International Symposium on
“More resilient non-engineered houses for earthquake disaster reduction”

「途上国のノンエンジニアド住宅の地震被害軽減」に関する国際シンポジウム

資　料　集

2010 年 2 月 26 日（金）
場　所：政策研究大学院大学　想海楼ホール

主　催：独立行政法人建築研究所、政策研究大学院大学
後　援：国土交通省、内閣府（防災担当）、国連防災戦略、国連地域開発センター

1. Outline of the Symposium

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Background and Objectives

Like the earthquake in Haiti on 12 January 2010, many people have been killed by earthquakes repeatedly in developing countries. In most of deaths caused by earthquakes, people are killed by their own houses. Most of the world's population lives in vernacular houses that are built of adobe, brick, stone, and wood, and are non-engineered and thus vulnerable to earthquakes. Generally, the safety structure of these non-engineered buildings are not verified when they are designed. There are also quality problems in materials used for construction and workmanship. Although it is indispensable to improve the structural safety of these houses in order to reduce the earthquake disasters, the actual situation of these non-engineered constructed is not fully understood.

National Graduate Institute for Policy Studies (GRIPS) and Building Research Institute (BRI) jointly conducting a research on non-engineered buildings in developing countries, namely, Peru, Indonesia, India, Nepal, Pakistan, and Turkey in 2009-2010. GRIPS and BRI co-organized the International Symposium on "More resilient non-engineered houses for earthquake disaster reduction" to share the result of the surveys and various efforts for safer houses, and to discuss how we can improve the safety of the non-engineered buildings.

This Symposium was co-organized by Building Research Institute (BRI) and National Graduate Institute for Policy Studies (GRIPS), and supported by Ministry of Land, Infrastructure Transport and Tourism (MLIT), Cabinet Office (Disaster Reduction), Cabinet Office (Disaster Reduction), UN International Strategy for Disaster Reduction (UNISDR) and UN Centre for Regional Development (UNCRD).

Date.

February 26th 2010（Friday）9:30～17:00

Venue

Sokairo Hall, National Graduate Institute for Policy Studies (GRIPS)

Language

English and Japanese (simultaneous translation is available)

No. of Participants

Approximately 140

１．シンポジウム概要

背景と目的

2010年1月に発生したハイチ地震に見られるように、近年途上国で大地震によって多くの人命が繰り返し失われている。このような被害は主に、途上国に普遍にみられる、レンガ造やアドベ造のような在来工法によって建設された庶民住宅が大量に倒壊することに原因がある。これらの住宅は工学的に構造安全性が検証されておらず(ノンエンジニアド)、また材料や施工の品質にも問題が多い。地震被害を軽減するためには、このようなノンエンジニアド住宅の耐震性を向上させることが不可欠であるが、途上国におけるノンエンジニアド住宅の実態は、十分把握されていないのが現状である。

このため、建築研究所と政策研究大学院大学では、2009年度にインド、インドネシア、トルコ、ネパール、パキスタン、ペルーにおけるノンエンジニアド住宅の構造安全性や建築材料、施工の品質等について現地調査を行い、国や地域による違いを把握することを目的とした共同研究を実施している。本シンポジウムは、この研究の一環として、各国の現地調査の成果を発表するとともにと各国及びわが国のノンエンジニアド住宅の耐震性向上のための取り組みを紹介し、途上国における地震被害軽減のための今後の方策のあり方について議論することを目的としている。

「途上国のノンエンジニアド住宅の地震被害軽減に関する国際シンポジウム」は、独立行政法人建築研究所（BRI)と政策研究大学院大学（GRIPS)による共催であり、国土交通省（MLIT)、内閣府（防災担当)、国連防災戦略（UNISDR)、国連地域開発センター（UNCRD)の後援により実施された。

開催日

2010年2月26日（金）9:30～17:00

場　所

政策研究大学院大学　想海楼ホール

使用言語

英語および日本語（同時通訳使用）

参加者数

約140名

（Leaflet）

International Symposium on "More resilient non-engineered houses for earthquake disaster reduction"

Date: February 26th 2010（Friday）9:30～17:00
Venue: Sokairo Hall, National Graduate Institute for Policy Studies (GRIPS), Tokyo
Organized by: Building Research Institute (BRI) and National Graduate Institute for Policy Studies (GRIPS)
Supported by: Ministry of Land, Infrastructure Transport and Tourism (MLIT), Cabinet Office (Disaster Reduction), UN International Strategy for Disaster Reduction(UNISDR), UN Centre for Regional Development (UNCRD)

9:30－9:50　Opening:

Shuzo Murakami, Chief Executive, Building Research Institute (BRI)
Tatsuo Hatta, President, National Graduate Institute for Policy Studies (GRIPS)
Message of Margareta Wahlstrom, UN Secretary-General's Special Representative for Disaster Reduction
(by Yuki Matsuoka, Head, Hyogo Office, UN Secretariat of the International Strategy for Disaster Reduction (UNISDR))
Motoi Sasaki, Deputy Director-General, Housing Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
Shoichi Hasegawa, Deputy Director General for Disaster Management, Cabinet Office

9:50－10:30　Keynote Speech on "Earthquake Damage and Non-engineered Construction"

Yuji Ishiyama, Professor emeritus, Hokkaido University

< Break >

10:40－12:30　Session 1 "Vulnerability of non-engineered houses and efforts to make them safer"

"Outline of the joint research" Kenji Okazaki, Professor, National Graduate Institute for Policy Studies (GRIPS)
"Peru" Carlos Zavala, Director, Japan Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID)
"Indonesia" Dyah Kusumastuti, Associate Professor, Institute of technology Bandung (ITB)
"India" Nitin Verma, Senior Programme Officer, SEEDS
"Nepal" Hima Gurubacharya (Shrestha), Senior Structural Engineer, National Society for Earthquake Technology (NSET)
“Pakistan" Najib Ahmad, Project Manager, Preston University
“Turkey" Alper Ilki, Associate Professor, Vice Head of Department of Civil Engineering, Istanbul Technical University

12:30－13:30　Lunch

13:30－15:40　Session 2　"Japanese efforts for safer non-engineered houses"

Special report "Damages of Haiti Earthquake Disaster"
Hidetomi Oi, Adviser, Global Environment Department, Japan International Cooperation Agency (JICA)
"Summary of International joint research project on comprehensive strategies for earthquake disaster mitigation"
Tatsuo Narafu, Information Center for Building Administration (ICBA)
"Seismic Performance of Masonry Buildings and Evaluation Methods"
Shunsuke Sugano, Professor emeritus, Hiroshima University
"Lessons from assistance for reconstruction in Indonesia"
Kozo Nagami, Information Policy Department, Japan International Cooperation Agency (JICA)
"Japan's ODA Project in Peru, Dissemination of Seismic Adobe House"
Akihiko Tasaka, Ex-First Secretary of Embassy of Japan in Peru
"Community based disaster management and assistance for retrofitting"
Shoichi Ando, United Nations Centre for Regional Development (UNCRD)
"Earthquake Risk Reduction and Recovery Preparedness in South Asia"
Atsushi Koresawa, Asian Disaster Reduction Center (ADRC)

< Break >

15:50－17:00　Panel "How to promote safety improvement of non-engineered houses in developing countries"

Chair: Taiki Saito, Chief Researcher, BRI
Panelists: Carlos Zavala, Dyah Kusumastuti, Alper Ilki, Najib Ahmad and Hiroshi Fukuyama (Chief Researcher, BRI)

17:15-　Reception

（リーフレット）

「途上国のノンエンジニアド住宅の地震被害軽減」に関する国際シンポジウム

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後　援：国土交通省、内閣府（防災担当）、国連防災戦略、国連地域開発センター

9:30－9:50　開会挨拶

建築研究所 理事長 村上周三
政策研究大学院大学 学長 八田達夫
国連・防災担当特別代表　マルガレータ・ワルストロム
（メッセージ代読　国連国際防災戦略事務局 兵庫事務所代表 松岡由季）
国交省大臣官房審議官（住宅局担当）　佐々木基
内閣府大臣官房審議官（防災担当）　長谷川彰一

9:50－10:30　基調講演「地震被害とノンエンジニアド建築」

北海道大学名誉教授　石山祐二

＜ 休憩　＞

10:40－12:30　第１分科会「途上国のノンエンジニアド住宅の脆弱性及び耐震性向上のための努力」

「共同研究の概要」 政策研究大学院大学 教授 岡崎健二
「ペルーからの報告」　ペルー日本地震防災センター 所長　カルロス・サバラ
「インドネシアからの報告」　バンドン工科大学　准教授 ダイア・クスマステュティ
「インドからの報告」　シーズ　シニアプログラムオフィサー ニティン・ヴァルマ
「ネパールからの報告」ネパール地震工学協会（NSET） 構造専門家　ヒマ・グルバチャリャ（シュレスタ）
「パキスタンからの報告」　プレストン大学 プロジェクトマネジャー ナジブ・アーメド
「トルコからの報告」イスタンブール工科大学 土木工学科副長 准教授 アルパー・イルキ

12:30－13:30　昼休み

13:30－15:40　第２分科会「途上国のノンエンジニアド住宅の耐震性向上のための我が国の取り組み」

特別報告「ハイチ地震の被害について」 国際協力機構 地球環境部 アドバイザー　大井英臣
「総合的な地震被害軽減方策についての国際共同研究の概要」建築行政情報センター建築行政研究所研究部長楢府龍雄
「組積造建築の耐震性能と評価法」 広島大学 名誉教授 菅野俊介
「インドネシア災害復興支援の教訓」 国際協力機構　情報政策部 永見光三
「ペルーにおける日本の ODA プロジェクト～アドベ耐震住宅の普及～」 前・在ペルー大使館書記官 田阪昭彦
「コミュニティ防災と建築耐震化の支援」 国連地域開発センター 防災計画兵庫事務所長 安藤尚一
「南アジアにおける地震防災対策の推進」 アジア防災センター所長 是澤優

＜ 休憩　＞

15:50－17:00　パネルディスカッション「ノンエンジニアド住宅の耐震性向上をいかに進めるか」

議長：建築研究所 国際地震工学センター 上席研究員 斉藤大樹
パネリスト：カルロス・サバラ（ペルー）、ダイア・クスマステュティ（インドネシア）
アルパー・イルキ（トルコ）、ナジブ・アーメド（パキスタン）、福山洋（建築研究所 上席研究員）

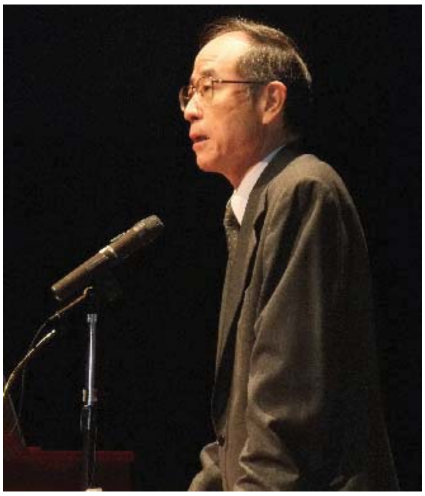
17:15－　　懇親会

BRI 独立行政法人 建築研究所　　GRIPS 政策研究大学院大学

2. Opening

2. Opening（開会挨拶）

建築研究所　村上理事長 挨拶



皆様おはようございます。御紹介いただきました建築研究所理事長の中村です。主催団体のひとつとして、一言ご挨拶を申し上げます。

本日は朝早くから「途上国のノンエンジニアド住宅の地震被害軽減に関する国際シンポジウム」にご参加いただきまして大変ありがとうございました。今回のハイチを始めとして、大地震が起きますと、発展途上国で大変多くのかたが亡くなられます。その多くが住宅の倒壊によるものです。発展途上国の耐震性を考えて設計されていない住宅をノンエンジニアド住宅と呼んでいます。充分に工学的に適用されていないという意味です。今後、地震災害による人災、災害において人命を救うために、世界的にノンエンジニアド住宅の改善が大変大きな課題です。

このノンエンジニアド住宅に関しては、工学的な研究開発がだいぶ不足しております。耐震化工法に関しても充分な成果は得られていません。それぞれの国の技術レベルの違いにより、先進技術が仮にあったとしても、それを実際、ご自身の国の住宅に適用するような技術基盤がないのです。人々が先進技術を使うだけの制度基盤、社会基盤も必要なのです。ノンエンジニアド住宅の普及のためには、職人あるいは技術者の人材育成、教育啓発も含めた取り組みが大切だということです。

こういった観点から建築研究所では過去 50 年、発展途上国の人たちを対象として国際的な地震工学研修を続けております。すでに 100 か国から 1400 人を超えるかたが研修を修了し、最近では GRIPS と連携して修士号を取得できる枠組みを作っております。卒業生の方々が各国に帰られて、要職につかれ、それぞれの国の耐震政策に大変大きな寄与をされています。

今回のシンポジウムはそういう方々とも協力して、地震のたびに大変大きな災害の起きるノンエンジニアド住宅のさらなる改善を図ろうという趣旨の国際会議です。今日はペルー、インドネシア、インド、ネパール、パキスタン、トルコなど、多くの研究者の方々にご参加していただいております。また講演後には、その研究者の皆さんとノンエンジニアド住宅の耐震性能をいかに進めるかというテーマでパネルディスカッションを行う予定でございます。会場の皆様からの活発なご発言を期待しております。

今回のシンポジウムが今後起きるかもしれない大きな地震に備えて一刻も早くノンエンジニアド住宅の耐震性能の改善に繋がることを期待して、ご挨拶にかえさせていただきたいと思います。どうもありがとうございました。

政策研究大学院大学　八田学長　挨拶

本日は皆様お忙しいところお越しいただきましてありがとうございました。

村上先生のお話にありましたように、今年1月のハイチ地震で 20 万人の尊い命が失われました。地震そのものは避けられないわけですが、専門家の指摘によれば、一番大きな原因は建物が地震に対する対策がたてられていない建物であったということ。そのことによって、あれだけの大きな被害が出たということのようです。ということは被害の多くは人災であったと言えるのであろうと思います。

しかし、ハイチだけではなく、この 21 世紀になってから各地で毎年のように数万人規模の被害の出る地震が起きています。インド、イラン、インドネシア、パキスタン、中国、ミャンマーというように続々と起きています。そういった地域の住居がノンエンジニアド住宅、例えばレンガ、木造、石造などの、近代工法とは別の伝統的な工法で建てられている建物であり、充分な耐震構造、工学的な措置が講じられていないというわけですから、これは何とかしなければならない。しかしながら伝統的な建物に対する耐震化をどうしたらいいかという研究は必ずしも進んでいないのです。政策的にも、それに対する対応が十分でないということです。

建築研究所と GRIPS は共同研究をやっております。本年度はペルー、インドネシア、ネパール、インド、パキスタン、トルコ、エジプトの７カ国とともに、在来工法の建築現場に実際に出向き、調査し、設計や建て方、資材がどのように行われているか、建築労働者がどのように働いているのかを調査して、耐震化の観点から安全性向上のためにどういうことができるかということを調査しています。

今朝の発表では、各国の調査結果と、各国でノンエンジニアド工法に対して、どのような安全性向上の措置が取られているかを発表いただくことになります。シンポジウムでは今後、耐震性向上のためにどういうことが考えられるのかを皆様に議論していただきます。さらに、ハイチからお帰りになったばかりの JICA の大井様よりハイチの状況についてお話いただきます。

大地震があった後で、また元と同じ建物を建てたら無意味なわけです。地震を機会に耐震性の向上した建物を造れるということが必要だろうと思います。今回のシンンポジウムが、多くの途上国での建物の耐震性向上のために役に立ち、さらにハイチの地震からの回復にも工学的に役立つことに繋がることを祈念いたしまして、私のご挨拶とさせていただきます。どうもありがとうございました。

Message of Ms. Margareta Wahlström,
UN Secretary General's Special Representative for Disaster Risk Reduction
To be delivered on her behalf by Ms. Yuki Matsuoka, Head of the UNISDR Hyogo Office

Dear Participants,

I am pleased to share with you the message of Ms. Margareta Wahlström, UN Secretary General's Special Representative for Disaster Risk Reduction to the participants of the International Symposium on "More Resilient non-engineered houses for earthquake disaster reduction", organized by the National Graduate Institute for Policy Studies and the Building Research Institute, in collaboration with several partner organizations.

As all of you know, 5 years ago in Kobe, at the UN World Conference on Disaster Reduction, 168 Governments adopted the Hyogo Framework for Action to build resilience of nations and communities to disasters by 2015, underlining thus the urgent need to shift efforts from only preparing for disaster response to focusing on reducing risk and vulnerability, and spelling out the specific responsibilities of Governments, international and regional organizations on how to do so. For the last five years, significant progress has been achieved as recognized at the second session of the Global Platform for Disaster Risk Reduction held in June 2009 and reported in the Global Assessment Report on Disaster Risk Reduction issued in 2009, particularly in terms of life-saving measures such as improved disaster preparedness and response, but much more needed to be done.

Governments, international and regional organizations, NGOs, and other partners have been more united in the belief that greater urgency is required to address the factors that are driving the increase in disaster risk, such as rural poverty and vulnerability, unplanned and poorly managed urban growth, and decline of ecosystems. Urgent action is necessary not only to reduce disaster risk, but also to maintain momentum in Millennium Development Goal achievement, including poverty reduction, adaptation to climate change and better health outcomes.

Ladies and gentlemen, it has now been more than a month since the catastrophic earthquake struck Haiti, leaving much of the Capital city Port-au-Prince and surroundings totally devastated. The entire international community, including the UN is doing their utmost to assist the Haitian Government and the millions of people who have been affected by the tragedy, and is helping to push forward the relief and recovery process. The United Nations International Strategy for Disaster Reduction (UNISDR) will pursue the work with President Clinton, the UN Special Envoy for Haiti, to make the country more resilient to future disasters.

The principal causes of destruction and death in Haiti were construction on unstable land and collapsing buildings. The problems with building construction were not just a lack of seismic building standards but the inadequate standards of construction to resist the risks that are common in Haiti such as hurricanes, floods and mudslides. Haiti's burden is heavy, but there is also a new opportunity today to engage with the international community that is genuinely supportive, to plan a determined reconstruction effort that will ensure its long-term safety and stability. Hopefully, no new hospital, school or public structure will be built without integrating disaster risk reduction principles into its design and construction.

The initiative of organizing today's international symposium entitled "More resilient nonengineered houses for earthquake disaster reduction" is very timely in this context. People from developing countries sometimes mention that they cannot use nor develop highly advanced technology to make buildings more resilient such as in countries like Japan. However, there is a lot of expertise that can be shared with these countries and be of concrete use to build more resilient buildings and housing. In this context, this symposium can certainly make an important contribution to international efforts to understand non-engineered construction and improve the structural safety of houses, buildings, and so forth.

Ladies and gentlemen, as we begin the second decade of a new century, more than half of the world's population lives in cities and urban centers. Urban settlements are the lifelines of today's society. They serve as nations' economic engines, centers of technology and innovation and function as living examples of our cultural heritage. But the consequences of their success are inherent in the important roles they play in society. Cities also can become generators of new risks evidenced by poverty, social inequality and environmental degradation. This makes many urban citizens more vulnerable to suffer losses if a natural hazard strikes.

The United Nations International Strategy for Disaster Reduction is working with its partners to raise awareness and commitment for sustainable development practices as a means to reduce disaster risk and to increase the wellbeing and safety of citizens- to invest today for a better tomorrow. Building on previous years' campaigns focusing on education and school, and also hospital safety, UNISDR partners are launching a new campaign in 2010 – *Making Cities Resilient* – to enhance awareness about the benefits of focusing on sustainable urbanization to reduce disaster risks. The Campaign will seek to engage and convince city leaders and local governments to be committed to a checklist of *Ten Essentials for Making Cities Resilient* and to work on these together with local actors, grass-root networks and national authorities.

The UNISDR secretariat looks forward to having your active engagement in the *Making Cities Resilient* Campaign, and working closely with all of you in promoting disaster risk reduction, towards a safer world. I am also looking very much forward to hearing more about the research conducted in major disaster-affected countries, and the recommendations drawn from this research, as well as learning from your discussions on how to improve the safety of non-engineered buildings.

Thank you very much and I wish you all a very successful Symposium.

Margareta Wahlström
Special Representative of the UN Secretary-General
for Disaster Risk Reduction
by Yuki Matsuoka
Head, Hyogo Office, UN Secretariat of the International Strategy for Disaster Reduction (UNISDR))

ISDR
United Nations
International Strategy for Disaster Reduction

国交省　佐々木大臣官房審議官　挨拶

皆様、おはようございます。政策研究大学院大学と独立行政法人建築研究所の共催で行われますこの催しにお集まりになられた皆様に、国土交通省を代表いたしまして、そして後援する立場として、心より歓迎を申し上げます。

本年 1 月に発生しましたハイチにおける大地震において、20 万とも、30 万ともいわれる方々が亡くなったという話を聞いております。我が国においても 1995 年に阪神淡路大震災、その後、新潟での中越地震もありました。我が国をはじめ、地震の多発地帯に住む者にとりましては、地震被害による被害を少なくしていくことが極めて重要な課題となっております。特に近年、途上国で大地震によって多くのかたがたの人命が失われているわけですが、このような被害につきましては途上国に多く見られる、技術者が関わらずに造られたノンエンジニアド住宅が大量に倒壊するということによって、非常に大きな被害が生じているという実態があります。途上国における地震被害の軽減のためには、ノンエンジニアド住宅の耐震性を向上するという取り組みを進めていくことが何よりも重要であると考えております。

建築研究所と政策研究大学院大学においては、ノン・エンジニアドな構造に焦点を当てた住宅の安全性に関する研究プロジェクトを各国の現地調査も含めて進めており、ノン・エンジニアド住宅の実態については、国や地域によって異なるため、学問的にも政策的にも取り組みが遅れており、その意味で建築研究所と政策研究大学院大学が実施している本研究プロジェクトは、まことに時宜にかなった貴重なことだと考えています。

今回のシンポジウムにおきましては、この共同研究の一環として各国のノン・エンジニアド住宅の実態と耐震性向上のための取組を紹介し、途上国における地震被害軽減のための今後の方策のあり方について議論がなされるとお伺いしております。

このように世界各国における取り組みを学びあい、分かち合うことで、私たちがリスクを低減させていく取り組みを広めることができると信じております。そうした視点から私どもは今回のシンポジウムの議論に非常に期待をしているところです。ご参会の皆様方が、ここで学ばれたことを是非世界の地震の防災に役立てていただければと思います。また、ここでの交流がそれぞれの出身国においても広く共有されることを期待しております。わたしども国土交通省はこうした取り組みを今後とも強く支援していきたいと考えております。

最後に、本日のシンポジウムが実り多きものになりますこと、またこのシンポジウム開催における関係者の皆様のご労苦に深く敬を表しまして、私の挨拶にさせていただきます。

内閣府　長谷川大臣官房審議官　挨拶

皆様、おはようございます。ただ今ご紹介あずかりました内閣府防災担当審議官の長谷川です。

本日は独立行政法人建築研究所並びに政策研究大学院大学の共催でこのシンポジウムが開催され皆様方にお集まりいただきました。盛大に開催されますことをお喜び申し上げます。

海外からお越しの方もおられるので、私がここに呼ばれました所以をお話しします。日本では防災対策に各省庁で取り組んでおります。例えば、国土交通省では河川整備、堤防整備など各種防災対策に取り組んでいます。その中で住宅局では耐震化基準づくり、耐震化建物の増加に取り組んでいる。わたくしども内閣府では、各省庁の取り組みを全体として取りまとめて、国全体の防災対策を進めていく立場で仕事を進めています。

昨日来、ハイチの話題がでていますが、海外で起こる災害に関する協力についても、わたくしどもの方で積極的に取り組ませていただいております。後ほど、お話があると思いますが、ＪＩＣＡの方々が現地調査に向かわれた調査結果報告なども拝見させていただいております。海外における地震についての備えがなされていない実態についてはわたくしどもも大変憂いております。

わたくしどもも、国際防災協力に様々取り組んでおりますが、例えば、地震による被害の軽減に積極的に取り組むために 20 年度、21 年度では 2 箇年に亘り、外務省主催の防災災害無償支援の資金協力事業で、国連開発計画を通じて南アジア地域における地震防災対策計画の取り組みを進めています。

こういった中では、ノンエンジニアド建築物にも焦点を当てて、わが国の知見を生かしてお役に立つべく、神戸のアジア防災センターの専門家などを派遣しているところです。昨年の 10 月に神戸で日中韓の防災担当大臣級会合があり。３国で耐震化への取り組みを進めようと合意し推進をしています。

ハイチについても、今後わが国として貢献をしたいと考えているが、わが国が持つ知見、耐震化への技術、基準についても大きく期待されている。そういった意味でも努力を続けてまいりたいと思っております。

このようなコンテクストのなかで、本日のシンポジウムが開催されますことを、誠に喜ばしい事と考えております。皆様方のご議論を通じて、実り多いモノが得られ、それが世界の防災対策に役立って行く事をご祈念致しますとともに、本日主催されました建築研究所、政策研究大学院大学の益々のご発展をご祈念申し上げましてご挨拶とさせて頂きます。ありがとうございました。

3. Keynote Speech

3. Keynote Speech “Earthquake Damage and Non-Engineered Construction “
Yuji Ishiyama Professor Emeritus, Hokkaido University NewsT Research Lab.

International Symposium on
“More resilient non-engineered houses
for earthquake disaster reduction”

Earthquake Damage and Non-Engineered Construction

Yuji Ishiyama
Professor Emeritus, Hokkaido University
NewsT Research Lab.

Typical Earthquake Damage to Engineered Construction

- Earthquake Damage
- Behavior of Buildings during Earthquakes and Earthquake Forces

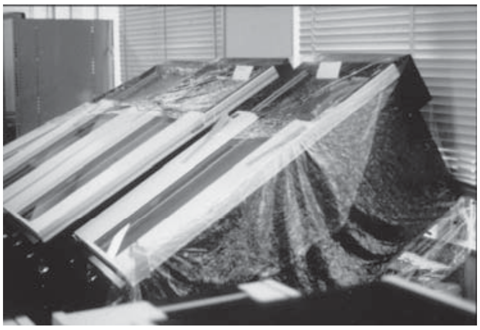
(1978 Miyagi-ken-oki Earthquake)

Since the shear force becomes max. at 1^{st} story, damage to 1^{st} story is common.

