Installation of Preformed Neoprene Compression Joint Seals

STEWART C. WATSON, Acme Highway Products Corporation

ABRIDGMENT

•THE effectiveness of in-service performance of a compression joint seal is dependent to some degree upon proper installation.

SEAL POSITION IN JOINT SHAPE—CONTRACTION JOINTS

Generally, the following principles of positioning in contraction jointing apply (see Fig. 1):

1. The seal configuration should be positioned in the joint shape with its vertical axis reasonably parallel to the joint interfaces.
2. The inner and outer webs of the seal configuration should be juxtaposed in their true congruence rather than being intussuscepted or telescoped with a resultant potential for "popping" as the joints begin to open in contraction.
3. The top corners of the seal should be in reasonable contact with the joint interfaces.
4. The top of the seal, at the time of installation preferably, should not be higher than $\frac{1}{4}$ in. below the riding surface of the pavement for contraction joint seals $\frac{13}{16}$ in. (uncompressed width) and smaller. For larger seals, such as $1\frac{1}{4}$-in. contraction seals (uncompressed width) and down to but not including $\frac{13}{16}$-in. sizes, the top surface should be positioned at approximately $\frac{1}{2}$ in. below the riding surface of the pavement at the time of installation. While this might appear to be somewhat low in the joint, long-term experience has shown that typical attrition to the top edges of joints, as well as the inevitable minor edge raveling from joint sawing, justifies these setting heights as being practical. To obtain their full life, these rubber seals should never under any condition of slab movement be touched by traffic, studded tires, snowplow, etc., since attrition will take its toll. The top portions can actually sustain wear not unlike the heels of shoes.

SEAL POSITION IN JOINT SHAPE—EXPANSION JOINTS

Pavement expansion joints are normally wider, usually anywhere from $\frac{3}{4}$ to $1\frac{1}{2}$ in. wide, and since they exist to relieve compressive stress, they require different construction practices to reflect movement phenomena peculiar to their specific application. When used in a line of contraction joints or as bridge approach joints, expansion joints, in addition to reflecting normal thermal volume change, can and usually do progressively close. The construction practice recommendations shown in Figure 2 are simply obtained in the field and preclude the possibility of seal extrusion. Generally, the same four positioning rules used in contraction jointing will apply to expansion joints as well. Due to the complete absence of control of joint geometry, plus a tendency toward durability loss from the old hand-edging process, a recent strong trend is in evidence toward the sawing of expansion joints. Ideal control of expansion joint geometry, including the relief steps in Figure 2, is now being achieved by tandem blade sawing over the joint filler material.

Paper sponsored by Committee on Sealants and Fillers for Joints and Cracks in Pavements and presented at the 48th Annual Meeting.

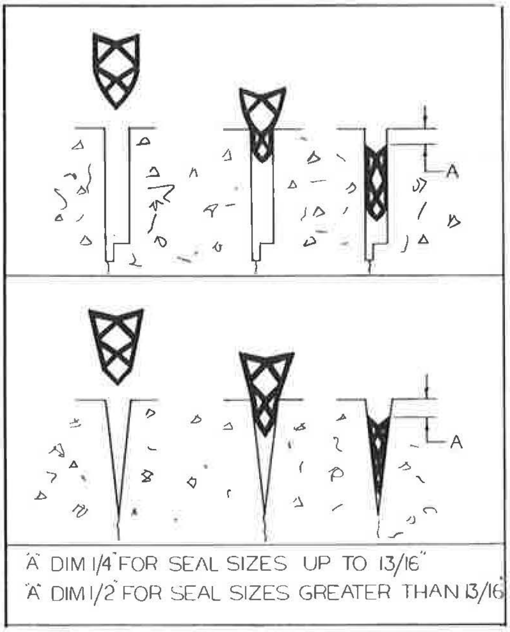


Figure 1. Seal position in joint shape—contraction joint.

