

Best Practices for Transition Design of Concrete Pavement Intersections and Related Transitions

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Abstract

Pavement transitions are one of the key elements of pavement performance often overlooked in the design process. Improperly designed pavement transition elements lead to poor pavement performance and often creating a need for frequent maintenance and repair. Transition elements are necessary to ensure a smooth transition between two different pavement sections and to minimize future pavement performance issues. This paper addressed the transition of intersections, ramp/gore areas, drainage inlets, and the conversion between a portland cement concrete and asphalt concrete materials. The design standards of most state Department of Transportation (DOT) were reviewed and the best practices identified toward incorporating them into a set of guidelines for design and construction purposes. Moreover, field visits were conducted to survey the conditions of these transition types relative to slab cracking and associated distresses due to inappropriate jointing or other design-related factors. Based on this information, specific design practices are suggested to enhance the design standard for different transition types based on simple and sound concepts substantiated by observed field performance. The guidelines address the design of concrete pavement transition areas including joints and related details.

Introduction

In a concrete pavement system, transition design often evolves around the placement and detailing of joints that are placed in the pavement to control cracking and to facilitate construction. Joints divide the pavement into practical construction increments, delineate traffic lanes, and accommodate slab movements. The three types of joints commonly used in concrete pavement construction are contraction joints, construction joints, and isolation joints. The purpose of a contraction joint is to control cracking caused by restrained drying shrinkage and thermally induced movements of the concrete and the concomitant effects of curling and warping. The contraction joints without dowels, if spaced closely enough, may provide the prerequisite load transfer through aggregate interlock across the joint. Construction joints are typically constructed with dowel bars. In terms of transitions, longitudinal joints are mainly of the construction type but they are

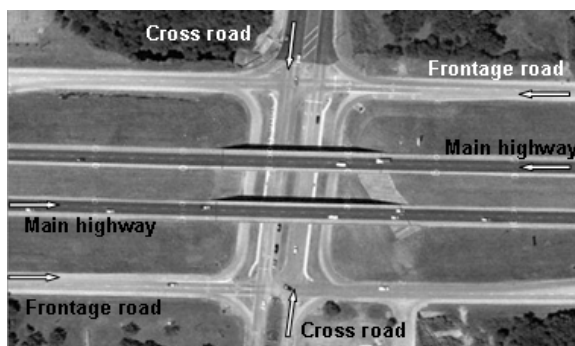
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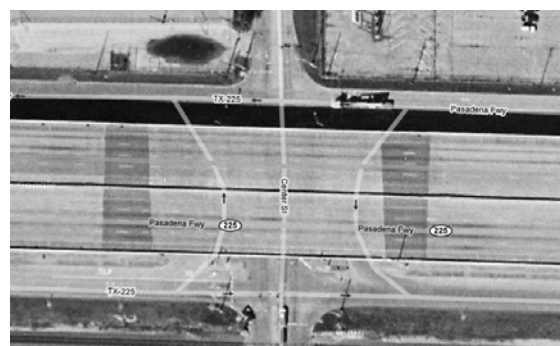
very useful in controlling irregular longitudinal cracking that would otherwise occur in panel widths exceeding certain limits. Isolation and expansion joints allow for anticipated differential horizontal and vertical movements (if no dowels are used) between a pavement element and another structure. With respect to all practical intents and purposes, isolation joints perform the same function as expansion joints and often serve as a replacement for expansion joints. Proper jointing of concrete pavements is essential to ensure good performance since it is the primary key to avoiding random cracking and irregular joint movements.

Joint spacing, slab thickness, and joint stiffness are the prime factors in the performance of concrete pavement transitions. Maximum joint spacing is a function of environmental factors such as temperature and moisture changes in the pavement. When joint spacings are short, curling stress in the pavement tend to be minimized, and sawcut joint openings between two adjoining slab segments can be kept to a minimum and load transfer (by aggregate interlocking) maximized; however, it may increase sawcutting costs and cause more chance of faulting and spalling by the increased number of sawcut joints. Whether sawed or constructed joint, dowels do tend to compensate for the lack of load transfer efficiency (LTE) generated by aggregate interlock. The load transfer of a joint or crack has an important effect on the composite stiffness of a concrete pavement section and ultimately affects its performance under repetitive loading. Relative to diminished load transfer and stiffness as would be reflected in the radius of relative stiffness (ℓ), a systematic design process can be employed to correlate joint stiffness to aggregate interlock, dowel bar structural stiffness, interlayer friction, slab thickness, and the configuration of the steel at the joint. The proper joint spacing can be balanced against the economy associated with dowelling and good performance (Ioannides and Hammons 1996, Jeong and Zollinger 2001).

Most highway systems in Texas are composed with main lanes, ramp and frontage roads, and intersections located where frontage and cross roads meet. Figure 1 shows the layout of typical intersections in Texas. The transition at the intersection in Figure 1-b and other places were surveyed, relative to slab cracking and associated distresses that may be related to improperly restrained segments due to inappropriate jointing practices or other design-related factors.



1-a) Intersection layout of Rural Highway System in Texas



1-b) Intersection of Urban Highway System (SH225, Houston, Texas)

Figure 1 Intersections of Highway Systems.

Research Significance

Pavement transitions are often overlooked in the design process but serve as key elements of pavement performance. Improperly designed pavement transition elements lead to poor pavement performance and often creating a need for frequent maintenance and repair. Transition details are necessary for joining pavement sections which may involve only a single joint and a single slab panel, a series of joints and slab panels, or a series of short sections of adjoining pavements that incorporate different design elements that vary depending on pavement type and structure. In this paper, the current practices for concrete pavement transitions of intersection, ramp/gore area, drainage inlets, and the transition between PCC pavement and AC pavement are subsequently discussed. The general features such as joint details, tie bars, and dowels are addressed within the context of each transition type. Moreover, limitations and optimized configurations relative to deflection criteria are identified for design improvement for various transitions.

Intersection Transitions

The functions of a pavement transition is to maintain rideability allowing gradual transition in geometry and structural capacity of the pavement while accommodating slab end movements and minimizing drainage-related issues. Intersections encompass two orthogonally arranged pavement segments which can be mutually restricting, and if there is no proper isolation from each other, restraint cracking may occur. Therefore, the objective of a transition for intersections is to promote compatibility of the movements between orthogonally arranged pavement segments included in the intersection.

