

## **CHAPTER 4**

### **JOINT CONSTRUCTION**

All pavements have one potential internal weakness – joints. Whether concrete or asphalt, joints probably cause more problems than any other. However, when constructed properly a joint area will perform as well as the remainder of the asphalt pavement. It is difficult if not impossible to construct a pavement without any joints. Therefore, the real trick is to make as few joints as possible and to construct them carefully and properly. The appearance and quality of the joints determines the overall appearance and quality of the finished mat. Fortunately, it is not difficult to construct a good quality joint.

#### **Transverse Joints**

##### **Purpose**

When the placement of the asphalt mix is to be suspended for a period of time, it is necessary to construct a transverse joint across the pavement being placed. This is accomplished in one of several ways, depending primarily on whether traffic is to travel over the asphalt mix between the time the paving is stopped and it is started again.

If traffic is not going to pass over the end of the paving, a vertical butt joint can be constructed. If traffic will be permitted to travel over the transverse joint, a tapered joint will be necessary.

##### **End of Paving**

It is very important that the paver be run in normal fashion right up to the point at which the transverse joint is constructed. This means that the head of material carried in front of the screed should be as consistent as possible at the location of the joint. This requirement permits the forces acting on the screed to be constant and maintains the angle of attack for the paver screed. The result of such a paving operation is a uniform mat thickness through the joint area.

It is a common but incorrect practice, however, to empty out the paver hopper whenever a transverse joint is to be built. It is a much better practice to locate the transverse joint at the point where the amount of material in front of the screed is normal.

##### **Butt Joint**

For a butt joint, a vertical face is constructed by hand methods across the width being paved. This operation consists of raking, shoveling, and then removing the mix that is located downstream of the selected joint location. The asphalt mix that is in place upstream of the joint is not touched in any manner. The mix that is removed from the downstream side of the joint is then recycled or discarded.

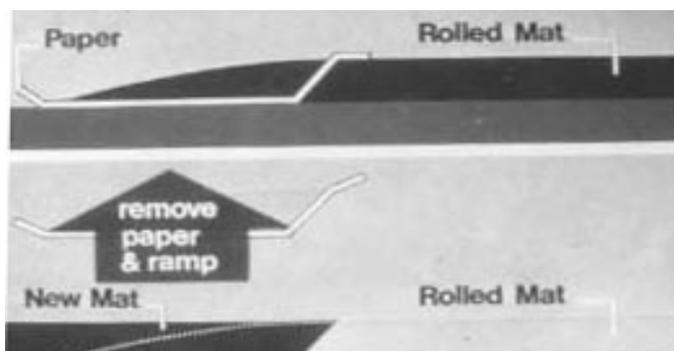
Compaction of the mix on the upstream side of the joint is accomplished in normal fashion. It is necessary, however, for the rollers to compact the mix immediately adjacent to the joint. For this to be done properly, runoff boards must be placed next to the joint.

Passing the rollers over the edge of the transverse joint, without having any boards beyond the edge to support the weight of the rollers, will cause rounding of the edge of the joint. This latter type of joint construction results in two problems. First, the rounding of the edge of the butt joint prevents the construction of a proper vertical joint when paving is restarted. Second, the amount of compactive effort applied to the asphalt to the joint is typically not adequate.

### Tapered Joints

If traffic is to be carried over the transverse joint, it is necessary to build a tapered joint. For this type of joint, as for the butt joint, it is proper for the paver operator to keep the head of material in front of the paver screed as consistent as possible up to the point that the joint is to be built. This process assures that the thickness of the mix being placed is uniform up to the joint. There is more opportunity for this to be done in practice with tapered joint construction than with butt joint construction because the mix left in the paver hopper can be used to build the taper.

At the point of the transverse joint, the asphalt mix downstream of the joint is temporarily pushed aside. A vertical edge is formed at the upstream face of the mix. If the tapered joint is to be only temporary, treated paper or other similar material is then placed downstream of the joint directly on the existing pavement surface. This paper is used because the asphalt mix will not stick to it. The length of the paper is dependent on the thickness of the course just placed but is typically about 3 or 4 feet long and the width of the lane being paved.



Once the paver is in place, the asphalt mix is shoveled back over the paper and a ramp is formed in this mix with a lute or rake. Any asphalt mix that is not used to construct the ramp or taper is discarded. If the joint is to be left in place permanently, the taper is constructed in the same manner except that the paper is not used.

Constructing a temporary tapered joint using sand or dirt as the bond-breaking medium is not an acceptable paving practice.

