A STUDY OF AGING EFFECT ON A RUBBER BEARING AFTER ABOUT TWENTY YEARS IN USE

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Introduction

Most building owners ask how long the lifetime of rubber bearings is, when they consider applying seismic isolation to their buildings. It is natural for them to doubt the durability of rubber bearings because most rubber materials such as tires, seals and rubber bands are easily damaged in daily use. Average lifetime of buildings with reinforced concrete or steel frames is assumed to be several decades in Japan. Thus rubber bearings are expected to have enough durability for at least several decades to 100 years. Rubber bearing was developed in late 1970's. The first seismically isolated building in Japan was completed in 1983. It is only about a quarter of a century since rubber bearings have been applied to buildings. Thus the quality of aged rubber bearings has not been proved enough to convince building owners.

Takenaka & Bridgestone conducted a study of aging effect on natural rubber bearings actually used in a seismically isolated building after about twenty years in use.

Outline of the Study

The building is a three-story dormitory for employees of Takenaka Corporation located about 25 km east of the center of Tokyo, which was completed in 1987.

What we conducted for rubber bearings used for the building is shown in Figure 1. Compressive creep and mechanical characteristics such as vertical stiffness and horizontal stiffness were measured. Various characteristics of the rubber material such as hardness, strength and adhesion to steel plates were investigated after the bearing was cut into pieces.

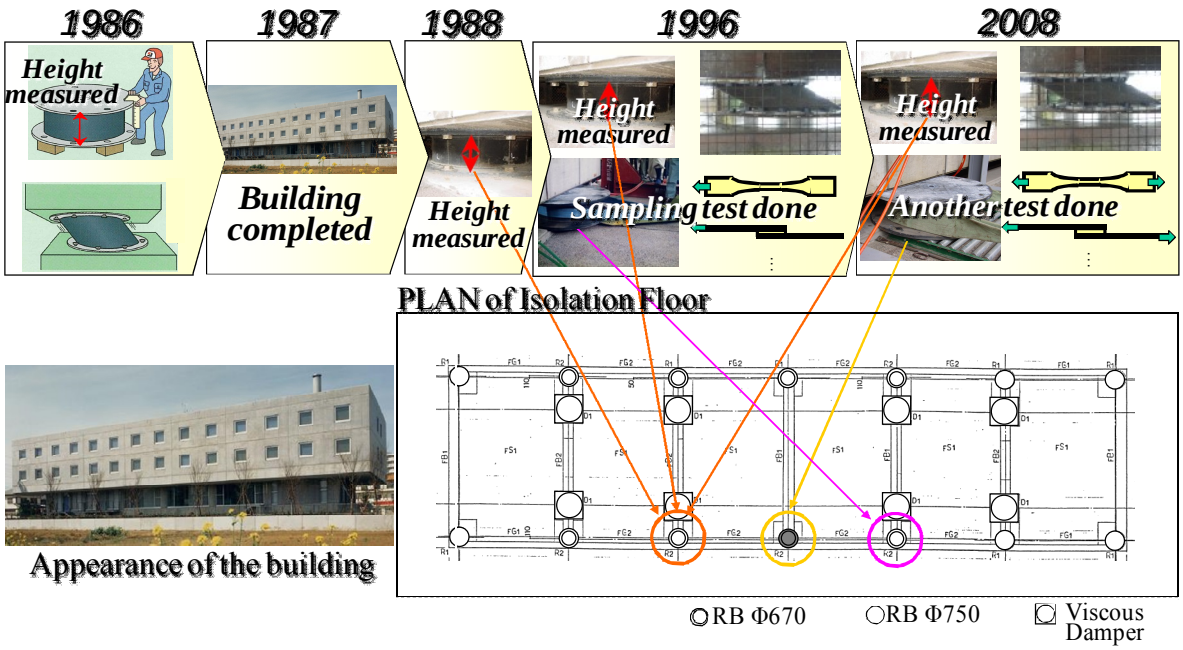

Figure 1 What We Did for Actually Used Rubber Bearings in a SI Building

Test results are shown in Figure 2, 3 and 4. The creep fitted with a suggested predicting equation, while vertical and horizontal stiffness slightly increased from initial values, respectively. Also the test results of the rubber material showed no obvious change in mechanical characteristics.