(1978 Miyagi-ken-oki Earthquake)

Damage to 1^{st} story (soft and weak first story)
1995 Hyogo-ken-nanbu (Kobe) Earthquake

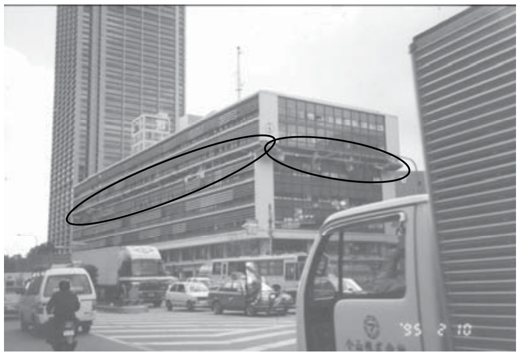
Damage to 1^{st} story (soft and weak first story)
(1995 Kobe Earthquake)



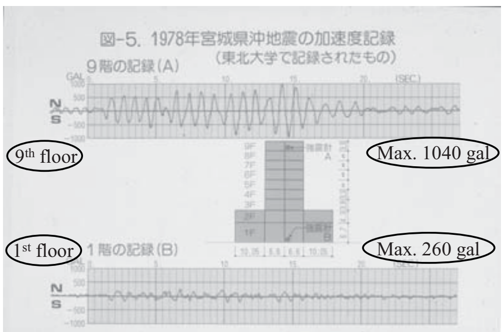
Overturning of Computers
(1978 Miyagi-ken-oki Earthquake)

Uppermost small parts suffer from severe damage
(1989 Loma Prieta, California Earthquake)

Unusual mid-story collapse
1995 Hyogo-ken-nanbu (Kobe) Earthquake

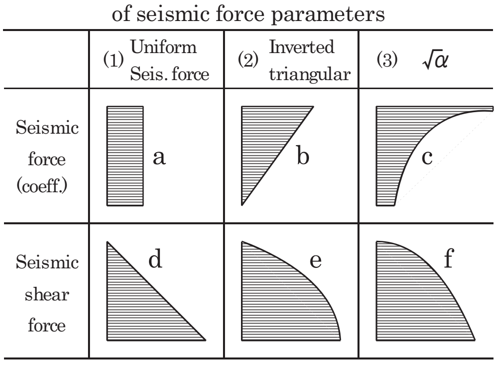


(1995 Kobe Earthquake)



Acceleration time histories of 9th floor & 1st floor
(1978 Miyagi-ken-oki Earthquake)

Three typical distributions
of seismic force parameters



(1978 Miyagi-ken-oki Earthquake)

Damage to non-structural elements
(1978 Miyagi-ken-oki Earthquake)

(1978 Miyagi-ken-oki Earthquake)

Overturning of furniture
(1978 Miyagi-ken-oki Earthquake)

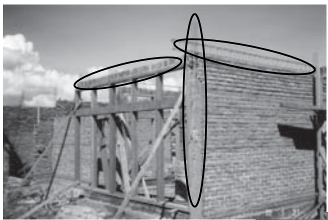
Damage caused by soil failure
(1993 Kushiro-oki Earthquake)

Damage caused by soil failure
(1974 Izo-oshima-kinnkai Earthquake)

Non-Engineered Construction and its Earthquake Damage

- Non-engineered buildings are spontaneously and informally constructed in the traditional manner without intervention by qualified architects and engineers in their design.
- Non-engineered construction is most common construction technique in the world and also most vulnerable against earthquakes.

Un-reinforced brick masonry with no columns and beams (Java, Indonesia)



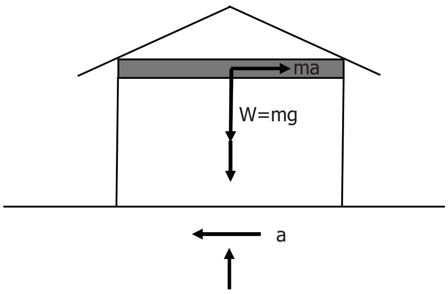
Un-reinforced brick wall farmed with RC columns and beams (Confined masonry)

Wood frame for door sash can support brick wall.

Wooden houses have better performance against EQ's.

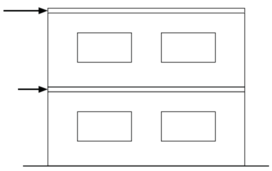
Roof sheathing board is not used.

Seismic force is the inertia force.

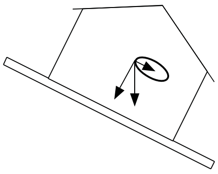


Damage to brick masonry, most of them have no reinforcement.

2006 Central Java, Indonesia EQ



Hydraulic jacks where there are floor diaphragms



Lateral component of gravity forces acts as EQ forces

Hydraulic jacks applying lateral forces (Peru)

Tilting table (Indonesia)

Structural test (Lima, Peru)

Reinforced concrete frame with un-reinforced brick infill walls

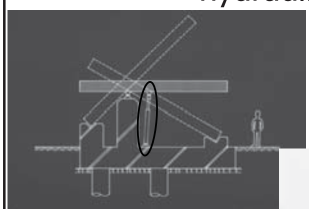
Unreinforced masonry infill walls are used in many countries.

Brick infill wall in Egypt

Low-rise building with RC frame with un-reinforced brick infill walls (Confined masonry) (Lima, Peru)

High rise buildings with un-reinforced brick infill walls (Lima, Peru)

Tilting Table with a long stroke hydraulic jack

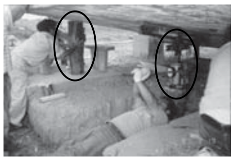


Hydraulic jack is not very expensive.

Research Center for Human Settlement (RCHS, Indonesia)

Tilting table moved to a new laboratory

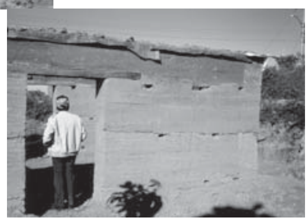
Tilting Table in Cuzco, Peru



Damage to Adobe (sundried mud block) construction (1996 Nazca, Peru EQ)

Damage to Adobe (2001 Atico, Peru EQ)

Damage to Tapial construction (1990 Peru EQ)



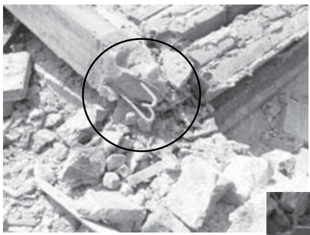
Tapial is cast-in-place mud construction (1990 Peru EQ)

Damage to Japanese traditional wooden houses (1995 Kobe EQ)

Narrow boards nailed to frame cannot resist lateral forces (1995 Kobe EQ)

Braces are effective to resist lateral forces (1995 Kobe EQ)

Connections of braces and frames should be sound (1995 Kobe EQ)



Connections of RC members are also important

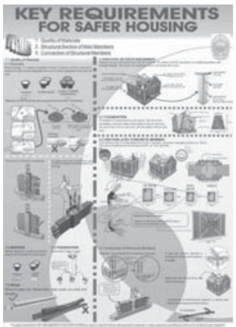
Re-bars of columns should be anchored to foundation (2006 Central Java, Indonesia EQ)

Haiti Earthquake

- Widespread damage: lack of attention and construction to the possibility of earthquakes
- The earthquake did not produce sufficient to severely damage well-engineered structures.
- Many bearing-wall structures survive the earthquake, even though they are unlikely to have ductile details.

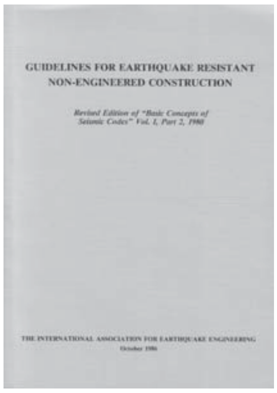
USGS/EERI Advance Reconnaissance Team Report, Feb 18, 2010

Key Requirements



- Quality of materials
- Structural members
- Connection of structural members

(After 2006 Central Java, Indonesia EQ)



GUIDELINES FOR EARTHQUAKE RESISTANT NON-ENGINEERED CONSTRUCTION

Revised Edition of "Basic Concepts of Seismic Codes" Vol. 1, Part 2, 1980

THE INTERNATIONAL ASSOCIATION FOR EARTHQUAKE ENGINEERING
October 1986

Guidelines for Earthquake Resistant Non-Engineered Construction

Revised Edition (1986)

International Association for Earthquake Engineering

(IAEE)

Anand S. Arya (India)
Teddy Boen (Indonesia)
Yuji Ishiyama (Japan)
A. I. Martemianov (USSR)
Roberto Meli (Mexico)
Charles Scawthorn (USA)
Vargas Julio N. (Peru)
Ye Xaoxian (China)

Easy to understand with many illustrations

Applicable at construction site

Down Load
http://www.nicee.org/IAEE_English.php

If you have interest, please contact

Anand S. Arya : anandsarya@gmail.com
Teddy Boen : tedboen@cbn.net.id
Yuji Ishiyama : to-yuji@nifty.com

Thank you
for your attention

4. Session 1

“Vulnerability of non-engineered houses and efforts to make them safer”

4.1 Outline of the joint research
Presented by Kenji Okazaki, Professor, National Graduate Institute for Policy Studies (GRIPS)
政策研究大学院大学 教授 岡崎健二

International Symposium on "More Resilient Non-engineered Houses for Earthquake Disaster Reduction"
26 February 2010, GRIPS, Tokyo

SESSION 1: "VULNERABILITY OF NON-ENGINEERED HOUSES AND EFFORTS TO MAKE THEM SAFER"

Session 1:
"Vulnerability of non-engineered houses and efforts to make them safer"

- Objectives of the session
  To share some findings from the joint survey on "non-engineered houses in developing countries" and share the efforts and activities to make them safer.
- Presentations
  - Peru: Japan-Peru Center for Earthquake Engineering and Disaster Mitigation （CISMID）
  - Indonesia: Center for Disaster Mitigation, Institute of Technology Bandung (ITB)
  - India: SEEDS
  - Nepal: NSET-Nepal
  - Pakistan: Preston University
  - Turkey: Istanbul Technical University (ITU)

A Study on Non-engineered Construction

- Objective of the study
  To collect basic data on non-engineered houses in developing countries to better understand their actual conditions and practices.
- Method of the Study
  The study is Jointly conducted 2009-2010 by Building Research Institute (BRI) and National Graduate Institute for Policy Studies (GRIPS) together with the partner institutions in Peru, Indonesia, Nepal, Pakistan, India, Turkey, and Egypt.
- Data collection
  The partner institution conducted a field survey to 5 construction sites or more to collect necessary data, following the same data sheet.

Data to be collected

- General
  - Most common building types and their brief description
  - Technical requirements for the brick masonry construction
- Field Survey at 5 construction sites
  - Location, construction cost, soil type, building function, size and area, foundation type, masonry type, plan and elevation, etc.
  - Wall: material, thickness, height to thickness ratio, opening ratio
  - Beams and columns: material, yield strength, steel bars and stirrup
  - Roof structure and connection of structural elements
  - Non-structural elements: Roofing material, floor material
  - Masonry: brick/stone, grout mortar, plaster
  - Concrete: compression strength, aggregates, composition, water/cement ratio
  - Steel: strength and durability
  - Contractor: number of workers, skill, education

4.2 Report from Peru
Presented by Carlos Zavala, Director, Japan Peru Center for Earthquake Engineering and Disaster Mitigation (CISMID) / ペルー日本地震防災センター 所長　カルロス・サバラ

Vulnerability of Non-engineered Buildings And Efforts To Make Them Safer

Dr. Carlos Zavala
Msc. Lourdes Cárdenas
Msc. Jenny Taira
Eng. Francisco Ríos

February 2010

Japan-Peru Center for Earthquake Engineering Research and Disaster Mitigation-CISMID
National University of Engineering

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Housing build without standards and quality control

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Building that try to imitate conventional structural system without engineer assistance

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Building that try to imitate conventional structural system without engineer assistance

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Building without elements of reinforce

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Housing build without previous studies of soil, materials, disasters hazards

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010
C. Zavala
CISMID-FIC-UNI

What is a non engineered building?

- Housing build by their or owner or an empirical technician.

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010

C. Zavala
CISMID-FIC-UNI

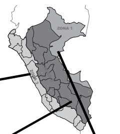
Factors that contribute with vulnerability

- Soil conditions
- Topography
- Morphology of roof systems
- Non reinforce elements
- Seismic Zone
- Type of housing

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010

C. Zavala
CISMID-FIC-UNI

Zone and type of Housing



Zone 3- Coastal city (Lima)

Zone 2 - Highland city (Cuzco)

Zone-1 Jungle city (Lamas)

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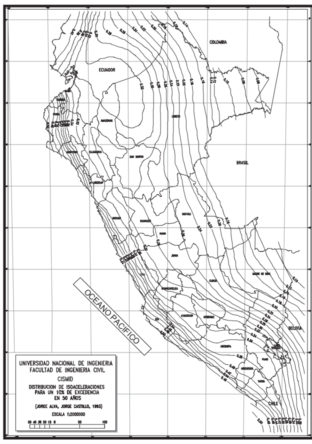

DISTRIBUTION OF ISOACELERATION FOR 10% EXCEDENCY IN 50 YEARS

(Alva y Castillo, 1993)

C. Zavala
CISMID-FIC-UNI

Coastal City Lima

- Capital city of the country
- Location: Western coast over the Pacific Ocean
- Population: 8'219,000 Inhab.
- Size: 2,800 sq meter.
- Growth rate in last five years: 1.5%
- Average income: US$ 500.00
- Common types of buildings: Confined masonry, unconfined masonry walls buildings, concrete resistant frames.

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010

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CISMID-FIC-UNI

Lima Microzonification and Soil types

ZONAS	TIPO DE SUELO	SIMBOLO
ZONA I	S1	
ZONA II	S2	
ZONA III	S3	
ZONA IV	S4	
ZONA V	Rellenos de desmonte basura ubicados	

Source: CISMID-UNI APESEG Project

Symposium on Non-engineered Houses
GRIPS – Tokyo 26th 2010

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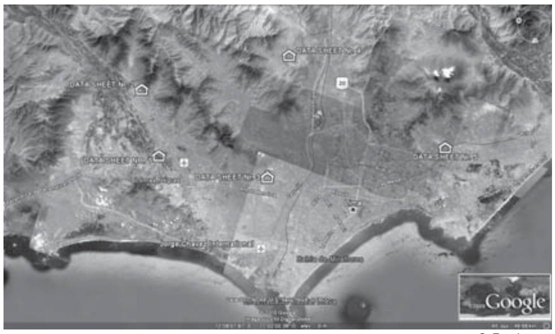
CISMID-FIC-UNI

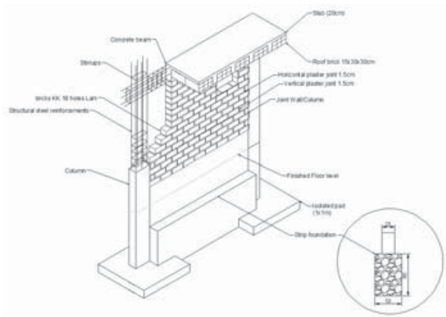
Expected Intensities in Lima

Source: IGP

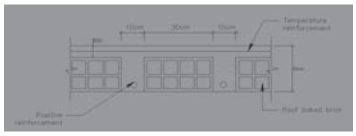
Surveyed locations



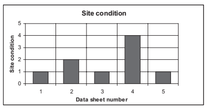
Basic scheme of Masonry Construction in Lima

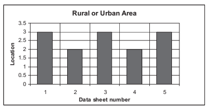


Typical Roof System



Statistical results from survey Site condition and location

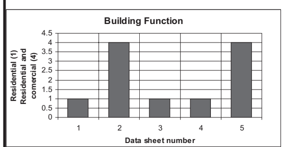


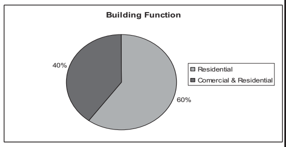


(1) Flat gentle slope
(2) On step slope
(3) Under slope

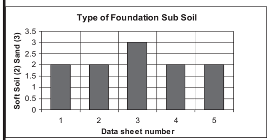
(2) Semi Urban
(4) Urban

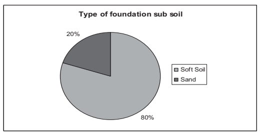
Statistical results from survey building function

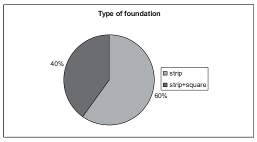




Statistical results from survey
Type of foundation and soil

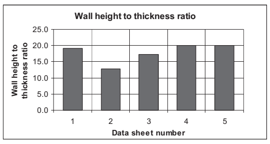




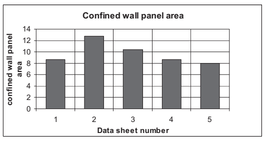


(2) Stripe
(4) Stripe and square

Statistical results from survey
Wall Information parameters

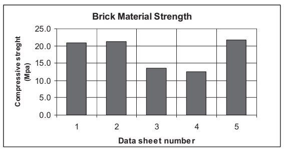


Height / thickness ratio
Average 17.9

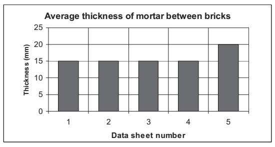


Confined panel
Average

Statistical results from survey
Wall Information parameters

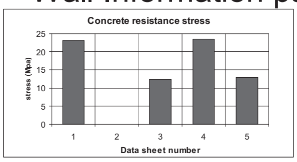


Brick Material strength
Average 17.9 MPa

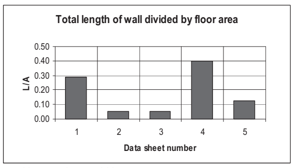


Average thickness mortar
16 mm.

Statistical results from survey
Wall Information parameters



Concrete strength
Average 14.4 MPa

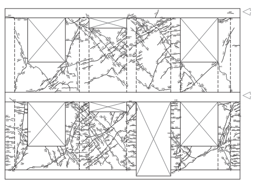


L/A= Length/ Area

Efforts to improve Non engineered housing

2001-2003
Construction Technology Development and Promotion Program by MLIT, IDI, JAPAN in cooperation with CISMID

Final state of house



Drift
1/65

Use of wire mesh for reinforce masonry walls

- Wire mesh
- Nails and wire
- Epoxy
- Mortar
- Tools

Procedure for reinforce masonry walls

- Put out the plaster
- Reduce the wall thickness

Procedure for reinforce masonry walls

- Fix the wire mesh (4”x4” with 4 mm.) with nails on both directions each 50 cm. and use the cracks for fix the wire.

Procedure for reinforce masonry walls

- Put mortar of cement sand ratio 1:4

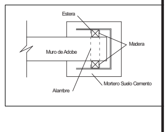
- Final plaster

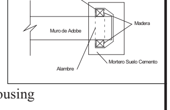
Efforts to improve Non engineered housing

2004-2006
Dissemination of Seismic Adobe Houses by JICA, in cooperation with SENCICO (National Services of Training for the Construction Industry) and CIDAP, Peruvian NGO.

Model house in Cañete, no damage in 2007 Pisco earthquake

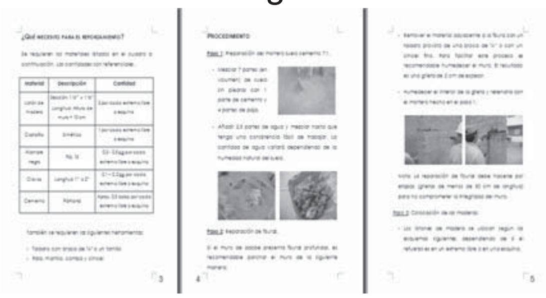
Efforts to improve Non engineered housing





Proposal for reinforce adobe walls on existing housing
Eng. Lucia Igarashi – Dr. Carlos Zavala

Manual for reinforce adobe existing walls



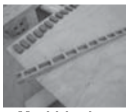
Dynamic tests through shaking table 1/8 scale at CISMID-UNI Lab

NON REINFORCE

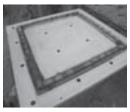
WOOD+MATS REINFORCE

Construction of the non reinforce specimen

earth



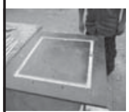
Mud blocks



First layer

Finishing model

Construction of the reinforce specimen



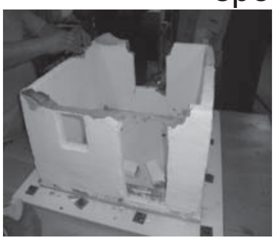
Footing

Mats + wood

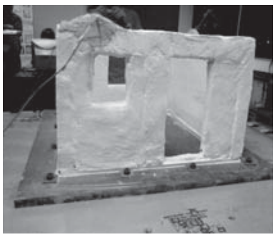
Reinforce

Increment of Section

Shacking Table Test on 1/8 specimens

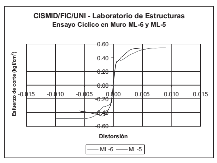


NON REINFORCE



WOOD+MATS REINFORCE

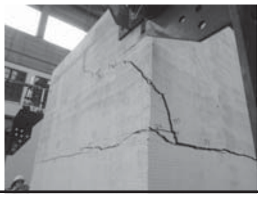
Efforts to improve Non engineered housing



Proposal for reinforce adobe walls on existing Housing – JICA Project – Professor

Efforts to improve Non engineered housing

ID	Tipo	Refuerzo Horizontal			Refuerzo Vertical	Material
		Norte	Sur	Ortogonal		
MC-1,MC-2	C	Caña partida @ 4 hiladas	Caña partida @ 2 hiladas	Caña partida @ 4 hiladas	Cañas @ 600 mm	Adobe
ML-1, ML-2	L	Geomalla @ 4 hiladas	–	Geomalla @ 4 hiladas	Columnetas de Concreto	Adobe
ML-3, ML-4	L	Geomalla @7 hiladas	–	Geomalla @ 7 hiladas	Columnetas de Concreto	Adobe
ML-5, ML-6	L	_	_	_	Varillas de Φ3/8”	Tapial



CONCLUSIONS

- Survey methodology was applied on 6 countries producing interesting data.
- Diverse documents has been developed for improve the resistance of walls.
- CISMID proposal for masonry walls, and adobe walls are an alternative for contribute to have a safer non engineered house.

Thank you
Sulpaa
Gracias

4.3 Report from Indonesia
Presented by Dyah Kusumastuti, Associate Professor, Institute of technology Bandung (ITB)
バンドン工科大学　准教授 ダイア・クスマステュティ

Data Collection on Non-Engineered Construction in Indonesia

Case Study: Bandung, Indonesia

Dyah Kusumastuti
Krishna S. Pribadi

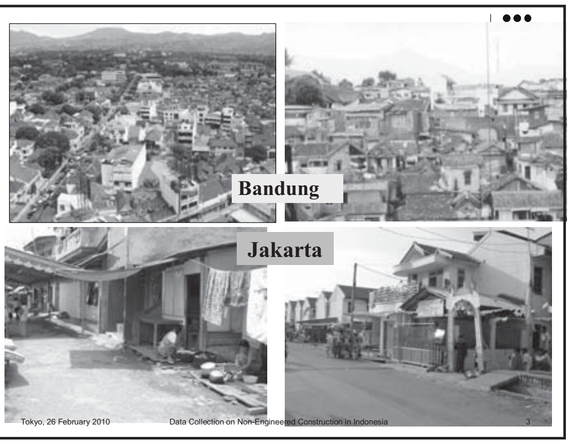
Center for Disaster Mitigation
Institut Teknologi Bandung

Tokyo, 26 February 2010 Data Collection on Non-Engineered Construction in Indonesia 1

Introduction

- Indonesia has high seismic risk
- Past earthquakes show that structural damages due to earthquake caused many fatalities and economic losses
- 70 percents of buildings in Indonesia are non-engineered structures, i.e. built traditionally with very little or no assistance from engineers,
- Most buildings affected by earthquake are non-engineered structures, including houses and public facilities
- Occupancy rates for public facilities are high
- Experience shows that:
  - **Good quality** of non-engineered structures **can survive** earthquake with little or no damage
  - **Poor quality** of non-engineered structures are **vulnerable** to earthquakes, and the occupants are susceptible to earthquake

Tokyo, 26 February 2010 Data Collection on Non-Engineered Construction in Indonesia 2



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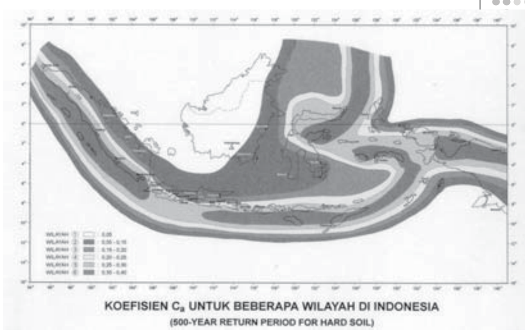
Seismic Zonation of Indonesia
(based on Seismic Risk Analysis)



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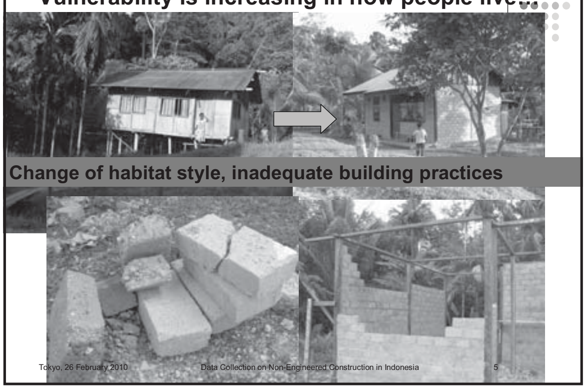
Vulnerability is increasing in how people live…



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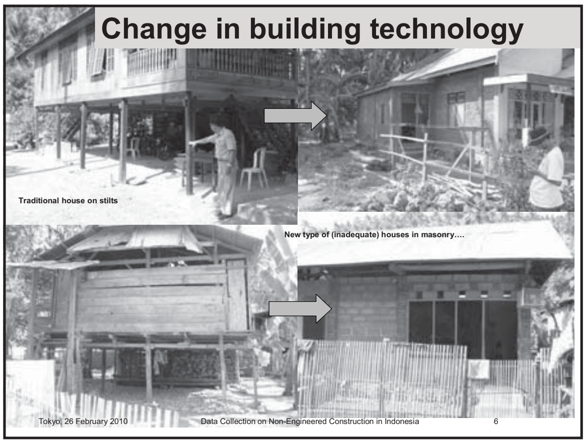
Change in building technology



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Problems Found on Non Engineered Structures

- Problems mainly due to minimum reference to codes:
  - No/minimal verification of design adequacy
  - Structures are built by local masons/workers, using local materials and traditional construction methods
  - Minimum supervisions during construction
  - Building permits may be issued without proper inspections
- Typical problems on buildings:
  - Improper structural design (structural irregularities, inadequate, structural elements, heavy masses for roofs or facades)
  - Poor detailing
  - Wide variety of quality of materials
  - Wide variety of construction methods

Problems Found on Non Engineered Structures

Damage on Non Engineered Structures

Improving Performance of Non-Engineered Structures

- Structures should be built properly according to the building codes/standards
- Better understanding of earthquake hazard and structural behavior due to earthquake
- Efforts should be:
  - Multidisciplinary aspects
  - Involve all parties in building construction
  - On national level
- Improvement should consider building functions, occupancy, and available resources
- Different approach should be used for new buildings and existing structures

Improving Performance of Non-Engineered Structures

- Possible approach for **new buildings**:
  - Development of system for dissemination of building standards/codes
  - Publication of national standard of field manuals and guidelines for proper design and construction for non-engineered structures
  - Installment of system for strict enforcement (regulations) for building construction
  - Introducing a common perception of damage level in educating the community regarding buildings' safety and earthquake vulnerability
  - Development of seismic risk map for Indonesia that considers local soil characteristics and potential seismic sources
  - Development of appropriate building technology using local materials and local construction techniques
- Possible approach for **existing structures**:
  - Evaluation of existing structural conditions to improve safety against future earthquake risk.
  - Conducting appropriate retrofitting strategy for structures with deficiencies and poor quality
  - Buildings with high occupancy rates such as school buildings should have higher priority for technical evaluation and possible retrofitting efforts

Research Collaboration of CDM ITB – GRIPS

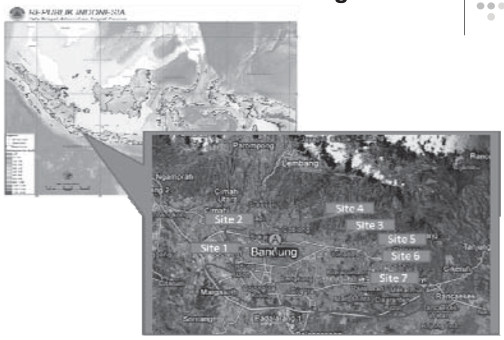
- Project:

  Data collection on non-engineered construction in developing countries
- Background:
  - Many buildings were damaged due to recent earthquakes in developing countries
  - Damage on buildings caused casualties and economic losses
  - Most buildings in developing countries are non engineered structures
  - Majority of damaged buildings are non engineered structures
- Objectives:
  - To better understand the current situations and practices of the non-engineered construction in developing countries
  - To develop appropriate technologies and policies to reduce the vulnerability of non engineered construction against earthquakes

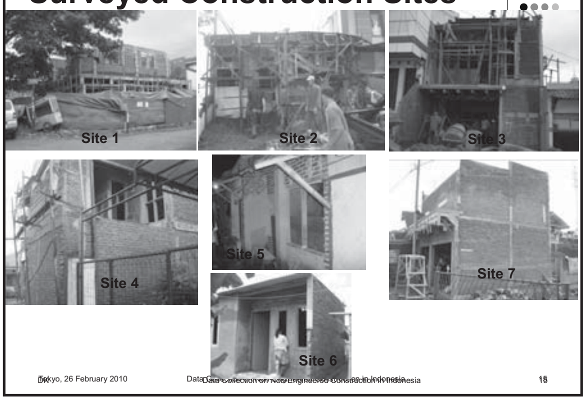
Field Survey (January – February 2010)

- Location: Bandung City
- Information on Bandung:
  - Capital of West Java Province
  - 107º 36´ East and 6º 55´ South
  - Southern Bandung until the line of grade crossing is relatively flat, while the northern part is mountainous.
  - Consisted 30 districts (Kecamatan), and the population reached 2,390,120 persons (2008).
  - Growth rate in the last five years is about 1.73%
  - Average of local income of population per year is IDR 26.3 million/USD 2,874 (2008)
  - Potential hazards are earthquake, flood, wind/storm, and landslide

Location of the Surveyed Construction Sites in Bandung



Surveyed Construction Sites



Building Regulations

- Indonesia has a national building law (UU No.28/Th.2002)
- No building code for non-engineered structures, but the national government provided some guidelines of earthquake resistant construction for non-engineered building
- Building law is mandatory for whole country, but implemented through Government Regulations and/or other related laws including Local Government Regulations.
- Not all local governments in Indonesia have local regulation on building construction.
- In Bandung City, building regulation is mandatory by local authority regulation and each building construction should have building permit.
- However, many building constructions in Bandung City were found with no building permit.

