DCT 283

Synthesis Study of Jointless Bridge Design and Details

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Executive Summary

Jointless bridges have become an increasingly common choice for bridge owners because of their reduced maintenance costs that result from not having joints, leading to lower total lifetime costs. The Delaware Department of Transportation (DelDOT) has implemented jointless bridge designs in the recent past to take advantage of the many benefits this approach offers in the long-term performance and maintenance of the bridge. However, DelDOT has experienced cracking of the barrier and parapet on a few new jointless bridges, and questions have been raised regarding the design and construction of jointless bridges, since unlike traditional jointed bridges, the design and construction of jointless structures are not widely standardized. It is for these reasons that this synthesis study has been conducted, with the goal to gather and synthesize information on the design and performance of jointless bridges in the U.S. To achieve this goal, the research team (1) conducted a literature review of relevant documents on jointless bridges, (2) gathered plans and details for jointless bridges used in other states, (3) conducted interviews with bridge engineers from various states, and (4) convened a virtual Round Table meeting of state engineers and consultants to discuss the design, construction, and performance of jointless bridges.

The literature review revealed past research on jointless bridges that involved survey questionnaires of various Departments of Transportation on their experiences with jointless bridges. These surveys showed that some issues have persisted for decades, and knowledge was not being shared among states that might lead to implementation of best practices for jointless bridges. From the literature review, it was evident that jointless bridges tend to experience approach settlement (as do traditional jointed bridges), unpredicted cracking, and are frequently geometrically limited to accommodate their movement.

Plans and details for jointless bridges were gathered from numerous states. Many of these details are available to the public, online. They have been organized by type of detail, e.g., Approach, Beam, Bearing, Fully integral, etc., and included in an appendix.

Virtual interviews were held with nine state engineers to further learn about current practices for jointless bridges and explore standardized design and construction details. Many states consider jointless bridges to be their ideal choice of structure for a new bridge and also work to rehabilitate aging jointed bridges to be jointless. State DOTs have experienced similar successes and problems with their new and retrofitted jointless bridges, but each engineer interviewed expressed that the benefits of jointless bridges far outweigh the shortcomings they have experienced. States have standardized details for bridge design and construction, and some provided details or procedures specific to jointless bridges, which have been synthesized.

Following the individual state interviews, a virtual roundtable meeting was conducted with representatives from DelDOT, the nine states that were interviewed, engineers from four consulting firms, and faculty and students from the University of Delaware. The meeting included brief presentations from each of the states and consulting firms, discussion among the entire group, two break-out sessions, and online poll surveys. Participants discussed their processes and success with jointless bridges and common issues and solutions were explored. Problems with jointless bridges that were observed through the literature review continued to be problems discussed during the roundtable meeting. The consensus of the meeting was that jointless bridges are valuable structures that reduce maintenance time and costs and sharing knowledge will support the continued use and innovation of jointless bridges.

Chapter 1: Introduction

Joints serve an important function in the life-cycle of a bridge. They provide a smooth transition from one span to another in a multi-span bridge or from the approach roadway to the deck, and direct water and chemicals off of the deck and away from the bridge. While the cost of a joint may be small compared to the total cost of the bridge, the consequences of a joint failure can be significant. It can lead to deterioration of the superstructure, bearings, and substructure in the form of corrosion of steel girders, spalling of concrete, and erosion of embankments. It is for this reason that many states are moving towards jointless designs with their new bridges.

In a national survey of bridge owners, 57% said their agency was eliminating most or all joints in new construction; only 8% said they were not eliminating any joints in new construction. And for existing bridges, 75% responded that they were eliminating some or most of the joints during rehabilitation (Shenton, et al, 2016). This interest notwithstanding, jointless designs can be problematic if not designed, constructed, and maintained properly.

The Delaware Department of Transportation (DelDOT) has implemented jointless bridge designs in the recent past, to take advantage of the many benefits this approach offers in the long-term performance and maintenance of the bridge. DelDOT has experienced cracking of the barrier and parapet on a few new jointless bridges, and questions have been raised regarding the amount of steel reinforcement needed in the approach and sleeper slab, specifications for backfill, and the location of construction joints to provide pressure relief. It is for these reasons that this synthesis study has been conducted.

This research consisted of a literature review of previous surveys of state Departments of Transportation (DOTs) on their use of jointless bridge structures as well as the current state of practice of jointless bridges. Subsequent to the literature review, standardized drawings provided by state DOTs for jointless bridge design and construction in each state were identified and synthesized. Nine states were then virtually interviewed on their use of jointless bridges, their successes, and issues with jointless bridges and specific design considerations. From the interviews, it became apparent that no best practice for jointless bridges could be identified, and a virtual roundtable meeting was held with representatives from the state DOTs that were interviewed, consulting firms, DelDOT and the University of Delaware. The roundtable meeting consisted of discussions regarding design and construction of new jointless bridges as well as retrofitting existing jointed structures to be jointless.

Chapter 2: Literature Review of Various Jointless Bridge Surveys of State Departments of Transportation

Executive Summary

The use of integral abutment bridges (IAB) has become more common over the past few decades in the United States and they have been shown to be an affordable and high quality alternative to conventional bridges. Due to their relatively new use, integral abutment bridges are not standardized across the country, and there have been several surveys conducted asking individual State Departments of Transportation about their IABs. For this report, five past surveys were reviewed and synthesized to determine what common design practices are used for integral abutment bridges, what issues these structures have seen and in what areas IABs can be improved and standardized. These surveys include: a 1999 survey performed by the University of West Virginia, a 2005 survey done by the Federal Highway Administration, a 2009 survey conducted by the University of Maryland, a 2009 survey done by the University of Illinois and a 2010 survey performed by the University of Missouri.

A review of each of these surveys showed that, among the states that responded, most consider their integral abutment bridges to be performing successfully. The design of an IAB differs from the design of a traditional bridge, so engineers that are tasked with creating these structures must pay careful attention to their design and construction. Integral abutment bridges are generally limited in their length and skew due to their lack of joints and bearings, so they are not practical in all situations. When they are geometrically acceptable, the entire integral abutment bridge is important to design carefully as they are not standardized across states. Moreover, some parts of IABs are known to present more challenges than others, particularly the bridge's backwall and abutment, approach slabs, backfill, foundation and thermal loading. Due

to their integral nature, IAB's beams, abutments, approach slabs and foundations move as one unit. This is different than conventional bridges and has been the central cause of issues that states have reported with their integral abutment bridges. This integral movement directly affects the design of the intersection of the bridge's beams, deck, abutment backwall and approach slabs. It also plays a role in the density of the backfill material, which impacts the approach slabs directly off the structure and has been seen to cause settlement of the approaches. The structure's movement also affects the type and flexibility needed for the bridge's foundation. Given the aforementioned challenges, integral abutment bridges are still considered, among many states, to be a lower cost, lower maintenance option for their bridges in many situations.

2.1 Introduction

Traditionally, bridges are built as either simple span or continuous structures with expansion joints at the ends of the spans, above the abutments and piers, and bearings for the beams to sit. This method of design has worked for countless years, but expansion joints and bearings require continued maintenance and if they are not looked after correctly, their failure can be detrimental to the entire structure. Joints are expensive and difficult to install and replace and if they are penetrated by water, road salts or other chemicals, the beams and abutments have been seen to deteriorate. Bearings allow the beams to move as they expand and contract, and if they become locked, the bridge will not perform as intended. While there are methods used today to repair expansion joints and bearings and mitigate any damage that may be caused by their failure, it is ideal to eliminate them on bridges. For this reason, fully integral abutment bridges, with no joints or bearings at the ends of the spans, have been designed and implemented. Semi-integral abutment bridges have also been used which are jointless structures like fully integral abutment bridges, but they do have bearings. A handful of jointless bridges are multi-span structures and will have bearings at piers, though single span integral structures are much more common. Figure 1a shows an elevation view of a conventional bridge with joints. Figure 1b shows a simplified elevation view of an integral structure without joints and semi-integral abutments. Figure 1c show a simplified elevation view of a jointless bridge with fully integral abutments.

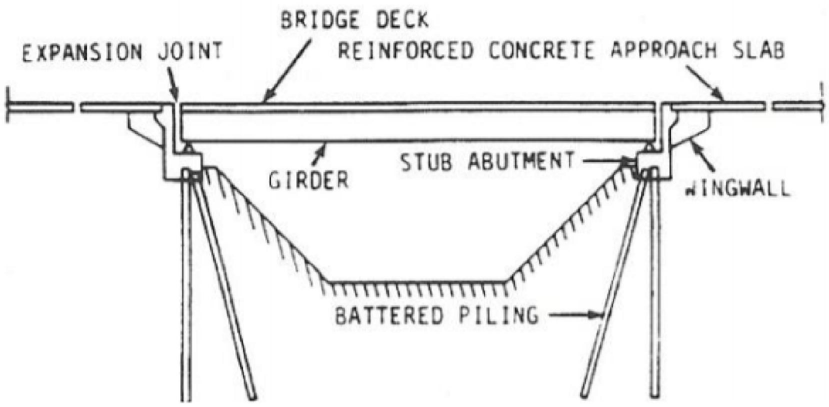

Figure 1a: Elevation View of a Bridge with Joints (Barr, 2013)

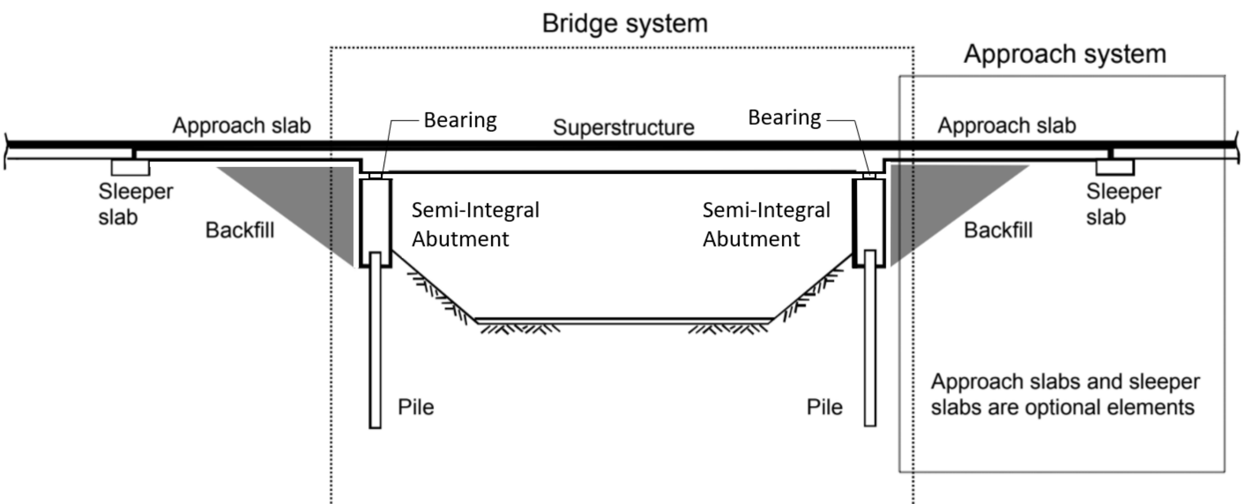

Figure 1b: Elevation View of Jointless Bridge with Semi-Integral Abutments Bridge (Lan, 2012)

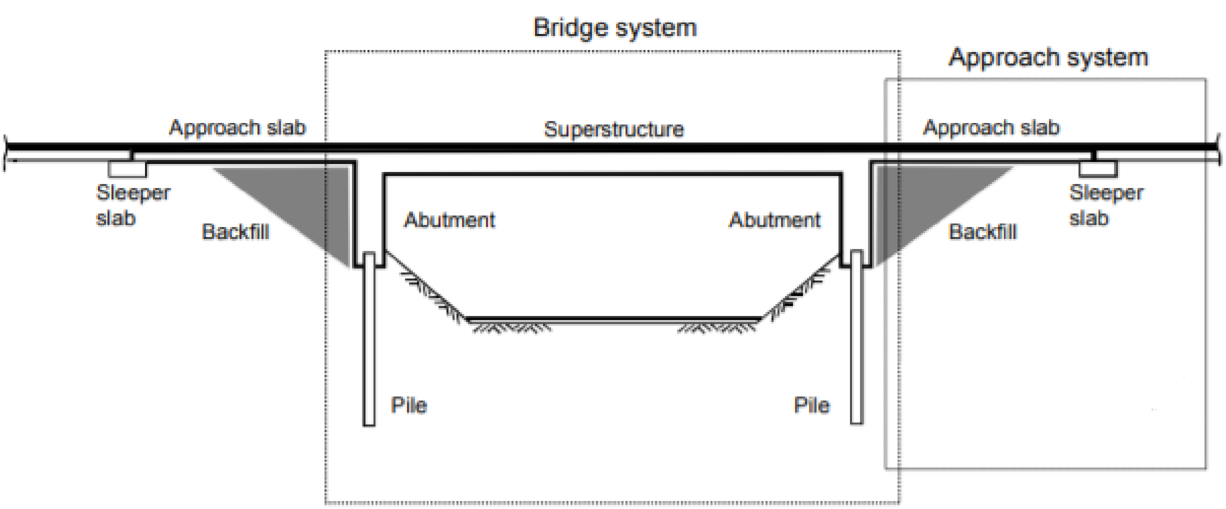

Figure 1c: Elevation View of Jointless Bridge with Fully Integral Abutments Bridge (Lan, 2012)

Both integral structures are built with the same approach system consisting of an approach slab, backfill, and in many cases a sleeper slab. They both typically utilize steel pile foundations as shown in the figures, though other footing configurations have been constructed.
Integral abutment bridges (IABs) have been reported as less expensive to construct and maintain, have suffered from less damage to beams and abutments due to corrosive elements and have been designed and built successfully by many states.

The concrete deck slab of an integral abutment bridge is cast monolithically with the abutment backwall, or end diaphragm, which encases the girders. Both concrete and steel girders are used in integral abutment bridges. The backwall is connected to the abutment, typically with a construction joint between them. The backwall supports the approach slab, retains the backfill material and is part of the bridge substructure system. An approach slab will be placed off the bridge adjacent to the end of the deck with a joint between the roadway and the approach slab. Backfill material is placed behind the backwall and underneath of the approach slab. A typical section for both a full and semi-integral abutment is shown in Figure 2.

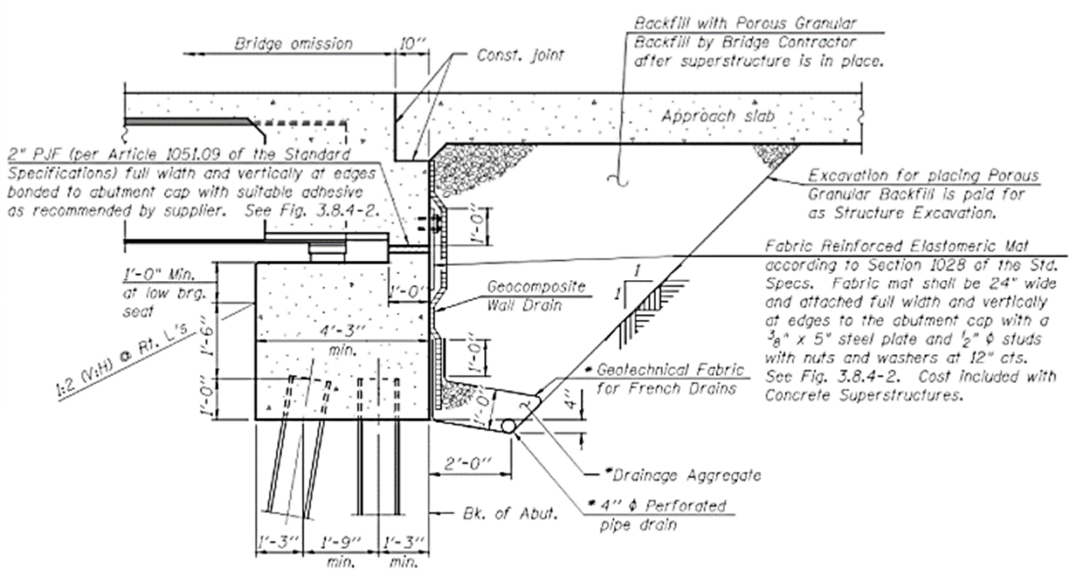

Figure 2a: Typical Section Through a Semi-Integral Abutment from Illinois DOT

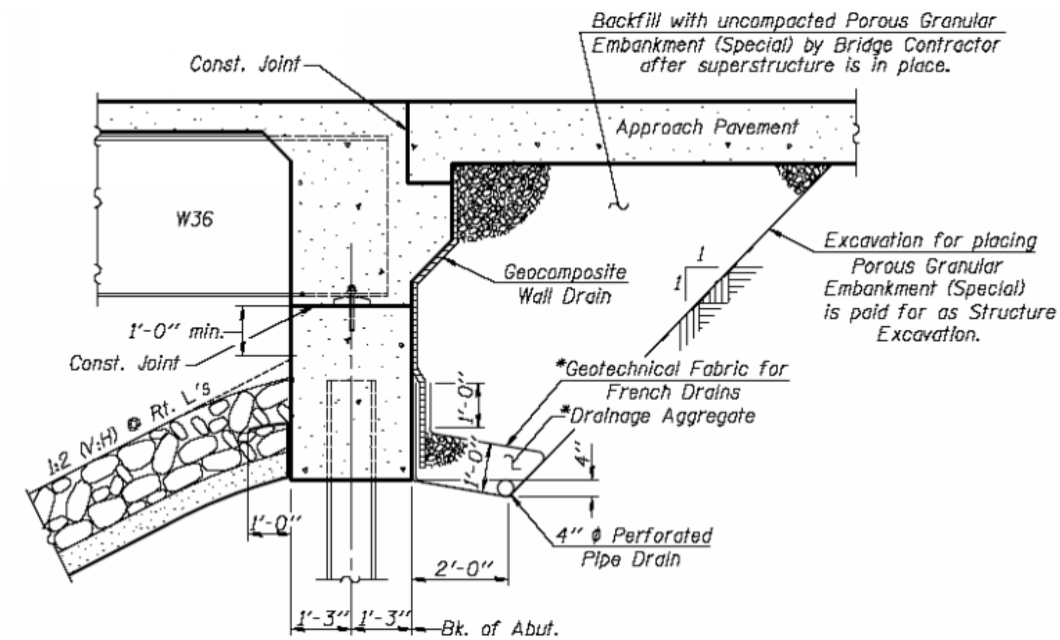

Figure 2b: Typical Section Through a Fully Integral Abutment from Illinois DOT

All these components act together to form an integral abutment bridge and many act differently from traditional bridges, so careful design considerations must be taken when using IABs.

Design and construction of integral abutment bridges has been evolving since their first implementation in the 1930s. There is no federally standard design process for IABs, but through surveying various Departments of Transportation (DOTs), commonalities have been discovered. The majority of states that have integral abutment bridges use them for simple geometries with low skew angles, relatively short lengths and no curvature. All DOTs that use IABs also use approach systems. These typically consist of an approach slab supported by backfill material and the abutment backwall on the end closest to the bridge and a sleeper slab closest to the roadway. IABs have been found to perform best with steel pile foundations over spread foundations due to the need for added flexibility of the substructure.

2.2 Details of Integral Abutment Bridges from Past Surveys

2.2.1 Overview

Over the past few decades, a variety of organizations have conducted surveys of State Departments of Transportation to gain knowledge on their use, design, and issues with integral abutment bridges. Table 1 shows details of the surveys synthesized and full questionnaires that were sent to DOTs can be found in Appendix A.

Table 1: Details of Surveys

Surveyor	Year	Surveyee	Number of States Sent Survey	Number of States that Responded	Number Responding States Responding Utilizing IABs
University of West Virginia	1999	State DOTs in the Northeast & Mid-Atlantic	24	18	11
FHWA	2005	State DOTs	50	39	Not Reported
University of Illinois	2009	State DOTs with similar climate to Illinois and/or innovative IABs	23	16	16
University of Maryland	2009	State DOTs	50	47	41
Missouri DOT	2010	State DOTs	21	20	Not Reported

The overall response to these surveys was that many states use integral abutment bridges as an alternative to conventional bridges where appropriate due to reduced life-cycle costs and reduced maintenance. The design and construction of IABs is not standardized across states and there are a number of areas of integral abutment bridge design and construction that could benefit from more research and information. Many of the surveys reviewed noted similar challenges with integral abutment bridges such as their limited geometry, accounting for thermal loading, approach settlement, and rideability. These challenges have not discouraged states from implementing internal abutment bridges, but many noted that standardization at the federal and/or state level would be beneficial. Overall, the surveys were comparable in what questions they asked, the most common ones were regarding what types of issues the states were currently facing with their integral abutment bridges. The responses they received to those questions often centered on thermal loading and approach settlement. Many of the surveys also inquired about the amount of integral abutment bridges in use and what benefits the DOTs saw with their IABs. Over time, the surveys revealed that states were continuing to construct integral abutment bridges due to their beneficial qualities like low cost and reduced maintenance.

2.2.2 Bridge Layout

2.2.2.1 Bridge Length

Most of the states that responded to the surveys reviewed use single span IABs and limit the total length of their integral abutment bridges and others noted that they allow multi-span integral abutment bridges with limits on the span lengths. The maximum length allowed varied among surveys and from state to state. The type of abutment (full or semi-integral), size, grade and orientation of the piles as well as type of beam all affected the maximum allowable length. Overall, the allowable length of integral abutment bridges was found to be less than the length of traditional bridges. Table 1 shows design limitations of bridge lengths provided by the thirty-nine states that responded to the Federal Highway Administration (FHWA) survey in 2005.

2.2.2.2 Bridge Skew

Integral abutment bridges are often limited to relatively low skews. Higher skewed bridges are subjected to additional design concerns, and due to the nature of the already complex design of integral abutment bridges, skews are typically limited. Some of the states that replied to the surveys reviewed here noted that they had issues with integral abutments on high skews as the superstructures were found to be twisting. The allowable skew for an integral abutment bridge is dependent on the bridge length and type of beam for many states. Typical skews for integral abutment bridges ranged from zero degrees to forty-five degrees. Table 2 shows design limitations of bridge skews provided by the thirty-nine states that responded to the Federal Highway Administration (FHWA) survey in 2005.

Table 2: Design Criteria for Integral Abutment Bridges (FHWA, 2005)

PRESTRESSED CONCRETE GIRDERS	RANGE
MAXIMUM SPAN	
Full Integral	60 – 200
Semi Integral	90 – 200
Deck extensions	90 – 200
Integral Piers	120 – 200
TOTAL LENGTH	
Full Integral	150 – 1175
Semi Integral	90 – 3280
Deck extensions	200 – 750
Integral Piers	300 – 400
MAXIMUM SKEW	
Full Integral	15 – 70
Semi Integral	20 – 45
Deck extensions	20 – 45
Integral Piers	15 – 80
MAXIMUM CURVATURE	
Full Integral	0 – 10
Semi Integral	0 – 10
Deck extensions	0 – 10
Integral Piers	3 - No Limit

STEEL GIRDERS	RANGE
MAXIMUM SPAN	
Full Integral	65 - 300
Semi Integral	65 - 200
Deck extensions	80 - 200
Integral Piers	100 - 300
TOTAL LENGTH	
Full Integral	150 - 650
Semi Integral	90 - 500
Deck extensions	200 - 450
Integral Piers	150 - 1000
MAXIMUM SKEW	
Full Integral	15 - 70
Semi Integral	30 - 40
Deck extensions	20 - 45
Integral Piers	15-No Limit
MAXIMUM CURVATURE	
Full Integral	0 - 10
Semi Integral	0 - 10
Deck extensions	0 - 10
Integral Piers	0 - No Limit

2.2.2.3 Curved Bridges

When integral abutment bridges were first implemented, curved geometries were seldom used (Franco, 1999). This limited the locations where integral abutment bridges could be used as many roadway geometries called for curved girders. Over time, curved bridges have become slightly more common, with a handful of states allowing for integral abutment bridges to be curved to accommodate roadway geometry, but still recommending against it unless necessary. There is not much information available on the design, construction and performance of integral abutment bridges with curved girders as there are not many in use today, and it is an area that could benefit from additional research and standardization.

2.2.3 Design Considerations for IABs

Integral abutment bridges require careful design considerations that can differ from traditional bridges. Their connectivity causes additional forces that are not present in non-integral bridges and consequently there are additional factors that need to be considered while designing them. Since IABs do not have joints or bearings to absorb forces caused by the movement of the structure, those loads need to be accommodated in other parts of the bridge that are not always designed to resist those forces. The interface between the approach slab, bridge deck, abutment backwall and backfill material is also unique in integral abutment bridges and requires additional thought and care when designing, detailing and constructing IABs.

2.2.3.1 Thermal Loads

In conventional bridges, the movement of the superstructure due to thermal expansion and contraction is accommodated by the expansion joints and bearings. Fully integral abutment bridges do not have joints or bearings, so these loads must be accounted for in other aspects of the design. While semi-integral abutment bridges do have bearings that can account for some of the thermal loading the bridge experiences, there are still additional design challenges for thermal loading that must be considered. Due to their jointless nature, thermal loads can be the controlling loads for IABs, and have even been the cause for some states to completely rid of them (Paraschos, 2009). States that responded to the surveys reviewed that use integral abutment bridges accounted for thermal stresses in different ways, but a point of commonality was that the approach slabs off the structure will have joints at the ends, which can accommodate a portion of the thermal movement of the superstructure. Thermal stresses are also accounted for in the movement of the abutment and backwall as well as flexible piles and sleeper slabs if they are provided.

2.2.3.2 Creep

Creep stresses in bridges are caused by the materials decreasing in stiffness over time which results in additional deflections of the superstructure in relatively long spans. Traditionally, integral abutment bridges have relatively short overall span lengths, so creep is not always a consideration. For longer IABs, the effects of creep can cause increased moments at the supports, and from the states surveyed, some do account for this effect. These incidental forces from creep effects have been found to cause cracks in the bridge abutments which have caused approach slabs to perform poorly (Thiagarajan, 2010).

2.2.3.3 Backfill

Backfill material is placed on the rear face of the backwall and abutment and underneath the approach slab. It resists the longitudinal movement of an integral abutment bridge and supports the approach slab. The backfill material, as well as any water that has infiltrated the fill, will exert pressures onto the bridge abutment. The nature of these pressures differ slightly from a traditional bridge due to the fact that the abutment and superstructure move as a unit, and as they move into the backfill on one end of the bridge, they will pull away from the backfill on the opposite end of the bridge. This causes both passive and active earth pressures to develop. Passive earth pressures are exerted on the rear face of the abutment that moves toward the backfill, while active earth pressures are exerted on the opposite abutment that moves away from the backfill (Franco, 1999). Which abutment experiences which type of earth pressure changes as the abutment and superstructure move. Each state that responded to the survey's accounts for these pressures in different ways. Some account for a combination of both types earth pressures, while others only account for passive earth pressures. The method of calculation for determining the passive and active pressures that the backfill exerts also differs amongst Departments. A less compacted backfill will exert smaller pressures on the abutment, and a handful of survey responders noted that they use a reduction in pressure to design integral abutment bridges with certain types of backfill. Backfill material for integral abutment bridges is not standardized across State Departments, but many have similar recommendations and that they provide to their engineers for IAB design.

Many states that responded to the surveys reviewed noted that they recommend the use of a compacted granular fill that drains well, such as number 57 coarse aggregate stone, as backfill for integral abutment bridges. Not all Departments specify a type or density of backfill and leave the design of the backfill material to the engineer. It is important that the backfill has good drainage properties because when water infiltrates the backfill and goes through freeze thaw cycles, the expansion and contraction of the backfill has been seen to cause the approach slab resting on top to settle and experience transverse cracking. While typically a denser backfill material would be favorable because a higher density would allow for less water infiltration and less settlement of the approach slab, that is not the case for integral abutment bridges. This is due to the cyclical movement of the abutment/superstructure unit, which will compact loose backfill or loosen compacted backfill that is directly adjacent to the rear face of the abutment and backwall. This motion creates a new backfill density other than what was placed during construction, making the design of the backfill pressures and density challenging, and has led to backfill being deemed the central cause of issues for some integral abutment bridges (Yen, 2004).

In the surveys reviewed, a few of the states that noted that backfill material has been a cause of problems in their integral abutment bridges have either eliminated IABs completely or revised the types of backfill materials that may be used on integral abutment bridges. A handful of Departments either require or provide the option of the use of alternate materials to be used as backfill, such as a controlled low strength material (CLSM), colloquially known as flowable fill, especially in areas with poor soil parameters. As backfill issues continue to arise in integral abutment bridges, the use of CLSMs is becoming more common (Thiagarajan, 2010). Issues with traditional backfill materials were noted amongst numerous states that responded to past surveys, and as time progressed, many DOTs starting researching and utilizing alternative materials. Even in the most recent survey, conducted in 2010, settlement of backfill is an issue. While it is an area of design that is important for integral abutment bridges, there is not much information on ways to mitigate the issues with backfill and it is an area of IAB design that could benefit from additional research and standardization.

2.2.3.4 Abutment Backwall

In an integral abutment bridge, the deck is monolithic with the backwall, which is cast so that the ends of the beams are encased within it, with some states connecting reinforced concrete beams to backwalls using dowels. The backwall is integrally connected to the top of the abutment, typically though use of a construction joint. This section of the structure is what makes integral abutment bridges differ from traditional bridges that have joints at the abutments. A typical section of an abutment is shown in Figure 3. Beams, deck, approach slab and backfill are not shown for clarity.

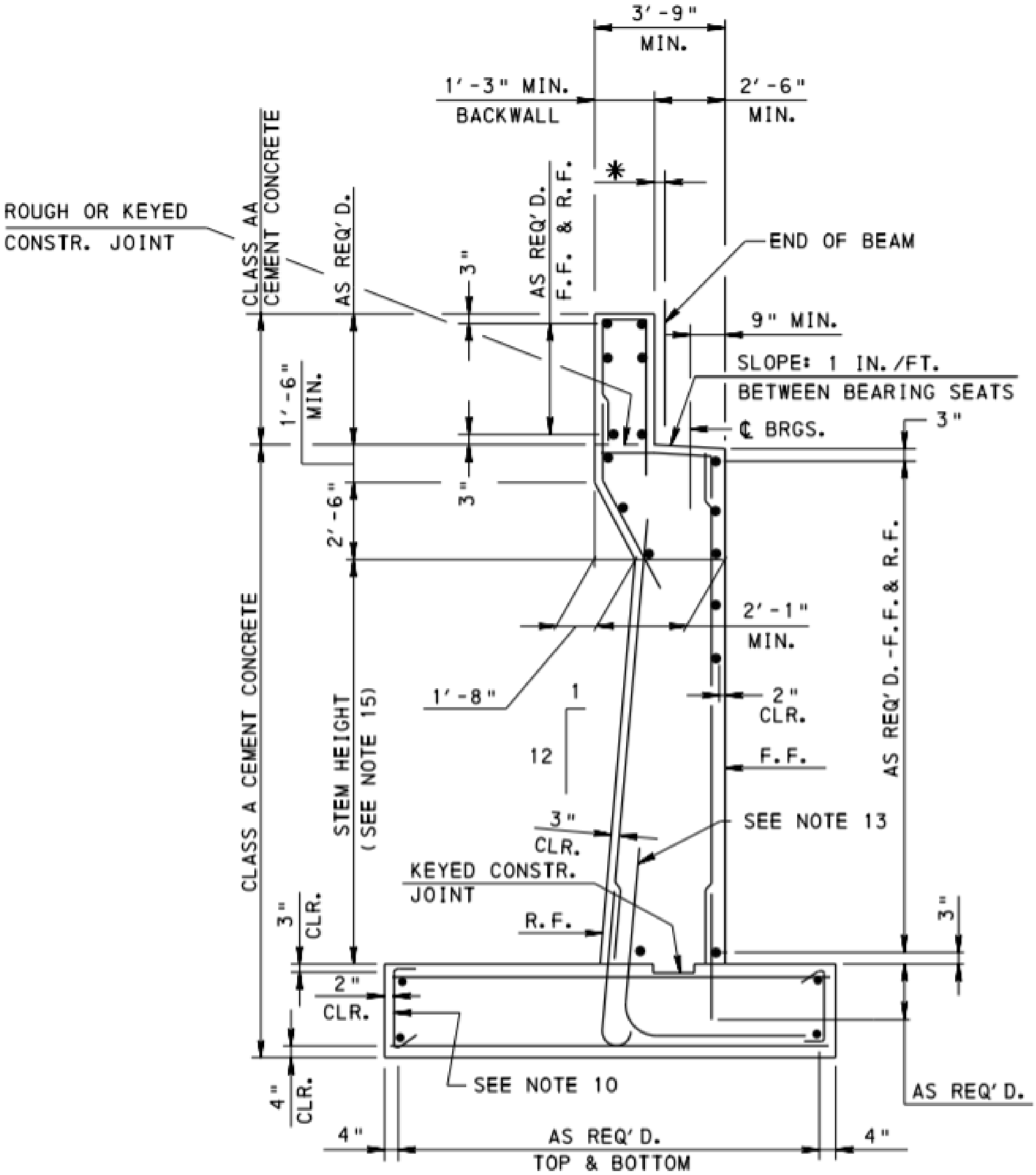

Figure 3: Typical Abutment Section from Pennsylvania DOT

Backwalls for integral abutment bridges are frequently constructed with paving notches for the adjacent approach slab to rest on. Figure 4 shows a section through an integral abutment with a paving notch.

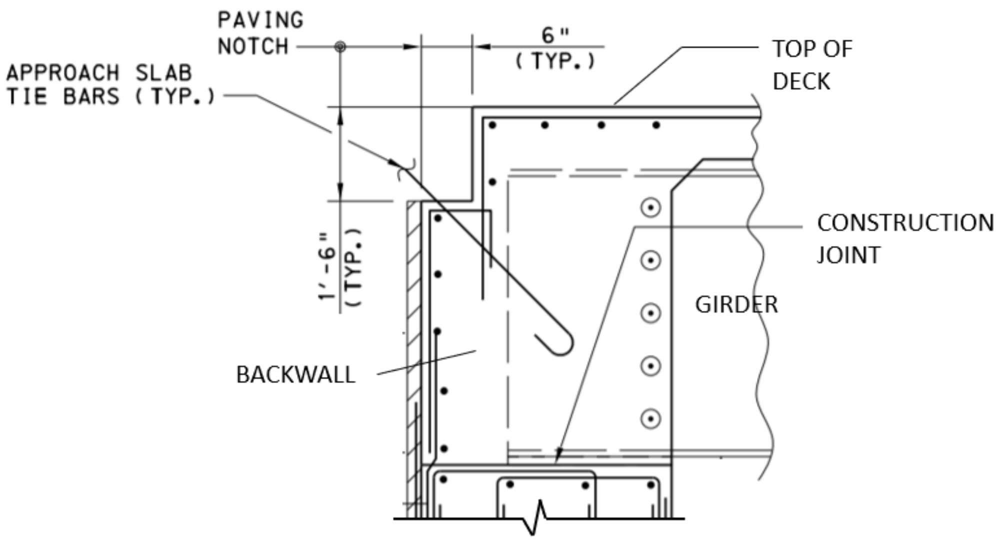

Figure 4: Typical Section of an Integral Abutment Bridge Backwall with a Paving Notch from Pennsylvania DOT

The interface of the approach slab and paving notch has been a location of shear failures in some states due to erosion of the backfill material which caused a formation of a gap between the backwall and approach slab. To mitigate failures of the paving notch, many states have revised integral abutment backwall design to have reinforcement projecting from the backwall to the approach slab to create a connection between the two. A few states that have responded to past surveys noted that they have had IAB backwalls suffer from cracking. One cause of the cracking was found to be insufficient cover of dowels and reinforcement connecting the backwall to the beams and approach slabs (Franco, 1999). Cracks formed in areas of insufficient cover after bridges experienced freeze thaw cycles and superstructure expansion and contraction. While these cracks have been considered minor in some cases, states noted that they will revise the design of future integral abutment bridges to ensure proper cover and hopefully prevent this cracking.

Backfill material that is placed adjacent to the rear face of the abutment and backwall plays a large role in their design for integral abutment bridges. Backfill exerts pressures onto the backwall and abutment of a bridge and a number of states have come up with innovate ways to relieve some of this pressure, other than changing the backfill material. A vertical layer of cushioning material can be placed on the rear face of the abutment backwall to reduce the earth pressures that the backwall sees. Numerous materials have been used on integral abutment bridges for this purpose, including neoprene sponges, flexible foam and corrugated metal sheets. All of these materials act as pressure relievers, though it is not apparent if one is better than the others. States that use these materials do not design for the relieved pressure as it is conservative to still account for the full pressure that the backfill exerts, and the additional material acts as a factor of safety.

2.2.3.5 Approach Slabs

Nearly all integral abutment bridges are built with approach slabs directly off the structure that are connected to the abutment backwall. Since IABs have no joints on the bridge, it is common practice to place joints at the end of the approach slabs. The type of joint at the ends of approach slab is not consistent across states. Some joint types that are used include; expansion joints, neoprene seals, open joints and a number of other compressible materials. These joints are typically the part of integral abutment bridges that require the most maintenance, as the joint material will wear out over time and will no longer be able to withstand the movement of the structure.

Approach slabs that are part of integral abutment bridges need to allow for longitudinal movement. To accommodate this movement, many states specify that a material needs to be placed between the bottom of the approach slab and the top of the backfill so that the approach can easily glide. The type of material varies among states, but it commonly a type of plastic that is placed on top of the backfill just before the approach slab is constructed. In order to keep the approach slabs from moving too much, they are often placed on sleeper slabs, which act as footings for the approach slabs, and create a frictional force between the interface of the two, somewhat restricting the motion of the approach slabs (Thiagarajan, 2010). This helps to keep the approach slab attached to the abutment. A typical elevation view of an approach slab is shown in Figure 5.

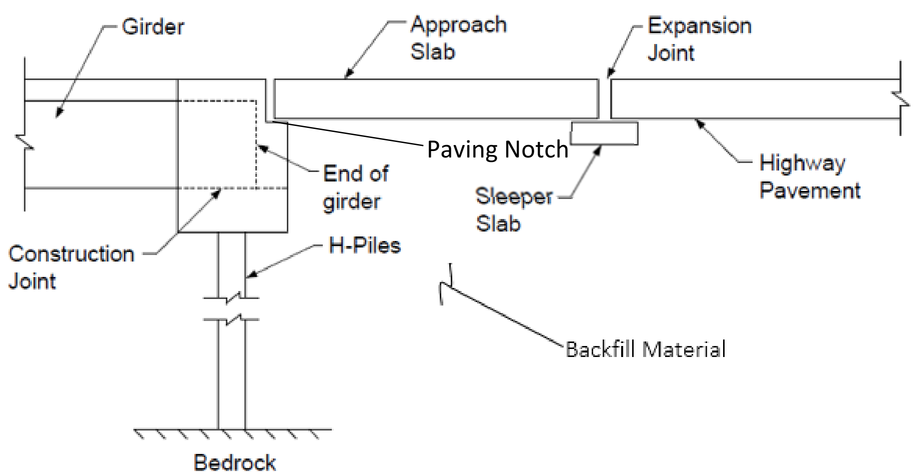

Figure 5: Elevation View of an Integral Abutment Approach Slab (Wahls, 1990)

A handful of states that have constructed integral abutment bridges with approach slabs and no sleeper slabs have noted that they have had issues with the approaches pulling away from the abutment. This has led to the bridge deck failing at the interface of the backwall and approach slab in extreme cases and poor rideability and spalling in less severe cases.

Approach slabs are supported by the backfill material that is adjacent to the rear face of the abutment and backwall of the bridge. The cyclical movement of the abutment and freeze thaw cycles causes the backfill to change densities and expand and contract, which inevitably leads to settlement of the approach slab. The settlement often causes the approach slab to crack and depending on the depth and speed at which the approach slab settles, the cracking can be anywhere from very mild to severe causing the need to replace the slab. While it has been stated by numerous researchers and states that approach slabs built with natural backfill materials will always settle, there are ways that bridge owners have attempted to mitigate this settling. Some states mentioned in the 1999 survey performed by West Virginia University, that they utilize a saw cut joint filled with a silicone material at the center line of the structure along the length of the approach slab, perpendicular to the bridge, to attempt to reduce transverse cracking (Franco 1999). The purpose of this cut was to attempt to relieve the forces that the approach slabs see, but in the responses some states noted that these cuts were found to be ineffective, and none of the more recent surveys mentioned the use of these saw cuts. States that undergo less freeze thaw cycles have found saw cut joints to be more useful than other states because their approach slabs are not subjected to as much differential settlement. Other methods that have been used to try to reduce approach slab settlement are the use of buried approach slabs, resurfacing approach slabs with asphalt overlays and injecting grout into voids under approach slabs that have been in use and began to settle (Thiagarajan, 2010). All of these methods have been seen to slow the settlement of integral abutment bridge approach slabs, but each state that responded to the surveys said that they have not been able to completely stop their approach slabs from settling. Approach settlement can lead to a bump at the beginning and end of the structure causing poor rideability conditions, and for some states this poor rideability has been a concern that has led to either elimination or reduced use of integral abutment bridges. Due to the integral nature of jointless bridges, as they accommodate loads, they move as a unit. This affects soil properties and compaction behind abutments and under the bridge's approach slabs, which can cause greater settlement of the bridge approach than that of a traditional bridge. Even though approach slabs for IABs always settle and require maintenance, it has been reported that it is still less maintenance than traditional bridges.

2.2.3.6 Foundation

Soil conditions vary widely across the United States and can be a controlling factor in determining what type of foundation to use for a structure. In reviewing past surveys, it was found that there were many different acceptable designs for integral abutment bridge foundations. The commonality amongst most states is that spread footings are rarely used for integral abutment bridges due to their low flexibility. IABs cannot expand and contract at joints located at the ends of the spans like traditional bridges, and these movements are accounted for in part, by the bridge's foundation. Thermal loads on integral abutment bridges generate additional moments and horizontal forces at the interface of the superstructure and substructure to accommodate those loads, a flexible foundation is needed.

Steel pile foundations provide the necessary flexibility for integral abutment bridges to expand and contract under certain geological conditions dependent on factors such as soil cohesion and depth to bedrock as well as other effects such as anticipated scour and frequency of freeze thaw cycles. Almost every state that responded to the surveys that inquired about foundations said that they have had success with the use of steel piles, though not all piles currently in use on integral abutment bridges have the same shape, size and orientation. The majority of DOT's use a variety of standard sized HP piles, but some integral abutment bridges have also been built with HSS and pipe piles. When using a pile that is unsymmetric about at least one axis, like an HP pile, most states said that they orient their piles with the weak axis parallel to the centerline of bearing (Olson, 2009). Many surveys concluded that this is the best pile orientation as it will result in maximum flexibly and durability of the piles, but there are integral abutment bridges in use today that have oriented their piles for strong axis bending without issue. The flexibility of the foundation piles is important because it has a direct effect on the maximum length of the bridge. The distance that the top of the pile moves laterally, relative to the bottom of the pile that is embedded in the earth, effects the amount of axial load that the pile can carry, which can limit the bridge length if the pile is unable to carry enough load. Since many states limit either the span length or overall length of their integral abutment bridges to relatively short distances, it is important that the foundations are flexible enough so that their lengths are not limited further.

2.2.3.7 Wingwalls

Wingwall design for integral abutment bridges is treated the same, or very similarly, to their design when used with traditional bridges. Wingwall necessity and shape can be dictated by the surrounding conditions as well as what the bridge crosses and carries. Both U-shaped wings and straight wings have been seen to perform well for integral abutment bridges. Occasionally, wingwalls are built monolithically with their adjacent abutment. When this is the case, many states limit the length of the wingwalls on integral abutment bridges so that there is less structure that needs to move with the superstructure/abutment unit as it undergoes thermal movement. When it is impractical to use short wingwalls, they can be built separately from the integral abutment bridge and are then designed on their own, separate from the bridge, to be able to withstand the necessary lateral loads.

2.3 Strategic Highway Research Program

The most recent Strategic Highway Research Program in 2014 (SHRP2) discussed jointless bridges and many of the design considerations that DOTs have noted in surveys over the past few decades were touched upon. Thermal loads are accounted for in two categories, uniform temperature change based on girder material and soil parameters and temperature gradient based on location. This method may lead to more accurate thermal movement calculations than what states were implementing when the surveys were conducted, which could lead to integral abutment designs that are better equipped to handle thermal loading, a central factor in IAB design. The SHRP2 also reported that many DOTs use an approach slab length of at least twenty feet as it has been shown that at twenty feet or more away from the backwall of an integral abutment bridge, there is significantly less settlement than at the rear face of the abutment. It was also noted that a porous backfill material is necessary for drainage purposes and will also help to mitigate approach settlement. Overall, the SHRP2 lays out design provisions for jointless bridges in two ways: 1) the simplified method of analysis and 2) the detailed methods of analysis. In order to meet the criteria for the simplified method, bridges must meet certain criteria regarding their geometry, internal forces, and foundations. If requirements for the simplified method cannot be met and the detailed process must be used, then the design process for a jointless bridge structure can be and arduous to ensure that all loads can be resisted by the structure.

2.4 Conclusions

The following are the major conclusions that have been drawn based on the review of the prior surveys:

- The majority of responding states to the surveys synthesized have implemented integral abutment bridges.
- IABs are cost-effective alternatives to typical jointed bridges.
- Many State DOTs limit the use of integral abutment bridges to certain geometric conditions such as: low skew, short spans, and limited curvature.
- Common issues with jointless bridges include accommodating thermal loads, approach slab settlement and rideability.
- Many respondents stated that thermal loads can be pinpointed as a main cause to cracking in the structure, poor approach slab performance and unpleasant rideability conditions.
- Commonalities across states include the necessity of approach slabs, the use of flexible steel pile foundations instead of spread footings and the need for a well-designed backfill material.
- 2014 SHRP2 report allows for a simplified design method that can be utilized to design an integral abutment bridge that meets specific requirements.

Chapter 3: State Department of Transportation Jointless Bridge Details

The Federal Highway Administration (FHWA) provides links to state DOT websites that house the states standardized drawings as part of their technical resources (FHWA, March 2021). Each link was explored to locate all structural drawings and it was discovered that a handful of states include details specific to jointless bridges as part of their standardized drawings, which have been synthesized and included in Appendix B. The details are sorted by type and state, with the detail of interest being circled in red on sheets that hold multiple details. An outline of jointless bridge details synthesized is listed below.

1. Approach Details

Illinois

Approach Slab Ledge Details

Massachusetts

Integral Abutment Approach Slab Bracket

Minnesota

Bridge Abutment Approach Treatment for Integral Abutments

Michigan

Integral and Semi Integral Abutment Empirical Approach Slab Details

Integral and Semi Integral Abutment Sleeper Slab Details

New Hampshire

Approach and Sleeper Slab Reinforcement

Sleeper Slab Detail for Compression Seal Expansion Joint

Sleeper Slab Detail for Closed Cell Expansion Joint

Sleeper Slab Bearing Strip Detail

Approach and Sleeper Slab Masonry

Approach and Sleeper Slab Reinforcement

Sleeper Slab Elevation

Pennsylvania

Integral Abutment Approach Slab Details

Rhode Island

Approach Slab Typical Section for Fully and Semi Integral Abutments

2. Joint Details

Illinois

Semi-Integral Abutment Joint Details

Massachusetts

Movement Joint Section

New Hampshire

Sleeper Slab Detail for Compression Seal Expansion Joint

Sleeper Slab Detail for Closed Cell Expansion Joint

3. Beams Details

Illinois

Top Flange Clip Detail for Steel Beams on Integral Abutments

Top Flange Clip Detail for PPC Beams on Integral Abutments

Massachusetts

Beam End Details for Integral Abutments

Rolled Beams

Plate Girders

NEBT Beams

Spread Box Beams

NEXT F Beams

Pennsylvania

Beam Ends Supported on Integral Abutments

4. Bearing Details

Illinois

Integral Abutment Bearing for Steel Beams

New York

Bearing Pad Placement

Ohio

Bearing Details for Integral Abutments

5.a) Fully Integral Abutment Plan View

Massachusetts

Integral Abutment Plan

Horizontal Section at Integral Abutment Seat

Horizontal Section at Integral Abutment

Ohio

Plan at Integral Abutment

NOTE: Ohio provides similar details for various beam and transition types

Plan at Integral Abutment Diaphragm

Oklahoma

Abutment Details for P.C. Beams

Rhode Island

Integral Abutment Plan at Beam Seats

Pennsylvania

Typical Plan of Integral Abutment

Wisconsin

Integral Abutment Plan

Slab Span with Fixed Seat

Girder Span with Fixed Seat

5.b) Fully Integral Abutment Typical Section

Colorado

Integral Abutment on H-Piles

Illinois

Integral Abutment for Steel Beams

Integral Abutment for PPC Beams

Integral Abutment for Slab Bridges

Integral Abutment Details for PPC Beams on Large Grades

Massachusetts

Section at Center Line of Integral Abutment

Typical Integral Abutment Section (Rolled Beams)

NOTE: MassDOT provides similar details for various types of beams

Typical Integral Abutment Reinforcement

Michigan

Typical Integral Abutment Section

Integral Abutment – Single Row of Piles (Section Through Stub Abutment)

Integral Abutment Backwall

New Hampshire

Typical Integral Abutment Section

Integral Abutment Section Between Girders

Integral Abutment Section at Girders

New York

Integral Abutment Adjacent PC Beams Typical Sections

Ohio

Elevation and Typical Sections at Integral Abutment

NOTE: Ohio provides similar details for various beam and transition types

Oklahoma

Integral Abutment with P.C. Beams Elevation and Typical Section Through Seat

Pennsylvania

Integral Abutment Elevation

Typical Sections Through Abutment

Steel Girders

Concrete Girders

Slab-Abutment Connection Detail

Rhode Island

Front Elevation at Integral Abutment

Typical Sections at Fully Integral Abutment

Wisconsin

Typical Section Through Integral Abutment Body

5.c) Fully Integral Abutment Diaphragm Details

Illinois

Steel Beams to Diaphragm Connection for Integral Abutment

PPC Beams to Diaphragm Connection for Integral Abutment

Iowa

Integral Abutment and Pier Diaphragm Details

NOTE: Iowa has similar details for various beam types and skew ranges

Ohio

Integral Abutment Diaphragm Detail

6.a) Semi-Integral Abutment Plan View

Ohio

Plan at Semi-Integral Abutment

NOTE: Ohio provides similar details for various beam and transition types

Rhode Island

Integral Abutment Plan at Beam Seats

Pennsylvania

Typical Plan of Semi Integral Abutment

Wisconsin

Semi Integral Abutment Plan

Slab Span with Semi Expansion Seat

Girder Span with Semi Expansion Seat

6.b) Semi-Integral Abutment Typical Section

Colorado

Typical Semi Integral Abutment Section

Illinois

Typical Semi Integral Abutment Section

Michigan

Semi Integral Abutment Backwall

New Hampshire

Typical Semi Integral Abutment Section

New York

Typical Semi Integral Abutment Section

Ohio

Elevation and Typical Sections at Semi Integral Abutment

NOTE: Ohio provides similar details for various beam and transition types

Rhode Island

Elevation at Semi Integral Abutment

Typical Sections at Semi Integral Abutment

6.c) Semi-Integral Abutment Diaphragm Details

Illinois

Semi Integral Abutment Diaphragm for Steel Beams

Semi Integral Abutment Diaphragm for PPC Beams

New Hampshire

Semi Integral Abutment Typical Diaphragm Section

Ohio

Semi Integral Abutment Diaphragm Guide

7. Wingwalls, Mechanically Stabilized Earth Retaining Wall and Corner Details

Illinois

MSE Wall Section at Integral Abutment

MSE Wall Section at Semi Integral Abutment

Corner Treatment of Skewed Integral Abutments

Massachusetts

Wingwall Elevation for Integral Abutments

Integral Wingwall Sections

Horizontal Section of Integral Abutment and Wingwalls

Wingwall Section for Integral Abutments

Oklahoma

Section Through Wing at Back Face of Integral Abutment Seat

Integral Abutment Wing Elevation

Pennsylvania

Integral Abutment Wingwall Details

Wisconsin

Plan and Section View of Integral Abutment Wingwalls

Wingwall Corner Details for Skewed Integral Abutment Bridges

8. Foundation Details

Colorado

Integral Abutment on Drilled Shafts

Illinois

Integral Abutment Pile Orientation

NOTE: Illinois provides similar detail for pile orientation for integral piers

Iowa

Integral Abutment Footing Details

NOTE: Iowa provides similar details for many beam types & skew ranges

Pennsylvania

Integral Abutment Pile Connection Details

Fixity Arrangement for Multi Span Structures

Mixed Substructure Types with Integral Abutments

Rhode Island

Foundation Plan

9. General Notes

Massachusetts

Integral Abutment Terminology

Construction Notes for Integral Abutments

Pile Notes for Integral Abutments

Designer Notes for Integral Abutments

Ohio

General Notes for Integral Abutment Construction

Pennsylvania

General Notes for Integral Abutments

Wisconsin

Designer Notes for Integral Abutments

10. Miscellaneous Integral Abutment Bridges State DOT Standard Details

Illinois

Integral Abutment Drainage Details

Semi-Integral Abutment Drainage Details

Integral Abutment Headed Bar Placement

Iowa

Deck and Drainage Details

NOTE: Iowa has many of these details for various roadway lengths

Massachusetts

Pedestal Plan Details

Deck Placement Sequence

Integral Abutment Backfill

Utility Details at Abutment

Pennsylvania

Waterproofing and Scour Protection Details

Chapter 4: State Department of Transportation Interviews

Prior to conducting a review of all available state details on jointless bridges, nine states were interviewed on their use of jointless bridges, their successes and issues with jointless bridges and specific design considerations. A synopsis of questions posed to each state are listed below.

<u>General Questions:</u>

Contact information

- a. Name
- b. State/District
- c. Organization
- d. Job title
- e. Email address
- f. Phone number

1. How many jointless bridges (both full and semi-integral abutment) do you have in your inventory of state-owned bridges?
2. Under what circumstances would you use a jointless bridge over a traditional bridge?
3. Are you generally satisfied with the way your jointless bridges have performed?
4. Have you experienced any problems with bridges of this type? *
   a. If "yes", please explain some of the problems you have encountered. What measures have you taken to remedy these problems?
5. Have you set any design limitations on jointless bridges in your state? (i.e., skew, span length, ADT, etc.) *
6. Do you have construction specifications for jointless bridges? *
   a. Have you experienced any construction related issues with jointless bridges?
7. Is there anything else you would like to share?
8. Is there anything you would like to learn about jointless bridges?

Detail Specific Questions:

1. How do you connect your approach slab and abutment on jointless bridges? *
2. How do you prevent settlement of approach slabs on jointless bridges? *
3. What specifications and design criteria do you have in place for backfill material behind jointless bridge abutments? *
4. Have there been any issues with rideability on your jointless bridges?
5. How do you account for thermal loads on jointless bridges? *
6. Has there been any cracking (of the abutment, deck, barriers, etc.) in your jointless bridges that differs from traditional bridges? i.e., excess cracking, premature cracking, cracking in unexpected locations, etc.*
    a. What can this cracking be attributed to? i.e., construction, design
7. What type of foundations do you allow? What constitutes which foundation type is utilized? *
    a. For steel pile foundations, how do you orient your piles, what shape piles do you allow, what yield strength do you require for your piles?
8. Do you use integral wingwalls with jointless bridges?
9. Have you experienced construction issues with jointless bridges? i.e., sequencing issues, cracking immediately after construction, improper installation, etc.

*Denotes a question carried over from past surveys (Franco, 1999; Yen & Kup, 2005; Olson et al., 2009; Paraschos & Amde, 2009; Thiagarajan et al., 2010)

Each state has a unique approach to retrofitting and constructing jointless bridges, but many issues were common among states. Experience of the states interviewed varied from over 50 years of practice and approximately ten thousand jointless bridges in the states inventory, to about 10 years of experience and nearly one hundred jointless bridges owned by the state. Regardless of issues that each state faces with jointless bridges, each said that a type of jointless bridge is their first choice for new construction, with the majority saying that fully integral abutments bridges are their initial consideration. The limiting factor for nearly every state was the bridge's expansion length and whether the movement of the jointless bridge will be able to be accommodated.

Common issues among the states interviewed included cracking in the end diaphragm and settlement and cracking of the approach slab. Many states have found some remedies to these issues and agree that the benefits of jointless bridges far outweigh their problems but look for continued investigation into how to mitigate common concerns. Success among the states interviewed included (1) jointless bridges requiring less maintenance than traditional bridges, (2) their substructures and beams having longer life spans and, (3) burying approach slabs, or eliminating them, leading to reduced settlement. Key highlights of responses from the interviews can be found in the list below.

Iowa:

- Use mostly fully integral abutment bridges
- Lengths are up to 575' for concrete and 400' for steel
- Experienced issues with diaphragm cracking when beams were locked so that they could not expand/contract freely
- Use approach slabs, but no sleeper slabs
    - Have had issues with approach slab settlement and water infiltration
- Working to use new slab over backwall detail and fix issues

Maryland:

- Mostly use jointless bridges on shorter spans (up to 55')
    - Rarely use fully integral bridges, prefer semi-integral
- Do not use approach slabs
- Have not experienced many issues

Massachusetts:

- Use a slab over backwall detail (semi-integral) that has worked for over 100 years, also own some fully integral abutment bridges

- Semi-integral abutments have no length, skew, ADT, etc. limitations. Only limiting factor is the thermal movement, which affects the type of joint
- Bury all approach slabs so that the back of the abutment doesn't need to be designed for live load
    - Also improves rideability

Minnesota:

- Majority of bridges owned are not jointless, but since 2004 they have been constructing most of their new bridges with jointless abutments
    - Typically opt for semi-integral abutments because they can be taller
- Jointless bridge maximum length is 300'
- Experienced issues with diaphragm cracking due to beam ends locked in too early, rip rap settlement leading to pile erosion, approach slab cracking and settlement and joint failure at the ends of the approach slabs

New York:

- Fully integral abutments are the first choice and will use other jointless structures only if a fully integral abutment will not work
- Use approach slabs connected to abutment with angled reinforcement supported on sleeper slab
- Experienced some issues with approach slab settlement and cracking
- New York has been researching how to convert older traditional abutments to semi-integral abutments without replacing the superstructure

Pennsylvania:

- Fully integral abutments are the first choice and are used on spans up to about 100' but also own a number of semi-integral abutment bridges
- Experienced issues with approach slab settlement and are mitigating it with reinforced earth
- Also experienced cracking at the acute corners

Tennessee:

- About half of bridge inventory is jointless
- Lengths are typically 800' or less for concrete and 400' or less for steel but have built jointless bridges as long as 1000', longer than any other state

- Occasional cracking issues and deck deterioration, but substructure always lasts longer on jointless bridges than on traditional bridges
- For concrete beams, project strands into diaphragm rather than using rebar
- Orient piles for strong axis bending rather than weak axis
- Jointless bridges have more damping than traditional bridges and make them better for seismic resistance than traditional bridges

Virginia:

- Always use a jointless abutment and must get state bridge engineer approval to use a jointed abutment
- Invented the "Virginia Abutment" which is a semi-integral detail where the slab extends over the backwall and there is a tooth joint between the approach and the deck. A trough collects debris and runoff on the rear face of the backwall.
- Use at grade and buried approach slabs

Vermont:

- Have approximately 60-75 jointless bridges with maximum lengths of about 400' for steel and 700' for concrete
- Issues with backwall cracking between beams due to transverse steel spacing and wingwall cracking at the acute corner on skewed bridges
- Implemented some curved girder jointless bridges
- Use Vermont Joints which are open joints with steel plates when larger movements need to be accommodated on longer spans

The nine state interviews provided new insight into current practices in jointless bridge design and construction. Nearly every state mentioned innovations in their jointless bridges that included advancements to their abutment details, reinventing approach specifications, and eliminating previous limits placed on jointless bridge length, skew, and curvature. Common issues arose in multiple interviews such as unforeseen cracking, settlement and accommodating movement. Some states noted that along with constructing new jointless bridges, they are working to retrofit their existing jointed bridge structures to be jointless so that they will have extended life spans and require less regular maintenance.

Chapter 5: Roundtable Meeting

While some design and detailing commonalities were identified during the interview process to exist between states, there was no clear best practice for jointless bridges, so a virtual meeting was held so that bridge owners, consulting firms, and the University of Delaware could discuss jointless bridges further. A roundtable meeting was held via Zoom on September 16, 2021 with participants from ten state DOTs, four consulting firms and the University of Delaware. Meeting participants were chosen based on expertise on jointless bridges, the literature review, and relationships with the Delaware Department of Transportation. A list of roundtable participants can be found in Table 3.

Table 3: Roundtable Participants

Affiliation	Name
University of Delaware	Tripp Shenton, Monique Head, Michael Chajes, Hannah Power
Delaware DOT	Jason Hastings, Craig Stevens, Jonathan Tice, Nicholas Dean, Sean Weaver, Marie Burns, Michael Haddad, Eric Yoder
Iowa DOT	Michael Nop
Maryland DOT	Jeff Robert
Massachusetts DOT	Alex Bardow
Minnesota DOT	Dave Dahlberg, Dave Conkel
New York DOT	Harry White, Jim Scarlata
Pennsylvania DOT	Lloyd Ayres
Tennessee DOT	Ted Kniazewycz, Houston Walker
Vermont DOT	Jim Lacroix, Bob Klinefelter
Virginia DOT	Junyi Meng, Adam Matteo
Pennoni	Philip Horsey, Mark Powell, Nate Buttorff, Houston Brown, Tony Manzella
GPI	Barry Benton, J.D. Simpson
TYLin	Bala Sivakumar, Ryan Becraft
AECOM	Adam Heckroth, Neil Shemo

The purpose of this meeting was to explore the current state of practice, share knowledge and experiences and discuss innovative design solutions that have emerged for jointless bridges in recent years. Table 4 shows the agenda for the meeting.

Table 4: Roundtable agenda

1:00 – 1:20	Welcome, introduction and purpose of roundtable meeting
1:20 – 2:00	State highlight presentations: Brief of experience with jointless bridges
2:00 – 2:15	Consultant highlight presentations: Brief of experience with jointless bridges
2:15 – 2:45	Breakout Session 1: Retrofitting traditional bridges to be jointless
2:45 – 2:55	Break
2:55 – 3:25	Group report out: Synopsis of retrofit discussions
3:25 – 3:55	Breakout Session 2: Design and construction of new jointless bridges
3:55 – 4:05	Break
4:05 – 4:35	Group report out: Synopsis of new jointless bridge discussions
4:35 – 5:00	Wrap-up

Throughout the meeting, participants were polled on their use and successes with jointless bridges. The first poll was conducted after the purpose of the roundtable was discussed and it regarded the participants use of jointless bridges. The results of the first poll are in Table 5.

Table 5: Poll 1 Responses

Question 1: Approximately what percentage of the bridges in your inventory are jointless (fully and semi-integral bridges)?	
Answer	% of Votes
< 10%	20%
10% to 25%	40%
25% to 50%	20%
50% to 75%	5%
75% to 100%	10%
We don't have any jointless bridges	5%
Question 2: Approximately how long have you been designing/building jointless bridges?	
Answer	% of Votes
Less than 5 years	5%
5 to 10 years	40%
10 to 20 years	20%
20 to 40 years	15%
More than 40 years	20%
We don't design/build jointless bridges	0%

State and consultant highlight presentations each touched on successes, innovations, challenges, and areas in need of improvement with jointless bridges. Many successes regarded extending the life of the beams and substructure and saving time and money on maintaining the structures. Common challenges noted were cracking, approach settlement and expansion length, as well as not having a universal resource for jointless bridge details. There are several innovative solutions to these problems that were discussed during the presentations and throughout the meeting, notably burying or eliminating approach slabs, expanding design limitations, and creating various semi-integral abutment details. Slides from the state and consultant highlight presentations are in Appendix C.

The second poll was taken at the conclusion of the presentations, and it questioned the participants experiences on retrofitting existing structures to be jointless, the results of this poll are in Table 6.

Table 6: Poll 2 Results

Question 1: How often do you retrofit existing jointed bridges to be jointless?	
Answer	% of Votes
All the time, every chance we get	17%
Often, but not always	67%
Rarely	17%
Never, we don't retrofit our bridges to be jointless	0%
Question 2: Are you satisfied with the way your retrofitted jointless bridges have performed?	
Answer	% of Votes
Yes, very satisfied	39%
Generally satisfied	56%
Somewhat satisfied	6%
Not very satisfied	0%
We don't retrofit our bridges to be jointless	0%

In the first breakout session, the participants were asked questions regarding retrofitting their existing jointed bridges to be jointless. This retrofit is more costly in construction than rehabilitation of the existing structure, but there was consensus that the upfront costs are worth the additional service life, improved rideability and decreased maintenance that are associated with retrofitted jointless structures. A handful of bridge owners have standardized metrics that evaluate if a bridge should be retrofitted to jointless which are based on the bridge's age, condition and what needs to be replaced among other things. The most expensive part of the retrofit is typically the ultra-high-performance concrete (UHPC) that is used to create link slabs which are used to connect adjacent spans that used to be separated by a joint, but as its use becomes more common the cost of UHPC has been decreasing. While retrofitting is a common practice and considered a success, there are issues that arise when a jointed structure is converted to jointless. Concerns with jointless bridge retrofits include traffic control, designing link slabs, drainage, and educating engineers and contractors on the change in behavior of the bridge that the retrofit causes.

The third poll examined the participants policies and success with designing and constructing new jointless bridge structure: the third poll was taken before the second breakout session, which focused on this topic. Results of the poll are in Table 7.

Table 7: Poll 3 Results

Question 1: What is your policy on making new bridges jointless?	
Answer	% of Votes
We always consider jointless for our new bridges	78%
We do on a case-by-case basis	22%
We never consider jointless for our new bridges	0%
Question 2: How would you describe the performance of your new construction jointless bridges?	
Answer	% of Votes
Very good, we are quite happy with them	50%
Generally good, but there are areas for improvement	50%
It's been a mixed bag	0%
Not good, they haven't performed as well as expected	0%
We don't build jointless bridges	0%

During the second breakout session, construction of new jointless bridges, with both fully and semi-integral abutments, was discussed. The majority of DOTs prefer fully integral abutment bridges, and only use semi-integral abutments when the design movement of the bridge is too great to be accommodated with a fully integral abutment. Overall, there was agreement that both types of abutments are valuable and provide the owners with less maintenance and lower life cycle costs. The main issues associated with fully integral abutments include backwall cracking, construction sequencing problems leading to unintended movement, and shallow depth to bedrock. Challenges with semi-integral abutments include bearings moving out of place and drainage. The states and consultants use a variety of details for semi-integral abutments and overall reported having very limited issues with all of them. In designs of both fully and semi-integral abutment bridges where approach slabs are used, settlement was noted. Many of the participants said that they have worked to mitigate this settlement by using design details such as reinforced soil and buried approach slabs, or by eliminating the approach slab all together. The consensus of the roundtable meeting on jointless bridges was that the life cycle cost of these structures is lower than traditional bridges, there are a handful of common issues with both retrofitting and constructing new jointless bridges that would benefit from further study to resolve, and it would be valuable to have a resource of successful jointless bridge details for future use in design and construction.

Chapter 6: Summary

Jointless bridge structures provide a solution to failing bridge joints that lead to high maintenance costs and deterioration of the super and substructures. Jointless bridges can have either fully or semi-integral abutments, both of which have joints that are moved off the bridge. State Departments of Transportation use various methods for designing and constructing their new jointless bridges and for rehabilitating their conventional bridges to be jointless. Some commonalities exist across states in terms of standardized details, design limitations, and challenges faced with jointless bridges, but there is no consensus or standardized practice on how best to implement them.

The literature review of past surveys that have been conducted of state DOTs on their use of jointless bridges revealed that many responders had issues with thermal loads, cracking, poor approach performance and unpleasant rideability conditions. These concerns as well as design limitations, criteria used to determine if a jointless structure will be used and detailing specifics were key topics of conversation when interviews were conducted with representatives from nine different states. Through the interviews, common challenges and successes with both fully and semi-integral abutment bridges were identified though no clear best practice could be identified. The nine states interviewed along with four consulting firms, the Delaware Department of Transportation and the University of Delaware attended a virtual roundtable meeting to further discuss jointless bridges. The meeting explored the current state of practice, shared knowledge and experiences and discussed innovative design solutions for jointless bridges. Prevalent issues with both jointless bridge retrofit and new construction arose, but there was consensus that jointless bridges perform well overall, have lower life-cycle costs, and will continue to be leading choice for bridge designs in the future. Final recommendations based on this research as listed below.

1. Many states standardize various jointless bridge details, and it is recommended that Delaware utilize Appendix B to aide in creating their own standardized details. The Table 8 displays which States currently provide which jointless bridge details, all of which are provided in Appendix B.

Table 8: States with Standardized Jointless Bridge Details

Various Approach Slab Details	IL, MA, MN, MI, NH, PA, RI
Joint Details Specific to Integral & Semi-Integral Abutments	IL, MA, NH
Beams for Integral Abutments	IL, MA, PA
Bearings for Jointless Bridges	IL, NY, OH
Fully Integral Abutment Details	CO, IL, MA, MI, NH, NY, OH, OK, RI, PA, WI
Fully Integral Diaphragms	IL, IA, OH
Semi-Integral Abutment Details	CO, IL, MI, NH, NY, OH, RI, PA, WI
Semi-Integral Diaphragms	IL, NH, OH
Wingwalls, MSE Walls, Corner Details	IL. MA, OK, PA, WI
Foundation Details	CO, IL, IA, PA, RI
General Notes on Jointless Bridges	MA, OH, PA, WI
Miscellaneous Jointless Bridge Details	IL, IA, MA, PA

2. While specific details for jointless bridges that will perform best in Delaware cannot be determined based solely on the performed literature review, interviews and round table meeting, there are key details and innovations from other states that provide solutions to common problems that DelDOT should consider while implementing recommendation 1, and they are as follows:
    1. The “Viginia Abutment”, Virginia’s semi-integral abutment design
    2. Innovations in link slab use and design, such as New York’s design of link slabs using UHPC
    3. Various states’ designs to eliminate the use of approach slabs for jointless bridges, such as Pennsylvania and Maryland, or to bury approach slabs such as Massachusetts
    4. States with innovative design details for highly skewed (Tennessee), long span (Tennessee) and curved girder (Vermont) designs for jointless abutments

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APPENDIX A

PREVIOUS SURVEY QUESTIONNAIRES

APPENDIX C

QUESTIONNAIRE

JOINTLESS BRIDGE DESIGN AND CONSTRUCTION

Your response to the following questions will be used by the Federal Highway Administration to develop an agenda for a jointless bridge seminar in the fall of 1996. The seminar is being developed to assist in technology transfer activities and to provide information on successes and failures. Than you for taking the time to fill out this questionnaire, your answers will provide insight into the development of sound practices and design specifications for jointless bridges.

State Name: ________________

A. JOINTLESS BRIDGE SEMINAR

1. How many individuals do you plan to send to the upcoming seminar?

2. Do you think that a limited number of individuals from the consultant industry should be invited to attend the seminar? Yes _____ No _____

3. Would you be willing to share your States current practices/policies and etc. on jointless bridges at this seminar? Yes _____ No ______
   If "Yes" what would be the topic and how much time would it take?
   ____
   ____
   ____
   ____
   (i.e., Successes/Failures, Details that work or Don't Work)

B. GENERAL

1. In your state, how many Jointless Bridges are in service?
   Integral: _____ Semi-Integral: _____ None: _____

   If "None", what are your future plans on Jointless Bridge Construction?
   ____
   ____
   ____
   (If "None", there is no need to fill out the remainder of the questionnaire.)

2. Does your State design and construct Jointless Bridges with:
   Single Spans: _____ Multiple Spans: _____ or Both: _____

3. Number of Jointless Bridges based on superstructure type:

	Number	Max. Span	Max. Skew
Steel:	_______	_________	_________
Prestressed:	_______	_________	_________

4. How many Jointless Bridges do you plan to build between 1995-2000?
   0-5 _____ 6-20 _____ 21-50 _____ 50 or more _____

C. DESIGN AND DETAILS

1. Please attach to this survey, if not previously supplied, any standard details you may have that relates to Jointless Bridges (i.e., Bearing Details).

2. Do you have a design procedure for Jointless Bridges?
   Yes _____ No _____ If Yes, please send a typical design calculation.

3. How do you account for temperature (temperature gradient, thermal expansion and contraction in longitudinal and transverse directions), and creep in your designs?

D. FOUNDATION

1. What is the most common type of foundation used in your State for Jointless Bridges?
   Bearing Piles _____ Friction Piles _____ Spread Footing _____ Hinged Abutment _____
   Other_____,Describe____
   ____

2. What direction do you orient your piles?
   Weak Axis Parallel to the Centerline of Bearing _____
   Strong Axis Parallel to the Centerline of Bearing _____
   Other _____ Please Describe:____
   ____
   ____

3. Under what circumstance do you use spread footing as opposed to pile foundation?
   ____
   ____
   ____

E. ABUTMENT/BACKFILL

1. What measure have you taken to reduce passive earth pressures in Jointless Bridges?
____
____
____

2. Have you observed any cracking in abutments/wingwalls caused by bridge movement?
____
____

3. Please provide information on: A. Type of Backfill, B: Gradation, and C: Method and degree of Compaction.______________________________________
____
____
____

F. APPROACH SLAB

1. Please send us a copy of your connection details of an approach slab to a bridge, and approach pavement.

2. Describe any problems you may be having with your approach slabs and how you are dealing with them? ______________________________________
____
____
____

G. RETROFIT (JOINTED TO JOINTLESS)

1. How many Retrofit Projects do you plan to undertake during 1995-2000?
0-5 _____ 6- 20 _____ 21-50 _____

2. Please send us the design and construction details for a typical bridge.

3. Has the retrofitting reduced the maintenance problem of leaking expansion joints?
____
____
____

4. What modifications do you make in the foundation for retrofitting?

5. Approximately, how much does it cost to retrofit a typical joint? ________________________

2009 Survey Performed by University of Maryland

1. Does your state currently build integral abutment bridges?
2. What year did your state first build an integral abutment bridge?
3. What are your reasons for building integral abutment bridges?
4. What problems have you had with integral abutment bridges?

APPENDIX A TARGETED SURVEY QUESTIONNAIRES

Questions asked of DOT structural engineers

1. What are the limits for length and skew of IABs? How were these limits determined? And have these limits been met or exceeded?
2. Do you use approach slabs? If so, what is the detail of the slab and the connection to the abutment?
3. What typical pile type does your state use? And what is its yield strength?
4. What typical wingwall geometry does your state use? What are the advantages of this?
5. Does your state use a construction joint between the pile cap and the abutment?
6. Are there any bridges that have been instrumented and studied in your state? Is data still being collected and is it available? What conclusions were reached? Has your state made any modifications to IAB design details and usage limits based on this work?
7. Can we have a copy of a typical IAB design?

Questions asked of DOT geotechnical engineers

1. What are the design criteria for pile type? What criteria does your state use for orienting the piles? Does your state use predrilling, overdrilling, or backfill with weak materials for piles? How were these criteria determined?
2. What are the design criteria for backfill gradation and compaction? How were these determined?
3. What specifications does your state use for the backfill against the abutment for countering displacements? Does your state use MSE walls or flowable fill behind the abutment?
4. Has your state seen any evidence of ratcheting or passive pressures behind the abutment backwall?
5. Are there any bridges that have been instrumented and studied in your state? Is data still being collected and is it available? What conclusions were reached? Has your state made any modifications to IAB design details and usage limits based on this work?

Questions asked of DOT construction and maintenance personnel

1. What are the primary problems that your state has experienced with IABs? How expensive is it (unit cost) to replace/fix that/those particular problem(s)? How often does that/those particular problem(s) occur? How do these problems and expenses compare to those of conventional bridges?
2. Has your state seen differences in approach slab performance between conventional and integral abutment bridges?
3. Has your state seen any evidence of excessive pressures or cracking on the back wall of the abutments?
4. Has your state observed deck cracking near the abutment?

The six basic questions that were asked in the survey were as follows-

1. Do you face frequent problems with Bridge Approach Slabs in your state? If yes, how would you categorize the approach slab problem in your state?
2. What types of major failures do you see with the approach slabs? (A major failure is one which would require the replacement of the slab and or extensive mud jacking work to be performed).
3. What type of minor failures do you see with approach slabs? (A minor failure is one where the DOT maintenance personnel would be able to fix the problem).
4. Are you satisfied with the current design or are you planning to change it?
5. Do you always specify special backfill for all approach slabs? Or do you have certain minor routes where no special backfill is specified and that you see a greater number of approach slab failure problems under those conditions.
6. Any other thoughts on this problem that you would like to share.

APPENDIX B

STATE DEPARTMENT OF TRANSPORTATION JOINTLESS BRIDGE DETAILS

1. Approach Details

Illinois

Approach Slab Ledge Details

Massachusetts

Integral Abutment Approach Slab Bracket

Minnesota

Bridge Abutment Approach Treatment for Integral Abutments

Michigan

Integral and Semi Integral Abutment Empirical Approach Slab Details

Integral and Semi Integral Abutment Sleeper Slab Details

New Hampshire

Approach and Sleeper Slab Reinforcement

Sleeper Slab Detail for Compression Seal Expansion Joint

Sleeper Slab Detail for Closed Cell Expansion Joint

Sleeper Slab Bearing Strip Detail

Approach and Sleeper Slab Masonry

Approach and Sleeper Slab Reinforcement

Sleeper Slab Elevation

Pennsylvania

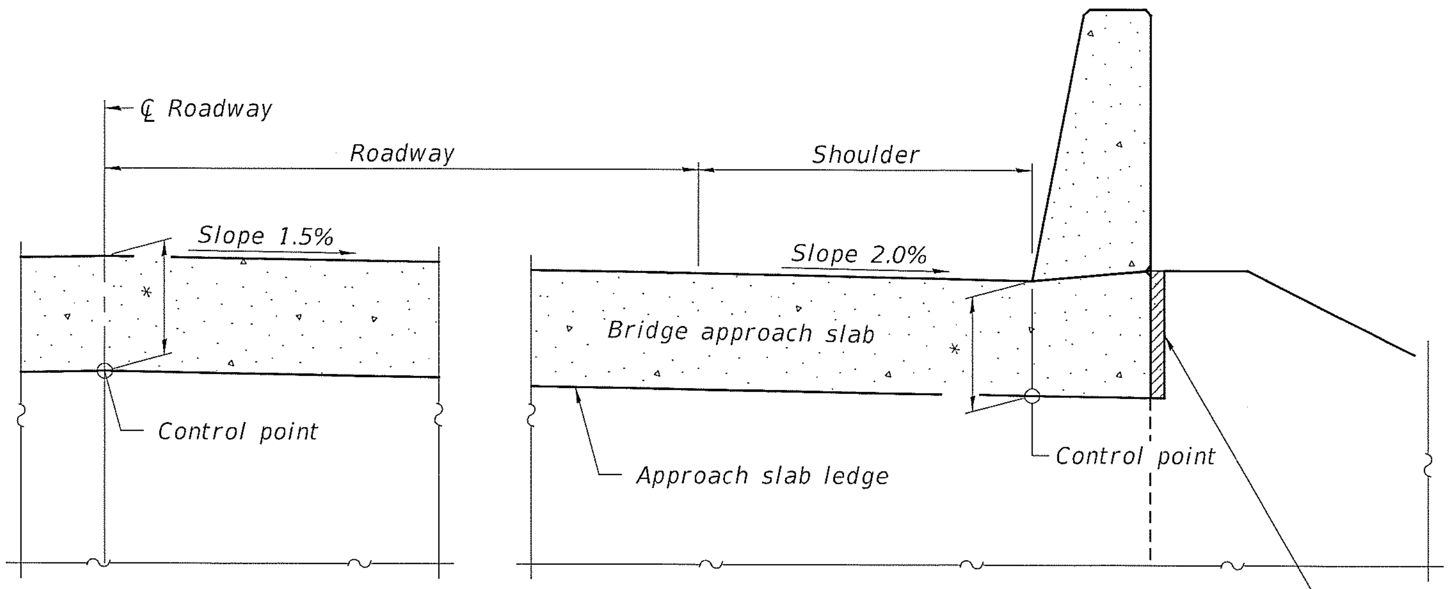
Integral Abutment Approach Slab Details

Rhode Island

Approach Slab Typical Section for Fully and Semi Integral Abutments

Figure 8

APPROACH SLAB LEDGE DETAILS



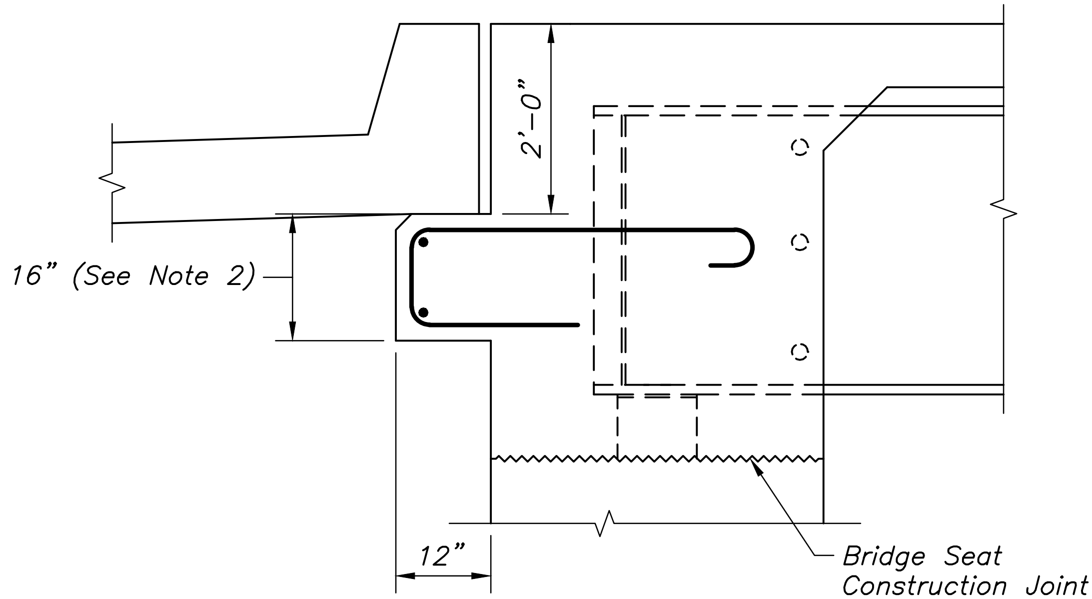
ELEVATION
(Looking at back of abutment)

Notes:

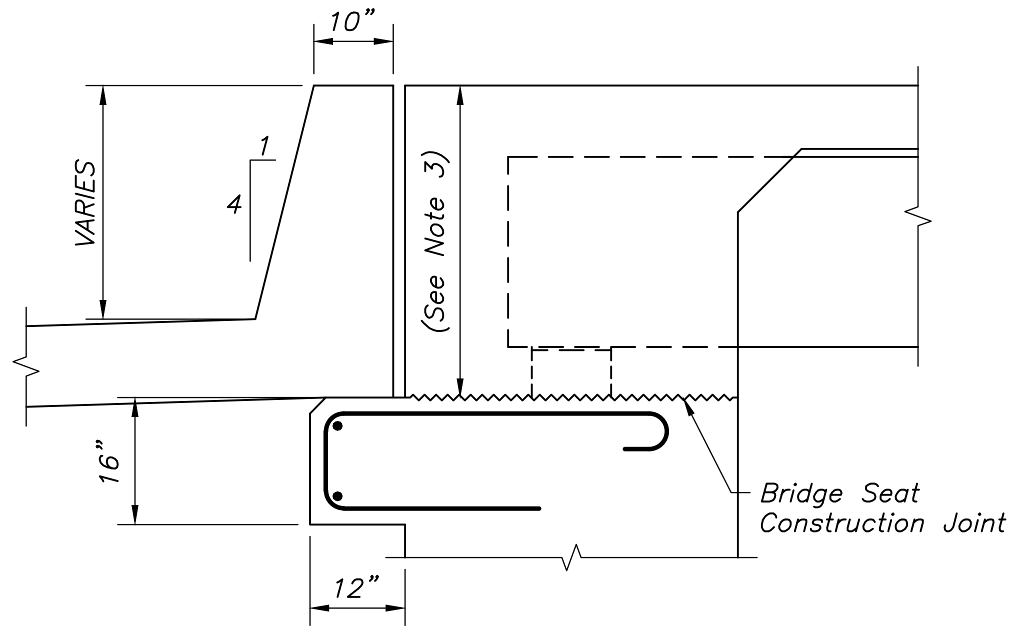
The approach slab ledge shall have a constant slope determined from the control points shown.

The precast bridge approach slabs are not allowed for slab bridges.

* 1'-3" for cast in place bridge approach slab and 1'-4½" for precast bridge approach slab.



APPROACH SLAB BRACKET ABOVE BRIDGE SEAT CONSTRUCTION JOINT

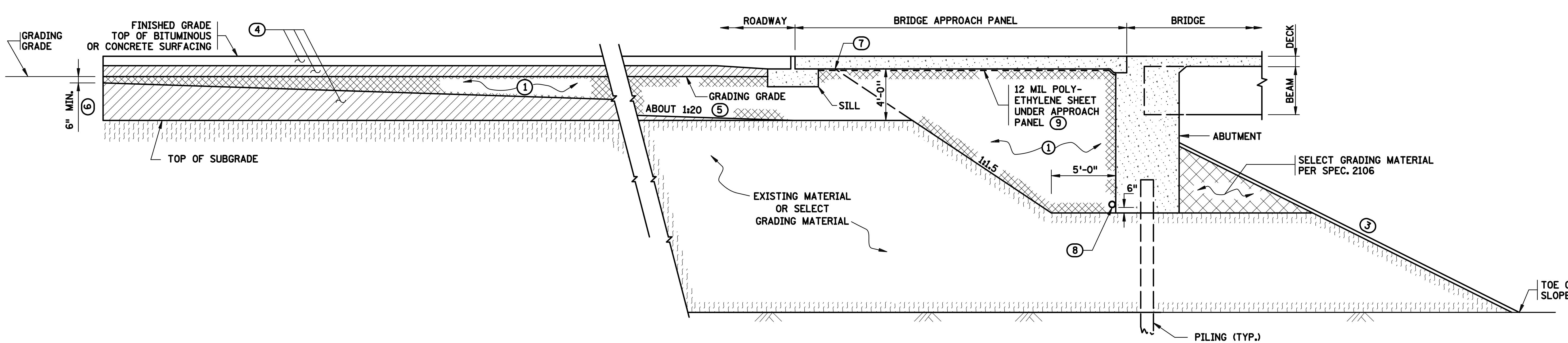


APPROACH SLAB BRACKET BELOW BRIDGE SEAT CONSTRUCTION JOINT

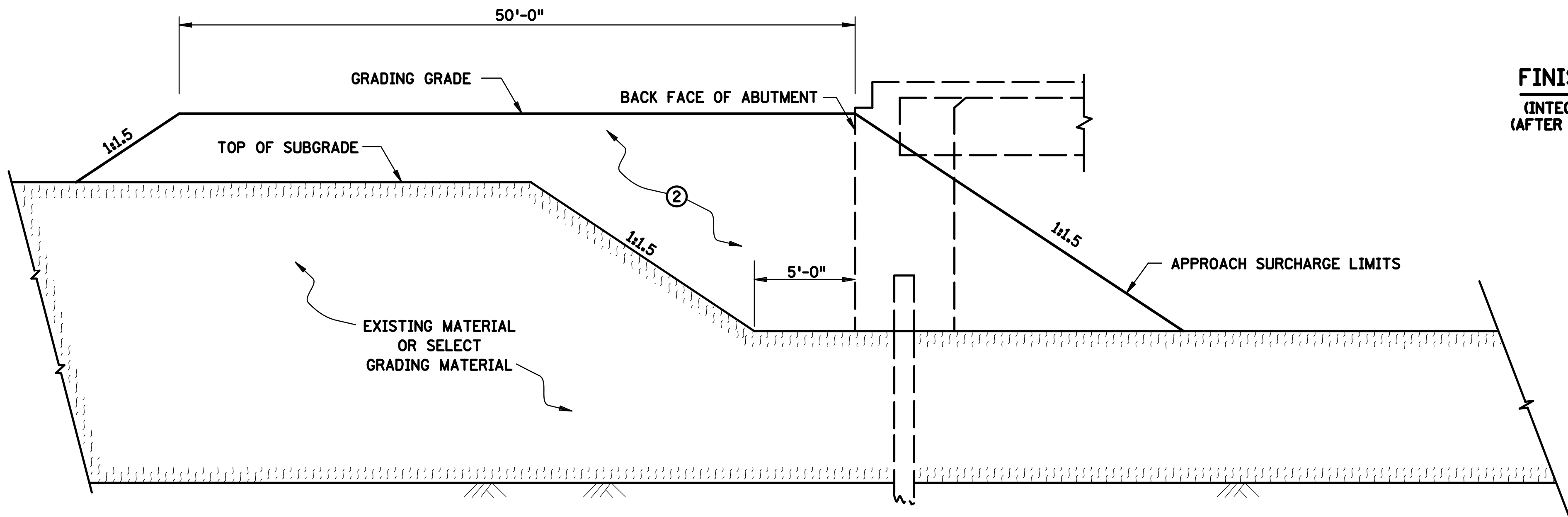
NOTES:

1. Modify Dwg. No's. 12.2.1 through 12.2.6 and 3.1.14 according to requirements of Dwg. No. 12.2.8.
2. Approach Slab Bracket shall be 16" deep. If bracket of this dimension will not fit above the bridge seat construction joint, relocate entire bracket below bridge seat construction joint and modify approach slab as shown in the detail below.
3. Minimum depth shall be 2'-0". Top of approach slab shall match top of abutment diaphragm.

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	APPROACH SLAB BRACKET INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.2.8**



ELEVATION
FINISHED GRADING SECTION
(INTEGRAL ABUTMENT ON PILING SHOWN)
(AFTER ABUTMENT HAS BEEN CONSTRUCTED)



ELEVATION
ROUGH GRADING SECTION
(PRIOR TO ABUTMENT CONSTRUCTION)

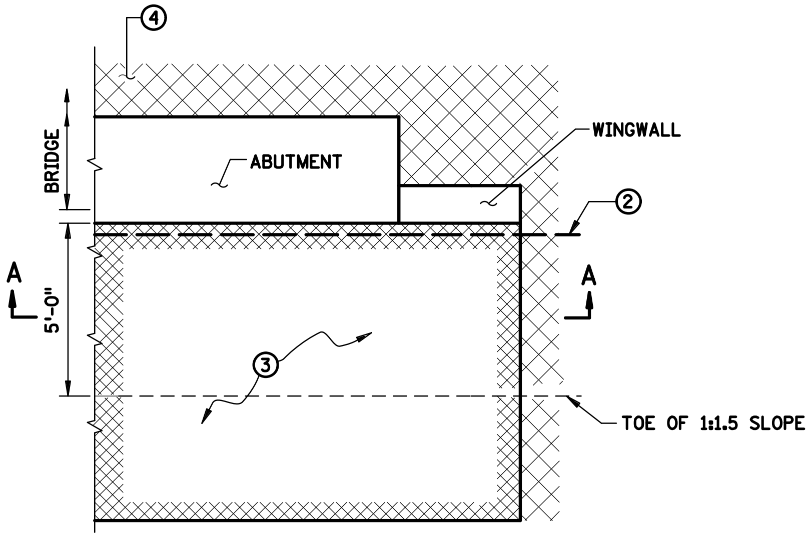
NOTES:

1. QUANTITY OF STRUCTURAL BACKFILL (SPEC. 3149.2.D.2) IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SEE PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES ARE CONSIDERED INCIDENTAL.
2. PLACE ABUTMENT APPROACH SURCHARGE MATERIAL PRIOR TO ABUTMENT CONSTRUCTION. AFTER COMPLETION OF SURCHARGE WAITING PERIOD, REMOVE SURCHARGE AND EXISTING MATERIAL OR SELECT 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.
3. SEE BRIDGE PLAN FOR SLOPE AND SLOPE PROTECTION.
4. SEE PLAN FOR TYPE OF MATERIAL.
5. START 1:20 TAPER AT END OF APPROACH PANEL. 1:20 VARIES WHEN APPROACH PANEL IS SKEWED.
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. SEE BRIDGE PLAN FOR STANDARD DETAIL B910 FOR DETAILS.
9. PLACE 12 MIL POLYETHYLENE SHEETING (OR TWO LAYERS OF 6 MIL) UNDER THE LIMITS OF THE APPROACH PANEL TO ALLOW THE PANEL TO MOVE LONGITUDINALLY ON THE GRADE. SHEETING IS INCIDENTAL.

REVISION:
APPROVED: AUGUST 22, 2019
GLENN ENGSTROM
DIRECTOR, OFFICE OF MATERIALS AND ROAD RESEARCH

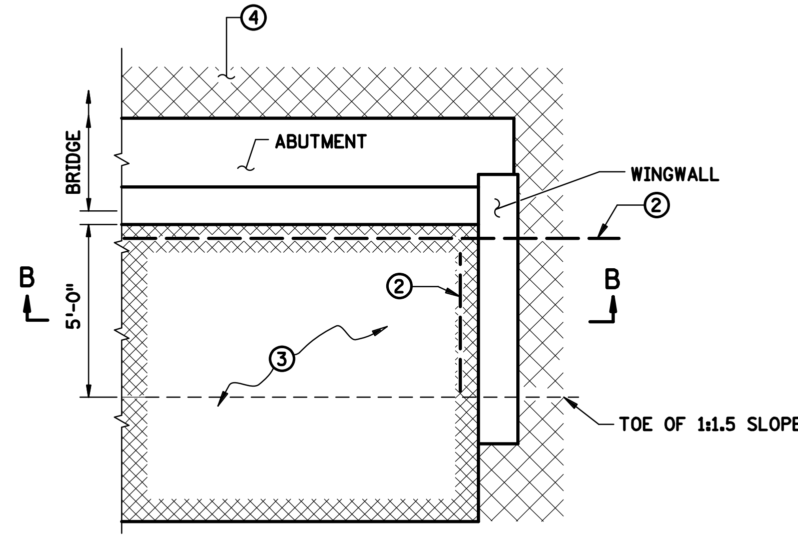
MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.234	1 OF 2	BRIDGE ABUTMENT APPROACH TREATMENT FOR INTEGRAL ABUTMENTS
Peter A Harff, STATE DESIGN ENGINEER	APPROVED: 08-22-2019 REVISED:	
STATE PROJ. NO.	(T.H.)	SHEET NO. OF SHEETS



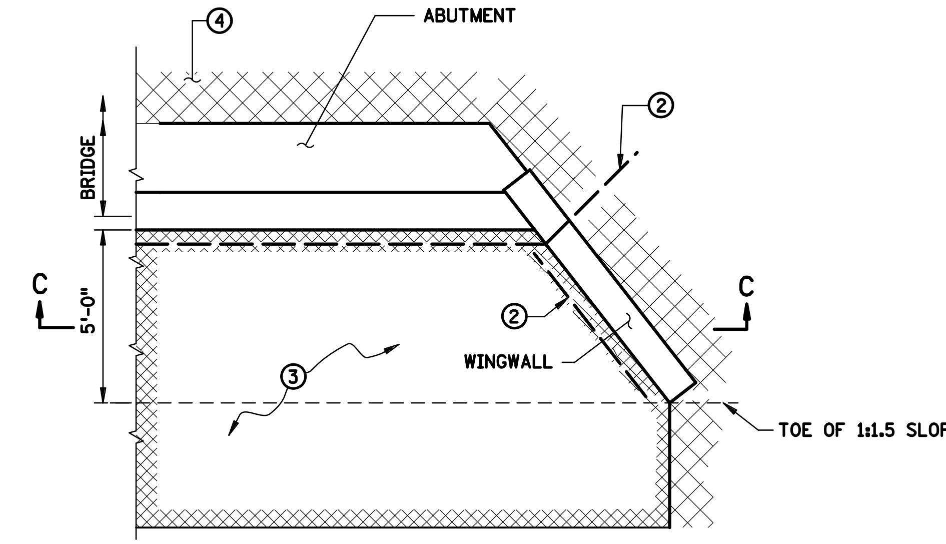
PARTIAL PLAN VIEW AT ABUTMENT

(WINGWALL AT 180°) (FINISHED GRADING)



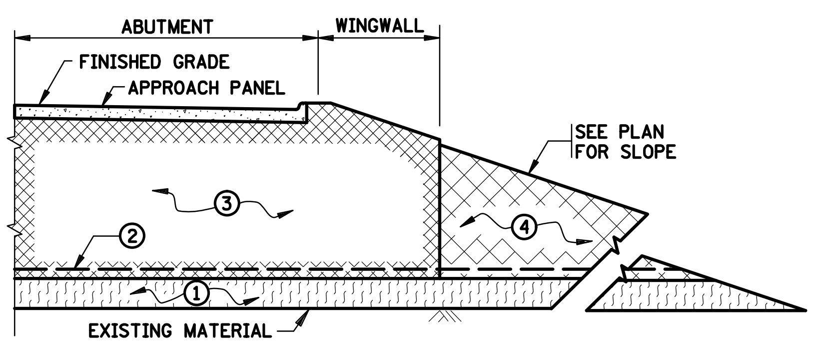
PARTIAL PLAN VIEW AT ABUTMENT

(WINGWALL AT 90°) (FINISHED GRADING)



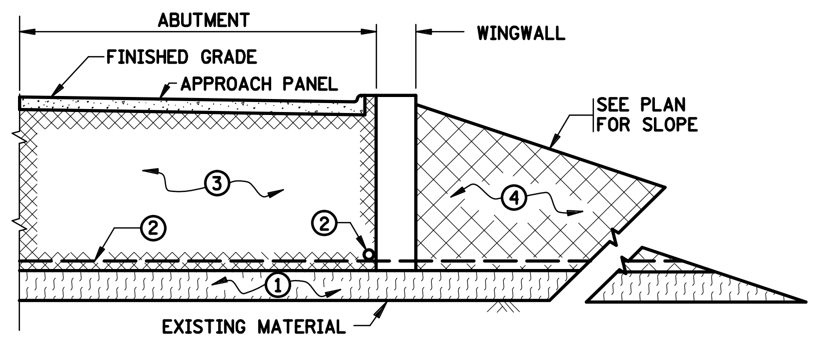
PARTIAL PLAN VIEW AT ABUTMENT

(WINGWALL AT ANY OTHER ANGLE) (FINISHED GRADING)



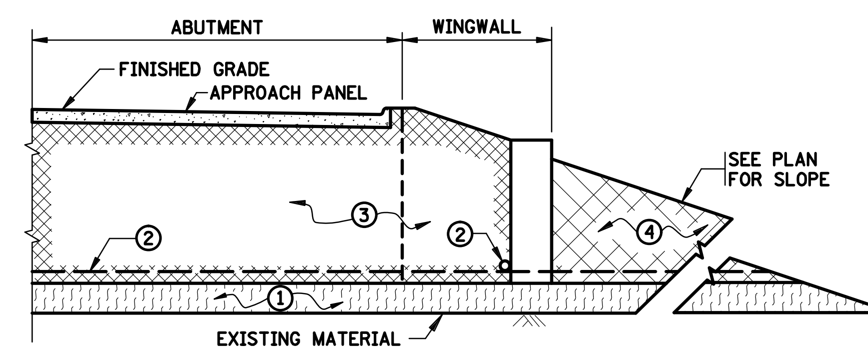
FINISHED GRADING SECTION A-A

(FILL SECTION)



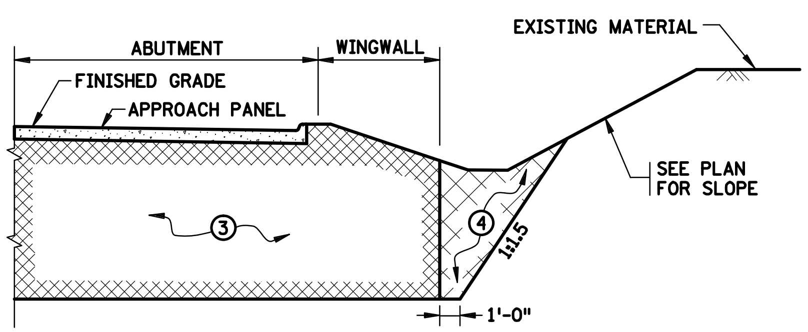
FINISHED GRADING SECTION B-B

(FILL SECTION)



FINISHED GRADING SECTION C-C

(FILL SECTION)



FINISHED GRADING SECTION A-A

(CUT SECTION)

(BRIDGE DETAIL B910 DRAIN NOT SHOWN)

NOTES:

① EXISTING MATERIAL OR SELECT GRADING MATERIAL (SPEC. 2106).

② SUBSURFACE PIPE DRAIN. SEE BRIDGE PLAN FOR STANDARD DETAIL B910 FOR DETAILS.

③ QUANTITY OF STRUCTURAL BACKFILL (SPEC. 3149.2.D.2) IS BASED ON DIMENSIONS SHOWN, AND PAYMENT IS BASED ON THIS QUANTITY. SEE PLAN FOR QUANTITY. IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS, ANY QUANTITY INCREASES ARE CONSIDERED INCIDENTAL.

④ SELECT GRADING MATERIAL (SPEC. 2106).

PLOTTED/REVISED: 27-AUG-2019

PLOT NAME: s234_2.spn

PATH & FILENAME: OTS\DesignStandards\Development\StandardPlansDEV\200_Series\s234_2.spn.dgn

REVISION:

APPROVED: AUGUST 22, 2019

GLENN ENGSTROM

DIRECTOR, OFFICE OF MATERIALS AND ROAD RESEARCH

MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.234 | 2 OF 2

APPROVED: 08-22-2019

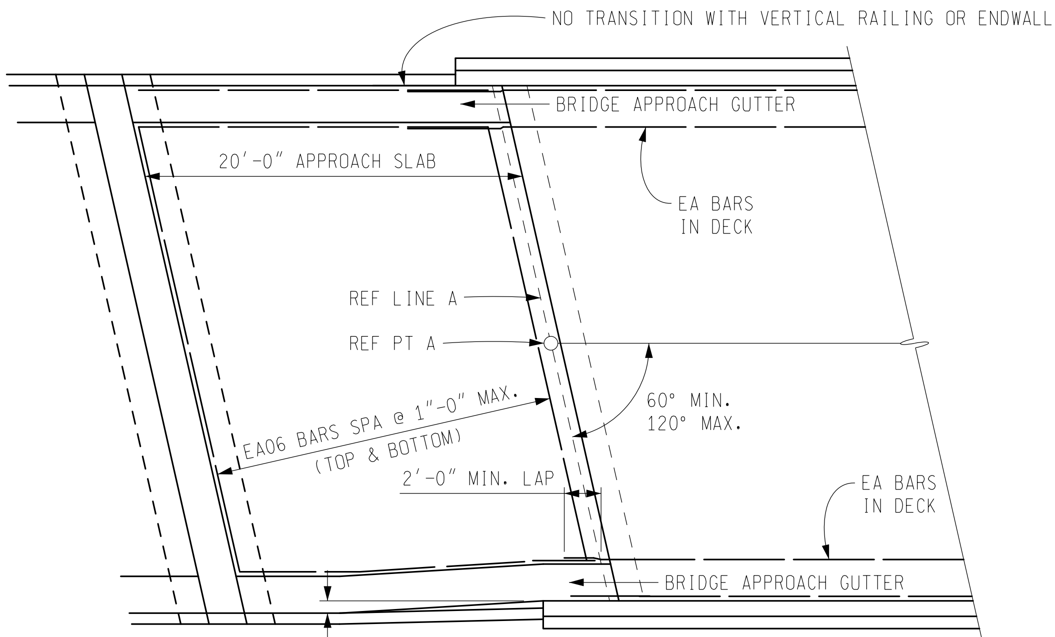
REVISED:

STATE DESIGN ENGINEER

STATE PROJ. NO. (T.H.) SHEET NO. OF SHEETS

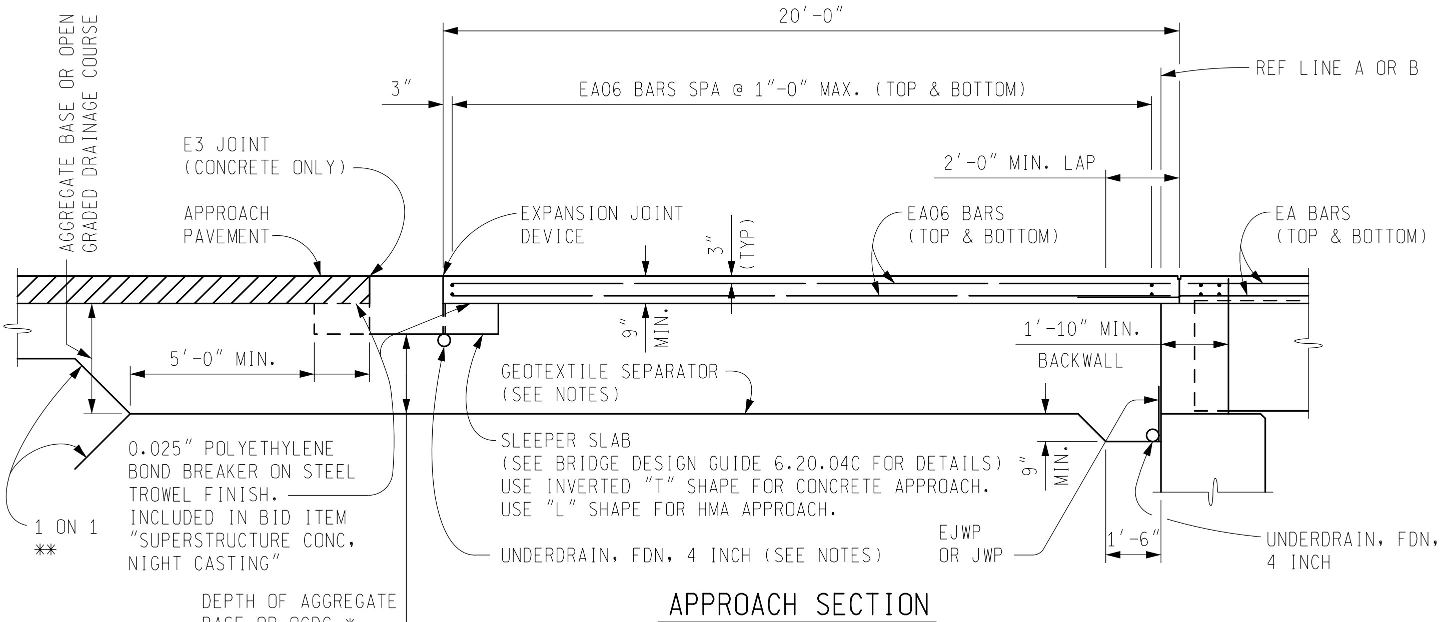
BRIDGE ABUTMENT APPROACH TREATMENT FOR INTEGRAL ABUTMENTS

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: BMW	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT INTEGRAL AND SEMI-INTEGRAL ABUTMENT EMPIRICAL APPROACH SLAB DETAILS	ISSUED: 10/22/18 SUPERSEDES: 10/19/15



* AGGREGATE BASE OR OGDC SHALL EXTEND FROM BOTTOM OF SLEEPER SLAB FOR A DEPTH OF 36" MAX., NOT TO EXTEND BELOW THE TOP OF ABUTMENT WALL EXCEPT WHEN NECESSARY TO PROVIDE A MINIMUM OF 12" BELOW SLEEPER SLAB.

PLAN OF APPROACH



APPROACH SECTION

SLAB THICKNESS WILL MATCH THE ROAD APPROACH PAVEMENT THICKNESS (9" MIN.)

NOTES:

ATTACH APPROACH CURB AND GUTTER TO THE APPROACH SLAB WITH BOTTOM MAT TRANSVERSE REINFORCEMENT AND TO THE BRIDGE DECK WITH BOTTOM MAT LONGITUDINAL REINFORCEMENT.

POUR APPROACH SLABS FROM EXPANSION LOCATION TOWARD REFERENCE LINE.

APPROACH SLABS SHOULD BE CAST AT NIGHT WITH NIGHT TIME CASTING OF SUPERSTRUCTURE CONCRETE.

AGGREGATE BASE IS TO BE COMPACTED TO 98%. ADD SPECIAL PROVISION FOR "AGGREGATE BASE DENSITY, BRIDGE APPROACH" TO THE PROJECT.

USE GEOTEXTILE SEPARATOR ONLY WITH OPEN GRADED DRAINAGE COURSE.

OMIT UNDERDRAIN UNDER SLEEPER SLAB IF OPEN GRADED DRAINAGE COURSE IS USED INSTEAD OF AGGREGATE BASE.

USE SLEEPER SLAB WITH ALL APPROACH SLABS INCLUDING HMA ROADWAY.

USE APPROACH SLAB DETAILS ON STANDARD PLAN R-45-SERIES WHEN THE LENGTH OF BRIDGE CONTRIBUTING TO EXPANSION AT AN ABUTMENT IS LESS THAN 50' FOR CONCRETE BEAM BRIDGES AND LESS THAN 25' FOR STEEL BEAM BRIDGES.

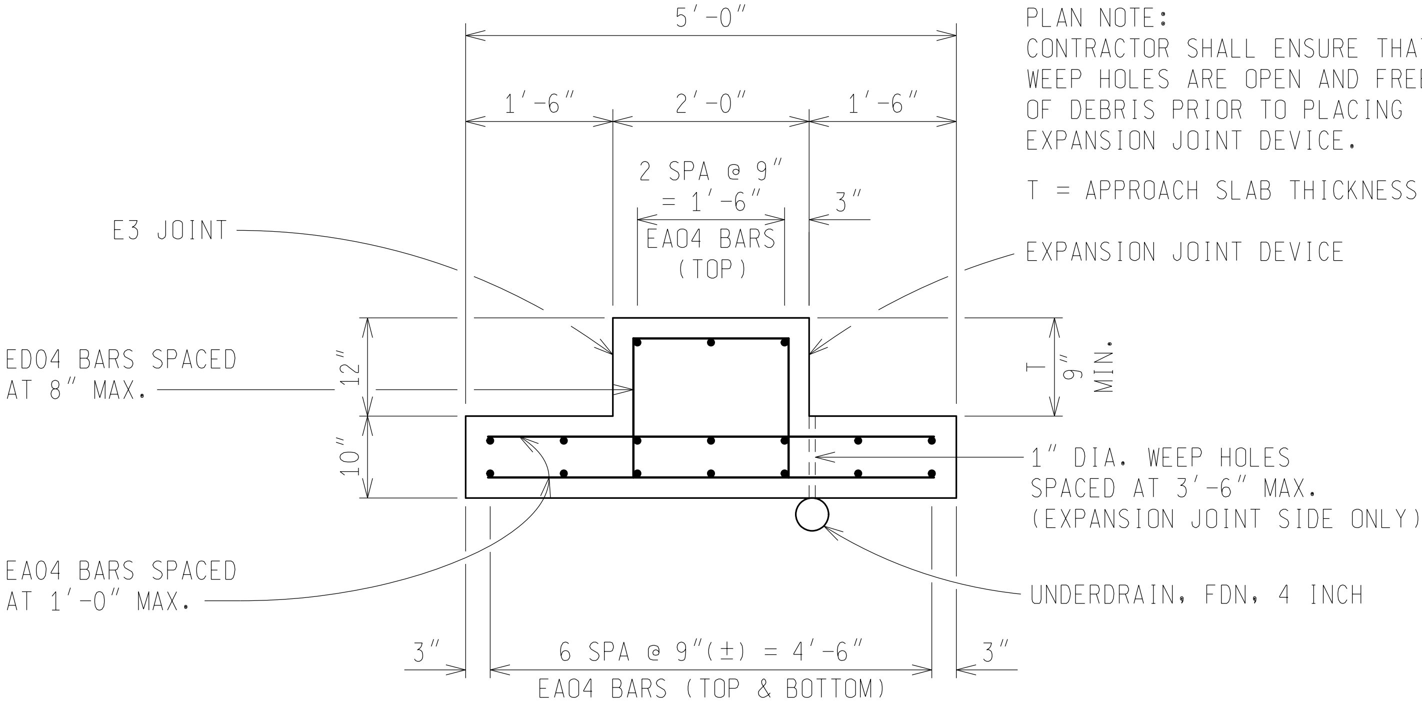
** SEE GUIDE 5.46.01 FOR TERMINATION LIMITS OF AGGREGATE BASE OR OPEN GRADED DRAINAGE COURSE.

PLAN NOTE:
DO NOT USE WHEELED, ROLLER BASED OR MACHINE MOUNTED COMPACTION EQUIPMENT TO COMPACT THE SUBGRADE, SUBBASE, AND BASE WITHIN 10' OF THE SLEEPER SLAB AFTER IT IS BUILT. USE ONLY HAND/PLATE COMPACTORS. CONTACT PRESSURE OF COMPACTION EQUIPMENT SHALL NOT EXCEED 10 PSI.

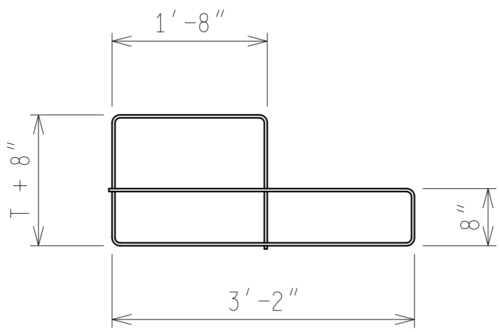
PREPARED BY DESIGN DIVISION	6.20.04B

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: DAJ	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAY DEVELOPMENT INTEGRAL AND SEMI-INTEGRAL ABUTMENT SLEEPER SLAB DETAILS	ISSUED: 02/18/14 SUPERSEDES: 11/28/11

PLAN NOTE:
CONTRACTOR SHALL ENSURE THAT WEEP HOLES ARE OPEN AND FREE OF DEBRIS PRIOR TO PLACING EXPANSION JOINT DEVICE.

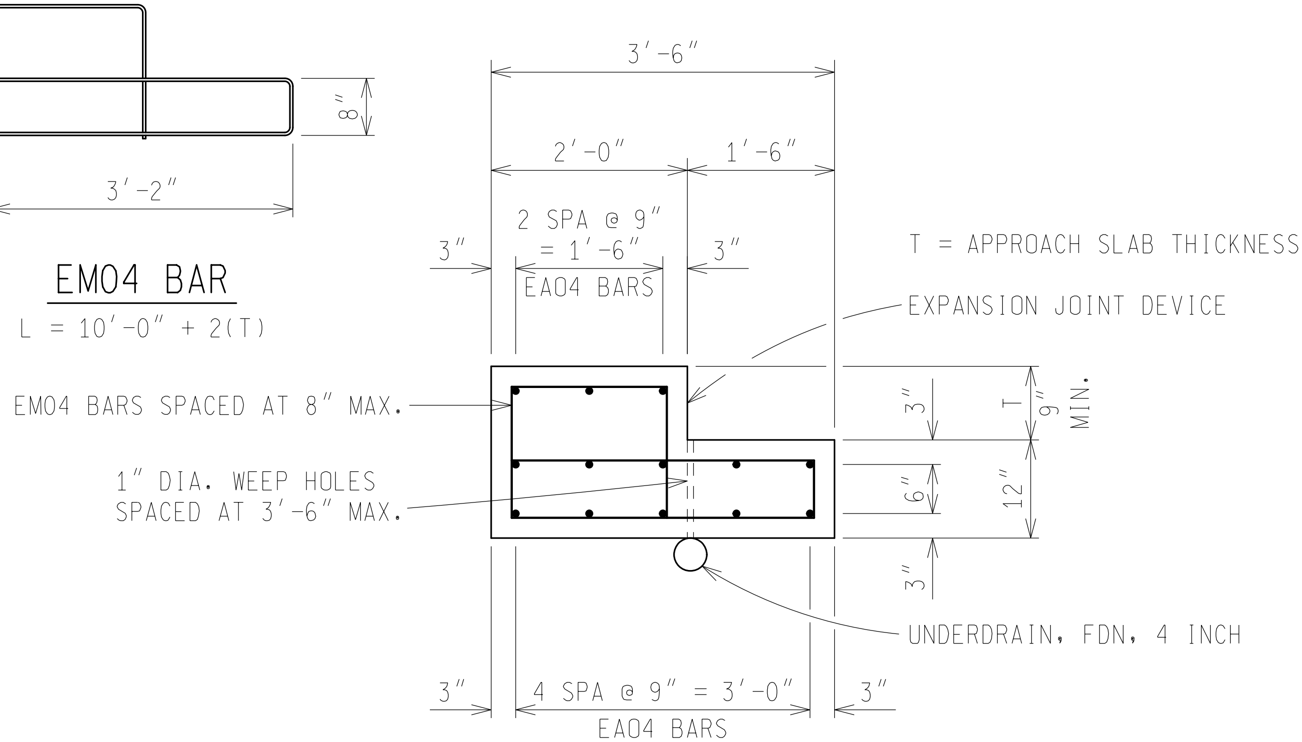


TYPICAL SECTION THRU SLEEPER SLAB WITH CONCRETE APPROACH



EM04 BAR

L = 10'-0" + 2(T)



TYPICAL SECTION THRU SLEEPER SLAB WITH HMA APPROACH

NOTES:
OMIT UNDERDRAIN UNDER SLEEPER SLAB IF OPEN GRADED DRAINAGE COURSE IS USED INSTEAD OF AGGREGATE BASE.

PREPARED BY DESIGN DIVISION	6.20.04C

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

BUREAU OF BRIDGE DESIGN

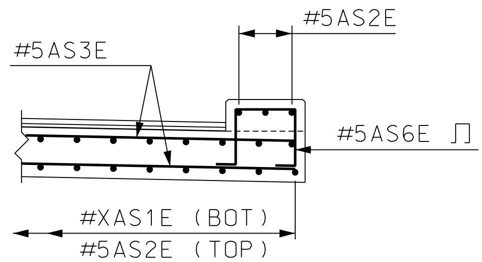
DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. APPR. & SLEEPER SLAB REINF. SECTION

DATE REVISED: 4/4/2018

APPROACH AND SLEEPER SLABS NOTES

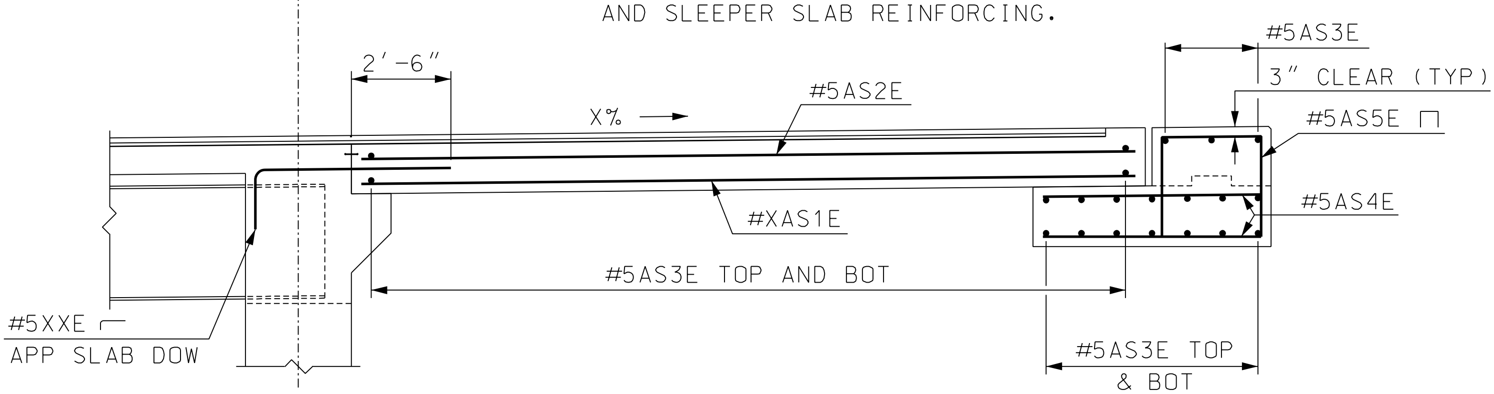
1. APPROACH SLABS SHALL BE POURED FULL WIDTH AFTER THE CONCRETE DECK HAS BEEN CONSTRUCTED.
2. CONCRETE FOR APPROACH SLABS AND SLEEPER SLABS SHALL BE PAID FOR UNDER ITEM 520.0302, CONCRETE CLASS AA, APPROACH SLABS (QC/QA) (F).
3. 3-1" Ø PVC DRAINS SHALL BE INSTALLED (AT THE LOW END ONLY, BOTH CURB LINES) IN A 1/2" DEPRESSION. SET PIPES TO DRAIN INTO THE UNDERDRAIN BELOW THE APPROACH SLAB.
4. UNDERDRAINS SHALL MEET THE REQUIREMENTS OF SECTION 605. UNDERDRAINS SHALL BE PERFORATED, PLACED ON A PREPARED SURFACE WITH THE PERFORATIONS FACING DOWN, AND ON A MINIMUM SLOPE OF 2%. UNDERDRAIN SHALL BE CONTINOUS ALONG THE FULL WIDTH OF THE SLEEPER SLAB. PIPE INVERTS SHALL EXTEND A MINIMUM OF 3" BEYOND THE TOP SURFACE OF THE STONE SLOPE. WITNESS MARKERS SHALL BE PLACED AT THE OUTLET OF EACH DRAIN PIPE.
5. ITEM 534.3, WATER REPELLENT (SILANE-SILOXANE), SHALL BE APPLIED TO THE EXPOSED CONCRETE ON THE TOP OF THE SLEEPER SLAB AND THE APPROACH SLAB ARMOR.

MODIFY TO FIT PROJECT



SECTION C-C

NOTE:
PROVIDE 3" MIN CLEAR COVER FOR BOTTOM APPROACH SLAB REINFORCING AND SLEEPER SLAB REINFORCING.



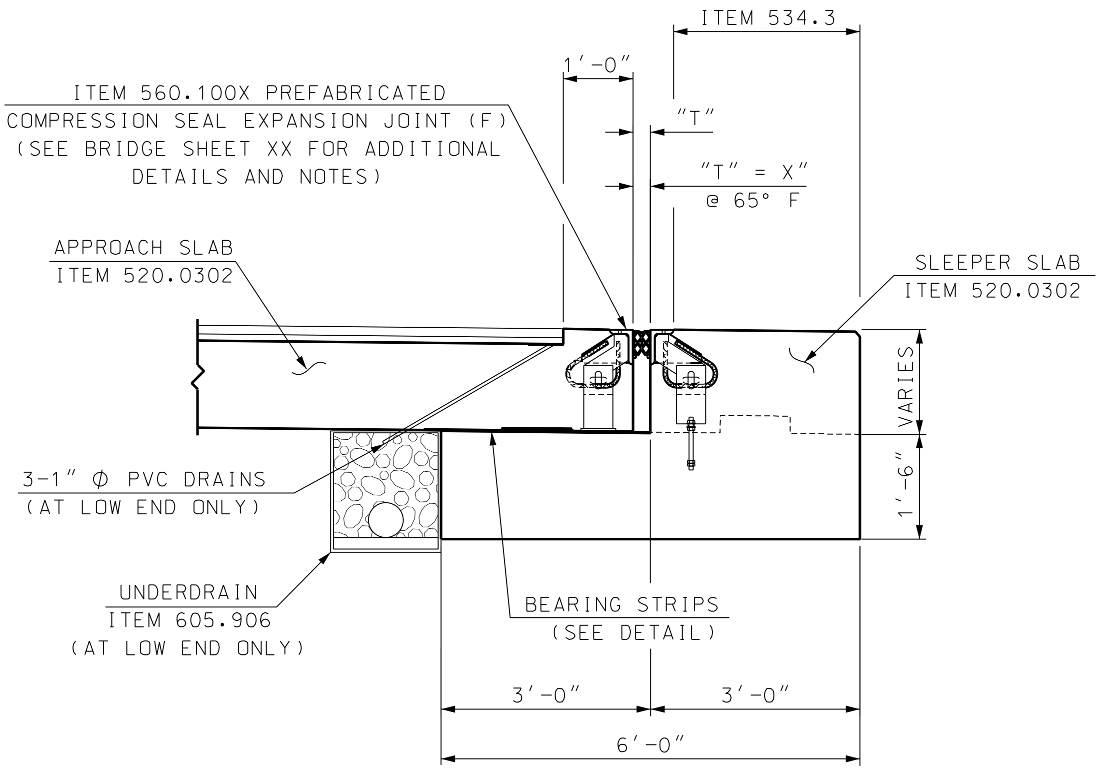
TYP APPROACH AND SLEEPER SLAB REINFORCEMENT

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB DETAIL COMPRESSION SEAL EXP. JT.	DATE REVISED: 4/4/2018



TEMP (°F)	"T" (INCH)
20	XX
35	XX
50	XX
65	XX
80	XX
95	XX

MODIFY TO FIT PROJECT

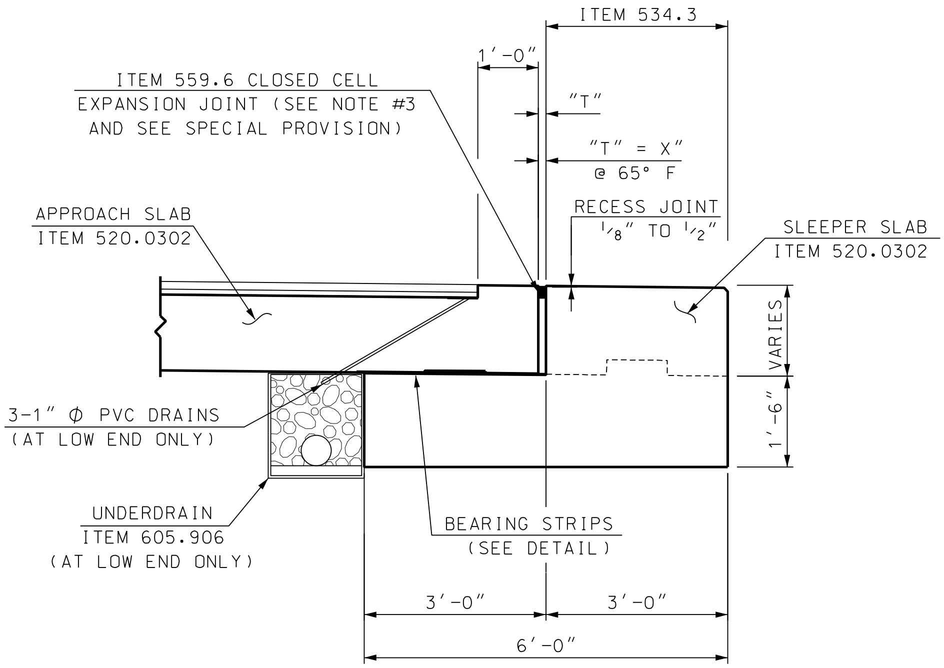
SLEEPER SLAB DETAIL FOR COMPRESSON SEAL EXPANSION JOINT (ITEM 560.100X)

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB DETAIL CLOSED CELL EXP. JT.	DATE REVISED: 4/4/2018



TEMP (°F)	"T" (INCH)
20	XX
35	XX
50	XX
65	XX
80	XX
95	XX

SLEEPER SLAB DETAIL FOR CLOSED CELL EXPANSION JOINT (ITEM 559.6)

MODIFY TO FIT PROJECT

SLEEPER SLAB CLOSED CELL EXPANSION JOINT NOTES

1. ITEM 559.6, PREFORMED CLOSED CELL EXPANSION JOINT SYSTEM (F), INCLUDES CLOSED CELL EXPANSION MATERIAL AND JOINT ADHESIVE AS NOTED IN THE SPECIAL PROVISION.
2. MINIMUM WIDTH "T" FOR INSTALLATION = XX" (APPROX. 65°F OR LESS).
3. THE CONTRACTOR SHALL USE CLOSED CELL *WABO EVAZOTE UV, EV X.XXXX BY WATSON BOWMAN ACME OR PLY-SEAL XE BEIGE #X.X BY POLYSET CO.* THE CLOSED CELL EXPANSION MATERIAL HAS BEEN DESIGNED TO STAY IN COMPRESSION. THIS DESIGN INCLUDES MOVEMENT DUE TO TEMPERATURE, SKEW, SHRINKAGE, AND MINIMUM INSTALLATION.
4. VALUES IN THE TEMPERATURE ADJUSTMENT TABLE ARE FOR ADJUSTING THE EXPANSION JOINT ASSEMBLY IMMEDIATELY PRIOR TO POURING THE CONCRETE BLOCKOUTS.
5. THE JOINT OPENING "T" MAY BE FORMED WITH OTHER CLOSED CELL EXPANSION MATERIAL NOTED ON THE QPL UNDER ITEM 559E. THE MATERIAL LISTED ON THE QPL IS DIFFERENT THAN ITEM 559.6. IF THE MATERIAL LISTED ON THE QPL IS USED FOR FORMING, THE MATERIAL CAN STAY IN THE JOINT HOWEVER, THE THICKNESS OF THE FORM MATERIAL MUST BE THE DIMENSION "T" OF THE JOINT OPENING FOR THE AMBIENT TEMPERATURE AT THE TIME OF THE CONCRETE POUR.
6. DO NOT USE EXTRUDED POLYSTRENE (XPS) RIGID FOAM NOTED ON THE QPL UNDER ITEM 520 M. FOR FORMING THE JOINT OPENING "T" UNLESS IT CAN BE COMPLETELY REMOVED FROM THE JOINT OPENING. THIS MATERIAL DOES NOT COMPRESS AND EXPAND.

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

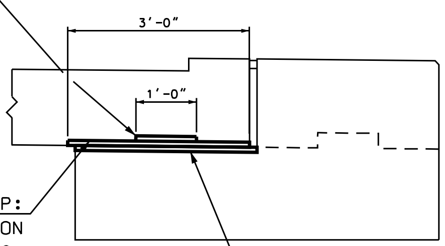
BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB BEARING STRIP DETAIL

DATE REVISED: 8/27/2019

APPROACH SLAB STRIP:
BOND RUBBER BACKED SIDE OF A 1′-0″ WIDE STRIP TO TOP OF THE APPROACH SLAB STRIP FOR THE FULL LENGTH OF THE APPROACH SLAB STRIP.

BEARING STRIPS
(RUBBER BACKED UHMW-PE, 1/4″ THICK MIN. 3/8″ MAX.) (SEE QUALIFIED PRODUCTS LIST, SECTION 520 FOR MATERIALS & BONDING AGENT) (ALL COSTS SUBSIDIARY TO ITEM 520.0302)



APPROACH SLAB STRIP:
EMBED 3′-0″ WIDE SECTION (RUBBER SIDE UP) INTO APPROACH SLAB FOR THE ENTIRE WIDTH.

SLEEPER SLAB STRIP:
GRIND TOP OF SLEEPER SLAB TO A SMOOTH FLAT SURFACE AND BOND RUBBER BACKED SIDE OF 3′-0″ WIDE SECTION TO TOP OF SLEEPER SLAB FOR THE ENTIRE LENGTH.

