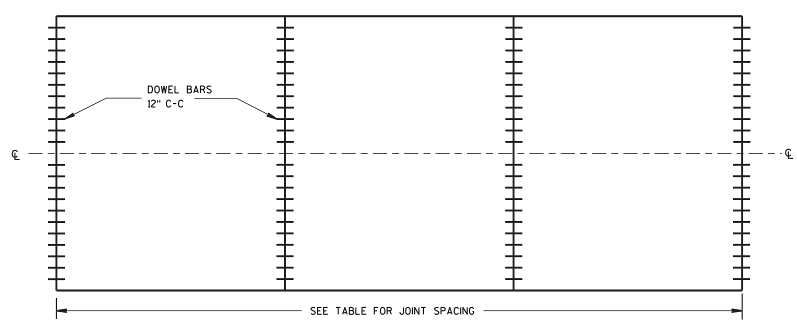
DOWELED CONTRACTION JOINT

PAVEMENT DEPTH, DOWEL BAR SIZE AND JOINT SPACING TABLE

PAVEMENT DEPTH (D)	DOWEL BAR DIAMETER	CONTRACTION JOINT SPACING
5 1/2", 6", 6 1/2"	NONE	12'
7", 7 1/2"	1"	14'
8", 8 1/2"	1 1/4"	15'
9", 9 1/2"	1 1/4"	15'
10" & ABOVE	1 1/2"	15'



DRILLED DOWEL BAR CONSTRUCTION JOINT ⑦



CONTRACTION JOINT LOCATIONS

GENERAL NOTES

CONTRACTION JOINTS

CONSTRUCT TRANSVERSE CONTRACTION JOINTS NORMAL TO THE CENTERLINE. SHOW THE LOCATION OF CONTRACTION JOINTS THROUGH INTERSECTIONS ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

DO NOT SEAL OR FILL CONTRACTION JOINTS.

INSTALL DOWEL BARS PARALLEL TO THE PAVEMENT CENTERLINE AND PAVEMENT SURFACE.

FOR PAVEMENT SLABS OF VARYING WIDTHS, LOCATE THE OUTER MOST DOWEL BAR SO THAT THE CENTER OF THE BAR IS A MINIMUM OF 6 INCHES AND A MAXIMUM OF 18 INCHES FROM THE LONGITUDINAL JOINT AND THE FREE EDGE OF PAVEMENT.

CONSTRUCTION JOINTS

LOCATE CONSTRUCTION JOINTS A MINIMUM OF 6 FEET FROM THE NEAREST CONTRACTION JOINT AND ALIGN PARALLEL TO CONTRACTION JOINTS.

① OBTAIN THE ENGINEER'S APPROVAL FOR THE USE OF ALTERNATIVE DESIGNS OF THE DOWEL ASSEMBLY. USE MECHANICAL DOWEL BAR INSERTERS OR DOWEL ASSEMBLIES WHEN CONSTRUCTING CONTRACTION JOINTS.

② SECURE BASKETS WITH ANCHORS TO HOLD DOWEL BARS IN THE CORRECT POSITION AND ALIGNMENT. TYPE, LOCATION, NUMBER AND LENGTH OF ANCHORS ARE DEPENDENT UPON FIELD CONDITIONS.

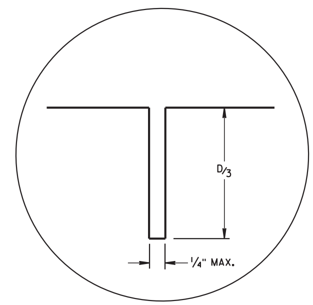
③ FORM OR SAW CONSTRUCTION JOINTS. PROVIDE A 1/4-INCH RADIUS AT FORMED JOINTS.

④ PROVIDE A SMOOTH VERTICAL FACE FOR THE ENTIRE DEPTH OF THE PAVEMENT WHEN FORMING CONSTRUCTION JOINTS.

⑤ INSTALL DOWEL BARS AT CONSTRUCTION JOINTS BY FORMING OR DRILLING. INSTALL FORMED DOWEL BARS 12 INCHES C-C AND 12 INCHES FROM PAVEMENT EDGE. REMOVE EXCESS CONCRETE FROM THE FREE END OF THE DOWEL BAR IF DOWEL BARS ARE FORMED THROUGH A HEADER BOARD. INSTALL DRILLED DOWEL BARS ACCORDING TO *DRILLED DOWEL BAR CONSTRUCTION JOINT* DETAIL.

⑥ APPLY A THIN UNIFORM COATING OF SURFACE TREATMENT TO THE FREE END OF DOWEL BARS TO PREVENT BONDING.

⑦ ANCHOR DOWEL BARS INTO DRILLED HOLES WITH AN EPOXY. MAXIMUM DRILLED HOLE SIZE IS 1/8-INCH GREATER THAN DOWEL BAR DIAMETER, 9 INCHES IN LENGTH.



JOINT DETAIL

URBAN DOWELED CONCRETE PAVEMENT
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION
APPROVED 5/3/2013 DATE /S/ Deb Bischoff PAVEMENT POLICY & DESIGN ENGINEER FHWA

6

S.D.D. 13 C 13-8

6

S.D.D. 13 C 13-8

B. Appendices

Colorado

SECTION 206
EXCAVATION AND BACKFILL
FOR STRUCTURES

DESCRIPTION

206.01 This work consists of the excavation, and backfill or disposal of all material required for the construction of structures. The excavation and disposal of excavated material for ditches and channels shall be accomplished in accordance with Section 203.

All excavation and backfill for structures below the designed slope or subgrade line provided in the Contract shall be included under this item.

Unless otherwise specified, structure excavation shall include all pumping, bailing, draining, and incidentals required for proper execution of the work.

MATERIALS

206.02 General. All structure backfill, bed course material, and filter material will be accepted in place.

(a) *Structure Backfill.* Class 1 and Class 2 structure backfill shall be composed of non-organic mineral aggregates and soil from excavations, borrow pits, or other sources. Material shall conform to the requirements of subsection 703.08. Class of material shall be as specified in the Contract or as designated.

Structure backfill (flow-fill) meeting the following requirements shall be used to backfill bridge abutments. The Contractor may substitute structure backfill (flow-fill) for structure backfill (class 1) or structure backfill (class 2) to backfill culverts and sewer pipes.

Ingredients	Lbs./Cu. Yd.
Cement	50
Coarse Aggregate (AASHTO No. 57 or 67)	1700
Fine Aggregate (AASHTO M 6) Water	1845 325 (or as needed)

The amount of water shall be such that the structure backfill (flow-fill) flows into place properly without excessive segregation. Approximately 39 gallons of water per cubic yard of structure backfill (flow-fill) is normally needed.

The Contractor may use aggregate which does not meet the above specifications if the cement is increased to 100 pounds per cubic yard and the aggregate conforms to the following gradation:

Sieve Size	Percent Passing
25.0 mm (1 inch)	100
75 µm (No. 200)	0-10

The Contractor may substitute 30 pounds per cubic yard of cement and 30 pounds per cubic yard of fly ash for 50 pounds per cubic yard of cement or may substitute 60 pounds per cubic yard of cement and 60 pounds per cubic yard of fly ash for 100 pounds per cubic yard of cement.
Recycled broken glass (glass cullet) is acceptable as part or all of the aggregate. Aggregate including glass must conform to the required gradations. All containers used to produce the cullet shall be empty prior to processing. Chemical, pharmaceutical, insecticide, pesticide, or other glass containers containing or having contained toxic or hazardous substances shall not be allowed and shall be grounds for rejecting the glass cullet. The maximum debris level in the cullet shall be 10 percent. Debris is defined as any deleterious material which impacts the performance of the flowfill including all non-glass constituents.

(b) *Bed Course Material.* Material shall conform to the requirements of subsection 703.07. Upon approval, aggregate base course conforming to the requirements of subsection 703.03 may be used in lieu of bed course material.

(c) *Filter Material.* Class A, Class B, and Class C filter material shall conform to the requirements of subsection 703.09. Class of material shall be as specified or designated.

CONSTRUCTION REQUIREMENTS

206.03 Structure Excavation and Structure Backfill. Unsuitable foundation material shall be removed and wasted in a manner acceptable to the Engineer, and the excavated material will be paid for as structure excavation. Excavation and backfill for areas in excess of 3 feet below designed elevation will be paid for as provided in subsections 104.03 and 109.04. Unsuitable foundation material which is suitable for embankments and suitable surplus excavated material shall be used in the construction of embankments. Unsuitable material removed below designed elevation shall be replaced with approved material.

If asbestos containing material (ACM) is suspected or found, the ACM and the suspected ACM shall be managed in accordance with the Air Quality Control Commission Regulation No. 8 Part B or Section 5.5 of the solid Waste Regulation 6 CCR 1007-2, which ever applies. All work conducted on site shall be in accordance with the Colorado Department of Public Health and Environment's Asbestos-Contaminated Soil Guidance Document or the State of Colorado's Asbestos Contaminated Soil Statewide Management Plan (ACS), whichever is more recent at the time of advertisement, and in accordance with subsection 250.07(d).

Rock, hardpan, or other unyielding material encountered in trenches for culvert pipe or conduit shall be removed below the designed grade for a minimum depth of 12 inches. This extra depth excavation shall be backfilled with loose structure backfill (Class 1) or other approved material. The base of structure backfill shall be scarified to a depth of 6 inches and compacted with moisture and density control prior to placement of any structural element or structure backfill. The type of compaction shall be the same as that required for structure backfill (Class 2), as specified below.

Backfill shall consist of approved materials uniformly distributed in layers brought up equally on all sides of the structure. Each layer of backfill shall not exceed 6 inches before compacting to the required density and before successive layers are placed. Structure backfill (Class 1) shall be compacted to a density of not less than 95 percent of maximum density determined in accordance with AASHTO T 180.

Required density for structure backfill (Class 2) shall conform to subsection 203.07. The type of compaction shall be as specified in the contract for embankment construction. When there is no embankment in the Contract or the type of compaction for structure backfill (Class 2) is not designated, the type of compaction shall be AASHTO T 180.

Pipes, culverts, sewers, and other miscellaneous structures outside the roadway prism and not subjected to traffic loads shall be backfilled in layers as described above but shall be compacted to the density of the surrounding earth.

The excessive use of water during backfilling operations will not be permitted.

Compaction equipment or methods that produce horizontal or vertical earth pressures, which may cause excessive displacement or overturning, or may damage structures, shall not be used.

Backfill material shall not be deposited against newly constructed masonry or concrete structures until the concrete has developed a compressive strength of $0.8f'_c$.

Backfill at the inside of bridge wingwalls and abutments shall be placed before curbs or sidewalks are constructed over the backfill and before railings on the wingwalls are constructed.

Unless otherwise indicated in the Contract or directed, all sheeting and bracing used in making structure excavation shall be removed by the Contractor prior to backfilling.

Structure backfill placed at bridge piers in waterways and water channels, that does not support embankments, pavements, or slope protection, will not require compaction.

Compaction of structure backfill (flow-fill) will not be required.

The maximum layer thickness for structure backfill (flow-fill) shall be 3 feet. Additional layers shall not be placed until the structure backfill (flow-fill) has lost sufficient moisture to be walked on without indenting more than 2 inches. Damage resulting from placing structure backfill (flow-fill) in layers that are too thick or from not allowing sufficient time between placement of layers shall be repaired at the Contractor’s expense.

When the Contractor substitutes Structure Backfill (Flow-Fill) for Structure Backfill (Class 1) or (Class 2), the trench width may be reduced to provide a minimum 6 inch clearance between the outside diameter of the culvert and the trench wall.

206.04 Bed Course Material. Construction requirements for bed course material for sidewalks and curbing shall conform to the applicable requirements of Sections 608 and 609.

206.05 Filter Material. Construction requirements for filter material for subsurface drains shall conform to the applicable requirements of Section 605.

Filter material shall be placed behind bridge abutments, wingwalls, and retaining walls as provided in the Contract and in accordance with the following requirements:

When provided in the Contract, wall drain outlets shall be backed with sacked filter material conforming to the gradation requirements for coarse aggregate No. 3 or No. 4 set forth in Table 703-2.

Filter material shall be placed in horizontal layers along with and by the same methods specified for structure backfill.

METHOD OF MEASUREMENT

206.06 Structure excavation, structure backfill, and bed course material will not be measured but will be the quantities designated in the Contract. When field changes are ordered or when there are errors on the plans, quantities will be measured as follows:

(a) For bridges and irregular shaped structures, quantities will be computed to neat lines 18 inches outside and parallel to the outline of the revised foundation plan or as shown on the plans.

(b) For pipes, a profile will be made along the bottom of the center line extending 18 inches beyond the end of the structure, including end sections. Material excavated between this profile and a profile 1 foot above the top of the pipe will not be measured for payment, but shall be included in the bid price for the pipe. In excavation sections the area above the profile 1 foot above the top of the pipe and below the limits of roadway excavation will be multiplied by the width shown on the plans to obtain the volume of structure excavation measured for payment. In embankment sections the area above the profile 1 foot above the top of the pipe and below the natural ground will be multiplied by the width shown on the plans to obtain the volume of structure excavation measured for payment.

(c) Backfill and filter material will be the calculated volume of material lying within the prism shown on the plans, from which shall be deducted the volume occupied by the structure.

(d) Bed course material will be the calculated volume of material lying within the prism shown on the plans.

BASIS OF PAYMENT

206.07 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Structure Excavation	Cubic Yard
Structure Backfill (Class____)	Cubic Yard
Structure Backfill (Flow-fill)	Cubic Yard
Bed Course Material	Cubic Yard
Filter Material (Class____)	Cubic Yard

Compaction, water, and all other work necessary to complete the above items will not be measured and paid for separately but shall be included in the work.

Structure backfill, including bed course material, for pipes and end sections will not be measured and paid for separately, but shall be included in the work. Where only end section work is required the structure excavation quantity and the structure backfill quantity will not be measured and paid for separately, but shall be included in the work.

