CTC Headquarters, Ain Defla, Algeria

The National Technical Control of Construction Centre (CTC) headquarters was the first isolated building in the Algerian Republic. Completed in 2007, the pilot project showed the economic effectiveness of the seismic isolation technique for reinforced concrete frame buildings designed according to the Eurocode 8.

4-storey Apartment Block, Java, Indonesia

Indonesia’s first building installed with HDNR bearings was a four-storey apartment block constructed in 1994 under UNIDO/MRB project.

Retrofit of 5-storey Unreinforced Masonry Apartment Block, Vanadzor, Armenia

This is a 1995 UNIDO/MRB Project. 30 HDNR bearings fabricated in Malaysia were installed. People continued living in the apartment while the bearings were being installed at the basement.

4-storey Apartment Block, Java, Indonesia

Indonesia’s first building installed with HDNR bearings was a four-storey apartment block constructed in 1994 under UNIDO/MRB project.

LNG Tank Project, Shantou, China

Three liquefied natural gas (LNG) tanks were constructed installed with HDNR bearings designed by MRB and fabricated in Malaysia in 2005.

Parand Township Project, Parand, Iran

The 5 blocks of 12-storey apartment buildings under the Parand project were installed with HDNR bearings in 2007.

Aston Hotel, Medan, Indonesia

12-storey Aston Hotel in Medan was the 2nd Indonesian building on HDNR bearings. The building was completed in 2010 and sits on 25 bearings.

MPOB 3-storey office block in Lahad Datu, Sabah, Malaysia

Completed in 2011, the building sits on 28 natural rubber bearings designed and fabricated in Malaysia.

Gudang Garam Tower, Jakarta, Indonesia

Completed in 2013, the 26-storey Gudang Garam Tower was the first building in Jakarta isolated on 40 seismic rubber bearings.

This information is assembled and distributed by the Malaysian Rubber Export Promotion Council (USA), which is registered under the Foreign Agents Registration Act as an agent of the Malaysian Rubber Export Promotion Council (Malaysia). Public information about the registration is available at the US Department of Justice.
Rubber bearings are increasingly being used for base isolation of buildings, bridges and other structures in areas with high seismic activity. With this technology, the building or structure is isolated from the horizontal components of the earthquake ground motion by interposing elastomeric bearings with low horizontal stiffness between the structure and the foundation. In an earthquake, the superstructure responds as a rigid body, with the deformation occurring in the bearings.

The most commonly-used seismic rubber bearings are High Damping Natural Rubber (HDNR) bearings. They are simple, cost effective and maintenance-free. This type of rubber bearing was developed by the Malaysian Rubber Board (MRB) in the late 70s as part of a joint R&D effort with the University of California, Berkeley, to evaluate the use of seismic rubber bearings for structures. The project culminated in the construction in 1985 of the first base-isolated building in the US - the five-storey Law and Justice Center building in San Bernardino, California.

The HDNR bearings effectively protect structures from earthquake damage and protect occupants and contents inside the buildings by significantly reducing higher mode response in structures. Now more than 30,000 structures all over the world use this system and other base isolation techniques.

HDNR bearings are made by bonding sheets of vulcanized rubber to thin steel reinforcing plates. They are flexible horizontally and capable of isolating low to medium rise buildings and other structures from the destructive effects of earthquakes. The exact maximum height of a building suitable for isolation depends on its location and characteristics.

Advantages of HDNR bearings

- Rubber-steel laminated bearings based on natural rubber have been in service since 1950s; hence their ageing behaviour is known and predictable. A large body of field data on performance of rubber in the bearings are available for evaluation and comparison.

- Rubber bearings have no moving parts and are therefore maintenance free, remain unaffected by time and are resistant to environmental degradation.

- HDNR bearings are able to sustain some tensile loads without damage; therefore can be used if tensile stresses are present as may happen when vertical seismic excitations are significant.

- The behaviour of the elastomeric isolation system can normally be approximated by linear models; this allows for analysis by most of the commercially available Finite Element software and for a safe engineering judgement-based assessment of the calculated results.

- HDNR bearings could cope with displacement inputs larger than the design displacements, thus providing a “safety” factor with respect to beyond design earthquake.

SECOND PENANG BRIDGE, MALAYSIA

World’s Largest Structure on Seismic Bearings

The Second Penang Bridge is the longest bridge in Southeast Asia. More than 2,000 units of HDNR bearings were installed on this cable-stayed bridge connecting Batu Maung in Penang to Batu Kawan on the mainland.

The HDNR bearings are made by bonding sheets of vulcanized rubber to thin steel reinforcing plates. They are flexible horizontally and capable of isolating low to medium rise buildings and other structures from the destructive effects of earthquakes. The exact maximum height of a building suitable for isolation depends on its location and characteristics.

- **Overall Length**: 24km
- **Length Over Water**: 16.7km
- **Main Bridge (type)**: Cable-stayed bridge with beam & slab deck
- **Approach Bridge (type)**: Box Girder
- **Main Navigation Span - Ship Protection**: Steel box buffer system

OTHER STRUCTURES WITH RUBBER BEARINGS

- **USC University Hospital, California, United States**
  The University of Southern California (USC) University Hospital was completed in 1991 at a construction cost of US$50 million. The seven-storey high building sits on 149 rubber anti-seismic bearings. The cost of the bearings was only 1.5% of the total construction cost.

- **West Japan Postal Computer Center, Sanda, Kobe Prefecture, Japan**
  Built in 1986, this 6-storey building exhibited excellence performance during the Kobe earthquake. In 2002, it was the largest base-isolated building in the world.

- **9-storey Building Apartment, Shantou, China**
  This is a 1994 UNIDO/MRB project. The apartment was the first building in China installed with HDNR bearings designed and fabricated in Malaysia.