RESEARCH
Oregon Department of Transportation

Research Notes

RSN 03-05 May 2003

Base Isolation Bearings Hold Up

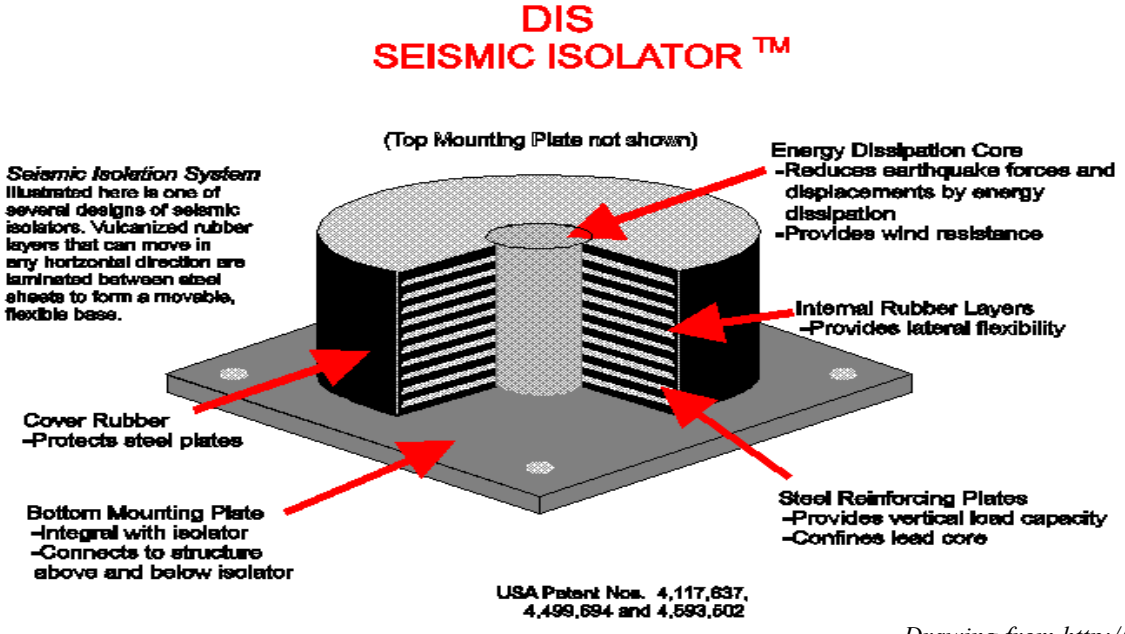
In the last decade, the Oregon Department of Transportation has been designing bridges to be "earthquake resistant". Warnings from geologists of a possible magnitude 9.0 earthquake in this region spurred this action. Their advice was based on an estimated 35,000-year geologic record of major quakes in Oregon caused by the Cascade subduction zone off the coast. Bridge collapses in California in 1989 and 1994, and in Kobe, Japan in 1995, verified the need for earthquake-resistant bridges.

Existing bridges, such as the Marquam Bridge in Portland, are given seismic retrofits, and new bridges are designed to more demanding seismic standards. Other structures may have a seismic device built in. The ODOT Research Unit has monitored one such structure since 1994 – the connector ramp from the Clackamas Highway (224) to 99E near Milwaukie, Oregon.

The seismic device used on this structure is a base isolation bearing made by Dynamic Isolation Systems, Inc. Note in the drawing below that the bearings are rubber-based with lead cores. These bearings carry the load of the deck and superstructure of the bridge. Their action is similar to motor mounts in a car engine. Their flexible nature allows them to move with the earthquake motion and then return to their original position.

A 5.3 magnitude earthquake occurred in April 1993, but strong-motion detection equipment on the bridge was not installed and operational until October of that year. The equipment, housed in a vault under the north end of the bridge, has not recorded a strong motion exceeding 0.01g (0.32 f/s^2) since it was installed.

A similar base isolation system was used on a bridge in Iceland. In June 2000, two major earthquakes of magnitude 6.6 and 6.5 struck within 15 km of the bridge. The base isolation performed well, and will be used in the design of a new bridge in the area. (*Nordic Road & Transport Research No. 1, 2003)*



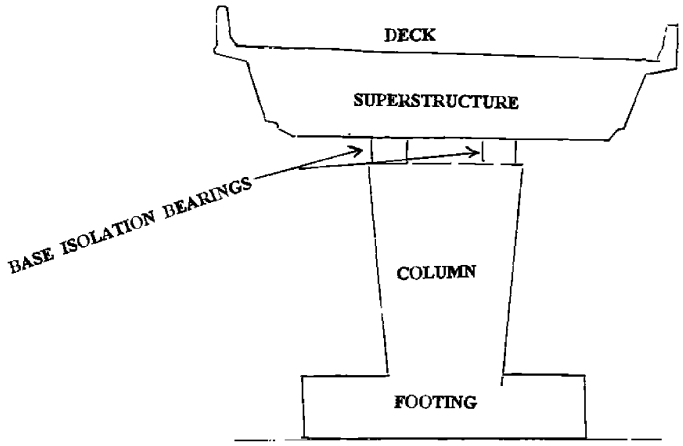
Drawing from http://www.dis-inc.com.

An inspection access for the base isolation bearings

On August 15, 2002, an inspection was made of the bearings. No changes were found from the 1993 and 1997 inspections. The bearings have a slight inclination from vertical, ranging from ½-inch on bent 5, to 4 inches on bent 2. This leaning was expected by the bridge designers due to the curve of the bridge deck.

The bridge was also found to be friendly to wildlife. Many pigeons find their way to the bearings through the inspection opening. Their droppings could be the cause of minor rust found on the base plates.

Recent minor earthquakes in the Portland area in April 2003 offered another opportunity to inspect the bearings and instrumentation. The strong-motion instruments did not detect movements strong enough to trigger a recording, and there were no visible changes to the bearings.



Base isolation bearings transmit the traffic loading and dead loads from the deck and superstructure to the columns

Request a copy of the 1998 construction report **"Base Isolation Bearings"** from ODOT Research by phone, e-mail, or in person.

For more information on this project, contact Steve Starkey, ODOT Bridge Section, at 503-986-3388; or Matthew Mabey, Research Coordinator, at 503-986-2847 or via e-mail at mailto:matthew.mabey@odot.state.or.us

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