Steelquake Structure – JRC, Ispra, Italy

**Project Description:**

The “Steelquake” structure corresponds to a two-story frame as depicted in the figure below. It was investigated during the European COST F3 action as benchmark example to compare different damage identification algorithms at the European Joint Research Center JRC in Ispra, Italy. The main dimensions are 8m x 3m x 9m. The stories are a composite of corrugated steel sheets supporting a concrete slab having orthotropic elastic characteristics. The stories are connected by welded vertical steel columns and horizontal steel beams. The structure can be interpreted as a module of a high-rise building, which has been loaded via shakers to simulate an earthquake-like loading. During this loading, damage (cracks) occurred at several locations which had to be detected.

Steelquake Structure, European JRC, Ispra, Italy
Quick Facts:
- **Name and Location:** Steelquake Structure
- **Owner:** JRC, Ispra, Italy
- **Structure category:** two story frame building
- **Dimensions:** 8x3x9 m
- **Structural system:** Steel frame with stories made of concrete slabs
- **Start of SHM:** 1998
- **Number of sensors installed:** 15
- **Instrumentation design by:** JRC, Ispra, Italy

Description of Structure:
The main dimensions are 8m x 3m x 9m. The stories are made of corrugated sheets supporting a concrete slab, forming a composite with orthotropic elastic characteristics, and are connected by welded vertical and horizontal steel girders. The vertical steel girders were stiffened up by cross bracings in the plane parallel to the wall. In the background the reaction wall can be observed which supports the 4 pistons (not present in the photo) that will deform the structure (on each frame, on each story). There are several standard profiles of steel girders in use. The columns consist of HE300B, the stories of IPE400 on the long side and IPE300 on the short side. Bracings are made of L60x30x5 profiles.

Purpose of Inspection:
The benchmark was performed for testing and further enhancement of damage detection algorithms in the frame of the European COST F3 Action.

Sensor Details*:

<table>
<thead>
<tr>
<th>Type of sensors</th>
<th>Number</th>
<th>Location</th>
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<tbody>
<tr>
<td>Accelerometers</td>
<td>15</td>
<td>at the main girders and the orthotropic concrete slab</td>
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<tr>
<td>Force</td>
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<td>Hammer test</td>
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Measurement Equipment and Data Management:

<table>
<thead>
<tr>
<th>Type of system</th>
<th>Data Management</th>
<th>CMS</th>
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<tr>
<td>Workstation-based</td>
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<td></td>
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<tr>
<td>measurement system</td>
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Data Analysis Procedures:

<table>
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<tr>
<th>Type of analysis</th>
<th>Software</th>
<th>Additional features</th>
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</thead>
<tbody>
<tr>
<td>Modal Analysis</td>
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<td>based on hammer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>excitation and</td>
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<tr>
<td></td>
<td></td>
<td>acceleration data</td>
</tr>
</tbody>
</table>

Examples of Outcomes:

The damage could be detected, localized and quantified by means of an inverse eigensensitivity approach combined with parameter preselection and regularization techniques.

Detected damage along the structure (dark locations)

Benefits of Using SHM Technologies in the Project:

The benchmark could be used to test and to modify different approaches for damage identification along the European research community.

References:


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