EARTHQUAKES AND THE BUILT ENVIRONMENT

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LIVING WITH EARTHQUAKES: TOWARDS A MODEL FOR AMANDOLA AND THE MARCHE REGION
Jesus College Cambridge 24th-25th October 2017
Ounce of prevention, pound of cure

http://www.cam.ac.uk/research/features/ounce-of-prevention-pound-of-cure/
BETTER INFORMATION MEANS BETTER IDEAS, MEANS BETTER PROTECTION.
CURBE

CURBE has three primary functions:

- Research
- Dissemination of research findings
- Teaching

CURBE focuses on turning ideas into practical projects while creating a skilled team of workers. Research interests of CURBE fall into these areas:

- Monitoring and observation of the built environment and its hazards
- Theory and analysis of risks
- Policy and application of risk mitigation strategies
CURBE PROJECTS

1. **DATA COLLECTION- EEFIT**

2. **ANALYSES AND USE OF DATA- USGS PAGER AND GEM**

3. **APPLICATION OF RESEARCH- URBAN AND RURAL HOUSING, TOWN PLANNING**
THE L’AQUILA, ITALY
A PRELIMINARY FIELD REPORT

THE SOUTH PACIFIC ISLANDS EARTHQUAKE AND TSUNAMI
OF 29TH SEPTEMBER 2009

A PRELIMINARY FIELD REPORT BY EEFT
Earthquake impact characteristics of the 2016 Kumamoto earthquake are similar to those of the 1994 Northridge earthquake in the US.

Goda & Tesfamariam (2016)
RECORDED GROUND MOTIONS

Mashiki (KMMH16)

- Spectral Acceleration (g)
- Period (seconds)

- NS
- EW
- Vertical
- Code Spectrum
DAMAGE DUE TO LARGE DRIFTS
PERFORMANCE OF NEW HOUSES
RECOVERY TWO YEARS AFTER THE 2011 TÔHOKU EARTHQUAKE AND TSUNAMI: A RETURN MISSION REPORT BY EEFIT

The 2016 Kumamoto Earthquakes: Cascading Geological Hazards and Compounding Risks

A sequence of two strike-slip earthquakes occurred on April 14 and 16, 2016 in the intraplate region of Kyushu Island, Japan, apart from subduction zones, and caused significant damage and disruption to the Kumamoto region. The analyses of regional seismic catalog and available strong motion recordings reveal striking characteristics of the events, such as migrating asperity, earthquake surface ruptures, and major fore-arc-mainshock earthquake sequences. To gain valuable lessons from the events, a UK Earthquake Engineering Field Investigation Team (EEFT) was dispatched to Kumamoto, and earthquake damage surveys were conducted to relate observed earthquake characteristics to building and infrastructure damage caused by the earthquakes. The lessons learnt from this reconnaissance mission have important implications on current seismic design practice regarding the required seismic resistance of structures under multiple shocks and the seismic design of infrastructure subject to large ground motion. The observations also highlight the consequences of cascading geological hazards on community resilience. To share the gathered damage data widely, geo-tagged photos are organized using Google Earth and the first file is made publicly available.