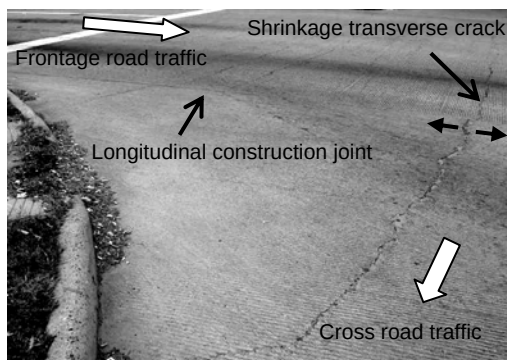
Current Practices. The intersections on SH 225 (Pasadena Freeway, Figures 2-a to 2-d) in Houston, Texas were constructed using continuously reinforced concrete (CRC) pavement with uni-directional reinforcing steel. The Frontage roads were paved continuously through the intersection and the cross roads tied to the frontage roads. In this instance, the construction has performed well except for the restraint slabs in the radial transition areas. Because the construction joint ties the radial areas of cross road to the frontage road, the transverse cracks on the frontage road reflect into the cross road. Perhaps if the joint was untied and consisted of a thickened edge on the cross roads or had a sleeper slab support, the cross road concrete may not be laterally restrained as much and less susceptible to reflective cracking. These measures would help eliminate the type of cracking shown in Figures 2-a and 2-b.

Figures 2-c and 2-d show uncontrolled longitudinal cracks which could be minimized by placement of an untied construction joint between the frontage road and the cross lanes. It appears that this cracking was caused by improper location of the longitudinal construction joint in the turning ramp between the frontage road and cross road pavement. Placement of the construction joint too far into the turning radius perhaps over restrains the intersection concrete perpendicular to the ramp concrete. An isolation of the frontage road pavement from the crossing road pavement is necessary to avoid lateral restraint caused by differential directional movement of the two concrete sections. The use of tie bars on such a longitudinal joint should also be avoided. Figures 2-b and 2-d show normal development of transverse cracking in the frontage road

concrete, but some cracking reflected into the transition between the frontage road and the cross street paving.

Figure 2-e shows transition details for CRC pavement (TxDOT Houston District 2005). The interesting feature of this detail is the longitudinal steel of each lane is continuous in both longitudinal directions through the center portion of the intersection (i.e., the longitudinal steel in one segment serves as the transverse steel in the other segment). Moreover, multi-piece tie bars are used on the longitudinal steel crossing the longitudinal joints. Based on before and after performance comparisons it was concluded that this reinforcement serves as a shear key to strengthen and prevent distress at the transverse joint of the continuously paved lanes; however, it creates a heavily restrained area in the overlap section, which may be subject to diagonal and related cracking in this portion of the intersection. This reinforcing scheme has been employed for several years in intersection construction in the Houston District but as an alternative, continuous paving of the main lane pavement would help to isolate and promote directional movement of the pavement segments and minimize the degree of restraint and cracking associated with it.

Figure 2-f shows pavement joints and pattern details recommended by the American Concrete Pavement Association to minimize random cracking for jointed concrete (JC) pavement in intersections (ACPA 1992). The joint spacing should not exceed 4.5 m, and no slab corners should be cut any sharper than 60 degrees without reinforcing to prevent corner break. Similar restrictions should apply for CRC pavement construction.



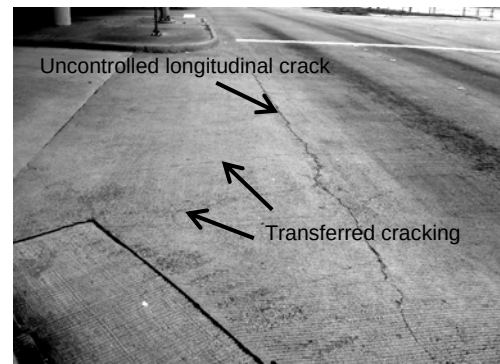
2-a) Restraint Cracks in the Turning Radius Area