Typical Non Engineered Structures

- *Reinforced Concrete with Infill Masonry Walls Building*
  - Relies on the reinforced concrete columns and beams as the main load bearing structural elements.
  - Masonry infill walls will behave as strutting components when the lateral loads are applied.
- *Confined Masonry Building*
  - Relies on masonry walls as the main load bearing structural elements.
  - Confinement also contributes to maintain the integrity of the wall.
  - Confinement can be of various systems, such as practical columns/beams, and iron wire mesh.
  - Most structures in Bandung are confined by reinforced concrete practical columns/beams.
- *Unconfined Masonry Building*
  - Relies on the wall as the only load bearing structural elements.
  - No confinement or reinforcement used on this type of building.
  - Rarely found in Bandung area.

Survey Findings

- The survey was conducted to study the characteristics of non engineered constructions in Bandung, and to assess their vulnerability against earthquake.
- The survey sites only consists of a very small population (7 samples) of non engineered buildings in Bandung city. Therefore, the results may not represent the typical conditions of non engineered buildings in the area.
- All buildings surveyed were located at the flat/gentle slope area.
- The construction cost could not be estimated because it depended on the availability of the budget.
- Most buildings use simple equipments for construction.

Survey Findings

- Fired brick wall is still the most popular material for wall construction.
- The arrangement of bricks in unconfined masonry was found to be better than in confined masonry / reinforced concrete frame with infill walls
- Most buildings use sideways roof structure.
- The use of light steel truss for roof structure is increasing.
- Few workers had some knowledge on determining proper spacing of stirrups at joint and midspan
- Problems on connections and detailing

General Problems

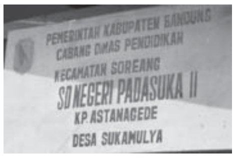
- Improper detailings
  - Use of plain rebars as longitudinal rebars
  - No seismic hook on transverse reinforcements
- Improper connections of buildings elements (orthogonal walls, column and walls, beams and columns)
- Most craftmen do not have formal training on building constructions and they obtained their skill from practices/experiences.
- Many building owners and craftmen have limited knowledge on proper construction methods, and they do not consider earthquake as potential hazard.
- Guideline for non engineered structures is not well disseminated.
- Some owners tend to lower the structural quality to reduce the construction cost due to limited budget, although craftmen may understand that the practice is not appropriate.

Recommendations

- Guideline for non engineered structures should be well disseminated, and the implementation should be enforced by regulation, i.e., building permit.
- Workers should be educated on simple earthquake resistant constructions to produce good quality of building.
- Wall reinforcement should be explored to strengthen wall elements and to reduce the risk of damage due to earthquake.
- Considering the increasing use of light steel trusses, there is a need on developing specific national codes for light steel construction.

SD Padasuka II

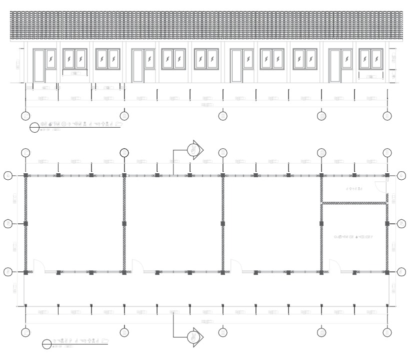
- Located in Kabupaten Bandung, West Java, with moderate seismic risk
- High occupancy during the day
  - 400 students
  - School time: 7:00 – 17:00
- Building layout
  - 2 buildings, 4 rooms each
- Structural system
  - Unconfined masonry structures



CDM ITB - UNCRD Collaboration on Reducing Vulnerability of School Children to Earthquake

- School Earthquake Safety Initiative (SESI)
- **Background** of project:
  - School buildings need to perform well under earthquake loads
  - Children are more vulnerable during the earthquake
  - School buildings may be used for emergency facilities in post-earthquake recovery efforts, thus need to behave elastically under earthquake loading
- **Objectives** of project:
  - Reducing vulnerability of school children to earthquakes
  - Reducing number of victims due to earthquakes
  - Preparing school communities/elements in facing earthquake disaster
- **Participants**
  - SD Cirateun Kulon II, Bandung
  - SD Padasuka II, Bandung

Typical Layout of SD Padasuka II



Existing Condition of SD Padasuka II

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Structural Survey

- Similar structural system for both buildings
- Unconfined masonry structures
- Inadequate foundation system
  - Shallow foundation, no tie beam
  - Soil cover and support eroded on some parts
- Inadequate roof system
  - Poor connection of roof system and walls
  - Poor quality of roof truss members and connections
  - Roof was deformed on top chordnan
- Damage on walls with cracks and gaps
- Conclusions:
  - Inadequate structural system to support lateral loads
  - Poor quality of materials and detailing
  - Need of finishing/cosmetic repair and improvement on sanitation facility

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Retrofitting Strategy of SD Padasuka II

- Retrofitting strategy
  - Install columns with footings on corners
  - Install wire mesh for strengthening wall elements
  - Add double tie beams for better foundation system
- Improvement for structures:
  - Replacement of roof truss members and installing proper detailing of roof truss systems
  - Repair of nonstructural elements, e.g. doors, windows, and ceilings
  - Repair of sanitary facilities

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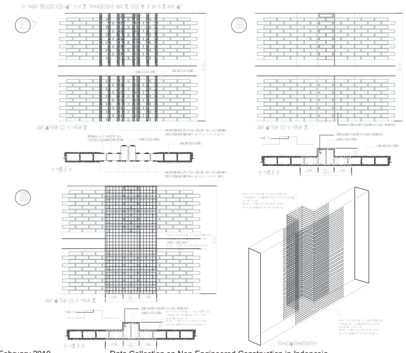
Design of Retrofitting of SD Padasuka II



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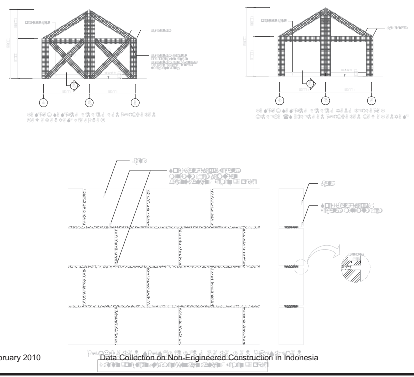
Design of Retrofitting of SD Padasuka II



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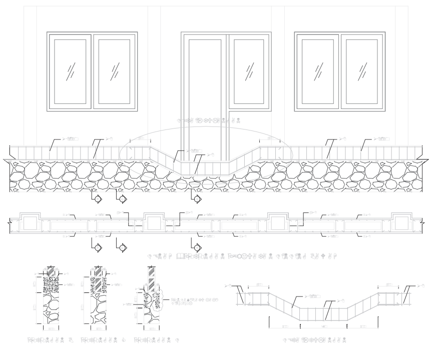
Design of Retrofitting of SD Padasuka II



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Implementation of Retrofitting of SD Padasuka II

Building Performance during West Java Earthquake

Performance of SD Padasuka II

Performance of School Building in Soreang

Building Performance during West Java Earthquake

- Damage were non structural and required *finishing/cosmetic repair*
- Minor cracks were found near openings and connections to plafond
- Damage on the buildings were less severe compared to other buildings in the area with similar existing conditions
- Considering the condition prior to retrofitting projects, the structural repair was successful in improving structural performance against earthquake loads

THANK YOU

4.4 Report from India
Presented by Nitin Verma, Senior Programme Officer, SEEDS
シーズ　シニアプログラムオフィサー ニティン・ヴァルマ

"Vulnerability of Non-Engineered Buildings and Efforts to Make them Safer in India"

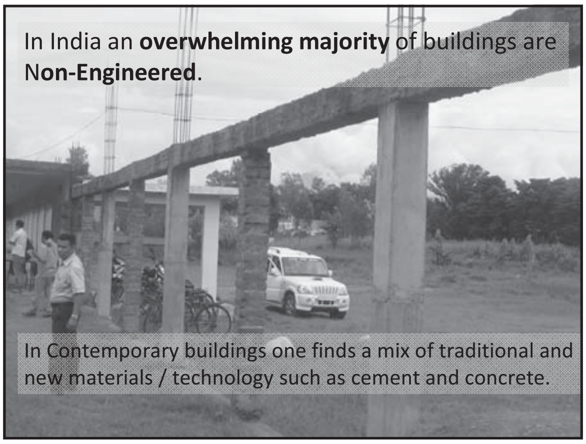
Presentation By:
SEEDS Technical Services, India

SEEDS INDIA
www.seedsindia.org

"Vulnerability of Non-Engineered Buildings and Efforts to Make them Safer in India"

- General Conditions of Buildings in India
- Findings from the Field Survey
- Efforts to tackle these Non-Engineered houses for structural improvement
- Based on the Outcome of the Survey It would be necessary to ….

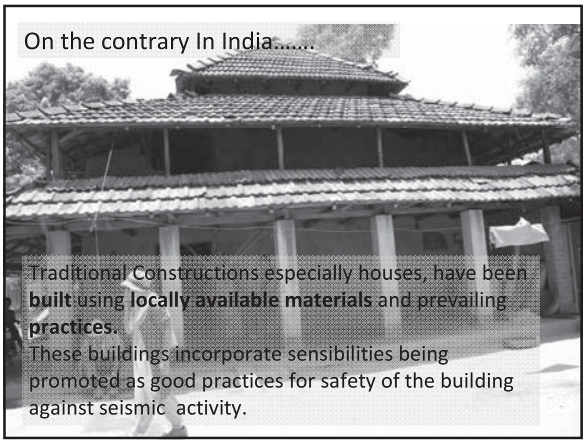
- **General Conditions of Buildings in India**
- Findings from the Field Survey
- Efforts to tackle these Non-Engineered houses for structural improvement
- Based on the Outcome of the Survey It would be necessary to ….



In India an **overwhelming majority** of buildings are N**on-Engineered**.

Baring exceptions a majority of these structures have no engineering input and the people who build them have no formal technical knowledge of construction.

For various reasons most of these buildings have not been built to withstand the forces of an earthquake.

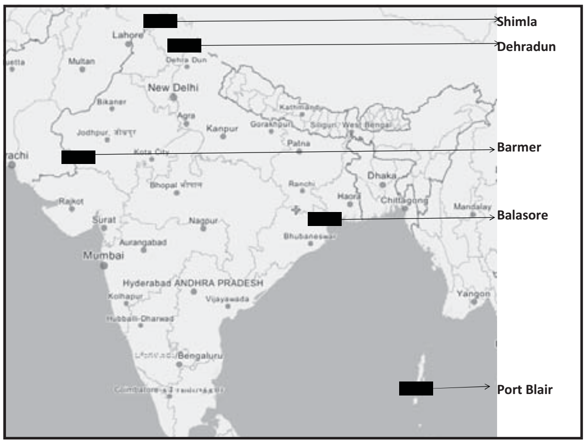


- General Conditions of Buildings in India
- **Findings from the Field Survey**
- Efforts to tackle these Non-Engineered houses for structural improvement
- Based on the Outcome of the Survey It would be necessary to ….

Findings from the survey…

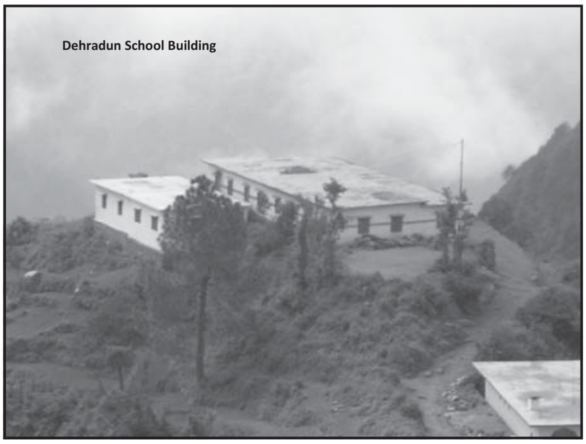
Selection of 5 sites for sample survey included selection on basis of practices and varied construction technologies

Sample Sites	1. Balasore	2. Dehradun	3. Barmer	4. Portblair	5. Shimla
Category	Traditional	Contemporary	Traditionally adapted	Contemporary	Traditional
Construction Period	August 2008 to Dec 2008	1995	Jan - July 2007	completed Jan 2008	1990
Project Delivery Method	Owner appointed	Public department (Govt.)	Community Driven construction	Trust owned	Private



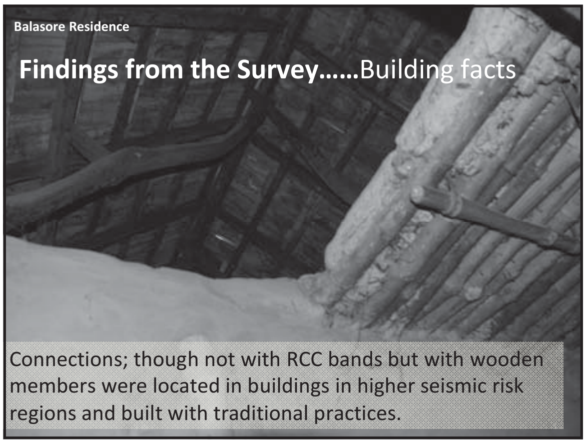
Findings from the Survey……Building Codes

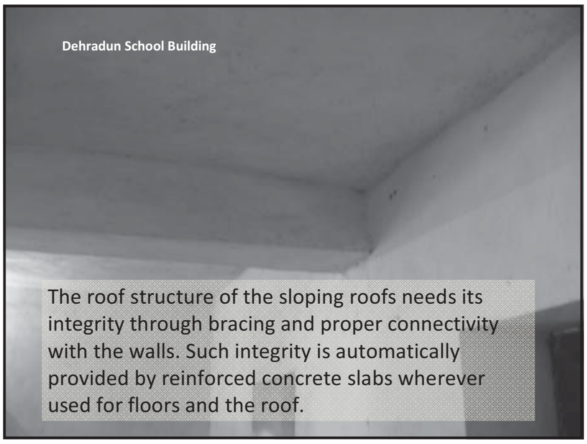
- In India there is big gap between knowledge and practice.
- **Building Codes (NBC) and Regulations (BIS)**exist but are not enforced.
- Barring few local bodies in urban areas no agency is responsible for its enforcement especially in rural parts
- Now Guidelines have been issued for construction of Non-engineered buildings by NDMA.



Findings from the Survey……Building facts

- In traditional construction (and traditionally adaptive buildings) the storey height is controlled by limiting walls height to thickness ratio.
- All the buildings surveyed had small opening against high wall area to display the fact that care has been taken in design of structures for seismic resistance.





Findings from the Survey……Work Force

- All mason teams who have worked on these projects have learnt these skills traditionally and were not exposed to any formal training or certification programme.
- The fact is that communities depend on these masons for technical advices and decides against calling an engineer or an architect.

- General Conditions of Buildings in India
- Findings from the Field Survey
- **Efforts to tackle these Non-Engineered houses for structural improvement**
- Based on the Outcome of the Survey It would be necessary to ….

Efforts to tackle these Non-Engineered Buildings for Structural Improvement

- Structural Retrofitting
- Strict Adherence to building codes in all future constructions
- Mason Certification programme

- General Conditions of Buildings in India
- Findings from the Field Survey
- Efforts to tackle these Non-Engineered houses for structural improvement
- **Based on the Outcome of the Survey It would be necessary to ….**

Based on the Outcome of the survey
It would be necessary to…….

- *Noted t*he major deficiencies indicating *non-compliance with Codal provisions.*
- *The house* owner may need to be sensitized with the kind of damage to which his building may be subjected.
- Those deficiencies will need to be considered for upgrading the seismic safety by retrofitting the building suitably to prevent total or partial collapse of in future.

4.5 Report from Nepal
Hima Shrestha, Senior Structural Engineer, National Society for Earthquake Technology (NSET)
ネパール地震工学協会（NSET） 構造専門家　ヒマ・シュレスタ

Study of Non-Engineered Buildings in Nepal

International Symposium on" More Resilient Non-engineered Houses for Earthquake Disaster Reduction

Hima Shrestha

National Society for Earthquake Technology-Nepal(NSET)

26th Feb 2010, Tokyo, Japan

Non-Engineered Building Types in Nepal

- Prevalent Building Types in Nepal

-Unreinforced masonry buildings mostly in semi urban and rural areas

 -Brick in cement in hilly and plain region and Stone in cement/mud in mountainous region

 -More than 60% of the buildings are of these types (NSET,JICA 2001, Study on Earthquake Disaster Mitigation in Kathmandu Valley)

-RC buildings with brick masonry infill in urban and semi urban areas

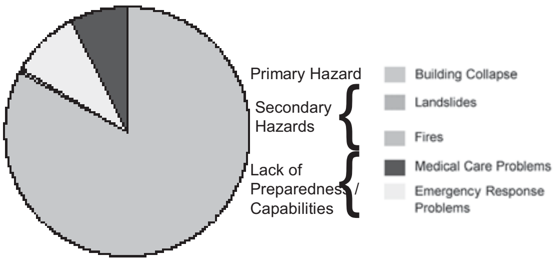
-Non-engineered / Owner built

-Haphazard construction

-Urbanization and hike in land price

-Rise in building height

Sources of Earthquake Risk in Kathmandu (source: GESI)



Outcomes on Study of Non-Engineered Brick Masonry Buildings in Nepal

Location of survey area

- Three districts of Kathmandu Valley
  - -Kathmandu
  - -Lalitpur
  - -Bhaktapur

  2 types of brick masonry buildings prevails in Nepal

  -Brick in cement masonry

  -RC frame with brick infill

Characteristics of Selected Brick Masonry Construction

- Unreinforced Masonry
- Mostly built by local masons and craftsmen
- With no consideration for earthquake

Typical structural details of selected buildings

-230mm wall thick

-cement mortar

-Thickness of mortar layer-19mm

-Compressive strength of local bricks=6-10 MPa

-RC slab of 100mm thick

-Brick on edge over door/window

-No bands, vertical reinforcement and corner stitches

Characteristics of RC Buildings with brick masonry infill

- Rapidly growing in Urban and Semi Urban region, Informal Construction
- Light frame irrespective to height
- Poor ductile detailing
- High seismic vulnerability/Experience from recent earthquakes

Typical structural details of selected buildings

-Column size 230 X 230 mm with 6 nos of vertical bar and 8 mm dia stirrup @ 150-200 mm spacing

-Beam size 230 X 325 mm

-Slab thickness = 100mm

-Grade of steel = 415 tor or 500, 550 TMT

-Concerte mix =1:2:4, Water poured from pipe

-Thickness of brick infill 230mm

Laboratory Experimental Test

S.N.	Description	Compressive Strength (MPa)	Remarks
1	Concrete (1:2:4)	9.4	Corrected to 28 day strength; Water poured from pipe as per site
2	Concrete (1:1.5:3)	12.5	Corrected to 28 day strength; Water poured from pipe as per site
3	Brick (LYP)	9.86	Balkot, Hattiban, Imadole Site (Dry Test)
4	Brick (LYP)	8.03	Balkot, Hattiban, Imadole Site (Wet Test)
5	Brick (BBT)	6.55	Nankhel Site (Dry Test)
6	Brick (BBT)	5.91	Nankhel Site (Wet Test)
7	Brick (S)	13.69	Kirtipur Site (Dry Test)
8	Brick (S)	10.25	Kirtipur Site (Wet Test)

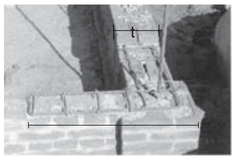

Typical Deficiencies (Masonry Buildings)

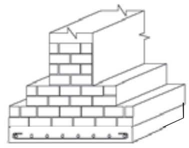
- Lack of integrity between walls
- Lack of roof anchorage to wall
- Lack of strength/Lack of ductility
- Long unsupported walls
- Door/Window opening attached to wall junction


Probable Damage to Masonry buildings



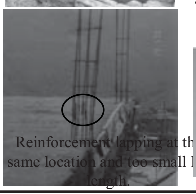

National Building Code Requirement



Typical Deficiencies (RC Buildings with masonry infill)

- Insufficient size of structural elements
- Lack of ductility/Improper detailing of steel bars
- Weak columns and strong beams
- Open ground floor
- Lack of connectivity between frame and brick infill
- Large Window openings

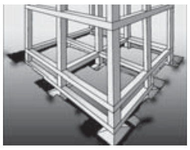


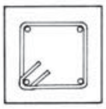

Probable Damage to RC buildings with brick infill





National Building Code Requirement





Focus on Proper Configuration and Detailing

Why Vulnerable Buildings???

- Out of 75 districts Building Code is Mandatory only in 6 districts
- Building Code prevails but not practically implemented
- Lack of Awareness in community
- Lack of Ignorance because the last big earthquake was 76 years back
- Lack of monitoring from Government Agencies/Lack of resources
- Lack of capacity of Technicians/Engineers
- Knowledge gap between academic researchers and end users

NSET Activities on Earthquake Risk Management

- Earthquake orientation to community/various organizations for awareness raising
- Earthquake Safety day celebration
- Mason Training
- Engineer /Overseer Training
- School Earthquake Safety Programme
- Construction of earthquake resistant buildings/Retrofitting of buildings
- Free consultation every Friday for the general public
- Earthquake mobile clinic

Intervention Options

Suitable strengthening measures for non-engineered buildings in Nepal

- Splint and Bandage
- Reinforced Concrete Wall jacketing
- GI Wire Mesh Wall jacketing

Reasons
- Most economic out of various available methods
- Practically feasible
- Local materials and manpower can be used
- Most widely used as viable methods

Conclusions

- Highly vulnerable building stock to impending earthquake
- New constructions at least should meet the building standard
- Strengthening of existing structures necessary to reduce the existing high vulnerability
- Challenge for the government, NGO's and INGO's and other stakeholders working for earthquake risk reduction
- Strategic approach has to be taken to make it practically feasible in developing countries like Nepal.

Thank you for your kind attention !

4.6 Report from Pakistan
Presented by Najib Ahmad, Project Manager, Preston University
プレストン大学 プロジェクトマネジャー　ナジブ・アーメド

INTERNATIONAL SYMPOSIUM ON "MORE RESILIENT NON-ENGINEERED HOUSES FOR EARTHQUAKE DISASTER REDUCTION"

February 26, 2010

National Graduate Institute for Policy Studies, (GRIPS) Tokyo

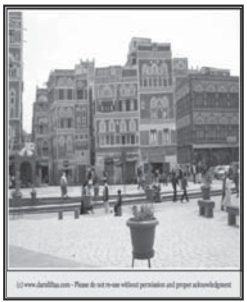
"VULNERABILITY OF NON-ENGINEERED HOUSES AND EFFORTS TO MAKE THEM SAFER IN PAKISTAN"

DR. KENJI Okazaki – GRIPS, Japan

Engr. Najib AHMAD - DRI – Preston University,
Field Help by
MR. GHULAM ABBAS, ETSSR Centre, Pakistan.
Engineering Staff – DESIGNMEN
Engr. Akash Shahzad Khan
Engr. Asjid Ali
Engr. Shahid Amin
Engr. Muhammad Khurshid

1.0 Introduction

- In most deaths caused by earthquake, people are killed by their own houses.
- Majority of the world population in developing countries lives in their non-engineered abode, which are vulnerable to earthquake, and other disasters.
- Typical non-engineered multi-storey structures in burnt clay brick houses in Yemen (see photograph).



