### INJECTION TECHNIQUE

**APPLICABLE BUILDING TYPES:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Taxonomy Parameters</th>
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<tbody>
<tr>
<td>Main Structural System</td>
<td>A</td>
</tr>
<tr>
<td>Height Range</td>
<td>Low (LR)</td>
</tr>
<tr>
<td>Seismic Design Level</td>
<td>Medium (MR)</td>
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<tr>
<td>Structural Health Condition</td>
<td>Poor (PD)</td>
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</tbody>
</table>

**EXISTING STRUCTURAL DEFICIENCIES:**
- Limited tensile strength, cohesion and friction due to poor quality or deteriorated materials; - Localized failure of walls; - Existing cracks; - Poorly connected wythes in multi-wythe walls.

**STRUCTURAL IMPROVEMENTS AFTER STRENGTHENING:**
- Shear and tensile strength is increased thereby improving the wall integrity, strength and ductility.
- Local failure modes are controlled.
- Existing cracks and voids are sealed.
- Out of plane detachment of wall panels is controlled.
- Wythes are connected properly for combined action thus reducing the possibility of delamination.

**STRENGTHENING INTERVENTION DESCRIPTION:**

This is a local type of non-invasive intervention technique on masonry structures. In this technique, cement-based grout or epoxy resins are used as the injection material. Epoxy resins are excellent binding agents. This intervention does not alter the aesthetic or the architectural features of the building.

If the cracks are minor (less than about 2 mm), epoxy resins are appropriate, while cement-based grouts are favorable for filling larger cracks (ElGawady et al., 2004). In the weaker walls, holes are created and epoxy or grout is injected through the holes to improve the integrity of the walls. Injection technique can also be used to improve the tensile strength, cohesion and friction at the wall-frame interface in CM buildings by removing the existing poor quality mortar layer and injecting epoxy resin or cement-based grouts. Cement-based grouting can be also used to fill the empty collar in the multi-wythe walls.


**ILLUSTRATIVE FIGURES:**

Grout of epoxy injection in existing weak walls (Reproduced from IAEE, 2004).

Grout of epoxy injection in existing cracks in masonry walls (Reproduced from Arya et al., 2013).

Example illustration and procedure for injection techniques to strengthen weaker walls or to repair small cracks in masonry.
## REFERENCES:

- The design details and figures shown here are for illustration purpose only.
- Experienced structural engineers have to design (dimensions, details and material specifications) and supervise the interventions for each application case.

### PRECAUTIONS AND LIMITATIONS:

This strengthening technique requires skilled masons as it involves plaster removal, drilling through the walls etc. The injector machine might not be available in particular areas.

### REFERENCES:


### Notes:

- The authors do not assume any responsibility for the consequences of adopting the proposed strengthening solution.