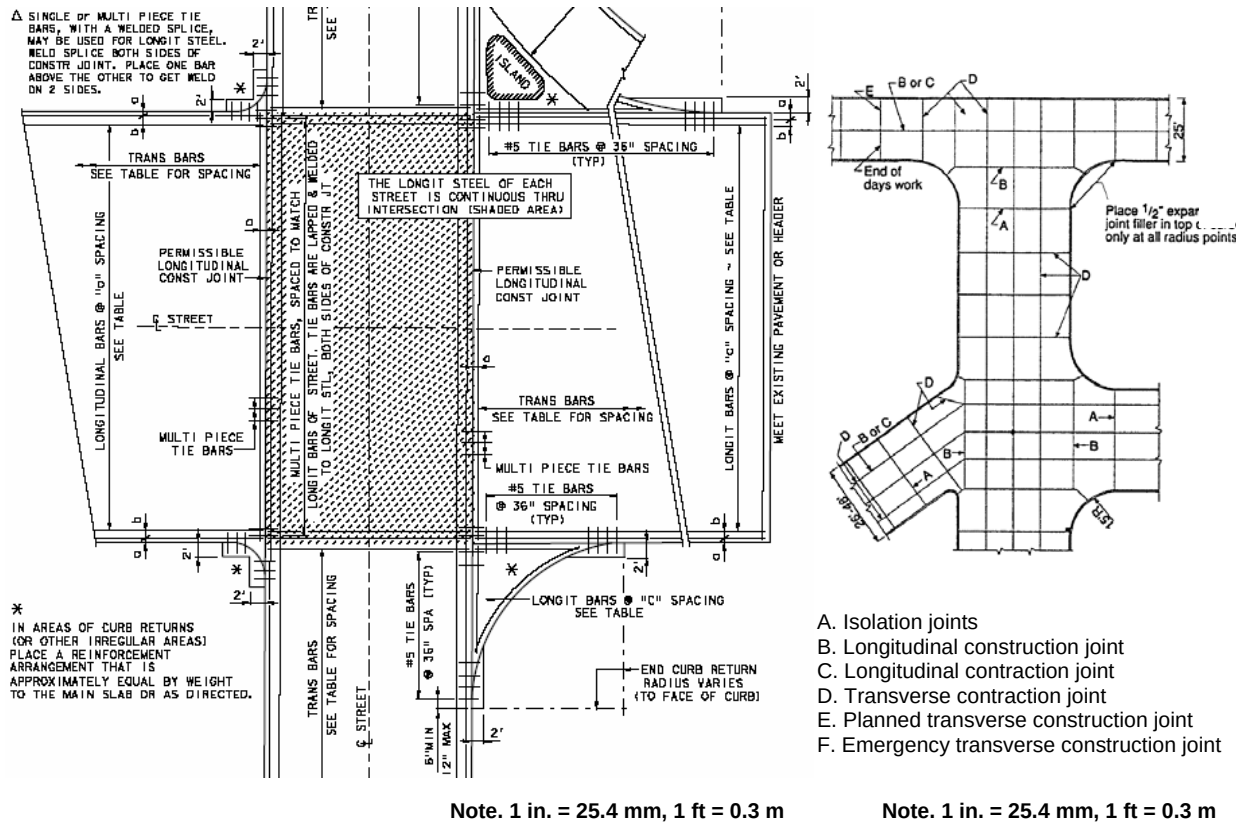
2-b) Transferred Cracking



2-c) Uncontrolled Longitudinal Cracking



2-d) Uncontrolled Longitudinal Cracking



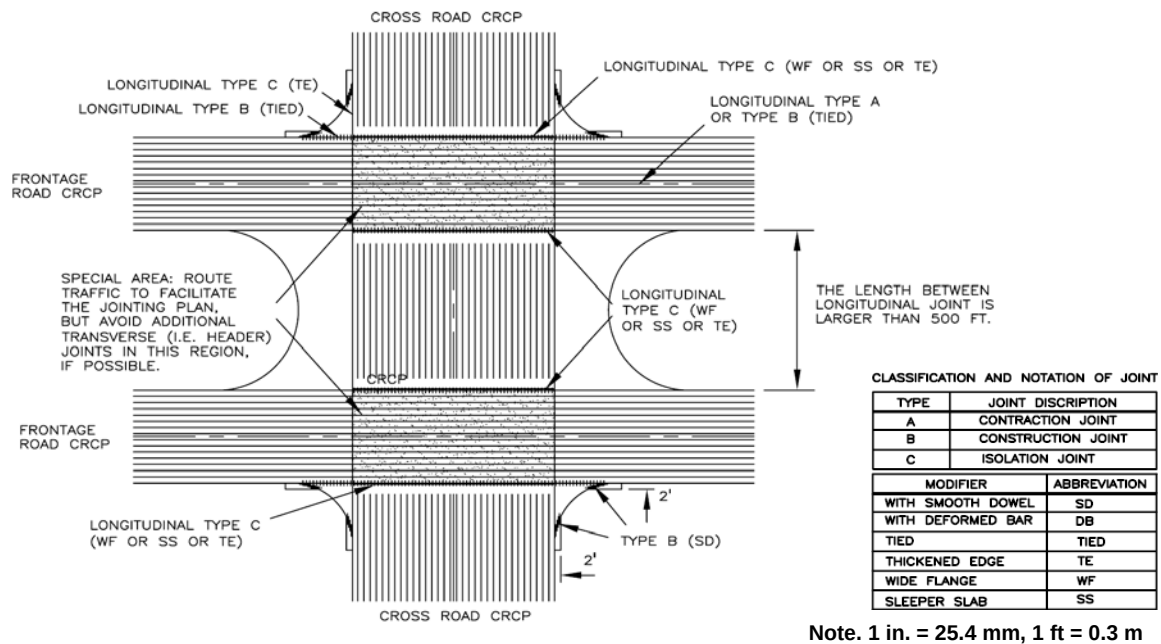
2-e) CRC Pavement Intersection Plan (TxDOT Houston District 2005)

2-f) JC Pavement Joint Details (ACPA 1992).

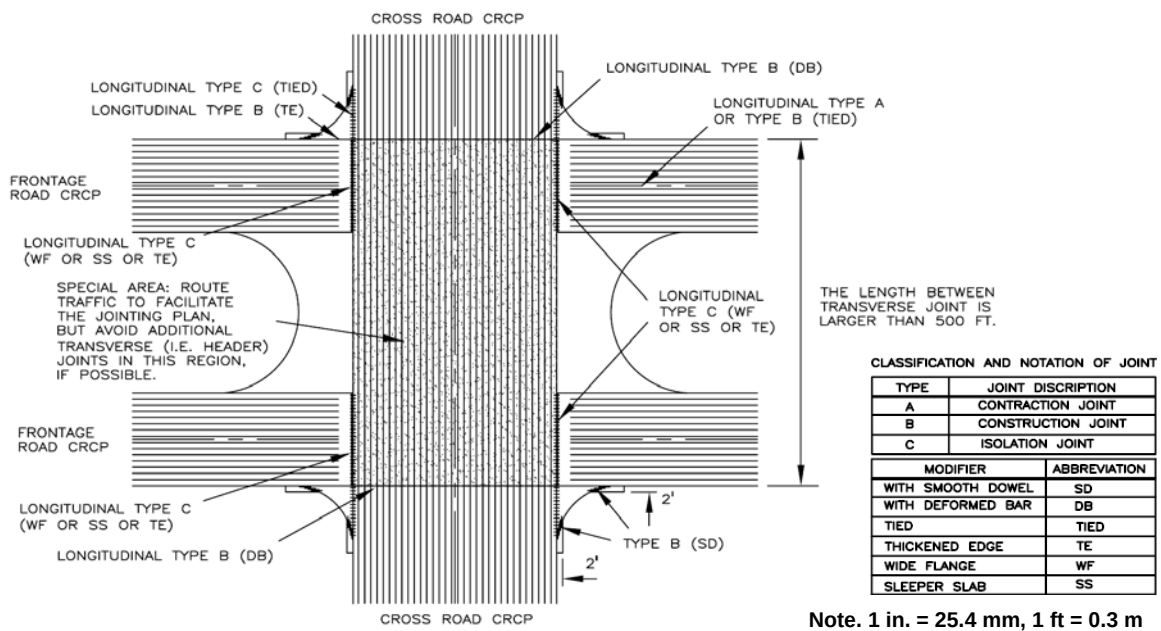
Figure 2 Performances and Current Design Details of Intersection Transition.

Design Improvements. Figures 3-a and 3-b are suggestions to reduce the level of restraint relative to the orientation of continuously paved lanes of concrete. Figure 3-a is appropriate when the frontage road would be paved continuously through the intersection and the cross road isolated from the frontage road in the intersection. When the length between the frontage road longitudinal joints is less than 150 m, the contraction design using JC pavement should be used instead of CRC pavement since proper development of CRC pavement cracking patterns cannot be assured. Figure 3-b is for continuous paving of the cross road and isolation of the frontage road. A wide flange, sleeper slab, or thickened edge joint type may be applicable for the isolation joints. In the special area where the two directional pavement segments overlap, a transverse contraction joint with reinforcing steel (i.e. a header joint) is employed if the paving is interrupted. The longitudinal construction joint between CRC pavement and the turning radius will be tied with deformed bars. The thickened edge isolation joint type is used on the other directional edge of the turning radius to avoid restriction of the CRC pavement end movement while reducing deflection. The 0.6 m supplementary slab is doweled at the corner of the turning radius to prevent corner cracking. The continuously paved pavement segment and the orthogonal pavement segment should be isolated to avoid lateral restraint caused by differential directional movement using a wide flange, sleeper slab, or thickened edge. Traffic routing during paving should facilitate construction of

the jointing plan, but avoid additional transverse (i.e., header) joints in this region, if possible. Figure 3-c shows the proper location of the construction joint between the frontage road and cross road at the intersection. General conditions of the recently constructed intersection on US 59 in Houston, Texas are very good. Figure 3-c shows a longitudinal construction joint that isolates the frontage road from the cross road. Any restriction between frontage road and cross road appears to be minimized with this joint configuration.



3-a) Intersection Transition for Continuous Frontage Road Paving



3-b) Intersection Transition for Continuous Cross Road Paving



3-c) Good Performance with Proper Construction Joint between the Frontage and Cross Roads

Figure 3 Design Improvements of Intersection Transition.

