Seismic performance of RC low-rise building structures having irregularities at the ground story during the 15 November 2017 Korea earthquake

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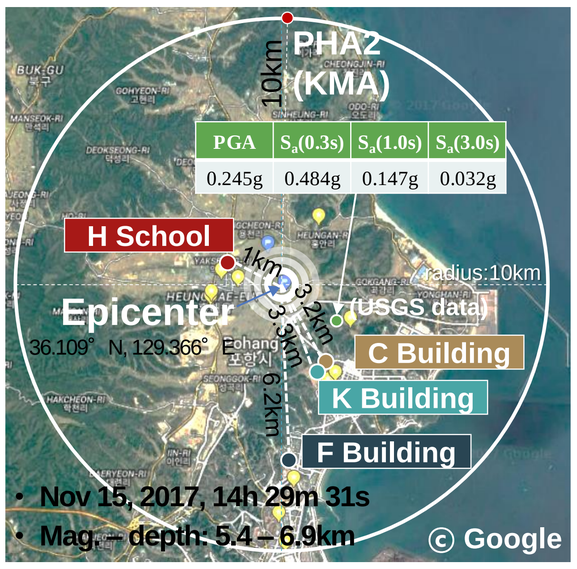
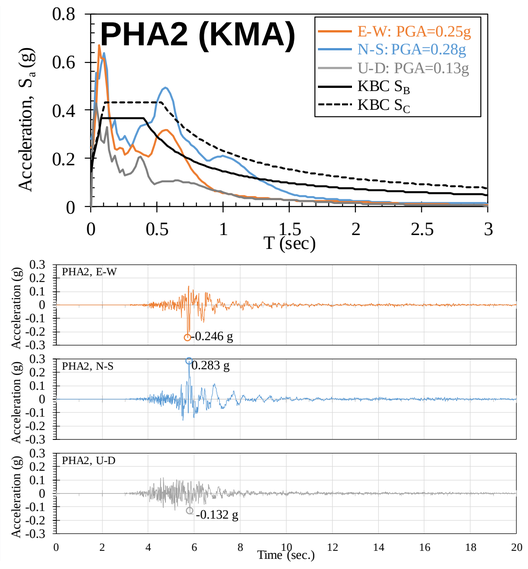
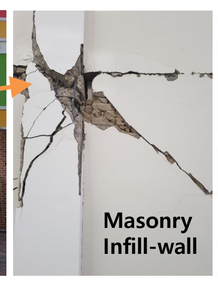
Introduction

This poster presents seismic failure of RC low-rise building structures having irregularities at the ground story during the 15 November 2017 Pohang earthquake, M_w=5.4, which is the second strongest since the government began monitoring them in 1978 in South Korea. This earthquake caused serious damage at the piloti story of RC low-rise building structures within the epicenter distance of 3km with a brittle shear failure of columns and walls due to severe torsional behavior.