When the Contractor substitutes Structure Backfill (Flow-Fill) for Structure Backfill (Class 1) or (Class 2), there will be no adjustment in the price or the quantity paid for structure excavation or structure backfill as a result of reducing the trench width.

Illinois

206.08 Basis of Payment. This work will be paid for at the contract unit price per ton (metric ton), or cubic yard (cubic meter) for GRANULAR EMBANKMENT, SPECIAL.

Aggregate required for maintenance will be paid for at the contract unit price per ton (metric ton) or cubic yard (cubic meter) for GRANULAR EMBANKMENT, SPECIAL.

Calcium chloride will be paid for according to Article 663.05.

SECTION 207. POROUS GRANULAR EMBANKMENT

207.01 Description. This work shall consist of furnishing, transporting, and placing porous granular material. For the purpose of this specification, the embankment may be above the original ground line, or it may be below the water elevation.

207.02 Materials. Materials shall be according to the following.

Item	Article/Section
(a) Coarse Aggregate	1004.05
(b) Fine Aggregate	1003.04

CONSTRUCTION REQUIREMENTS

207.03 General. The aggregate shall be placed in 6 in. (150 mm) lifts, loose measurement, and compacted in a manner approved by the Engineer, except that if the desired results are being obtained, the compacted thickness of any lift may be increased to a maximum of 8 in. (200 mm).

207.04 Method of Measurement. This work will be measured for payment in tons (metric tons) according to Article 311.08(b), or in cubic yards (cubic meters) compacted in place and the volume computed by the method of average end areas.

207.05 Basis of Payment. This work will be paid for at the contract unit price per ton (metric ton) for POROUS GRANULAR EMBANKMENT, or at the contract unit price per cubic yard (cubic meter) for POROUS GRANULAR EMBANKMENT.

SECTION 208. TRENCH BACKFILL

208.01 Description. This work shall consist of furnishing aggregate for backfilling all trenches made in the subgrade of the proposed improvement, and all trenches where the inner edge of the trench is within 2 ft (600 mm) of the proposed edge of pavement, curb, gutter, curb and gutter, stabilized shoulder, or sidewalk.

This work also includes the disposal of the surplus excavated material which is replaced by trench backfill. Such disposal shall be made according to Article 202.03.

Indiana

provisions of this specification shall apply to the entire right-of-way for the full contract length.

Unless otherwise set out in the special provisions for a contract which includes work for patching, widening, resurfacing, surface treating, undersealing, or for a combination of these, or for a contract through which traffic is being maintained during construction, these requirements will apply only to that portion of the right-of-way disturbed by the operations.

210.03 Method of Measurement

Final trimming and cleaning will not be measured for payment unless otherwise provided.

210.04 Basis of Payment

Final trimming and cleaning will not be paid for directly. The cost thereof shall be included in the cost of other pay items.

SECTION 211 – B BORROW AND STRUCTURE BACKFILL

211.01 Description

This work shall consist of backfilling excavated or displaced peat deposits; filling up to designated elevations of spaces excavated for structures and not occupied by permanent work; constructing bridge approach embankment; and filling over structures and over arches between spandrel walls, all with special material.

MATERIALS

211.02 Materials

Materials shall be in accordance with the following:

B Borrow	As Defined*
Flowable Backfill	213
Geotextile	918.02
Structure Backfill	904

* The material used for special filling shall be of acceptable quality, free from large or frozen lumps, wood, or other extraneous matter and shall be known as B borrow. It shall consist of suitable sand, gravel, crushed stone, ACBF, GBF, or other approved material. The material shall contain no more than 10% passing the No. 200 (75 µm) sieve and shall be otherwise suitably graded. The use of an essentially one-size material will not be allowed unless approved.

Aggregate for end bent backfill shall be No. 8 or No. 9 crushed stone or ACBF, class D or higher.

The Contractor has the option of either providing B borrow or structure backfill from an established CAPP source, or supplying the material from another source.

The Contractor has the following options for supplying B borrow or structure backfill from a local site:

(a) the establishment of a CAPP Producer Yard at the local site in accordance with 917; or

(b) use a CAPP Certified Aggregate Technician or a consultant on the Department's list of approved Geotechnical Consultants For Gradation Control Testing.

For material excavated within the project limits, gradation control testing will be performed by the Department if the Contractor is directed to use the material as B borrow or as structure backfill.

The frequency of gradation control testing shall be one test per 2,000 t based on production samples into a stockpile or by over the scales measurement, with a minimum of two tests per contract, one in the beginning and one near the mid-point. The sampling and testing of these materials shall be in accordance with applicable requirements of 904 for fine and coarse aggregates. The Contractor shall advise the Engineer in writing of the plan to measure the material.

CONSTRUCTION REQUIREMENTS

211.03 General Requirements
If B borrow or structure backfill is obtained from borrow areas, the items of obtaining the areas, their locations, depths, drainage, and final finish shall be in accordance with 203.

Unless otherwise specified, if excavated material complies with 211.02 and if B borrow or structure backfill is required for special filling, the excavated material shall be used as such. If there is a surplus of this material, such surplus shall be used in embankment. The provisions of 203.19 shall apply to placing this material at structures. All surplus in excess of the directed or specified use on the right-of-way shall be disposed of in accordance with 201.03.

If fill or backfill as described in this specification is within embankment limits, and if it is not required that the entire fill or backfill be of B borrow and placed as such, then that portion above the free-water level shall be placed in accordance with applicable provisions of 203 and compacted to the required density.

If borrow is required outside the specified limits of B borrow, material in accordance with the specifications for B borrow may be furnished at the contract unit price for borrow; however, the quantity of borrow measured for payment outside the limits of structure backfill will not exceed the theoretical quantity of B borrow furnished.

Unless otherwise specified, all spaces excavated for and not occupied by bridge abutments and piers, if within embankment limits, shall be backfilled to the original ground line with B borrow, and placed in accordance with 211.04.

Where B borrow or structure backfill is required as backfill at culverts, retaining walls, sewers, manholes, catch basins, and other miscellaneous structures, it shall be compacted in accordance with 211.04.

Where specified, aggregate for end bent backfill shall be placed behind end bents and compacted in accordance with 211.04. Prior to placing the aggregate, a geotextile shall be installed in accordance with 616.11.

211.03.1 Structure Backfill Types
The structure backfill type shall be as specified.

Within each of the following structure backfill types, the Contractor shall choose from the listed options for each type:

(a) Type 1

1. Structure backfill in accordance with 904.05.

2. Non-removable or removable flowable backfill in accordance with 213.

(b) Type 2

1. Crushed stone aggregate or ACBF structure backfill in accordance with 904.05, except No. 30, No. 4, and 2 in. nominal size aggregate shall not be used.

2. Non-removable or removable flowable backfill in accordance with 213.

(c) Type 3
Structure backfill in accordance with 904.05, except only nominal size aggregates 1 in., 1/2 in., No. 4 or No. 30, and coarse aggregate No. 5, No. 8, No. 9, No. 11, or No. 12 shall be stone or ACBF.

A type A certification in accordance with 916 for the additional structure-backfill testing described below shall be furnished to the Engineer prior to use. An approved geotechnical laboratory shall be used to perform the tests.

Structure backfill for all retaining walls shall be in accordance with the following criteria:

Property	Criteria	Test Method
pH	5 < pH < 10	AASHTO T 289
Organic Content	1% max.	AASHTO T 267
Permeability, min.	30 ft/day	AASHTO T 215

The gradation shall be run on the material used in the permeability test. Testing for permeability shall be performed on the sample of the material compacted to 95% in accordance with AASHTO T 99, Method C or D. All of the tests listed above shall be run a minimum of once every 12 months per source. The Office of Materials Management will evaluate the material from each source and determine the appropriate tests to be performed.

In addition to the criteria above, structure backfill for retaining wall systems containing metal components in contact with structure backfill shall also be in accordance with the following criteria:

Property	Criteria	Test Method
Chlorides	< 100 ppm	AASHTO T 291
Sulfates	< 200 ppm	AASHTO T 290
Resistivity, min.	3,000 Ω·cm	AASHTO T 288
Internal friction angle, φ, min.	34°	AASHTO T 236* or T 297*

* under consolidated drained conditions

If the minimum resistivity exceeds 5,000 Ω·cm, the requirement for the testing of chlorides and sulfates will be waived. The resistivity shall be tested at 100% saturation. All of the tests listed above shall be run a minimum of once every 12 months per source. The Office of Materials Management will evaluate the material from each source and determine the appropriate tests to be performed.

Testing for φ shall be performed using a sample of the material compacted to 95% in accordance with AASHTO T 99, Method C or D. Testing for φ will not be required when using coarse aggregate No. 5, No. 8, or No. 9.

(d) Type 4

Removable flowable backfill in accordance with 213.

(e) Type 5

Non-removable flowable backfill in accordance with 213.

211.04 Compaction

B borrow and structure backfill types 1, 2, and 3 shall be compacted with mechanical tamps or vibrators in accordance with the applicable provisions of 203.23 except as otherwise set out herein.

Aggregate for end bent backfill and coarse aggregate used for structure backfill shall be deposited in layers not to exceed 12 in. loose measurement. Each layer shall be mechanically compacted with a compactor having a plate width of 17 in. or larger that delivers 3,000 to 9,000 lb per blow. Each lift shall be compacted with two passes of the compactor.

211.05 Embankment for Bridges

When special filling is required, the embankment for bridges shall be constructed using B borrow within the specified limits shown on the plans. All embankment construction details specifically set out in this specification for embankment for bridges shall be considered in accordance with the applicable requirements of 203.

At the time B borrow is being placed for approach embankment, a well compacted watertight dam shall be constructed in level lifts, the details of which are shown on the plans. Except as hereinafter specified for material to be used in constructing the enclosing dam, and for growing vegetation, and unless otherwise provided, the material for constructing bridge approach embankment shall be B borrow compacted by mechanical methods. If approach embankment or shoulders are constructed of material not suitable for growing seed or sod, and if one or both of these is required, then such areas shall, unless otherwise specified, be covered with a layer of clay, loam, or other approved material. This layer shall be approximately 1 ft thick after being compacted into place.

211.06 B Borrow Around Bents

When specified, B borrow shall be placed around all bents falling within the limits of the approach grade as shown on the plans. Before placing, the surface of the ground on which it is to be placed shall be scarified or plowed as directed. The embankment slope shall be 2:1 on the sides and beneath the structure, and shall be 6:1 from the end of the bridge down to the average ground line, or it may be required to complete the approaches back to the existing grade. An enclosing dam and provisions for growing vegetation shall be constructed in accordance with 211.05.

211.07 Blank

211.08 Spandrel Filling

Unless otherwise specified, spandrel fills for arch structures shall be composed of B borrow. The fill shall be carried up symmetrically in lifts from haunch to crown and simultaneously over all piers, abutments, and arch rings. Compaction shall be in accordance with 211.04.

211.09 Method of Measurement

B borrow, structure backfill types 1, 2, or 3, and aggregate for end bent backfill will be measured by the cubic yard as computed from the neat line limits shown on the plans. If cubic yards are set out as the pay item for B borrow or structure backfill in the Schedule of Pay Items and if neat line limits are not specified for measurement of volume for the material, measurement will be made by the cubic yard at the loading point in truck beds which have been measured, stenciled, and approved. The

B borrow may be weighed and converted to cubic yards by assuming the weight per cubic foot to be 90% of the maximum wet density in accordance with AASHTO T 99. The material may be cross sectioned in its original position and again after excavation is complete, and the volume computed by the average end area method. If B borrow is used for backfill in areas where unsuitable material is present or peat excavation has been performed, unless otherwise directed, the B borrow will be cross sectioned, and the volume will be computed by the average end area method.

Structure backfill types 4 or 5 will be measured by the cubic yard as computed from the neat line limits shown on the plans. If neat line limits are not shown on the plans, the volume in cubic yards of flowable backfill furnished and placed as structure backfill type 4 or 5 will be computed from the nominal volume of each batch and a count of the batches. Unused and wasted flowable backfill will be estimated and deducted.

If the material is to be paid for by the ton, it shall be weighed in accordance with 109.01(b).

If the material comes from a wet source such as below water or a washing plant, and weighing is involved in the method of measurement, there shall be a 12 h drainage period prior to the weighing.

Geotextile will be measured in accordance with 616.12.

211.10 Basis of Payment

The accepted quantities of B borrow will be paid for at the contract unit price per cubic yard or per ton as specified, complete in place.

Structure backfill will be paid for at the contract unit price per cubic yard of the type specified, provided the material comes from outside the permanent right-of-way.

B borrow material placed outside the neat lines will be paid for as borrow when such B borrow eliminates required borrow material. Otherwise, no payment will be made for backfill material placed outside the neat lines.

Aggregate for end bent backfill will be paid for at the contract unit price per cubic yard, based on the neat line limits shown on the plans.

Geotextile will be paid for in accordance with 616.13.

If topsoil, loam, or other suitable material in accordance with 211.05 is used for expediting the growth of seed or sod, it will be paid for at the contract unit price per cubic yard for borrow, unless otherwise provided.

Payment will be made under the following:

Pay Item	Pay Unit Symbol
Aggregate For End Bent Backfill	CYS
B Borrow	CYS
	TON
Structure Backfill, Type _____	CYS

No payment will be made under this section for material obtained within the excavation limits of the project if the Contractor is directed to use the material as B borrow or structure backfill in a pipe trench, culvert, construction of an embankment or fill, or if the Contractor uses the material for its own convenience. Material obtained from within the excavation limits of the project and which the Contractor is directed to use as B borrow or structure backfill for other purposes including replacement of undercut areas, support for a retaining wall system, and end bent fill will be paid for at the contract unit price of $5.00 per cubic yard for B borrow/structure backfill handling.

The cost of disposal of excavated material shall be included in the cost of the pay items in this section.

