REVIEW OF PAST PERFORMANCE OF AND SOME NEW CONSIDERATIONS IN BRIDGE EXPANSION JOINTS

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ABRIDGMENT

TWO NEW TYPES OF RUBBER-CUSHION SYSTEMS

Gland Type of System Using Rubber Block Interfaces

Figure 1 shows a gland type of system consisting of two 10- to 12-ft, 75-durometer, extruded neoprene blocks incorporating integral steel bearing plates connected by a replaceable low-stress rolling gland that takes the movements. The neoprene rubber blocks are doweled end to end, and the gland is installed in a continuous piece across the deck.

Advantages of a system of this type are the complete elimination of plastic flow or upward buckling of the blocks during cycling, low stress transmission to the structure, noise elimination, attrition resistance, ideal suitability to vertical movements and skewed joints, simplified temperature width setting, adaptability to deck rehabilitation and joint reconstruction under traffic, and on-site variability of bolt spacing. The use of a continuous sealing gland in one piece across the bridge appears to ensure a high leakproofing potential. This type of system should be restricted to movements of 4 in. or less.

Armored, Skid-Resistant, Rubber-Cushion System

Significant design improvements over earlier concepts of high-stress, rubber-cushion systems have been incorporated into the armored, skid-resistant, rubber-cushion device shown in Figure 2. A high-strength, corrosion-resistant, alloyed aluminum extrusion wear plate protects and structurally supports the 45-durometer (shore A) neoprene molding, which is bolted to the deck over the joint opening. A number of sizes reflecting differing movement capabilities from $1\frac{1}{2}$ to 13 in. are now being specified by bridge engineers.

Reduction in stress transmission to the structure, lessened long-term plastic flow potential, minimal deflection under live loading, and armoring for improved attrition and snowplow resistance are some of the advantages over previous concepts where unprotected neoprene is exposed to heavy traffic and environmental service conditions.

STRIP-SEAL SYSTEM WITH EXTRUDED STEEL INTERFACES

German bridge engineers are responsible for the strip-seal systems (Fig. 3) that are currently in wide use.

An optimization of parts, use of steel extrusions, and low cost have made this type of system attractive not only to designers of new bridges but also to bridge maintenance people.

It was developed for improved strength-to-weight ratios and reduced welding requirements, and a number of configurations of standard extruded steel interfaces with varying heights are now available. These ASTM A-242 steel extrusions are bolted to the deck ends or cast in place by using conventional anchorage after which a heavy-duty neoprene gland is snap-locked into the receptacle provided in the interfacial armor.

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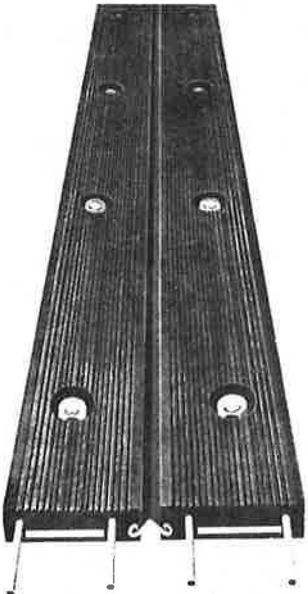


Figure 1. Gland type of system using rubber block interfaces.

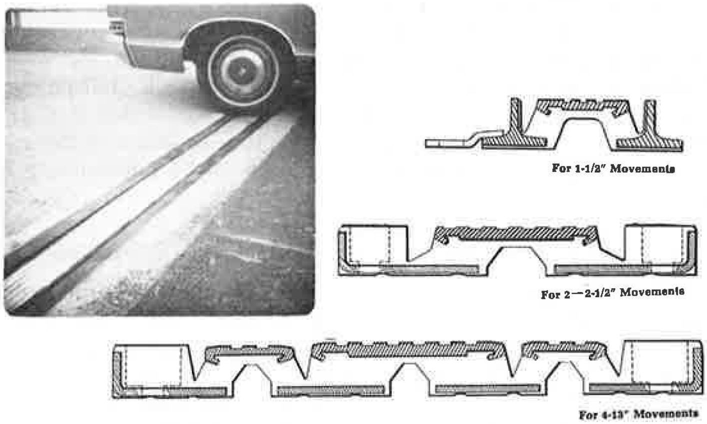


Figure 2. Armored, skid-resistant, rubber-cushion system.