SLEEPER SLAB BEARING STRIP DETAIL

NOT TO SCALE

MODIFY TO FIT PROJECT

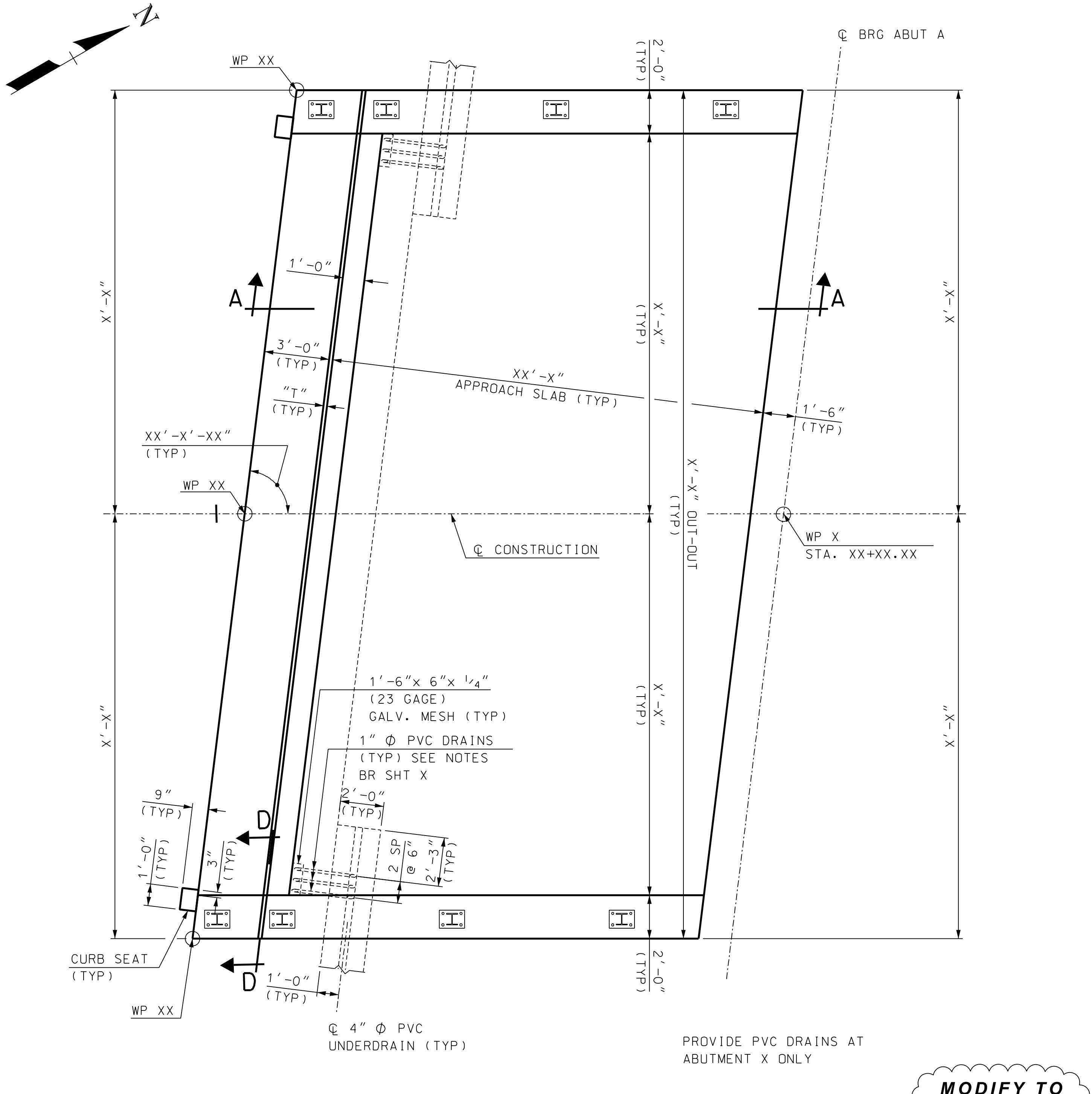
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. APPROACH AND SLEEPER SLAB PLAN

DATE REVISED: 4/4/2018



APPROACH AND SLEEPER SLAB MASONRY

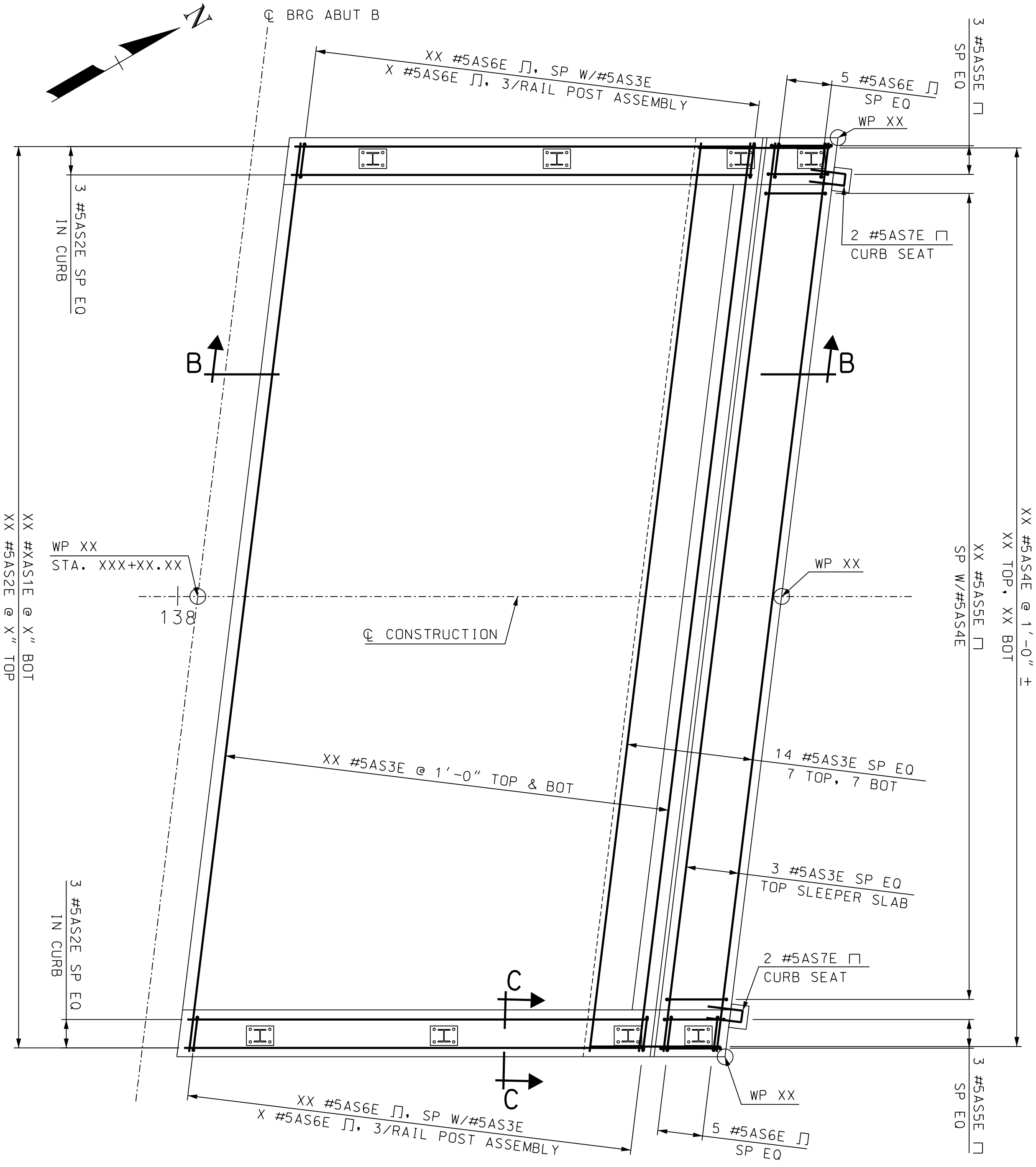
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. APPROACH AND SLEEPER SLAB PLAN

DATE REVISED: 4/4/2018



AS = REBAR DESIGNATION FOR ABUT A & B APPROACH SLAB AND SLEEPER SLAB

MODIFY TO FIT PROJECT

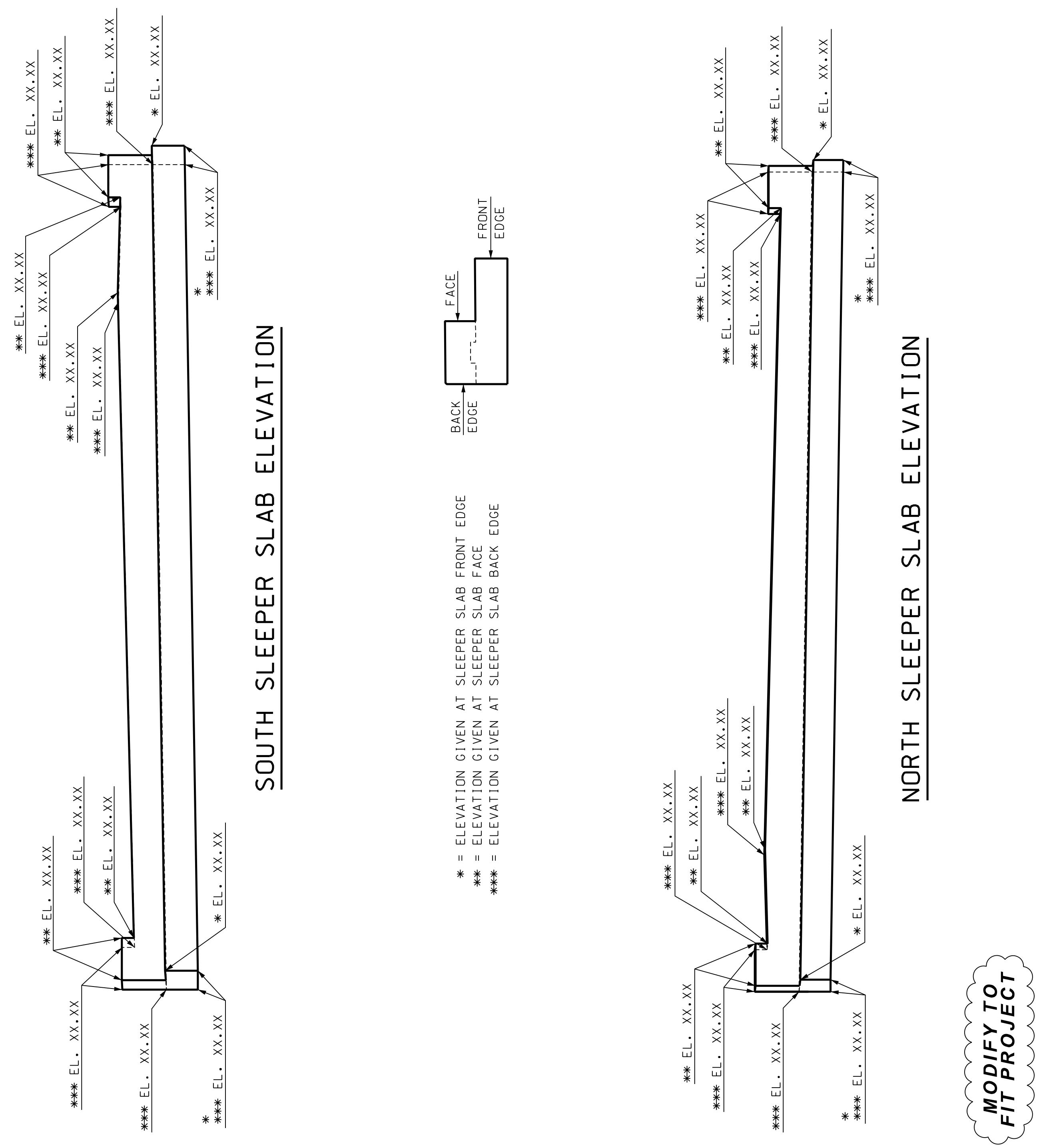
APPROACH AND SLEEPER SLAB REINFORCEMENT

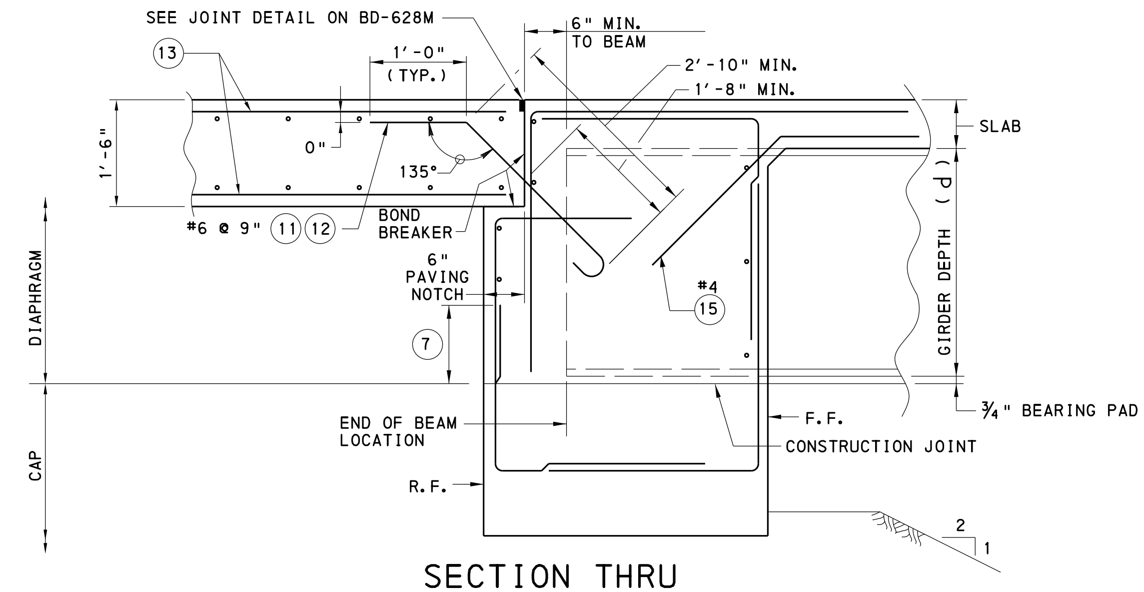
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

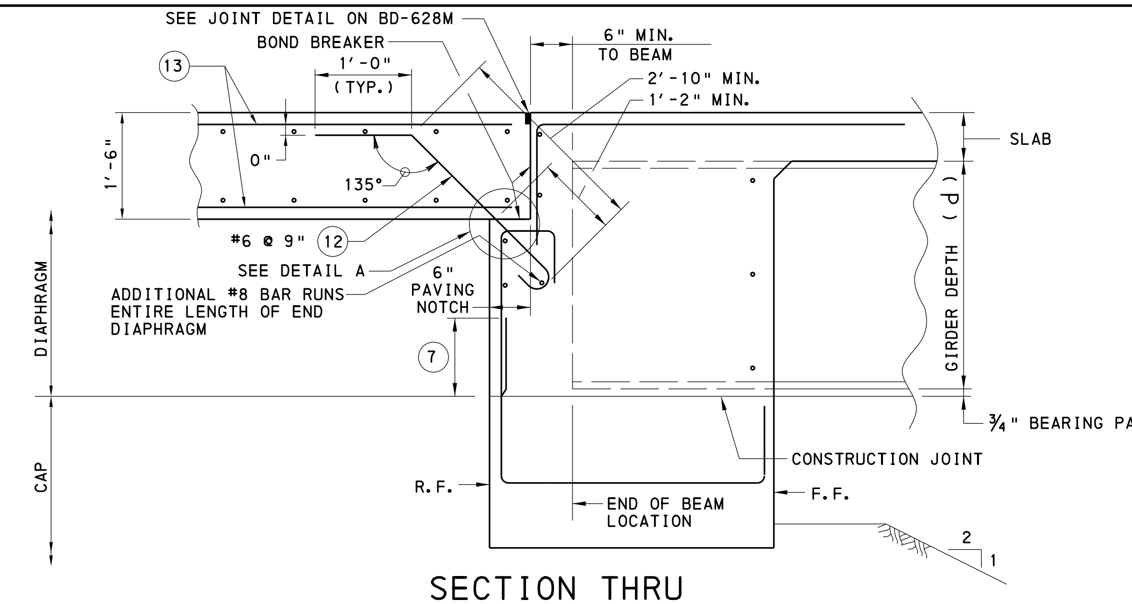
BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB ELEVATION	DATE REVISED: 4/4/2018



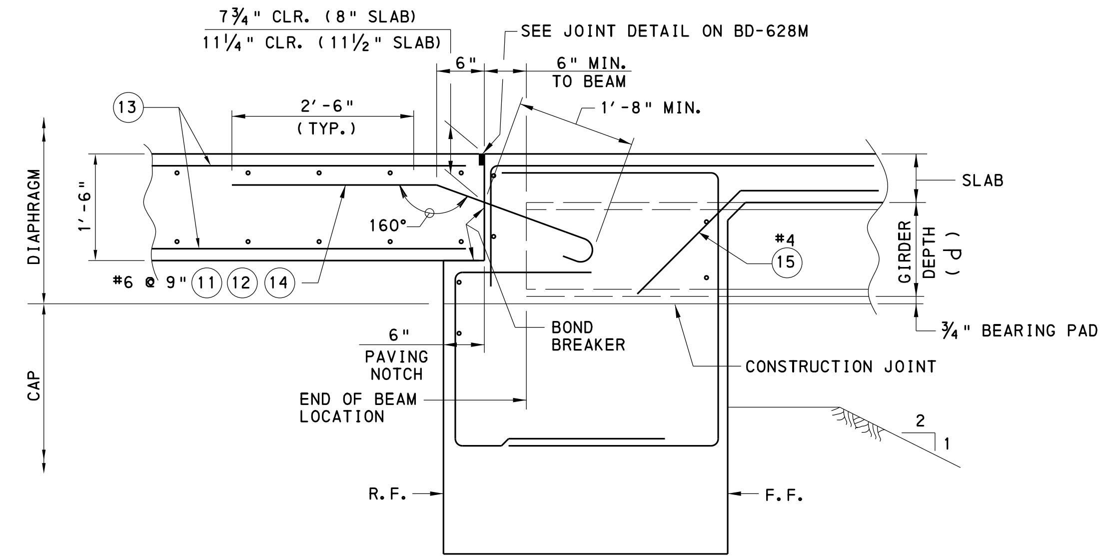


SECTION THRU
END DIAPHRAGM BETWEEN BEAMS
GIRDER DEPTH ≥ 2'-0"

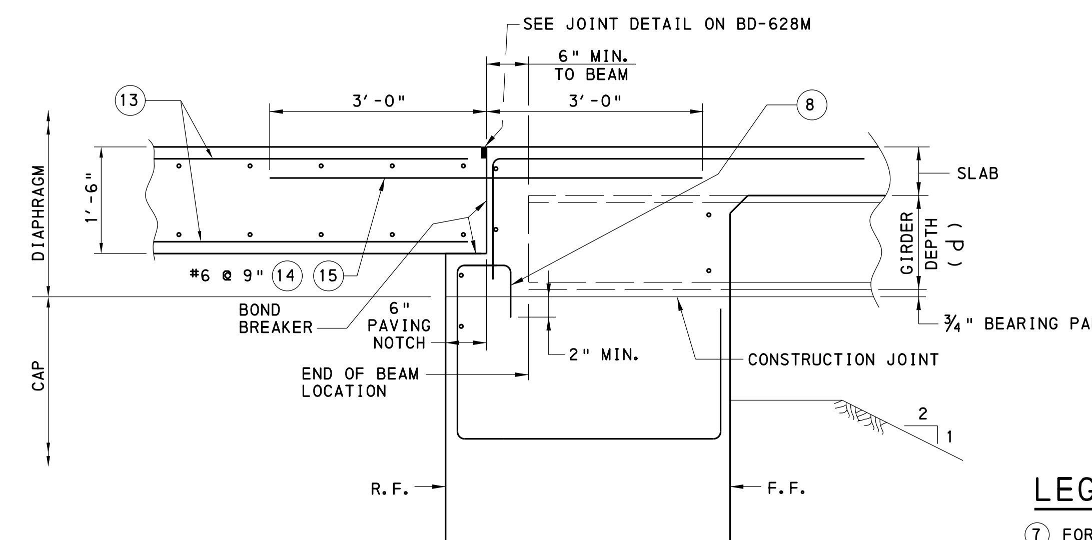


SECTION THRU
END DIAPHRAGM AT BEAMS
GIRDER DEPTH ≥ 2'-0"

NOTE: DECK AND CAP REINFORCEMENT NOT SHOWN FOR CLARITY.



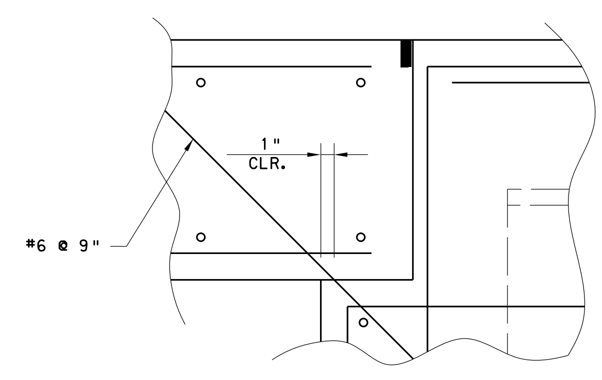
SECTION THRU
END DIAPHRAGM BETWEEN BEAMS
GIRDER DEPTH < 2'-0"



SECTION THRU
END DIAPHRAGM AT BEAMS
GIRDER DEPTH < 2'-0"

LEGEND:

7. FOR GIRDERS TOO SHALLOW TO PERMIT A 2'-1" OVERLAP, THE SPLICE IS NOT PERMITTED. ELIMINATING THE SPLICE IS OPTIONAL IN ALL OTHER CASES.
8. IF BAR EXTENDS INTO CAP EXTEND BAR TO PROVIDE 2" MIN. EMBEDMENT.
11. DETAIL SPACING TO CLEAR GIRDERS.
12. FOR 180° HOOK DIMENSIONS, REFER TO BC-736M.
13. FOR DIMENSIONS AND REINFORCEMENT OF APPROACH SLAB, SEE STANDARD DRAWING BD-628M.
14. THE HORIZONTAL LEG OF THE BAR IS TO BE LOCATED AT THE SAME PLANE AS THE LONGITUDINAL DECK REINFORCEMENT IN THE BOTTOM MAT OF THE DECK.
15. SPACED WITH LONGITUDINAL DECK REINFORCEMENT



DETAIL A

MINIMUM APPROACH SLAB LENGTH TABLE

GIRDER DEPTH (d)	SKEW=90°	60° ≤ SKEW < 90°	45° ≤ SKEW < 90°
17" ≤ d ≤ 24"	12'-0"	14'-0"	18'-0"
24" < d ≤ 36"	14'-0"	16'-0"	20'-0"
36" < d ≤ 48"	15'-0"	18'-0"	22'-0"
48" < d ≤ 60"	17'-0"	20'-0"	24'-0"
60" < d ≤ 72"	18'-0"	22'-0"	25'-0"
72" < d* ≤ 84"	20'-0"	24'-0"	---
84" < d* ≤ 96"	22'-0"	25'-0"	---

NOTES FOR USE OF TABLE:

1. THE 25'-0" APPROACH SLAB LENGTH SHOWN ON BD-628M, SHEET 35 OF 35 (TYPE 5), MAY BE REDUCED TO THE VALUE INDICATED ABOVE WHEN SITE CONDITIONS EXIST THAT RESTRICT THE USE OF THE 25'-0" APPROACH SLAB LENGTH OR WHEN DIRECTED BY THE DISTRICT BRIGE ENGINEER.
2. DO NOT CHANGE THE APPROACH SLAB REINFORCEMENT SPECIFIED ON BD-628M IF THE APPROACH SLAB LENGTH IS REDUCED.

* - CHIEF BRIDGE ENGINEER APPROVAL IS REQUIRED FOR BEAM DEPTHS GREATER THAN 6'-0"

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

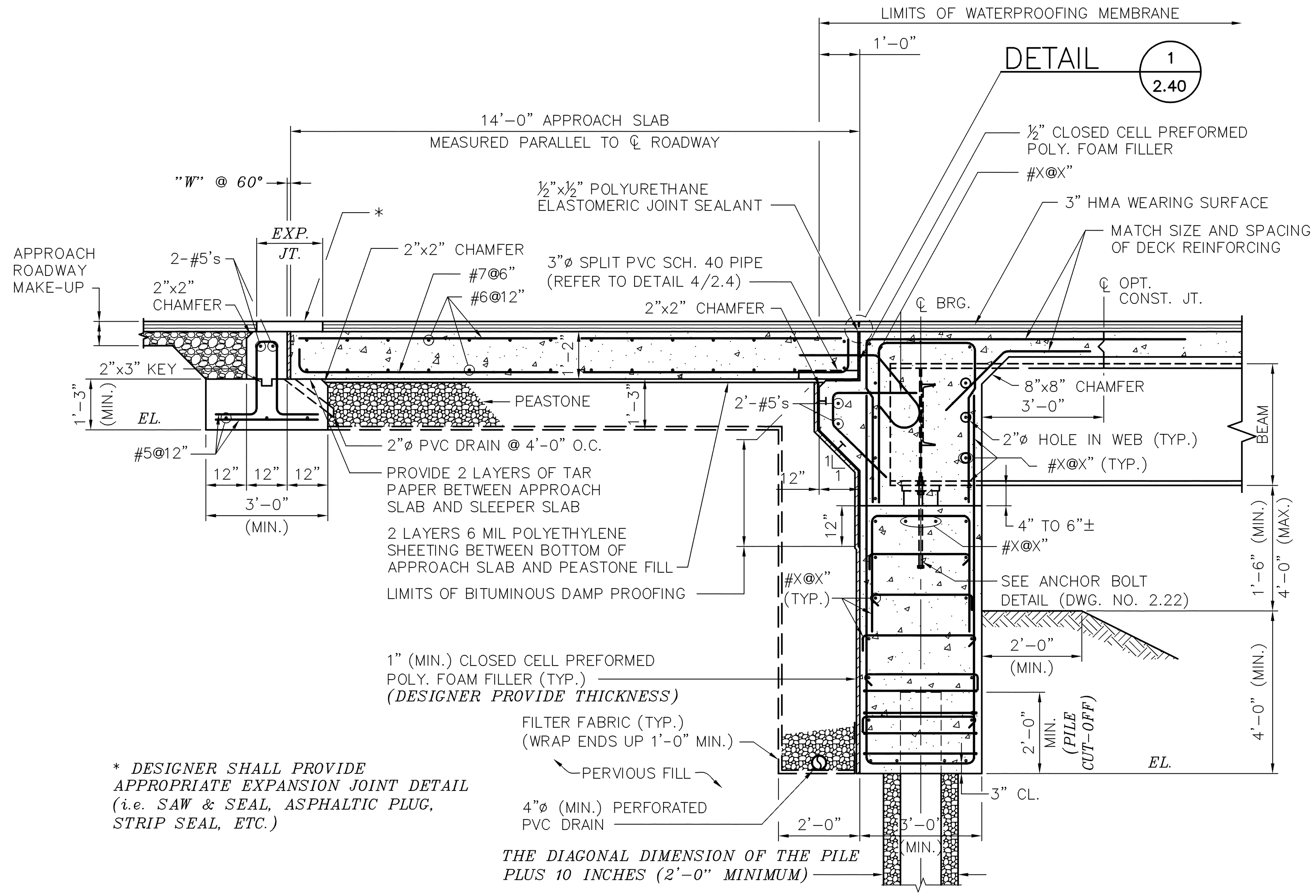
STANDARD
INTEGRAL ABUTMENT
APPROACH SLAB DETAILS

RECOMMENDED APR. 29, 2016
Thomas P. Macioce
CHIEF BRIDGE ENGINEER

RECOMMENDED APR. 29, 2016
Brian G. Thompson
DIRECTOR, BUR. OF PROJECT DELIVERY

SHEET 7 OF 9

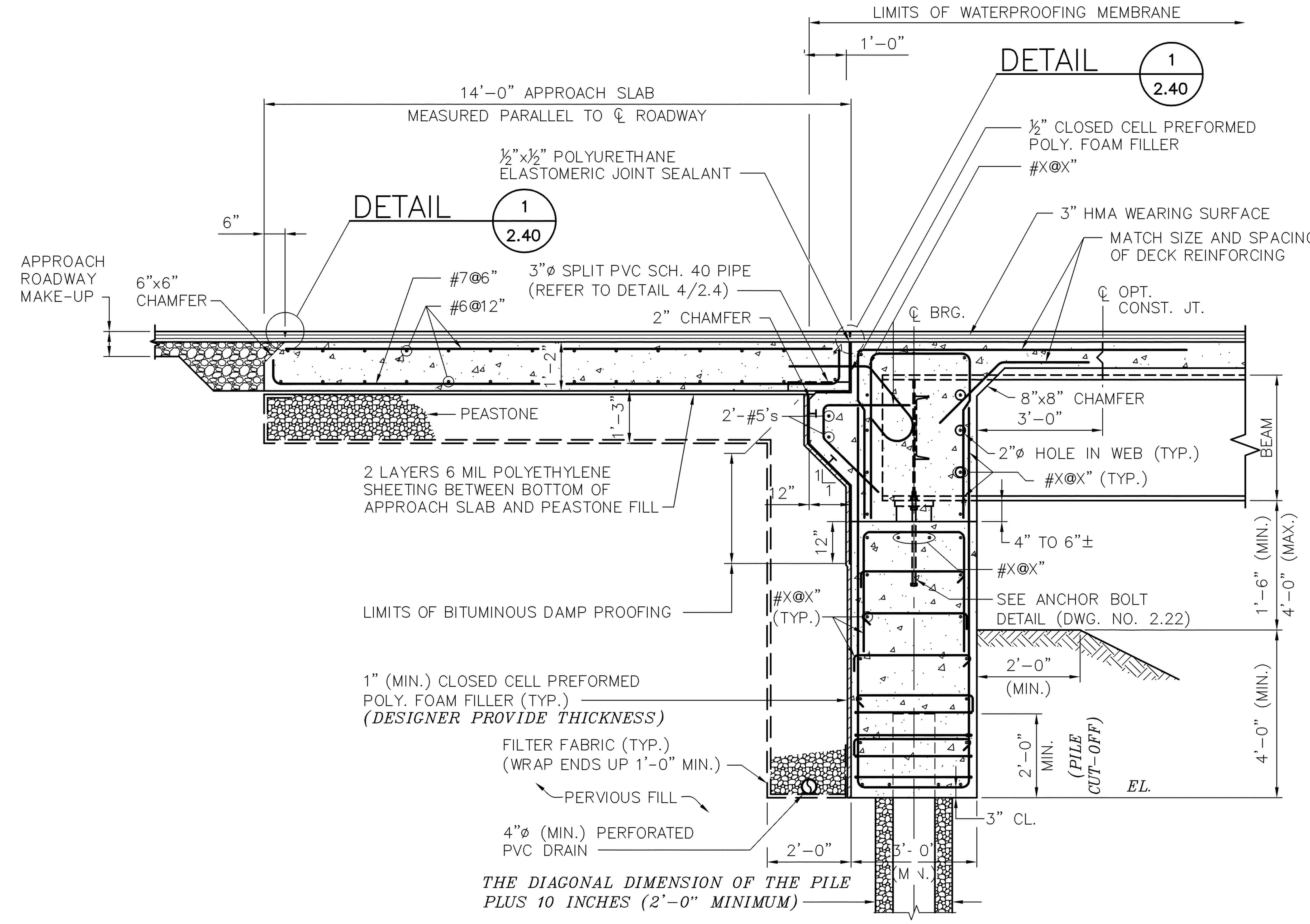
BD-667M



SPANS > 60'-0"

SECTION A 2.21

SCALE:1/2"=1'-0"



SPANS ≤ 60'-0"

SECTION A 2.21

SCALE:1/2"=1'-0"

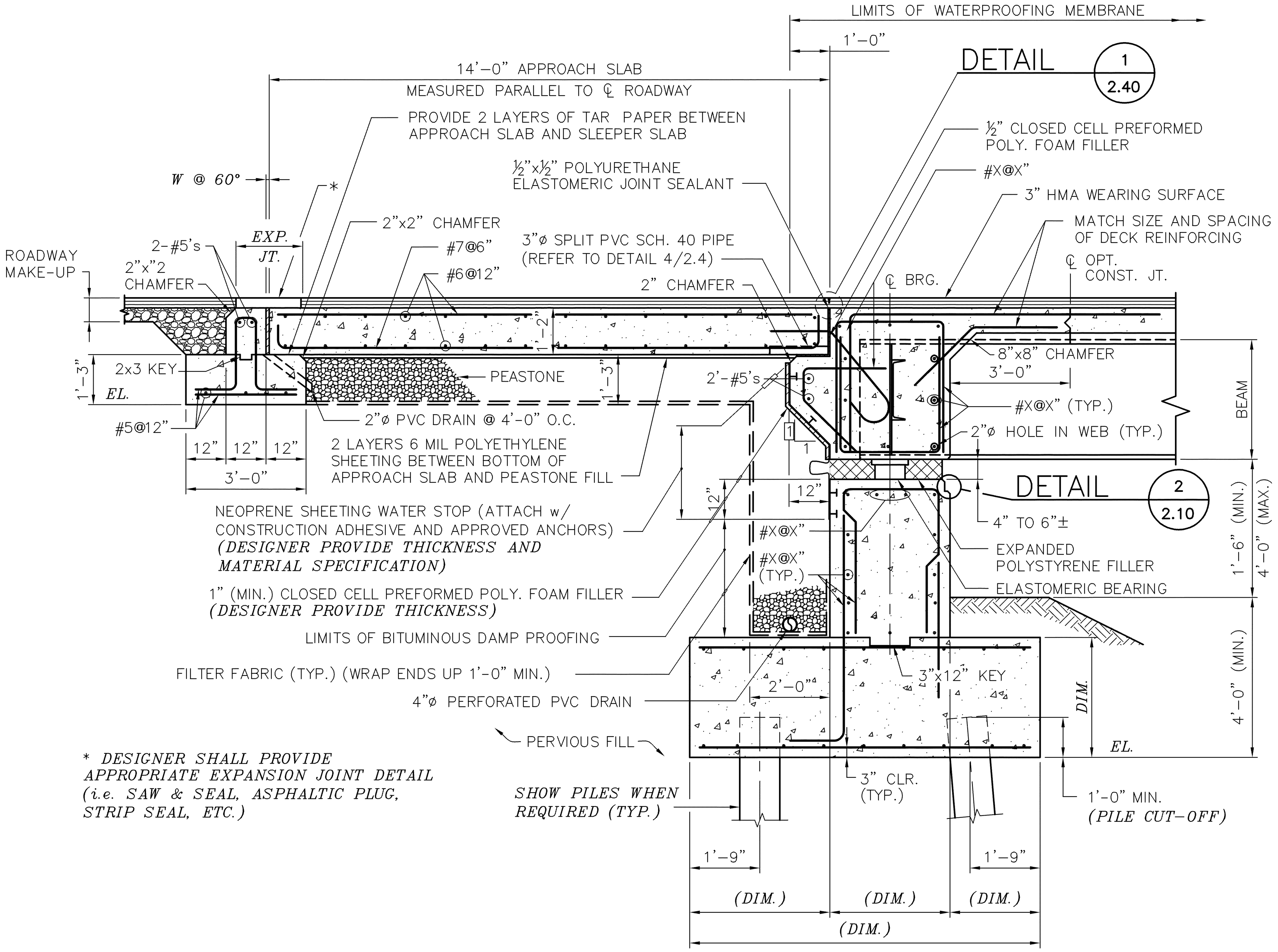
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

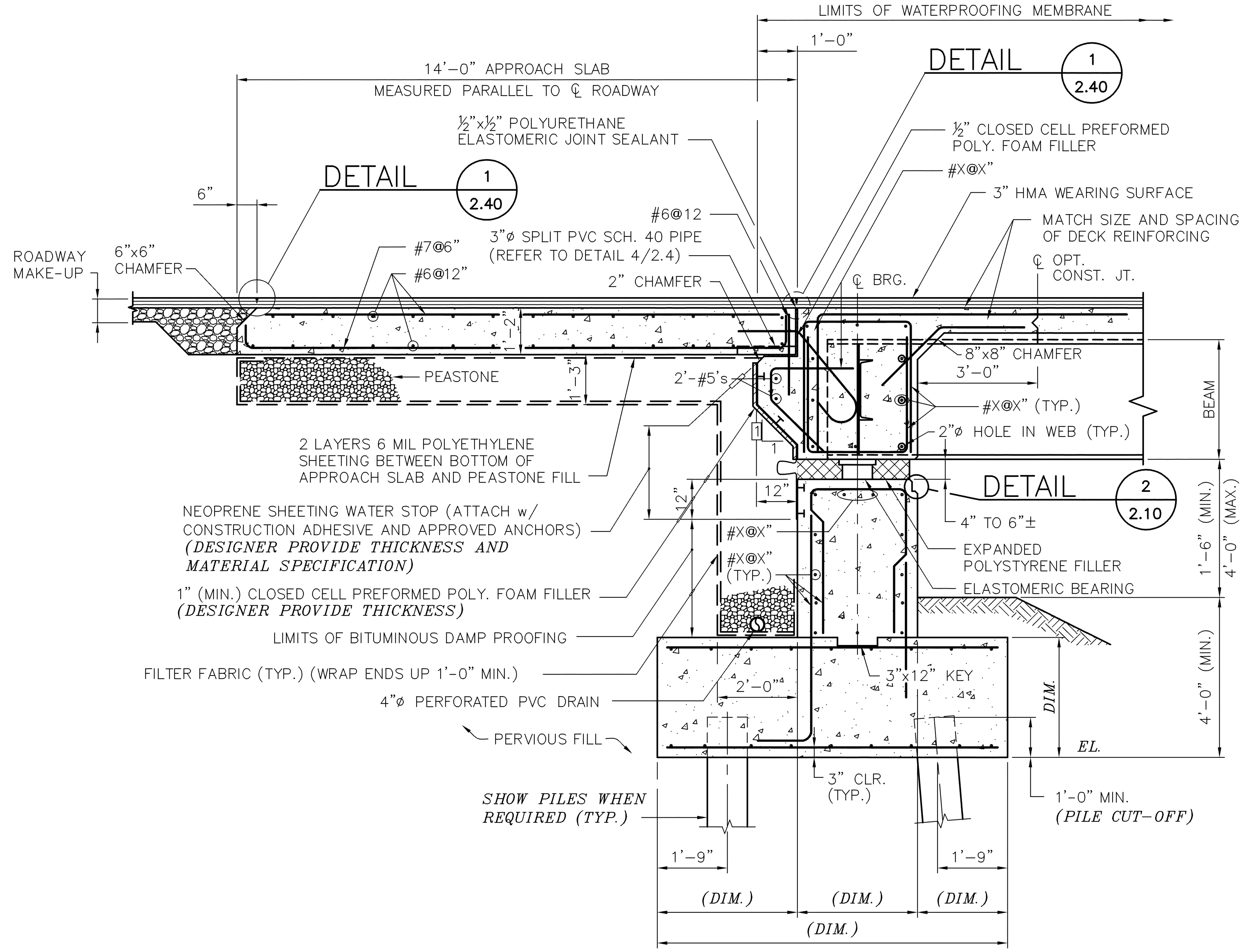
INTEGRAL ABUTMENT
SHEET 2

DRAWING NUMBER: 2.21



SPANS > 60'-0"

SECTION A 2.31
SCALE:1/2"=1'-0"



SPANS ≤ 60'-0"

SECTION A 2.31
SCALE:1/2"=1'-0"

REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

SEMI INTEGRAL ABUTMENT
SHEET 2

DRAWING NUMBER: 2.31

2. Joint Details

Illinois

Semi-Integral Abutment Joint Details

Massachusetts

Movement Joint Section

New Hampshire

Sleeper Slab Detail for Compression Seal Expansion Joint

Sleeper Slab Detail for Closed Cell Expansion Joint

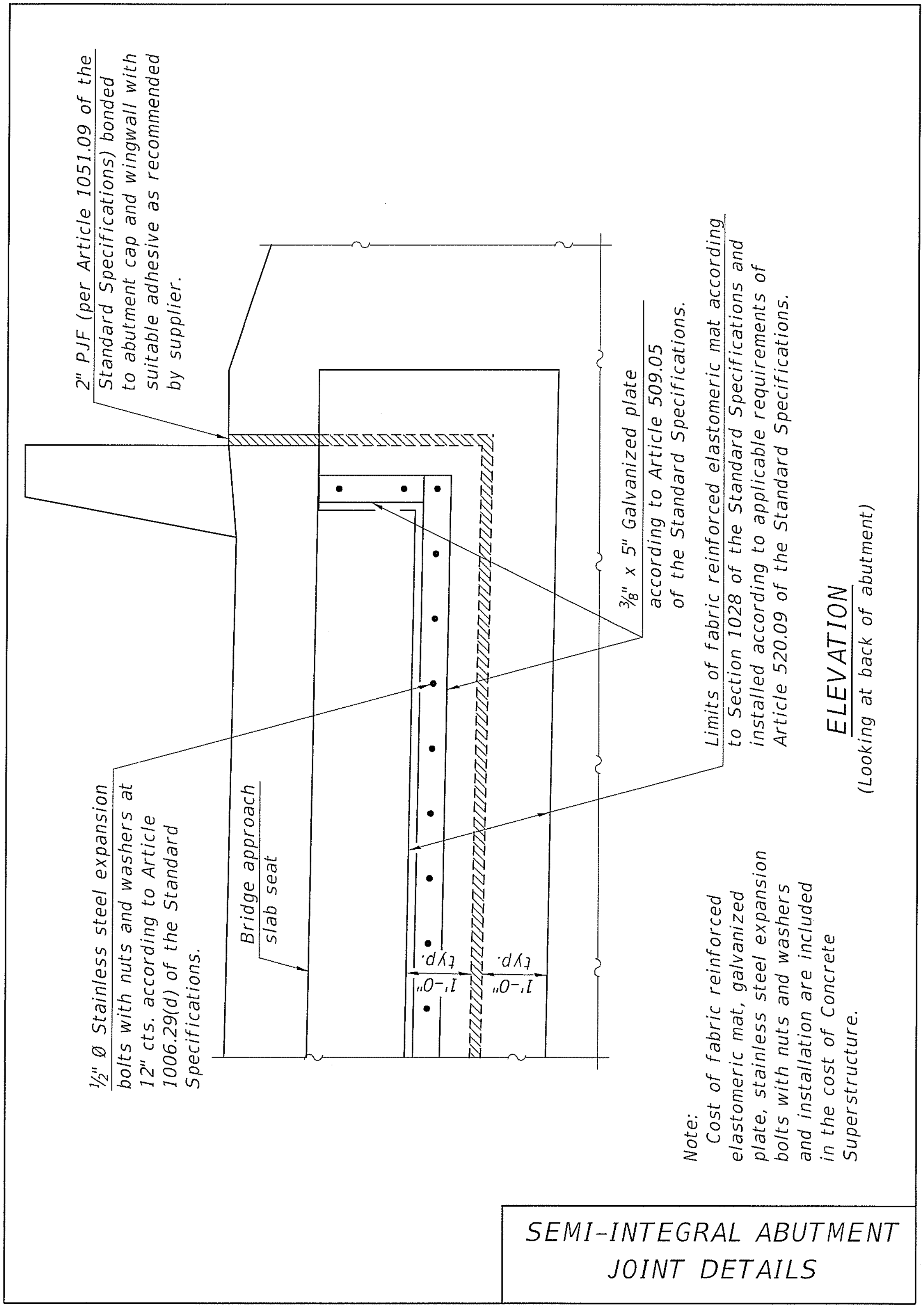
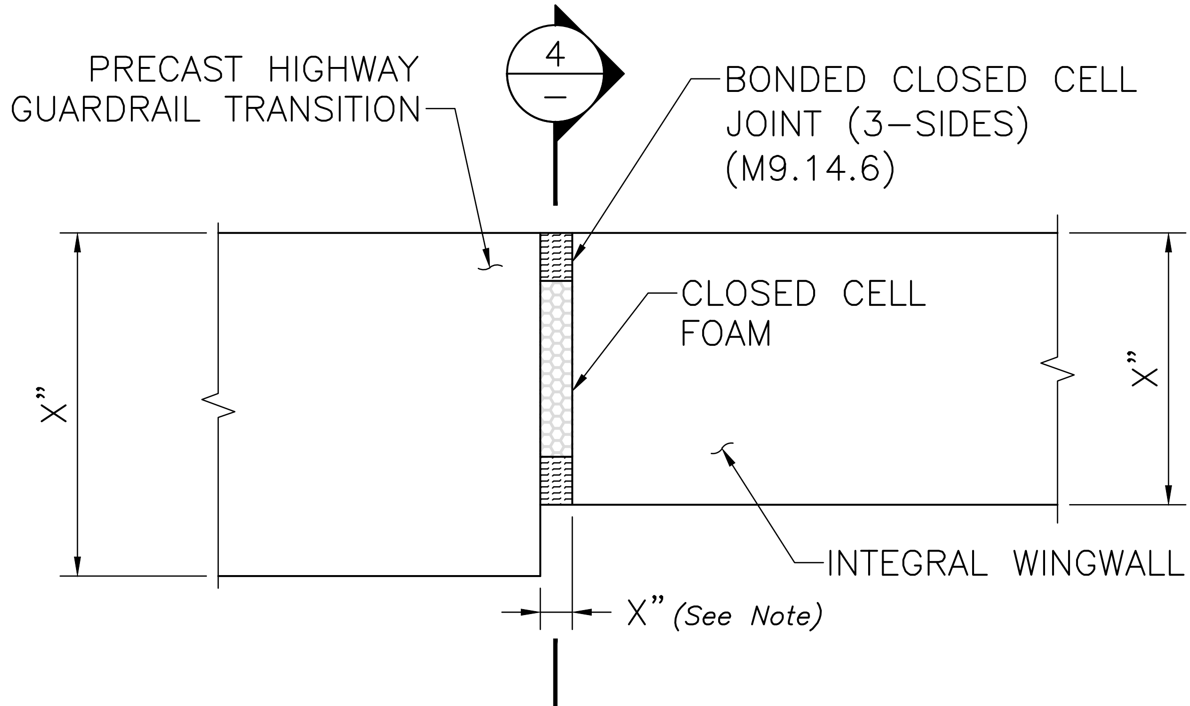


Figure 17

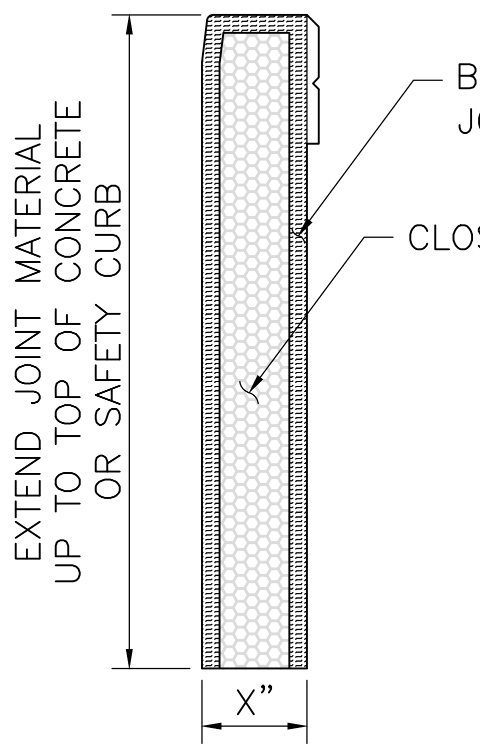
Illinois



NOTE:
REINFORCEMENT NOT SHOWN FOR CLARITY.

SECTION 3

SCALE: 1" = 1'–0"



SECTION 4

SCALE: ½" = 1'–0"

NOTE:
Movement joint width based on length of bridge and stringer material, as shown below.

JOINT WIDTH	*MAXIMUM TOTAL BRIDGE LENGTH* *STEEL*	*CONCRETE*
1"	*85'*	*200'*
1¼"	*135'*	*300'*
1½"	*185'*	*450'*
2"	*215'*	*550'*
2½"	*265'*	*600'*
3"	*300'*	

massDOT Massachusetts Department of Transportation Highway Division

LRFD BRIDGE MANUAL, PART II

WINGWALL SECTION AND MOVEMENT JOINT SECTION

INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

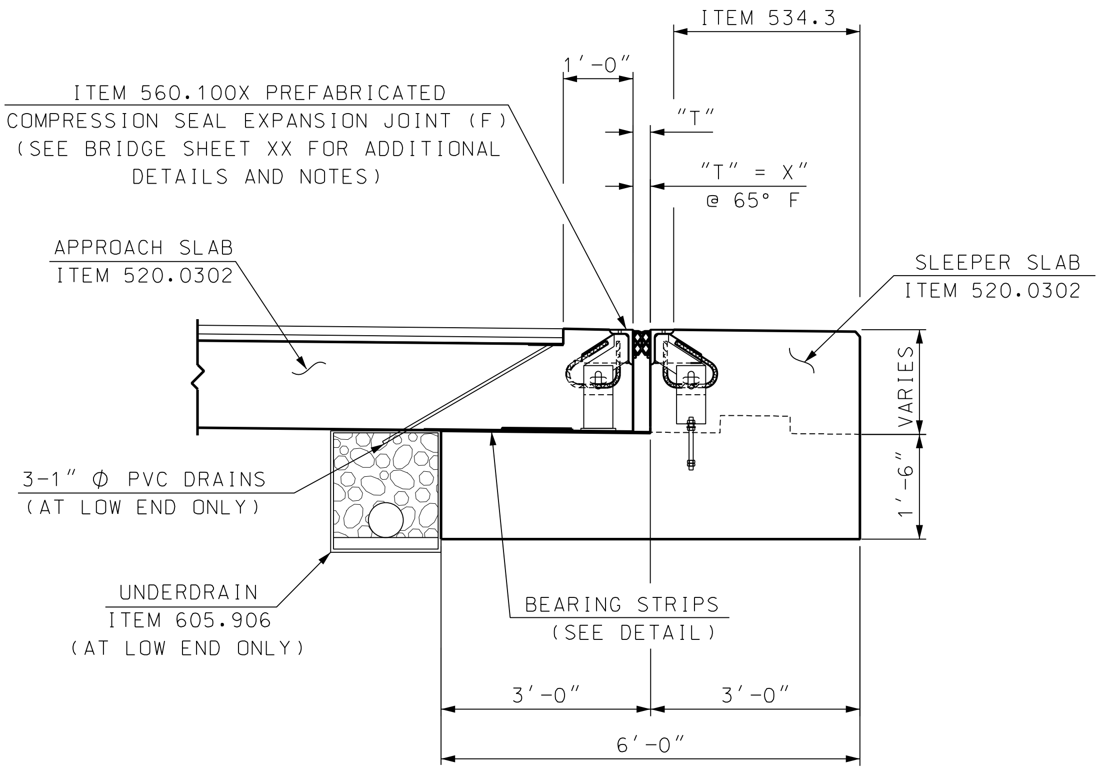
DRAWING NUMBER
12.1.6

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB DETAIL COMPRESSION SEAL EXP. JT.

DATE REVISED: 4/4/2018



TEMP (°F)	"T" (INCH)
20	XX
35	XX
50	XX
65	XX
80	XX
95	XX

MODIFY TO FIT PROJECT

SLEEPER SLAB DETAIL FOR COMPRESSON SEAL EXPANSION JOINT (ITEM 560.100X)

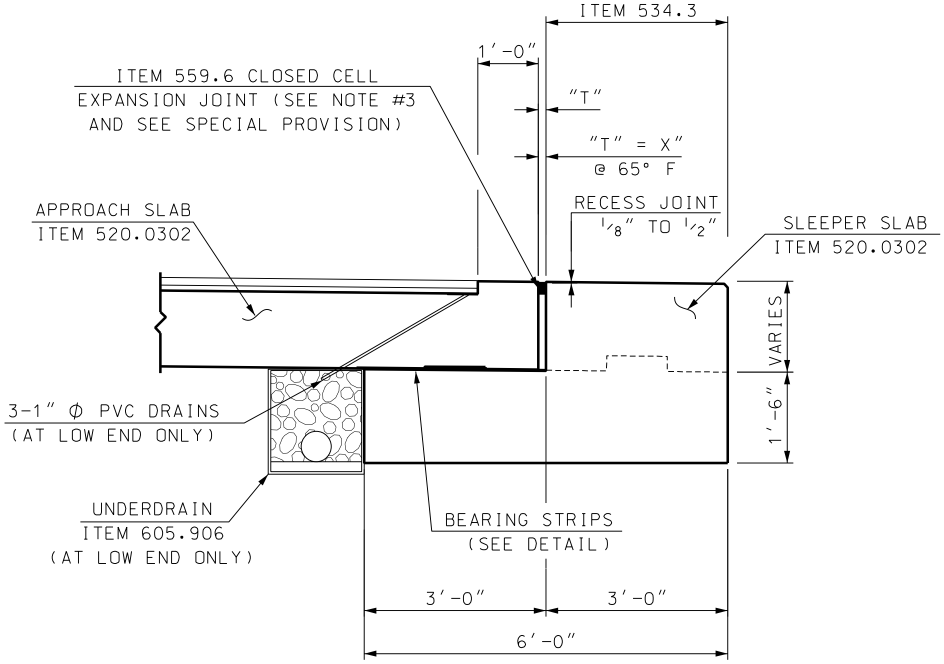
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - SLEEPER SLAB DETAIL CLOSED CELL EXP. JT.

DATE REVISED: 4/4/2018



TEMP (°F)	"T" (INCH)
20	XX
35	XX
50	XX
65	XX
80	XX
95	XX

SLEEPER SLAB DETAIL FOR CLOSED CELL EXPANSION JOINT (ITEM 559.6)

MODIFY TO FIT PROJECT

SLEEPER SLAB CLOSED CELL EXPANSION JOINT NOTES

1. ITEM 559.6, PREFORMED CLOSED CELL EXPANSION JOINT SYSTEM (F), INCLUDES CLOSED CELL EXPANSION MATERIAL AND JOINT ADHESIVE AS NOTED IN THE SPECIAL PROVISION.
2. MINIMUM WIDTH "T" FOR INSTALLATION = XX" (APPROX. 65°F OR LESS).
3. THE CONTRACTOR SHALL USE CLOSED CELL *WABO EVAZOTE UV, EV X.XXXX BY WATSON BOWMAN ACME OR PLY-SEAL XE BEIGE #X.X BY POLYSET CO.* THE CLOSED CELL EXPANSION MATERIAL HAS BEEN DESIGNED TO STAY IN COMPRESSION. THIS DESIGN INCLUDES MOVEMENT DUE TO TEMPERATURE, SKEW, SHRINKAGE, AND MINIMUM INSTALLATION.
4. VALUES IN THE TEMPERATURE ADJUSTMENT TABLE ARE FOR ADJUSTING THE EXPANSION JOINT ASSEMBLY IMMEDIATELY PRIOR TO POURING THE CONCRETE BLOCKOUTS.
5. THE JOINT OPENING "T" MAY BE FORMED WITH OTHER CLOSED CELL EXPANSION MATERIAL NOTED ON THE QPL UNDER ITEM 559E. THE MATERIAL LISTED ON THE QPL IS DIFFERENT THAN ITEM 559.6. IF THE MATERIAL LISTED ON THE QPL IS USED FOR FORMING, THE MATERIAL CAN STAY IN THE JOINT HOWEVER, THE THICKNESS OF THE FORM MATERIAL MUST BE THE DIMENSION "T" OF THE JOINT OPENING FOR THE AMBIENT TEMPERATURE AT THE TIME OF THE CONCRETE POUR.
6. DO NOT USE EXTRUDED POLYSTRENE (XPS) RIGID FOAM NOTED ON THE QPL UNDER ITEM 520 M. FOR FORMING THE JOINT OPENING "T" UNLESS IT CAN BE COMPLETELY REMOVED FROM THE JOINT OPENING. THIS MATERIAL DOES NOT COMPRESS AND EXPAND.

3. Beams Details

Illinois

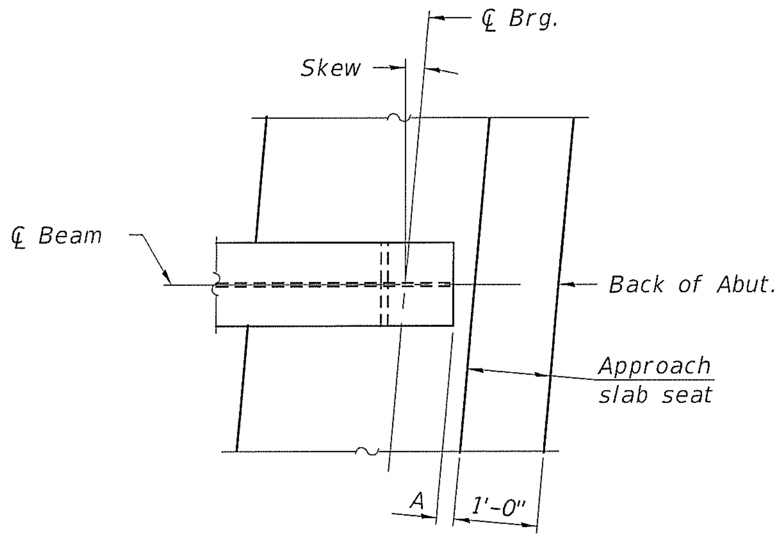
- Top Flange Clip Detail for Steel Beams on Integral Abutments
- Top Flange Clip Detail for PPC Beams on Integral Abutments

Massachusetts

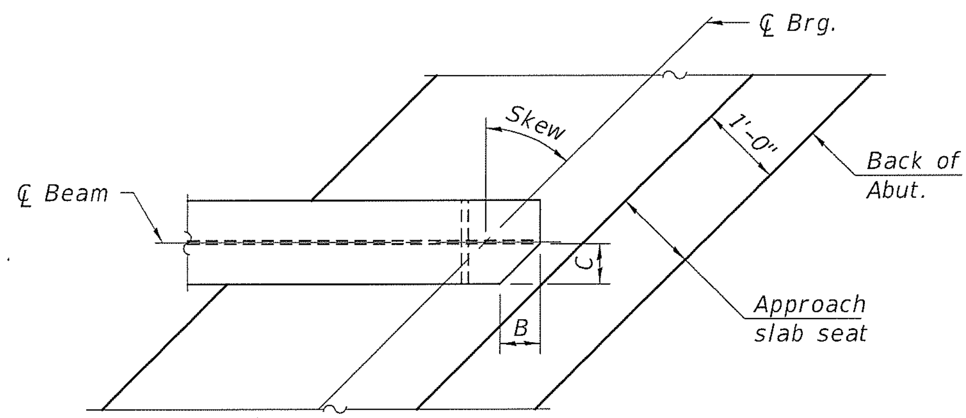
- Beam End Details for Integral Abutments
  - Rolled Beams
  - Plate Girders
  - NEBT Beams
  - Spread Box Beams
  - NEXT F Beams

Pennsylvania

- Beam Ends Supported on Integral Abutments



TOP FLANGE PLAN - NO CLIP



$B = C \tan(\text{skew})$

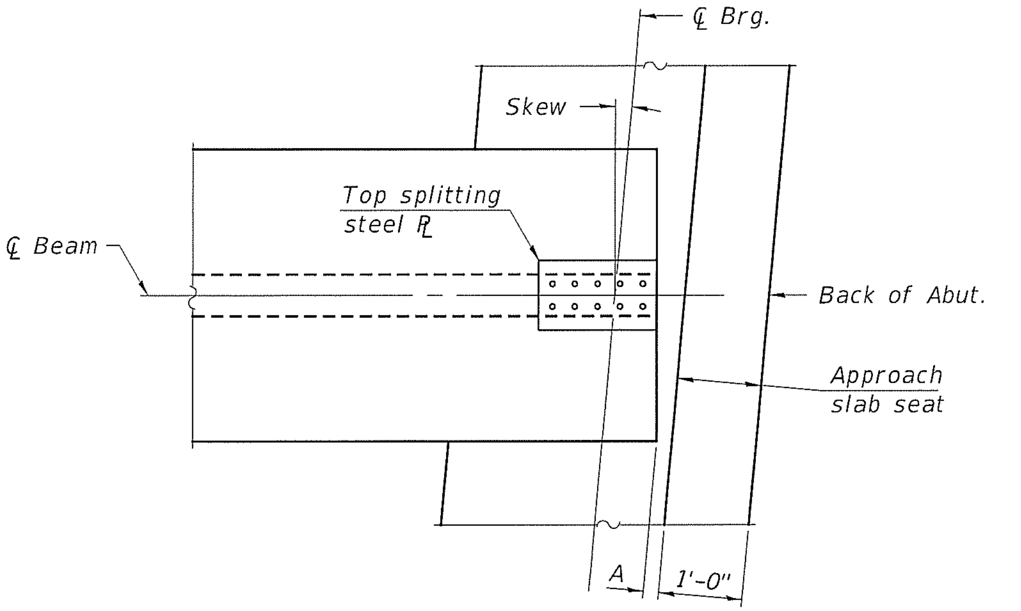
TOP FLANGE PLAN - CLIPPED

Notes:
Clip top flange when dimension "A" is less than 1". Calculate dimension "B" based on skew angle. Dimension "C" is half the top flange width minus half the web thickness.

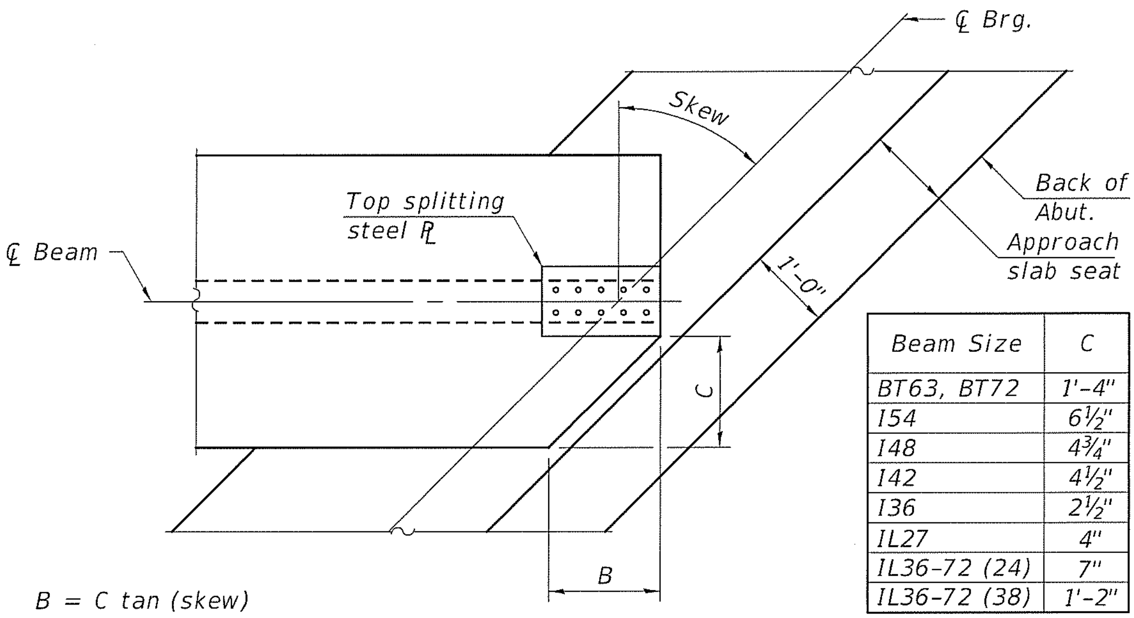
TOP FLANGE CLIP DETAIL FOR STEEL BEAMS ON INTEGRAL ABUTMENTS

Figure 13

Illinois



TOP FLANGE PLAN - NO CLIP



Beam Size	C
BT63, BT72	1'-4"
I54	6½"
I48	4¾"
I42	4½"
I36	2½"
IL27	4"
IL36-72 (24)	7"
IL36-72 (38)	1'-2"

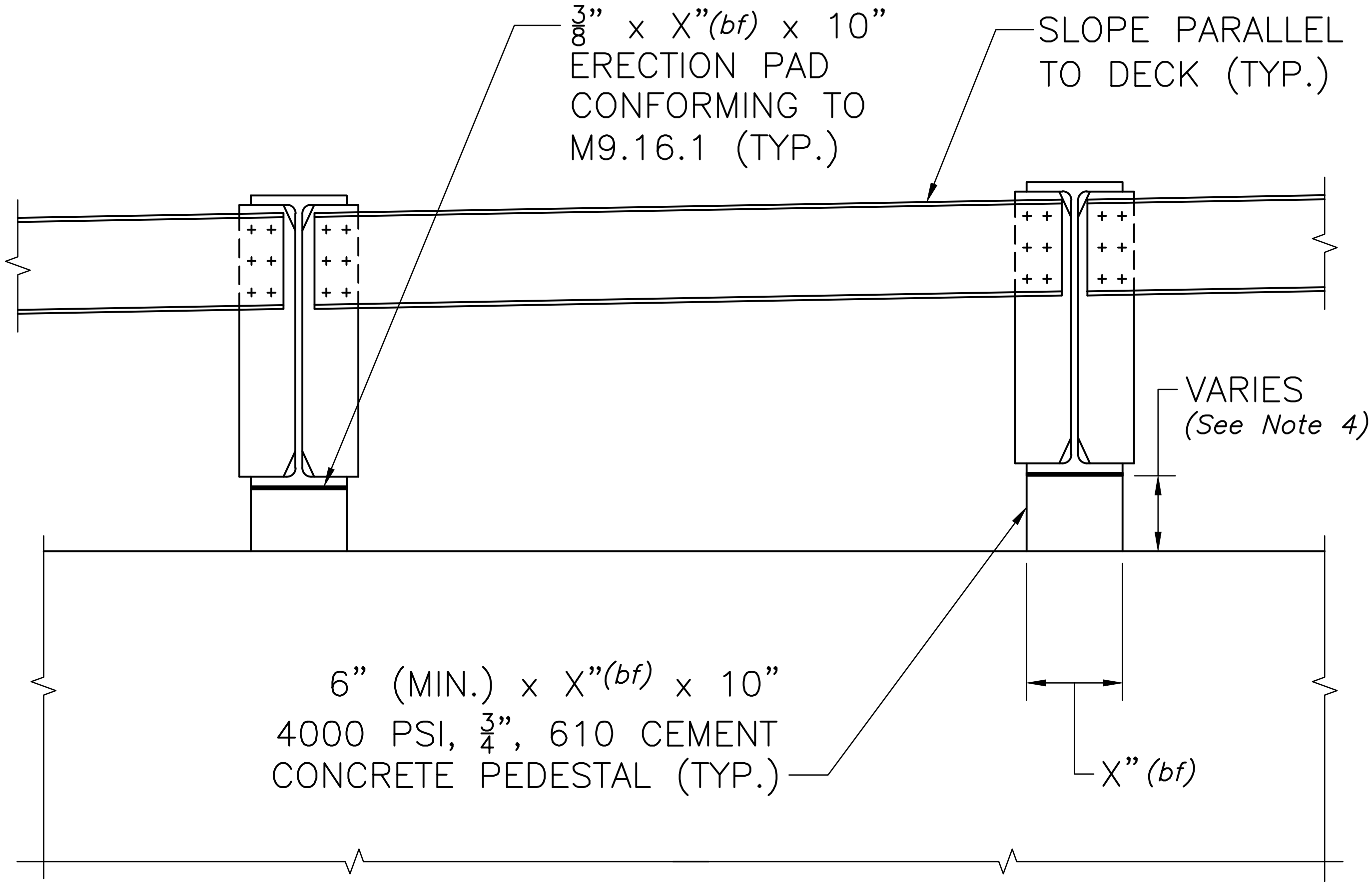
TOP FLANGE PLAN - CLIPPED

Note:
Clip top flange when dimension "A" is less than 1". Calculate dimension "B" based on skew angle. Dimension "C" is provided in table.

TOP FLANGE CLIP DETAIL
FOR PPC BEAMS
ON INTEGRAL ABUTMENTS

Figure 14

Illinois



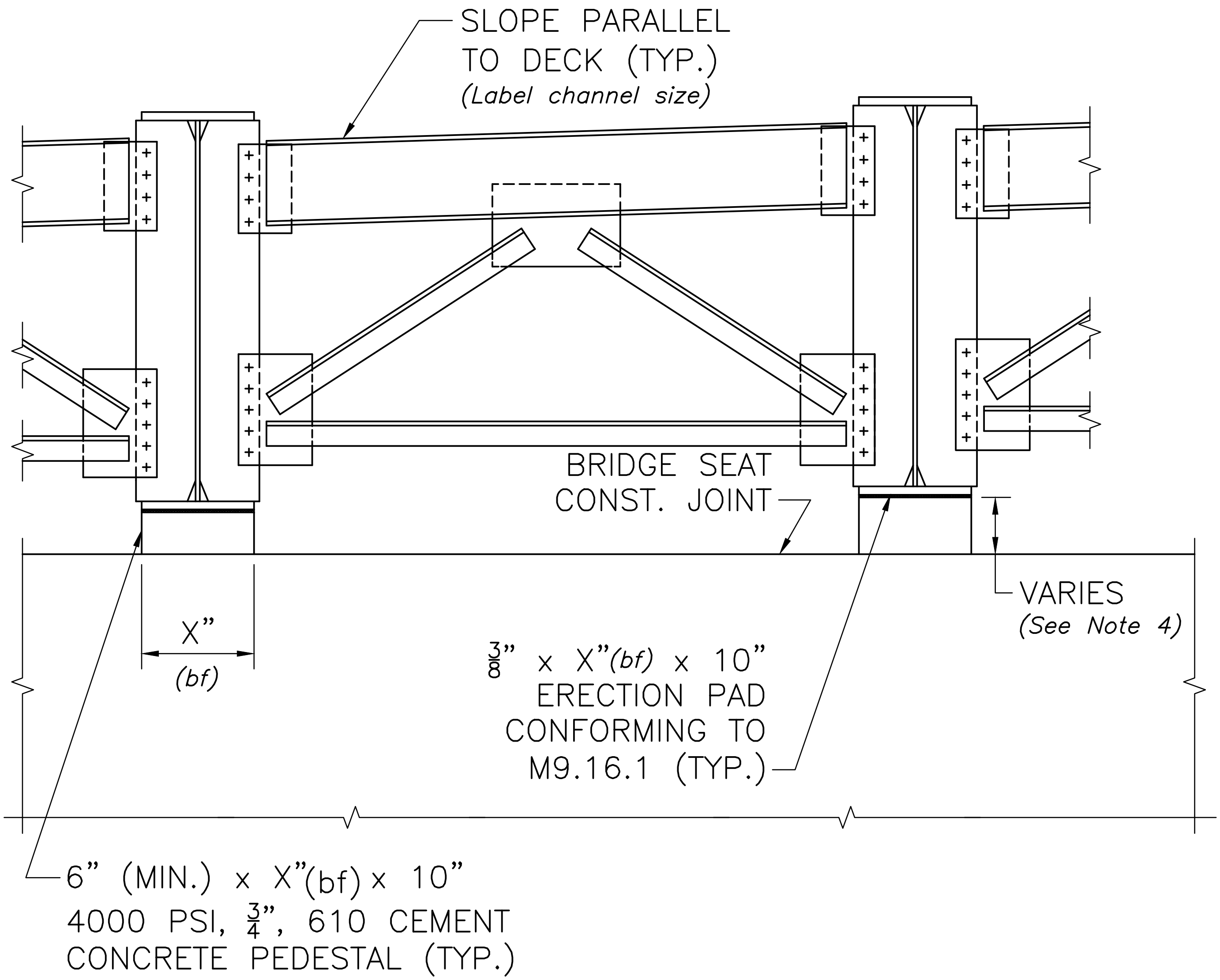
BEAM END DETAILS

SCALE: 1/2" = 1'–0"

NOTES:

1. *Provide End Diaphragm Details as shown on Dwg. No. 5.1.4.*
2. *End diaphragms shall be placed parallel to the centerline of abutment as shown in the Framing Plan.*
3. *If stage construction is present, omit end diaphragms in the affected bays and provide additional reinforcing that is to be spliced using dowel bar splicers.*
4. *Minimum pedestal height shall be 6"; maximum shall be 12" excluding pad thickness. Steps in bridge seat construction joint may be used to accommodate bridge cross slope. Use only the minimum number of steps necessary.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	BEAM END DETAILS ROLLED BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.1**



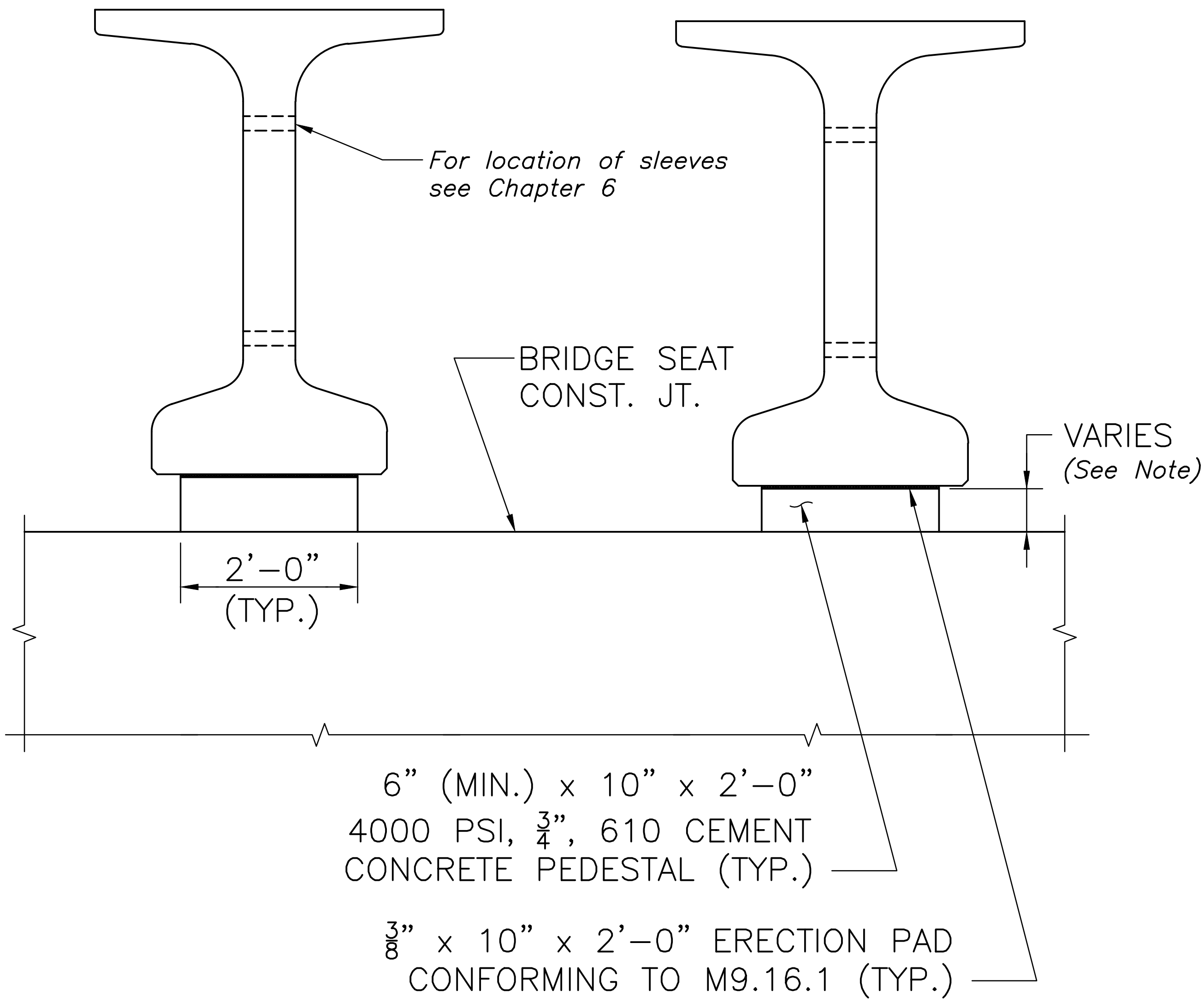
BEAM END DETAILS

SCALE: ½" = 1'–0"

NOTES:

1. *Provide End Cross Frame Details as shown on Dwg. No. 5.2.7.*
2. *End Cross Frames shall be placed parallel to the centerline of abutment and be shown in the Framing Plan.*
3. *If stage construction is present, omit End Cross Frames in the affected bays and provide additional reinforcing that is to be spliced using dowel bar splicers.*
4. *Minimum pedestal height shall be 6"; maximum shall be 12" excluding pad thickness. Steps in bridge seat construction joint may be use to accommodate bridge cross slope. Use only the minimum number of steps necessary.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	BEAM END DETAILS PLATE GIRDERS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.2**



NOTE:

THE LATERAL STABILITY OF THE BEAMS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR DURING ERECTION AND CONSTRUCTION. A LATERAL SUPPORT SYSTEM SHALL BE DESIGNED BY THE CONTRACTOR IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN AND BRIDGE CONSTRUCTION SPECIFICATIONS.

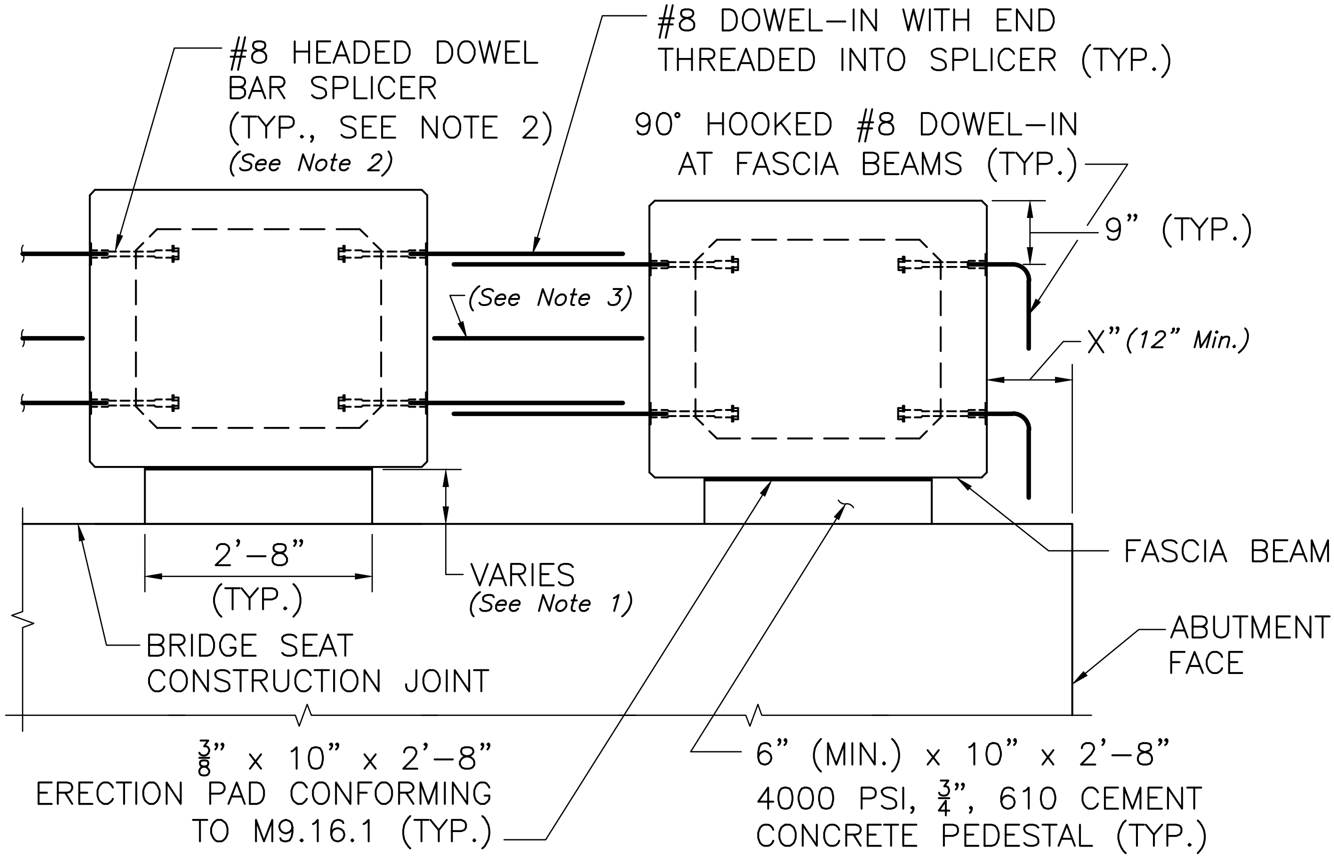
BEAM END DETAILS

SCALE: 1/2" = 1'–0"

NOTE:

Minimum pedestal height shall be 6" and maximum shall be 12", excluding erection pad thickness. Steps in bridge seat construction joint may be used to accommodate bridge cross slope. Use only the minimum number of steps necessary.

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	BEAM END DETAILS NEBT BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.3**



NOTES:

1. THE LATERAL STABILITY OF THE BEAMS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR DURING ERECTION AND CONSTRUCTION. A LATERAL SUPPORT SYSTEM SHALL BE DESIGNED BY THE CONTRACTOR IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN AND BRIDGE CONSTRUCTION SPECIFICATIONS.

2. #8 HEADED DOWEL BAR SPLICERS SHALL BE CAST-IN-PLACE IN THE PRECAST BEAMS BY THE FABRICATOR AND SHALL BE EMBEDDED AS REQUIRED TO PROVIDE A MINIMUM NOMINAL TENSILE RESISTANCE OF 71.0 KIPS AS SPECIFIED BY THE MANUFACTURER.

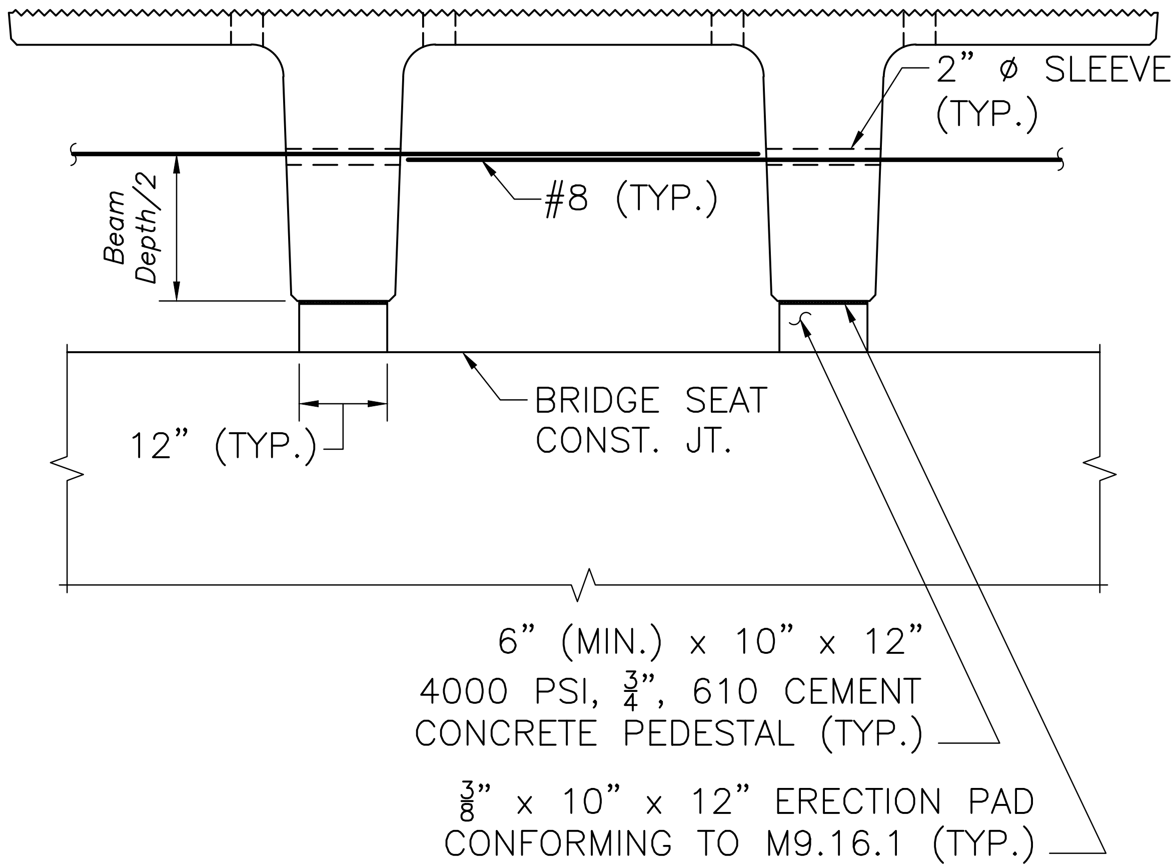
BEAM END DETAILS

SCALE: $\frac{1}{2}$" = 1'-0"

NOTES:

1. *Minimum pedestal height shall be 6"; maximum shall be 12" excluding pad thickness. Steps in bridge seat construction joint may be used to acommodate bridge cross slope; use only the minimum number of steps necessary.*
2. *Provide #8 headed splicers by beam depth as follows:*
   Beam depth 28" and less: 1 headed splicer at mid depth of beam;
   Beam depth greater than 28": 2 headed splicers as shown.
3. *Provide #8 intermediate reinforcing bars by beam depth as follows:*
   Beam depth 32" and less: no intermediate bar;
   Beam depth greater than 32": 1 intermediate bar midway between splicers.
4. *Modify detail as required for Deck Beam stringer bridges.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	BEAM END DETAILS SPREAD BOX BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.4**



NOTE:

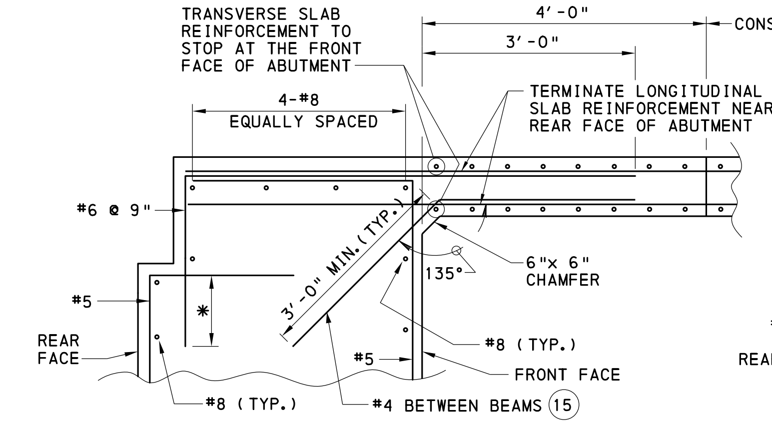
THE LATERAL STABILITY OF THE BEAMS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR DURING ERECTION AND CONSTRUCTION. A LATERAL SUPPORT SYSTEM SHALL BE DESIGNED BY THE CONTRACTOR IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN AND BRIDGE CONSTRUCTION SPECIFICATIONS.

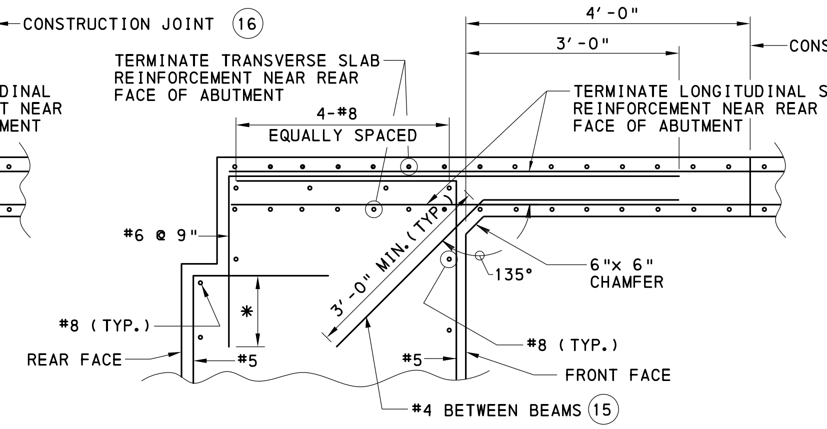
BEAM END DETAILS

SCALE: $\frac{1}{2}$" = 1'–0"

NOTE:
Minimum pedestal height shall be 6" and maximum shall be 12", excluding erection pad thickness. Steps in bridge seat construction joint may be used to accommodate bridge cross slope. Use only the minimum number of steps necessary.

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	BEAM END DETAILS NEXT F BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.5**





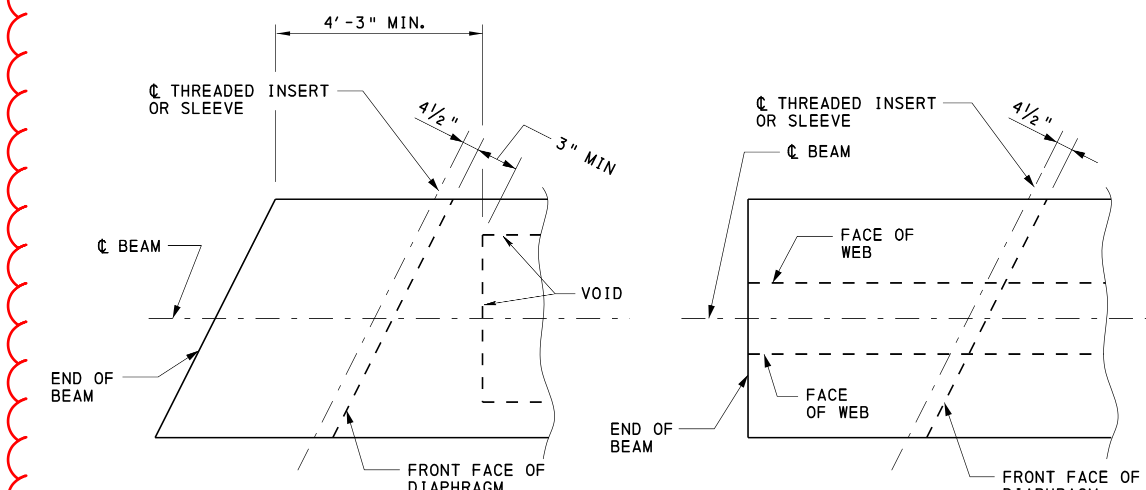
✱ 1'-6" MAXIMUM LENGTH ALLOWED DUE TO GIRDER DEPTH.

TRANSVERSE SLAB REINFORCEMENT
PARALLEL TO ABUTMENT
(SKEWS OF 75° TO 90°)

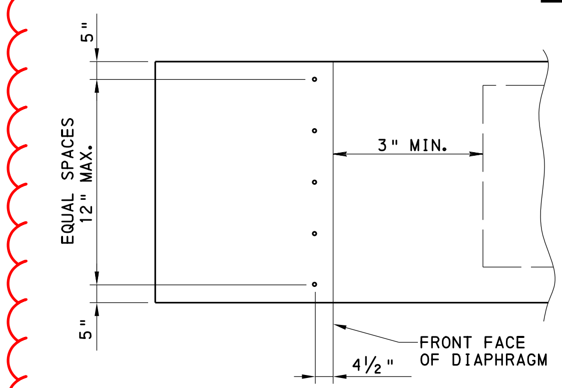
TRANSVERSE SLAB REINFORCEMENT
NOT PARALLEL TO ABUTMENT
(SKEWS < 75°)

SLAB-ABUTMENT CONNECTION DETAIL

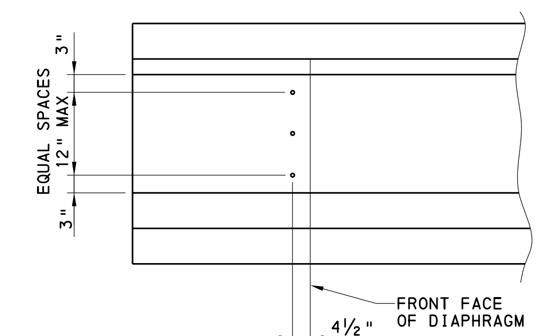
- FOR DECK TOP REINFORCEMENT MAT: TRANSVERSE BARS SHOWN ON TOP, SIMILAR WHEN LONGITUDINAL BARS ON TOP.
- SECTIONS BETWEEN GIRDERS SHOWN



PLAN VIEWS



CONCRETE BOX BEAMS

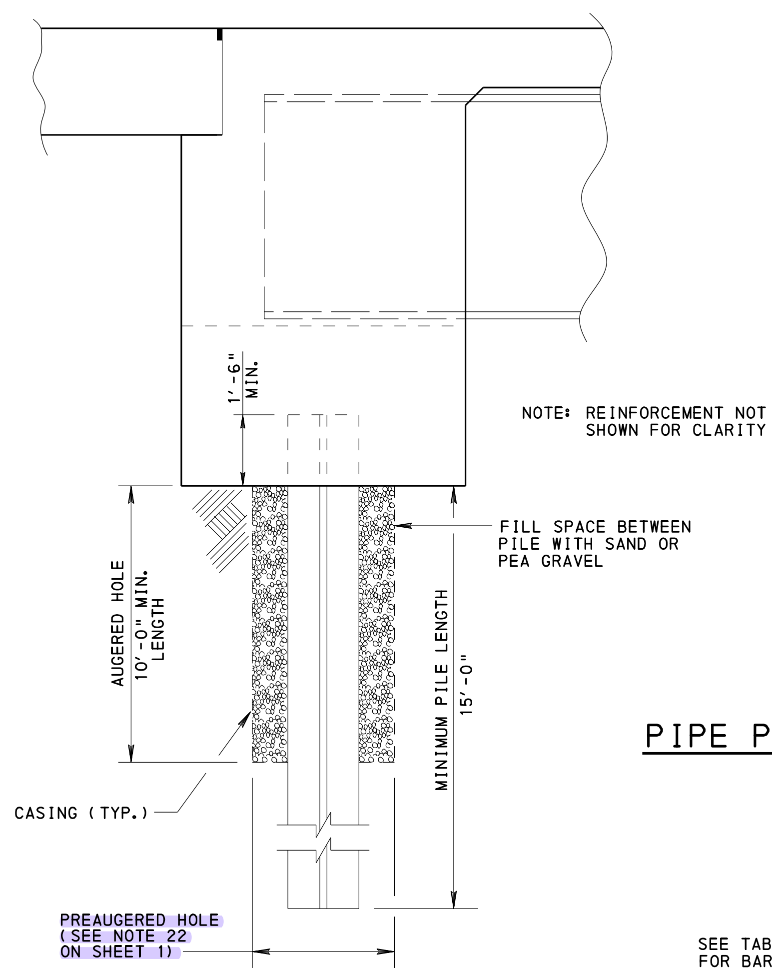


CONCRETE I-BEAMS

ELEVATION VIEWS

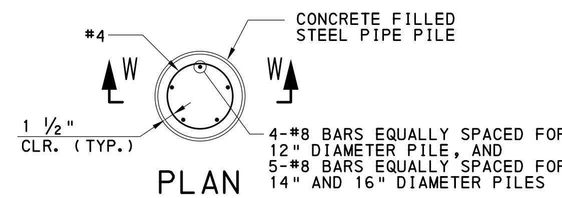
THREADED INSERT LOCATIONS IN PRESTRESS BEAMS, BEAM ENDS SUPPORTED ON INTEGRAL ABUTMENTS

(SEE SHEET 3 FOR HOLE LOCATION IN WEBS OF STEEL BEAMS)

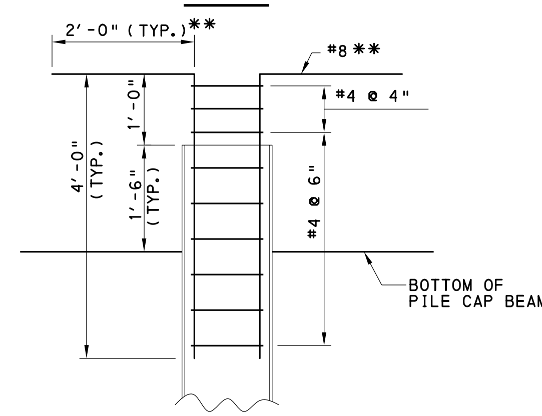


INTEGRAL ABUTMENT PILE INSTALLATION DETAIL

- SEE APPENDIX G OF DESIGN MANUAL PART 4 SECTION 1.4.2 FOR PRE AUGERING REQUIREMENTS
- PREDRILL OVERSIZED HOLES FOR ALL PILES IN ACCORDANCE WITH DESIGN MANUAL PART 4 AP.G.1.4.2.1. PLACE PILES VERTICAL IN THE HOLES BEFORE FILLING THE HOLES. FILL THE HOLES WITH DRY LOOSE SAND OR PEA GRAVEL BEFORE DRIVING THE PILES.



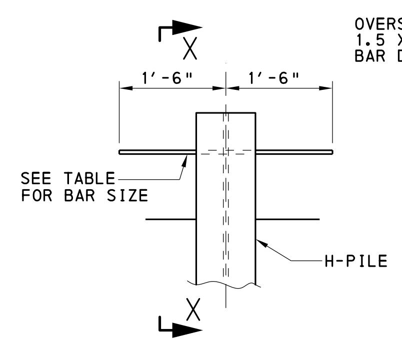
PLAN



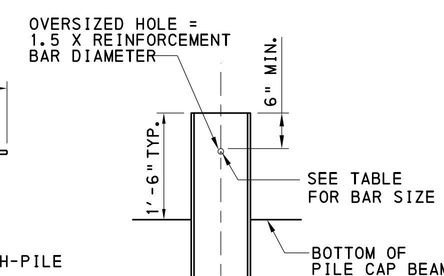
SECTION W-W

✱✱ HOOK 180° PER BC-736M OR ROTATE TO FIT SHORTER CAP WIDTHS

PIPE PILE-TO-PILE CAP CONNECTION DETAIL



ELEVATION



VIEW X-X

H-PILE-TO-PILE CAP CONNECTION DETAIL

H-PILE TO PILE CAP CONNECTION REINFORCEMENT

PILE SIZE	BAR
HP 10 x 57	#6
HP 12 x 53	#6
HP 12 x 63	#6
HP 12 x 74	#6
HP 12 x 84	#7
HP 14 x 73	#6
HP 14 x 89	#7
HP 14 x 102	#7
HP 14 x 117	#8

LEGEND:

(15) SPACED WITH LONGITUDINAL DECK REINFORCEMENT

(16) DECK PLACEMENT SEQUENCE:
1. POUR THE ENTIRE DECK EXCEPT THE PORTIONS WITHIN 4'-0" FROM THE FRONT FACES OF THE ABUTMENTS.
2. THEN POUR THE END DIAPHRAGMS.
3. FOR GIRDER DEPTHS >36", WAIT A MINIMUM OF 2 HOURS BEFORE POURING THE REMAINER OF THE DECK. FOR GIRDER DEPTHS ≤36" THE REMAINDER OF THE DECK CAN BE POURED SIMULTANOUSLY WITH THE END DIAPHRAGMS.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
SLAB-ABUTMENT CONNECTION AND
PILE-ABUTMENT CONNECTION DETAILS

RECOMMENDED APR. 29, 2016	RECOMMENDED APR. 29, 2016	SHEET 8 OF 9
Thomas P Macioce CHIEF BRIDGE ENGINEER	Brian G Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M

4. Bearing Details

Illinois

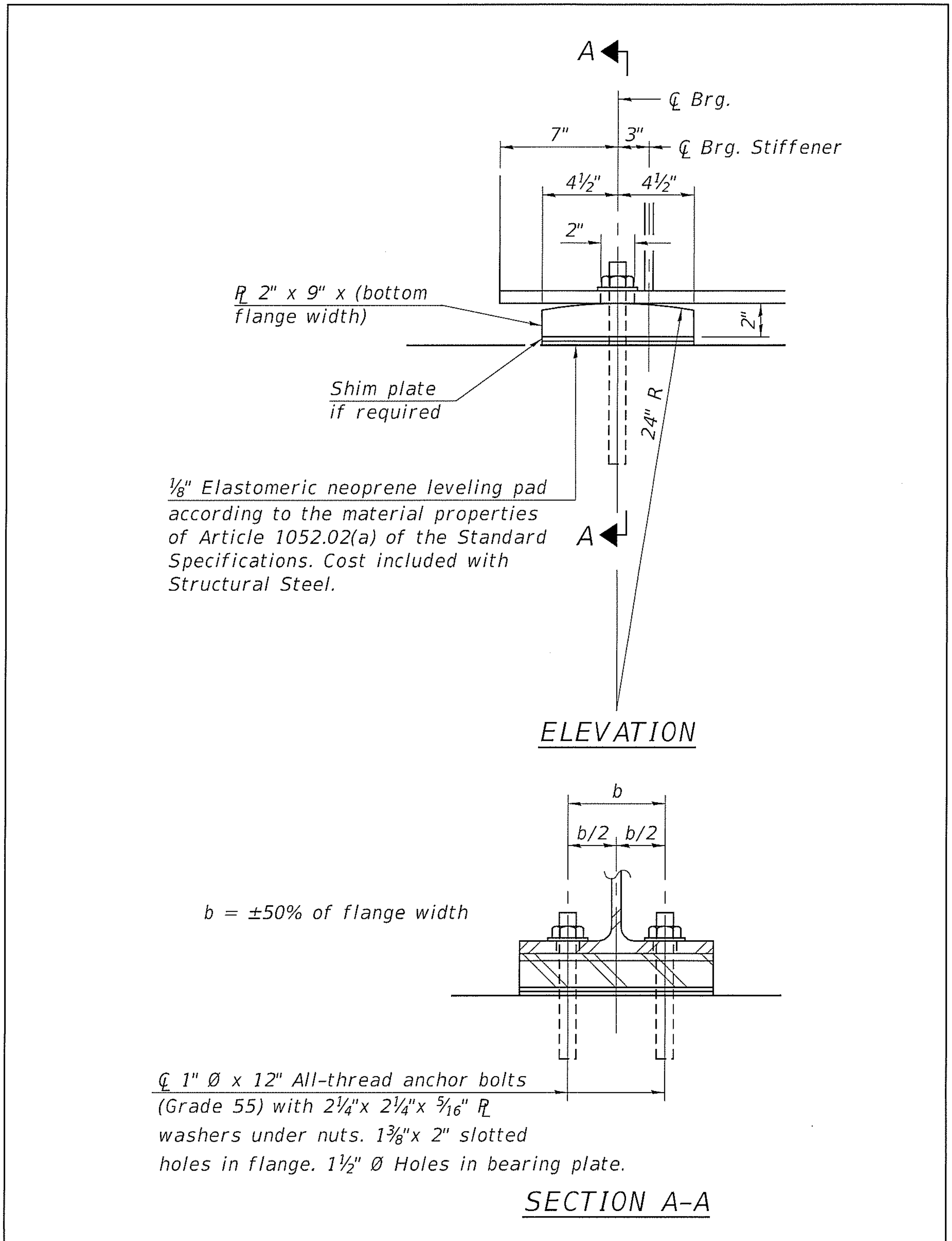
Integral Abutment Bearing for Steel Beams

New York

Bearing Pad Placement

Ohio

Bearing Details for Integral Abutments

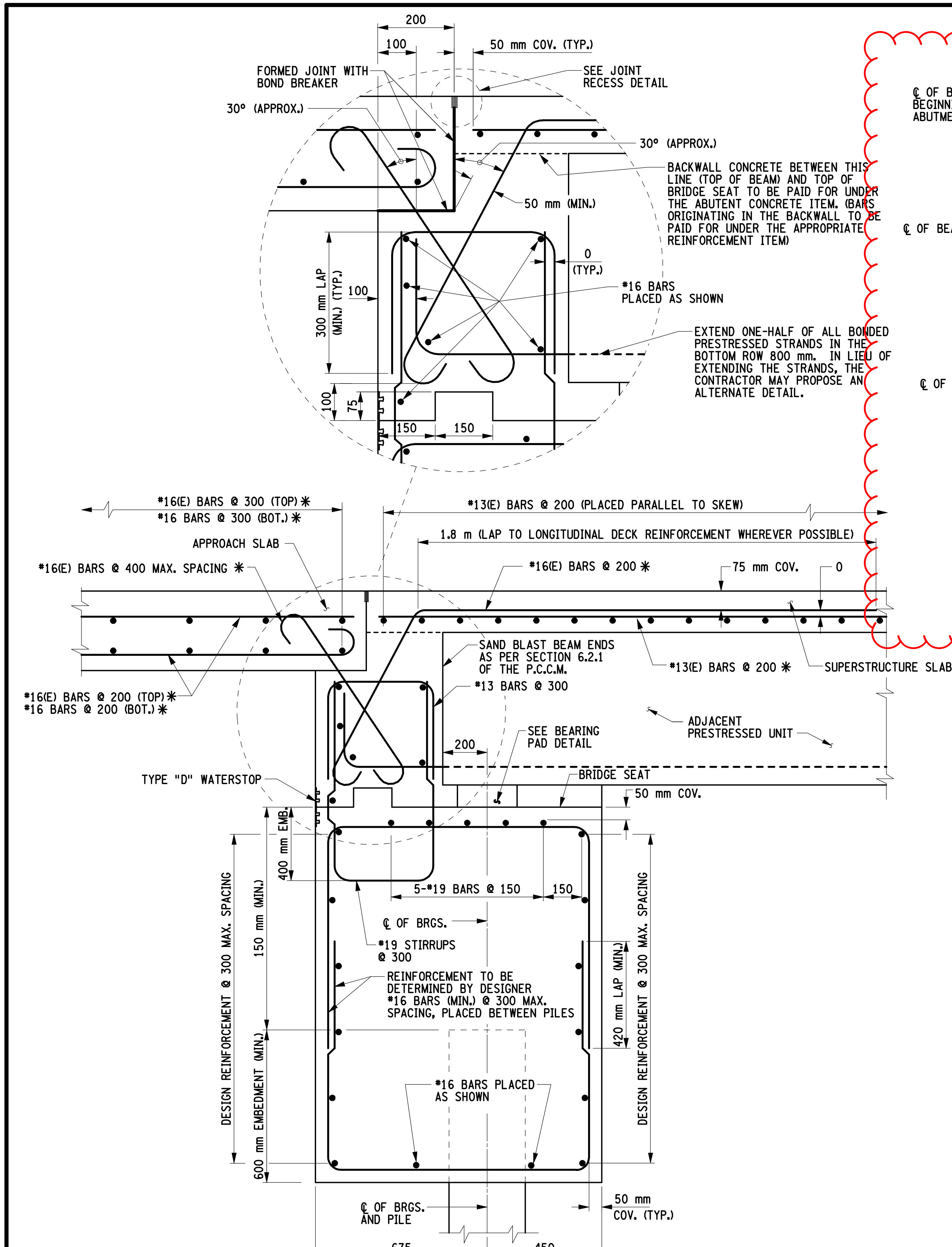


INTEGRAL ABUTMENT BEARING FOR STEEL BEAMS

Figure 15

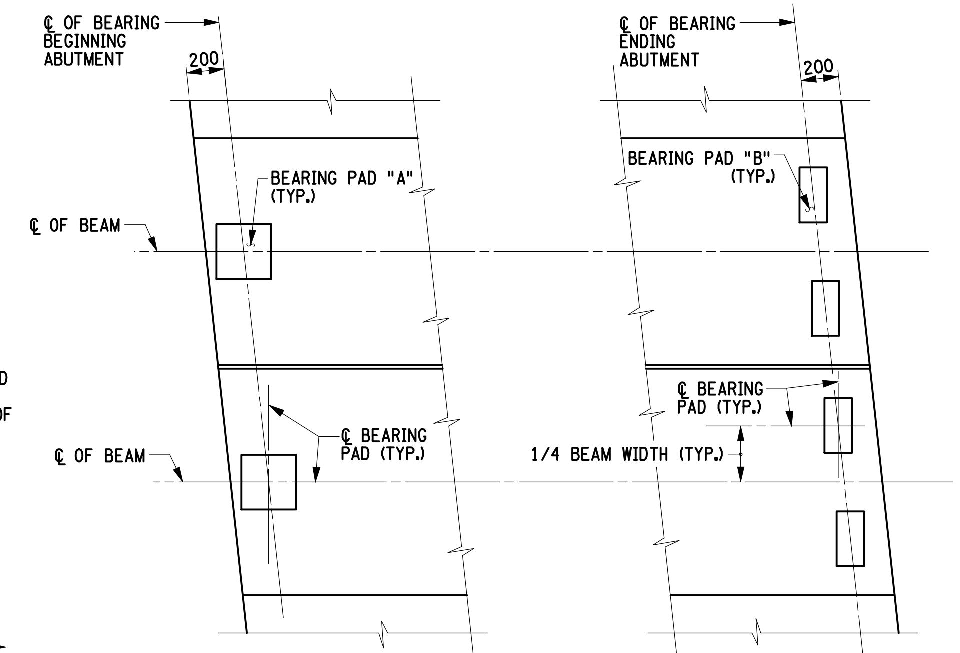
Illinois

BD-ID1
R2

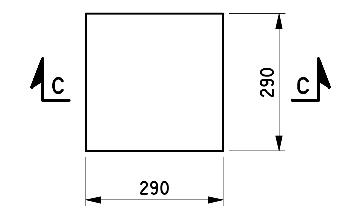


✱ SPACINGS SHOWN FOR THESE BARS ARE PARALLEL OR PERPENDICULAR TO STATION LINE OR BEAMS.

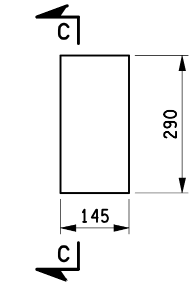
INTEGRAL ABUTMENT DETAIL
(SECTION TAKEN PERPENDICULAR TO ABUTMENT)
NOT TO SCALE



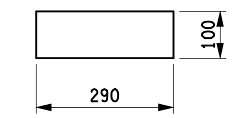
PLAN
BEARING PAD PLACEMENT
PRESTRESSED ADJACENT BEAM
NOT TO SCALE



PLAN
BEARING PAD "A"



PLAN
BEARING PAD "B"



SECTION C-C

DESIGNER NOTES:

DECK REINFORCEMENT FOR SKEWS 30° OR UNDER SHOWN. FOR SKEWS OVER 30° PLACE TRANSVERSE BARS PERPENDICULAR TO BEAMS.

THE 290 x 145 x 100 BEARING PAD "B" SHALL ONLY BE USED AS SHOWN ON THE PRESTRESSED ADJACENT BEAM BEARING PAD LAYOUT.

EPOXY-COATED BARS SHOWN. OTHER CORROSION PROTECTION OPTIONS ARE AVAILABLE. REFER TO SECTION 15.12 OF THE BRIDGE MANUAL.

REFER TO BRIDGE MANUAL, SECTION 15.12 FOR THE REQUIREMENTS FOR CORROSION PROTECTED REINFORCEMENT IN SUBSTRUCTURES.

SEE EARTHWORK DETAILS ON BD-ID3 FOR FURTHER DETAILS.

FOR JOINT RECESS DETAIL, SEE BD-ID6.

FOR TYPE "D" WATERSTOP DETAILS, SEE BD-MS3.

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE ADJACENT PRESTRESSED CONCRETE SUPERSTRUCTURE

1. FOR BRIDGE LENGTHS OVER 30 m, PRE-EXCAVATE HOLES TO A DEPTH OF 2.5 m BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION NOTES.
2. DRIVE PILES AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH SAND MEETING THE REQUIREMENTS OF NYS MATERIAL SUBSECTION 703-06, CUSHION SAND. (COST TO BE INCLUDED IN PILE ITEM).
4. IF CIP PILES ARE USED, FILL PILES WITH CONCRETE.
5. PLACE ABUTMENT STEM CONCRETE TO BRIDGE SEAT ELEVATION.
6. BACKFILL ABUTMENT STEMS TO 150 mm BELOW THE BRIDGE SEAT ELEVATION. NO BACKFILL OF THE ABUTMENT STEMS ALLOWED UNTIL THE ABUTMENTS HAVE CURED FOR 7 DAYS.
7. PLACE STONE FILL OR SLOPE PROTECTION.
8. ERECT PRESTRESSED UNITS ON BEARING PADS.
9. PLACE CONCRETE ABOVE BRIDGE SEAT ELEVATION FOR THE ABUTMENT BACKWALL AND DECK SLAB. TO FACILITATE COMPLETE CONSOLIDATION OF CONCRETE BETWEEN THE TOP OF THE BRIDGE SEAT AND THE BOTTOM OF THE BEAM, VENT HOLES SHALL BE PROVIDED FOR THE INSERTION OF A 25 mm DIAMETER VIBRATOR IN THE FRONT FORM FROM UNDER EACH BEAM. HIGH RANGE WATER REDUCERS (SUPER PLASTICIZER) MAY BE ADDED ONLY FOR THE REMAINDER OF THE ABUTMENT POUR, UP TO THE TOP OF THE PRESTRESSED UNITS. HIGH RANGE WATER REDUCERS SHALL NOT BE ALLOWED FOR THE DECK SLAB.
10. PLACE TOP OF INTEGRAL WINGWALLS CONCRETE.
11. BACKFILL ABUTMENT BACKWALLS. NO BACKFILLING OF BACKWALL IS ALLOWED UNTIL THE BACKWALLS HAVE CURED FOR 7 DAYS.
12. PLACE CONCRETE FOR APPROACH SLABS.

NOTES:

(E) DENOTES EPOXY-COATED BARS.

BEARING PAD TO MEET THE REQUIREMENTS OF NYS MATERIAL SPEC. 728-01, RUBBER-IMPREGNATED WOVEN COTTON-POLYESTER FABRIC BEARING PAD. BEARING PAD TO BE PAID FOR UNDER ITEM 565.30.

ALL DIMENSIONS AND BAR SPACINGS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED.

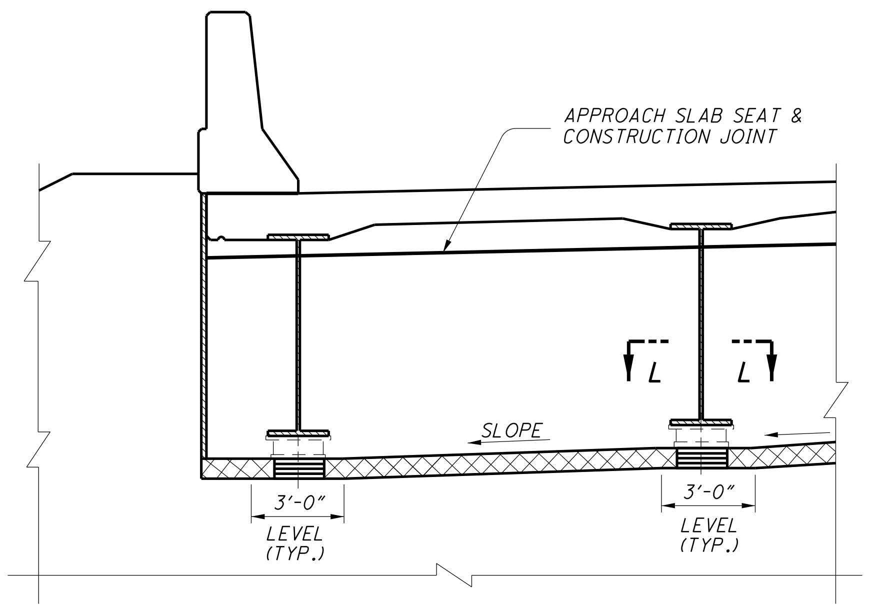
ISSUED 6/13/05
REVISED 12/5/05
6/28/10

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN AND CONSTRUCTION DIVISION

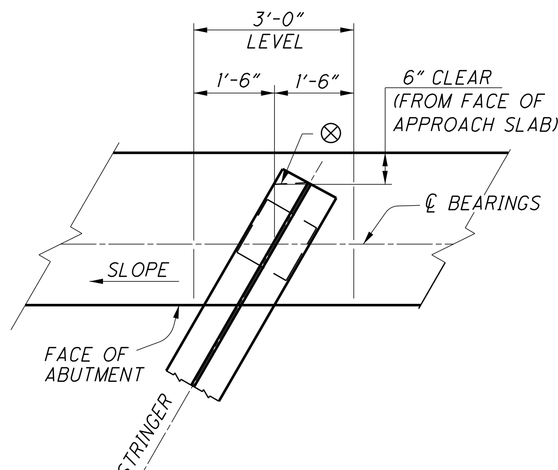
INTEGRAL ABUTMENTS
ADJACENT PC BEAMS
TYPICAL SECTIONS & DETAILS

APPROVED: 6/28/10
ORIGINAL SIGNED BY
ARTHUR P. YANNOTTI, P.E.
ACTING DEPUTY CHIEF ENGINEER (STRUCTURES)

ISSUED UNDER EB 10-024
EFFECTIVE WITH THE LETTING OF 1/06/11



PART ELEVATION OF BEAM SEAT



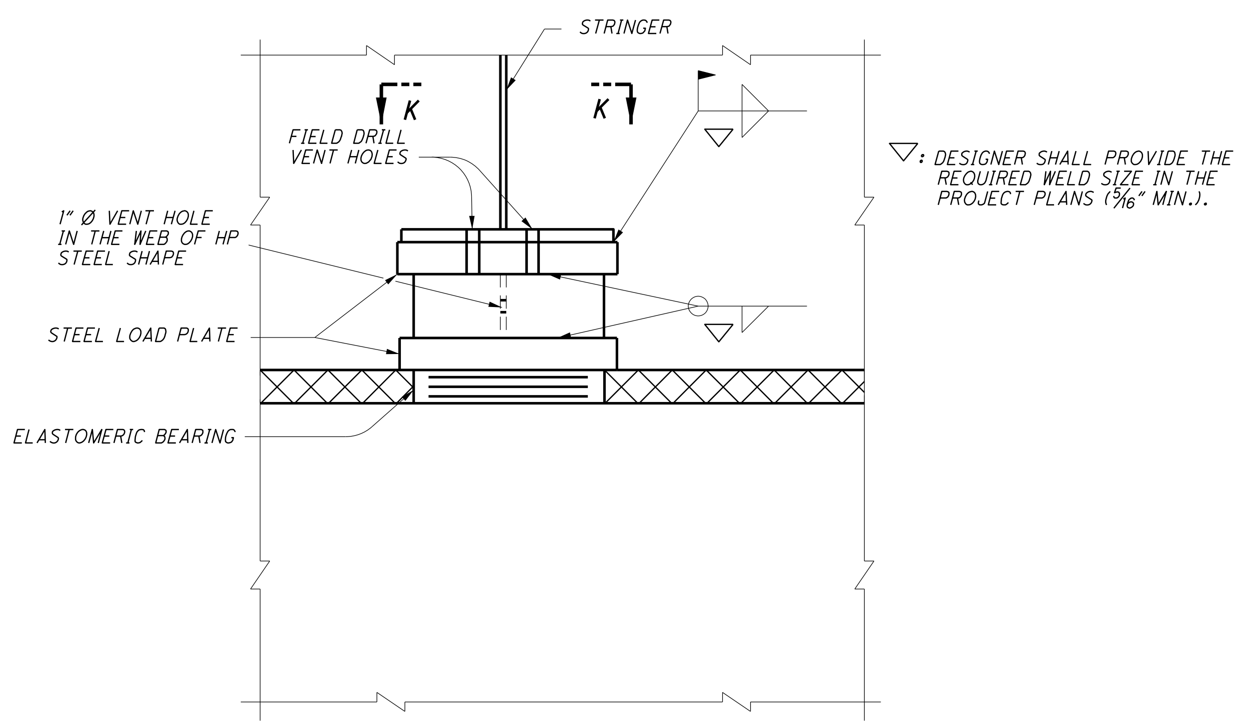
SECTION L-L

⊗ - CLIP ONLY THE TOP FLANGE TO MAINTAIN THE CLEARANCE

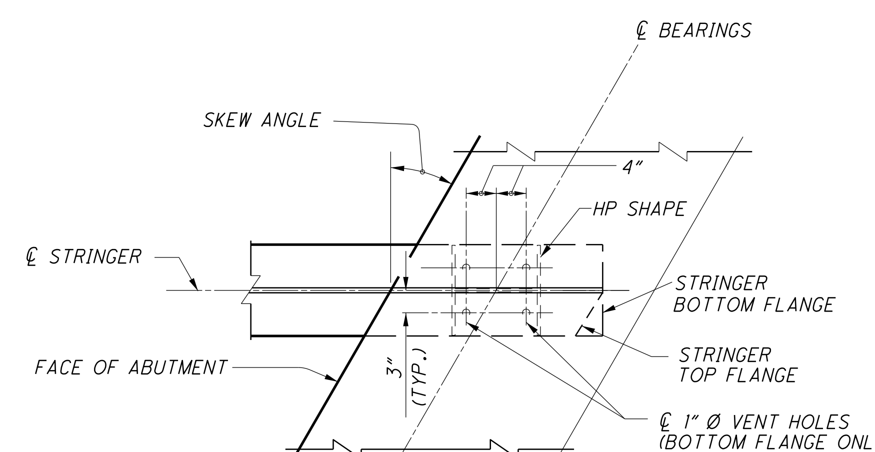
NOTE:

HP STEEL SHAPE INCLUDED WITH ELASTOMERIC BEARING FOR PAYMENT.

SEE NOTES ON SHEET 7/7 FOR ADDITIONAL REQUIREMENTS.



BEARING DETAIL



SECTION K-K

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

Brad Fagrell
ADMINISTRATOR

02-12-97
DATE

REVISIONS
04-20-01
07-19-02
07-18-14

CHECKED MRG/JS	REVIEWED LMW
DESIGNED WLE	DRAWN WLE

OFFICE OF STRUCTURAL ENGINEERING

STANDARD BRIDGE DRAWING

SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96

5.a) Fully Integral Abutment Plan View

Massachusetts

- Integral Abutment Plan
- Horizontal Section at Integral Abutment Seat
- Horizontal Section at Integral Abutment

Ohio

- Plan at Integral Abutment
  - NOTE: Ohio provides other similar details for various beam and transition types
- Plan at Integral Abutment Diaphragm

Oklahoma

- Abutment Details for P.C. Beams

Rhode Island

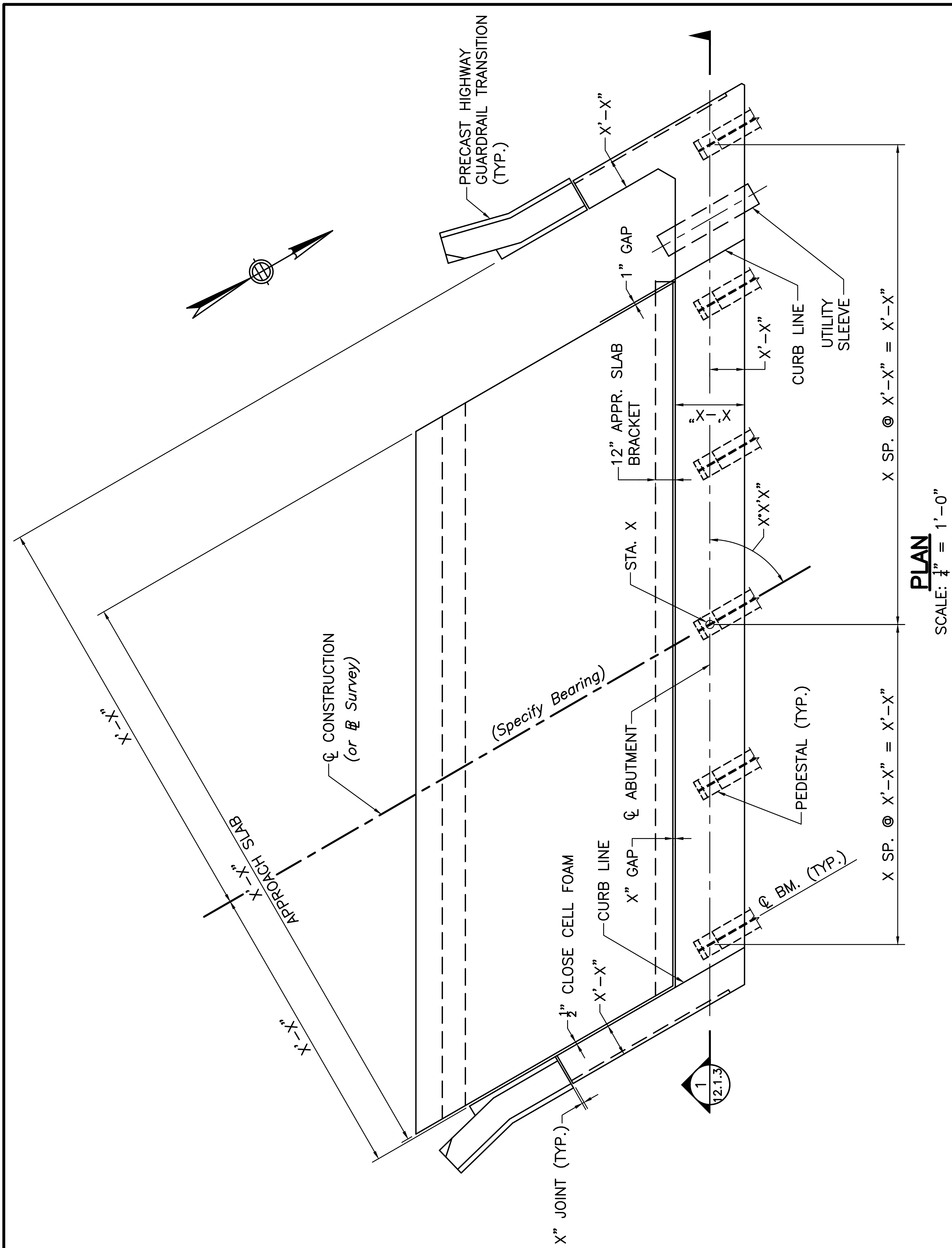
- Integral Abutment Plan at Beam Seats

Pennsylvania

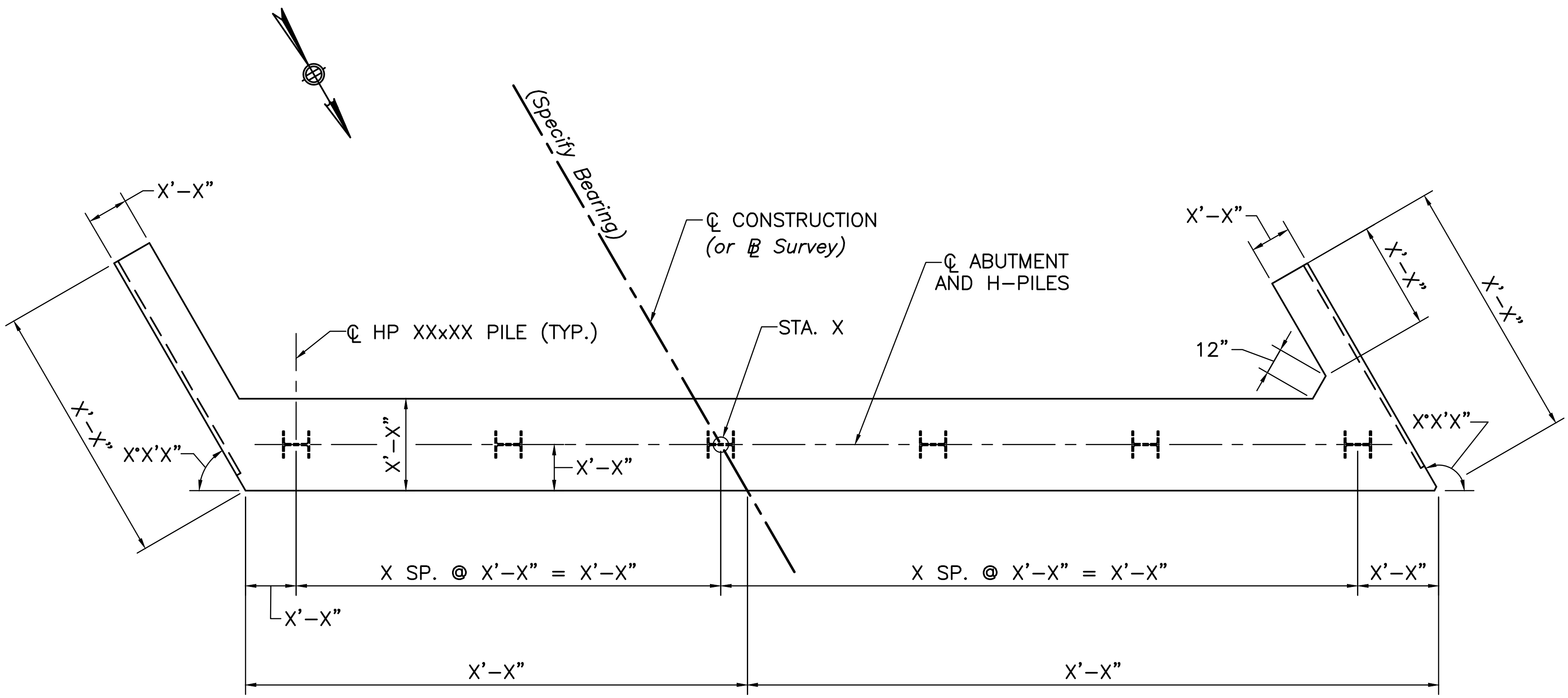
- Typical Plan of Integral Abutment

Wisconsin

- Integral Abutment Plan
  - Slab Span with Fixed Seat
  - Girder Span with Fixed Seat



massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	ABUTMENT PLAN INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.1.2**



SECTION 2

SCALE: $\frac{1}{4}$" = 1'–0"

NOTES:

1. *Stage construction joint(s), if any, shall be shown on the plan view on Construction Drawings.*
2. *The plan view of each abutment shall be shown and aligned with elevation view.*
3. *Show steps in the bridge seat, if any, centered between stringers and square to the abutment centerline. Minimize the number of required steps (refer to Dwg. No. 12.3.1 thru 12.3.4).*
4. *Movement joint between Integral and Independent Wingwalls shall be dimensioned as specified on Dwg. No. 12.1.6.*

massDOT Massachusetts Department of Transportation Highway Division

LRFD BRIDGE MANUAL, PART II

HORIZONTAL SECTION AT BRIDGE SEAT

INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.1.4

MassDOT Massachusetts Department of Transportation Highway Division

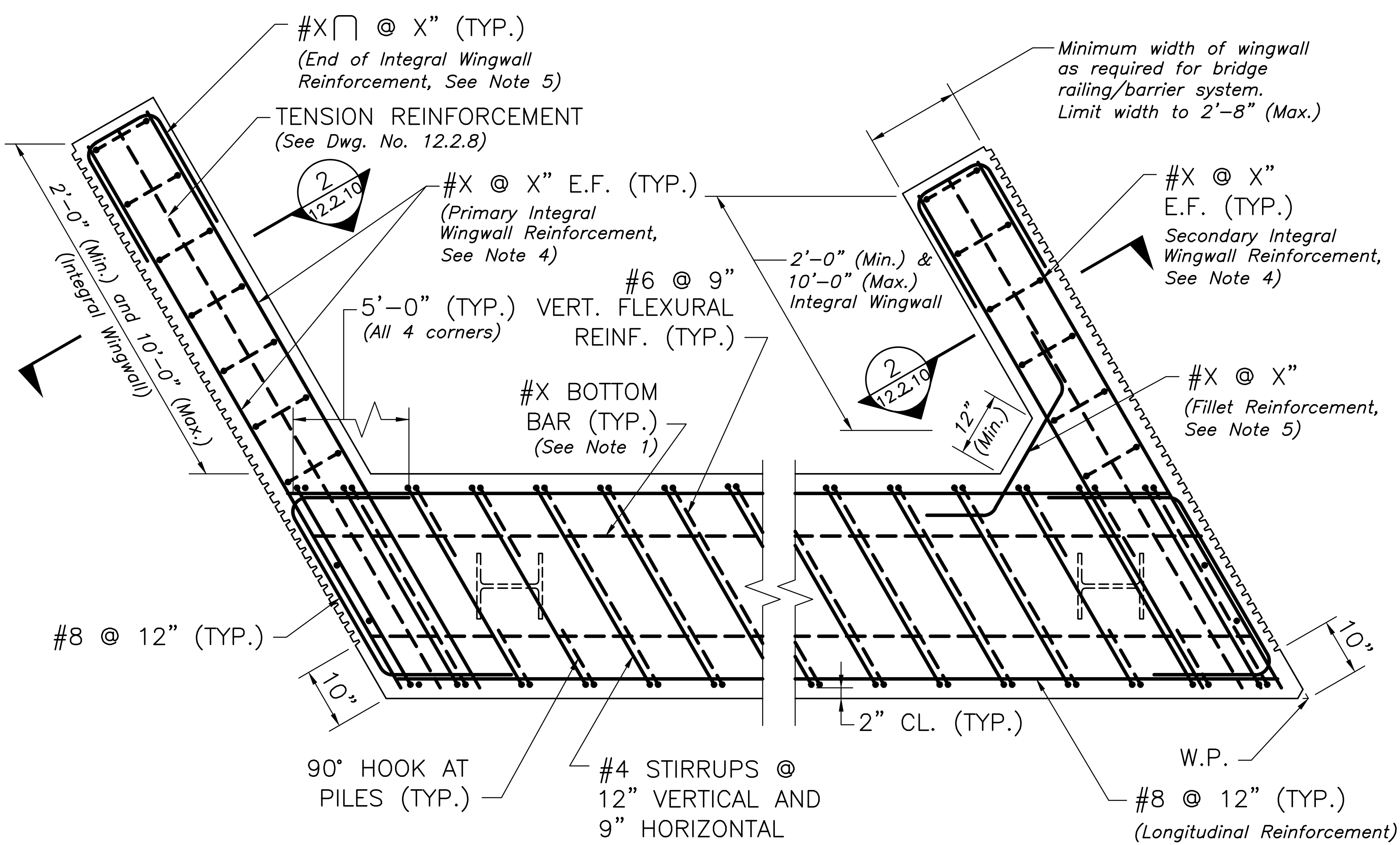
LRFD BRIDGE MANUAL, PART II

HORIZONTAL SECTION

INTEGRAL ABUTMENTS

DATE OF ISSUE JUNE 2013

DRAWING NUMBER **12.2.9**



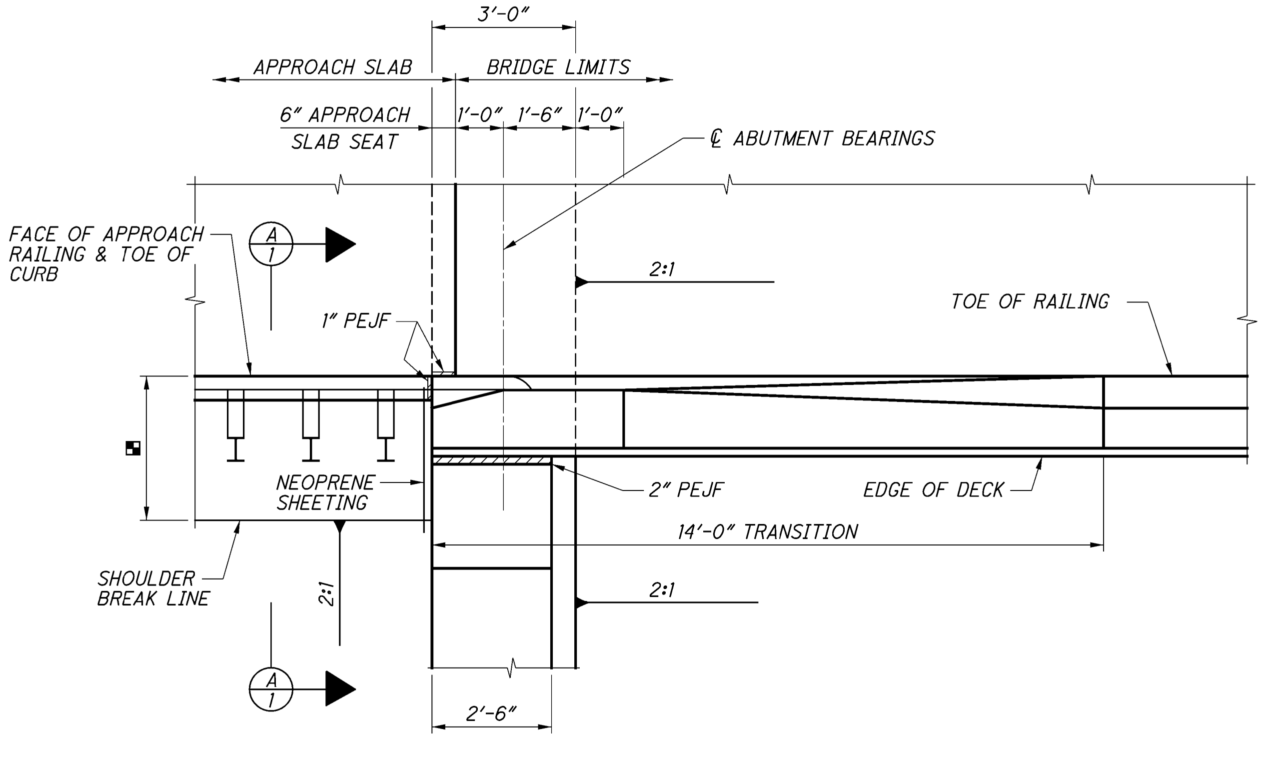
NOTE:

SECTION IS TAKEN BELOW CAP TOP LONGITUDINAL REINFORCEMENT AT BRIDGE SEAT CONSTRUCTION JOINT.

HORIZONTAL SECTION

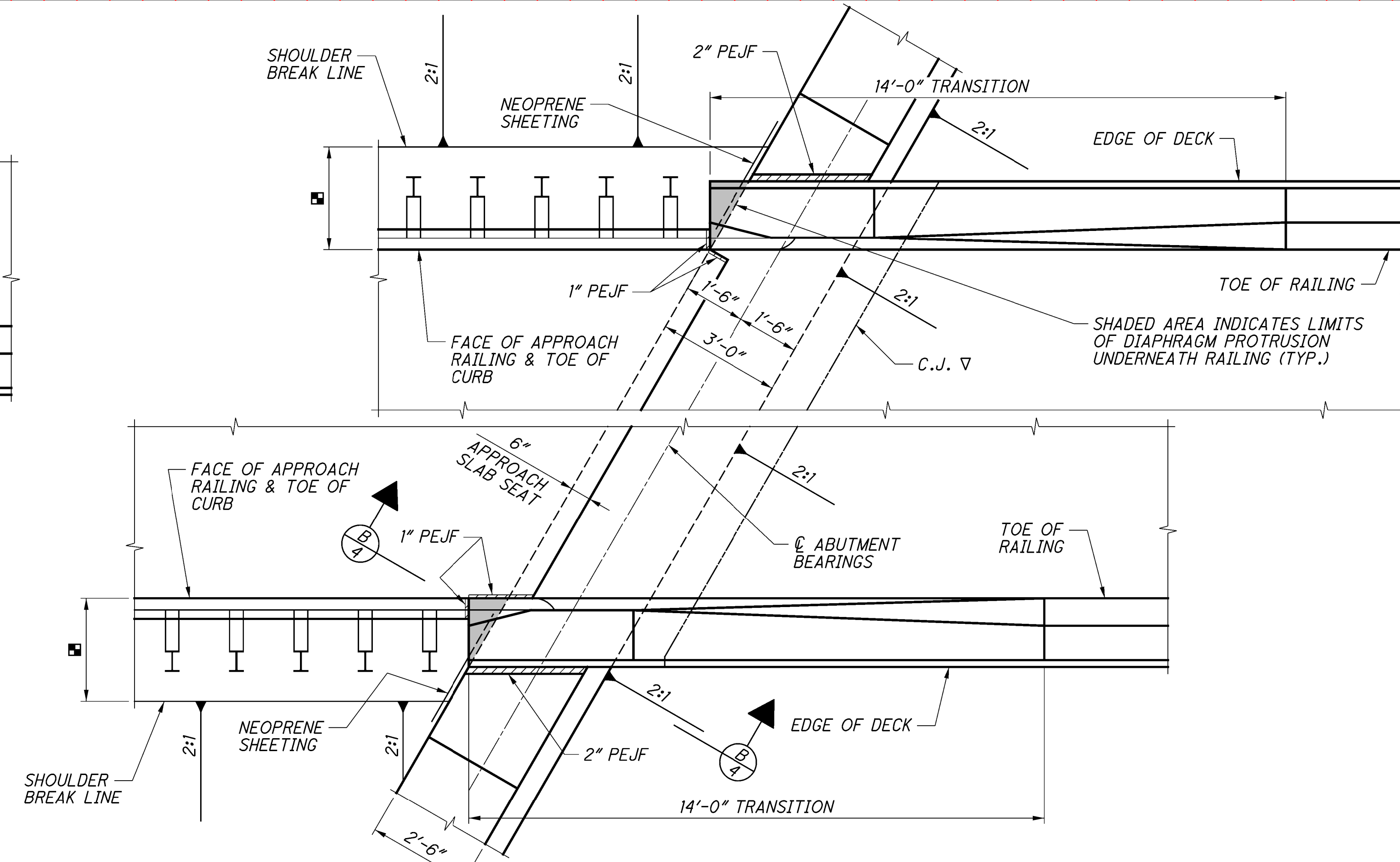
SCALE: $\frac{1}{2}$" = 1'–0"

For Designer Notes see Dwg. No. 12.2.14.



