Unreinforced Masonry

History
Long Beach Earthquake
- Took place in 1933
- 120 lives were lost
- The Coroner’s Jury in Long Beach concluded, “Masonry buildings were the principal suffers and their failure occasioned the principal loss of life.”
- Despite this known fact it still took the city almost forty years to adopt an ordinance requiring seismic upgrades

Sylmar Earthquake
- Took place in 1971
- 65 lives were lost
- Two hospitals were severely damaged

State Response
- Fields Act of 1933
  - Required schools to be inspected during construction
- Riley Act of 1935
  - Required buildings to resist lateral loads
- Hospital Act 1973
  - Required new and old hospitals to be reinforced

Long Beach Requirements
- Long Beach earthquake caused Long Beach to adopt the strictest requirements in the nation
- First adopted in 1970s
- URM buildings were inspected and divided into 3 categories
  - Most dangerous – repair immediately or tear down
  - More dangerous – given until 1985 to be brought to code
  - Least dangerous – given until 1991 to comply
- Retrofitting is the sole responsibility of the owner and must be completed within two years of starting the project.
- The city would finance building owners

2003 URM Survey
- 936 URM buildings exist in Long Beach
- 90% are commercial
- 10% are residential
- 370 buildings had been demolished at this time
Un-reinforced Masonry Study Guide

**Components of URM**
Footing made of concrete, masonry or rock
- Contains very little cement
- Moisture has deteriorated it over time

Load bearing exterior walls less than 6 stories
Wood floor and roof systems
- Conventional or heavy timber
- Arched roofs are common

Sand lime mortar

No rebar

Exterior walls about 13 inches thick that taper vertically

Parapet walls

Floor and roof joists that rest in a cavity

Fire cut floor and roof joists

Government anchor used to anchor fire cut rafter into cavity, usually spaced every 8-10 rafters

**Common Seismic Upgrades**

Roof/floor to wall ties
- Rafter tie plates
- Tie rods and turn buckles
- Must be torqued to UBC standard

Bond Beams

Concrete Caps
- On parapets over walkways and exits

Parapet Bracing

Tuck Pointing
- Mortar must resist 30psi or greater

Metal strapping across roof (Drag Strap)
Indications of Pre 33 construction

Rafter tie plates
- Squares, stars, diamonds, straight bars or s-shaped rods.
- Give you a good idea of roof and floor lines
- Un-evenly spaced may indicate parapet supports
- May represent location of tie rod turnbuckle between floors

Deeply recessed windows

Concrete bond beams
- On the tops of exterior walls or between floors, over windows and doors, corners of building

King Rows
- Done every four to seven rows of bricks.
- You will see the ends of bricks

Windows will have lintels
- May be arched or straight
  o Arched window uses the brick as the lintel
  o Square window uses angle iron as lintel
  o Both are used as a horizontal beam to support and distribute load

Mortar
- May be crumbling away
- Can be uneven or sloppy

Stucco Buildings
- Lintels and recessed window will help you identify
- Usually only the front is stucco

Hazards

Wall collapse
- 90 degree, pancake, inward outward, curtain
- Tie plates make fire cuts ineffective and can cause total wall collapse
- The hip sections of arched roofs will push out the exterior walls if the roof collapses
- Roofs carry a severe dead load because of the multiple layers of comp

Retrofits
- Made of unprotected steel and can fail under fire conditions

Mortar
- Hose lines can deteriorate sand lime mortar
- Mortar chemically changes at 600 degrees and loses all structural integrity

Masonry
- Spalling can remove or weaken masonry units
**Operational Considerations**

**Collapse**
- Zones may be greater than the wall height
  - Corners are safe zones
  - Resources should be located away from the structures
- Fire exposure can cause parapet bracing to fail

**Ventilation**
- Metal strapping can interfere with your cuts

**Steel lintels**

**Watch Outs**

- Sagging floors
- Spongy floors or roofs
- Bulging or leaning walls
- Abnormally tight doors or windows
- Flame impingement on steel lintels
- Smoke showing through walls
- Cracking, groaning or creaking
- Rafter tie plates and bars protruding from walls
- Rafter tie plates and bars pulled back into walls
- Cracks running full wall height
- Numerous individual bricks breaking or fragmenting in a localized area
- Separation of plaster overcoat
- Large portion of building is involved