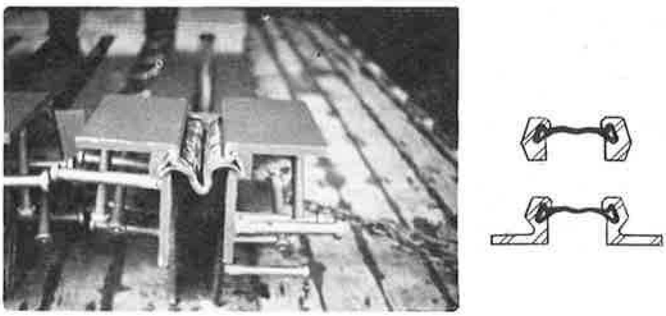
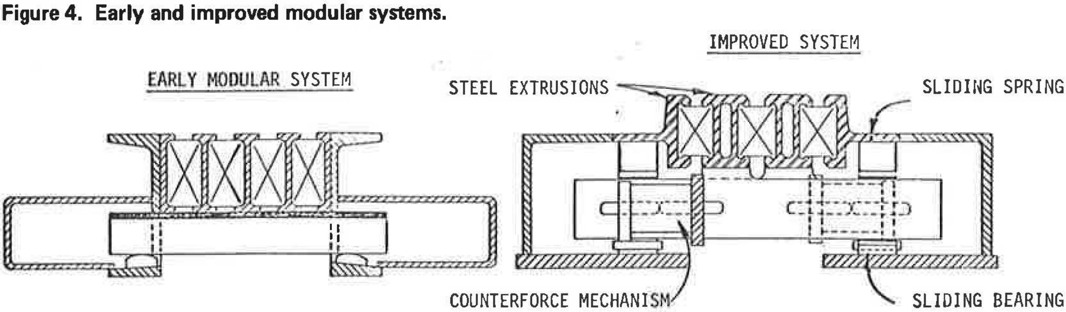


Figure 3. Strip-seal system with extruded steel interfaces.

Figure 4. Early and improved modular systems.



Because the strip-seal element during movement cycling develops very low forces, it is ideally suited for skewed joints, vertical movements, and time-dependent and irreversible joint width changes of either progressively opening or closing type.

The simplicity of the strip-sealing system enhances quick, inexpensive fabrication of lateral and vertical changes in direction of curbs, gutters, and malls. Because the sealing gland is continuous throughout the deck, 100 percent leakproofing is achieved with relative ease as compared to sealing systems that arrive on site in discontinuous sections. An absolute minimum of steel to achieve the rubber armoring of interfaces so necessary to long-life performance is the outstanding feature of the strip-seal system.

IMPROVEMENTS IN MODULAR-COMPRESSION SEALING SYSTEMS

Performance surveys of the earlier generation of modular-compression sealing systems installed on North American bridges during the midsixties and early seventies have called attention to a critical need for certain improvements to correct problems such as (a) upward buckling or lifting of separation beams, (b) rotation or tilting of separation beams, (c) unequal distance between adjacent separation beams, (d) objectionable amplification of traffic-activated noise, (e) acceleration and deceleration cracking of components, (f) high cyclic forces in compression from heavily webbed seal elements and high friction sliding surfaces, (g) premature leaking from loss of interfacial contact, and (h) insufficient lateral or torsional strength of separation beams.

Figure 4 shows improvements that have been made to earlier systems. The early systems had free sliding parts operating out of control, wearing points, high noise potential, tilting plus lifting up of separation beams, bearings subjected to wear, and an uneven surface for traffic. They were potentially susceptible to premature failure from braking forces, snowplows, and long-term pressure decay. The advantages of the improved system are use of steel extrusions (greater strength-to-weight ratio), corner locking of seal elements, separation beams welded to support bars, positively noise-proofed system, teflon to stainless steel sliding surfaces, low-stress seal elements, equidistance control of elements, and fail-safe counterforce mechanism.

Details of the improved systems on prestigious bridges such as Pine Valley Creek Bridge, Auburn-Foresthill Bridge (record 26-in. movements), and Kolmar-Oland Bridge in Sweden (Europe's longest bridge) are described in another report (1).

REFERENCE

1. Watson, S. C. A Review of Past Performance and Some New Considerations in the Bridge Expansion Joint Scene. Watson Bowman Assoc., Inc., Buffalo, 1972.