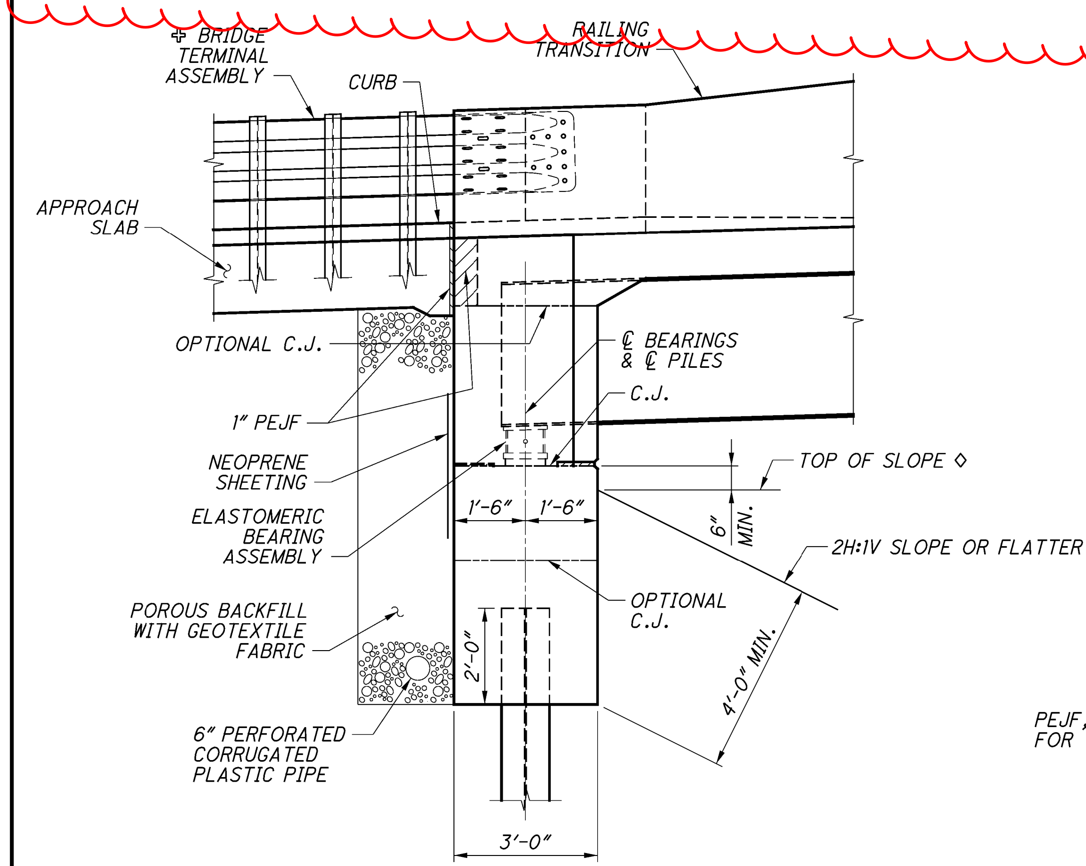
PART PLAN AT ABUTMENT

(SQUARE STRUCTURE WITH CONCRETE RAILING)
(SBR-1-20 SHOWN, SBR-3-20 SIMILAR)

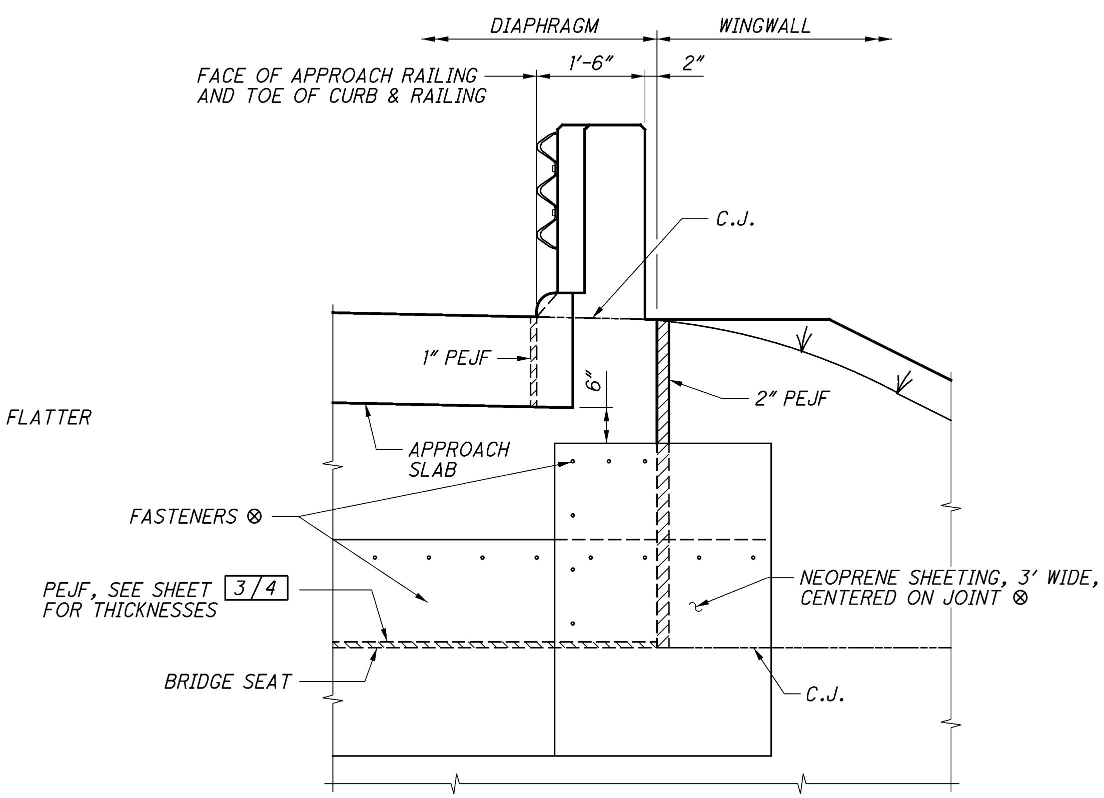


PART PLAN AT ABUTMENT

(STRUCTURE WITH LEFT FORWARD SKEW AND CONCRETE RAILING)
(SBR-1-20 SHOWN, SBR-3-20 SIMILAR)



ELEVATION



SECTION A-A

SHEET 1 NOTES AND LEGEND:

C.J. = CONSTRUCTION JOINT. REFER TO BDM SECTION 304.2.3 FOR DESIGN REQUIREMENTS.

PEJF = PREFORMED EXPANSION JOINT FILLER

⊗ = SEE PROJECT PLANS AND/OR CMS 516.05 FOR ADDITIONAL NEOPRENE SHEETING PLACEMENT REQUIREMENTS.

◪ = SEE ROADWAY TYPICAL SECTION FOR LOCATION OF SHOULDER BREAK LINE.

◇ = TOP OF SLOPE: ON SUPERELEVATED STRUCTURES, A LATERALLY SLOPING "TOP OF SLOPE" MAY BE USED TO AVOID EXCESSIVELY LONG WINGWALLS.

✤ = SEE ROADWAY STANDARD DRAWING MGS-3.1 OR MGS-3.2 FOR BRIDGE TERMINAL ASSEMBLY DETAILS. STATE ON THE PROJECT PLANS WHICH STANDARD DRAWING APPLIES.

∇ = THE CONTRACTOR MAY ELECT TO SUBMIT AN ALTERNATE PROCEDURE THAT PLACES THE DIAPHRAGM AND DECK CONCRETE IN THE SAME POUR; HOWEVER, THIS REQUIRES APPROVAL OF THE ENGINEER.

DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

07-17-20
DATE

ADMINISTRATOR

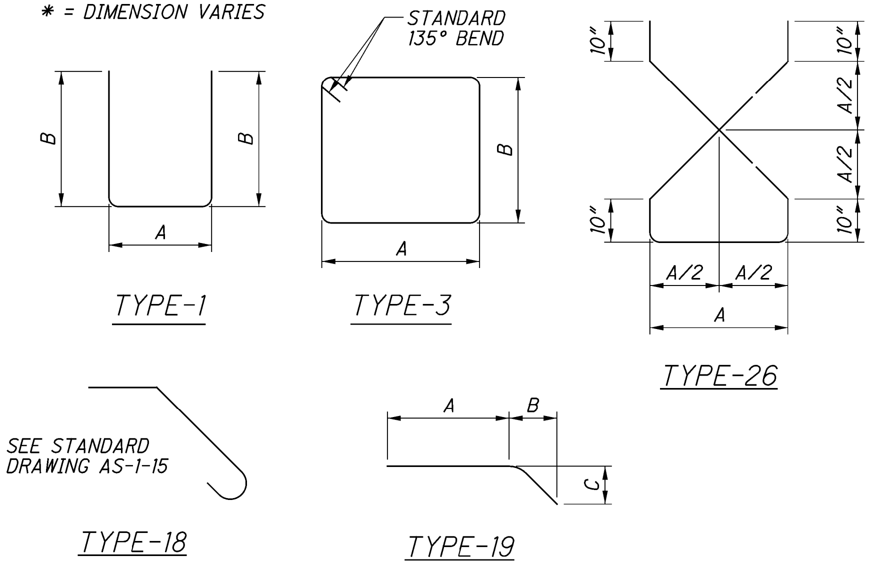
REVISIONS

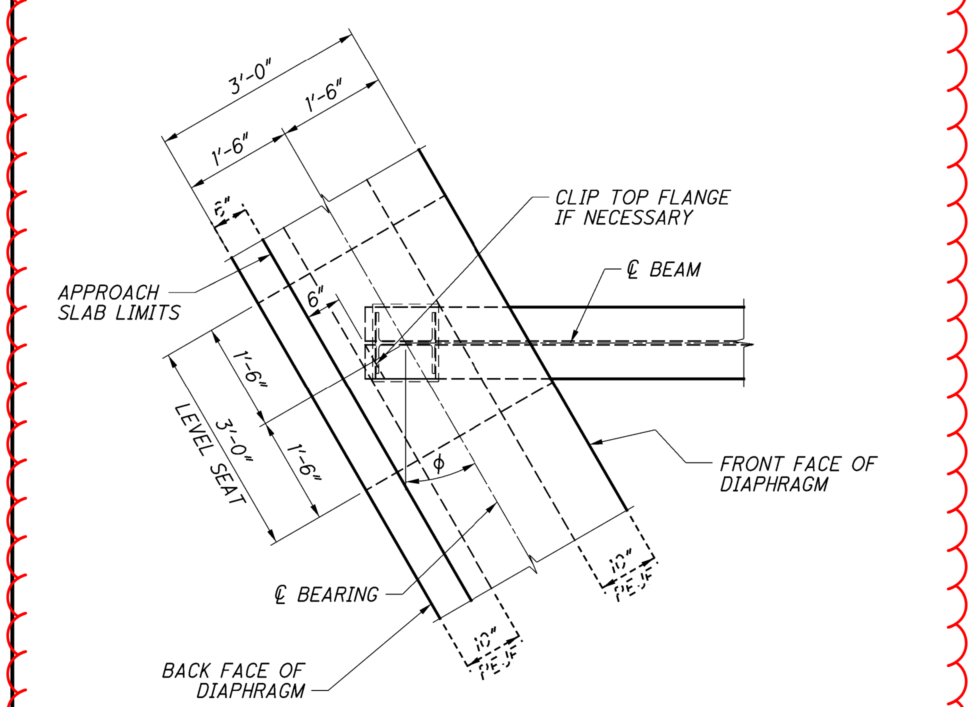
ICD-1-20

STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS

REINFORCING STEEL LIST					
MARK	LENGTH	TYPE	A	B	C
A401	9'-6"	3	2'-6"	2'-0"	
A501	*	1	2'-8"	*	
A502	*	1	2'-2"	*	
A503	SERIES *	1	2'-2"	SERIES *	
A504	*	1	2'-2"	*	
A505	*	1	2'-2"	*	
A506	*	19	*	*	*
A601	*	26			
D401	8'-1"	1	1'-4"	3'-6"	
D501	*	1	2'-8"	*	
D502	*	2	2'-2"	*	
D801	*	18			

* = DIMENSION VARIES





INTEGRAL ABUTMENT PARTIAL PLAN

GENERAL NOTES:

LIMITATIONS:

THIS STANDARD DRAWING PROVIDES PREFERRED AND/ OR TYPICAL DETAILS FOR INTEGRAL ABUTMENTS. TREAT THE ABUTMENT DIMENSIONS, CONSTRUCTION JOINTS AND REINFORCING SHOWN IN THIS DRAWING AS MINIMUM VALUES AND A PERFORM A COMPLETE DESIGN FOR THE ABUTMENT. DO NOT REFERENCE THESE DRAWINGS IN THE CONTRACT PLANS AND DO NOT USE AS STANDALONE CONSTRUCTION DRAWINGS.

PROVIDE ALL INFORMATION REQUIRED TO CONSTRUCT THE ABUTMENT IN THE PROJECT PLANS.

THE INTEGRAL ABUTMENT DETAILS PRESENTED IN THIS DRAWING ARE INTENDED FOR USE ON STRAIGHT OR CURVED ALIGNMENT WITH TANGENT SUPERSTRUCTURES WITH A MAXIMUM SKEW OF 30°. AT 0° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM OR GIRDER BRIDGES IS 267' (400' TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). AT 30° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM AND GIRDER BRIDGES IS 133' (200' TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). FOR SKEWS BETWEEN 0° AND 30°, STRAIGHT LINE INTERPOLATION SHALL BE USED TO DETERMINE THE MAXIMUM PERMISSIBLE EXPANSION LENGTH.

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON A SINGLE ROW OF PILES. ALLOWABLE PILE TYPES AND SIZES, ALONG WITH MINIMUM FRISTION PILE LENGTHS, ARE SHOWN IN THE TABLE BELOW.

PILE SIZE	MINIMUM LENGTH, FT.	
	CLAY	SAND
HP10x42	30	25
HP12x53	35	25
HP14x73	40	30
12" CIP	45	30
14" CIP	50	35

IF THE MINIMUM LENGTH SHOWN IN THE TABLE ABOVE CANNOT BE OBTAINED, THEN THE DESIGNER SHALL PROVIDE CALCULATIONS TO SUPPORT THE USE OF A SHORTER LENGTH, AND, IN THE CASE OF PILES DRIVEN TO REFUSAL ON BEDROCK, REFER TO BDM SECTION 305.3.5.7. THE CALCULATIONS SHALL DEMONSTRATE THAT ADEQUATE LATERAL RESISTANCE IS AVAILABLE, THAT NO LATERAL DEFLECTION OCCURS AT THE BOTTOM OF THE PILES, AND THAT THE COMBINED AXIAL COMPRESSION AND FLEXURE IN THE PILES SATISFIES THE REQUIREMENTS OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

PILE TYPES AND SIZES OTHER THAN THOSE SHOWN IN THE TABLE ABOVE SHALL NOT BE USED UNLESS APPROVED BY THE DEPARTMENT. THE MAXIMUM ALLOWABLE PILE SPACING IS 8'. THE MINIMUM ALLOWABLE PILE SPACING IS 3 PILE DIAMETERS. THE PILE DIAMETER FOR AN HP SHAPE SHALL BE TAKEN AS THE DIAGONAL DISTANCE BETWEEN FLANGE TIPS.

LIMITATIONS CONT'D:

THE HEIGHT OF THE PILE CAP SHALL NOT EXCEED 7'-6".

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON AT LEAST 4 PILES. FOR PHASED CONSTRUCTION PROJECTS, EACH PHASE SHALL BE SUPPORTED ON AT LEAST 4 PILES.

INTEGRAL ABUTMENTS SHALL NOT BE USED WHERE THERE ARE CONCERNS ABOUT SETTLEMENT OR DIFFERENTIAL SETTLEMENT.

DESIGN SPECIFICATIONS:

THIS STRUCTURE SHALL CONFORM TO THE LATEST "LRFD BRIDGE DESIGN SPECIFICATIONS" ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AND THE ODOT BRIDGE DESIGN MANUAL.

DESIGN LOADING:

HL-93 LIVE LOAD
FUTURE WEARING SURFACE (FWS) OF 0.060 KSF

DESIGN DATA:

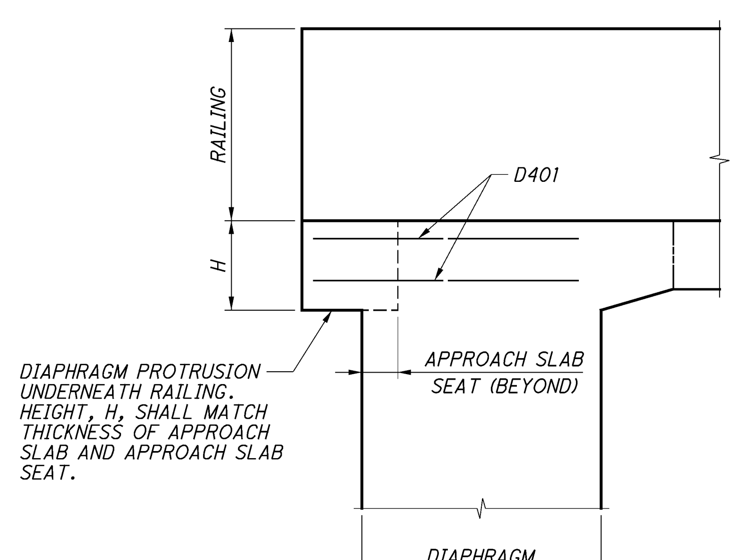
CONCRETE CLASS QC2 - COMPRESSIVE STRENGTH 4.5 KSI (SUPERSTRUCTURE)
CONCRETE CLASS QC1 - COMPRESSIVE STRENGTH 4.0 KSI (SUBSTRUCTURE)
REINFORCING STEEL - MINIMUM YIELD STRENGTH 60 KSI
STRUCTURAL STEEL - ASTM A709 GRADE 36 OR 50 - YIELD STRENGTH 36 OR 50 KSI (THE DESIGNER SHALL SPECIFY THE REQUIRED STEEL GRADE AND YIELD STRENGTH IN THE BRIDGE GENERAL NOTES)
STEEL H-PILES - ASTM A572 - YIELD STRENGTH 50 KSI

PAINTING OF STRUCTURAL STEEL:

THE ENTIRE SURFACE AREA ENCASED WITHIN THE ABUTMENT DIAPHRAGM AND EXTENDING 1'-0" OUTSIDE THE DIAPHRAGM, SHALL BE COATED WITH A SHOP APPLIED, INORGANIC ZINC PRIME COAT ACCORDING TO C&MS 514. NO ADDITIONAL COATINGS ARE REQUIRED ON THE EMBEDDED STEEL SURFACES. THE COST OF APPLYING THE PRIME COAT IS INCIDENTAL TO THE BID FOR STRUCTURAL STEEL. REPAIR COATING DAMAGED BY WELDING ACCORDING TO C&MS 514.22.

ELASTOMERIC BEARING ASSEMBLY:

UTILIZE A WIDE FLANGE SHAPE IN LIEU OF AN HP SHAPE IN THE BEARING ASSEMBLY IF THE STRUCTURAL STEEL FOR THE MAIN MEMBER IS WEATHERING STEEL.



SECTION B-B
(APPLIES AT BOTH ENDS OF ABUTMENT)
(BEAM & APPROACH RAILING NOT SHOWN)

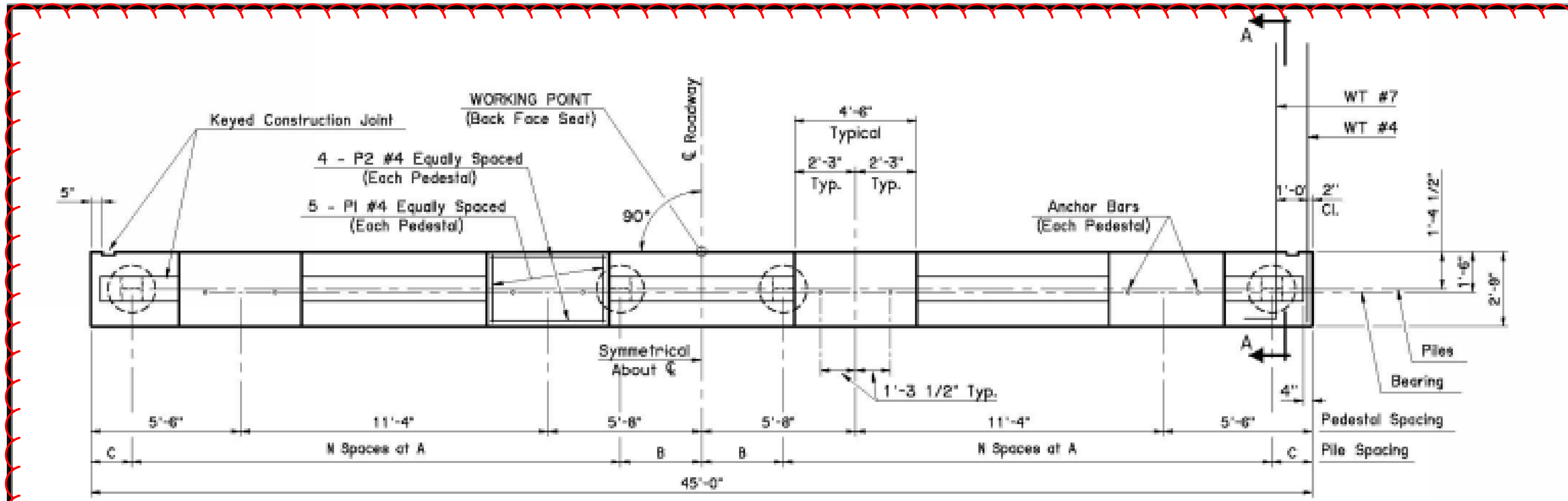
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
07-17-20
DATE
ADMINISTRATOR

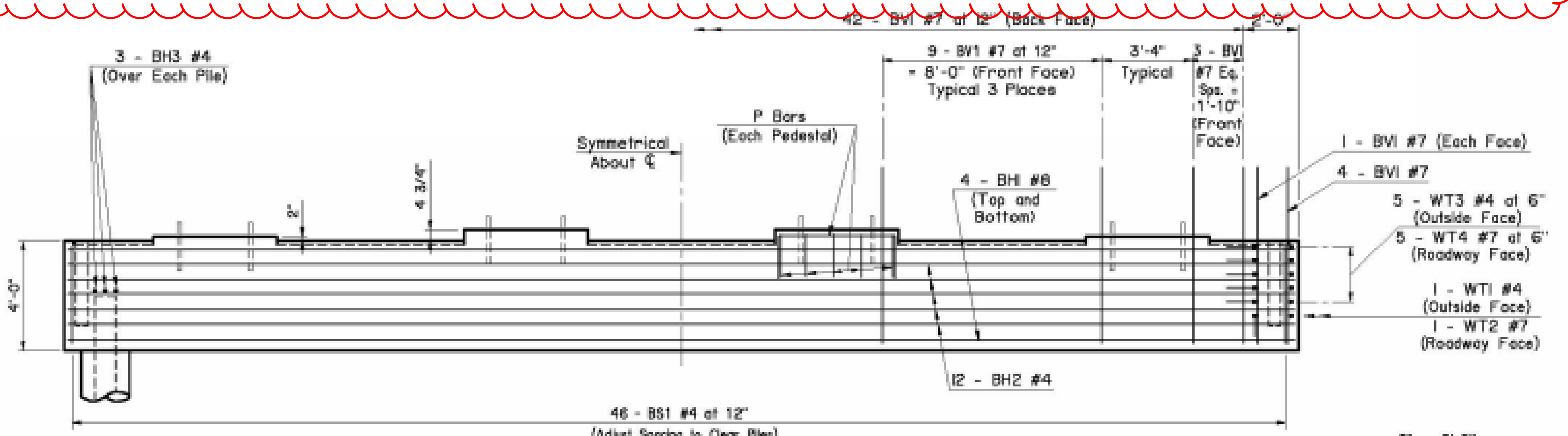
REVISIONS

ICD-1-20

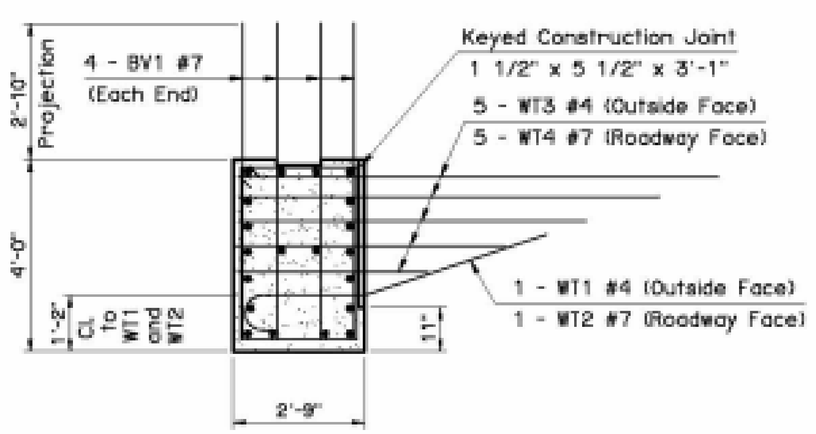
STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS



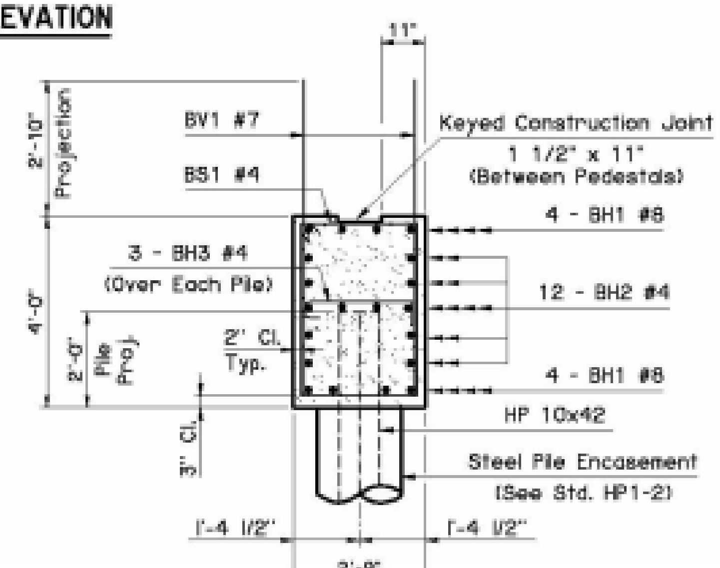
PLAN



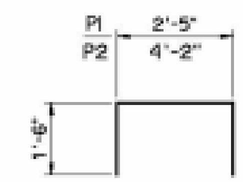
ELEVATION



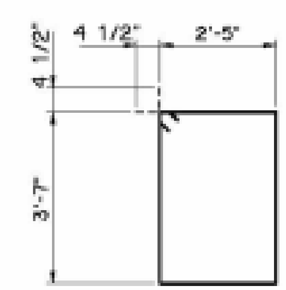
SECTION A-A



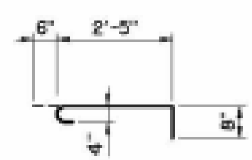
TYPICAL SECTION THRU SEAT



P1 #4 x 5'-5"
P2 #4 x 7'-2"

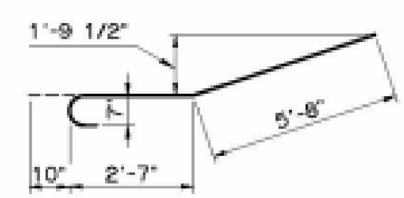


BS1 #4 x 12'-9"

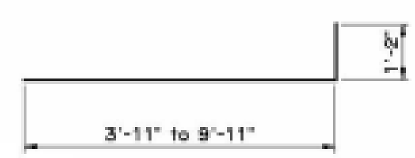


BH3 #4 x 3'-7"

WT1 #4 x 5'-2"



WT2 #7 x 9'-1"



WT4 #7 x 8'-1" Avg.

PILE SCHEDULE						
SPAN	TOTAL NUMBER OF PILES	N	A	B	C	MAXIMUM FACTORED PILE LOAD
65'	8	3	5'-8"	2'-10"	2'-8"	74.6 TON
70'	8	3	5'-8"	2'-10"	2'-8"	77.3 TON
75'	9	4	5'-0"	0"	2'-6"	71.1 TON
80'	9	4	5'-0"	0"	2'-6"	73.4 TON
85'	9	4	5'-0"	0"	2'-6"	75.7 TON
90'	9	4	5'-0"	0"	2'-6"	78.1 TON
95'	10	4	4'-6"	2'-3"	2'-3"	72.3 TON
100'	10	4	4'-6"	2'-3"	2'-3"	74.4 TON

Place all WT Wing reinforcing tied to Abutment Seat reinforcing before placing Abutment Seat concrete. Do not place Abutment Wing concrete until concrete for the Abutment Diaphragm and Deck Slab have attained a strength of 3000 p.s.i. For additional details, see ABUTMENT DIAPHRAGM DETAILS (SHEET 1 OF 2 AND SHEET 2 OF 2) and ABUTMENT WING DETAILS (SHEET 2 OF 2).

	ABUTMENT SEAT BAR LIST					
	MARK	SIZE	NO.	FORM	LENGTH	LENGTH VARIATION
	EPOXY COATED REINFORCING					
	BV1	#7	87	STR.	6'-7"	
	BH1	#8	8	STR.	44'-8"	
	BH2	#4	12	STR.	44'-8"	
	BS1	#4	46	BNT.	12'-9"	
	P1	#4	20	BNT.	5'-5"	
	P2	#4	16	BNT.	7'-2"	
	WT1	#4	2	BNT.	5'-2"	
	WT2	#7	2	BNT.	9'-1"	
①	WT3	#4	10	STR.	6'-11" AVG.	3'-11" to 9'-11"
①	WT4	#7	10	BNT.	8'-1" AVG.	5'-1" to 11'-1"
	8 PILE ABUTMENT					
	BH3	#4	24	BNT.	3'-7"	
	9 PILE ABUTMENT					
	BH3	#4	27	BNT.	3'-7"	
	10 PILE ABUTMENT					
	BH3	#4	30	BNT.	3'-7"	

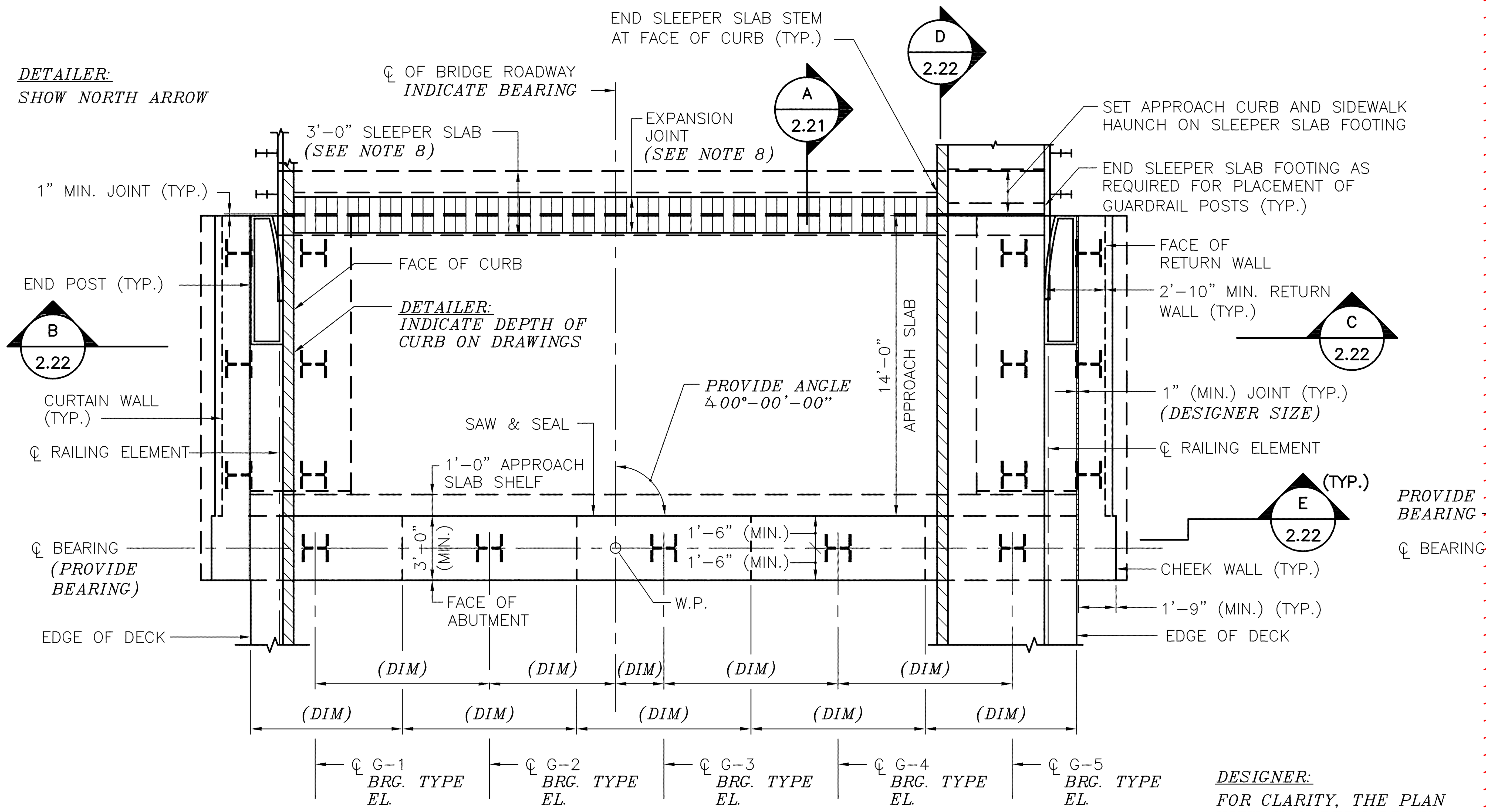
① 2 Sets of 5

APPROVED BY BRIDGE ENGINEER [signature] DATE 4/2/10

OKLAHOMA DEPT. OF TRANSPORTATION
BRIDGE STANDARD (ENGLISH)

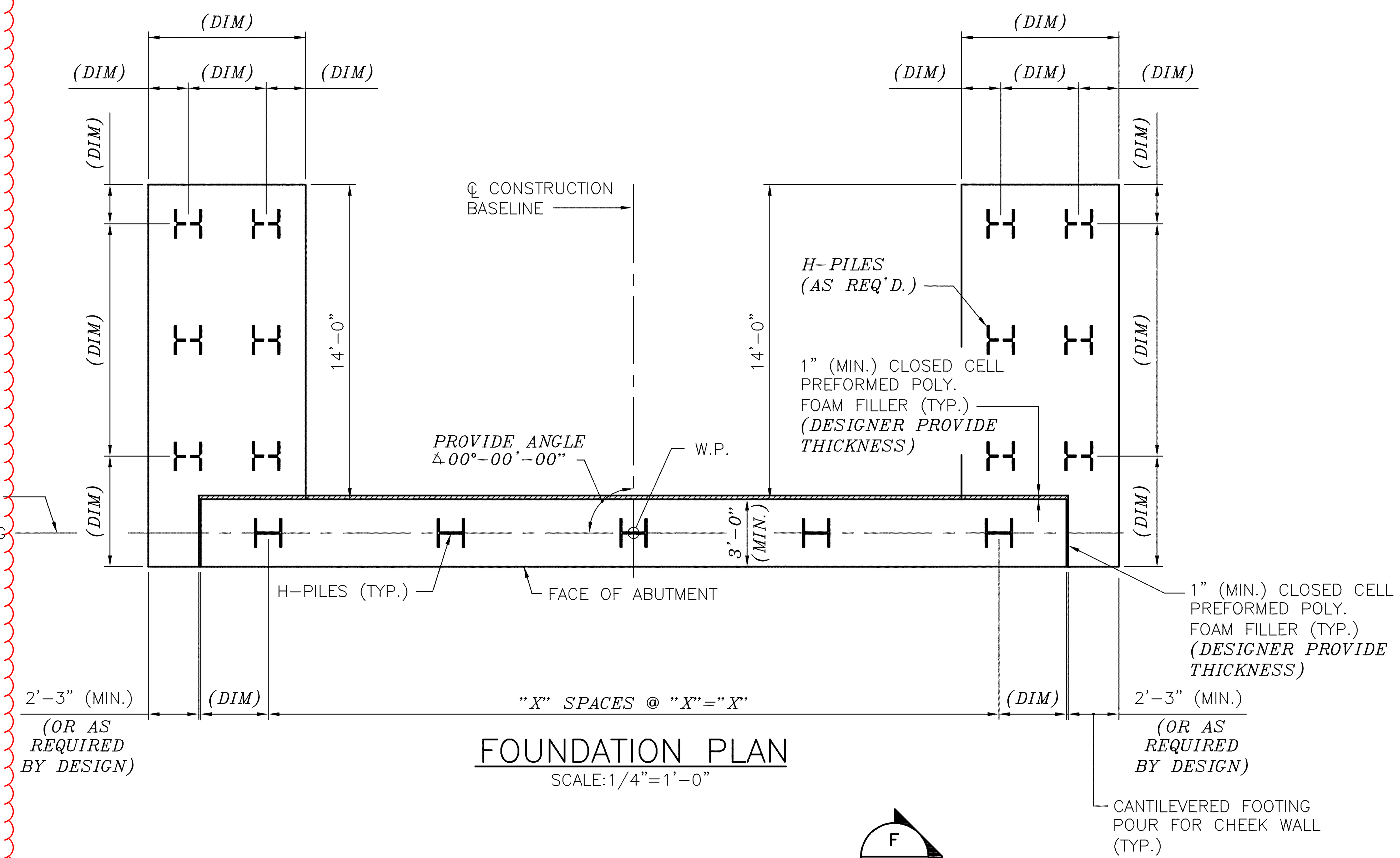
ABUTMENT DETAILS
TYPE IV P.C. BEAMS
INTEGRAL (SHEET 1 OF 2)

2009 SPECIFICATIONS	B40-I-ABUT-PC4-1	01E
		B-44E

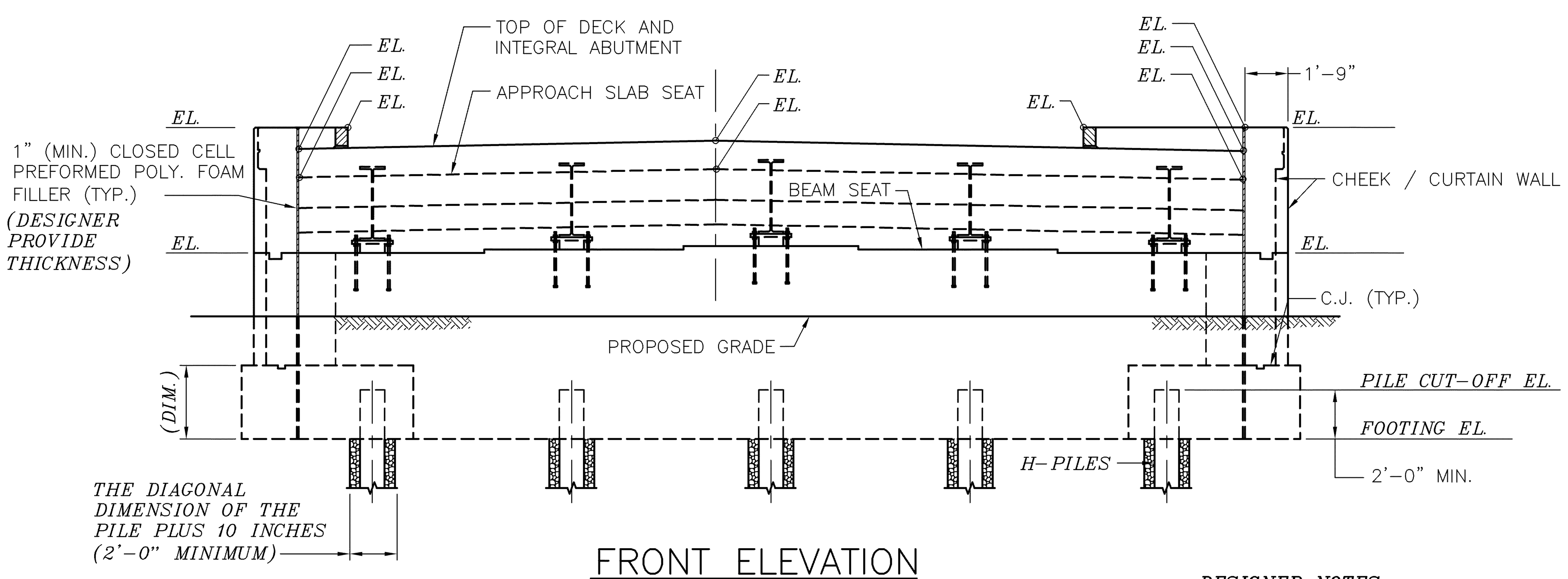


DESIGNER:
FOR CLARITY, THE PLAN VIEW HAS BEEN DRAWN WITHOUT THE BEAMS AND ANCHOR ASSEMBLIES.

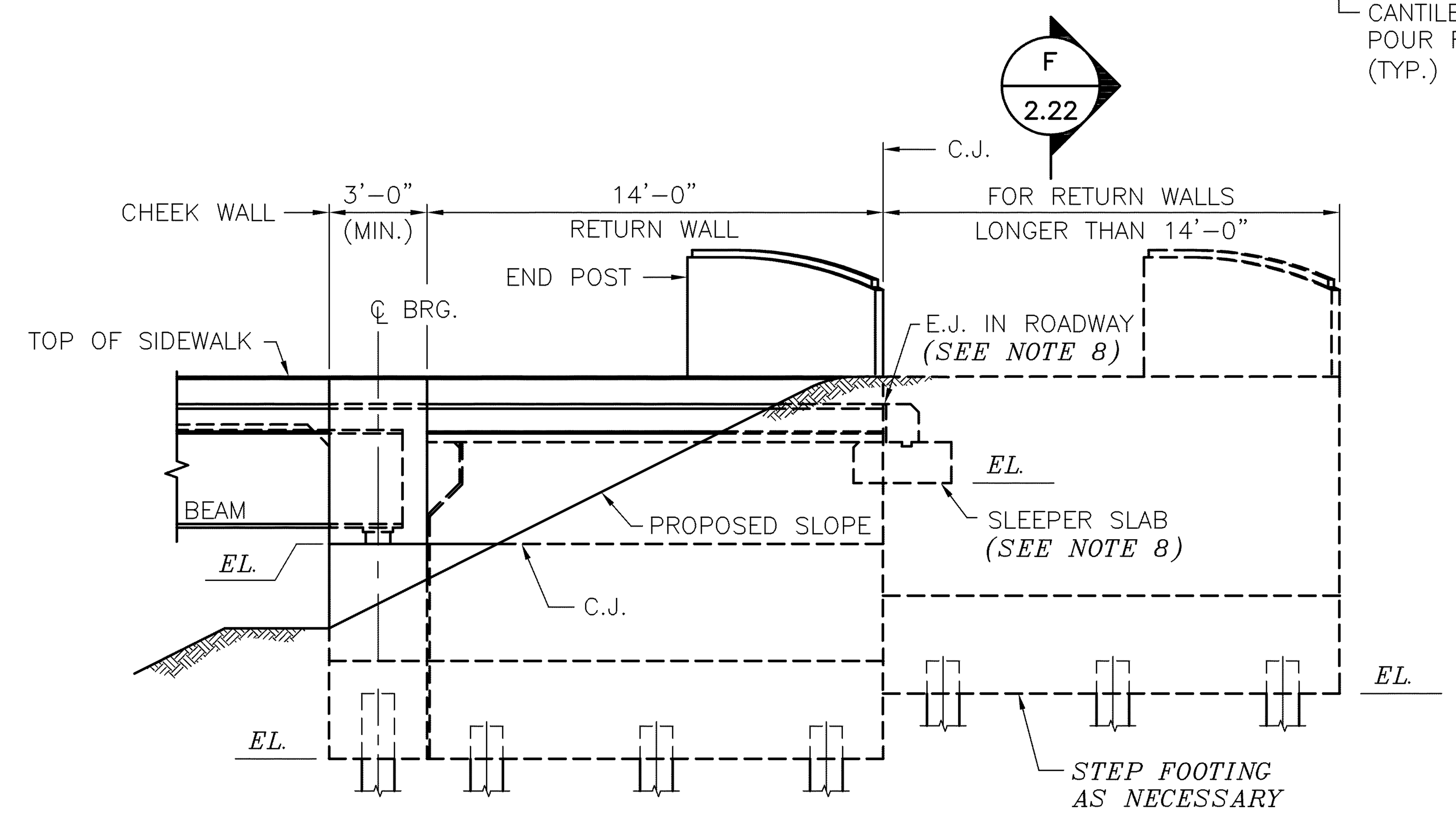
PLAN AT BEAM SEATS
SCALE:1/4"=1'–0"



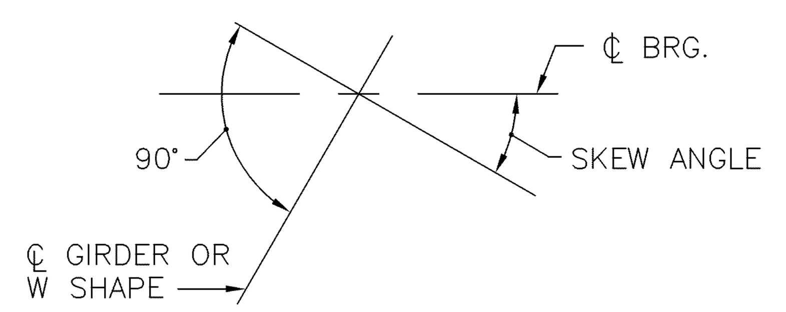
FOUNDATION PLAN
SCALE:1/4"=1'–0"



FRONT ELEVATION
SCALE:1/4"=1'–0"



RETURN WALL AT SIDEWALK / SAFETY WALK
SCALE:1/4"=1'–0"



SKEW ANGLE DESIGNATION

DESIGNER NOTES:

1. *THE DESIGNER SHALL REFER TO SECTION 11.3.3 (INTEGRAL ABUTMENTS) OF THE RIDOT LRFD BRIDGE DESIGN MANUAL FOR DESIGN AND DETAILING REQUIREMENTS AND LIMITATIONS ON THE USE OF INTEGRAL ABUTMENTS*
2. *A NOTE SHALL BE PROVIDED ON THE CONTRACT DRAWINGS STATING THAT THE TOP OF DECK ELEVATIONS ARE GIVEN AT THE FRONT FACE OF INTEGRAL ABUTMENTS.*
3. *UTILITY PASSAGE THROUGH THE INTEGRAL ABUTMENT SHOULD BE AVOIDED. (SEE SECTION 11.3.3 OF THE RIDOT LRFD BRIDGE DESIGN MANUAL).*
4. *ABUTMENT DETAILS FOR SKEWED ABUTMENTS ARE SIMILAR.*
5. *REINFORCING SHOWN IS MINIMUM ONLY.*
6. *THE SUGGESTED SCALE FOR ANY ABUTMENT PLAN AND ELEVATION IS 1/4"=1'–0".*
7. *REFERENCES TO END POSTS AND CENTERLINES OF RAILING ELEMENTS ARE INTENDED TO REFER TO THE DETAILS SHOWN ELSEWHERE IN THESE BRIDGE STANDARDS (SEE APPROPRIATE DETAILS).*
8. *SLEEPER SLAB AND EXPANSION JOINT IN ROADWAY MAY BE OMITTED FOR BRIDGE SUPERSTRUCTURE SPANS 60 FEET OR LESS.*
9. *SEE DWG. 2.22 FOR RETURN WALL DETAILS*

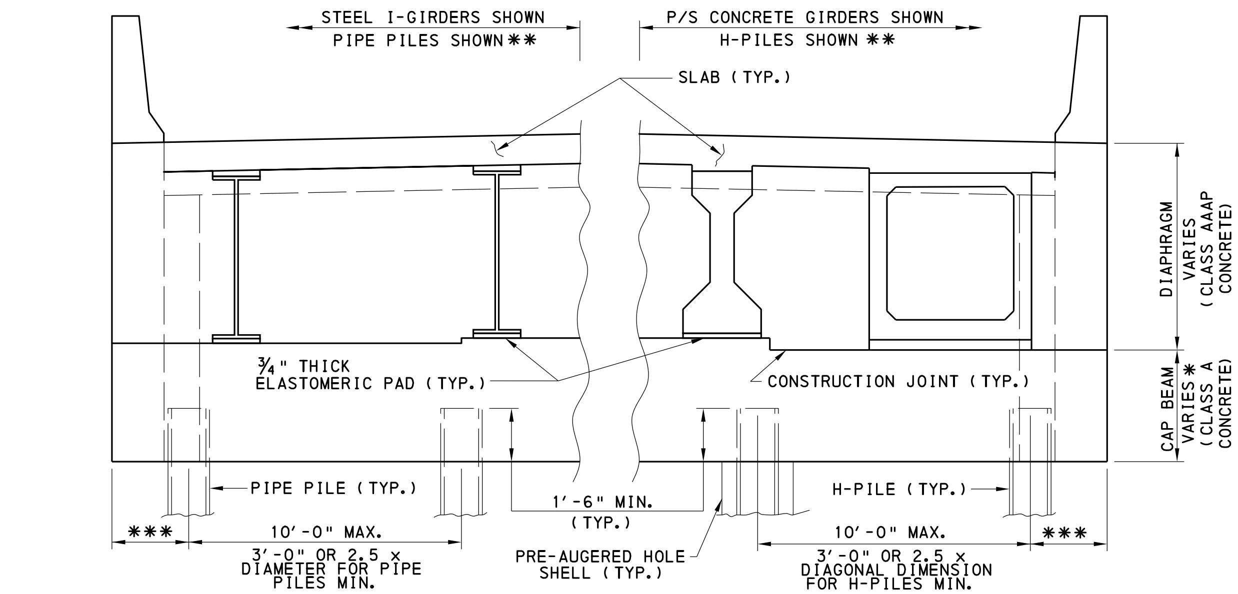
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

INTEGRAL ABUTMENT
SHEET 1

DRAWING NUMBER: 2.20



TYPICAL ELEVATION

* DEPTH OF ABUTMENT BELOW CONSTRUCTION JOINT IS 3'-3" AT SHALLOWEST POINT (SEE DM-4 AP.G.1.4.1) THE MAXIMUM DIFFERENCE BETWEEN THE MINIMUM AND MAXIMUM CAP DEPTH WILL NOT EXCEED 1'-0" FOR SKEW <80° OR 1'-6" FOR SKEW ≥ 80°.

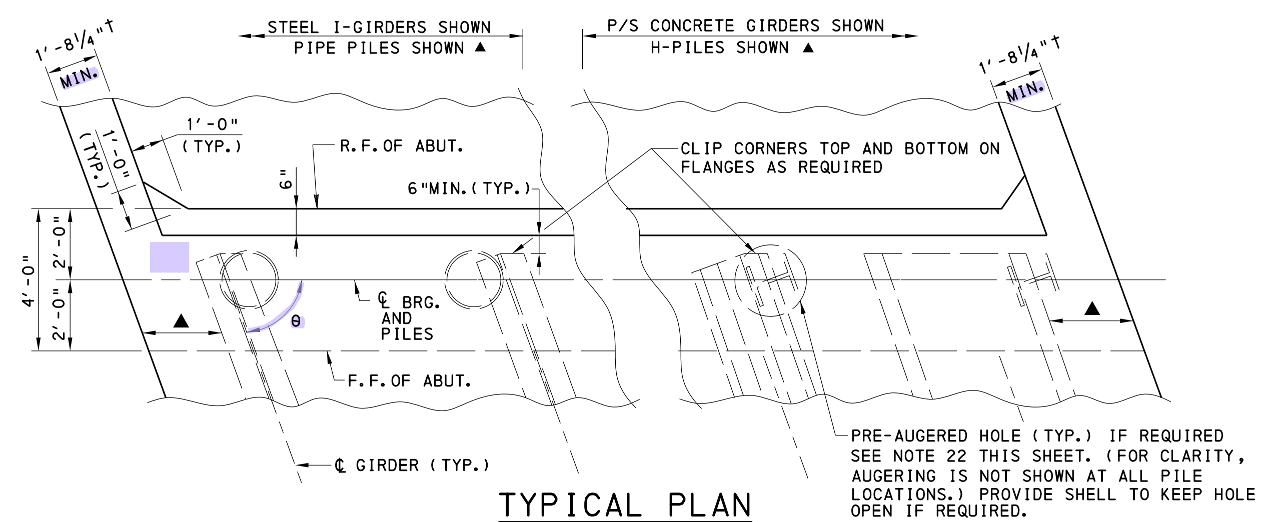
** BOTH H-PILES AND PIPE PILES MAY BE USED WITH STEEL OR CONCRETE GIRDERS. GALVANIZE TOP 15'-0" LENGTH OF THE PILES OR ENTIRE PILES LENGTH.

*** THE MAXIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 2'-6" AND $\frac{(W+dpile/2)}{\sin(\theta)}$ (ROUNDED UP TO THE NEXT 3" INCREMENT)
- WHERE: W: WIDTH OF WINGWALL AT REAR FACE OF INTEGRAL ABUTMENT, NEGLECTING THE 1' HAUNCH (ft.)
- dpile: OUTSIDE DIAMETER FOR PIPE PILES OR PILE DEPTH FOR H-PILES (ft.)

THE MINIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 1'-6"
- THE DISTANCE REQUIRED TO PROVIDE 3" CLEARANCE FROM THE PILES ~~TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALL.~~



TYPICAL PLAN

† ~~WINGWALL WIDTH MAY VARY BASED ON BARRIER TYPE SELECTED.~~

▲ EXTERIOR BEAMS TO BE LOCATED TO PROVIDE 3" CLEAR TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALLS.

DETACHED WINGWALL NOTES

1. DETERMINE THE MOVEMENT REQUIREMENTS AND THE OPENING OF THE EXPANSION DAM FOR THE EXPANSION JOINT BETWEEN THE ABUTMENT AND DETACHED WINGWALLS, AT THE TIME OF CONSTRUCTION, IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.6.
2. BOND THE PREFORMED NEOPRENE COMPRESSION SEAL BETWEEN THE ABUTMENT AND THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO BOTH THE ABUTMENT AND THE DETACHED WINGWALL.
3. BOND THE CLOSED CELL NEOPRENE SPONGE IN THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO THE WINGWALL. RECESS THE NEOPRENE SPONGE 1/2" INTO THE WINGWALL.
4. THE WATERPROOFING MEMBRANE ACROSS THE EXPANSION JOINT BETWEEN THE INTEGRAL ABUTMENT AND DETACHED WINGWALLS WILL BE IN ACCORDANCE WITH PUBLICATION 408, SECTION 680. THE MEMBRANE SHALL SPAN THE WIDTH OF THE RECESS IN THE ABUTMENT AND IN THE DETACHED WALL, AND SHALL HAVE 8" BONDED ON EACH SIDE. THE LENGTH OF THE MEMBRANE SHALL BE 6" LONGER THAN THE SPANNED LENGTH (i.e. 6" SLACK) AT THE TIME OF INSTALLATION. SEE DETAIL P ON SHEET 6.
5. PAINT THE CONTACT SURFACE BETWEEN THE APPROACH SLAB AND WINGWALL WITH AN APPROVED BOND BREAKER AND SEAL WITH AN APPROVED SEALER.

GENERAL NOTES

1. ALL DIMENSIONS GIVEN IN U.S. CUSTOMARY UNITS.
2. DESIGN SPECIFICATIONS
   - AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
   - PENNDOT DESIGN MANUAL PART 4, VOLUME 1, PART B: DESIGN SPECIFICATIONS AND VOLUME 2, APPENDIX G
3. PROVIDE MATERIALS AND WORKMANSHIP IN ACCORDANCE WITH PUBLICATION 408 AND THE CONTRACT SPECIAL PROVISIONS.
4. MATERIAL STRENGTH
   - REINFORCEMENT STEEL fy = 60 KSI
   - CONCRETE f'c = 4000 PSI (CLASS AAAP CONCRETE) FOR DECK SLABS, APPROACH SLABS, AND END DIAPHRAGMS AND WINGWALLS ABOVE CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3500 PSI (CLASS AA CONCRETE) FOR BARRIERS, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3000 PSI (CLASS A CONCRETE) FOR CAP BEAM AND WINGWALLS BELOW CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 9.
5. DEAD LOAD
   - DENSITY OF NORMAL WEIGHT CONCRETE = 150 PCF
   - FUTURE WEARING SURFACE = 30 PSF
6. LIVE LOAD
   - LIVE LOAD IS CALCULATED ASSUMING ALL POTENTIAL LANES ARE LOADED. USE A MULTIPLE PRESENCE FACTOR OF 1.0 FOR DESIGN OF THE INTEGRAL ABUTMENT CAP AND SUPPORTING PILES.
   - THE LIVE LOAD IS ASSUMED TO BE EVENLY DISTRIBUTED TO ALL PILES.
7. DYNAMIC LOAD ALLOWANCE (IM) = 33% IS APPLIED TO LIVE LOADS ON THE ABUTMENTS AND THE PILES IN ACCORDANCE WITH ARTICLES A3.6.2.1 AND D3.6.2.1.
8. DESIGN CONTROLS
   - CONCRETE COVER: INTEGRAL ABUTMENT (i.e., CAP BEAM AND END DIAPHRAGM) AND WINGWALLS = 3"
   - UNLESS OTHERWISE INDICATED, USE THE FOLLOWING MINIMUM REINFORCEMENT SPLICE LENGTHS:

#4	2'-1"	#6	3'-1"	#8	5'-1"	#10	8'-2"
#5	2'-7"	#7	3'-10"	#9	6'-5"	#11	10'-0"

   - BAR SIZE: MAXIMUM BAR SIZE #11
     MINIMUM BAR SIZE #4
9. FOR DESIGN CONTROLS OF DECK AND BARRIERS, SEE STANDARD DRAWING BD-601M.
10. USE ONLY ONE ROW OF VERTICAL PILES PER ABUTMENT. PILES MAY BE H-PILES OR PIPE PILES. FOR H-PILES, ORIENT THE WEB PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE GIRDER OF THE END SPAN. TAPERED PILES MAY BE USED PROVIDED THE TAPER POINT IS BELOW THE POINT OF CONTRAFLEXURE.
11. ALL REINFORCING BARS ARE TO BE EPOXY COATED.
12. USE ONLY NORMAL WEIGHT CONCRETE FOR WINGWALLS AND ABUTMENTS.
13. DETAIL ALL BARS ON THE CONTRACT DRAWINGS.
14. PROVIDE A TROWEL SMOOTH SURFACE OF THE CONSTRUCTION JOINT DIRECTLY UNDER THE GIRDERS AND THE AREA EXTENDING 2" OUTSIDE OF THAT AREA. ON ALL OTHER CONSTRUCTION JOINTS, PROVIDE A RAKED SURFACE.
15. PROVIDE 3/4" THICK, 50 DUROMETER NEOPRENE PADS UNDER ALL GIRDERS. ALL PADS WILL BE 12" ALONG THE LENGTH OF THE BEAM AND MATCH THE WIDTH OF THE BEAM MINUS ANY CHAMFERS. BLOCK THE AREAS UNDER THE GIRDERS NOT IN CONTACT WITH THE BEARING PADS USING 1" THICK BACKER RODS.
16. TAKE LIMITS OF FILL BEHIND THE ABUTMENT AND THE WINGWALLS AS SHOWN ON STANDARD DRAWING RC-12M.
17. FOR DETAILS OF INSERTS IN PRECAST CONCRETE BEAMS, SEE STANDARD DRAWING BD-655M IN ADDITION TO SHEETS 2 AND 8 OF THIS STANDARD.
18. FOR DETAILS OF APPROACH SLABS FOR INTEGRAL ABUTMENT BRIDGES, SEE STANDARD DRAWING BD-628M.
19. PLACE ALL GIRDERS, INCLUDING BOX BEAMS, WITH THEIR WEBS VERTICAL. STEP TOP OF CAP BEAM TO PROVIDE THE CORRECT BEAM SEAT ELEVATION. CHANGE HAUNCH THICKNESS ACROSS THE WIDTH OF THE GIRDERS TO PROVIDE THE CORRECT ROADWAY CROSS-SLOPE AND SUPERELEVATION. SLOPE BEAM SEAT IN THE LONGITUDINAL DIRECTION TO MATCH BOTTOM OF BEAM.
20. THE BOTTOM OF THE ABUTMENT MAY BE HORIZONTAL. HOWEVER, THE VARIATION IN THE PILE CAP DEPTH FROM ONE END OF THE ABUTMENT TO THE OTHER DUE TO SUPERELEVATION IS LIMITED TO 1'-6" [1'-0" FOR SKEWS LESS THAN 80 DEGREES]. FOR SUPERELEVATIONS THAT WOULD RESULT IN GREATER VARIATIONS, THE BOTTOM OF THE ABUTMENT MUST BE PARALLEL TO THE SLOPE OF THE ROADWAY. FOR THE REINFORCEMENT SHOWN, THE PILE CAP IS TO BE A MINIMUM 3'-3" THICK, WITH A MAXIMUM DEPTH OF 4'-3" FOR SKEWS LESS THAN 80 DEGREES, AND A MAXIMUM DEPTH OF 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES. PILE CAP DEPTHS GREATER THAN 4'-3" FOR SKEWS LESS THAN 80 DEGREES AND PILE CAP DEPTHS GREATER THAN 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES MUST BE APPROVED BY CHIEF BRIDGE ENGINEER.
21. INTEGRAL ABUTMENTS AT OPPOSITE ENDS OF A BRIDGE SHALL BE THE SAME DEPTH EXCEPT FOR VARIATIONS DUE TO DIFFERENCES IN ROADWAY CROSS SLOPE OR SUPERELEVATION. THE BEAM SEAT MUST BE PARALLEL TO THE ROADWAY GRADE, IN THE LONGITUDINAL DIRECTION.
22. DETERMINE THE MINIMUM DIAMETER OF THE PRE-AUGERED HOLES IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.4.2.1.
23. BEAM DEPTH IS RESTRICTED TO A 6'-0" MAXIMUM DEPTH WHEN USED FOR INTEGRAL ABUTMENT UNLESS APPROVED BY CHIEF BRIDGE ENGINEER.
24. USE OF ADJACENT BOX BEAMS IS NOT PERMITTED, DETAILS FOR BEAMS LESS THAN 1'-5" ARE NOT INCLUDED IN THIS STANDARD.
25. SKEW LIMITATION FOR INTEGRAL ABUTMENTS PER SECTION 1.2.2 OF DESIGN MANUAL, PART 4 APPENDIX "G".
26. FLARED WINGWALLS ARE NOT TO BE USED WITH INTEGRAL ABUTMENTS. REFERENCE APPENDIX "G" OF DESIGN MANUAL PART 4 SECTION 1.4.4.
27. BOTH THE TYPICAL AND ALTERNATE SIDEWALK DETAILS MAY BE USED ON INTEGRAL ABUTMENT BRIDGES. IF USED, THOSE DETAILS MUST BE CARRIED THROUGH THE APPROACH SLAB.
28. ALL REINFORCEMENT STEEL BARS SHOWN MEET THE REQUIREMENTS OF ASTM A 615, A 996 OR A 706.
29. THE STLRFD SOFTWARE REQUIRES BEARING STIFFENERS AT THE CENTERLINE OF BEARING AND ALSO CONSIDERS THE GIRDERS TO BE LATERALLY BRACED AT THE CENTERLINE OF BEARING. THE DESIGNER IS RESPONSIBLE FOR DETAILING THE BEARING STIFFENERS. THE LATERAL BRACING (END DIAPHRAGM) IS TO BE OMITTED AND THE FOLLOWING NOTE ADDED TO THE CONSTRUCTION DRAWINGS:
    - THE CONTRACTOR IS RESPONSIBLE FOR TEMPORARY BRACING OF THE GIRDERS. PLACE THE #8 REINFORCEMENT BARS THROUGH THE BEAMS AND THE CAP FORMWORK PRIOR TO PLACING ANY DECK CONCRETE.
30. SUPERSTRUCTURE MUST BE ERECTED AND CONNECTED TO THE INTEGRAL ABUTMENTS PRIOR TO PLACING BACKFILL BEHIND THE ABUTMENTS.
31. IF AN INTEGRAL ABUTMENT BRIDGE IS BEING REDECKED, THE END DIAPHRAGM MUST BE REMOVED COMPLETELY PRIOR TO DECK REMOVAL TO AVOID SUBJECTING THE GIRDERS TO STRUCTURE AND PAVEMENT TEMPERATURE FORCES AND EARTH PRESSURE.

BD-601M	CONCRETE DECK SLAB
BD-628M	BRIDGE APPROACH SLABS
BD-655M	TYPICAL SUPERSTRUCTURE SECTIONS
BD-656M	TYPICAL LONGITUDINAL SECTIONS
BC-736M	REINFORCEMENT BAR FABRICATION DETAILS
BC-739M	BRIDGE BARRIER TO GUIDE RAIL TRANSITION
BC-751M	BRIDGE DRAINAGE
BC-788M	TYPICAL WATERPROOFING AND EXPANSION DETAILS
RC-12M	BACKFILL AT STRUCTURES

REFERENCE DRAWINGS

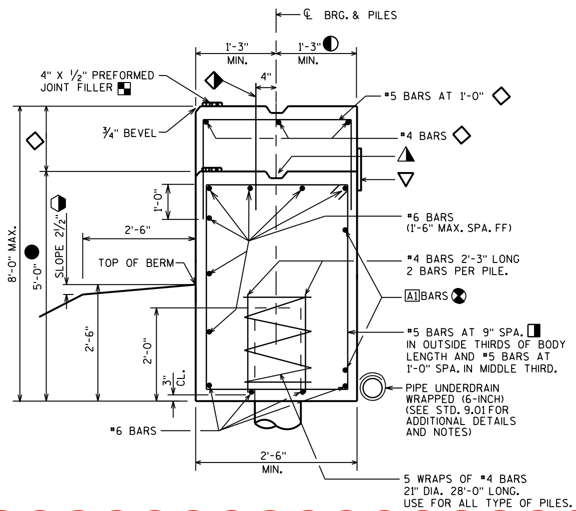
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
LAYOUT AND GENERAL NOTES

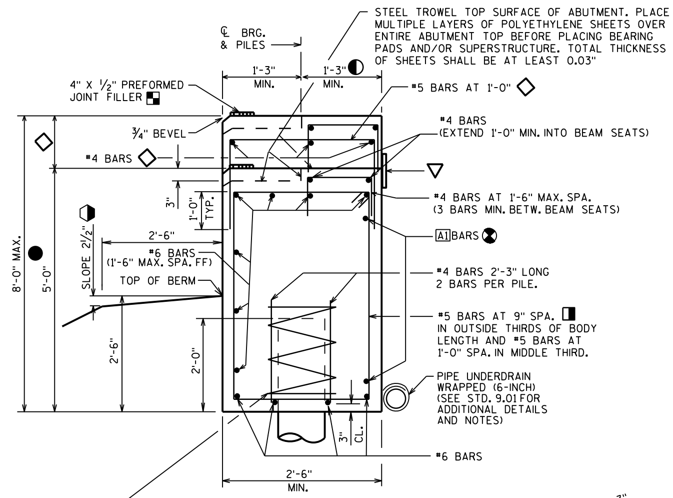
RECOMMENDED APR. 29, 2016
Thomas P Macioce
CHIEF BRIDGE ENGINEER

RECOMMENDED APR. 29, 2016
Brian G Thompson
DIRECTOR, BUR. OF PROJECT DELIVERY

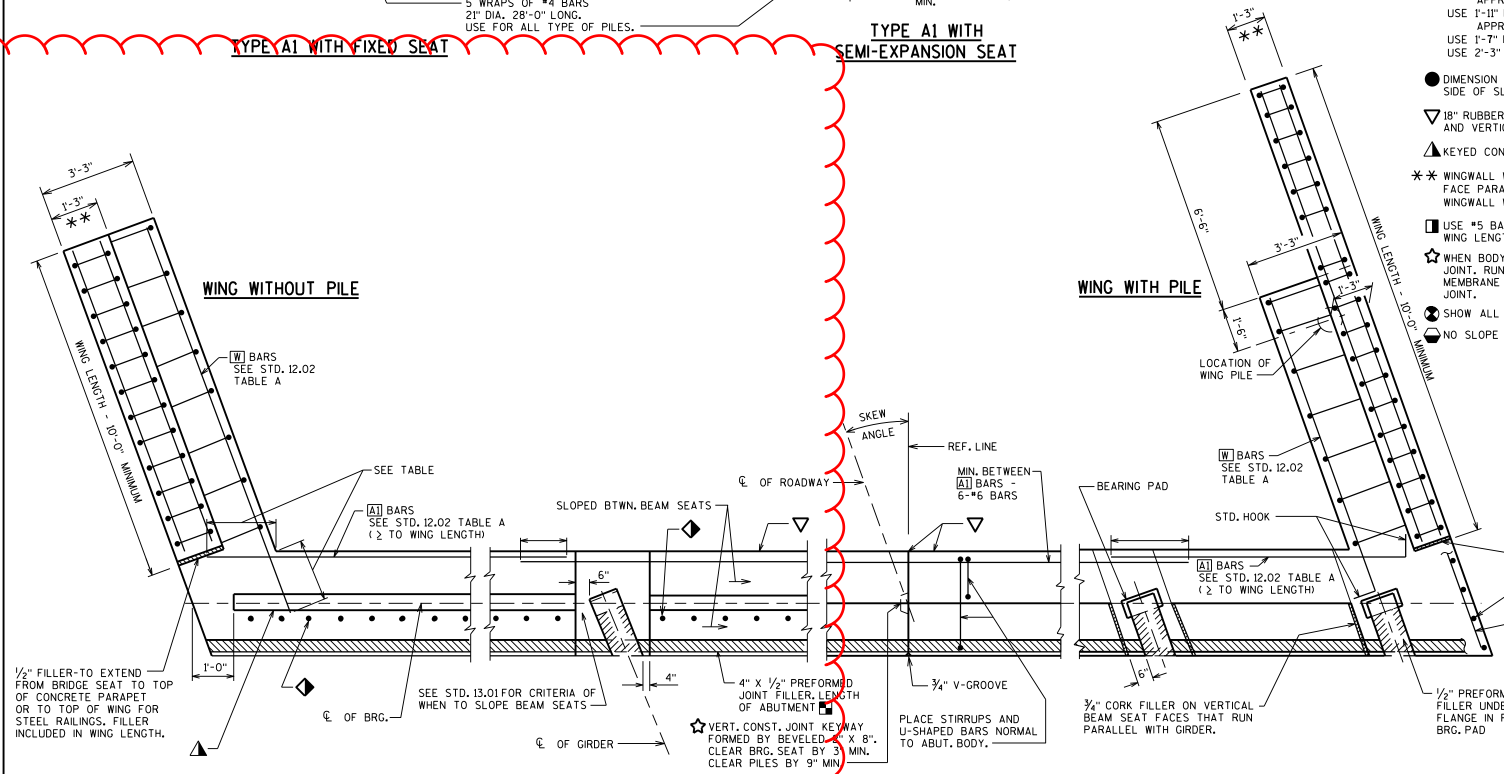
BD-667M



TYPE A1 WITH FIXED SEAT



TYPE A1 WITH SEMI-EXPANSION SEAT



SLAB SPAN WITH FIXED SEAT

GIRDER SPAN WITH FIXED SEAT

SLAB SPAN WITH SEMI EXPANSION SEAT

GIRDER SPAN WITH SEMI EXPANSION SEAT

DESIGNER NOTES

LAP LENGTHS FOR HORIZONTAL BARS SHALL BE BASED ON A "CLASS C" TOP TENSION LAP SPLICE.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

PILING SPACING IN ABUTMENT BODY SHALL BE 8'-0" MAX. FOR ALL TYPES OF PILING. THE MAX. PILE SPACING FROM THE END OF THE ABUT. BODY TO THE FIRST PILE SHALL BE THE MINIMUM OF ONE-HALF PILE SPACE OR 2'-6".

TOTAL LENGTH OF A1 BARS SHALL BE ≥ TO WING LENGTH.

CONCRETE POURED UNDER WATER WILL BE ALLOWED AND SHALL BE DONE IN ACCORDANCE WITH SECTION 502.3.5.3 STANDARD SPECIFICATIONS.

THE SEMI-EXPANSION SEAT SHALL BE USED WHEN REQUIRED AS STATED IN CHAPTER 12, FIGURE 12.7-1 OF THE BRIDGE MANUAL OR WHENEVER A WING PILE IS REQUIRED.

THE FIXED SEAT CANNOT BE USED WHEN A WING PILE IS REQUIRED (SEE STD. 12.02 FOR CRITERIA).

WHEN THE BOTTOM OF GIRDER SLOPES MORE THAN 1%, SLOPE THE BEAM SEAT BASED ON ADDING THESE TWO VALUES:
- LONGITUDINAL GRADE OF GIRDER (PERCENT)
- CAMBER EFFECT = 4(RC)/L X 100 (PERCENT), WHERE:
  RC = RESIDUAL CAMBER (INCHES)
  L = GIRDER LENGTH (INCHES)

(SEE STANDARD 13.01 FOR SLOPED SEAT DETAILS)

ABUTMENT DETAILED WITHOUT STRUCTURAL APPROACH SLAB. SEE STD. 12.10 THRU 12.13 FOR STRUCTURAL APPROACH DETAILS.

USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

LEGEND

- #5 BARS (COATED) AT 1'-0" (2'-0" LONG). THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED BUT BEFORE INITIAL SET HAS TAKEN PLACE.
- WHEN THIS DIMENSION ≥ 4" THIS ADDITIONAL REINFORCEMENT SHALL BE ADDED. MAX. SPA. OF HORIZ. #4 BARS = 1'-0".
- USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
  USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
  USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
  USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
  USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
  USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
- DIMENSION IS FROM BOTTOM OF ABUTMENT TO LOW BEAM SEAT OR LOW SIDE OF SLAB TYPE SUPERSTRUCTURE.
- 18" RUBBERIZED MEMBRANE WATERPROOFING. SEAL ALL HORIZONTAL AND VERTICAL JOINTS ON BACKFACE.
- KEYED CONST. JOINT FORMED BY BEVELED 2" × 6".
- ** WINGWALL WIDTH SHALL BE 1'-6" WHEN TYPE "M" RAILING, VERTICAL FACE PARAPET "TX", OR SINGLE SLOPE PARAPET "56SS" IS USED. WINGWALL WIDTH SHALL BE 1'-9" WHEN TYPE "NY3" OR "NY4" RAILING IS USED.
- USE #5 BARS AT 6" SPA. IN OUTSIDE THIRDS OF BODY LENGTH WHEN THE WING LENGTH > 20'-0" AND WING HEIGHT > 10'-0".
- WHEN BODY SECTION IS > 50'-0"± LONG PROVIDE VERTICAL CONSTRUCTION JOINT. RUN BAR STEEL THRU JOINT AND SEAL JOINT WITH 18" RUBBERIZED MEMBRANE WATERPROOFING. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.
- SHOW ALL BARS FOR CLARITY.
- NO SLOPE FOR HEAVY RIPRAP. SEE STANDARD 12.08 FOR DETAILS.

TABLE

BAR SIZE	DISTANCE*
#5	1'-9"
#6	2'-1"
#7	2'-9"
#8	3'-8"
#9	4'-7"
#10	5'-10"

* OR EQUIVALENT STD. HOOK USE STRAIGHT BARS WHEN POSSIBLE

ABUTMENT TYPE A1 (INTEGRAL ABUTMENT)

BUREAU OF STRUCTURES

APPROVED: Bill Oliva

DATE: 1-20

5.b) Fully Integral Abutment Typical Section

Colorado

Integral Abutment on H-Piles

Illinois

Integral Abutment for Steel Beams

Integral Abutment for PPC Beams

Integral Abutment for Slab Bridges

Integral Abutment Details for PPC Beams on Large Grades

Massachusetts

Section at Center Line of Integral Abutment

Typical Integral Abutment Section (Rolled Beams)

NOTE: MassDOT provides numerous similar details for various types of beams

Typical Integral Abutment Reinforcement

Michigan

Typical Integral Abutment Section

Integral Abutment – Single Row of Piles (Section Through Stub Abutment)

Integral Abutment Backwall

New Hampshire

Typical Integral Abutment Section

Integral Abutment Section Between Girders

Integral Abutment Section at Girders

New York

Integral Abutment Adjacent PC Beams Typical Sections

Ohio

Elevation and Typical Sections at Integral Abutment

NOTE: Ohio provides other similar details for various beam and transition types

Oklahoma

Integral Abutment with P.C. Beams Elevation and Typical Section Through Seat

Pennsylvania

Integral Abutment Elevation

Typical Sections Through Abutment

Steel Girders

Concrete Girders

Slab-Abutment Connection Detail

Rhode Island

Front Elevation at Integral Abutment

Typical Sections at Fully Integral Abutment

Wisconsin

Typical Section Through Integral Abutment Body

Skewed bridges induce biaxial bending into the foundation elements from passive soil pressure. Unless otherwise approved by Staff Bridge, limit skew angles to 30° or less. The Designer shall also include in the analysis all forces that rotate the structure.

On skewed bridges, the Designer shall provide 3 in. minimum clearance from the girder flanges to the back face of abutment. If sufficient clearance is not provided, the flange shall be coped or the abutment width increased. The coping shall parallel the centerline of abutment and not extend across the girder web.

For pre-tensioned or post-tensioned concrete bridges, use methods to increase foundation flexibility when the girder contraction due to elastic shortening, creep, shrinkage and temperature fall exceeds 1 in. Methods include temporarily sliding elements between the diaphragm and bearing cap, details that increase the foundation flexibility, or other approved details. Take steps to ensure that the movement capability at the end of the approach slab is not exceeded.

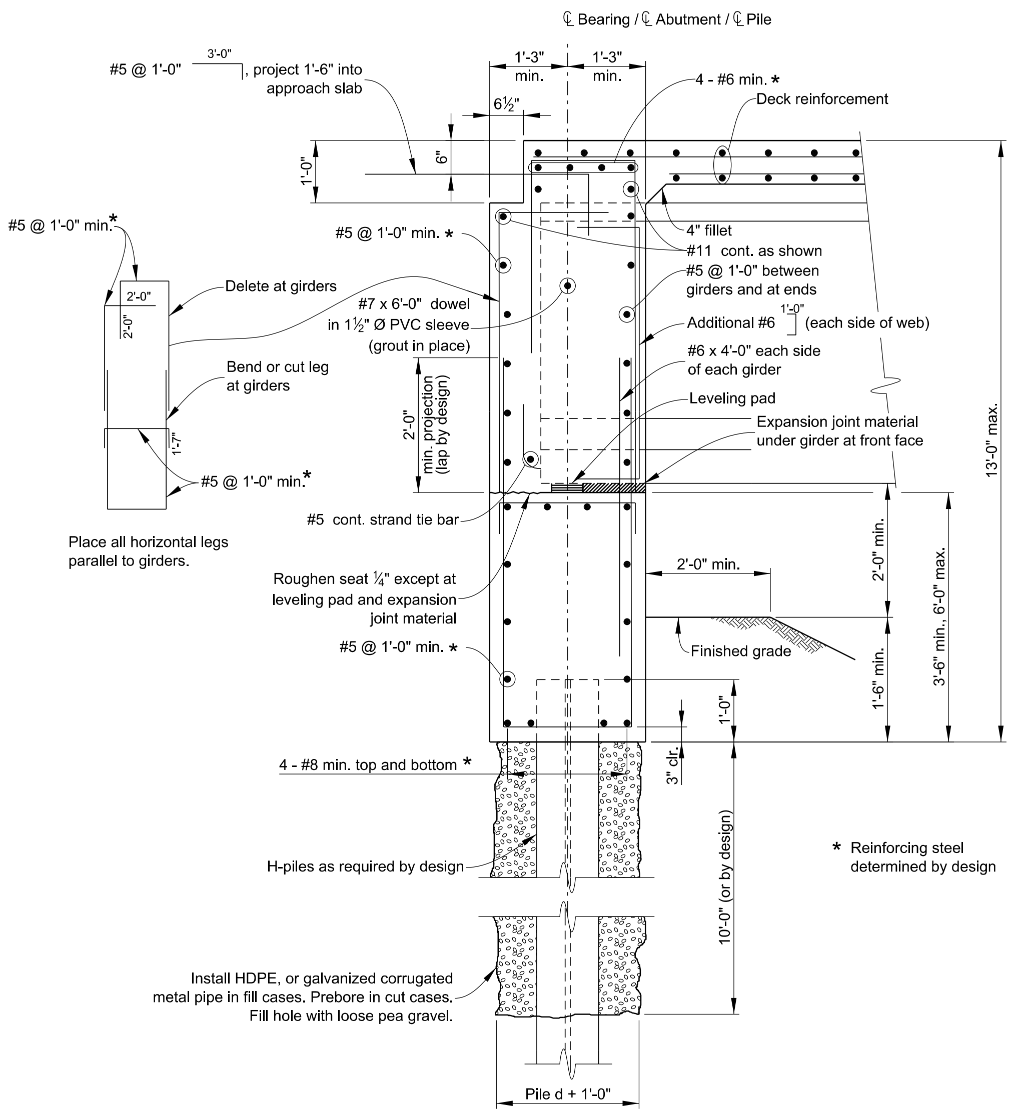
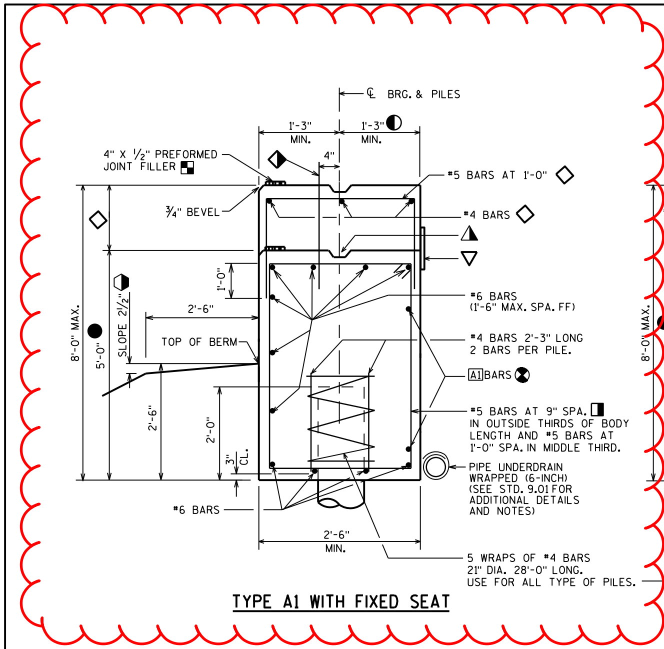
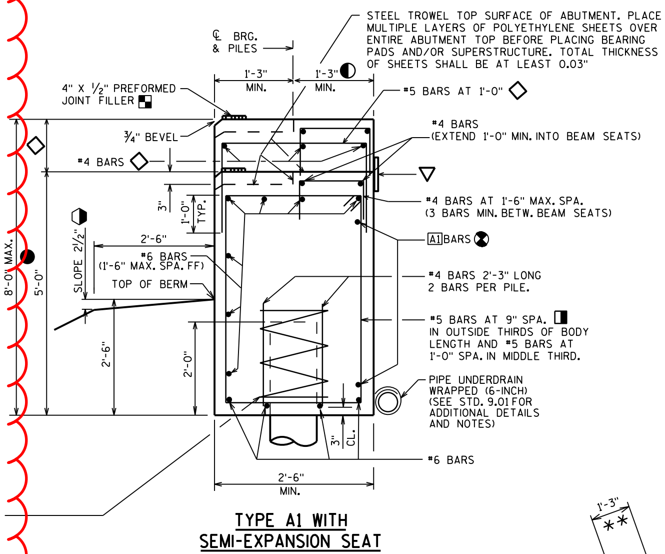
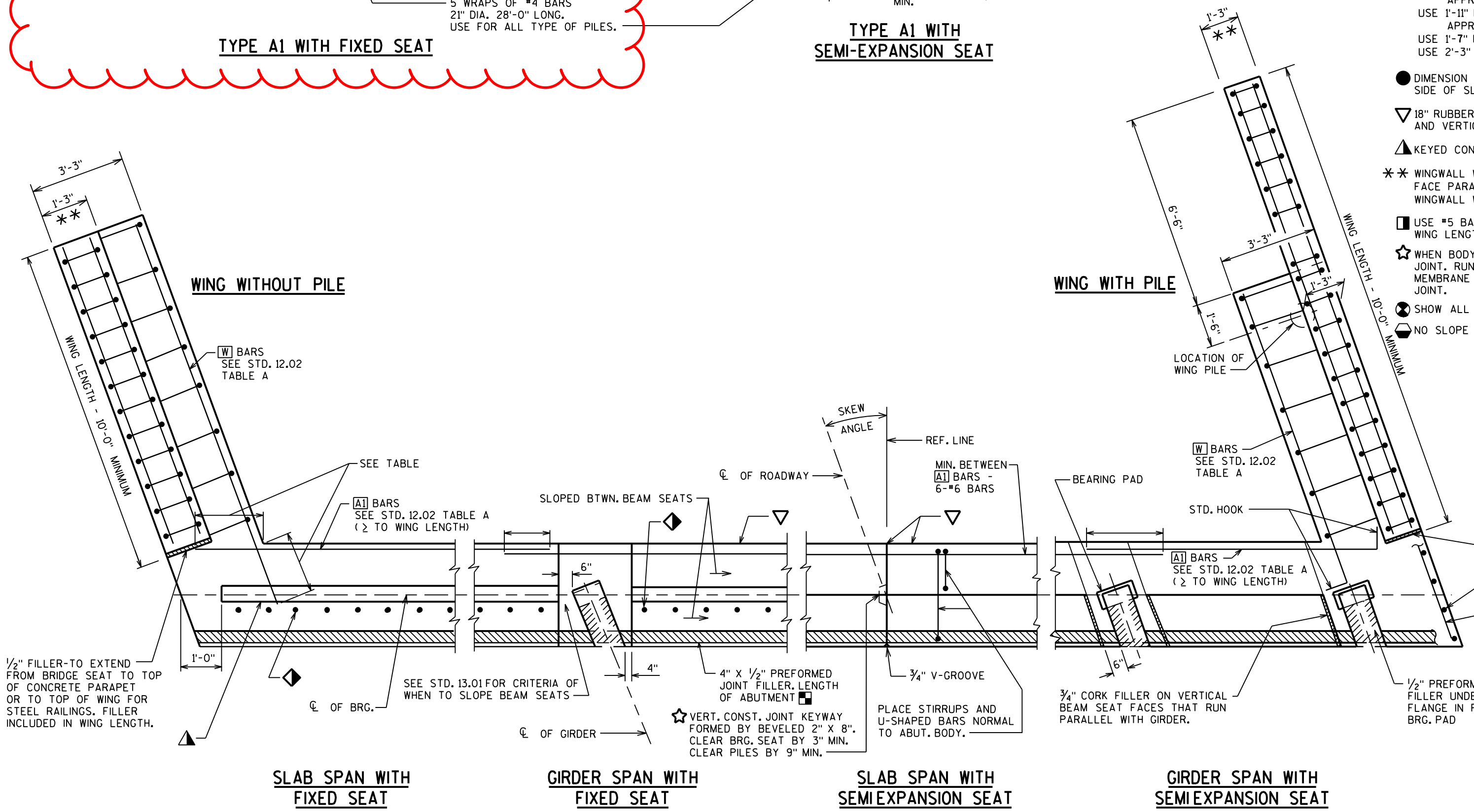


Figure 11-1: Integral Abutment on H-Piles







DESIGNER NOTES

LAP LENGTHS FOR HORIZONTAL BARS SHALL BE BASED ON A "CLASS C" TOP TENSION LAP SPLICE.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

PILING SPACING IN ABUTMENT BODY SHALL BE 8'-0" MAX. FOR ALL TYPES OF PILING. THE MAX. PILE SPACING FROM THE END OF THE ABUT. BODY TO THE FIRST PILE SHALL BE THE MINIMUM OF ONE-HALF PILE SPACE OR 2'-6".

TOTAL LENGTH OF A1 BARS SHALL BE ≥ TO WING LENGTH.

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  L = GIRDER LENGTH (INCHES)

(SEE STANDARD 13.01 FOR SLOPED SEAT DETAILS)

ABUTMENT DETAILED WITHOUT STRUCTURAL APPROACH SLAB. SEE STD. 12.10 THRU 12.13 FOR STRUCTURAL APPROACH DETAILS.

USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

LEGEND

#5 BARS (COATED) AT 1'-0" (2'-0" LONG). THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED BUT BEFORE INITIAL SET HAS TAKEN PLACE.

WHEN THIS DIMENSION ≥ 4" THIS ADDITIONAL REINFORCEMENT SHALL BE ADDED. MAX. SPA. OF HORIZ. #4 BARS = 1'-0".

USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
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USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)

DIMENSION IS FROM BOTTOM OF ABUTMENT TO LOW BEAM SEAT OR LOW SIDE OF SLAB TYPE SUPERSTRUCTURE.

18" RUBBERIZED MEMBRANE WATERPROOFING. SEAL ALL HORIZONTAL AND VERTICAL JOINTS ON BACKFACE.

KEYED CONST. JOINT FORMED BY BEVELED 2" x 6".

** WINGWALL WIDTH SHALL BE 1'-6" WHEN TYPE "M" RAILING, VERTICAL FACE PARAPET "TX", OR SINGLE SLOPE PARAPET "56SS" IS USED. WINGWALL WIDTH SHALL BE 1'-9" WHEN TYPE "NY3" OR "NY4" RAILING IS USED.

USE #5 BARS AT 6" SPA. IN OUTSIDE THIRDS OF BODY LENGTH WHEN THE WING LENGTH > 20'-0" AND WING HEIGHT > 10'-0".

WHEN BODY SECTION IS > 50'-0"± LONG PROVIDE VERTICAL CONSTRUCTION JOINT. RUN BAR STEEL THRU JOINT AND SEAL JOINT WITH 18" RUBBERIZED MEMBRANE WATERPROOFING. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.

SHOW ALL BARS FOR CLARITY.

NO SLOPE FOR HEAVY RIPRAP. SEE STANDARD 12.08 FOR DETAILS.

TABLE

BAR SIZE	DISTANCE*
#5	1'-9"
#6	2'-1"
#7	2'-9"
#8	3'-8"
#9	4'-7"
#10	5'-10"

* OR EQUIVALENT STD. HOOK
USE STRAIGHT BARS WHEN POSSIBLE

ABUTMENT TYPE A1 (INTEGRAL ABUTMENT)

WISCONSIN DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURES

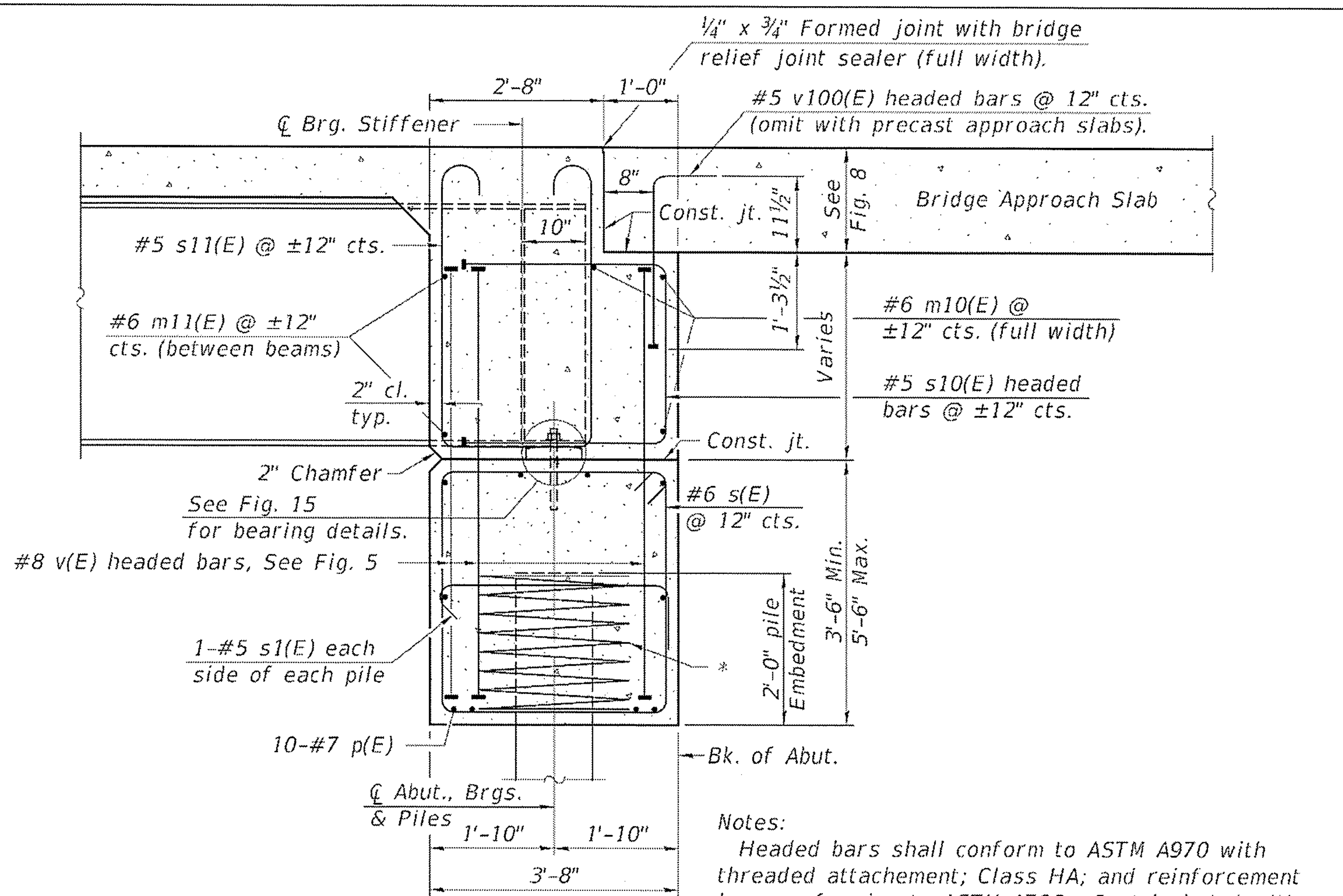
APPROVED: Bill Oliva

DATE: 1-20

Figure 2

Illinois

INTEGRAL ABUTMENT FOR STEEL BEAMS



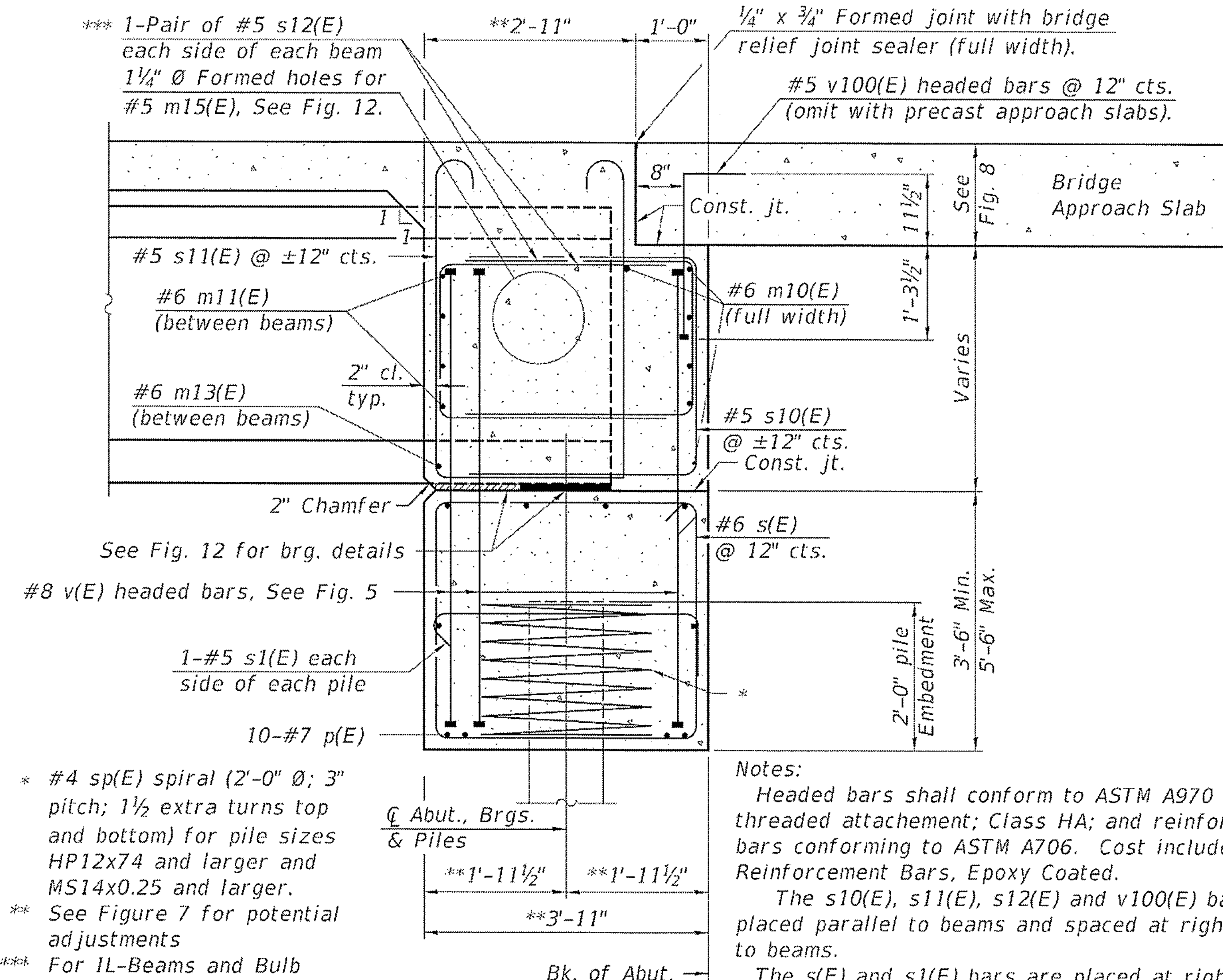
* #4 sp(E) spiral (2'-0" Ø; 3" pitch; 1½ extra turns top and bottom) for pile sizes HP12x74 and larger and MS14x0.25 and larger.

Notes:

Headed bars shall conform to ASTM A970 with threaded attachement; Class HA; and reinforcement bars conforming to ASTM A706. Cost included with Reinforcement Bars, Epoxy Coated.

The s10(E), s11(E), and v100(E) bars are placed parallel to beams and spaced at right angles to beams.

The s(E) and s1(E) bars are placed at right angles to cap and spaced along cap.



* #4 sp(E) spiral (2'-0" Ø; 3" pitch; 1½ extra turns top and bottom) for pile sizes HP12x74 and larger and MS14x0.25 and larger.

** See Figure 7 for potential adjustments

*** For IL-Beams and Bulb T-Beams only.

Notes:

Headed bars shall conform to ASTM A970 with threaded attachement; Class HA; and reinforcement bars conforming to ASTM A706. Cost included with Reinforcement Bars, Epoxy Coated.

The s10(E), s11(E), s12(E) and v100(E) bars are placed parallel to beams and spaced at right angles to beams.

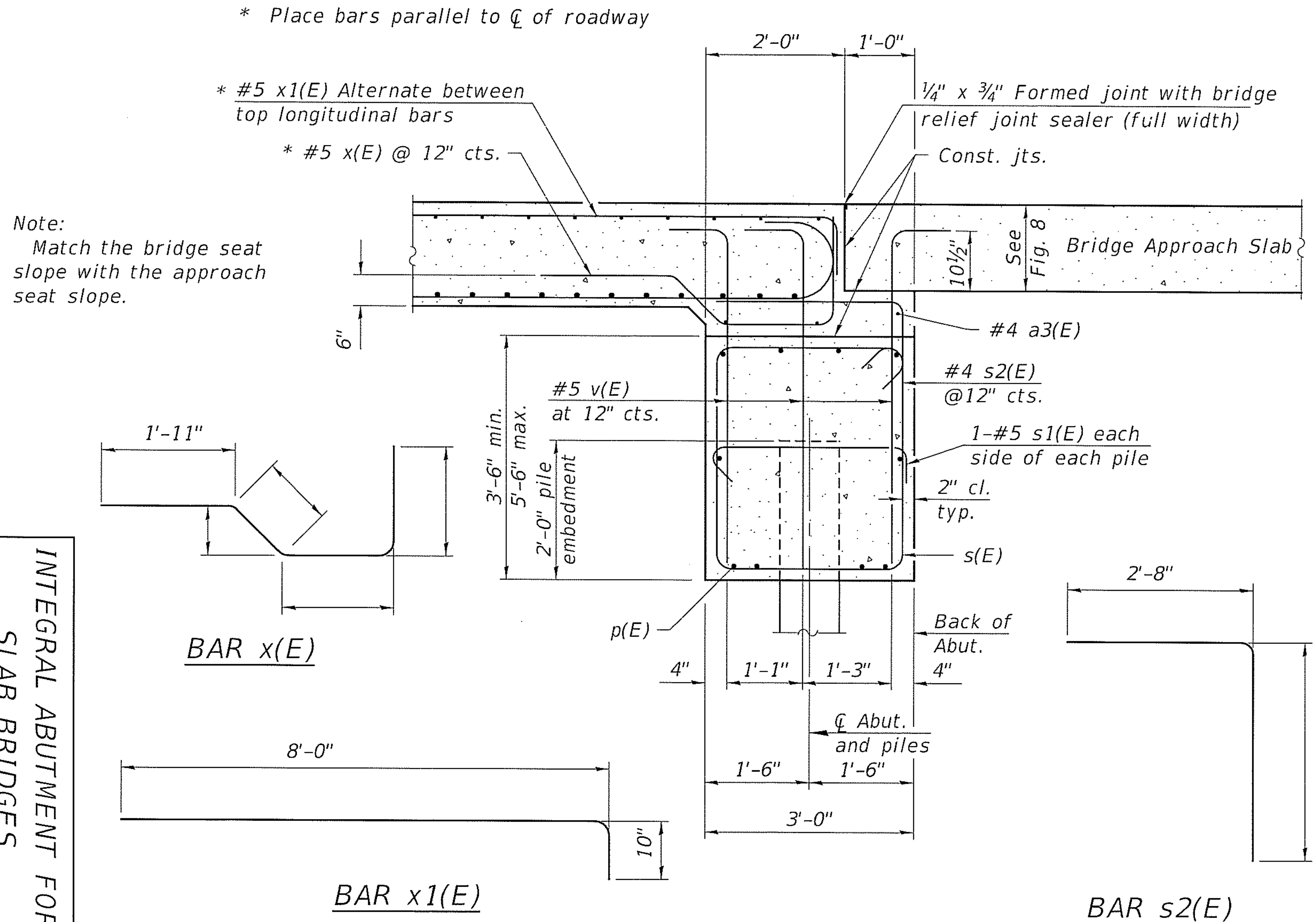
The s(E) and s1(E) bars are placed at right angles to cap and spaced along cap.

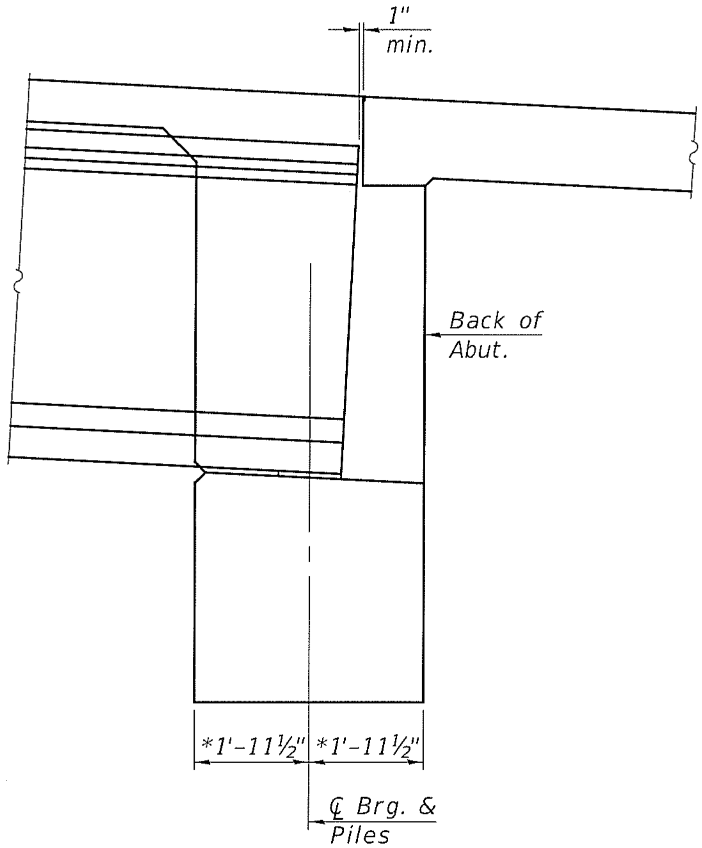
INTEGRAL ABUTMENT FOR PPC BEAMS

Figure 3

Figure 4

INTEGRAL ABUTMENT FOR SLAB BRIDGES





SECTION THRU ABUTMENT

* Increase as needed to maintain 1" minimum clearance between beam and approach pavement. The skew angle will also need to be considered (See top flange clip details) as well as the camber.

Notes:

The grade of the bridge shall be considered when detailing integral abutments with PPC beams. Since the beams are cast such that the beam ends are 90 degrees to the top and bottom flanges the beam ends will not be vertical if the beams are placed on a grade. In addition beam camber will cause further rotation of the beam end.

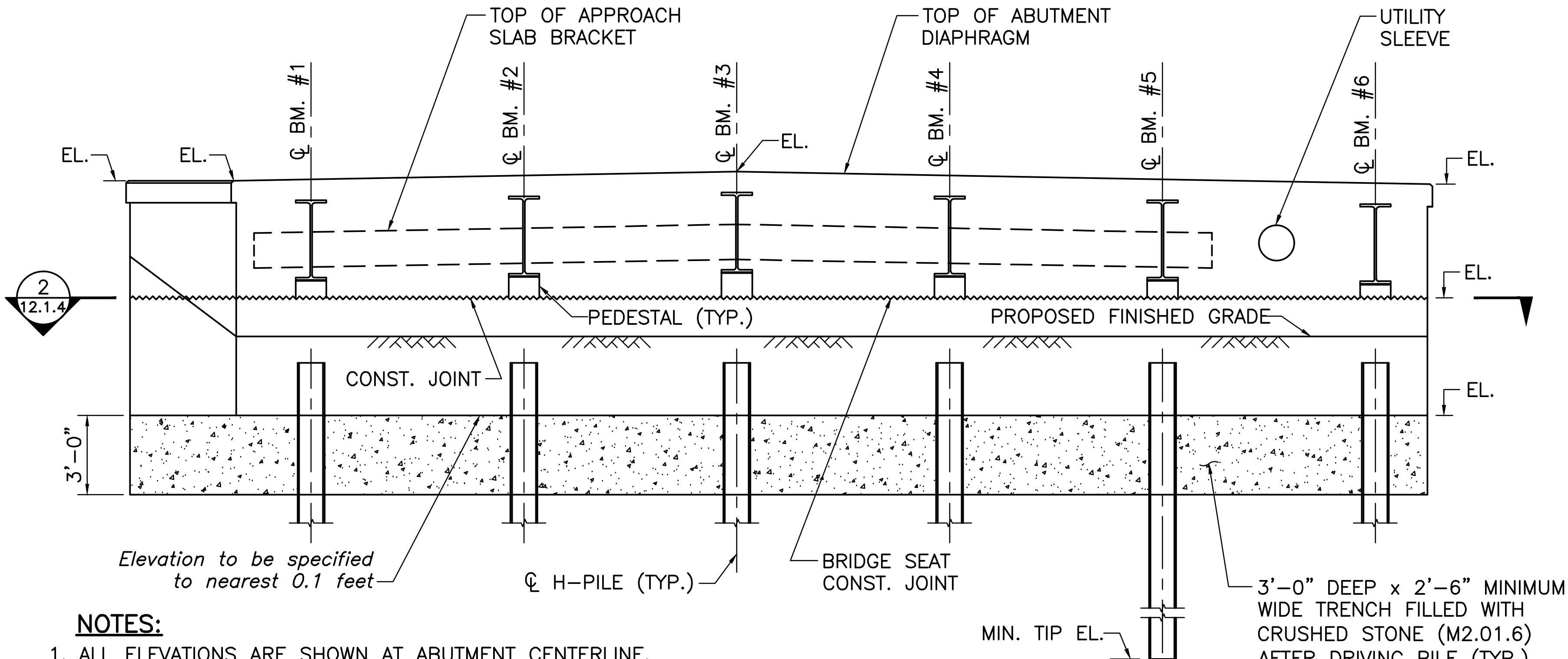
Abutment caps shall be sloped to match the grade when the change in elevation exceeds ¼" from the front face of abutment to the end of the beam. This is done to ensure the fabric bearing pad and polystyrene are under a more uniform bearing pressure. Reinforcement as shown on the base sheets may need to be adjusted to accommodate the slope.

Integral abutments with steel beams do not need these adjustments since the beam ends can be clipped vertically and the steel rocker plate can accommodate grades.

INTEGRAL ABUTMENT DETAILS FOR PPC BEAMS ON LARGE GRADES

Figure 7

Illinois



NOTES:

1. ALL ELEVATIONS ARE SHOWN AT ABUTMENT CENTERLINE.
2. DETAILS ABOVE DECK LEVEL AND INDEPENDENT WINGWALLS OMITTED FOR CLARITY.

SECTION 1

SCALE: ¼" = 1'–0"

TOP OF PEDESTAL ELEVATIONS			
BM. #1	##.##	BM. #4	##.##
BM. #2	##.##	BM. #5	##.##
BM. #3	##.##	BM. #6	##.##

NOTES:

1. *Show and label stage construction joint(s), if any.*
2. *Show and label construction joint(s), if any. Construction joints shall be located at intervals of not more than 24'.*
3. *Provide top of pedestal elevations to nearest 0.01 ft.*
4. *Rolled beams are shown. Show actual beam type and position of the beams relative to the piles at the centerline of the abutment.*
5. *Show steps in the bridge seat, if any, centered between stringers.*

NOTE:

ELEVATIONS DO NOT INCLUDE ERECTION PAD THICKNESS.

massDOT Massachusetts Department of Transportation Highway Division

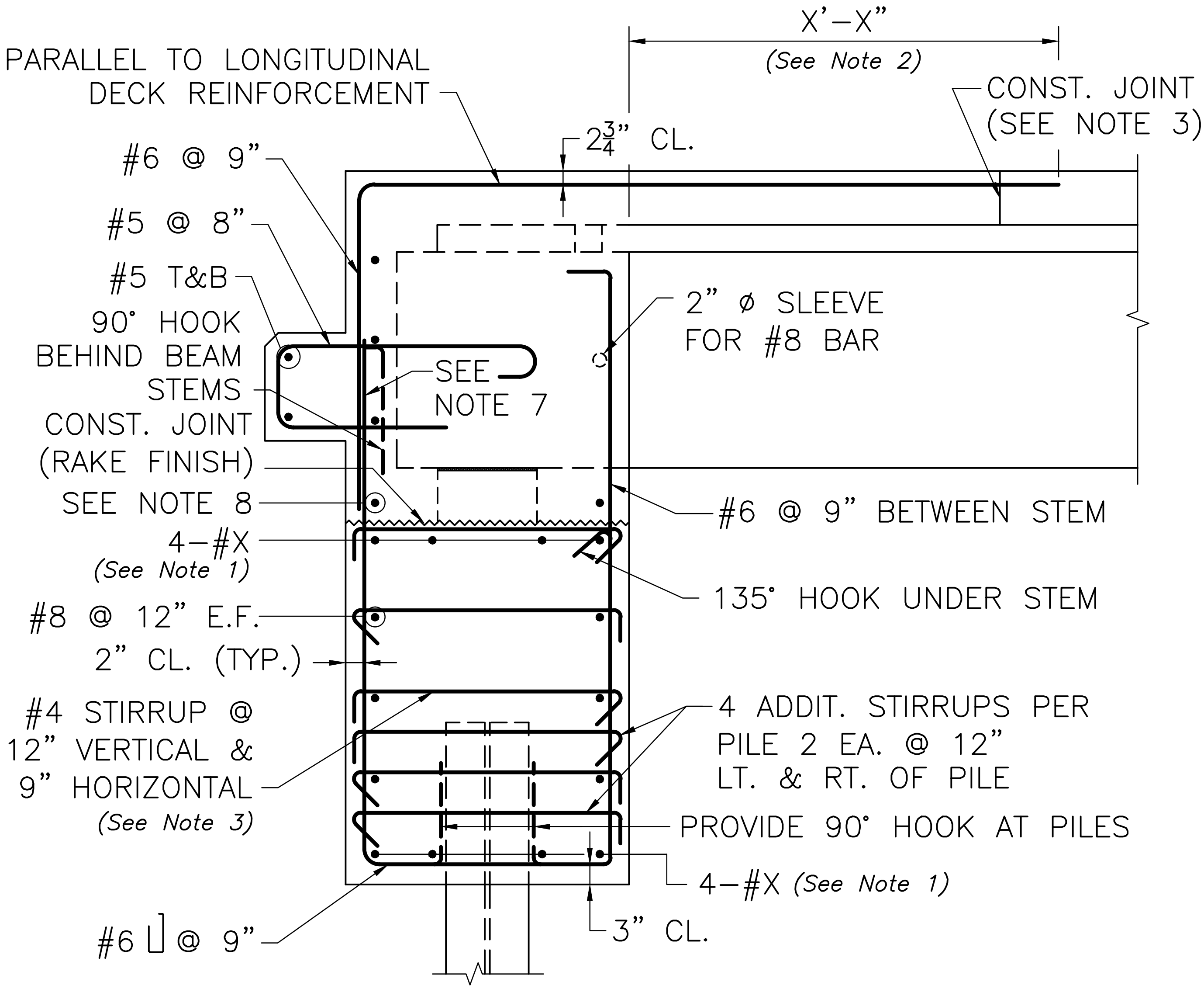
LRFD BRIDGE MANUAL, PART II

SECTION AT CENTERLINE OF ABUTMENT

INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.1.3



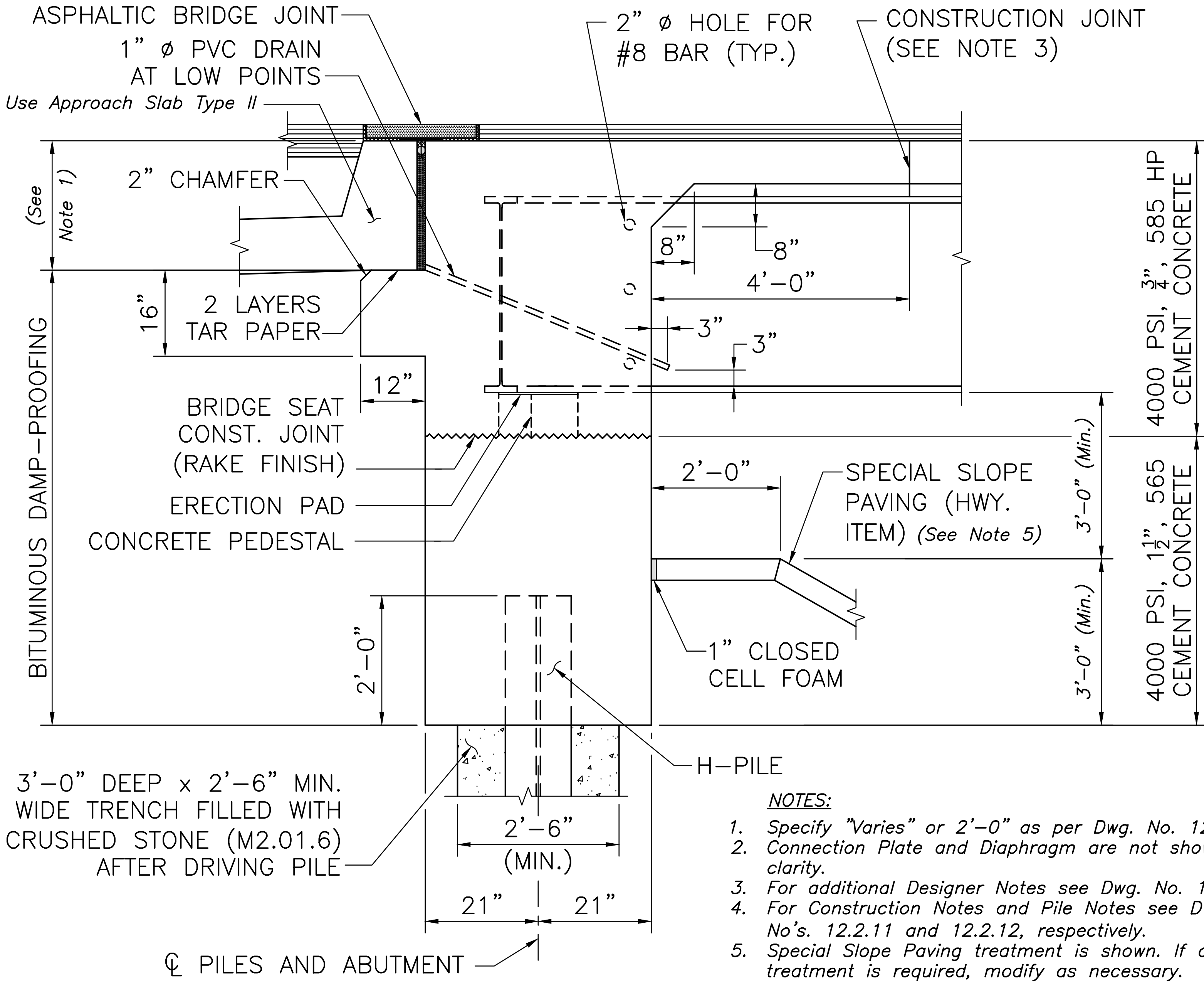
TYPICAL INTEGRAL ABUTMENT REINFORCEMENT

SCALE: $\frac{1}{2}$" = 1'–0"

NOTES:

1. *For Designer Notes see Dwg. No. 12.2.14.*
2. *For Integral Abutment Construction Notes see Dwg. No. 12.2.11.*
3. *For Integral Abutment Pile Notes see Dwg. No. 12.2.12.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	ABUTMENT REINFORCEMENT BRIDGE w/ NEXT F BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.2.7**



NOTES:

1. Specify "Varies" or 2'–0" as per Dwg. No. 12.2.8.
2. Connection Plate and Diaphragm are not shown for clarity.
3. For additional Designer Notes see Dwg. No. 12.2.14.
4. For Construction Notes and Pile Notes see Dwg. No's. 12.2.11 and 12.2.12, respectively.
5. Special Slope Paving treatment is shown. If different treatment is required, modify as necessary.

INTEGRAL ABUTMENT SECTION

SCALE: 1/2" = 1'–0"

massDOT
Massachusetts Department of Transportation
Highway Division

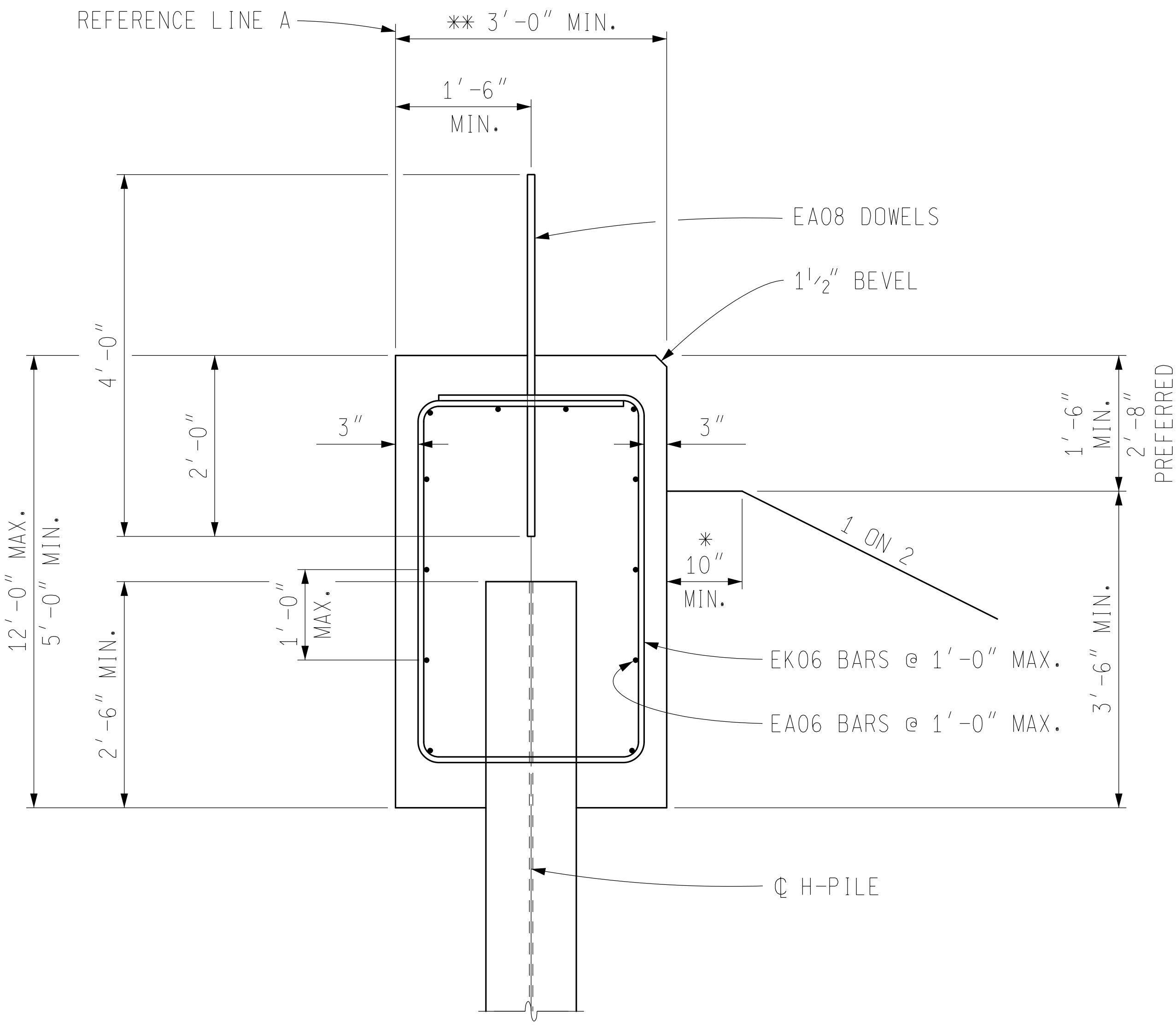
LRFD BRIDGE MANUAL, PART II

ABUTMENT SECTION
ROLLED BEAMS
INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.2.1

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: BMW	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT INTEGRAL ABUTMENT - SINGLE ROW OF PILES (SECTION THRU STUB ABUTMENT)	ISSUED: 04/29/19 SUPERSEDES: 11/27/01



SECTION THRU STUB ABUTMENT

NOTES:

INTEGRAL STUB ABUTMENT BRIDGES WILL HAVE A SINGLE ROW OF PILES ORIENTED FOR WEAK AXIS BENDING.

THE WEBS OF THE H-PILES SHALL BE ORIENTED PARALLEL TO THE BRIDGE REFERENCE LINE.

PILES WILL BE EMDEDDED 2′-6″ INTO THE ABUTMENT WALL.

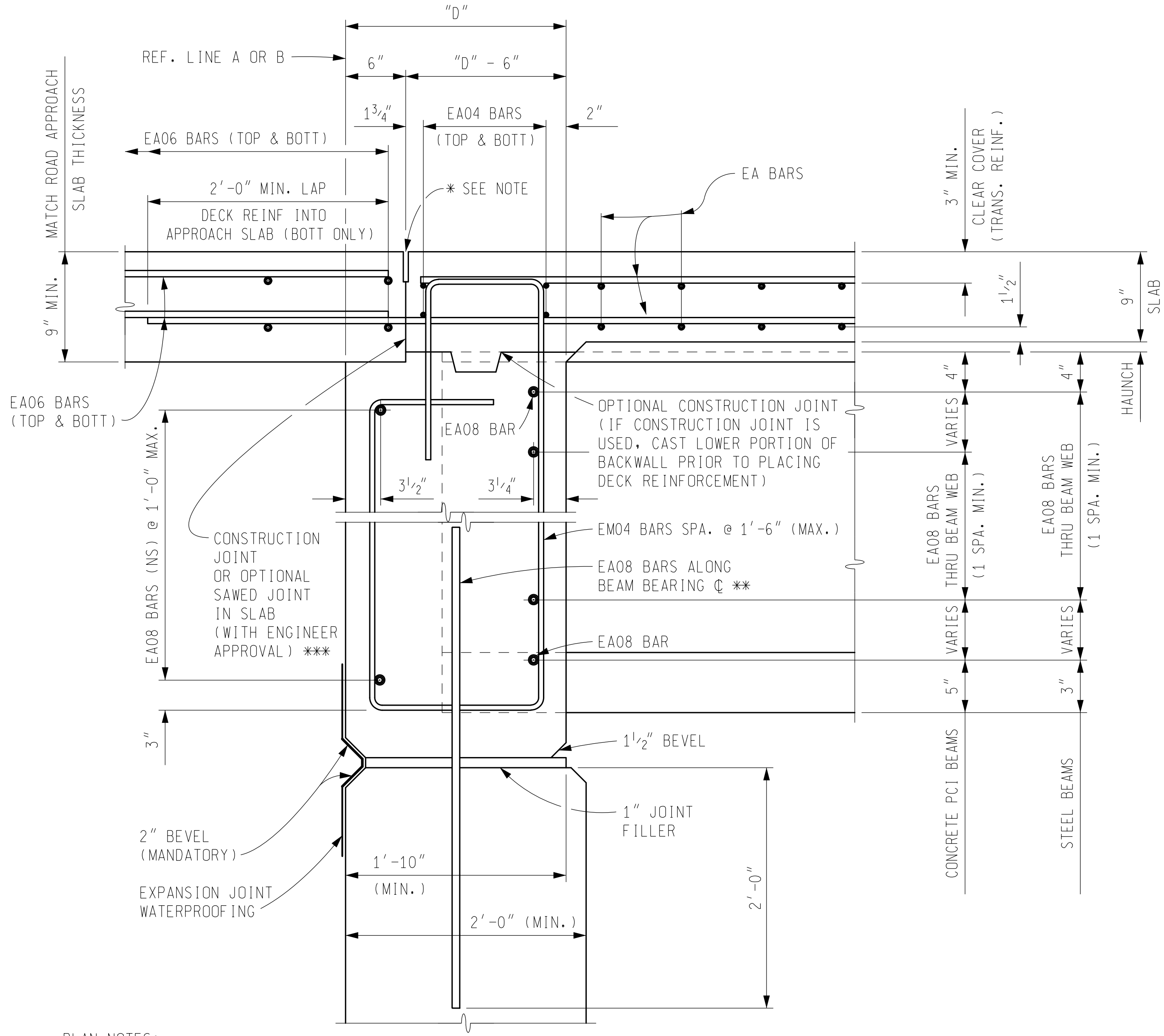
UPON RECOMMEDATION FROM GEOTECHNICAL SERVICES SECTION, PREBORE PILE HOLE ACCORDING TO SECTION 705 OF STANDARD SPECIFICATIONS.

BACKFILL SHALL BE "BACKFILL, STRUCTURE, CIP" AS PER STANDARD SPECIFICATIONS.

* DELETE BERM WHEN STUB ABUTMENT HEIGHT IS GREATER THAN 5′-6″.

** INCREASE AS REQUIRED FOR PILE SIZE AND FORCES IN STUB ABUTMENT.

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: DAJ	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT INTEGRAL AND SEMI-INTEGRAL ABUTMENT BACKWALL	ISSUED: 12/26/17 SUPERSEDES: 07/18/16



PLAN NOTES:

WHERE OPTIONAL CONSTRUCTION JOINTS ARE USED, THERE WILL BE NO PAYMENT FOR THE REQUIRED JOINT WATERPROOFING.

* IF A CONSTRUCTION JOINT IS NOT USED, THE CONTRACTOR IS TO PROVIDE A SAWED JOINT [1/3 DECK SLAB THICKNESS]" DEEP BY 1/4" WIDE (MINIMUM) IN THE TOP OF SLAB AT TRANSVERSE CONSTRUCTION JOINTS OVER THE BACKWALL. IF A CONSTRUCTION JOINT IS NOT USED, THE JOINT IS TO BE SAWED WITHIN 24 HOURS OF PLACING THE CURING AND IS TO BE FILLED TO 1/2" BELOW TOP OF CONCRETE WITH POLYURETHANE OR POLYURETHANE HYBRID JOINT SEALANT. (INCLUDED IN THE BID ITEM "SUPERSTRUCTURE CONC, FORM, FINISH, AND CURE, NIGHT CASTING (STRUCTURE NO.)").

NOTES:

INTEGRAL AND SEMI-INTERGRAL ABUTMENT BRIDGES SHALL BE CONSIDERED FOR STEEL BRIDGES LESS THAN 300' AND CONCRETE BRIDGES LESS THAN 400' IN LENGTH.

APPROACH SLAB THICKNESS WILL MATCH THE ROAD APPROACH THICKNESS (9" MIN.)

CONTINUE BOTTOM MAT OF REINFORCEMENT THROUGH CONSTRUCTION JOINT. ADD EXTRA REINFORCEMENT OVER BEAM (EA050400 BARS).

** USE FOR INTEGRAL ABUTMENT BRIDGES ONLY.

*** THE JOINT IS NOT OPTIONAL, BUT REQUIRED IF CASE I (SEE BRIDGE MANUAL 7.03.01) REQUIRES NOT BACKFILLING ABOVE THE BRIDGE SEAT.

SEMI-INTEGRAL ABUTMENTS SHOULD BE USED AT STREAM CROSSINGS.

D = BACKWALL THICKNESS. SEE GUIDE 6.20.01 FOR DEFINITION.

PREPARED BY DESIGN DIVISION

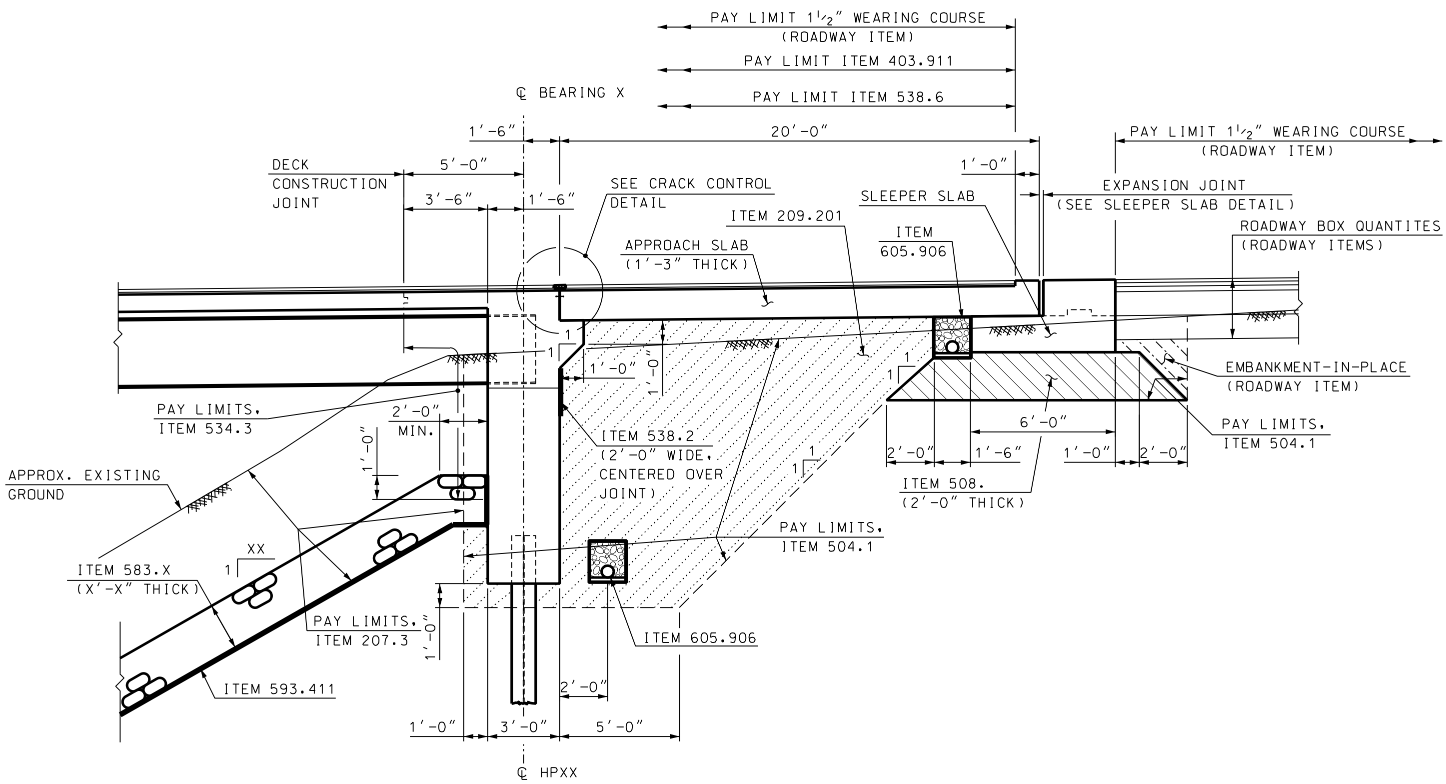
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. INTEGRAL ABUTMENT SECTION

DATE REVISED: 4/4/2018



TYPICAL INTEGRAL ABUTMENT SECTION

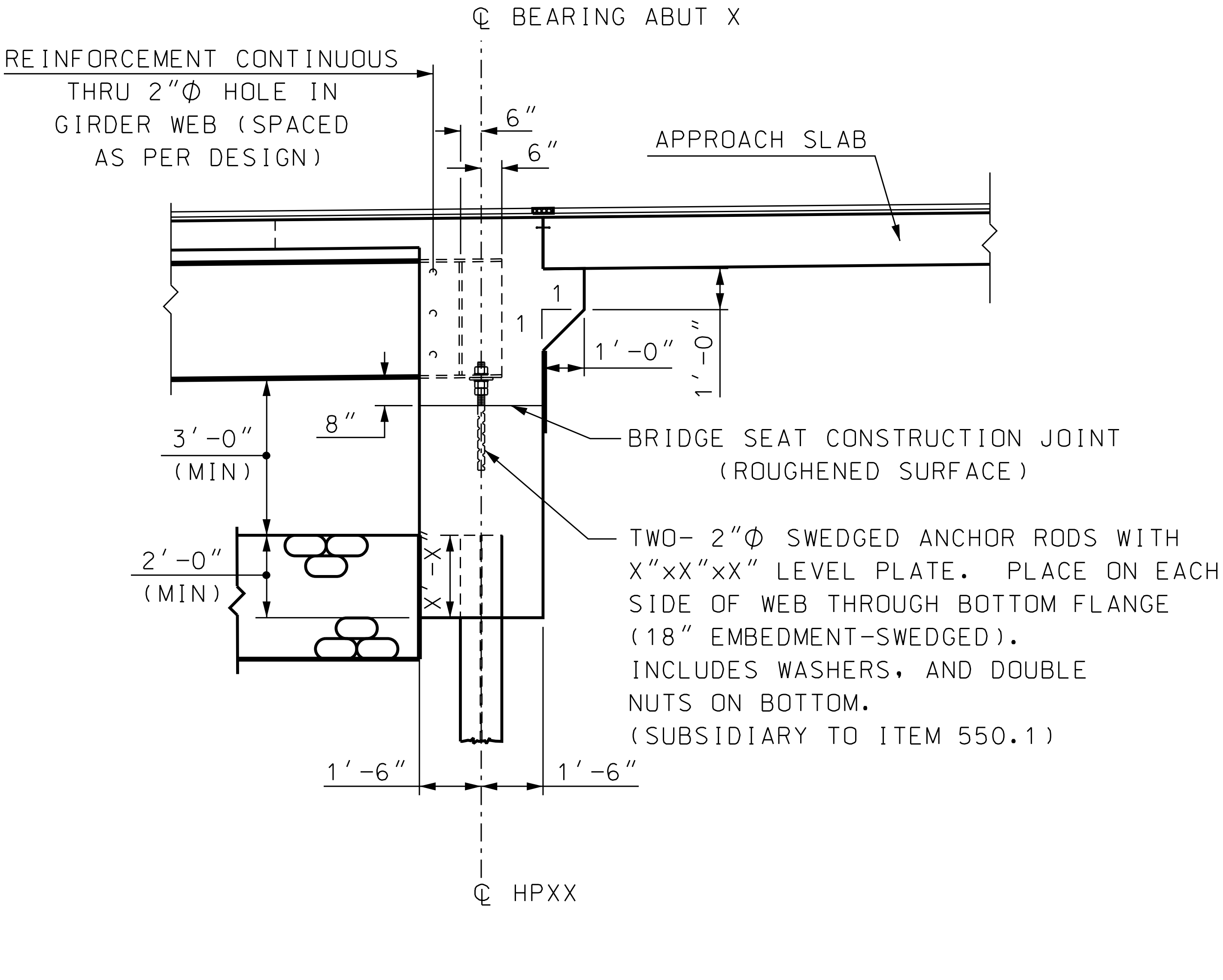
MODIFY TO FIT PROJECT

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. INTEGRAL ABUT. SECTION	DATE REVISED: 12/5/2018



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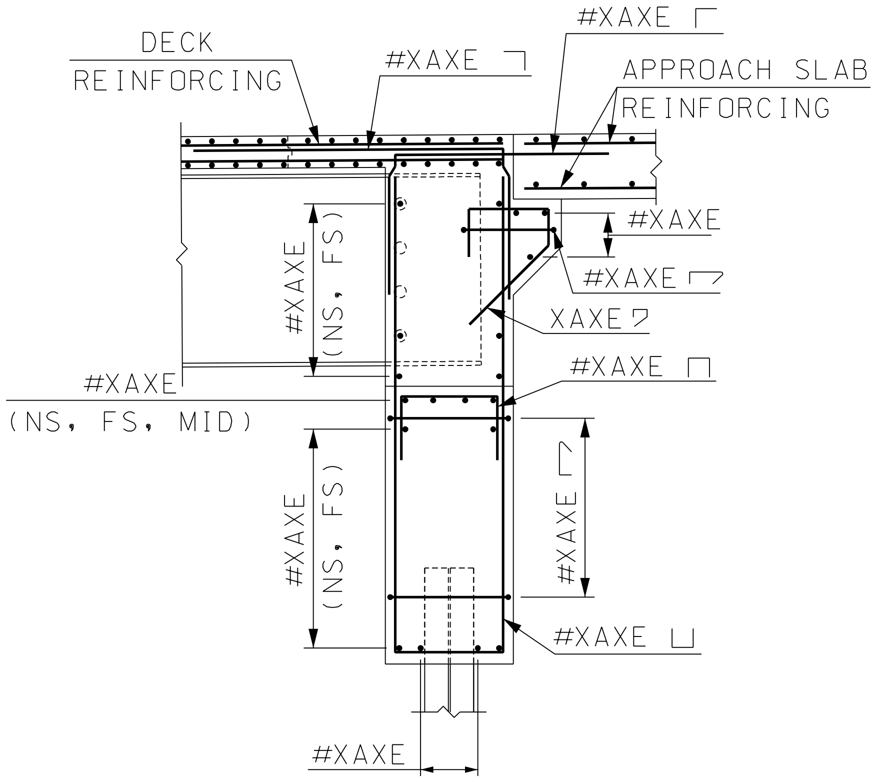
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. INTEGRAL ABUT. REINF. SECTION	DATE REVISED: 4/4/2018



SECTION BETWEEN GIRDERS

MODIFY TO FIT PROJECT

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

THE STATE OF NEW HAMPSHIRE ★ DEPARTMENT OF TRANSPORTATION ★

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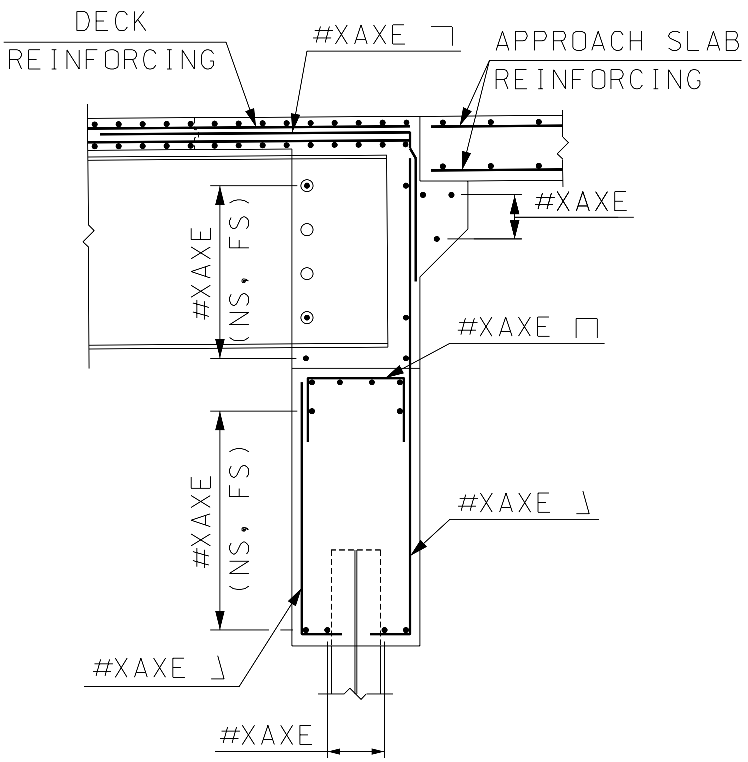
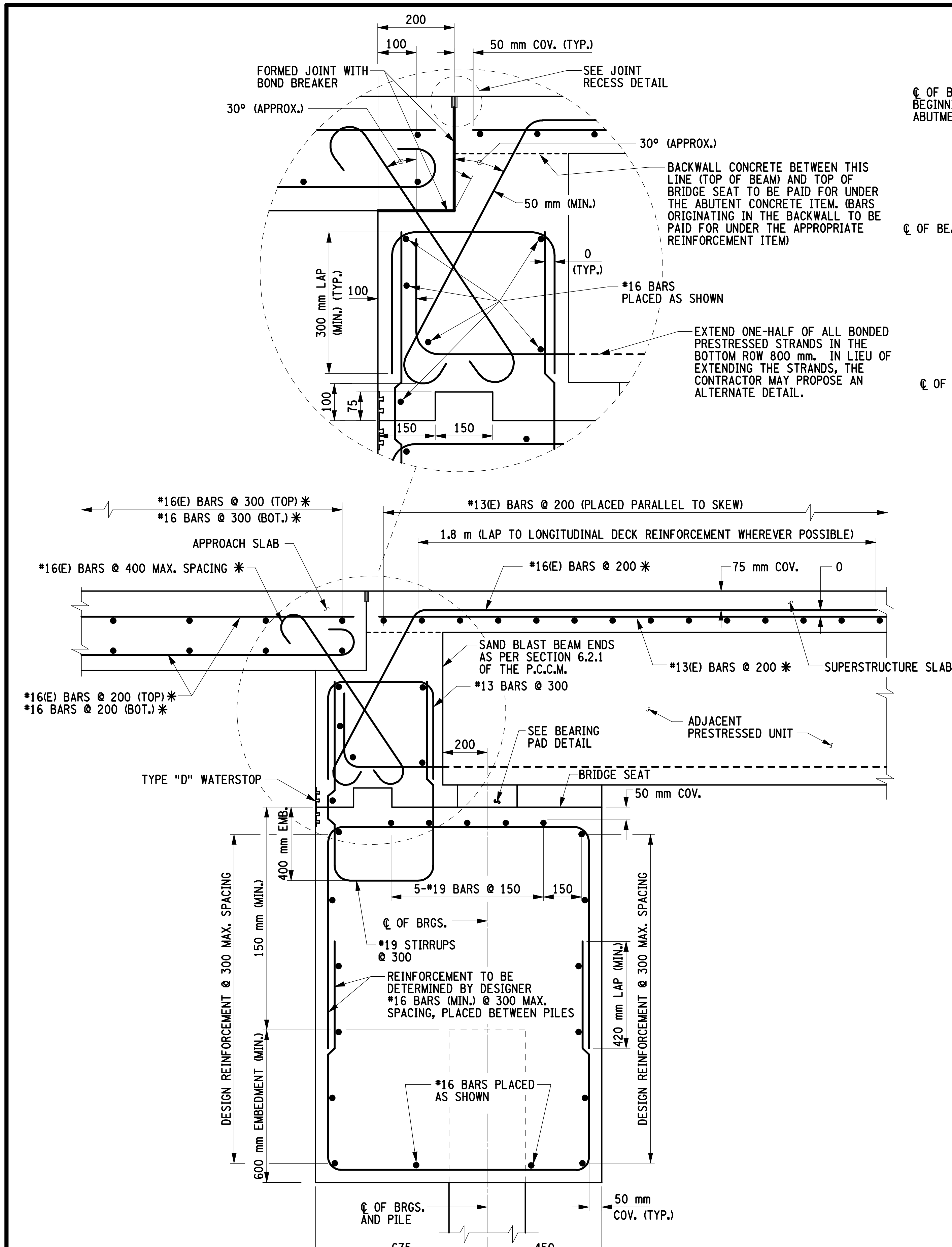


SECTION AT GIRDERS

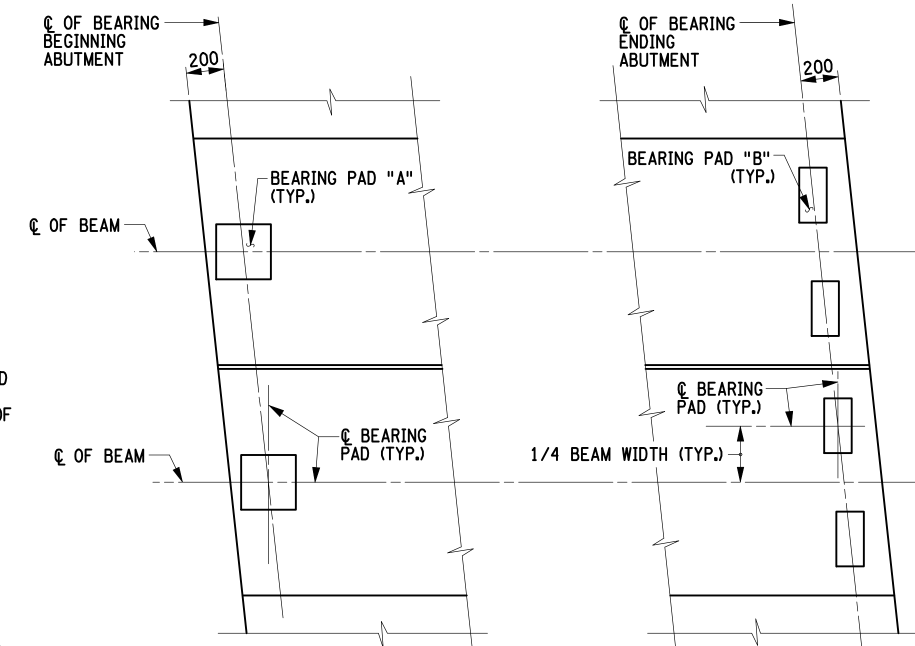
MODIFY TO FIT PROJECT

BD-ID1
R2

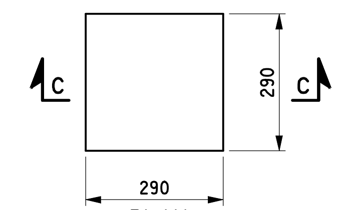


✱ SPACINGS SHOWN FOR THESE BARS ARE PARALLEL OR PERPENDICULAR TO STATION LINE OR BEAMS.