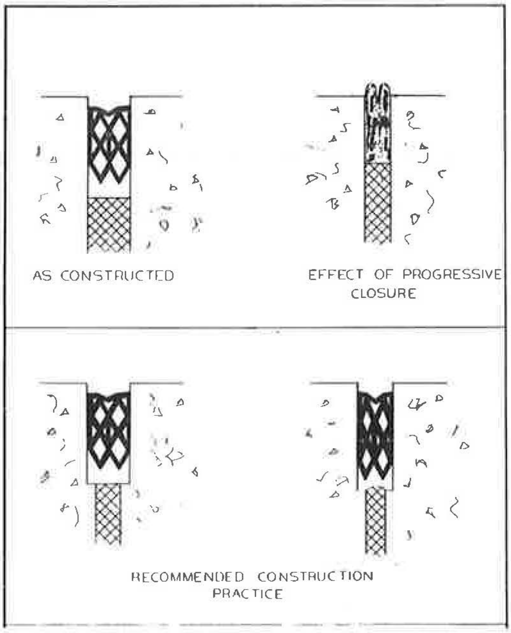


Figure 2. Seal position in joint shape—expansion joint.

SEAL POSITION IN JOINT SHAPE—LONGITUDINAL JOINTS

Since most longitudinal joints are tied together with a variety of devices, keys, etc., it is logical to assume that a zero movement condition prevails. Based on wide-spread photographic evidence from thousands of miles of concrete pavements now in service throughout North America and abroad, it is suggested that there may well be a number of categories of movement phenomena that can and actually do occur at longitudinal joints which would permit the entry of free water, solids and chemicals deleterious not only to concrete, but the highly corrodible metals used in tie bars and hook bolts and the hydraulically vulnerable subbase as well.

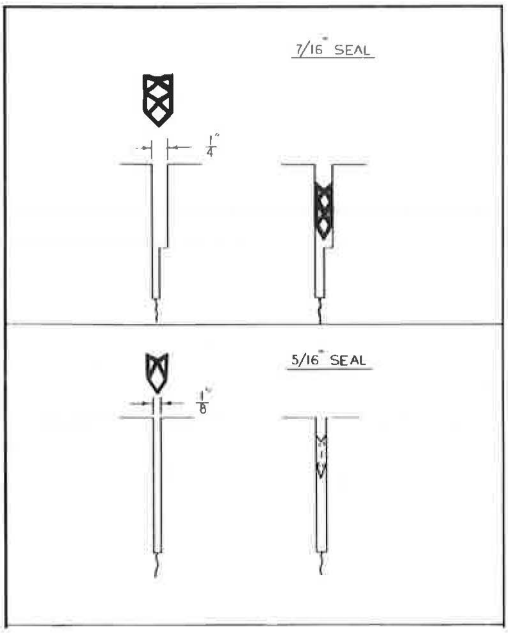


Figure 3. Seal position in joint shape—longitudinal joint.

The rules for positioning transverse joints similarly apply to longitudinal joints. Since the stroke of movement is not nearly so dynamic as with transverse joints, smaller seal, and in non-freeze-thaw areas, narrower joint widths have appeared to offer successful sealing solutions.

Figure 3 illustrates ⅛-in. saw cuts and small $^5/_{16}$-in. seals currently in wide use on Texas Highway Department longitudinal joints in continuously reinforced pavements. The ¼-in. saw cut with a $^7/_{16}$-in. seal is used on longitudinal joints in New York, Maryland, Ontario, and Quebec, and freeze-thaw areas in general.

