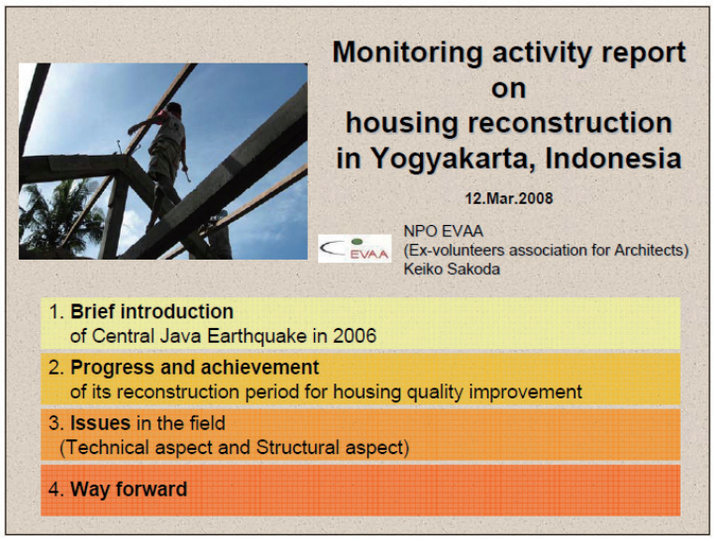
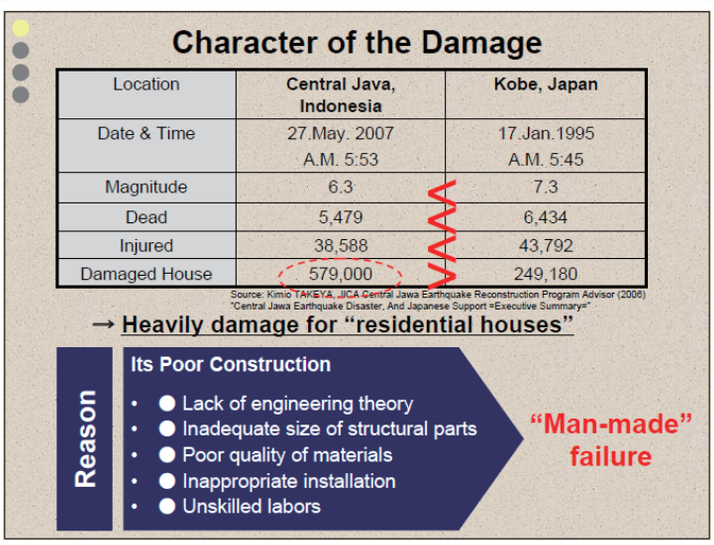
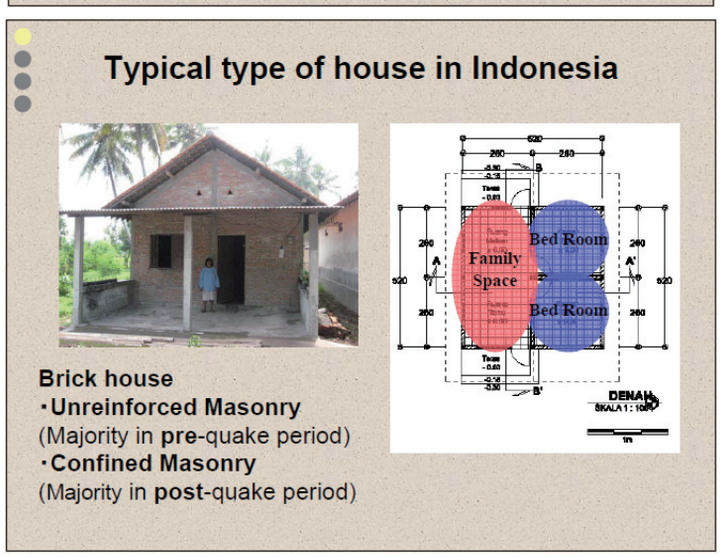
2.9. Report on Monitoring of Construction Practices of Confined Masonry Structure in Indonesia
（Keiko SAKODA）

インドネシアの枠組み組積造建設モニタリング結果の概要と課題 （迫田恵子）





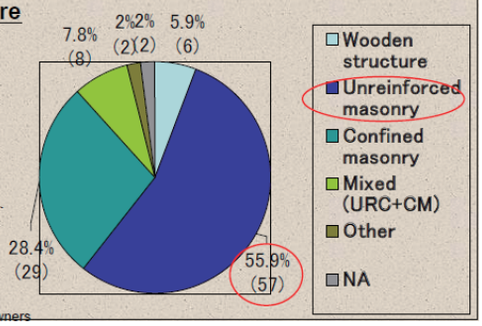


Pre-earthquake condition of housing component

■ **Field Survey** ■
- 102 sampling (6 samples × 17 districts in Bantul)
- Interview with owners and construction workers

● Housing Structure

- Almost 56% was Unreinforced Masonry without column nor beam.
- Even Confined Masonry, many of them were only with column not with beam.