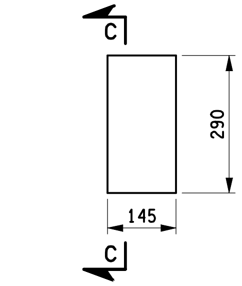
INTEGRAL ABUTMENT DETAIL
(SECTION TAKEN PERPENDICULAR TO ABUTMENT)
NOT TO SCALE



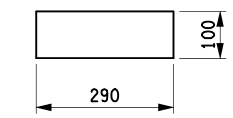
PLAN
BEARING PAD PLACEMENT
PRESTRESSED ADJACENT BEAM
NOT TO SCALE



PLAN
BEARING PAD "A"



PLAN
BEARING PAD "B"



SECTION C-C

INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE
ADJACENT PRESTRESSED CONCRETE SUPERSTRUCTURE

1. FOR BRIDGE LENGTHS OVER 30 m, PRE-EXCAVATE HOLES TO A DEPTH OF 2.5 m BELOW THE STEM AT THE DIAMETER SPECIFIED IN THE FOUNDATION NOTES.
2. DRIVE PILES AND CUT OFF PILES AT ELEVATIONS SHOWN.
3. BACKFILL HOLES WITH SAND MEETING THE REQUIREMENTS OF NYS MATERIAL SUBSECTION 703-06, CUSHION SAND. (COST TO BE INCLUDED IN PILE ITEM).
4. IF CIP PILES ARE USED, FILL PILES WITH CONCRETE.
5. PLACE ABUTMENT STEM CONCRETE TO BRIDGE SEAT ELEVATION.
6. BACKFILL ABUTMENT STEMS TO 150 mm BELOW THE BRIDGE SEAT ELEVATION. NO BACKFILL OF THE ABUTMENT STEMS ALLOWED UNTIL THE ABUTMENTS HAVE CURED FOR 7 DAYS.
7. PLACE STONE FILL OR SLOPE PROTECTION.
8. ERECT PRESTRESSED UNITS ON BEARING PADS.
9. PLACE CONCRETE ABOVE BRIDGE SEAT ELEVATION FOR THE ABUTMENT BACKWALL AND DECK SLAB. TO FACILITATE COMPLETE CONSOLIDATION OF CONCRETE BETWEEN THE TOP OF THE BRIDGE SEAT AND THE BOTTOM OF THE BEAM, VENT HOLES SHALL BE PROVIDED FOR THE INSERTION OF A 25 mm DIAMETER VIBRATOR IN THE FRONT FORM FROM UNDER EACH BEAM. HIGH RANGE WATER REDUCERS (SUPER PLASTICIZER) MAY BE ADDED ONLY FOR THE REMAINDER OF THE ABUTMENT POUR, UP TO THE TOP OF THE PRESTRESSED UNITS. HIGH RANGE WATER REDUCERS SHALL NOT BE ALLOWED FOR THE DECK SLAB.
10. PLACE TOP OF INTEGRAL WINGWALLS CONCRETE.
11. BACKFILL ABUTMENT BACKWALLS. NO BACKFILLING OF BACKWALL IS ALLOWED UNTIL THE BACKWALLS HAVE CURED FOR 7 DAYS.
12. PLACE CONCRETE FOR APPROACH SLABS.

DESIGNER NOTES:

DECK REINFORCEMENT FOR SKEWS 30° OR UNDER SHOWN. FOR SKEWS OVER 30° PLACE TRANSVERSE BARS PERPENDICULAR TO BEAMS.

THE 290 x 145 x 100 BEARING PAD "B" SHALL ONLY BE USED AS SHOWN ON THE PRESTRESSED ADJACENT BEAM BEARING PAD LAYOUT.

EPOXY-COATED BARS SHOWN. OTHER CORROSION PROTECTION OPTIONS ARE AVAILABLE. REFER TO SECTION 15.12 OF THE BRIDGE MANUAL.

REFER TO BRIDGE MANUAL, SECTION 15.12 FOR THE REQUIREMENTS FOR CORROSION PROTECTED REINFORCEMENT IN SUBSTRUCTURES.

SEE EARTHWORK DETAILS ON BD-ID3 FOR FURTHER DETAILS.

FOR JOINT RECESS DETAIL, SEE BD-ID6.

FOR TYPE "D" WATERSTOP DETAILS, SEE BD-MS3.

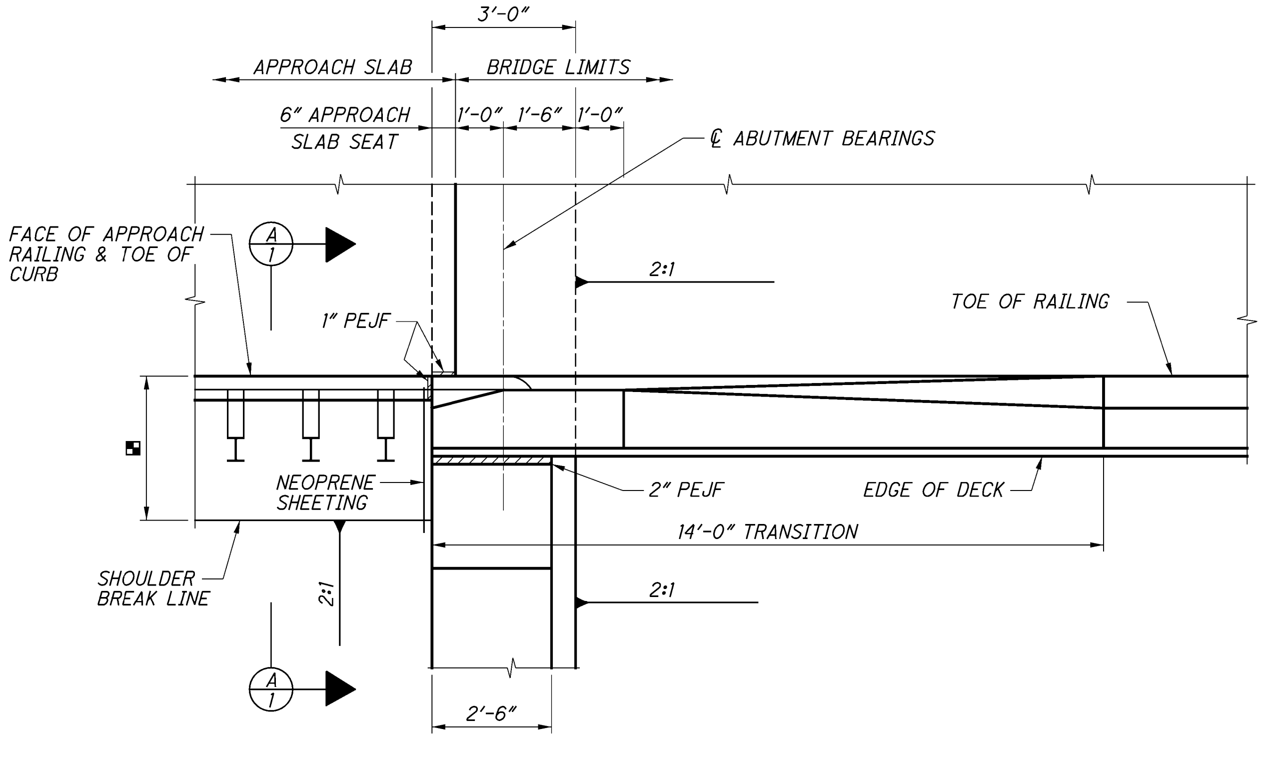
NOTES:

(E) DENOTES EPOXY-COATED BARS.

BEARING PAD TO MEET THE REQUIREMENTS OF NYS MATERIAL SPEC. 728-01, RUBBER-IMPREGNATED WOVEN COTTON-POLYESTER FABRIC BEARING PAD. BEARING PAD TO BE PAID FOR UNDER ITEM 565.30.

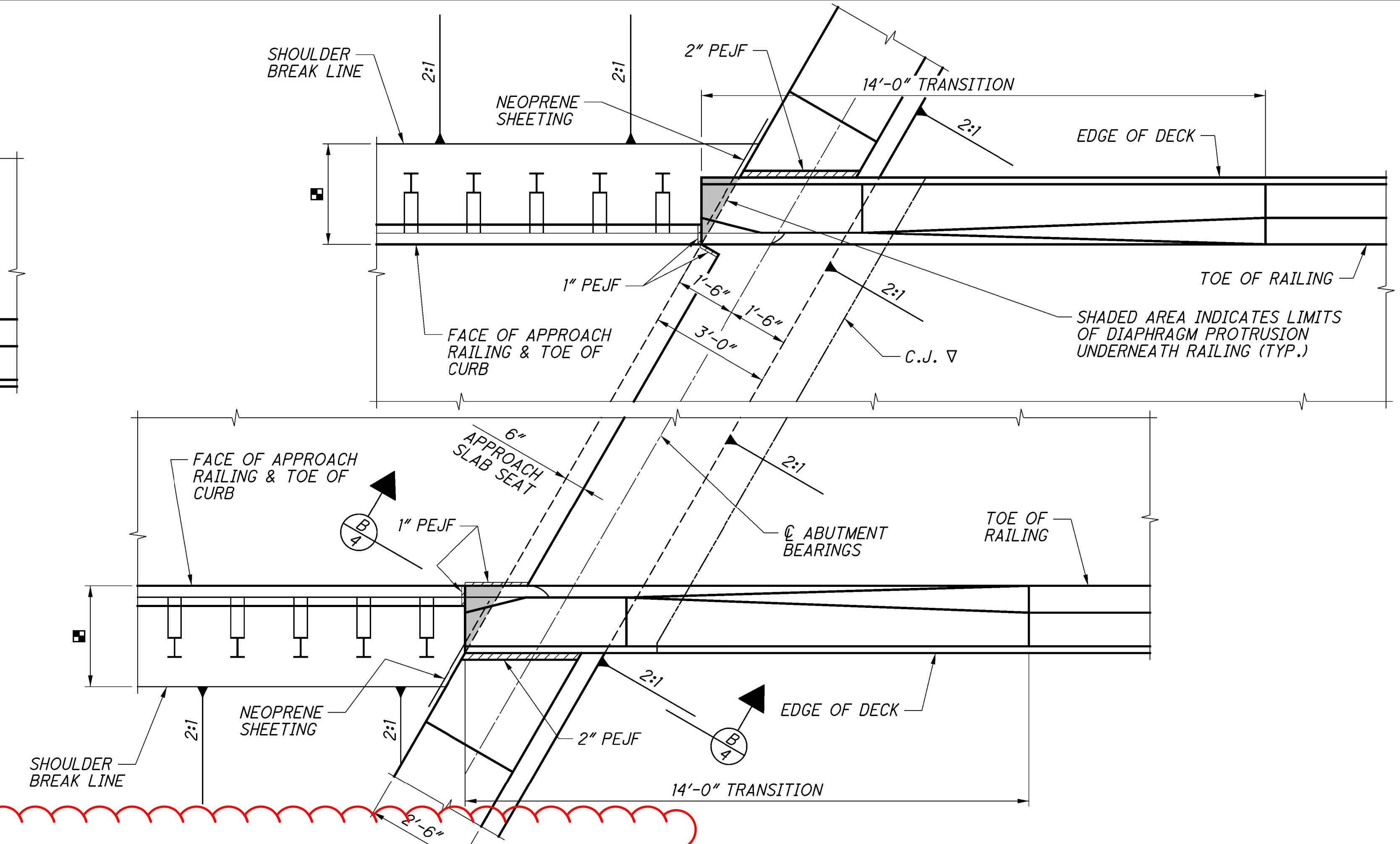
ALL DIMENSIONS AND BAR SPACINGS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED.

ISSUED 6/13/05	STATE OF NEW YORK DEPARTMENT OF TRANSPORTATION STRUCTURES DESIGN AND CONSTRUCTION DIVISION
REVISED	
12/5/05	INTEGRAL ABUTMENTS ADJACENT PC BEAMS TYPICAL SECTIONS & DETAILS
6/28/10	
	APPROVED: 6/28/10 ORIGINAL SIGNED BY ARTHUR P. YANNOTTI, P.E. ACTING DEPUTY CHIEF ENGINEER (STRUCTURES)
	ISSUED UNDER EB 10-024 EFFECTIVE WITH THE LETTING OF 1/06/11



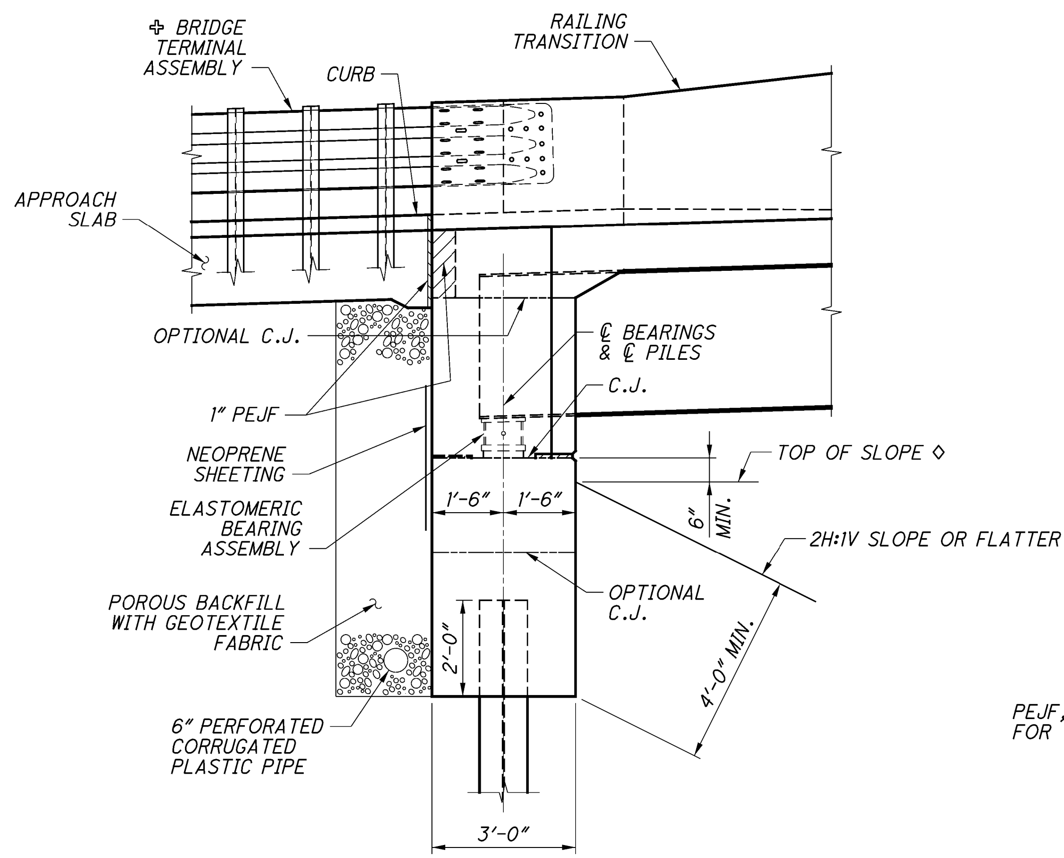
PART PLAN AT ABUTMENT

(SQUARE STRUCTURE WITH CONCRETE RAILING)
(SBR-1-20 SHOWN, SBR-3-20 SIMILAR)

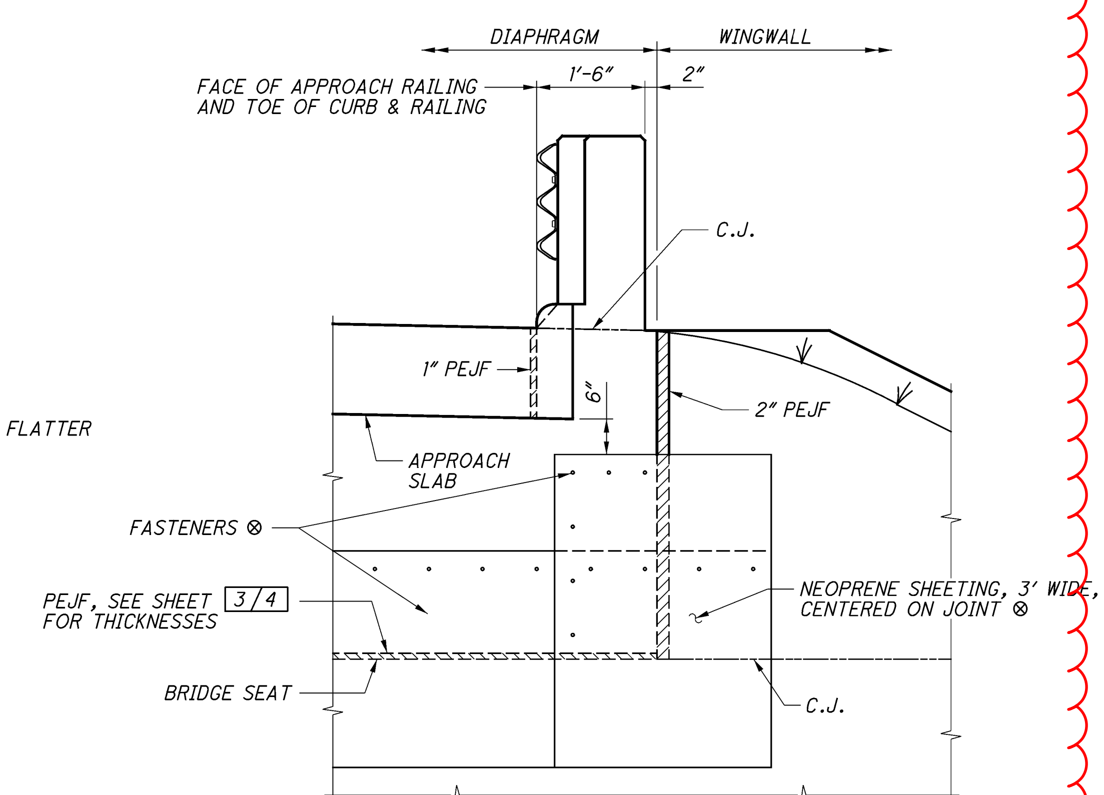


PART PLAN AT ABUTMENT

(STRUCTURE WITH LEFT FORWARD SKEW AND CONCRETE RAILING)
(SBR-1-20 SHOWN, SBR-3-20 SIMILAR)



ELEVATION



SECTION A-A

SHEET 1 NOTES AND LEGEND:

C.J. = CONSTRUCTION JOINT. REFER TO BDM SECTION 304.2.3 FOR DESIGN REQUIREMENTS.

PEJF = PREFORMED EXPANSION JOINT FILLER

⊗ = SEE PROJECT PLANS AND/OR CMS 516.05 FOR ADDITIONAL NEOPRENE SHEETING PLACEMENT REQUIREMENTS.

◪ = SEE ROADWAY TYPICAL SECTION FOR LOCATION OF SHOULDER BREAK LINE.

◇ = TOP OF SLOPE: ON SUPERELEVATED STRUCTURES, A LATERALLY SLOPING "TOP OF SLOPE" MAY BE USED TO AVOID EXCESSIVELY LONG WINGWALLS.

✣ = SEE ROADWAY STANDARD DRAWING MGS-3.1 OR MGS-3.2 FOR BRIDGE TERMINAL ASSEMBLY DETAILS. STATE ON THE PROJECT PLANS WHICH STANDARD DRAWING APPLIES.

∇ = THE CONTRACTOR MAY ELECT TO SUBMIT AN ALTERNATE PROCEDURE THAT PLACES THE DIAPHRAGM AND DECK CONCRETE IN THE SAME POUR; HOWEVER, THIS REQUIRES APPROVAL OF THE ENGINEER.

DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

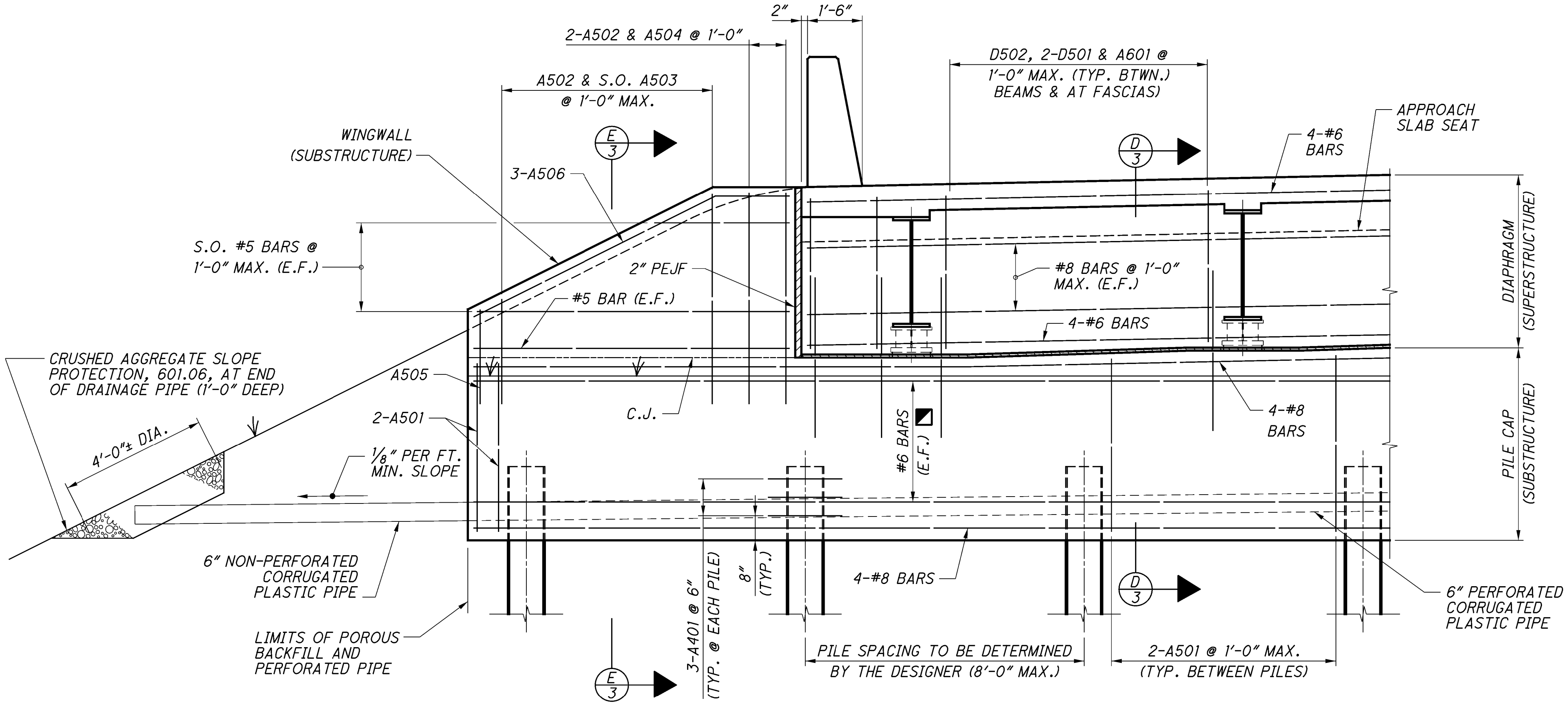
07-17-20
DATE

ADMINISTRATOR

REVISIONS

ICD-1-20

STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS



ELEVATION
(NO SKEW, RAILING NOT SHOWN)

SHEET 3 NOTES AND LEGEND:

C.J. = CONSTRUCTION JOINT. REFER TO BDM SECTION 304.2.3 FOR DESIGN REQUIREMENTS.

PEJF = PREFORMED EXPANSION JOINT FILLER

E.F. = EACH FACE

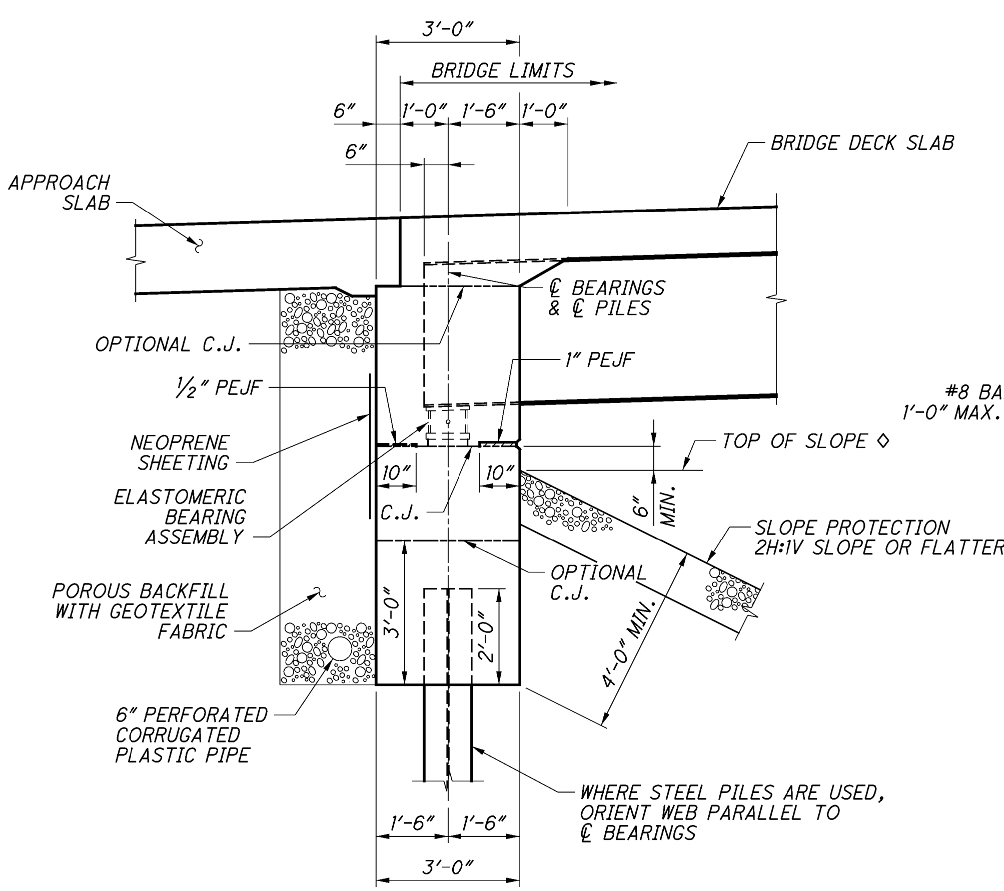
S.O. = SERIES OF

◪ = A MINIMUM OF 5-#6 BARS SHALL BE PLACED IN EACH SIDE FACE OF THE PILE CAP. THE BAR SPACING SHALL NOT EXCEED 1'-0".

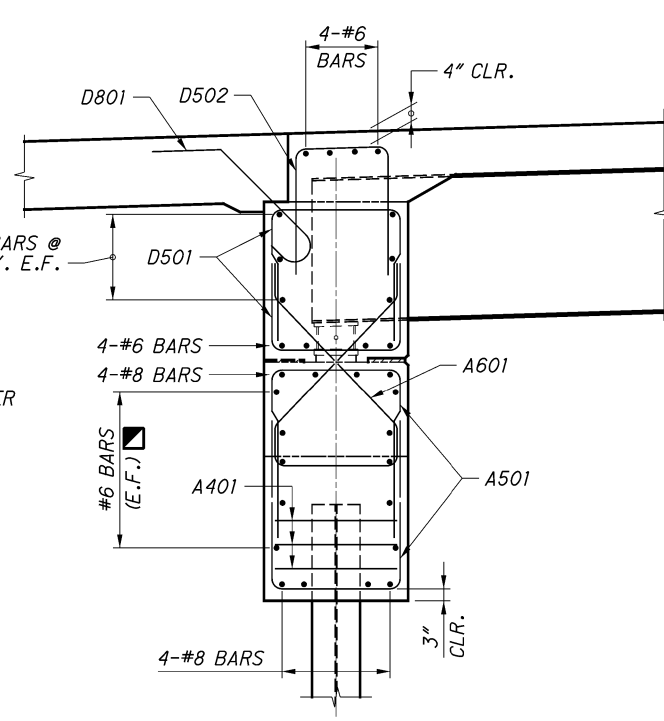
◇ = TOP OF SLOPE: ON SUPERELEVATED STRUCTURES, A LATERALLY SLOPING "TOP OF SLOPE" MAY BE USED TO AVOID EXCESSIVELY LONG WINGWALLS.

REINFORCING STEEL SHOWN IS MINIMUM. PROVIDE THE REINFORCEMENT REQUIRED IN THE PROJECT PLANS. REFER TO THE SUPPLEMENT FOR STANDARD DRAWING ICD-2-18 FOR DESIGN METHODOLOGY ANDEXAMPLE CALCULATIONS.

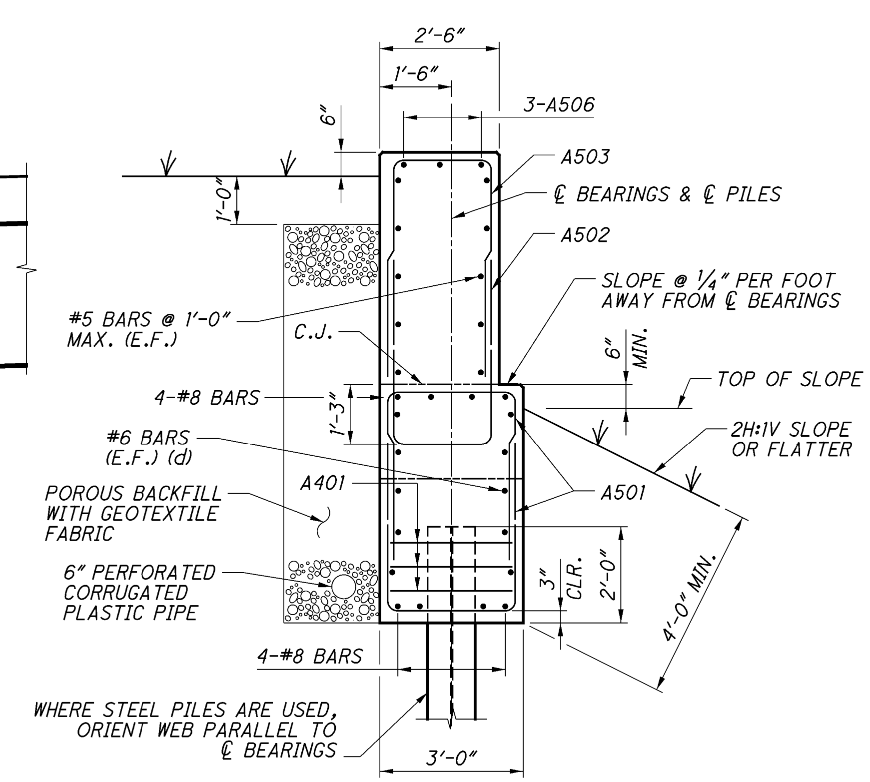
MINIMUM LAP LENGTHS FOR #5 VERTICAL BARS IN DIAPHRAGM AND PILE CAP SHALL BE 2'-5".



SECTION D-D (DIMENSIONS)



SECTION D-D (REINFORCING)



SECTION E-E

DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

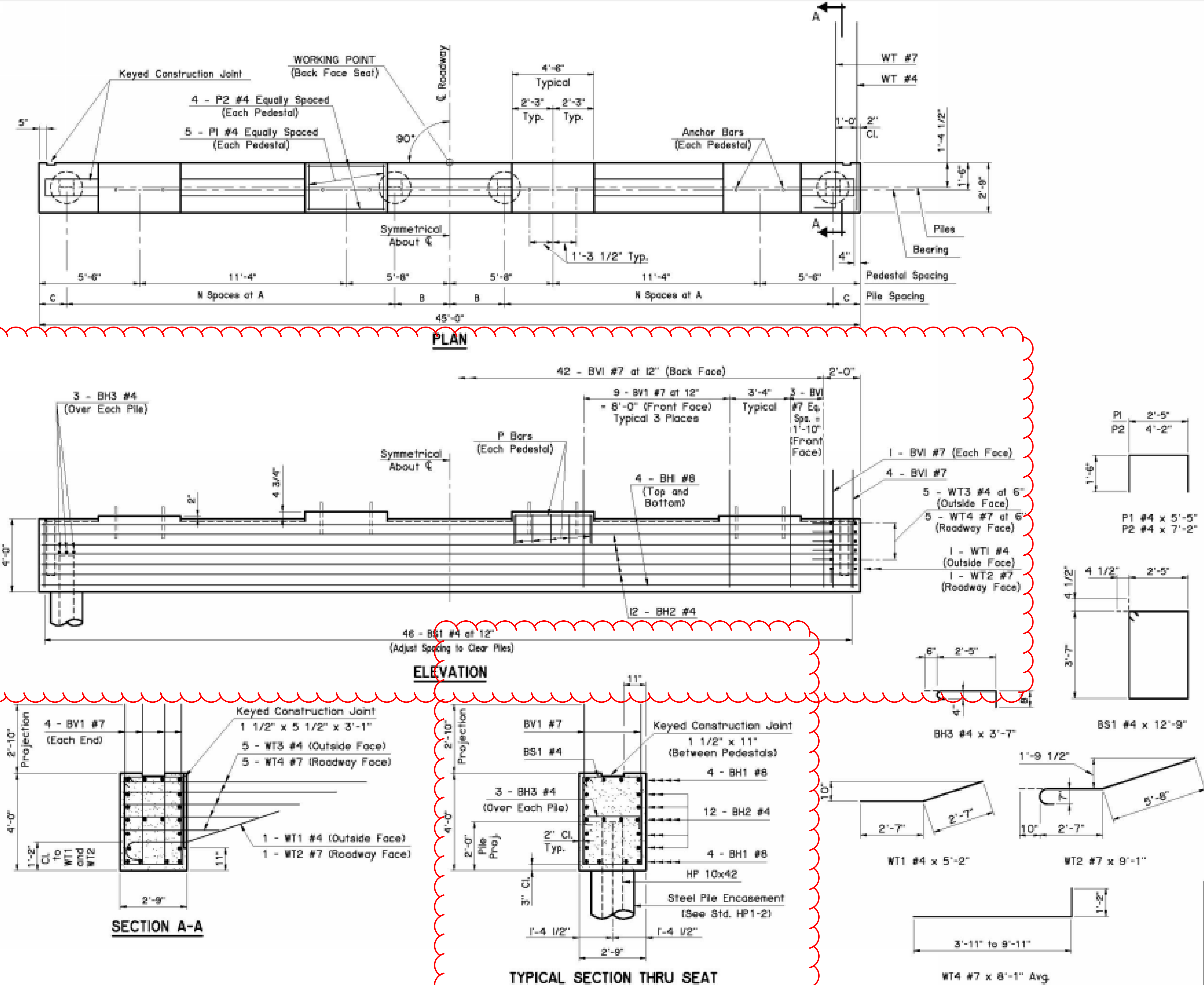
07-17-20
DATE

ADMINISTRATOR

REVISIONS

ICD-1-20

STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS



PILE SCHEDULE						
SPAN	TOTAL NUMBER OF PILES	N	A	B	C	MAXIMUM FACTORED PILE LOAD
65'	8	3	5'-8"	2'-10"	2'-6"	74.6 TON
70'	8	3	5'-8"	2'-10"	2'-6"	77.3 TON
75'	9	4	5'-0"	0"	2'-6"	71.1 TON
80'	9	4	5'-0"	0"	2'-6"	73.4 TON
85'	9	4	5'-0"	0"	2'-6"	75.7 TON
90'	9	4	5'-0"	0"	2'-6"	78.1 TON
95'	10	4	4'-6"	2'-3"	2'-3"	72.3 TON
100'	10	4	4'-6"	2'-3"	2'-3"	74.4 TON

Place all WT Wing reinforcing tied to Abutment Seat reinforcing before placing Abutment Seat concrete. Do not place Abutment Wing concrete until concrete for the Abutment Diaphragm and Deck Slab have attained a strength of 3000 p.s.i. For additional details, see ABUTMENT DIAPHRAGM DETAILS (SHEET 1 OF 2 AND SHEET 2 OF 2) and ABUTMENT WING DETAILS (SHEET 2 OF 2).

	ABUTMENT SEAT BAR LIST					
	MARK	SIZE	NO.	FORM	LENGTH	LENGTH VARIATION
	EPOXY COATED REINFORCING					
	BV1	#7	87	STR.	6'-7"	
	BH1	#8	8	STR.	44'-8"	
	BH2	#4	12	STR.	44'-8"	
	BS1	#4	46	BNT.	12'-9"	
	P1	#4	20	BNT.	5'-5"	
	P2	#4	16	BNT.	7'-2"	
	WT1	#4	2	BNT.	5'-2"	
	WT2	#7	2	BNT.	9'-1"	
①	WT3	#4	10	STR.	6'-11" AVG.	3'-11" to 9'-11"
①	WT4	#7	10	BNT.	8'-1" AVG.	5'-1" to 11'-1"
	8 PILE ABUTMENT					
	BH3	#4	24	BNT.	3'-7"	
	9 PILE ABUTMENT					
	BH3	#4	27	BNT.	3'-7"	
	10 PILE ABUTMENT					
	BH3	#4	30	BNT.	3'-7"	

① 2 Sets of 5

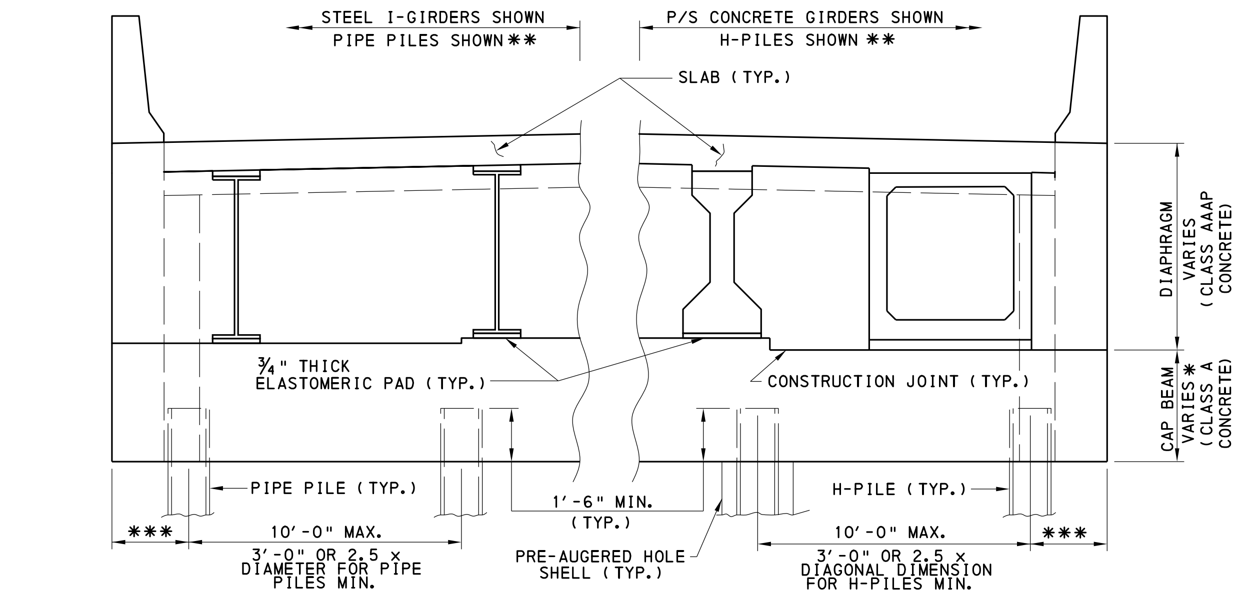
APPROVED BY BRIDGE ENGINEER [signature] DATE 3/1/10

OKLAHOMA DEPT. OF TRANSPORTATION
BRIDGE STANDARD (ENGLISH)

ABUTMENT DETAILS
TYPE IV P.C. BEAMS
INTEGRAL (SHEET 1 OF 2)

2009 SPECIFICATIONS | B40-I-ABUT-PC4-1 | 01E

B-44E



TYPICAL ELEVATION

* DEPTH OF ABUTMENT BELOW CONSTRUCTION JOINT IS 3'-3" AT SHALLOWEST POINT (SEE DM-4 AP.G.1.4.1) THE MAXIMUM DIFFERENCE BETWEEN THE MINIMUM AND MAXIMUM CAP DEPTH WILL NOT EXCEED 1'-0" FOR SKEW <80° OR 1'-6" FOR SKEW ≥ 80°.

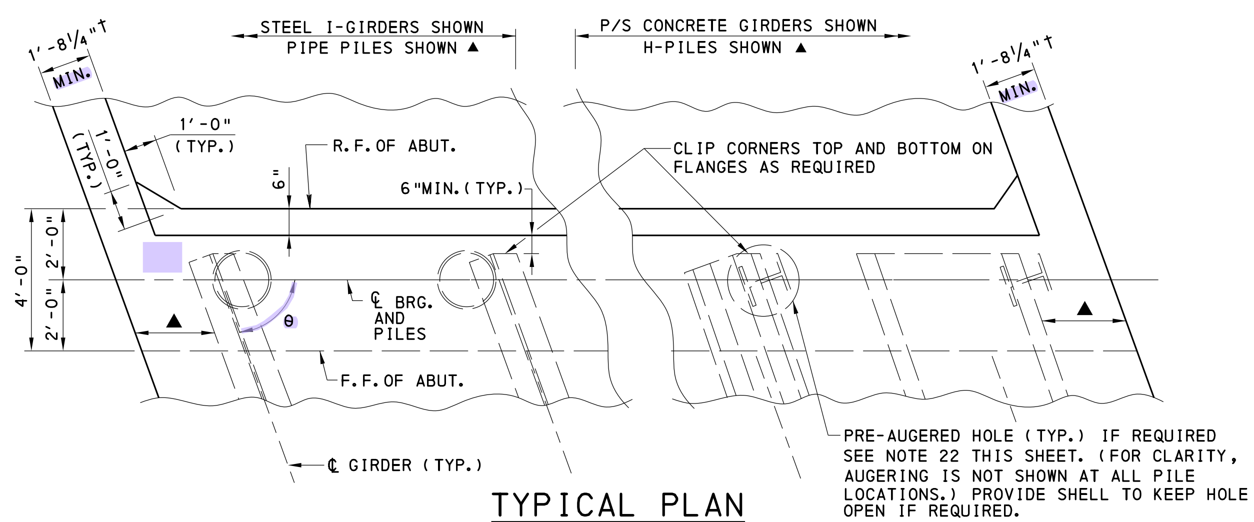
** BOTH H-PILES AND PIPE PILES MAY BE USED WITH STEEL OR CONCRETE GIRDERS. GALVANIZE TOP 15'-0" LENGTH OF THE PILES OR ENTIRE PILES LENGTH.

*** THE MAXIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 2'-6" AND $\frac{(W+dpile/2)}{\sin(\theta)}$ (ROUNDED UP TO THE NEXT 3" INCREMENT)
- WHERE: W: WIDTH OF WINGWALL AT REAR FACE OF INTEGRAL ABUTMENT, NEGLECTING THE 1' HAUNCH (ft.)
- dpile: OUTSIDE DIAMETER FOR PIPE PILES OR PILE DEPTH FOR H-PILES (ft.)

THE MINIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 1'-6"
- THE DISTANCE REQUIRED TO PROVIDE 3" CLEARANCE FROM THE PILES TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALL.



TYPICAL PLAN

† WINGWALL WIDTH MAY VARY BASED ON BARRIER TYPE SELECTED.

▲ EXTERIOR BEAMS TO BE LOCATED TO PROVIDE 3" CLEAR TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALLS.

DETACHED WINGWALL NOTES

1. DETERMINE THE MOVEMENT REQUIREMENTS AND THE OPENING OF THE EXPANSION DAM FOR THE EXPANSION JOINT BETWEEN THE ABUTMENT AND DETACHED WINGWALLS, AT THE TIME OF CONSTRUCTION, IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.6.
2. BOND THE PREFORMED NEOPRENE COMPRESSION SEAL BETWEEN THE ABUTMENT AND THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO BOTH THE ABUTMENT AND THE DETACHED WINGWALL.
3. BOND THE CLOSED CELL NEOPRENE SPONGE IN THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO THE WINGWALL. RECESS THE NEOPRENE SPONGE 1/2" INTO THE WINGWALL.
4. THE WATERPROOFING MEMBRANE ACROSS THE EXPANSION JOINT BETWEEN THE INTEGRAL ABUTMENT AND DETACHED WINGWALLS WILL BE IN ACCORDANCE WITH PUBLICATION 408, SECTION 680. THE MEMBRANE SHALL SPAN THE WIDTH OF THE RECESS IN THE ABUTMENT AND IN THE DETACHED WALL, AND SHALL HAVE 8" BONDED ON EACH SIDE. THE LENGTH OF THE MEMBRANE SHALL BE 6" LONGER THAN THE SPANNED LENGTH (i.e. 6" SLACK) AT THE TIME OF INSTALLATION. SEE DETAIL P ON SHEET 6.
5. PAINT THE CONTACT SURFACE BETWEEN THE APPROACH SLAB AND WINGWALL WITH AN APPROVED BOND BREAKER AND SEAL WITH AN APPROVED SEALER.

GENERAL NOTES

1. ALL DIMENSIONS GIVEN IN U.S. CUSTOMARY UNITS.
2. DESIGN SPECIFICATIONS
   - AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
   - PENNDOT DESIGN MANUAL PART 4, VOLUME 1, PART B: DESIGN SPECIFICATIONS AND VOLUME 2, APPENDIX G
3. PROVIDE MATERIALS AND WORKMANSHIP IN ACCORDANCE WITH PUBLICATION 408 AND THE CONTRACT SPECIAL PROVISIONS.
4. MATERIAL STRENGTH
   - REINFORCEMENT STEEL fy = 60 KSI
   - CONCRETE f'c = 4000 PSI (CLASS AAAP CONCRETE) FOR DECK SLABS, APPROACH SLABS, AND END DIAPHRAGMS AND WINGWALLS ABOVE CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3500 PSI (CLASS AA CONCRETE) FOR BARRIERS, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3000 PSI (CLASS A CONCRETE) FOR CAP BEAM AND WINGWALLS BELOW CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 9.
5. DEAD LOAD
   - DENSITY OF NORMAL WEIGHT CONCRETE = 150 PCF
   - FUTURE WEARING SURFACE = 30 PSF
6. LIVE LOAD
   - LIVE LOAD IS CALCULATED ASSUMING ALL POTENTIAL LANES ARE LOADED. USE A MULTIPLE PRESENCE FACTOR OF 1.0 FOR DESIGN OF THE INTEGRAL ABUTMENT CAP AND SUPPORTING PILES.
   - THE LIVE LOAD IS ASSUMED TO BE EVENLY DISTRIBUTED TO ALL PILES.
7. DYNAMIC LOAD ALLOWANCE (IM) = 33% IS APPLIED TO LIVE LOADS ON THE ABUTMENTS AND THE PILES IN ACCORDANCE WITH ARTICLES A3.6.2.1 AND D3.6.2.1.
8. DESIGN CONTROLS
   - CONCRETE COVER: INTEGRAL ABUTMENT (i.e., CAP BEAM AND END DIAPHRAGM) AND WINGWALLS = 3"
   - UNLESS OTHERWISE INDICATED, USE THE FOLLOWING MINIMUM REINFORCEMENT SPLICE LENGTHS:

#4	2'-1"	#6	3'-1"	#8	5'-1"	#10	8'-2"
#5	2'-7"	#7	3'-10"	#9	6'-5"	#11	10'-0"

   - BAR SIZE: MAXIMUM BAR SIZE #11
     MINIMUM BAR SIZE #4
9. FOR DESIGN CONTROLS OF DECK AND BARRIERS, SEE STANDARD DRAWING BD-601M.
10. USE ONLY ONE ROW OF VERTICAL PILES PER ABUTMENT. PILES MAY BE H-PILES OR PIPE PILES. FOR H-PILES, ORIENT THE WEB PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE GIRDER OF THE END SPAN. TAPERED PILES MAY BE USED PROVIDED THE TAPER POINT IS BELOW THE POINT OF CONTRAFLEXURE.
11. ALL REINFORCING BARS ARE TO BE EPOXY COATED.
12. USE ONLY NORMAL WEIGHT CONCRETE FOR WINGWALLS AND ABUTMENTS.
13. DETAIL ALL BARS ON THE CONTRACT DRAWINGS.
14. PROVIDE A TROWEL SMOOTH SURFACE OF THE CONSTRUCTION JOINT DIRECTLY UNDER THE GIRDERS AND THE AREA EXTENDING 2" OUTSIDE OF THAT AREA. ON ALL OTHER CONSTRUCTION JOINTS, PROVIDE A RAKED SURFACE.
15. PROVIDE 3/4" THICK, 50 DUROMETER NEOPRENE PADS UNDER ALL GIRDERS. ALL PADS WILL BE 12" ALONG THE LENGTH OF THE BEAM AND MATCH THE WIDTH OF THE BEAM MINUS ANY CHAMFERS. BLOCK THE AREAS UNDER THE GIRDERS NOT IN CONTACT WITH THE BEARING PADS USING 1" THICK BACKER RODS.
16. TAKE LIMITS OF FILL BEHIND THE ABUTMENT AND THE WINGWALLS AS SHOWN ON STANDARD DRAWING RC-12M.
17. FOR DETAILS OF INSERTS IN PRECAST CONCRETE BEAMS, SEE STANDARD DRAWING BD-655M IN ADDITION TO SHEETS 2 AND 8 OF THIS STANDARD.
18. FOR DETAILS OF APPROACH SLABS FOR INTEGRAL ABUTMENT BRIDGES, SEE STANDARD DRAWING BD-628M.
19. PLACE ALL GIRDERS, INCLUDING BOX BEAMS, WITH THEIR WEBS VERTICAL. STEP TOP OF CAP BEAM TO PROVIDE THE CORRECT BEAM SEAT ELEVATION. CHANGE HAUNCH THICKNESS ACROSS THE WIDTH OF THE GIRDERS TO PROVIDE THE CORRECT ROADWAY CROSS-SLOPE AND SUPERELEVATION. SLOPE BEAM SEAT IN THE LONGITUDINAL DIRECTION TO MATCH BOTTOM OF BEAM.
20. THE BOTTOM OF THE ABUTMENT MAY BE HORIZONTAL. HOWEVER, THE VARIATION IN THE PILE CAP DEPTH FROM ONE END OF THE ABUTMENT TO THE OTHER DUE TO SUPERELEVATION IS LIMITED TO 1'-6" [1'-0" FOR SKEWS LESS THAN 80 DEGREES]. FOR SUPERELEVATIONS THAT WOULD RESULT IN GREATER VARIATIONS, THE BOTTOM OF THE ABUTMENT MUST BE PARALLEL TO THE SLOPE OF THE ROADWAY. FOR THE REINFORCEMENT SHOWN, THE PILE CAP IS TO BE A MINIMUM 3'-3" THICK, WITH A MAXIMUM DEPTH OF 4'-3" FOR SKEWS LESS THAN 80 DEGREES, AND A MAXIMUM DEPTH OF 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES. PILE CAP DEPTHS GREATER THAN 4'-3" FOR SKEWS LESS THAN 80 DEGREES AND PILE CAP DEPTHS GREATER THAN 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES MUST BE APPROVED BY CHIEF BRIDGE ENGINEER.
21. INTEGRAL ABUTMENTS AT OPPOSITE ENDS OF A BRIDGE SHALL BE THE SAME DEPTH EXCEPT FOR VARIATIONS DUE TO DIFFERENCES IN ROADWAY CROSS SLOPE OR SUPERELEVATION. THE BEAM SEAT MUST BE PARALLEL TO THE ROADWAY GRADE, IN THE LONGITUDINAL DIRECTION.
22. DETERMINE THE MINIMUM DIAMETER OF THE PRE-AUGERED HOLES IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.4.2.1.
23. BEAM DEPTH IS RESTRICTED TO A 6'-0" MAXIMUM DEPTH WHEN USED FOR INTEGRAL ABUTMENT UNLESS APPROVED BY CHIEF BRIDGE ENGINEER.
24. USE OF ADJACENT BOX BEAMS IS NOT PERMITTED, DETAILS FOR BEAMS LESS THAN 1'-5" ARE NOT INCLUDED IN THIS STANDARD.
25. SKEW LIMITATION FOR INTEGRAL ABUTMENTS PER SECTION 1.2.2 OF DESIGN MANUAL, PART 4 APPENDIX "G".
26. FLARED WINGWALLS ARE NOT TO BE USED WITH INTEGRAL ABUTMENTS. REFERENCE APPENDIX "G" OF DESIGN MANUAL PART 4 SECTION 1.4.4.
27. BOTH THE TYPICAL AND ALTERNATE SIDEWALK DETAILS MAY BE USED ON INTEGRAL ABUTMENT BRIDGES. IF USED, THOSE DETAILS MUST BE CARRIED THROUGH THE APPROACH SLAB.
28. ALL REINFORCEMENT STEEL BARS SHOWN MEET THE REQUIREMENTS OF ASTM A 615, A 996 OR A 706.
29. THE STLRFD SOFTWARE REQUIRES BEARING STIFFENERS AT THE CENTERLINE OF BEARING AND ALSO CONSIDERS THE GIRDERS TO BE LATERALLY BRACED AT THE CENTERLINE OF BEARING. THE DESIGNER IS RESPONSIBLE FOR DETAILING THE BEARING STIFFENERS. THE LATERAL BRACING (END DIAPHRAGM) IS TO BE OMITTED AND THE FOLLOWING NOTE ADDED TO THE CONSTRUCTION DRAWINGS:
    - THE CONTRACTOR IS RESPONSIBLE FOR TEMPORARY BRACING OF THE GIRDERS. PLACE THE #8 REINFORCEMENT BARS THROUGH THE BEAMS AND THE CAP FORMWORK PRIOR TO PLACING ANY DECK CONCRETE.
30. SUPERSTRUCTURE MUST BE ERECTED AND CONNECTED TO THE INTEGRAL ABUTMENTS PRIOR TO PLACING BACKFILL BEHIND THE ABUTMENTS.
31. IF AN INTEGRAL ABUTMENT BRIDGE IS BEING REDECKED, THE END DIAPHRAGM MUST BE REMOVED COMPLETELY PRIOR TO DECK REMOVAL TO AVOID SUBJECTING THE GIRDERS TO STRUCTURE AND PAVEMENT TEMPERATURE FORCES AND EARTH PRESSURE.

BD-601M	CONCRETE DECK SLAB
BD-628M	BRIDGE APPROACH SLABS
BD-655M	TYPICAL SUPERSTRUCTURE SECTIONS
BD-656M	TYPICAL LONGITUDINAL SECTIONS
BC-736M	REINFORCEMENT BAR FABRICATION DETAILS
BC-739M	BRIDGE BARRIER TO GUIDE RAIL TRANSITION
BC-751M	BRIDGE DRAINAGE
BC-788M	TYPICAL WATERPROOFING AND EXPANSION DETAILS
RC-12M	BACKFILL AT STRUCTURES

REFERENCE DRAWINGS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

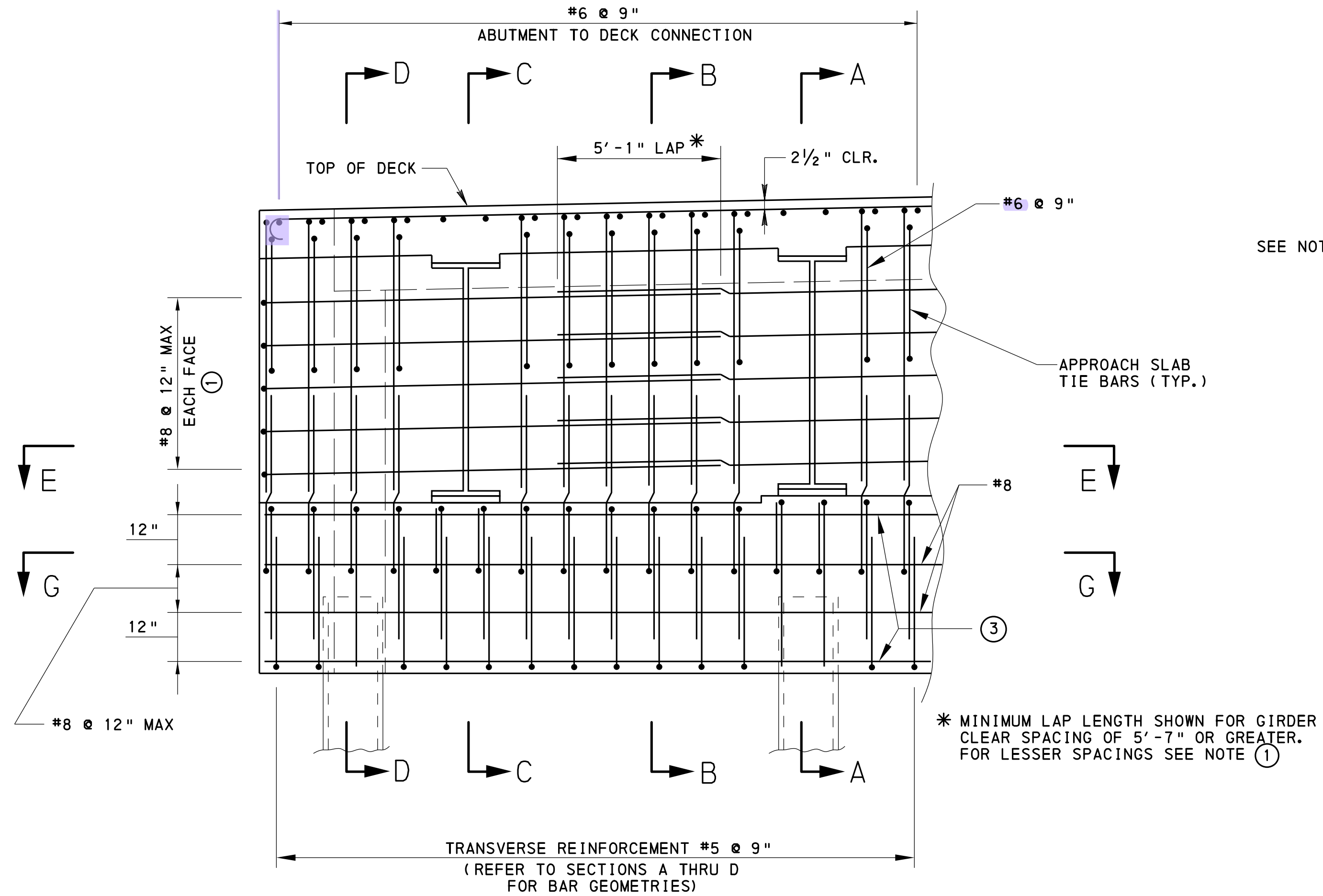
STANDARD
INTEGRAL ABUTMENT
LAYOUT AND GENERAL NOTES

RECOMMENDED APR. 29, 2016 — Thomas P. Macioce — CHIEF BRIDGE ENGINEER

RECOMMENDED APR. 29, 2016 — Brian G. Thompson — DIRECTOR, BUR. OF PROJECT DELIVERY

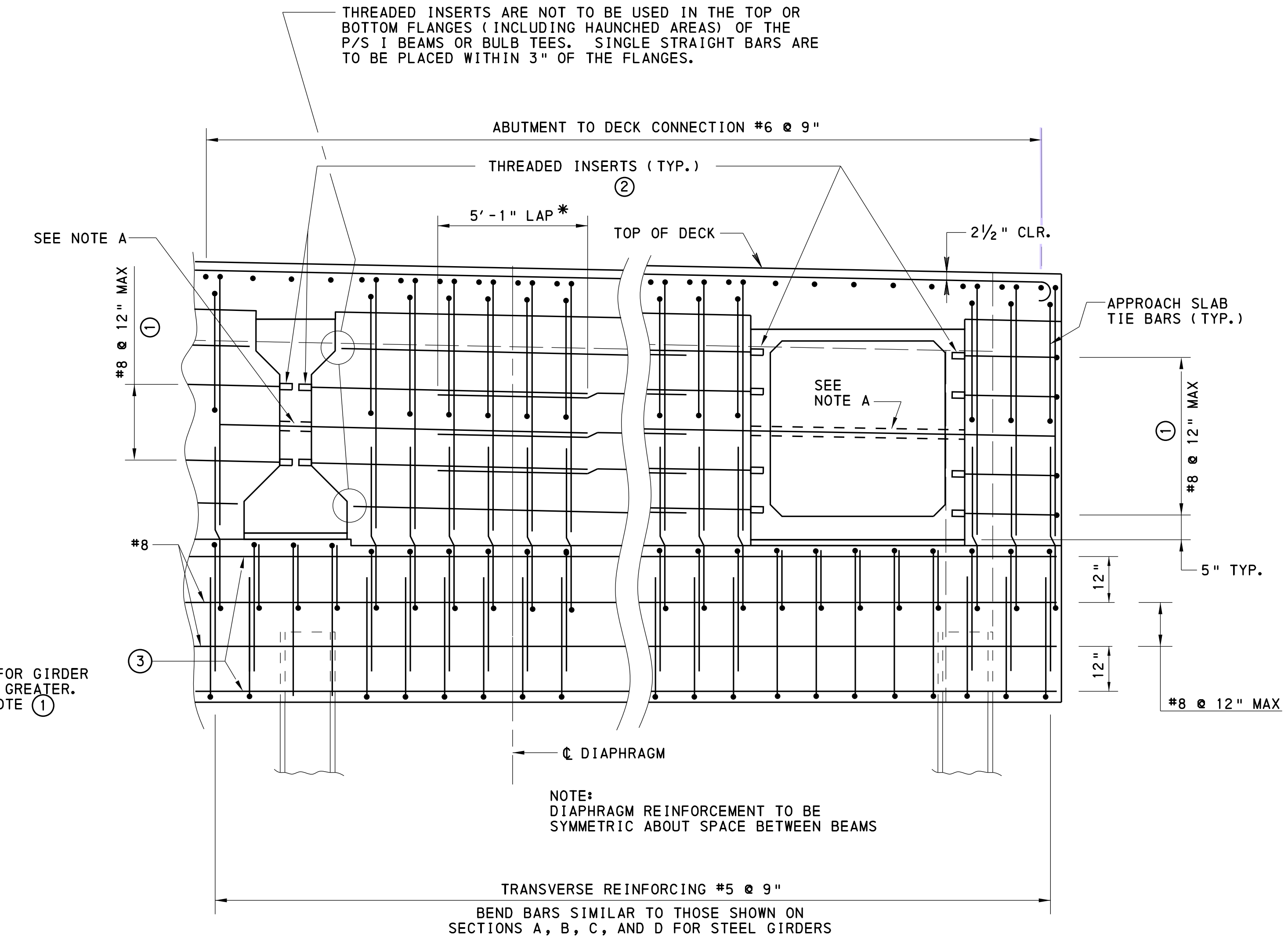
SHEET 1 OF 9

BD-667M



PARTIAL SECTION THRU ABUTMENT
STEEL GIRDERS

NOTE: FOR SECTION A-A, SEE SHEET 3.
FOR SECTION B-B, SEE SHEET 3.
FOR SECTION C-C, SEE SHEET 3.
FOR SECTION D-D, SEE SHEET 3.
FOR SECTION E-E, SEE SHEET 4.
DECK REINFORCEMENT NOT SHOWN FOR CLARITY

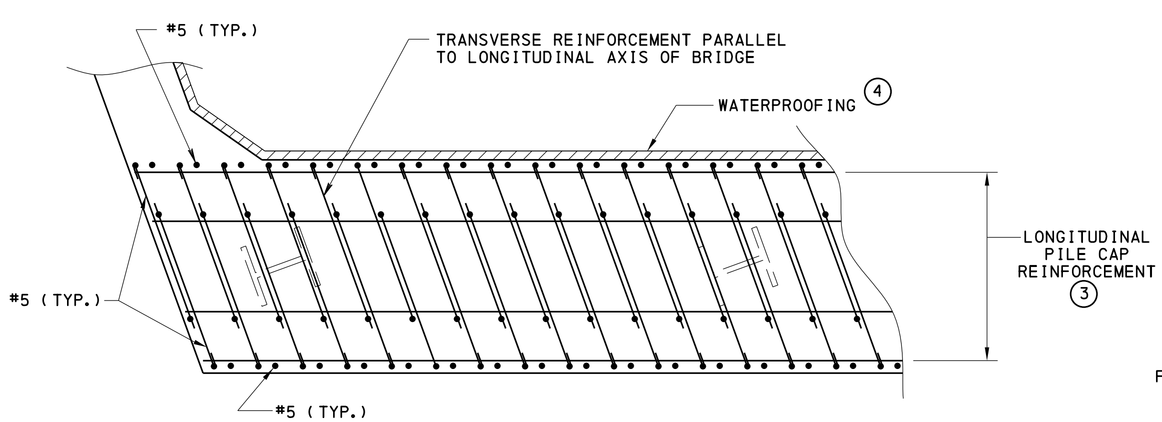


PARTIAL SECTION THRU ABUTMENT
CONCRETE GIRDERS

NOTE: DECK REINFORCEMENT NOT SHOWN FOR CLARITY

NOTE A:

AS AN ALTERNATE TO THREADED INSERTS AND BAR LAPS, SLEEVES MAY BE PROVIDED IN P/S BEAMS.



SECTION G-G

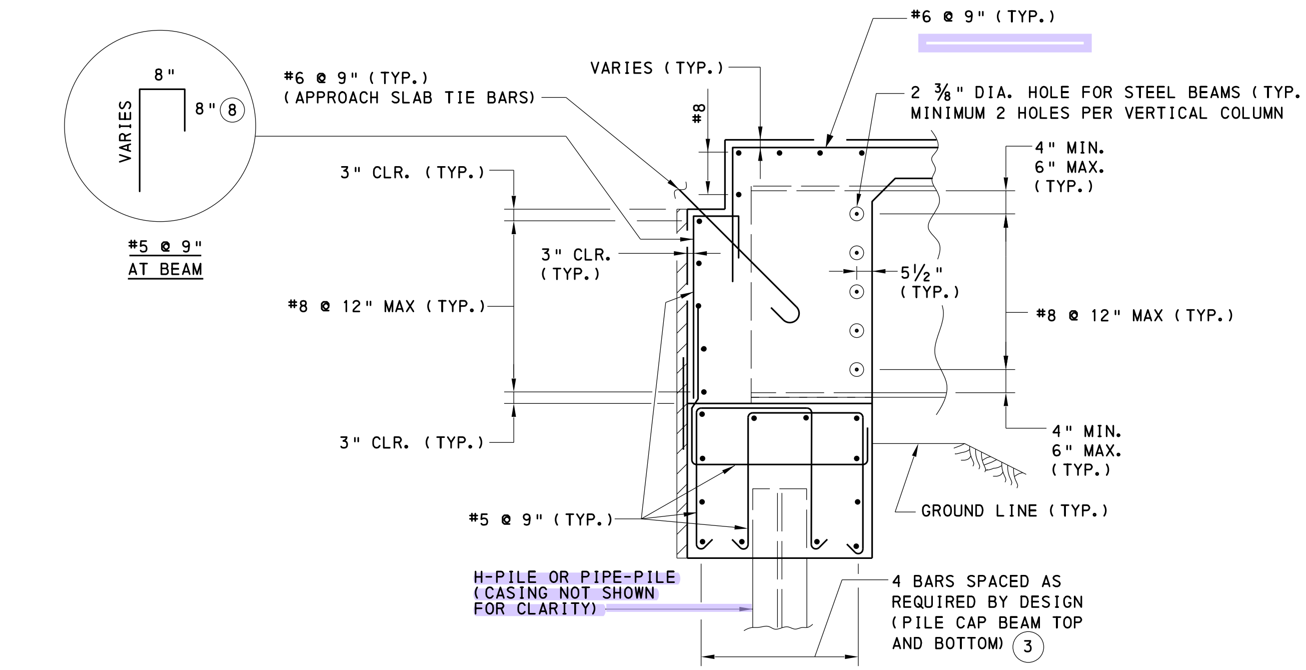
LEGEND:

1. LENGTH OF BARS BETWEEN GIRDERS:
   - FOR P/S BEAMS:
     - FOR BARS BETWEEN INTERIOR BEAMS, USE MINIMUM BAR LENGTH EQUAL TO 3" THREADING + ½ GIRDER CLEAR SPACING + ½ LAP SPLICE LENGTH. IF THE LAP SPLICE LENGTH IS GREATER THAN THE GIRDER CLEAR SPACING THE BARS SHOULD EXTEND TO WITHIN 3" OF THE ADJACENT BEAMS.
     - BAR LENGTH ON THE FASCIA SIDE OF THE FASCIA BEAM SHOULD BE TO WITHIN 3" OF THE END OF DIAPHRAGM WITH A 9" BENT LEG AND INCLUDE 3" THREADED.
   - FOR STEEL BEAMS:
     - FOR BARS BETWEEN INTERIOR BEAMS, USE MINIMUM BAR LENGTH EQUAL TO THE CLEAR SPACING + LAP LENGTH. IF THE LAP SPLICE LENGTH IS GREATER THAN THE GIRDER CLEAR SPACING EXTEND BARS TO WITHIN 3" OF THE ADJACENT BEAMS ON EACH SIDE.
     - BAR LENGTH ON THE FASCIA SIDE OF THE FASCIA BEAM SHOULD BE TO WITHIN 3" OF THE END OF DIAPHRAGM WITH A 9" BENT LEG.
2. FOR INSERT DETAILS, SEE BD-655M AND BD-656M FULL DEPTH DIAPHRAGM WITHOUT BACKWALL AND INTEGRAL ABUTMENT DETAILS. FOR INSERT LOCATIONS, SEE SHEET 8.
3. FOR BAR SIZES OF PILE CAP BEAM TOP AND BOTTOM REINFORCEMENT, SEE DM-4 AP. G 1.4.3
4. REFER TO WATERPROOFING DETAIL ON SHEET 4 FOR ADDITIONAL INFORMATION.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
TYPICAL SECTIONS

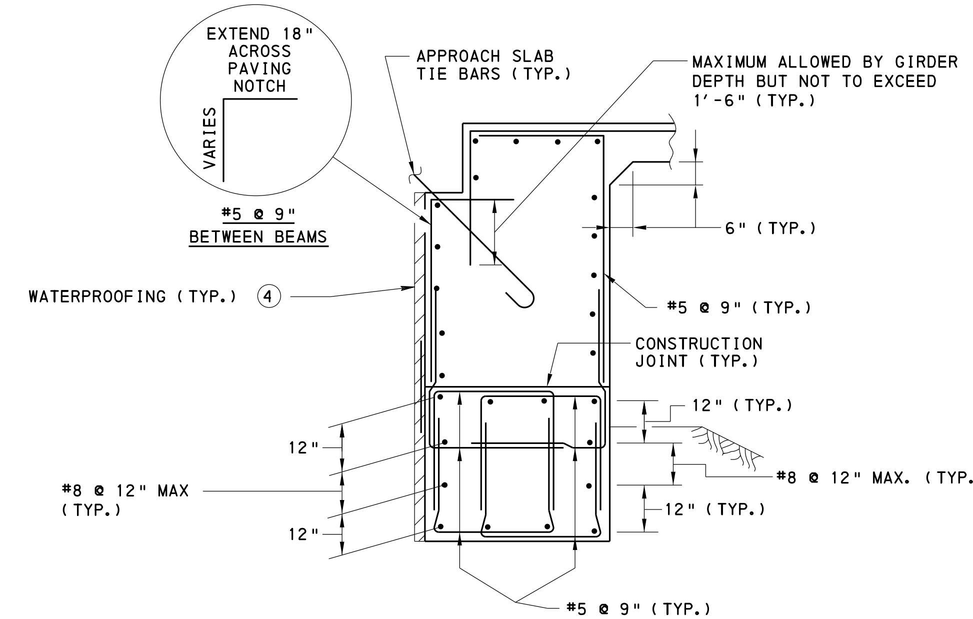
RECOMMENDED APR. 29, 2016 Thomas P Macioce CHIEF BRIDGE ENGINEER	RECOMMENDED APR. 29, 2016 Brian G Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	SHEET 2 OF 9 BD-667M



SECTION A-A

GIRDER WITH PILE (5) (6)

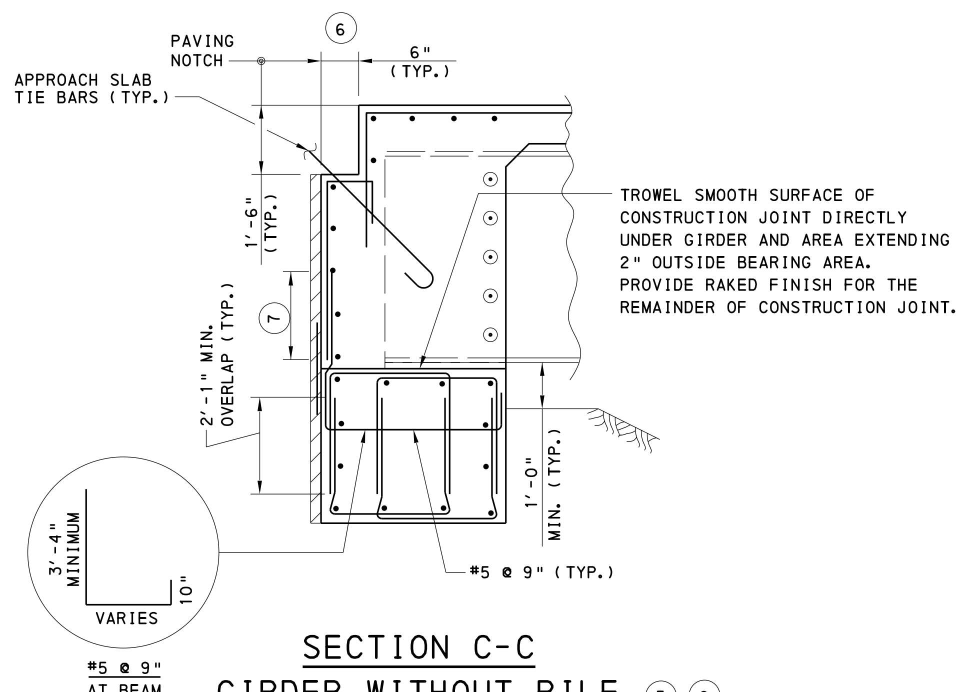
DECK REINFORCEMENT IS NOT SHOWN FOR CLARITY.



SECTION B-B

NO GIRDER, NO PILE (5)

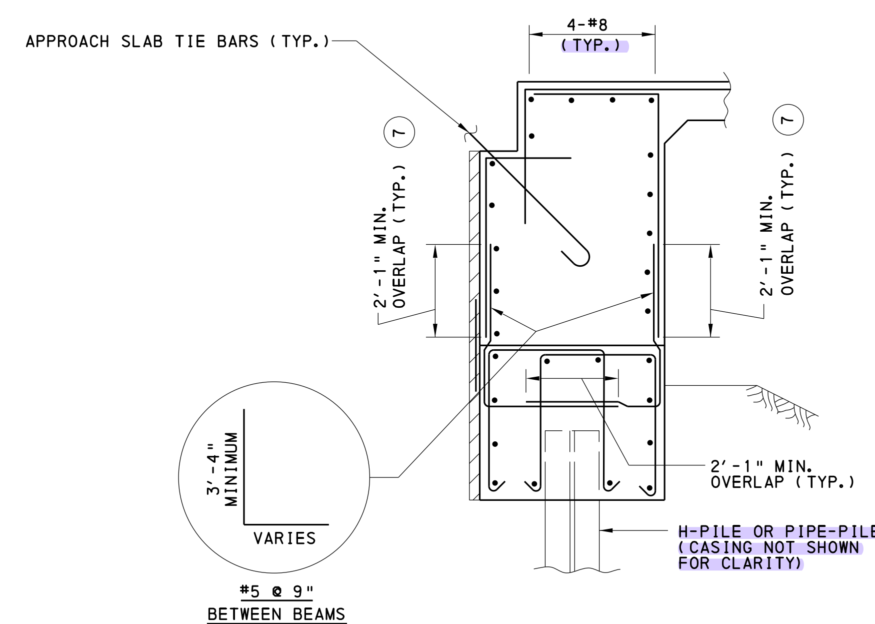
DECK REINFORCEMENT IS NOT SHOWN FOR CLARITY.



SECTION C-C

GIRDER WITHOUT PILE (5) (6)

DECK REINFORCEMENT IS NOT SHOWN FOR CLARITY.



SECTION D-D

PILE WITHOUT GIRDER (5)

DECK REINFORCEMENT IS NOT SHOWN FOR CLARITY.

NOTES:

1. FOR SECTIONS A-A, B-B, C-C, AND D-D THE REINFORCEMENT AND WATERPROOFING INDICATED AS TYPICAL IN THE SECTIONS IS PRESENT IN ALL SECTIONS WHETHER SPECIFICALLY STATED OR NOT.
2. DETAILS SHOWN ARE FOR STEEL BEAMS, DETAILS SIMILAR FOR P/S BEAMS. SEE SHEET 8 FOR INSERT LOCATIONS.
3. FOR SECTION CUTS A-A, B-B, C-C AND D-D SEE SHEET 2.

LEGEND:

(3) FOR BAR SIZES OF PILE CAP BEAM TOP AND BOTTOM REINFORCEMENT, SEE DM-4 AP. G 1.4.3

(4) REFER TO WATERPROOFING DETAIL ON SHEET 4 FOR ADDITIONAL INFORMATION.

(5) SECTIONS ARE DRAWN SHOWING STEEL I-GIRDERS AND H-PILES. SECTIONS WITH CONCRETE GIRDERS AND/OR PIPE PILES WOULD BE SIMILAR EXCEPT FOR THE THREADED INSERTS REQUIRED FOR CONCRETE GIRDERS (SEE NOTE 2) AND THE REINFORCEMENT REQUIRED TO ANCHOR PIPE PILES (SEE DETAIL ON SHEET 6).

(6) STEEL BEAM SHOWN P/S BEAMS SIMILAR. SEE SHEET 8 AND PARTIAL SECTION THRU ABUTMENT CONCRETE GIRDERS, ON SHEET 2 FOR INSERT/SLEEVE LOCATIONS.

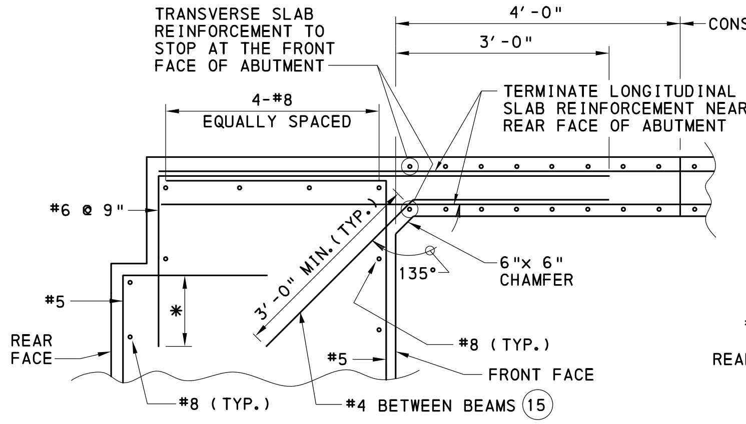
(7) FOR GIRDERS TOO SHALLOW TO PERMIT A 2'-1" OVERLAP, THE SPLICE IS NOT PERMITTED. ELIMINATING THE SPLICE IS OPTIONAL IN ALL OTHER CASES.

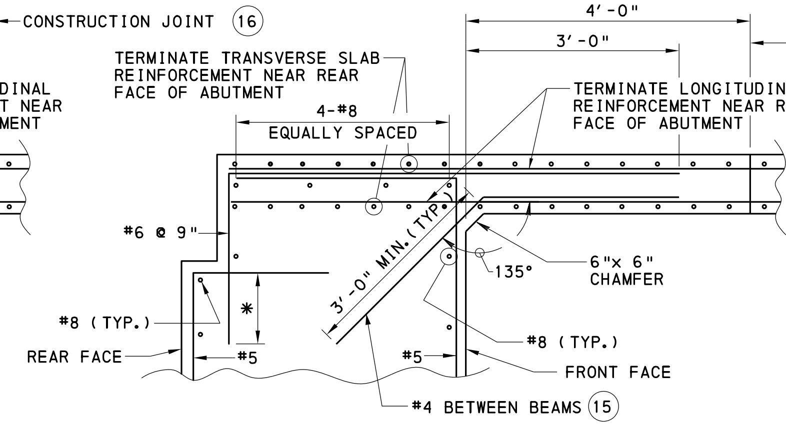
(8) IF BAR EXTENDS INTO CAP EXTEND BAR TO PROVIDE 2" MIN. EMBEDMENT.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
TYPICAL SECTIONS

RECOMMENDED APR. 29, 2016	RECOMMENDED APR. 29, 2016	SHEET 3 OF 9
Thomas P Macioce CHIEF BRIDGE ENGINEER	Brian G Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M





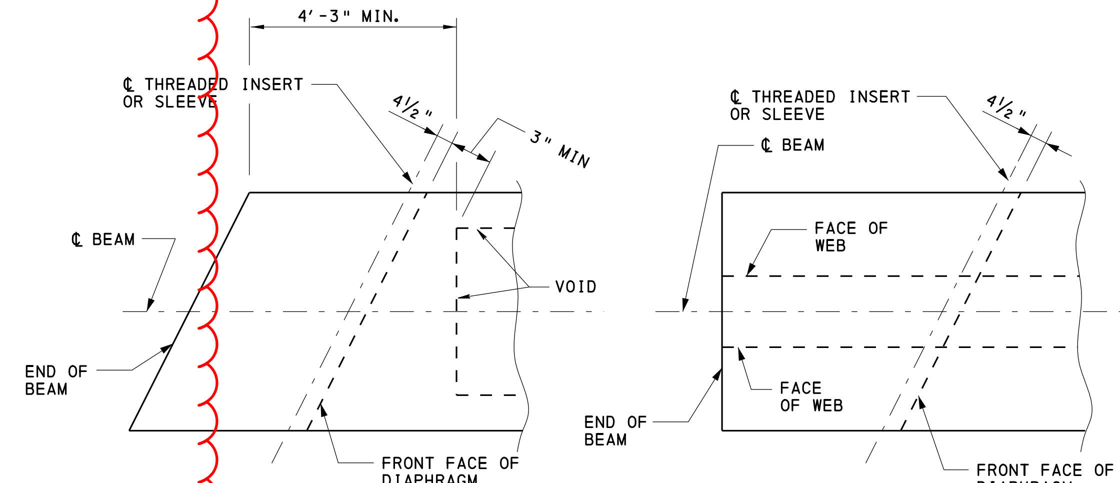
✱ 1'-6" MAXIMUM LENGTH ALLOWED DUE TO GIRDER DEPTH.

TRANSVERSE SLAB REINFORCEMENT
PARALLEL TO ABUTMENT
(SKEWS OF 75° TO 90°)

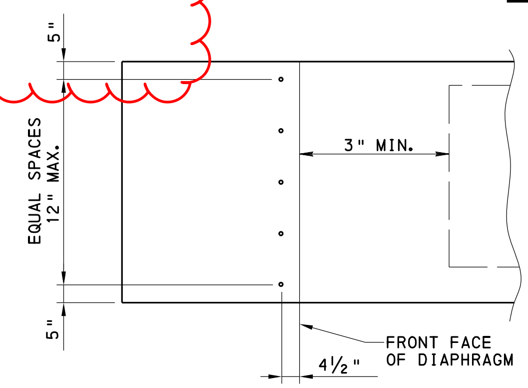
TRANSVERSE SLAB REINFORCEMENT
NOT PARALLEL TO ABUTMENT
(SKEWS < 75°)

SLAB-ABUTMENT CONNECTION DETAIL

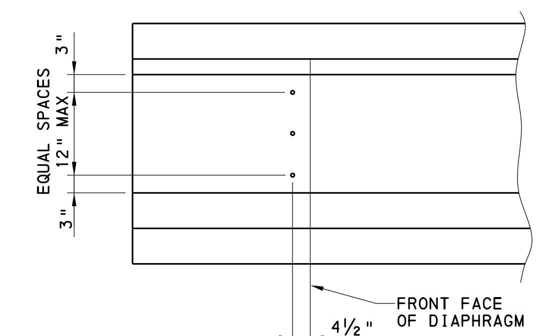
- FOR DECK TOP REINFORCEMENT MAT: TRANSVERSE BARS SHOWN ON TOP, SIMILAR WHEN LONGITUDINAL BARS ON TOP.
- SECTIONS BETWEEN GIRDERS SHOWN



PLAN VIEWS



CONCRETE BOX BEAMS

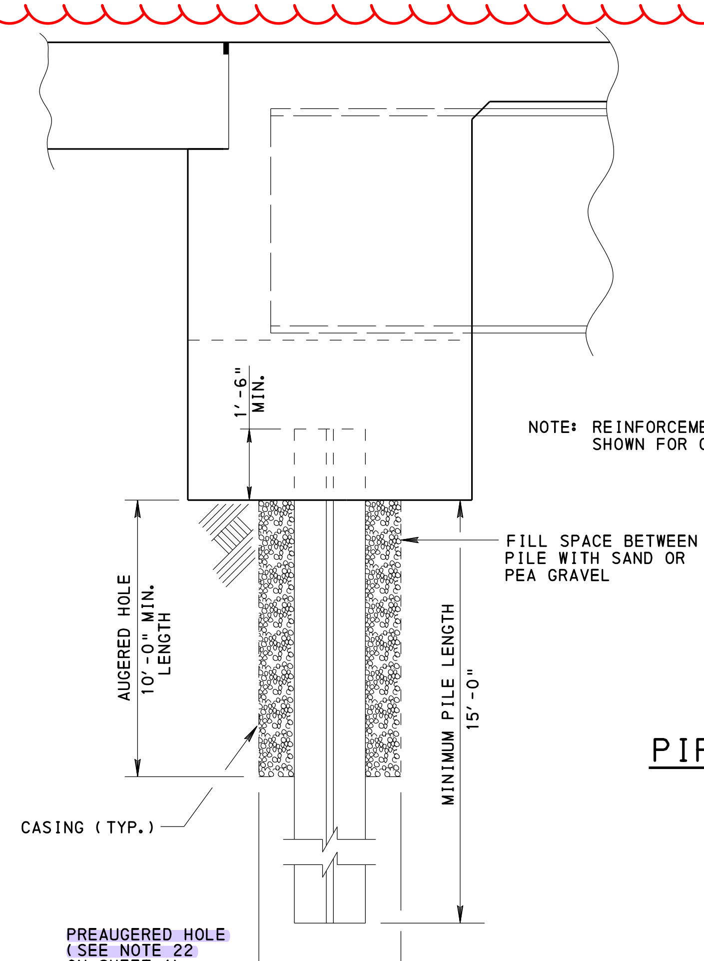


CONCRETE I-BEAMS

ELEVATION VIEWS

THREADED INSERT LOCATIONS IN PRESTRESS BEAMS, BEAM ENDS SUPPORTED ON INTEGRAL ABUTMENTS

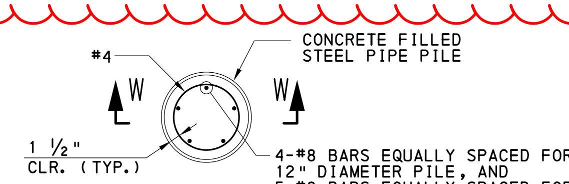
(SEE SHEET 3 FOR HOLE LOCATION IN WEBS OF STEEL BEAMS)



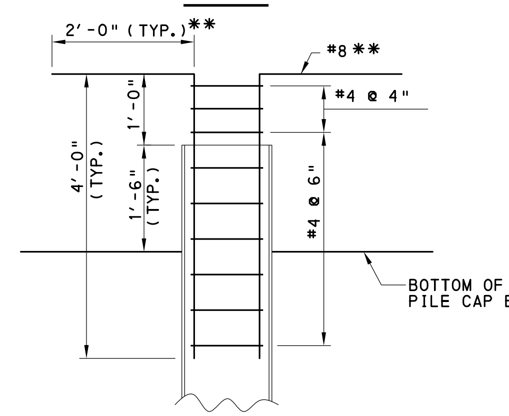
PREAUGERED HOLE (SEE NOTE 22 ON SHEET 1)

INTEGRAL ABUTMENT PILE INSTALLATION DETAIL

- SEE APPENDIX G OF DESIGN MANUAL PART 4 SECTION 1.4.2 FOR PRE AUGERING REQUIREMENTS
- PREDRILL OVERSIZED HOLES FOR ALL PILES IN ACCORDANCE WITH DESIGN MANUAL PART 4 AP.G.1.4.2.1. PLACE PILES VERTICAL IN THE HOLES BEFORE FILLING THE HOLES. FILL THE HOLES WITH DRY LOOSE SAND OR PEA GRAVEL BEFORE DRIVING THE PILES.



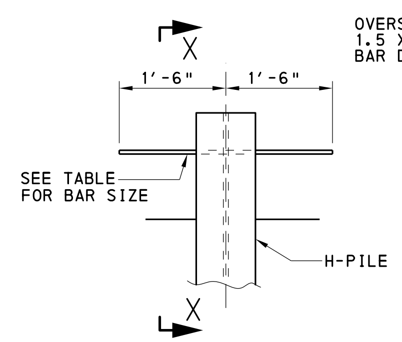
PLAN



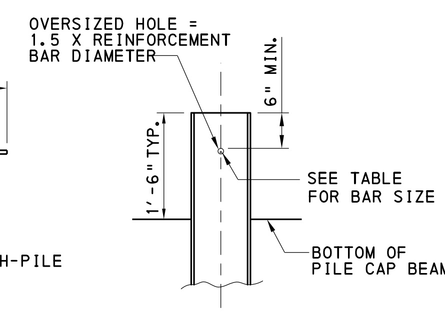
SECTION W-W

** HOOK 180° PER BC-736M OR ROTATE TO FIT SHORTER CAP WIDTHS

PIPE PILE-TO-PILE CAP CONNECTION DETAIL



ELEVATION



VIEW X-X

H-PILE-TO-PILE CAP CONNECTION DETAIL

H-PILE TO PILE CAP CONNECTION REINFORCEMENT

PILE SIZE	BAR
HP 10 x 57	#6
HP 12 x 53	#6
HP 12 x 63	#6
HP 12 x 74	#6
HP 12 x 84	#7
HP 14 x 73	#6
HP 14 x 89	#7
HP 14 x 102	#7
HP 14 x 117	#8

LEGEND:

(15) SPACED WITH LONGITUDINAL DECK REINFORCEMENT

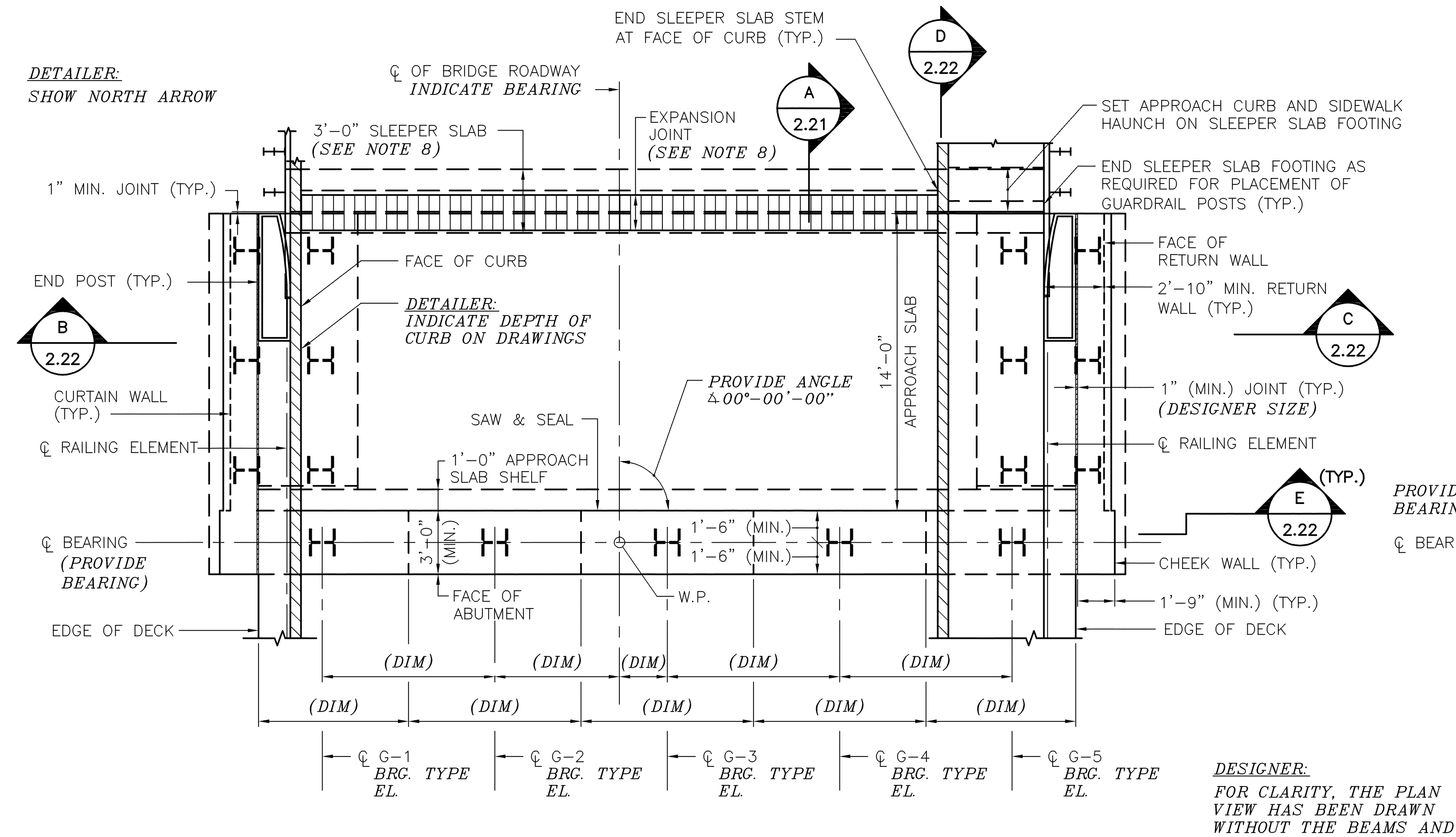
(16) DECK PLACEMENT SEQUENCE:
1. POUR THE ENTIRE DECK EXCEPT THE PORTIONS WITHIN 4'-0" FROM THE FRONT FACES OF THE ABUTMENTS.
2. THEN POUR THE END DIAPHRAGMS.
3. FOR GIRDER DEPTHS >36", WAIT A MINIMUM OF 2 HOURS BEFORE POURING THE REMAINER OF THE DECK. FOR GIRDER DEPTHS ≤36" THE REMAINDER OF THE DECK CAN BE POURED SIMULTANOUSLY WITH THE END DIAPHRAGMS.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

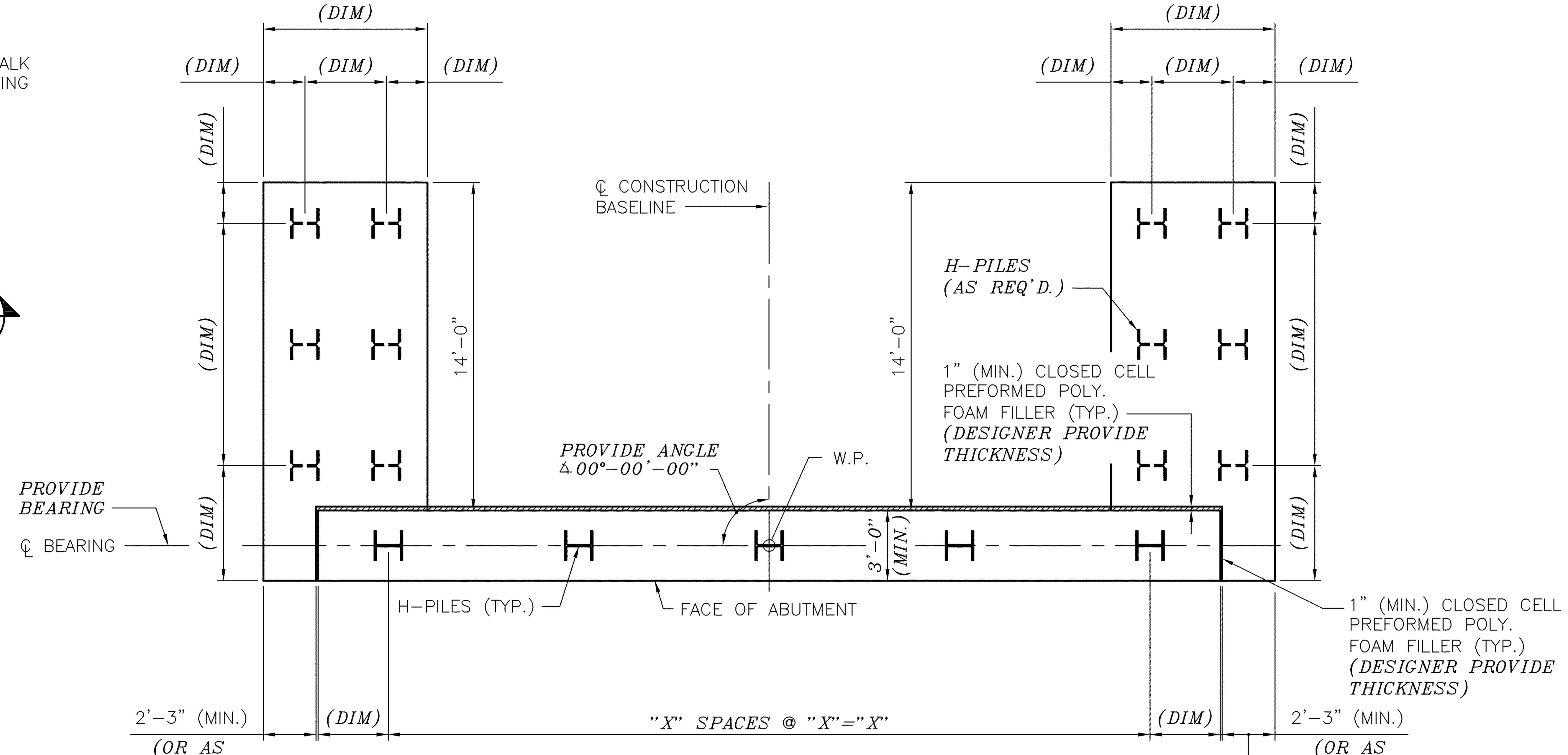
STANDARD

INTEGRAL ABUTMENT
SLAB-ABUTMENT CONNECTION AND
PILE-ABUTMENT CONNECTION DETAILS

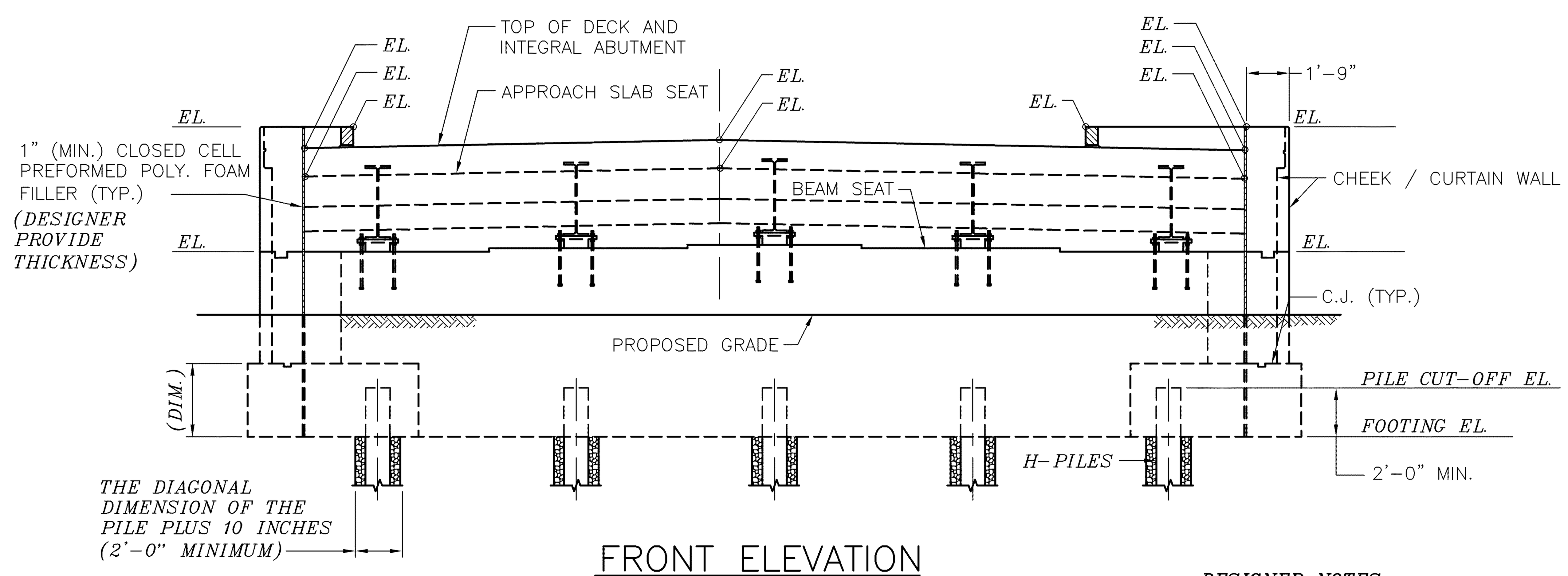
RECOMMENDED APR. 29, 2016	RECOMMENDED APR. 29, 2016	SHEET 8 OF 9
Thomas P Macioce CHIEF BRIDGE ENGINEER	Brian G Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M



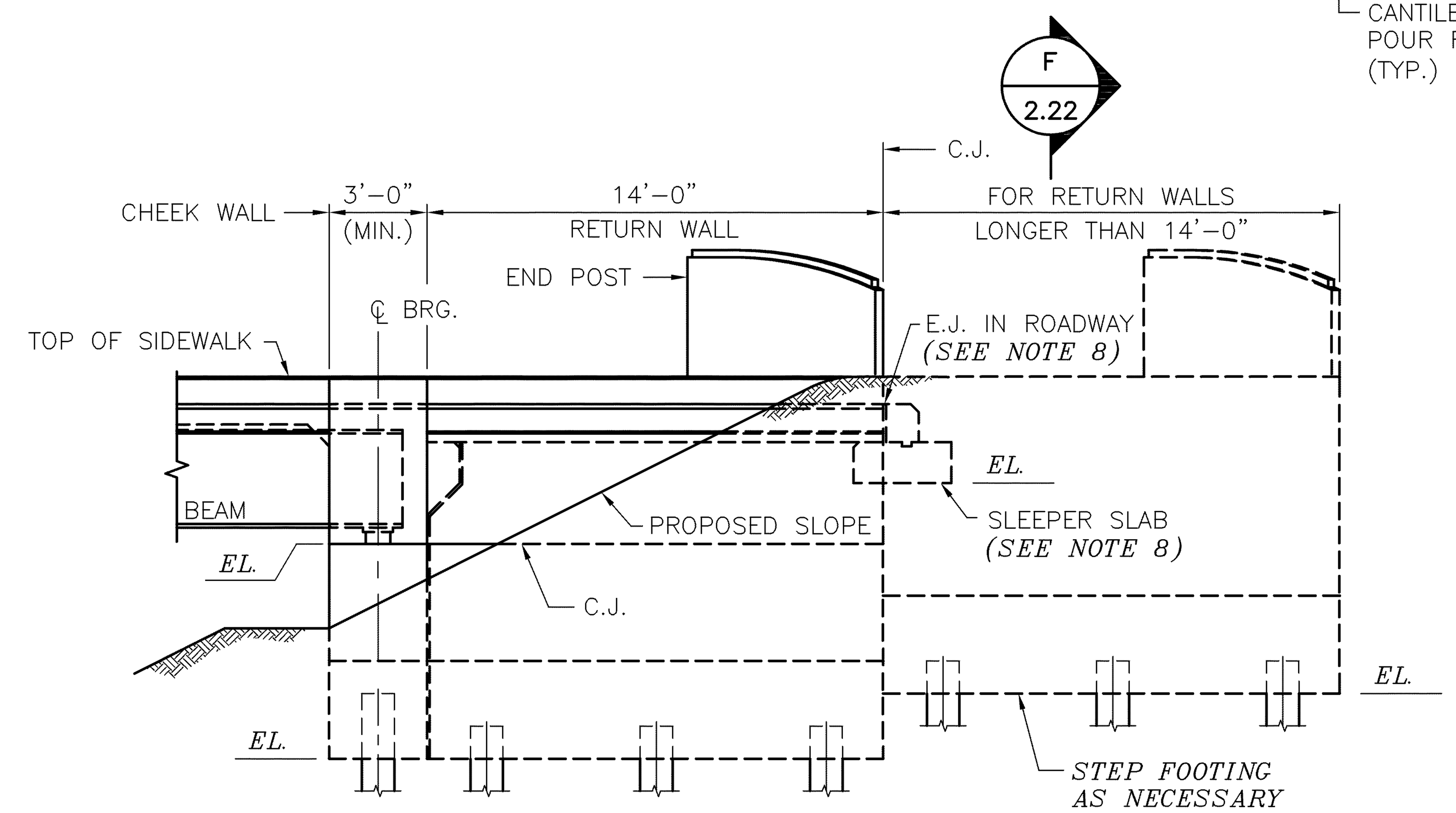
PLAN AT BEAM SEATS
SCALE:1/4"=1'-0"



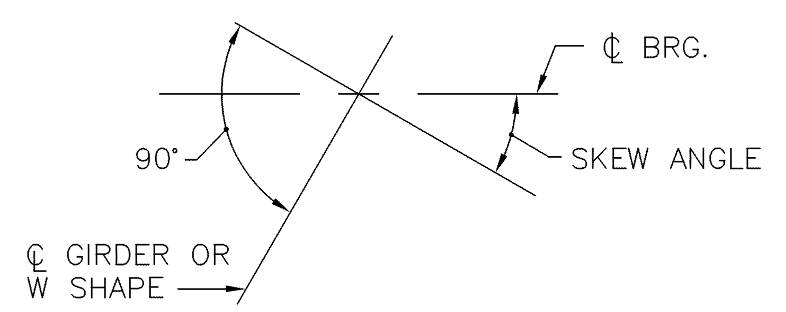
FOUNDATION PLAN
SCALE:1/4"=1'-0"



FRONT ELEVATION
SCALE:1/4"=1'-0"



RETURN WALL AT SIDEWALK / SAFETY WALK
SCALE:1/4"=1'-0"



SKEW ANGLE DESIGNATION

DESIGNER NOTES:

1. *THE DESIGNER SHALL REFER TO SECTION 11.3.3 (INTEGRAL ABUTMENTS) OF THE RIDOT LRFD BRIDGE DESIGN MANUAL FOR DESIGN AND DETAILING REQUIREMENTS AND LIMITATIONS ON THE USE OF INTEGRAL ABUTMENTS*
2. *A NOTE SHALL BE PROVIDED ON THE CONTRACT DRAWINGS STATING THAT THE TOP OF DECK ELEVATIONS ARE GIVEN AT THE FRONT FACE OF INTEGRAL ABUTMENTS.*
3. *UTILITY PASSAGE THROUGH THE INTEGRAL ABUTMENT SHOULD BE AVOIDED. (SEE SECTION 11.3.3 OF THE RIDOT LRFD BRIDGE DESIGN MANUAL).*
4. *ABUTMENT DETAILS FOR SKEWED ABUTMENTS ARE SIMILAR.*
5. *REINFORCING SHOWN IS MINIMUM ONLY.*
6. *THE SUGGESTED SCALE FOR ANY ABUTMENT PLAN AND ELEVATION IS 1/4"=1'-0".*
7. *REFERENCES TO END POSTS AND CENTERLINES OF RAILING ELEMENTS ARE INTENDED TO REFER TO THE DETAILS SHOWN ELSEWHERE IN THESE BRIDGE STANDARDS (SEE APPROPRIATE DETAILS).*
8. *SLEEPER SLAB AND EXPANSION JOINT IN ROADWAY MAY BE OMITTED FOR BRIDGE SUPERSTRUCTURE SPANS <u>60</u> FEET OR LESS.*
9. *SEE DWG. 2.22 FOR RETURN WALL DETAILS*

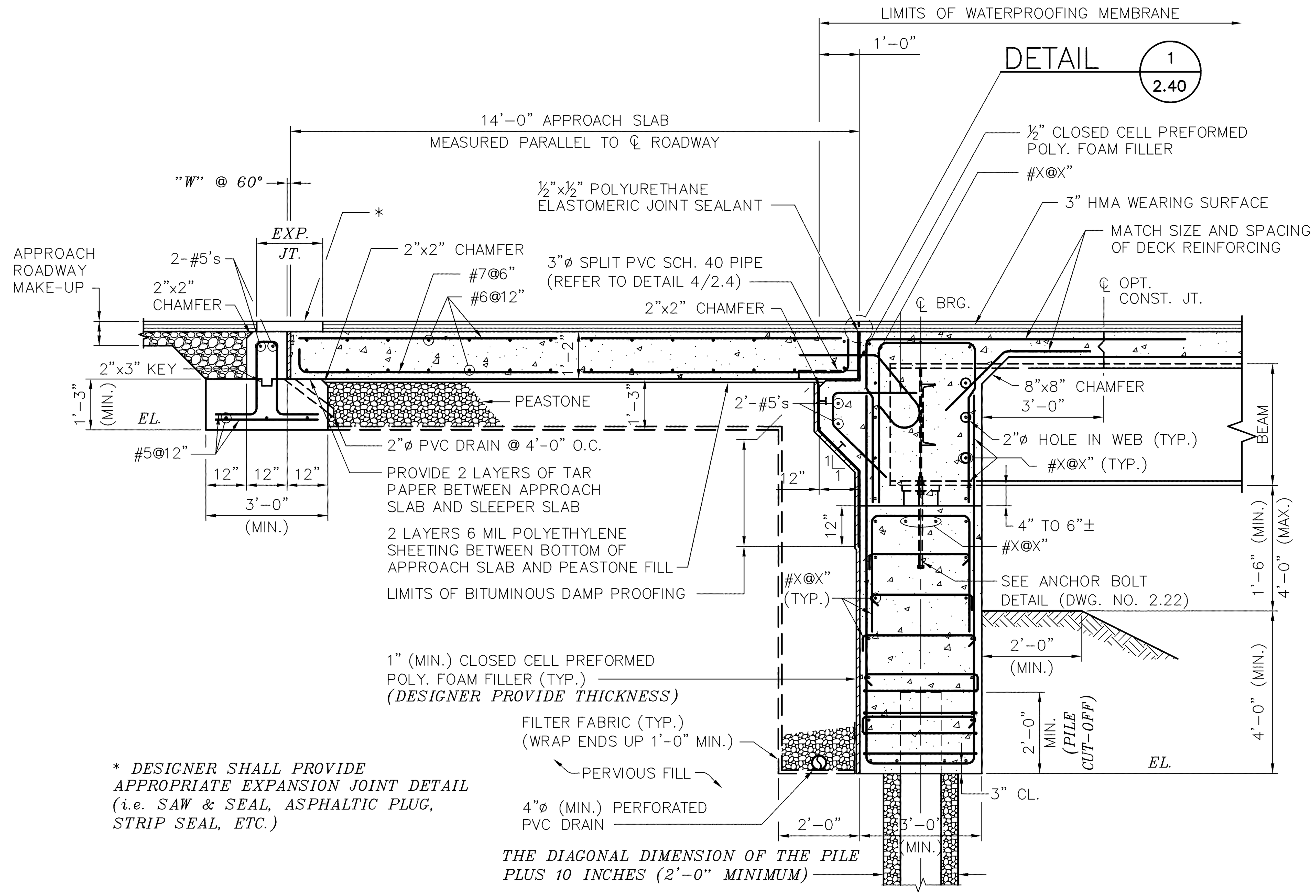
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

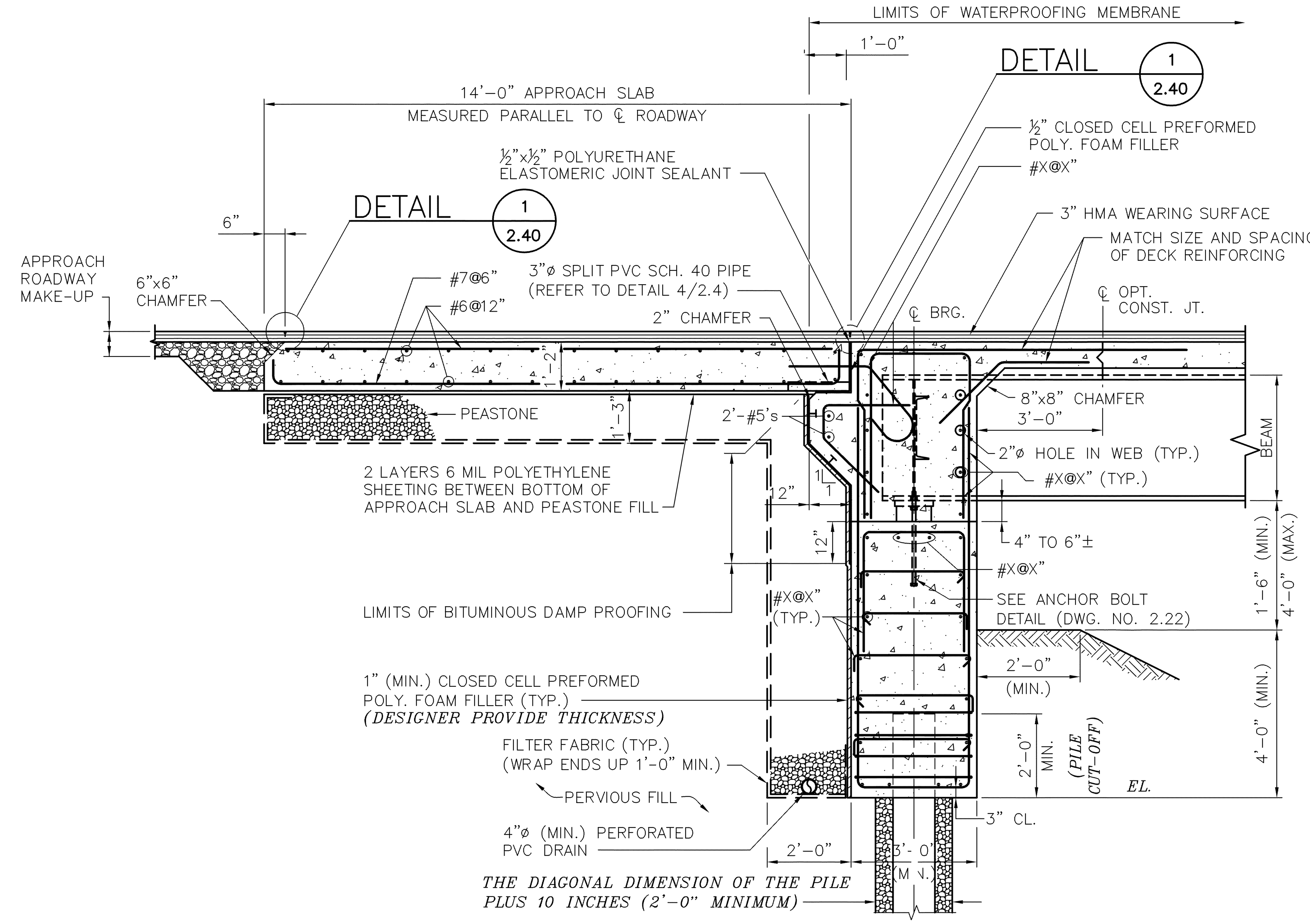
INTEGRAL ABUTMENT
SHEET 1

DRAWING NUMBER: 2.20



SPANS > 60'-0"

SECTION A 2.21
SCALE:1/2"=1'-0"



SPANS ≤ 60'-0"

SECTION A 2.21
SCALE:1/2"=1'-0"

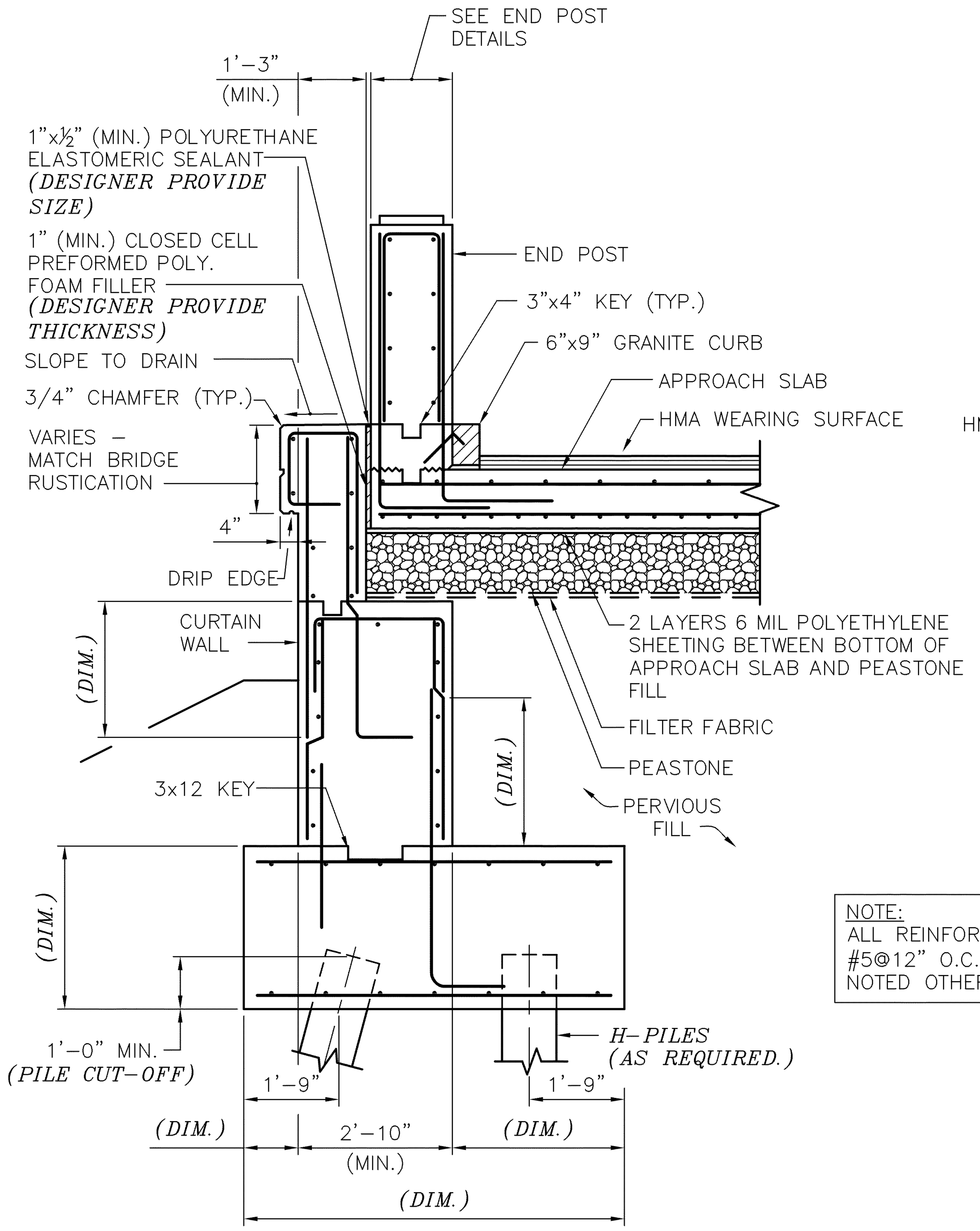
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

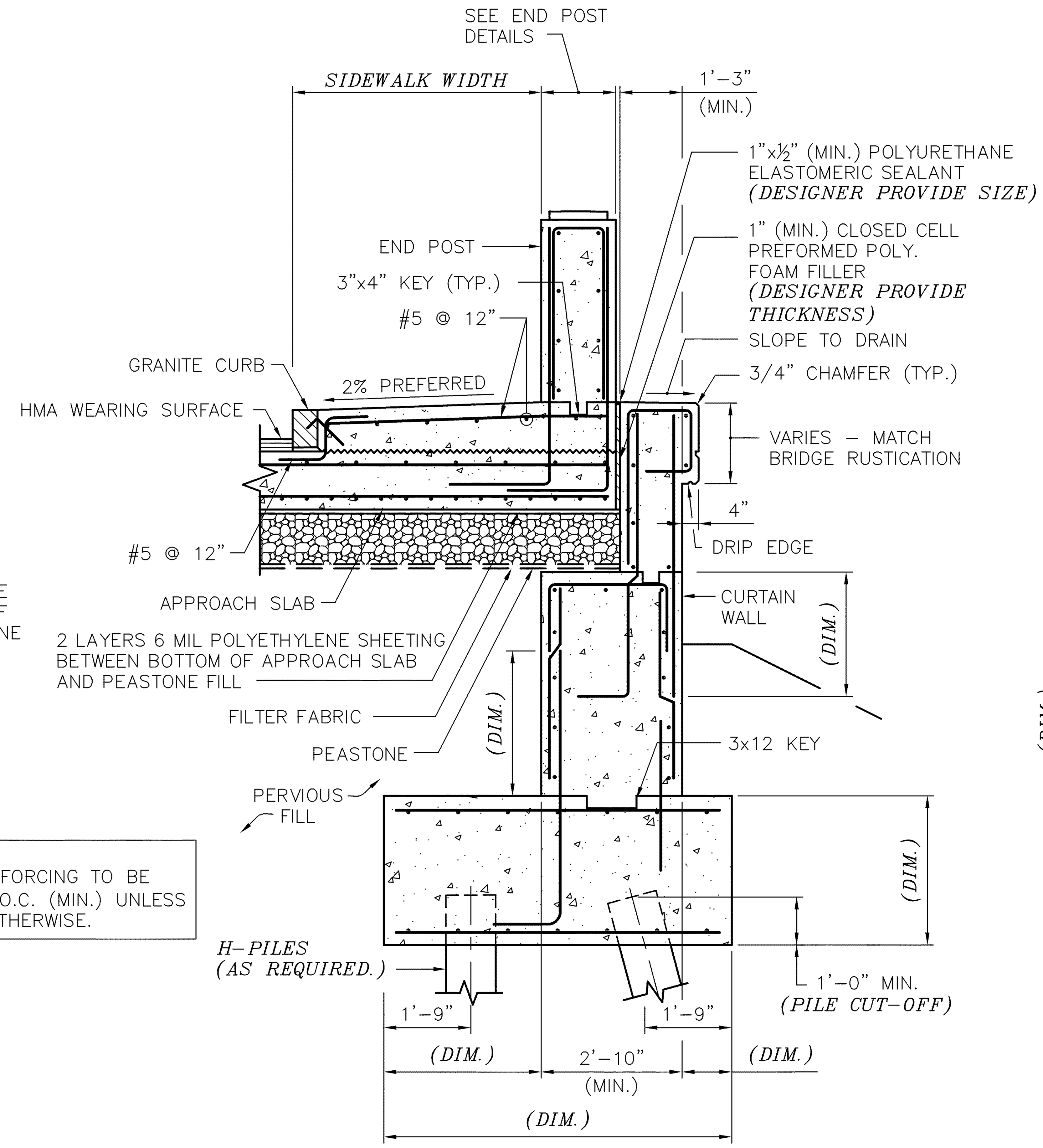
BRIDGE STANDARDS

INTEGRAL ABUTMENT
SHEET 2

DRAWING NUMBER: 2.21

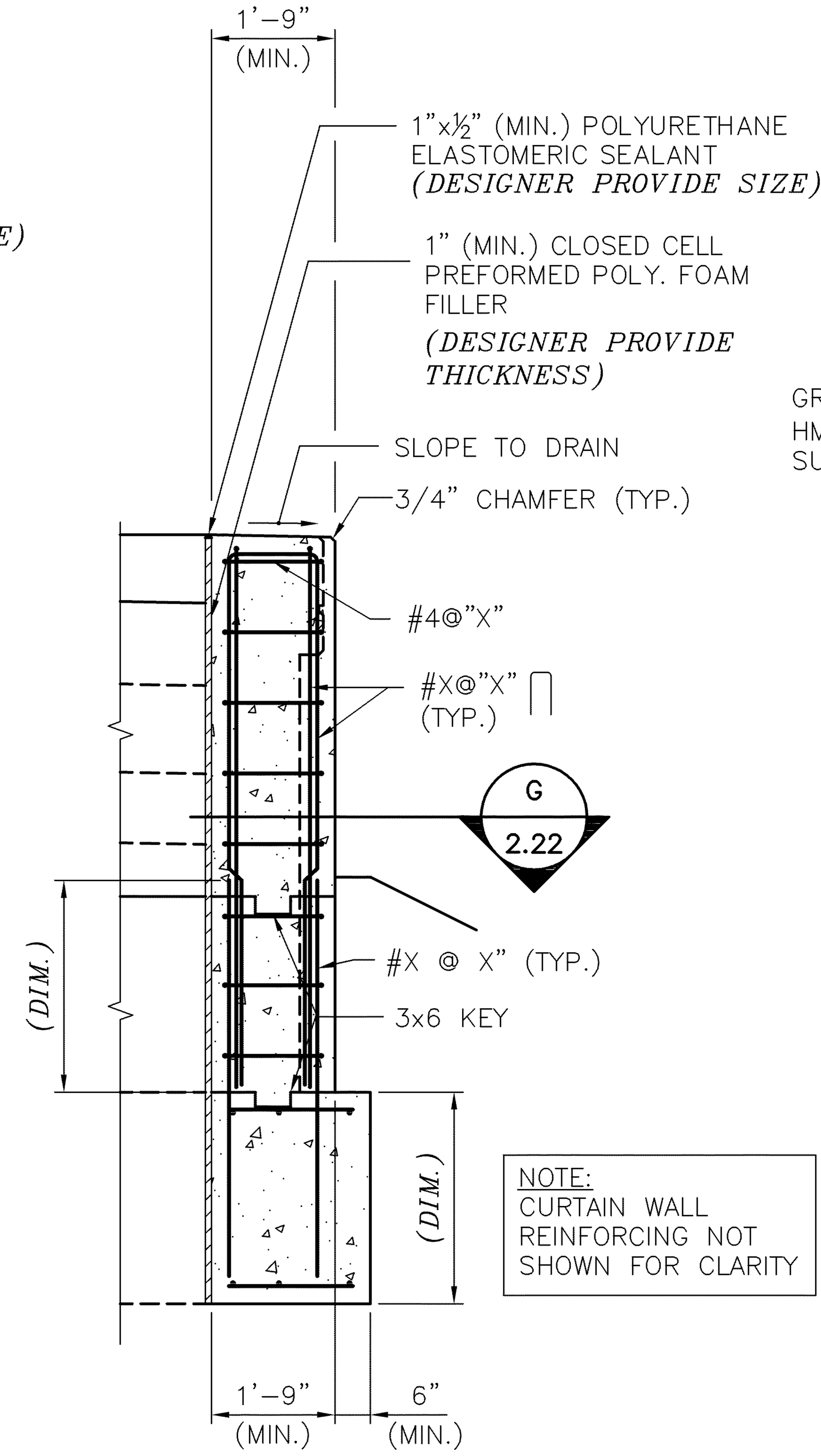


SECTION B/2.22
SCALE:1/2"=1'-0"



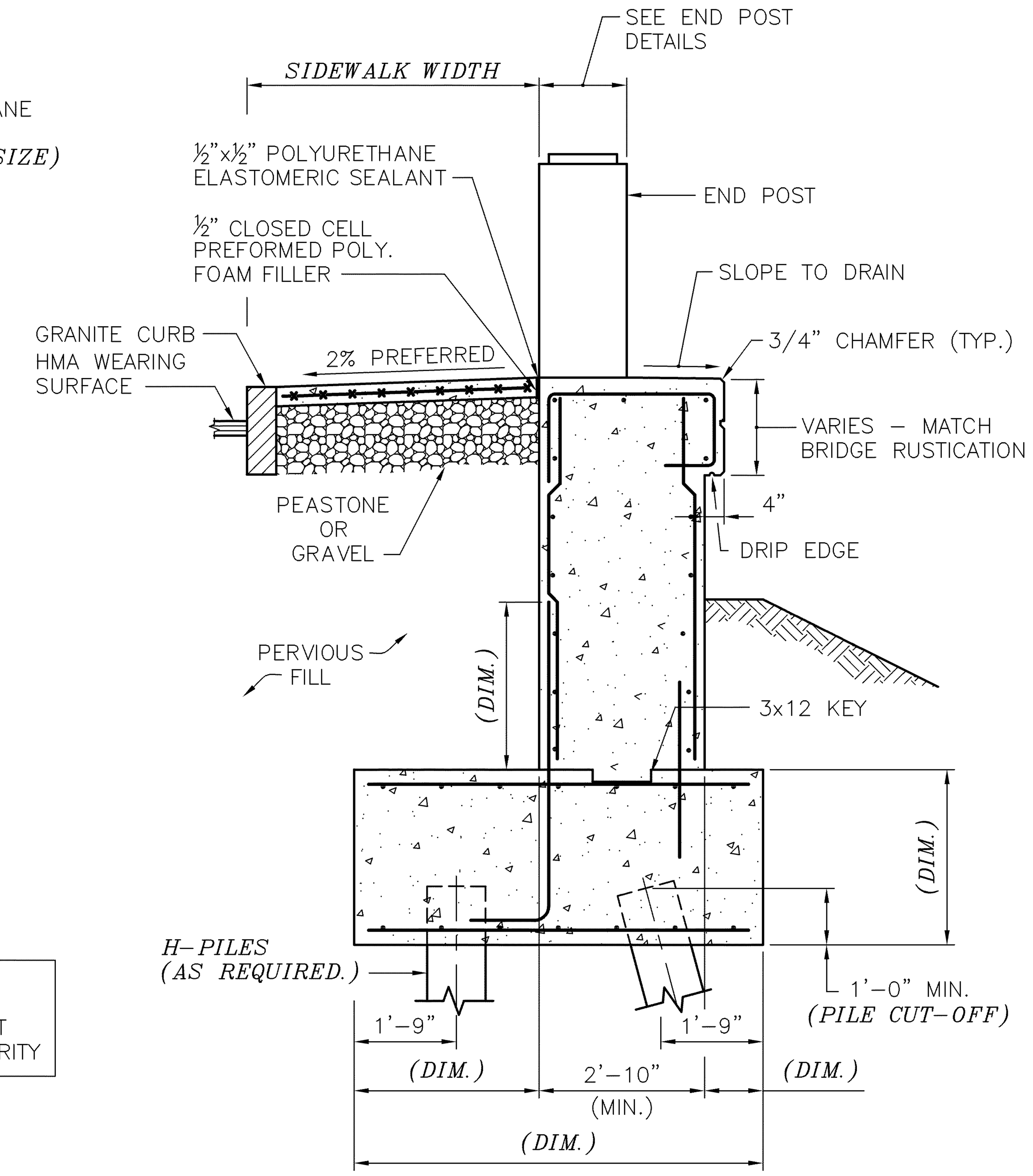
NOTE:
ALL REINFORCING TO BE #5@12" O.C. (MIN.) UNLESS NOTED OTHERWISE.