SECTION 212 – STOCKPILED SELECTED MATERIALS

212.01 Description

This work shall consist of excavating selected road material from within the construction limits and stockpiling it on the right-of-way at designated locations. It also includes any subsequent removal of the material from the stockpile, if to be used in the work.

212.02 Materials

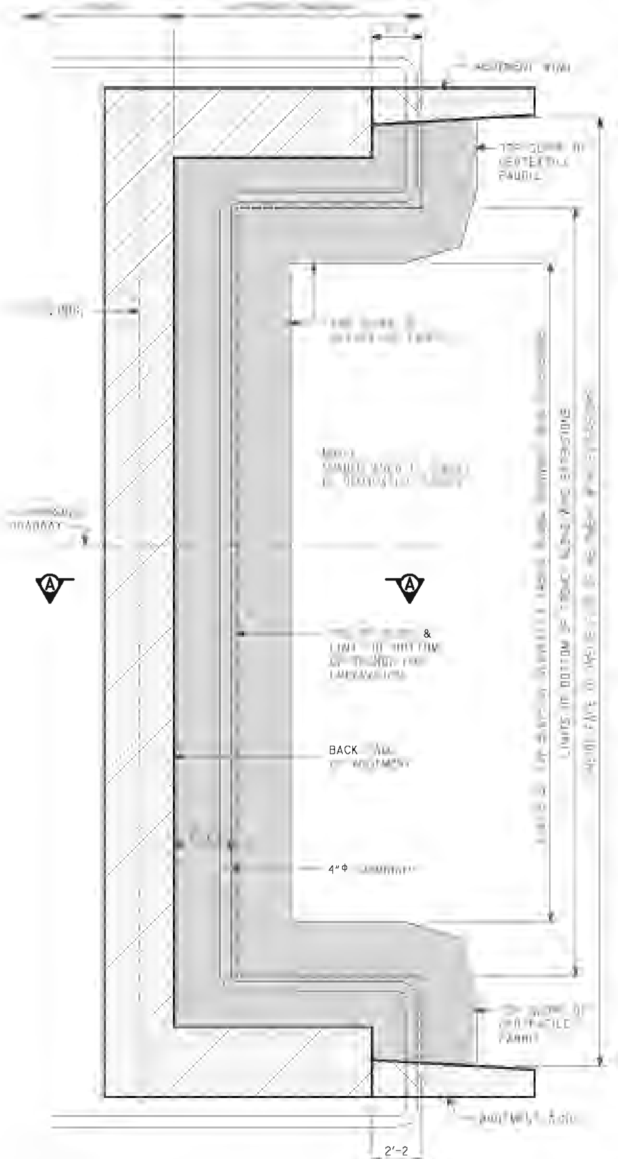
Any material to be excavated and stockpiled will be specifically named and described in the special provisions and may include rock, top soil, material in accordance with 211.02, or any other material selected, any of which may be excavated as common excavation.

After the selected material is stockpiled it shall be known as stockpiled selected material and if any of this material is required to be removed from the stockpile and used in the work, its removal and its incorporation into the work shall be known as salvaged stockpiled selected material.

212.03 Construction Requirements

Selected material shall be excavated from specified areas and stockpiled on the right-of-way at designated locations. The depth of excavation shall be as directed.

Iowa



ABUTMENT PLAN WITH WING EXTENSIONS

ABUTMENT BACKFILL PROCESS:

[illegible] 4% SLOPE AWAY FROM THE ABUTMENT FOOTING AND A 2% [illegible]

[illegible] 2 [illegible]

[illegible]

[illegible] #200 [illegible]

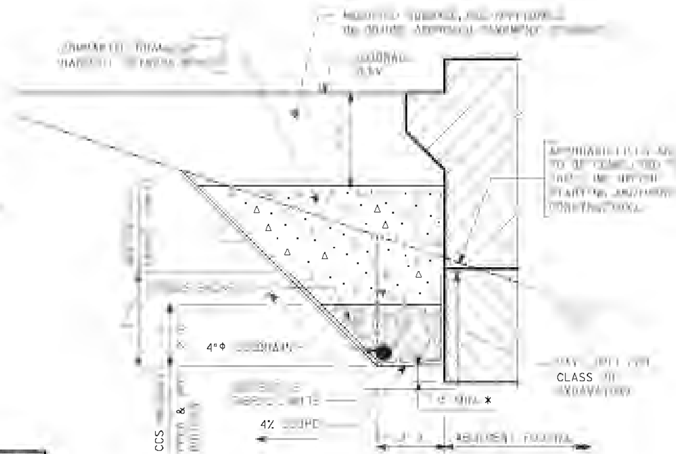
[illegible] 2 [illegible] 5 [illegible] 6 [illegible] 8 [illegible]

[illegible]

[illegible]

[illegible]

TECHNICAL DATA INFORMATION - GEOTEXTILE FABRIC				
MECHANICAL PROPERTIES	TEST METHOD	UNIT	MINIMUM AVERAGE ROLL VALUE	
			(MD)	(CD)
TENSILE STRENGTH (AT 5% STRAIN)	ASTM D 4595	[illegible]	[illegible]	[illegible]
PERMEABILITY	ASTM D 4491	[illegible]	0.038	
FLOW RATE	ASTM D 4491	[illegible]	750	
UV RESISTANCE (AT 500 HOURS)	ASTM D 4355	% STRENGTH RETAINED	70	



SECTION A-A

GRANULAR BACKFILL DETAILS

* [illegible] 2% [illegible]

[illegible] 2% [illegible] ROADWAY [illegible]

[illegible] 2% [illegible]

[illegible]

ABUTMENT BACKFILL DETAILS

IOWA [illegible]

Kansas

SECTION 204

EXCAVATION AND BACKFILL FOR STRUCTURES

204.1 DESCRIPTION

Excavate for the structures as shown in the Contract Documents. Unless specified otherwise, backfill the completed structures to the original ground line.

BID ITEMS	UNITS
Class * Excavation	Cubic Yard
Concrete (Grade **)(***)	Cubic Yard
Concrete for Seal Course (Set Price)	Cubic Yard
Foundation Stabilization	Cubic Yard
Foundation Stabilization (Set Price)	Cubic Yard
Granular Backfill	Cubic Yard
Granular Backfill (Wingwalls) (Set Price)	Cubic Yard
Water (Grading) (Set Price)	M Gallon

*Class of Excavation
**Grade of Concrete
***AE (air-entrained), if specified

204.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete .... **DIVISION 400**
Aggregates for Backfill .... **DIVISION 1100**
Water .... **DIVISION 2400**

Provide sand, or other aggregate that contains sufficient binder to allow compaction and limit the flow of water through the material, as granular material for culvert bedding. Provide material with enough moisture to allow compaction. The Engineer will accept the granular bedding material based on visual inspection of the material placed on the project.

204.3 CONSTRUCTION REQUIREMENTS

a. Classification of Excavation.

(1) Class I Excavation and Class II Excavation. Excavation for bridges is normally classified as Class I and Class II Excavation. Class I and Class II Excavation are referenced to the Excavation Boundary Plane (a horizontal plane at a given elevation) shown in the Contract Documents.

(a) Class I Excavation is the entire volume of whatever nature, except water, found above the Excavation Boundary Plane, within the limits specified.

(b) Class II Excavation is the entire volume of whatever nature, including water, found below the Excavation Boundary Plane, within the limits specified.

(2) Class III Excavation. Bridge excavation not classified as Class I or Class II, is classified as Class III Excavation. Excavation for structures other than bridges is also classified as Class III Excavation.

(a) Class III Excavation is the entire volume of whatever nature encountered, including water, within the limits specified. The water level for determining quantities is the water level during construction at which pumping or bailing is necessary to continue excavation.

b. Excavation Requirements.

(1) General. Allow the Engineer to define the limits of the excavation and cross-section the original ground before beginning the excavation for the structure.

Excavate all foundations to the elevations and dimensions shown in the Contract Documents. If rock of the quality that will not erode is encountered in the toe wall excavation, the Engineer may allow the toe wall to be keyed into the rock.

Follow OSHA safety regulations for sloping the sides of excavations, using shoring and bracing as required.

If material encountered below the foundation elevation will not support the structure, remove such material and replace with stable backfill material approved by the Engineer.

Save excavated material for structure backfill. Dispose of surplus excavated material and excavated material unsuitable as backfill material.

Provide temporary erosion and pollution control according to **SECTION 901**.

(2) Cofferdams. Use watertight cofferdams if excavating in water, or if the excavation is affected by groundwater. Construct and shore the cofferdams according to OSHA safety regulations. The minimum size of the cofferdams shall be greater than the limits for pay excavation. Extend the cofferdams below the bottom of the footing, or at least to an elevation as near the bottom of the excavation as foundation conditions will allow. If necessary, dewater the cofferdams.

(3) Foundations with Piling. Complete the foundation excavation before driving any piling. After driving all piling, remove the loose and displaced material in the foundation pit. If necessary, reshape and recompact the bottom of the excavation according to the Contract Documents.

(4) Spread Footing Bridge Foundations. From the elevation that rock or shale is encountered or from the top elevation of the footing, whichever is lower, excavate the footing as shown in the Contract Documents. No side forming is allowed below the top elevation of rock or shale, or below the top of the footing, whichever is lower. Cut spread footing bridge foundations in rock, using hand equipment. Do not use blasting or machine rock excavation below the top of the footing.

If the bottom elevation of the spread footing excavation is in shale, minimize the time the shale is exposed to the elements before placing the concrete footing. Place the concrete footing within the time limits designated in the Contract Documents. Contact the KDOT Regional Geologist if the shale exposure exceeds the maximum time specified. Mitigate the effects of the shale exposure by excavating a minimum of 4 inches below the over-exposed shale to expose sound material. The Contractor has the option (at own expense) to negate the time limits imposed for exposure of the shale by placing a 4 inch (minimum) concrete seal of Grade 4.0 concrete over the exposed shale before the specified time limits expire. If the Contractor chooses this option, excavate to 4 inches below the plan bottom of footing elevation so the bottom of footing elevation remains at the elevation designated by the Contract Documents.

After the excavation is completed, and all loose material is removed from the footing, drill exploratory borings 1½ to 2 inches in diameter and 5 foot deep to verify the quality and soundness of the material below the bottom of the footing. Notify the Engineer before starting the exploratory borings.

- For footings with an area of less than 12 square yards, drill the boring in the center of the footing.
- For footings with an area of 12 square yards or greater, drill a boring within 3 feet of each corner of the footing.

If an exploratory boring encounters unsound material, or if the material at the bottom of the footing does not match the material shown on the geology sheet in the Contract Documents, do not proceed with the construction of the spread footing until the site is reviewed by the Geologist and a recommended course of action made.

(5) Excavation for Metal Pipe, Reinforced Concrete Pipe and Structural Plate Structures.

- Pipes and Culverts less than 3 feet in diameter. Excavate the bottom of the channel to the elevation shown in the Contract Documents. While excavating, use a template to shape the bottom of the channel so that at least 10% of the overall height of the pipe or culvert is in contact with the bottom of the channel. Excavate recesses into the channel to accept all protrusions from the perimeter of the pipe or culvert. Alternate methods of bedding the pipe or culvert: (1) Place and compact a bed of granular material (4 inch minimum thickness) on the bottom of the channel, and then use a template to shape the granular material to accept the culvert. (2) Place the pipe or culvert on the bottom of the channel, then place and tamp granular material (4 inch minimum thickness) under the haunch area of the pipe or culvert.
- Pipes and Culverts greater than 3 feet in diameter. Excavate the bottom of the channel to the elevation shown in the Contract Documents. Excavate recesses into the channel to accept all protrusions from the perimeter of the pipe or culvert. After the pipe or culvert is placed on the bottom of the channel,

place and tamp granular material under the haunch area of the pipe or culvert so that 20% of the overall height of the pipe or culvert is bedded in the granular material. An alternate method of bedding the pipe or culvert is to place and compact a bed of granular material (approximately half the total quantity needed) on the bottom of the channel, then use a template to shape the granular material to accept the pipe or culvert. Place and tamp the remainder of the granular material after the pipe or culvert is placed so that 20% of the overall height of the pipe or culvert is bedded in the granular material.

- If rock is encountered, remove the rock to an elevation 12 inches below the elevation shown in the Contract Documents for the bottom of the channel. If blasting is used to remove rock, take the precautions to protect the previously placed portions of the structure. Backfill and compact the bottom 12 inches of the excavation with soil from the roadway excavation.

(6) Excavation for PE and PVC Pipes. Excavate and form a bed for PE and PVC pipes according to AASHTO LRFD Bridge Design Specifications, Section 12, with these alterations:

- The minimum trench width = (1½ times the pipe diameter) + 12 inches.
- The space between the pipe and the trench wall shall be wider than the compaction equipment used in the pipe zone.
- The trench width in unsupported, unstable soils will depend on the size of the pipe, the stiffness of the backfill and insitu soil, and the depth of cover.

c. Foundation Stabilization. When designated in the Contract Documents, the Contractor has the option to construct the foundation stabilization 6 inches thick, according to the details shown, or underrun the item when deemed unnecessary. When conditions require, the Engineer may approve a depth greater than 6 inches.

d. Foundation Stabilization (Set Price). If the Contract Documents do not designate foundation stabilization and a firm foundation is not encountered at the established grade for boxes or pipe culverts, the Engineer may approve the removal of unsound material and installation of suitable foundation stabilization material.

Before this work is done, the Engineer will determine the limits of excavation for the material removal.

e. Concrete Seal Course (Set Price). When designated in the Contract Documents, construct the concrete seal course according to the details shown.

When the Contract Documents do not show a concrete seal course, but the bottom of the excavation can not be pumped free of water, the Engineer may approve the placement of a concrete seal course. When approved by the Engineer, construct a 3 inch seal course of commercial grade concrete below the bottom of footing elevation. If the Contract Documents call for foundation stabilization, and the Engineer determines the conditions require a concrete seal course as specified above, underrun the foundation stabilization. The Engineer will consider alternate methods of sealing out the water. The burden of proof regarding an alternate method of sealing out the water will be on the Contractor.

