EXPERIMENTAL CORROBORATION OF THE BEHAVIOUR OF A BOLTED RBS CONNECTION UNDER CYCLIC LOAD

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NODES
CONNECTIONS

Northbridge (1994) and Kobe (1995) earthquakes

New way of forming moment connections seeking:

- Increased rotational capacity of nodes
- Better behaviour of steel frames
- Protection of the connection parts and the column
Reducing the Beam Section relatively far from the connection
RBS GEOMETRICAL PARAMETERS

\( a \): distance from the column head to the beginning of the cut

\( b \): cut length

\( g \): cut depth
## NORM LIMITS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Eurocode 8</th>
<th>FEMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>$0.60 \cdot b_f$</td>
<td>$(0.5 - 0.75) \cdot b_f$</td>
</tr>
<tr>
<td>b</td>
<td>$0.75 \cdot d_b$</td>
<td>$(0.65 - 0.85) \cdot d_b$</td>
</tr>
<tr>
<td>g</td>
<td>$&lt; 0.25 \cdot b_f$</td>
<td>$0.20 \cdot b_f$</td>
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</tbody>
</table>
RBS PARAMETER CHOICE

\[ a = 0.45 \cdot b_f \]
\[ b = 0.75 \cdot d_b \]
\[ g = 0.20 \cdot b_f \]
FINITE ELEMENT MODEL DESCRIPTION

Part
Material
Assembly
Step
Interaction
Load
Mesh
PARTS
STRUCTURE OF THE EXPERIMENT
<table>
<thead>
<tr>
<th>$\sigma$ (MPa)</th>
<th>$\varepsilon_{\text{plastic}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>505</td>
<td>0.00</td>
</tr>
<tr>
<td>525</td>
<td>0.02</td>
</tr>
<tr>
<td>575</td>
<td>0.04</td>
</tr>
<tr>
<td>625</td>
<td>0.08</td>
</tr>
<tr>
<td>650</td>
<td>0.20</td>
</tr>
</tbody>
</table>
LOAD PROTOCOL
INTERACTION

Ties
INTERACTION

Ties
INTERACTION

Contact
MESH

The division of the parts into shapes that allow the computer to approximate the behaviour of the whole, solving a set of simple equations

- Directly linked with the results’ accuracy
- Coincident nodes where different parts meet
- Rectangular elements are optimum
MESH
RESULTS
RESULTS

\[ M - \varphi \text{ στο κέντρο του RBS} \]

- \[ kN\text{m} \]
- \[ \text{Rigid} \]
- \[ \text{Semi-rigid} \]
- \[ \text{Nominally pinned} \]

\[ \text{rad} \]
RESULTS COMPARISON
FEM-EXPERIMENT CONTRASTING
CONCLUSIONS

The behaviour of the connection is satisfactory as the plastic hinge is created at the position of the cut

The analytical model is reliable

Although in one of the controlled parameters the recommended by EC8 value is not used, we conclude that the method is indeed effective. Such fact provides reasonable doubt about the recommendations of the code as they are a result of an adoption of what FEMA is proposing

The rotational capacity of the node is at least satisfactory as it proved to be way higher than the limits of EC8 and those of FEMA

The lower limit of parameter $a$ that the Eurocode 8 recommends is justified as we observe the plastic hinge tend to get closer to the connection and therefore the possibility of the connection getting is higher. In none of the anterior experiments, that honoured the limit, had occurred such displacement
Experimental Procedure

Girder cutting
Part perforation
Part welding
RBS cut
Tension test
Structure Assembly
Pilot load

Dimension check
Dimension check
Weld control
Dimension check
Material determination
Optimal positioning
Equipment control
Simulation Procedure

Material Input
Element determination
  2d-3d elements
Calibrating Model

Actions

Tensile test simulation
Model efficiency and accuracy
Along with data from previous experiments
Actual beam's vertical deformation @60cm