SECTION C/2.22
SCALE:1/2"=1'-0"



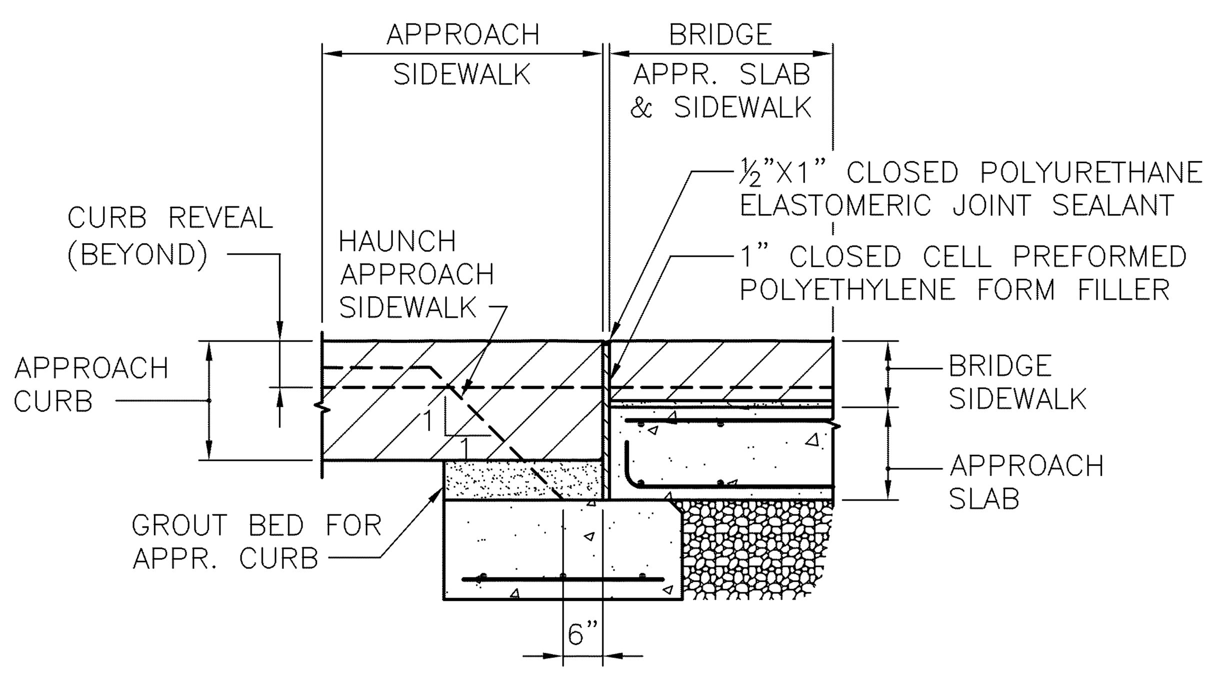
NOTE:
CURTAIN WALL REINFORCING NOT SHOWN FOR CLARITY

SECTION E/2.22
SCALE:1/2"=1'-0"

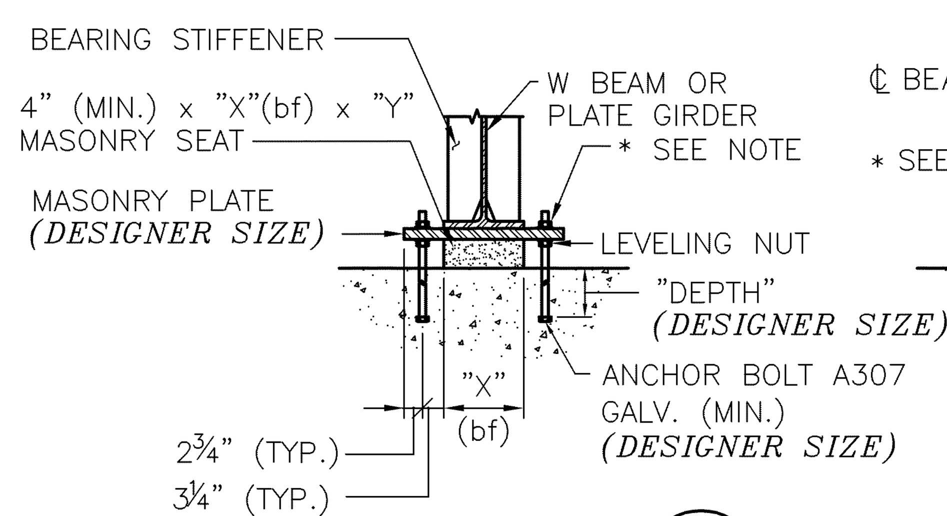


NOTE:
SECTION AT SAFETY WALK IS SIMILAR

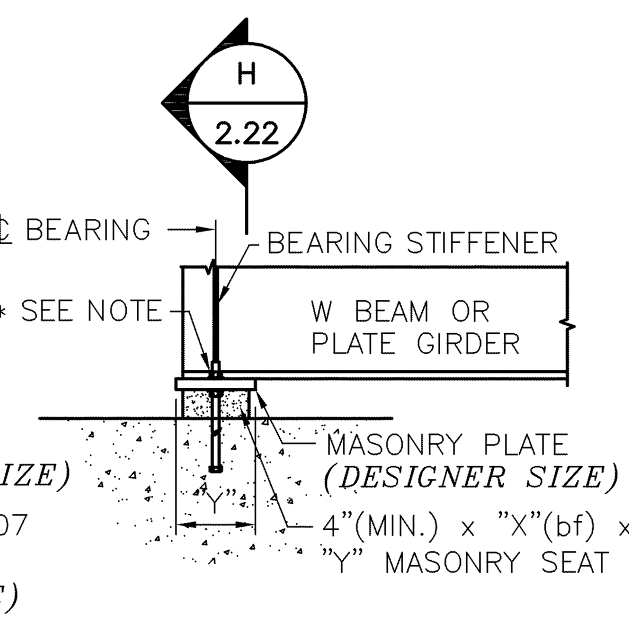
SECTION F/2.22
SCALE:1/2"=1'-0"



SECTION D/2.22
SCALE:1/2"=1'-0"



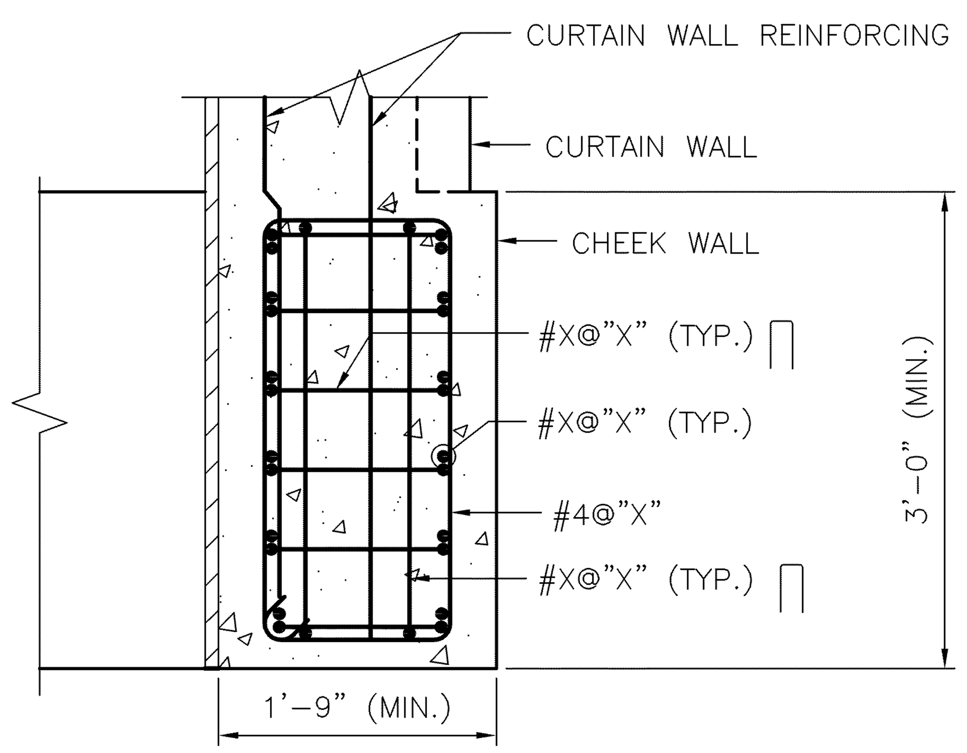
SECTION H/2.22



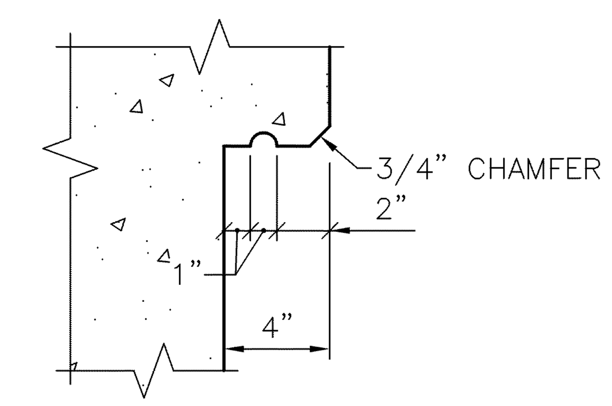
SIDE ELEVATION

* NOTE:
LEAVE TOP BOLT LOOSE UNTIL DECK CONCRETE IS PLACED

ANCHOR BOLT DETAIL
SCALE:1/2"=1'-0"



SECTION G/2.22
SCALE:1"=1'-0"



DRIP EDGE FOR COPING DETAIL
SCALE:3"=1'-0"

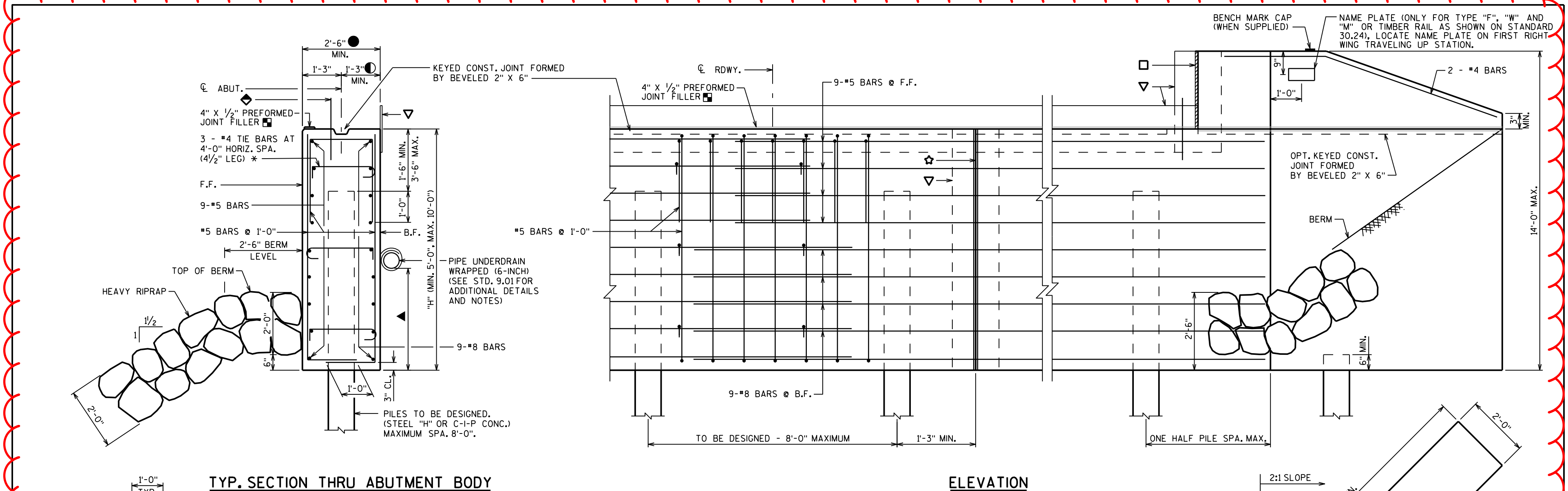
REVISIONS	
No.	DATE

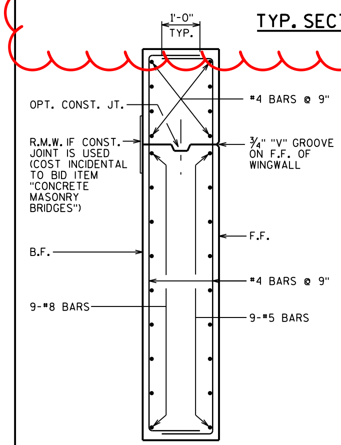
RHODE ISLAND DEPARTMENT OF TRANSPORTATION

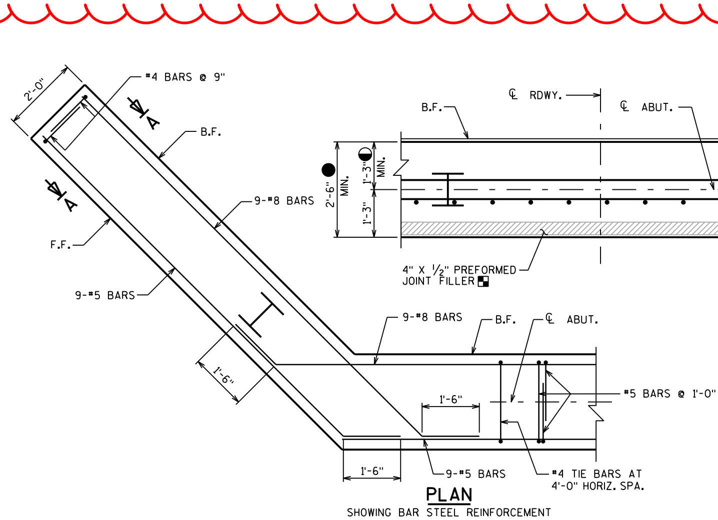
BRIDGE STANDARDS

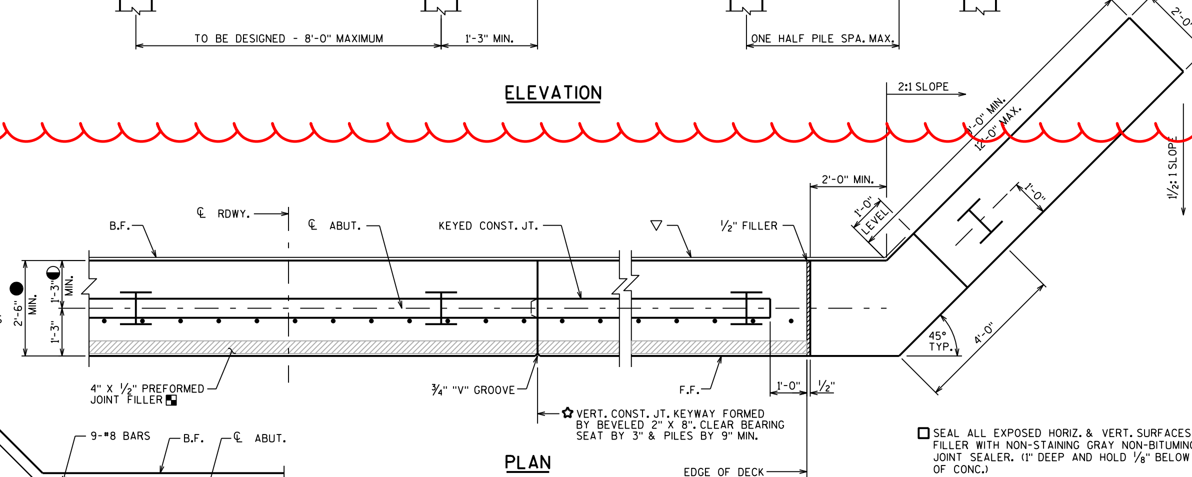
INTEGRAL ABUTMENT SHEET 3

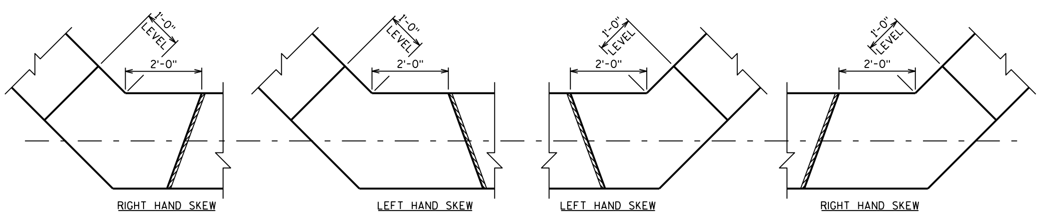
DRAWING NUMBER: 2.22











WING DETAIL FOR SKEWED STRUCTURES

DESIGNER NOTES

FOR SLAB AND PRESTRESSED GIRDER SPANS L < 200'-0" & FOR STEEL GIRDER SPANS L < 150'-0" WHERE L = LENGTH OF CONTINUOUS SUPERSTRUCTURE BETWEEN ABUTMENTS.

WHEN GIRDERS WITH SEMIEXPANSION SEAT OR FIXED SEAT, OR SLAB SPAN WITH SEMIEXPANSION SEAT ARE USED, MAKE BEAM SEATS SIMILAR TO THAT SHOWN ON STANDARD 12.01.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

✩ WHEN BODY SECTION IS > ± 50'-0" LONG, PROVIDE VERT. CONST. JOINT. RUN BAR STEEL THRU JOINT. BEVEL EXPOSED EDGES 3/4" AND SEAL JOINT. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.

◐ USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)

▲ FOR BOTTOM OF ABUTMENTS LOCATED ABOVE NORMAL WATER, PLACE UNDERDRAIN NEAR THE BOTTOM OF ABUTMENT AS SHOWN IN STANDARD 12.01. FOR BOTTOM OF ABUTMENTS LOCATED BELOW NORMAL WATER, PLACE UNDERDRAIN ABOVE NORMAL WATER. SEE BRIDGE MANUAL 12.6.1 FOR ADDITIONAL GUIDANCE. FOR UNDERDRAIN EXPOSED TO HIGH WATER, CONSIDER CAPPING THE UPSTREAM END TO PREVENT CLOGGING.

□ SEAL ALL EXPOSED HORIZ. & VERT. SURFACES OF 1/2" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD 1/8" BELOW SURFACE OF CONC.)

DO NOT PLACE FILL ABOVE 3'-0" FROM BOTTOM OF ABUTMENT UNTIL SUPERSTRUCTURE IS IN PLACE.

▽ 18" RUBBERIZED MEMBRANE WATERPROOFING.

● WHEN ABUTMENT WIDTH > 2'-10" FIXED POINT OF WING ROTATION SHALL BE ON F.F. OF ABUTMENT (0° SKEW ONLY).

◆ THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED, BUT BEFORE INITIAL SET HAS TAKEN PLACE. SEE STD. 12.01 & 27.05

◪ USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

* ALTERNATE THE POSITION OF THE 90° AND 180° HOOKS AT EACH VERTICAL LAYER OF TIES.

ABUTMENT A5 (INTEGRAL, PILE ENCASED ABUTMENT)

WISCONSIN DEPARTMENT OF TRANSPORTATION

BUREAU OF STRUCTURES

APPROVED: *Bill Oliva*

DATE: 7-20

5.c) Fully Integral Abutment Diaphragm Details

Illinois

Steel Beams to Diaphragm Connection for Integral Abutment

PPC Beams to Diaphragm Connection for Integral Abutment

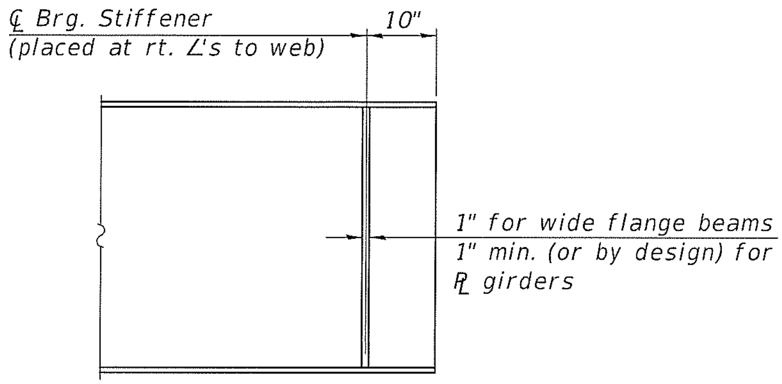
Iowa

Integral Abutment and Pier Diaphragm Details

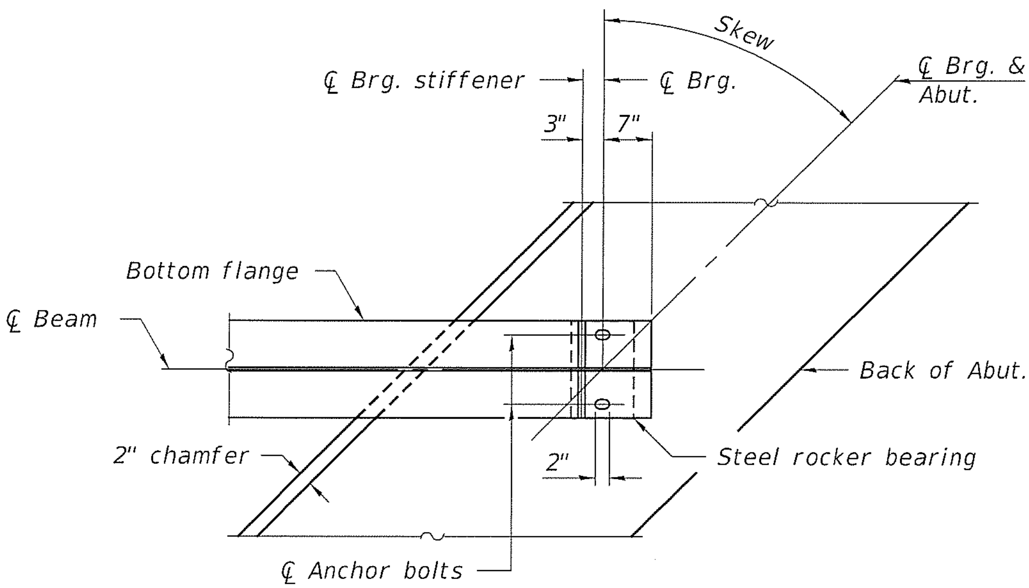
NOTE: Iowa has similar details for various beam types and skew ranges

Ohio

Integral Abutment Diaphragm Detail



END ELEVATION

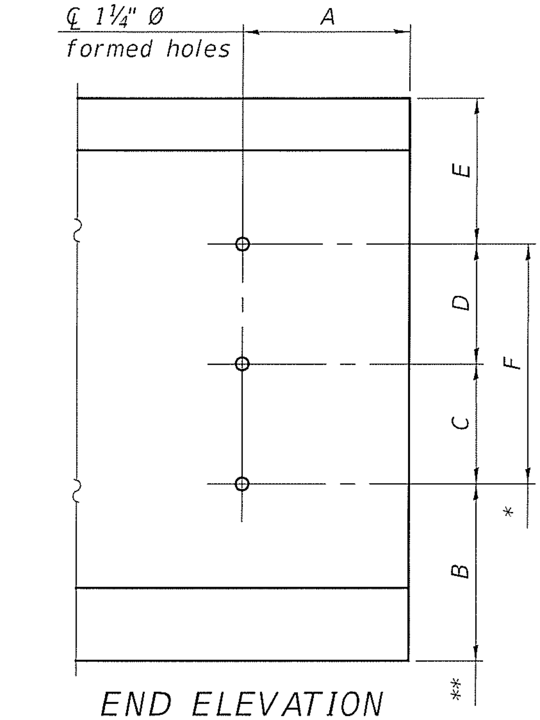


PLAN

Note:
See figure 15 for bearing and anchor bolt details.

STEEL BEAM TO DIAPHRAGM
CONNECTION DETAIL
FOR INTEGRAL ABUTMENTS

Figure 11



END ELEVATION

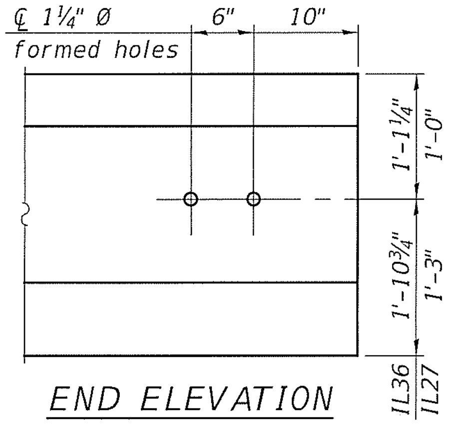
(I36-I54, BT63-BT72 and IL45-IL72)

* Two holes required for I36-I54 and IL45-IL54

** Three holes required for BT63-BT72 and IL63-IL72.

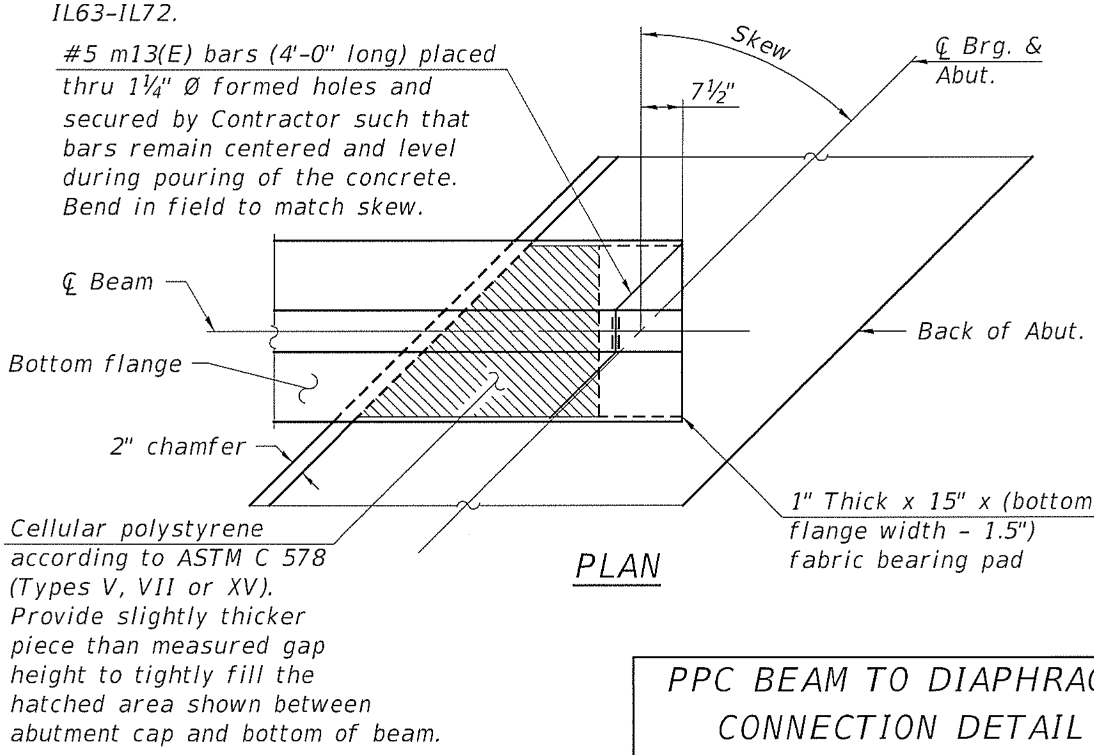
TABLE OF DIMENSIONS

Beam	A	B	C	D	E	F
I36	1'-0"	1'-3"	N.A.	N.A.	10"	11"
I42	1'-0"	1'-5"	N.A.	N.A.	10"	1'-3"
I48	1'-0"	1'-7"	N.A.	N.A.	1'-0"	1'-5"
I54	1'-0"	1'-7"	N.A.	N.A.	1'-0"	1'-11"
BT63	1'-4"	1'-5"	1'-4"	1'-4"	1'-2"	N.A.
BT72	1'-4"	1'-5"	1'-9"	1'-8"	1'-2"	N.A.
IL45	1'-0"	1'-11"	N.A.	N.A.	1'-2"	8"
IL54	1'-0"	1'-11"	N.A.	N.A.	1'-2"	1'-5"
IL63	1'-0"	1'-11"	1'-1"	1'-1"	1'-2"	N.A.
IL72	1'-0"	1'-11"	1'-5½"	1'-5½"	1'-2"	N.A.



END ELEVATION

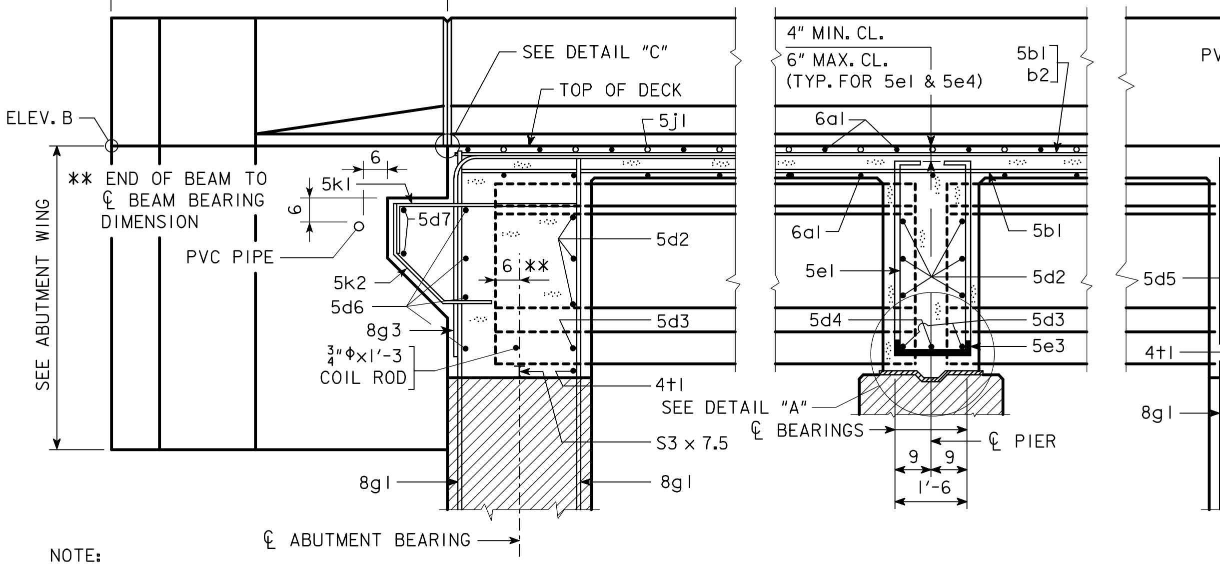
(IL27 and IL36)



PLAN

PPC BEAM TO DIAPHRAGM CONNECTION DETAIL FOR INTEGRAL ABUTMENT

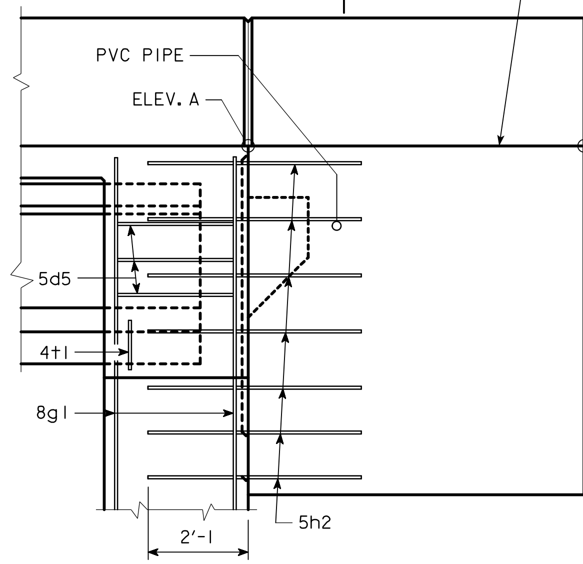
Figure 12



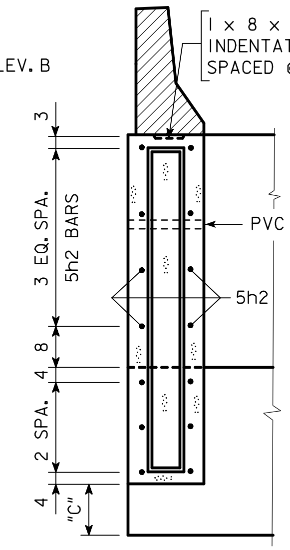
NOTE:
PLUG 3"Φ PVC PIPE WITH EXPANDING FOAM PRIOR TO BACKFILLING BEHIND ABUTMENTS.

PART LONGITUDINAL SECTION NEAR GUTTER

(FOR DETAILS OF INTERMEDIATE DIAPHRAGM SEE DESIGN SHEET ??)



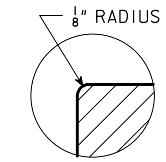
PART END VIEW AT ABUTMENT



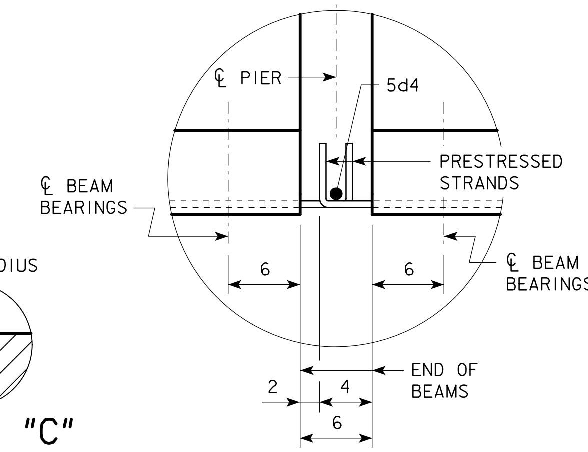
SECTION A-A

TABLE OF WING ELEVATIONS

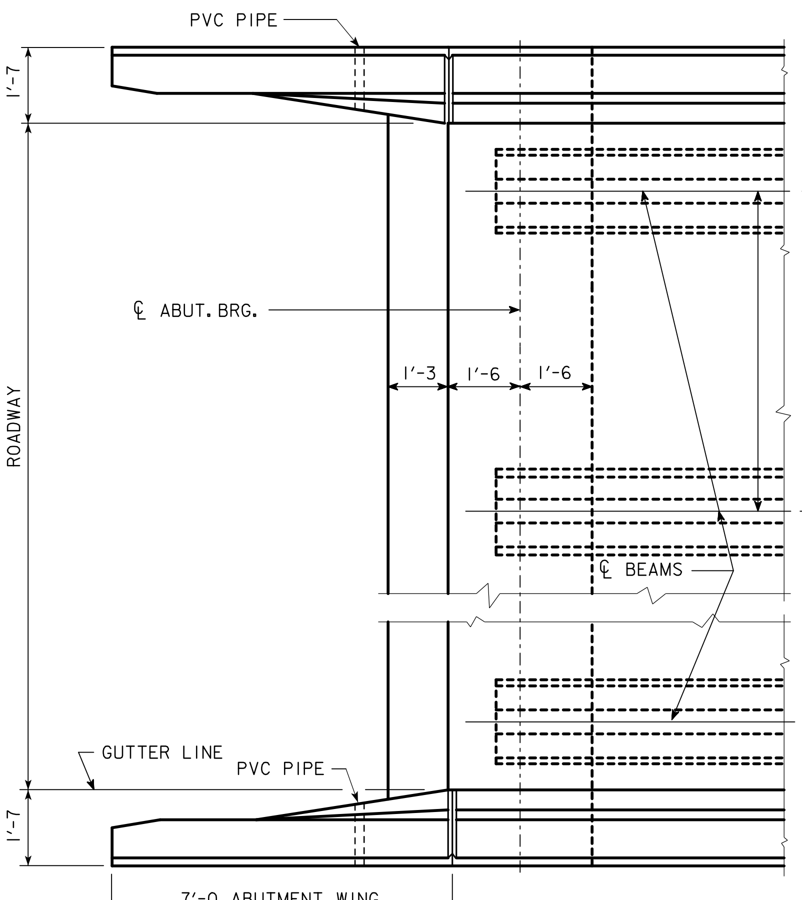
LOCATION	DIM "C"	ELEV. A	ELEV. B
S.W. CORNER			
N.W. CORNER			
S.E. CORNER			
N.E. CORNER			



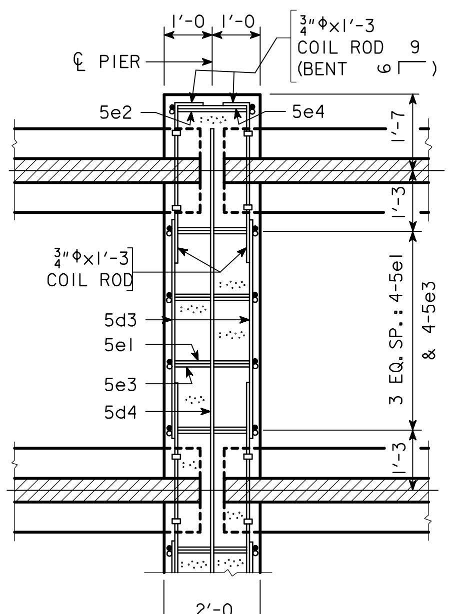
DETAIL "C"



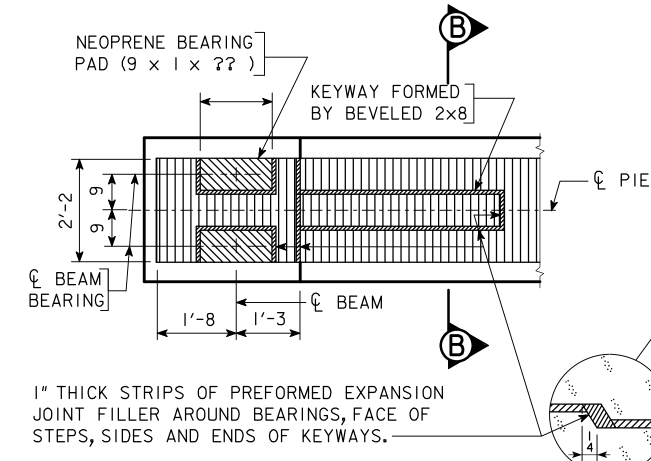
DETAIL "A"



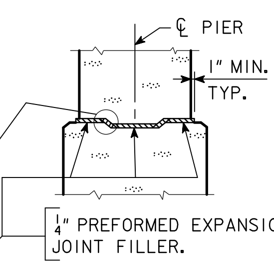
PART PLAN



PART SECTION AT PIER



PART PLAN



SECTION B-B

TOP OF PIER DETAILS

REVISION 07-08 - DISTANCE FROM ℄ BEAM TO STEP CHANGED TO 1'-3.
ENGLISHINTEGRALBRIDGES.DGN 4500 - THIS SHEET REDRAWN 9-8-88

ABUT. & PIER DIAPHRAGM DETAILS

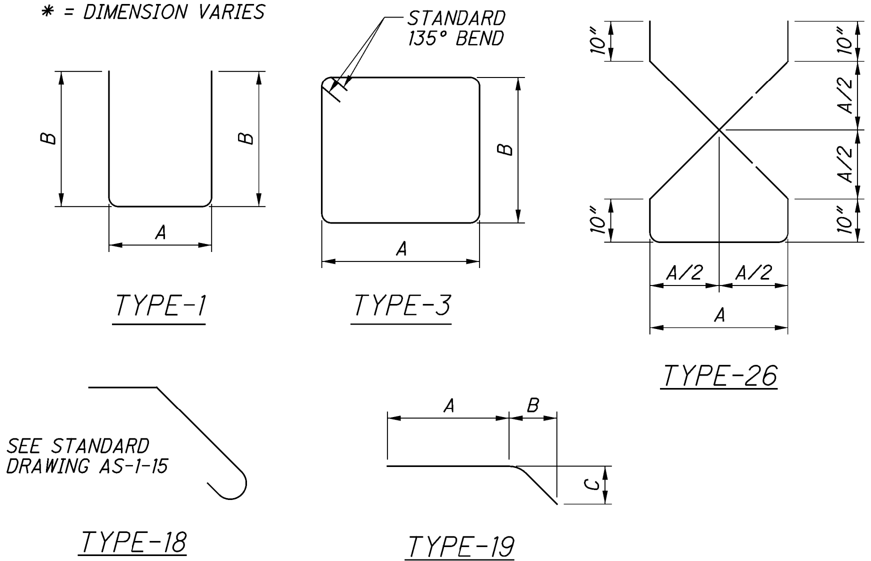
IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. ____ OF ____ FILE NO. ________ DESIGN NO. ________

DESIGN TEAM	"A" or "B" BEAMS - PART PLAN & LONGIT. SECTION - 0° SKEW	STANDARD SHEET 4500	COUNTY	PROJECT NUMBER	SHEET NUMBER

REINFORCING STEEL LIST					
MARK	LENGTH	TYPE	A	B	C
A401	9′-6″	3	2′-6″	2′-0″	
A501	*	1	2′-8″	*	
A502	*	1	2′-2″	*	
A503	SERIES *	1	2′-2″	SERIES *	
A504	*	1	2′-2″	*	
A505	*	1	2′-2″	*	
A506	*	19	*	*	*
A601	*	26			
D401	8′-1″	1	1′-4″	3′-6″	
D501	*	1	2′-8″	*	
D502	*	2	2′-2″	*	
D801	*	18			

* = DIMENSION VARIES



GENERAL NOTES:

LIMITATIONS:

THIS STANDARD DRAWING PROVIDES PREFERRED AND/ OR TYPICAL DETAILS FOR INTEGRAL ABUTMENTS. TREAT THE ABUTMENT DIMENSIONS, CONSTRUCTION JOINTS AND REINFORCING SHOWN IN THIS DRAWING AS MINIMUM VALUES AND A PERFORM A COMPLETE DESIGN FOR THE ABUTMENT. DO NOT REFERENCE THESE DRAWINGS IN THE CONTRACT PLANS AND DO NOT USE AS STANDALONE CONSTRUCTION DRAWINGS.

PROVIDE ALL INFORMATION REQUIRED TO CONSTRUCT THE ABUTMENT IN THE PROJECT PLANS.

THE INTEGRAL ABUTMENT DETAILS PRESENTED IN THIS DRAWING ARE INTENDED FOR USE ON STRAIGHT OR CURVED ALIGNMENT WITH TANGENT SUPERSTRUCTURES WITH A MAXIMUM SKEW OF 30°. AT 0° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM OR GIRDER BRIDGES IS 267′ (400′ TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). AT 30° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM AND GIRDER BRIDGES IS 133′ (200′ TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). FOR SKEWS BETWEEN 0° AND 30°, STRAIGHT LINE INTERPOLATION SHALL BE USED TO DETERMINE THE MAXIMUM PERMISSIBLE EXPANSION LENGTH.

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON A SINGLE ROW OF PILES. ALLOWABLE PILE TYPES AND SIZES, ALONG WITH MINIMUM FRISTION PILE LENGTHS, ARE SHOWN IN THE TABLE BELOW.

PILE SIZE	MINIMUM LENGTH, FT.	
	CLAY	SAND
HP10x42	30	25
HP12x53	35	25
HP14x73	40	30
12″ CIP	45	30
14″ CIP	50	35

IF THE MINIMUM LENGTH SHOWN IN THE TABLE ABOVE CANNOT BE OBTAINED, THEN THE DESIGNER SHALL PROVIDE CALCULATIONS TO SUPPORT THE USE OF A SHORTER LENGTH, AND, IN THE CASE OF PILES DRIVEN TO REFUSAL ON BEDROCK, REFER TO BDM SECTION 305.3.5.7. THE CALCULATIONS SHALL DEMONSTRATE THAT ADEQUATE LATERAL RESISTANCE IS AVAILABLE, THAT NO LATERAL DEFLECTION OCCURS AT THE BOTTOM OF THE PILES, AND THAT THE COMBINED AXIAL COMPRESSION AND FLEXURE IN THE PILES SATISFIES THE REQUIREMENTS OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

PILE TYPES AND SIZES OTHER THAN THOSE SHOWN IN THE TABLE ABOVE SHALL NOT BE USED UNLESS APPROVED BY THE DEPARTMENT. THE MAXIMUM ALLOWABLE PILE SPACING IS 8′. THE MINIMUM ALLOWABLE PILE SPACING IS 3 PILE DIAMETERS. THE PILE DIAMETER FOR AN HP SHAPE SHALL BE TAKEN AS THE DIAGONAL DISTANCE BETWEEN FLANGE TIPS.

LIMITATIONS CONT'D:

THE HEIGHT OF THE PILE CAP SHALL NOT EXCEED 7′-6″.

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON AT LEAST 4 PILES. FOR PHASED CONSTRUCTION PROJECTS, EACH PHASE SHALL BE SUPPORTED ON AT LEAST 4 PILES.

INTEGRAL ABUTMENTS SHALL NOT BE USED WHERE THERE ARE CONCERNS ABOUT SETTLEMENT OR DIFFERENTIAL SETTLEMENT.

DESIGN SPECIFICATIONS:

THIS STRUCTURE SHALL CONFORM TO THE LATEST "LRFD BRIDGE DESIGN SPECIFICATIONS" ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AND THE ODOT BRIDGE DESIGN MANUAL.

DESIGN LOADING:

HL-93 LIVE LOAD
FUTURE WEARING SURFACE (FWS) OF 0.060 KSF

DESIGN DATA:

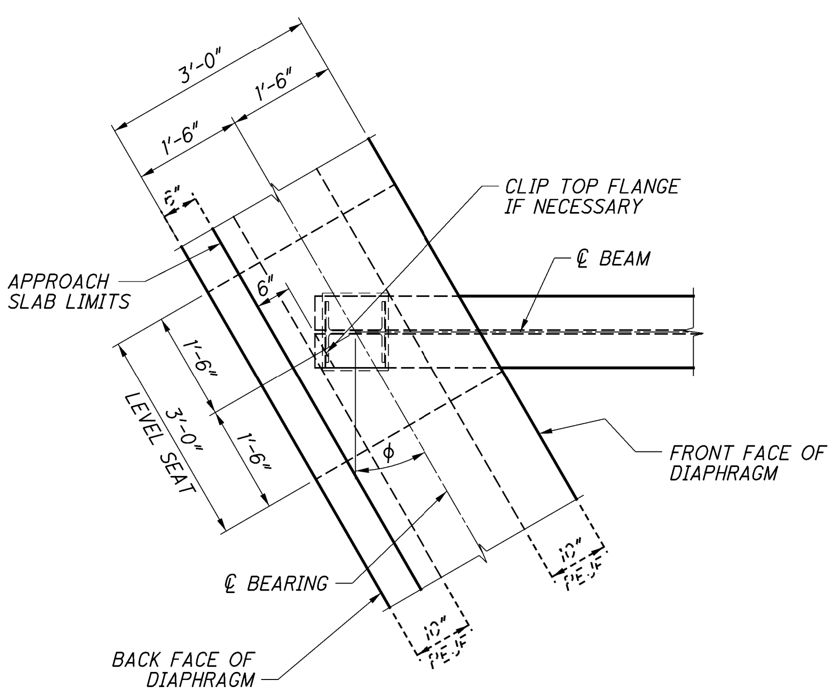
CONCRETE CLASS QC2 - COMPRESSIVE STRENGTH 4.5 KSI (SUPERSTRUCTURE)
CONCRETE CLASS QC1 - COMPRESSIVE STRENGTH 4.0 KSI (SUBSTRUCTURE)
REINFORCING STEEL - MINIMUM YIELD STRENGTH 60 KSI
STRUCTURAL STEEL - ASTM A709 GRADE 36 OR 50 - YIELD STRENGTH 36 OR 50 KSI (THE DESIGNER SHALL SPECIFY THE REQUIRED STEEL GRADE AND YIELD STRENGTH IN THE BRIDGE GENERAL NOTES)
STEEL H-PILES - ASTM A572 - YIELD STRENGTH 50 KSI

PAINTING OF STRUCTURAL STEEL:

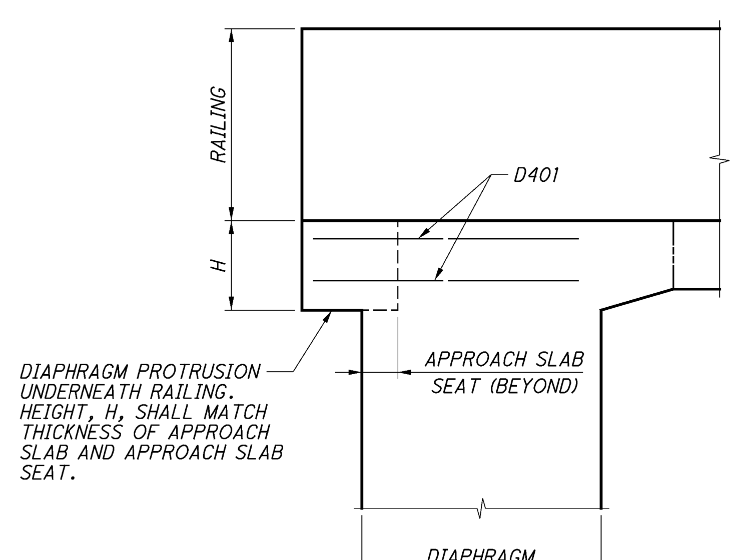
THE ENTIRE SURFACE AREA ENCASED WITHIN THE ABUTMENT DIAPHRAGM AND EXTENDING 1′-0′ OUTSIDE THE DIAPHRAGM, SHALL BE COATED WITH A SHOP APPLIED, INORGANIC ZINC PRIME COAT ACCORDING TO C&MS 514. NO ADDITIONAL COATINGS ARE REQUIRED ON THE EMBEDDED STEEL SURFACES. THE COST OF APPLYING THE PRIME COAT IS INCIDENTAL TO THE BID FOR STRUCTURAL STEEL. REPAIR COATING DAMAGED BY WELDING ACCORDING TO C&MS 514.22.

ELASTOMERIC BEARING ASSEMBLY:

UTILIZE A WIDE FLANGE SHAPE IN LIEU OF AN HP SHAPE IN THE BEARING ASSEMBLY IF THE STRUCTURAL STEEL FOR THE MAIN MEMBER IS WEATHERING STEEL.



INTEGRAL ABUTMENT PARTIAL PLAN



SECTION B-B
(APPLIES AT BOTH ENDS OF ABUTMENT)
(BEAM & APPROACH RAILING NOT SHOWN)

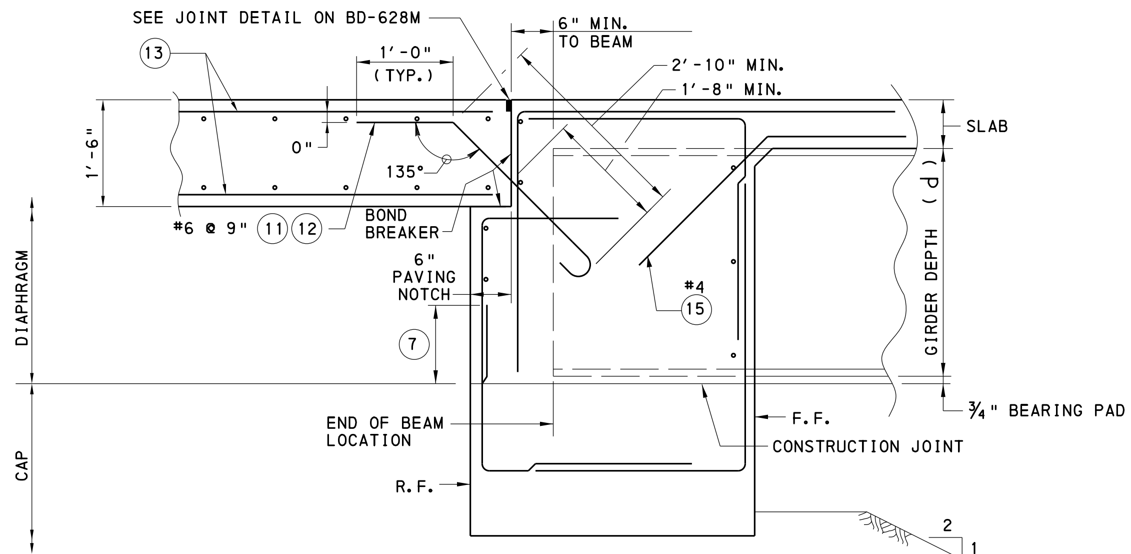
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
07-17-20
DATE
ADMINISTRATOR

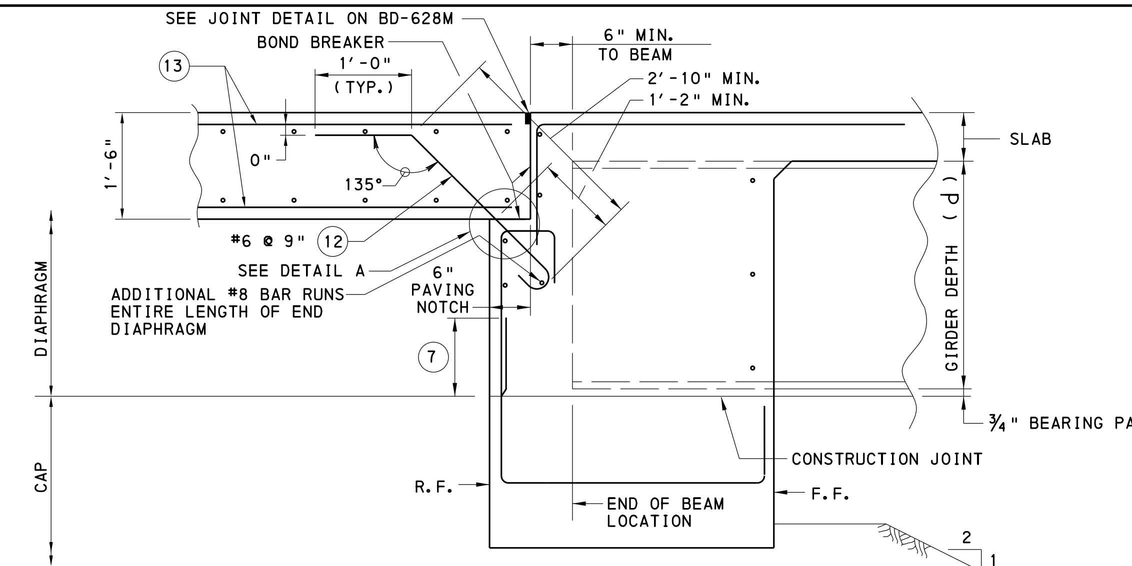
REVISIONS

ICD-1-20

STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS

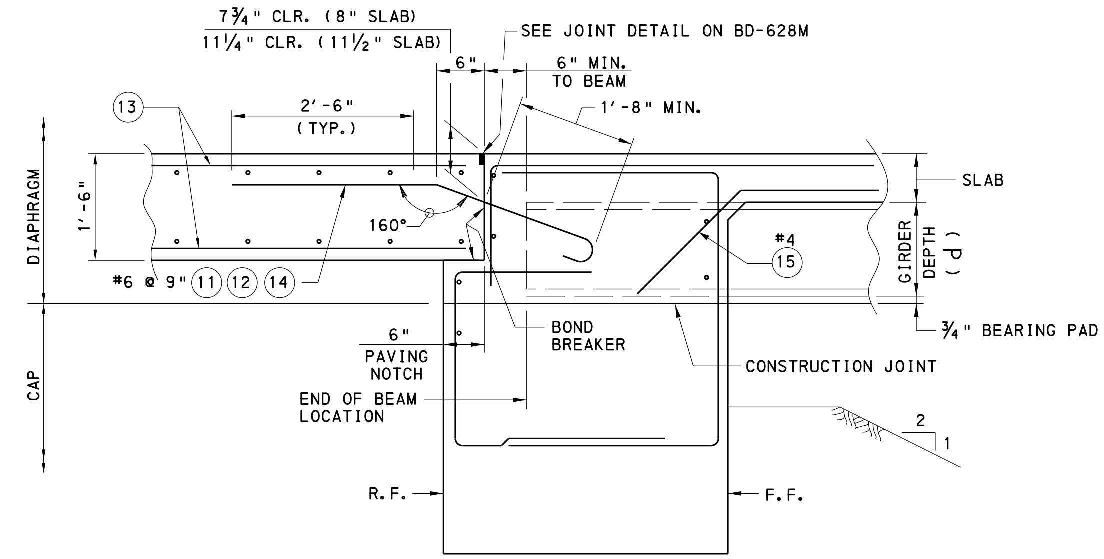


SECTION THRU
END DIAPHRAGM BETWEEN BEAMS
GIRDER DEPTH ≥ 2'-0"

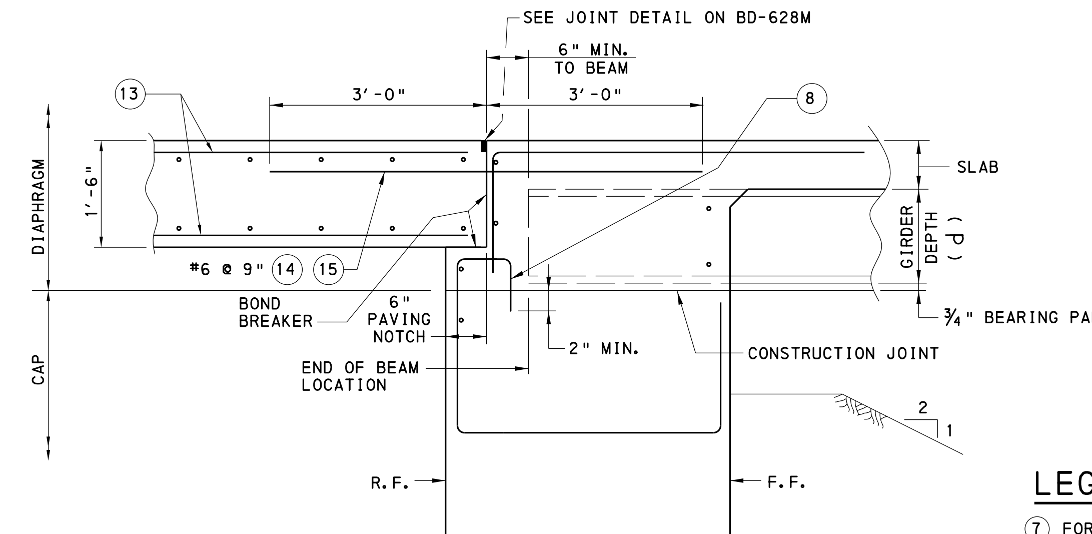


SECTION THRU
END DIAPHRAGM AT BEAMS
GIRDER DEPTH ≥ 2'-0"

NOTE: DECK AND CAP REINFORCEMENT
NOT SHOWN FOR CLARITY.



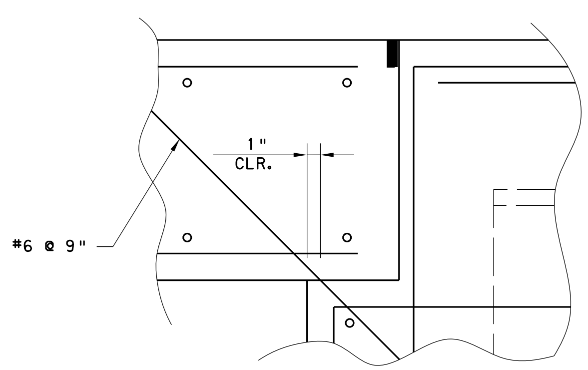
SECTION THRU
END DIAPHRAGM BETWEEN BEAMS
GIRDER DEPTH < 2'-0"



SECTION THRU
END DIAPHRAGM AT BEAMS
GIRDER DEPTH < 2'-0"

LEGEND:

7. FOR GIRDERS TOO SHALLOW TO PERMIT A 2'-1" OVERLAP, THE SPLICE IS NOT PERMITTED. ELIMINATING THE SPLICE IS OPTIONAL IN ALL OTHER CASES.
8. IF BAR EXTENDS INTO CAP EXTEND BAR TO PROVIDE 2" MIN. EMBEDMENT.
11. DETAIL SPACING TO CLEAR GIRDERS.
12. FOR 180° HOOK DIMENSIONS, REFER TO BC-736M.
13. FOR DIMENSIONS AND REINFORCEMENT OF APPROACH SLAB, SEE STANDARD DRAWING BD-628M.
14. THE HORIZONTAL LEG OF THE BAR IS TO BE LOCATED AT THE SAME PLANE AS THE LONGITUDINAL DECK REINFORCEMENT IN THE BOTTOM MAT OF THE DECK.
15. SPACED WITH LONGITUDINAL DECK REINFORCEMENT



DETAIL A

MINIMUM APPROACH SLAB LENGTH TABLE

GIRDER DEPTH (d)	SKEW=90°	60° ≤ SKEW < 90°	45° ≤ SKEW < 90°
17" ≤ d ≤ 24"	12'-0"	14'-0"	18'-0"
24" < d ≤ 36"	14'-0"	16'-0"	20'-0"
36" < d ≤ 48"	15'-0"	18'-0"	22'-0"
48" < d ≤ 60"	17'-0"	20'-0"	24'-0"
60" < d ≤ 72"	18'-0"	22'-0"	25'-0"
72" < d* ≤ 84"	20'-0"	24'-0"	---
84" < d* ≤ 96"	22'-0"	25'-0"	---

NOTES FOR USE OF TABLE:

1. THE 25'-0" APPROACH SLAB LENGTH SHOWN ON BD-628M, SHEET 35 OF 35 (TYPE 5), MAY BE REDUCED TO THE VALUE INDICATED ABOVE WHEN SITE CONDITIONS EXIST THAT RESTRICT THE USE OF THE 25'-0" APPROACH SLAB LENGTH OR WHEN DIRECTED BY THE DISTRICT BRIGE ENGINEER.
2. DO NOT CHANGE THE APPROACH SLAB REINFORCEMENT SPECIFIED ON BD-628M IF THE APPROACH SLAB LENGTH IS REDUCED.

* - CHIEF BRIDGE ENGINEER APPROVAL IS REQUIRED FOR BEAM DEPTHS GREATER THAN 6'-0"

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
APPROACH SLAB DETAILS

RECOMMENDED APR. 29, 2016	RECOMMENDED APR. 29, 2016	SHEET 7 OF 9
Thomas P. Macioce — CHIEF BRIDGE ENGINEER	Bruce S. Thompson — DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M

6.a) Semi-Integral Abutment Plan View

Ohio

Plan at Semi-Integral Abutment

NOTE: Ohio provides other similar details for various beam and transition types

Rhode Island

Integral Abutment Plan at Beam Seats

Pennsylvania

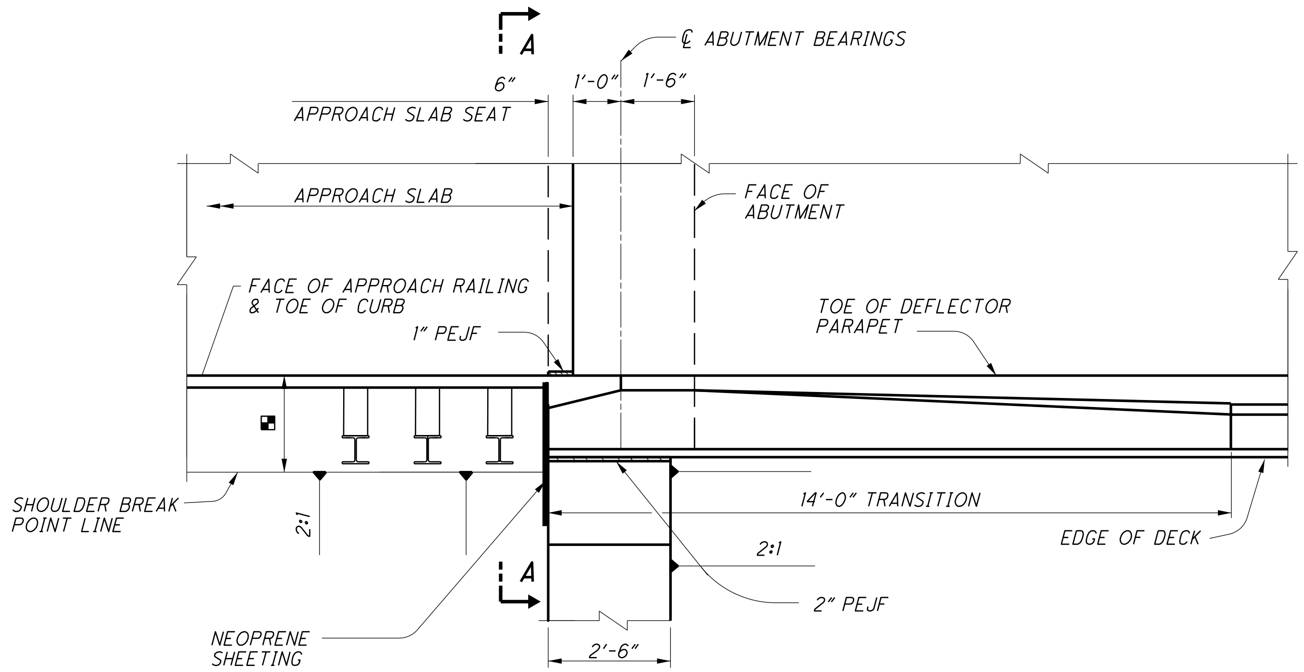
Typical Plan of Semi Integral Abutment

Wisconsin

Semi Integral Abutment Plan

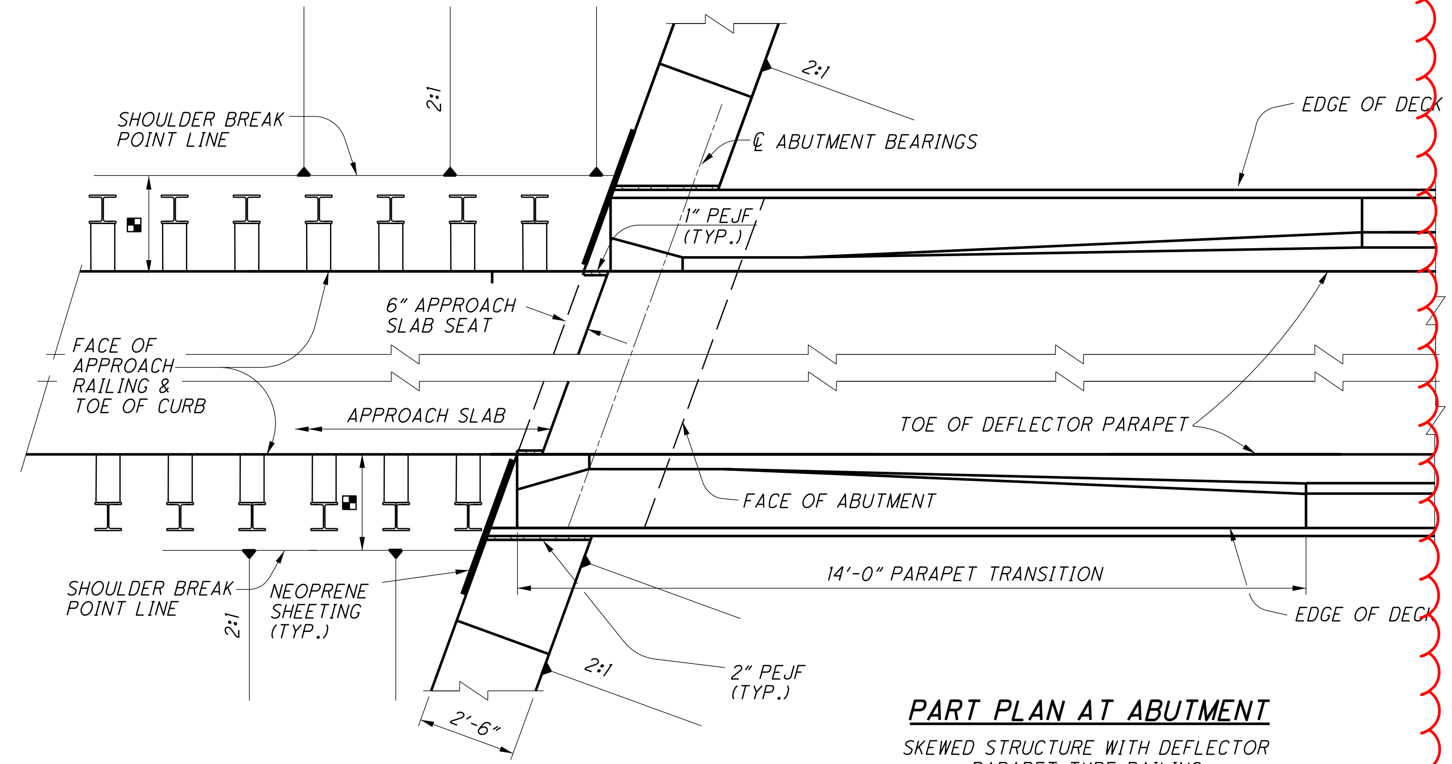
Slab Span with Semi Expansion Seat

Girder Span with Semi Expansion Seat



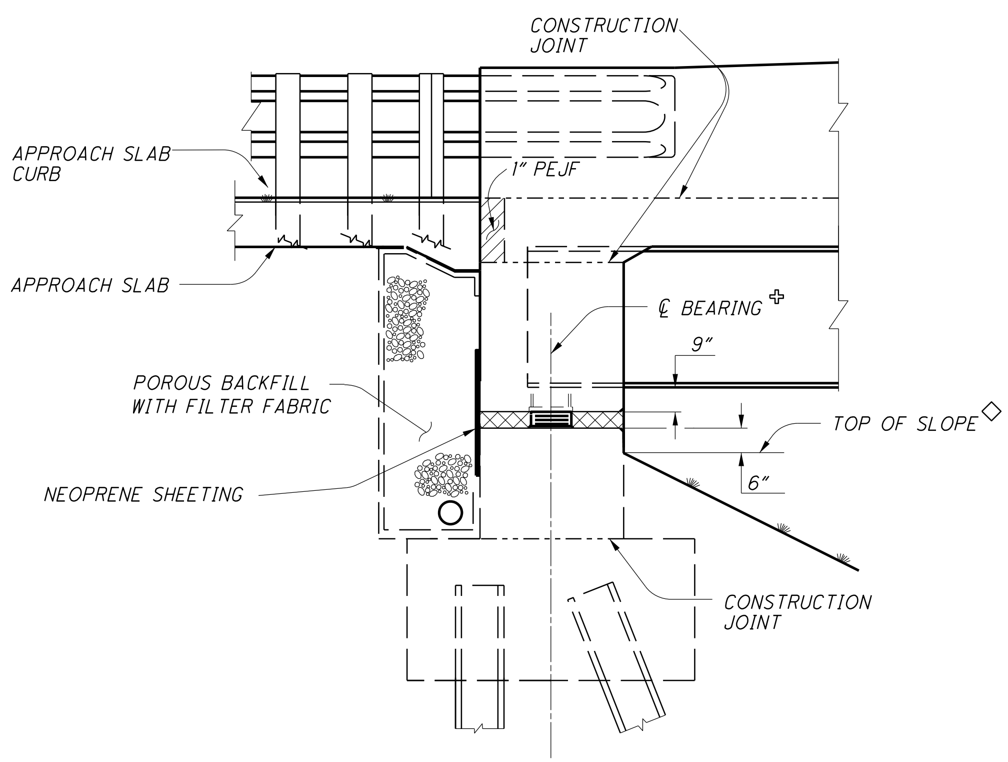
PART PLAN AT ABUTMENT

SQUARE STRUCTURE WITH DEFLECTOR PARAPET TYPE RAILING (BR-1-13 SHOWN, SBR-1-13 SHALL BE SIMILAR)

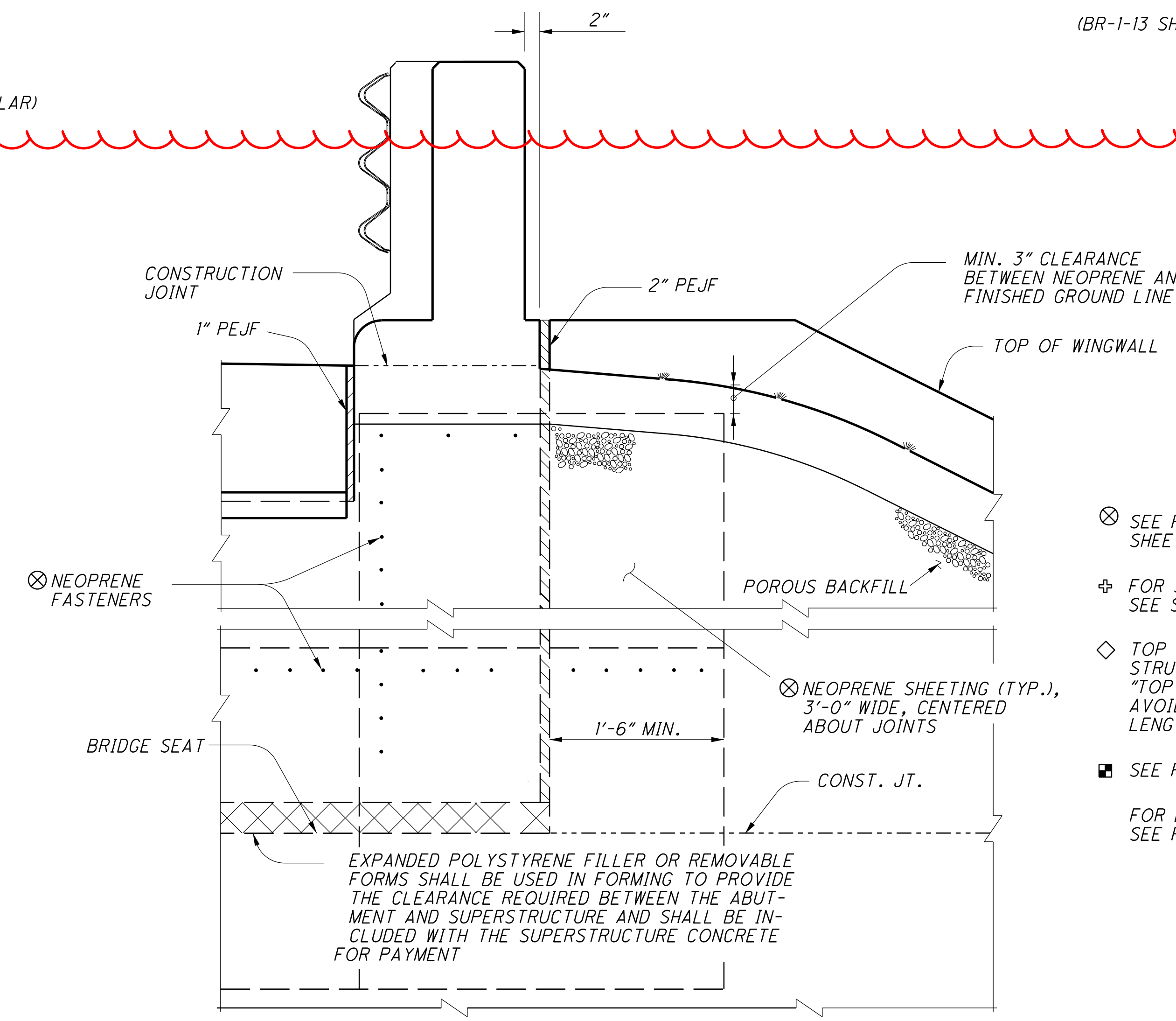


PART PLAN AT ABUTMENT

SKEWED STRUCTURE WITH DEFLECTOR PARAPET TYPE RAILING (BR-1-13 SHOWN, SBR-1-13 SHALL BE SIMILAR)



ELEVATION



SECTION A-A

⊗ SEE PROJECT PLANS FOR ADDITIONAL NEOPRENE SHEETING PLACEMENT REQUIREMENTS.

✣ FOR SEISMIC PEDESTAL REQUIREMENTS SEE SHEET 6 / 7.

◇ TOP OF SLOPE: ON SUPERELEVATED STRUCTURES, A LATERALLY SLOPING "TOP OF SLOPE" MAY BE USED TO AVOID EXCESSIVELY LONG WING WALL LENGTHS.

■ SEE ROADWAY TYPICAL SECTION.

FOR BRIDGE TERMINAL ASSEMBLY SEE ROADWAY PLAN SHEET MGS-3.1.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

Brad Fagrell
ADMINISTRATOR

02-12-97
DATE

REVISIONS
04-20-01
07-19-02
07-18-14

DESIGNED	WLE	CHECKED	MRG/JS
DRAWN	WLE	REVIEWED	LMW

OFFICE OF STRUCTURAL ENGINEERING

STANDARD BRIDGE DRAWING

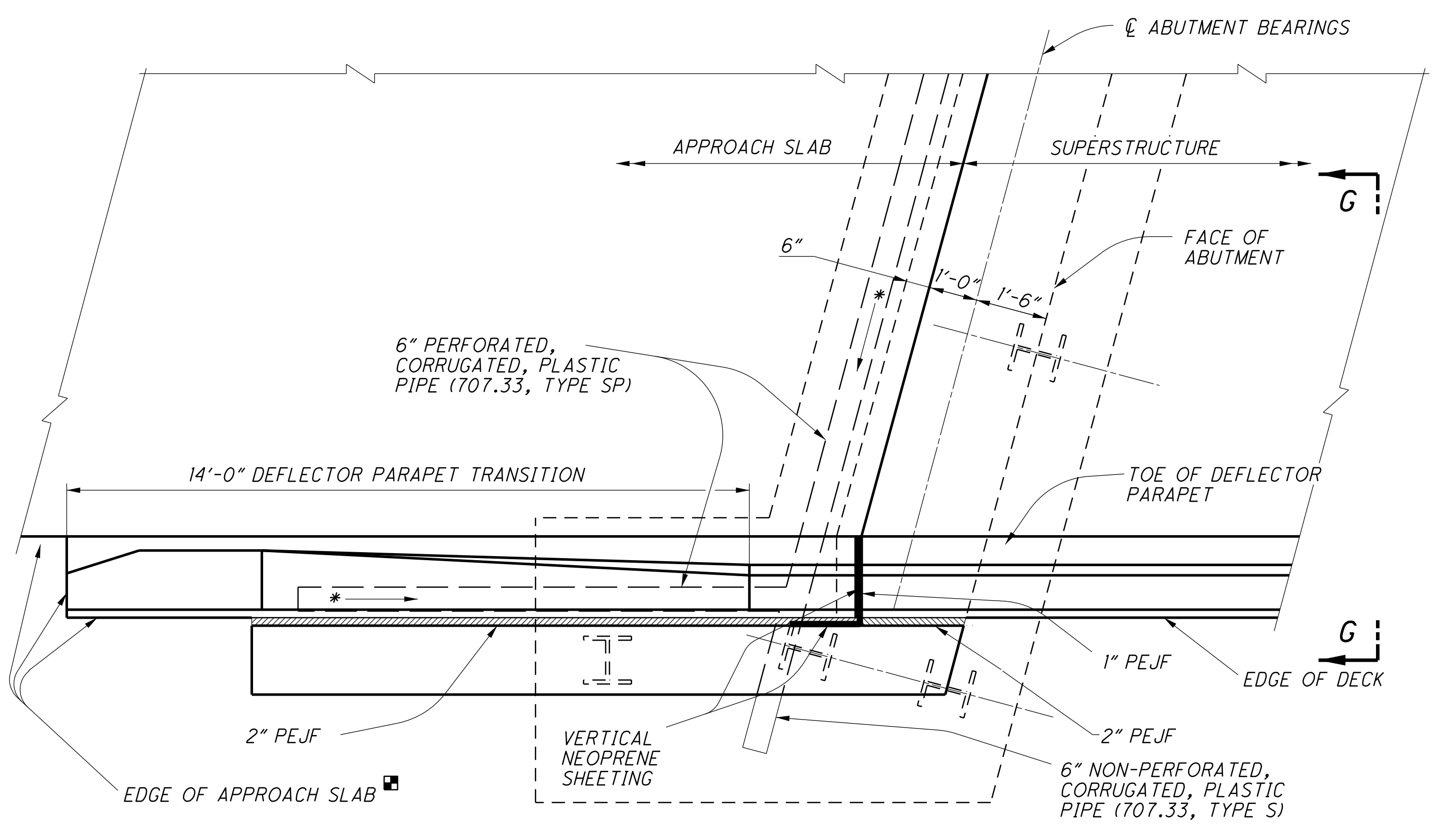
SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96

NOTE:
REINFORCING STEEL SHOWN IS MINIMUM. DESIGNER SHALL PROVIDE THE REINFORCEMENT REQUIRED FOR THE INDIVIDUAL STRUCTURE.

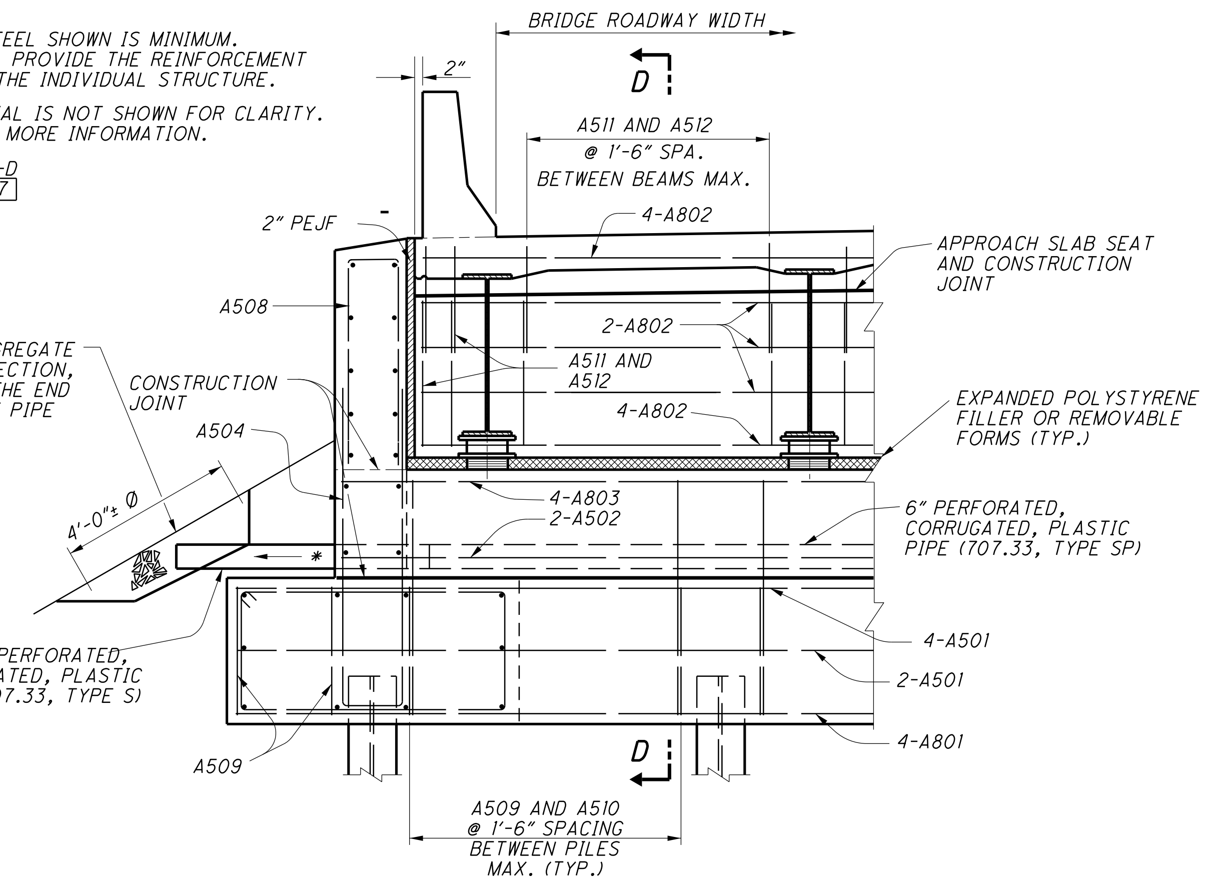
SEISMIC PEDESTAL IS NOT SHOWN FOR CLARITY. SEE 6/7 FOR MORE INFORMATION.

FOR SECTION D-D SEE SHEET 3/7

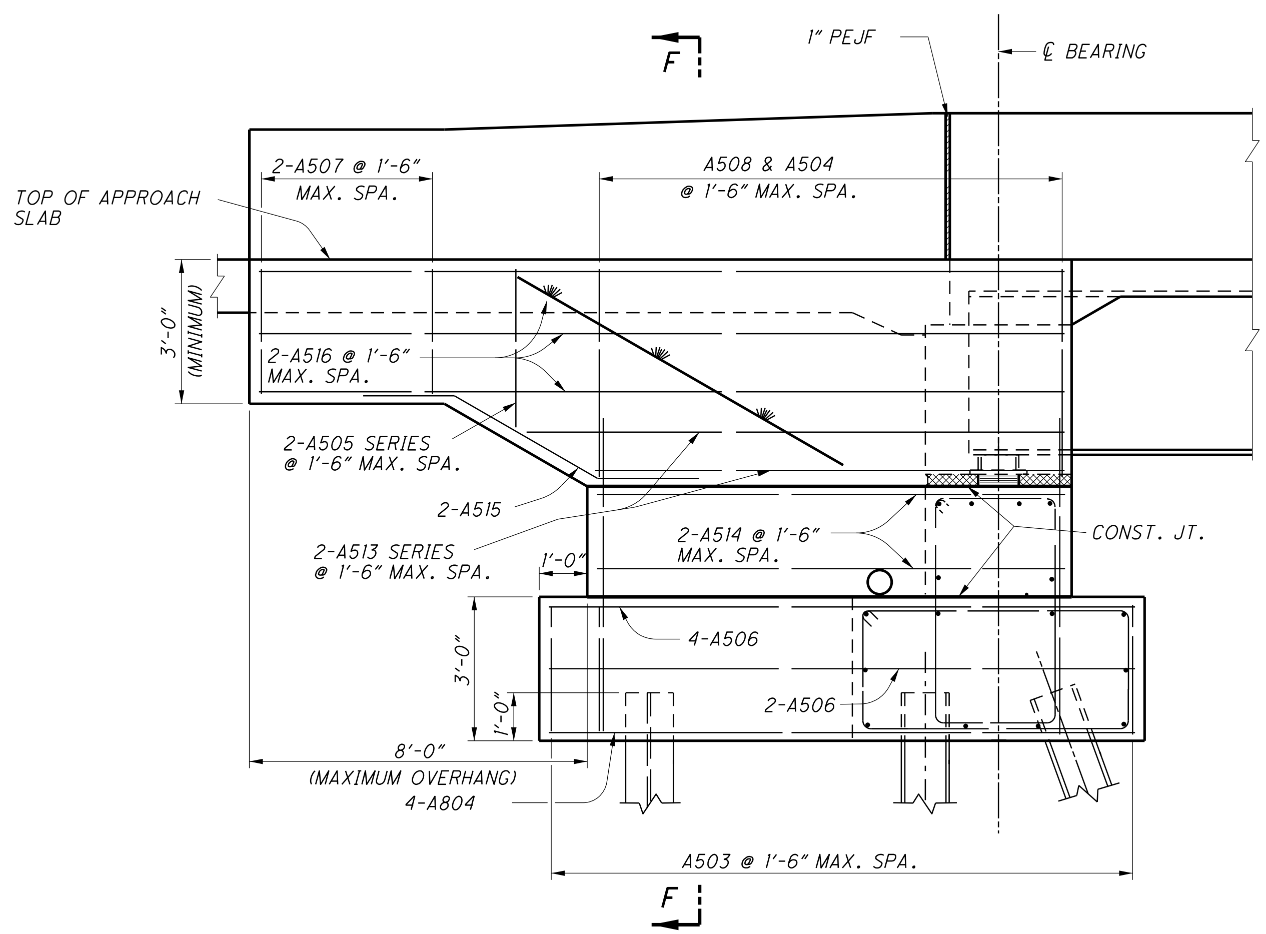


PART PLAN

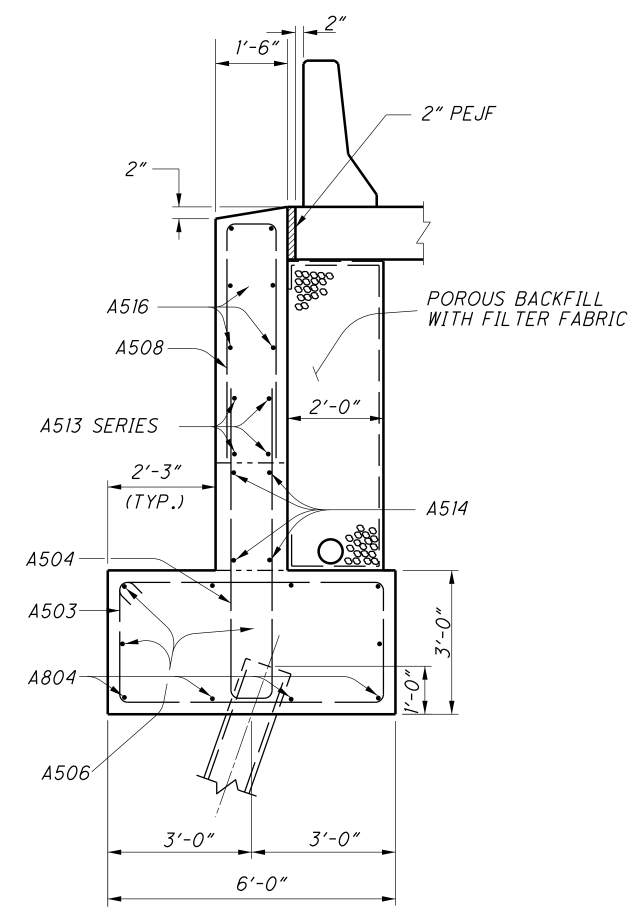
SPECIAL DESIGN OF APPROACH SLAB MAY BE REQUIRED



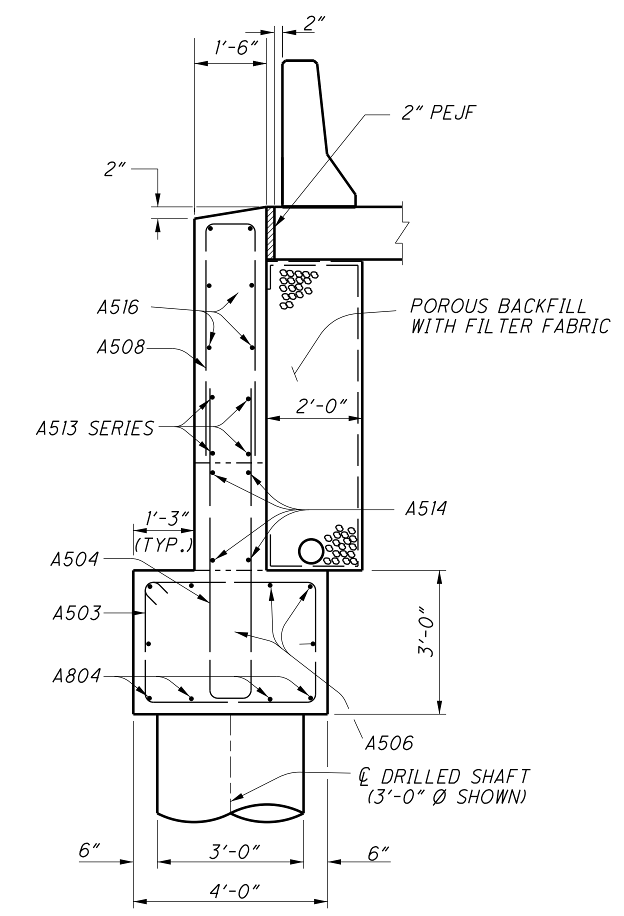
VIEW G-G



ELEVATION



SECTION F-F
(ON PILES)



SECTION F-F
(ON DRILLED SHAFTS)

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
Brad Fagell
ADMINISTRATOR
02-12-97
DATE

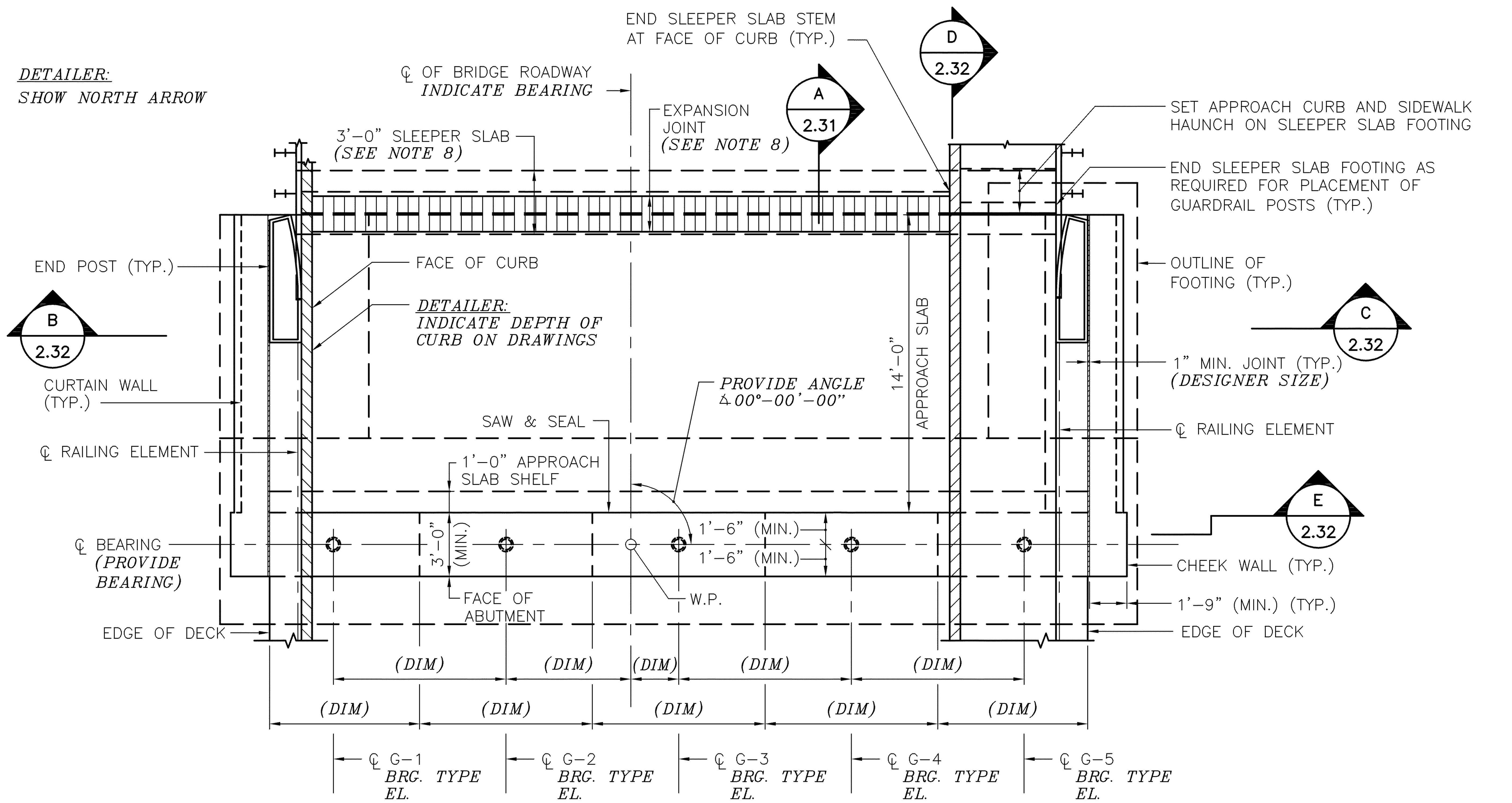
REVISIONS
04-20-01
07-19-02
07-18-14

CHECKED MRG/JS
REVIEWED LMW
DESIGNED WLE
DRAWN WLE

OFFICE OF STRUCTURAL ENGINEERING

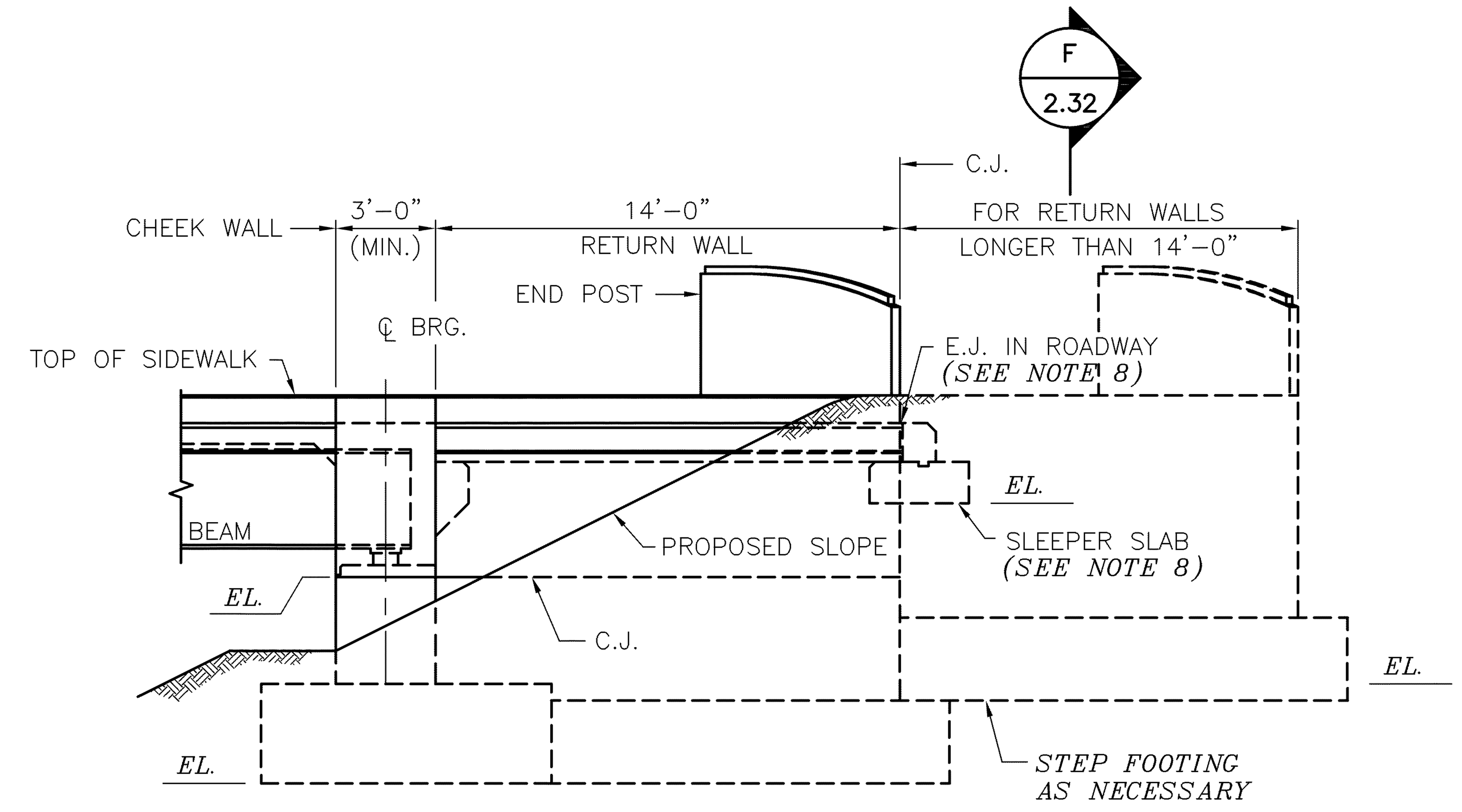
STANDARD BRIDGE DRAWING
SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96



DESIGNER:
INTEGRAL DECK HAS BEEN REMOVED AT THE FACE OF ABUTMENT FOR CLARITY.

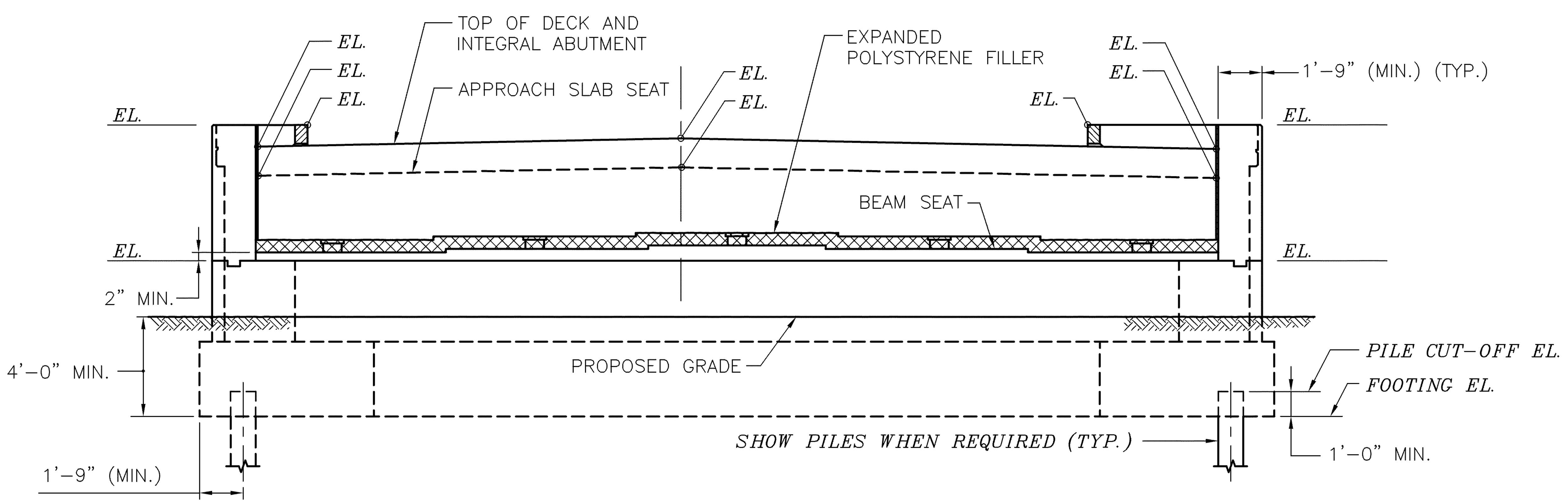
PLAN AT BEAM SEATS
SCALE: 1/4"=1'-0"



RETURN WALL AT SIDEWALK / SAFETY WALK
SCALE: 1/4"=1'-0"

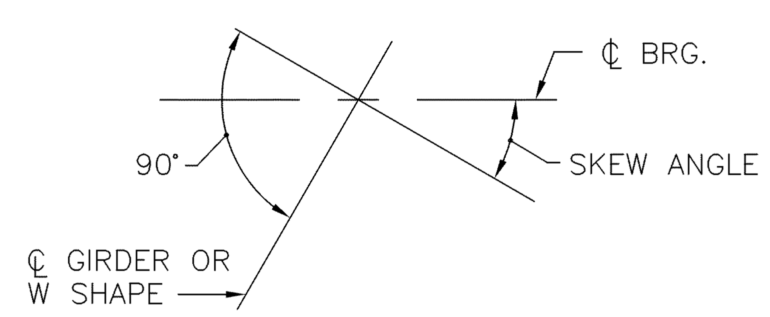
DESIGNER NOTES:

1. *THE DESIGNER SHALL REFER TO SECTION 11.3.4 (SEMI-INTEGRAL ABUTMENTS) OF THE RIDOT LRFD BRIDGE DESIGN MANUAL FOR DESIGN AND DETAILING REQUIREMENTS AND LIMITATIONS ON THE USE OF SEMI-INTEGRAL ABUTMENTS.*
2. *A NOTE SHALL BE PROVIDED ON THE CONTRACT DRAWINGS STATING THAT TOP OF DECK ELEVATIONS ARE GIVEN AT FRONT FACE OF INTEGRAL ABUTMENT.*
3. *UTILITY PASSAGE THROUGH THE SEMI-INTEGRAL ABUTMENT SHOULD BE AVOIDED. (SEE SECTION 11.3.4 OF THE RIDOT LRFD BRIDGE DESIGN MANUAL).*
4. *ABUTMENT DETAILS FOR SKEWED ABUTMENTS ARE SIMILAR.*
5. *REINFORCING SHOWN IS MINIMUM ONLY.*
6. *THE SUGGESTED SCALE FOR ANY ABUTMENT PLAN AND ELEVATION IS 1/4"=1'-0".*
7. *REFERENCES TO END POSTS AND CENTERLINES OF RAILING ELEMENTS ARE INTENDED TO REFER THE DETAILS SHOWN ELSEWHERE IN THESE BRIDGE STANDARDS (SEE APPROPRIATE DETAILS).*
8. *SLEEPER SLAB AND EXPANSION JOINT IN ROADWAY MAY BE OMITTED FOR BRIDGE SUPERSTRUCTURE SPANS 60 FEET OR LESS.*
9. *SEE DWG. 2.32 FOR RETURN WALL DETAILS*



** REINFORCE BEAM SEAT WHEN HEIGHT OF BEAM SEAT EXCEEDS 4".*

ELEVATION
SCALE: 1/4"=1'-0"



SKEW ANGLE DESIGNATION

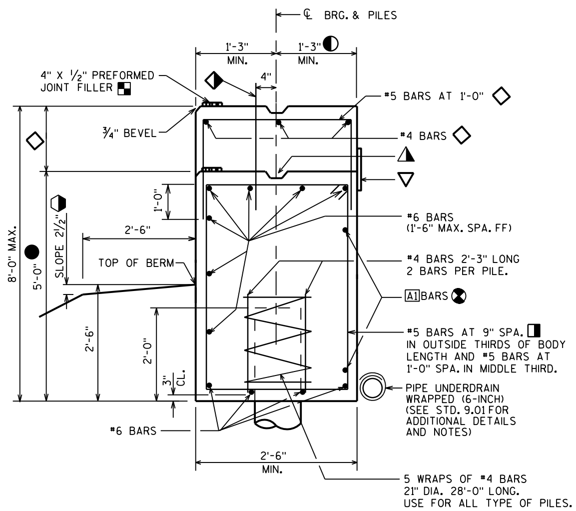
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

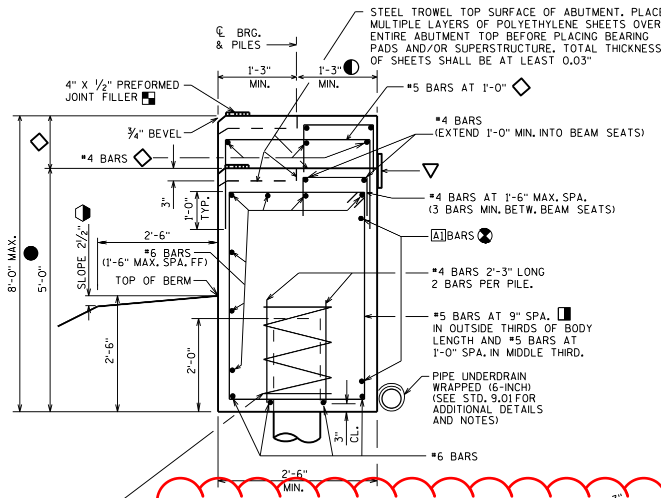
BRIDGE STANDARDS

SEMI INTEGRAL ABUTMENT SHEET 1

DRAWING NUMBER: 2.30



TYPE A1 WITH FIXED SEAT



TYPE A1 WITH SEMI-EXPANSION SEAT

DESIGNER NOTES

LAP LENGTHS FOR HORIZONTAL BARS SHALL BE BASED ON A "CLASS C" TOP TENSION LAP SPLICE.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

PILING SPACING IN ABUTMENT BODY SHALL BE 8'-0" MAX. FOR ALL TYPES OF PILING. THE MAX. PILE SPACING FROM THE END OF THE ABUT. BODY TO THE FIRST PILE SHALL BE THE MINIMUM OF ONE-HALF PILE SPACE OR 2'-6".

TOTAL LENGTH OF A1 BARS SHALL BE ≥ TO WING LENGTH.

CONCRETE POURED UNDER WATER WILL BE ALLOWED AND SHALL BE DONE IN ACCORDANCE WITH SECTION 502.3.5.3 STANDARD SPECIFICATIONS.

THE SEMI-EXPANSION SEAT SHALL BE USED WHEN REQUIRED AS STATED IN CHAPTER 12, FIGURE 12.7-1 OF THE BRIDGE MANUAL OR WHENEVER A WING PILE IS REQUIRED.

THE FIXED SEAT CANNOT BE USED WHEN A WING PILE IS REQUIRED (SEE STD. 12.02 FOR CRITERIA).

WHEN THE BOTTOM OF GIRDER SLOPES MORE THAN 1%, SLOPE THE BEAM SEAT BASED ON ADDING THESE TWO VALUES:
- LONGITUDINAL GRADE OF GIRDER (PERCENT)
- CAMBER EFFECT = 4(RC)/L X 100 (PERCENT), WHERE:
  RC = RESIDUAL CAMBER (INCHES)
  L = GIRDER LENGTH (INCHES)

(SEE STANDARD 13.01 FOR SLOPED SEAT DETAILS)

ABUTMENT DETAILED WITHOUT STRUCTURAL APPROACH SLAB. SEE STD. 12.10 THRU 12.13 FOR STRUCTURAL APPROACH DETAILS.

USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

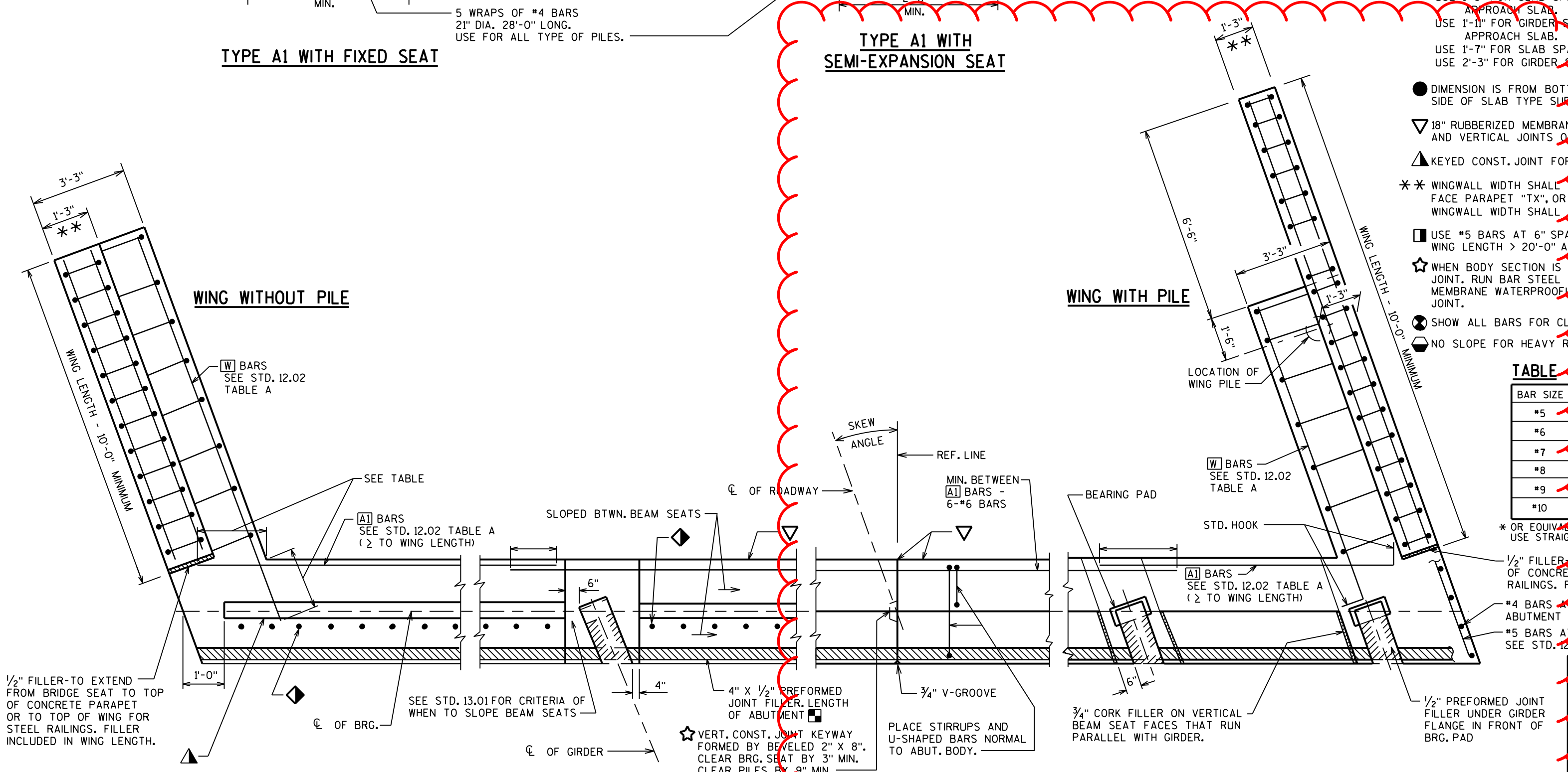
LEGEND

- #5 BARS (COATED) AT 1'-0" (2'-0" LONG). THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED BUT BEFORE INITIAL SET HAS TAKEN PLACE.
- WHEN THIS DIMENSION ≥ 4" THIS ADDITIONAL REINFORCEMENT SHALL BE ADDED. MAX. SPA. OF HORIZ. #4 BARS = 1'-0".
- USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH. USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°. USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB. USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB. USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10) USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
- DIMENSION IS FROM BOTTOM OF ABUTMENT TO LOW BEAM SEAT OR LOW SIDE OF SLAB TYPE SUPERSTRUCTURE.
- 18" RUBBERIZED MEMBRANE WATERPROOFING. SEAL ALL HORIZONTAL AND VERTICAL JOINTS ON BACKFACE.
- KEYED CONST. JOINT FORMED BY BEVELED 2" x 6".
- ** WINGWALL WIDTH SHALL BE 1'-6" WHEN TYPE "M" RAILING, VERTICAL FACE PARAPET "TX", OR SINGLE SLOPE PARAPET "56SS" IS USED. WINGWALL WIDTH SHALL BE 1'-9" WHEN TYPE "NY3" OR "NY4" RAILING IS USED.
- USE #5 BARS AT 6" SPA. IN OUTSIDE THIRDS OF BODY LENGTH WHEN THE WING LENGTH > 20'-0" AND WING HEIGHT > 10'-0".
- ☆ WHEN BODY SECTION IS > 50'-0"± LONG PROVIDE VERTICAL CONSTRUCTION JOINT. RUN BAR STEEL THRU JOINT AND SEAL JOINT WITH 18" RUBBERIZED MEMBRANE WATERPROOFING. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.
- SHOW ALL BARS FOR CLARITY.
- NO SLOPE FOR HEAVY RIPRAP. SEE STANDARD 12.08 FOR DETAILS.

TABLE

BAR SIZE	DISTANCE*
#5	1'-9"
#6	2'-1"
#7	2'-9"
#8	3'-8"
#9	4'-7"
#10	5'-10"

* OR EQUIVALENT STD. HOOK
USE STRAIGHT BARS WHEN POSSIBLE



SLAB SPAN WITH FIXED SEAT

GIRDER SPAN WITH FIXED SEAT

SLAB SPAN WITH SEMI EXPANSION SEAT

GIRDER SPAN WITH SEMI EXPANSION SEAT

ABUTMENT TYPE A1
(INTEGRAL ABUTMENT)

WISCONSIN DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURES

APPROVED: *Bill Oliva*

DATE: 1-20

STANDARD 12.01

6.b) Semi-Integral Abutment Typical Section

Colorado

Typical Semi Integral Abutment Section

Illinois

Typical Semi Integral Abutment Section

Michigan

Semi Integral Abutment Backwall

New Hampshire

Typical Semi Integral Abutment Section

New York

Typical Semi Integral Abutment Section

Ohio

Elevation and Typical Sections at Semi Integral Abutment

NOTE: Ohio provides other similar details for various beam and transition types

Rhode Island

Elevation at Semi Integral Abutment

Typical Sections at Semi Integral Abutment

When semi-integral abutments are used, intermediate shear blocks between girders or end blocks beyond the edge of deck shall allow a means for lateral load distribution to the substructure. If a shear block is not practical, use anchor bolts with a sole plate. The Designer shall provide an area to allow for jacking the superstructure and bearing replacement per Section 14.5.6 of this BDM.

Figure 11-3 and Figure 11-4 show semi-integral abutments on drilled shafts.

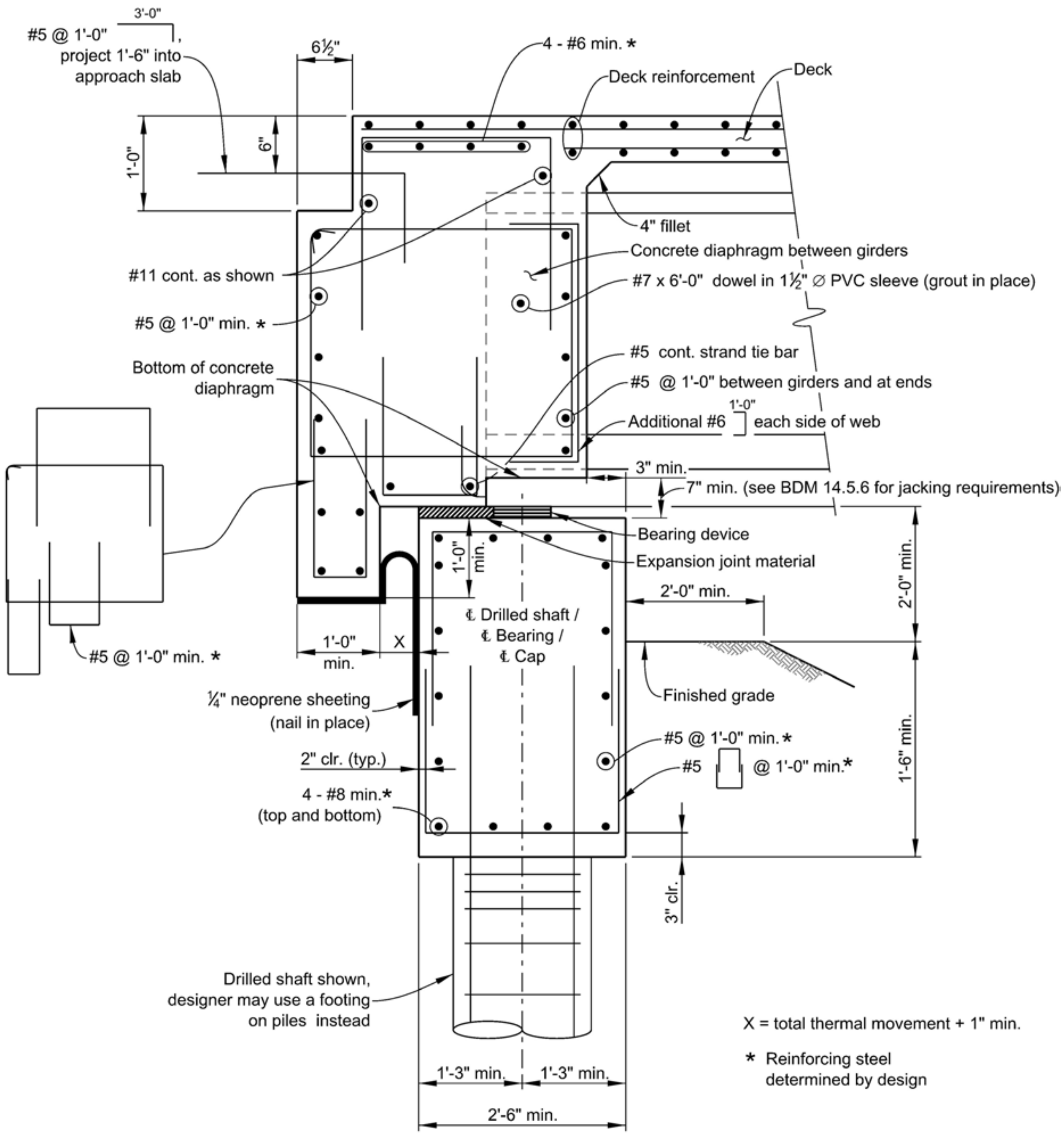


Figure 11-3: Semi-Integral Abutment (Alternative 1)

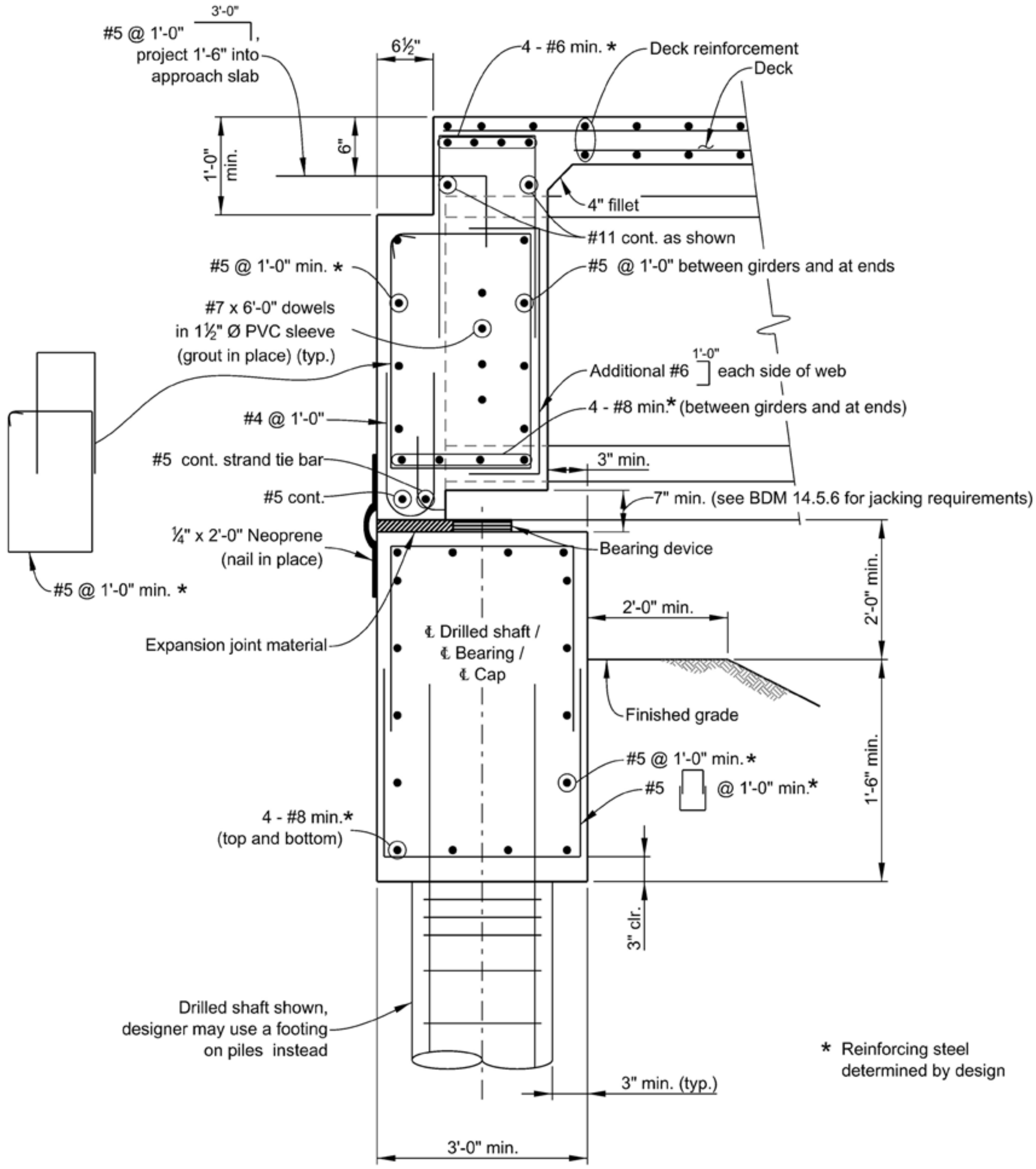
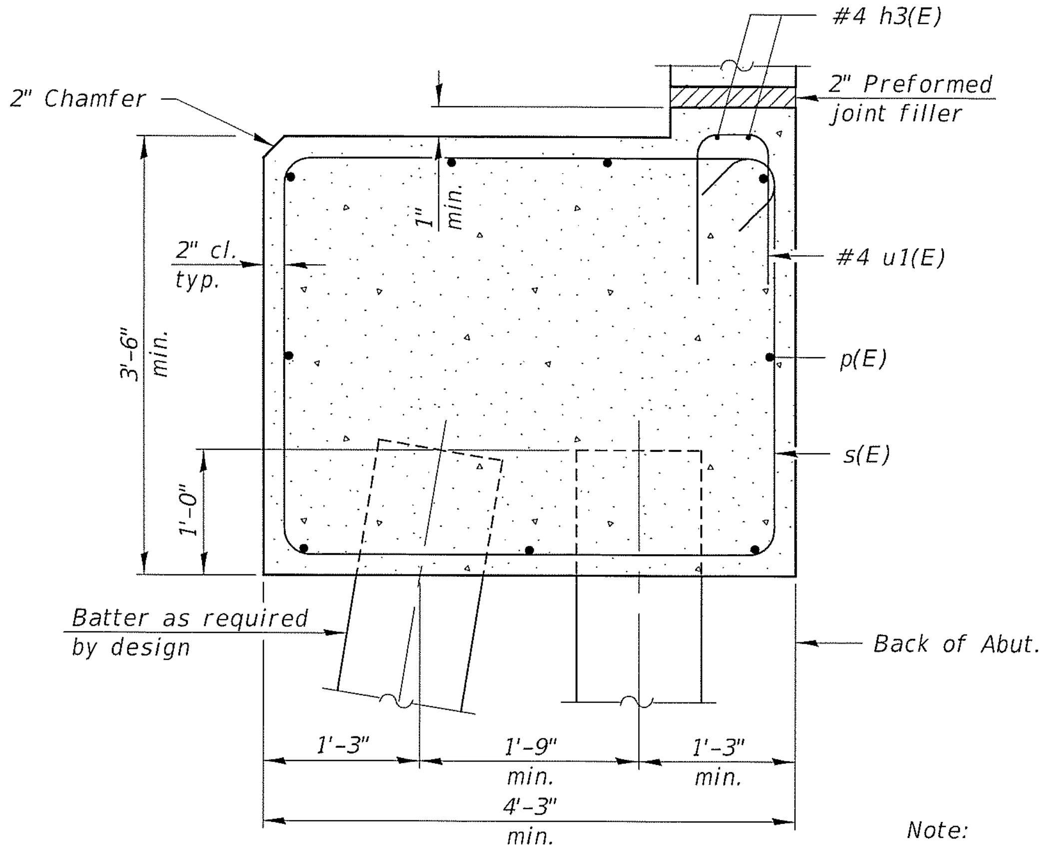


Figure 11-4: Semi-Integral Abutment (Alternative 2)
(See Notes with Figure 11-3)

11.3.3 Seat Type Abutments

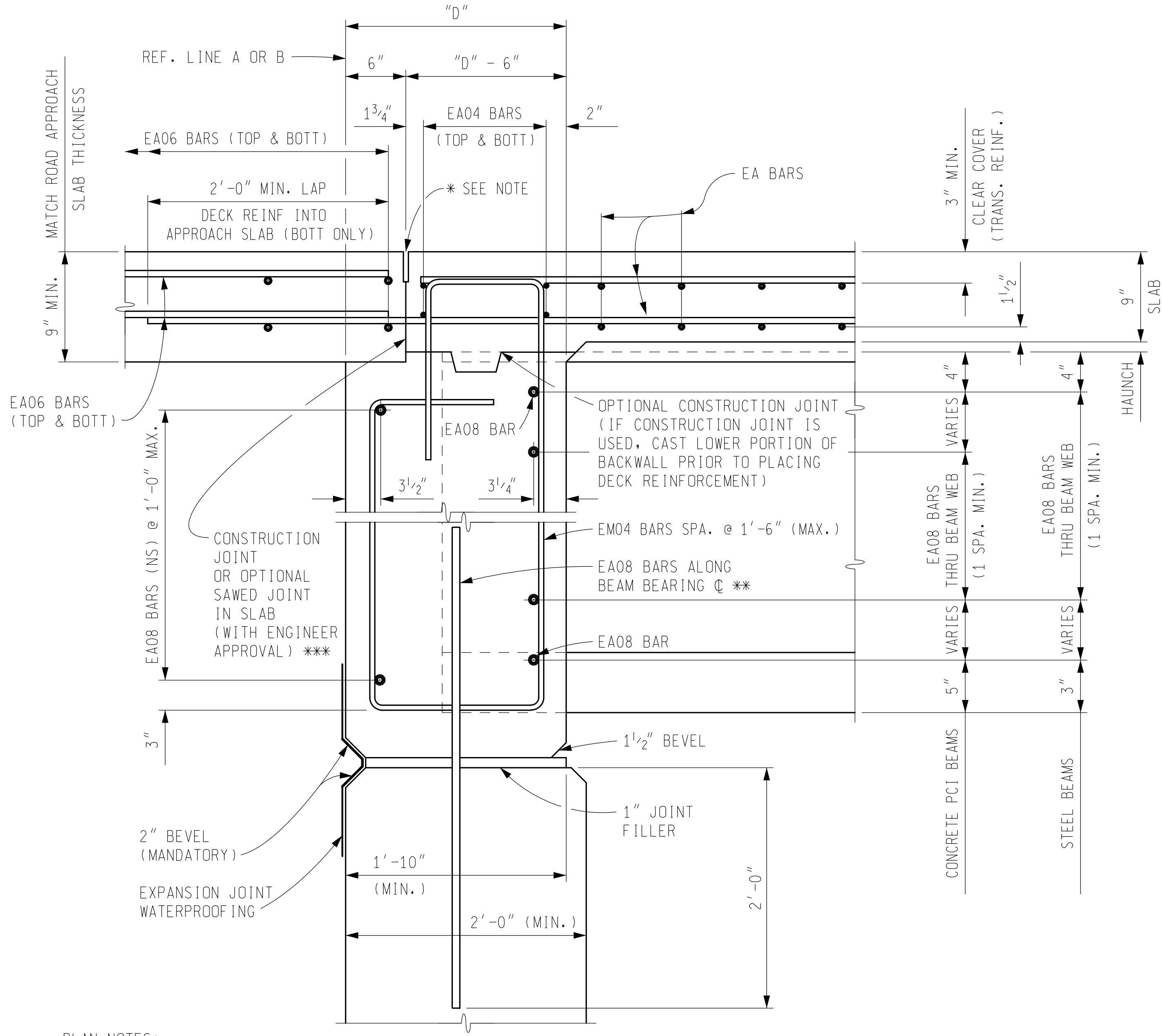
Seat type abutments have an expansion gap between the backwall and end of girders, as shown on Figure 11-5, and are typically used when large movements require a modular expansion device rather than a strip seal placed at the end of the approach slab. To provide a pinned connection between the superstructure and substructure, place the girders on bearing devices, thereby allowing rotational and horizontal movements. Using seat type abutments is discouraged due to the high maintenance costs associated with leaking expansion joints, substandard expansion device performance, and being prone to rotation and closing the expansion device.



Note:
The u1(E) and s(E) bars are placed at right angles to cap and spaced along cap.

SEMI-INTEGRAL ABUTMENT

DRAWN BY: BLT CHECKED BY: VZ APPROVED BY: DAJ	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT	ISSUED: 12/26/17 SUPERSEDES: 07/18/16
	INTEGRAL AND SEMI-INTEGRAL ABUTMENT BACKWALL	



PLAN NOTES:

WHERE OPTIONAL CONSTRUCTION JOINTS ARE USED, THERE WILL BE NO PAYMENT FOR THE REQUIRED JOINT WATERPROOFING.

* IF A CONSTRUCTION JOINT IS NOT USED, THE CONTRACTOR IS TO PROVIDE A SAWED JOINT [1/3 DECK SLAB THICKNESS]" DEEP BY 1/4" WIDE (MINIMUM) IN THE TOP OF SLAB AT TRANSVERSE CONSTRUCTION JOINTS OVER THE BACKWALL. IF A CONSTRUCTION JOINT IS NOT USED, THE JOINT IS TO BE SAWED WITHIN 24 HOURS OF PLACING THE CURING AND IS TO BE FILLED TO 1/2" BELOW TOP OF CONCRETE WITH POLYURETHANE OR POLYURETHANE HYBRID JOINT SEALANT. (INCLUDED IN THE BID ITEM "SUPERSTRUCTURE CONC, FORM, FINISH, AND CURE, NIGHT CASTING (STRUCTURE NO.)").

NOTES:

INTEGRAL AND SEMI-INTERGRAL ABUTMENT BRIDGES SHALL BE CONSIDERED FOR STEEL BRIDGES LESS THAN 300' AND CONCRETE BRIDGES LESS THAN 400' IN LENGTH.

APPROACH SLAB THICKNESS WILL MATCH THE ROAD APPROACH THICKNESS (9" MIN.)

CONTINUE BOTTOM MAT OF REINFORCEMENT THROUGH CONSTRUCTION JOINT. ADD EXTRA REINFORCEMENT OVER BEAM (EA050400 BARS).

** USE FOR INTEGRAL ABUTMENT BRIDGES ONLY.

*** THE JOINT IS NOT OPTIONAL, BUT REQUIRED IF CASE I (SEE BRIDGE MANUAL 7.03.01) REQUIRES NOT BACKFILLING ABOVE THE BRIDGE SEAT.

SEMI-INTEGRAL ABUTMENTS SHOULD BE USED AT STREAM CROSSINGS.

D = BACKWALL THICKNESS. SEE GUIDE 6.20.01 FOR DEFINITION.

