Preliminary Building Damages Due to Mamuju Earthquake, West Sulawesi

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Outline

1 Examples of Building Damages
2 Possible Causes
3 Closure
Governor Office (2009)

House of Representative Office (2010)
Low Rise Precast Apartment Building (2016)

The use of plain bars

Local Hospital (2013)

The use of plain bars

Concrete core crushed (due to inadequate confinement (the space between transversal bars is too wide))
The use of plain bars
Regional Hospital (2017)
Causes of Building Damages

- Seismic shear demand due to recent earthquake > shear capacity (especially for buildings designed based on old seismic codes)
- Seismic detailing is inadequate for location with high seismicity (as that in West Sulawesi)
- Inconsistent design/construction (inadequate dilatation gap, integral stair construction etc)

Actual Elastic Spectra Demand

Actual elastic spectra shown are due to January 15 earthquake. The maximum spectra value in Mamuju (the most affected area) is 0.3 g and in Majene 0.16 g.

Ariska Rudiyanto dan Daryono (2021)
Evolution of Sulawesi Seismic Map

Actual Seismic Shear Demand versus Code-Based Shear Demand

Actual elastic spectra due to January 15 earthquake is close to the elastic design spectra of 2002 code (for moderate soil).
Causes of Building Damages

- Seismic shear demand due to recent earthquake > shear capacity (especially for buildings designed based on old seismic codes)
- Seismic detailing is inadequate for location with high seismicity (as that in West Sulawesi)
- Inconsistent design/construction (inadequate dilatation gap, integral stair construction etc)

Inadequate Seismic Detailing

Notes:
- The use of plain bars
- No cross-ties installed
- The space between transverse bars is sometimes too wide
Level of Seismicity and Detailing Requirement

In SNI 1726-2002, in which the PGA value in West Sulawesi is 0.1 g, the level of seismicity there is considered as low (in this case, you can apply any structural system (ordinary, intermediate or special).

Since the implementation of SNI 1726-2012, because spectral values at short period is much higher than before, than all the new buildings there are assigned with seismic design category of D (requires special structural system with higher demand of seismic detailing).

However, the special seismic detailing requirement has not been implemented consistently there. Sometimes, the higher R values were used but with ordinary types of seismic detailing.

Causes of Building Damages

• Seismic shear demand due to recent earthquake > shear capacity (especially for buildings designed based on old seismic codes)

• Seismic detailing is inadequate for location with high seismicity (as that in West Sulawesi)

• Inconsistent design/construction (inadequate dilatation gap, integral stair construction, precast connections at plastic hinge zones etc)
Vulnerability of Survived Existing Buildings

• Shear capacity of the buildings, especially those designed based on older seismic code (2002 or before) is much lower than those designed based on SNI 2012/2019

• The existing seismic detailing may not be adequate for area with high seismicity (especially to anticipate “the unexpected”)

Thank You