Rigid Body Response & Performance Based Design of Seismically Isolated Structures

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Rigid Body Approach

Source: Kulkarni and Jangid
Model Description

5-story Steel Moment Frame Building

Lead Plug Rubber Bearings

Source: Buckle
Flexible vs Rigid Structure
Effects of Structural Stiffness

**5 STORY ISOLATED BUILDING SUBJECTED TO EARTHQUAKE 1 - ACCELERATION TIME HISTORY**

<table>
<thead>
<tr>
<th></th>
<th>SMFRS Shear Frame (Optimized Design)</th>
<th>SMFRS Non-Shear Frame (Optimized Design)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Top Floor Displacement (m)</td>
<td>8.2</td>
<td>11.3</td>
<td>32%</td>
</tr>
<tr>
<td>Max Mid Floor Displacement (m)</td>
<td>7.4</td>
<td>7.4</td>
<td>0%</td>
</tr>
<tr>
<td>Max Top Floor Acceleration (g)</td>
<td>0.84</td>
<td>0.60</td>
<td>34%</td>
</tr>
<tr>
<td>Max Mid Floor Acceleration (g)</td>
<td>0.84</td>
<td>0.86</td>
<td>2%</td>
</tr>
</tbody>
</table>

Note:
1. Original Design Refers to Original Calculations (No-SMFRS Designed)
2. Optimized Design Refers to SMFRS non-isolated Optimized design per current bld codes
Conclusions

- Rigid body approach is an excellent means of getting preliminary results.
- Time history results are great but variations in spectra also need to be considered in determining methods of approach.
- Idealizations in structural flexibility can also lead to variations in response with some areas of over- or under-estimation.
- More complex modeling is needed to better understand the relationship between floor responses and PBD of isolation.
Come see my Poster!

Today’s Poster Session:

- **Time**: 5:15 – 7:00 pm
- **Room**: Pasadena (Exhibit Hall)
- **Poster location**: Number 141