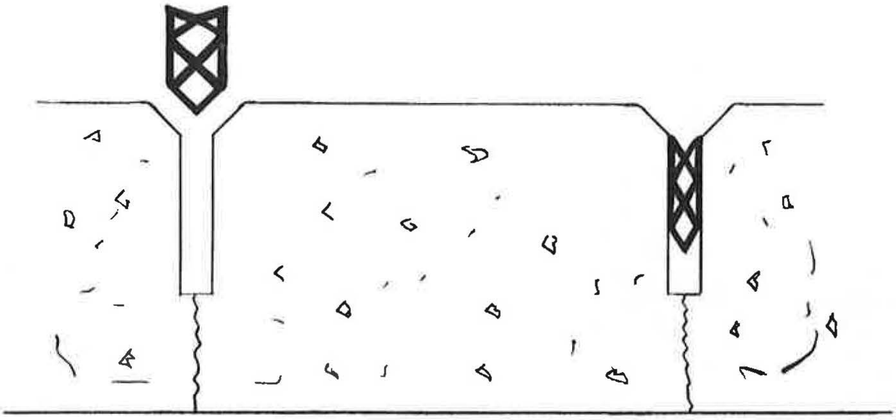


Figure 4. Detail of beveled saw cuts showing position of compression seal (Swiss-German system, slab length 7.8 meters).

LUBRICANT-ADHESIVE

It would be extremely difficult, if not impossible, to insert a compression seal into most joint openings without lubricating the joint interfaces. In addition to this, a priming agent is required to establish continuity of the seal with the joint interfaces. Further, it would be desirable to bond compression seals in place and so a lubricant that is also an adhesive with an approximate 3- to 5-min pot life is used. Insufficient as well as excessive lubricity can be troublesome in the installation practice. A sufficient amount of the lubricant-adhesive should be used to negate the forces of frictional refusal as differentiated from mechanical refusal.

EDGE BEVELING

The practice of beveling the edges of saw cuts and setting the compression seals near the bottom of the bevel began in Switzerland and is now spreading throughout Europe. Figure 4 illustrates the principle involved, and long-term comparisons of performance in the field of both conventional saw cuts and beveled edge saw cuts have proved the latter markedly superior. New York State, with its wide comparison seal experience, and a number of other states are now requiring beveled edges.

Post-construction condition surveys of many millions of feet of both compression seals and field-molded sealants have left no question in the writer's mind that this is the direction to go in jointing and sealing practice.

Figure 5. Fully automatic compress-eject machine with edge ramp for transverse joints.

GROWTH—STRETCH

Realizing that a resulting condition of over-compression could be equally as detrimental as over-elongation, limits of somewhere between 5 and 8 percent elongation in properly constructed contraction joints appear to be desirable.

MACHINE INSTALLATION METHODS

Automatic and semiautomatic methods of machine installation are presently in

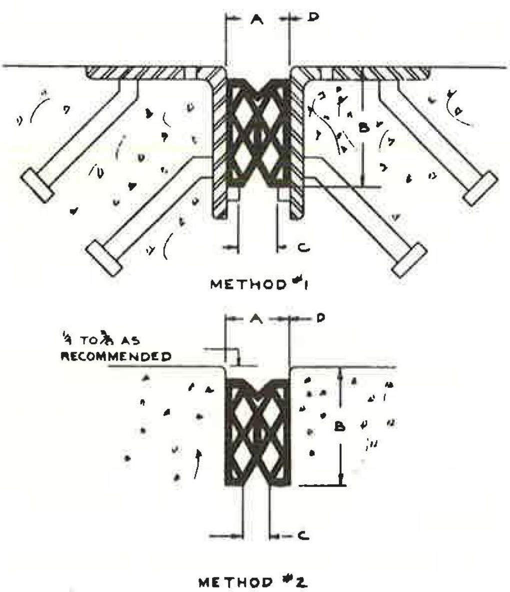
Figure 6. Self-operating vacuumatic longitudinal installing machine preceded by upcutting wire brush cleaning operation.

various stages of development and use, both in North America and in Europe (Fig. 5 and 6). They currently may be categorized in principle as follows: (a) mechanical compress-eject, (b) vacuum compress-eject, (c) two-phase pull down, (d) combination vacuum compress-two-phase pull down, (e) progressive set of rolling wheels, and (f) compress-eject hand roller.