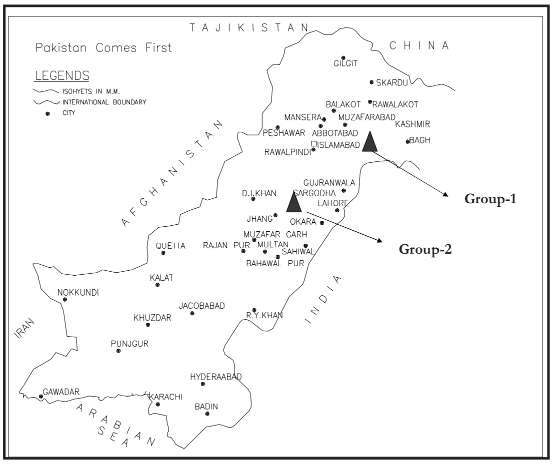
Typical buildings and multi-storey structures in burnt clay bricks

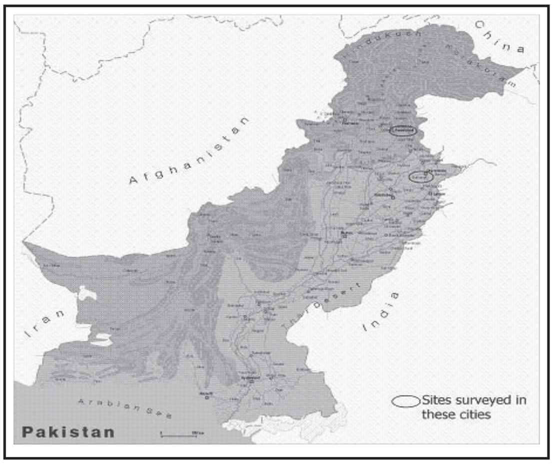
- The non-engineered houses in seismic zones are responsible for deaths upto (85%) of total casualties in an earthquake.
- This latest research, which has been initiated jointly by National Graduate Institute for Policy Studies (GRIPS) and Building Research Institute (BRI) on non-engineered buildings, which is initiated in six selected developing countries i.e. Peru, Indonesia, India, Nepal, Pakistan and Turkey.
- We are here to share the results of the survey to improve the safety of the non-engineered buildings.

2.0 Location and Features of Study Areas

- A study of typical non-engineered house construction in Pakistan in two areas.
- The research survey was conducted in central part of Pakistan where more than 60% of the total population resides.
- This Central part can be divided topographically into two regions i.e. Potohar Plateau and Plains of Punjab.

- To clearly appreciate and see, if different types of materials are being used in different areas.
- Both areas are 100 – 150 KM apart and have different types of soil conditions.
- One area is in North (near Islamabad) has an altitude of 1500 – 1800 feet (500 – 600 m.) from sea level, and seismically is in higher zone.
- Topographically it is a plateau and has stones, clay-stone and gravely surface with ground water quite deep.
- The second area is in plains of Punjab, where generally the level is around 300 feet (100 m.) from mean sea level. The soil is mostly sand, silt and clay.





- The materials for manufacture of burnt bricks are different in both areas, similarly the sand being used in mortar/plaster both areas are from quite different source and constituents.
- The sand in north is mostly clear, particle size is larger, with smaller amount of clayey silt. The aggregate is also different, resulting in different strengths of concrete, with same volumetric ratios.
- Three typical houses were taken in each area, with a view to have a better understanding of construction being done in Pakistan.

The location of 6 sites (GRIPS 1 TO GRIPS-6) within the two areas are grouped as described below:

GROUP-1

i. Grips 1, 5 & 6 - Potohar Plateau

GROUP-2

ii. Grips 2, 3 & 4 - Plains of Punjab (Hafizabad)

The soil types and available sands used in mortar are:

1. Potohar Plateau - Lawrancepur Sand
2. Plains of Punjab - Chenab Sand/Ravi Sand

Table of Duties

Sr. No.	Project Site	Site Survey Date	Survey Conducted By	Description of Site Responsibility			
				Engr. Asjad Ali	Engr. Shahid Amin Khan	Engr. Akash Shahzad Khan	Engr. Khursheed
1.	GRIPS Site 01	24 – 12 – 09	Engr. Asjad Engr. Shahid Engr. Akash	Sample Preparation and Photography	Sample Preparation and data collection	Data Collection and Photography	N/A
2.	GRIPS Site 02	30 – 12 – 09	Engr. Asjad Engr. Akash	Site Selection and sample Preparation	Data Collection and Photography	N/A	N/A
3.	GRIPS Site 03	31 – 12 – 09	Engr. Asjad Engr. Akash Engr. Khursheed	Data Collection and Photography	N/A	Sample Preparation	Sample Preparation
4.	GRIPS Site 04	01 – 01 – 10	Engr. Asjad Engr. Akash Engr. Khursheed	N/A	Data Collection, Photography	N/A	Sample Preparation
5.	GRIPS Site 05	13 – 01 – 10	Engr. Asjad Engr. Akash Engr. Khursheed	Data Collection and Photography	N/A	Sample Preparation and Photography	Sample Preparation
6.	GRIPS Site 06	14 – 01 – 10	Engr. Khursheed Engr. Shahid	N/A	Sample Preparation and Photography	N/A	Data Collection and Sample Preparation

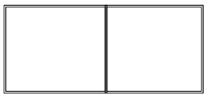
3.0 General Condition of Non-engineered Houses in Pakistan

- Non-engineered houses, are vulnerable to any natural phenomenon like floods, tsunami, fire, mud slides etc., which can lead to a disaster, but earthquake are most important, as they are responsible for loss of lives in much greater number in a disaster.
- The vulnerability of these non-engineered house structures in Pakistan can be due to many reasons, the important ones are listed below; for the typical (most common) non-engineered house structure, which is made of burnt clay bricks;

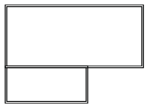
(**Some Photographs of Non-engineered structures)**




- Low quality of bricks.
- Bricks not layed in proper systematic manner. When bricks are laid in mortar in a proper systematic manner, they form a homogenous mass, which can withstand lateral and vertical forces without disintegration.
- Use of low cement-sand mortar ratio or use of mud mortar.
- Large sizes of rooms, where the structure doesn't behave/act as a 'box" or in other words the "shoe box effect" is lost due to abnormal sizes and unsysmetric geometry (See Fig .)



1. Box Structure



2. Unsafe _______

- Similarly, other factors in structural elements like overhangs, small dia "verandah" columns made up of pipes which are vulnerable and can cause damage in an earthquake.
- Abnormal height of rooms should be avoided.
- Though RCC slab helps in certain level of stability, but it was seen that it caused much more damage, was responsible for deaths of children in schools (8th October, 2005 earthquake).
- Therefore, lighter wooden/steel roof should be used.

Samples under preparation of project site.

Non-engineered house with columns in Verandah

4.0 Current Situation "Field Survey Result"

- As indicated above 6 projects were under taken within the parameter of survey developed by the Center for **Disaster Mitigation-Institute Technology Bandung**, Indonesia, in collaboration with **GRIPS**, Tokyo, Japan.
- The Data sheets, are used to collect and record the basic data on the non-engineered buildings, which includes the structural safety, construction work, quality of construction materials, current (technical) requirements pertinent to non-engineered structures, etc. consisting of quantitative as well as qualitative data.

- The data on typical mortar being used for brick laying and plaster was collected and mortar cubes were got tested from standard laboratory of a Engineering University near Islamabad. Similarly, the concrete samples for quality of concrete being used in roof slabs was also collected and samples got tested.
- Slump tests were made for each site, for fresh concrete when concrete slabs were poured. The results of slumps were recorded and noted (see Table 1.2).

- Similarly, relevant features of each project site was recorded for location of the house (site condition), Characteristics and types of hazards, soil type and condition, design intervention etc.
- A summary of the test results on different construction materials obtained, is presented below (See Table 1.3).

Table 1.2

Sr. No.	Project Site	Slump (mm)
1.	GRIPS Site 01	--------
2.	GRIPS Site 02	150
3.	GRIPS Site 03	Collapse
4.	GRIPS Site 04	102
5.	GRIPS Site 05	205
6.	GRIPS Site 06	101

Summary of Test Results for Data Sheets

Basic Data on Non – Engineered Buildings

Conducted & Prepared By :

DESIGNMEN Consulting Engineers (Pvt) Ltd.
ETSSR CENTRE.

Tests Conducted at:
University of Engineering & Technology, Taxila, Pakistan.

SUMMARY OF TEST RESULT FOR DATA SHEET

Sr. No.	Project Site	Compressive Strength of Concrete (Mpa)*		Compressive Strength of Mortar (Mpa)a		Crushing Strength of Bricks (Mpa)*	Tensile Strength of Reinforcement (Mpa)*(Bar No.)
		14 DAYS	28 DAYS	14 DAYS	28 DAYS		
GROUP-1							
1.	Grips Site - 01	-----	-----	4	4.45	9	562(#2), 570(#3)
5	Grips Site - 05	14	17.5	10	12.5	9	462(#4)
6	Grips Site - 06	20	25	11	13.75	10	460(#4)
GROUP - 2							
2	Grips Site - 02	15	18.75	7	8.75	9	347(#3), 390(#6)
3	Grips Site - 03	11	13.75	2**	4	4	318(#2), 401(#4)
4	Grips Site - 04	9	11.25	2**	4	10	318(#2), 401(#4)

*Rounded up to the next whole number.

** Compressive strength of mortar cube tested at 7 days.

Sr. No.	Project Site	Mix Ratio of Concrete	Mix Ratio of Mortar	Mix Ratio of Plaster
Group 1				
1	Grips Site - 01	1:2:4	1:6	1:4
5	Grips Site - 05	1:2:4	1:5	1:3
6	Grips Site - 06	1:2:4	1:5	1:4
Group 2				
2	Grips Site - 02	1:2:4	1:6	1:4
3	Grips Site - 03	1:2:4	1:4	1:4
4	Grips Site - 04	1:2:4	1:4	1:4

Sr. No.	Project Site	Cast Date of Test Samples	Test Date	Difference (Days)*
Group 1				
1	Grips Site - 01	24-12-09	16-01-10	21
5	Grips Site - 05	13-01-10	01-02-10	14
6	Grips Site - 06	14-01-10	01-02-10	14
Group 2				
2	Grips Site - 02	30-12-09	16-01-10	14
3	Grips Site - 03**	31-12-09	16-01-10	14
4	Grips Site - 04**	01-01-10	16-01-10	14

* Reported to the nearest number of days as specified by codes.
** Compressive Strength of mortar cubes measured at 7 days.

Mix – Ratios

- The mix ratio of concrete by volume at all sites was reported to be 1:2:4, i.e.;
  - 1 part of cement.
  - 2 parts of fine aggregates.
  - 4 parts of coarse aggregates.
- Similarly for mortar and plaster the ratio ranges from 1:4 to 1:6, i.e.,
  - 1 part of cement.
  - 4/6 parts of sand.
- Where the above quantities are measured by volume

5.0 Comparison of Data

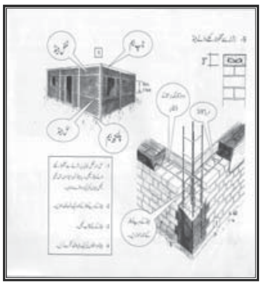
- The strength of mortar/plaster and concrete in the samples from Group-1 is better than that of Group-2 because of the possible variation of aggregates used as the aggregates found in the Potohar area are stronger than the river aggregate being used in plains. They have also better shape factor like less flaky etc.
- The quality of both the sands is different that is probably another reason for better strength obtained in GROUP-1, sample tests as compared to Group-2 result of mortar and concrete.
- The low strength of mortar used at site 1 is quite low even when taken at 28 – days possibly due to the reason that the mix ratio reported by the contractor was incorrect.

- The steel reinforcement being used in the plain areas of Group-2 are of much lower strength due to the fact that the bars are not being rolled according to the standard specifications. Most of the bars tested were under weight (Figure).
- The percentage elongation of the steel samples in the Group – 2 showed a higher value than that of Group – 1 probably due to the same reason described above.

- Bricks of the both area are of almost the same strength although the quality and strength is much lower as compared to the bricks being used in the houses where proper engineering design in involved.
- Another factor, which is not taken but people should be made aware of is curing. Even with low cement-sand ratio, better results are expected due to curing, and therefore, this should be emphasized. Water cement ratio may have also played some part in strength variation.
- No particular quality control system was found on the construction sites.

6.0 Efforts To Make Them Safer

- Efforts are afoot, after the great Northern Pakistan earthquake of 8th October, 2005 for improvement in construction of safer houses.
- The improvement in “risk perception” in general of the people and the resulting desire to have safer houses is leading people to ask question, about safety of their houses and buildings.
- Training to masons & contractors by UNDP, JICA, BRI etc. have contributed towards efforts to improve construction in earthquake prone areas.



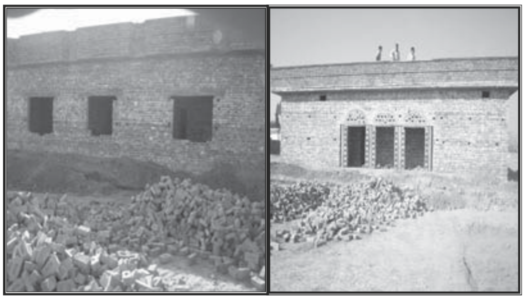
- Efforts made to improve the minimum design standards which are applied without general intervention of the engineers (by different development authorities in some cities).
- Awareness to improve construction techniques of bricks to have proper bonds to ensure the greatest possible interlocking for longitudinal and lateral strength of structure.
- Awareness to Introduce confined masonry concept with columns and plinth beams, seismic based etc. this is the most simple and direct technique, which is gaining some respect. Some literature in this respect has been prepared by ERRA & UN HABITATE.

7.0 Necessary Steps for Improvement/ Retrofitting these buildings in Pakistan.

- As anticipated and is quite obvious house structures vulnerable to earthquake require to be designed properly or in case of non-engineered construction, some minimum parameters to be taught to the master masons, which can reduce the vulnerability of these houses.
- The minimum parameters should be such that they can be followed easily, without engineering intervention and provide resistance for a certain level of earthquake.

- For the existing structures, vulnerability reduction can be achieved by using some "minimum amount of Retrofitting, like strengthening of corners or strengthening of "verandah etc"., where support is being provided through very vulnerable columns.
- Another way can be by use of Light Weight roof, instead of heavy RCC slabs, which can cause much damage. This is being some what followed now in public buildings (engineered) but still the local house construction requires some minimum rules.
- **Still much has to be done and awareness inculcated in the people for improvement in construction of non-engineered houses.**

8. Photographs of the Typical Non-Engineered Building Sites



THANK YOU

4.7 Report from Turkey

Presented by Alper Ilki, Associate Professor, Vice Head of Department of Civil Engineering, Istanbul Technical University /イスタンブール工科大学 土木工学科副長 准教授 アルパー･イルキ

A BRIEF LOOK AT THE TURKISH MASONRY BUILDING STOCK

Mustafa Comert

Alper Ilki

Photo:Ara Güler

Introduction

Istanbul is the heart of Turkey

Population: 13 000 000 (Turkey ~ 70 000 000)

Probability of M>7 EQ in few decades is over 50%

Foreseen death toll is around 75 000

Heavily injured around 120 000

Introduction

Poor construction (existing buildings); RC, Masonry

All > NONENGINEERED (PARTIALLY-ENGINEERED?)

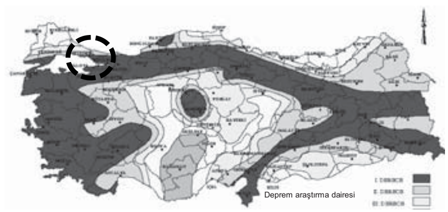
New buildings; RC, much better quality after 1999 Eqs

No new masonry buildings

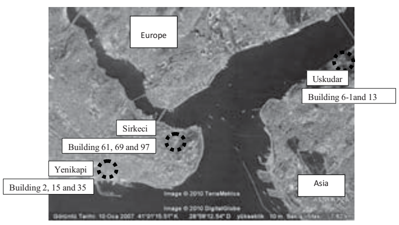
76% of existing buildings RC + so-called RC

22% of existing buildings unreinforced masonry

Seismic risk map of Turkey



Locations of the buildings



All 8 buildings are in the first level EQ zone

Buildings

2, 15 and 35 in Yenikapi

- Wide openings
- Vertical discontinuities
- Existing damages
- Wall removals
- Story addition
- Non-orthogonal

6-1 and 13 in Uskudar

61, 69 and 97 in Sirkeci

Structural materials

		Structural load bearings	Non-bearing partitions	Roof structure materials	Foundations
Yenikapi	Building 15	Fired Brick Walls	Fired Brick Walls	Reinforced concrete slab and wooden truss	Strip stone masonry
	Building 35	Fired brick and hollow brick walls and reinforced concrete columns	Fired Brick Walls	Reinforced concrete slab and wooden truss	Strip stone masonry
	Building 2	Fired Brick Walls	Fired Brick Walls	Reinforced concrete slab	Strip stone masonry
Sirkeci	Building 61	Fired brick and hollow brick walls	Wooden	Reinforced concrete slab and wooden truss	Strip stone masonry
	Building 69	Fired Brick Walls	Fired Brick Walls	Steel truss	Strip stone masonry
	Building 97	Fired Brick Walls	Fired Brick Walls	Brick vault	Strip stone masonry
Uskudar	Building 6-1	Fired Brick Walls	Fired Brick Walls	Reinforced concrete slab and wooden truss	Strip stone masonry
	Building 13	Fired brick and hollow brick walls	Fired Brick Walls	Reinforced concrete slab and wooden truss	Strip stone masonry

Structural materials

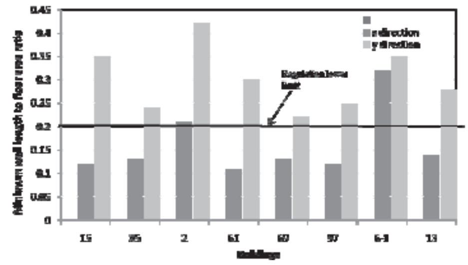
Brick vaults supported by one-way steel members, I140 or I160.

Mechanical characteristics of walls

Both mortar and bricks are poor

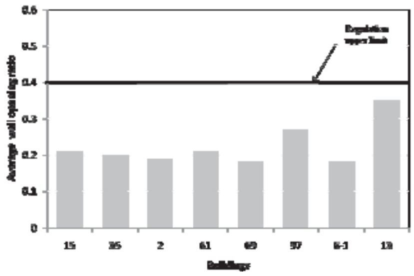
		Average compressive strength of brick-mortar prisms (MPa)
Yenikapi	Building 15	1.10
	Building 35	4.10
	Building 2	1.20
Regional average		2.13
Sirkeci	Building 61	1.70
	Building 69	4.20
	Building 97	2.50
Regional average		2.42
Uskudar	Building 6-1	4.20
	Building 13	1.70
Regional average		2.53
City average		2.59
City standard deviation		1.37

Comparison of several characteristics with code requirements



Ratio of minimum wall lengths to floor area in comparison with code limits

Comparison of several characteristics with code requirements

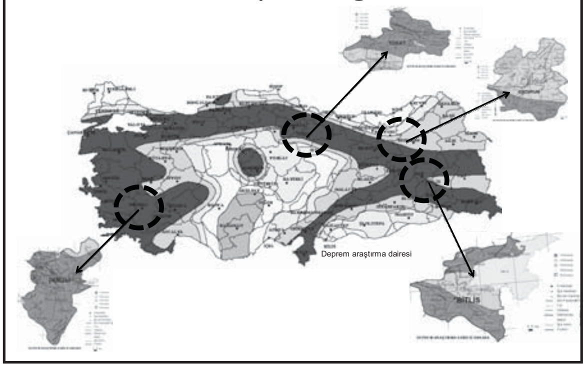


Maximum wall opening ratios in comparison with code limits

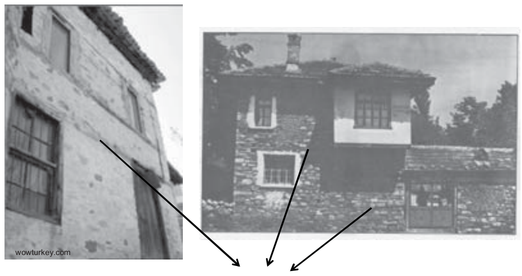
Dominant quantitative problems

- i) generally the heights of the buildings are remarkably higher than permitted,
- ii) the irregularity of the structural system; generally strong in one direction and weak in the other,
- iii) insufficient wall lengths, less than 20% of the floor area,
- iv) large openings of certain walls reaching up to approximately 80% for some buildings.

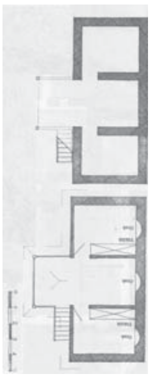
Seismic risk map of regions



Denizli Typical house type



Typical floor plans



Buildings are generally two stories

Typical wall details

Negative factors of this regions buildings

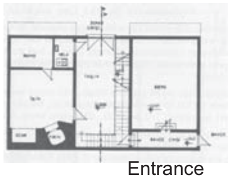
- Irregularity on vertical arrangements of windows
- Windows and doors are too close to corner of walls
- Irregular wall bonding (continuity of vertical mortar layer)
- Mud mortar (less adhesive effect)
- Thin or unsupported walls
- Less shear effects in one direction (Because of one way wooden slab beams)
- Weak connections at the corners
- Irregularity of structural load bearing system in plan

Tokat-Typical house type

Timber structures

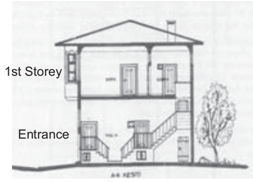
- •Wooden frame is main load bearing system
- •Adobe is used as infill materials

Typical floor plans



Entrance

1st Storey



Buildings are generally two stories

Negative factors of this regions buildings

•Generally 1st storey load bearing walls has 40 cm – 70 cm offset in two side of buildings

• Plan irregularity is the most encountered problem

•One side of the buildings are attached to one side of the next building

•Most of this regional buildings were constructed as attached to next building

Erzurum-Typical house type

Typical floor plans

Buildings are generally two stories

Negative factors of this regions buildings

• Generally 1st storey load bearing walls has 50 cm – 150 cm offset in two side of buildings

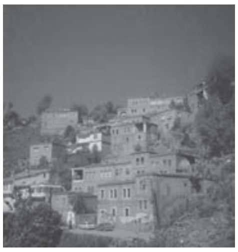
• Plan irregularity

•Soil roof (high weight contrubition during seismic event)

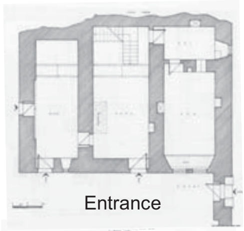
•Big openings because of windows of doors

•Irregular shear strength and out-of-plane stability of walls because of one way wooden slab beams

Bitlis-Typical house type




Typical floor plans



Buildings are generally two stories

Negative factors of this regions buildings

•The region is on the high slope

•Soil roof (High weight contrubiton during seismic events)

•Generally, high ratio of wall openings are encountered at living room walls

Comparison of the regional materials

	Structural load bearings	Non-bearing partitions	Roof structure materials	Mortar	Foundations	Windows and doors	Staircases
Bitlis	Uniform ashler stone walls	Stone walls and half timber frames with adobe infills	Wooden beams + soil roofs	Thatched mud	Strip stone masonry	Wooden	Wooden
Erzurum	Corners and some parts of exterior walls are ashler stone walls and the others are random rubble walls	Adobe walls	Wooden beams + soil roofs	Thatched mud and lime mortar	Strip stone masonry	Wooden	Wooden
Tokat	Half timber frames with adobe infill walls	Adobe walls	Wooden slabs and wooden beams + traditional tile roofs	Thatched mud	Strip stone masonry	Wooden	Wooden
Denizli	Variable size stone Walls	Stone and wooden walls	Wooden and wooden beams + tile roofs	Mud	Strip stone masonry	Wooden	Wooden

Typical problems and strengthening concepts

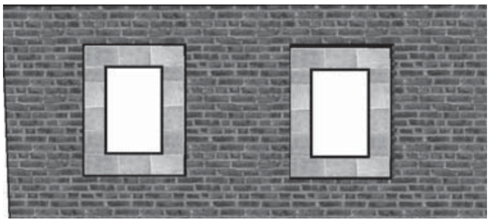
- Wrong type of bricks, wrong coursing, removal of walls

Typical problems and strengthening concepts

- Heavy roofs and one way structural system of roofs/floors

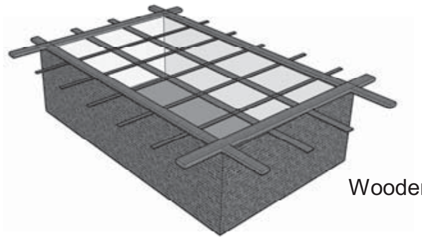
Typical problems and strengthening concepts

- Too many and too wide openings



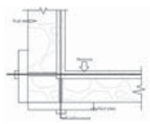
Typical problems and strengthening concepts

- Insufficient diaphragm action



Typical problems and strengthening concepts

- Weak corner connections



Conclusions

- This survey study revealed that all examined buildings have inconsistencies with the relevant regulations at different levels in terms of configuration of structural system and material quality.
- Further studies towards increasing the number of examined buildings may create a chance of identifying the typologies of existing masonry buildings more realistically, and this can bring forward some efficient and feasible retrofitting techniques

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Thanks & Questions

5. Session 2

“Japanese efforts for safer non-engineered houses”

Presented by Hidetomi Oi, Adviser, Global Environment Department, Japan International Cooperation Agency (JICA) / 国際協力機構 地球環境部 アドバイザー　大井英臣

ハイチ震災復興支援

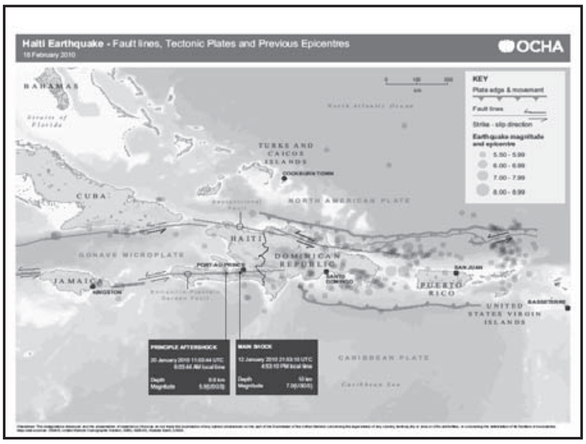
- Towards a Resilient Haiti -

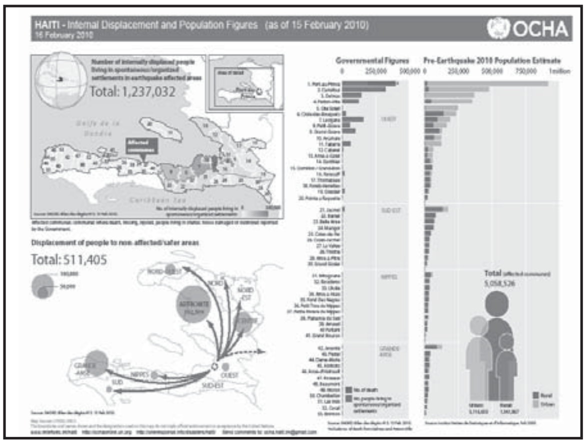
2010年2月26日

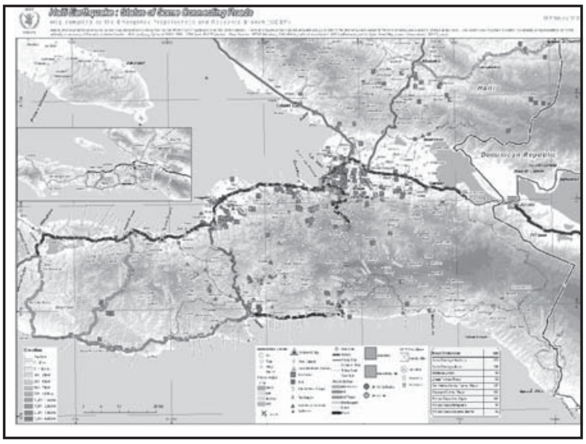
大井英臣

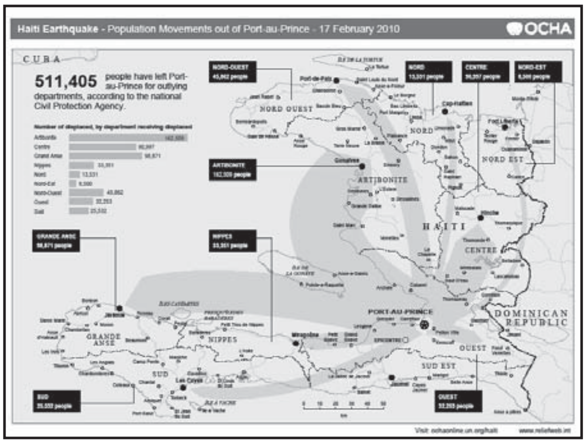
被害の概要

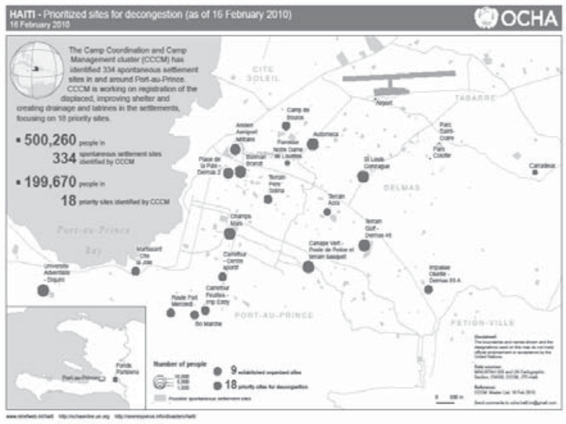
死者　　217,366人
避難者　120万人
家屋　　285,677戸
　　　　（全壊97,294、半壊188,383）
首都から地方への疎開　50万人

