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Recent improvements in application of base isolation

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Abstract

Base isolation is a technology that is widely accepted by the profession as an effective means to protect structures and non-structural components against earthquake damage. This is demonstrated by the large number of buildings and bridges that have been built or retrofitted using this technology. It is contended, however, that, at present, the existing isolation systems have limitations and that these limitations have prevented a widespread use of the technology in ordinary structures and in developing and emerging countries. It is the purpose of this paper to make a brief review of the predominant isolation systems, pinpoint their major disadvantages, and describe some of the solutions that have been proposed to overcome these disadvantages. The systems considered are (a) laminated elastomeric bearings, (b) friction pendulum bearings, and (c) sliding bearings. The review reveals that many researchers are still active in the base isolation field and that many interesting improvements have been proposed over the last few years.

Keywords: base isolation, friction bearing, elastomeric bearing, sliding bearing

1. INTRODUCTION

It can be said that, currently, base isolation technology is an established field, widely accepted by the profession as an effective means to reduce structural and nonstructural damage during earthquakes. Evidence of this is the large number of buildings and bridges that have been constructed using this technology. Some of the latest statistics in this respect show that the number of applications is over 5,000 in Japan, 400 in China, 550 in the Russian Federation, 90 in Italy, 80 in the United States, and 32 in Armenia. Of the types of isolation systems used in actual implementations, three of them seem to be the predominant ones. These are: (a) laminated elastomeric bearings, (b) friction pendulum bearings, and (c) sliding bearings. It is interesting to know, however, that despite their popularity, these systems still have some limitations and that these limitations, for the most part, have prevented their widespread use. That is, they have prevented their use in ordinary structures and in developing and emerging countries.
In general, it seems that the major limitations that have impeded a wide use of the technology are [1]:

- Knowledge gaps (many aspects of device and system response still unknown)
- Procedural obstacles (design methods difficult and code provisions burdensome)
- Economic barriers (technology still too expensive for ordinary structures)

To overcome these gaps, obstacles, and barriers, improvements to the predominant base isolation systems have been proposed over the last few years. It is the purpose of this paper to present a brief review of the main characteristics of such predominant systems, pinpoint their limitations, and describe some of the aforementioned improvements. The objective is not too present a comprehensive state-of-the art report. The objective is, rather, to highlight the advances made in this field and show that these advances hold a promise toward the achievable goal of a simple, reliable and inexpensive isolation system that can facilitate a wider implementation of base isolation. Emphasis is placed on the description of two particular sliding systems: (a) hydrostatic bearings, and (b) hydromagnetic bearings. These two systems depart significantly from conventional sliding bearings and require a more detailed description.