If a concrete seal course is not shown in the Contract Documents, or the Engineer does not approve one, the Contractor may still place one at own expense.

When the Contract Documents show constructing foundation stabilization, the Contractor has the option of constructing a concrete seal course in its place. However, the concrete seal course will be paid for as foundation stabilization at the contract quantity and unit price.

f. Backfill for Structures.

(1) General. Do not place backfill against any structure without the Engineer's approval.

Remove all shoring, bracing and cofferdams before backfilling a structure.

Use material from the structure excavation or material from the roadway excavation for the backfill of structures. If necessary, adjust the moisture content of the soil by adding water to or aerating the material.

Do not use hydraulic methods of backfill.

After the designated cure period for a concrete structure expires, wait at least 3 days before subjecting the structure to the pressures of backfilling or to live loads. If adverse curing conditions exist, the Engineer may extend this period.

Provide for drainage at all weep holes in concrete structures. Unless drainage is provided for otherwise in the Contract Documents, place approximately 2 cubic feet of crushed stone or sand gravel at each weep hole.

Place granular backfill as detailed in the Contract Documents. If the area for granular backfill is excavated beyond the theoretical limits of the granular backfill, fill the over-excavation with granular backfill material.

Place the backfill in horizontal layers evenly on all sides of the structure, a maximum of 8 inches thick (loose measurement). If the backfill is placed on only one side of a structure (such as abutments, piers, wingwalls), do not put excessive pressure against the structure. Prevent wedging action against the structure during the backfill. Bench the slopes bounding the excavation.

Extend each layer of the backfill to the limits of the excavation or to the original ground line. Continuously level and manipulate the material during the placing and compacting of each layer of the backfill. Use a motorgrader where possible. Compact each layer as specified before placing the next layer.

Drain all water from areas before backfilling. If backfill compaction is not required for piers, it is not necessary to drain the water from the pier excavations before backfilling.

If it is impossible to drain the water, deposit thin layers of backfill material into the water. When placing backfill material into water, the compaction requirements do not apply until the backfill progresses to the point that all water is absorbed by the backfill material.

Unless otherwise shown in the Contract Documents, backfill compaction is not required around piers, except piers adjacent to railroad tracks, roadways or in the toe slopes of embankments.

If the Contract Documents provide for "Compaction of Earthwork", compact the backfill according to **SECTION 205**. If the Contract Documents do not provide for compaction, compact the backfill according to Type B compaction in **SECTION 205**.

If the Contract Documents designate a moisture range for the embankment adjacent to the structure, use backfill material with uniform moisture content within the specified range according to **SECTION 205**. If the Contract Documents do not designate a moisture range, use backfill material with uniform moisture content adequate to produce the specified density.

(2) Backfill of Reinforced Concrete Box. If the top of a reinforced concrete box extends above the original ground line, continue the compacted backfill to the top of the reinforced concrete box. Place the backfill 10 feet wide on each side of the culvert for the full width of the roadway embankment.

(3) Backfill of Metal Pipe, Reinforced Concrete Pipe and Structural Plate Structures. If the top of a pipe or culvert extends above the original ground line, continue the compacted backfill to the top of the pipe culvert. Place the backfill 1½ times the external diameter of the pipe on each side of the culvert for the full width of the roadway embankment. Take the necessary precautions to prevent distortion of the pipe or culvert while backfilling.

Backfill structural plate structures and metal pipes greater than 60 inches in diameter with granular backfill. Use deflection control measures, including hand tamping, to maintain the original shape of the structure.

If the height of fill over the top of a reinforced concrete pipe is greater than 27.5 feet, place the backfill using the imperfect trench method in this manner:

- Place the reinforced concrete pipe in the excavation, as specified.
- Place and compact the earthen backfill to a height above the top of the pipe equal to the external width of the pipe.
- After the backfill is placed and compacted as specified, excavate the compacted earth from the prism directly over the pipe.
- Backfill the resulting trench with earth placed in the loosest possible condition.
- After the trench is filled with loose earth, construct the remainder of the embankment as specified in the Contract Documents.

If it is necessary for construction equipment to travel over a corrugated metal pipe culvert before the backfill is completed above the top of the culvert, place additional backfill over the top of the pipe. Use **TABLE 204-1** as a guide.

TABLE 204-1: APPROXIMATE MINIMUM COVER OVER THE TOP OF THE PIPE

CMP Size (inches)	Approx. Min. Cover Required for Axle Load of 18 to 50 Kip (feet)	Approx. Min. Cover Required for Axle Load of 50 to 75 Kip (feet)	Approx. Min. Cover Required for Axle Load of 75 to 110 Kip (feet)	Approx. Min. Cover Required for Axle Load of 110 to 150 Kip (feet)
12 to 42	2.0	2.5	3.0	3.0
48 to 72	3.0	3.0	3.5	4.0
78 to 120	3.0	3.5	4.0	4.0

(4) Backfill of PE and PVC Pipe. Backfill PE and PVC pipe according to the AASHTO LRFD Bridge Design Specifications, Section 12, with these alterations:

- If the fill to the top of the subgrade is 3 feet or less, backfill with granular material to the top of the subgrade.
- If the fill to the top of the subgrade is greater than 3 feet, backfill with granular material to a point 12 inches above the top of the pipe.
- Prevent floating the pipe during the backfilling operations. Do not deform or damage the pipe while compacting the granular backfill. Hand tamping may be necessary adjacent to the pipe to prevent distortion.
- The maximum barrel deflection of the pipe (reduction of the barrel nominal base inside diameter) shall not exceed 5%. Use a mandrel to measure the barrel deflection of the pipe. Take the measurement at least 30 days after the installation and backfilling. If oversized diameter pipes are installed, actual inside pipe diameters may need to be considered. Remove, reinstall or replace any pipes deformed more than 5%.

(5) Granular Backfill (Wingwalls) (Set Price). When designated in the Contract Documents, construct the granular backfill for wingwalls according to the details shown.

204.4 MEASUREMENT AND PAYMENT

a. Contract Quantities. Provided the project is constructed essentially to the lines and grades shown in the Contract Documents, the quantities shown in the Contract Documents for the various balances will be the quantities for which payment is made.

If the Contract Documents have been altered, or if the Engineer or Contractor questions the accuracy of the contract quantities at any location, either party may request the quantities involved be measured.

b. Measured Quantities. The Engineer will measure quantities for the various classes of excavation by cross-sectioning the area. The Engineer will compute the quantities (volume) by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer will use 3-dimensional measurements. Measurement will not include additional excavation required to mitigate the effects of over-exposed shale in foundations.

(1) Bridge Excavation. The Engineer will measure the various classes of excavation by the cubic yard. If the Contract Documents show excavation dimensions, the measured quantity is limited to the volume bounded by vertical planes at the contract dimensions. When excavation dimensions are not shown in the Contract Documents, the quantity measured for payment is the quantity removed, limited to the volume bounded by vertical planes 2 feet outside the footings and tie beams.

(2) Excavation for Structures Other Than Bridges. If shown as a bid item in the Contract Documents, the Engineer will measure Class III excavation by the cubic yard. If not shown as a bid item in the Contract Documents, Class III excavation for structures other than bridges is subsidiary to other items of work.

If the Contract Documents show excavation dimensions, the measured quantity is limited to the volume bounded by vertical planes at the contract dimensions. When excavation dimensions are not shown in the Contract Documents, the quantity measured for payment is the quantity removed, limited to the volume bounded by vertical planes 2 feet outside the footings.

Excavation for reinforced concrete box culverts, pipe culverts or headwalls for culverts is not measured for payment. Excavation over the culvert necessitated by the imperfect trench method of backfill is not measured for payment. If rock is not shown in the Contract Documents and is encountered during the excavation for reinforced concrete box culverts, pipe culverts or headwalls for culverts, the rock excavation is paid for as Extra Work, **subsection 104.6**.

(3) Concrete for Seal Course (Set Price). The Engineer will measure concrete placed for a seal course (either shown in the Contract Documents or approved by the Engineer) by the cubic yard. The quantity measured for payment is the quantity placed, limited to the volume bounded by vertical planes at the limits of the pay excavation for the structure. If the excavation for the structure is subsidiary, the quantity of concrete measured for payment is the quantity placed, limited to the volume bounded by vertical planes 2 feet outside the footings.

If the Contractor elects to use a concrete seal course in place of the foundation stabilization shown in the Contract Documents, the Engineer will measure and pay for the concrete seal course as the foundation stabilization at the contract quantity and at the contract unit price.

The excavation necessary to place the concrete seal course is not measured for payment.

(4) Foundation Stabilization. When designated in the Contract Documents and the Contractor opts to construct it, the Engineer will measure the foundation stabilization for box and pipe culverts by the cubic yard to the volume bounded by vertical planes at the contract dimensions to a depth of 6 inches, or greater depth approved by the Engineer.

If the Contractor deems the foundation stabilization unnecessary, the Engineer will underrun the item.

The Engineer will not measure excavation necessary to place the foundation stabilization.

(5) Foundation Stabilization (Set Price). The Engineer will measure the foundation stabilization (Set Price) by the cubic yard. The quantity measured for payment is the quantity placed, limited to the volume bounded by vertical planes at the limits of the pay excavation for the structure. If the excavation for the structure is subsidiary, the quantity of foundation stabilization measured for payment is the quantity placed, limited to the volume bounded by vertical planes 2 feet outside the footings.

The excavation necessary to place the foundation stabilization (Set Price) is not measured for payment.

(6) Granular Backfill and Granular Backfill (Wingwalls) (Set Price). The Engineer will measure granular backfill by the cubic yard. The Engineer will measure to the neat lines shown in the Contract Documents. The Engineer will not measure for payment the excavation required to place the granular backfill or any granular backfill material placed beyond the limits shown in the Contract Documents (over-excavated areas).

(7) Water (Grading) (Set Price). The Engineer will measure water used for earthwork compaction by the M gallon, by means of calibrated tanks or water meters. Water used for dust control, water wasted through the Contractor's negligence, water in excess of the quantity required to obtain the proper moisture content or water used for compaction of earthwork (backfill) around structures classified as bridges is not measured for payment.

c. Payment. Payment for the various classes of "Excavation", the various grades of "Concrete", "Foundation Stabilization" and "Granular Backfill" at the contract unit prices is full compensation for the specified work.

Payment for "Concrete for Seal Course (Set Price)", "Foundation Stabilization (Set Price)", "Granular Backfill (Wingwalls) (Set Price)" and "Water (Grading) (Set Price)" at the contract set unit prices is full compensation for the specified work.

If the Engineer determines it is necessary to lower a footing below the elevation shown in the Contract Documents, the additional excavation is paid as follows:

- Additional excavation up to and including 2 feet below the contract elevation is paid at the contract unit price.
- Additional excavation from more than 2 feet up to and including 6 feet below the contract elevation is paid at 1½ times the contract unit price.
- Additional excavation more than 6 feet below the contract elevation is paid as Extra Work, **subsection 104.6**.

Kentucky

SECTION 603 — FOUNDATION PREPARATION AND BACKFILL

603.01 DESCRIPTION. Excavate and backfill or dispose of all materials required for the construction of bridges, box culverts, and other structures for which excavation is not otherwise provided.

603.02 MATERIALS AND EQUIPMENT. Use fabric wrapped backfill drains conforming to Section 845.

603.03 CONSTRUCTION. Remove and dispose of all materials excavated for the construction of the foundations for all structures, including the removal of existing structures. Place backfill to the original ground level and perform final cleaning up.

603.03.01 Classification. Perform structure excavation necessary for all bridge foundations and culverts, except pipe culverts, as Structure Excavation Solid Rock or Structure Excavation Common. Perform structure excavation necessary in the construction of cribwalls and retaining walls as Structure Excavation Unclassified.

A) Structure Excavation Solid Rock. The Department considers all of the following Structure Excavation Solid Rock:

1) All rock in solid beds, detached masses, or ledge formations which cannot be removed without blasting or quarrying. Hoe-rams and jackhammers may be required for solid rock removal.
2) Detached rocks or boulders having a volume of 0.5 cubic yards or more each.
3) Shale, slate, or coal which cannot be removed without blasting or quarrying.
4) Rock layers interspersed with strata of earth, or all conglomerate boulder formations, when rock strata or boulders constitute 60 percent or more of the volume to be removed.

B) Structure Excavation Common. The Department considers Structure Excavation Common as all material not classified as Solid Rock Structure Excavation.

C) Structure Excavation Unclassified. The Department considers Structure Excavation Unclassified as all excavation regardless of the materials encountered.

603.03.02 Channel Preservation. When any excavation or dredging is done at the site of the structure, do not excavate outside of caissons, cofferdams, steel piling, or sheeting, and do not disturb the natural stream bed adjacent to the structure without the Engineer's written permission.

603.03.03 Footing Excavation. Notify the Engineer at least 48 hours in advance of beginning structure excavation.

Excavate the foundation pits to allow placing of the full width and length of footings specified in the Plans with full horizontal beds. Do not use rounded or undercut corners and edges of footings. Ensure that all rock and other hard foundation material is free from all loose material, cleaned, and cut to a firm surface, either level, stepped, or roughened, as directed. Clean all seams and fill with concrete, mortar, crushed stone, or sand. When masonry is to rest on an excavated surface other than durable rock or durable shale (SDI equal to or greater than 95 according to KM 64-513), do not disturb the bottom of the excavation, and do not make the final removal of the foundation material to grade until just before the masonry is to be placed. When unsuitable foundation material is encountered, excavate and replace with acceptable material as the Engineer directs. Maintain the excavation free of standing water, insofar as is practical.

When the Plans require the foundation for a bridge or culvert to be solid rock or shale, drill into the foundation material to confirm its suitability. Drill according to the Division of Construction's Guidance Manual.