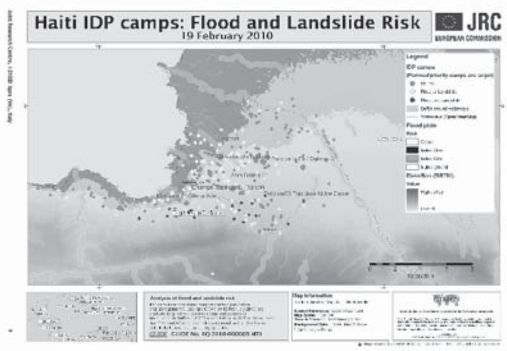


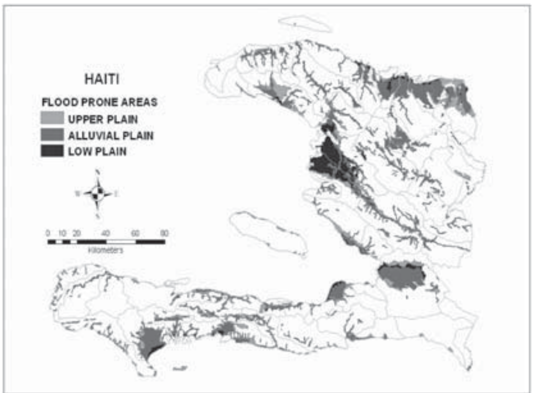


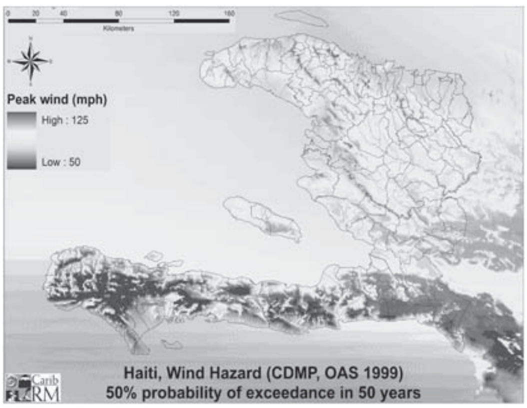












復興ニーズ調査(Post Disaster Needs Assessment：PDNA)

2月 8日～2月17日　Planning Mission
2月18日～2月20日　オリエンテーション
2月22日～3月11日　本格調査
～3月12日　報告書ドラフト
～3月18日　分析、協議
～3月24日　最終報告書

支援国会合

3月17日　支援国実務者会合（於ドミ共）
3月31日　支援国会合（ニューヨーク）

PDNA調査分野			
国土整備	国土整備	ガバナンス	法治国家
	地方分権化		司法・警察・国境監視
	土地管理、		行政・公共サービス
	流域・山地斜面管理		民主化プロセス
インフラ	住宅	経済分析	マクロ経済分析
	都市インフラ	分野横断的テーマ	ジェンダー・青少年
	交通		環境
	エネルギー		リスクと災害の管理
	通信		障害者・孤児・エイズ患者支援
	コミュニティーインフラ		
社会サービス	教育		
	保健		
	給水		
	衛生・下水		
生産	漁業・農業		
	商業・工業		
	観光		
	雇用		

防災体制

- ■ National Disaster Risk Management Systems (NDRMS) 2001
- ■ National Disaster Risk Management Plan (NDRMP)
- ■ National Risk and Disaster Management Committee (CNGRD)
- ■ Directorate of Civil Protection (DPC) 1997
- ■ Permanent Secretariat of Risk and Disaster Management (SPGRD)

- ■ Department DRM Committee at all 10 departments
- ■ Municipal DRM Committee at 110 municipalities out of 165

支援策の基本的な考え方

- 短期、中期的な支援ニーズに即した支援
- 日本の協力の継続性
- 日本の強み、リソースの活用
- 他ドナーとの調整
- 実施可能性（スキーム、実施体制等）

5.2 Summary of International joint research project on comprehensive strategies for earthquake disaster mitigation / 総合的な地震被害軽減方策についての国際共同研究の概要

Presented by Tatsuo Narafu, Information Center for Building Administration (ICBA) /
建築行政情報センター建築行政研究所研究部長楢府龍雄

Summary of International Joint Research Project on Comprehensive Strategies for Earthquake Disaster Mitigation

International Symposium on
"More resilient non-engineered houses for earthquake disaster reduction"
at Sokairo Hall, National Graduate Institute for Policy Studies (GRIPS), Tokyo, Japan

February 26, 2010

Dr. Tatsuo Narafu

Director, Research Department-1, Building Administration Research Institute,
Information Center for Building Administration (ICBA)

Background of Joint Research Project

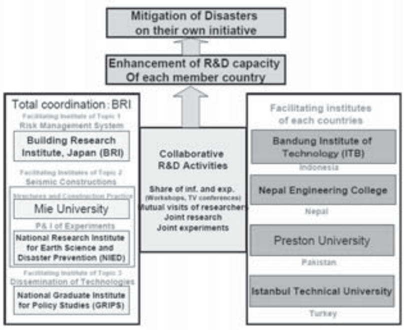
- Earthquakes cause serious damages to human societies
- Non-engineered houses are the main cause of human casualties
- Comprehensive approach is necessary for disaster mitigation including appropriate technologies, dissemination of technologies and risk management system/approach

Approach of the Joint Research Project

- R&D focuses on realization of mitigation of disasters
- To concentrate on conventional houses which is the main cause of human losses
- To prepare complete proposal of strategies based on comprehensive approach

Outline of the research project

- **Term of R&D**
  three years
  (2006-2008)
- **Target structures**
  Non-engineered constructions in developing countries, also applicable to developed countries like Japanese conventional houses
- **Funds**
  The Asia S&T Strategic Cooperation Promotion Program prepared by Ministry of Education, Culture, Sports, Science and Technology (MEXT)



Participating institutes

- **Indonesia**: Bandung Institute of Technology (ITB)
  Research Institute for Human Settlement (RIHS), Ministry of Public Works
  Gadjah Mada University (UGM)
  Syiah Kuala University (Unsyiah)
- **Nepal**: Nepal Engineering College (nec)
  National Society for Earthquake Technology-Nepal (NSET)
  Department of Urban Development and Building Construction (DUDBC), Nepal Government
- **Pakistan**: Preston University
  NWFP University of Engineering and Technology Peshawar

Participating institutes

- **Turkey**: Istanbul Technical University (ITU)
  Middle East Technical University (METU)
  Earthquake Research Division, Ministry of Public Works and Settlement, Turkey
- **Japan**: Building Research Institute (BRI)
  National Research Institute for Earth Science and Disaster Reduction (NIED)
  National Graduate Institute for Policy Studies (GRIPS)
  Mie University

Platform activities for the joint research project

- International symposium and video workshops connecting all the participating countries
- 18 events for three years for close collaboration

Research topics

- **Feasible and Affordable Seismic Constructions**

To develop appropriate seismic structures and construction practices, which will be expected to be accepted by communities

- Study by full scale shaking table experiments
- Bridge between engineering and construction practices
- Simple and affordable seismic isolation

- **Strategies for Dissemination of Technologies to Communities**

To develop strategies and tools for dissemination of technologies to people and communities

- **Risk Management System**

To develop systems and tools for evaluation of seismic risks by assumed earthquakes and for managing them

Topic 1: Feasible and Affordable Seismic Constructions

Study by Full Scale Shaking Table Experiments

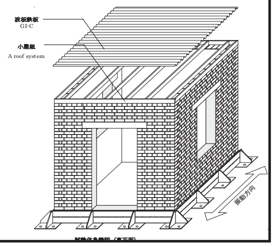
- **Full Scale Shaking Table Experiments on Several Types of Structures in Asia**
- **Several Methods are applied to analyze the results**
- **Activities Program**

2007 First Experiment in NIED
2007 Second Experiment in NIED
2008 Third Experiment in Peru

Shaking Table Experiment in NIED in Tsukuba on Dec. 27, 2007

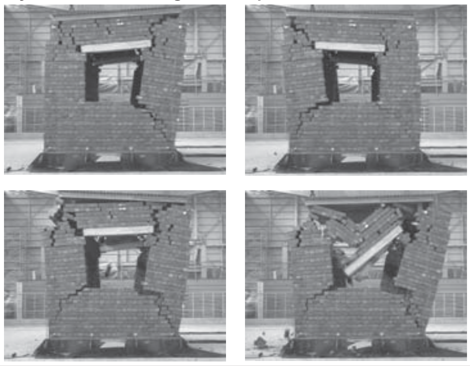
Table: 14.5mx15m

Loading Capacity: 90cm/sec., 940gals



Topic 1: Feasible and Affordable Seismic Constructions
Study by Full Scale Shaking Table Experiments

Collapse Procedure



Topic 1: Feasible and Affordable Seismic Constructions
Study by Full Scale Shaking Table Experiments

- Prepare DVD of results of experiments and distribute to share the data
- Organize workshops for detail explanation and discussion
- Approaches for analysis

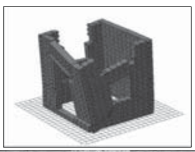
- Finite Element Method (FEM)
- Distinct Element Method (DEM)
- Frame Analysis Method
- Simplified Evaluation Methods

Topic 1: Feasible and Affordable Seismic Constructions
Study by Full Scale Shaking Table Experiments

- Analysis by several methods by participating researches

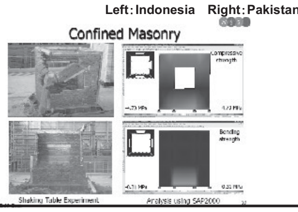
Finite element method (FEM)
Distinct element method (DEM)

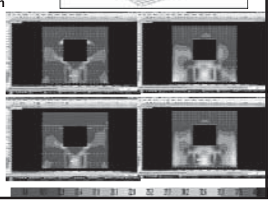
Result of DEM



Result of FEM

Left: Indonesia Right: Pakistan





Topic 1: Feasible and Affordable Seismic Constructions

Bridge between Engineering and Construction Practices

- Monitoring Construction Practices on Site
- Elaborating Recommendations which could be accepted and adopted by Local Workers

Samples from Indonesia, Peru and Iran

Indonesia

Buy at a small shop and obtain at a construction site

Peru

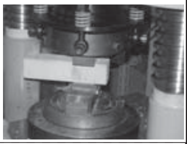
Buy at a small shop and a home center

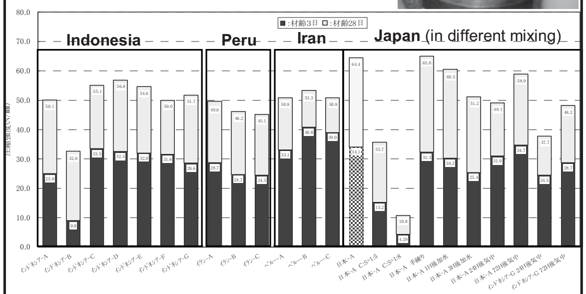
Iran

Obtain at a radey mixed concrete plant and a construction site

Compression strength of cement mortar by sample cement

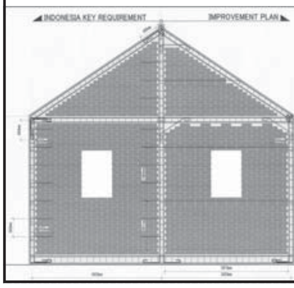
age: 28 days
age: 3 days

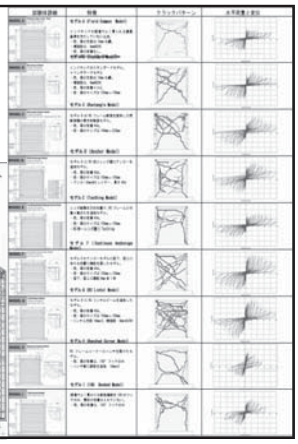




Bridge between Engineering and Construction Practices

- Proposed designs and result of cyclic loading test





Topic 1: Feasible and Affordable Seismic Constructions

Bridge between Engineering and Construction Practices

- Joint experiment of proposed designs in Bandung, Indonesia

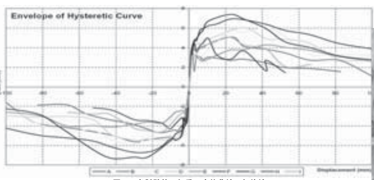
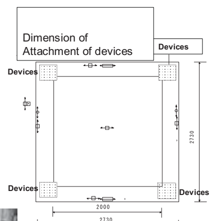


図1 各試験体の加重—変位曲線の包絡線

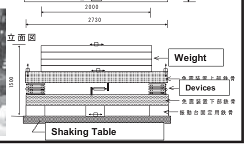
Topic 1: Feasible and Affordable Seismic Constructions

Simple and Affordable Seismic Isolation

- **Research Topics**
  - **- development of low cost isolation devices**
  - **- low cost rigid base**
  - **- simple construction procedures**
- **Activities**
  - **- Experiments on devices**
  - **- Workshops for dissemination**
  - **- Pilot project**

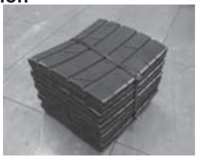


Shaking Table in Building Research Institute (BRI) in Tsukuba used for the experiments



Topic 1: Feasible and Affordable Seismic Constructions Simple and Affordable Seismic Isolation

- Several proposals were examined
  - -sliding device with stone and metal plates
  - -scrap tire pads
  - -geo textile sheets
  - -low cost rolling device





Topic 2: Dissemination of Technologies to Communities

- **Comprehensive Study on Dissemination of Technologies consisting followings**
  - **- collecting and analyzing good practices**
  - **- interview survey on risk perception of communities**
  - **- survey on policies of local and central government on disaster mitigation strategies**
  - **- pilot project with several approaches**
  - **- analysis of effectiveness of each approach**

Topic 2: Dissemination of Technologies to Communities

- Interview survey by same questionnaires in five countries
- ・interviewee
  - -people in two communities in different experiences of disasters in each countries
  - -construction workers
  - -officials of central governments
  - -officials of local governments

Interviews in Nepal

Interviews in Pakistan

Topic 2:Dissemination of Technologies to Communities

- Pilot project for dissemination and evaluation of effects in four countries
  - -Indonesia：disaster management education in primary schools
  - -Nepal：training programs for house wives
  - -Pakistan：demonstration with simple shaking table, training programs for masons
  - -Turkey：disaster management education in rural areas

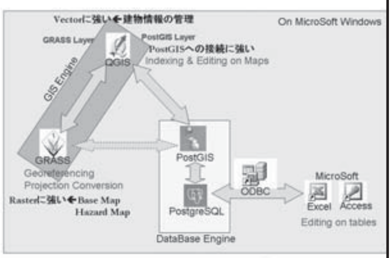
Nepal

Pakistan

Turkey

Topic 3: Risk Management System

- Development of a new system for Risk Management which enhances risk recognition of communities
- Community-based approach/Community participation
- Activities Program
  - preparation of tools
    mapping base using satellite image/aero photos
    simple evaluation criteria of seismic safety of houses
  - case study in several districts
  - elaboration of the system

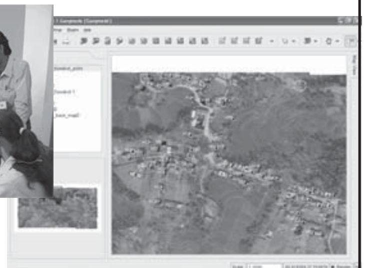


選定したフリーソフトウェアによるシステム構成概念図

Topic 3: Risk Management System

- Case study with tools prepared by the joint research project
- Successful result

high school students could have a good command of the tools


Firm international platform for collaboration
was established
through intensive joint research
We drew a lot of lesson from our activities
and share them by
periodical video workshops
Thank you for your kind attention

5.3 Lessons from assistance for reconstruction in Indonesia / インドネシア災害復興支援の教訓

Presented by Kozo Nagami, Information Policy Department, Japan International Cooperation Agency (JICA) / 国際協力機構　情報政策部 永見光三

インドネシア協力 災害復興支援の教訓
Lessons from JICA Disaster Reconstruction Assistance in Indonesia

February 2010
Japan International Cooperation Agency
永見　光三　Kozo Nagami

第一部：北スマトラ島沖地震津波災害復興支援
Part 1: Reconstruction support program for Aceh

北スマトラ島沖地震津波
2004 Indian Ocean Earthquake

- Devastating Damage (M9.0)
- Damage in Indonesia
  - 12/26/2004
  - Killed and Missing:　more than 200,000
  - Seriously Damaged Houses：81,942
  - Partly Damaged Houses：58,785

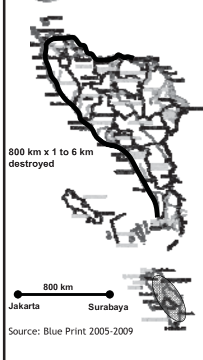
Source: BRR and International Partners (Aceh and Nias One Year After the Tsunami, 2005)

2004 Indian Ocean Earthquake

スマトラ島北西部沖の震源地（M9.0）Epicenter
(2004年12月26日午前8時7分：現地時間)

出典：インドネシア国北スマトラ島沖地震津波災害緊急復旧・復興プログラム(URRP)

Tsunami Impact on Economy



Source: Blue Print 2005-2009

5 %	Economic Decrease Projection in Aceh
20 %	Economic Decrease Projection in Nias
32 %	Income per capita decrease
5.176	SMEs damaged/destroyed
7.529	Small shops damaged/destroyed
1.191	Restaurants damaged/destroyed
25	General Banks damaged/destroyed
4	People's Credit Banks (BPR) damaged/destroyed
20	Microfinance Institutions damaged/destroyed
195	markets damaged/destroyed
20.000 ha	fishpond damaged
60.000 ha	agricultural land damaged
220.907	people lost their job

出典：BRR（2007年4月CFAN3報告）/ Source: BRR (CFAN3 report, Apr. 2007)

JICA Reconstruction Assistance

- Emergency Relief right after
- Rehabilitation and Reconstruction Assistance
  - Core Project = URRP (Urgent Rehab and Recon Plan)
    - BA City Reconstruction Urban Planning
    - Engineering Survey for the Infrastructure Rehabilitation Non-project Type Grant Aid
    - GIS Data Mapping
    - Septage Treatment Plant Rehabilitation
  - Community Empowerment (Trauma care, Livelihood Revitalization etc.)

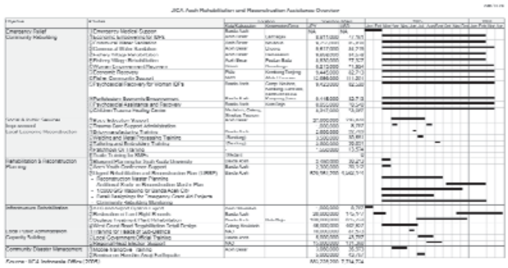


表1：アチェ復旧・復興支援事業の展開状況（2005年11月時点）
Table 1: JICA Aceh Rehab and Recon Overview (as of Nov. 2005)

BA Reconstruction Urban Plan

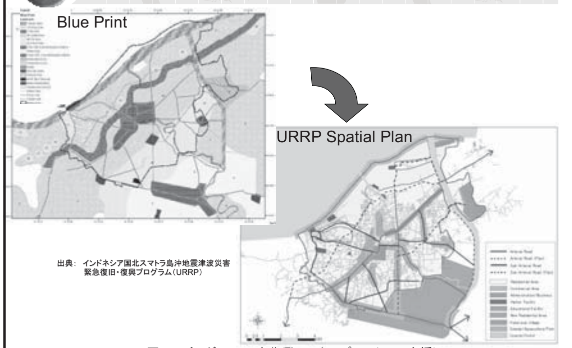


図1：バンダ・アチェ市復興マスタープラン（JICA支援）
Chart 1: BA City Reconstruction Master Plan

Septage Treatment Plant Rehab

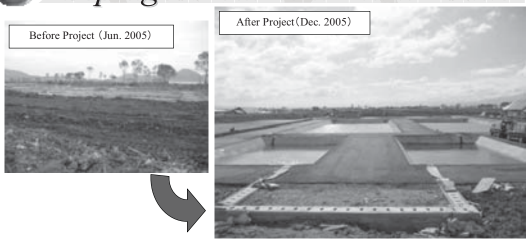


写真1：緊急インフラ復旧（し尿処理場）Photo1: Urgent Rehabilitation

- Sanitary and environmental negative impact from the human waste ocean dumping by collection vehicles
- Capacity: 50 m^3/day (100,000 population)
- One of few projects completed before the first anniversary

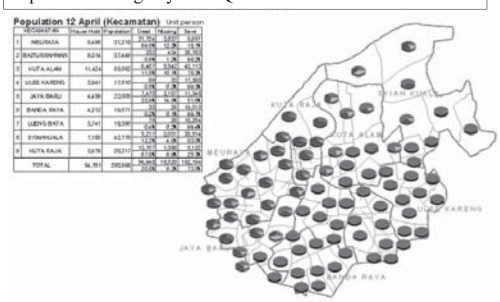
Sanitary/Environmental Education

Transit to Mid-/Long-term Recon.

- Trigger: GAM Peace Agreement (Aug 2005)
- Reflection from the prior results
  - Insufficient integration between infrastructure and community
    - Infrastructure assistance in coastal heavily damaged area
    - Community assistance in inland less damaged area
- Integrated assistance at the community buildings
  - Urban Disaster Mitigation Facility (JICA Mater Plan) = Community buildings
  - Livelihood revitalization activity
    - Activities: local cake baking, dried-salted fish, traditional handicraft, etc
    - Institutionalization and instruction by facilitators
    - Succeeded as a model reconstruction activity
    - Resulted in sustainable replication (second and third generation)

Damage on Banda Aceh City

Population change by the EQ and Tsunami



地区（Desa）別人口変化概況図（2005年4月12日時点）

Livelihood Revitalization Assistance

写真2：住民生計向上支援 / Photo 2: Livelihood Revitalization Activity
バンダ・アチェ市ウレレ地区(2006年) / Ulee Lheue, Banda Aceh City (2006)

Community Building

写真3：コミュニティ・ビル建設 / Photo 3: Community Building
バンダ・アチェ市ウレレ地区(2008年3月完成) / Ulee Lheue, Banda Aceh City (Mar. 2008)

- Escape facility for the coastal zone (3 in Ulee Lheue)
- Community daily activity base

Extending Community Assistance

- Project on Self-sustainable Community Empowerment Network Formulation (アチェ州住民自立支援ネットワーク形成プロジェクト)
  - Extending the Ulee Lheue model to other regions in Aceh province（Jan 2007 – Mar 2009）

写真4：アチェ復興支援ラジオ番組（2007年9月）
Photo 4: Aceh Radio Broadcasting Support (Sep 2007)

- Broadcasted from RRI station rehabilitated by the Japan Grant Aid
- Weekly one hour program (from Jul 2005 – Mar 2009)
- Interactive telephone dialogue with listeners

Problems in the Aceh Recon Process

- Initiative from the central government
  - Political importance ⇒ BRR (Apr 2005)
    - Prolonged GAM conflict
    - Need quick remedy for social and economic confusion
  - Insufficient local government capacity (Aceh province, kabupaten and BA)
    - Massive damage scale
    - Local gov officials also disaster affected
  - Difficult community involvement

BRR Strategy

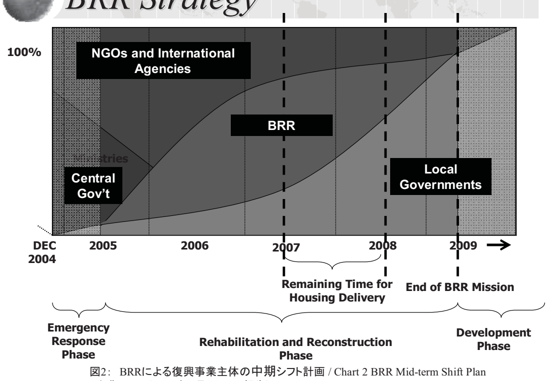


図2：BRRによる復興事業主体の中期シフト計画 / Chart 2 BRR Mid-term Shift Plan
出典：BRR（2007年4月CFAN3報告）/ Source: BRR (CFAN3 report, Apr. 2007)

Progress after 2.5 years

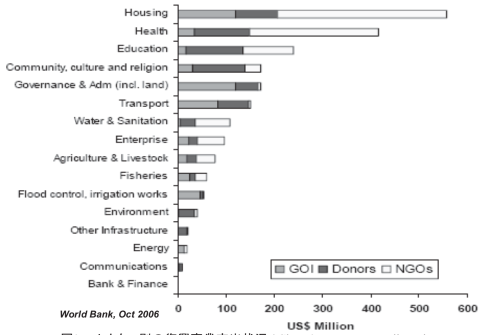


図3：セクター別の復興事業支出状況 / Chart 3: Recon expenditure by sector
出典：BRR（2007年4月CFAN3報告）/ Source: BRR (CFAN3 report, Apr. 2007)

Problems in the Aceh Recon Process

- Delay in house reconstruction (Apr 2007)
  - Direct support (temporary/permanent house provision) by GOI and NGOs
    - Limited support from donors
    - ⇔ donors were rather concentrating on transportation and education sector infrastructure
  - Problems in acquiring speed and quality
    - Low quality house problems
    - Limited house option for residents (allocated by areas)