Transition of Ramp/Gore Area

The objective of a CRC pavement ramp transition is to tie the movements of the ramps with the movements of the main lanes to achieve sufficient load transfer while maintaining a smooth riding surface.

Current Practices. Figures 4-a and 4-b show newly constructed CRC pavement on SH 288 in the Austin, Texas at the end of a gore area on a ramp. Where the ramp and main traffic lane meet, a 0.6 to 0.9 m squared-off end section is normally formed and uncontrolled cracking is induced because of this squared-off area. The use of a transverse sawcut at the end of the gore area may help eliminate this type of cracking. A transverse construction joint at this location would also help to prevent uncontrolled diagonal cracking on the ramp concrete surrounding the gore area.

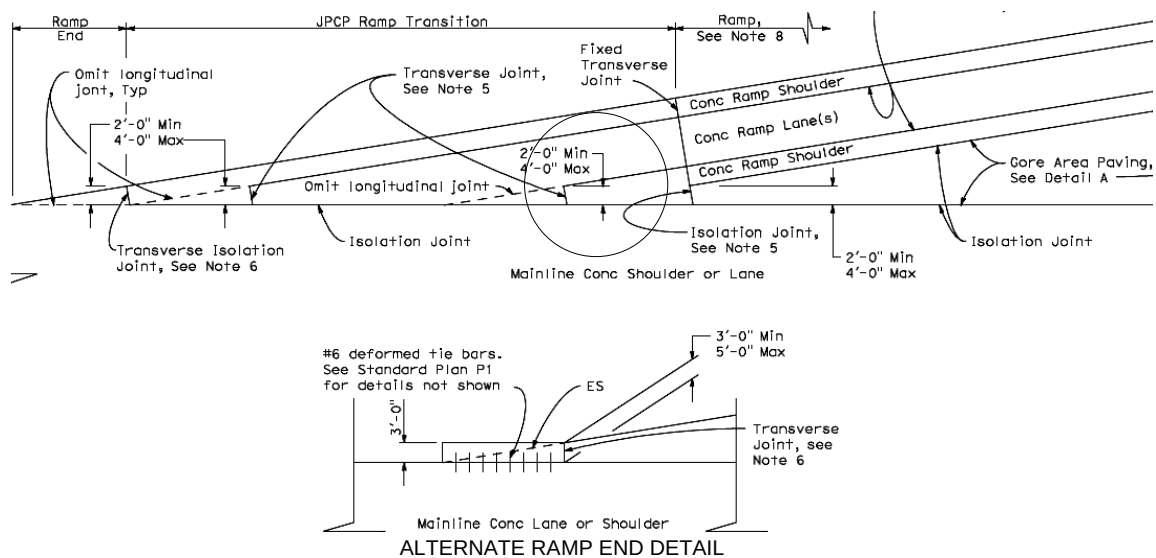
Figure 4-c shows the paving details of a ramp entrance gore area and an alternate ramp end detail (California DOT, 2006). A 0.6 to 1.2 m wide squared-off end section is shown in Figure 4-c where the mainline and ramp meet to terminate the end of the gore area. Plan notes match the location of the squared-off segment joint with the ramp transverse joint. However, in the alternative ramp end detail, a 0.9 m wide additional block is tied and matched at the location of the mainline transverse joints. Although not shown explicitly, the squared-off segment should be matched with the ramp transverse joint to minimize the tendency for uncontrolled cracking in the ramp concrete. Moreover, the load transfer between the mainline and ramp segments should be considered as well as some degree of isolation to reduce possible cracking and faulting issues, especially when mainline thickness is different from the ramp pavement thickness.



4-a) Gore Area in the Ramp Transition



4-b) Random Diagonal Crack on the Gore Area



Note. 1 in. = 25.4 mm, 1 ft = 0.3 m

4-c) Ramp Entrance Gore Area and Alternate Ramp End Detail (California DOT, 2006)

Figure 4 Performances and Current Details of Ramp/Gore Area Transition.

Design Improvements. Figure 5 shows the design improvement concept for ramp gore area transition. Gore area termination may need to be at least 0.6 m wide to allow for construction. A transverse contraction or construction joint should be matched at the end of the gore area to prevent diagonal random crack propagation into the ramp pavement.

Since the dimensions between main lane and ramp would be different whether the same pavement type or material, stiffness cannot be the same and subsequently deflections are also uneven. Making gradual changes between two slabs or employing load transfer equipment could reduce this discontinuous transition problem and achieve better performance such as less faulting, longer joint life, and better rideability. Thickness transition should be completed before this transverse contraction joint at the end of gore area and transition over a distance of 6 m.

If ramp pavement is JC pavement, the tapered slab is approximately 4.5 m in length but should be less than 4.5 times of radius of relative stiffness (ℓ) of ramp pavement to prevent random cracking occurrences between the joints. Transverse construction joint with smooth dowel would be used at the end of the tapered transition to facilitate matching the transition at the ends of the construction.

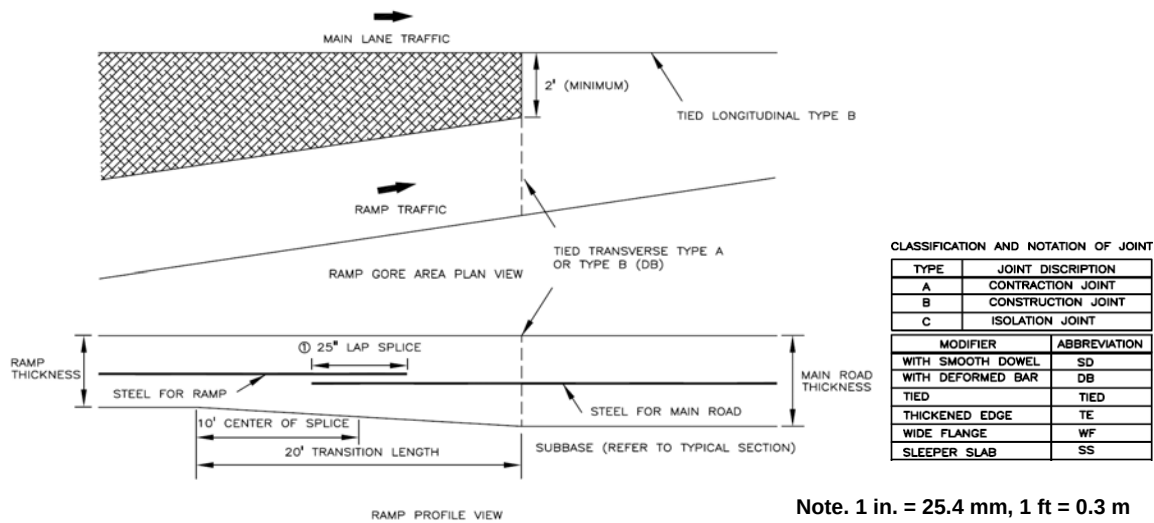


Figure 5 Design Improvements of Ramp/Gore Area Transition.