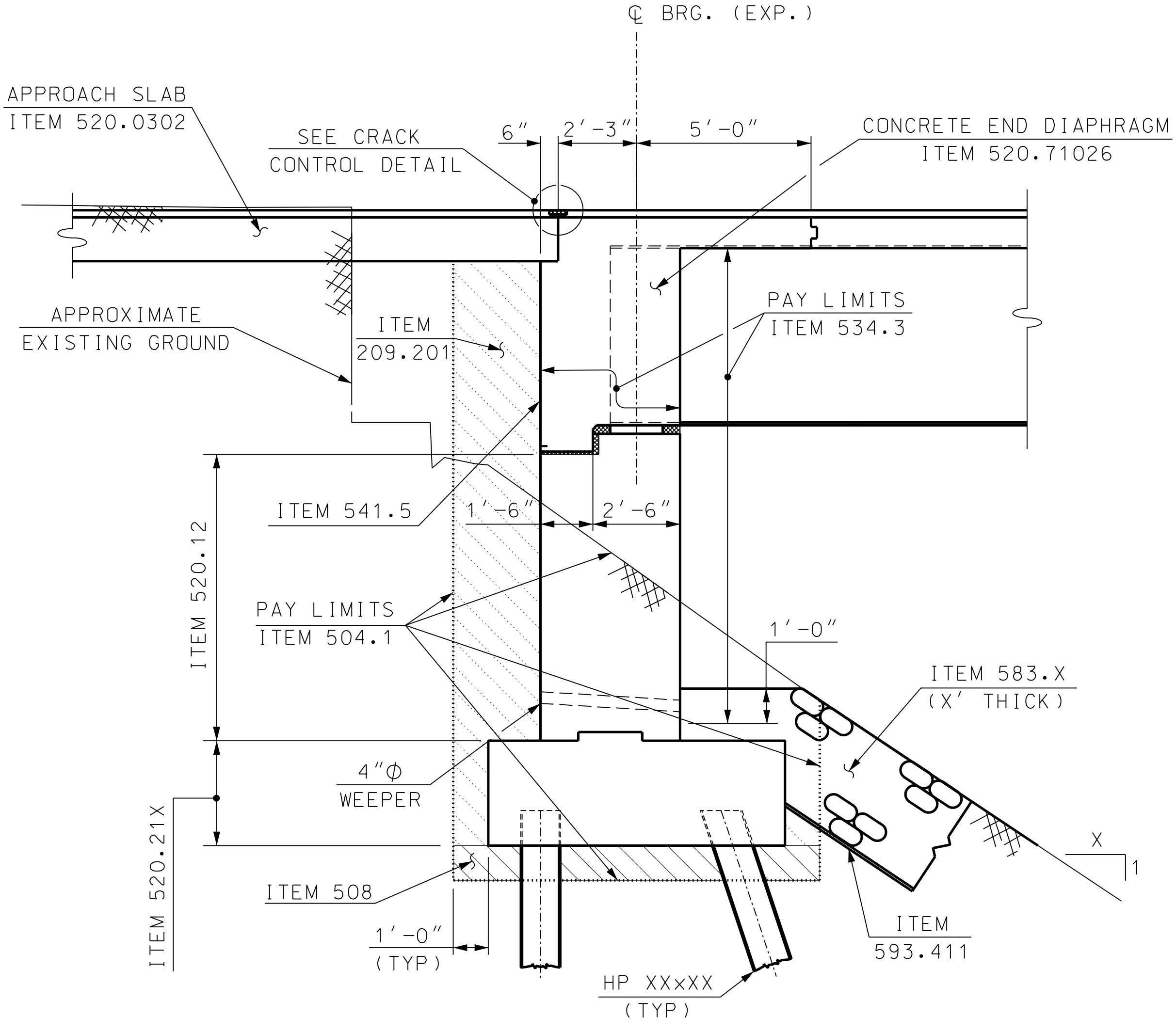
PREPARED BY DESIGN DIVISION

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

New Hampshire DOT Department of Transportation

BUREAU OF BRIDGE DESIGN

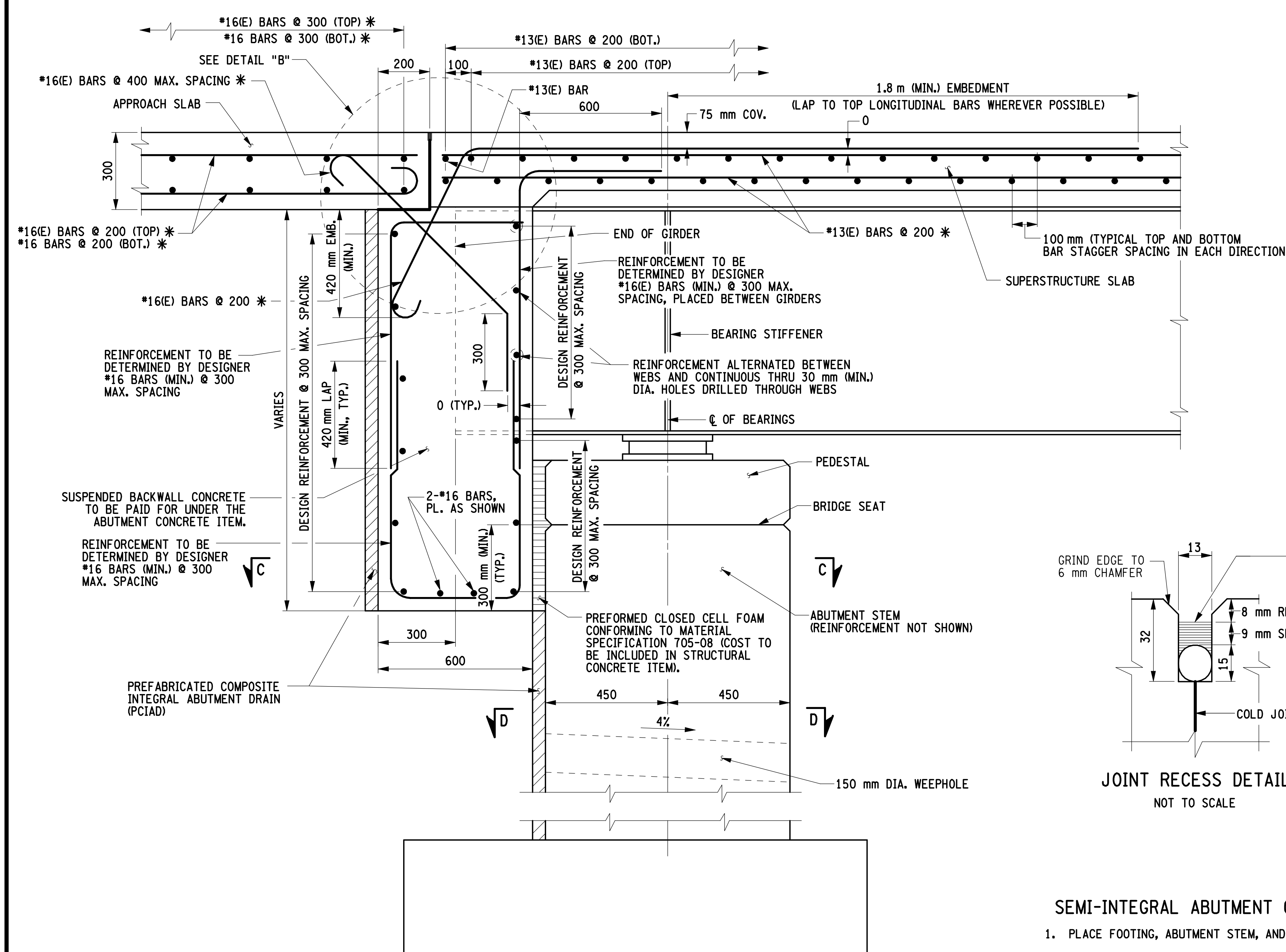
DESCRIPTION: SUBSTRUCTURE DETAILS - TYP. SEMI-INTEGRAL ABUTMENT SECTION	DATE REVISED: 2/8/2016



TYPICAL SEMI-INTEGRAL ABUTMENT SECTION

MODIFY TO FIT PROJECT

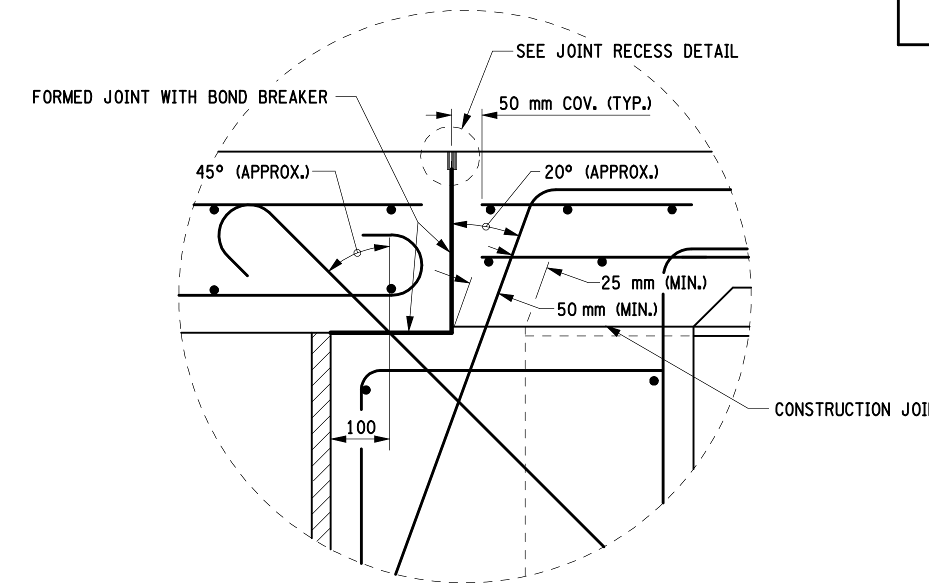
BD-ID6
R1



SEMI-INTEGRAL ABUTMENT DETAIL
(SECTION TAKEN PERPENDICULAR TO ABUTMENT)

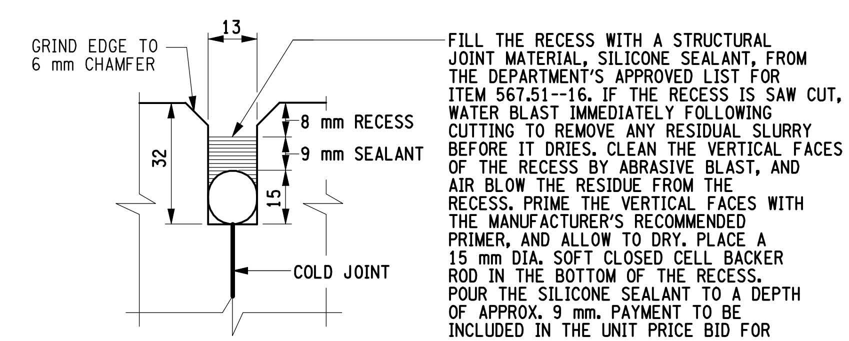
NOT TO SCALE

✱ SPACINGS SHOWN FOR THESE BARS ARE PARALLEL OR PERPENDICULAR TO STATION LINE OR GIRDER.



DETAIL "B"

NOT TO SCALE



JOINT RECESS DETAIL

NOT TO SCALE

DESIGNER NOTES:

THE GAP BETWEEN THE ABUTMENT STEM AND BACKWALL SHALL BE SET AT A MAXIMUM OF 50 mm PLUS THE EXPECTED MOVEMENT FOR STEEL STRUCTURES FOR A TEMPERATURE FALL FROM 20°C TO -35°C (UPSTATE) OR -18°C (REGIONS 10 AND 11) ROUNDED TO THE NEAREST 5 mm OR TWICE THE EXPECTED EXPANSION PLUS CONTRACTION MOVEMENTS.

EVERY BAY SHALL HAVE AN INTERMEDIATE DIAPHRAGM INSTALLED AT THE CENTERLINE OF BEARINGS FOR EACH ABUTMENT. FOR TYPICAL DIAPHRAGM DETAILS, SEE THE BD-SD DRAWINGS.

TOP REINFORCEMENT IN SLAB NEEDS TO BE CHECKED FOR NEGATIVE MOMENT DEVELOPED FROM BACKWALL AND APPROACH SLAB.

EXCAVATION AND EMBANKMENT DETAILS FOR SEMI-INTEGRAL ABUTMENTS ARE GENERALLY THE SAME AS FOR CONVENTIONAL ABUTMENTS. SEE CURRENT BD SHEETS FOR DETAILS. PLACE SELECT STRUCTURE FILL A MINIMUM OF 1 m BEYOND THE HEEL OF THE FOOTING OR REAR FACE OF THE BACKWALL, WHICHEVER IS GREATER.

ABUTMENT STEM AND PEDESTAL REINFORCEMENT SIMILAR TO CONVENTIONAL ABUTMENT DETAILS.

ISOTROPIC DECK REINFORCEMENT FOR SKEWS 30° AND UNDER SHOWN. FOR TRADITIONAL DECK REINFORCEMENT, SEE BD-SS6 & 7.

EPOXY-COATED (E) BARS ARE SHOWN. OTHER CORROSION PROTECTION OPTIONS ARE AVAILABLE. REFER TO SECTION 15.12 OF THE BRIDGE MANUAL.

REFER TO BRIDGE MANUAL, SECTION 15.12 FOR THE REQUIREMENTS OF CORROSION PROTECTED REINFORCEMENT IN SUBSTRUCTURES.

THE LOCATION AND DIAMETER OF THE HOLES IN THE STEEL GIRDER WEB ARE DEPENDENT UPON THE SKEW. LOCATE THE HOLES TO MEET CONCRETE COVER REQUIREMENTS. SIZE THE HOLES TO MEET SKEW REQUIREMENTS.

FOR SECTION C-C AND D-D, SEE BD-ID7.

SEMI-INTEGRAL ABUTMENT CONSTRUCTION PROCEDURE

1. PLACE FOOTING, ABUTMENT STEM, AND PEDESTALS.
2. BACKFILL ABUTMENT STEMS TO 300 mm BELOW THE BRIDGE SEAT ELEVATION. NO BACKFILL OF THE ABUTMENT STEMS IS ALLOWED UNTIL THE ABUTMENTS HAVE CURED FOR 7 DAYS.
3. ERECT GIRDERS AND INSTALL ALL DIAPHRAGMS.
4. PLACE CONCRETE FOR SUSPENDED BACKWALL.
5. BACKFILL ABUTMENT BACKWALLS. NO BACKFILLING OF THE ABUTMENT IS ALLOWED UNTIL BACKWALLS HAVE CURED FOR 7 DAYS. BACKFILLING SHALL BE CONDUCTED SUCH THAT THE MAXIMUM DIFFERENTIAL IN FILL HEIGHT BETWEEN THE TWO ABUTMENTS (AS MEASURED FROM THE BOTTOM OF THE BACKWALL) DOES NOT EXCEED 600 mm. IN ADDITION, THE FILL HEIGHT BEHIND ANY SINGLE ABUTMENT BACKWALL SHALL NOT VARY MORE THAN 600 mm.
6. PLACE CONCRETE FOR DECK SLAB.
7. PLACE CONCRETE FOR APPROACH SLABS.

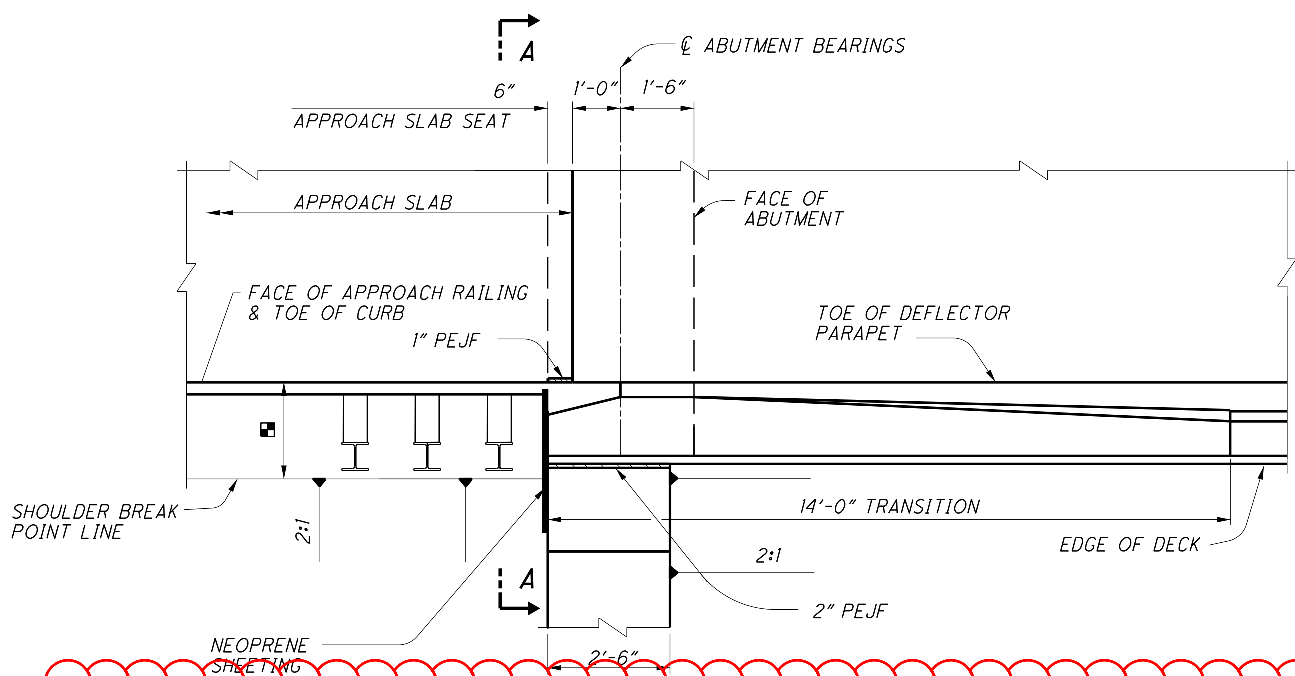
NOTE:

ALL COVER TO BE 50 mm UNLESS OTHERWISE SHOWN.

(E) DENOTES EPOXY-COATED BARS.

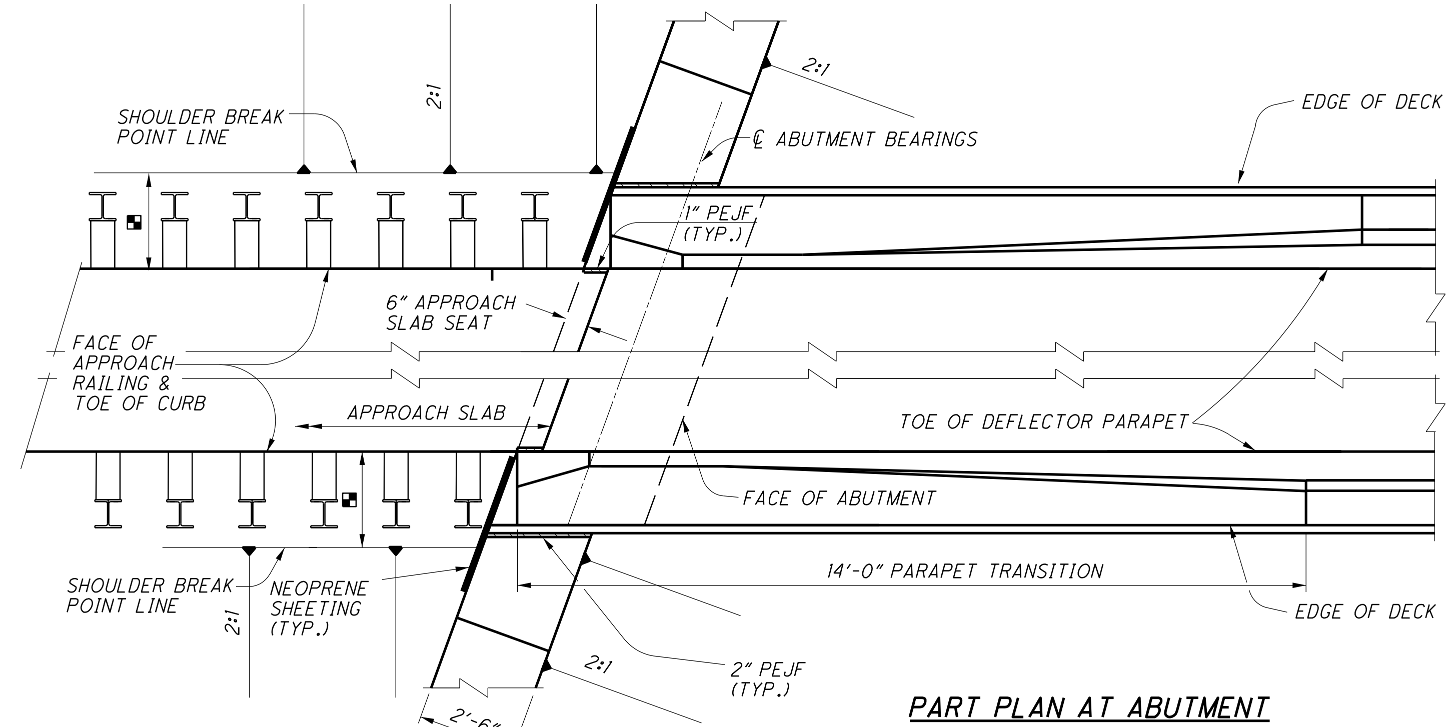
ALL DIMENSIONS AND BAR SPACINGS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED.

ISSUED 6/13/05	STATE OF NEW YORK DEPARTMENT OF TRANSPORTATION STRUCTURES DESIGN AND CONSTRUCTION DIVISION	
REVISED 6/28/10	SEMI-INTEGRAL ABUTMENTS TYPICAL SECTIONS & DETAILS	
	APPROVED: 6/28/10 ORIGINAL SIGNED BY ARTHUR P. YANNOTTI, P.E. ACTING DEPUTY CHIEF ENGINEER (STRUCTURES)	ISSUED UNDER EB 10-024 EFFECTIVE WITH THE LETTING OF 1/06/11



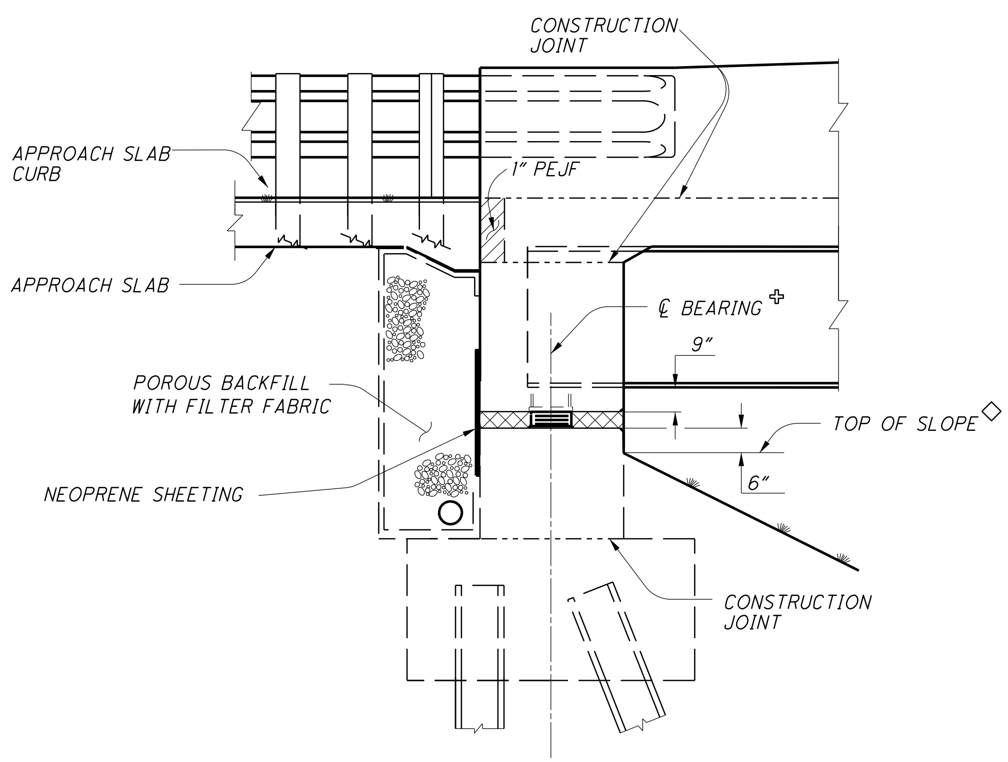
PART PLAN AT ABUTMENT

SQUARE STRUCTURE WITH DEFLECTOR PARAPET TYPE RAILING (BR-1-13 SHOWN, SBR-1-13 SHALL BE SIMILAR)

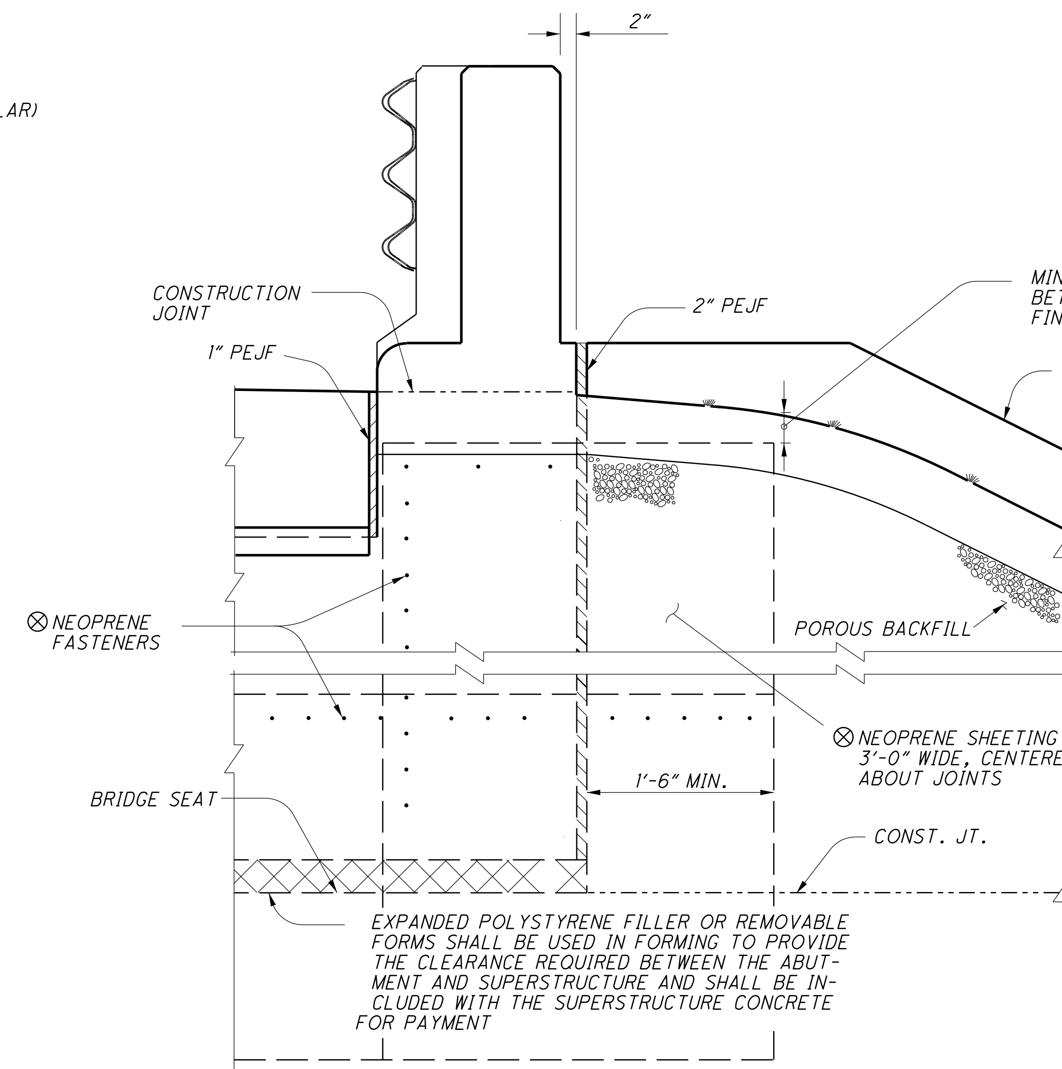


PART PLAN AT ABUTMENT

SKEWED STRUCTURE WITH DEFLECTOR PARAPET TYPE RAILING (BR-1-13 SHOWN, SBR-1-13 SHALL BE SIMILAR)



ELEVATION



SECTION A-A

⊗ SEE PROJECT PLANS FOR ADDITIONAL NEOPRENE SHEETING PLACEMENT REQUIREMENTS.

✣ FOR SEISMIC PEDESTAL REQUIREMENTS SEE SHEET 6 / 7.

◇ TOP OF SLOPE: ON SUPERELEVATED STRUCTURES, A LATERALLY SLOPING "TOP OF SLOPE" MAY BE USED TO AVOID EXCESSIVELY LONG WING WALL LENGTHS.

◘ SEE ROADWAY TYPICAL SECTION.

FOR BRIDGE TERMINAL ASSEMBLY SEE ROADWAY PLAN SHEET MGS-3.1.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

Brad Fagrell
ADMINISTRATOR

02-12-97
DATE

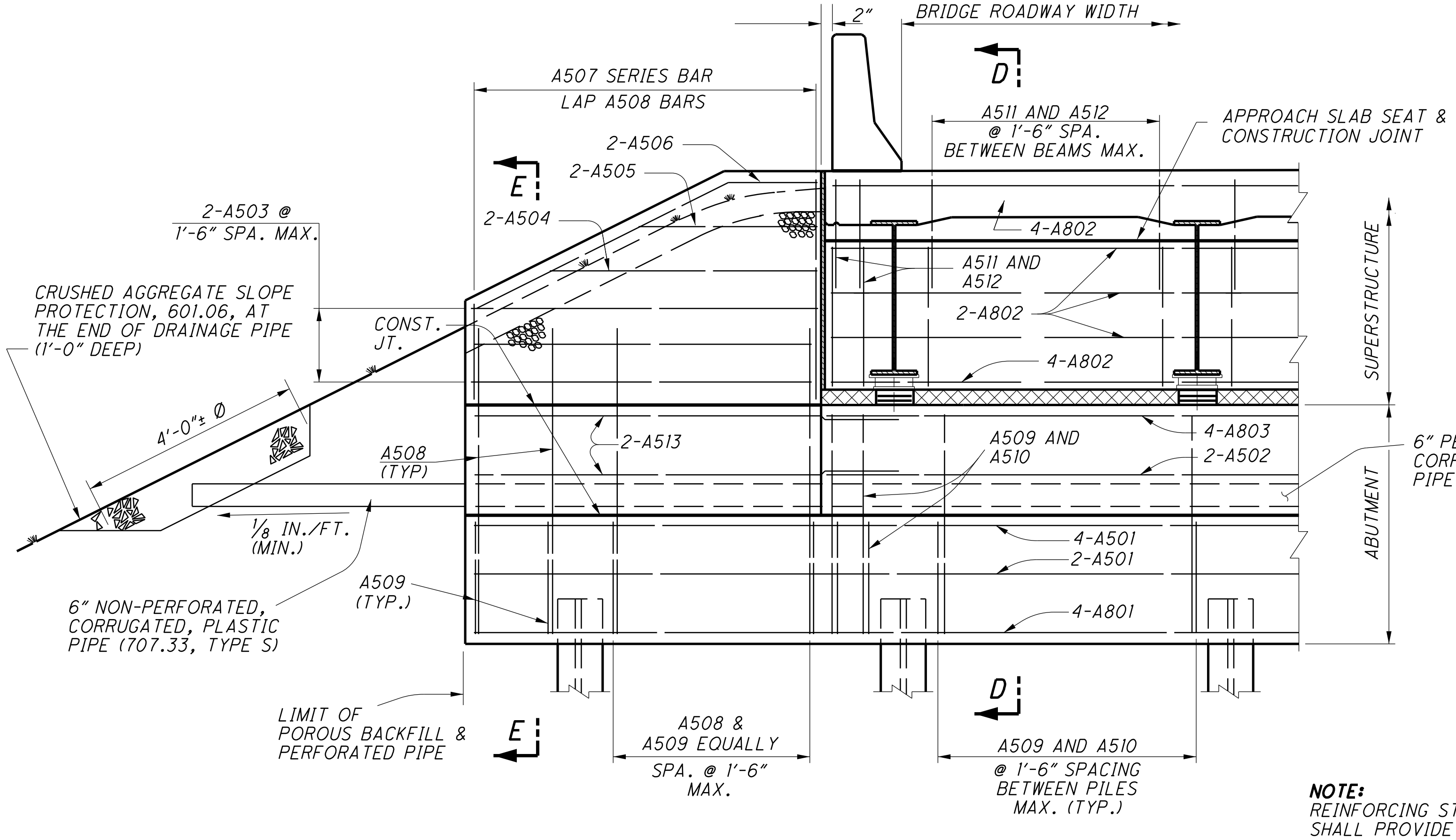
REVISIONS
04-20-01
07-19-02
07-18-14

CHECKED MRG/JS
REVIEWED LMW
DESIGNED WLE
DRAWN WLE

OFFICE OF STRUCTURAL ENGINEERING

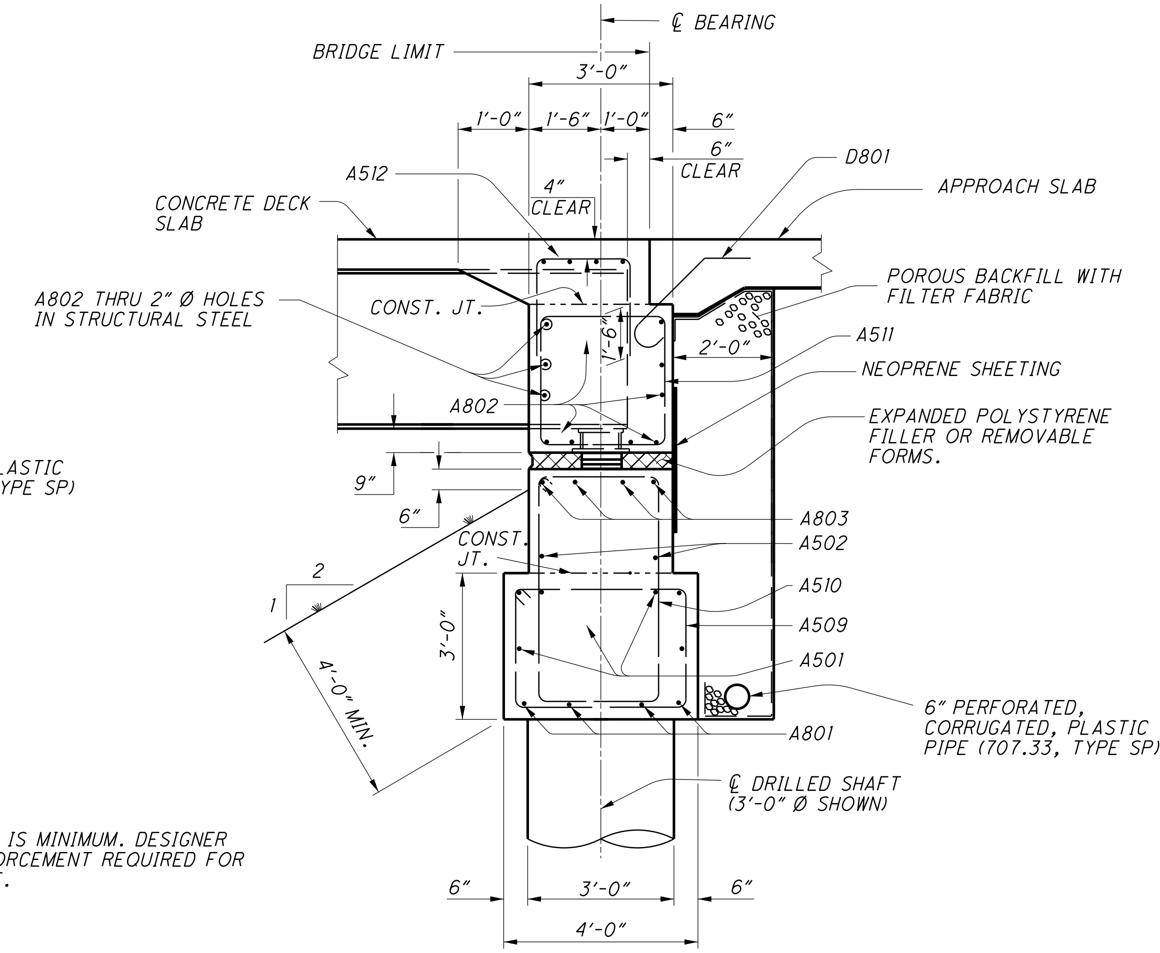
STANDARD BRIDGE DRAWING
SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96

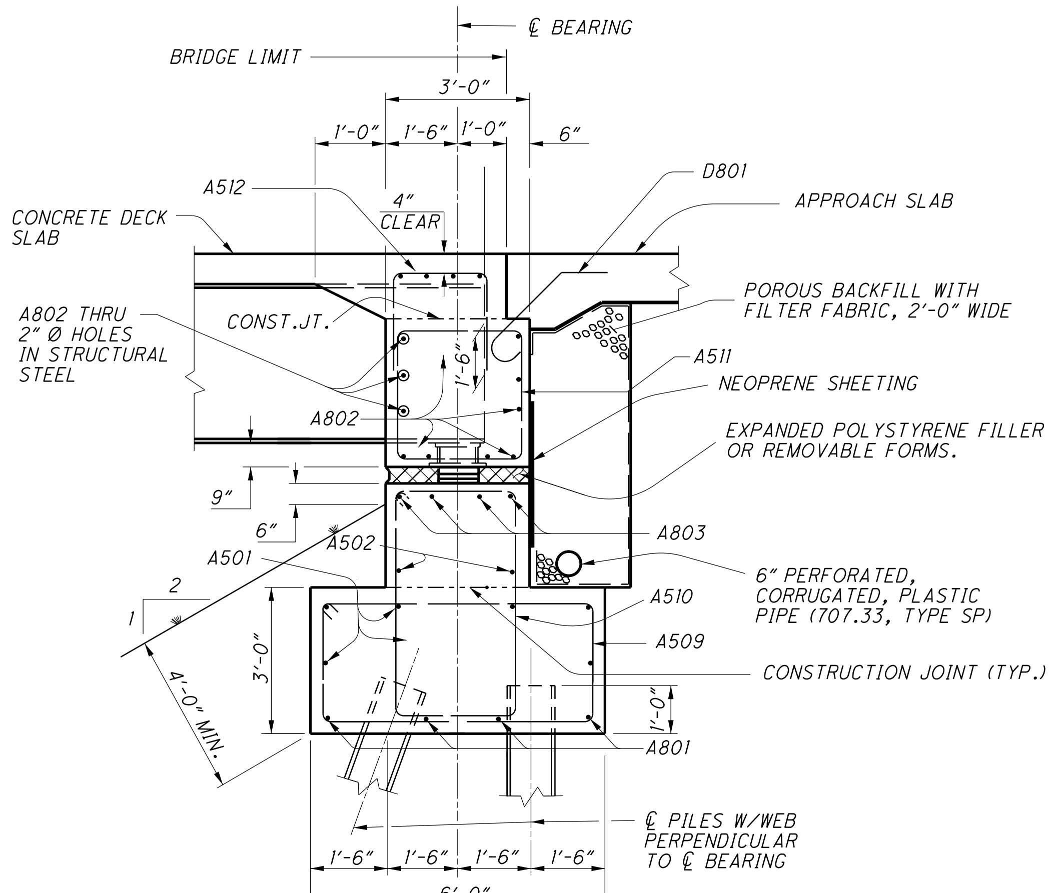


NOTE:
REINFORCING STEEL SHOWN IS MINIMUM. DESIGNER SHALL PROVIDE THE REINFORCEMENT REQUIRED FOR THE INDIVIDUAL STRUCTURE.

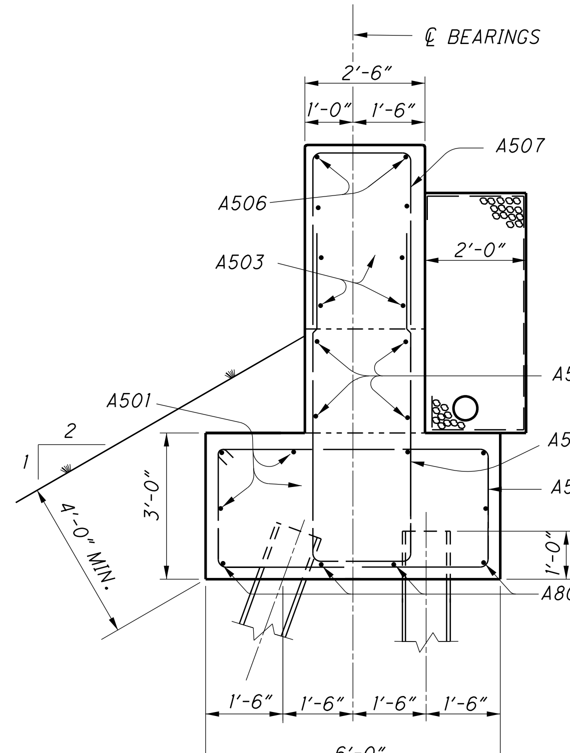
PART ELEVATION



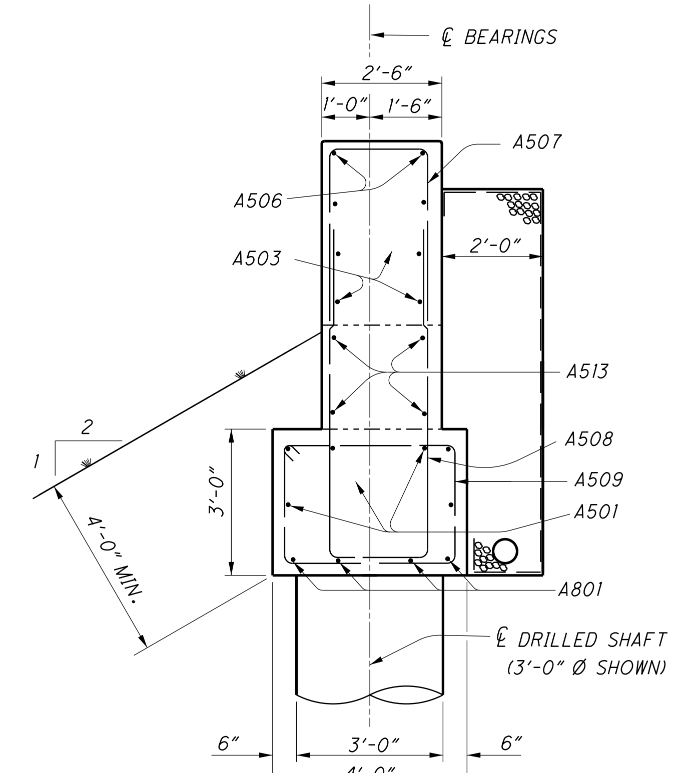
SECTION D-D
(ON DRILLED SHAFT)



SECTION D-D
(ON PILES)



SECTION E-E
(ON PILES)



SECTION E-E
(ON DRILLED SHAFT)

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
Brad Fagrell
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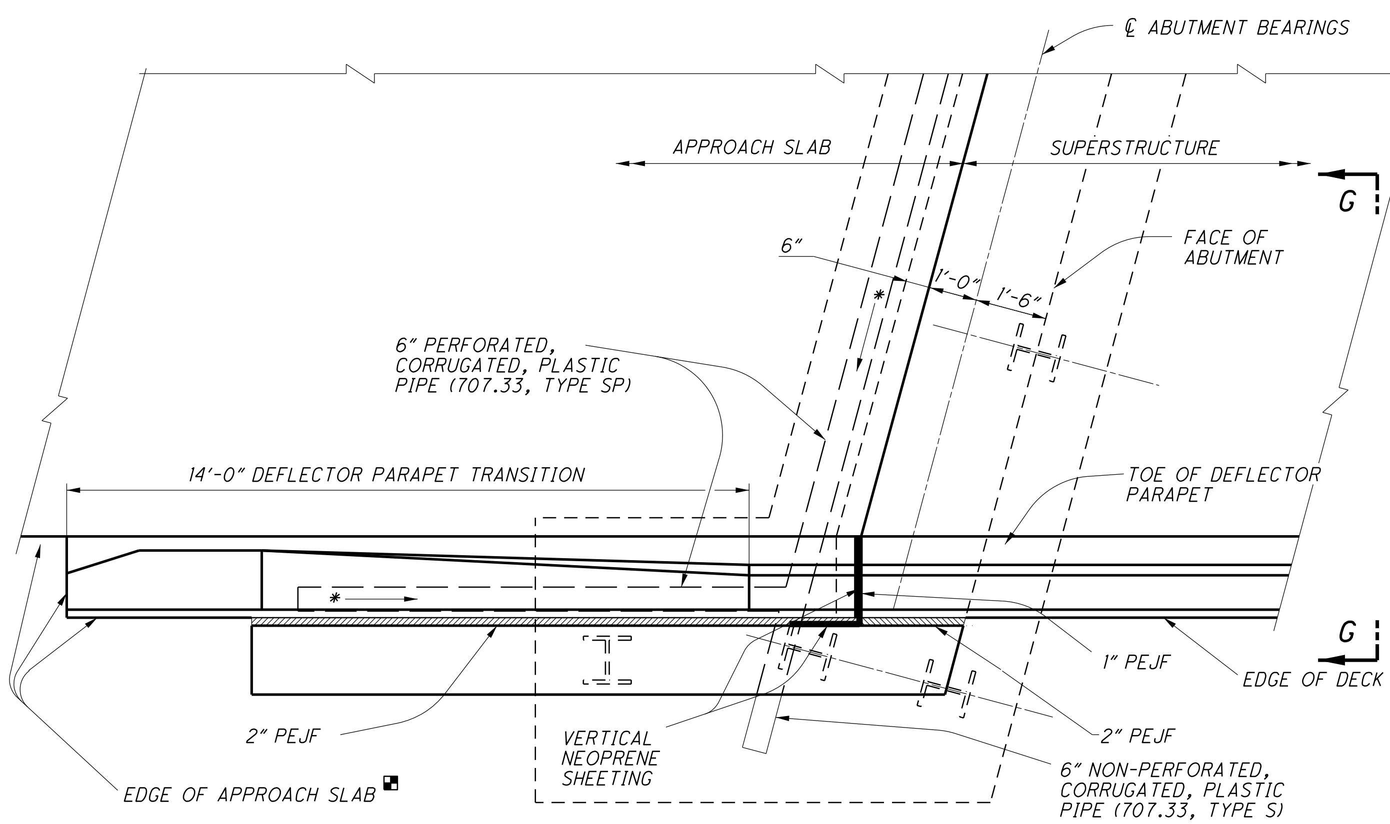
SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96

3/7



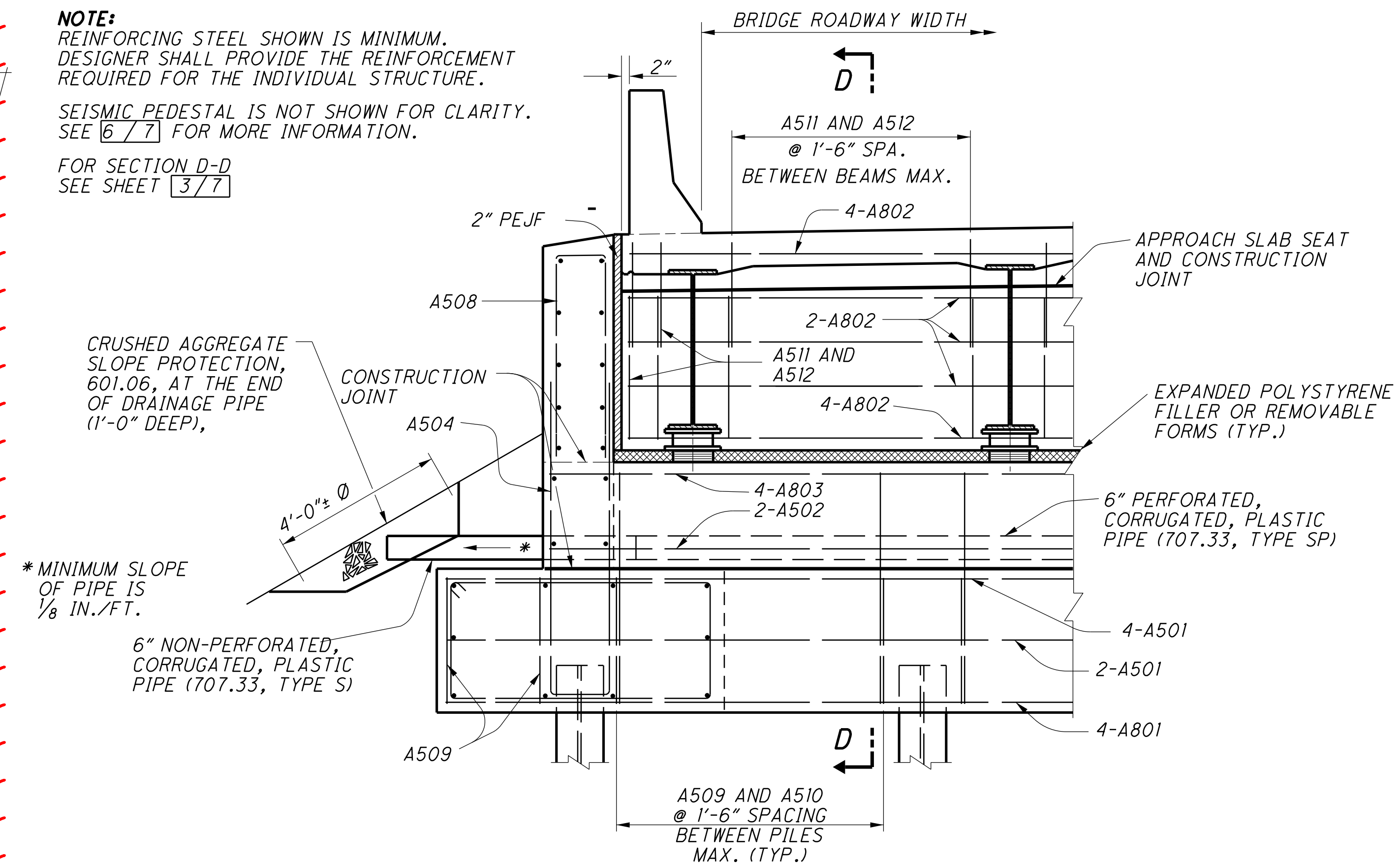
PART PLAN

■ SPECIAL DESIGN OF APPROACH SLAB MAY BE REQUIRED

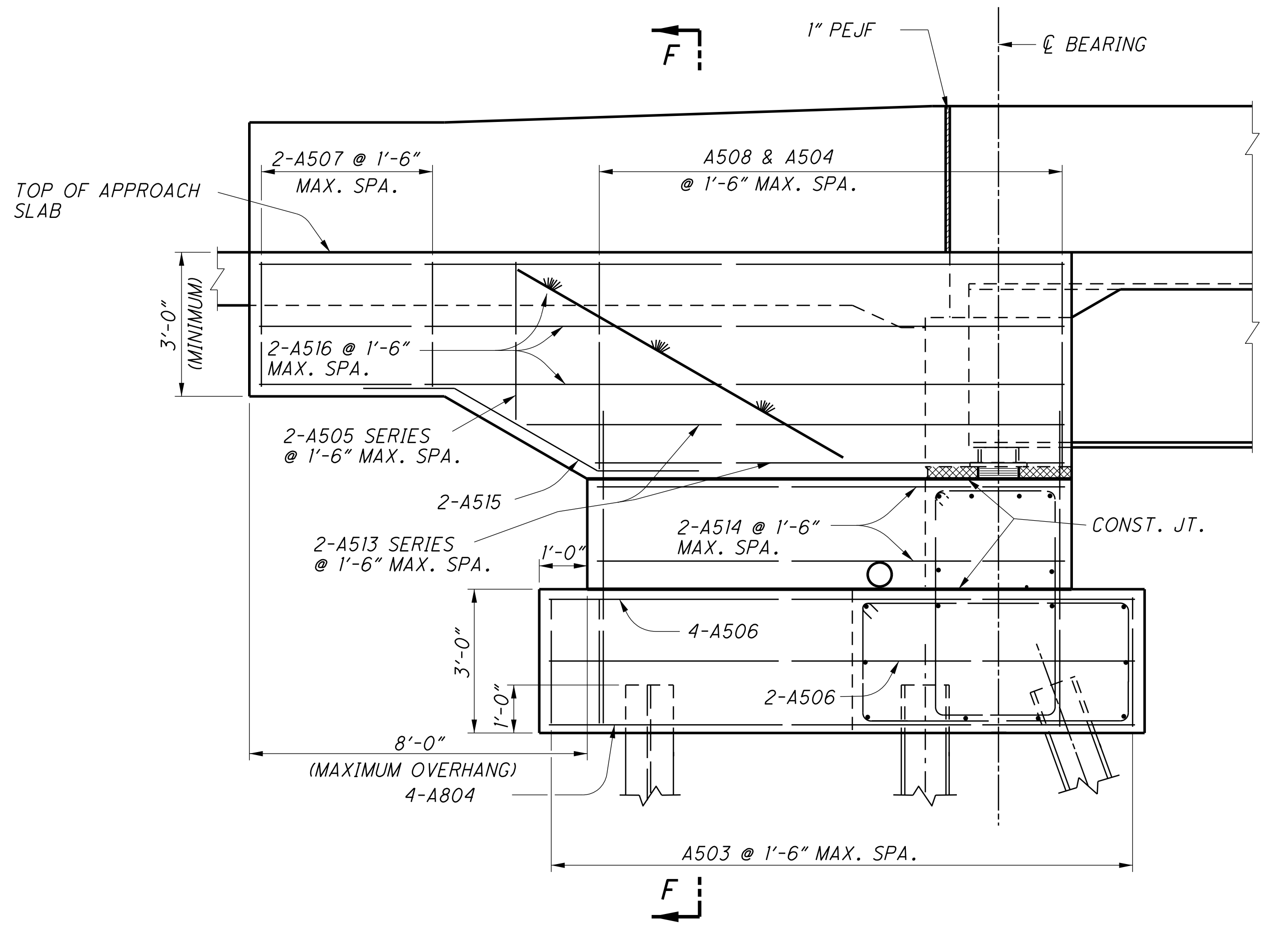
NOTE:
REINFORCING STEEL SHOWN IS MINIMUM. DESIGNER SHALL PROVIDE THE REINFORCEMENT REQUIRED FOR THE INDIVIDUAL STRUCTURE.

SEISMIC PEDESTAL IS NOT SHOWN FOR CLARITY. SEE 6/7 FOR MORE INFORMATION.

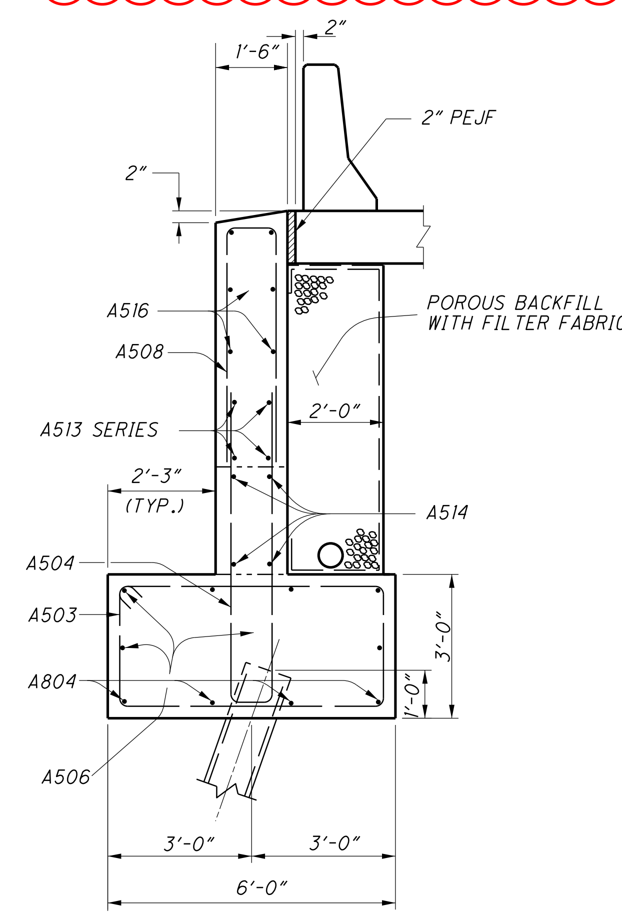
FOR SECTION D-D SEE SHEET 3/7



VIEW G-G

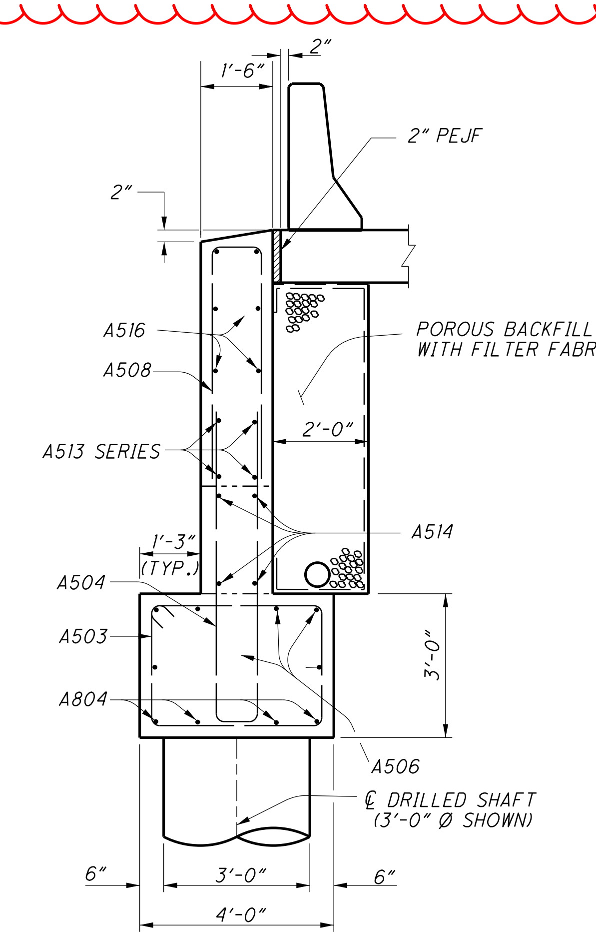


ELEVATION



SECTION F-F

(ON PILES)



SECTION F-F

(ON DRILLED SHAFTS)

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

Brad Fagrell
ADMINISTRATOR

02-12-97
DATE

REVISIONS
04-20-01
07-19-02
07-18-14

CHECKED MRG/JS
REVIEWED LMW
DESIGNED WLE
DRAWN WLE

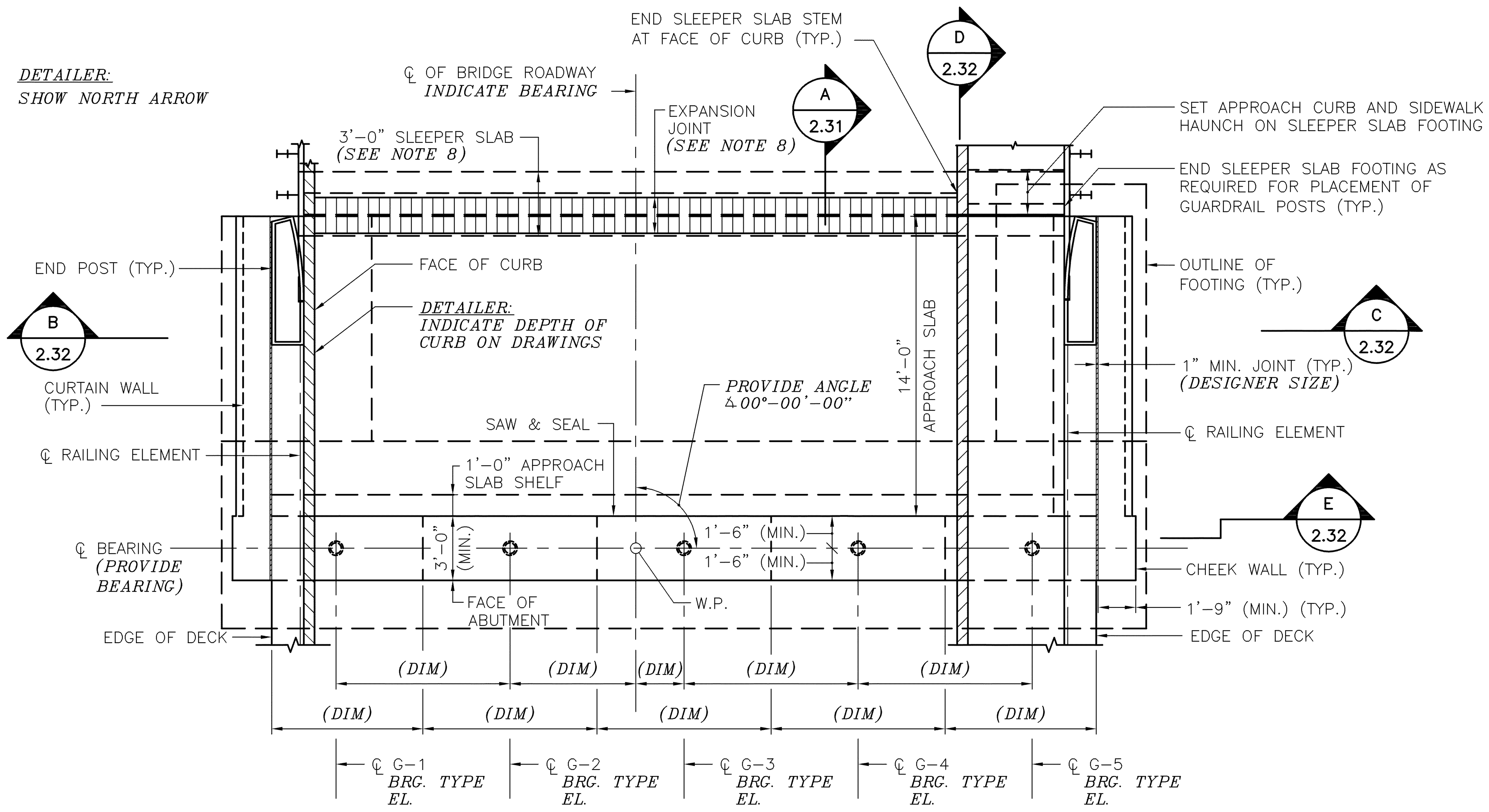
OFFICE OF STRUCTURAL ENGINEERING

STANDARD BRIDGE DRAWING

SEMI-INTEGRAL CONSTRUCTION DETAILS FOR STEEL BEAM AND GIRDER BRIDGES ON RIGID ABUTMENTS

SCD NUMBER
SICD-1-96

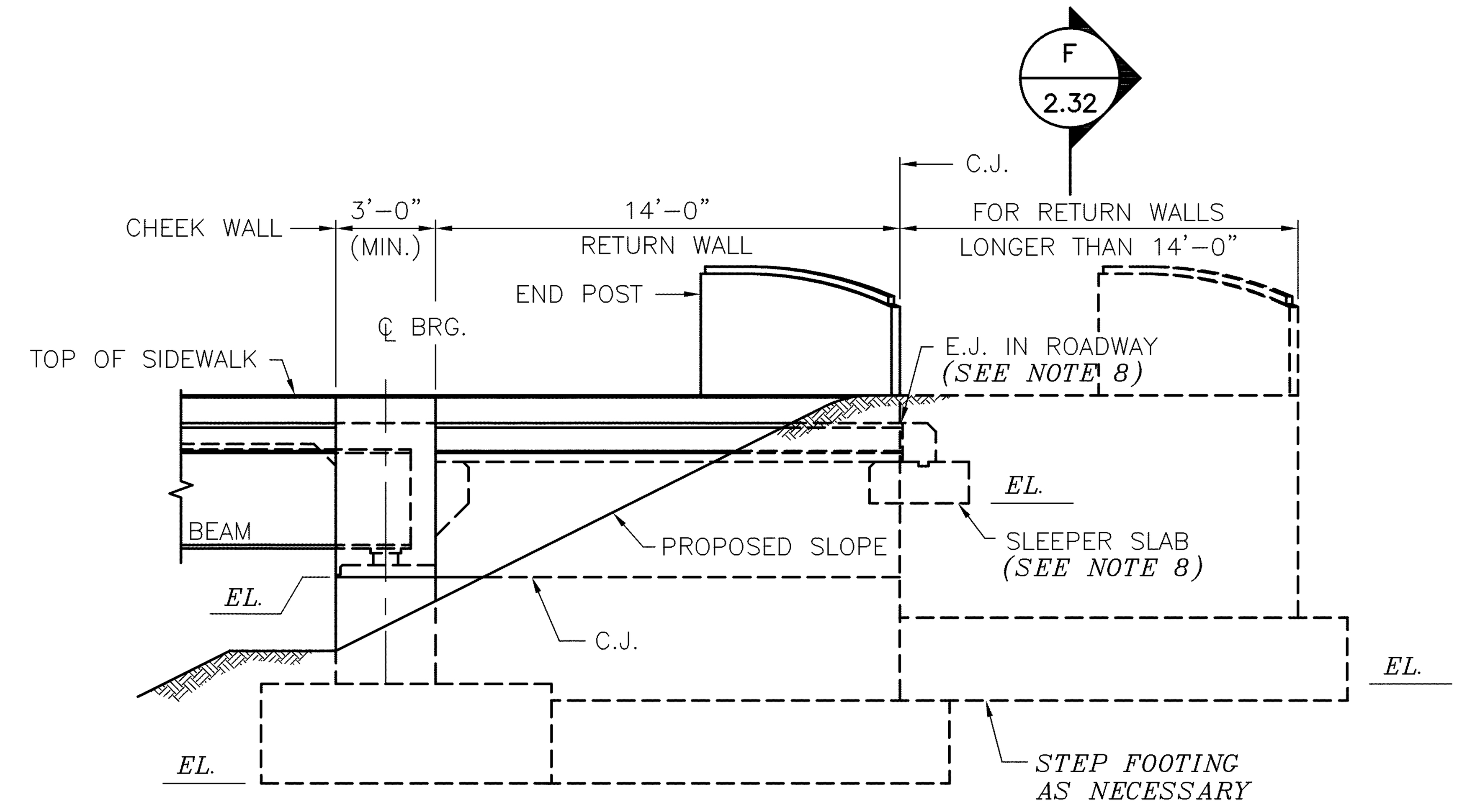
DETAILER:
SHOW NORTH ARROW



DESIGNER:
INTEGRAL DECK HAS BEEN REMOVED AT THE FACE OF ABUTMENT FOR CLARITY.

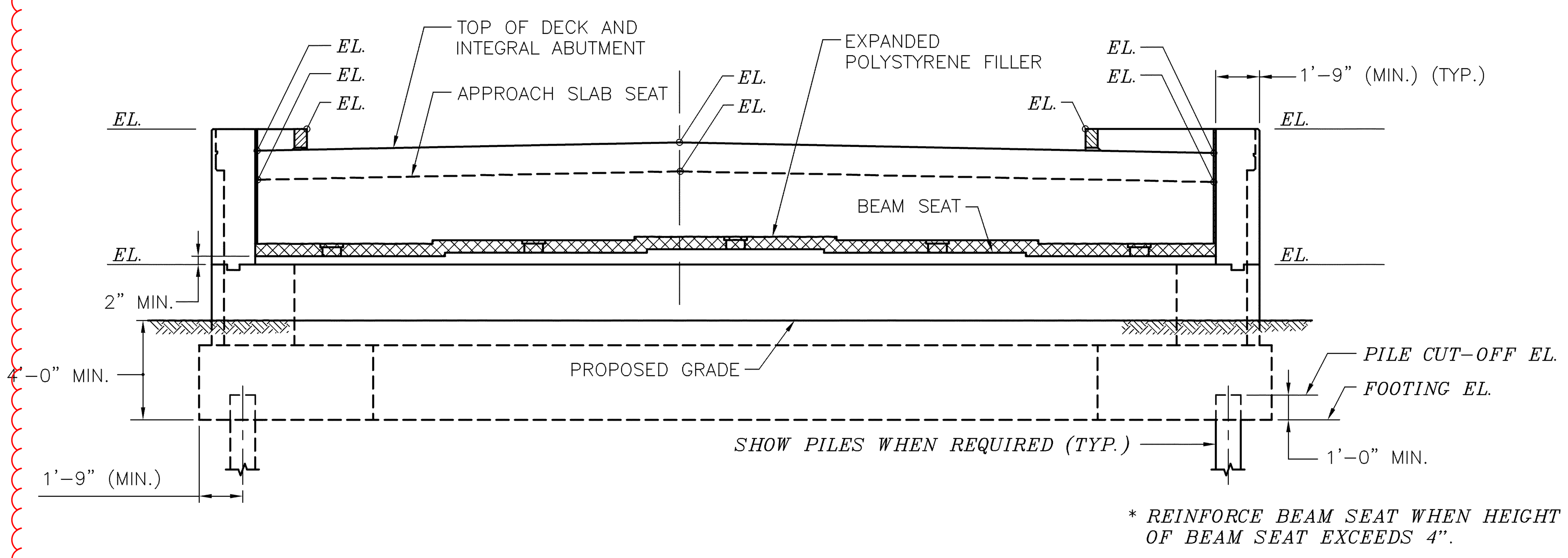
PLAN AT BEAM SEATS

SCALE:1/4"=1'-0"



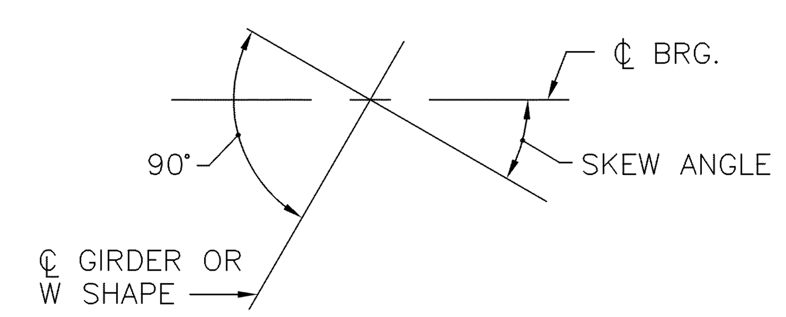
RETURN WALL AT SIDEWALK / SAFETY WALK

SCALE:1/4"=1'-0"



ELEVATION

SCALE:1/4"=1'-0"



SKEW ANGLE DESIGNATION

DESIGNER NOTES:

1. *THE DESIGNER SHALL REFER TO SECTION 11.3.4 (SEMI-INTEGRAL ABUTMENTS) OF THE RIDOT LRFD BRIDGE DESIGN MANUAL FOR DESIGN AND DETAILING REQUIREMENTS AND LIMITATIONS ON THE USE OF SEMI-INTEGRAL ABUTMENTS.*
2. *A NOTE SHALL BE PROVIDED ON THE CONTRACT DRAWINGS STATING THAT TOP OF DECK ELEVATIONS ARE GIVEN AT FRONT FACE OF INTEGRAL ABUTMENT.*
3. *UTILITY PASSAGE THROUGH THE SEMI-INTEGRAL ABUTMENT SHOULD BE AVOIDED. (SEE SECTION 11.3.4 OF THE RIDOT LRFD BRIDGE DESIGN MANUAL).*
4. *ABUTMENT DETAILS FOR SKEWED ABUTMENTS ARE SIMILAR.*
5. *REINFORCING SHOWN IS MINIMUM ONLY.*
6. *THE SUGGESTED SCALE FOR ANY ABUTMENT PLAN AND ELEVATION IS 1/4"=1'-0".*
7. *REFERENCES TO END POSTS AND CENTERLINES OF RAILING ELEMENTS ARE INTENDED TO REFER THE DETAILS SHOWN ELSEWHERE IN THESE BRIDGE STANDARDS (SEE APPROPRIATE DETAILS).*
8. *SLEEPER SLAB AND EXPANSION JOINT IN ROADWAY MAY BE OMITTED FOR BRIDGE SUPERSTRUCTURE SPANS 60 FEET OR LESS.*
9. *SEE DWG. 2.32 FOR RETURN WALL DETAILS*

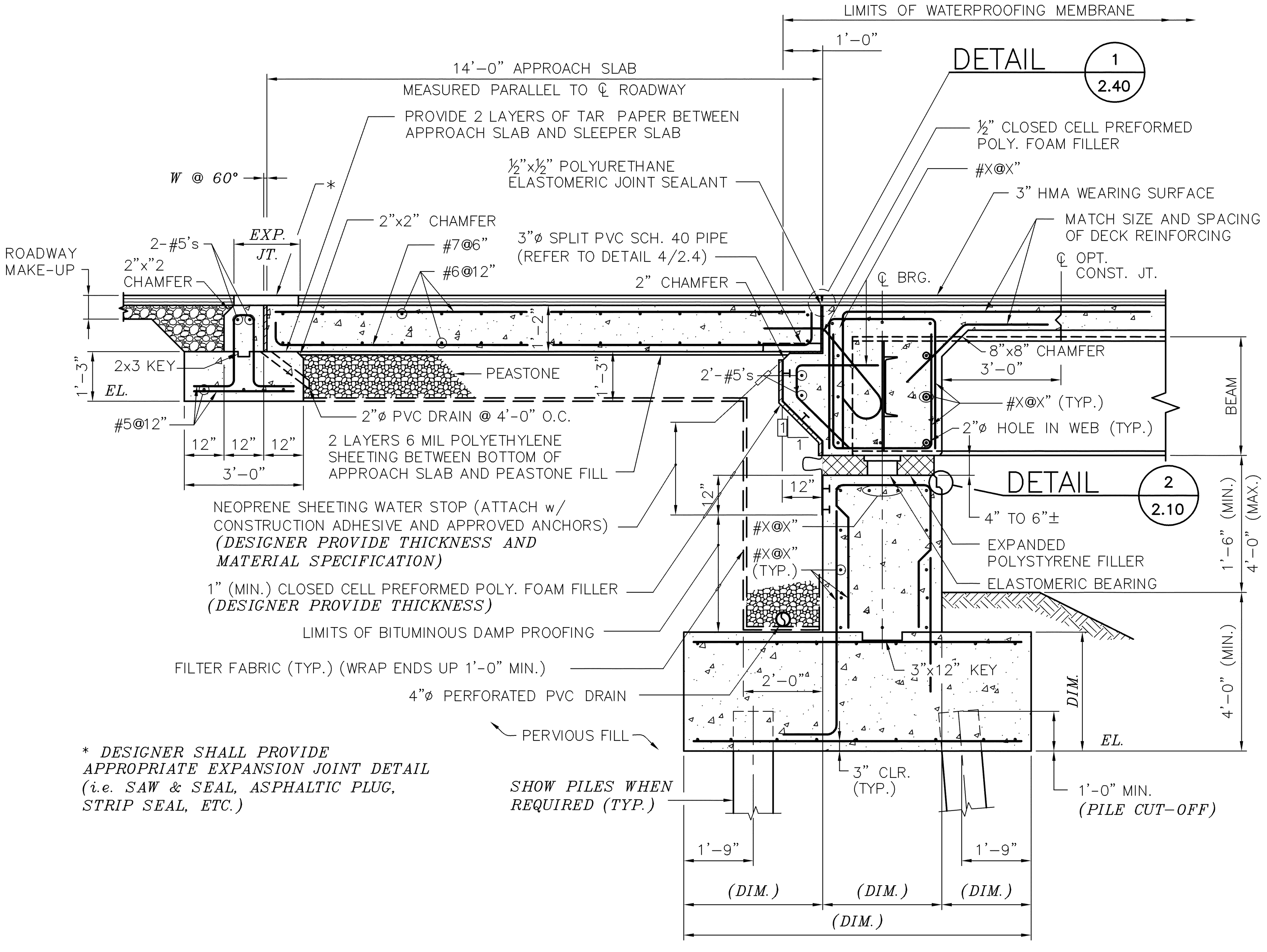
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

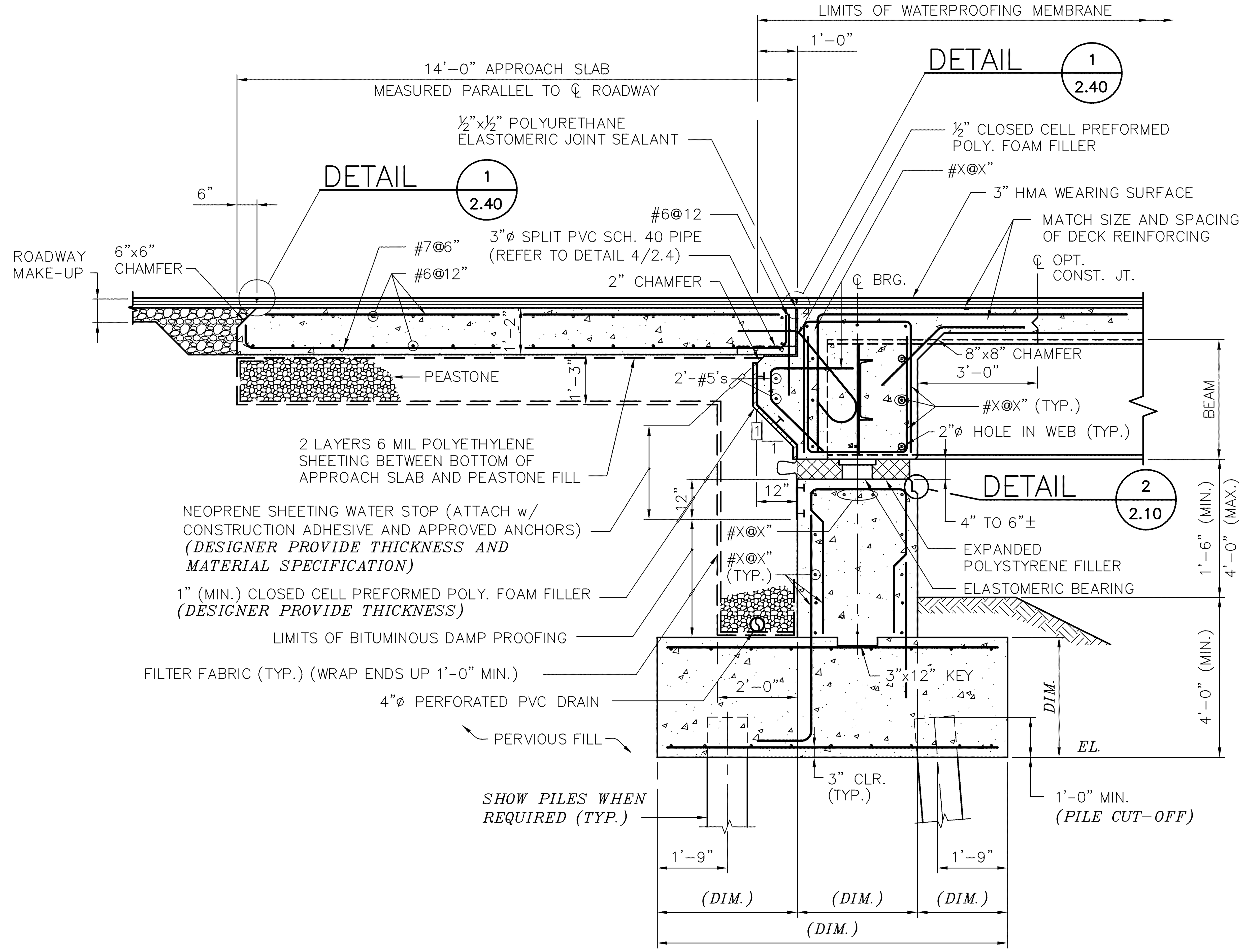
SEMI INTEGRAL ABUTMENT
SHEET 1

DRAWING NUMBER: 2.30



SPANS > 60'-0"

SECTION A 2.31
SCALE: 1/2"=1'-0"



SPANS ≤ 60'-0"

SECTION A 2.31
SCALE: 1/2"=1'-0"

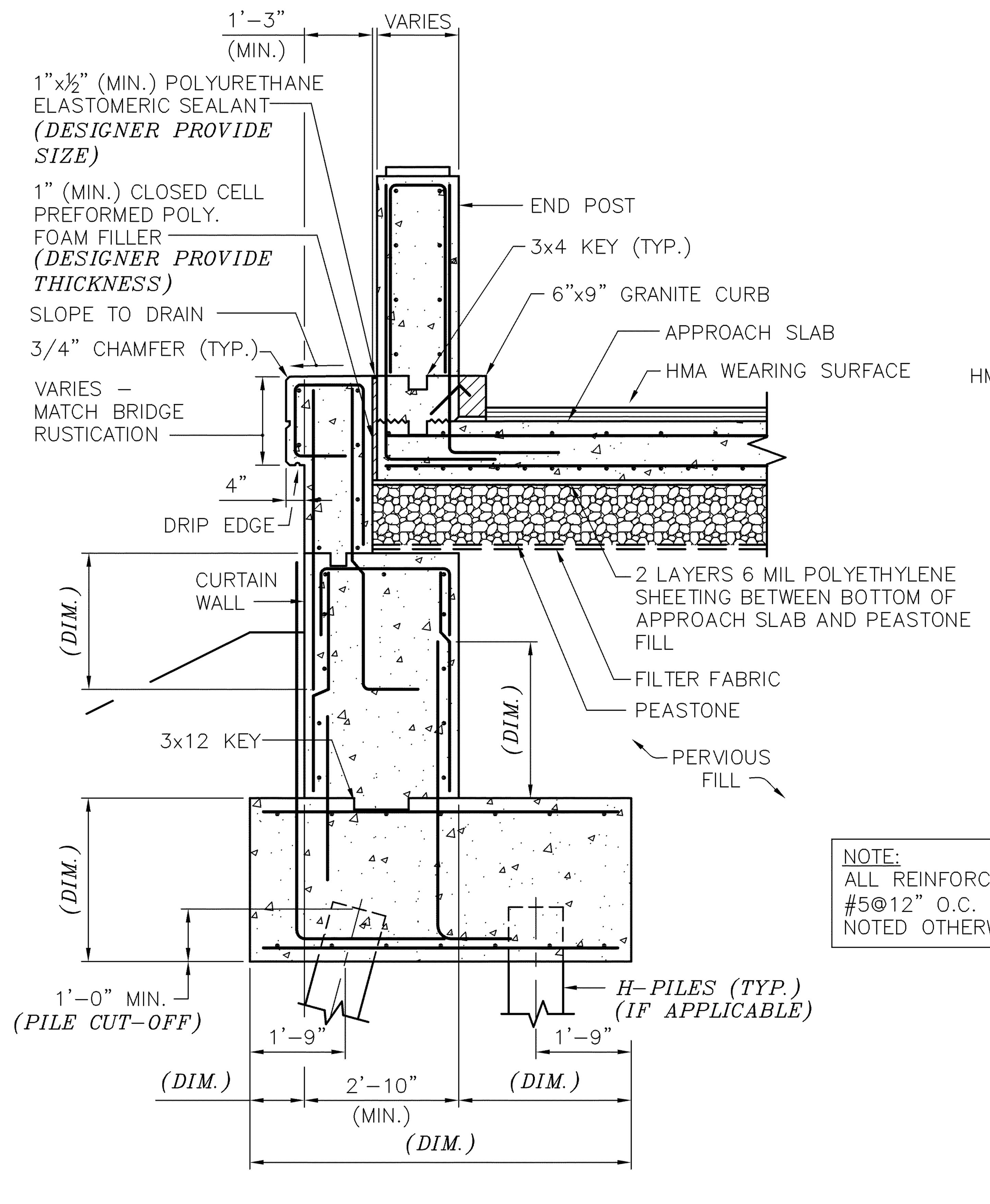
REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

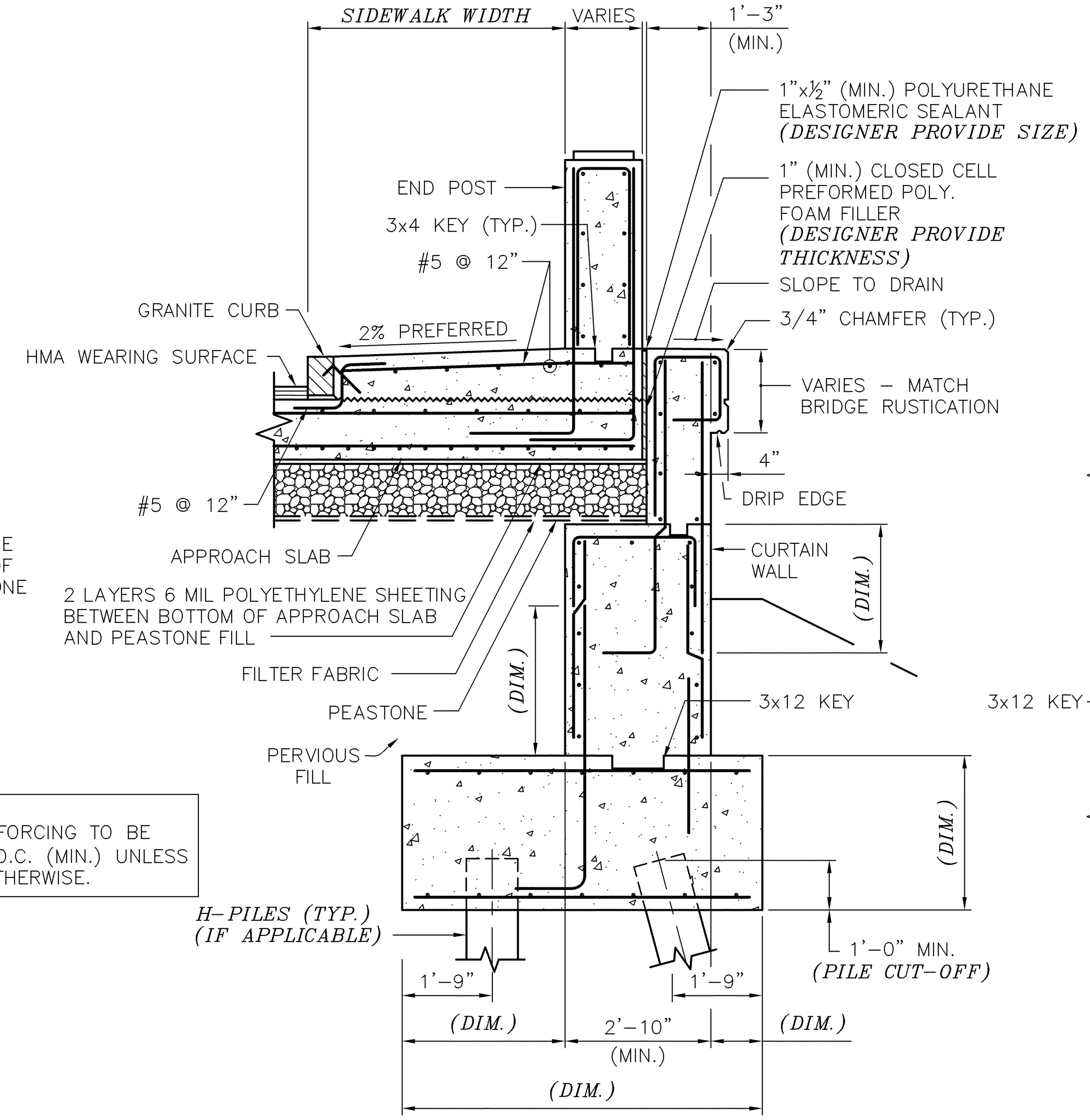
BRIDGE STANDARDS

SEMI INTEGRAL ABUTMENT
SHEET 2

DRAWING NUMBER: 2.31

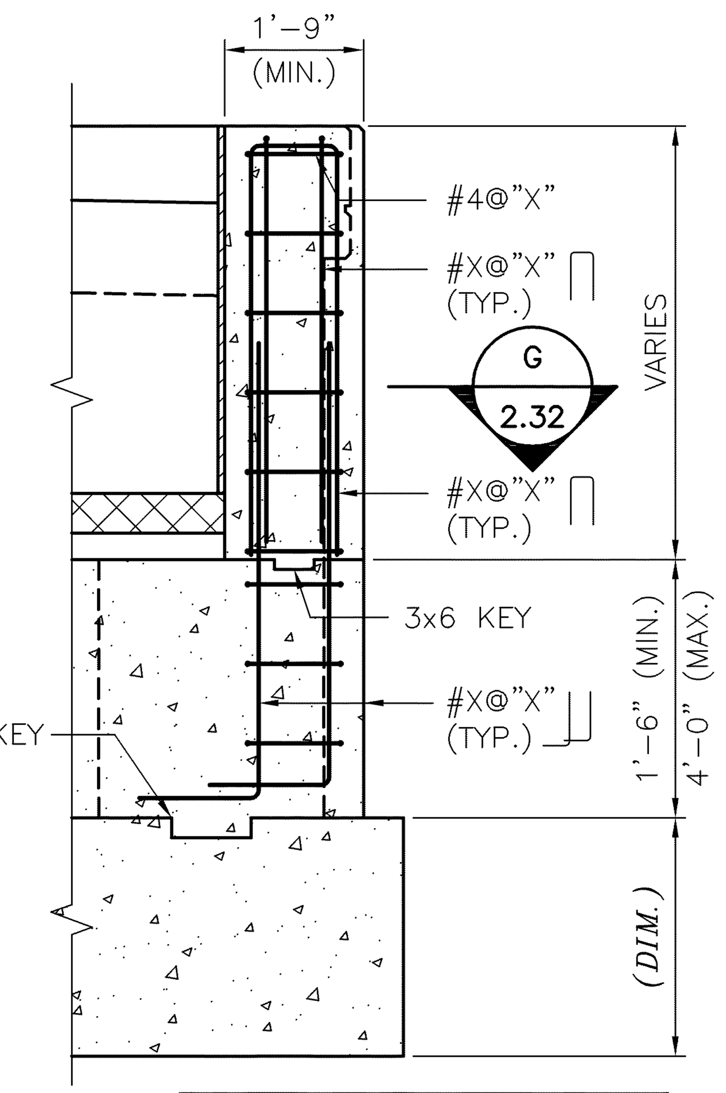


SECTION B 2.32
SCALE:1/2"=1'-0"



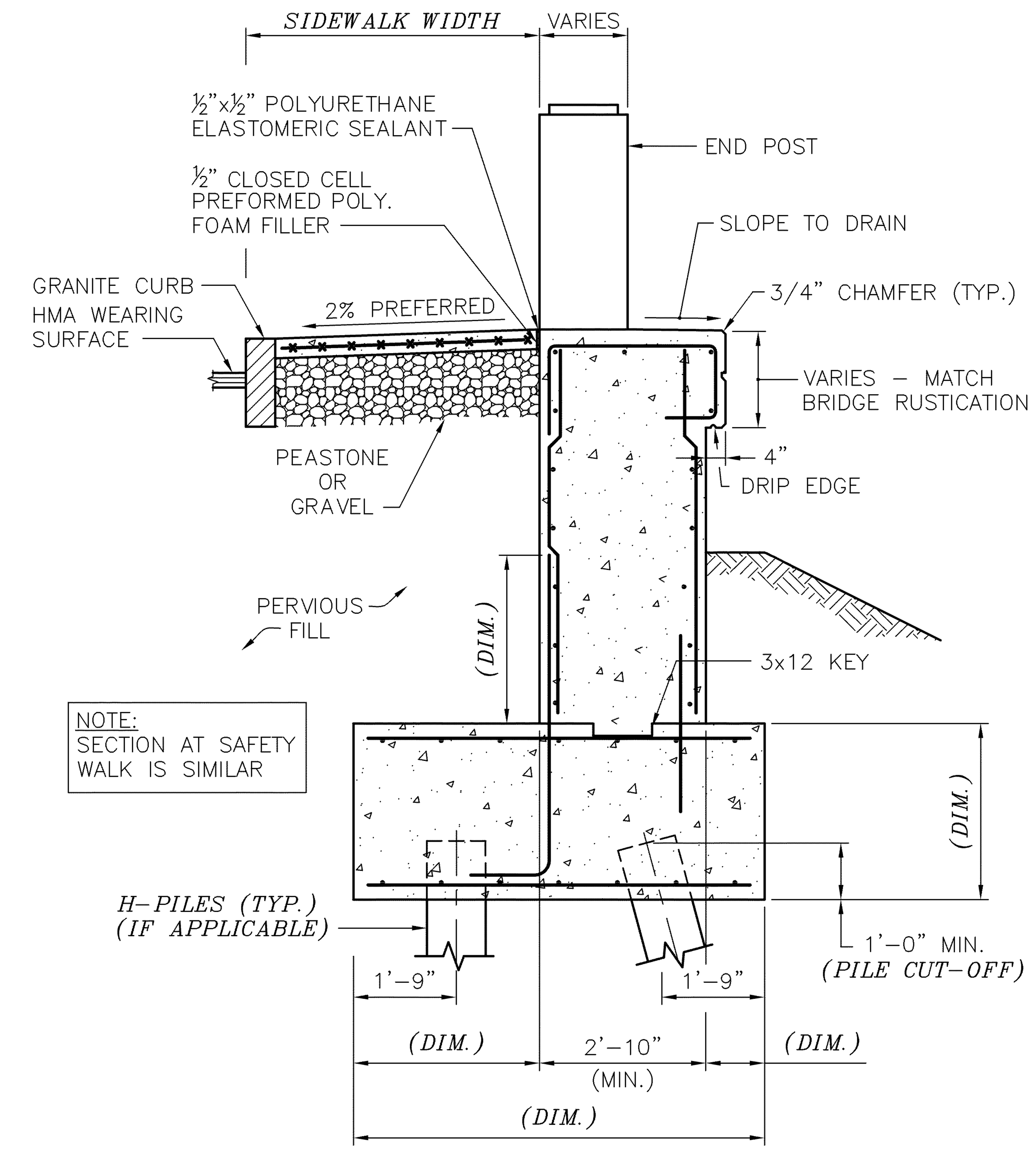
NOTE:
ALL REINFORCING TO BE #5@12" O.C. (MIN.) UNLESS NOTED OTHERWISE.

SECTION C 2.32
SCALE:1/2"=1'-0"



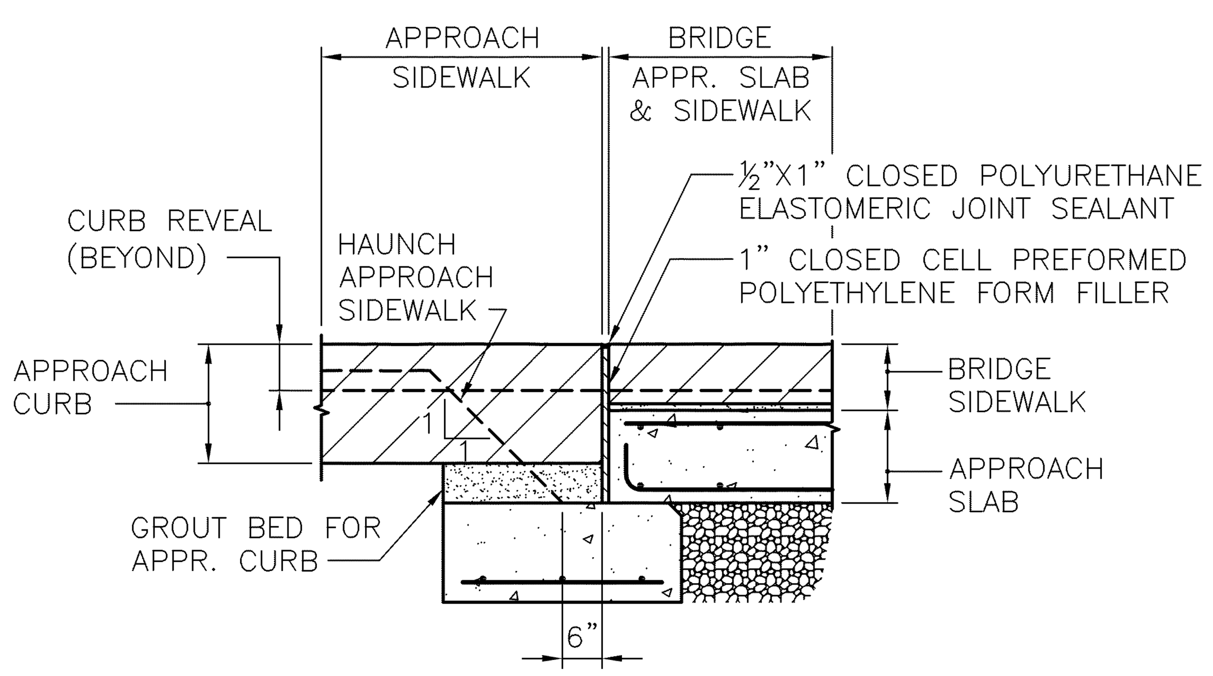
NOTE:
ABUTMENT STEM AND CURTAIN WALL REINFORCING NOT SHOWN FOR CLARITY.

SECTION E 2.32
SCALE:1/2"=1'-0"

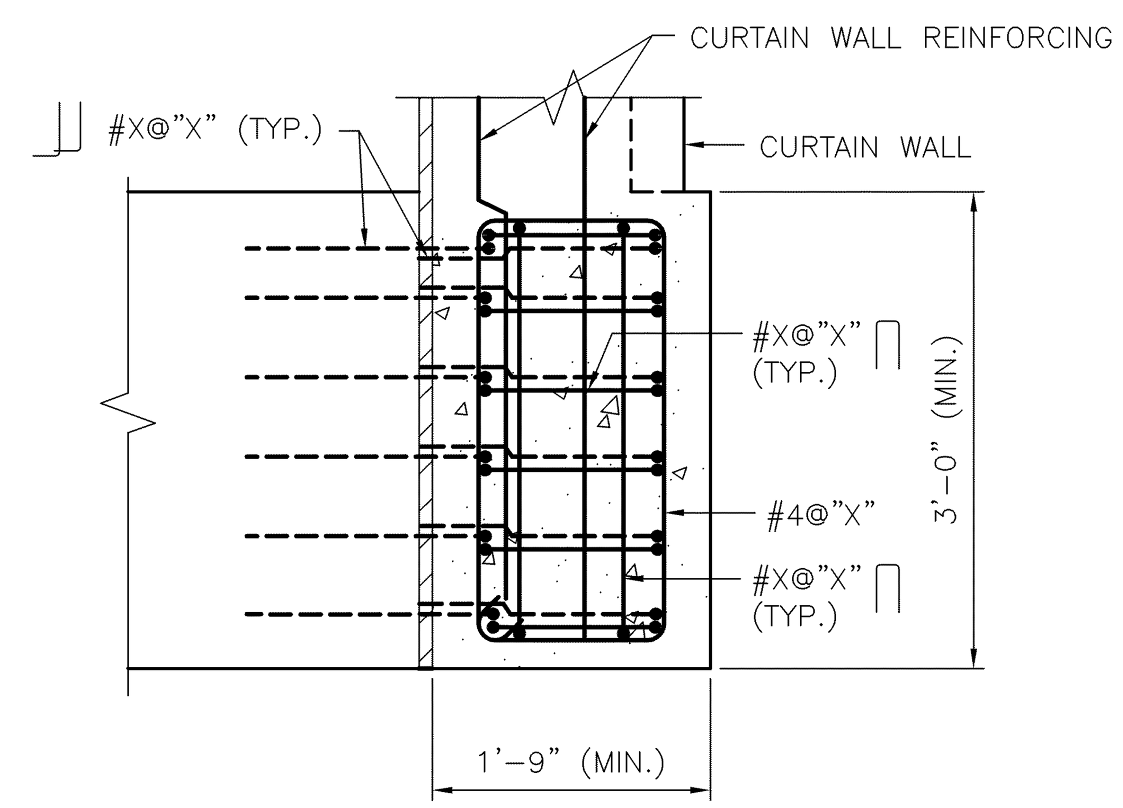


NOTE:
SECTION AT SAFETY WALK IS SIMILAR

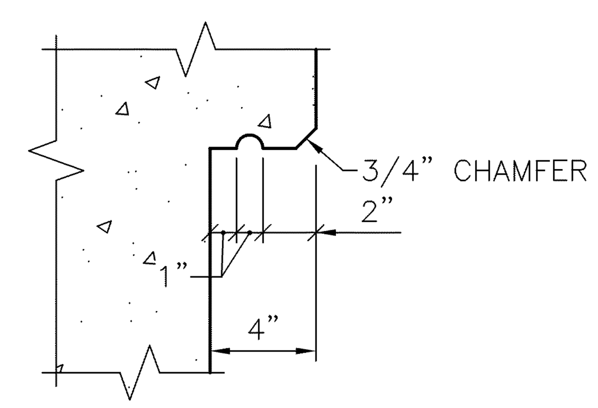
SECTION F 2.32
SCALE:1/2"=1'-0"



SECTION D 2.32
SCALE:1/2"=1'-0"



SECTION G 2.32
SCALE:1"=1'-0"



DRIP EDGE FOR COPING DETAIL
SCALE:3"=1'-0"

REVISIONS	
No.	DATE

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

SEMI INTEGRAL ABUTMENT SHEET 3

DRAWING NUMBER: 2.32

6.c) Semi-Integral Abutment Diaphragm Details

Illinois

Semi Integral Abutment Diaphragm for Steel Beams

Semi Integral Abutment Diaphragm for PPC Beams

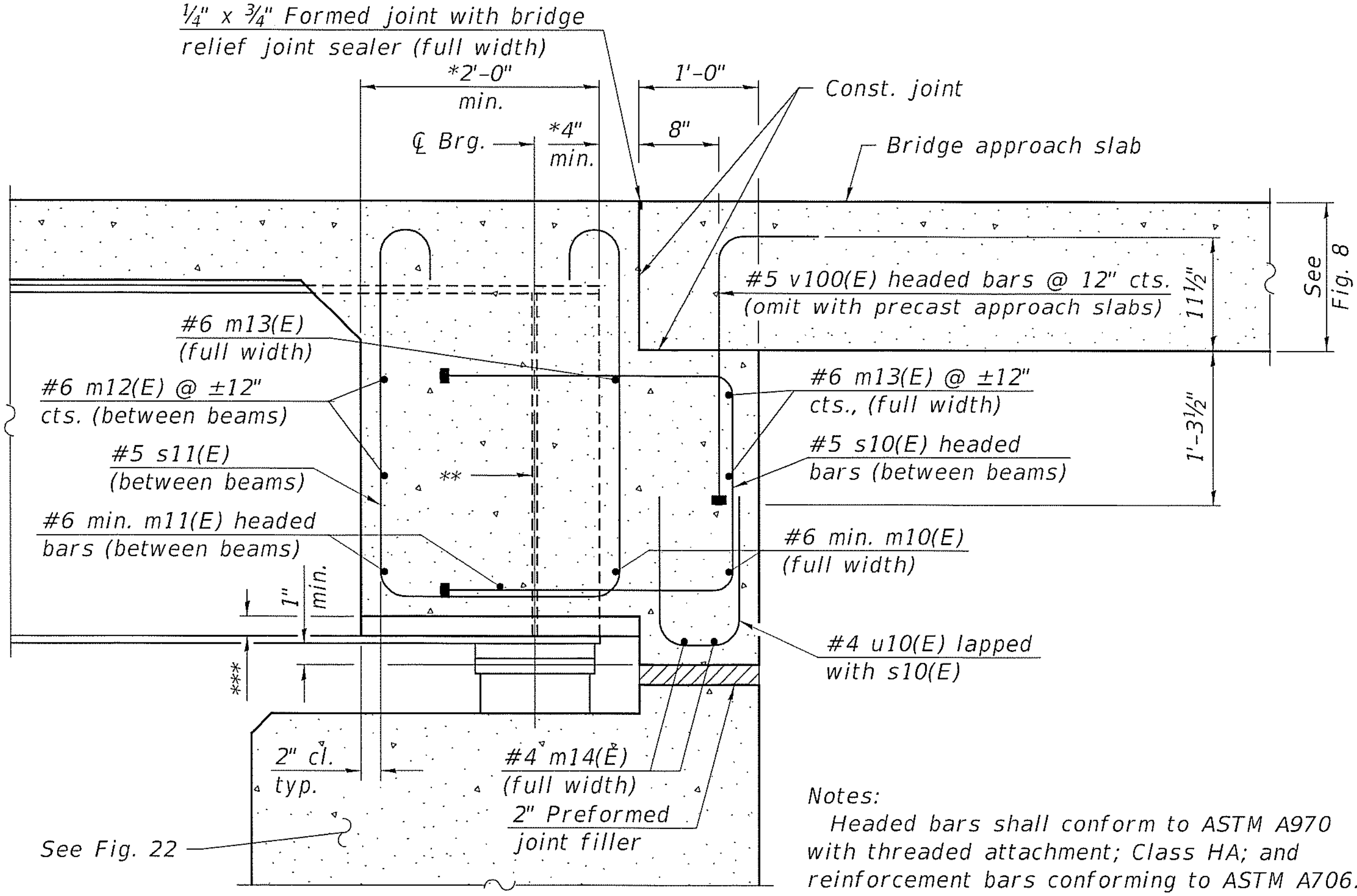
New Hampshire

Semi Integral Abutment Typical Diaphragm Section

Ohio

Semi Integral Abutment Diaphragm Guide

SEMI-INTEGRAL ABUTMENT DIAPHRAGM FOR STEEL BEAMS



* See Figure 21 for orientation.

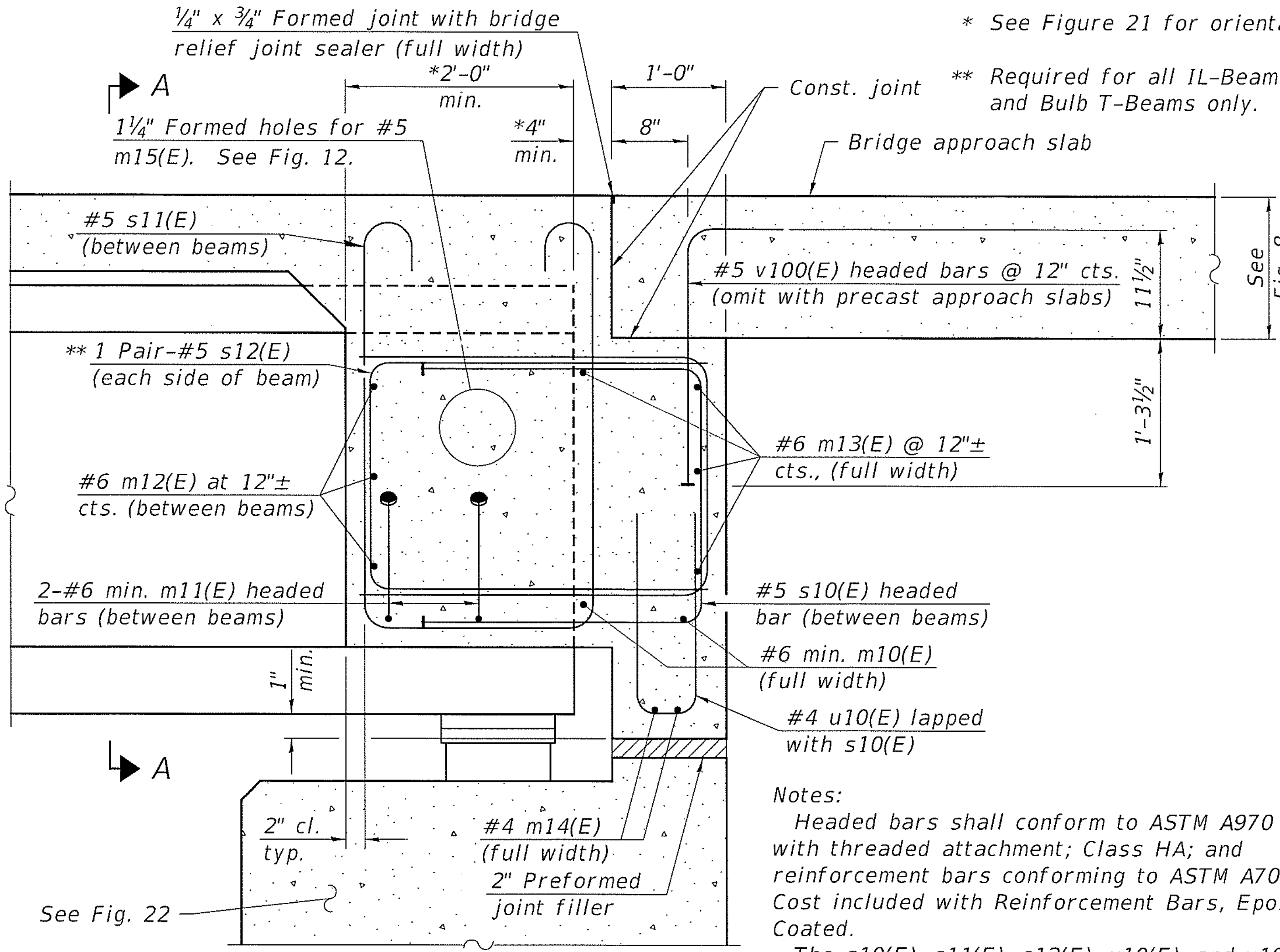
** Bearing stiffener placed at right angles to beam web. 1" thick for wide flanges and 1" min. (or by design) for plate girders.

*** See Chapter 3.7 of Bridge Manual.

Notes:

Headed bars shall conform to ASTM A970 with threaded attachment; Class HA; and reinforcement bars conforming to ASTM A706. Cost included with Reinforcement Bars, Epoxy Coated.

The s10(E), s11(E), u10(E), and v100(E) bars are placed parallel to beams and spaced at right angles to beams.



* See Figure 21 for orientation.

** Required for all IL-Beams and Bulb T-Beams only.

Notes:

Headed bars shall conform to ASTM A970 with threaded attachment; Class HA; and reinforcement bars conforming to ASTM A706. Cost included with Reinforcement Bars, Epoxy Coated.

The s10(E), s11(E), s12(E), u10(E), and v100(E) bars are placed parallel to beams and spaced at right angles to beams.

See Figure 20 for Section A-A.

SEMI-INTEGRAL ABUTMENT DIAPHRAGM FOR PPC BEAMS

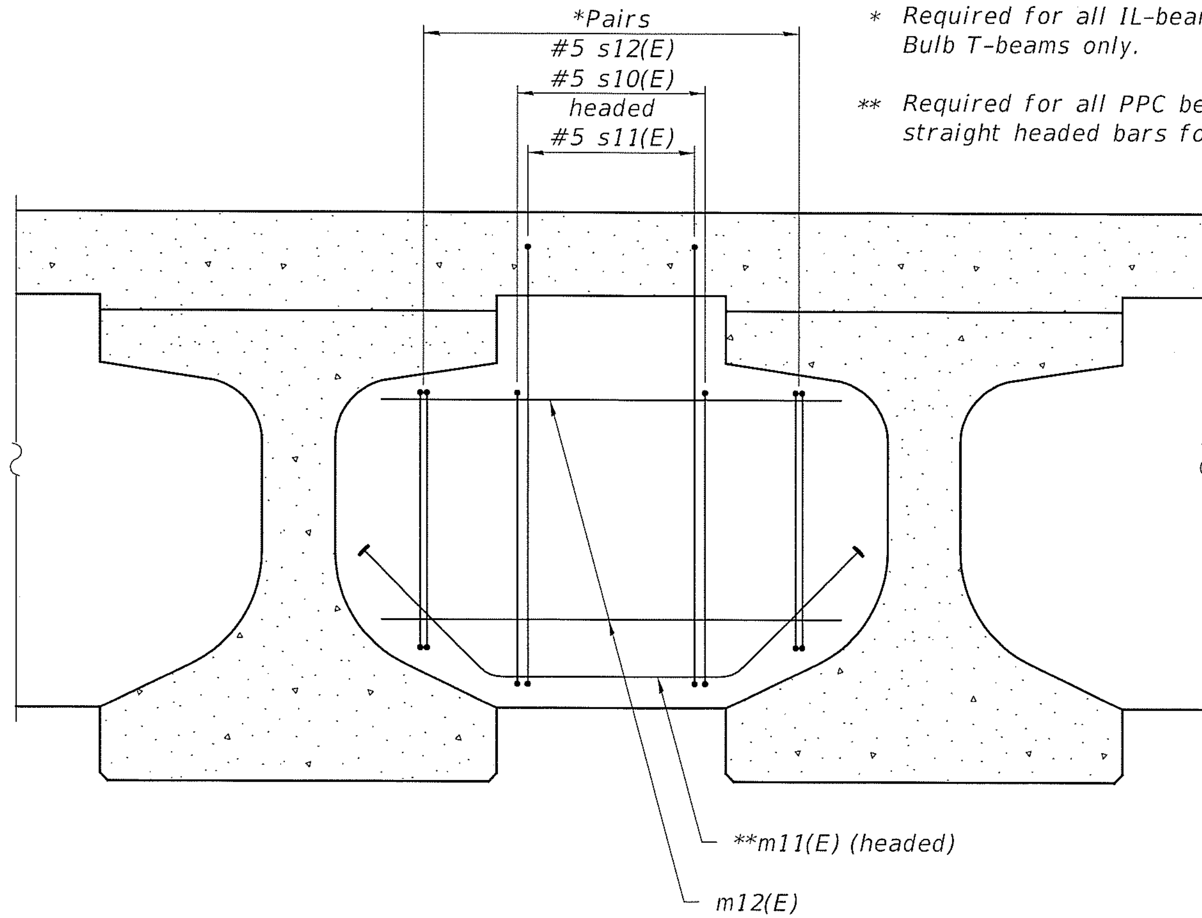
Figure 19

Figure 20

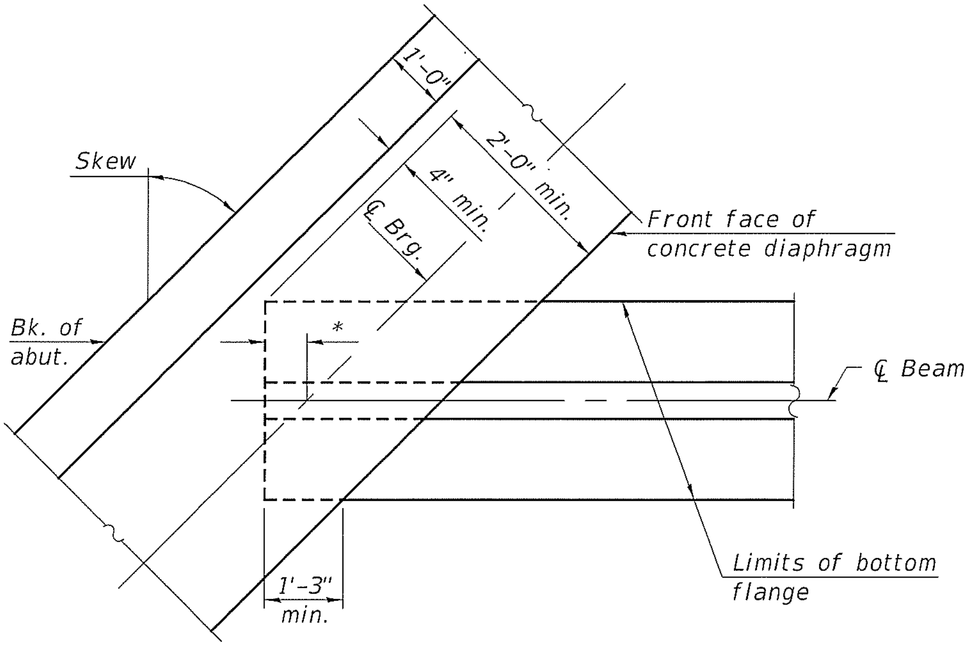
SEMI-INTEGRAL ABUTMENT DIAPHRAGM SECTION A-A

* Required for all IL-beams and Bulb T-beams only.

** Required for all PPC beams. Use straight headed bars for steel beams.



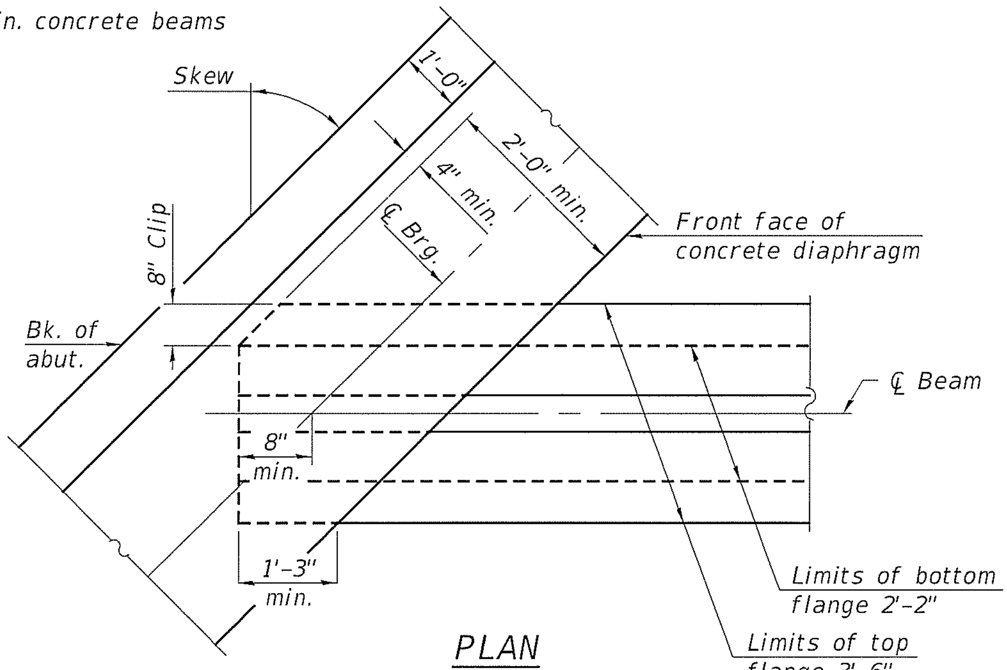
SECTION A-A



PLAN

(Showing all PPC beams except bulb T-beams; steel beams similar)

* 5½" min. steel beams
8" min. concrete beams



PLAN

(Showing bulb T-beams)

Note:
Clipping of top flange is only required on bulb T-Beams. Clipping is not allowed on the bottom flanges.
The 4" minimum clearance shown at the back of the beam also applies to the bearing.

SEMI-INTEGRAL ABUTMENT DIAPHRAGM DETAILS

Figure 21

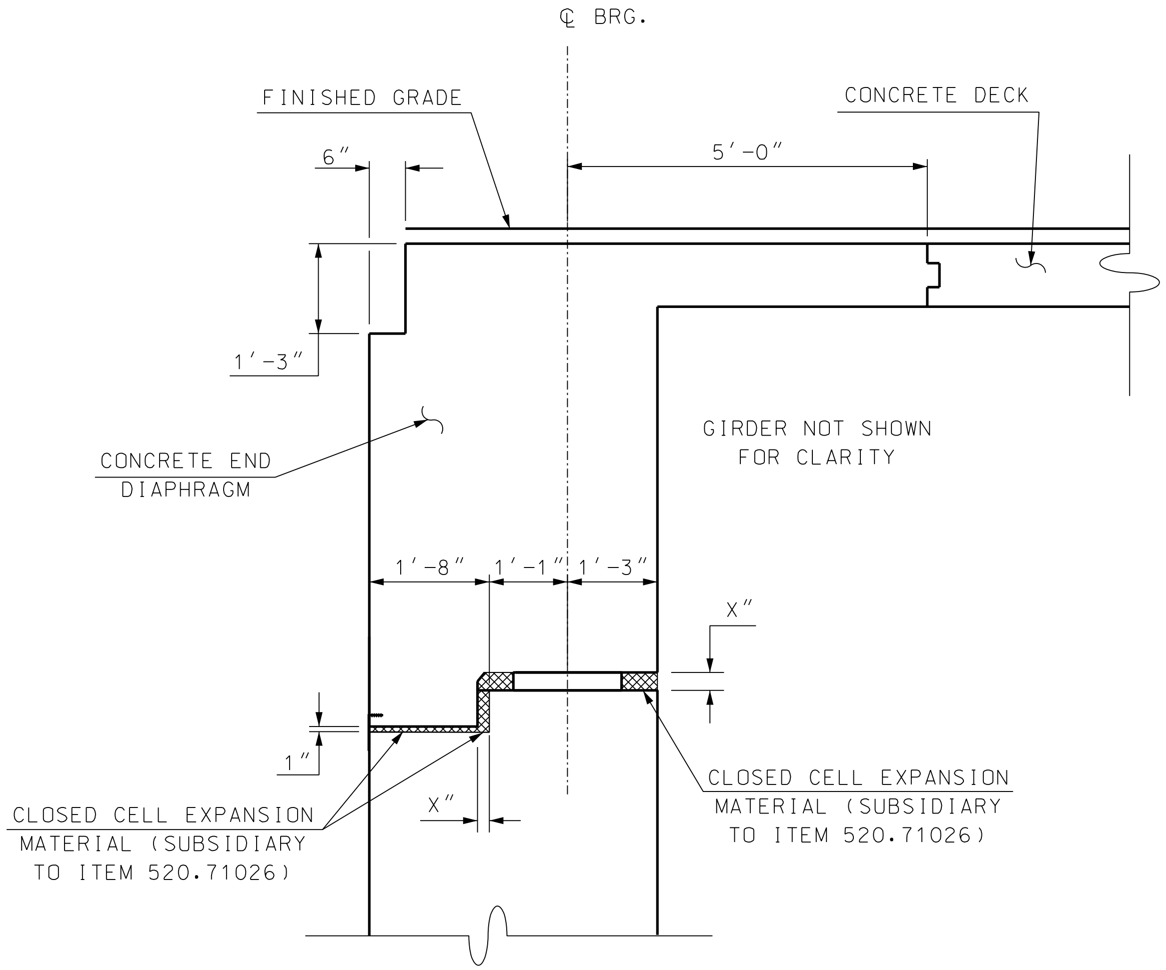
Illinois

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

BUREAU OF BRIDGE DESIGN

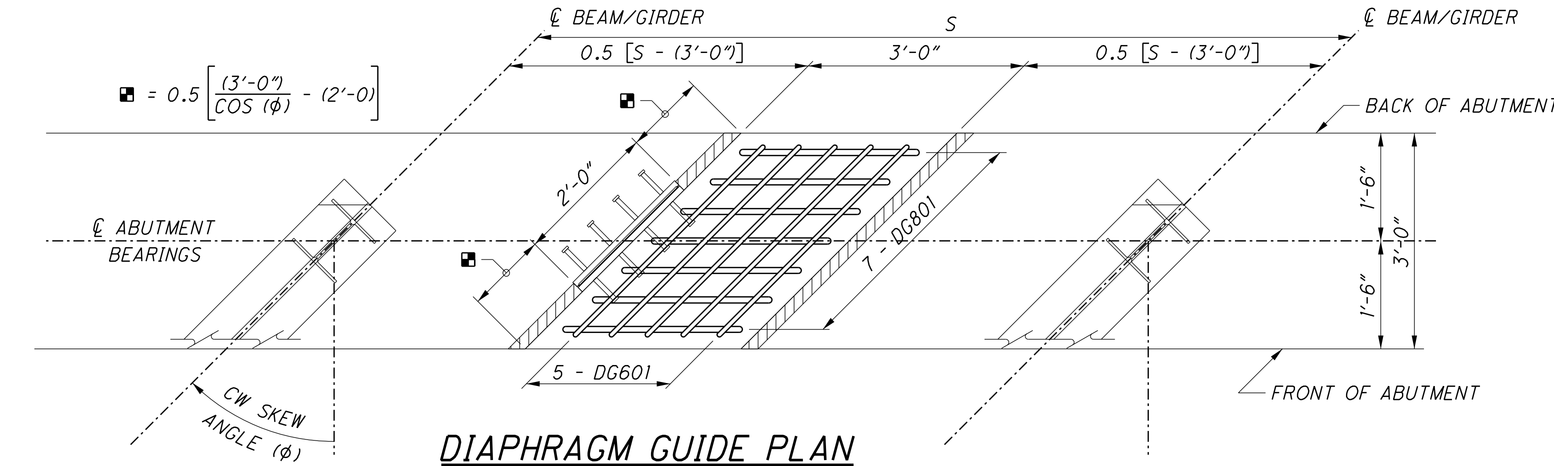
DESCRIPTION: SUBSTRUCTURE DETAILS - TYPICAL SEMI-INTEGRAL DIAPHRAGM SECTION

DATE REVISED: 2/8/2016



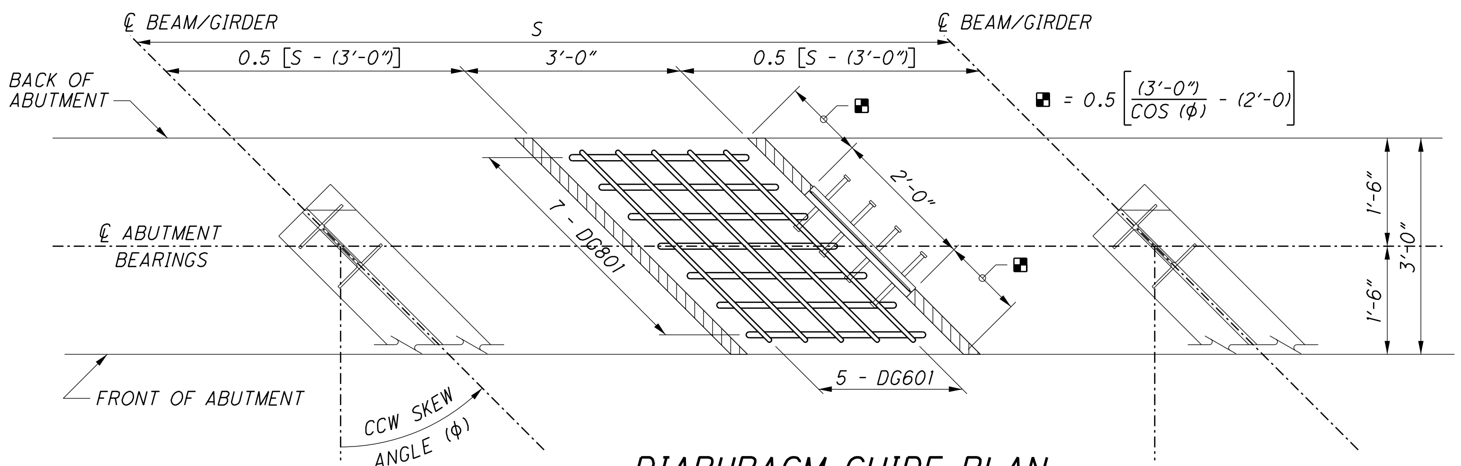
TYPICAL SEMI-INTEGRAL DIAPHRAGM SECTION

MODIFY TO FIT PROJECT



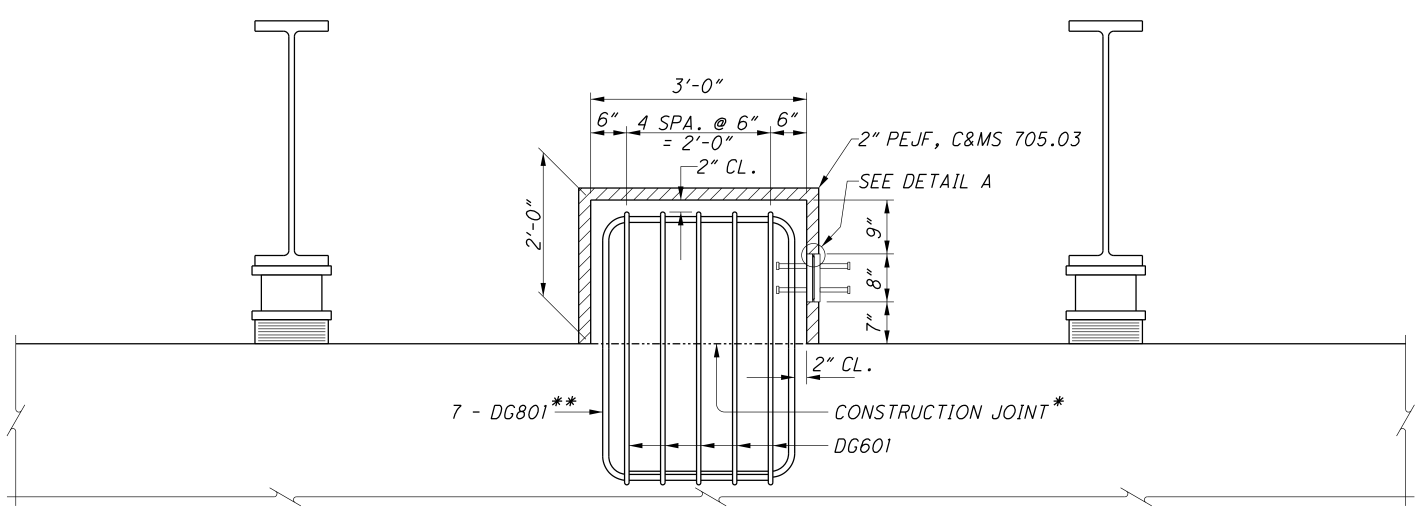
DIAPHRAGM GUIDE PLAN

(CW SKEW ANGLE SHOWN. SEE NOTE FOR 0° SKEW)
CW = CLOCKWISE



DIAPHRAGM GUIDE PLAN

(CCW SKEW ANGLE SHOWN. SEE NOTE FOR 0° SKEW)
CCW = COUNTERCLOCKWISE

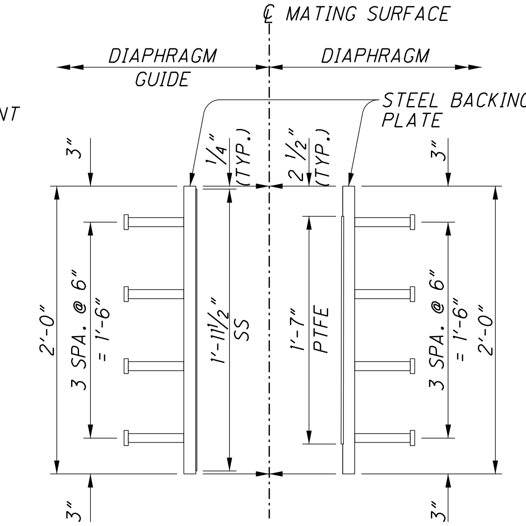


DIAPHRAGM GUIDE ELEVATION

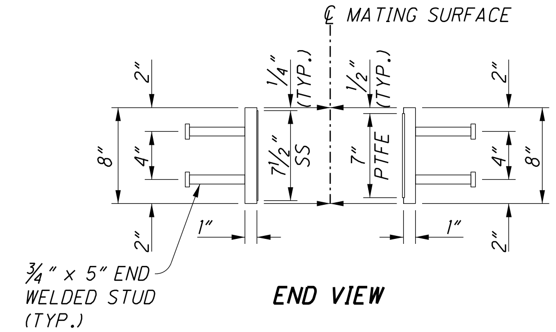
(CCW SKEW ANGLE SHOWN, CW SIMILAR)

* - FINISH THE SURFACE OF THE CONSTRUCTION JOINT WITH A SERRATED TROWEL. THE SERRATIONS SHALL BE 1/4" DEEP MINIMUM

** - PLACE TO AVOID INFERENCE WITH LONGITUDINAL REINFORCEMENT IN THE BEAM SEAT.



TOP VIEW



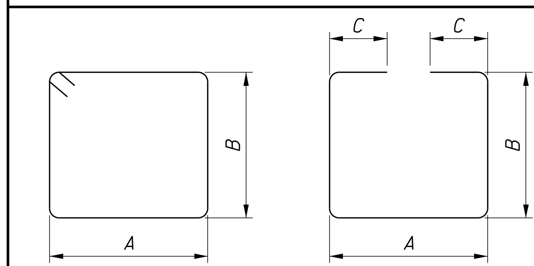
END VIEW

RUB PLATE DETAILS

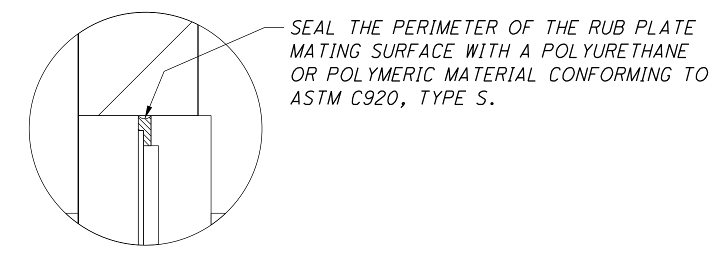
SS = STAINLESS STEEL
PTFE = POLYTETRAFLUORETHYLENE

MARK	NUMBER TOTAL	TYPE	DIMENSIONS A	DIMENSIONS B	DIMENSIONS C
DG601	5	3	(2'-8")/COS (φ)	3'-8 1/2"	
DG801	7	5	2'-8"	3'-7"	2'-4"

BENDING DIAGRAMS



TYPE-3 TYPE-5



DETAIL A

GENERAL NOTES

DESCRIPTION: THIS DRAWING PROVIDES THE COMPLETE PLAN DETAILS FOR SEMI-INTEGRAL DIAPHRAGM GUIDES.

DESIGNER NOTES: EACH DIAPHRAGM GUIDE HAS BEEN DESIGNED TO A FACTORED CAPACITY NORMAL TO THE RUB PLATES OF 517 KIP AND PARALLEL TO THE RUB PLATES OF 103 KIP. FOR IMPOSED FACTORED LOADING EXCEEDING THESE CAPACITIES, ADDITIONAL GUIDES SHALL BE SPECIFIED.

THE PROJECT PLANS SHALL DETAIL THE LOCATION OF EACH DIAPHRAGM GUIDE. THE VOLUME OF CONCRETE AND REINFORCING STEEL FOR THE DIAPHRAGM GUIDES SHALL NOT BE INCLUDED IN THE PLAN QUANTITIES.

SKEW: FOR BRIDGES WITH SKEW ANGLE EQUAL TO 0°, RUB PLATES SHALL BE INSTALLED ON BOTH SIDES OF THE DIAPHRAGM GUIDE.

CONCRETE:
PERFORM WORK ACCORDING TO C&MS 511. USE THE SAME CLASS OF CONCRETE USED IN THE ABUTMENT. F'C = 4.0 KSI.

REINFORCING STEEL:
PROVIDE REINFORCEMENT ACCORDING TO C&MS 509. MIN. YIELD STRENGTH = 60 KSI

STAINLESS STEEL:
13 GAGE STAINLESS STEEL, TYPE 304, ASTM A167 OR A240 WITH A SURFACE FINISH OF 8.0 μ-IN OR BETTER WELDED AROUND THE ENTIRE PERIMETER TO THE 1" BACKING PLATE PER 869.12.

PTFE:
PROVIDE PTFE SHEET OR FABRIC PER SUPPLEMENTAL SPECIFICATION 869.10 AND ATTACH PER 869.11.

STEEL BACKING PLATE:
PROVIDE ASTM A709 GRADE 50 STEEL BACKING PLATES ACCORDING TO C&MS 711.01.

END WELDED STUDS:
PROVIDE END WELDED STUDS IN ACCORDANCE WITH C&MS 513.22.

RUB PLATES: FABRICATE RUB PLATES ACCORDING TO SUPPLEMENTAL SPECIFICATION 869. SHIP AND PACKAGE FABRICATED UNITS ACCORDING TO 869.18. LEAVE WRAPPING, STRAPS OR RETAINING CLAMPS IN PLACE UNTIL BOTH SIDES OF THE UNIT ARE SECURED IN THIER FINAL POSITION. ADDITIONAL REINFORCEMENT MAY BE INCLUDED IN THE GUIDE FOR THIS PURPOSE.

CORROSION PROTECTION:
SHOP METALLIZE AND SEAL ALL STEEL SURFACES, EXCEPT PTFE-STAINLESS STEEL SLIDING SURFACES PER 869.13.

BASIS OF PAYMENT:
THE DEPARTMENT WILL PAY FOR ACCEPTED QUANTITIES OF CAULK, PEJF, CONCRETE, REINFORCEMENT AND RUB PLATES AS FOLLOWS:

ITEM	UNIT	DESCRIPTION
511	EACH	SEMI-INTEGRAL DIAPHRAGM GUIDE

DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
07-18-14
DATE
ADMINISTRATOR

REVISIONS

SICD-2-14

STANDARD BRIDGE DRAWING
SEMI-INTEGRAL ABUTMENT DIAPHRAGM GUIDE

1/1

7. Wingwalls, Mechanically Stabilized Earth Retaining Wall and Corner Details

Illinois

MSE Wall Section at Integral Abutment

MSE Wall Section at Semi Integral Abutment

Corner Treatment of Skewed Integral Abutments

Massachusetts

Wingwall Elevation for Integral Abutments

Integral Wingwall Sections

Horizontal Section of Integral Abutment and Wingwalls

Wingwall Section for Integral Abutments

Oklahoma

Section Through Wing at Back Face of Integral Abutment Seat

Integral Abutment Wing Elevation

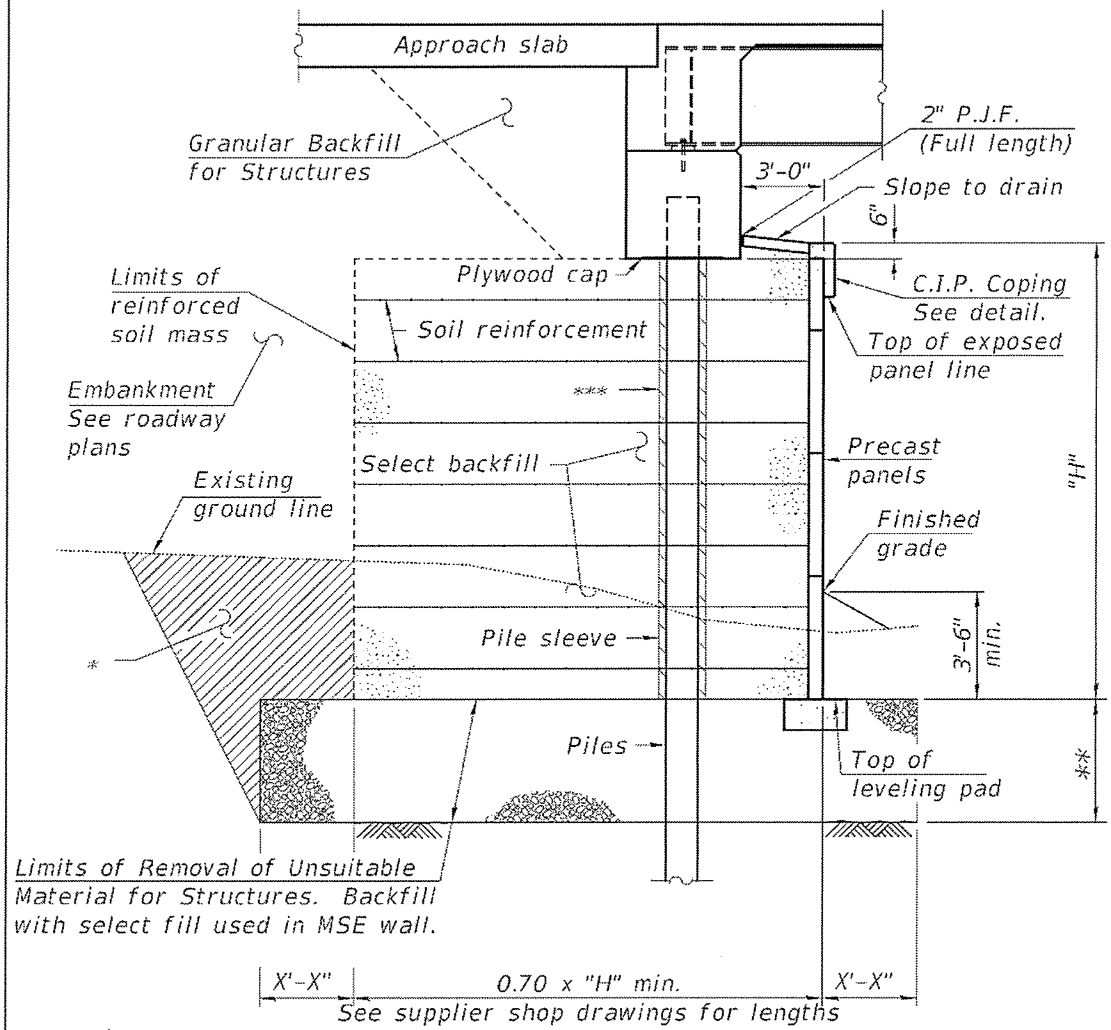
Pennsylvania

Integral Abutment Wingwall Details

Wisconsin

Plan and Section View of Integral Abutment Wingwalls

Wingwall Corner Details for Skewed Integral Abutment Bridges



* Overexcavation beyond structure excavation and removal of unsuitable material. This area not measured for payment. Backfill overexcavation with same material used for select fill used in MSE wall.