A third type of tapered joint is the non-formed, sawed joint. For this type of joint, the paver operator keeps the paver operating normally until there is no more mix in the hopper or in the auger chamber. At the point where the mix becomes non-uniform across the width of the lane being paved, a ramp is constructed with the “left-over” mix. No vertical face is formed, and the mix is merely tapered from the proper layer thickness to the level of the adjacent existing pavement. Any mix not needed to make the ramp is removed.

One advantage of the tapered joint is the fact that the compaction equipment can run over the transverse joint and down the ramp without rounding the joint. Because the rollers can pass over the end of the mat easily, the compaction of the mix upstream of the joint is usually superior to the mix adjacent to the butt type joint. A second advantage is that generally there is less mix to shovel from the joint, because some of the extra mix is used to make the ramp or taper. The disadvantage of this kind of joint is that this mix must eventually be removed before paving commences downstream of the transverse joint.

### **Tying In**



In areas where the new hot-mix asphalt layer abuts an existing structure, such as a bridge deck, it is often necessary to place the mix adjacent to the joint by hand. The mix that is needed to complete the joint is deposited in the area to be paved either by the paver or by being dumped from a haul truck. In order to avoid overworking the mix and possibly causing segregation, the mix should be placed as close as feasible to its final location. The mix is then spread by hand methods, normally using rakes or lutes.

In addition, the mix must be “left high” in order to allow for the compression of the material by the compaction equipment. Because the mix is being placed by hand, it will not be as dense as it would be if it were laid by the paver. Thus the  $\frac{1}{4}$  in/1 inch rule of thumb usually used will not be valid for hand-spread mix. To permit proper compaction of the mix and have the mix end up at the proper elevation to match the adjacent structure, the level of the mix should be approximately  $\frac{3}{8}$  inch higher than the surrounding pavement for each 1 inch of compacted layer thickness.

**Note: The loose to compacted thickness ratio varies by mix and is determined by experience.**

The hand work area must be rolled by the compaction equipment as soon as possible after the mix is in the proper location. Because of the time necessary to place the mix, rolling will be delayed and the mix will be cooling during the placement process. In order to achieve the required density, extra rolling may be needed.

## Start of Paving

### Squaring Up

A straightedge should be used to determine the condition of the transverse joint before paving begins. If the mix upstream of the joint is level, the location of the transverse joint is fine. If the straightedge indicates that the previously placed mix is not level, the location of the transverse joint should be moved to a point where the proper thickness and smoothness of the pavement layer exists. The mix downstream of the new joint location should be removed and recycled.

### Removal of Material

If a tapered joint has been constructed at the transverse joint, the mix in the ramp or taper must be removed before the paving can be started. For a taper built with treated paper, there is no bond between the mix in the ramp and the underlying pavement. The paver and the mix are readily removed and returned for recycling. A vertical face is left at the upstream edge of the joint.

For a taper constructed with the board and a ramp of asphalt mix, the material downstream of the board will be partially bonded to the existing pavement surface. A front-end loader typically is used to pry up the mix in the taper. This can be very difficult to do, depending on the amount of traffic that has passed over the transverse joint and the environmental conditions at the site. Once the mix has been removed, the board is then removed, exposing the vertical face of the joint.



If a non-formed tapered transverse joint is used, it is necessary first to saw a transverse joint in the asphalt mat. It can be placed far enough back from the taper to assure that the thickness of the layer is constant. Once the joint is cut completely through the asphalt mat, a front-end loader is used to pry up the mix that is downstream of the saw cut.



As with the tapered joint that uses the board, one disadvantage of this type of joint is that it is often very difficult to remove the mix downstream of the saw cut from the existing roadway. As an alternative, a cold-milling machine can be used both to form the vertical edge of the transverse joint and to remove the mix in the taper.

### **Cleaning and Tacking**



After the existing joint materials are removed it is important to thoroughly clean the area exposed and properly tack the surfaces. It requires little work and is good practice to heavily tack the vertical edge of the joint such that slight puddling occurs at its base before paving resumes.

### **Raking/Luting the Joint**

If the transverse joint is constructed properly up to this point, the amount of raking that needs to be done is minimal. If the paver screed starts out on blocks and if the head of material against the screed is constant, the thickness of the mat downstream of the joint will be correct. Very little mix, if any, will need to be brushed back from the joint. There is never any reason to rake a transverse joint excessively.

It is considered good practice to shovel up and recycle any coarse aggregate that remains after luting a surface course. The appearance of the final surface is very important and should be as uniform as possible.