Drainage Inlet and Related Transitions

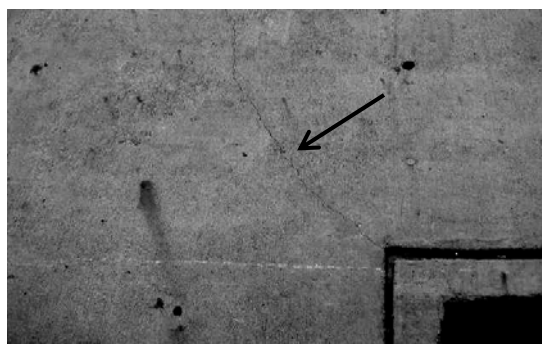
The main objective of a drainage inlet transition is to isolate movement between a structure and the surrounding pavement. To this end, drainage structures need to be isolated from the pavement using an isolation joint. When pavement areas have drainage structures, joints should be aligned with the corners of the structure configuration. Since uncontrolled cracking often occurs on the corner of a drainage structure, transverse contraction joints could be placed matching with the transverse edge to prevent uncontrolled cracking.

Current Practices. Figure 6-a shows diagonal crack caused by a drainage inlet box. Most corners of drainage box or drainage inlet structures generate a random diagonal crack in the pavement. The box would need to be isolated to a greater extent from the pavement structure in order to minimize the occurrence of such restraint cracking developing at the corners. Figure 6-b shows diagonal random crack at the corner of a manhole structure, even though it appears to be isolated from the pavement.

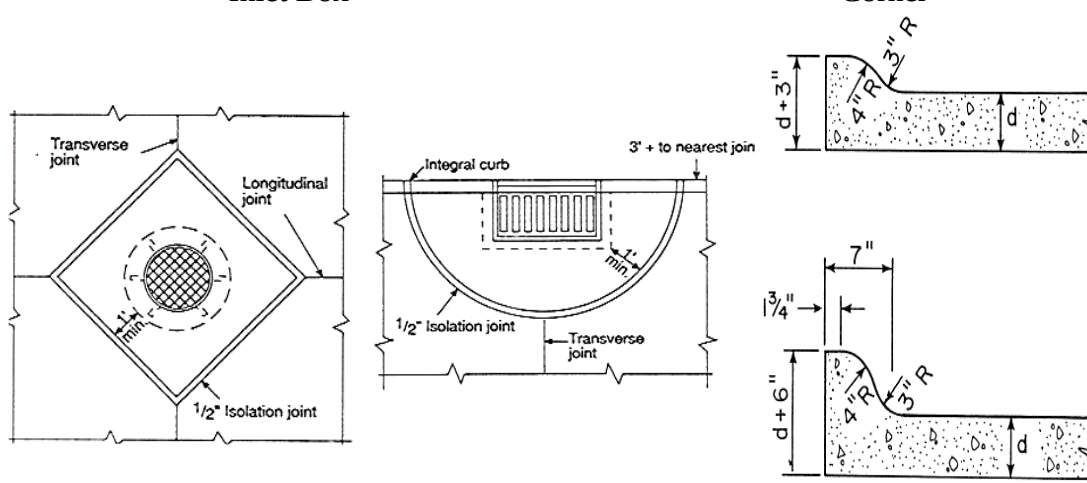
Figure 6-c shows the details of a drainage structure with a manhole (ACPA 1992). The drainage structure and the manhole cover are typically blocked out and isolated from the pavement using an isolation joint. Shortcoming of this design is the segment around manhole may lack sufficient load transfer. Doweling on the transverse joints is a means to provide load transfer while minimizing restraint between the drainage structure and the main lanes. Construction involving an integral curb should be discontinuous at the isolation joint.



6-a) Restraint Cracking from Drainage Inlet Box



6-b) Random Crack on the Drainage Box Corner



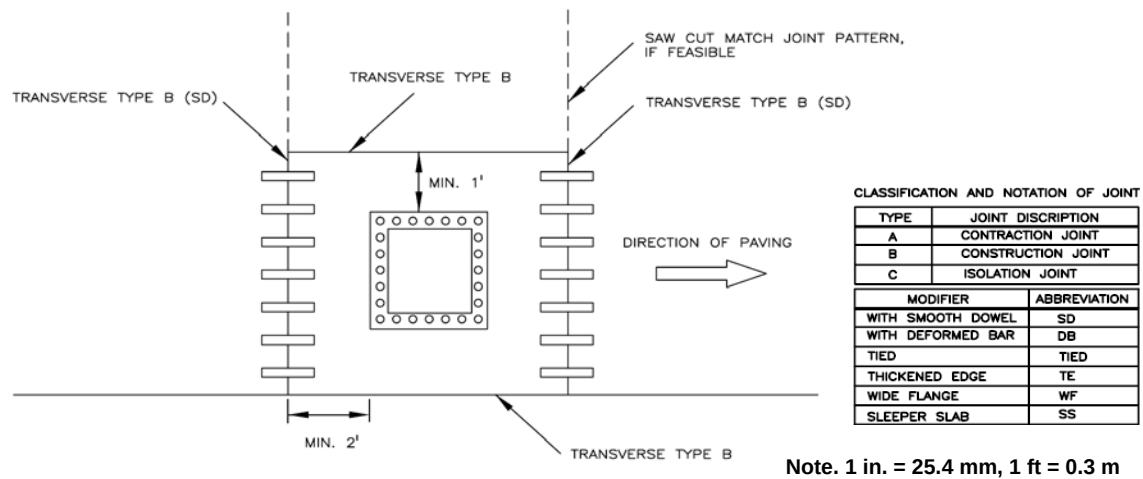
Note. 1 in. = 25.4 mm, 1 ft = 0.3 m

6-c) Drainage Structure, Manhole Covers, and Integral Curb (ACPA 1992)

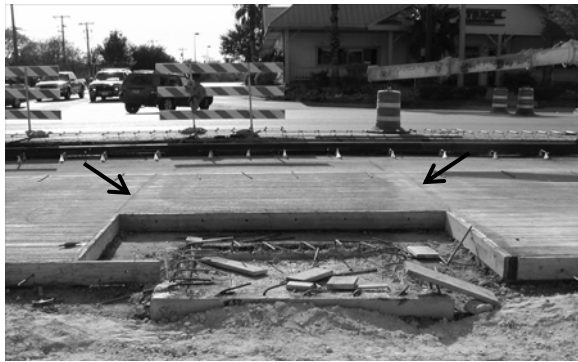
Figure 6 Performances and Current Details of Drainage Inlet or Manhole Covers.

Design Improvements. Figure 7-a shows the manhole/drainage inlet design. Manhole structures should be isolated from the pavement structure because they are relatively fixed. A doweled transverse construction joint is used between the structure and the pavement. The transverse contraction joint should match inlet corners to prevent diagonal random cracking in the pavement.