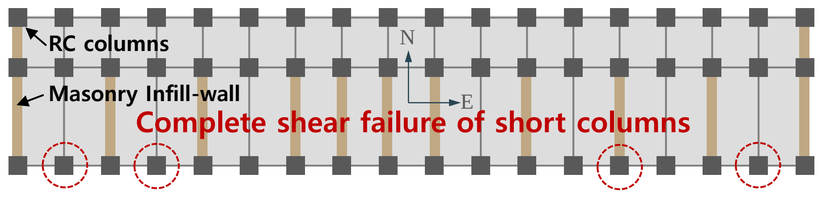




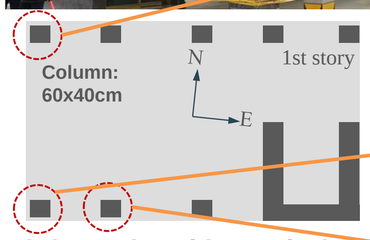
H school: 3-story RC MRF structure

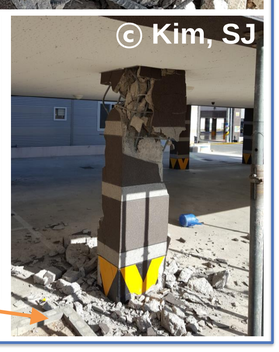


One-way asymmetric RC moment frame structure
→ Torsional irregularity



C building: 4-story RC piloti-type bldg. structure

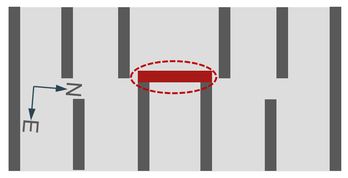




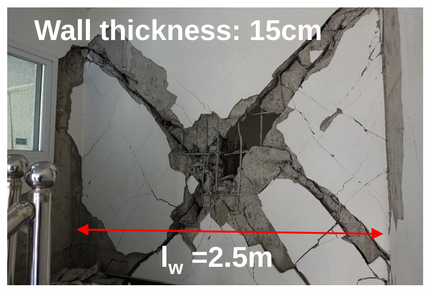
High torsional irregularity
→ unexpected large drift
→ shear failure of column

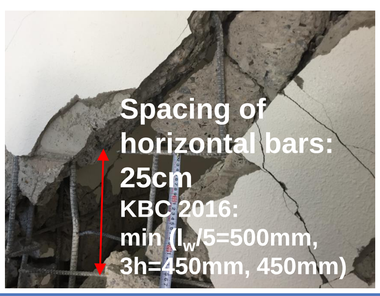
K building: 4-story RC wall building structure

In a shear wall in the horizontal direction, serious shear failure occurred. The wall is not placed in the center of the plan. Because of this torsional irregularity, many cracks in the wall in the transverse direction are observed, despite a large amount of wall in the transverse direction.

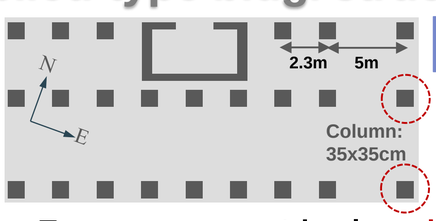


Other photos Dropbox link



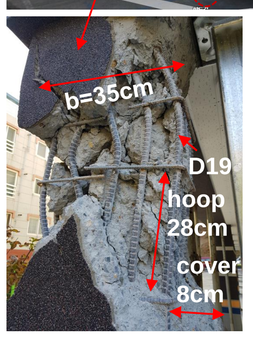


F building: 5-story RC piloti-type bldg. structure



Shear failure YouTube link

- **Two-way asymmetric-plan: shear failure** occurred at columns in the flexible edge.
- **Columns have inadequate details of hoop, tie, and cover**

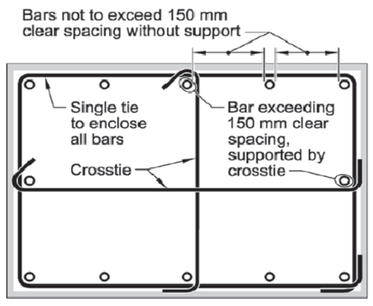


ACI 318-14
(KBC 2016)

Min hoop spacing

= min ($8d_{b,l}$, $24d_{b,h}$, 1/2b, 300mm)

= min (152mm, 240mm, 175mm, 300mm) = **152mm**



Conclusions

- After the 2017 Pohang earthquake (M_w=5.4), **some 2,000 private houses were damaged or destroyed**. A large number of the houses are RC low-rise building structures (less than five-story) having a high torsional irregularity.
- Before 2005, **buildings below six stories** did not have to satisfy the seismic design requirement.
- The earthquake caused **unexpected brittle shear failures in columns** on the flexible side of RC low-rise piloti-type building structures having **torsional irregularity**.
- **Confinement detailing of columns and walls** apparently led to inadequate performance.
- A **building plan orientation of damaged structural element** appears to be consistent with the horizontal component N-S of the ground motion.
- **Appropriateness of torsion design approaches** in the current code should be **examined**.

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