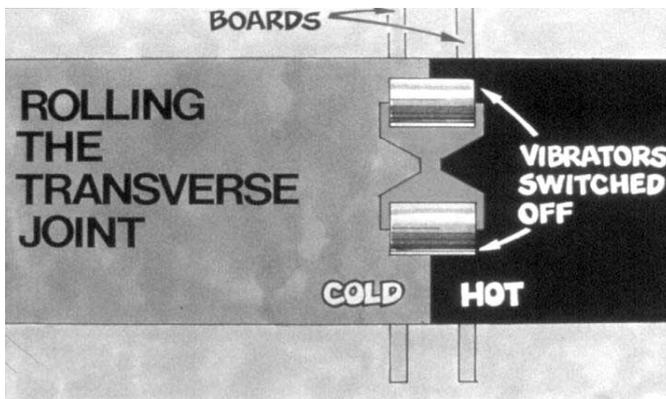
## Initial Straightedge Check

Before the material on the downstream side of the joint is compacted, it should be determined if the joint is smooth by running a straightedge across the joint. The straightedge should rest on the uncompacted mat and extend over the already compacted mix. The distance between the bottom of the straightedge and the top of the compacted mat should be equal to the amount of rolldown that will occur during the compaction process.

## Compacting



Ideally, a transverse joint should be compacted transversely. If the rolling is done transversely, wood boards must be used to support the roller as it moves beyond the longitudinal edge of the pavement. If the roller cannot compact the joint in the transverse direction because of site restrictions (adjacent guardrail or steep side slope, for example) or traffic in the next lane, the transverse joint will have to be rolled in the longitudinal direction.



The initial (breakdown) rolling should be accomplished, however, as quickly as possible after the paver has moved off of the joint. The roller should pass slowly and completely over the joint before the machine is reversed. If the joint has been constructed properly, the compaction process is no different from the application of ordinary compactive effort on any other part of the asphalt mixture.

## Final Straightedge Check



The straightedge should be used again to check the level of the joint once the compaction process has been completed.

## **Longitudinal Joints**



The longitudinal joint occurs when one lane of asphalt mix is constructed adjacent to a previously placed lane of mix.

The first pull of a paver almost always leaves at least one unsupported longitudinal edge in the mat. This joint will be a potential weakness in the finished pavement and must be handled carefully to minimize or avoid this potential.

## Staggered Joints



When placing multiple layers of HMA, longitudinal joints should be staggered so a single vertical joint does not run the depth of the pavement.

### **Conventional Unconfined Longitudinal Joint**

A conventional unconfined longitudinal joint is most common. The edge of the material is extruded through the screed and restrained by the edge plate. The material is compacted from the top down and is unconfined on one edge. Therefore, there is a tendency for the edge of the mat to have a lower density than say the middle of the mat which has adequate mix confinement all around.



All longitudinal joints should be constructed as cleanly and straight as possible. This joint matching process has a much higher success rate than a joint that isn't cleaned and meanders side to side.

### **Compaction of Unsupported Joints**



Longitudinal joints can be compacted in a variety of ways. During the initial construction of an unsupported or wedge joint, the roller should hang the edge of the roller drum approximately 6 inches over the unsupported edge to provide some confinement. On thicker lifts, another technique is to hold the first pass of the roller approximately 1 foot inside of the outside edge, then compact the strip of mix in a subsequent pass. Compaction will be covered in greater detail in a later chapter.

### **Preparing a Cold Joint**

The edge of the longitudinal joint may contain loose materials after being exposed to traffic and should be swept before a new mat is placed along side. The cold joint should then be tacked as described later in this chapter.

## Paving a Longitudinal Joint



One of the keys to the construction of a good longitudinal joint between lanes of asphalt mix is the amount of overlap between the new mat and the previously placed mat. This amount of overlap provides just enough material on top of the joint to allow for proper compaction without having extra mix, which must be pushed back from the joint by a raker. Overlap a sufficient amount to produce a tight joint and allow for the steering tolerance of the paver.

This distance varies, but 1 to 1½ inches has worked successfully in many cases. The end gate should be in full contact with surface and leave a tight edge. It is important that there be enough HMA material placed by the paver on the hot mat side of the joint construction such that when fully compacted, it is as high or slightly higher than the adjoining mat (cold side). Should the second lift placed end up slightly higher than the adjoining mat after compaction, the chances are good that acceptable joint density has been obtained.