Figure 7-b shows recent construction in College Station, Texas where transverse sawcuts were made at the corner of the manhole structure. These sawcuts induced a transverse contraction joint in the pavement to prevent a diagonal crack from forming, effectively isolating the pavement from the manhole structure. Figure 7-c shows good performance of manhole structure after 2 years of service.



7-a) Details of Manhole/Drainage Inlet



7-b) Transverse Sawcuts on the Manhole Structure Corner



7-c) Good Performances of Manhole Structure by Improved Design

Figure 7 Design Improvements of Drainage Inlet or Manhole Covers.

Transition between PCC and AC Pavement.

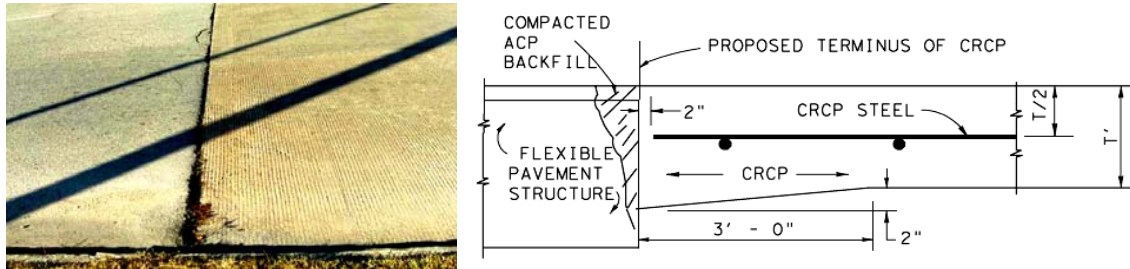
The transition between a PCC and AC pavement is very common, as well as problematic. Unless there are provisions made to gradually transition the expansion and contraction of the concrete (particularly CRC pavement) to the AC pavement, there is a distinct possibility of developing a bump on the asphalt side of the transition. The objective of a CRC to AC pavement transition is to reduce the free edge deflection to those deflections developing at an interior slab location with a concomitant reduction in subgrade stress. A PCC slab should be employed as a buffer between the two different material types. The desirable features of the transverse joint between PCC slab and AC pavement include continuous behavior while the joint between the CRC pavement and the jointed slab would also include similar behavior while being subjected to wider openings. Load transfer with isolation between CRC and JC pavement may be addressed through the use of a sleeper slab or, in some instances, a wide flange or elastomeric concrete joint.

Current Practices. Figure 8-a shows a faulted transition joint and the associated design detail between the concrete and AC sections (TxDOT Houston District 1998). A thickened edge is typically used with a butt joint as shown in this case between the AC and the CRC pavement. A butt joint inherently allows for expansion at the joint between the asphalt and the concrete although there is no overriding need to isolate the movements of the concrete slab from the AC pavement section. Unless there are special measures employed to assure support uniformity across the joint between the two pavement sections, differential deflection between them can be a major issue relative to the performance of the transition. Consequently, a sleeper slab used in this detail would enhance performance given traffic and subgrade strength considerations. An additional concern with the Figure 8-a details is that there is no provision to counter the effects of the expansion and contraction of the CRC pavement. Typically the terminal ends of CRC pavement experience movement of 2.5 to 3.8 cm and without the restriction of the movement between the CRC and the AC pavement, uneven filling and build up of debris may occur in the transition joint.

Figure 8-b shows commonly used designs for the transition to a flexible pavement system that has the objective of converting the surface layer from AC to PCC. Performance-wise, the tapered concrete slab is intended to minimize differential deflection between the PCC and the AC pavement sections. Sections of this design constructed in the Bryan District, Texas have shown good performance after having been under traffic for two years. Another similar section in the Beaumont District, Texas developed a transverse crack at the end of the tapered slab about a year after construction. In many instances, transverse cracking initiates at this point and eventually propagates to the top of the asphalt surface. Consequently, any measures to reduce the concentration of stress at this point would constitute an improvement in the design of this transition – such as may be the case with the use of a beveled or rounded edge at the end of the tapered concrete slab may help alleviate reflective transverse cracks in the AC layer. Moreover, careful construction will also help by reducing consolidation deformation in the AC layer. As previously noted, since CRC pavement experiences a significant amount of movement at the terminal ends, an expansion joint is often justified at this location. The movement, however, at the expansion joint shown in Figure 8-b is typically very difficult to seal for an extensive period of time, as an improvement to this detail, the use of a sleeper slab or dowels, may be more suited for a JC pavement section; detail B shows the dowel and joint sealing (TxDOT Bryan District 2005). Nonetheless, the inclusion of an expansion joint effectively isolates the tapered section from the rest of the pavement. In addition to the previous comments about doweling, this detail would also work for a JC pavement.

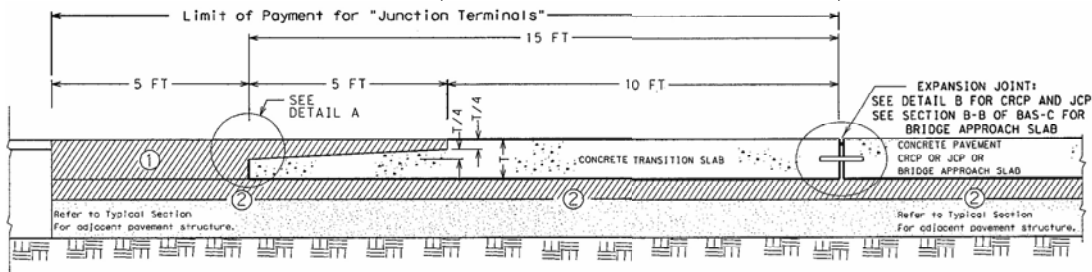
Figure 8-c shows a variation of the Figure 8-b detail that was used on the SH 130 project in Austin, Texas (TxDOT Ausin District 2004). A modification was adopted to minimize the formation of a ‘shoving’ bump at the end of the concrete ramp by insertion of an elastomer concrete plug between the concrete and the asphalt material to enhance the vertical deflection compatibility between the two pavement sections. Elastomer concrete is a type of material that bonds reasonably well with both AC and PCC to resist the effects of high deflection difference at the joint while at the same time allowing sufficient movement to minimize shoving. Delpatch or similar material is recommended for elastomeric concrete on the SH 130 project.

Figure 8-d shows another concrete to flexible pavement conversion. Incorporation of a sleeper slab ensures deflection continuity across the joint (TxDOT Fort Worth District 2003). However, the deflection patterns could generate a crack at the end of the sleeper slab into the AC layer; for this purpose justification for a treated subgrade is perhaps warranted.