603.03.04 Backfilling. Use only approved materials that will provide a dense well-compacted backfill. Ensure that the backfill material is free of frozen lumps, vegetation, debris, and rock fragments larger than 4 inches in any dimension. Before starting backfill, clear the excavated pits of all form material and rubbish, and, when practical dewater the pits.

Place and compact backfill material in uniform horizontal lifts not exceeding one foot for stone and 6 inches for soil and rock/soil combination material. For backfill that will be beneath, or within a proposed embankment, backfill according to Subsection 206.03.03.

When backfilling piers constructed in a stream bed or flood plain, the Department will allow material removed from the excavation as backfill material provided no large rock or broken concrete fragments are placed in contact with the structure, and provided no logs, stumps or rubbish are used. Backfill below normal low water elevation will not require compaction.

Shape the backfilled areas lying outside the limits of roadway embankment to a uniform finish.

As a precaution against introducing unbalanced stresses in masonry walls or columns, place and compact the backfill to the same elevation on both sides of culverts, wingwalls, piers, and abutments before proceeding to the next layer.

For structures over which rock fills will be constructed, first cover the structures to a minimum depth of 2 feet with materials placed and compacted as required for backfill.

Obtain the Engineer's permission before backfilling against any concrete masonry structure.

603.03.05 Drainage. At locations where depth to weep hole flowline is 30 feet or less, drain backfill by installing a fabric-wrapped drain.

Center a fabric-wrapped drain over the inlet end of each weep hole with a wide side against the concrete, and glue the drain in place. Use a glue recommended by the drain manufacturer. Ensure that glue is not placed over the portion of the drain covering the weep hole. Place drains vertically at each weep hole.

Extend the drain from top of footing or from 6 inches below the inlet end of weep holes to 6 inches below subgrade elevation or, in the case of box culverts, to the top of the top slab. Avoid damaging or compressing the drain during backfilling.

When splices are required, provide a 6-inch lap of fabric to be glued to the adjacent piece so the spliced drain is completely covered by fabric.

Provide flaps or separate pieces of fabric to cover the top and bottom of the drain, and overlap the fabric on all sides of the drain at least 6 inches.

At the weep hole, if necessary, puncture the plastic core to provide free drainage from the drain to the weep hole. If puncturing of the core is necessary do not puncture the geotextile fabric on the outside face of the drain. Place a piece of plastic, at least 8 inches by 8 inches by 3/16 inches on the outside face of the drain over the weep hole, as reinforcement.

When depth to weep hole flow line is greater than 30 feet, cover the inlet ends of weep holes with at least 2 cubic feet of No. 57 coarse aggregate. Place the aggregate to allow free drainage but at the same time prevent the fill from washing. From approximately 6 inches below the bottom of the inlet ends of the weep holes, place a column of clean crushed stone or gravel, at least one square foot, up against the back of the wall to the upper limits of the backfill. At the time of placing the remainder of embankment adjacent to the structure, continue placing the column of stone up to subgrade elevation, or, in the case of box culverts, to the top of the top slab.

603.03.06 Cofferdams. For foundation construction, drive sheet piles for cofferdams to an elevation well below the bottom of the footings. Brace walls to ensure against collapse. Provide interior dimensions that allow sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside the forms. Right, reset, or enlarge cofferdams that are tilted or moved laterally during the process of sinking to provide the necessary clearance. Construct cofferdams sufficiently watertight to prevent water from coming in contact with fresh concrete. Do not allow bracing to extend into the substructure masonry unless the Engineer permits in writing. Submit drawings prepared by a Registered Professional Engineer showing the design and construction methods of proposed cofferdams. Include in the drawings all necessary details and design calculations. The type and clearance of cofferdams, details that affect the character of the finished work and the safety of the installation are subject to Department approval. The Department will review design details of cofferdams, bracing, shoring, or other work.

Remove all cofferdams, including all sheeting and bracing, after completion of the substructure without disturbing or causing damage to the finished masonry.

603.03.07 Foundation Seals. When conditions are encountered which, in the judgement of the Engineer, render it impracticable to remove water from the cofferdam before placing masonry, the Engineer may require construction of a concrete foundation seal according to Subsection 601.03.09 B).

Do not dewater cofferdam until the concrete seal has set sufficiently to withstand the hydrostatic pressure and in no case less than 72 hours after placement.

The Engineer may require longer than 72 hours.

603.04 MEASUREMENT. The Department will not measure the removal of existing structures, or portions thereof, in structure excavation when listed in the Contract as a bid item.

The Department will measure removing masonry necessary in the building of extensions to or the rebuilding of an existing structure according to Section 203.

The Department will consider removal of existing pipe incidental to structure excavation and will deduct the interior volume of the pipe from the structure excavation quantity.

When the Plans require the foundation to be solid rock or shale, drilling to confirm suitability is incidental to the structure excavation.

603.04.01 All Structures. When it is necessary to backfill in excess of the material excavated, the Department will measure the quantity of the additional material necessary for such backfill in cubic yards in its original position under Borrow Excavation or Roadway Excavation, unless it is paid for as Extra Work.

The Department will not measure dewatering excavated pits and placing and compacting backfill for payment and will consider them incidental to the structure excavation bid items.

When not listed as a bid item, the Department will not measure furnishing and placing fabric wrapped drains or coarse aggregate at weep holes for payment and will consider them incidental to the structure excavation bid items.

When it is necessary to construct any footing more than 5 feet below the elevation specified in the Plans for structures, except pipe culverts, sewers, and underdrains, the Department will pay for all excavation below plan elevation as Extra Work.

The Department will not measure excavation or backfill in excess of the limits described in this section for payment.

603.04.02 Bridges, Culverts, and Retaining Walls. The Department will measure the quantity of all excavation in its original position as that actually excavated within the limits bounded by vertical planes 18 inches outside the footings and parallel thereto except as follows. The Department will measure between the original ground surface and the bottom of the excavated pit, except in cuts where the finished cross section will govern, and except when structures are removed, the bottom of the excavation for removal shall govern. The Department will not include in the quantity the volume of the waterway of existing culverts and bridges, the volume of materials removed as Remove Existing

Structure, nor materials removed as incidental. The Department will not measure structure excavation for pipe culverts and pipe culvert headwalls, sewer pipe, or combination sewer and storm pipe.

Where tie beams, struts, web walls, overhangs, or similar construction are required on the substructure above the bottom of the footings and extend beyond the area bounded by vertical planes 18 inches outside the footings, the Department will measure the excavation, except that the Department will measure the area bounded by vertical planes 18 inches outside the footings and 18 inches outside the neat lines of the tie beams, struts, web walls, and other similar construction. The Department will measure between the original ground surface and a plane 18 inches below the bottom of the tie beams, struts, web walls, and other similar construction.

The Department will not measure excavation necessary to construct concrete encasement for an individual steel pile for payment and will consider it incidental to the pile. The Department will not measure Structure Excavation in the construction of timber bents or backing planks, or for excavation incidental to splicing piling for payment.

603.04.03 Foundation Preparation. When listed as a bid item, the Department will measure all work performed as part of Foundation Preparation as a lump sum for each structure. The Department will not measure cofferdams, shoring, dewatering, common excavation, or backfill for payment, and will consider them incidental to this bid item. The Department will measure Structure Excavation Solid Rock and removal of unsuitable foundation material and refill separately for payment.

603.04.04 Structure Excavation Common. When Foundation Preparation is not listed as a bid item, the Department will measure the quantity, in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.05 Structure Excavation Solid Rock. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.06 Structure Excavation Unclassified. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.07 Foundation Undercut. When Foundation Preparation is not a bid item and the Engineer directs that unsuitable foundation material is be excavated and replaced, the Department will measure the quantity of excavation as Structure Excavation Common, Structure Excavation Solid Rock, or Structure Excavation Unclassified in cubic yards, as applicable, which will be complete compensation for all excavation, disposal, backfill, and all other incidentals necessary to prepare a suitable foundation.

When Foundation Preparation is a bid item, the Department will pay for Foundation Undercut as Extra Work.

603.04.08 Cofferdams. The Department will not measure the quantity unless it is listed as a separate bid item and will consider it incidental to the bid item Structure Excavation or Foundation Preparation.

603.04.09 Foundation Seals. The Department will not measure the quantity unless it is listed as a separate bid item or the work is directed by the Engineer.

603.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08002	Structure Excavation Solid Rock	Cubic Yard
08001	Structure Excavation Common	Cubic Yard
02203	Structure Excavation Unclassified	Cubic Yard
02210	Borrow Excavation	See Section 205.05
02200	Roadway Excavation	See Section 204.05
08003	Foundation Preparation	Lump Sum

The Department will consider payment as full compensation for all work required under this section.

Minnesota

Before application, agitate the curing compound in the shipping containers to obtain a homogeneous mixture. Apply the compound to provide a uniform, solid white opaque coverage equal to a white sheet of paper on exposed concrete surfaces Respray areas that appear to have a coating that is less than a white sheet of paper. Respray membrane film damaged before the placement of the wet cure.

Apply the membrane within 30 min after placing concrete. Apply the membrane within 45 min after depositing concrete if revibrating the concrete as directed by the Engineer. If the Contractor fails to apply membrane curing in the required time after depositing concrete, the Department will consider this as unacceptable work in accordance with 1512, "Unacceptable and Unauthorized Work." Remove and replace concrete in areas not coated with membrane curing compound within the required time at no additional cost to the Department.

When the concrete can be walked on without damage, place wet burlap or curing blankets in accordance with 2401.3.G, "Concrete Curing and Protection," for at least 96 h. Maintain burlap in a wet condition for the entire curing period.

Do not allow vehicular traffic on the concrete wearing course during the 96 h curing period. If the daily mean temperatures during the 96 h curing period fall below 60 °F [16 °C], provide additional curing time before allowing traffic on the surface as required by the Engineer.

2404.4 METHOD OF MEASUREMENT

The Engineer will measure the concrete wearing course by surface area based on the dimensions shown on the plans. The Engineer will not deduct the surface area of expansion devices or other miscellaneous appurtenances.

2404.5 BASIS OF PAYMENT

The Department will pay for concrete wearing course for bridges on the basis of the following schedule:

Item No.:	Item:	Unit:
2404.501	Concrete Wearing Course ___	square foot [square meter]

2405 PRESTRESSED CONCRETE BEAMS

SEE 2014 MATERIALS LAB SUPPLEMENTAL SPECIFICATIONS FOR CONSTRUCTION

2406 BRIDGE APPROACH PANELS

2406.1 DESCRIPTION

This work consists of constructing bridge approach panels.

2406.2 MATERIALS

A Concrete 2461

A.1 Mix Designation .... Mix No. 3A42

B Reinforcement Bars 3301

C Curing Materials

C.1 Burlap Curing Blankets 3751

C.2 Poly Alpha Methylstyrene (AMS) Membrane Curing Compound 3754

C.3 Linseed Oil Membrane Curing Compound 3755

C.4 Plastic Curing Blankets 3756

D Granular Materials...3149

E. Form Coating Material..3902

2406.3 CONSTRUCTION REQUIREMENTS

A Foundation Preparations

Excavate, shape, and compact the foundation to a firm, uniform bearing surface in accordance with 2105, "Excavation and Embankment." Construct bridge approach panels to the section and grade shown on the plans.

B Forms

Provide forms made of non-reactive metal, wood, or other material capable of maintaining the concrete until the concrete can retain the molded shape. Provide forms with a height at least equal to the approach panel thickness of the formed concrete as shown in the plans. Support the forms on the foundation to maintain the line and grade as shown on the plans.

On curves with a radius of 100 ft [30 m] or less, use flexible or curved forms of the radius as shown on the plans.

Before placing the concrete, coat the contact surfaces of all forms with form coating material.

C Placing and Finishing Concrete

Immediately before placing the concrete, thoroughly wet the foundation and forms.

Place the concrete in a manner that will prevent segregation. Consolidate the concrete to fill voids using internal vibration. Strike off the concrete to the grade shown on the plans, and float the surface smooth.

Provide the same surface texture as the bridge deck and construct in accordance with 2401, "Concrete Bridge Construction," or 2404, "Concrete Wearing Course for Bridges."

Finish edges with a ⅜ in [10 mm] radius edging tool.

Keep side forms in-place for at least 12 h after casting the concrete.

D Joint Construction

Place joints as shown on the plans.

E Metal Reinforcement

Provide and place metal reinforcement as shown on the plans and in accordance with 2472, "Metal Reinforcement."

F Workmanship and Finish

Ensure completed concrete work is uniform in surface contour and texture and conforms to the lines and grades shown on the plans. Finish the flow line surface of gutters as necessary to eliminate low spots and avoid entrapment of water.

The Engineer will measure the surfaces of the panels with a 10-foot [3-meter] straightedge. The Engineer will consider horizontal or vertical deviations in the surface equal to or greater than ⅜ in [10 mm] in any 10 ft [3 m] length of the finished concrete approach panel to be unacceptable work. Remove and replace extensive areas with deviations greater than ½ in [13 mm]. Remove and replace unacceptable work as directed by the Engineer.

If the Engineer does not direct the removal and replacement of the unacceptable work, the Contractor may leave the work in-place and the Engineer will adjust the contract unit price as follows:

(1) For ⅜ in [10 mm] to $^{9}/_{16}$ in [14 mm] deviations, payment at 75 percent of the contract unit price.
(2) For minor areas with deviations over $^{9}/_{16}$ in [14 mm], payment at 50 percent of contract unit price.

G Concrete Curing and Protection

After completing final finishing operations, cure all exposed concrete surfaces for at least 72 h. If using cementitious substitutions as defined in 2461.2.A.6, "Cementitious Substitutions," extend the minimum curing period to 96 h. Use one of the following curing methods:

(1) Place the membrane curing compound conforming to 3754, "Poly-Alpha Methylstyrene (AMS) Membrane Curing Compound," or 3755, "Linseed Oil Membrane Curing Compound," within 30 min of concrete placement or once the bleed water has dissipated, unless the Engineer directs otherwise in accordance with 2406.3.G.1.a, "Membrane Curing Method." Place the membrane curing compound on the edges within 30 min after permanent removal of the forms or curing blanket, unless the contract requires otherwise.
(2) Place plastic curing blankets or completely saturated burlap curing blankets in accordance with 2406.3.G.1.b, "Blanket Curing Method," as soon as practical without marring the surface.