One major problem with longitudinal joint construction is an excessive amount of overlap of the paver screed over the previously placed mat. (This may be caused, in part, by a ragged or wavy longitudinal edge on the first pass. Use of a string to guide the paver operator as the first lane is placed will usually reduce this problem greatly.) Because this extra asphalt mix cannot be pushed into the compacted mat, the material is raked or luted onto the new mat. If the longitudinal edge of the first lane is straight and if the correct amount of overlap is used, the amount of raking that must be done will be minimal. Excessive luting and raking can also be a safety issue if the cold lane is under traffic.

## Luting the Joint

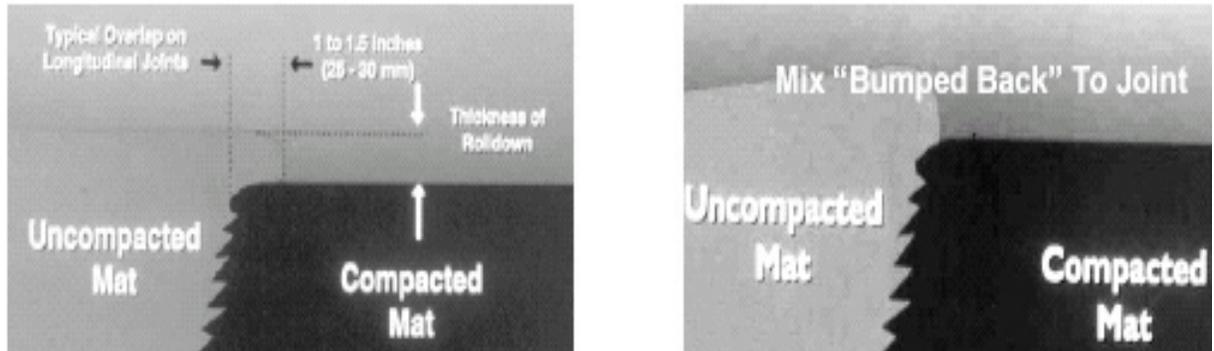


If the amount of overlap of the new mix on the old lane is 1 to 1½ inches, any raking that is done should be used merely to “bump” the joint, pushing the mix off of the old lane and onto the new mat directly over the joint. If the adjacent lane is overloaded too far and too much mix is deposited on the old mat, the excess material should be pulled away from the new mat instead of being pushed onto the new mix. The mix should not rebroadcast across the new lane. The excess mix should be picked up and recycled.

Excellent longitudinal joints can be constructed without raking the joint. If the new mix has been properly overlapped on the previously placed mat, raking of the longitudinal joint can be eliminated. It is recommended that raking of this joint be deleted if proper overlap and compaction can be obtained.

## Compacting the Joint

As previously mentioned, if the level of the new, uncompacted mix is even with or below the level of the compacted mix in the adjacent lane, the compaction equipment will not be able to densify the mix along the joint properly. Whether the first pass of the roller is on the cold side of the joint or on the hot side of the joint, part of the weight of the roller will be supported on the previously compacted mat.



This means that the compaction equipment will bridge over the mix in the joint, leaving it essentially uncompacted or only partially compacted. (Use of an intermediate pneumatic tire roller instead of a steel wheel roller-static or vibratory can reduce this problem.)

The level of the mix at the longitudinal joint must be above the elevation of the compacted mix, by an amount equal to approximately  $\frac{1}{4}$  inch for each 1 inch of compacted pavement, if proper compaction of the mix at the joint is to be accomplished.

## Edge Definitions

### **Unconfined Edges**



No Unconfined Edges



One Unconfined Edge



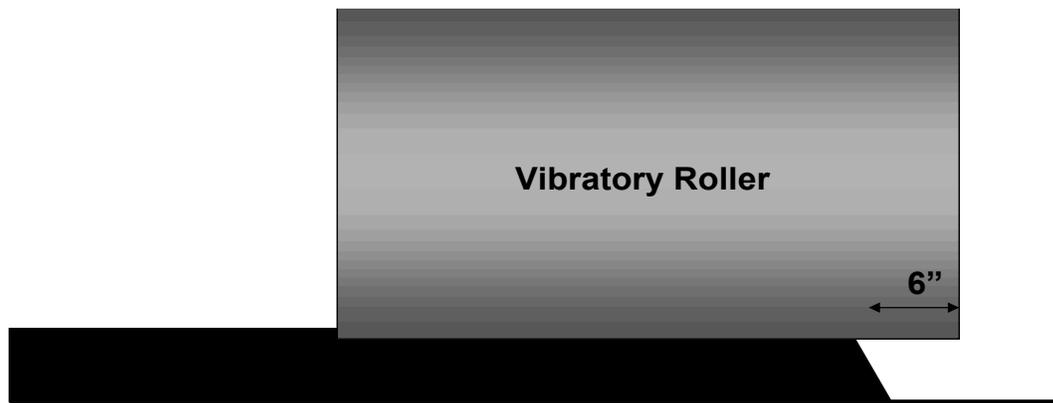
Two Unconfined Edges

## Longitudinal Joint Compaction Procedure

### **Rolling Unconfined or Unsupported Edge -First Paver Pass**

This method is usually best for achieving maximum density at the unsupported edge.