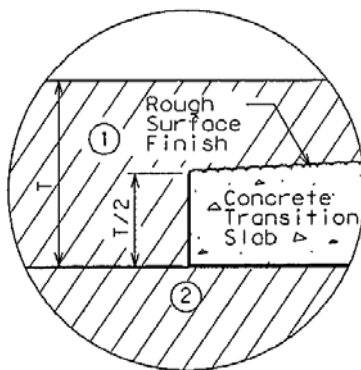


Note. 1 in. = 25.4 mm, 1 ft = 0.3 m

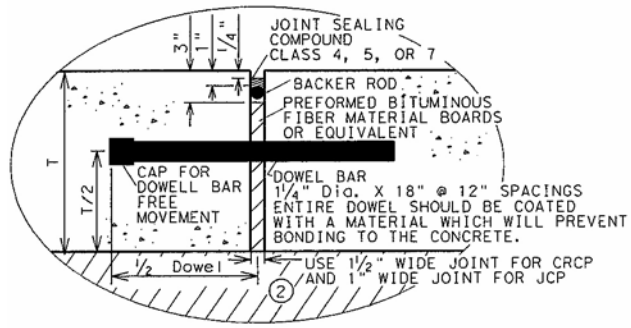
8-a) A Faulted Transition Example and Transition Detail between CRC and AC Pavement (TxDOT Houston District 1998)



Note. 1 in. = 25.4 mm, 1 ft = 0.3 m



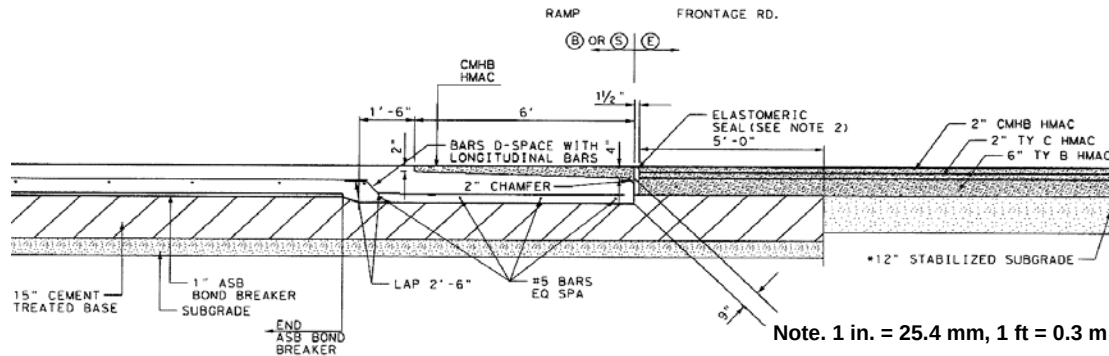
DETAIL A



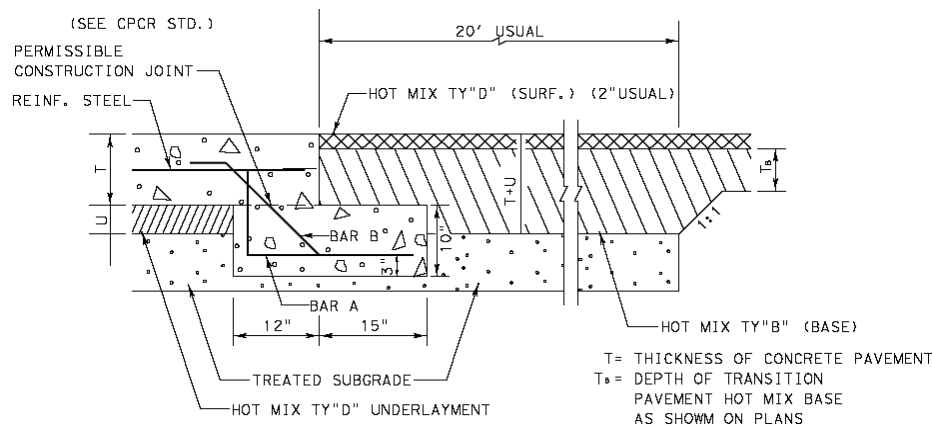
DETAIL B

Note. 1 in. = 25.4 mm, 1 ft = 0.3 m

8-b) Transition between AC and PCC Pavement (TxDOT Bryan District 2005)



8-c) Tapered Transition between PCC and AC Pavement (TxDOT Ausin District 2004)



8-d) Concrete Pavement Terminus at Hot Mix Transition
(TxDOT Fort Worth District 2003)

Figure 8 Current Transition Details between PCC and AC Pavement.

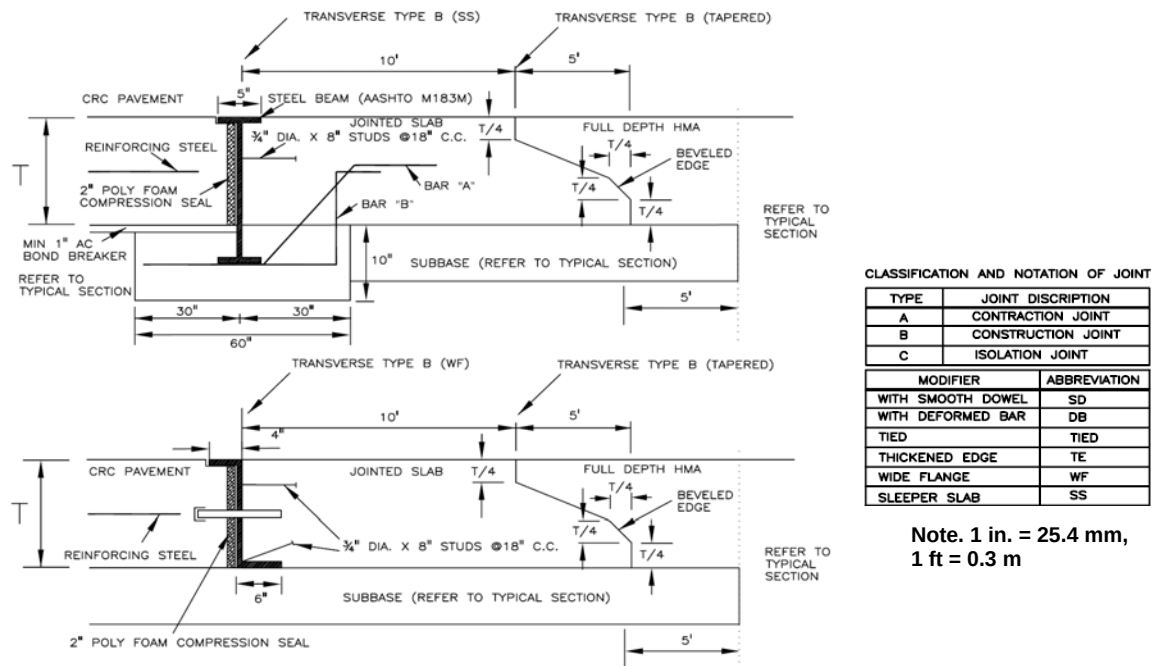
Design Improvements. The transitions of CRC to AC pavement and JC to AC pavement are partially the same as between two concrete pavements since in both cases the detail incorporates a jointed transition segment in order to minimize the joint openings between a JC slab and AC pavement. Generally speaking, the incorporation of a slab segment in the transition allows two joint transitions: one for CRC to JC pavement or JC to JC pavement transition and the other for JC pavement slab and the AC pavement transition to be sealed and movement kept to a minimum. The bridge approach and terminal transitions are unique in that designs typically include an expansion joint that can be combined with a sleeper slab element, but opening should be minimized to the extent possible.

