Florida Department of Transportation Research

Evaluation of Tapered Bridge Bearing Pads

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Current Situation

Despite their massive weight, bridge components can move relative to each other, either under the influence of traffic loading or due to temperature-induced expansion and contraction. To allow for both types of movement, the superstructure components of a bridge rest on bearing pads rather than directly on the vertical support structure. Bearing pads are often made of alternating layers of steel and a spongy material called elastomer, and considering the enormous weight they carry, their proper function depends on even distribution of weight across the pad. This is simpler when the bridge components are precisely horizontal and vertical, which makes the surfaces above and below the bearing pad parallel. But when the bridge lies on a slope, the surfaces above and below the pad form an angle. For small slopes, the Florida Department of Transportation (FDOT) allows the lower surface to be sloped to compensate. But above a 2.0% slope, FDOT requires carefully tapered steel shims to compensate for the angle, which while necessary, are expensive and time-consuming. In many cases, using a tapered bearing pad would save this time and expense, if it meets performance requirements.

Bearing pads allow massive bridge parts to safely move under the influences of traffic loads and temperature.

Research Objectives

University of Florida researchers conducted experiments to evaluate tapered bearing pads for use in Florida bridge construction.

Project Activities

The researchers found limited research on important design properties of tapered bearing pads such as axial stiffness, shear stiffness, horizontal restraining force and displacement generated in tapered pads under pure compression, and shear strain at slip. To evaluate these properties, they developed tapered pads with varying overall dimensions, elastomer thicknesses, and slope angles by modifying elastomer thicknesses and shim orientations of standard FDOT flat pads. Unaltered flat pads served as controls. Experiments showed that shear stiffness was not significantly influenced by taper angle or the direction of shear along the length of pads, remaining within 15% of flat pads. However, axial stiffness, horizontal restraining force, and horizontal displacement in tapered pads were found to depend on the taper slope angle. As taper slope increased, axial stiffness decreased, and horizontal restraining force and displacement increased. Based on these data, equations were developed to estimate axial stiffness, shear stiffness, horizontal restraining force, and horizontal displacement.

The effect of taper slope on shear strain at pad slip was also investigated. Tapered pads placed against concrete surfaces satisfied the AASHTO requirement of minimum 0.5 shear strain before slip, but tapered pads placed against steel surfaces generally did not. The researchers proposed further work to evaluate options to prevent premature slip of tapered pads on steel surfaces. The equations developed in this project could be useful in those studies.

Project Benefits

The results of this project can provide designers with new options for bearing pads and reduce the time and expense of constructing sloped bridges sites.

For more information, please see www.fdot.gov/research/.