Failure to comply with these provisions will result in the Engineer applying a monetary deduction in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work." If the contract does not contain a separate contact unit price for *Structural Concrete*, the Department will apply a monetary deduction of $50.00 per cu. yd [$65.00 per cu. m] or 50 percent of the Contractor-provided invoice amount for the concrete in question, whichever is less.

Whenever weather conditions are such as to cause unusual or adverse placing and finishing conditions, expedite the application of a curing method or temporarily suspend the mixing and placing operations, as the conditions require.

If necessary to remove the coverings to saw joints or perform other required work, and if the Engineer approves, remove the covering for the minimum time required to complete that work.

G.1 Curing Methods

G.1.a Membrane Curing Method

Before application, agitate the curing compound as received in the shipping container to obtain a homogenous mixture. Protect membrane curing compounds from freezing before application. Handle and apply the membrane curing compound in accordance with the manufacturer's recommendations.

Apply the curing compound with an approved airless spraying machine in accordance with the following:

(1) At a rate of 1 gal per 150 sq. ft [1 L per 4 m²] of surface curing area.
(2) Apply homogeneously to provide a uniform solid white opaque coverage on all exposed concrete surfaces (equal to a white sheet of typing paper). Some MnDOT approved curing compounds may have a base color (i.e. yellow) that cannot comply with the above requirement. In this case, provide a uniform solid opaque consistency meeting the intent of the above requirement.
(3) If the curing compound is damaged during the curing period, immediately repair the damaged area by re-spraying.

The Engineer will approve the airless spraying machine for use if it is equipped with the following:

(1) A re-circulating bypass system that provides for continuous agitation of the reservoir material,
(2) Separate filters for the hose and nozzle, and
(3) Multiple or adjustable nozzle system that provides for variable spray patterns.

If the Engineer determines that the initial or corrective spraying results in unsatisfactory curing, the Engineer may require the Contractor to use the blanket curing method at no additional cost to the Department.

G.1.b Blanket Curing Method

After completion of the finishing operations and without marring the concrete, cover the concrete with curing blankets. Install in a manner that envelops the exposed concrete and prevents loss of water vapor. After the concrete has cured, apply membrane curing compound to the concrete surfaces that will remain exposed in the completed work.

G.2 Protection Against Rain

Protect the concrete from damage due to rain. Have available, near the site of the work, materials for protection of the edges and surface of concrete. Should any damage result, the Engineer will suspend operations until the Contractor takes corrective action and may subject the rain-damaged concrete to 1503, “Conformity with Contract Documents,” and 1512, “Unacceptable and Unauthorized Work.”

G.3 Protection Against Cold Weather

If the national weather service forecast for the construction area predicts air temperatures of 34 °F [1 °C] or less within the next 24 h and the Contractor wishes to place concrete, submit a cold weather protection plan in accordance with 2406.3.G.3.a, “Cold Weather Protection Plan.”

Protect the concrete from damage, including freezing due to cold weather. Should any damage result, the Engineer will suspend operations until the Contractor takes corrective action and may subject the damaged concrete to 1503, “Conformity with Contract Documents,” and 1512, “Unacceptable and Unauthorized Work.”

G.3.a Cold Weather Protection Plan

Submit a written cold weather protection plan to the Engineer for approval. The plan shall include a proposed time schedule for concrete placement and curing, and plans for adequately protecting the concrete during placement and curing. Do not place concrete until the Engineer approves the Contractor's cold weather protection plan.

H Backfill Construction

Protect newly placed concrete from damage by adjacent vibratory or backfilling operations for a minimum of 24 h. Resume vibratory and backfilling operations after the concrete has reached a minimum compressive strength of 2,000 psi [13.7 MPa] or a flexural strength of 250 psi [1.7 MPa]. Cast concrete control specimens in accordance with 2461.3.G.5, “Test Methods and Specimens.” The Engineer will test the control specimens. If damage results from any of these operations, the Engineer will suspend all operations until the Contractor takes corrective action and the Engineer approves of a new method. The Engineer may subject damaged concrete to 1503, “Conformity with Contract Documents,” and 1512, “Unacceptable and Unauthorized Work.”

The Contractor may use hand-operated concrete consolidation equipment and walk behind vibratory plate compactors 24 h after placing the concrete, and other equipment as approved by the Engineer, in conjunction with the Concrete Engineer. The Contractor may also use rollers in “static” mode and fine grading machines.

As soon as possible after the curing is complete and without subjecting the concrete work to damaging stresses, perform the backfill or embankment construction to the elevations shown on the plans. If the contract does require a specific backfill material, use suitable grading materials from the excavations in accordance with 2105, “Excavation and Embankment.” Place and compact the backfill material in accordance with 2105, “Excavation and Embankment.”

Dispose of surplus excavated materials in accordance with 2105, “Excavation and Embankment.”

I Preformed E8H Expansion Joint Sealers

Select preformed expansion joint material for the E8H expansion joints from the Approved/Qualified Products List.

Install expansion joint material in accordance with the manufacturer's recommendations and as shown on the plans.

2406.4 METHOD OF MEASUREMENT

If the contract contains a contract item (or contract items) for the construction of bridge approach panels, the Engineer will measure their construction as complete-in-place items. The Engineer will measure the total area of all panels of the same basic design. If the contract does not contain this contract item, the Engineer will measure their construction under the relevant contract items provided for pavement construction.

The Engineer will measure the length of expansion joints along the joint line as shown on the plans.

2406.5 BASIS OF PAYMENT

The cost of the following is included in the contract unit price for *Bridge Approach Panels*:

(1) Providing and placing concrete, steel, drainage system, and polyethylene sheeting;
(2) Constructing the integrant curb, terminal headers, and concrete sills;
(3) Protecting and curing the concrete, and
(4) Other incidental work not specifically included for payment under other contract items.

The cost of constructing the joints complete in-place as shown on the plans, including the providing and placing of all materials such as filler, and sealer material is included in the contract unit price for *Expansion Joints, Design E8H*.

Item No.:	Item:	Unit:
2406.553	Bridge Approach Panels	square yard [square meter]
2406.531	Expansion Joints, Design E8H	linear foot [meter]

2411 MINOR CONCRETE STRUCTURES

2411.1 DESCRIPTION

This work consists of constructing concrete structures of miscellaneous types and varied designs, with or without metal reinforcement, and including box culverts, retaining walls, culvert headwalls, open flumes, and other cast-in-place items.

2411.2 MATERIALS

A Concrete **2461**

Provide mix designations as shown on the plans.

B Reinforcement Bars **3301**

C Steel Fabric **3303**

D Preformed Joint Fillers **3702**

E Geotextile Filter **3733**

2411.3 CONSTRUCTION REQUIREMENTS

Construct minor concrete structures in accordance with 2401.3, "Concrete Bridge Construction, Construction Requirements," and the following:

A General

The Department considers the structure locations shown in the plans as approximate only. The Engineer will establish the exact locations in the field. Each structure shall conform to the planned design, but the Engineer

Missouri

SECTION 1010

SELECT GRANULAR BACKFILL FOR STRUCTURAL SYSTEMS

1010.1 Scope. This specification covers backfill material used as part of a mechanically stabilized earth wall system or in other applications requiring an engineered backfill material.

1010.2 Material. Aggregate used for backfill material may consist of gravel, crushed stone, reclaimed concrete, or other approved material meeting the requirements of this Section. The requirements for the gradation of the material, the general makeup of the material, and the testing of the material will apply to all potential uses of this material, unless otherwise specified on the plans or in the contract documents. The electrochemical requirements listed in this specification will apply to backfill material used for mechanically stabilized earth wall systems.

1010.3 General.

1010.3.1 To ensure proper functioning of the structure, the backfill material used for structural applications shall be in accordance with the following:

Sieve Size	Percent Passing by Weight
4-inch	100
No. 40	0-60
No. 200	0-10 *

* May be increased to 15% if gradation sample is obtained from the compacted backfill material.

1010.3.2 The frequency of sampling of the backfill material necessary to assure gradation control throughout construction shall be as directed by the engineer.

1010.3.3 The plasticity index (PI) of the backfill material shall be determined in accordance with AASHTO T 90 and shall not exceed 6.

1010.3.4 The angle of internal friction for the backfill material shall be no less than 34 degrees. No testing will be required whenever 80 percent of the particle sizes are greater than 0.75 inch or whenever the backfill material consists entirely of crushed stone. When testing is required, testing shall be in accordance with one of the tests specified below.

1010.3.5 The angle of internal friction may be determined by the direct shear test in accordance with AASHTO T 236. This test shall be performed on the portion of the material finer than the No. 10 sieve, utilizing a sample of the material compacted to 95 percent of the maximum density as determined by AASHTO T 99, Methods C or D (with oversize correction as outlined in Note 7 in that publication), at optimum moisture content.

1010.3.6 For select granular backfill other than crushed stone the organic content of the backfill material shall be less than or equal to one percent and shall be measured in accordance with AASSHTO T 267 for material finer than the No. 10 sieve.

1010.4 Electrochemical Requirements. The following electrochemical requirements will apply to this backfill material whenever the material is used for mechanically stabilized earth wall systems.

1010.4.1 Metallic Soil Reinforcement.

1010.4.1.1 When metallic soil reinforcements are used, the backfill material shall be in accordance with the electrochemical requirements as follows:

Requirement	Test Method
Resistivity > 2000 ohm-cm	AASHTO T 288
pH of 5-10**	AASHTO T 289
Chlorides ≤ 100 ppm	AASHTO T 291
Sulfates ≤ 200 ppm	AASHTO T 290*

* Water soluble sulfates shall be tested in accordance with AASHTO T 290 Method A-Gravimetric Method with the following modifications: Per section 13, follow subsection 13.1 through 13.3 as stated in the test procedure. Transfer 250 ml of extracted sample to a 400-ml plastic beaker and place in a 90 C oven for 30 minutes. A blank should be run concurrently with the test sample using 250 ml of DI water. After 30 minutes, add 10 ml of barium chloride (100g/L) to test sample and blank. Place test sample and blank back into a 90 C oven and let samples digest for 12 to 24 hours. Filter through a retentive paper, wash the precipitate thoroughly with hot DI water, place the paper and contents in a weighted porcelain crucible, and slowly char and consume the paper without inflaming. Ignite at 1000 C for 2 hours, cool in a desiccator, and determine the mass as grams of barium sulfate. Subtract the blank and convert grams of barium sulfate to mg/kg of sulfate ion content.

** Use pH of 5-9 for aluminized soil reinforcement.

1010.4.1.2 Whenever the resistivity of the backfill material is greater than or equal to 5000 ohm-cm, the chlorides and sulfates requirements may be waived.

1010.4.1.3 Resistivity shall be tested by the contractor in accordance with AASHTO T 288. Resistivity result will be defined by the minimum resistivity noted during the test. Resistivity shall be tested a minimum of once per 30,000 tons, by the Contractor and a minimum of once by quality assurance representing the engineer. Minimum sample frequency is per project, per source, per product. For samples that do not meet specifications a split sample shall be obtained from the source stockpile for final comparison testing. Contact the State Construction and Materials Engineer for acceptance.

1010.4.2 Polymeric Soil Reinforcement. When polymeric soil reinforcements are used, the backfill material shall be in accordance with the electrochemical requirements as follows:

Requirement	Test Method
pH of 4.5-9	AASHTO T 289

1010.5 Certification and Acceptance.

1010.5.1 The contractor shall furnish to the engineer written certification that the backfill material provided complies with the applicable sections of this specification. Test results in the certification shall be within one year from the start of construction of each wall. Copies of all test results for tests performed to ensure compliance with this specification shall be furnished to the engineer. The engineer will assure a minimum of one complete set of quality assurance tests for each complete certification supplied by the contractor, within the same time constraints.

1010.5.2 Acceptance will be based on the written certification, accompanying test reports, and any applicable tests performed as directed by the engineer.

203.5.4 Structure Approach. Roadway embankment within 100 feet of each end of a structure on which the top slab or deck is to be used as the riding surface and the spill fill under such a structure shall be compacted to no less than 95 percent of maximum density.

203.5.5 Rocky Fill. Density requirements will not apply to portions of embankments constructed of material so rocky that the embankment cannot be satisfactorily tested in accordance with AASHTO T 191 or T 205. Material of a gradation having more than approximately 20 percent retained on a 3/4-inch sieve will generally be considered too rocky for satisfactory density testing. In lieu thereof, the compactive effort on rocky material shall consist of making four complete passes on each layer with a tamping-type roller or two complete passes on each layer with a vibratory roller. The tamping-type roller shall have tampers or feet protruding no less than 6 inches from the surface of the drum and shall have a minimum load on each tamper of 250 psi of tamping area. The vibratory roller shall have a manufacturer's rating of 16 to 20 tons compacting power. During compaction, each layer shall have the moisture content controlled such that, in the judgment of the engineer, any silt and clay fraction is in a plastic state. Simple diagnostic tests to establish such a plastic state will include ability to indent with a thumb or heel or to roll a short thread of soil between the hands. Material that crumbles under pressure will be considered too dry.

203.5.6 Lift Consistency. Each layer shall be wetted or dried as necessary, and shall be compacted to the required density. Regardless of the type of equipment used, the roadway shall be compacted uniformly and the surface kept reasonably smooth at all times. If large pieces of heavy clay are encountered, the material shall be broken down by suitable manipulation to permit satisfactory embankment construction. If shale is encountered, the shale shall be broken down as much as practical and compacted at or above optimum moisture.