- Roll from the outside edge toward the middle.
- The preferred approach shown below is done by overlapping the outside edge with the drum by about 6 inches to obtain some confinement.



**Edge of drum outside of unsupported edge - Preferred approach**

Shown below is an alternate method of rolling the first pass on an unsupported edge. This method can cause cracking near the edge and lateral mix movement at the unsupported edge.



**Edge of drum inside unsupported edge**

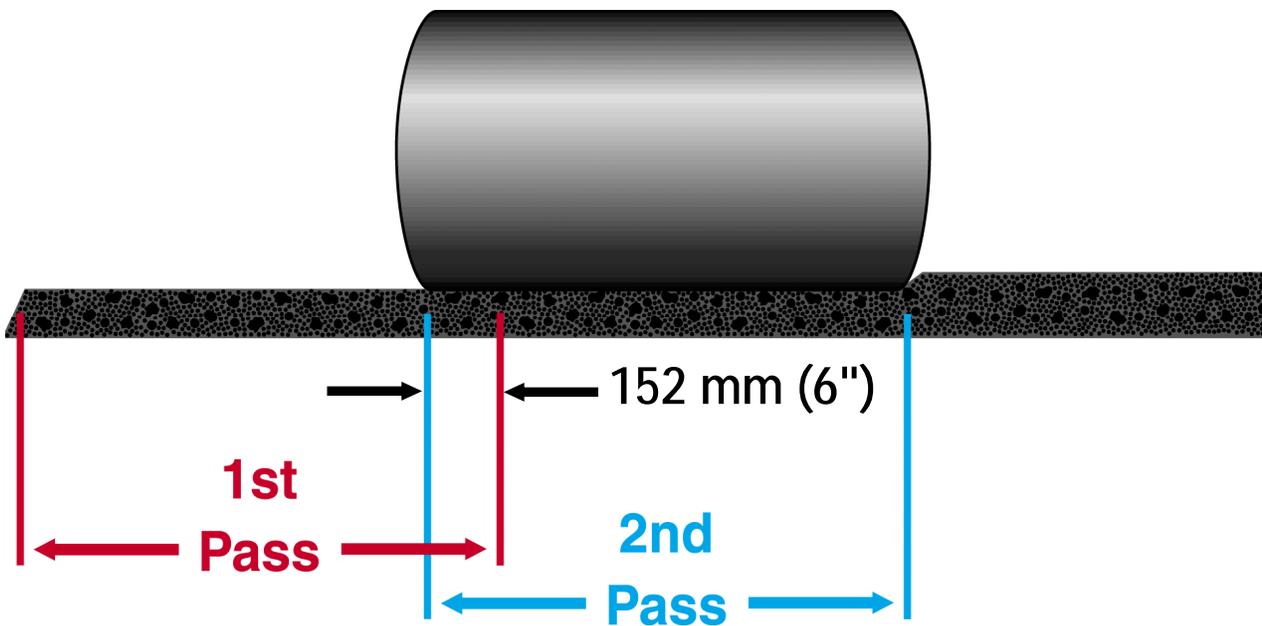
Here is another alternate method for rolling an uncompacted edge. This method can cause lateral mix movement at the unsupported edge.