The development of reliable automatic or semiautomatic machines has been relatively costly and slow, primarily because no two paving projects appear to have exactly the same joint geometry, thermal movement, seal configuration, construction personnel, etc. The causes of seal refusal are many and any abrupt change in the joint geometry, whether it is due to small spalls, excessive cavitation of interfaces, differential raveling, etc., will still cause the most sophisticated installing machine to balk. Small stones or debris on the pavement can operate to change the desired setting height.

PAVEMENT EDGE SEALING

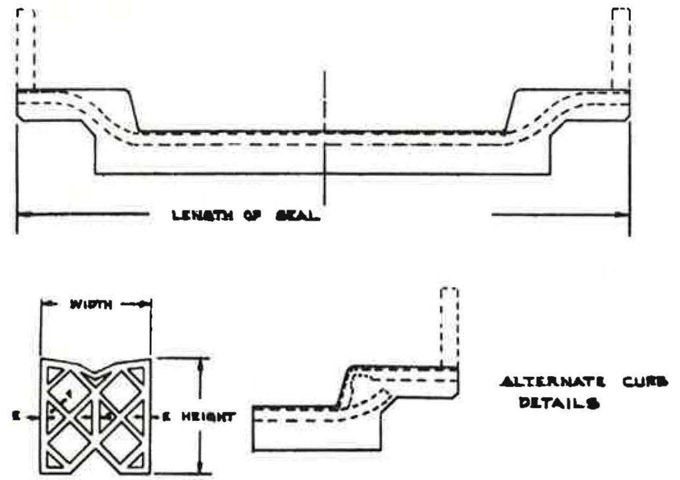
As jointed concrete pavements proceed through and respond to the normal conditions of service life, evidence of overstressing from entry of shoulder materials into the sides of pavement slabs at the joints is often apparent. Snowplows and graders can also produce corner breaks, the result of which is to rule out the effectiveness of any sealing system at this location of the slab



GROOVE SIZE				SEAL SIZE		SLAB LENGTH MAX.							
A	B	C	D	WIDTH	HEIGHT	60	80	90	100	120	140	160	200
1	2 3/8	5/8	3/64	1 3/4	2	■							
1 3/16	2 3/4	3/4	1/16	2	2 1/16		■						
1 3/8	3 1/2	1	5/64	2 1/4	2 5/8			■					
1 1/2	3 1/2	1	5/64	2 1/2	2 3/4				■				
1 3/4	4 1/4	1 1/4	3/32	3	3 13/32					■			
2	4 1/2	1 1/2	7/64	3 1/2	3 1/2						■		
2 3/8	5 3/4	1 1/2	1/8	4	4 23/32							■	
2 3/4	6 1/2	1 1/2	5/32	5	5 5/16								■

NOTE:
A Dim. is measured at 70 F
D Dim. is minus for every 10 F increase in temp.
D Dim. is plus for every 10 F decrease in temp.

Figure 7. Seal sizing for joints in bridges and structures.