Delay in House Reconstruction

	Reconstruction and Relocation			Rehabilitation			Renters/Squatters		
ORGS	Need	Commit	Complete	Need	Commit	Complete	Need	Commit	Complete
NGO/IA		104,148	48,450		2,058	1,605		492	0
MDF	136,000	8,113	2,645	39,000	3,271	3,210	12,000	0	0
BRR		33,224	10,623		8,776	8,496			
Total	136,000	145,485	61,718	39,000	14,105	13,311	12,000	0	0

表3：各主体による住宅再建事業の進捗状況 / Housing Progress by Organizations
出典：BRR（2007年4月CFAN3報告）/ Source: BRR (CFAN3 report, Apr. 2007)

Delay in Community Revitalization

- House reconstruction delay resulted in community revitalization delay
  - It took 1.5 years until JICA could proceed into integrated assistance for community (since mid 2006)
  - Infrastructure assistance by donors could not properly yield the expected impact due to the community recovery delay
- Total reconstruction delay

第二部：ジャワ島中部地震災害復興支援
Part II: Central Java Earthquake Reconstruction Program

ジャワ島中部地震災害
Central Java Earthquake

- Damage
  - 5/27/2006
  - Killed and Missing:　5,716
  - Houses Destroyed:　156,664
  - Houses Damaged:　202,032

Source: International Recovery Platform (The Yogyakarta and Central Java Earthquake, 2006)

Damage Assessment Result

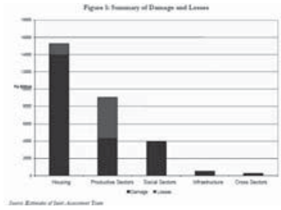


Chart 4: Damage by sector

Source: CGI Report (2006/6/14) "Preliminary Loss and Damage Assessment"

■ Majority in housing

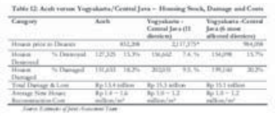


Table 12: Aceh versus Yogyakarta/Central Java – Housing Stock, Damage and Costs

Source: CGI Report (2006/6/14) "Preliminary Loss and Damage Assessment"

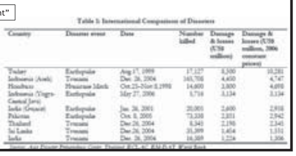


Table 1: International Comparison of Disasters

Actions Taken by GOI

- ■ GOI announcement
  - Community self-supported reconstruction
  - Local government initiative
    - Yogyakarta special district (DIY) + Kota/Kabupaten
    - Little intervention from central (except fund)
    - Reflections from Aceh experience
- ■ House reconstruction subsidy
  - Subsiding house reconstruction cost (15 mil rup. per household)
  - Subsidy delivery through POKMAS (victim cooperatives)
    - Consist of 10-15 destroyed house owners
    - 11,545 POKMAS (141,691HH)
  - Mobilizing facilitators
    - Technical support of house reconstruction
    - 3 per (building, structure, social science) × 1,500 team

Facilitator Assignment Result

県・市		計画人数	2006年度配置済み人数(*1)				2007年度配置済み人数(*2)			
			シニア	技術系	社会系	合計	シニア	技術系	社会系	合計
Sleman県		405	112	137	125	374	124	147	132	403
Gunungkidul県		382	21	110	121	252	23	117	128	268
Kulon Progo県		153	49	47	51	147	49	48	51	148
Jogyakarta市		318	-	70	96	166	-	141	143	284
Bantul県		2,185	-	930	1,041	1,971	-	1,073	1,066	2,139
Bantul県内訳	a)Bantul 1	447	-	168	240	408	-	222	238	460
	b)Bantul 2	453	-	143	172	315	-	212	187	399
	c)Bantul 3	370	-	185	185	370	-	185	185	370
	d)Bantul 4	528	-	243	252	495	-	260	264	524
	e)Bantul 5	387	-	191	192	383	-	194	192	386
合計		3,443	182	1,294	1,434	2,910	196	1,526	1,520	3,242

単位）人

資料）州公共事業局の内部資料、2007年3月9日現在

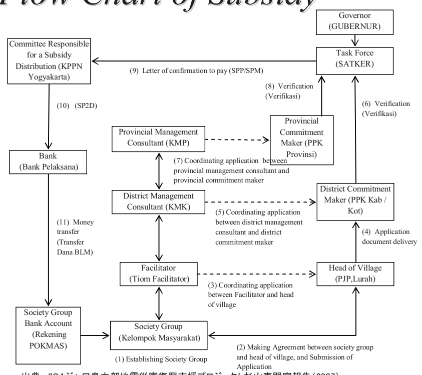
注１）*1の契約期間は2006年8月～2007年1月

注２）*2の契約期間はバントール県が2007年2月～2007年7月、その他県・市が2007年2月～2007年4月

出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

表4：　実際のファシリテーター配置状況 / Table 4: Facilitator assignment result

Flow Chart of Subsidy



出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

図5：　補助金支給の流れ / Chart 5: Flow mechanism of subsidy

Challenge in Program Formulation

- ■ Biggest needs in housing
- ■ Obstacles
  - ① Housing = Private property –> unfair?
  - ② GOI public administration capacity
  - ③ Urgency in disaster recon assistance
- ■ Prolongation risk

⇩

- ■ Adverse opinions and questionable comments on effectiveness

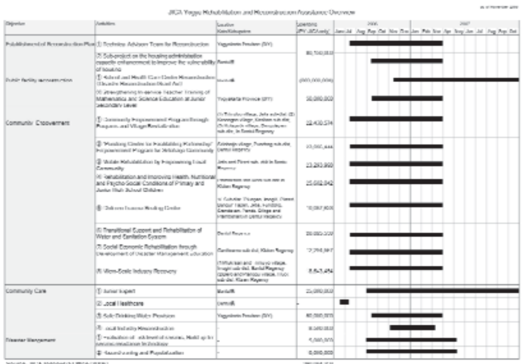


表4：　ジャワ島中部地震災害復興支援事業の展開状況（2006年11月時点）

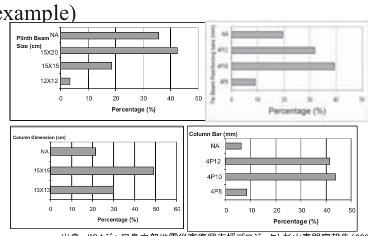
Table 4: JICA Yogya Rehab and Recon Assistance Overview

House Reconstruction Assistance

- "Sub-project on building administration capacity enhancement to improve the vulnerability of housing"「住宅再建促進及び建築強度改善のための建築行政支援サブ・プロジェクト」の実施
  - To disseminate, publicize and enlighten the know-how and technique of improving building strength
  - To propose essential conditions of EQ-resistant houses affordable even for the poor
  - To propose a rational, efficient and accountable process of building administration
  - To propose a comprehensive plan for dissemination of EQ-resistant building

Inventory Survey

- Information gathering for "Key Requirement"
- Feasibility and objectivity assurance
  - Surveying 133 houses (29 types) by NGO/GOI
  - Tie beam (example)
  - Column



出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

図6： インベントリ調査結果（例） / Chart 6: Inventory Survey Result Examples

Key Requirement

- Essential conditions of EQ-resistant houses attaining both feasibility and effectiveness
- Co-editing with local expertise (Teddy Boen and UGM faculty)

Items	Category		Standard
材料品質 Material	コンクリート concrete		cement : fine aggregate : coarse aggr＝1 : 2 : 3
	モルタル mortar		cement : fine aggr＝1 : 4
	基礎石 foundation stone		Yes
	乾燥した木 dried wood		Yes
主要部材の構造断面 Structural Profile	基礎 foundation	底面幅 bottom width	over 60cm
		上部幅 upper width	over 30cm
		高さ height	over 60cm
	地中梁 tie beam	最小断面 dimension	over 20cm × 15cm
		主筋 steel bar	over 4 × 10mm
		肋筋 stirrups	8mm@15cm spacing or 6mm@12cm spacing
	柱 column	最小断面 dimension	over 15cm × 15cm
		主筋 steel bar	over 4 × 10mm
		帯筋 stirrups	8mm@15cm spacing or 6mm@12cm spacing
	梁 beam	最小断面 dimension	over 12cm × 15cm
		主筋 steel bar	over 4 × 10mm
		肋筋 stirrups	8mm@15cm spacing or 6mm@12cm spacing
	壁最大面積 maximum wall dimension		less or equal 9 square meter
	妻側斜め筋 inclined beam at gable		Yes
	壁フレーム wall frame		Yes
構造部材の接合 Structural Member Jointing	柱と地中梁の定着 anchoring b/w column and u/g beam		over 40cm
	壁への接合 anchor of wall		Yes
	妻側定着 anchor of gable		Yes
	屋根桁側筋かい wind bracing		Yes
	鉄筋定着長さ overlapping of reinforcements		over 40cm

表5： キー・リクワイヤメント規程内容 / Table 5: Key Requirement Prescriptions

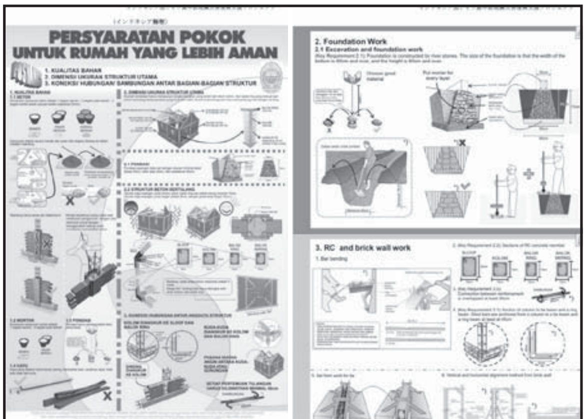


図7： キー・リクワイヤメント・ポスター / Chart 7: Key Requirement Poster

Legislation on Key Requirement

- POSYANIS set at 17 Kecamatan, Bantul (1/30/2007)
- Empowering Kecamatan regarding the IMB (building certification) process (2/6/2007)
- Bupati decree on the technical support centers (PUSYANIS (Kabupaten) and POSYANIS (Kecamatan)) (2/8/2007)
  - Legislating the key requirement, exceptional free of charge IMB process, process flow, proto-type house design.
- Public announce of officials at PUSYANIS and POSYANIS by name (2/17/2007)

写真－ DLINGO郡のPOSYANIS
Photo- POSYANIS at DLINGO

写真－ 村での再建組合リーダーへの技術普及集会
Photo- Technical Workshop for POKMAS leaders

写真－ POSYANIS職員向け建築申請研修
Photo- IMB Process Training for POSYANIS officials

出典：JICAジャワ島中部地震災害復興支援プロジェクト竹谷ジェネラル・アドバイザー報告（2007）

Significance of Self Recon Process

- Value criteria survey for housing
  - Safety is the highest ⇔ Social failure
    - Constructor (mandor) skill? Moral?
    - Lack of monitoring mechanism by the gov?

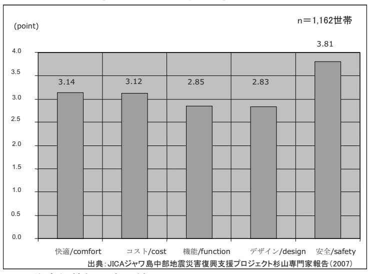
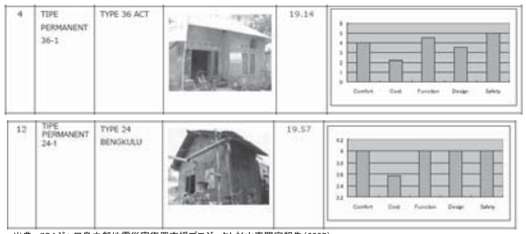


図8: 住宅価値観調査の結果 / Chart 8: Value Scale Survey Result

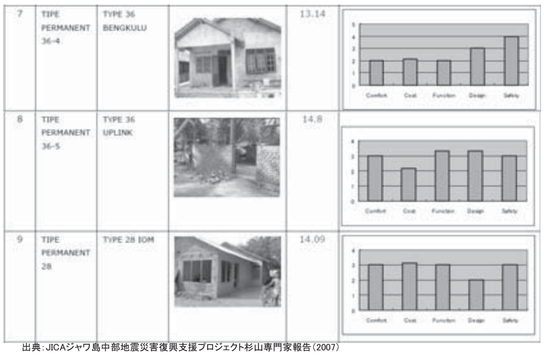
Value Criteria Survey on Housing



出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

- High safety level with balanced scores (except cost)

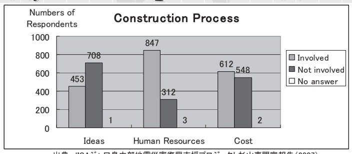
Value Criteria Survey on Housing



出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

Community Participation

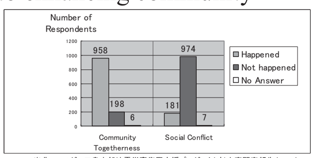
- High participation



出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

図9: 建築プロセスへの住民参加率 / Chart 9: Participation Rate

- Contribution to enhancing community

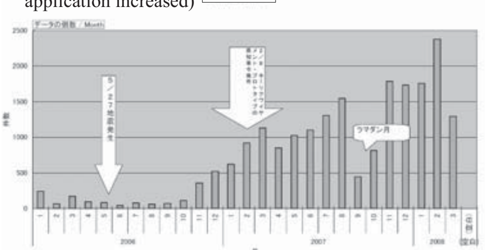


出典：JICAジャワ島中部地震災害復興支援プロジェクト杉山専門家報告（2007）

図10: コミュニティ関係への影響 / Chart 10: Effect on Community Relationship

Ex-post Assessment Result

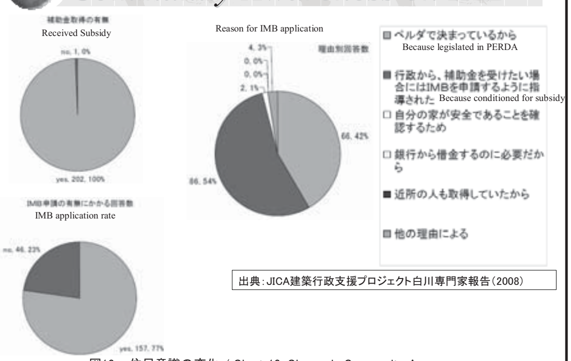
- Increased IMB applied
- Enhanced but still limited process capacity (Unprocessed application increased)



出典：JICA建築行政支援プロジェクト白川専門家報告（2008）

図11: 月別建築確認（IMB）発行数 / Chart 11: Processed number of IMB

Community Awareness on IMB



出典：JICA建築行政支援プロジェクト白川専門家報告（2008）

図12: 住民意識の変化 / Chart 12: Change in Community Awareness

第三部：教訓と提言
Part 3: Lessons and Recommendation

Comparison Aceh and Central Java

	Aceh	Central Java (Yogyakarta)
GOI policy	Central Gov initiative	Community self reconstruction
House Recon Actor	BRR	House owners
Fund Flow	Nation to BRR	Nation/province to community
Constructor	BRR	Owners or *mandor* (local master builder)
House Recon Speed	**68,881 houses / 2 year** Source: BRR (2007)	**146,173 houses / 1 year** Source: Java Reconstruction Fund (2007)
JICA Assistance (house related)	Urban recon planning (incl. Community building)	Building administration enhance IMB (Building certification) process enhancement for EQ resistant house
JICA Assistance (other)	Community empowerment Economic reconstruction Infrastructure rehabilitation Local government CB Social welfare service (education)	Community empowerment Local industry revitalization Reconstruction design of schools and health centers Junior experts
Total JICA Exp.	approx. 874 mil yen (as of 11/2005)	approx. 400 mil yen (as of 11/2006)
Japan Grant Aid	approx. 14,600 mil yen	approx. 1,000 mil yen

表5：　アチェと中部ジャワのケース比較 / Table 5: Comparison Aceh and Central Java

教訓 *Lessons*

- Common understanding "direct assistance not applicable to personal property i.e. housing" might lead to 個人財産である住宅再建の直接支援は難しいという共通認識　⇒
  - Housing issue not included in the recon program. 復興支援で住宅再建支援が置き去り。
  - Just a technical assistance such as retrofitting pilot and building code revision cannot assure the effectiveness. 耐震補修や建設基準・方式にかかる技術提言、パイロット建設での小規模供給では実効性確保が課題になる。
  - Thus, infrastructure biased recon program might further delay the community revitalization and thus yield insufficient assistance impact. インフラ支援偏重の結果、さらにコミュニティ全体の復興遅延が生じ、支援インパクトが発現しにくくなる。

教訓 *Lessons*

- Opportunity given in the Central Java EQ Recon Program ジャワ島中部地震復興における機会
  - GOI policy to subsidize house owners enabled indirect housing assistance in the IMB process. 住民への補助金直接支給というインドネシア政府の政策　⇒　行政面（建築確認プロセス）から住宅再建支援を実施
  - Quick actions e.g. legislation and decrees by GOI. インドネシア政府側の迅速な制度化（県知事令など）

教訓 *Lessons*

- Success Factor 成功要因
  - Key Requirement
    - Recognized as the highest priority government action that is highly feasible even with the immature public administration capacity in a severe post-disaster situation. 未熟な建築行政能力をもってしても、また、震災復興という厳しい状況であっても、十分に実現可能性が高く、かつ、真に重要で最優先すべき行政課題として認識されたから
    - Replication request was made for the West Sumatra (Padang) EQ Reconstruction パダン沖地震復興でも同様支援要請を受けた

今後の課題（提言） *Recommendation*

- Legislation assistance on the house reconstruction subsidy mechanism before EQs. 住宅再建支援（補助金支給）にかかる制度設立支援（平常時から法制度化）
- Building administration assistance with the Key Requirement after EQs. 住宅再建支援制度の被災地における施行支援（キーリクワイヤメント普及等）
- Consider housing as the core issue when designing the entire reconstruction program. 復興支援にかかる住宅再建支援の重要性の認識強化と、住宅再建を幹にした復興支援全体像の設計の重視
- Schematic invention to directly assist housing such as financial assistance loan. 住宅再建支援にかかる直接支援策（財政支援ローン等の活用）
- Combined assistance with house provision by NGOs and donors. NGO・他ドナーとの住宅再建連携（例：制度面JICA+住宅供給NGO）

5.4 Japan's ODA Project in Peru, Dissemination of Seismic Adobe House / ペルーにおける日本のODAプロジェクト～アドベ耐震住宅の普及～

Presented by Akihiko Tasaka, Ex-First Secretary of Embassy of Japan in Peru / 前・在ペルー大使館書記官 田阪昭彦

Japan's ODA Project in Peru, Dissemination of Seismic Adobe House.

ペルーにおける日本のODAプロジェクト
～アドベ耐震住宅の普及～

Akihiko TASAKA, Ex-First Secretary of Embassy of Japan in Peru
田阪昭彦(前・在ペルー日本大使館　一等書記官)

Abstract

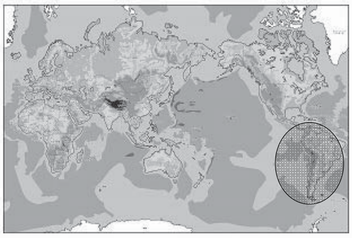
- 1.Social background
- 2.Project background
- 3.Project-Phase 1
- 4.Project-Phase 2
- 5.Consideration

2

1.Social Background

Geographical Features

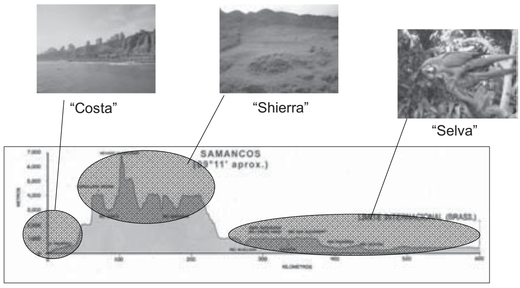
Republic of Peru
Land Area 1,285,216 km2
latitude S3-18, longitude W69-81



3

1.Social Background

Topography and Climate



4

1.Social Background

Population

- Population has increased, but inflow from mountain to costal are has accelerated.
- Currently, 75.9 percent of the population are concentrated in urban areas, while urban and rural gap widening.

Area	28,221 thousnds
Costal Area	54.6%
Mountain Area	32.0%
Jangle Area	13.4%

Source : Censos Nacionales 2007: XI de Población y VI de Vivienda
Instituto Nacional de Estadística e Informática (INEI)

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1.Social Background

Social Situation

Social INDEX	2006	2007	2008	Source
GDP Growth	7.74%	8.86%	9.84%	Inter-American Development Bank
Government Budget (Million Nuevo Soles)	45,388	61,998	71,342	Ministry of Economy and Finance *1USD=2.85 Nuevo Soles (Jan,2010)
GNI per capita (USD)	2,960	3,450	3,990	World Bank
DAC Category	Lower Middle Income Countries (LMICs)			OECD-DAC
Poverty Rate (Extreme Poverty)	44.5 % (16.1%)	39.3% (13.7%)	36.2% (12.6%)	Instituto Nacional de Estadística e Informática (INEI) Encuesta Nacional de Hogares Anual 2004-2008
Mortality rate, infant (per 1,000 live births)	27	25	17	World Bank
GINI Index	49.6			UNDP, Human Development Report 2009

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2.Project Background

Abstract

- 1.Social background
- 2.Project background
- 3.Project-Phase 1
- 4.Project-Phase 2
- 5.Consideration

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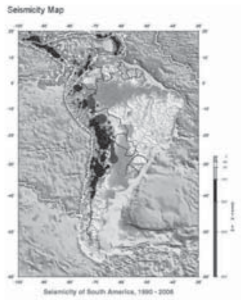
2.Project Background

Earthquake History

Historic Earthquake in Peru

- 1970.5.31 Chimbote,Hualas (M7.9)
- 1974.10.3 Lima (M 8.1)
- 2001.6.23 Moquegua (M 8.4)
- 2005.9.26 Moyobamba (M 7.5)
- 2006.10.20 Ica (M 6.7)
- 2007.8.15 Ica (M 8.0)

1970 Hualas (Photo: INDECI)



Source:The United States Geological Survey(USGS), Instituto Nacional de Defensa Civil, Peru

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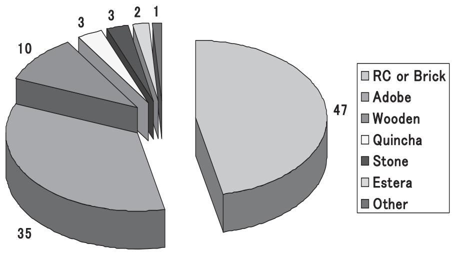
2.Project Background

House Type



Source : Censos Nacionales 2007: XI de Población y VI de Vivienda
Instituto Nacional de Estadística e Informática (INEI)

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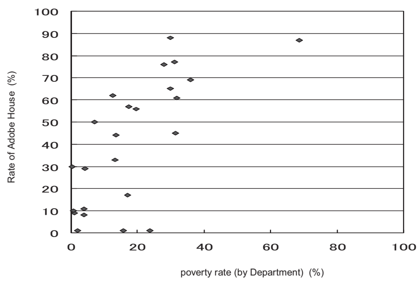
2.Project Background

Residents of Adobe House

- Relation between Poverty rate and adobe house



Source : Instituto Nacional de Estadística e Informática (INEI)

10

2.Project Background

Adobe houses Damage

- Adobe houses have been damaged severely, every time an earthquake occurs.

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2.Project Background

Building Codes

■On the other hand…

"REGLAMENTO NACIONAL DE EDIFICACION
-NORMA E.080 Adobe

12

2.Project Background

Project background

- If constructed in appropriate method…

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2.Project Background

Focus of the Project

- Conventional method
- Local materials
- Conventional construction system
  (Constructed by non-engineered residents)

Appropriate construction methods

Safer Seismic Adobe House

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3.Project Phase 1

Abstract

- 1.Social background
- 2.Project background
- 3.Project-Phase 1
- 4.Project-Phase 2
- 5.Consideration

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3.Project Phase 1

Project Objectives

[Overall Goal]
Decrease of earthquake damages by disseminating the technologies of seismic house in poverty areas.

[Project Objectives]
Dissemination of technologies of seismic non-engineered adobe house in the project areas.

[Term]
August 2005 – March 2007

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3.Project Phase 1

Overview of the Project

- Workshop
- Construction of Model Houses
- Regular Monitoring by Engineers

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3.Project Phase 1

Project Site

site	Building Type
Lunahuaná	House (1)
Pacarán	House(2)
Zúñiga	Communal Refectory (1)
Huangáscar	Communal House(1) Mothers' Center (1)
Huac-Huas	Communal House(1)

Google Map

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Workshop

- Design of the Model House
  - Adaptive design to the lifestyle of residents
  - Residents' increasing interest in their houses through participation.
- Enlightenment of Seismic Awareness
- Learning program about Adobe Construction

Photo:JICA

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Construction of Model Houses

- On the Job Training with NGO

Photo:JICA

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Regular Monitoring by Engineers

- Peruvian Engineers
- Japanese Expert

Photo:JICA

Photo:JICA

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Evaluation (by JICA and Experts)

- Model House was constructed in appropriate method, keeping high quality.
- Through the WS, residents have higher interests in their own houses.
- Residents and their community basically accept model houses and it's construction method, as well as their concept.

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Issues to Solve (By JICA and Experts)

- Continued Monitoring
  - Improvement of easier or reasonable construction method , through the continued Monitoring.
  - "Dissemination" has achieved some degree, then "implementation "?
- Cost Reduction – achieve some reduction, but…
  - Further reduction
  - Government involvement. Subsidy System, Establishment of system for compliance with building codes

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Lessons Learned (By JICA and Experts)

- Communication with Community
  - Through NGO, through community leaders
- Further Training
  - Not only the construction method, but the meaning of that method.
- Cost Reduction
  - Cost of cargo transportation (mountain area)
  - Local materials

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3.Project Phase 1

Abstract

- 1.Social background
- 2.Project background
- 3.Project-Phase 1
- 4.Project-Phase 2
- 5.Consideration

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4.Project Phase 2

Project Objectives

[Overall Goal]
Improve the safety and health conditions of adobe houses in poverty areas.

[Project Objectives]
Dissemination of technologies of seismic, sanitary functional and durable adobe house, so that engineers, construction masters (Maestro de Obra) and residents in poverty areas can acquire them.