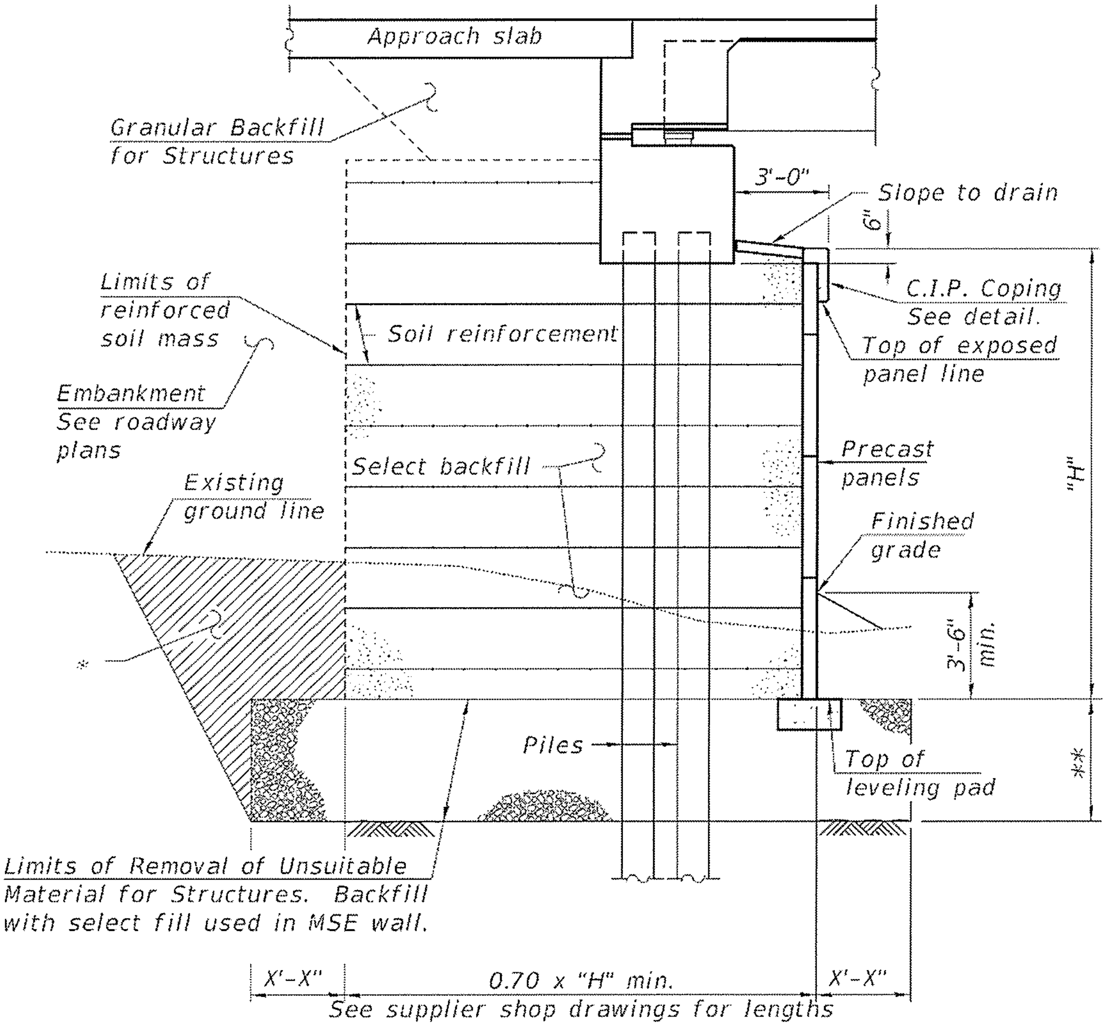
** If required by structure geotechnical report.

*** Place Bentonite between pile sleeve and pile.

M.S.E. WALL SECTION AT INTEGRAL ABUTMENT

Figure 23

Illinois



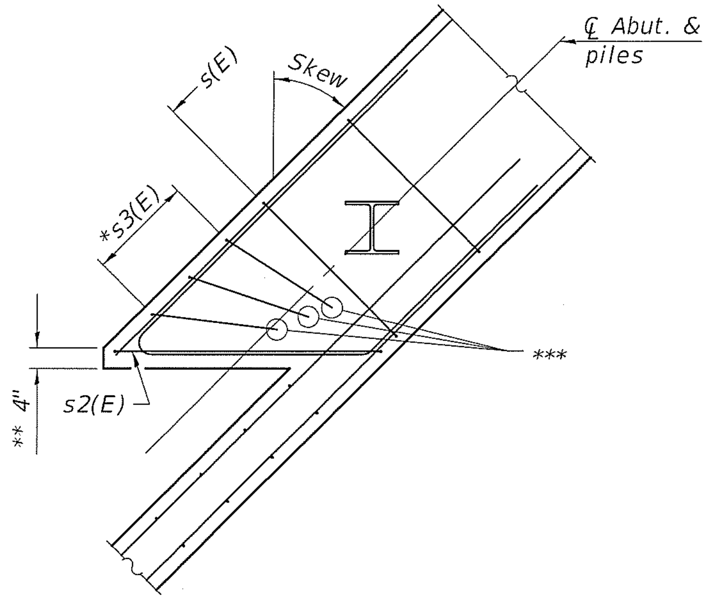
* Overexcavation beyond structure excavation and removal of unsuitable material. This area not measured for payment. Backfill overexcavation with same material used for select fill used in MSE wall.

** If required by structure geotechnical report.

M.S.E. WALL SECTION AT SEMI-INTEGRAL ABUTMENT

Figure 24

Illinois



ABUTMENT CAP PLAN

* Add s3(E) bars when the spacing between s(E) and s2(E) bars exceeds what is required by design or 12".

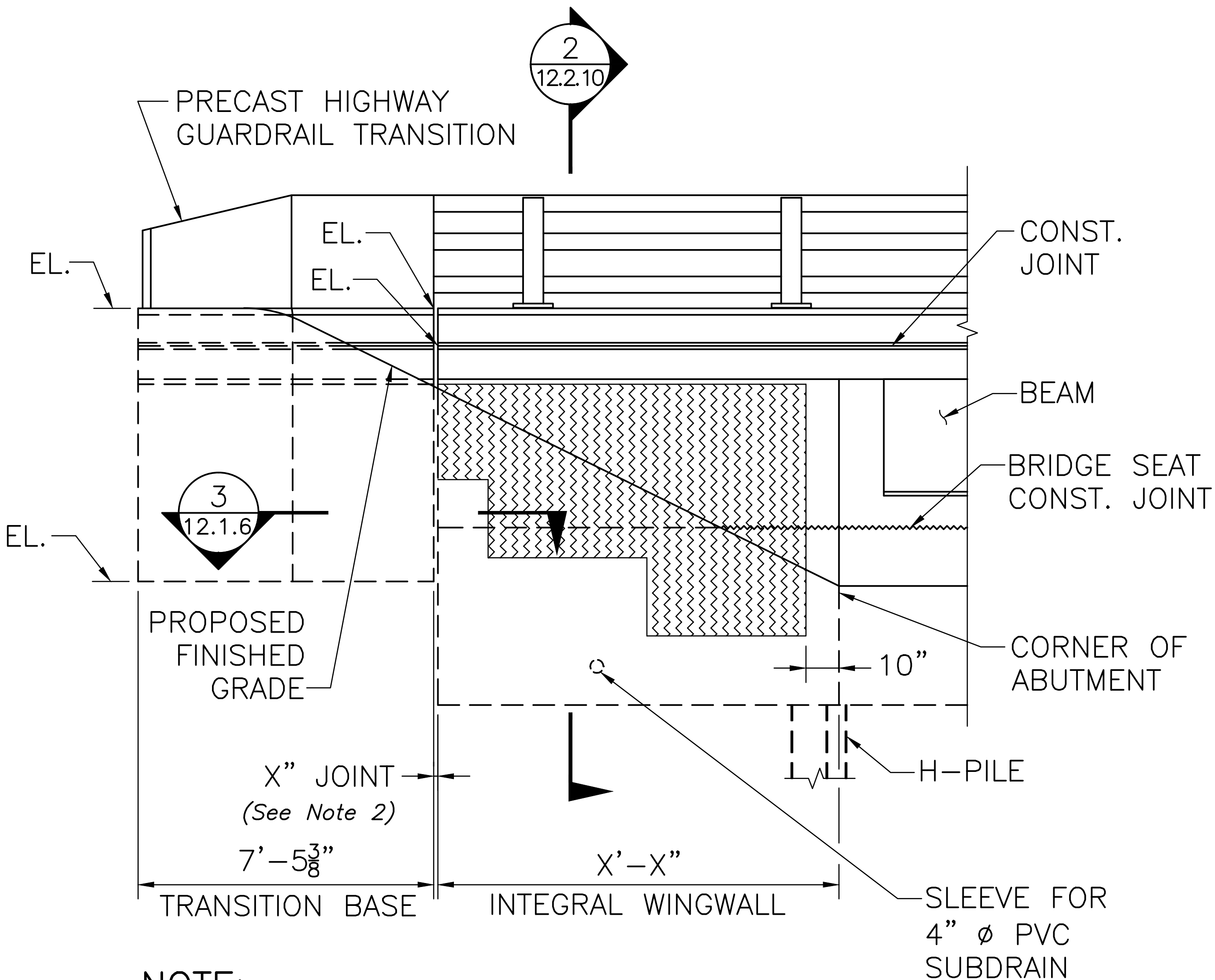
** Block out sharp corner of abutment cap and diaphragm as shown for skews 25 degrees and larger.

*** Detail legs of s3(E) bars such that they do not all come to a point causing congestion.

CORNER TREATMENT OF SKEWED INTEGRAL ABUTMENTS

Figure 6

Illinois



NOTE:

RAILING PICKETS NOT SHOWN FOR CLARITY.

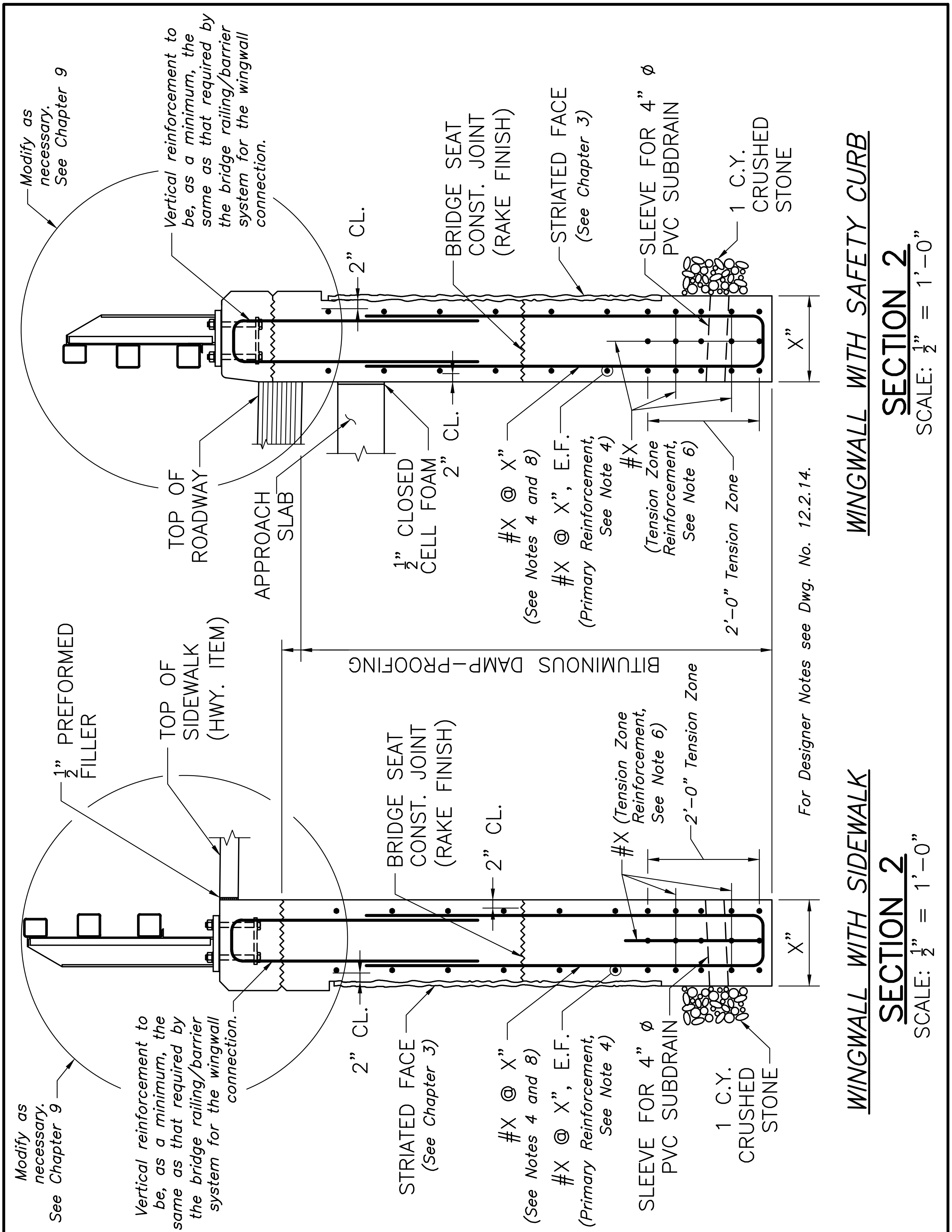
WINGWALL ELEVATION

SCALE: $\frac{1}{4}$" = 1'-0"

NOTES:

1. *Rolled Beam with Type S3-TL4 railing shown. Modify for other beam types and railing/barriers as required.*
2. *See Dwg. No. 12.1.6 to determine movement joint width.*
3. *Show each wingwall in elevation.*
4. *Refer to Chapter 3 for wingwall and guardrail transiton base geometry.*
5. *Striations shall be provided on wingwall only. They shall not be provided on front face of abutments. See Section 3.4 for general striation details.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	WINGWALL ELEVATION INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER 12.1.5



massDOT Massachusetts Department of Transportation Highway Division

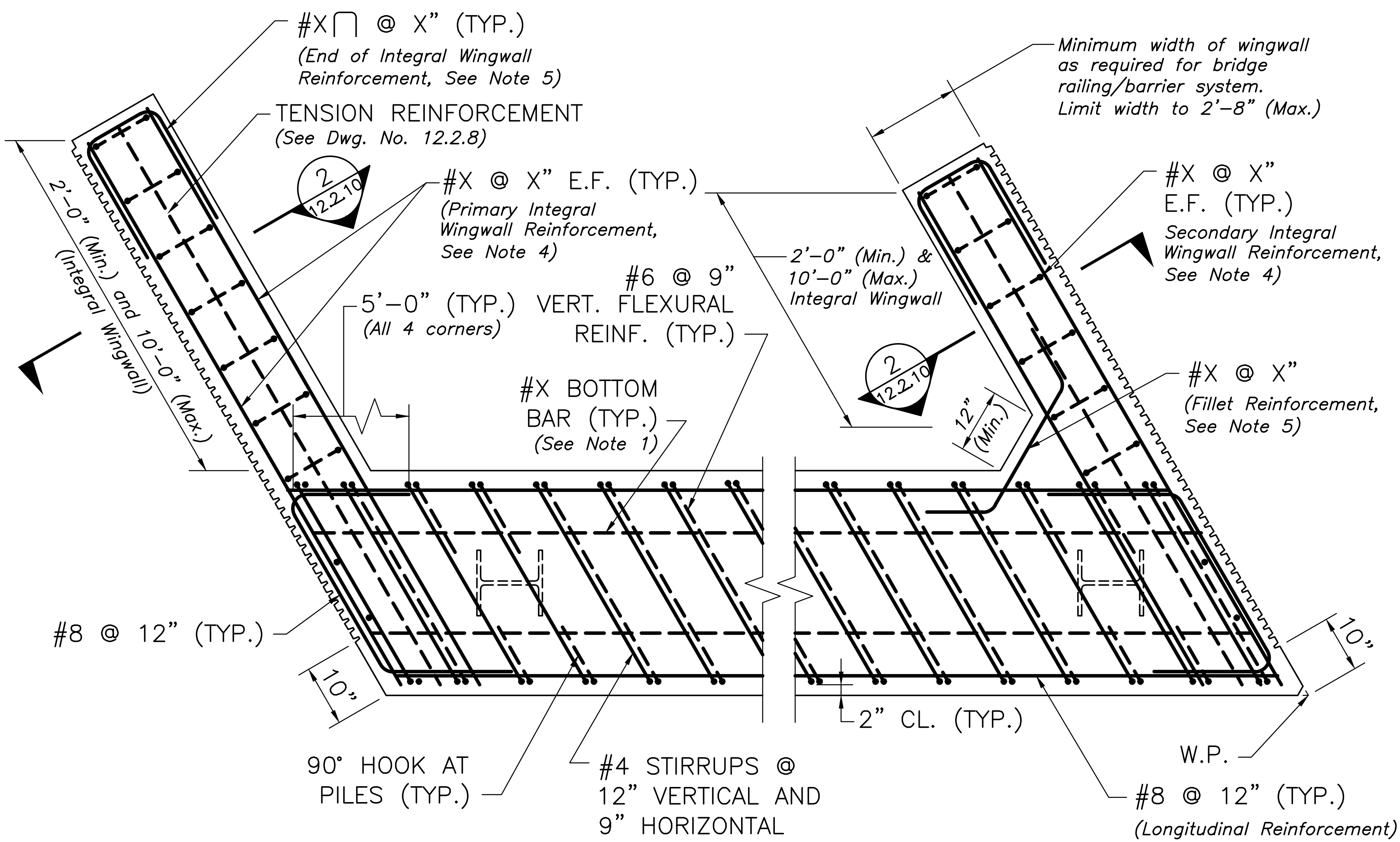
LRFD BRIDGE MANUAL, PART II

INTEGRAL WINGWALL SECTIONS

INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.2.10



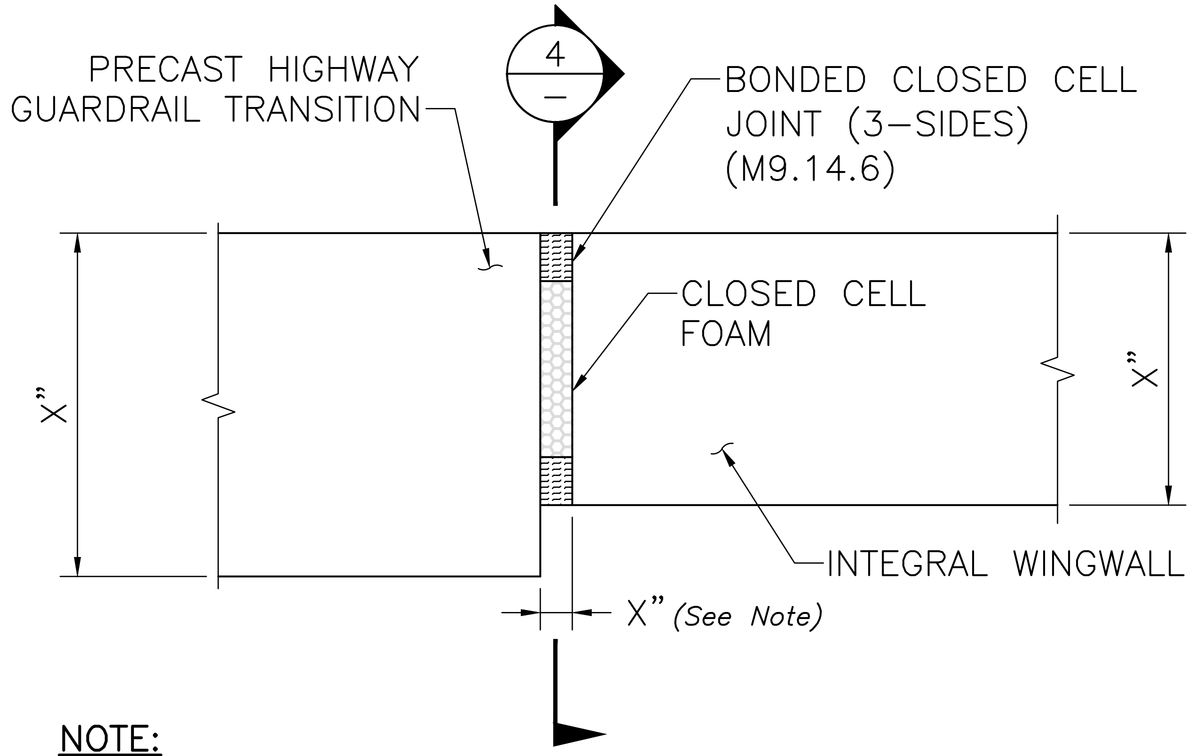
NOTE:

SECTION IS TAKEN BELOW CAP TOP LONGITUDINAL REINFORCEMENT AT BRIDGE SEAT CONSTRUCTION JOINT.

HORIZONTAL SECTION

SCALE: $\frac{1}{2}$" = 1'–0"

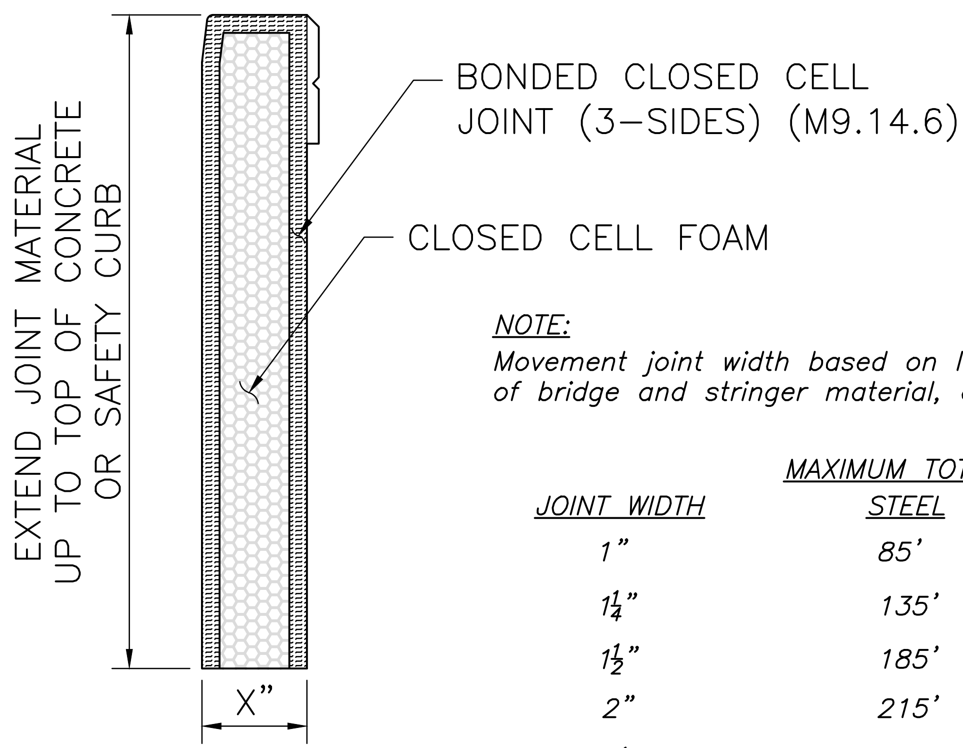
For Designer Notes see Dwg. No. 12.2.14.



NOTE:
REINFORCEMENT NOT SHOWN FOR CLARITY.

SECTION 3

SCALE: 1" = 1'–0"



SECTION 4

SCALE: $\frac{1}{2}$" = 1'–0"

NOTE:
Movement joint width based on length of bridge and stringer material, as shown below.

JOINT WIDTH	MAXIMUM TOTAL BRIDGE LENGTH STEEL	CONCRETE
1"	85'	200'
$1\frac{1}{4}$"	135'	300'
$1\frac{1}{2}$"	185'	450'
2"	215'	550'
$2\frac{1}{2}$"	265'	600'
3"	300'	

massDOT Massachusetts Department of Transportation Highway Division

LRFD BRIDGE MANUAL, PART II

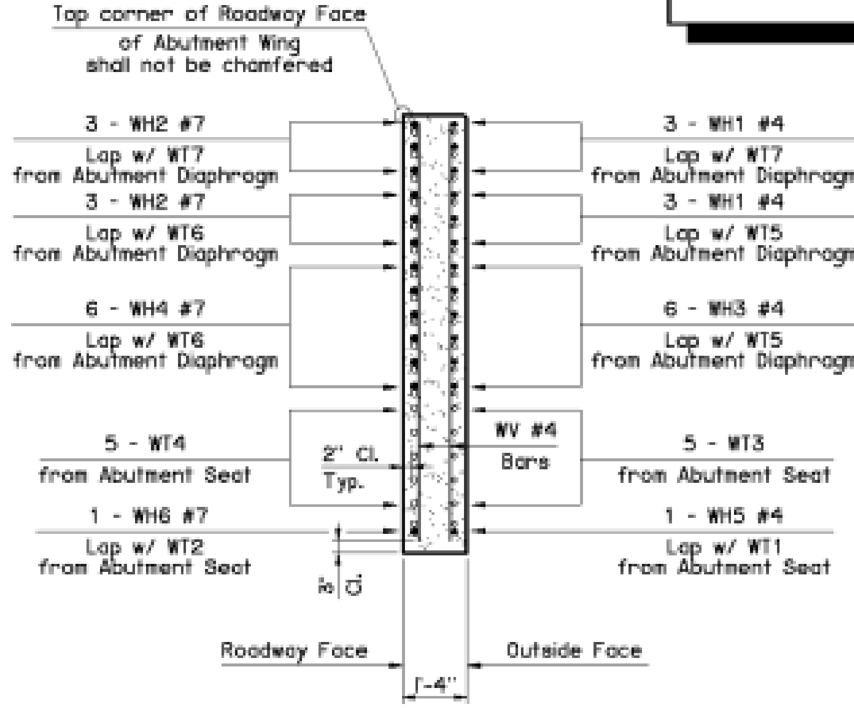
WINGWALL SECTION AND MOVEMENT JOINT SECTION

INTEGRAL ABUTMENTS

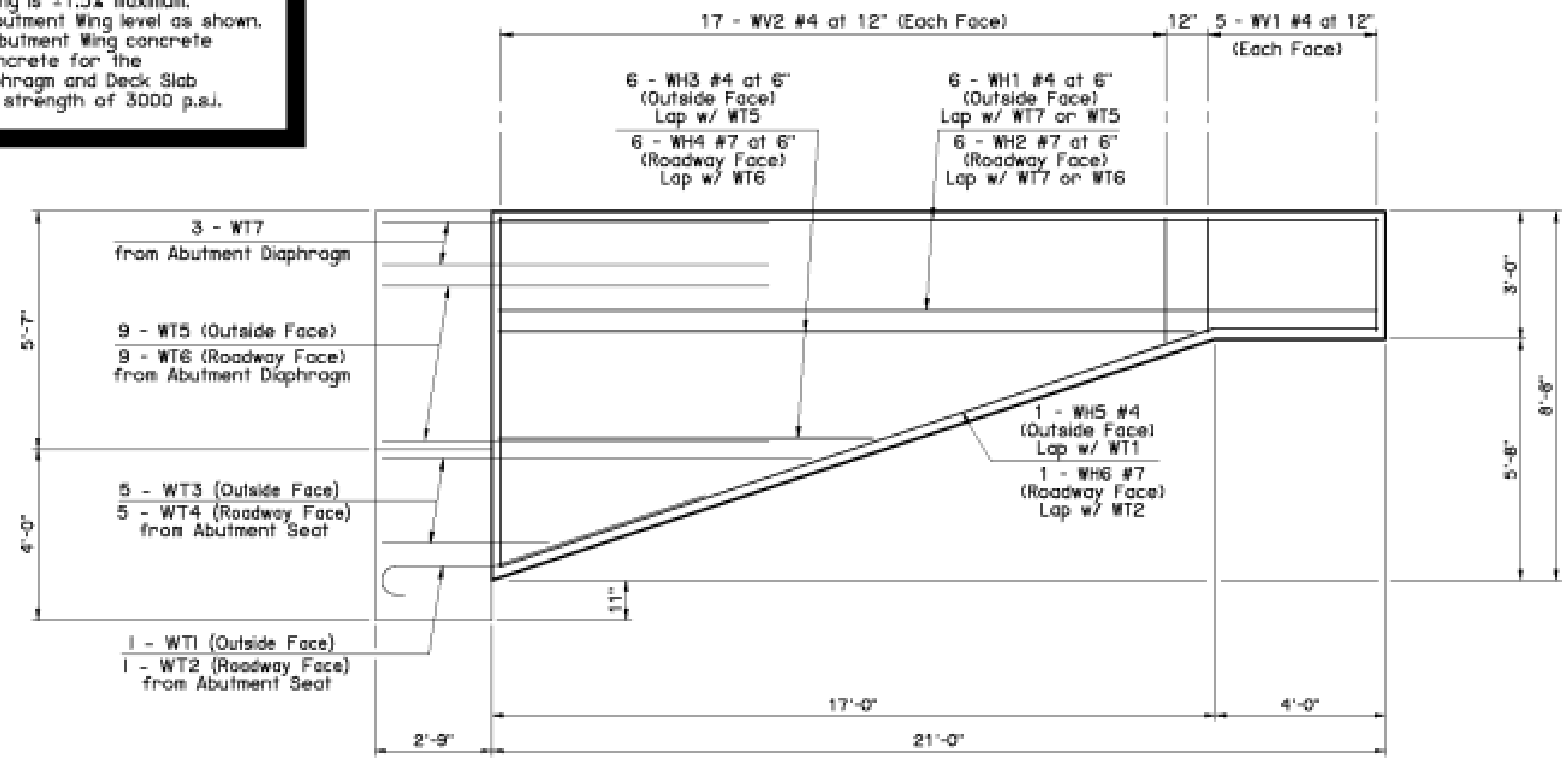
DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.1.6

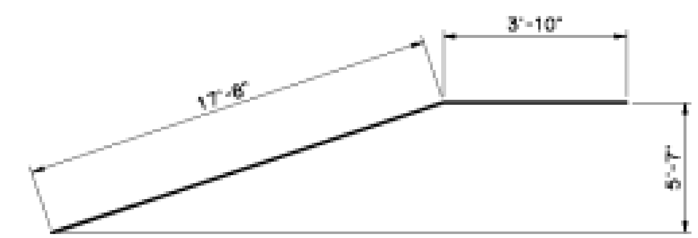
This standard may be used only if grade from Back Face of Abutment Seat to end of Wing is ±1.5% maximum.
Construct top of Abutment Wing level as shown.
Do not place Abutment Wing concrete until concrete for the Abutment Diaphragm and Deck Slab have attained a strength of 3000 p.s.i.



SECTION THRU WING AT BACK FACE OF ABUTMENT SEAT



WING ELEVATION



WH5 #4 x 21'-6"
WH6 #7 x 21'-6"

ABUTMENT QUANTITIES		
ITEM	UNIT	TOTAL
SUBSTRUCTURE EXCAVATION COMMON	C.Y.	45
CLSM BACKFILL	C.Y.	100
CLASS A CONCRETE	C.Y.	29.8
EPOXY COATED REINFORCING STEEL	LB.	4,830
PILES, FURNISHED (HP10x42)	L.F.	
PILES, DRIVEN (HP10x42)	L.F.	
WATER REPELLENT (VISUALLY INSPECTED)	S.Y.	11
6" PERFORATED PIPE UNDERDRAIN ROUND	L.F.	42
6" NON-PERF. PIPE UNDERDRAIN RND.	L.F.	

NOTE:
See TYPICAL CROSS SECTION for extent of Water Repellent Treatment.

ABUTMENT WING BAR LIST
ONE SHOWN, TWO REQUIRED

	MARK	SIZE	NO.	FORM	LENGTH	LENGTH VARIATION
	EPOXY COATED REINFORCING					
	WH1	#4	6	STR.	20'-8"	
	WH2	#7	6	STR.	20'-8"	
	WH3	#4	6	STR.	12'-5" AVG.	8'-8" to 16'-2"
	WH4	#7	6	STR.	12'-5" AVG.	8'-8" to 16'-2"
	WH5	#4	1	BNT.	21'-6"	
	WH6	#7	1	BNT.	21'-6"	
	WV1	#4	10	STR.	2'-7"	
①	WV2	#4	34	STR.	5'-6" AVG.	2'-10" to 8'-2"

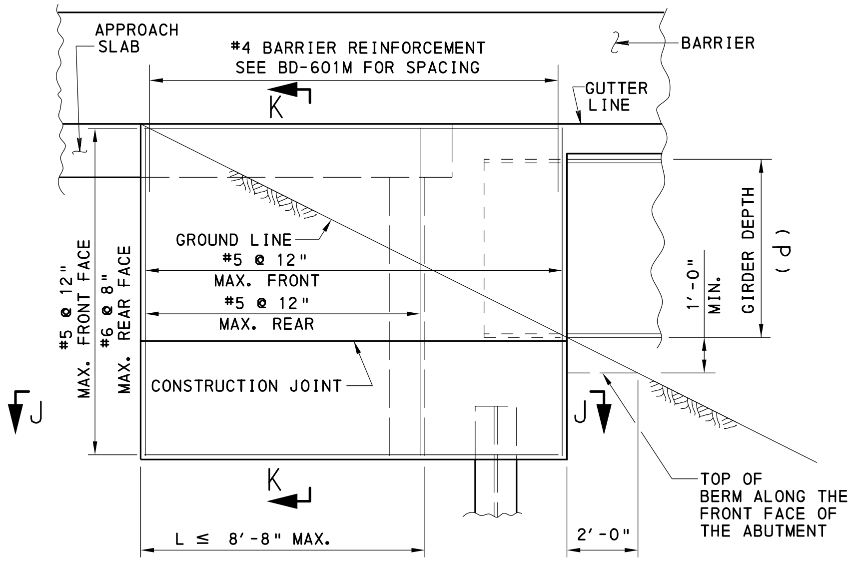
① 2 Sets of 17

APPROVED BY BRIDGE ENGINEER [signature] DATE 4/2/10

OKLAHOMA DEPT. OF TRANSPORTATION
BRIDGE STANDARD (ENGLISH)

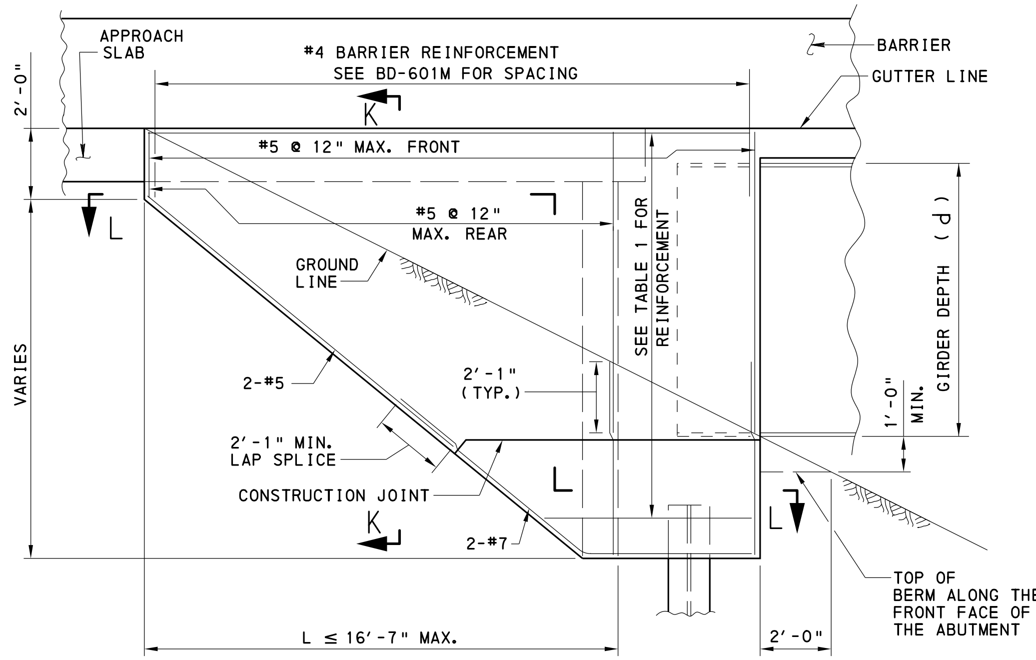
ABUTMENT DETAILS
TYPE IV P.C. BEAMS
INTEGRAL (SHEET 2 OF 2)

2009 SPECIFICATIONS | B40-I-ABUT-PC4-2 | 01E
B-45E



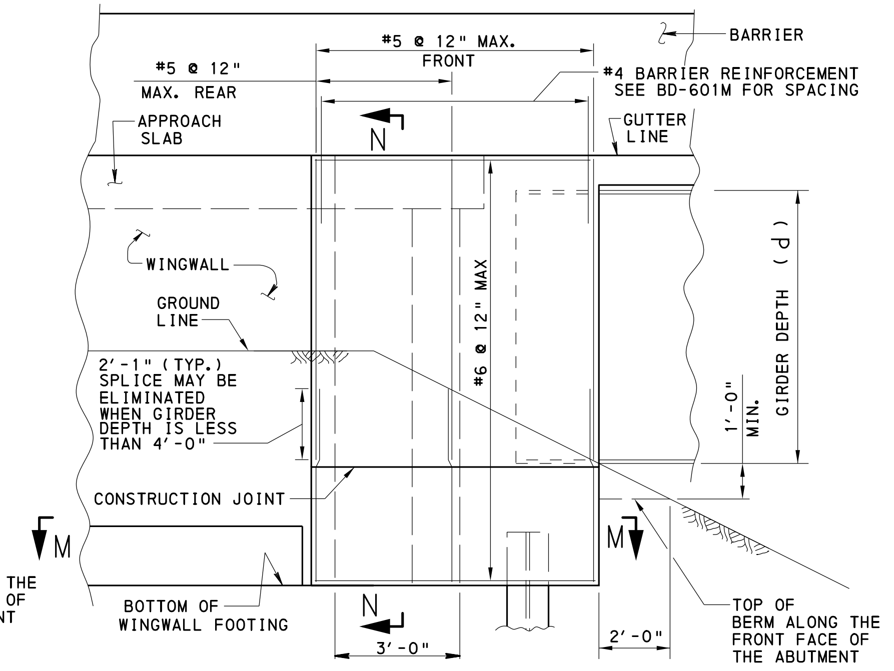
ATTACHED RECTANGULAR WINGWALL ELEVATION

(FOR GIRDER DEPTH d < 5'-0")

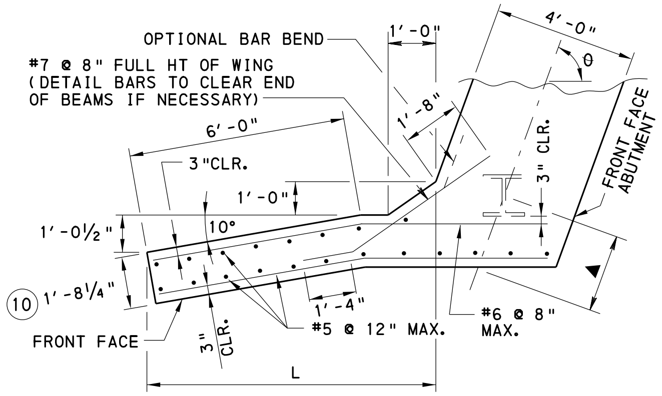


ATTACHED TAPERED WINGWALL ELEVATION

(FOR GIRDER DEPTH 5'-0" ≤ d < 8'-0")

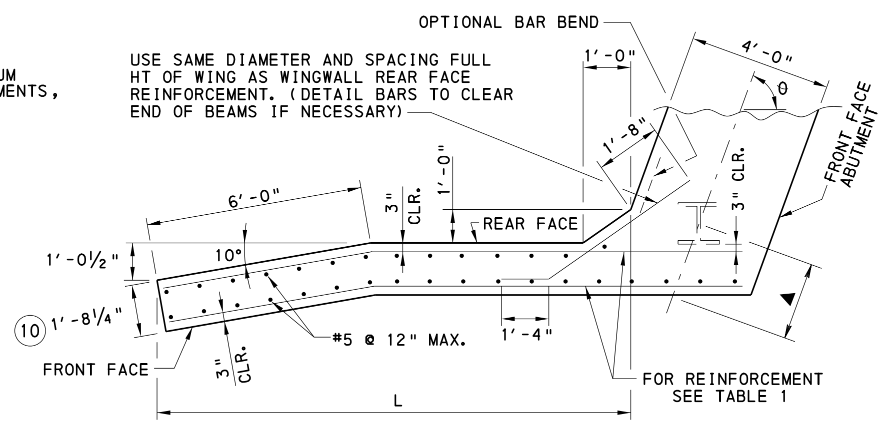


DETACHED WINGWALL ELEVATION

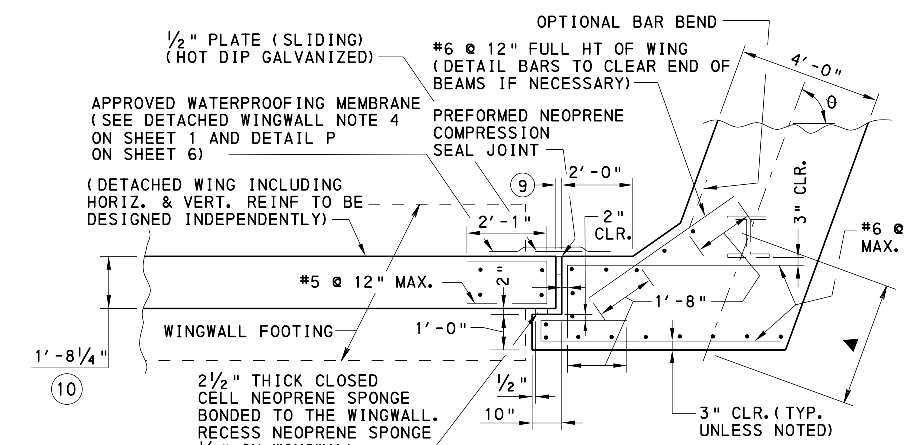


▲ FOR MINIMUM AND MAXIMUM EDGE DISTANCE REQUIREMENTS, SEE SHEET 1.

SECTION J-J

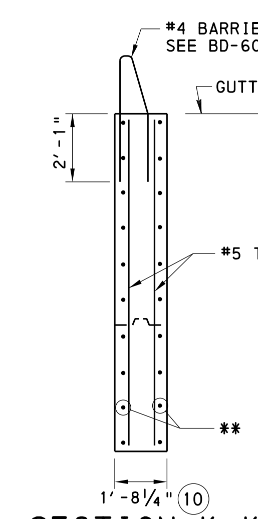


SECTION L-L



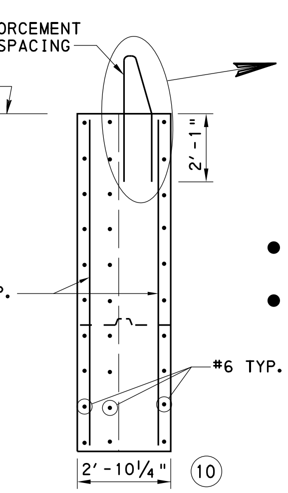
SECTION M-M

FOR MEMBRANE SLACK, SEE DETAIL P SHEET 6



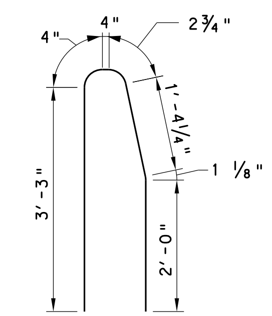
SECTION K-K

(RECTANGULAR OR TAPERED WING)



SECTION N-N

(DETACHED WING)



● DIMENSIONS ARE MEASURED ALONG OUTSIDE FACE OF BAR

● INSIDE RADII ARE 2"

** FOR RECTANGULAR WINGWALL REINFORCEMENT:
SEE SECTION J-J.
FOR TAPERED WINGWALL REINFORCEMENT:
SEE TABLE 1 THIS SHEET.

TABLE 1: TAPERED WINGWALL REINFORCEMENT

GIRDER DEPTH (d)	WINGWALL LENGTH BEYOND THE REAR FACE OF THE ABUTMENT (L)	REINFORCEMENT	
(In)	(ft)	REAR FACE	FRONT FACE
60 ≤ d < 72	L ≤10'-7"	#8 @ 12"	#5 @ 12"
	10'-7"< L ≤ 14'-2"	#8 @ 6"	#5 @ 12"
72 ≤ d* < 84	L ≤10'-7"	#8 @ 12"	#5 @ 12"
	10'-7"< L ≤ 15'-0"	#8 @ 6"	#5 @ 12"
84 ≤ d* < 96	L ≤12'-0"	#8 @ 10"	#5 @ 12"
	12'-0" < L ≤ 15'-10"	#8 @ 6"	#5 @ 12"
96 = d*	L ≤14'-2"	#8 @ 8"	#5 @ 12"
	14'-2"< L ≤ 16'-7"	#8 @ 6"	#5 @ 12"

* CHIEF BRIDGE ENGINEER APPROVAL IS REQUIRED FOR BEAM DEPTHS GREATER THAN 6'-0"

MINIMUM ATTACHED WINGWALL LENGTH (L)***

	GIRDER DEPTH (d)	SKEW=90°	45° ≤ SKEW < 90°
ATTACHED RECTANGULAR WINGWALL	d < 48"	7'-6"	7'-6"
	48" ≤ d < 60"	7'-8"	8'-8"
ATTACHED TAPERED WINGWALL	60" ≤ d < 72"	9'-8"	10'-8"
	72" ≤ d* < 84"	11'-8"	12'-8"
	84" ≤ d* < 96"	13'-8"	14'-8"
	d = 96"*	14'-0"	15'-0"

*** ACTUAL WINGWALL LENGTH SHALL BE DETERMINED BASED ON GRADING-CONTOURS.

LEGEND:

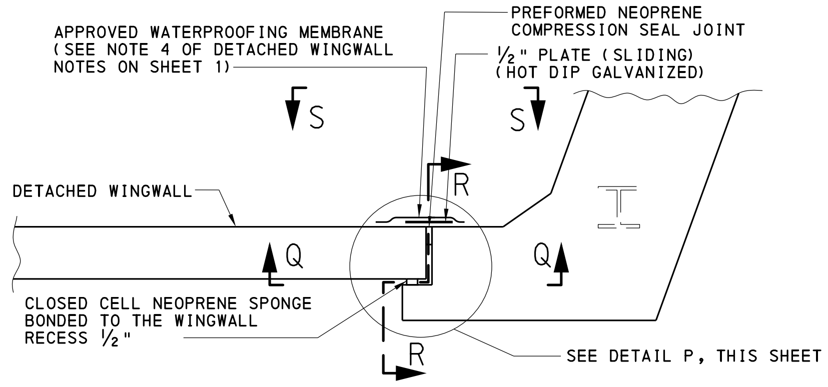
9 DISTANCES TO BE DETERMINED BASED ON DESIGN MOVEMENT, CONSTRUCTION TEMPERATURE, AND COMPRESSION SEAL JOINT MINIMUM INSTALLATION OPENING REQUIREMENTS. SEE NOTE 1 OF DETACHED WINGWALL NOTES, ON SHEET 1.

10 WINGWALL WIDTH MAY VARY BASED ON BARRIER TYPE. MINIMUM WINGWALL WIDTH EQUALS 1'-8¼".

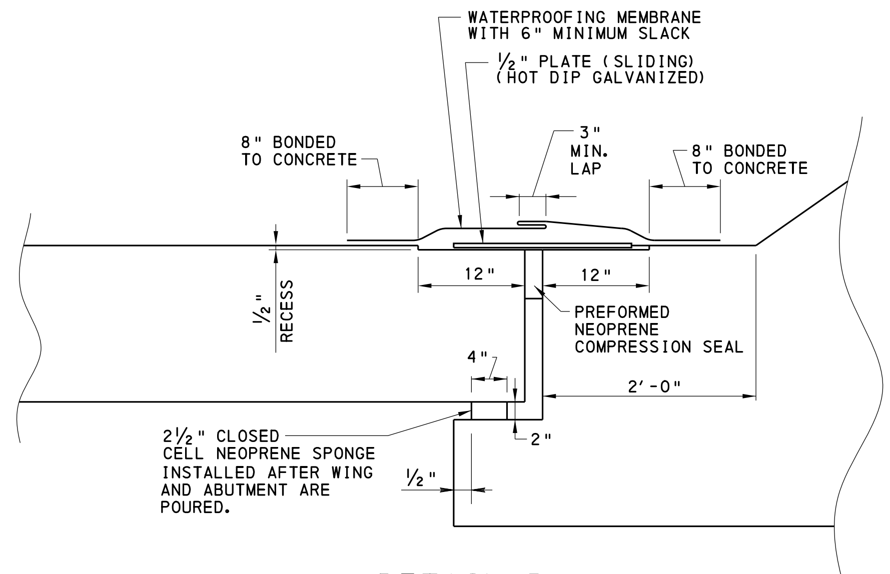
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
WINGWALL DETAILS

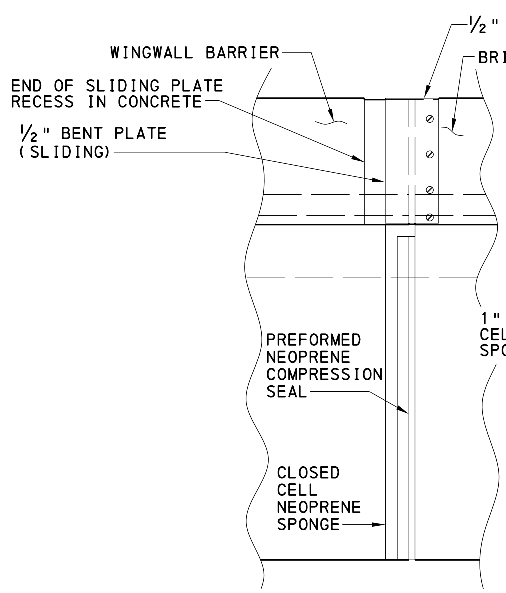
RECOMMENDED APR. 29, 2016 Thomas P Macioce CHIEF BRIDGE ENGINEER	RECOMMENDED APR. 29, 2016 Brian D Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	SHEET 5 OF 9 BD-667M

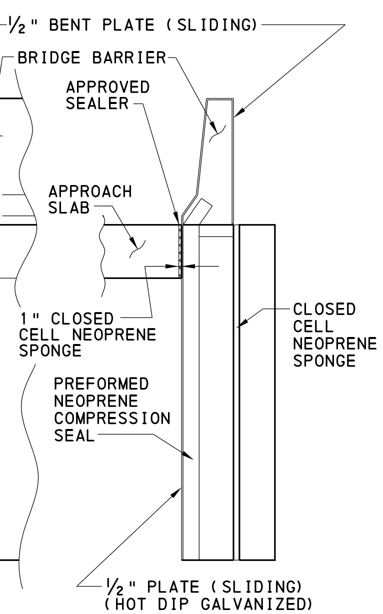


PARTIAL SECTION THRU DETACHED WINGWALL EXPANSION JOINT

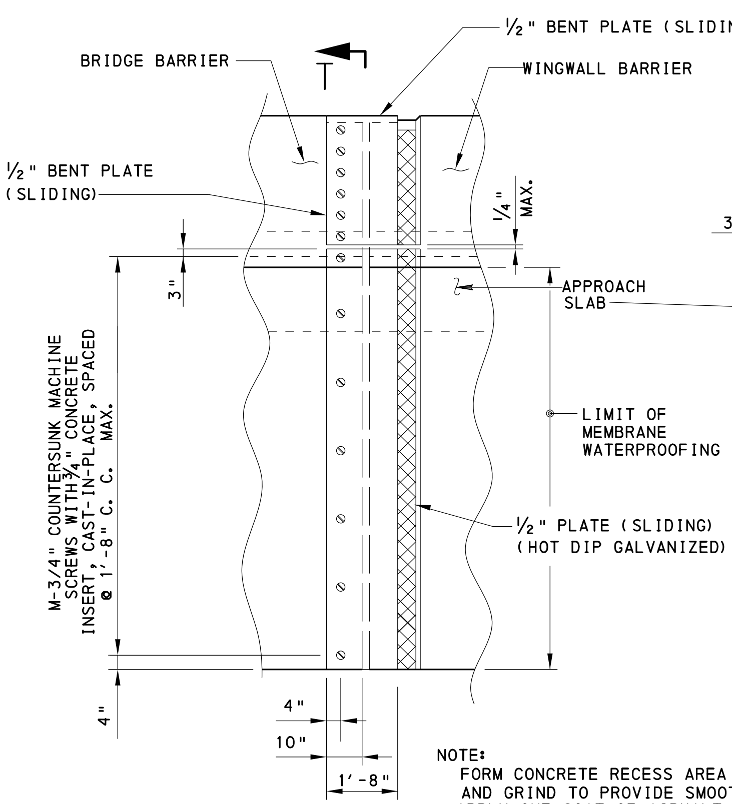


DETAIL P





SECTION Q-Q SECTION R-R

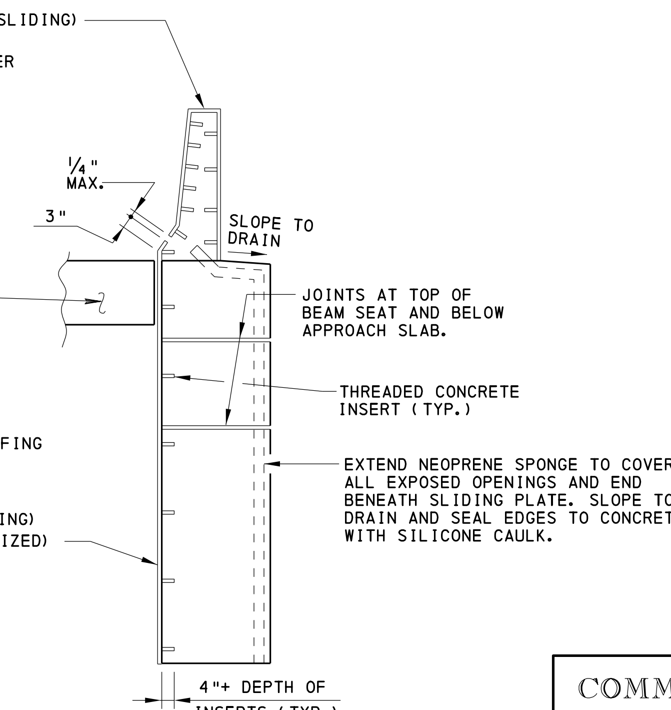


NOTE:
FORM CONCRETE RECESS AREA IN BARRIER AND GRIND TO PROVIDE SMOOTH SURFACE. APPLY ONE COAT OF ASPHALT CEMENT PAINT WA-1 OR PERFORMANCE GRADED ASPHALT CEMENT PG 64-22 TO ALLOW BENT SLIDING PLATE TO MOVE FREELY WITHOUT FRICTION.

T

VIEW S-S

(WATERPROOFING MEMBRANE AND LIMITS OF RECESS IN CONCRETE REMOVED FOR CLARITY)

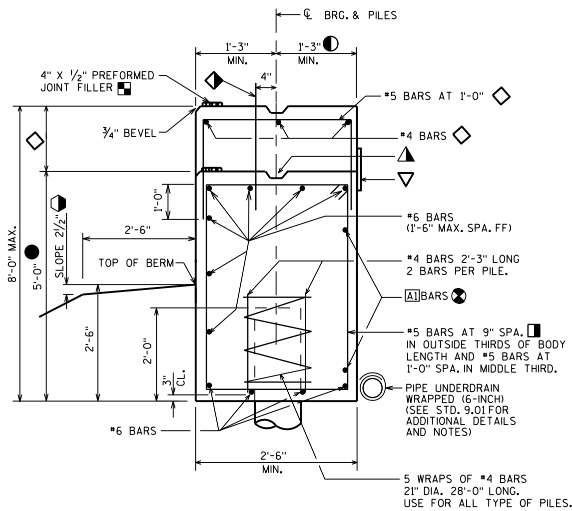


SECTION T-T

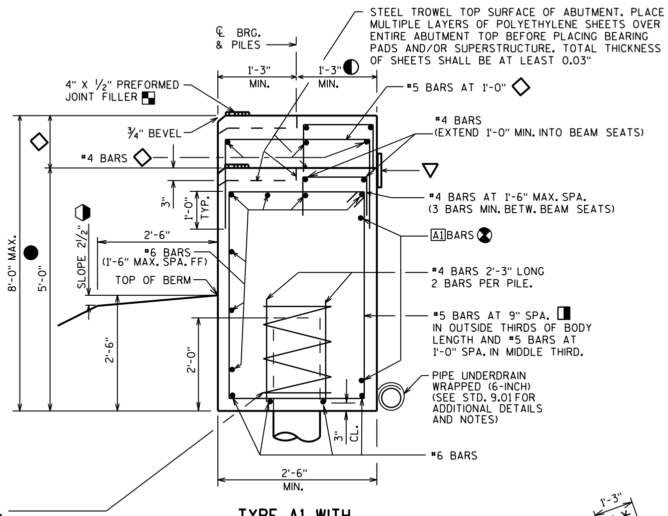
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
DETACHED WINGWALL DETAILS

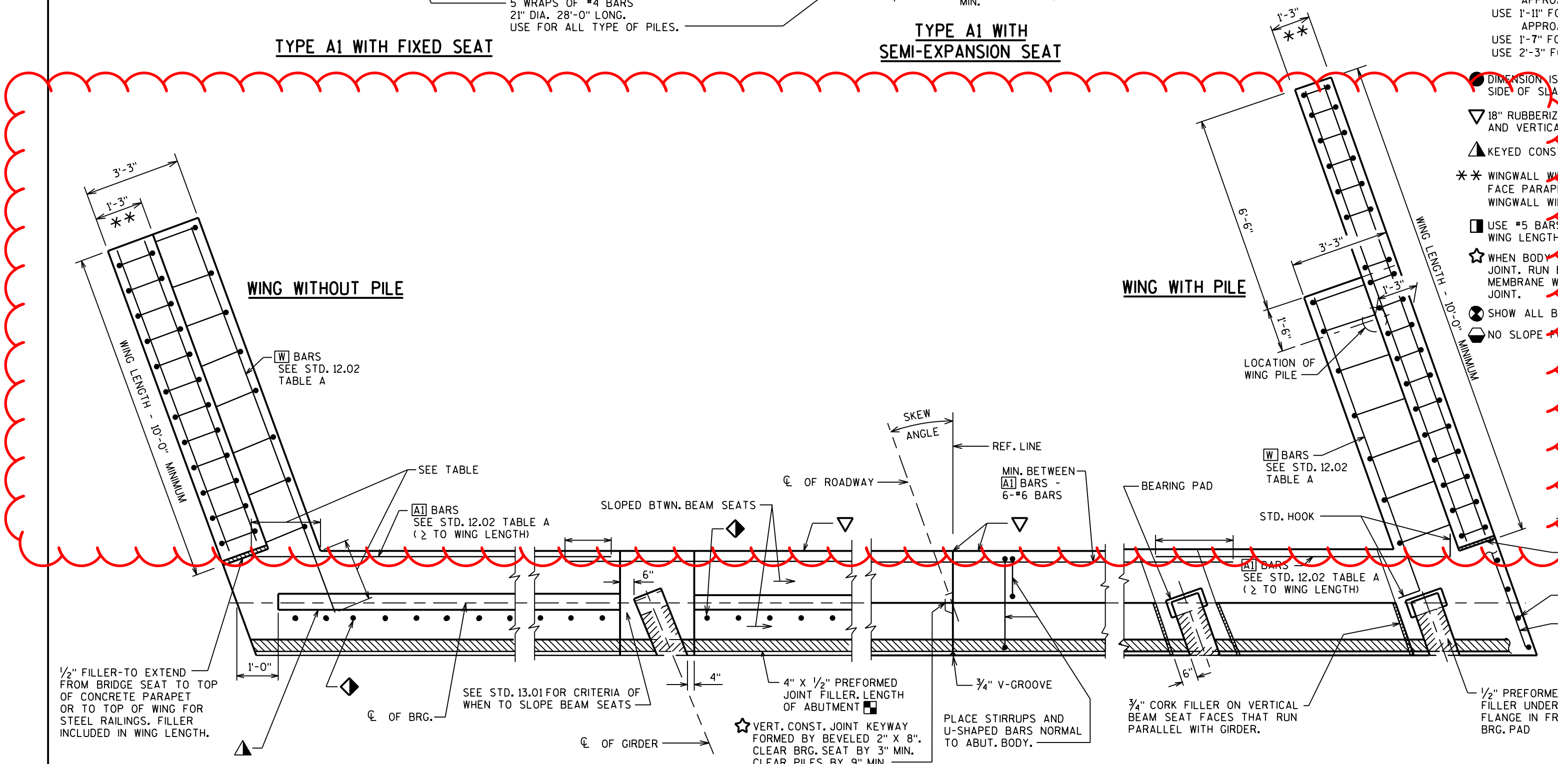
RECOMMENDED APR. 29, 2016	RECOMMENDED APR. 29, 2016	SHEET 6 OF 9
Thomas P Macioce CHIEF BRIDGE ENGINEER	Brian D Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M



TYPE A1 WITH FIXED SEAT



TYPE A1 WITH SEMI-EXPANSION SEAT



SLAB SPAN WITH FIXED SEAT

GIRDER SPAN WITH FIXED SEAT

SLAB SPAN WITH SEMIEXPANSION SEAT

GIRDER SPAN WITH SEMIEXPANSION SEAT

DESIGNER NOTES

LAP LENGTHS FOR HORIZONTAL BARS SHALL BE BASED ON A "CLASS C" TOP TENSION LAP SPLICE.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

PILING SPACING IN ABUTMENT BODY SHALL BE 8'-0" MAX. FOR ALL TYPES OF PILING. THE MAX. PILE SPACING FROM THE END OF THE ABUT. BODY TO THE FIRST PILE SHALL BE THE MINIMUM OF ONE-HALF PILE SPACE OR 2'-6".

TOTAL LENGTH OF A1 BARS SHALL BE ≥ TO WING LENGTH.

CONCRETE POURED UNDER WATER WILL BE ALLOWED AND SHALL BE DONE IN ACCORDANCE WITH SECTION 502.3.5.3 STANDARD SPECIFICATIONS.

THE SEMI-EXPANSION SEAT SHALL BE USED WHEN REQUIRED AS STATED IN CHAPTER 12, FIGURE 12.7-1 OF THE BRIDGE MANUAL OR WHENEVER A WING PILE IS REQUIRED.

THE FIXED SEAT CANNOT BE USED WHEN A WING PILE IS REQUIRED (SEE STD. 12.02 FOR CRITERIA).

WHEN THE BOTTOM OF GIRDER SLOPES MORE THAN 1%, SLOPE THE BEAM SEAT BASED ON ADDING THESE TWO VALUES:
- LONGITUDINAL GRADE OF GIRDER (PERCENT)
- CAMBER EFFECT = 4(RC)/L X 100 (PERCENT), WHERE:
  RC = RESIDUAL CAMBER (INCHES)
  L = GIRDER LENGTH (INCHES)

(SEE STANDARD 13.01 FOR SLOPED SEAT DETAILS)

ABUTMENT DETAILED WITHOUT STRUCTURAL APPROACH SLAB. SEE STD. 12.10 THRU 12.13 FOR STRUCTURAL APPROACH DETAILS.

USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

LEGEND

#5 BARS (COATED) AT 1'-0" (2'-0" LONG). THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED BUT BEFORE INITIAL SET HAS TAKEN PLACE.

WHEN THIS DIMENSION ≥ 4" THIS ADDITIONAL REINFORCEMENT SHALL BE ADDED. MAX. SPA. OF HORIZ. #4 BARS = 1'-0".

USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)

DIMENSION IS FROM BOTTOM OF ABUTMENT TO LOW BEAM SEAT OR LOW SIDE OF SLAB TYPE SUPERSTRUCTURE.

18" RUBBERIZED MEMBRANE WATERPROOFING. SEAL ALL HORIZONTAL AND VERTICAL JOINTS ON BACKFACE.

KEYED CONST. JOINT FORMED BY BEVELED 2" x 6".

** WINGWALL WIDTH SHALL BE 1'-6" WHEN TYPE "M" RAILING, VERTICAL FACE PARAPET "TX", OR SINGLE SLOPE PARAPET "56SS" IS USED. WINGWALL WIDTH SHALL BE 1'-9" WHEN TYPE "NY3" OR "NY4" RAILING IS USED.

USE #5 BARS AT 6" SPA. IN OUTSIDE THIRDS OF BODY LENGTH WHEN THE WING LENGTH > 20'-0" AND WING HEIGHT > 10'-0".

WHEN BODY SECTION IS > 50'-0"± LONG PROVIDE VERTICAL CONSTRUCTION JOINT. RUN BAR STEEL THRU JOINT AND SEAL JOINT WITH 18" RUBBERIZED MEMBRANE WATERPROOFING. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.

SHOW ALL BARS FOR CLARITY.

NO SLOPE FOR HEAVY RIPRAP. SEE STANDARD 12.08 FOR DETAILS.

TABLE

BAR SIZE	DISTANCE*
#5	1'-9"
#6	2'-1"
#7	2'-9"
#8	3'-8"
#9	4'-7"
#10	5'-10"

* OR EQUIVALENT STD. HOOK
USE STRAIGHT BARS WHEN POSSIBLE

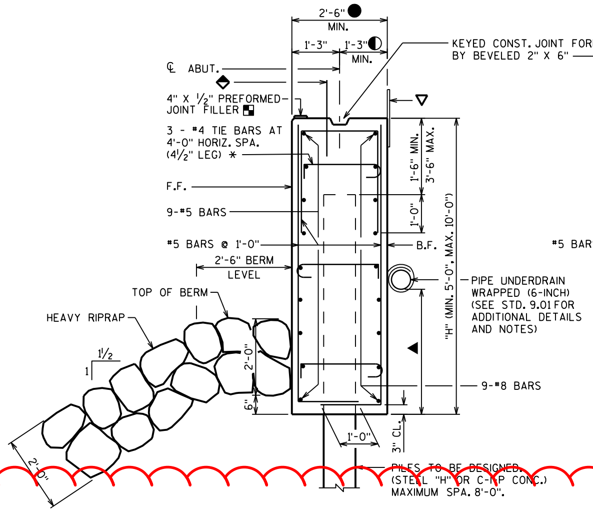
ABUTMENT TYPE A1 (INTEGRAL ABUTMENT)

WISCONSIN DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURES

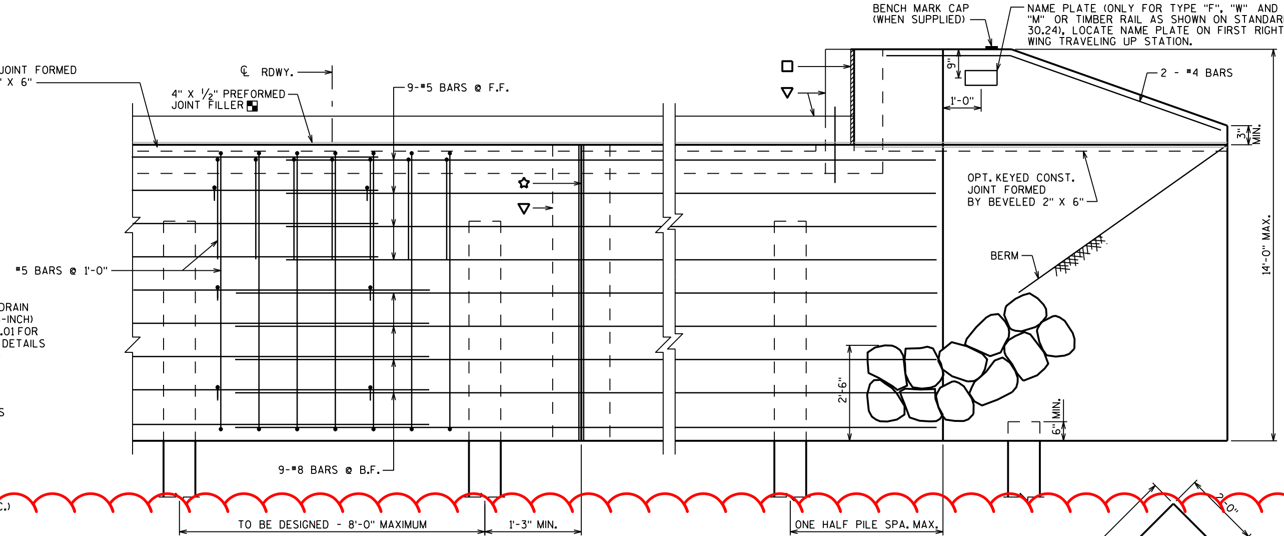
APPROVED: *Bill Oliva*

DATE: 1-20

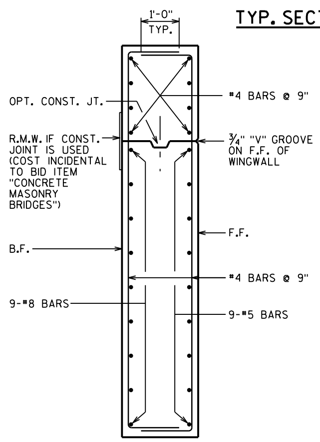
STANDARD 12.01



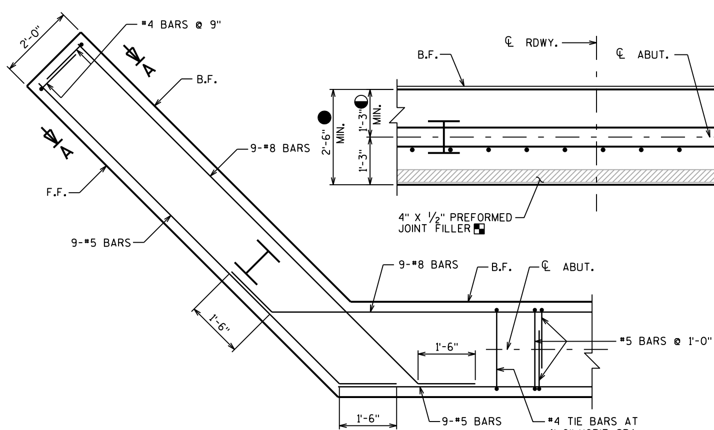
TYP. SECTION THRU ABUTMENT BODY



ELEVATION

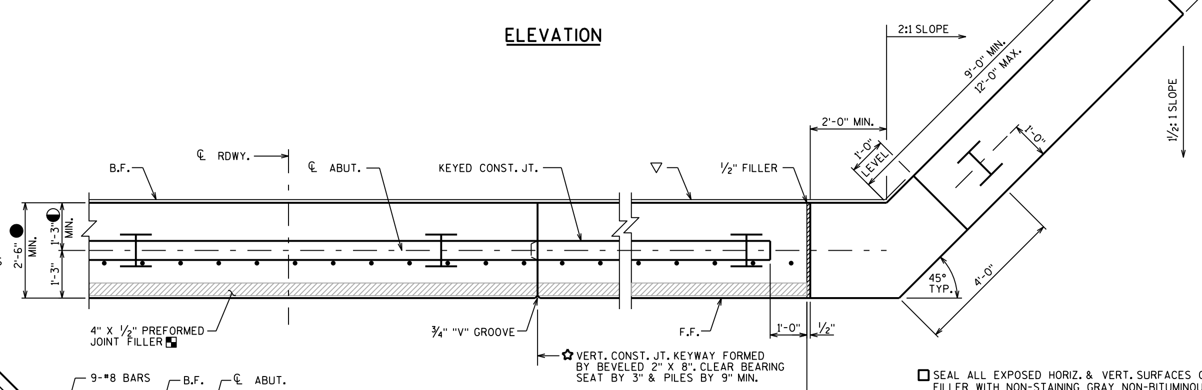


SECTION A-A

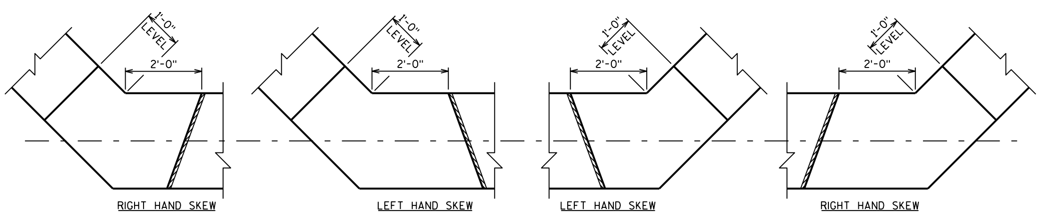


PLAN

SHOWING BAR STEEL REINFORCEMENT



PLAN



WING DETAIL FOR SKEWED STRUCTURES

DESIGNER NOTES

FOR SLAB AND PRESTRESSED GIRDER SPANS L < 200'-0" & FOR STEEL GIRDER SPANS L < 150'-0" WHERE L = LENGTH OF CONTINUOUS SUPERSTRUCTURE BETWEEN ABUTMENTS.

WHEN GIRDERS WITH SEMIEXPANSION SEAT OR FIXED SEAT, OR SLAB SPAN WITH SEMIEXPANSION SEAT ARE USED, MAKE BEAM SEATS SIMILAR TO THAT SHOWN ON STANDARD 12.01.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

✩ WHEN BODY SECTION IS > ± 50'-0" LONG, PROVIDE VERT. CONST. JOINT. RUN BAR STEEL THRU JOINT. BEVEL EXPOSED EDGES 3/4" AND SEAL JOINT. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.

◐ USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)

▲ FOR BOTTOM OF ABUTMENTS LOCATED ABOVE NORMAL WATER, PLACE UNDERDRAIN NEAR THE BOTTOM OF ABUTMENT AS SHOWN IN STANDARD 12.01. FOR BOTTOM OF ABUTMENTS LOCATED BELOW NORMAL WATER, PLACE UNDERDRAIN ABOVE NORMAL WATER. SEE BRIDGE MANUAL 12.6.1 FOR ADDITIONAL GUIDANCE. FOR UNDERDRAIN EXPOSED TO HIGH WATER, CONSIDER CAPPING THE UPSTREAM END TO PREVENT CLOGGING.

□ SEAL ALL EXPOSED HORIZ. & VERT. SURFACES OF 1/2" FILLER WITH NON-STAINING GRAY NON-BITUMINOUS JOINT SEALER. (1" DEEP AND HOLD 1/8" BELOW SURFACE OF CONC.)

DO NOT PLACE FILL ABOVE 3'-0" FROM BOTTOM OF ABUTMENT UNTIL SUPERSTRUCTURE IS IN PLACE.

▽ 18" RUBBERIZED MEMBRANE WATERPROOFING.

● WHEN ABUTMENT WIDTH > 2'-10" FIXED POINT OF WING ROTATION SHALL BE ON F.F. OF ABUTMENT (0° SKEW ONLY).

◆ THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED, BUT BEFORE INITIAL SET HAS TAKEN PLACE. SEE STD. 12.01 & 27.05

◩ USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

* ALTERNATE THE POSITION OF THE 90° AND 180° HOOKS AT EACH VERTICAL LAYER OF TIES.

ABUTMENT A5 (INTEGRAL, PILE ENCASED ABUTMENT)	
WISCONSIN DEPARTMENT OF TRANSPORTATION — BUREAU OF STRUCTURES	
APPROVED: Bill Oliva	DATE: 7-20

8. Foundation Details

Colorado

Integral Abutment on Drilled Shafts

Illinois

Integral Abutment Pile Orientation

NOTE: Illinois provides a similar detail for pile orientation for integral piers

Iowa

Integral Abutment Footing Details

NOTE: Iowa provides similar details for various beam types and skew ranges

Pennsylvania

Integral Abutment Pile Connection Details

Fixity Arrangement for Multi Span Structures

Mixed Substructure Types with Integral Abutments

Rhode Island

Foundation Plan

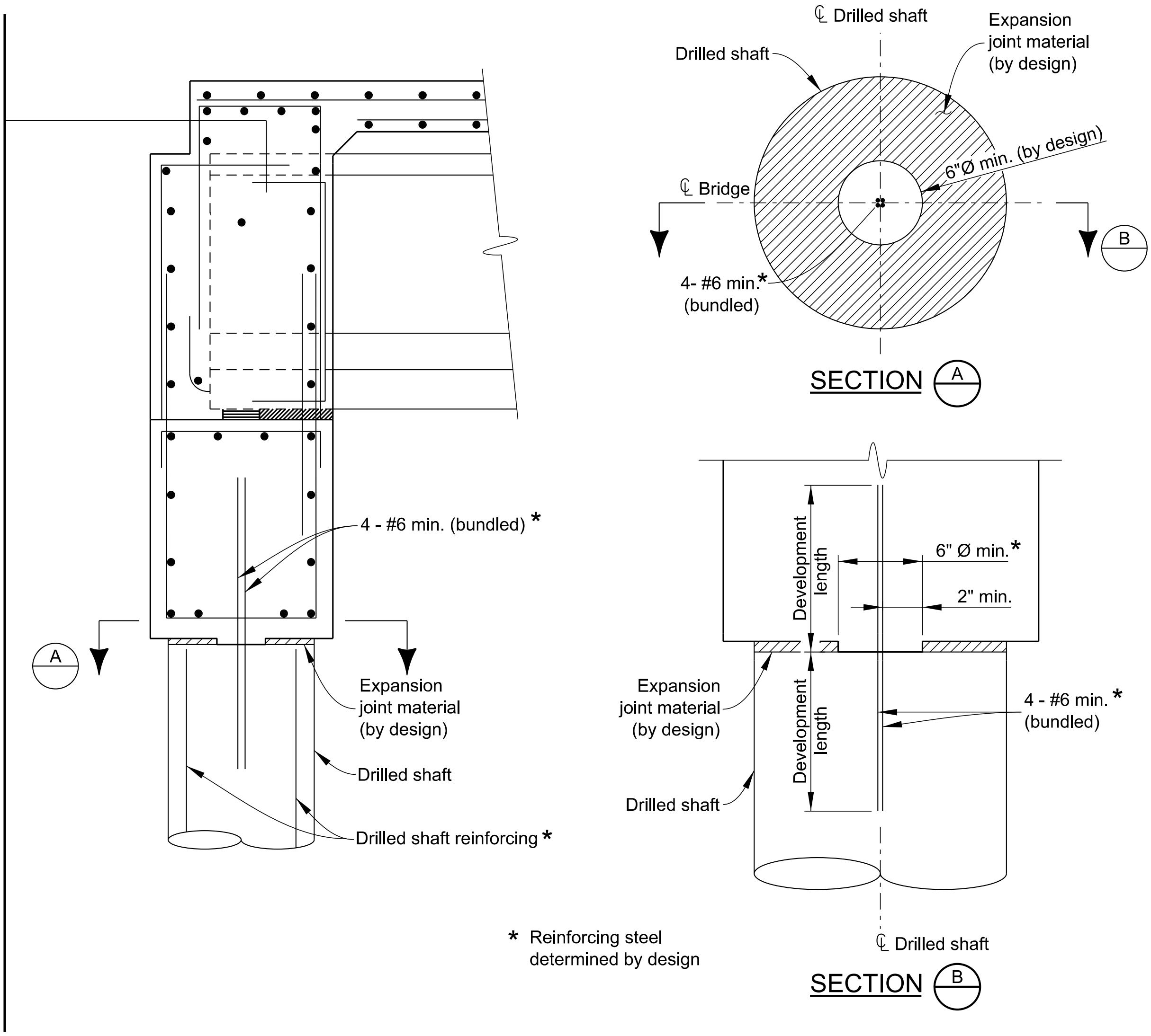
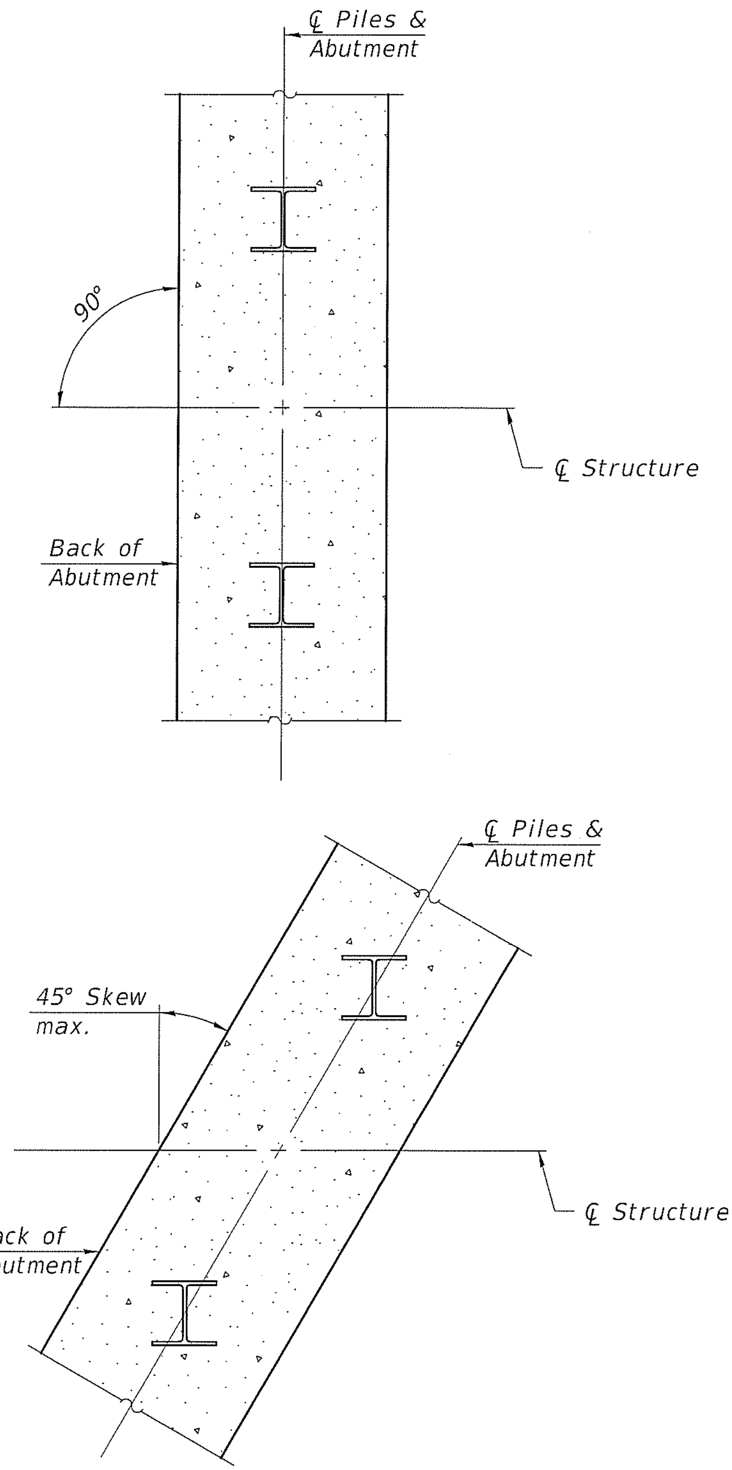


Figure 11-2: Integral Abutment on Drilled Shafts

(For details of reinforcement, refer to Figure 11-1.
See Notes 1-13 with Figure 11-1.)

11.3.2 Semi-integral Abutments

Semi-integral abutments are like integral abutments because both eliminate the expansion joints at supports and encase the girder ends in concrete. The difference is that the pin for a semi-integral abutment is located at the top of bearing seat via a bearing device and the foundation element connection at the bottom of bearing cap is fixed. The bearings accommodate the rotational and horizontal movements. Using spread footings, footings on piles or drilled shafts, multiple rows of piles, or drilled shafts can establish abutment fixity.



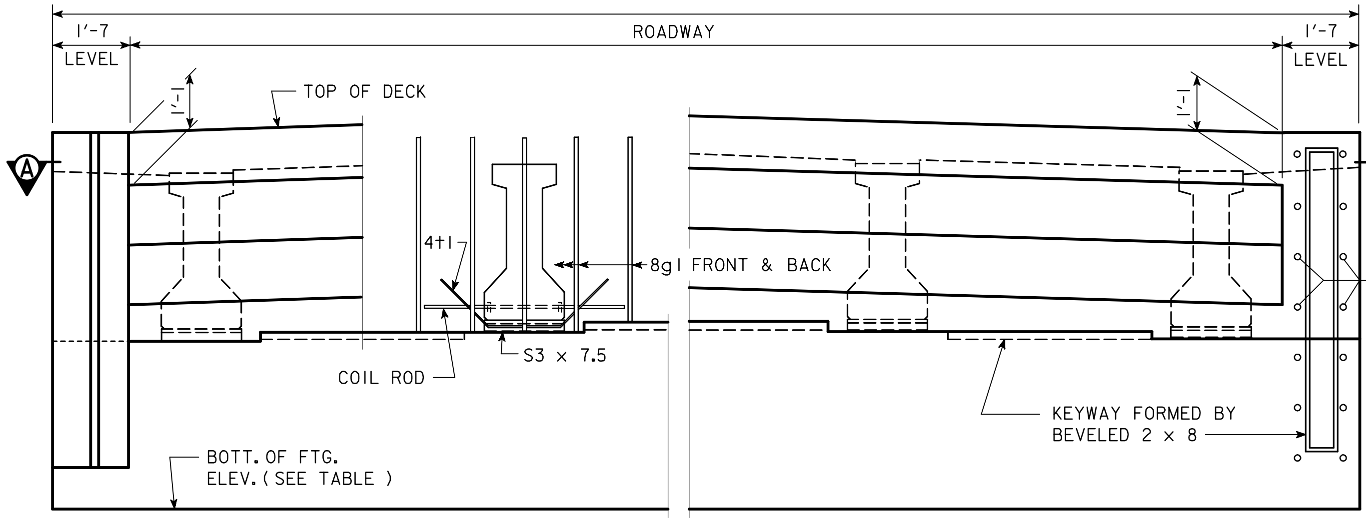
Note:
For integral abutments, the pile web is always perpendicular to the ℄ of structure.

INTEGRAL ABUTMENT PILE ORIENTATION

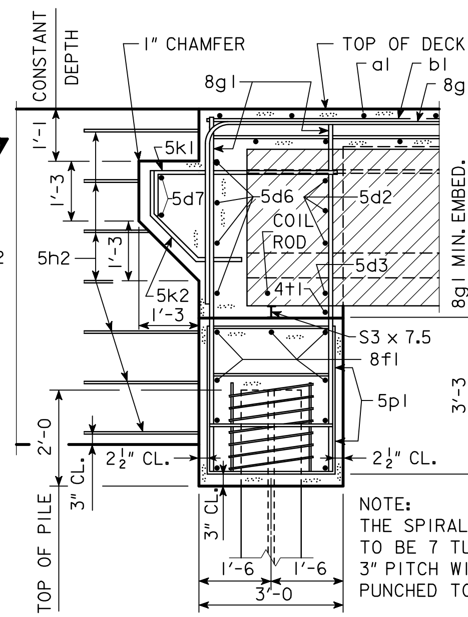
Figure 9

Illinois

BENCH MARK :



PART REAR ELEVATION AT ABUTMENT



NOTE:
THE SPIRAL AT THE TOP OF EACH PILE TO BE 7 TURNS OF No. 2 BAR, 21" DIAMETER, 3" PITCH WITH 3 - $L\frac{7}{8} \times \frac{7}{8} \times \frac{1}{8}$ SPACERS PUNCHED TO HOLD SPIRAL.

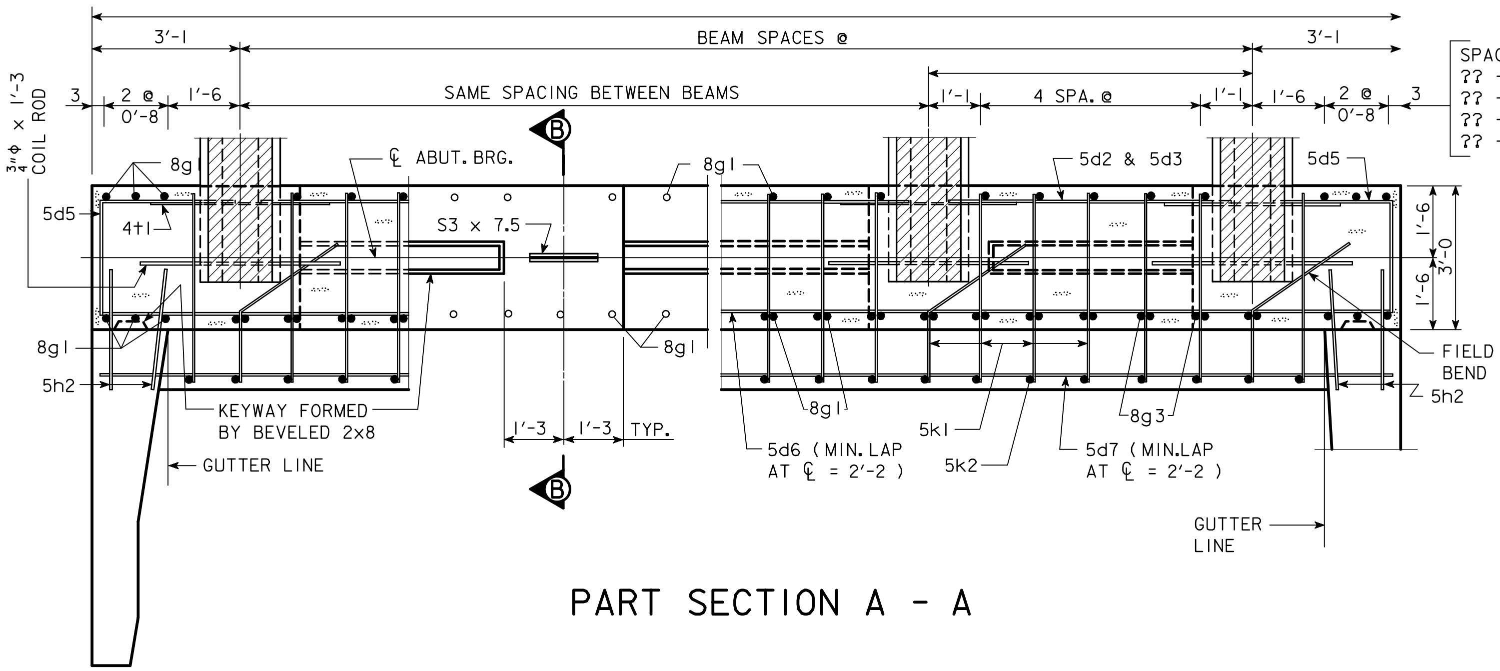
PART SECTION B-B

ABUTMENT STEP DIAGRAM

(REAR ELEVATION)

TABLE OF ABUTMENT ELEVATIONS		
POINT	ABUT.	ABUT.
ELEV. A		
BOTT. FTG. ELEV.		

TABLE OF ABUTMENT STEPS		
STEP	ABUT.	ABUT.
a		



SPACING FOR :
?? - 8g1 BACK FACE
?? - 8g1 FRONT FACE
?? - 8g3 BACK FACE
?? - 5k1 & 5k2 BACK FACE

NOTE: PLACE 5h2 BAR AT 1:6 SLOPE TO MATCH TRAFFIC SIDE OF ABUTMENT WING FACE (BOTH SIDES TYPICAL).

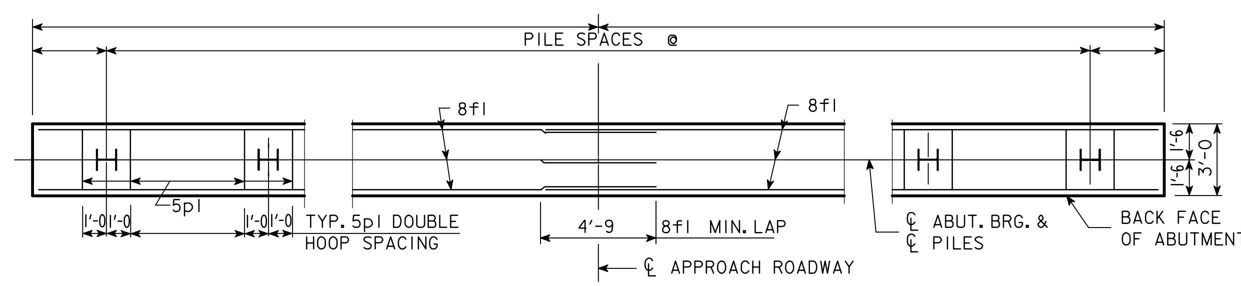
PART SECTION A - A

ABUTMENT CONCRETE QUANTITY	
LOCATION	QUANTITY
______ ABUTMENT FOOTING	
______ ABUTMENT FOOTING	
TOTAL (CU. YDS.)	

NOTE: CONCRETE QUANTITIES ARE INCLUDED ON THE SUMMARY QUANTITIES SHEET.

NOTE:
?? - HP 10 x 57 STEEL BEARING PILING REQUIRED AT EACH ABUTMENT.

NOTE: BARRIER RAIL NOT SHOWN IN DETAILS.



ABUTMENT PILE PLAN

ABUTMENT NOTES:

MINIMUM CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR REINFORCING BAR IS TO BE 2" UNLESS OTHERWISE NOTED OR SHOWN.

IF NECESSARY TO PREVENT DAMAGE TO THE END OF THE BRIDGE DECK AND BACKWALL FROM CONSTRUCTION EQUIPMENT, AN APPROPRIATE METHOD OF PROTECTION APPROVED BY THE ENGINEER SHALL BE PROVIDED BY THE BRIDGE CONTRACTOR AT NO EXTRA COST TO THE STATE.

CORRECTION 04-14 - ADDED CONCRETE QUANTITY TABLE & REFERRAL NOTE TO SUMMARY QUANTITY SHEET. REMOVED DESIGN BEARING NOTE FOR ABUT. PILING FROM ABUTMENT NOTES.
ENGLISHINTEGRALBRIDGES.DGN 2078 - THIS SHEET REDRAWN 9-8-88

ABUTMENT FOOTING DETAILS

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION
DESIGN SHEET NO. ____ OF ____ FILE NO. ________ DESIGN NO. ________

DESIGN TEAM	"A" OR "B" BEAMS - INTEGRAL ABUT. DETAILS - 0° SKEW	STANDARD SHEET 2078	COUNTY	PROJECT NUMBER	SHEET NUMBER

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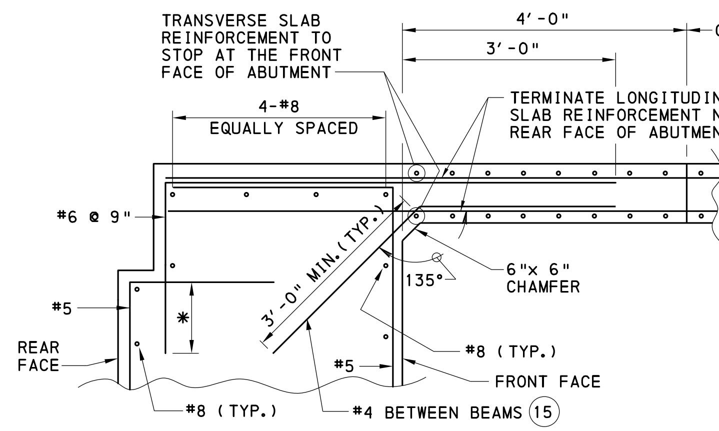
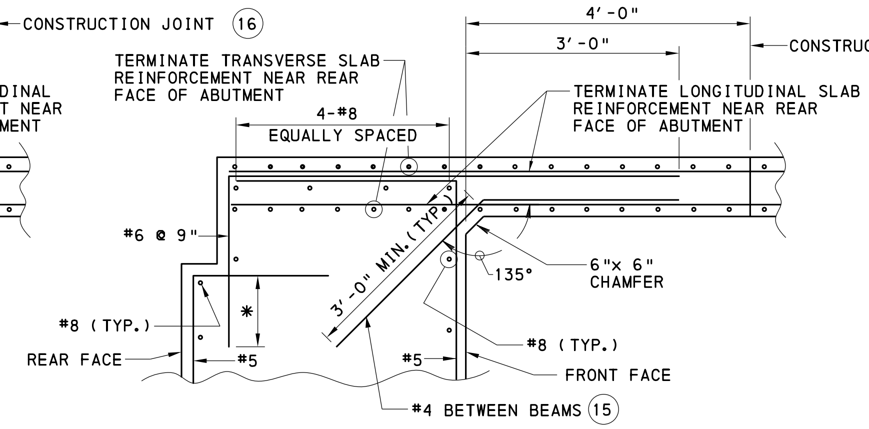




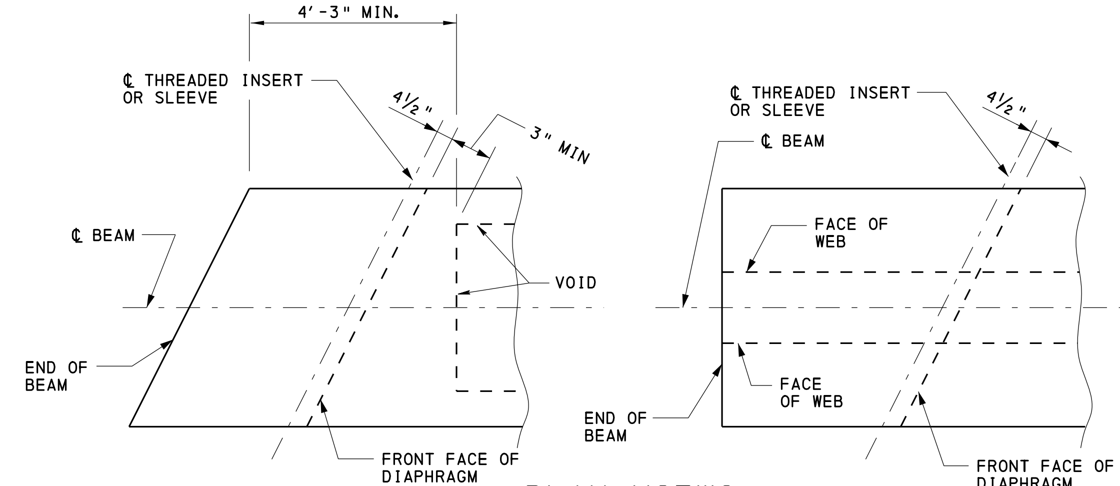
* 1'-6" MAXIMUM LENGTH ALLOWED DUE TO GIRDER DEPTH.

TRANSVERSE SLAB REINFORCEMENT
PARALLEL TO ABUTMENT
(SKEWS OF 75° TO 90°)

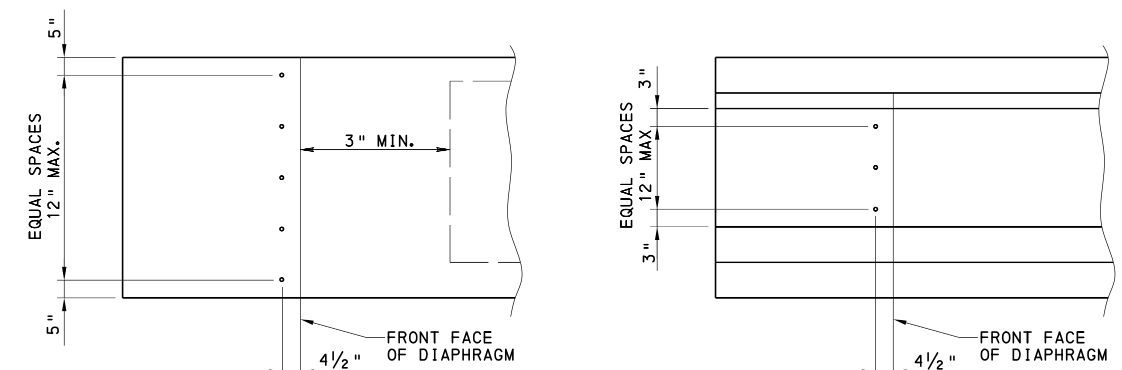
TRANSVERSE SLAB REINFORCEMENT
NOT PARALLEL TO ABUTMENT
(SKEWS < 75°)

SLAB-ABUTMENT CONNECTION DETAIL

- FOR DECK TOP REINFORCEMENT MAT: TRANSVERSE BARS SHOWN ON TOP, SIMILAR WHEN LONGITUDINAL BARS ON TOP.
- SECTIONS BETWEEN GIRDERS SHOWN



PLAN VIEWS



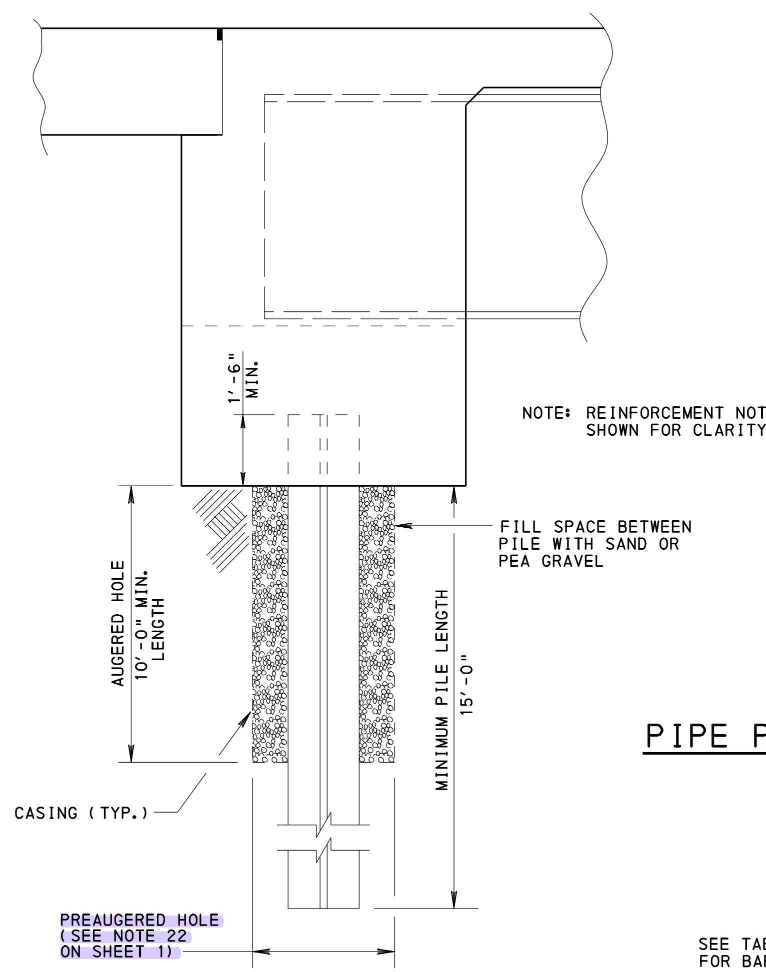
CONCRETE BOX BEAMS

CONCRETE I-BEAMS

ELEVATION VIEWS

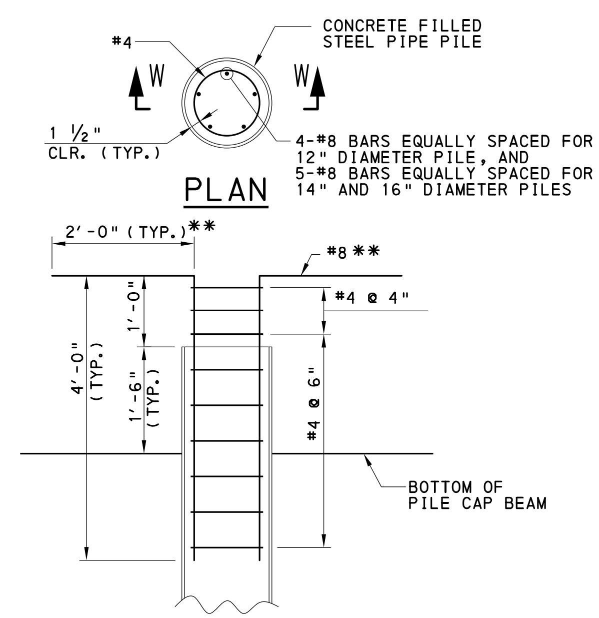
THREADED INSERT LOCATIONS IN PRESTRESS BEAMS. BEAM ENDS SUPPORTED ON INTEGRAL ABUTMENTS

(SEE SHEET 3 FOR HOLE LOCATION IN WEBS OF STEEL BEAMS)



INTEGRAL ABUTMENT PILE INSTALLATION DETAIL

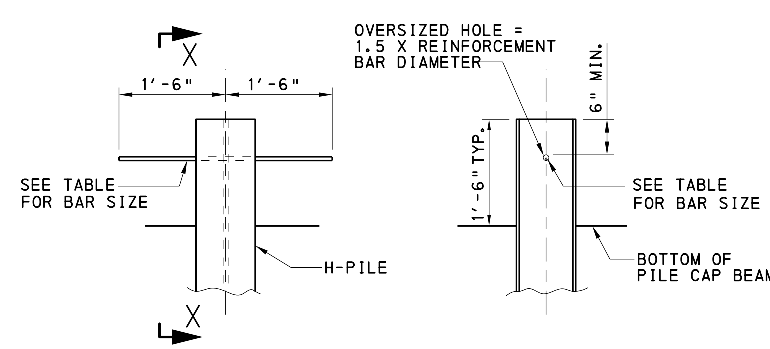
- SEE APPENDIX G OF DESIGN MANUAL PART 4 SECTION 1.4.2 FOR PRE AUGERING REQUIREMENTS
- PREDRILL OVERSIZED HOLES FOR ALL PILES IN ACCORDANCE WITH DESIGN MANUAL PART 4 AP.G.1.4.2.1. PLACE PILES VERTICAL IN THE HOLES BEFORE FILLING THE HOLES. FILL THE HOLES WITH DRY LOOSE SAND OR PEA GRAVEL BEFORE DRIVING THE PILES.



SECTION W-W

** HOOK 180° PER BC-736M OR ROTATE TO FIT SHORTER CAP WIDTHS

PIPE PILE-TO-PILE CAP CONNECTION DETAIL



ELEVATION

VIEW X-X

H-PILE-TO-PILE CAP CONNECTION DETAIL

H-PILE TO PILE CAP CONNECTION REINFORCEMENT

PILE SIZE	BAR
HP 10 x 57	#6
HP 12 x 53	#6
HP 12 x 63	#6
HP 12 x 74	#6
HP 12 x 84	#7
HP 14 x 73	#6
HP 14 x 89	#7
HP 14 x 102	#7
HP 14 x 117	#8

LEGEND:

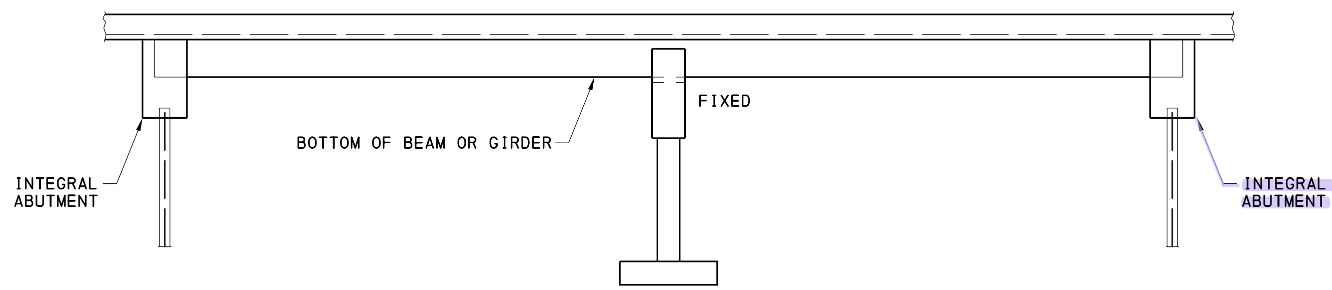
(15) SPACED WITH LONGITUDINAL DECK REINFORCEMENT

(16) DECK PLACEMENT SEQUENCE:
1. POUR THE ENTIRE DECK EXCEPT THE PORTIONS WITHIN 4'-0" FROM THE FRONT FACES OF THE ABUTMENTS.
2. THEN POUR THE END DIAPHRAGMS.
3. FOR GIRDER DEPTHS >36", WAIT A MINIMUM OF 2 HOURS BEFORE POURING THE REMAINER OF THE DECK. FOR GIRDER DEPTHS ≤36" THE REMAINDER OF THE DECK CAN BE POURED SIMULTANOUSLY WITH THE END DIAPHRAGMS.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
SLAB-ABUTMENT CONNECTION AND
PILE-ABUTMENT CONNECTION DETAILS

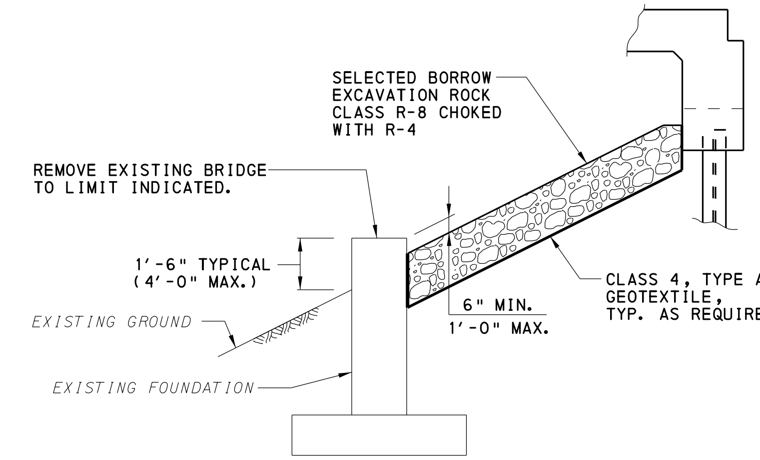
RECOMMENDED APR.29, 2016 — CHIEF BRIDGE ENGINEER
RECOMMENDED APR.29, 2016 — DIRECTOR, BUR. OF PROJECT DELIVERY



FIXITY ARRANGEMENT FOR MULTI SPAN STRUCTURES

NOTES:

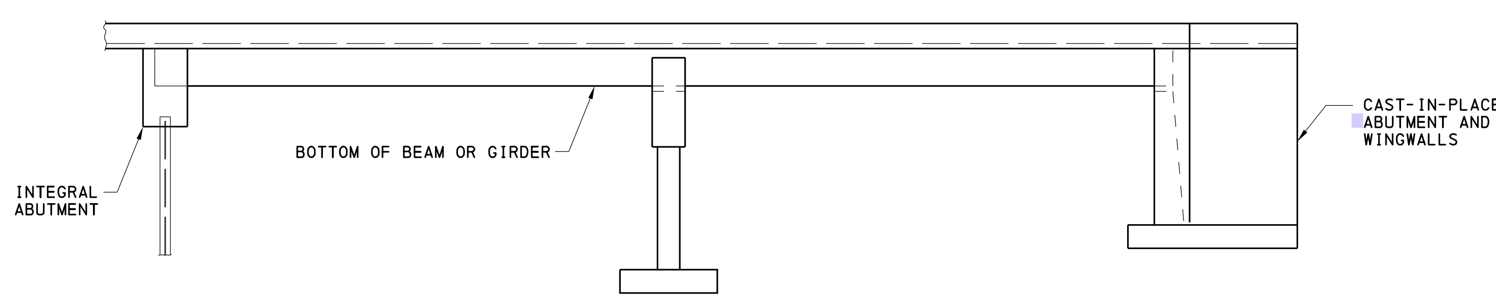
- FOR TWO SPAN ARRANGEMENT THE PIER SHOULD BE FIXED TO MINIMIZE LONGITUDINAL SUPERSTRUCTURE FORCES AT ABUTMENTS.
- FOR ADDITIONAL SPANS, PIER STIFFNESS MUST BE CONSIDERED TO DEVELOP THE MOST EFFICIENT DESIGNS AND MINIMIZE MOVEMENT.



DETAIL FOR USING EXISTING SUBSTRUCTURE UNIT FOR SLOPE PROTECTION

NOTE:

THE ABOVE DETAIL HAS PROVEN AN ECONOMICAL OPTION FOR MANY BRIDGE REPLACEMENTS. STABILITY OF THE REMAINING EXISTING STRUCTURE FOR PROPOSED CONDITIONS NEEDS TO BE CHECKED.
ADDITIONAL RIPRAP CAN BE ADDED TO AUGMENT THE EXISTING SUBSTRUCTURE UNIT IF THE LENGTH OR POSITION DOES NOT MEET SITE NEEDS COMPLETELY.



MIXED SUBSTRUCTURE TYPES

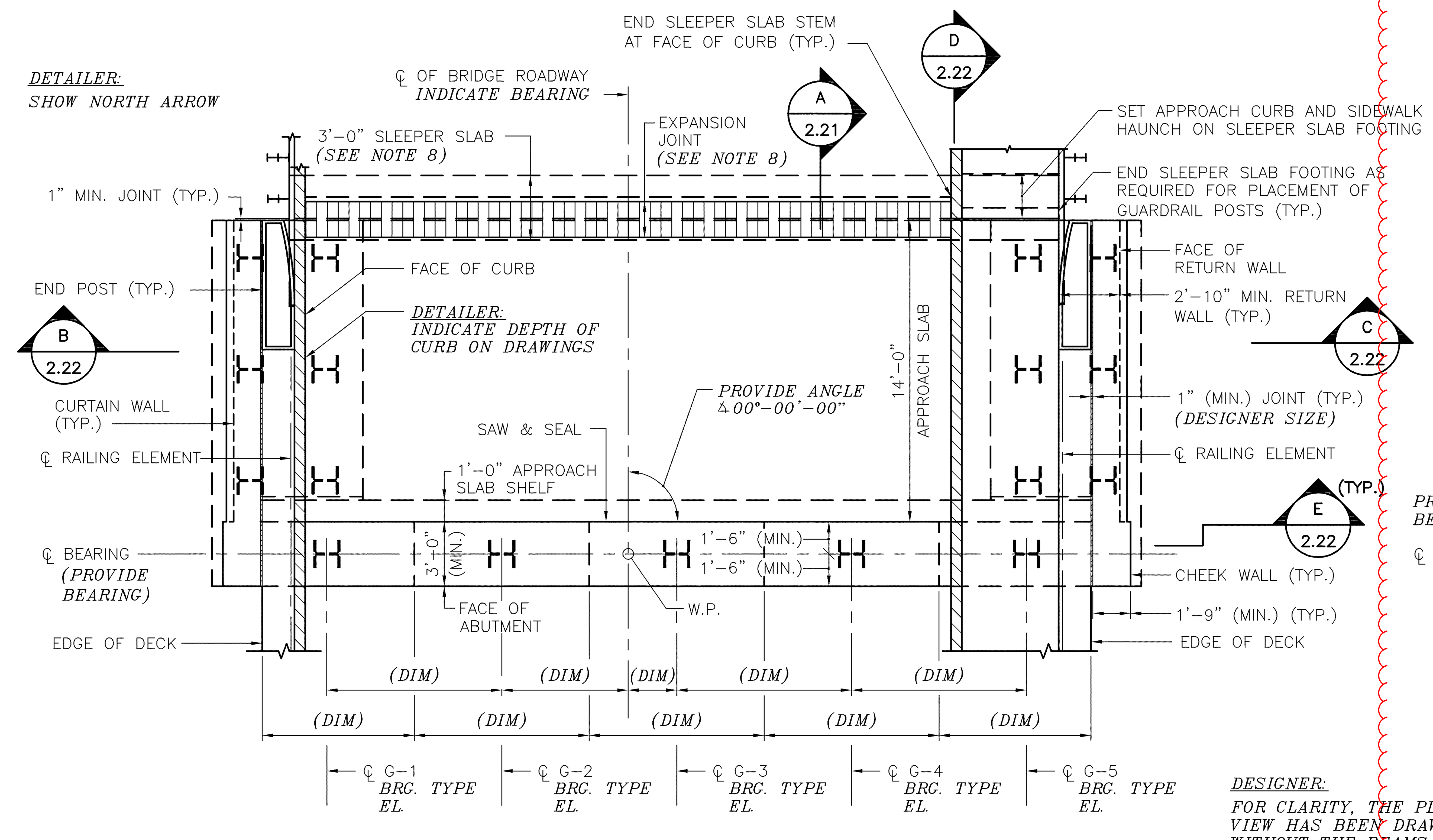
NOTE:

INTEGRAL ABUTMENTS MAY BE USED WITH OTHER ABUTMENT TYPES TO MEET SITE REQUIREMENTS FOR GEOMETRY OR GEOTECHNICAL FEATURES. FIXITY SHOULD BE CAREFULLY CONSIDERED TO MINIMIZE JOINTS AND FOUNDATION PRESSURES.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
MISCELLANEOUS DETAILS

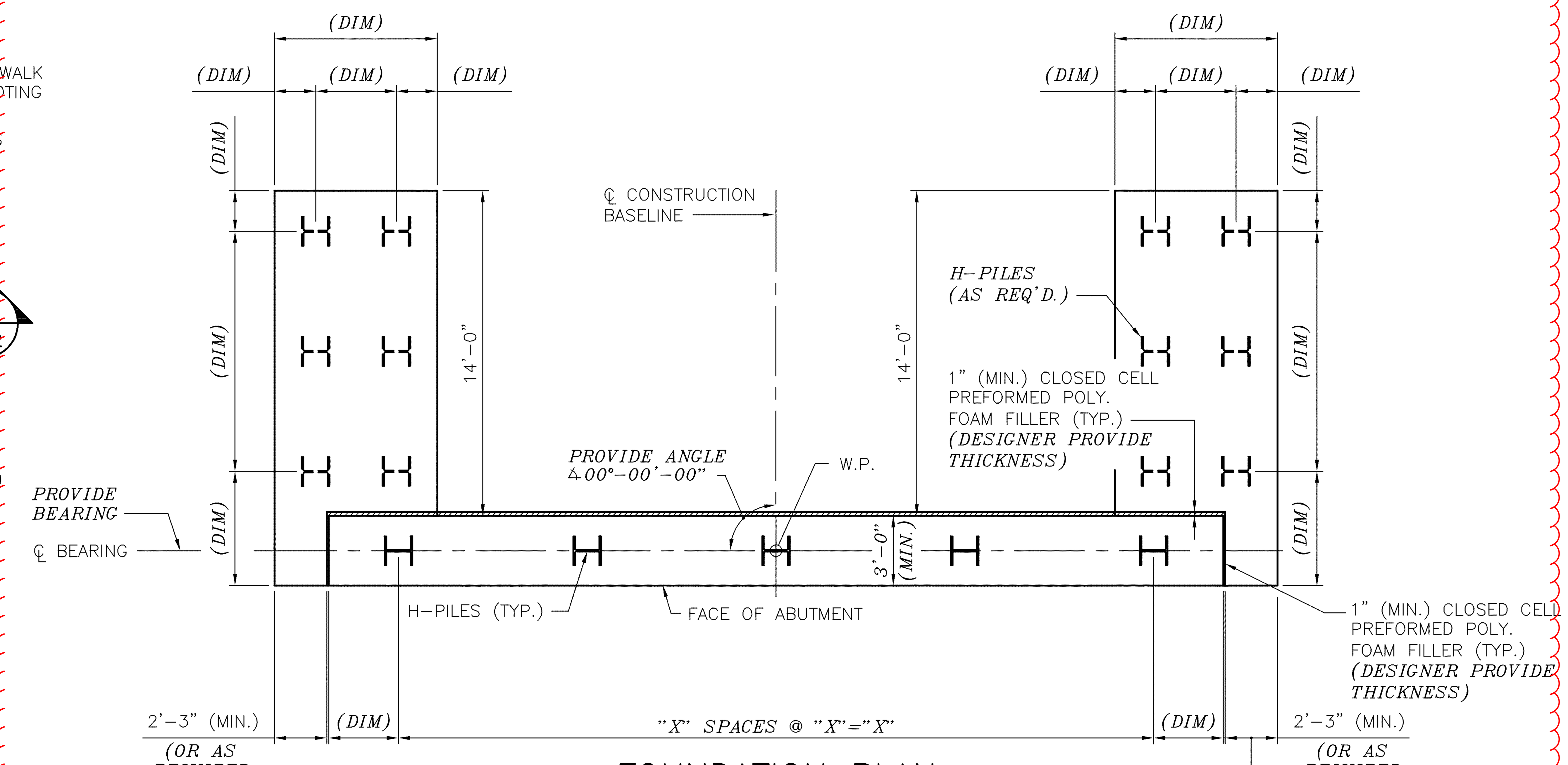
RECOMMENDED APR. 29, 2016 Thomas P. Macioce CHIEF BRIDGE ENGINEER	RECOMMENDED APR. 29, 2016 Brian G. Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	SHEET 9 OF 9 BD-667M



PLAN AT BEAM SEATS

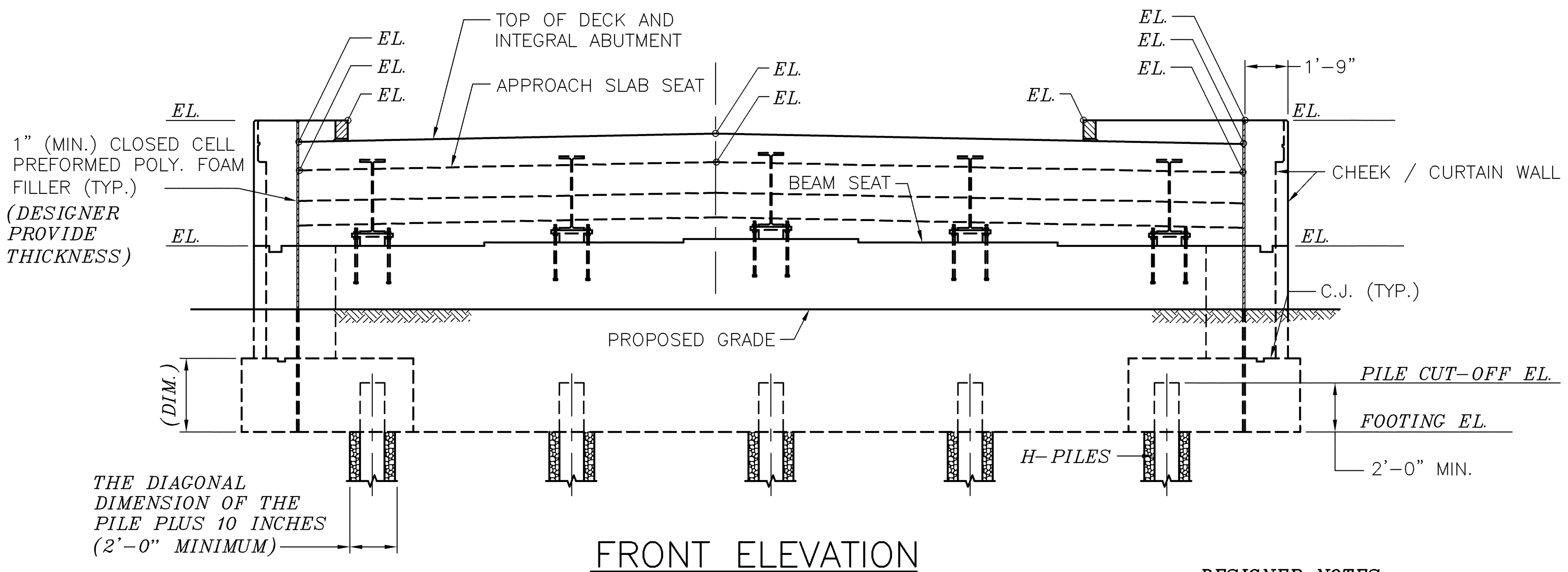
SCALE: 1/4"=1'–0"

DESIGNER:
FOR CLARITY, THE PLAN VIEW HAS BEEN DRAWN WITHOUT THE BEAMS AND ANCHOR ASSEMBLIES.



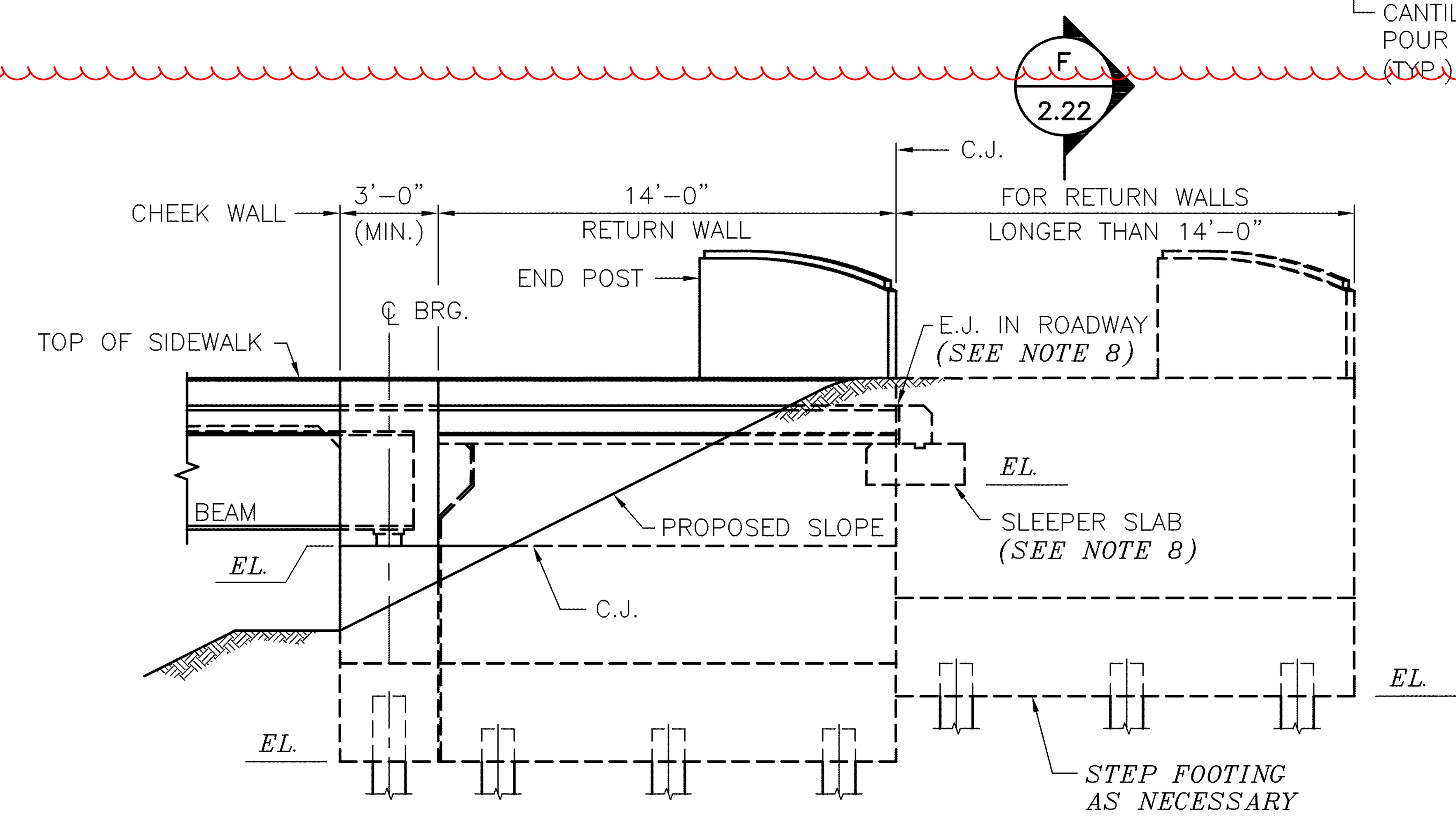
FOUNDATION PLAN

SCALE: 1/4"=1'–0"



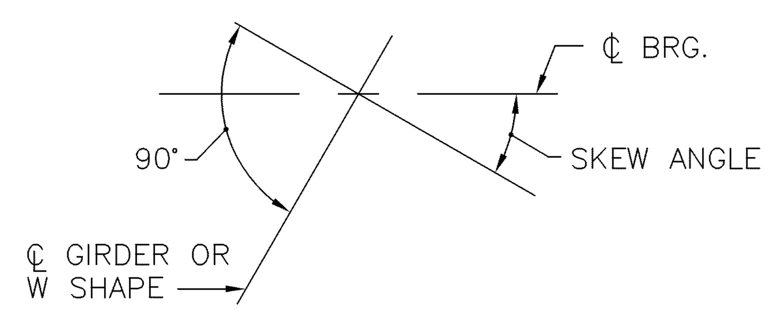
FRONT ELEVATION

SCALE: 1/4"=1'–0"



RETURN WALL AT SIDEWALK / SAFETY WALK

SCALE: 1/4"=1'–0"



SKEW ANGLE DESIGNATION

DESIGNER NOTES:

1. *THE DESIGNER SHALL REFER TO SECTION 11.3.3 (INTEGRAL ABUTMENTS) OF THE RIDOT LRFD BRIDGE DESIGN MANUAL FOR DESIGN AND DETAILING REQUIREMENTS AND LIMITATIONS ON THE USE OF INTEGRAL ABUTMENTS*
2. *A NOTE SHALL BE PROVIDED ON THE CONTRACT DRAWINGS STATING THAT THE TOP OF DECK ELEVATIONS ARE GIVEN AT THE FRONT FACE OF INTEGRAL ABUTMENTS.*
3. *UTILITY PASSAGE THROUGH THE INTEGRAL ABUTMENT SHOULD BE AVOIDED. (SEE SECTION 11.3.3 OF THE RIDOT LRFD BRIDGE DESIGN MANUAL).*
4. *ABUTMENT DETAILS FOR SKEWED ABUTMENTS ARE SIMILAR.*
5. *REINFORCING SHOWN IS MINIMUM ONLY.*
6. *THE SUGGESTED SCALE FOR ANY ABUTMENT PLAN AND ELEVATION IS 1/4"=1'–0".*
7. *REFERENCES TO END POSTS AND CENTERLINES OF RAILING ELEMENTS ARE INTENDED TO REFER TO THE DETAILS SHOWN ELSEWHERE IN THESE BRIDGE STANDARDS (SEE APPROPRIATE DETAILS).*
8. *SLEEPER SLAB AND EXPANSION JOINT IN ROADWAY MAY BE OMITTED FOR BRIDGE SUPERSTRUCTURE SPANS 60 FEET OR LESS.*
9. *SEE DWG. 2.22 FOR RETURN WALL DETAILS*

REVISIONS	
No.	DATE

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

BRIDGE STANDARDS

INTEGRAL ABUTMENT
SHEET 1

DRAWING NUMBER: 2.20

9. General Notes

Massachusetts

Integral Abutment Terminology

Construction Notes for Integral Abutments

Pile Notes for Integral Abutments

Designer Notes for Integral Abutments

Ohio

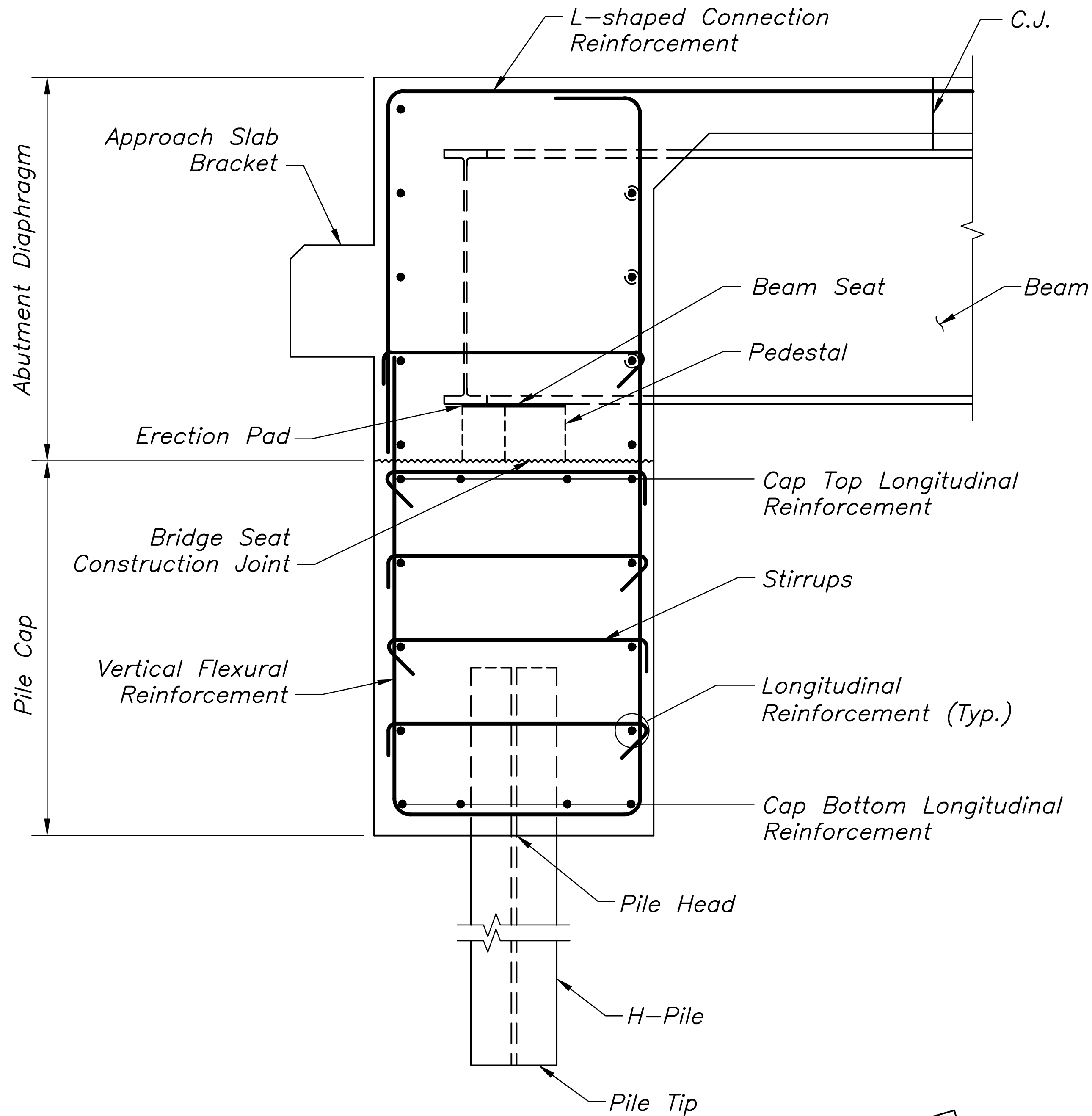
General Notes for Integral Abutment Construction

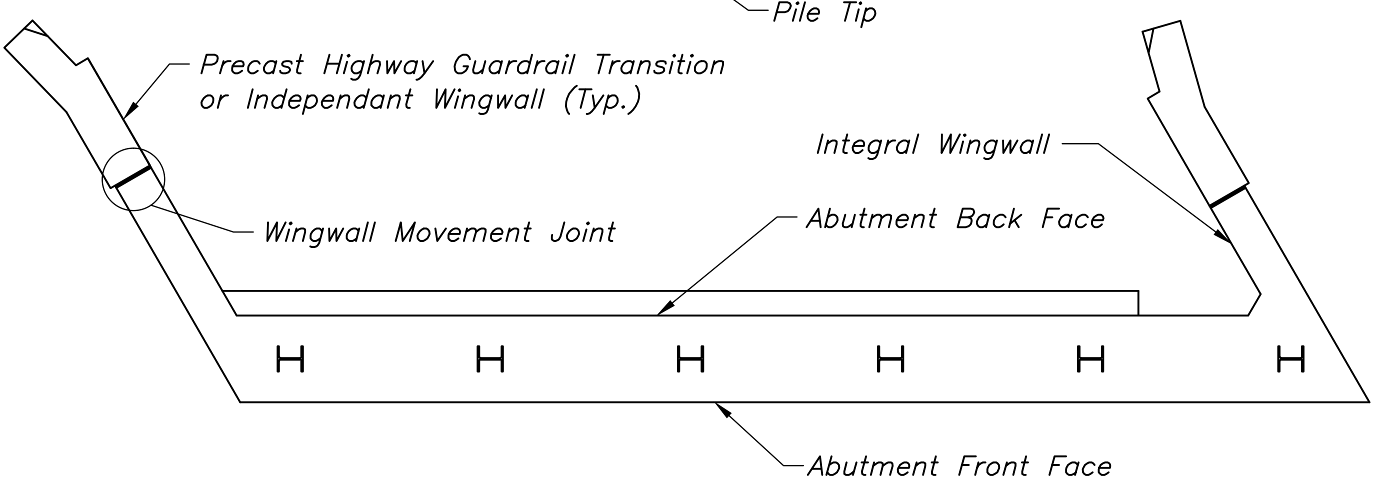
Pennsylvania

General Notes for Integral Abutments

Wisconsin

Designer Notes for Integral Abutments





massDOT
Massachusetts Department of Transportation
Highway Division

LRFD BRIDGE MANUAL, PART II

TERMINOLOGY

INTEGRAL ABUTMENTS

DATE OF ISSUE
JUNE 2013

DRAWING NUMBER
12.1.1

Place these notes on the Construction Drawing containing the Abutment Section (Dwg. Nos. 12.2.1 thru 12.2.5) and place the Abutment Section Reinforcement drawing (Dwg. Nos. 12.2.6 and 12.2.7) on that same sheet. Use the appropriate notes to the particular superstructure type.

