Solutions for the Province of Groningen

Seismic retrofit of historic Amsterdam School houses

P5 presentation Pasquale A. van Dijk
• Introduction

• Problem statement

• Boundary conditions

• Designs

• Conclusions
Introduction
Introduction
7.8 on the Richter scale
Introduction
3.6 on the Richter scale
### Introduction

<table>
<thead>
<tr>
<th>EMS-98 Intensity</th>
<th>Felt</th>
<th>Impact</th>
<th>Magnitude (Approximate Value)</th>
<th>Building Damage (Masonry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
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<tr>
<td>II-III</td>
<td>Weak</td>
<td>Felt indoors by a few people. People at rest feel a swaying or light trembling.</td>
<td>2</td>
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<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many people, outdoors by very few. A few people are awakened. Windows, doors and dishes rattle.</td>
<td>3</td>
<td></td>
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<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt indoors by most, outdoors by few. Many sleeping people wake up. A few are frightened. Buildings tremble throughout. Hanging objects swing considerably. Small objects are shifted. Doors and windows swing open or shut.</td>
<td>4</td>
<td><img src="https://via.placeholder.com/150" alt="House 4" /></td>
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<tr>
<td>VI</td>
<td>Strong</td>
<td>Many people are frightened and run outdoors. Some objects fall. Many houses suffer slight non-structural damage like hair-line cracks and falling of small pieces of plaster.</td>
<td>5</td>
<td><img src="https://via.placeholder.com/150" alt="House 5" /></td>
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<td>VII</td>
<td>Very strong</td>
<td>Most people are frightened and run outdoors. Furniture is shifted and objects fall from shelves in large numbers. Many well-built ordinary buildings suffer moderate damage; small cracks in walls, fall of plaster, parts of chimneys fall down; older buildings may show large cracks in walls and failure of in-fill walls.</td>
<td>6</td>
<td><img src="https://via.placeholder.com/150" alt="House 6" /></td>
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<td>VIII</td>
<td>Severe</td>
<td>Many people find it difficult to stand. Many houses have large cracks in walls. A few well built ordinary buildings show serious failure of walls, while weak older structures may collapse.</td>
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<td><img src="https://via.placeholder.com/150" alt="House 7" /></td>
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<td>Violent</td>
<td>General panic. Many weak constructions collapse. Even well built ordinary buildings show very heavy damage; serious failure of walls and partial structural failure.</td>
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<td>X+</td>
<td>Extreme</td>
<td>Most ordinary well built buildings collapse, even some with good earthquake resistant design are destroyed.</td>
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<td><img src="https://via.placeholder.com/150" alt="House 8" /></td>
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**Loppersum**

**Kathmandu**
Problem statement
35,000 - $100,000
Demolition?
Amsterdam School style buildings in the Province of Groningen
Reinforcement measures to protect the building against earthquakes, United States
Problem statement

Temporary reinforcement measure, centre of Loppersum
Boundary conditions
Level 1
Restraint of possible falling hazards
Broken chimney after an earthquake, United States
Boundary conditions
Lightweight chimney
Boundary conditions

Level 2
Tying of floors and walls
Boundary conditions

Pattress plate
Boundary conditions

Masonry wall
Boundary conditions

Masonry wall

Wooden floor

Wooden beam
Boundary conditions

Masonry wall
Steel profile
Wooden floor
Wooden beam
Level 3
Stiffening of flexible diaphragms
Boundary conditions

Stress, $\sigma$ vs. Strain, $\varepsilon$

- **Brittle**
- **Ductile**

Area under curve = absorbed energy

Stress-strain diagram
Boundary conditions

Distribution of forces stiff floor

Distribution of forces flexible floor
Boundary conditions

Wooden floor

Wooden beam
Boundary conditions

Safe

Aesthetically
Goal

Safe

Feasible

Aesthetically

Boundary conditions

Goal
Designs
Case study 1
Case study 2
Case study 3
Design 1
Designs
Design 2
Designs
Design 3
Before retrofit

After retrofit
Designs

63
Design 4
Design 5
Design 6
Designs
Design 7
Conclusions
Conclusions
Conclusions

Residents

Centrum Veilig Wonen

Engineers

NAM

Municipality

Cultural Heritage Agency

Architect!
Cultural Heritage Agency

Aesthetic boundary conditions

Conclusions
Conclusions
Conclusions
Ik heb schade. Wat moet ik doen? En wat doet Centrum Veilig Wonen?

1. Schademelding
   U meldt uw schade bij CVW. Wij maken een afspraak voor u met de schade-expert.

2. Schade-expertise
   De schade-expert onderzoekt uw schade en bespreekt deze met u.

3. Expertiserapport
   U ontvangt het expertiserapport met de bevindingen van de schade-expert.

4. Keuzeformulier
   Indien aardbevingsschade is vastgesteld, stuurt u het keuzeformulier ondertekend retour.

5. Schadeherstel
   CVW zorgt voor schadeherstel of uitbetaling.

Uw gehele schadeherstelproces wordt begeleid door een vaste contactpersoon van CVW.

Front page website CVW
Conclusions

Centrum Veilig Wonen is een zelfstandige organisatie met de NAM als opdrachtgever en die ook rapporteert aan het door de minister van Economische Zaken ingestelde toezichtsorgaan.

We hebben de afspraak gemaakt om in 2015 te komen tot bouwkundige versterking van 3000 woningen en andere panden. Een deel daarvan volgt direct uit de inspecties. Een ander deel

Het is gemakkelijk om met Centrum Veilig Wonen in contact te komen. Alle gebruikelijke kanalen zoals telefoon, e-mail en sociale media zijn daarvoor te gebruiken en natuurlijk kan wie dat wil ook ‘gewoon’ langs komen in ons pand in Appingedam. Het hart van onze organisatie wordt gevormd door het bewonerscontactcentrum. Bij het aannemen van schades
Architect!

Custom design

Conclusions