[Term]
April 2007 – March 2010

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4.Project Phase 2

Overview of the Project

- Training to Architects, Engineers, Construction Master and Residents
- Construction of Model Houses
- Regular Monitoring by Engineers
- Structure Experiment
- Improvement of Manual

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3.Project Phase 1

Project Site

Site		Building Type
District	Department	
Lunahuaná	Lima	House (2)
Guadalupe	Ica	Communal House(1)
San juan	Cajamarca	Communal House(1)
Tarma	Junín	Communal House(1)

(cancellation)

Lunahuaná	Lima	House (2)
José sabogal	Cajamarca	Communal House(1)

Google Map

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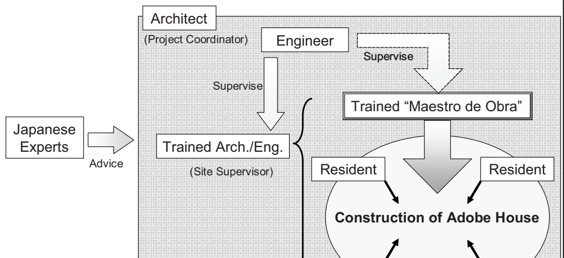
4.Project Phase 2

Project Team



Team 1- Tarma Department (Acobamba and Palca)
Team 2 - Cajamarca Department (San Juan and San Marcos)
Team 3 – Ica Department (Guadalupe)

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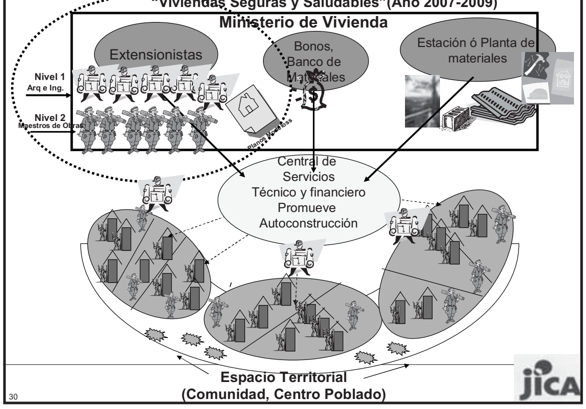
4.Project Phase 2

Propuesta del JICA para la 2da. Etapa del Proyecto "Viviendas Seguras y Saludables"(Año 2007-2009)



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Training to Architects and Engineers

Nº	Nombre y Apellido	Profesion	Centro de Trabajo	Cargo	Distrito	Provincia	Departamento
1	German Oswaldo Ascoy Vidal	Ingeniero Civil	Munic. Distrital De Magdalena de Cao	Asistente de oficina de Desarrollo Urbano y Obras	Magdalena de Cao	Ascope	La Libertad
2	Orgio Luis Chota Calampa	Ingeniero Civil	Munic. Distrital de San Juan	Responsable de diversas obras	Cajamarca	Cajamarca	Cajamarca
3	Anner Moreno Adrianzén	Ingeniero Civil	Munic. Distrital de San Juan	Responsable de diversas obras	San Juan	Cajamarca	Cajamarca
4	Carlos Alfonso Najarro Becerra	Arquitecto	Munic. Distrital de Pocsi	Gerente de Infraestructura	Pocsi	Arequipa	Arequipa
5	Alex Walter Alvarado Cruz	Ingeniero Civil	Munic. Provincial de Pomabamba	Evaluador de Proyectos	Recuay	Recuay	Ancash
6	Haynes Cordova Peña	Profesor	Diócesis de Chulucanas - Piura	Responsable de diversas obras	Chulucanas	Morropon	Piura
7	Wilder Sandro Jesús Contreras	Bach. Ingenieria Civil	Municipalidad Distrital de Acobamba	Asistente de la Oficina de Obras y Desarrollo Urbano	Acobamba	Tarma	Junin
8	Jose Perata Ostolaza	Arquitecto	Ministerio de Vivienda	Encarg. Cartera de Proyectos	San Isidro	Lima	Lima
9	Marco Risco Zevallos	Ingeniero	Ministerio de Vivienda	Encarg. de Ing. Cartera Proy.	San Isidro	Lima	Lima
10	Liliana Ninaquispe Romero	Arquitecta	Ministerio de Vivienda	Coord.Cartera de Proyectos	San Isidro	Lima	Lima
11	Yoel Herrera Paraguez	Arquitecto	ONG CIED-Perú	Asesor Técnico ONG CIED	Antioquía	Huarochirí	Lima
12	Constante Guillermo Castillo Alva	Arquitecto	Municipalidad Provincial de Sánchez Carrión	Encargado de la División de Planeamiento Urbano y Catastro	Huamachuco	Sánchez Carrión	La Libertad
13	Freddy Salas Chavez	Ingeniero Civil	Gobierno Regional de Arequipa (COPASA)	Apoyo en la elaboración de expedientes tecnicos	Arequipa	Arequipa	Arequipa
14	Noé Juan Huamán Coronel	Arquitecto	Municipalidad Distrital de Palca	Sub-gerente de obras públicas y desarrollo urbano y rural.	Palca	Tarma	Junín
15	Paolo Minaya Gonzáles	Ingeniero Civil	Municipalidad Provincial de Pomabamba	Proyectista	Pomabamba	Pomabam ba	Ancash
16	Cristóbal Cornetero Ayudante	Agrónomo	Municipalidad Distrital Jose Sabogal	Jefe Oficina de Agua y Saneamiento	José Sabogal	San Marcos	Cajamarca

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Training to Construction Master and Residents

Photo:JICA

Photo:JICA

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Construction of Model Houses

Photo:JICA

Photo:JICA

Photo:JICA

Photo:JICA

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Regular Monitoring by Engineers

- Advice for the project
- Evaluation of the model houses of phase 1
- Propose of improved method

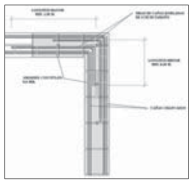

Photo:JICA

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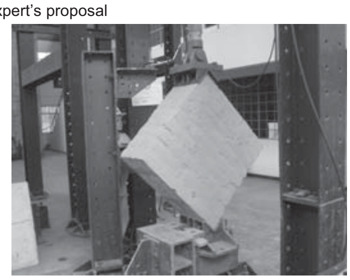
Structure Experiment

- Material Experiment
- Expert's proposal



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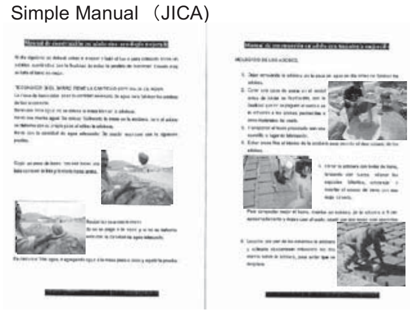
Improvement of Manual

- Simple Manual (JICA)



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Interim Evaluation (by Experts)

- Problems?
  - Not disseminated enough
  - Still Higher Cost
  - Lack of Publication
  - Incorrect Maintenance
  - Difficulty in Coordination with Ministry

Interim Evaluation (by Experts)

- Proposal
  - Improvement of the method (considering the local situation)
  - Cost Reduction
  - More public relations
  - Monitoring of Model House of phase 1

Abstract

- 1.Social background
- 2.Project background
- 3.Project-Phase 1
- 4.Project-Phase 2
- 5.Consideration

Consideration

- How to disseminate or Implement?
  - Approach from “Community Side”, not from the government side.
  - Target and concept.
- Why people don’t use this method.
  - Social and cultural background.
- Who take the main role ?
  - Government, Community, House Owner, NGO…
  - “Academic” or “Political”?
- Continuity

5.5 Community based disaster management and assistance for retrofitting /
インドネシア災害復興支援の教訓
Presented by Shoichi Ando, United Nations Centre for Regional Development (UNCRD) /
国連地域開発センター 防災計画兵庫事務所長 安藤尚一

コミュニティ防災と建築耐震化の支援
Community Based Disaster Management (CBDM) & Housing Erathquake Safety Initiative (HESI)

国際連合地域開発センター（UNCRD）

安藤尚一 Shoichi ANDO Dr.

Disaster Management Planning Hyogo Office
United Nations Centre for Regional Development (UNCRD)
United Nations Department of Economic and Social Affairs (UN/DESA)

26 Feb. 2010
2010年2月26日

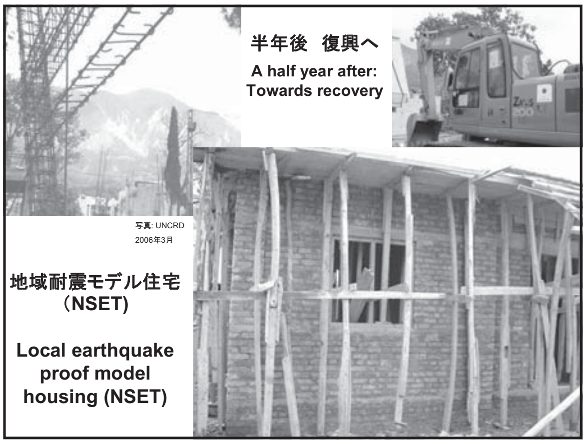
I. 最近の海外の災害事例から学ぶ Lessons from recent Disasters

Recent World Disasters　最近の世界の災害

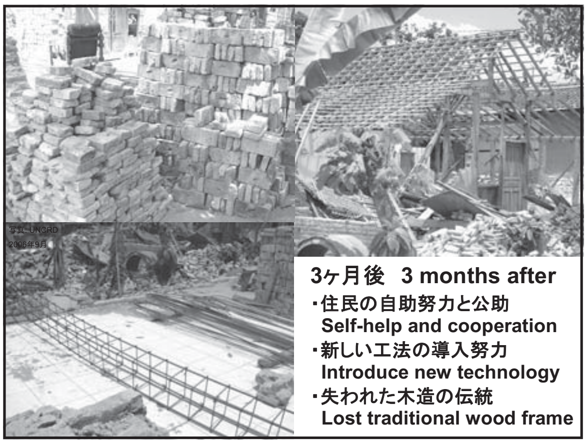
1. **Indian Ocean Tsunami インド洋津波 （2004.12.26）**
2. **Pakistan Earthquake パキスタン地震（2005.10.8）**
3. **Java Earthquake ジャワ島地震 （2006.5.27）**
4. **Peru Earthquake ペルー南部地震 （2007.8.15）**
5. **China Earthquake 中国四川大地震 （2008.5.12）**
6. **Cyclones in Asia アジア各地の台風 （2009ほか）**
7. **Haiti Earthquake ハイチ地震**(PAP) **（2010.1.12）**

災害の背景 Background of Disasters

1. 自然現象によるハザードは絶えず発生
   Constant occurrence of natural hazards
2. 人口の増加、都市の拡大等でリスクが増大
   Increasing risks by expansion of population/city
3. 途上国の貧困層に被害が集中する傾向
   Trends of heavier damages to the poor in LDCs
   （地震は中間層の場合も: Earthquake to middle incomes etc.）
4. 生態系の悪化、気候変動の激化
   Degradation of eco-system / Climate Change




半年後 A half year after:
DISASTER PREVENTION MODEL SCHOOL
SETHI BAGH GOVERNMENT GIRLS HIGH SCHOOL
APRIL 2007
URGENT REHABILITATION PROJECT
BY
JICA JAPAN INTERNATIONAL COOPERATION AGENCY
一年半後の被災地
One and a half year after
写真: UNCRD
2007年4月


3ヶ月後 3 months after
・住民の自助努力と公助
Self-help and cooperation
・新しい工法の導入努力
Introduce new technology
・失われた木造の伝統
Lost traditional wood frame

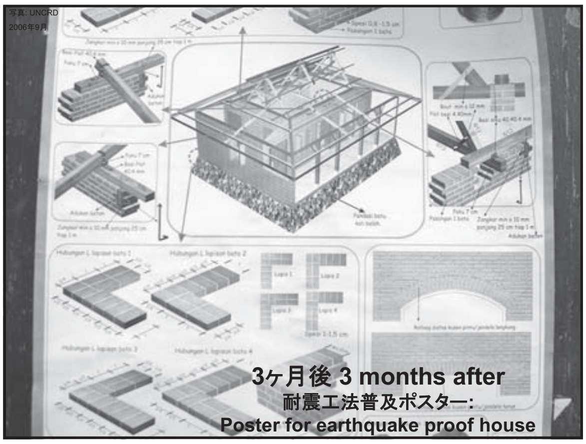


写真: UNCRD
2006年9月
3ヶ月後 3 months after
耐震工法普及ポスター:
Poster for earthquake proof house


一年後の被災地
One year after
SEMINAR
RECONSTRUCTION:
写真: UNCRD
2007年7月

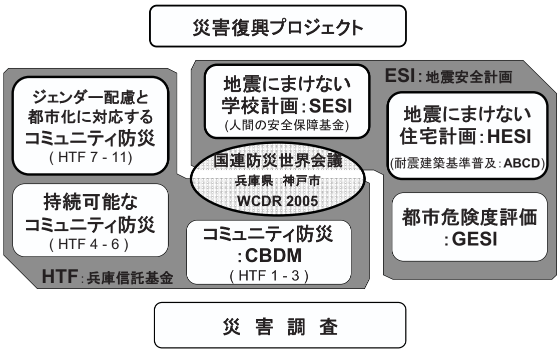

1週間後 One week after
写真: UNCRD
2007年8月


ペルーの太平洋
岸は雨が降らず
温暖なため屋根
が軽い
The roof is
light as there
is no rain and
warm weather.
写真: UNCRD
2007年8月
被災したアドベ住宅の内側
Inside of affected adobe house
2007.8 ペルー地震
Peru Earthquake

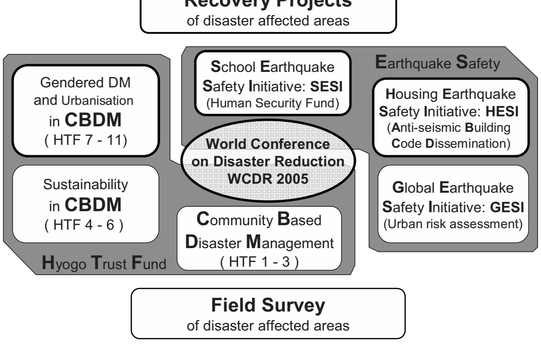
コミュニティ防災

Community Based Disaster Management

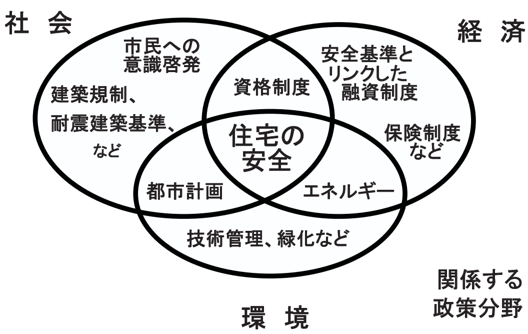
II. UNCRD 防災プロジェクト (1999 – 2009)

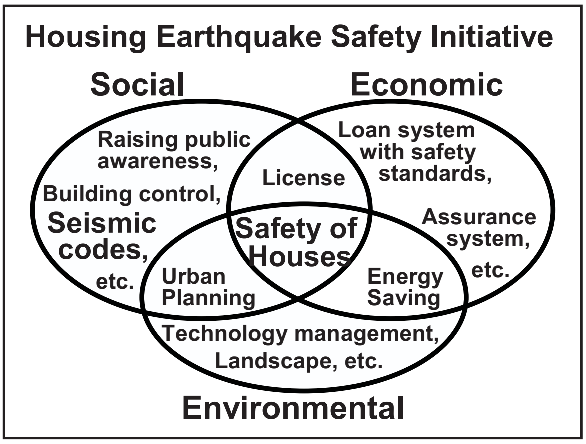


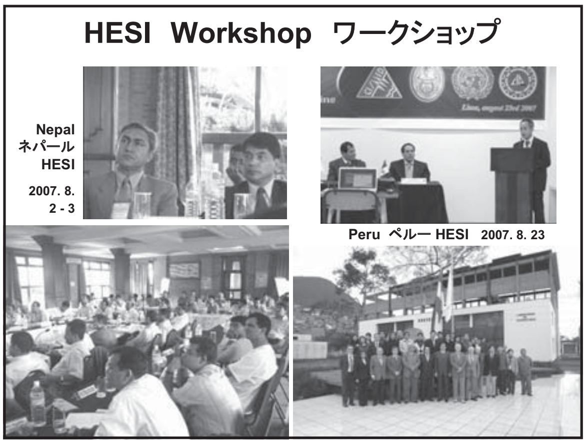
Projects (1999 - 2009) of UNCRD Hyogo



地震にまけない住宅計画 (HESI)







III. 結論 Conclusion

建築物の倒壊が地震災害の最大要因。
The collapse of building causes tragedies.

安全な建築は、技術者と行政の協力が必要。
Cooperation of engineers and governments,

その普及には、建築基準、検査制度のほかに技術者教育の仕組みやその材料が必要。
Building code, inspection system, engineer education and its materials are the keys.

他の地震国の経験を参考にすることも重要。
Experiences of other earthquake-prone country

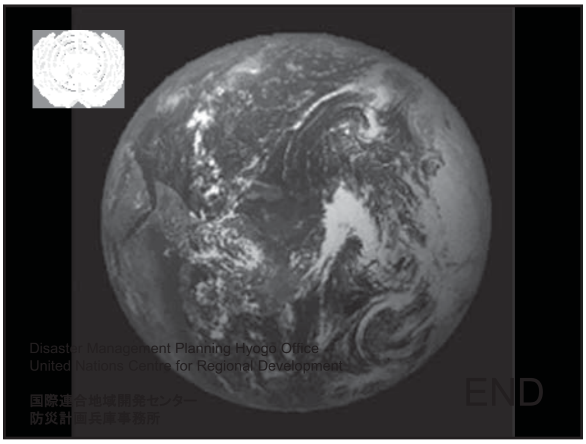
IV. 防災に関連する国連機関と対象範囲

Disaster related UN agencies / type of Hazards

- 調整機関 ISDR（旧 IDNDR, UNDRO）Coordination
- 人道支援機関 OCHA、UNICEF Humanitarian
- 開発融資機関 World Bank、ADB Finance
- 開発協力機関 UNDP、（JICA）Development
- 社会開発機関 UNESCO、WHO Social Dev.
- 研究・研修機関 UNU、**UNCRD** R&D / Training

- **政治 Policy** 防災体制、政策
- **経済 Economy** 防災事業、財政
- **社会 Social Affair** 防災教育、生活
- **知識 Knowledge** 防災技術、普及

災害	Hazards
洪水	Floods
暴風	Cyclones
地すべり	Land Slides
津波	Tsunamis
地震	Earthquakes
噴火	Volcano
干ばつ	Draught
疫病	Epidemics
森林火災	Forest Fires
温暖化	Global Warm
など	etc.



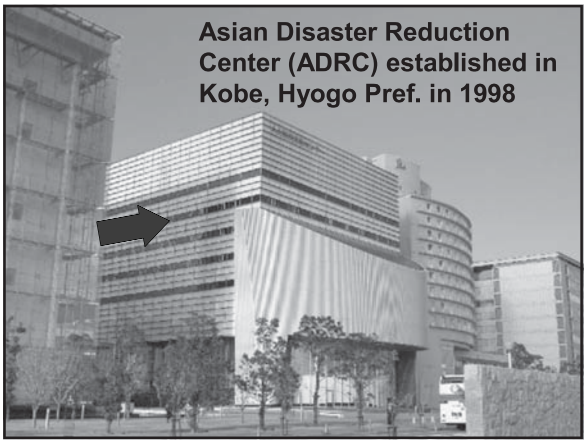
5.6 Earthquake Risk Reduction and Recovery Preparedness in South Asia /
南アジアにおける地震防災対策の推進
Presented by Atsushi Koresawa, Asian Disaster Reduction Center (ADRC) /
アジア防災センター所長 是澤優

Earthquake Risk Reduction and Recovery Preparedness Programme (ERRP) for South Asian Region

Atsushi KORESAWA

Asian Disaster Reduction Center

February, 2010



ADRC Member Countries

28 Member Countries, **5** Advisor Countries

Asian Conference on Disaster management

Held in Kobe, Hyogo, Japan, on 17-19 January 2010

Organized jointly by ADRC, UNSIDAR and Japan's Cabinet Office

Natural Disasters in South Asia

South Asia is regarded as one of the most critical hotspot of disasters

Disasters with more than 10,000 fatalities (1975-2008)

1983	Ethiopia	Drought	300,000
1976	China	Tangshan earthquake	242,000
2004	South Indian Ocean	Indian Ocean tsunami	226,408
1983	Sudan	Drought	150,000
1991	Bangladesh	Cyclone Gorky	138,866
2008	Myanmar	Cyclone Nargis	133,655
1981	Mozambique	Drought	100,000
2008	China	Sichuan earthquake	87,476
2005	India, Pakistan	Kashmir earthquake	73,338
2003	Europe	Heat wave	56,809

Source: EMDAT

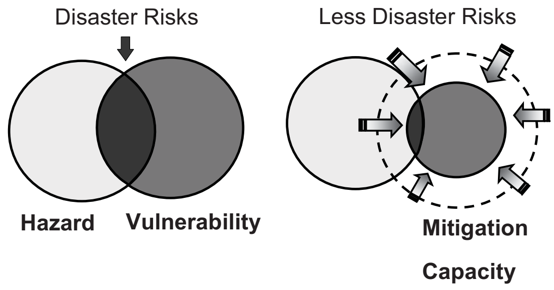
Earthquakes caused the deadliest disasters

"Earthquakes are the deadliest natural hazard of the past ten years and remain a serious threat for millions of people worldwide as eight out of the ten most populous cities in the world are on earthquake fault-lines"

"Disaster risk reduction is an indispensable investment for each earthquake-prone city and each community. Seismic risks is a permanent risk and cannot be ignored. Earthquake can happen anywhere at any time."

Margareta Wahlstrom, UN Special Representative of the Secretary-General for Disaster Risk Reduction

Conceptual Framework



Challenges facing South Asian countries

- Frequencies of earthquakes continue to result in extensive damages and loss of life
- Limited capacities of national organisations and low awareness in the most vulnerable communities add to the devastating impact of these disasters
- Public buildings (schools, hospitals, community centres etc.), infrastructure and private houses are in many cases highly vulnerable to earthquakes

Earthquake Risk Reduction and Recovery Preparedness Programme (ERRP)

Period: April 2007 – March 2010
Agencies: UNDP in partnership with ADRC
Budget : Approx. USD 4.8 million from Gov. of Japan
Coverage: Bangladesh, Bhutan, India, Nepal, Pakistan

Objectives:

- To strengthen the institutional and community capacity to plan and implement earthquake risk reduction strategies integrating disaster preparedness, mitigation and post disaster recovery
- To support regional cooperation for DRR and recovery preparedness in the context of SAARC Framework for Disaster Management

Roles of ADRC

At Regional Level

- Co-organize Regional Workshop
- Arrange Japanese and other experts as resources
- Facilitate regional cooperation
- Conduct "Pull Down Test"

At Country Level

- Provide training services
- Develop teaching materials
- Conduct Risk Assessment Reviews
- Hold Mini-workshop

Technical Assistance at country level

Delivered lectures to local officials and engineers at workshops in Bhutan, Nepal and Bangladesh on:
- Earthquake Safe Construction Design
- Retrofitting Techniques,
- Quality Management of Reinforced Building
- Earthquake Vulnerability Assessment

Developed:
- Lecture Notes for the Students of Colleges in Pakistan
- Training Slides on "Earthquake Damage to Buildings"
- Poster on "Key requirement for safer construction"

Reviewed:
- National Building Codes (Nepal)
- Existing Government and Municipal Policies (Nepal)
- Seismic Vulnerability Assessment of Buildings (Bhutan)
- Seismic Vulnerability Evaluation Guidelines (Bhutan)

Regional Workshop

Venues
Katmandu (Aug 2008), Islamabad (Apr 2009), Delhi (Jul 2009), Dhaka (Dec 2009)

Organizers
ADRC, UNDP, SAARC DMC, National Governments

Objectives
- Provide technical expertise on ERRP through presentations by experts
- Identify priority issues and address course of actions
- Facilitate knowledge-sharing and South-South cooperation

Pull Down Test

■ Objectives
- Main causes of deaths in past earthquakes were related to the collapse of buildings, especially non-engineered masonry buildings

- Examine seismic resistance of buildings with and without retrofitting and demonstrate differences

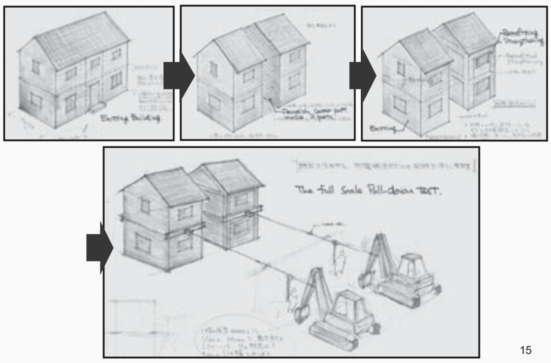
■ Retrofitting methods applied
- Use 1.6mm diameters, 19mm center-to-center distance galvanized wire mesh sheets on both sides of walls

- Drill holes for inserting binding wire @1 ft on center

- Plastering with 1:3= Cement :Sand Mortal

Retrofitting Method (Jacketing)

Process Image of Pull Down Test



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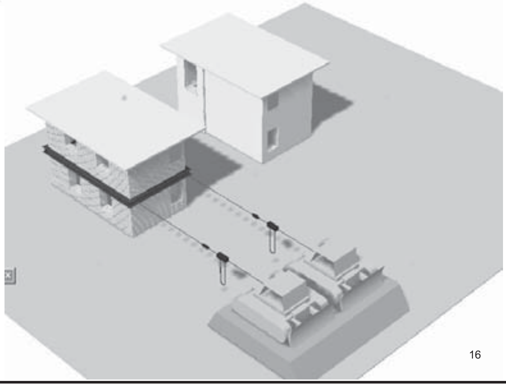
Bird’s Eye View of “Pull Down Test “



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Preparation for the pull down test

Original

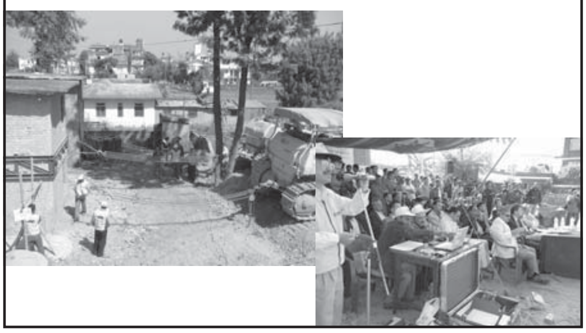
Brick Masonry in Mud Mortar built in 1967

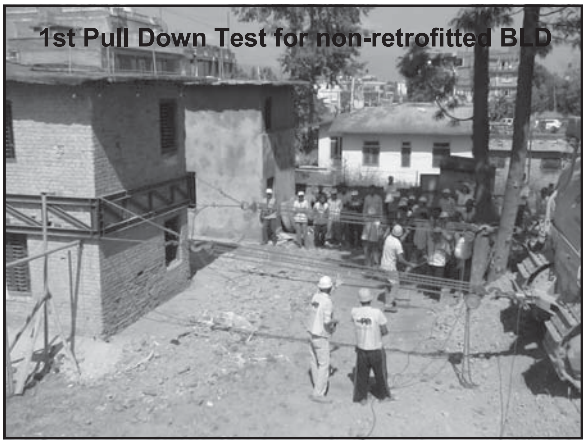
After separation

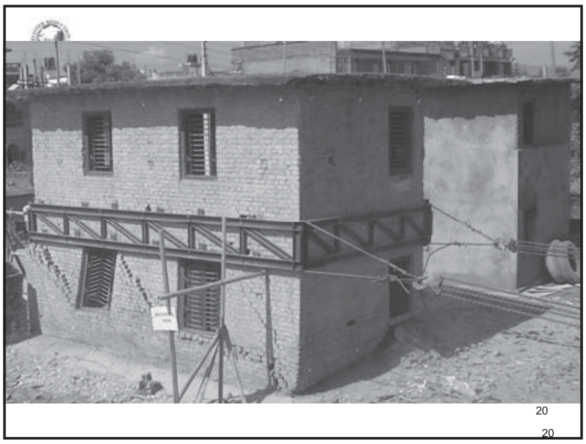
17

Pull Down Test

Oct. 15, 2009 : 1st Pull Down Test for non-retrofitted BLD
Nov.2-3 2009 : 2nd Pull Down Test for Retrofitted BLD