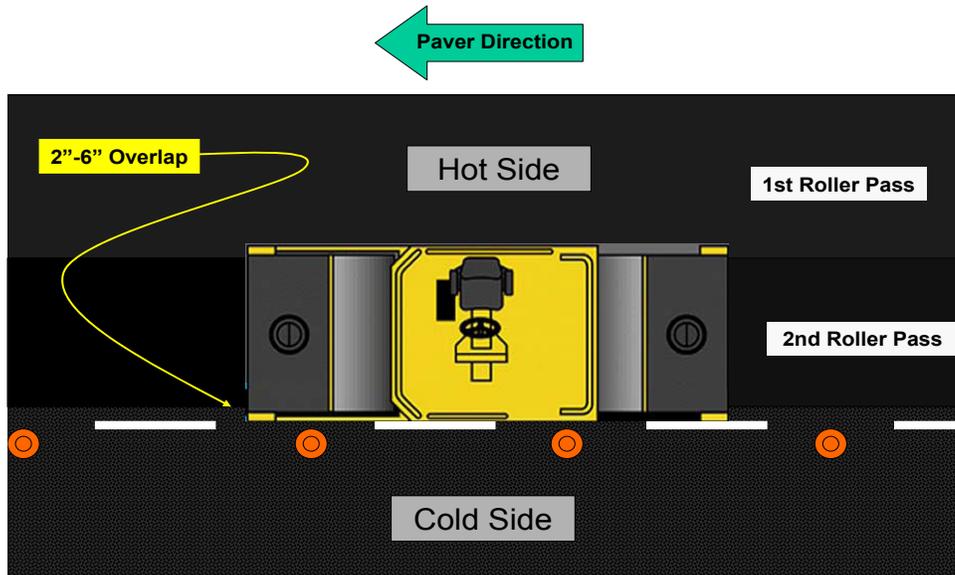
Edge of drum on the unsupported edge

### Mat Compaction - Subsequent Pass

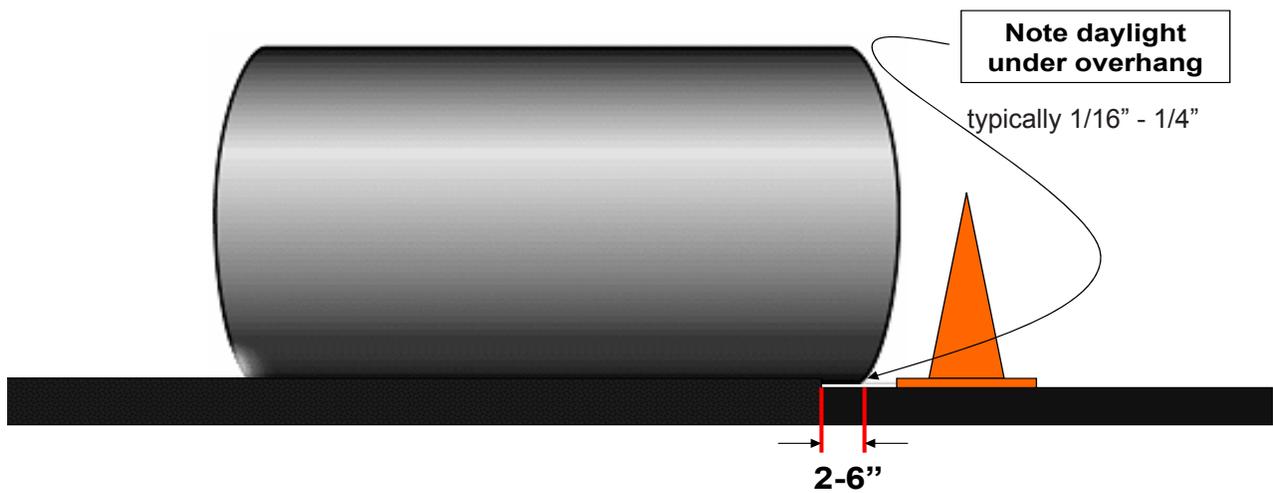
The mat should be rolled from the unconfined/outside edge to the longitudinal joint (number of passes to cover the mat depends on the roller widths).



# Confined Edge Compaction Adjacent Lane Open to Traffic



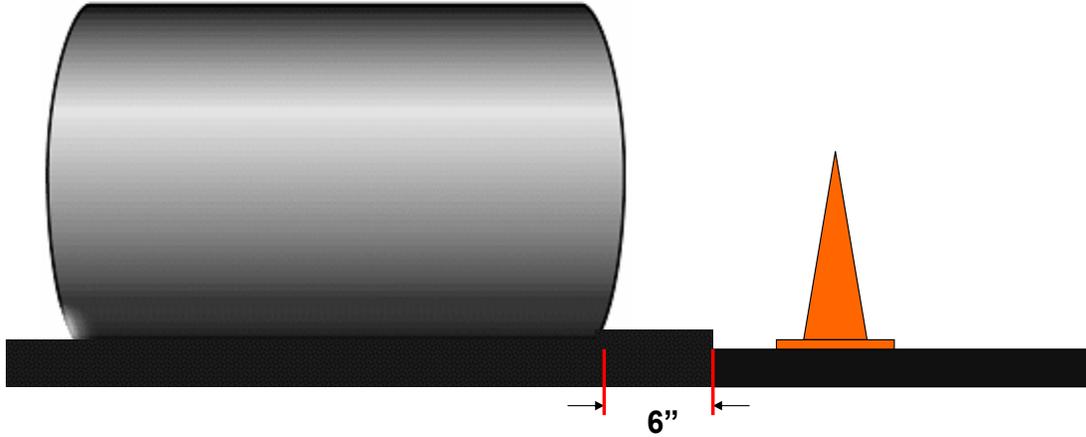
The last pass across the mat pinches the longitudinal joint.