CONSTRUCTION NOTES:

1. ALL REINFORCEMENT SHALL BE COATED.

2. DECK SLAB REINFORCEMENT NOT SHOWN FOR CLARITY. CONTINUE DECK SLAB REINFORCEMENT TO BACK OF ABUTMENT.

3. THE CONTRACTOR SHALL FOLLOW THE DECK PLACEMENT SEQUENCE AS SHOWN ON THESE CONSTRUCTION DRAWINGS.

4. ALL CONCRETE SHALL CONTAIN SUPERPLASTICIZER TO ENSURE ADEQUATE CONSOLIDATION.

5. BOTH ABUTMENTS SHALL BE BACKFILLED SIMULTANEOUSLY. NO MORE THAN TWO (2) FEET OF DIFFERENTIAL BACKFILL HEIGHT SHALL BE PERMITTED. BACKFILLING SHALL NOT BEGIN UNTIL THE ABUTMENT AND DECK CONSTRUCTION IS COMPLETE.

6. ALL UNPAINTED WEATHERING STEEL EMBEDDED IN THE ABUTMENT AND WITHIN 12" OF THE ABUTMENT FACE SHALL BE PAINTED. THE FINISH COAT COLOR SHALL MATCH COLOR CHIP NO. 30045 OF FEDERAL STANDARD 595B.
   (Do not include this note if weathering steel is not used.)

7. THE CONTRACTOR MAY USE MECHANICAL REINFORCING BAR SPLICERS IN LIEU OF TENSION LAP SPLICES TO FACILITATE CONSTRUCTION. HOWEVER, NO ADDITIONAL COMPENSATION WILL BE PROVIDED FOR THE USE OF MECHANICAL REINFORCING BAR SPLICERS.
   (Dimension the length required for a Class "C" Lap Splice. If a Class "C" Lap Splice will not fit into the depth provided, replace Note 7 with the following:)

   MECHANICAL REINFORCING BAR SPLICERS SHALL BE INSTALLED TO MAKE THIS REINFORCEMENT CONTINUOUS.

8. MECHANICAL REINFORCING BAR SPLICERS SHALL BE INSTALLED AT STAGE CONSTRUCTION JOINTS FOR ALL TRANSVERSE REINFORCEMENT.
   (Do not include this note if stage construction is not used.)

9. THE TOP OF THE APPROACH SLAB SHALL MATCH THE TOP OF THE ABUTMENT DIAPHRAGM.

INTEGRAL ABUTMENT PILE NOTES:

These Notes shall be modified, if necessary, based upon the recommendations contained within the Geotechnical Report.

1. A TRENCH WITH A DEPTH OF 3'–0" AND A MINIMUM WIDTH OF 2'–6" SHALL BE CONSTRUCTED DIRECTLY BELOW THE BOTTOM OF THE PILE CAP ELEVATION. AFTER THE PILES ARE DRIVEN, THE TRENCH SHALL BE FILLED WITH CRUSHED STONE (M2.01.6).

2. ALL SPLICES SHALL HAVE COMPLETE PENETRATION BUTT WELDS. THERE SHALL BE NO SPLICES WITHIN THE TOP 20 FEET OF PILE. SPLICE WELDS SHALL BE 100% UT.

3. THE FACTORED AXIAL DESIGN LOAD PER PILE IS X KIPS AS PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS STRENGTH I LOAD COMBINATION. *(Designer to specify the Limit State and the Group Load Combination that produce the highest axial load)*

4. THE FACTORED STRUCTURAL RESISTANCE PER PILE IS X KIPS AND IS THE PRODUCT OF THE NOMINAL STRUCTURAL RESISTANCE OF X KIPS AND A RESISTANCE FACTOR OF 0.XX.

5. THE FACTORED GEOTECHNICAL PILE RESISTANCE IS X KIPS. THE ESTIMATED TIP ELEVATION IS XXX FEET.
(Use this note only when the Factored Geotechnical Capacity controls the pile axial capacity, such as from friction or friction and end bearing as specified in the Geotechnical Report.)

6a. THE MINIMUM TIP ELEVATION IS XXX FEET.
(Use this note only when the required pile length is not determined by the required axial capacity, i.e., lateral loading, scour resistance, or other factors, as recommended in the Geotechnical Report, determine the pile length.)

6b. PILES SHALL BE DRIVEN TO BEDROCK WITH AN ESTIMATED TIP ELEVATION OF XXX FEET. HEAVY DUTY PILE SHOES SHALL BE INSTALLED ON THE TIPS OF ALL PILES. PREFABRICATED PILE SHOES MAY BE USED IF APPROVED BY THE ENGINEER.
(Include this note only when the Factored Structural Capacity controls the pile axial capacity due to end bearing on rock as specified in the Geotechnical Report.)

6c. DETERMINATION OF THE DRIVEN PILE RESISTANCE, PILE DRIVING CRITERIA, AND PILE INTEGRITY SHALL BE PERFORMED USING THE XX *(Designer to specify the Formula Method, WEAP, PDA, Static – Cyclic (Express) Load Test, Static Load Test, or other system, as recommended in the Geotechnical Report)* DRIVING/TESTING METHOD WITH A RESISTANCE FACTOR OF 0.XX. PILES SHALL BE INSTALLED TO ACHIEVE A FACTORED DRIVEN RESISTANCE EQUAL TO OR GREATER THAN THE FACTORED AXIAL DESIGN LOAD.

7. THE CONTRACTOR SHALL SUBMIT A PILE SCHEDULE, PILE INSTALLATION, AND PILE DRIVING/TESTING PLAN FOR REVIEW AND APPROVAL OF THE ENGINEER.

8. PILES SHALL CONFORM TO AASHTO M270 GRADE 50.

REQUIRED PILE LOCATION TOLERANCES:

1. CONFORMANCE TO THE FOLLOWING TOLERANCES IS OF EXTREME IMPORTANCE TO FOUNDATIONS OF THIS TYPE.

2. PRIOR TO DRIVING, EACH ABUTMENT PILE SHALL BE HELD BY TEMPLATE TO WITHIN 1" OF PLAN LOCATION.

3. AFTER EACH ABUTMENT PILE IS DRIVEN, THE TOP OF THE PILE SHALL BE WITHIN 3" OF PLAN LOCATION.

NOTES:

1. *Cap Top and Bottom Longitudinal Reinforcement shall be as per Table on Dwg. No. 12.2.13.*

2. *The horizontal leg of the L–shaped connection bars shall be extended into the deck beyond the inside face of the abutment diaphragm for a length of:*
   - *for Simple Span Bridges:*
     10% of the Span Length + Ld
   - *for Continuous Span Bridges:*
     10% of the End Span Length + Ld

3. *Continue stirrups to bridge seat construction joint or to a level just below approach slab support bracket, whichever is higher. Specify same spacings as horizontal and vertical bars.*

4. *Minimum Required Primary (Longitudinal) and Secondary (Vertical) Integral Wingwall Reinforcement shall be as per Dwg. No. 12.2.13.*

5. *The Fillet Reinforcement as well as the End of Integral Wingwall Reinforcement shall be of the same size and spacing as the Primary Integral Wingwall Reinforcement.*

6. *The Tension Zone Reinforcement shall be of the same size as the Primary Integral Wingwall Reinforcement and shall be distributed throughout the tension zone as shown.*

7. *Check constructability of NEBT integral abutment bridges on skew. Ensure sufficient clearance between flanges and the back of the abutment for placement of reinforcement and consolidation of concrete. The minimum clear cover between flanges and the back of the abutment shall be 4". The abutment thickness may be increased to accommodate these requirements. Box and Deck Beam ends shall be skewed for this purpose.*

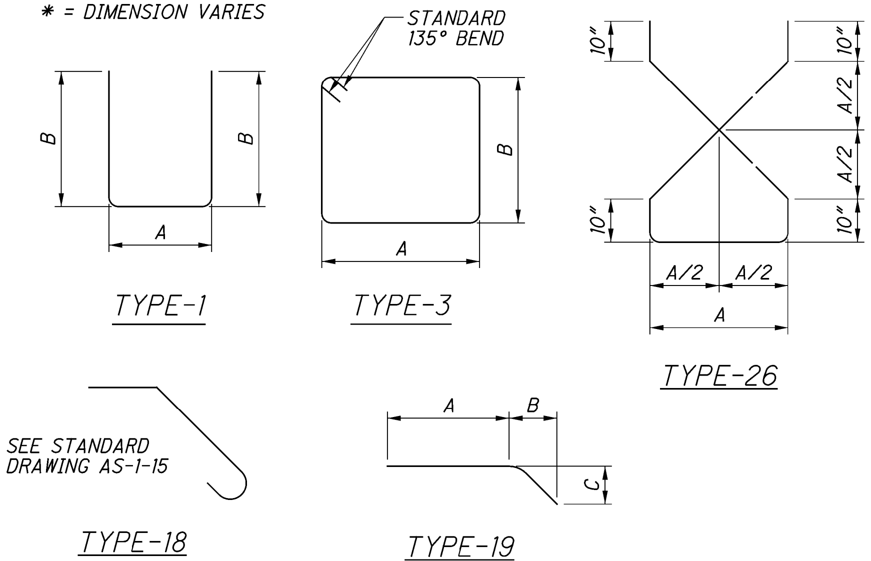
8. *Reinforcement configuration shown is conceptual. The Designer shall modify the arrangement as necessary by design.*

9. *Deck drains shall be specified for all integral abutment bridges with HMA wearing surface and shall be located in relation to the abutment diaphragm as shown on Dwg. No. 7.3.1.*

REINFORCING STEEL LIST

MARK	LENGTH	TYPE	A	B	C
A401	9'-6"	3	2'-6"	2'-0"	
A501	*	1	2'-8"	*	
A502	*	1	2'-2"	*	
A503	SERIES *	1	2'-2"	SERIES *	
A504	*	1	2'-2"	*	
A505	*	1	2'-2"	*	
A506	*	19	*	*	*
A601	*	26			
D401	8'-1"	1	1'-4"	3'-6"	
D501	*	1	2'-8"	*	
D502	*	2	2'-2"	*	
D801	*	18			

* = DIMENSION VARIES



GENERAL NOTES:

LIMITATIONS:

THIS STANDARD DRAWING PROVIDES PREFERRED AND/ OR TYPICAL DETAILS FOR INTEGRAL ABUTMENTS. TREAT THE ABUTMENT DIMENSIONS, CONSTRUCTION JOINTS AND REINFORCING SHOWN IN THIS DRAWING AS MINIMUM VALUES AND A PERFORM A COMPLETE DESIGN FOR THE ABUTMENT. DO NOT REFERENCE THESE DRAWINGS IN THE CONTRACT PLANS AND DO NOT USE AS STANDALONE CONSTRUCTION DRAWINGS.

PROVIDE ALL INFORMATION REQUIRED TO CONSTRUCT THE ABUTMENT IN THE PROJECT PLANS.

THE INTEGRAL ABUTMENT DETAILS PRESENTED IN THIS DRAWING ARE INTENDED FOR USE ON STRAIGHT OR CURVED ALIGNMENT WITH TANGENT SUPERSTRUCTURES WITH A MAXIMUM SKEW OF 30°. AT 0° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM OR GIRDER BRIDGES IS 267' (400' TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). AT 30° SKEW, THE MAXIMUM PERMISSIBLE EXPANSION LENGTH FOR INTEGRAL STEEL BEAM AND GIRDER BRIDGES IS 133' (200' TOTAL STRUCTURE LENGTH, ASSUMING 2/3 MOVEMENT COULD OCCUR IN ONE DIRECTION). FOR SKEWS BETWEEN 0° AND 30°, STRAIGHT LINE INTERPOLATION SHALL BE USED TO DETERMINE THE MAXIMUM PERMISSIBLE EXPANSION LENGTH.

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON A SINGLE ROW OF PILES. ALLOWABLE PILE TYPES AND SIZES, ALONG WITH MINIMUM FRISTION PILE LENGTHS, ARE SHOWN IN THE TABLE BELOW.

PILE SIZE	MINIMUM LENGTH, FT.	
	CLAY	SAND
HP10x42	30	25
HP12x53	35	25
HP14x73	40	30
12" CIP	45	30
14" CIP	50	35

IF THE MINIMUM LENGTH SHOWN IN THE TABLE ABOVE CANNOT BE OBTAINED, THEN THE DESIGNER SHALL PROVIDE CALCULATIONS TO SUPPORT THE USE OF A SHORTER LENGTH, AND, IN THE CASE OF PILES DRIVEN TO REFUSAL ON BEDROCK, REFER TO BDM SECTION 305.3.5.7. THE CALCULATIONS SHALL DEMONSTRATE THAT ADEQUATE LATERAL RESISTANCE IS AVAILABLE, THAT NO LATERAL DEFLECTION OCCURS AT THE BOTTOM OF THE PILES, AND THAT THE COMBINED AXIAL COMPRESSION AND FLEXURE IN THE PILES SATISFIES THE REQUIREMENTS OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

PILE TYPES AND SIZES OTHER THAN THOSE SHOWN IN THE TABLE ABOVE SHALL NOT BE USED UNLESS APPROVED BY THE DEPARTMENT. THE MAXIMUM ALLOWABLE PILE SPACING IS 8'. THE MINIMUM ALLOWABLE PILE SPACING IS 3 PILE DIAMETERS. THE PILE DIAMETER FOR AN HP SHAPE SHALL BE TAKEN AS THE DIAGONAL DISTANCE BETWEEN FLANGE TIPS.

LIMITATIONS CONT'D:

THE HEIGHT OF THE PILE CAP SHALL NOT EXCEED 7'-6".

INTEGRAL ABUTMENTS SHALL BE SUPPORTED ON AT LEAST 4 PILES. FOR PHASED CONSTRUCTION PROJECTS, EACH PHASE SHALL BE SUPPORTED ON AT LEAST 4 PILES.

INTEGRAL ABUTMENTS SHALL NOT BE USED WHERE THERE ARE CONCERNS ABOUT SETTLEMENT OR DIFFERENTIAL SETTLEMENT.

DESIGN SPECIFICATIONS:

THIS STRUCTURE SHALL CONFORM TO THE LATEST "LRFD BRIDGE DESIGN SPECIFICATIONS" ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS AND THE ODOT BRIDGE DESIGN MANUAL.

DESIGN LOADING:

HL-93 LIVE LOAD
FUTURE WEARING SURFACE (FWS) OF 0.060 KSF

DESIGN DATA:

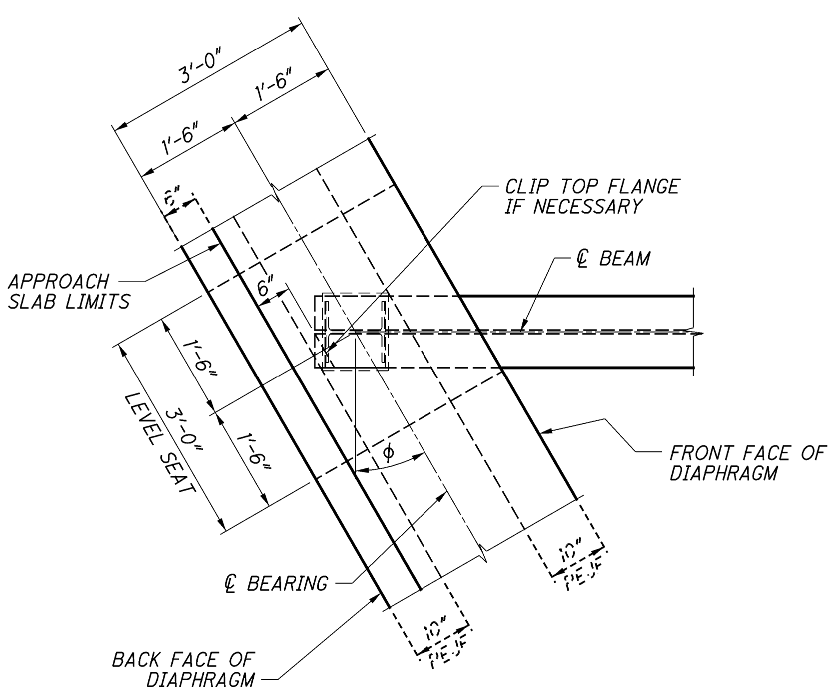
CONCRETE CLASS QC2 - COMPRESSIVE STRENGTH 4.5 KSI (SUPERSTRUCTURE)
CONCRETE CLASS QC1 - COMPRESSIVE STRENGTH 4.0 KSI (SUBSTRUCTURE)
REINFORCING STEEL - MINIMUM YIELD STRENGTH 60 KSI
STRUCTURAL STEEL - ASTM A709 GRADE 36 OR 50 - YIELD STRENGTH 36 OR 50 KSI (THE DESIGNER SHALL SPECIFY THE REQUIRED STEEL GRADE AND YIELD STRENGTH IN THE BRIDGE GENERAL NOTES)
STEEL H-PILES - ASTM A572 - YIELD STRENGTH 50 KSI

PAINTING OF STRUCTURAL STEEL:

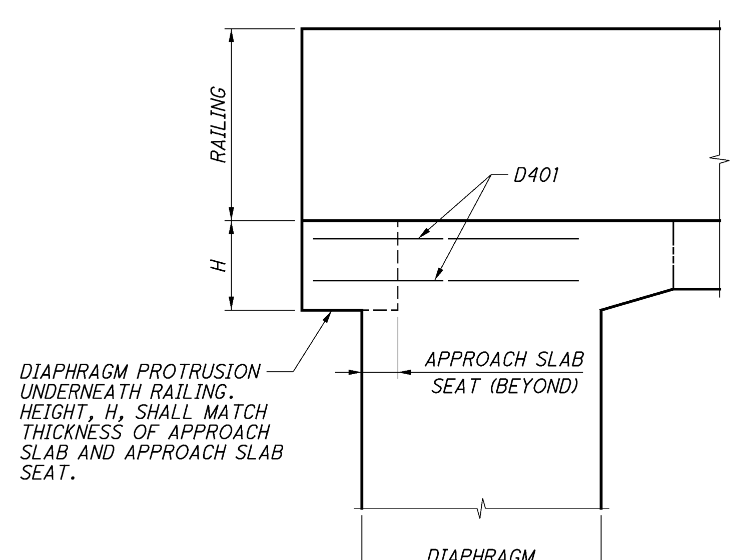
THE ENTIRE SURFACE AREA ENCASED WITHIN THE ABUTMENT DIAPHRAGM AND EXTENDING 1'-0' OUTSIDE THE DIAPHRAGM, SHALL BE COATED WITH A SHOP APPLIED, INORGANIC ZINC PRIME COAT ACCORDING TO C&MS 514. NO ADDITIONAL COATINGS ARE REQUIRED ON THE EMBEDDED STEEL SURFACES. THE COST OF APPLYING THE PRIME COAT IS INCIDENTAL TO THE BID FOR STRUCTURAL STEEL. REPAIR COATING DAMAGED BY WELDING ACCORDING TO C&MS 514.22.

ELASTOMERIC BEARING ASSEMBLY:

UTILIZE A WIDE FLANGE SHAPE IN LIEU OF AN HP SHAPE IN THE BEARING ASSEMBLY IF THE STRUCTURAL STEEL FOR THE MAIN MEMBER IS WEATHERING STEEL.



INTEGRAL ABUTMENT PARTIAL PLAN



SECTION B-B
(APPLIES AT BOTH ENDS OF ABUTMENT)
(BEAM & APPROACH RAILING NOT SHOWN)

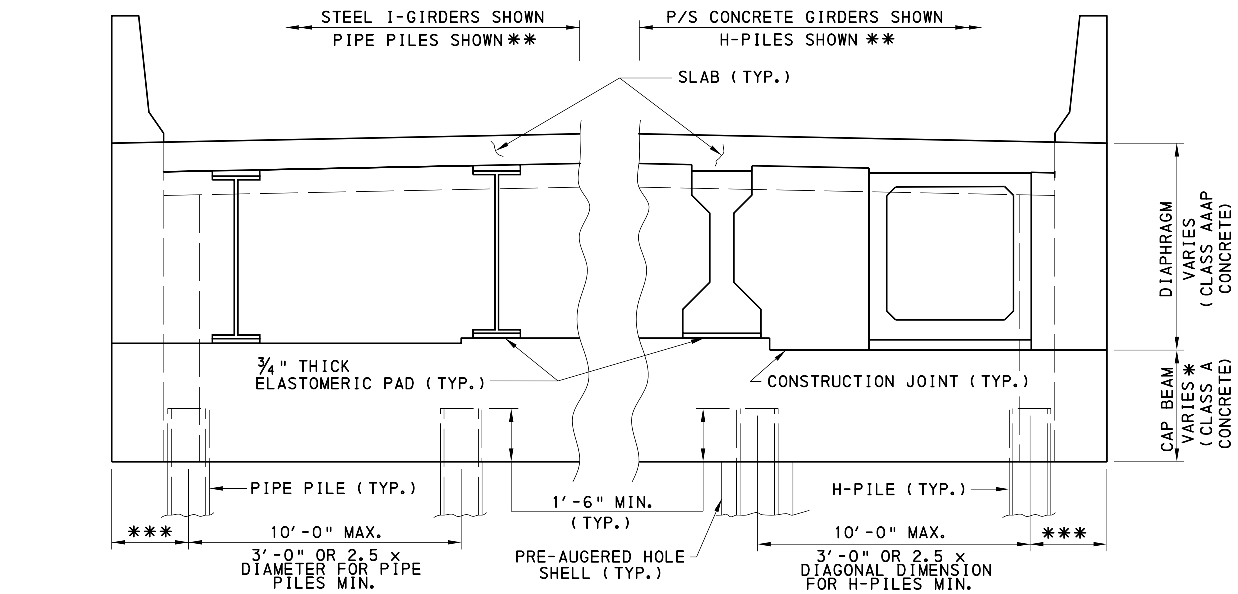
DESIGN AGENCY
OFFICE OF STRUCTURAL ENGINEERING

STATE OF OHIO DEPARTMENT OF TRANSPORTATION
07-17-20
DATE
ADMINISTRATOR

REVISIONS

ICD-1-20

STANDARD BRIDGE DRAWING
INTEGRAL CONSTRUCTION DETAILS FOR STEEL AND GIRDER BRIDGES ON FLEXIBLE ABUTMENTS



TYPICAL ELEVATION

✱ DEPTH OF ABUTMENT BELOW CONSTRUCTION JOINT IS 3'-3" AT SHALLOWEST POINT (SEE DM-4 AP.G.1.4.1) THE MAXIMUM DIFFERENCE BETWEEN THE MINIMUM AND MAXIMUM CAP DEPTH WILL NOT EXCEED 1'-0" FOR SKEW < 80° OR 1'-6" FOR SKEW ≥ 80°.

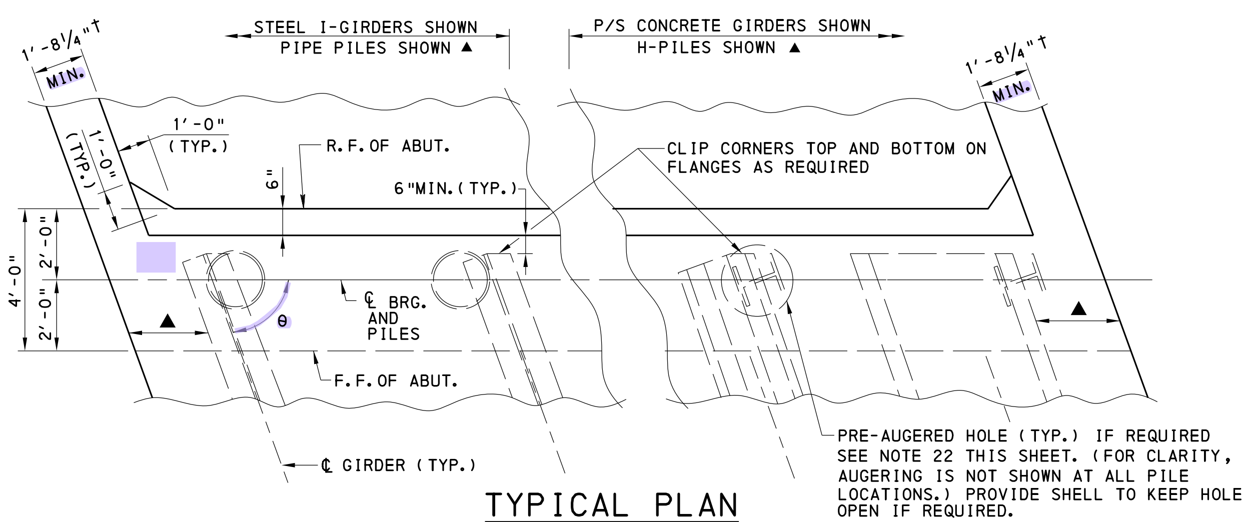
✱✱ BOTH H-PILES AND PIPE PILES MAY BE USED WITH STEEL OR CONCRETE GIRDERS. GALVANIZE TOP 15'-0" LENGTH OF THE PILES OR ENTIRE PILES LENGTH.

✱✱✱ THE MAXIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 2'-6" AND $\frac{(W+dpile/2)}{\sin(\theta)}$ (ROUNDED UP TO THE NEXT 3" INCREMENT)
- WHERE: W: WIDTH OF WINGWALL AT REAR FACE OF INTEGRAL ABUTMENT, NEGLECTING THE 1' HAUNCH (ft.)
- dpile: OUTSIDE DIAMETER FOR PIPE PILES OR PILE DEPTH FOR H-PILES (ft.)

THE MINIMUM EDGE DISTANCE BETWEEN THE CENTERLINE OF THE PILE AND THE END OF THE ABUTMENT, MEASURED ALONG THE SKEW, SHALL BE THE LARGER OF:

- 1'-6"
- THE DISTANCE REQUIRED TO PROVIDE 3" CLEARANCE FROM THE PILES TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALL.



TYPICAL PLAN

† WINGWALL WIDTH MAY VARY BASED ON BARRIER TYPE SELECTED.

▲ EXTERIOR BEAMS TO BE LOCATED TO PROVIDE 3" CLEAR TO THE HORIZONTAL REINFORCEMENT EXTENDING FROM THE WINGWALLS.

DETACHED WINGWALL NOTES

1. DETERMINE THE MOVEMENT REQUIREMENTS AND THE OPENING OF THE EXPANSION DAM FOR THE EXPANSION JOINT BETWEEN THE ABUTMENT AND DETACHED WINGWALLS, AT THE TIME OF CONSTRUCTION, IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.6.
2. BOND THE PREFORMED NEOPRENE COMPRESSION SEAL BETWEEN THE ABUTMENT AND THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO BOTH THE ABUTMENT AND THE DETACHED WINGWALL.
3. BOND THE CLOSED CELL NEOPRENE SPONGE IN THE DETACHED WINGWALL EXPANSION JOINTS (SEE SECTION M-M ON SHEET 5) TO THE WINGWALL. RECESS THE NEOPRENE SPONGE ½" INTO THE WINGWALL.
4. THE WATERPROOFING MEMBRANE ACROSS THE EXPANSION JOINT BETWEEN THE INTEGRAL ABUTMENT AND DETACHED WINGWALLS WILL BE IN ACCORDANCE WITH PUBLICATION 408, SECTION 680. THE MEMBRANE SHALL SPAN THE WIDTH OF THE RECESS IN THE ABUTMENT AND IN THE DETACHED WALL, AND SHALL HAVE 8" BONDED ON EACH SIDE. THE LENGTH OF THE MEMBRANE SHALL BE 6" LONGER THAN THE SPANNED LENGTH (i.e. 6" SLACK) AT THE TIME OF INSTALLATION. SEE DETAIL P ON SHEET 6.
5. PAINT THE CONTACT SURFACE BETWEEN THE APPROACH SLAB AND WINGWALL WITH AN APPROVED BOND BREAKER AND SEAL WITH AN APPROVED SEALER.

GENERAL NOTES

1. ALL DIMENSIONS GIVEN IN U.S. CUSTOMARY UNITS.
2. DESIGN SPECIFICATIONS
   - -AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
   - -PENNDOT DESIGN MANUAL PART 4, VOLUME 1, PART B: DESIGN SPECIFICATIONS AND VOLUME 2, APPENDIX G
3. PROVIDE MATERIALS AND WORKMANSHIP IN ACCORDANCE WITH PUBLICATION 408 AND THE CONTRACT SPECIAL PROVISIONS.
4. MATERIAL STRENGTH
   - -REINFORCEMENT STEEL fy = 60 KSI
   - -CONCRETE f'c = 4000 PSI (CLASS AAAP CONCRETE) FOR DECK SLABS, APPROACH SLABS, AND END DIAPHRAGMS AND WINGWALLS ABOVE CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3500 PSI (CLASS AA CONCRETE) FOR BARRIERS, MODULAR RATIO (Es/Ec) n = 8.
     f'c = 3000 PSI (CLASS A CONCRETE) FOR CAP BEAM AND WINGWALLS BELOW CONSTRUCTION JOINT, MODULAR RATIO (Es/Ec) n = 9.
5. DEAD LOAD
   - -DENSITY OF NORMAL WEIGHT CONCRETE = 150 PCF
   - -FUTURE WEARING SURFACE = 30 PSF
6. LIVE LOAD
   - -LIVE LOAD IS CALCULATED ASSUMING ALL POTENTIAL LANES ARE LOADED. USE A MULTIPLE PRESENCE FACTOR OF 1.0 FOR DESIGN OF THE INTEGRAL ABUTMENT CAP AND SUPPORTING PILES.
   - -THE LIVE LOAD IS ASSUMED TO BE EVENLY DISTRIBUTED TO ALL PILES.
7. DYNAMIC LOAD ALLOWANCE (IM) = 33% IS APPLIED TO LIVE LOADS ON THE ABUTMENTS AND THE PILES IN ACCORDANCE WITH ARTICLES A3.6.2.1 AND D3.6.2.1.
8. DESIGN CONTROLS
   - -CONCRETE COVER: INTEGRAL ABUTMENT (i.e., CAP BEAM AND END DIAPHRAGM) AND WINGWALLS = 3"
   - -UNLESS OTHERWISE INDICATED, USE THE FOLLOWING MINIMUM REINFORCEMENT SPLICE LENGTHS:

#4 2'-1"	#6 3'-1"	#8 5'-1"	#10 8'-2"
#5 2'-7"	#7 3'-10"	#9 6'-5"	#11 10'-0"

   - -BAR SIZE: MAXIMUM BAR SIZE #11
     MINIMUM BAR SIZE #4
9. FOR DESIGN CONTROLS OF DECK AND BARRIERS, SEE STANDARD DRAWING BD-601M.
10. USE ONLY ONE ROW OF VERTICAL PILES PER ABUTMENT. PILES MAY BE H-PILES OR PIPE PILES. FOR H-PILES, ORIENT THE WEB PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE GIRDER OF THE END SPAN. TAPERED PILES MAY BE USED PROVIDED THE TAPER POINT IS BELOW THE POINT OF CONTRAFLEXURE.
11. ALL REINFORCING BARS ARE TO BE EPOXY COATED.
12. USE ONLY NORMAL WEIGHT CONCRETE FOR WINGWALLS AND ABUTMENTS.
13. DETAIL ALL BARS ON THE CONTRACT DRAWINGS.
14. PROVIDE A TROWEL SMOOTH SURFACE OF THE CONSTRUCTION JOINT DIRECTLY UNDER THE GIRDERS AND THE AREA EXTENDING 2" OUTSIDE OF THAT AREA. ON ALL OTHER CONSTRUCTION JOINTS, PROVIDE A RAKED SURFACE.
15. PROVIDE ¾" THICK, 50 DUROMETER NEOPRENE PADS UNDER ALL GIRDERS. ALL PADS WILL BE 12" ALONG THE LENGTH OF THE BEAM AND MATCH THE WIDTH OF THE BEAM MINUS ANY CHAMFERS. BLOCK THE AREAS UNDER THE GIRDERS NOT IN CONTACT WITH THE BEARING PADS USING 1" THICK BACKER RODS.
16. TAKE LIMITS OF FILL BEHIND THE ABUTMENT AND THE WINGWALLS AS SHOWN ON STANDARD DRAWING RC-12M.
17. FOR DETAILS OF INSERTS IN PRECAST CONCRETE BEAMS, SEE STANDARD DRAWING BD-655M IN ADDITION TO SHEETS 2 AND 8 OF THIS STANDARD.
18. FOR DETAILS OF APPROACH SLABS FOR INTEGRAL ABUTMENT BRIDGES, SEE STANDARD DRAWING BD-628M.
19. PLACE ALL GIRDERS, INCLUDING BOX BEAMS, WITH THEIR WEBS VERTICAL. STEP TOP OF CAP BEAM TO PROVIDE THE CORRECT BEAM SEAT ELEVATION. CHANGE HAUNCH THICKNESS ACROSS THE WIDTH OF THE GIRDERS TO PROVIDE THE CORRECT ROADWAY CROSS-SLOPE AND SUPERELEVATION. SLOPE BEAM SEAT IN THE LONGITUDINAL DIRECTION TO MATCH BOTTOM OF BEAM.
20. THE BOTTOM OF THE ABUTMENT MAY BE HORIZONTAL. HOWEVER, THE VARIATION IN THE PILE CAP DEPTH FROM ONE END OF THE ABUTMENT TO THE OTHER DUE TO SUPERELEVATION IS LIMITED TO 1'-6" [1'-0" FOR SKEWS LESS THAN 80 DEGREES]. FOR SUPERELEVATIONS THAT WOULD RESULT IN GREATER VARIATIONS, THE BOTTOM OF THE ABUTMENT MUST BE PARALLEL TO THE SLOPE OF THE ROADWAY. FOR THE REINFORCEMENT SHOWN, THE PILE CAP IS TO BE A MINIMUM 3'-3" THICK, WITH A MAXIMUM DEPTH OF 4'-3" FOR SKEWS LESS THAN 80 DEGREES, AND A MAXIMUM DEPTH OF 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES. PILE CAP DEPTHS GREATER THAN 4'-3" FOR SKEWS LESS THAN 80 DEGREES AND PILE CAP DEPTHS GREATER THAN 4'-9" FOR SKEWS GREATER THAN OR EQUAL TO 80 DEGREES MUST BE APPROVED BY CHIEF BRIDGE ENGINEER.
21. INTEGRAL ABUTMENTS AT OPPOSITE ENDS OF A BRIDGE SHALL BE THE SAME DEPTH EXCEPT FOR VARIATIONS DUE TO DIFFERENCES IN ROADWAY CROSS SLOPE OR SUPERELEVATION. THE BEAM SEAT MUST BE PARALLEL TO THE ROADWAY GRADE, IN THE LONGITUDINAL DIRECTION.
22. DETERMINE THE MINIMUM DIAMETER OF THE PRE-AUGERED HOLES IN ACCORDANCE WITH DESIGN MANUAL, PART 4 AP.G.1.4.2.1.
23. BEAM DEPTH IS RESTRICTED TO A 6'-0" MAXIMUM DEPTH WHEN USED FOR INTEGRAL ABUTMENT UNLESS APPROVED BY CHIEF BRIDGE ENGINEER.
24. USE OF ADJACENT BOX BEAMS IS NOT PERMITTED, DETAILS FOR BEAMS LESS THAN 1'-5" ARE NOT INCLUDED IN THIS STANDARD.
25. SKEW LIMITATION FOR INTEGRAL ABUTMENTS PER SECTION 1.2.2 OF DESIGN MANUAL, PART 4 APPENDIX "G".
26. FLARED WINGWALLS ARE NOT TO BE USED WITH INTEGRAL ABUTMENTS. REFERENCE APPENDIX "G" OF DESIGN MANUAL PART 4 SECTION 1.4.4.
27. BOTH THE TYPICAL AND ALTERNATE SIDEWALK DETAILS MAY BE USED ON INTEGRAL ABUTMENT BRIDGES. IF USED, THOSE DETAILS MUST BE CARRIED THROUGH THE APPROACH SLAB.
28. ALL REINFORCEMENT STEEL BARS SHOWN MEET THE REQUIREMENTS OF ASTM A 615, A 996 OR A 706.
29. THE STLRFD SOFTWARE REQUIRES BEARING STIFFENERS AT THE CENTERLINE OF BEARING AND ALSO CONSIDERS THE GIRDERS TO BE LATERALLY BRACED AT THE CENTERLINE OF BEARING. THE DESIGNER IS RESPONSIBLE FOR DETAILING THE BEARING STIFFENERS. THE LATERAL BRACING (END DIAPHRAGM) IS TO BE OMITTED AND THE FOLLOWING NOTE ADDED TO THE CONSTRUCTION DRAWINGS:
   - THE CONTRACTOR IS RESPONSIBLE FOR TEMPORARY BRACING OF THE GIRDERS. PLACE THE #8 REINFORCEMENT BARS THROUGH THE BEAMS AND THE CAP FORMWORK PRIOR TO PLACING ANY DECK CONCRETE.
30. SUPERSTRUCTURE MUST BE ERECTED AND CONNECTED TO THE INTEGRAL ABUTMENTS PRIOR TO PLACING BACKFILL BEHIND THE ABUTMENTS.
31. IF AN INTEGRAL ABUTMENT BRIDGE IS BEING REDECKED, THE END DIAPHRAGM MUST BE REMOVED COMPLETELY PRIOR TO DECK REMOVAL TO AVOID SUBJECTING THE GIRDERS TO STRUCTURE AND PAVEMENT TEMPERATURE FORCES AND EARTH PRESSURE.

BD-601M	CONCRETE DECK SLAB
BD-628M	BRIDGE APPROACH SLABS
BD-655M	TYPICAL SUPERSTRUCTURE SECTIONS
BD-656M	TYPICAL LONGITUDINAL SECTIONS
BC-736M	REINFORCEMENT BAR FABRICATION DETAILS
BC-739M	BRIDGE BARRIER TO GUIDE RAIL TRANSITION
BC-751M	BRIDGE DRAINAGE
BC-788M	TYPICAL WATERPROOFING AND EXPANSION DETAILS
RC-12M	BACKFILL AT STRUCTURES

REFERENCE DRAWINGS

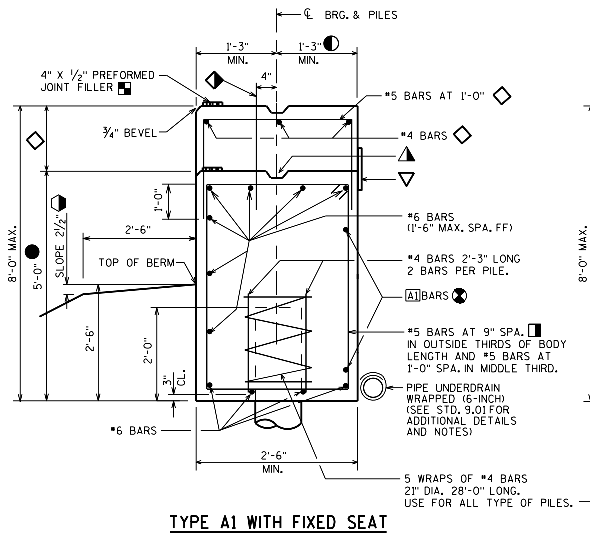
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
LAYOUT AND GENERAL NOTES

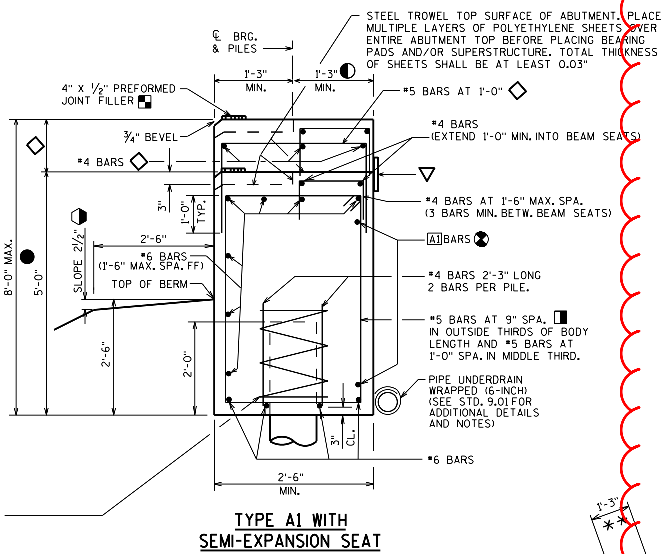
RECOMMENDED APR. 29, 2016
Thomas P Macioce
CHIEF BRIDGE ENGINEER

RECOMMENDED APR. 29, 2016
Brian G Thompson
DIRECTOR, BUR. OF PROJECT DELIVERY

BD-667M



TYPE A1 WITH FIXED SEAT



TYPE A1 WITH SEMI-EXPANSION SEAT

DESIGNER NOTES

LAP LENGTHS FOR HORIZONTAL BARS SHALL BE BASED ON A "CLASS C" TOP TENSION LAP SPLICE.

WING BARS AND DOWEL BARS SHALL BE EPOXY COATED.

PILING SPACING IN ABUTMENT BODY SHALL BE 8'-0" MAX. FOR ALL TYPES OF PILING. THE MAX. PILE SPACING FROM THE END OF THE ABUT. BODY TO THE FIRST PILE SHALL BE THE MINIMUM OF ONE-HALF PILE SPACE OR 2'-6".

TOTAL LENGTH OF A1 BARS SHALL BE ≥ TO WING LENGTH.

CONCRETE POURED UNDER WATER WILL BE ALLOWED AND SHALL BE DONE IN ACCORDANCE WITH SECTION 502.3.5.3 STANDARD SPECIFICATIONS.

THE SEMI-EXPANSION SEAT SHALL BE USED WHEN REQUIRED AS STATED IN CHAPTER 12, FIGURE 12.7-1 OF THE BRIDGE MANUAL OR WHENEVER A WING PILE IS REQUIRED.

THE FIXED SEAT CANNOT BE USED WHEN A WING PILE IS REQUIRED (SEE STD. 12.02 FOR CRITERIA).

WHEN THE BOTTOM OF GIRDER SLOPES MORE THAN 1%, SLOPE THE BEAM SEAT BASED ON ADDING THESE TWO VALUES:
- LONGITUDINAL GRADE OF GIRDER (PERCENT)
- CAMBER EFFECT = 4(RC)/L X 100 (PERCENT), WHERE:
  RC = RESIDUAL CAMBER (INCHES)
  L = GIRDER LENGTH (INCHES)

(SEE STANDARD 13.01 FOR SLOPED SEAT DETAILS)

ABUTMENT DETAILED WITHOUT STRUCTURAL APPROACH SLAB. SEE STD. 12.10 THRU 12.13 FOR STRUCTURAL APPROACH DETAILS.

USE 3/4" THICK FILLER FOR SLAB STRUCTURES.

LEGEND

#5 BARS (COATED) AT 1'-0" (2'-0" LONG). THESE BARS MAY BE PLACED AFTER CONCRETE IS POURED BUT BEFORE INITIAL SET HAS TAKEN PLACE.

WHEN THIS DIMENSION ≥ 4" THIS ADDITIONAL REINFORCEMENT SHALL BE ADDED. MAX. SPA. OF HORIZ. #4 BARS = 1'-0".

USE 1'-3" FOR SLAB SPANS AND FOR GIRDER SPANS WITH NO PAVING NOTCH.
USE 1'-6" FOR GIRDER SPANS WITH NO PAVING NOTCH, BUT WHERE 36W", 45W", 54", 54W", 70", 72W" OR 82W" GIRDERS ARE USED, AND SKEW > 25°.
USE 1'-3" FOR SLAB SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-11" FOR GIRDER SPANS WITH A PAVING NOTCH, BUT NO STRUCTURAL APPROACH SLAB.
USE 1'-7" FOR SLAB SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)
USE 2'-3" FOR GIRDER SPANS WITH A STRUCTURAL APPROACH SLAB. (STD. 12.10)

DIMENSION IS FROM BOTTOM OF ABUTMENT TO LOW BEAM SEAT OR LOW SIDE OF SLAB TYPE SUPERSTRUCTURE.

18" RUBBERIZED MEMBRANE WATERPROOFING. SEAL ALL HORIZONTAL AND VERTICAL JOINTS ON BACKFACE.

KEYED CONST. JOINT FORMED BY BEVELED 2" x 6".

** WINGWALL WIDTH SHALL BE 1'-6" WHEN TYPE "M" RAILING, VERTICAL FACE PARAPET "TX", OR SINGLE SLOPE PARAPET "56SS" IS USED. WINGWALL WIDTH SHALL BE 1'-9" WHEN TYPE "NY3" OR "NY4" RAILING IS USED.

USE #5 BARS AT 6" SPA. IN OUTSIDE THIRDS OF BODY LENGTH WHEN THE WING LENGTH > 20'-0" AND WING HEIGHT > 10'-0".

WHEN BODY SECTION IS > 50'-0"± LONG PROVIDE VERTICAL CONSTRUCTION JOINT. RUN BAR STEEL THRU JOINT AND SEAL JOINT WITH 18" RUBBERIZED MEMBRANE WATERPROOFING. SEE STD. 12.09 FOR ALTERNATE CONSTRUCTION JOINT.

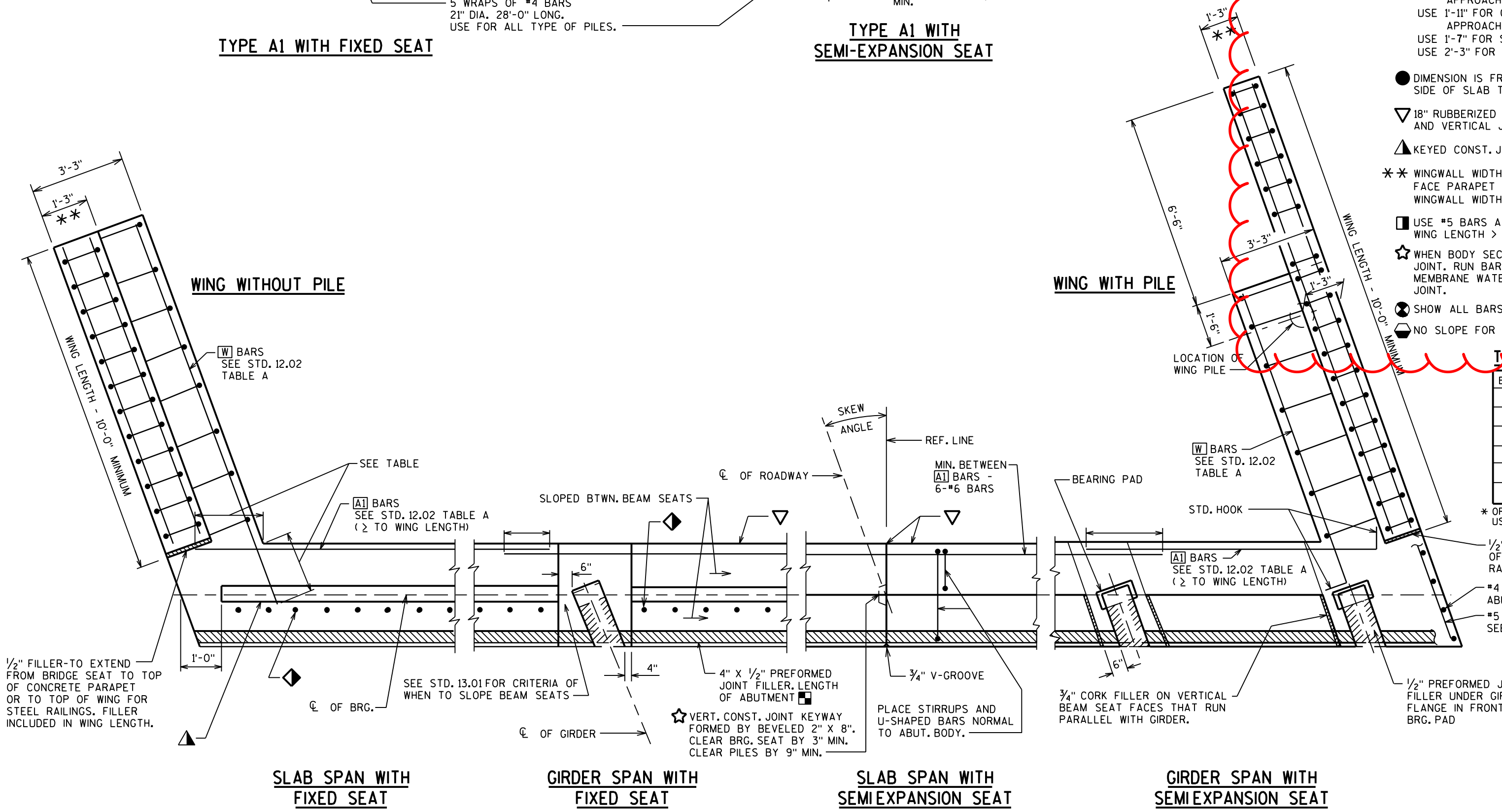
SHOW ALL BARS FOR CLARITY.

NO SLOPE FOR HEAVY RIPRAP. SEE STANDARD 12.08 FOR DETAILS.

TABLE

BAR SIZE	DISTANCE*
#5	1'-9"
#6	2'-1"
#7	2'-9"
#8	3'-8"
#9	4'-7"
#10	5'-10"

* OR EQUIVALENT STD. HOOK
USE STRAIGHT BARS WHEN POSSIBLE



SLAB SPAN WITH FIXED SEAT

GIRDER SPAN WITH FIXED SEAT

SLAB SPAN WITH SEMIEXPANSION SEAT

GIRDER SPAN WITH SEMIEXPANSION SEAT

ABUTMENT TYPE A1
(INTEGRAL ABUTMENT)

BUREAU OF STRUCTURES

APPROVED: Bill Oliva

DATE: 1-20

10. Miscellaneous Integral Abutment Bridges State DOT Standard Details

Illinois

Integral Abutment Drainage Details

Semi-Integral Abutment Drainage Details

Integral Abutment Headed Bar Placement

Iowa

Deck and Drainage Details

NOTE: Iowa has many of these details for various roadway lengths

Massachusetts

Pedestal Plan Details

Deck Placement Sequence

Integral Abutment Backfill

Utility Details at Abutment

Pennsylvania

Waterproofing and Scour Protection Details

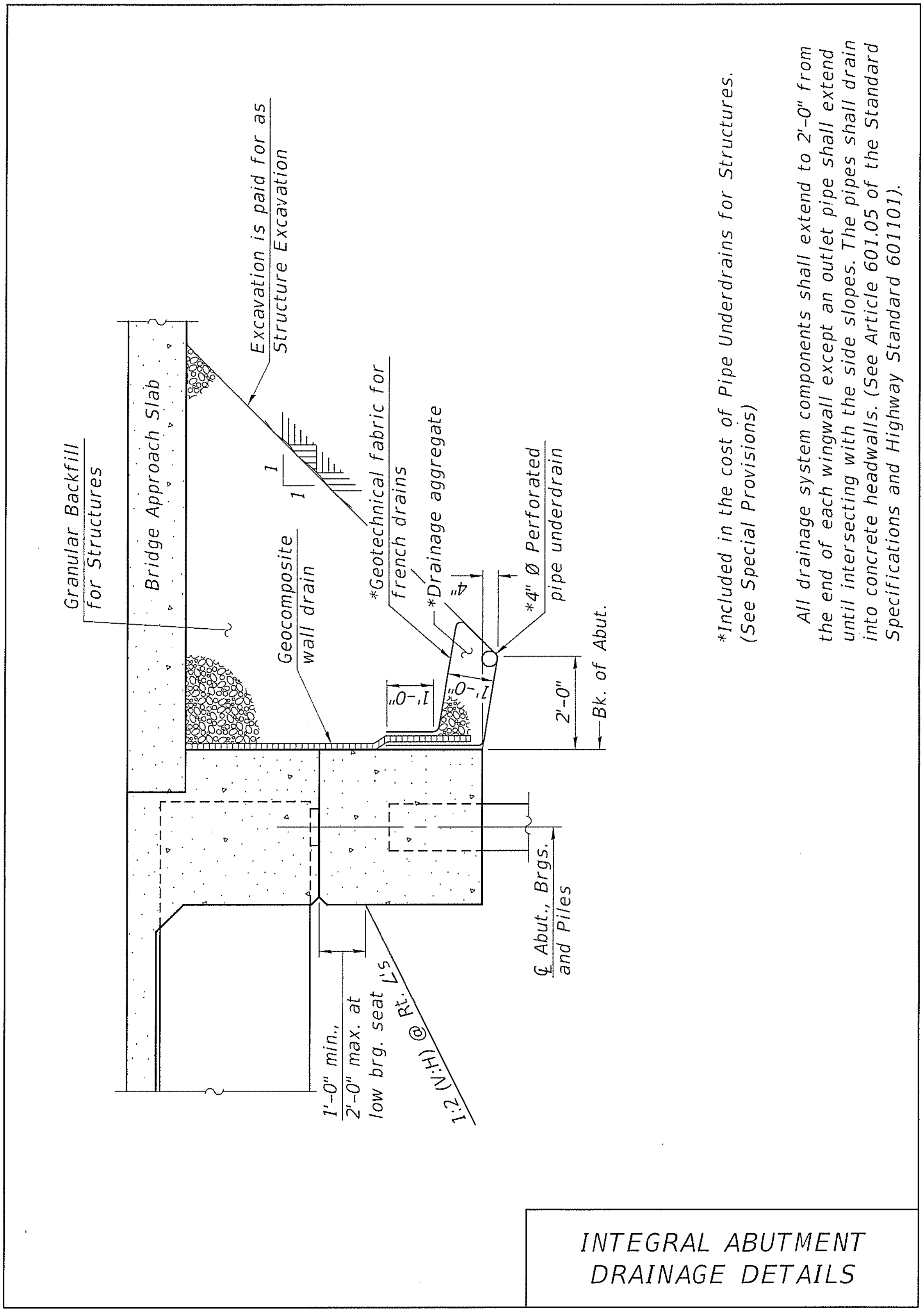


Figure 1

Illinois

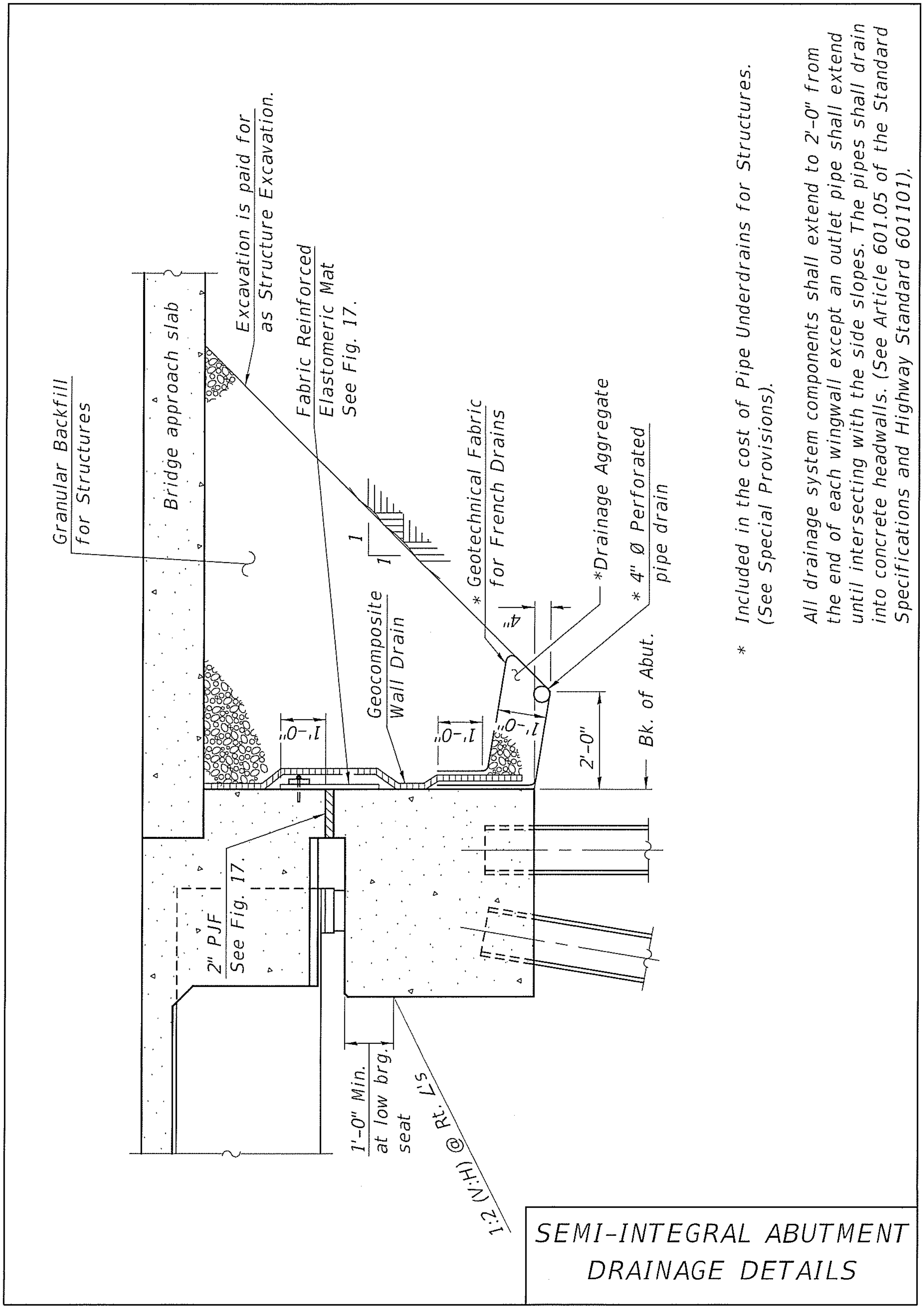


Figure 16

Illinois

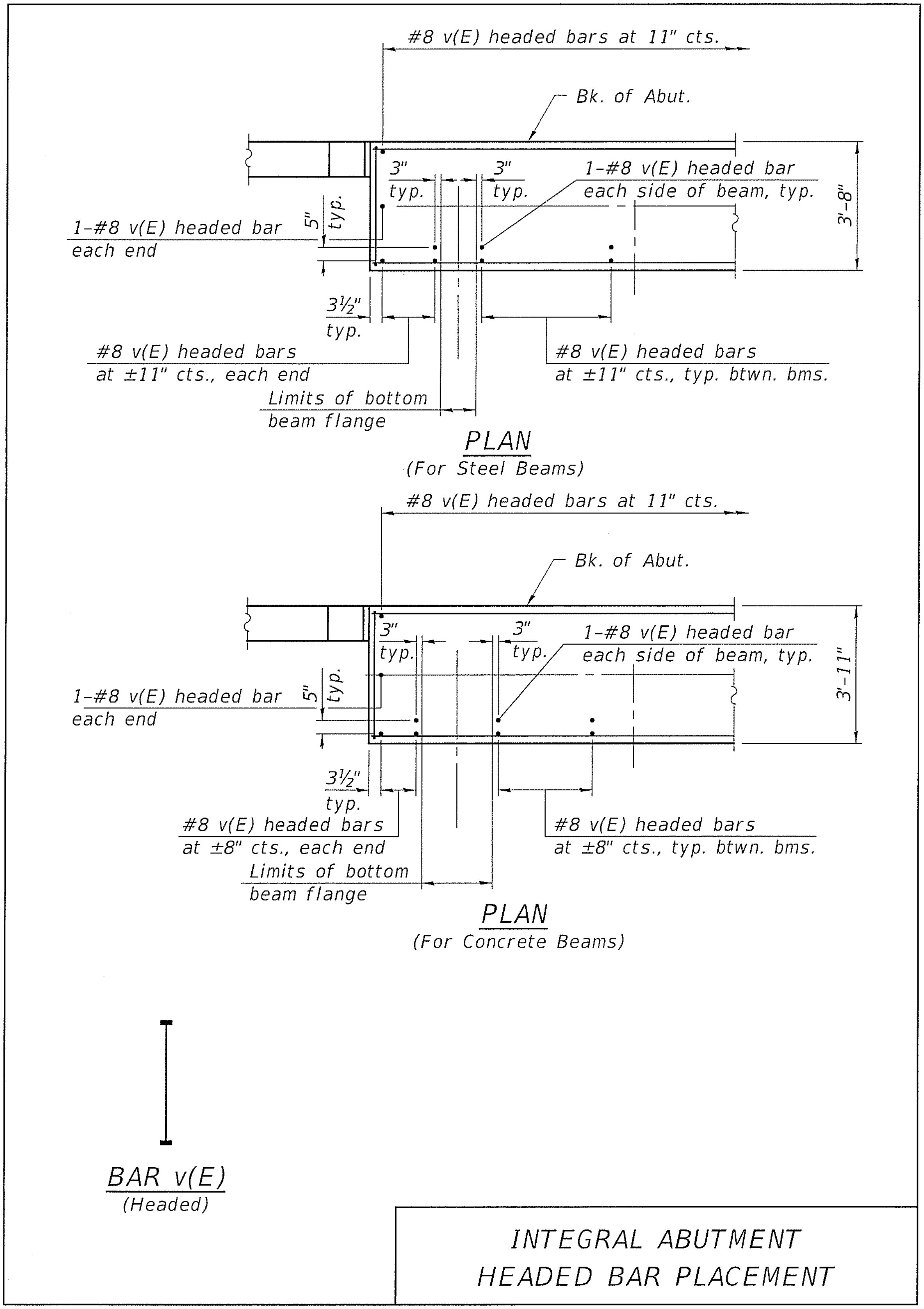


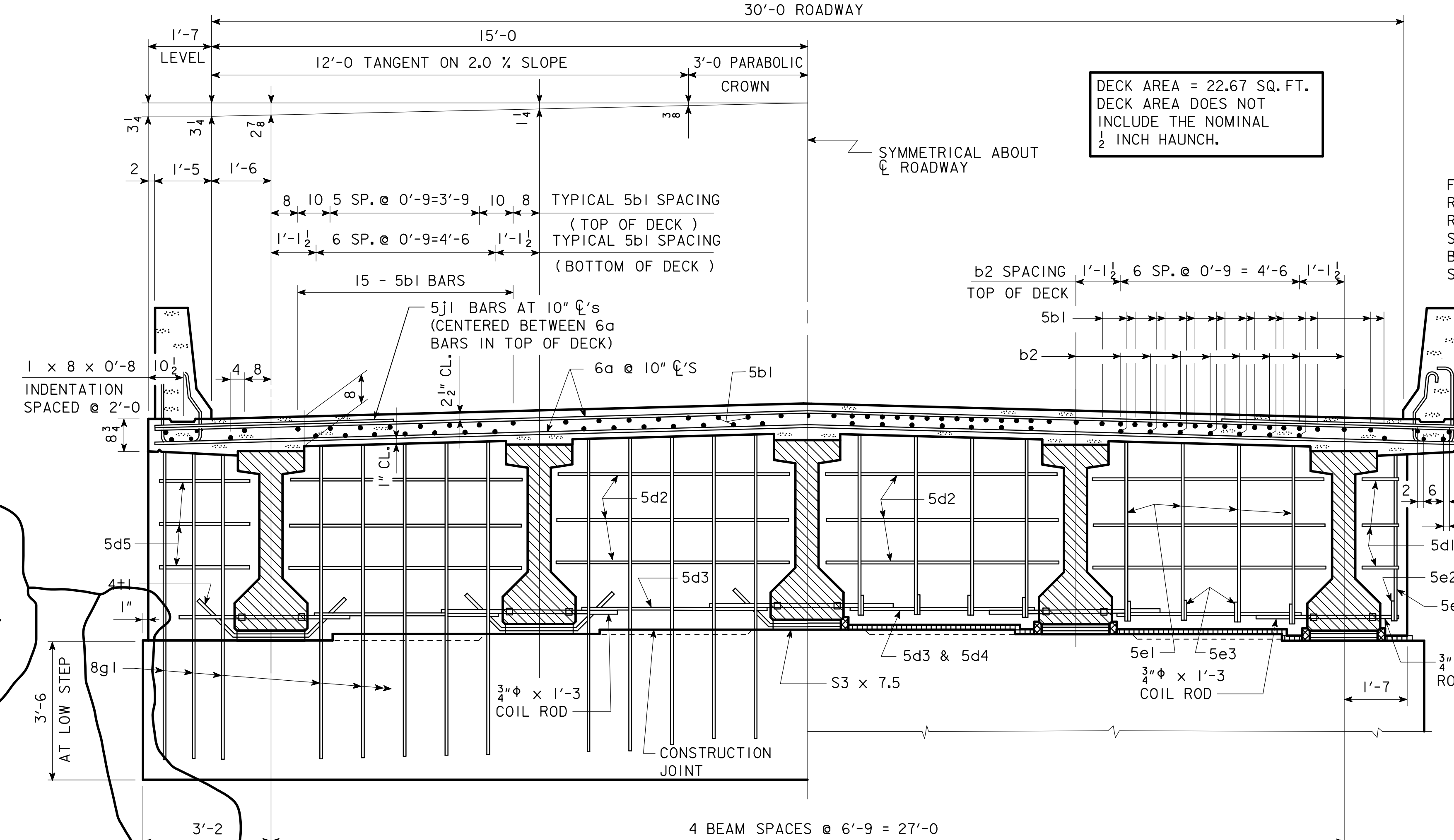
Figure 5

Illinois

TABLE OF SIZE OF 'b2' BAR

LONGEST ADJACENT SPAN BEAM A, B & C	LONGEST ADJACENT SPAN BEAM D	BAR SIZE
30'-0		5
34'-2	35'-0	5
38'-4	40'-0	5
42'-6	45'-0	5
46'-8	50'-0	5
50'-10	55'-0	6
55'-0	60'-0	6
59'-2	65'-0	6
63'-4		7
67'-6		7
71'-8	70'-0	7
75'-10	75'-0	8
80'-0	80'-0	8
	85'-0	8
	90'-0	8
	95'-0	8
	100'-0	9
	105'-0	9
	110'-0	9

THE MIDPOINT OF THE 'b2' BAR IS TO BE PLACED AT THE ℄ OF PIER.



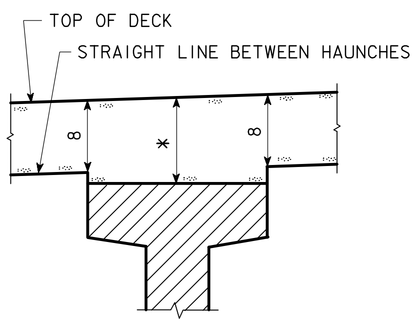
DECK AREA = 22.67 SQ. FT. DECK AREA DOES NOT INCLUDE THE NOMINAL ½ INCH HAUNCH.

REDRAW FOR A & B BEAMS TO ALIGN FOOTING & BACKWALL FACES. DIMENSION 3'-2 BECOMES 3'-1.

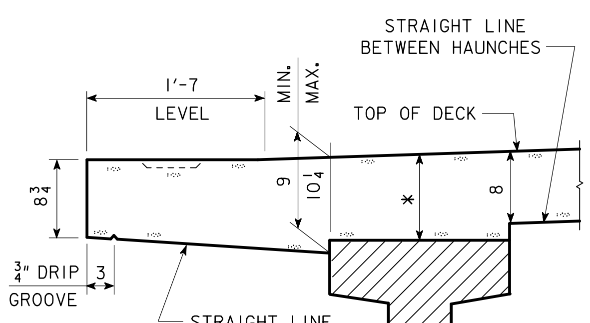
HALF SECTION NEAR ABUTMENT

HALF SECTION NEAR PIER

NOTE : FOR DETAILS OF INTERMEDIATE DIAPHRAGMS SEE DESIGN SHEET ??.



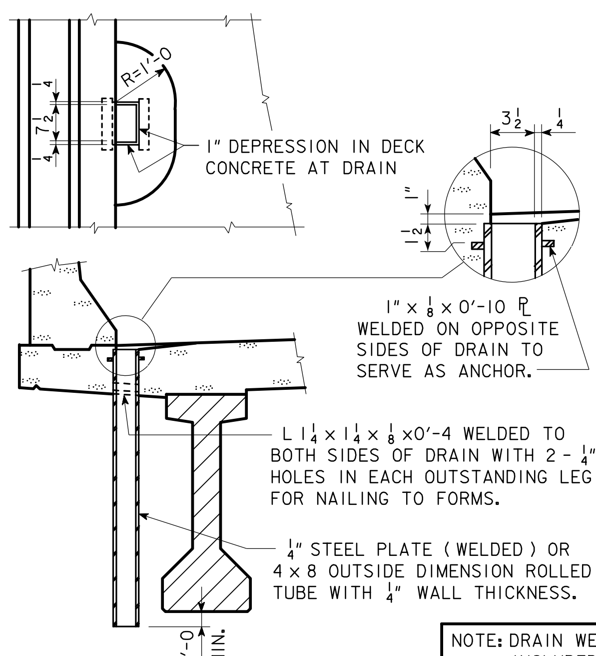
INTERIOR BEAMS



EXTERIOR BEAMS

TYPICAL DECK AND HAUNCH DETAIL

* FOR DECK THICKNESS OVER BEAMS SEE " DECK THICKNESS DETAILS " ON DESIGN SHEET NO. ____



DRAIN DETAILS

NOTE: DRAIN WEIGHTS ARE INCLUDED ON THE SUMMARY QUANTITIES SHEET.

NOTE :
DRAINS ARE TO BE GALVANIZED. ____ DRAINS REQUIRED. SEE " SITUATION PLAN " ON DESIGN SHEET ____ FOR LOCATION. WEIGHT OF DRAINS IS INCLUDED IN THE QUANTITY FOR "STRUCTURAL STEEL". WEIGHT IS BASED ON ROLLED TUBE.

DATA FOR ONE DRAIN

BEAM SIZE	A	B	C	D
WT. LBS.	85	96	106	120
LENGTH FT.	4'-4¾	4'-11¾	5'-5¾	6'-2¾

LENGTH OF S3 × 7.5
(ABUTMENT BEAM SEAT)

BEAM BOTTOM FLANGE WIDTH	LENGTH OF S3 × 7.5
1'-5	1'-3½
1'-8	1'-6½
1'-10	1'-8½

SUPERSTRUCTURE NOTES:

THE BRIDGE DECK AS SHOWN INCLUDES ½" INTEGRAL WEARING SURFACE.

THE PIER AND ABUTMENT DIAPHRAGM CONCRETE IS TO BE PLACED MONOLITHICALLY WITH THE BRIDGE DECK.

COST OF ALL PREFORMED EXPANSION JOINT FILLER MATERIAL IS TO BE INCLUDED IN THE PRICE BID FOR "STRUCTURAL CONCRETE (BRIDGE)".

ALL BEAMS ARE TO BE SET VERTICAL.

FORMS FOR THE BRIDGE DECK AND BARRIER RAIL ARE TO BE SUPPORTED BY THE PRESTRESSED CONCRETE BEAMS.

CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR REINFORCING BAR SHALL BE 2 INCHES UNLESS OTHERWISE NOTED OR SHOWN.

ALL DECK AND DIAPHRAGM REINFORCING IS TO BE WIRED IN PLACE AND ADEQUATELY SUPPORTED BEFORE CONCRETE IS PLACED.

TOP TRANSVERSE REINFORCING STEEL IS TO BE PARALLEL TO AND 2½" CLEAR BELOW TOP OF DECK. BOTTOM TRANSVERSE REINFORCING STEEL IS TO BE PARALLEL TO AND 1" CLEAR ABOVE BOTTOM OF DECK. TOP AND BOTTOM REINFORCING STEEL IS TO BE SUPPORTED BY INDIVIDUAL BAR CHAIRS SPACED AT NOT MORE THAN 3'-0 CENTERS LONGITUDINALLY AND TRANSVERSELY, OR BY CONTINUOUS ROWS OF BAR HIGH CHAIRS OR DECK BOLSTERS SPACED 4'-0 APART. I.M. 451.01 REQUIREMENTS SHALL APPLY FOR BAR CHAIRS, BAR HIGH CHAIRS, AND DECK BOLSTERS.

COST OF BEARING MATERIAL IS TO BE INCLUDED IN THE PRICE BID FOR "PRETENSIONED PRESTRESSED CONCRETE BEAMS".

NOTE: "STAINLESS STEEL" LEVEL OR "REBAR EPOXY A" LEVEL SHOULD BE ON OR OFF DEPENDING ON BARRIER RAIL STEEL EMBEDDED IN THE BRIDGE DECK.

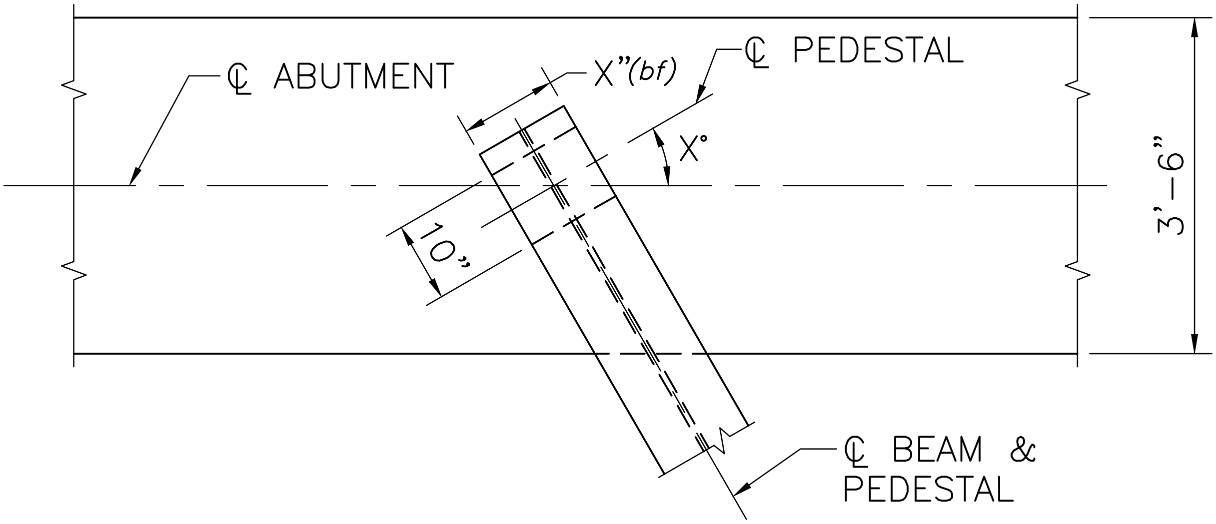
BRIDGE DECK CROSS SECTION

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

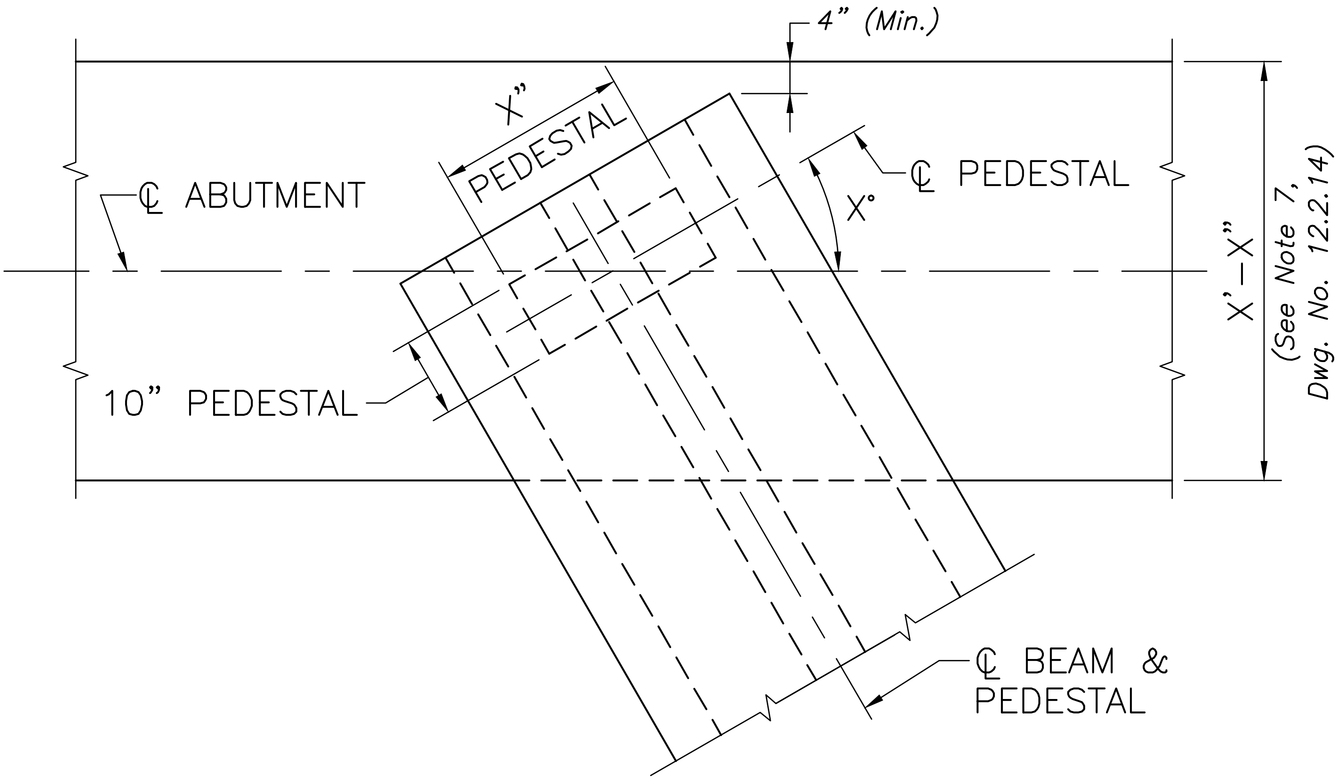
DESIGN SHEET NO. ____ OF ____ FILE NO. ________ DESIGN NO. ________

CORRECTION 04-14 - ADDED REFERRAL NOTE TO SUMMARY QUANTITIES SHEET FOR THE DRAIN WEIGHT. NOTE ABOUT CHOICE OF EPOXY OR STAINLESS STEEL DECK TO BARRIER RAIL BARS.
ENGLISHINTEGRALBRIDGES.DGN 4380 - THIS SHEET ISSUED 11-06. LRFD DESIGNED DECK.

DESIGN TEAM	30' RDWY. PPCB (ALL BEAMS - INTEGRAL ABUT.) CROSS SECTION - LRFD DESIGN	STANDARD SHEET 4380	COUNTY	PROJECT NUMBER	SHEET NUMBER



ROLLED BEAMS/PLATE GIRDERS

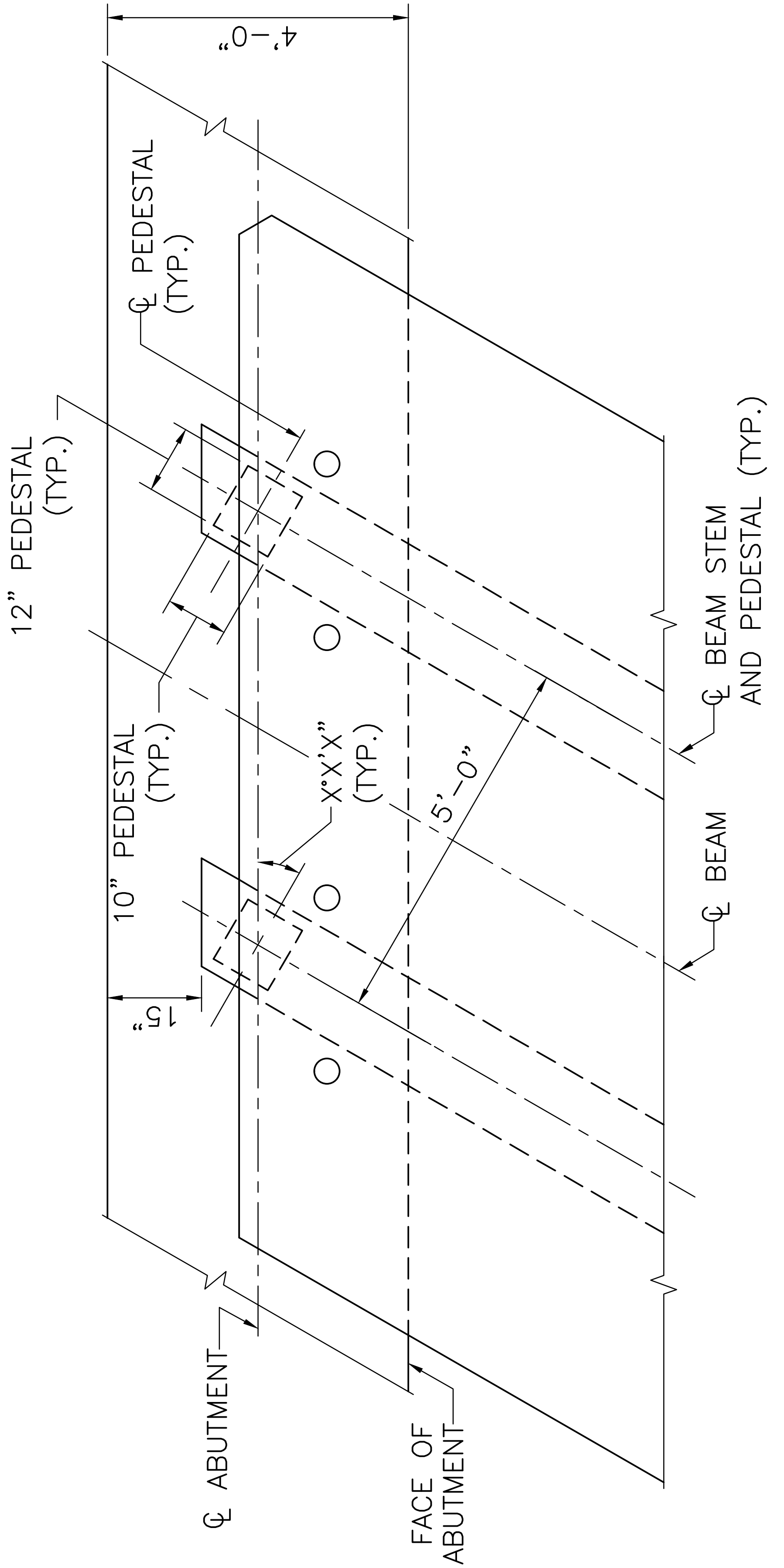


NEBT/SPREAD BOX AND DECK BEAMS

PEDESTAL PLAN

SCALE: $\frac{1}{2}$" = 1'–0"

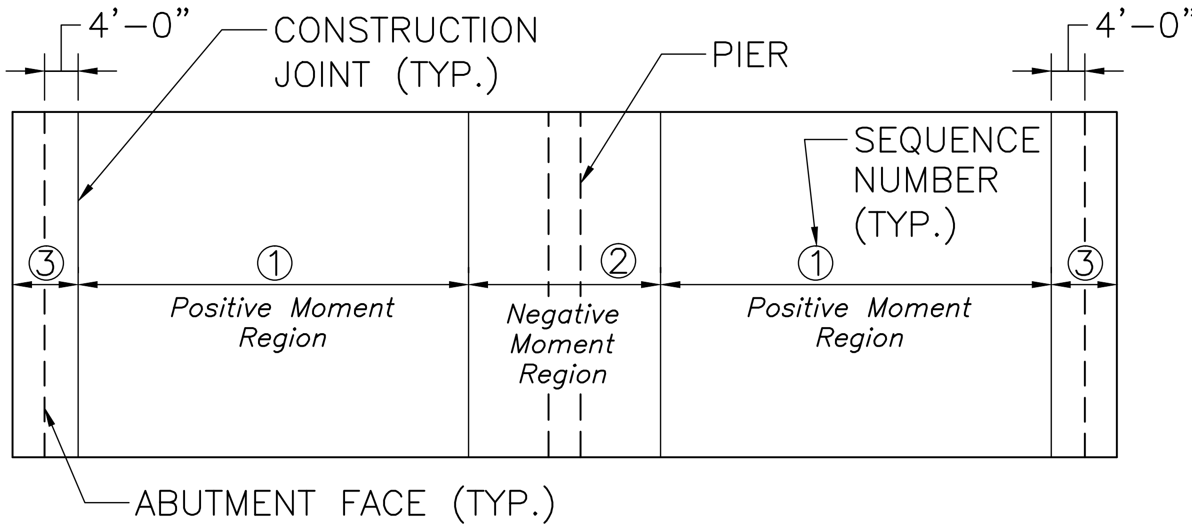
massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	PEDESTAL PLAN INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.6**



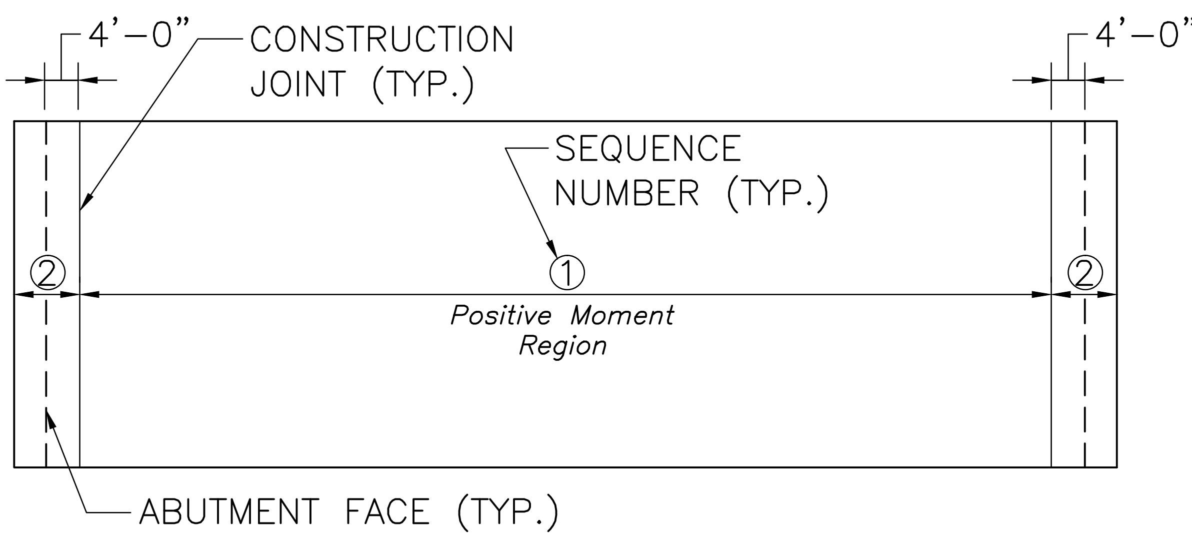
PEDESTAL PLAN

SCALE: $\frac{1}{2}$" = 1'-0"

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	PEDESTAL PLAN NEXT F BEAMS INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.3.7**



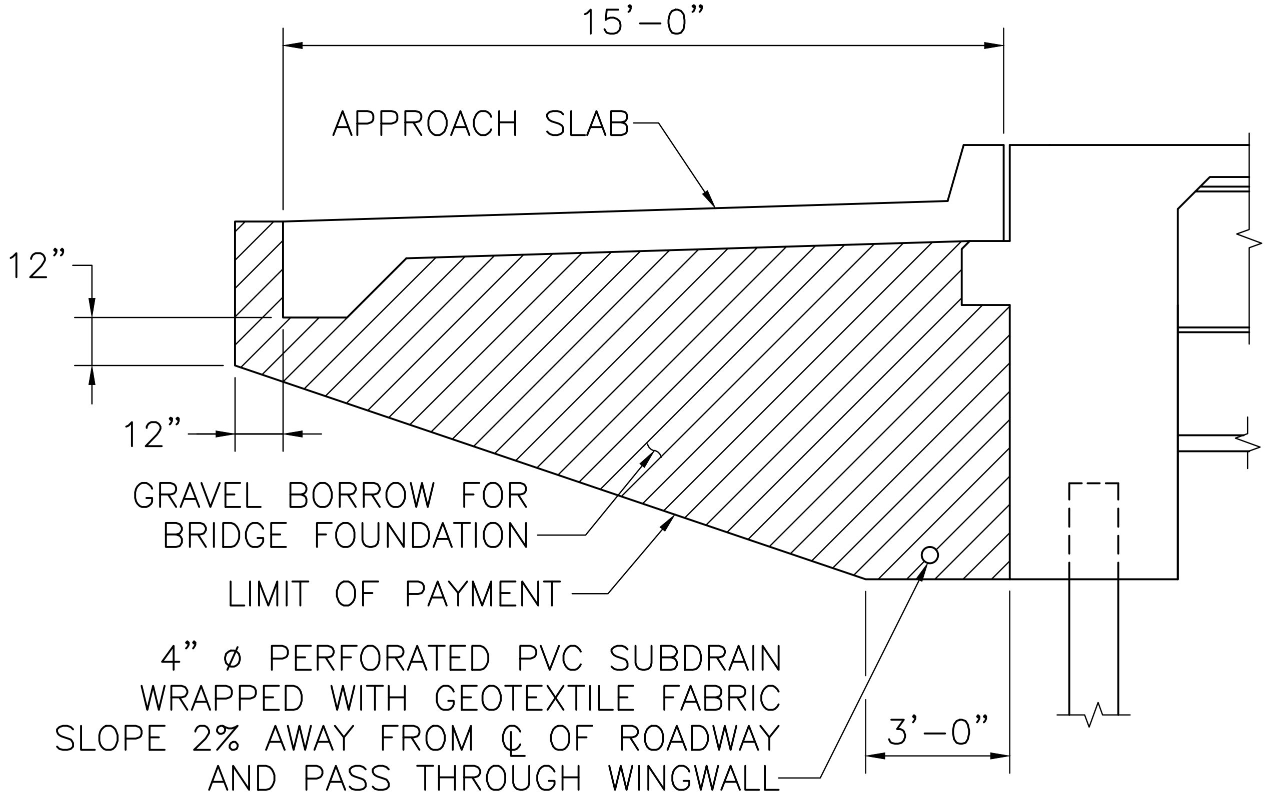
MULTIPLE SPAN BRIDGE



SINGLE SPAN BRIDGE

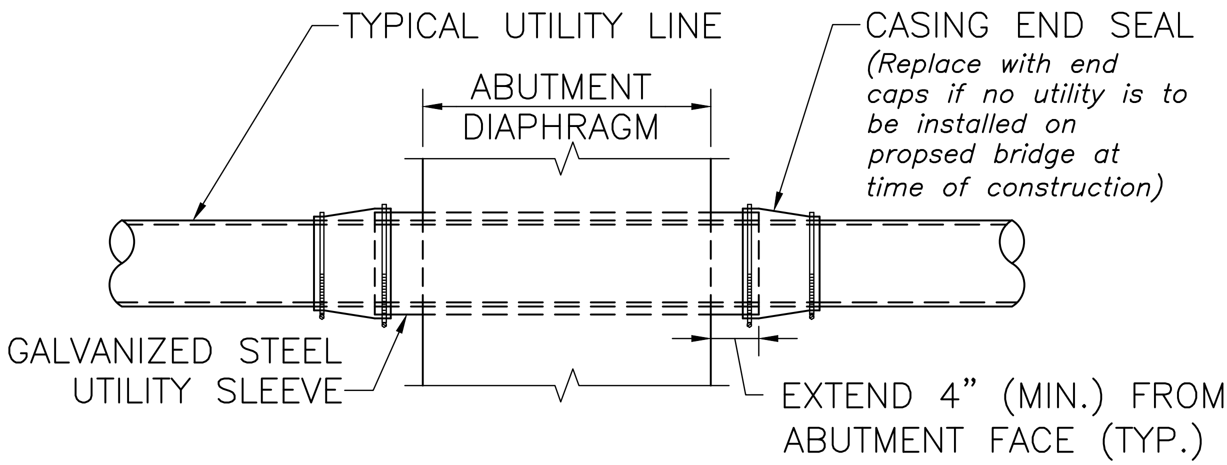
DECK PLACEMENT SEQUENCE

SCALE: 1" = 20'–0"

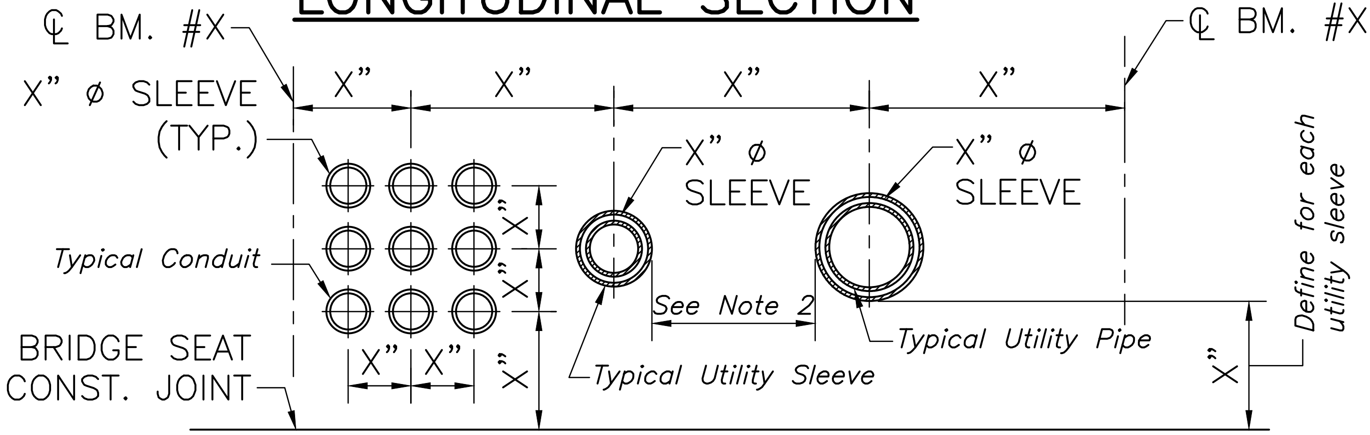


INTEGRAL ABUTMENT BACKFILL

SCALE: $\frac{1}{4}$" = 1'–0"



LONGITUDINAL SECTION



NOTES:

1. DIMENSIONS ARE SQUARE TO BEAMS.

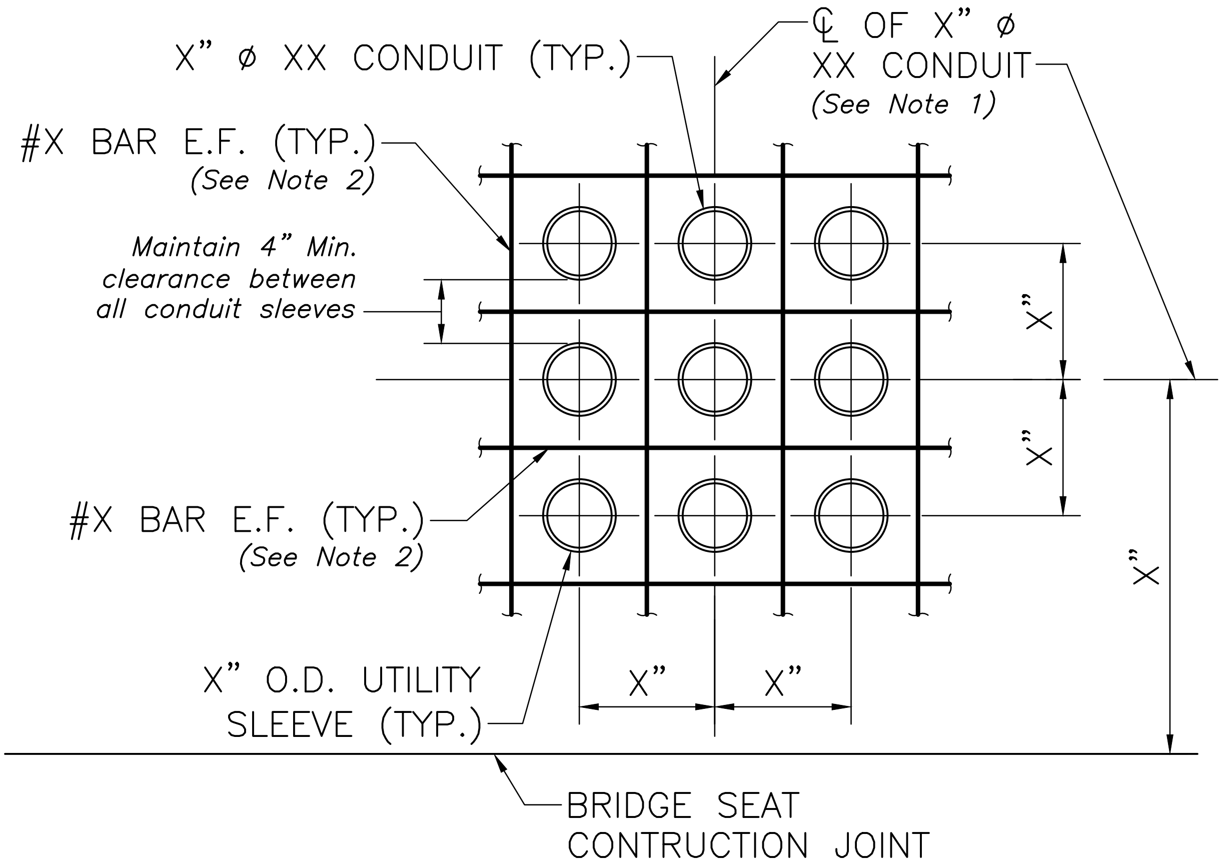
2. UTILITY SLEEVES SHALL BE STEEL PIPE CONFORMING TO ASTM A–53, TYPE S, GRADE B, STANDARD WEIGHT, PLAIN ENDS, HOT–DIP GALVANIZED AND SHALL BE SET IN THE FORMS PRIOR TO PLACING ABUTMENT DIAPHRAGM CONCRETE.

UTILITY DETAILS AT ABUTMENT

SCALE: $\frac{1}{2}$" = 1'–0"

NOTES:

1. *Designer shall contact the respective utility owners and send copies of all correspondence to the Utilities/Railroad Engineer regarding which utilities are to be carried by the structure and what the required sleeve diameters shall be.*
2. *Minimum clearances between the outsides of the sleeves shall be 4".*
3. *Label all utilities and utility pipe diameters.*
4. *For those bridges which do not carry Interstate Highways and are not currently required to support a utility, provide a single 16" ø sleeve in the bay under the sidewalk, as a provision for future utility placement.*



NOTE:

ALL REINFORCEMENT PASSING THROUGH CONDUIT BANK SHALL BE LAPPED WITH TYPICAL ABUTMENT REINFORCEMENT USING CLASS "C" TENSION LAP SPLICES.

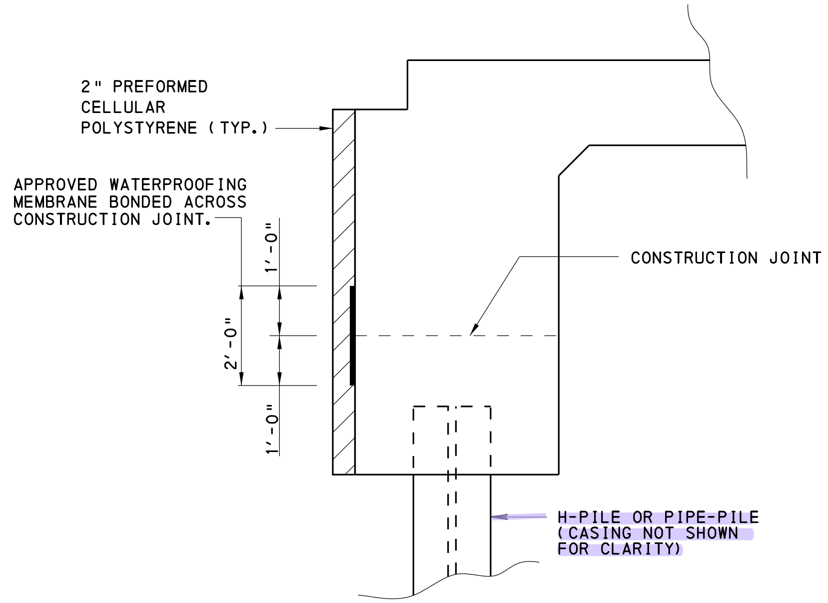
UTILITY DETAILS FOR CONDUIT BANK

SCALE: 1" = 1'–0"

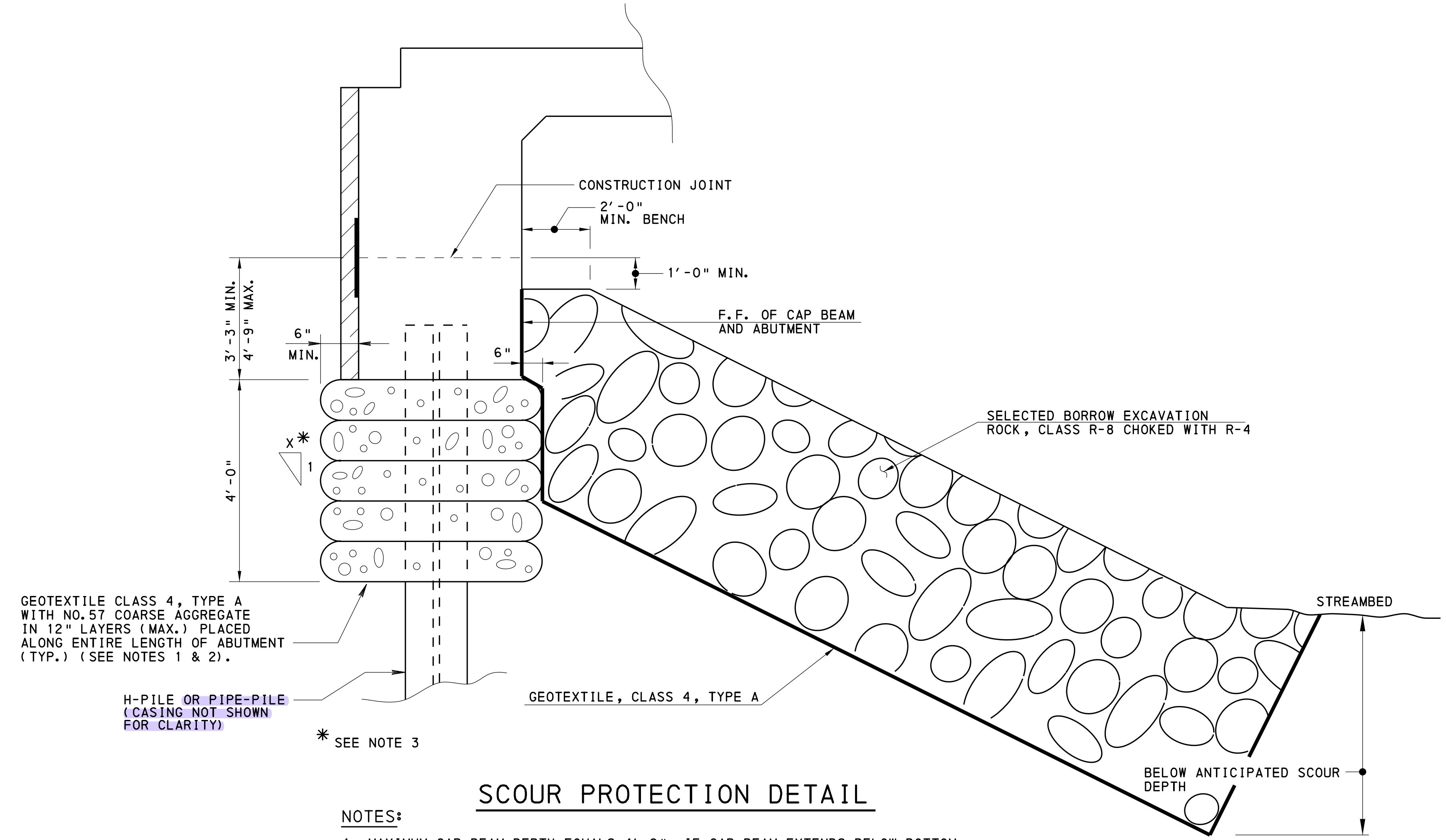
NOTES:

1. *Specify the number and type of utility conduits, i.e. electrical, cable, telephone, etc.*
2. *Specify reinforcement bars that will provide at a minimum the same As (in²/ft) as required for the typical abutment reinforcement.*

massDOT Massachusetts Department of Transportation Highway Division LRFD BRIDGE MANUAL, PART II	UTILITY DETAILS FOR CONDUIT BANK INTEGRAL ABUTMENTS	DATE OF ISSUE JUNE 2013 DRAWING NUMBER **12.4.4**



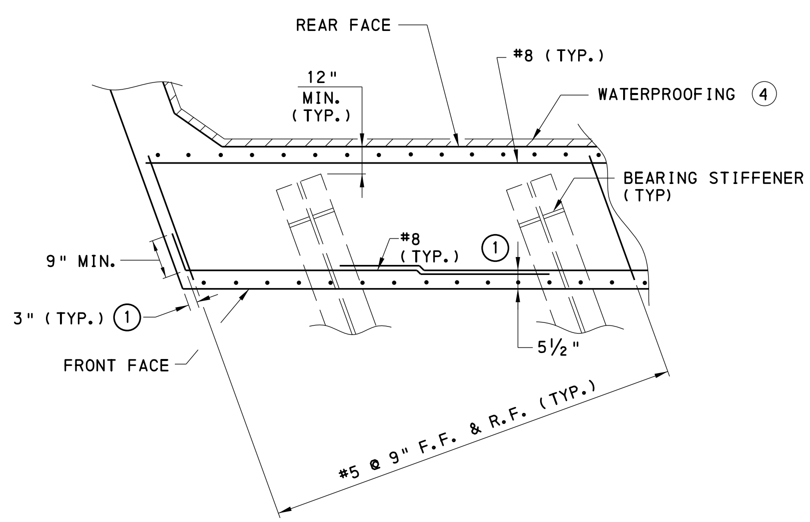
WATERPROOFING DETAIL



SCOUR PROTECTION DETAIL

NOTES:

1. MAXIMUM CAP BEAM DEPTH EQUALS 4'-9". IF CAP BEAM EXTENDS BELOW BOTTOM OF SELECT BORROW EXCAVATION ROCK, R-8, THE INDICATED GEOTEXTILE, CLASS 4 (TYPE A) WITH NO.57 COARSE AGGREGATE CAN BE ELIMINATED.
2. NO.8 COARSE AGGREGATE MAY BE USED IN LIEU OF THE NO.57 COURSE AGGREGATE FOR THE GEOTEXTILE.
3. PLACE GEOTEXTILE ALONG A VERTICAL REAR EXCAVATION FACE IF POSSIBLE. IF A VERTICAL EXCAVATION FACE CANNOT BE OBTAINED, GEOTEXTILE MAY BE PLACED ALONG THE EXCAVATION SLOPE NOT TO EXCEED 1.5H TO 1.0V.



SECTION E-E

NOTE: PROVIDE WATERPROOFING MEMBRANE IN ACCORDANCE WITH PUBLICATION 408, SECTION 680.2(b) ADHESIVE BACKED PREFORMED MEMBRANE.

LEGEND:

1 LENGTH OF BARS BETWEEN GIRDERS:

FOR P/S BEAMS —
- FOR BARS BETWEEN INTERIOR BEAMS, USE MINIMUM BAR LENGTH EQUAL TO 3" THREADING + ½ GIRDER CLEAR SPACING + ½ LAP SPLICE LENGTH. IF THE LAP SPLICE LENGTH IS GREATER THAN THE GIRDER CLEAR SPACING THE BARS SHOULD EXTEND TO WITHIN 3" OF THE ADJACENT BEAMS.
- BAR LENGTH ON THE FASCIA SIDE OF THE FASCIA BEAM SHOULD BE TO WITHIN 3" OF THE END OF DIAPHRAGM WITH A 9" BENT LEG AND INCLUDE 3" THREADED.

FOR STEEL BEAMS —
- FOR BARS BETWEEN INTERIOR BEAMS, USE MINIMUM BAR LENGTH EQUAL TO THE CLEAR SPACING + LAP LENGTH. IF THE LAP SPLICE LENGTH IS GREATER THAN THE GIRDER CLEAR SPACING EXTEND BARS TO WITHIN 3" OF THE ADJACENT BEAMS ON EACH SIDE.
- BAR LENGTH ON THE FASCIA SIDE OF THE FASCIA BEAM SHOULD BE TO WITHIN 3" OF THE END OF DIAPHRAGM WITH A 9" BENT LEG.

4 REFER TO WATERPROOFING DETAIL FOR ADDITIONAL INFORMATION.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
INTEGRAL ABUTMENT
DETAILS

RECOMMENDED APR.29, 2016	RECOMMENDED APR.29, 2016	SHEET 4 OF 9
Thomas P Macioce CHIEF BRIDGE ENGINEER	Brian G Thompson DIRECTOR, BUR. OF PROJECT DELIVERY	BD-667M

APPENDIX C

STATE DEPARTMENT OF TRANSPORTATION AND CONSULTATNT PRESENTATIONS FOR ROUNDTABLE MEETING

DelDOT/UD Virtual Round Table Meeting on Jointless Bridges **September 16, 2021**

Iowa DOT Slide 1 of 2: Successes and Innovations

Successes:
- First known integral abutment constructed in 1965 (FHWA 501510).
- First known semi-integral abutment in 1963 (FHWA 003410).
- Integral abutments are preferred followed by semi-integral abutments (and finally stub abutments which have expansion joints).
- Current integral abutment limits for prestressed beam bridges: 575 ft for 0 degree skew and 425 ft for 45 degree skew.
- Current integral abutment limits for steel beam bridges: 400 ft for 0 degree skew and 300 ft for 45 degree skew.
- Horizontally curved steel bridges are subject to additional limits of 900 ft minimum radius and maximum roadway width of 44 ft.
- Integral abutments can be used with MSE walls. Integral abutments are isolated to minimize interaction with MSE walls.
- Current semi-integral abutment limits are undefined, but typically 575 ft at any skew for prestressed and 400 ft at any skew for steel.
- Semi-integrals are common in shallow rock conditions where spread footings or drilled shafts may be needed, wide bridges of 120 ft or more to limit restraint and deck cracking, ABC lateral slide applications, and high abutments.
- Many older structures with stub abutments/expansion joints are converted to semi-integral abutments as part of deck overlay projects.
- Piling sizes updated to use compact/plastic sections for higher loads and movements. Typical standard pile change from HP10x42 to HP10x57. [Yield strength also increased from 36 ksi to 50 ksi.]
- Prebored holes are filled with bentonite material to reduce movement earth pressures and keep the hole open.
- Deeper prebored holes, 8 ft initially, increased to 10 ft and up to 15 ft to allow more flexibility in the abutment/piling movement.
- Drainage behind the abutments (granular backfill and underdrain placement) were improved/updated.
- Wider and stronger paving notches were implemented to support approach slabs.
- Concrete slab bridges use integral abutments with tied approach slabs and stainless steel ties and sleeper slab. These are short bridges (less than 150 ft). Longer bridges with semi-integral abutments also use this same arrangement. (One project has sleeper slab supported by driven steel piles.)

Innovations:
- In one case steel piles were "stabbed" into the top of drilled shafts so that integral abutments could be utilized.
- Tried precast approach slabs on a couple of projects.
- Some ABC lateral slide projects have used UHPC to create an integral abutment connection between the superstructure and abutment footing after the slide.
- Semi-integral abutments use outboard wingwalls so that concrete rail is cast on approach slab to improve drainage.
- A 228 ft wide SPUI bridge used EPS foam block as an insulator between the backfill and integral abutment concrete to limit thermal cracks.
- "Semi-stub abutment" has been used on one project. Abutment uses a tied approach slab that passes over the top of the abutment backwall and moves the expansion joint to the end of approach slab. Backwall is independent of the superstructure and its thermal movements such that the fill remains stationary.

1

DelDOT/UD Virtual Round Table Meeting on Jointless Bridges **September 16, 2021**

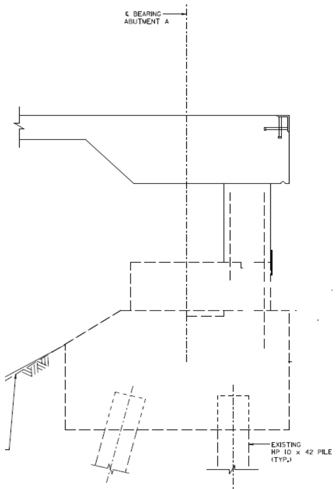
Iowa DOT Slide 2 of 2: Issues and Challenges

Issues:
- Thermal restraint resulting deck cracking.
- Bump at end of bridge affecting rideability.
- Settlement of berms around abutments.
- Damage to the top of integral abutments from trucks and snow plows due to approach slab settlement and exposed bridge ends.
- Approach slabs falling off paving supports (older structures).
- Failure of paving supports/notches.
- Issues with erosion around abutments and approach slab shoulder areas.
- Leaking of joint between abutment and approach slab. [Crumb rubber (CF) joints at the abutment/approach slab joint fail. Replacing with silicone sealant and backer rod.]
- Water leaking under abutments and eroding berms.
- Corrosion of piling at bottom of abutment footing.
- Field issues related to shallow bedrock and pile flexibility (and prebore) for integral abutments.

Challenges:
- Developing standards to more easily incorporate good practices. Vetting good details (constructability and durability) takes time.
- Setting bridge length and skew limits for semi-integral abutments.
- Construction quality on approaches (road versus bridge contractor).
- Interaction between road designers and bridge designers w.r.t. approach types and drainage.
- Shortened life span of bridge approaches.

2

SUCCESS!
BRIDGES WITH LENGTH CONTRIBUTING TO EXPANSION< 70’

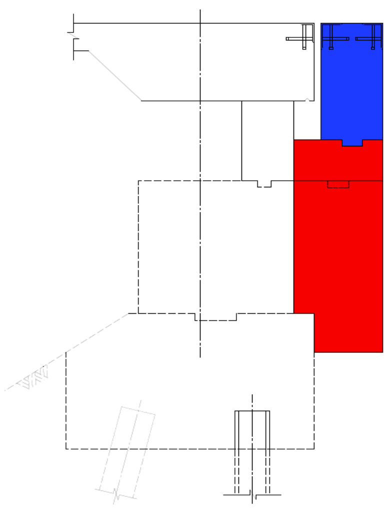


For small superstructure expansions, Maryland has simply eliminated the joint by extending the deck beyond the backwall. This has eliminated all the typical problems associated with joints. We have not noticed any problems at the tie in point with the approach roadway. We believe the flexibility of the approach asphalt can handle the small movements resulting from the superstructure expansion / contraction.

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

3

NEEDED IMPROVMENT!
BRIDGES WITH LENGTH CONTRIBUTING TO EXPANSION> 70’



For spans involving increased movement an expansion joint is still used. Maryland has moved the joint to behind the abutment to try to minimize problems associated with a joint. The red shaded area represent columns spaced 15’ max apart that support a beam (shaded blue) that is used to support the compression joint. The system has worked for Maryland, however, it is an expensive system to build.

Challenge Maryland faces is finding a system for large expansions that do not require an approach slab.

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

4

Massachusetts Jointless Bridge Successes

- Deck over Backwall
  - 90 years of in-service experience: No roadway joints – sawcut in pavement
  - Has performed very well
  - Minimal deterioration of beams and substructure
- Integral Abutments
  - 25 years of experience: have performed very well
  - Design has been simplified: if bridge fits into span length and skew limits, piles are pre-designed
  - Superstructure design is a regular beam design
- Buried Approach Slabs
  - 90 years of experience
  - Have been very effective of eliminating "bump at the end of the bridge"

5

Massachusetts Jointless Bridge Issues and Challenges

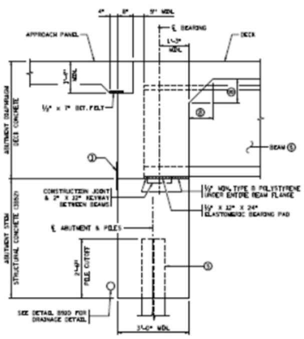
- Integral Abutments: How to handle bedrock
  - Bedrock close to surface so that there is not enough depth to the pile point of fixity
  - Sloping bedrock across abutment so that stiffness of pile varies greatly
  - Need research to develop design procedures
- Use of other types of piles than just H-piles
  - Micropiles
  - Project currently being designed with micropiles as a trial

6

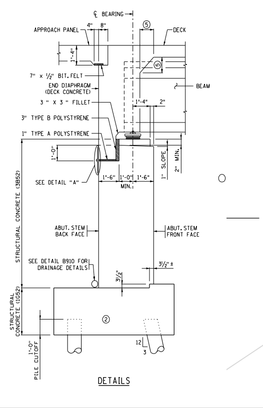
Jointless Bridges - Successes

- Mid-1990s: Began migration toward integral abutment bridges.
- Mid-2000s: Semi-integral abutment details were developed.
- Now: Jointless bridges are preferred option, (300 ft max length)
- Issues successfully overcome: Deck cracks near diaphragm, approach panel connection, pour sequence/construction joints for wings/diaphragm/deck.

1st choice Integral



2nd choice Semi-Integral



Dave Dahlberg – MnDOT
Bridge Design Manual Engr

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Jointless Bridges - Challenges

- Design and Detailing
  - Expand current limits (skew, length, height) for jointless bridges.
  - Simplify modeling and analysis of piles under axial and lateral loads. How do other states analyze piles, account for displacement, rotation, skew, and choose pile orientation?
  - Increase length limitation for CIP piles (currently 150 ft).
  - Flared wings, design for active pressure or passive pressure or… ?
  - Moment connection between superstructure and integral abutment?
- Construction and Maintenance
  - Settlement/washout of soils in front of integral abutments causes pile exposure, which leads to pile corrosion.
  - Joint failure at the end of the approach panel.

Dave Dahlberg – MnDOT
Bridge Design Manual Engr

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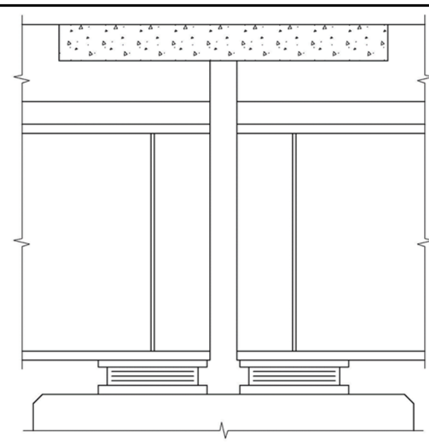
NYSDOT

Successes/Challenges

Two Slides about one interesting success/challenge concerning Jointless Bridges in New York State

9

SUCCESS – UHPC Link Slabs



- Elimination of deck joints
  - Leakage - accelerated deterioration of girder ends, bearings, substructures
  - Frequent maintenance
  - User comfort
- Simple span behavior retained
  - Girders function as originally designed
- Economical means to eliminate joints

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CHALLENGES – UHPC LINK SLABS

- UHPC is an Excellent Material that Presents Challenges
  - High Cost
  - Unique Material Requirements
  - Specialized Mixing Equipment
  - Specific Placement Procedures
  - Limited Number of Suppliers
- Other Innovative Materials Being Considered
  - Decrease Initial Cost
  - General Construction Techniques
  - Wider Availability

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PennDOT District 3

Pennsylvania Jointless Bridge Specifications

- PennDOT Publication 15M (Design Manual Part 4)
  - Appenix G
- PennDOT Publicatin 218M (Bridge Design Standards)
  - BD-628M (Approach Slabs)
  - BD-667M (Integral Abutments)

pennsylvania
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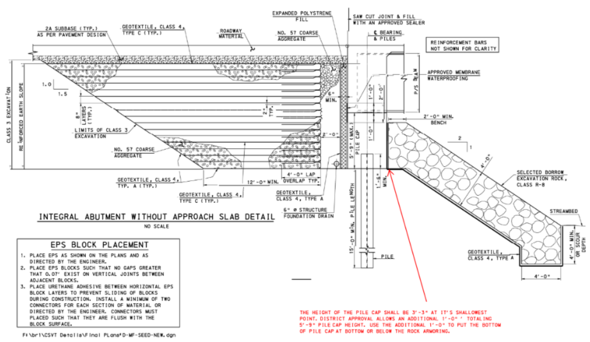
PennDOT District 3

Current Issues

- Developing Details to Eliminate Approach Slabs for Integral Abutments



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TN TDOT Department of Transportation™

14

Jointless Bridges in Tennessee

Pros of Eliminating Expansion Joints

Eliminates initial and routine joint maintenance costs
Eliminate joints leakage and staining issues
Eliminates salt laden water deterioration
Eliminates deterioration of bearings, beam ends, and substructures requiring continued maintenance
Eliminates the adage "Where Joints Go, Water Flows"



TN TDOT Department of Transportation

15

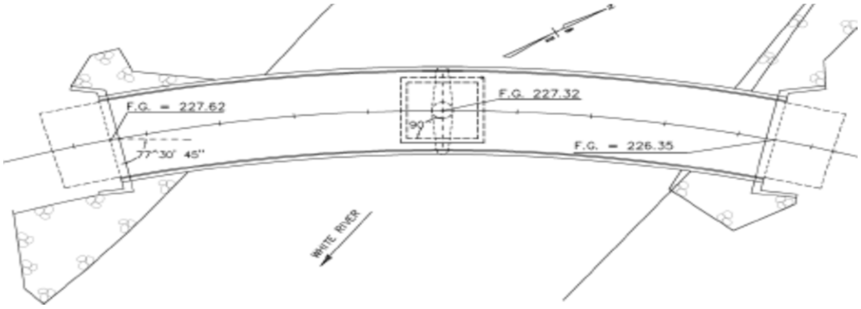
Jointless Bridges in Tennessee

Cons of Eliminating Joints

On rare occasions, integral abutments may cause thermal restraint resulting in deck or abutment cracking or spalling. These infrequent occurrences are acceptable risks and easily addressed compared to repairs on numerous beams, bents and bearings.


TN TDOT Department of Transportation

16



First curved girder IAB in Vermont built in 2008

No performance issues to date

Vermont has built 6 additional curved girder IABs of various length and Degree of Curvature with no known performance issues

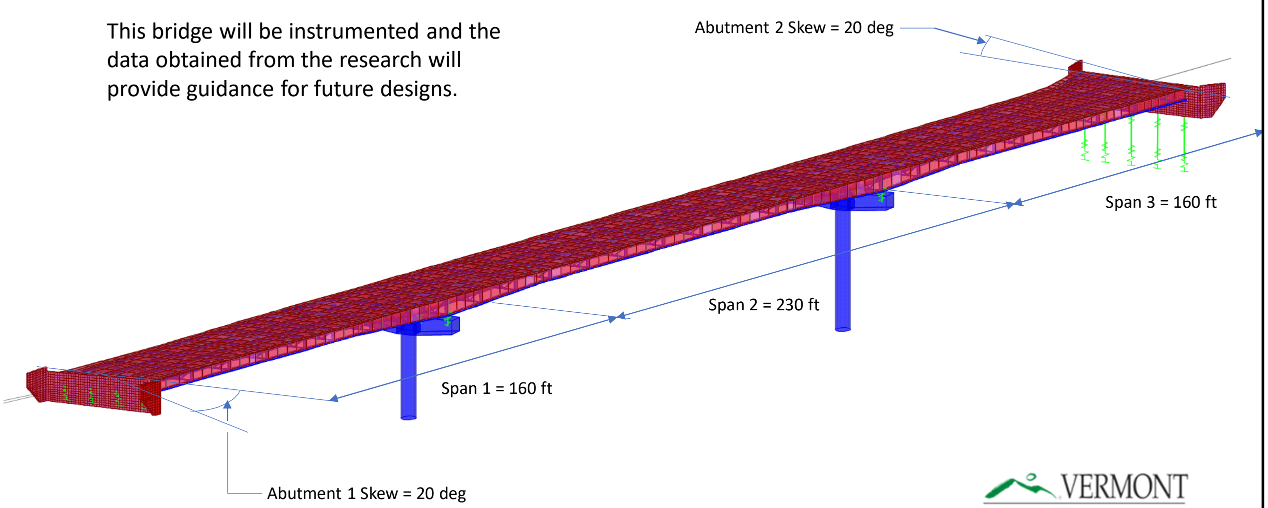
NETC currently has an ongoing research project to develop a design guide for curved IABs

VERMONT
AGENCY OF TRANSPORTATION

17

Bridge currently under design in Hartford Vermont. At 550' in length it will be the longest IAB in Vermont.

This bridge will be instrumented and the data obtained from the research will provide guidance for future designs.



VERMONT
AGENCY OF TRANSPORTATION

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Thoughts and Lessons Learned

- Early designs had vertical cracking between girders in the backwall
  - This has been mitigated by having the max spacing of horizontal steel in backwall @ 6”
- Cracking at acute corners in wingwalls
  - These appear to be stable with time and are not expected to affect service life
- Design straight and unskewed (less than 20 deg) IABs can be very simple
  - Straight-Forward conservative assumptions can be made and calculations can be done quickly and easily without a significant impact on Construction costs.
- Design of IABs with complex geometry is challenging (curved/skewed)
  - The use of full FEM models are required. Lateral Displacements and out-of-plane rotations must be considered.

VERMONT AGENCY OF TRANSPORTATION

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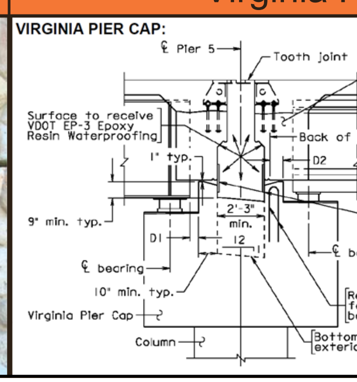
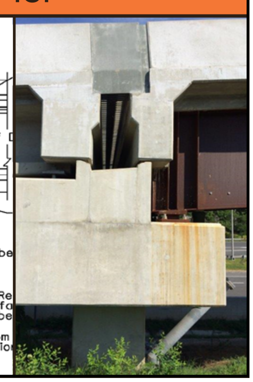
VDOT’s Jointless Bridge Program – New Bridges

- **VDOT has required all new bridges to be jointless since 2011**
- **Chapter 17 of the *Manual of the Structure and Bridge Division* establishes requirements**
  - **Fully integral abutments**
  - **Semi-integral abutments**
  - **deck extensions**
- **Long bridges can use the Virginia Pier or Virginia Abutment**

Virginia Abutment


Virginia Pier





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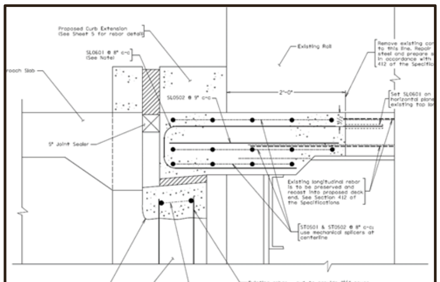
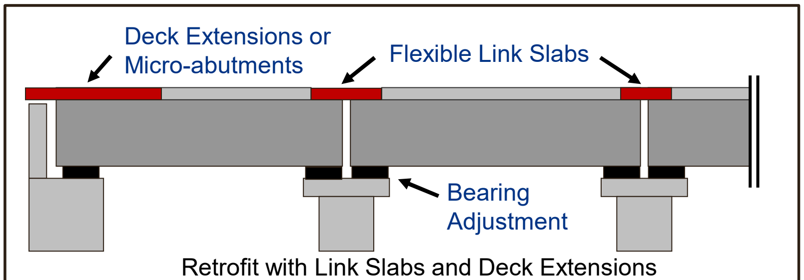
VDOT's Jointless Bridge Program – Existing Bridges

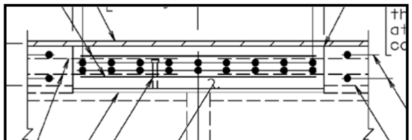
- **VDOT has built link slabs (eliminating joints) for 40 years**
- **Chapter 32 of the *Manual of the Structure and Bridge Division***



Virginia Micro-abutment



Joint Elimination Layout



Link Slab Detail

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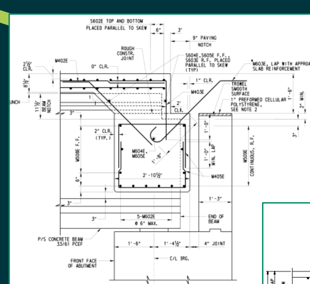
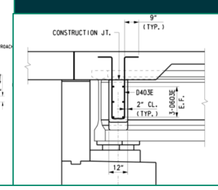
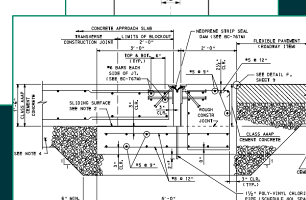
Moveable Approach Slabs

- Eliminates joints at abutments
- Achieved by tying together the deck and approach slab
- Approach slab intended to move with the superstructure
- Joint moved to roadway end of the approach slab (a.k.a PennDOT Type 3 Approach Slab)
- Details from DelDOT US 301 Section 2 shown

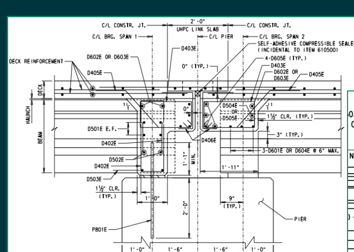


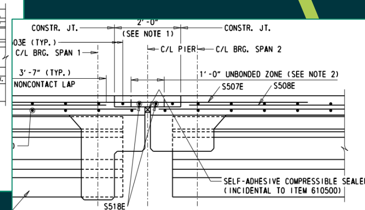




Link Slabs

- Eliminates joints at piers
- Rehab or new construction
- Advantageous for existing multi-span bridges that are not continuous (i.e. simply supported)
- Specialized materials for link slab
  - ECC
  - UHPC
- Needs tensile ductility
- Details from DelDOT BR 3-152 shown
- **Live load continuity** is an alternative to link slabs. SR 0476 Blue Route and DeLODT BR 1-634





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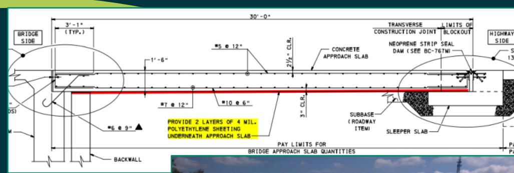

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Moveable Approach Slabs

…Devil is in the details…

- Proper debonding of the slab needed for free movement
- Ensure details elsewhere don't inhibit movement and or rotations
- Instances of approach slab cracking
- Potential area for further study

Link Slabs

- Considerations to material availability
- Problems locally sourcing of ECC (specific materials/gradations)
- UHPC can be used as an alternative
- UHPC can shorten link slab length, but more costly

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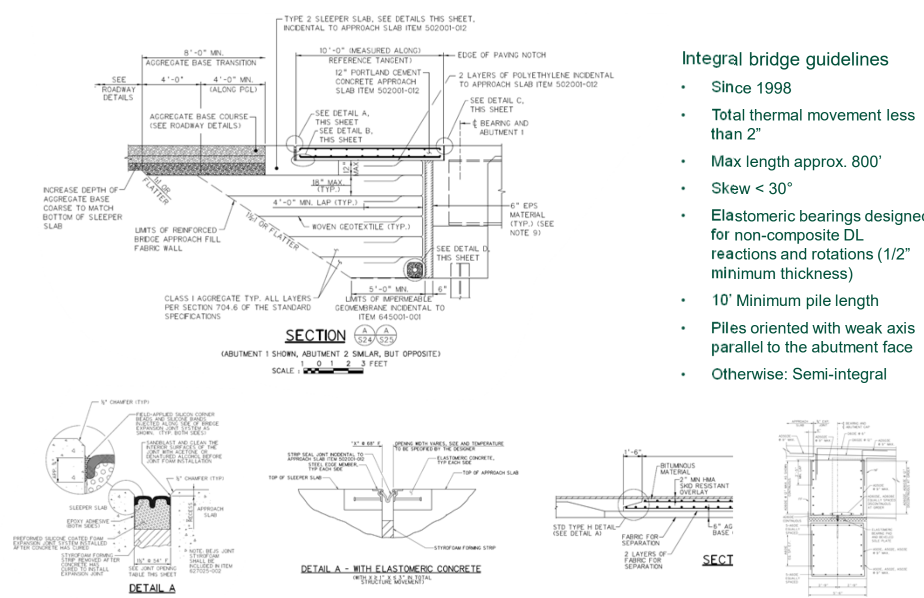

Integral bridge guidelines

- Since 1998
- Total thermal movement less than 2"
- Max length approx. 800'
- Skew < 30°
- Elastomeric bearings designed for non-composite DL reactions and rotations (1/2" minimum thickness)
- 10' Minimum pile length
- Piles oriented with weak axis parallel to the abutment face
- Otherwise: Semi-integral

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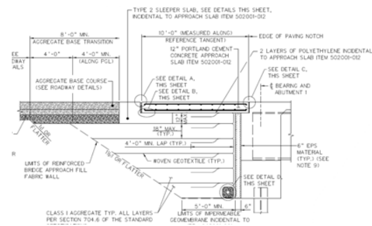
Challenges and Solutions

Challenges

- Original detail did not include a sleeper slab but used a Type H joint. Pavement at the interface with the bridge was a maintenance issue.
- Settlement of backfill behind the abutment created a bump at the back of the bridge.

Solutions

- Added approach slab and joint for movement at sleeper slab.
- In addition to approach slab, created a reinforced soil zone behind the abutment.

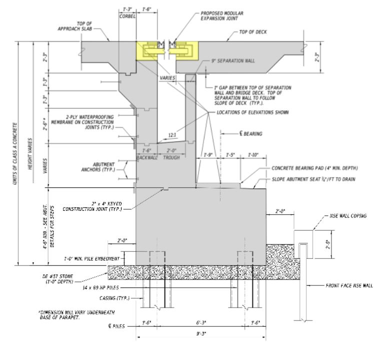


Challenge

- Not recommended for curved or highly skewed bridges.

Solution

- For a 900' long and highly curved structure (R=511') at DelDOT I-95/SR 896 interchange, using a detail from VA that separates the joint from the beam seat.



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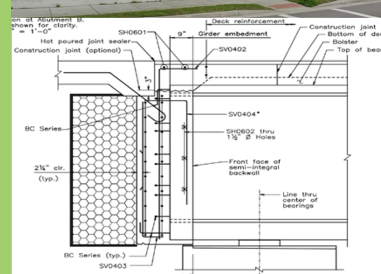
Success and Innovations

- Long Term Performance – Maintenance Savings
- Use of pavement joint filler in lieu of compression/strip seal joints to accommodate small movements.
- Elimination of intermediate bridge joints
  - Concrete diaphragm encasement of beams in lieu of link slabs which provided opportunities to reduce forces in existing girders
- Dominion Blvd. (US-17) over Cedar Road, Chesapeake, VA
  - Utilized a staggered row of plumb, square prestressed piles to achieve base fixity
  - EPS (Styrofoam) blocks used behind narrow semi-integral diaphragm to reduce passive resistance and facilitate superstructure movement.
- I-271 over SR-8, Macedonia, OH
  - Widened the existing bridge and converted the existing stub abutments to semi-integral design.
  - Utilizes two rows of steel H-piles (webs turned to strong axis), with the front pile row battered to achieve base fixity.
  - Achieved semi-integral behavior with a very large skew (45 degrees), and still performing well after about 15 years.



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CHALLENGES

- Level of details provided by different clients via standard details
  - Integral and Semi-Integral Abutments
  - Slab Extensions and interactions with Approach Slabs
- Differing limits on span length applicability from client to client
  - Current DelDOT BDM more restrictive than other neighboring states however can obtain design exception for elimination of joints on longer bridges.

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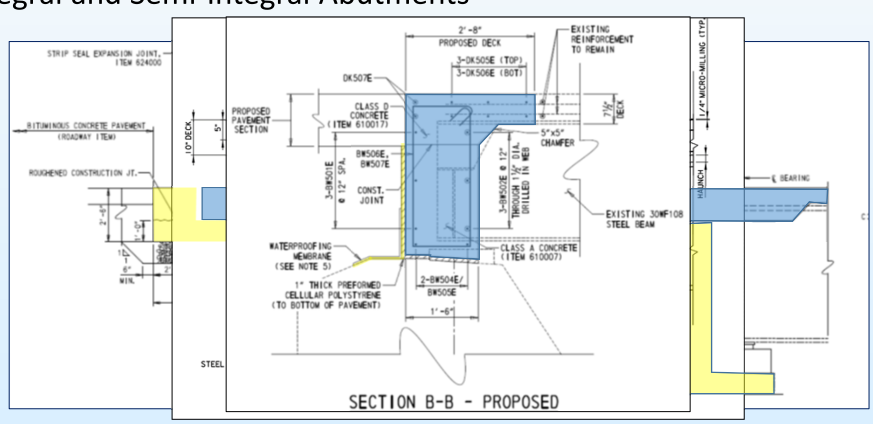
Jointless Bridge Successes

- Link Slabs
- Extending the Deck Over the Backwall
- Integral and Semi-Integral Abutments



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Jointless Bridge Challenges

- Lack of National Design Guidance
- Retrofit vs New Construction
  - Construction Phasing
  - Maintenance of Traffic
- Long-term Performance/Durability

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