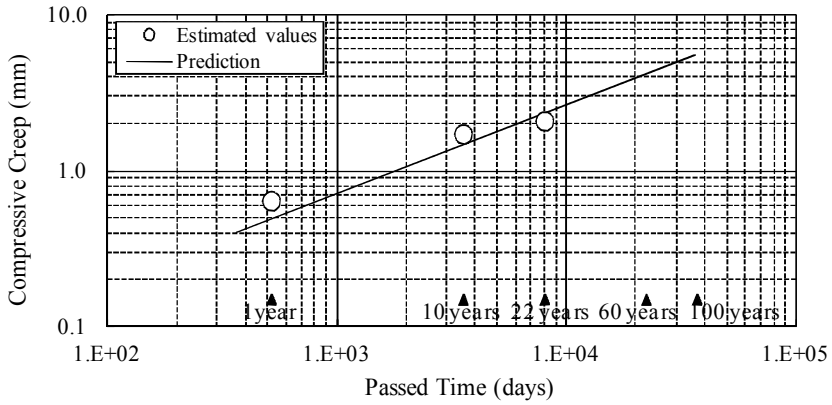

Figure 2 Increment in Compressive Creep

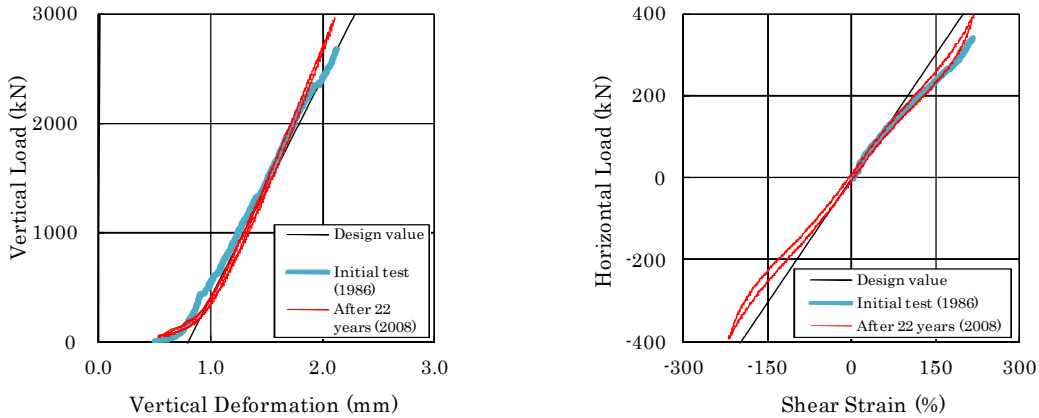

Figure 3 Comparison of Vertical and Horizontal Hysteresis Loops

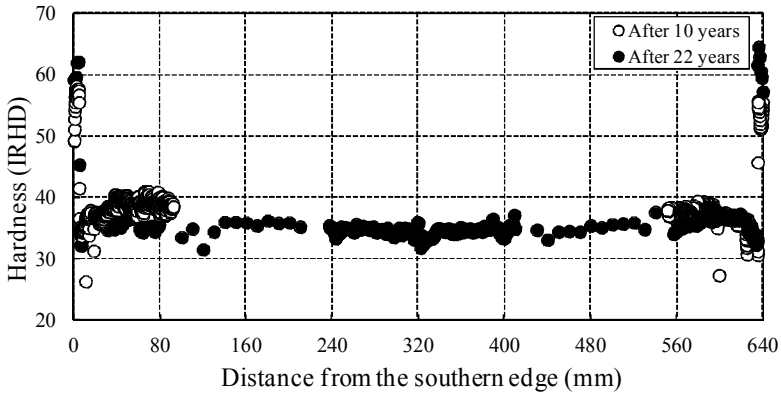

Figure 4 Hardness of Rubber Material after 10 and 22 Years

Conclusions

As an overall assessment, it is concluded that the changes in mechanical characteristics approximately fitted with some predictions and existing research results and that rubber bearings have a considerable durability.

For more information, please see the CIB/W114 site : http://www.cibw114.net/worldreport.html