Figure 9-a shows an option that uses a tapered slab between JC and AC pavement. As previously noted, a beveled edge should be placed at the end of the tapered section to minimize crack reflection in the AC pavement; a treated subbase needs to be extended into the AC pavement section for a distance of at least 1.5 m. Texas DOT typically uses a 15 cm thick CTB with a 2.5 cm thick AC bond breaker for the treated subbase layer in both CRC and JC pavement; 10 cm AC pavement or asphalt stabilized base (ASB) is also commonly used. The following are recommended construction practices:

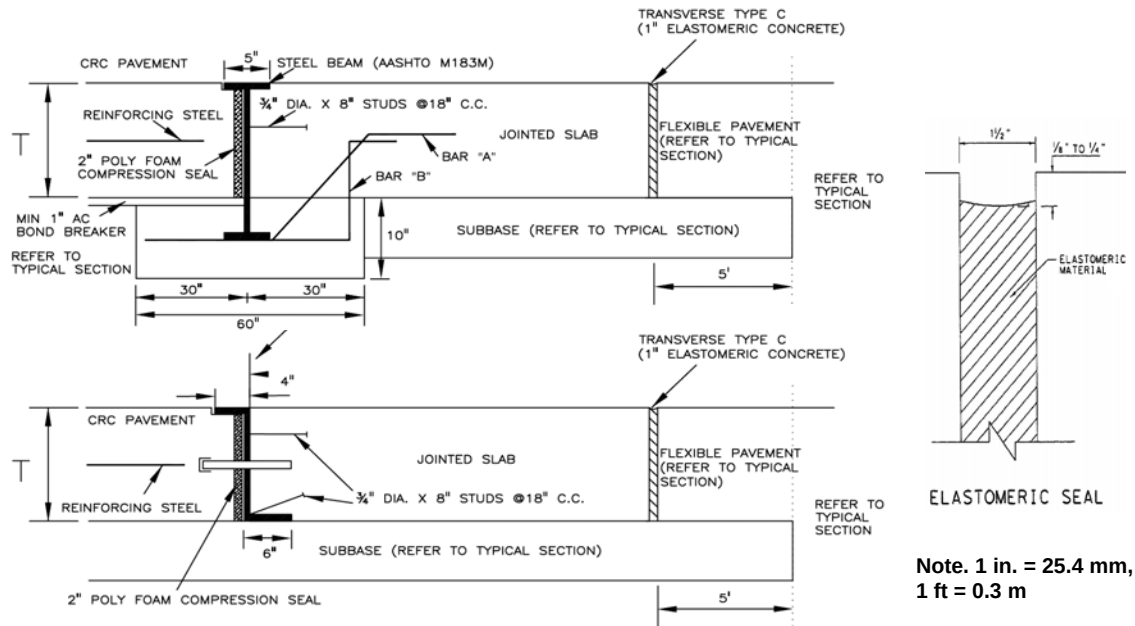
- Compaction of hot mixed asphalt and subgrade materials to 100 percent and 95 percent density, respectively.
- Subgrade may be either cement or lime stabilized.
- The tapered section should be rough finished with a beveled edge.

Figure 9-b shows the other option that uses an elastomeric concrete joint to transition the vertical movement between the jointed concrete slab and the AC pavement section. This option also needs a treated subbase extension into the AC pavement section at least 1.5 m, and a sleeper slab or wide flange joint type should be constructed between the CRC pavement and jointed concrete slab. Dowel size and spacing for wide flange joint design would be determined by design to achieve the appropriate LTE between CRC and JC pavement. Figure 9-c shows the guidelines for the elastic modulus of elastomeric concrete. The order of placement in the construction is the portland cement concrete first, the AC material next, and finally cutting a slot for placing the elastomeric concrete.

The objective and related performance factors for AC pavement transitions in JC pavement systems are similar to those previously stated for CRC pavement. Such transitions need special measures to ensure deflection or support continuity across the joint which may, under circumstances of traffic and subgrade strength combinations, pose no performance issues. Elaborating further, this transition need to promote continuous deflection between JC and AC pavement sections to maintain the riding quality and life of the transition. The improvement of the transition from JC to AC pavement is basically identical to the transition of CRC to AC pavement. However, the concrete pavement joint type is a normal construction joint type and not the isolation joint type because the joint opening between JC pavement segments would be less than the joint opening between CRC pavement and a jointed concrete slab.



9-a) Transition between CRC and AC Pavement Using Tapered Slab



9-b) Transition between CRC and AC Pavement Using Elastomeric Concrete

Brand Name (Manufacturer)	Compressive Strength	Tensile Strength	Elastic Modulus
Pro-Crete (Capital Services)	19.3 MPa (2,800 psi)	6.2 MPa (900 psi)	20.8×10^3 MPa (3.0×10^6 psi)
Delcrete™ (D.S. Brown)	5.5 MPa (800 psi)	4.1 MPa (600 psi)	11.1×10^3 MPa (1.6×10^6 psi)
Pro-Crete NH (Capital Services)	29.0 MPa (4,200 psi)	15.5 MPa (2,250 psi)	25.4×10^3 MPa (3.7×10^6 psi)

9-c) Properties of Elastomeric Concrete

Figure 9 Design Improvements of the Transition between CRC and AC Pavement.

Conclusions

This paper focuses on the measures to improve current transition design related with the design of concrete pavements. Concrete pavement transitions relative to slab cracking and associated distresses were surveyed to identify the performance issues that may be related to improperly restrained segments or other design-related factors associated with transition performance. In many transitions, various forms of cracking were witnessed, providing a means to ascertain the causes and concepts for design improvements to prevent such cracking in future construction. The objective of the transition for intersections is to promote compatibility of the movements between orthogonally arranged pavement segments, therefore, the continuously paved pavement segment and the orthogonal pavement segment should be isolated to avoid lateral restraint caused by differential directional movement using a wide flange, sleeper slab, or thickened edge. CRC pavement ramp transitions often tie the movements of the ramps with the movements of the main lanes to achieve sufficient load transfer. A transverse contraction or construction joint should be matched at the end of the gore area to prevent diagonal random crack propagation into the ramp pavement. Drainage structures need to be isolated from pavement using an isolation joint with dowels and transverse contraction joints matching with the transverse edge to prevent uncontrolled cracking. The goal of PCC to AC pavement transition is to reduce the free edge deflection to those developing

at an interior slab location with a concomitant reduction in subgrade stress. The desirable feature of the transverse joint between a JC slab or CRC pavement and AC pavement includes promoting continuous behavior across the joint.

Acknowledgments

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