Seismic Strengthening of Non-Ductile RC Frame using Steel Caging & Aluminum Shear Yielding Device (Al-SYD)

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Introduction

Non-ductile gravity load-designed RC frames suffer complete collapse or severe damages during earthquakes due to following reasons:

- Inadequate lateral strength
- Insufficient lateral stiffness
- Limited ductility & energy dissipation

Require strengthening of frame members for better seismic performance

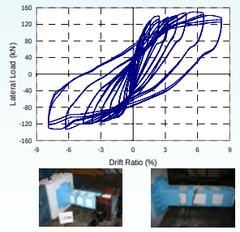
Objectives of Research

To design a simple, easy to implement and effective strengthening system to enhance seismic performance of non-ductile RC frame and experimentally verify the behaviour of strengthened frame subjected to gravity loads and lateral cyclic load

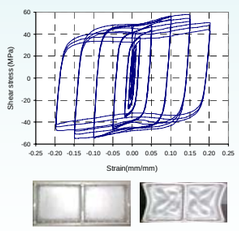
Strengthening Strategy

Two techniques: (a) Enhancement of lateral strength by strengthening columns using *steel caging technique* and *(b)* Enhancing overall lateral strength, stiffness and energy dissipation potential using *Aluminum Shear Yielding Device (Al-SYD) system*

Past Research



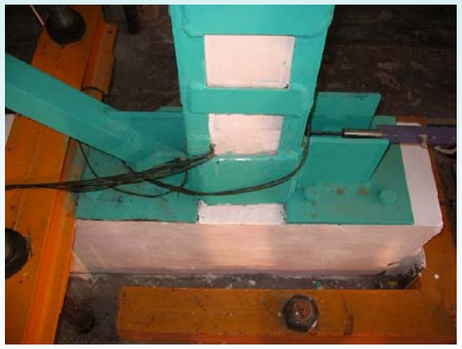
Column strengthening using Steel Caging technique (Nagaprasad, 2005)



Behaviour of Al-SYD (Jain, 2004)

Arrangement of Strengthening Scheme

Single-story single-bay reduced scale (1:0.4) RC frame subjected to gravity loads and reversed cyclic lateral displacements as per ACI-374 seismic testing loading protocol

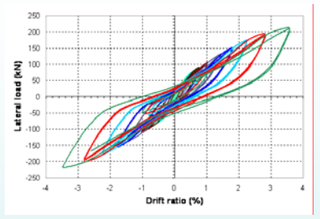


Design of connections of steel cage and bracing near footing

Arrangement of Al-SYD in strengthened frame

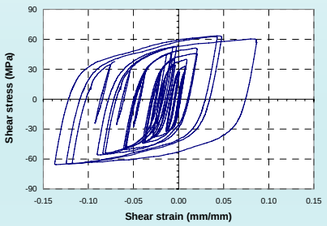
Test Results

State of strengthened frame at 3.5% drift



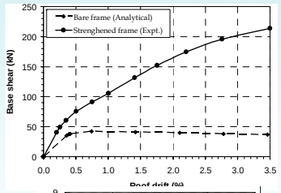
Hysteretic response of strengthened frame

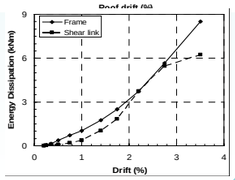
Shear yielding of Al-SYD Device



Hysteretic response of Al-SYD Device

- Lateral strength of strengthened frame increased by four times.
- Increased damping up to 15% against conventional 5% for ordinary RC frame
- Al-SYD reached 12% shear strain without buckling instability.





Conclusions

- Excellent seismic performance of strengthened frame in terms of lateral strength, lateral stiffness, and energy dissipation
- An effective strengthening scheme for RC frame with weak and soft story