Feature of UBB™

- Layout Image
  - Non-buckling and equivalent strength in tension and compression enables a variety of layout patterns.

- UBB™ Performance
  - HYBRID LOAD in tension and compression have equal strength and stiffness, in the pre- and post-yield ranges.
  - Same mechanics in tension and compression.
  - Stable and symmetric behavior in tension and compression.

- BCI Approval
  - UBBS were adopted in more than 800 projects in the world.
  - UBBS have been conducted a number of loading tests which satisfy design requirements of seismic design manual issued by American Institute of Steel Construction (AISC).

- Satisfaction of seismic manual issued by AISC

- Material Specifications

<table>
<thead>
<tr>
<th>Core Plate</th>
<th>Steel Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS SS400 [similar to ASTM A36]</td>
<td>ASTM A500, JIS STKR400 or JIS STK400, Thickness : 3.2 mm to 16 mm Width or Diameter : 100 to 500 mm (larger sizes are possible upon request)</td>
</tr>
</tbody>
</table>

- Steel Material:
  - JIS SN400 [similar to ASTM A1043(Gr.36)]
  - JIS SN490 [similar to ASTM A1043(Gr.50)]
  - NSSMC Standard BT-LYP225 (Certified material by Ministry of Land, Infrastructure, Transport and Tourism)
  - ASTM A36
  - ASTM A1043 (Gr. 36)
  - ASTM A1043 (Gr. 50)

- Minimum core plate thickness is 12mm (1/2in.) [19mm (3/4in.) or thicker is recommended].

- Design of Steel Tube

UBBS are adopted more than 800 projects in the world.

UBB™ (Unbonded Brace)
UBBTM is a structural brace element consisting of a steel core plate which is restrained by mortar and steel tube. This ingenious combination of components produces stable and symmetric tension-compression hysteretic behavior. The core plate do not transfer to the mortar and the steel tube.

### UB BM Main Components
- **UBBM**'s components
- **UBBM**'s concept

### UB BM Concept
**UBBM** is an innovative structural brace element consisting of a steel core plate which is restrained by mortar and steel tube. This combination of components produces stable and symmetric tension-compression hysteretic behavior. The core plate do not transfer to the mortar and the steel tube.

### UB BM Applications
- **UBBM** applications have started in Japan.
- **UBBM** applications at Carlton Science Building at U.C. Davis in 1999.
- **UBBM** application at Football stadium, Toyota, Aichi in 2000.
- **UBBM** application at NTU earth science building in Singapore in 2001.
- **UBBM** application at Tsinghua Science Park Building in Beijing in 2005.

### UB BM Performance Data
- **UBBM** has shown stable hysteretic behavior for axial strains as high as 7.2%.
- **UBBM** has shown stable hysteretic behavior for over 100 cycles at an axial strain of ± 1%.
- **UBBM** has shown stable hysteretic behavior for over 200 cycles at an axial strain of ± 4%.

### UB BM Configurations and Core Material Types
- **Flat Plate** (-)
- **Gusset Plate** (+)

### History of UB BM
- **1960s**
  - Early UB BM
  - UB BM development and applications in Japan by Nippon Steel Corporation (UBBM).
- **1980s**
  - UB BM applications have started in Japan.
  - UB BM applications at Taipei County Government Building in Taiwan.
  - UB BM applications at National Taiwan University in Taiwan.

### UB BM Research and Development
- **UBBM**'s main components
- **UBBM**'s concept
- **UBBM**'s configuration and core material types
- **UBBM**'s performance data
- **UBBM**'s applications
- **UBBM**'s history

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**What's response controlled structure?**

**Conventional Structure**
- Primary frame itself has to yield seismic force

**Response Controlled Structure with UBBTM**
- Response control devices absorb seismic force to minimize the damage and the horizontal deformation of structure

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**UBBM configurations and core material types**

**UBBM** configurations and core material types include: Flat Plate (-) and Gusset Plate (+). These configurations can be used for both yielding and non-yielding applications.

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- **UBBM** has shown stable hysteretic behavior for over 300 cycles at an axial strain of ± 10%.

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**UBBM's main components**

- **UBBM** consists of a steel core plate which is restrained by mortar and steel tube. This combination of components produces stable and symmetric tension-compression hysteretic behavior.
- The core plate do not transfer to the mortar and the steel tube.
- A membrane called the unbonding material, between the mortar and the core plate, ensures that axial forces in the core plate do not transfer to the mortar and the steel tube.

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**UBBM concept**

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