203.5.7 Deep Fills. Compaction to at least 95 percent of maximum density will be required for that portion of any embankment below an elevation 50 feet below the top of the finished subgrade. If, because of embankment foundation conditions, the 95 percent maximum density cannot be obtained after reasonable compactive effort has been expended, the engineer may waive the 95 percent requirement for a height not exceeding 3 feet above the embankment foundation.

203.5.8 Compacting in Cut. Cut compaction shall be performed in all Class A material areas and in all unclassified material areas that meet the requirements of Sec 203.2.2 after removal of the roadway excavation material to the required section. A surface parallel to the pavement slope, 12 inches below the bottom of the pavement or lowest base course, shall be temporarily exposed for the full width between roadway inslopes. The exposed material shall be manipulated and compacted to no less than the required density to a depth of 6 inches . The material above this compacted plane shall be spread in layers not exceeding 8-inch loose thickness, each layer being wetted or dried as necessary and compacted to the specified density. The entire volume of material so handled and compacted, including the 6-inch layer compacted in place, will be considered as Compacting in Cut. All Class A material having a liquid limit of 40 or more, including the 6-inch layer compacted in place, shall be compacted at no less than the optimum moisture content.

203.5.8.1 Cut compaction shall be performed to an additional depth of 12 inches for 50 feet on each side of the intersection of the natural ground and the top of the subgrade, then uniformly graded for 30 feet to meet the depth requirements of Sec 203.5.8 and, if necessary, Sec 203.5.8.2.

203.5.8.2 The existing ground for the full width between roadway slopes under embankments less than 18 inches high shall be treated in accordance with Sec 203.5.8 to only such depth as

Nebraska

4.2.2 – Abutment Drainage Policy

General Design

All bridge designs, except those with MSE walls, shall allow for drainage behind abutments with either a drainage system or weep holes.

Subsurface Drainage Matting

Drainage matting should be shown as constant depth piece of matting. It will wrap around a sloping drain pipe at the bottom and extend 3 ft. along the wing at the ends. Pipe layouts and drainage matting should preferably be shown in the elevation view on the abutment sheets. Standard Note # 602 shall be included on the Drainage Detail Sheet.

On existing bridges, drainage matting should be provided when abutments are to be remodeled to add turndowns. In such cases, drainage pipe may need to be 'daylighted' through the wings.

Weep Holes

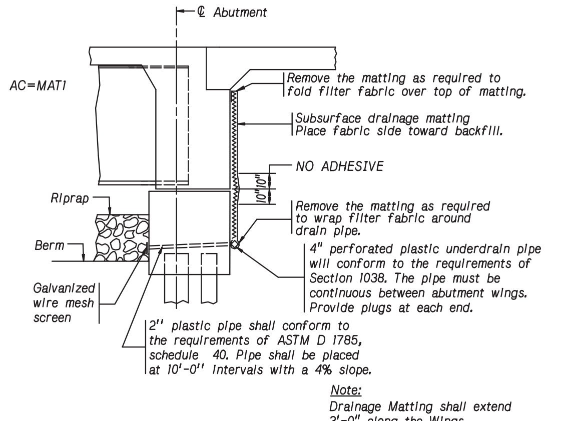
Weep holes should be one inch minimum diameter and provided at approximately 10 ft intervals along the abutment or between piling would be sufficient. Weep holes should be extended to daylight or into the rock riprap and be covered with a galvanized wire mesh screen.

Payment

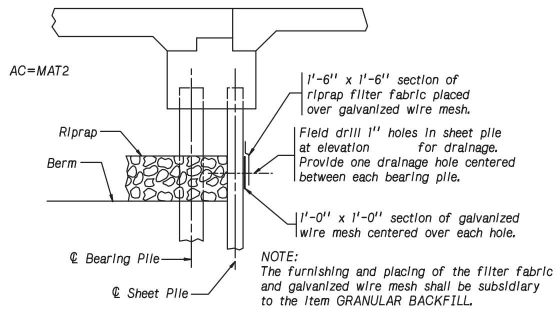
The Pay Item, **"Subsurface Drainage Matting"** (SY) shall be measured by the square yard and includes payment for furnishing and placing of PVC pipe, wire mesh and all miscellaneous items required for placement of the drainage matting.

CAD Cells

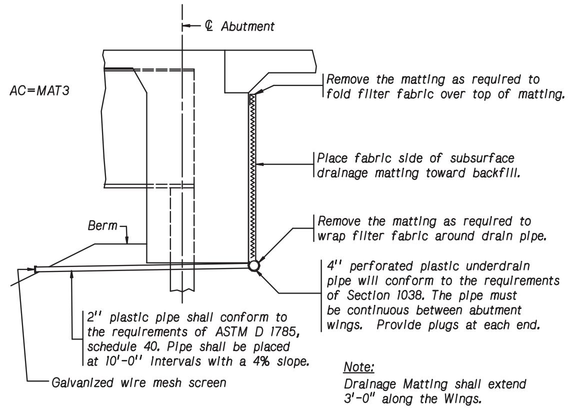
The CAD cells shown here are available for detailers.



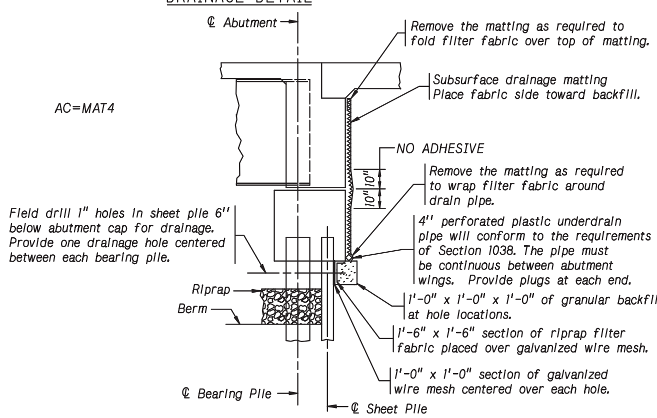
DRAINAGE DETAIL



DRAINAGE DETAIL



DRAINAGE DETAIL



DRAINAGE DETAIL

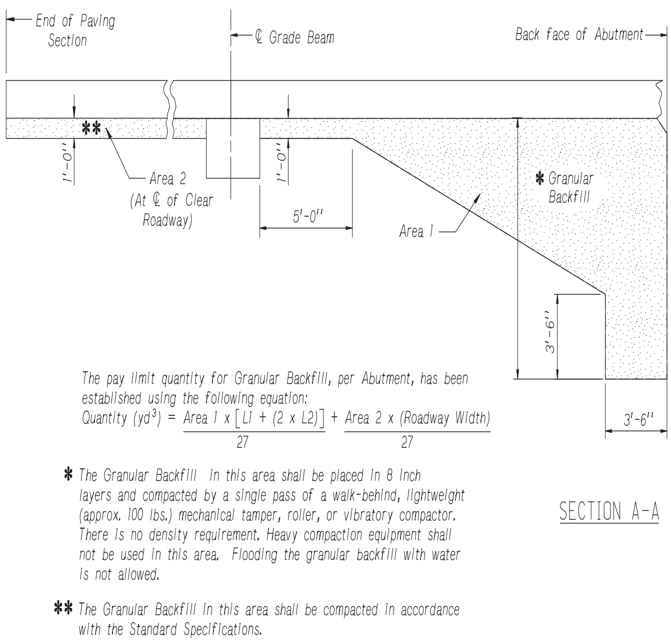
Note:
Extend drainage matting 3'-0" along the wings.

4.2.3 – Granular Backfill Policy

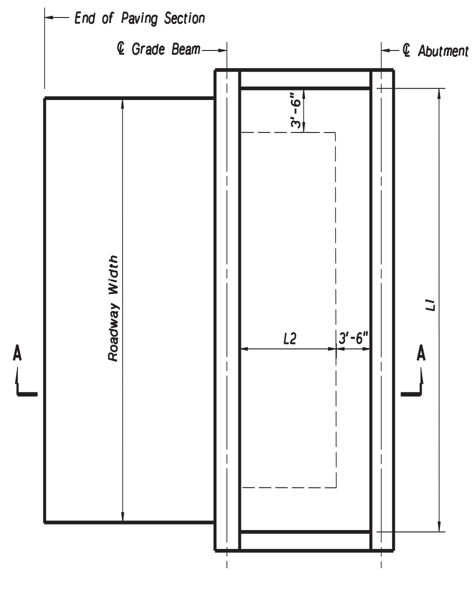
The interior of abutments and wing walls, tie rod trenches, and the area beneath approach slab sections, as excavated by the Contractor, shall be backfilled with granular backfill. See Section 702 Excavation of Structures in the NDOR Standard Specifications.

Payment

The Pay Item on the Front Sheet will be **"Granular Backfill"** (CY). The Bridge Division has determined that the Granular Backfill quantity shall be measured using a simplified cross-sectional area shown below, and calculated using the equation: Quantity (CY) = Area [L_1 + 2 (L_2)] / 27 + (Area 2 x Roadway Width) / 27. The plans must include a Granular Backfill Detail consisting of a Plan View, an appropriate Section (1 or 2), see Section A-A below:



SECTION A-A



PLAN OF GRANULAR BACKFILL

Quantity Definitions

L_1 = The horizontal distance between CL of sheet pile or inside face of concrete depending upon the depth of the granular backfill. Measured along the CL of abutment in Ft.

L_2 = The horizontal distance perpendicular to CL of abutment from the back face of abutment to the front face of grade beam in Ft., minus 3 ft. - 6 in.

A = The vertical distance from the bottom of the approach slab to the bottom of the abutment or drainage matting (whichever is lower), at CL of roadway.

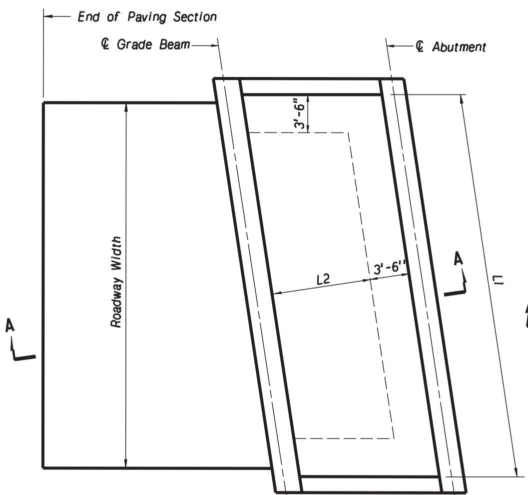
AREA = The cross-sectional area of granular backfill, normal to CL roadway.

Detailing

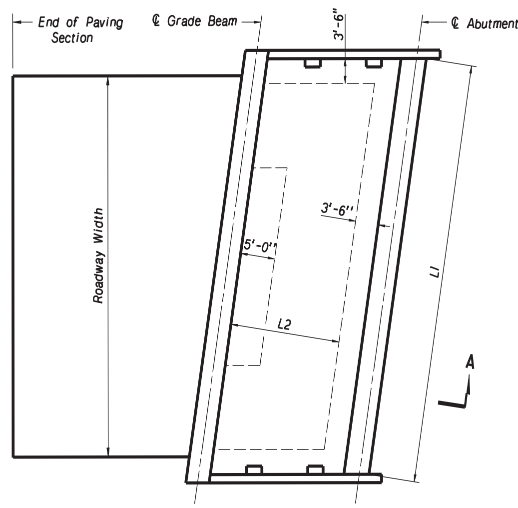
Plan details must provide all dimensions necessary to calculate the established volume for the quantity. The volume detailed must be clearly shown, but will not accurately describe the quantity required.

The following cells are recommended to indicate a Plan View and Section for a shallow abutment or a deep abutment:

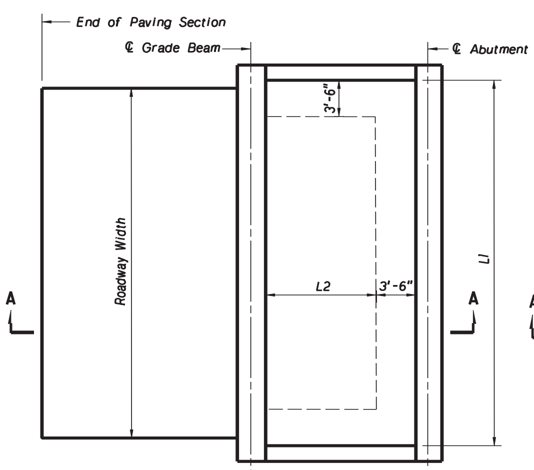
Shallow Abutment **Deep Abutment**



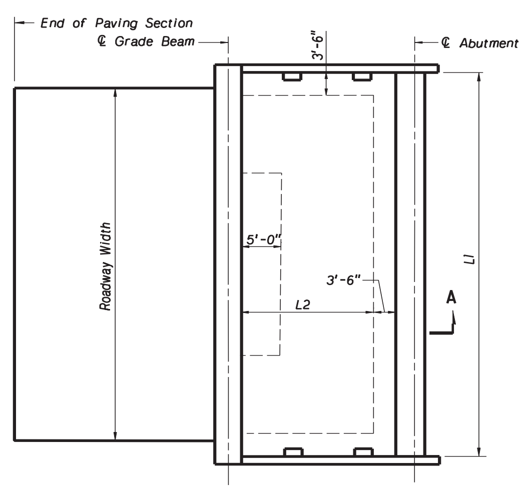
PLAN OF GRANULAR BACKFILL



PLAN OF GRANULAR BACKFILL

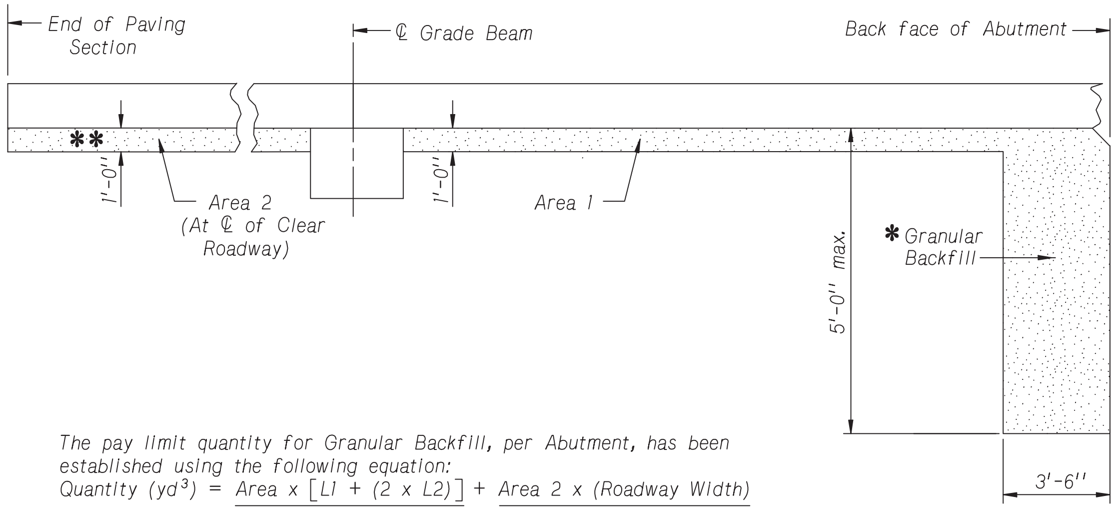


PLAN OF GRANULAR BACKFILL



PLAN OF GRANULAR BACKFILL

Shallow Abutment



The pay limit quantity for Granular Backfill, per Abutment, has been established using the following equation:

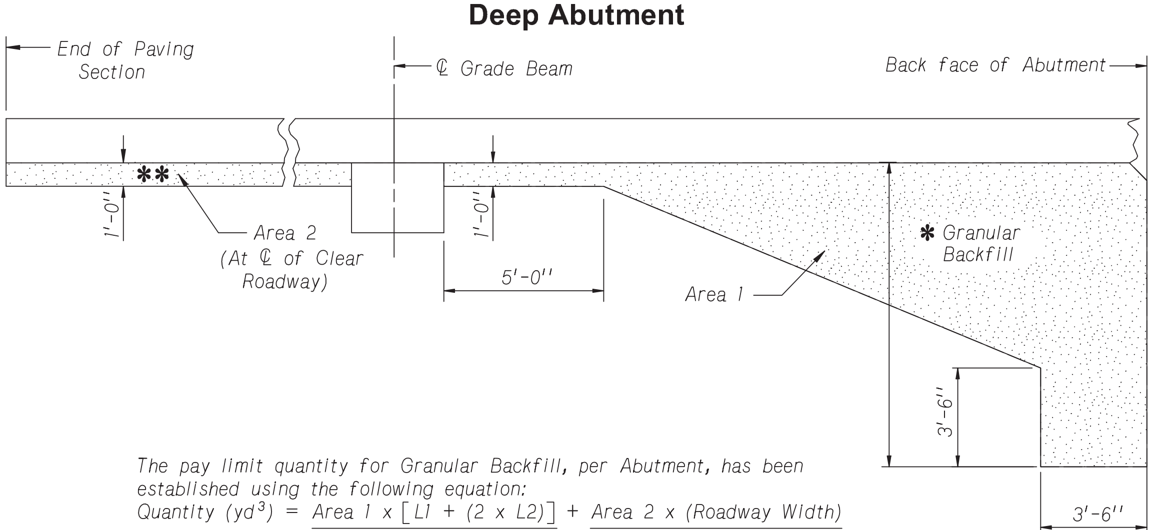
$$\text{Quantity (yd}^3) = \frac{\text{Area} \times [L1 + (2 \times L2)]}{27} + \frac{\text{Area 2} \times (\text{Roadway Width})}{27}$$

SECTION A-A

✱ The Granular Backfill in this area shall be placed in 8 inch layers and compacted by a single pass of a walk-behind, lightweight (approx. 100 lbs.) mechanical tamper, roller, or vibratory compactor. There is no density requirement. Heavy compaction equipment shall not be used in this area. Flooding the granular backfill with water is not allowed.

✱✱ The Granular Backfill in this area shall be compacted in accordance with the Standard Specifications.

Deep Abutment



The pay limit quantity for Granular Backfill, per Abutment, has been established using the following equation:

$$\text{Quantity (yd}^3) = \frac{\text{Area 1} \times [L1 + (2 \times L2)]}{27} + \frac{\text{Area 2} \times (\text{Roadway Width})}{27}$$

SECTION A-A

✱ The Granular Backfill in this area shall be placed in 8 inch layers and compacted by a single pass of a walk-behind, lightweight (approx. 100 lbs.) mechanical tamper, roller, or vibratory compactor. There is no density requirement. Heavy compaction equipment shall not be used in this area. Flooding the granular backfill with water is not allowed.

✱✱ The Granular Backfill in this area shall be compacted in accordance with the Standard Specifications.

North Dakota

SECTION 210
STRUCTURAL AND CHANNEL EXCAVATION, FOUNDATION FILL AND PREPARATION

210.01 DESCRIPTION

A. **Structural Excavation.**

1. **Class 1**
   Class 1 excavation will be defined in the Plans.
2. **Class 2**
   Class 2 excavation will be defined in the Plans.
3. **Box Culvert Excavation**
   Excavation and ordinary backfill required for installation of box culverts.

B. **Channel Excavation.**
Channel excavation will be designated on the Plans and includes excavation necessary to place riprap or aggregate cushions and to flatten and shape slopes around abutment locations.

C. **Foundation Preparation.**
Foundation preparation for installation of a box culvert or bridge.

210.02 EQUIPMENT

Reserved.

210.03 MATERIALS

A. **Ordinary Backfill.**
Use approved material from the excavation. Use borrow material as specified in Section 203.04 D, "Borrow Excavation" if additional material is required.

B. **Foundation Fill.**
Use CL 3 or CL 5 aggregate as specified in Section 816, "Aggregates."

210.04 CONSTRUCTION REQUIREMENTS

A. **Excavation.**

1. **General.**
   Perform excavation so that concrete can be placed in a dry area free of water.

   If excavation has been performed to the specified elevation and unsuitable material is encountered, remove the unsuitable material and place foundation fill to the specified elevation.

   Dispose of unsuitable excavated material as specified Section 107.17, "Removed Material."
2. **Class 1 and 2 Excavation.**
   If footings are to be placed on an excavated surface and the excavated surface is disturbed, scarify the area and compact the material using a mechanical

tamper. Perform final preparations of the foundation bed just before placing concrete.

When foundation piles are specified the bottom of the excavation may be extended below the footing to allow for heaving. Perform the extended excavation and place additional required backfill at no additional expense to the Department.

Use all suitable excavated material for backfilling in areas where ordinary backfill is specified. Dispose of remaining suitable excavation as specified in Section 107.17, "Removed Material."

B. **Backfill.**

1. **General.**
Place backfill material in an area free of water using tamping equipment that will not cause a wedging action of the material against the structure.

Place backfill material after the concrete has reached 70 percent of its designed strength. Place backfill material around box culverts after the roof has reached 70 percent of its designed strength.

If a wall depends on a superstructure for support, release the falsework before placing backfill material.

When placing of backfill material is required on only one side of a structure, compact backfill material without placing excessive pressure on the structure.

Place fill adjacent to a bridge abutment no higher than the berm elevation in front of the abutment until the superstructure is in place.

2. **Ordinary Backfill.**
Place ordinary backfill in layers not exceeding 6 inches.

3. **Foundation Fill.**
Place foundation fill as specified in Section 714.04 A.7, "Compaction Control for Aggregate."

C. **Foundation Preparation.**
Perform all work necessary to properly stage and maintain a site for construction of a structure. Construct and remove temporary features necessary to facilitate construction of the structure. Backfill the site as specified in the Plans and Section 210.04 B, "Backfill." Dispose of excess and waste materials as specified in Section 107.17, "Removed Material."

210.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

A. **Foundation Fill.**
The Engineer will measure foundation fill completed and in place. The Engineer will not measure beyond the excavation limits for payment.

B. **Channel Excavation.**
The Engineer will not measure beyond the excavation limits for payment.

210.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Channel Excavation	Lump Sum, Cubic Yard
Class __ Excavation	Lump Sum, Cubic Yard
Foundation Preparation	Lump Sum
Foundation Fill	Ton, Cubic Yard

Include dewatering of the construction site in the contract unit price for “Foundation Preparation.”

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

Ohio

off the bridge excluding the first posts off the bridge. If hand rails or tubular backup rails are used, the Department will not measure any portions extending beyond the first posts off the bridge. If twin steel tube bridge railing is used, the Department will measure the length of the railing between the second post off the bridge including the second post.

517.08 Basis of Payment. The cost of hand rails or tubular backup rails extending beyond the measured limits are included for payment in the unit price bid for the measured length.

The Department will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
517	Foot (Meter)	Railing (___)

ITEM 518 DRAINAGE OF STRUCTURES

518.01 Description
518.02 Fabrication
518.03 Materials
518.04 General
518.05 Porous Backfill
518.06 Pipe
518.07 Scuppers
518.08 Excavation
518.09 Method of Measurement
518.10 Basis of Payment

518.01 Description. This work consists of constructing drainage systems.

518.02 Fabrication. Fabricate scuppers according to Item 513. Select a fabricator that is at least pre-qualified at level SF. The Department will base final acceptance of all fabricated members on the Engineer's approval that the fabricated items can be successfully incorporated into the structures. Submit mill test reports for structural steel, steel castings, bronze, and sheet lead certified according to 501.06.

518.03 Materials. Furnish materials conforming to:

Scuppers, structural steel and cast steel 513
Metal pipe 707
Plastic pipe 707.33, 707.45
Other metals 711
Filter fabric, Type A.. 712.09

Furnish pipe specials of a grade at least as high as the type of pipe specified.

Furnish porous backfill consisting of gravel, stone, or air-cooled blast furnace slag, with a NO. 57 size gradation according to Table 703.01-1. The sodium sulfate soundness loss shall not exceed 15 percent.

Furnish ACBF slag conforming to Supplement 1027.

518.04 General. As shown on the plans, connect all parts to new or existing sewers or other outlets.

When installing to superstructure, take into account the deflection of spans under full dead load.

518.05 Porous Backfill. Place porous backfill as shown on the plans. When not shown on the plans, place backfill at least 2 feet (0.6m) thick behind the full length of abutments, wing walls, and retaining walls. Measure the thickness of porous backfill normal to the abutment or wall face. The Contractor may leave undisturbed rock or shale within 18 inches (0.5 m) of the abutment or wall. Place 2 ft^3 (0.23 m^3) of bagged No. 3 aggregate at each weep hole to retain the porous backfill. Place the porous backfill for the full width of the trench and extend it to the bottom of the approach slab or base, as shown in the plans. .

518.06 Pipe. For drain pipe leading down from the superstructure, use either galvanized steel pipe, 748.06; or plastic pipe, 707.45. Provide specials, elbows, tees, wyes, and other fittings essential for a complete and satisfactory installation of the same material and quality as the pipe. Construct watertight joints of adequate strength. In steel pipe, weld joints or use clamp-type couplings having a ring gasket. In plastic pipe, make joints according to the applicable ASTM standard. Securely fasten the pipe to the structure with hanger or clamp assemblies that are galvanized according to 711.02.

Place subsurface pipeas shown in the plans.. If the plans require drainage pipe in the porous backfill, provide plastic pipe conforming to 707.33.

For corrugated metal pipe, perforated specials are not required and the Contractor may make bends with adjustable elbows conforming to the thickness requirements of the pipe specifications.

518.07 Scuppers. Construct secure and watertight connections, including the connections to adjacent concrete. Provide castings, true to form and dimension. Weld the joints of structural steel scuppers. Galvanize scuppers according to 711.02.

518.08 Excavation. Excavate all material encountered to the dimensions necessary to provide ample space at least to install pipe or other drainage facility behind abutments and for outlets.

518.09 Method of Measurement. The Department will measure Porous Backfill and Porous Backfill with Filter Fabric by the number of cubic yards (cubic meters) or lump sum. The Department will measure pipe specials by the same method as the pipe. If pipe is by the foot (meter), the Department will measure the pipe along its centerline.

518.10 Basis of Payment. The cost to backfill, if not separately itemized in the Contract, and excavation is incidental to the drainage facility that necessitates them.

The Department will include bagged aggregate with porous backfill for payment.

The Department will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
518	Cubic Yard (Cubic Meter) or Lump Sum	Porous Backfill
518	Cubic Yard (Cubic Meter) or Lump Sum	Porous Backfill with Filter Fabric
518	Foot (Meter)	___ inch (___ mm) ___ Pipe, Including Specials
518	Each	Scuppers, Including Supports
518	Pound or Foot (Kilogram or Meter)	Trough Horizontal Conductors
518	Pound or Foot (Kilogram or Meter)	Pipe Horizontal Conductors
518	Foot (Meter)	___ inch (___ mm) Pipe Downspout Including Specials

ITEM 519 PATCHING CONCRETE STRUCTURES

519.01 Description. This work consists of removing all loose and disintegrated concrete; preparing the surface; furnishing and placing reinforcing steel including welded steel wire fabric, dowels, and expansion bolts; placing forms; and placing concrete patches, including curing of same.

519.02 Materials. Furnish materials conforming to:

Concrete, Class QC 2 * 499, 511
Dowels ....709.01, 709.03, or 709.05
Reinforcing steel... 509
Welded steel wire fabric........................ 709.10 or 709.12

* For aggregate for superstructure, conform to 703.02 and use No. 57 or 8 size.

519.03 Removal of Disintegrated Concrete. Remove all loose and disintegrated concrete from the areas to be repaired in such a manner and to such an extent as to expose a sound concrete surface. Provide patches at least 4 inches (100 mm) deep, except on top horizontal surfaces, provide patches at least 3 inches

WHRP
Wisconsin Highway Research Program
University of Wisconsin – Madison
1415 Engineering Drive
Madison, WI 53706
http://wisdotresearch.wi.gov/whrp