## Confined Edge Compaction - Alternate Method

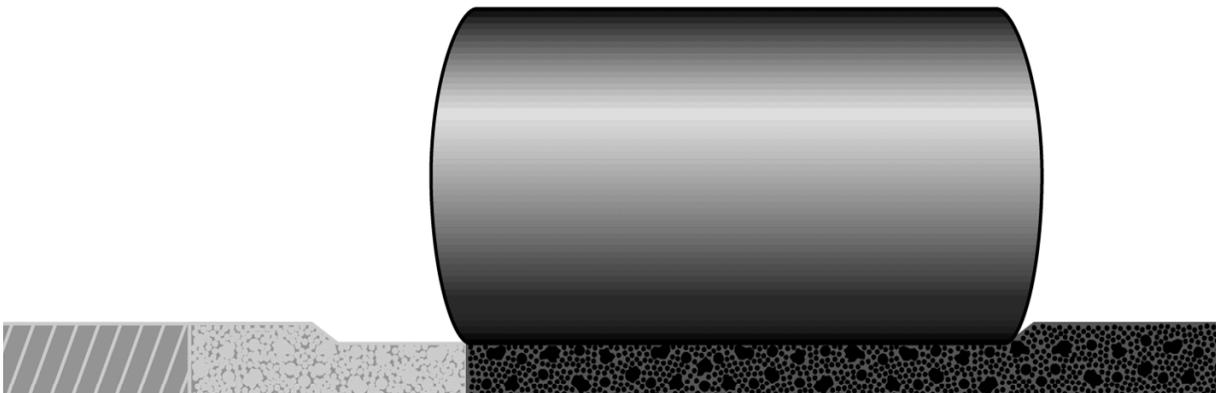
### Adjacent Lane Open to Traffic

The next to the last pass across the mat leaves 6" uncompactd at the joint. The last pass pinches the longitudinal joint.



## Confined Edge Compaction

This shows the first pass beside a curb and gutter section.



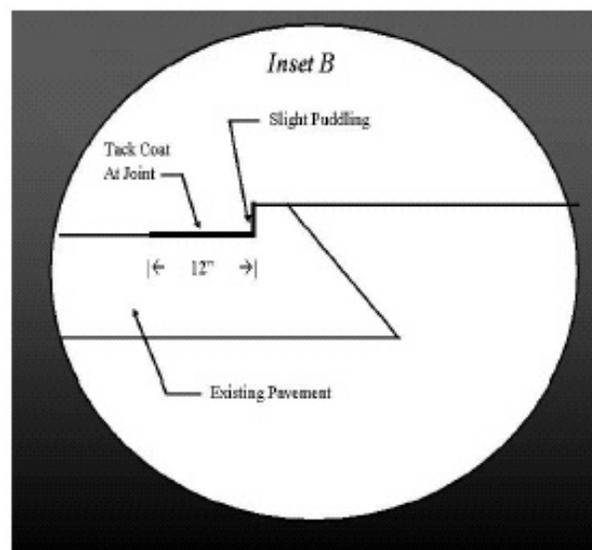
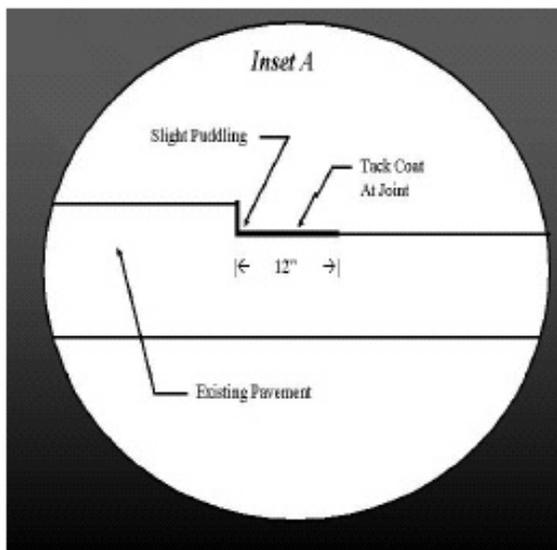
## Tacking Joints