Source: Field interview with house owners

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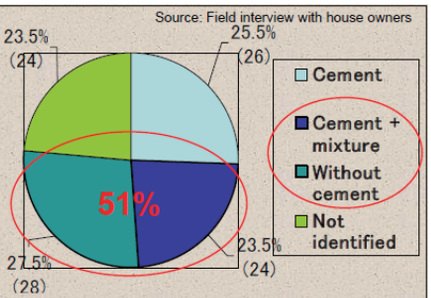
● Joint material (for bricks)

- Only ¼ use mortar but with **less cement**.
- 51% was mixed/solid use of lime ash, brick powder, mud, cray, etc.



"Before the earthquake, foundation was more shallow and no plinth beam…"

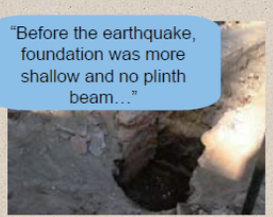


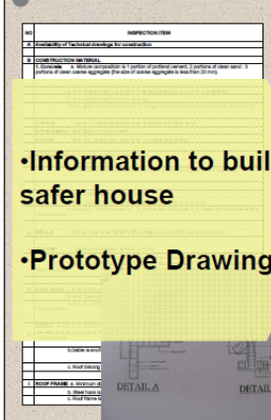
Photo: Dr. Iman Satyarto

Photo: Dr. Iman Satyarto

"Before, there was no connection between the iron bars for joint parts…"

Source: Field interview with construction workers

Housing Quality Improvement through housing reconstruction period



- **Information to build safer house**
- **Prototype Drawings**

Compared to pre-earthquake period,

→ URM to **CM**
→ **Better materials**
→ **Better mixture** (Mortar, Concrete)
→ More **firmed joint** parts
→ **Stronger foundation**

Field condition

From field survey with 102 sampling (6 samples × 17 districts), 3 major structural problems could be found as follows.

76.5% of total samples had one or more problems of those.

Exposed iron bars	Main structure parts with inadequate dimension	Not compacted concrete
30.39% (31)	26.47% (27)	30.39% (31)



Source: Field survey

Issue - Technical difficulty



- **Assembling many iron bars** (Max 12) in small dimension
- **Bending or arranging iron bars** with bigger dimension
- **Concrete filling** in small dimension parts because of bigger dimension's iron bar

Source: Field interview with construction workers

Issues - Structural topic

Confined Masonry

A. "Flame first"	B. "Wall first"
① Concrete structure ② Brick wall	① Brick wall ② Concrete structure


A. Flame first

Partly brick wall first and concrete structure next.
But this require **complicated form work**.

● **Merits:**
-**Easy to secure** appropriate **dimension of structure members**

● **Demerits:**
-**Less confined effects**,
-**Needs many form panels**,
-Complicated form work (need to cut panels → difficult to reuse)

B. Wall first

In Indonesia,
it's widely common to **sandwich** opening spaces of brick walls **with 2 form panels** (No spacer).

● **Merits:**
-**Higher confined effects**
-**Easy** form **work** and less form panels

● **Demerits:**
-Difficult to secure the adequate dimension of structure parts

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Issues in the field = { **Technical difficulties** + **Structural issues**

→ Both kinds of issues are related to **installment of material/structural parts** (Not material quality only).

In non-engineered site, **workers' skill levels vary** a lot.
→ Need to disseminate **workers-friendly construction methods** for higher quality control.

Way forward

Improvement through reconstruction work

HOUSE = { **Engineering Theory** (Appearance of structure parts (column, beam...)) ↗ + **Material** (Standardize of material) ↗ + **Construction workers' skill** (Improvement of const. Workers' skill & knowledge) →

- **Yogyakarta is a special case** – post-disaster area with reconstruction assistance for housing quality control.
- In **general case**, more **fundamental difficulties** will be found (No drawing, no financial assistance, no staff to check the quality).
- Need to develop **workers-friendly construction methods**.
- Consider the **balance** between **community's needs** (Originality) and **control convenience** (Prototype).