Testing of Buckling-Restrained Braces with Replaceable Steel Angle Fuses

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Description of the Proposed BRB

Three Key Assemblies:

Buckling-Restraining Mechanism (BRM)
- Restraining the inward buckling deformations of the angle fuses;
- Free axial direction.

Buckling-Restrained Angle Fuses
- Being bolted to the inner BRM;
- Being cold-folded from flat plates;
- Each angle fuse with two restrained yield segments and an interior restrained nonyielding segment.

Outer BRM
- Four identical components connected through high-strength bolts;
- Being reusable;
- Assembling and disassembling easily.

Process I
Assembly of the inner telescopic BRM.

Process II
Assemblage of angle fuses and inner BRM.

Process III
The proposed BRB after fabrication.
Specimens Design and Test setup

Parameters of angle fuses:

Test setup:

<table>
<thead>
<tr>
<th>Specimen ID</th>
<th>The key geometry parameters (mm)</th>
<th>Unbonding agent</th>
<th>Fuse steel</th>
<th>Weight of each fuse (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0</td>
<td>$L_{ny1} = L_{y1} + L_{y2}$, $L_{ny2}$, $r$, $t_a$, $B$, $b$</td>
<td>NA</td>
<td>Q235</td>
<td>12.07</td>
</tr>
<tr>
<td>B1</td>
<td>1100, 650, 0, 30, 5.4, 75, 45</td>
<td>SG</td>
<td>Q235</td>
<td>13.14</td>
</tr>
<tr>
<td>B2</td>
<td>890, 650, 210, 30, 5.7, 75, 45</td>
<td>SG</td>
<td>Q235</td>
<td>13.14</td>
</tr>
<tr>
<td>B3</td>
<td>850, 650, 230, 40, 5.7, 75, 35</td>
<td>SG</td>
<td>Q235</td>
<td>12.24</td>
</tr>
</tbody>
</table>

$\ast L_{ny1} = L_{ny3}$; and $b$ NA=Not Applied; SG = Silicon Grease.
Specimen B2 (Displacement Control)
Numerical Simulation by OpenSees

Fuse strain ductility $\mu$ ($\mu = \frac{\varepsilon}{\varepsilon_y}$)

Specimen B1

Specimen B2

Specimen B3

Axial force (kN)

Fuse strain $\varepsilon$ (%)
Conclusions

◆ Hysteretic behavior of the proposed BRB is similar to those of the ordinary BRBs. The compression strength adjustment factor, $\beta$, and the CPD satisfy the requirements specified by AISC 341-16.

◆ In practice, the proposed BRB can be used as surrogates to the ordinary BRBs if the proposed BRB can be properly designed to allow the structure inter-story drift associated with the ultimate BRB fuse strain to be higher than the expected inter-story drift.

◆ The test results demonstrated that the inner and outer BRMs can be re-used and that replacement of the angle fuses is convenient and prompt. The repaired specimens remained as satisfactory as expected.

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Today Poster Session:

- **Time**: 5:15 – 7:00 pm
- **Room**: Pasadena (Exhibit Hall)
- **Poster location**: Number 589 (location: 222)