It is often a challenge to achieve proper density at both transverse and longitudinal joints. Additional tack must be applied to vertical joint faces as well as underneath the joint area to aid in obtaining density requirements. Loose material should be removed before this area is tacked. (VDOT Road and Bridge Specification Section 315.05(b)1)



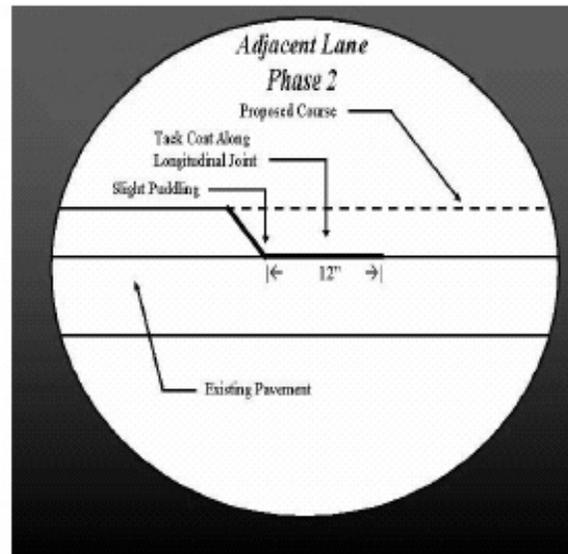
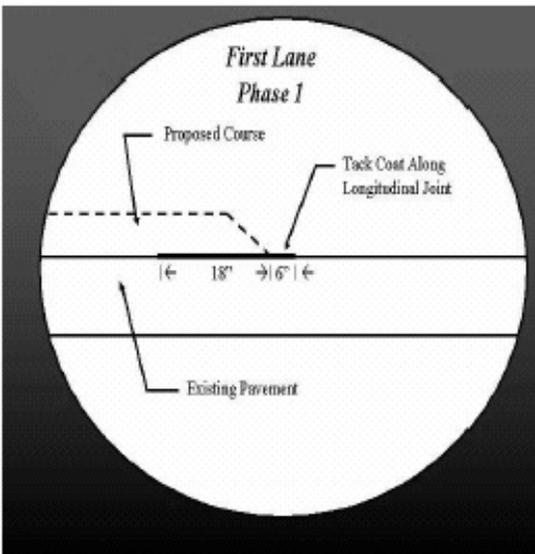
## Tacking of Joints After Milling

Tack is to be applied to the vertical face with a hand wand or spray bar at the rate of 0.2 gal/yd<sup>2</sup>. The application should be heavy enough that slight puddling occurs at the base of the vertical face. At the joints, the tack is applied shall be 2 feet in width with 4-6 inches protruding beyond the first pass. Tack for the adjacent pass shall completely cover the vertical face of the mat edge so that slight puddling of asphalt occurs at the joints and extends a minimum of 1 foot into the lane to be paved.



## Tacking of Joints During HMA Placement

Tack is applied under the proposed first lift 18 inches from the joint edge with a 6 inch overlap onto the second lift area. Tack is then applied on the second course to the vertical face and within 12 inches of the joint area. A longitudinal joint should be tacked using a hand wand or spray bar at the rate of 0.2gal/yd<sup>2</sup>. There should be slight puddling at the joints and extend a minimum of 1 foot into the lane to be paved.



**CHAPTER 4**  
**JOINT CONSTRUCTION**  
**Study Questions**

1. When the placement of the asphalt mix is to be suspended for a period of time and traffic is going to be passing over the end of the paving, a vertical butt joint may be constructed.  
  
A. True  
B. False
  
2. Constructing a temporary tapered joint using sand or dirt as the bond-breaking medium is not an acceptable VDOT paving practice.  
  
A. True  
B. False
  
3. Milled longitudinal joints should be tacked on the vertical face with slight puddling of tack at the base of the joint. The heavy tack coat should extend \_\_\_\_\_ inches into the lane to be paved.  
  
A. 6  
B. 12  
C. 18  
D. tack not required in this area
  
4. A \_\_\_\_\_ joint occurs when one lane of asphalt mix is constructed adjacent to a previously placed lane of mix.  
  
A. longitudinal  
B. conventional  
C. transverse  
D. uniform
  
5. One key to the construction of a good longitudinal joint between lanes of asphalt mix is the amount of overlap between the new mat and the previously placed mat.  
  
A. True  
B. False

