INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

R&D SHOWCASE 2021
Technology, Social Impact

IMPORTANCE OF SEISMIC SAFETY OF NONSTRUCTURAL ELEMENTS IN HOSPITAL BUILDINGS

Poor Seismic Performance of NSEs in Hospital Buildings

Non-Structural Elements (NSEs)

- Attached to the structural systems, but not a part of load resisting systems
  - Prefabricated panels, ceilings, storage racks, HVAC, fire sprinklers, transformers, generators, pipe ducts, medical equipments
- Vital for the daily operations of healthcare systems
- Accounts for roughly 92% of the total cost of hospital structures
- History of past earthquakes
  - Most of the hospitals lost its function due to failure of NSEs though the structural element remains intact
    - e.g., Christchurch earthquake, New Zealand 2011-Breaking of sewer lines caused geotechnical failure (Liquefaction) in Women's hospital and partly buried cars

Challenges

- Diverse nature of NSEs : Acceleration sensitive, Displacement sensitive and sometimes torsional effects
- Setting out the limits of NSEs for a Performance Based Design
  - Immediate Occupancy, Life Safety and Collapse Prevention
- Predicting the behaviour of NSEs under floor accelerations
- Analysis of fundamental time period and associated mode shape
- Dynamic characteristic of NSEs which will vary for each element
- Mass, Stiffness, amplification , ductility, response reduction and importance factors of the elements
- Height of attachment of NSEs from the ground
- Design and detailing of anchorage, bracing and connections to secure NSEs with structural elements
- Lack of information of NSEs regarding its location and proximity to the structural elements during the design stage
- Difficulty to simulate the practical conditions in software
- Insufficient code provisions and formulations
- Cost effectiveness

Objectives

- Develop detailed guidelines for seismic design of NSEs;
- Complement current NSEs seismic design recommendations and draft provisions;
- Understand nonlinear dynamic behaviour of NSEs for improving testing procedures;
- Recommend seismic design procedures of major NSEs including its connections to structural elements that causes significant damage to structural elements; and
- Implement Performance Based Seismic Design of NSEs.

Fig. 1 – Failure of ceiling grid, tiles, lights, in the 201 Chile Earthquake [FEMA E74, 2011]

Fig. 2 –Damages to Sewer Lines due to Liquefaction, 2011 Christchurch earthquake [McIntosh, 2012}

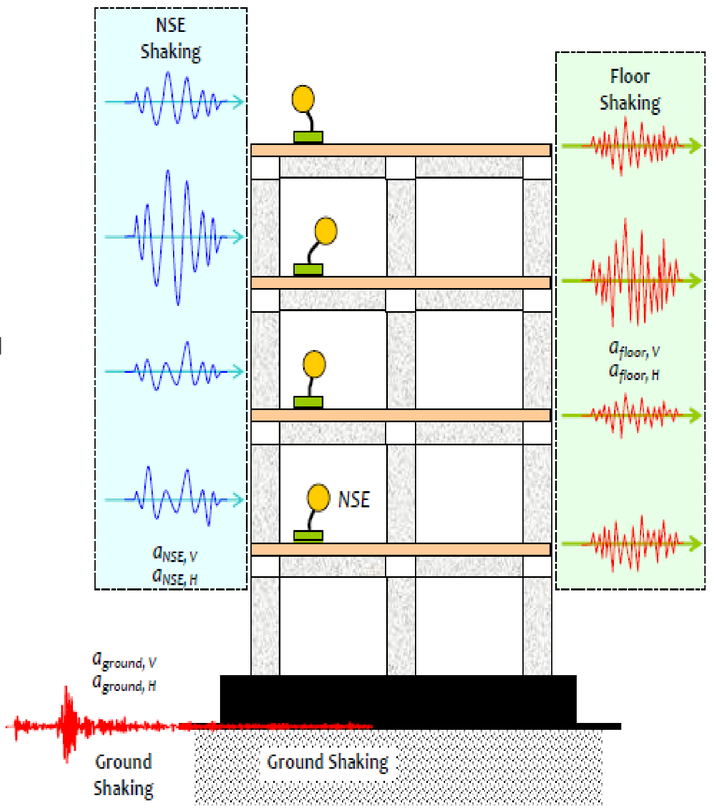

Fig. 3 – Acceleration response of NSEs [Murty et al, 2012]

Authors: S .Saranya and Sunitha Palissery

Research Center Name: EERC