WIDTH	HEIGHT	THICKNESS E	THICKNESS F
$1\frac{1}{4}{}^{+1/8}_{-0}$	$1\frac{5}{16}\pm\frac{1}{16}$	.062±.015	.062±.015
$1\frac{5}{8}{}^{+1/8}_{-0}$	$1\frac{5}{8}{}^{+1/8}_{-0}$	.078±.015	.078±.015
$1\frac{3}{4}{}^{+3/16}_{-0}$	$2\pm\frac{1}{8}$	$\frac{1}{8}{}^{+1/32}_{-1/64}$	$\frac{3}{32}{}^{+1/32}_{-1/64}$
$2^{+3/16}_{-0}$	$2\frac{1}{16}\pm\frac{1}{8}$	$\frac{1}{8}{}^{+1/32}_{-1/64}$	$\frac{3}{32}{}^{+1/32}_{-1/64}$
$2^{+1/8}_{-0}$	$2\frac{1}{16}\pm\frac{1}{8}$	.078±.015	.078±.015
$2\frac{1}{4}{}^{+3/16}_{-0}$	$2\frac{5}{8}\pm\frac{1}{8}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$	$\frac{3}{32}{}^{+1/32}_{-1/64}$
$2\frac{1}{2}{}^{+1/4}_{-0}$	$2\frac{3}{4}\pm\frac{1}{8}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$	$\frac{3}{32}{}^{+1/32}_{-1/64}$
$3^{+1/4}_{-0}$	$3\frac{13}{32}\pm\frac{3}{16}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$	$\frac{1}{8}{}^{+3/64}_{-1/64}$
$3\frac{1}{2}{}^{+1/4}_{-0}$	$3\frac{1}{2}\pm\frac{3}{16}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$	$\frac{1}{8}{}^{+3/64}_{-1/64}$
$4^{+5/16}_{-0}$	$4\frac{23}{32}\pm\frac{1}{4}$	$\frac{1}{4}{}^{+3/64}_{-1/32}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$
$5^{+5/16}_{-0}$	$5\frac{5}{16}\pm\frac{1}{4}$	$\frac{1}{4}{}^{+3/64}_{-1/32}$	$\frac{3}{16}{}^{+3/64}_{-1/64}$
$6^{+3/8}_{-0}$	$5\frac{3}{4}\pm\frac{5}{16}$	$\frac{5}{16}{}^{+3/64}_{-1/32}$	$\frac{1}{4}{}^{+3/64}_{-1/64}$

Figure 8. Seal positioning for joints in bridges and structures.

ends and to leave the extreme ends of seals uncompressed with freedom to migrate at will. It is therefore desirable, if practical, to seal the joints at the sides of pavement slabs. Forming edge grooves also tends to minimize the runaway cracks that migrate away from the desired location.

DURABILITY OF JOINT INTERFACES

Since it is not practical to recommend a joint forming or sawing practice that would work well for all pavement designs and environments, attention should be given to producing the most durable interfaces practical for whatever method is utilized.

The sharp edges of contraction joints should be taken off by dragging a form pin across or running a wire brush machine through the joint, the latter of the two being the most effective and consistent (Fig. 6).

The tendency of a seal to refuse installation can be markedly reduced if this practice is observed. The action of the wire brush against the joint interfaces tends to expose

Figure 9. "Pogo Stick" inserter for bridge seals.

Figure 10. Roller (250 lb) for inserting bridge seals.

any potential spalls and remove sawing residue, or loose concrete, as well as to produce an interface that is ideal for bonding of the compression seal to the concrete.

BRIDGE APPROACH JOINTS

Bridge approach joints have as their primary mission the provision for relief of compressive stress between a pavement and a bridge. When used in conjunction with contraction joint pavements, in addition to normal volume changes, they will tend to progressively close. They should therefore be designed in accordance with Figure 2 or 7.

JOINTS IN STRUCTURES

Marked differences in sealing practices are called for in the design of a compression sealing system for bridges. It must have the capability to respond successfully to the many different types of movement that might occur on a specific bridge, whether straight distance change between the joint interfaces; racking distortion from the many variations of skews; horizontal, angular, vertical and articulating motion patterns; differential vibrations of slab ends; impact, warping and rotation effects; permanent changes in deck length; creep; plastic flow; etc.

Figures 7 and 8 illustrate seal configurations and construction practice recommendations currently in wide use by state and provincial highway departments throughout North America. Optional curb treatments are included.

Figure 9 shows the use of a "pogo stick" inserter tool that is an effective, low-cost inserting tool when used in conjunction with the seal configurations and construction practice recommendations shown in Figure 7.

Figure 10 depicts a heavy steel roller inserter consisting of an inner wheel and two large outer wheels of 2-in. plate steel.