INTRODUCTION

A mid-sized intra-plate earthquake struck the Kumamoto region of Kyushu Island, Japan on April 14, 2016 (22:00 p.m., local time). The Japan Meteorological Agency (JMA) registered a magnitude of 6.3 (moment magnitude Mw 6.4). The fault rupture originated from the northern part of the Higo fault. This earthquake caused intense shaking in the northeastern part of Kumamoto Prefecture, and major earthquake damage was caused in Minamiaso town near the epicenter. Subsequently, on April 16, 2016 (00:54 a.m., local time), a large at 7.3 earthquake (Mw 7.3) occurred along the Hikosan fault (NE of the Higo fault). This earthquake caused significantly greater damage to wider areas near the fault (e.g., Minamiaso town, Takeno Village, and Yatsunao Village). The regional deformation...
<table>
<thead>
<tr>
<th>Earthquake</th>
<th>Fatalities</th>
<th>Lessons Learnt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kobe, Mw 6.9</td>
<td>5,502</td>
<td>Revised building code and Nationwide retrofit scheme of traditional timber residences.</td>
</tr>
<tr>
<td>Kocaeli, Mw 7.4</td>
<td>17,118</td>
<td>Building control called into question; new RC buildings performed worst than older traditional ones.</td>
</tr>
<tr>
<td>Chi Chi, Mw 7.6</td>
<td>2,492</td>
<td>Collapse of many public buildings which would have caused more fatalities of earthquake during work hours.</td>
</tr>
<tr>
<td>Bhuj, Mw 7.7</td>
<td>13,800</td>
<td>Site effects were significant on extremely weak masonry.</td>
</tr>
<tr>
<td>Bam, Mw 6.6</td>
<td>26,271</td>
<td>Extremely vulnerable dry mud brick buildings. 19% of Bam died.</td>
</tr>
<tr>
<td>Wenchuan, Mw 7.6</td>
<td>&gt;73,000</td>
<td>Bad sitting of towns and schools killed many.</td>
</tr>
<tr>
<td>Haiti, Mw 7.0</td>
<td>&gt;230,000</td>
<td>Extremely vulnerable sub standard buildings.</td>
</tr>
<tr>
<td>Christchurch, Mw 6.1</td>
<td>185</td>
<td>Collapses of two mid-rise RC buildings accounted for 70% of the deaths. People were killed on the streets by out-of-plane failure of masonry debris.</td>
</tr>
<tr>
<td>Great East Japan, Mw 9.0</td>
<td>&gt; 18,100</td>
<td>Deaths from earthquake was 125, tsunami heights were significantly above design allowances. Revisit nuclear facilities design.</td>
</tr>
<tr>
<td>Kumamoto, Japan Mw 7.3 (double shock)</td>
<td>69</td>
<td>Deformation demands in the near-fault region are significant. Buildings may need to be designed against the entire earthquake sequence.</td>
</tr>
<tr>
<td>Central Italy, Mw 6.2 (sequence)</td>
<td>299</td>
<td>Review of design and use of concrete ring beams as retrofitting measures.</td>
</tr>
</tbody>
</table>
Reducing Risks of Future Disasters
Priorities for Decision Makers
WORLD HOUSING ENCYCLOPAEDIA

Description
The World Housing Encyclopedia (WHE) Report Database contains 130 reports on housing construction types in 43 seismically active countries. Each housing report is a detailed description of a housing type in a particular country. The description is prepared from a number of standard closed-ended questions and some narrative that have been provided by report authors. Each report has five major categories including architectural and structural features; Building Materials and Construction Process; Socio-economic Issues; Past Performance In Earthquakes, Seismic Features and Vulnerability; and Retrofit. All of the housing reports in this database have been contributed by volunteers. If you are interested in writing a housing report please contact the WHE Editorial Board.

About
The World Housing Encyclopedia (WHE) is a collection of resources related to housing construction practices in the seismically active areas of the world. The mission is to share experiences with different...
SURVEY DATA CAN INFORM EARTHQUAKE LOSS ESTIMATION MODELS
GEM
GLOBAL EARTHQUAKE MODEL
working together to assess risk

- collaborative development of key components
- use > apply > discuss
- review > test > discuss
- share products / outcome with community
WHERE DOES ARCHITECTURE COME IN?
COMPETITIVE DESIGNS IN
LUDIAN, YUNNAN
小震不坏，中震可修，大震不倒
Placemaking

Fred Kent

Create places where people can walk.

Transportation:

What can you do here?

Hall of shame:

White stones

Black stones

Keep on

PARK

Organic natural process

Ten places

Ten things to do! (power of ten)

Beer garden

What do you want to do on the bridge?

Markets

How do we save a place?

You have to be a zealous nut!

Ice cream

Affection:

Infectious:

You take off your shoes!

When it wins an award you know something's wrong with it.

We have to turn everything upside down to turn it right side up.

Mode of transformation:

The uses people want

Climate Classroom

The street as public place

Fuss traffic

We call it multi-use

Public space in your community

Thinking small in a big way

Public spaces on the street

Boarding bench

Reduce autos

Protect legs

Protect legs

Create places where people can walk.

Intuitive intelligence

Community is the expert

Lighter, quicker, cheaper

People like to look at other people

Community engagement

Happiness

Earth Day 1970

Kissing!
CREDIT: ELEMENTAL, CHILE
ENCOURAGE UNUSUAL COMMUNICATION APPROACHES
THANK YOU

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