FRAGILITY/VULNERABILITY ASSESSMENT

GENERAL INFORMATION

RECTANGULAR BLOCK IN MUD MORTAR MASONRY INDEX BUILDING

INTRINSIC CHARACTERISTICS

General Geometry:

<table>
<thead>
<tr>
<th>Building Plan Area (m²)</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Total Floor Area (m²)</td>
<td>72</td>
</tr>
<tr>
<td>Number of Stories</td>
<td>1</td>
</tr>
<tr>
<td>Story Height (m)</td>
<td>2.6</td>
</tr>
<tr>
<td>Number of Spans in X Direction</td>
<td>3</td>
</tr>
<tr>
<td>Typical Span Length in X Direction (m)</td>
<td>5.5</td>
</tr>
<tr>
<td>Number of Spans in Y Direction (m)</td>
<td>1</td>
</tr>
<tr>
<td>Typical Span Length in Y Direction (m)</td>
<td>4.4</td>
</tr>
<tr>
<td>Wall Thickness (mm)</td>
<td>375</td>
</tr>
<tr>
<td>Wall Construction</td>
<td>English Bond</td>
</tr>
<tr>
<td>Thickness</td>
<td>One and a Half</td>
</tr>
</tbody>
</table>

Material Properties of Masonry:

| Unit Weight (γ kg/m²) | 1768        |
| Modulus of Elasticity, E (MPa) | 45         |
| Shear Modulus, G (MPa) | 18          |
| Compressive Strength, f'm (MPa) | 1.21        |
| Cohesion, c (MPa) | 0.047       |
| Tensile Strength, f_t (MPa) | 0.047       |
| Friction Coefficient, µ | 0.5         |

SEISMIC BEHAVIOR

Seismic Weight of IP Walls (kN): 420
Fundamental Time Period of IP Walls (sec): 0.27

Pushover Curve with Damage State Thresholds:
### IP Wall Behavior

**OP Threshold:** Hairline cracks (black) of maximum width 0.3 mm appeared at few corners of doors and windows.

**IO Threshold:** Hairline to minor cracks (black) of maximum width 5 mm developed at most of the corners of the openings.

**LS Threshold:** Left pier and spandrel start to damage in shear and flexure with extensive cracks of 9 mm maximum width (red). Other piers also start to develop extensive shear and flexural cracks.

**CP Threshold:** Most piers have developed extensive shear cracks (red) of width of more than 10 mm. Left most spandrel on the verge of collapse. Horizontal flexural cracks of maximum width 3 mm appeared in some piers at the base.

### OOP Wall Behavior

**OP Threshold:** Hairline cracks (black) starts to appear at the top connection with the in plane walls. Max crack width 0.2 mm.

**IO Threshold:** Minor cracks (black) start to extend downward at the IP connection, max crack width 3 mm. A minor horizontal bottom crack appears in the central part.

**LS Threshold:** Minor cracks (black) extended to most of the wall surface and at the connection with the IP walls. A horizontal crack of maximum opening 2 mm at the bottom appears. Some gable portions on the verge of collapse.

**CP Threshold:** Minor to major cracks extended everywhere in the wall (black). Portions of gables damaged. Horizontal bottom crack extends to full length with a maximum opening of 4 mm (red). Vertical shear cracks also extended to half of the length at IP wall connections, with a max crack width of 3 mm (red).
FRAGILITY/VULNERABILITY ASSESSMENT

RECTANGULAR BLOCK IN MUD MORTAR MASONRY INDEX BUILDING

SEISMIC PERFORMANCE ASSESSMENT

Analysis Considerations:
Analysis Methodology: Static Analysis (N2 Method)
Seismic Ground Motions:
Ground Motion Suite: FEMA P695 - 22 Far Field Ground Motions
Intensity Measure (IM): PGA (g)
Seismic Demand Parameter (EDP):
Roof Drift

Scaling Factor: 0.1
Minimum IM: 0
Maximum IM: 2g

Bilinear Idealization:

EDP Calculation:

Fragility Functions:

FRAGILITY ASSESSMENT

Integration Methodology: Least Square Method

Fragility Curves for IP Behavior

Fragility Curves for OOP Behavior

IB5_LBM_UCM-URM4_LR_LD
FRAGILITY/VULNERABILITY ASSESSMENT

RECTANGULAR BLOCK IN MUD MORTAR MASONRY INDEX BUILDING

VULNERABILITY ASSESSMENT

Damage to Loss Function:

OP (%): 2  IO (%): 10  LS (%): 43.5  CP (%): 100

Vulnerability Function:

![Building Vulnerability Curve]

GLOSARY

IP = In Plane  OOP = Out of Plane
OP = Operational  IO = Immediate Occupancy  LS = Life Safety  CP = Collapse Prevention
IM = Intensity Measure  EDP = Engineering Demand Parameter
ADRS = Acceleration Displacement Response Spectra
Sa = Spectral Acceleration  Sd = Spectral Displacement
PGA = Peak Ground Acceleration  T (s) = Time (second)

PRINCIPAL REFERENCES

Reference Project: Global Library of School Infrastructure - GLoSI
Main Bibliographical References:
- GLoSI Technical Report
- FEMA P-695
- ASCE 41-17
- N2 Method (Fajfar, 2000)
- GEM Analytical Vulnerability Assessment Guideline (D'Ayala et al., 2015)
- FUNVUL (www.ecapra.org)