1st Pull Down Test for non-retrofitted BLD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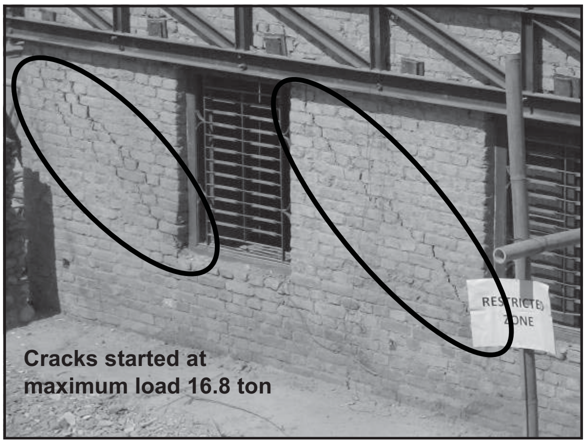
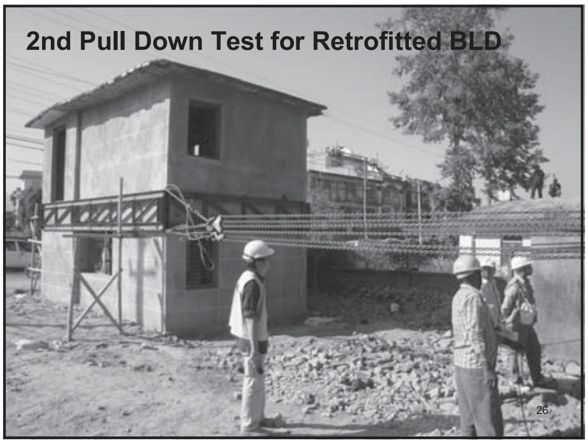
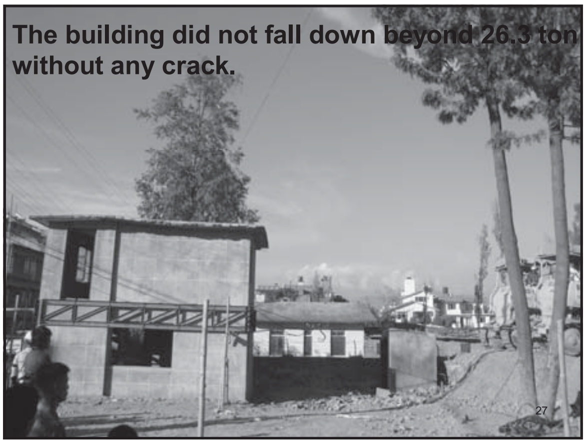

Cracks started at
maximum load 16.8 ton


Pull Down Test in NEPAL (1st IMAI camera).wmv
00:45:15
-00:01:44
22


Pull Down Test in NEPAL (1st IMAI camera).wmv
00:45:19
-00:01:41
23


Pull Down Test in NEPAL (1st IMAI camera).wmv
00:45:20
-00:01:40
24





Main outcomes of the pull-down test

- **The non-retrofitted building completely fell down by pulling with the intensity of 16.8 ton, whereas the retrofitted building did not even cause cracks when the intensity reached as much as 26.3 ton.**
- **The wire mesh with mortal coating method has been proved to be a effective and const-effective retrofitting method to increase seismic resistance of masonry buildings.**
- **More importantly, non-experts and ordinary citizens have witnessed such a difference.**

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Coverage by local newspapers

Special Announcement from ADRC and IRP

Roster of Experts on Haiti Recovery

International Recover Platform (IRP) is urging experts to become a member of the Technical Expert Group for Haiti Recovery. The list will be made available for Haitian Government and International organizations

- **Themes and Topics**
  shelter, infrastructure (utilities, telecom, roads and bridges, buildings, schools and hospitals, water and sanitation), health, psycho social, environment, livelihoods, and building code enforcement and implementation
- **Role of Experts**
  - Experts could be deployed in Haiti (or Washington DC) for about two weeks and work with the Haitian government and international organizations
  - Experts could provide assistance through virtual means, including email, video conference, and teleconference
- **Qualification**
  English speaker, long-term commitment
- **How to register**
  The registration form is available in this venue. Please fill in the form and send it to Ms. Gulizaer Keyimu (gulzar@recoveryplatform.org) by FAX, email or mail

International Federation of Red Cross and Red Crescent Societies

Invest today for a safer tomorrow

ASIAN DISASTER REDUCTION CENTER

Thank you very much!

6. Panel Discussion

“How to promote safety improvement of non-engineered houses in developing countries”

6.1 Outline of discussion


１．チェアマン挨拶

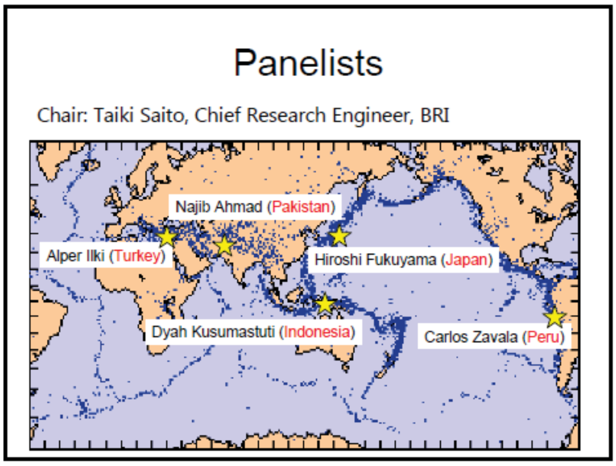
本日のチェアマンをつとめます建築研究所地震工学センターの斉藤と申します。本日のシンポジウムは建築研究所、ＧＲＩＰＳの共同で開催された。

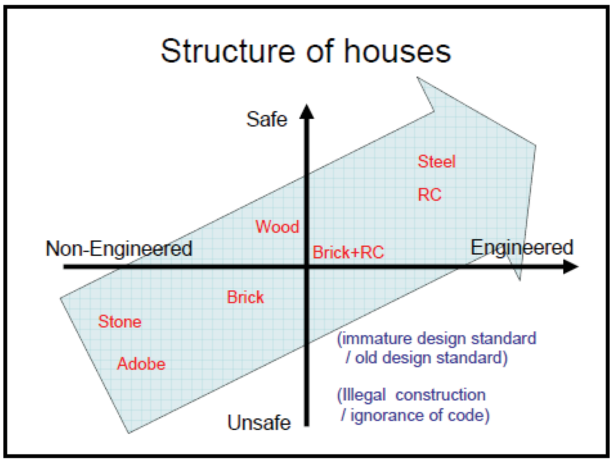
建築研究所は途上国支援として過去 50 年間の地震工学研修を行ってきた。これまで 1,400 人以上が修了した。これからも、日本の協力の一端を担って行きたいと思っている。

２．パネリストの紹介

右から、福山洋（日本)、ナジブ（パキスタン)、カルロス・サバラ（ペルー)、ダイヤ（インドネシア)、アルパー（トルコ)。

５名のパネリストは地震多発地帯である南米、東南アジア、中央アジア、中東の出身者であることから選定した。地域の独特の事情や建設環境が異なる。そういった話を聞ければと思っている。





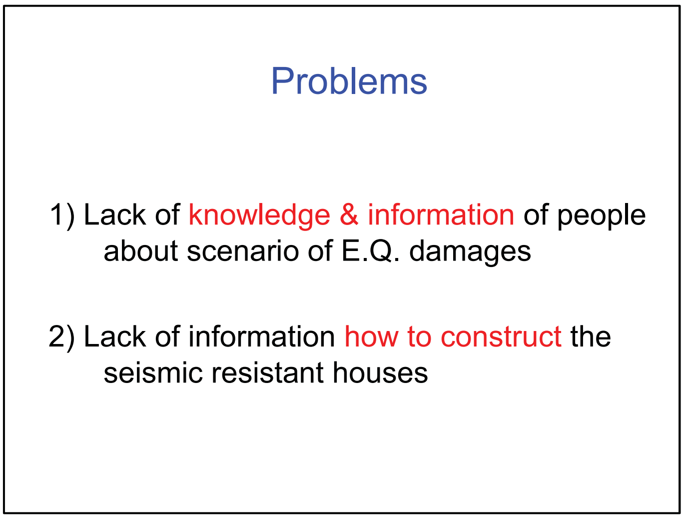
３．エンジニアドの定義（斉藤）

・技術的な見地からエンジニアド、ノンエンジニアドをみるとはっきり分かれている訳ではない。アドベ、石造、レンガはノンエンジニアドに分類され、耐震性の観点からは、耐震性が低い。左下に土の構造物が分類される。

・工学的な技術が反映されていくと鉄筋コンクリート、鉄骨造になり建物も大規模化していく。右側に向かっている。日本は右上の領域に建物があり、世界で被害が起きているのは左下の建物。

・アドベを止めて、鉄筋コンクリート造や鉄骨造に向かって行くのが、正しい方向なのかどうか皆さんの意見を聞きたい。
・アドベや石造は文化なので残しながら安全性を高める。アドベ造もエンジニアドになるのではないかという議論もあると思う。

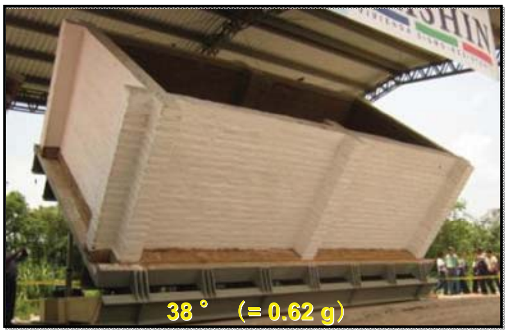
4．アドベ造をエンジニアドにした事例（福山）



・ノンエンジニアド住宅の問題点を整理し、将来の方向性を考えていく例として、エルサルバドルのＪＩＣＡ耐震プロジェクトを紹介する。このプロジェクトは、一般的な住宅の耐震性と普及策、技術的な向上を目的としたものである。
・ノンエンジニアド住宅を建設する一般の方々に対して①地震の際の崩壊のシナリオ、気を付けなければいけない問題の情報、知識が十分に行き渡っていない。②安全性を確保した住宅のつくり方についても十分に行き渡っていない。左記の２点が障害となる。

・2001.7/1 の大地震でノンエンジニアドの住宅に大きな被害が出た。これらを背景に低所得者向けの住宅での怪我人や死者を減らすのが目的となっている。
・四つの施工方法を耐震性を構造実験で調べ、普及のための建築マニュアルづくり、普及のためのワークショップの開催、コミュニティと一緒に現地でモデル住宅の建築を行った。
・その結果、政府やＮＧＯにより、ブロックパネル約 100 棟、アドベ 118 棟の住宅が建設された。

・礎石造のキイは面外破壊を以下に防ぐかにある。抵抗機構で補強したアドベ、エンジニアドアドベでは 38゜の傾斜（最大傾斜）でも崩壊しなかった。



・今後の方向は以下の６つ。同じ伝統的、文化的な構造形式でも、エンジニアドにしていく工夫はあり得る。

Future directions

1) Develop the simple & effective model of earthquake resistant mechanism
2) Propose the effective methods on seismic safety improvement of houses without changing its original structural types
3) Investigate the structural performance of the proposed safety improvement methods by tests
4) Develop the seismic safety evaluation methods based on the resistant mechanisms
5) Develop the construction manual based on the evaluation methods
6) Establish the supervision system for construction quality control

５．パネルディスカッション

Improvement strategy

People	Money
Earthquake risk perception Discipline / Morality	Construction cost Retrofitting cost
Technique	**Regulation & Guideline**
Structural system Retrofitting technique	Design code Construction guideline Inspection system / penalty Quality control

斉藤（日本）

・今後の対策を考える際に、技術面、法律・ガイドライン、それを使う人達の話し、住む人の話、実現するための一番の障害となるお金の話がある。これら４つに分けてパネリストとの議論を進めていく。

①各国のパネラーが耐震性向上において重要度が高いと考える事項？

ナジブ（パキスタン）

・パキスタンでは人々のリスクに関する受け止め方が最も重要だと考える。技術はあり、様々な研究も進められており、安全な住宅をつくるパンフレットや小冊子も用意しているが、人々がそれを受け入れる状況にない。

・最近、６つのプロジェクトを行ったが耐震性の面で安全ではなかった。人々は危険性、リスクに関して、住宅建設に関して意思をする必要がある。
・また、途上国では資金面での問題もあるが、人々は良い建物にはお金を支払う。当事者の危機意識、その受け止め方に問題があると思われる。
・パキスタンに関しては、リスクの受け止め方も含めて改善セミナー、啓蒙が必要だと思われる。

カルロス・サバラ（ペルー）
・トルコやインドネシアのような耐震プログラムもあり、耐震補強技術は既にあるが、あえて安全性の低い家に人々は住んでいる。経済の問題も当然あるが、資金だけが問題なわけではない。決定責任を持つ地域の市長などが自らも耐震性能のない家屋に住んでおり法律を受け入れていない。法律を遵守していない。
・ペルーでは、全ての住宅建設プロジェクトをチェックしなければならない。プロジェクトが建築基準を満たしているかをチェックしなければならない。という法律の書きぶりにはなっているが・・・・・・
・2007 年に JICA ミッションがつくった新規建設のガイドライン、最低基準や耐震検査の法律もあるが決定権を持つ人達が法律を尊重していない。
・建物オーナーが知事、市長、区長を買収して、２階建のホテルの５階建てへの変更を許可してしまう場合もある。地方自治体にお金を払えば、設計図も無い許可が下りて、その後は全くチェックが出来ない。ペルーでは市長など決定側に法律を尊重していないことに問題がある。

ダイヤ（インドネシア）
・技術の問題ではなく、人々の啓発、意識の向上が大切、意思決定者にも規則やガイドラインの関係で問題がある。被災経験の有無が対応の違い、問題意識の違い意に表れている。アンジェラアテやバンダン地域でのアンケートでは、被災経験が有るので、地震に対する問題意識も高く、ある程度お金を払ってもも自らをを守りたい気持ちもある。
・震災とは関係のないバンダル地域では「気にしない」、10%のコスト上昇でも人々は「耐震建築は好まない」という回答に現れている。10%のお金の違いは大きい、アパート暮らしの人も居る、洪水も頻繁なので地震被害だけではないとの理由。
・啓発啓蒙が重要で、全国一律の規制、誘導により、全てのインドネシア人が同じ問題意識を持つべき。中央政府が積極的に国民の啓発に取り組む必要がある。
・規則もある程度ある。耐震建築の規則もあるが全国一律ではない。地方でも遵守されるような努力が必要。
・全国レベルの建築基準法はあるが運用は地方政府の規制の下で行われる。バンドン、ジャカルタなど大都市は上手くいっている。離島ではほとんどルールを守らない。中央政府の地方政府の啓蒙努力、監督が必要。

アルパー（トルコ）
・建増をしたアパートが倒壊し 37 名が死亡したビグラ地震被害の責任は、土木建築専門家の資格剥奪で結審した。５階に建増ししたオーナーや許可した市の役員は責任を問われなかった。
・５％増の補強コストは耐震のためのネックにはならない。耐震安全性や既存建物の改修など細かな 2007 年ガイドラインがある。
・様々な制度改正があり、第三者や独立の業者がデザインからアプリケーションまで責任を持つようになった。これでも、検査を上手く出来ない中小業者の検査技術には疑問が残る。
・イスタンブールに沢山ある。エンジニアコミュニティの中高層、低層アパートには、ジャケッテイングなど新しい耐震技術も出てきたが、一時撤去しないと耐震補強が出来ない。

・イスタンブールなどの都会の場合、耐震補強は大工事になるので、一時転居が必要になったり、住んでいる人に煩雑な対応を求めることになる。
・イスタンブールの２大リスク地域、ブカルクとハリザンテでパーセプションスタディを行った。
・次に地震が起こったら大きな被害が想定されている２つの町は、リスクに関する意識は高いが「特段の用意はしていない、出来るだけ考えないようにしている。」という結果であった。
・トルコでは人々の住宅の床の仕上げや色への関心と同様に、耐震補強の重要性への認識を高める必要かある。

ニティン（インド）
・チェアマンのスライドはアンセーフ、ノンエンジニアドから出発すれば左下になり、住宅ならば自然に時計回りに動いて行くことになると思う。ノンエンジニアド・アンセーフ→セーフ・ノンエンジニアド→エンジニアド・セーフに移るのが自然だと思う。矢印の置き方を変更した方が良いと思った。
・自らが家を建設する場合、わざわざセーフではない家はつくらない。インドのＮＧＯにも技術はあり、ガイドラインはあるが、一般大衆にまで広まっていない。耐震補強に 100 ドルを出せる人も居ると思う。残る課題は、啓発する、人々の問題意識を高める必要がある。

ヒマ（ネパール）
・人々の耐震意識は低い。中低所得の人はお金の問題もあるが、カトマンズの住宅はノンエンジニアド、エンジニアドを問わず 60%以上が十分な耐震性能はない。
・最近の問題と昔の問題は違い、今の問題は非対称性の問題がある、学校を使って啓蒙もしているがエンジニアや技術者に知識が足りない。
・インドの裁判所ではレスポンスは５倍になる。労働を 10 倍減らすと、建設者は設計基準や耐震性の基礎も分っていないので。エンジニアを対象とした、基本的な耐震知識教育が重要だと思われる。高所得なオーナーは住宅に対して、相当多くの金額を支払っている。エンジニアの責任は重く、教育（トレーニング、意識を高める）が重要だと思われる。

佐々波（日本）
・新しい世紀を見据え、①エコシステム住宅と耐震性能をマッチさせた新しい工法の開発。②低所得者用住宅建設ローンを対象としたグラミンバンクシステムの導入。以上２点を提案する。

カルロス・サバラ（ペルー）
・ペルー建設省は低所得者（1.2 万円以下／月）が資材銀行を利用して 10～20 年ローンで自ら住宅を建築しているケースがある。耐震性のあるエンジニアリング住宅の設計図を銀行に提出して、資材銀行では運搬用のカートと建築資材を借りる事ができる。

プレティ（インド、千葉大学）
・ノンエンジニアド、エンジニアドハウジングにとっても経済は重要であると思う。
・建築基準を守らない、規則を破って住宅建築をしている人も居る。技術は開発されているが、大衆の物モノになるほど拡がっては居ない。
・つまり、建築基準や技術を農村地域や郊外に住む一般大衆に普及させるための、インセンテイブ・プログラムを数年間導入し防災意識を育むことが出来ないか。

②ノンエンジニアド住宅の耐震化に向けた国際的協力に期待すること、日本に望まれる協力

ナジブ（パキスタン）
・日本はパキスタンにとっての最大の援助国であるが、その 30～40%は有効に活用されていない。
・日本政府が啓蒙活動をすることが出来るかも知れないし、JICA やＧＲＩＰＳも人々を啓蒙することが出来るかもしれない。

・例えば、カシミール地方では2005年の被災から、地震リスクの受け止め方、認識が高まり、一般からもリスクの高い建物に対する当局への批判が出るような状況となっている。このようにＪＩＣＡや日本政府の協力は長期的な効果をもたらす。

カルロス・サバラ（ペルー）

・教育も重要だが、一般大衆や政策決者への知識の普及に関してマスコミの協力が必要だと思っている。対象層にわかり易い言葉で説明し、考え方を変えるきっかけづくりが必要である。子供の頃から耐震補強の重要性を認識することのノウハウの提供が重要と考えている。

・日本においてどのように人々の意識を高めることが出来たか、どのように住居を改修する気にさせたのか。過去の経験を教えて欲しい。補強するテクニックはあるので、それを普通の言葉で一般に伝えて理解させていくのが大切。

斉藤（日本）

・マニュアルやガイドラインを普及させていくツールが必要なのではないか。それは共通問題なのでシェアが出来る。それは国際協力も十分に可能な分野だと思われる。

ダイア（インドネシア）

・ジョイントで共同研究が出来ることに非常に助かっている。実験設備、施設の共同利用や分析能力の向上に感謝している。

・今後は現実的な観点からの経験を積上げて行きたいと思っている。日本の地震対応の経験（組織対応、十分なスタッフ、実施など）を生かす必要がある。ガイドラインや技術が一般に行渡っていないので、その普及・啓発の方法の検討を日本の取り組みから学びたいと思う。今までの取組ではそこが欠けていたと思う。

アルパー（トルコ）

・これなでも日本からはトルコの地震工学界に沢山の支援をいただいている。知事・市長・地方政府の技術者の防災管理研修の指導を日本人により受けた。過分のご協力をいただいているのでこれ以上期待してはいけないとも思う。

・お互いが協力して共通の問題を学び合う機会は重要だと思う。

・普通に暮らしながらも不便でない耐震補強の技術を開発する研究が必要か。住民に優しい、あまり邪魔にならない耐震補強のリサーチが必要か。

カルロス・サバラ（ペルー）

・中米では火山爆発の対応、啓蒙のためのドラマが流行した。マスコミを使った大衆意識の向上が重要かと思われる。

・耐震補強の仕方や地震の際の住居の倒壊の仕方を映像で見せるのは有効かも知れない。

福山（日本）

・お互いの問題点は同じだが、過去国の状況が異なる。様々な取り組みを通じて、基準や技術も開発されて来ている。これらの技術を蓄積し、各国の地震被害の経験の情報を共有することも非常に重要だと思われる。

・自由に情報をシェアできる環境づくりに日本は十分に貢献できるのではないか。

・必ずしもノンエンジニアドに限定した話ではなく、一般の方々に、如何にこの状況を知ってもらうか。これは危険な建物もまだまだ沢山ある日本でも重要な問題なので、私達も取組んでいる最中になっている。

・皆で成功事例を収集し、シェアしていく、協力できる分野をシェアしていく、ネットワークをよりタイトにする取組みにつながっていけば良いのではないかと思う。

③日本が出来る国際協力、今後進むべき方向性（会場からの自由意見）

藤村（鹿島建設）

・日本製は、技術、研究レベルは高いが、コストも高い。どうすれば管理（施工）の手間が省けるかを検討することが重要。

永見（ＪＩＣＡ）

・レギュレーションは４つのファンクションと並列ではなく、３つの象限を取り持つファンクションなのではないか。
・キイ・リクワイアメントはつくって終わりではなくて、取り組みの項目を絞って効果を上げるレギュレーション・キャパシティ・ビルディングの導入の効果が高いと思われる。

6.2 How to promote safety improvement of non-engineered houses in developing countries / ノンエンジニアド住宅の耐震性向上をいかに進めるか
Presented by Hiroshi Fukuyama, Chief Researcher, BRI / 建築研究所 上席研究員 福山洋

How to promote safety improvement of non-engineered houses in developing countries

Hiroshi Fukuyama
Building Research Institute, Japan

Contents

1) Problems

2) Introduction of JICA Project in El Salvador (Project Taishin)

3) Future Directions

Problems

1) Lack of knowledge & information of people about scenario of E.Q. damages

2) Lack of information how to construct the seismic resistant houses

Introduction of JICA Project in El Salvador (Project Taishin)

Strengthening of the Technology for the Construction and Dissemination of Earthquake-resistant Popular Housing

Background

Goals

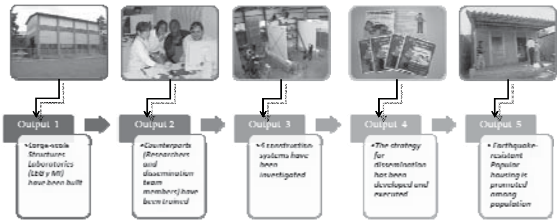
Project Goal
Earthquake-resistant popular housing has been enhanced

→

Overall Goal
Earthquake-related damages to low-income population have been reduced

Development

- TAISHIN Project was implemented from December 2003 through November 2008, achieving important progress on scientific research as well as dissemination activities.



Output 1 Design, construction and equipment of Large –scale Structures Laboratory

Large-scale Structures Laboratory at UCA- construction and equipment

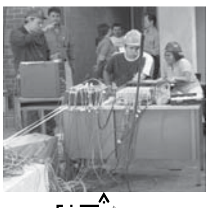
Large-scale Structures Laboratory at UCA was finished on December 2004

Output 1 Large-scale Structures Laboratory – Tilting Table at UES

Quick specs:
Inclination capacity: **40˚**
Maximum supported weight : **60 tons**
Dimensions: **8m x 5m**
Location: National University of El Salvador

The Tilting Table was designed by Salvadorean researchers with advice from Japanese and Mexican experts.

Output 2 Counterpart Training



- Researchers and dissemination team members have been trained in Mexico and Japan
- Short-term Mexican and Japanese experts advice project counterpart
- At the present time 10 Salvadorean counterparts have obtained master degrees at Building Research Institute - BRI

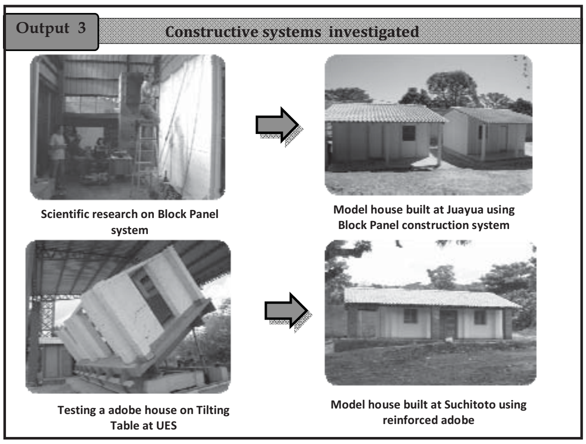
Construction systems investigated

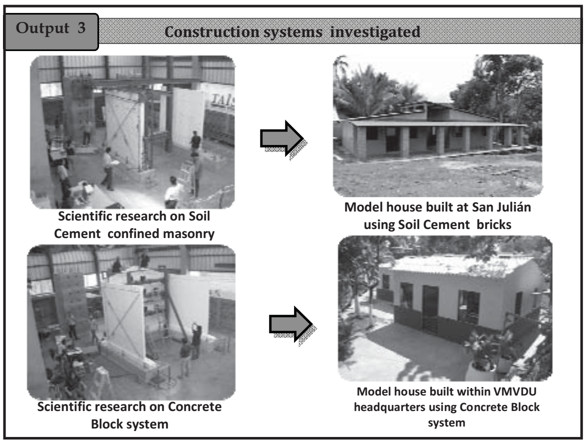
Block Panel System

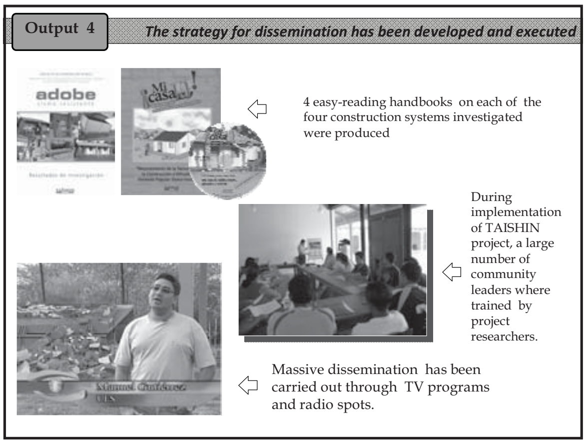
Reinforced adobe

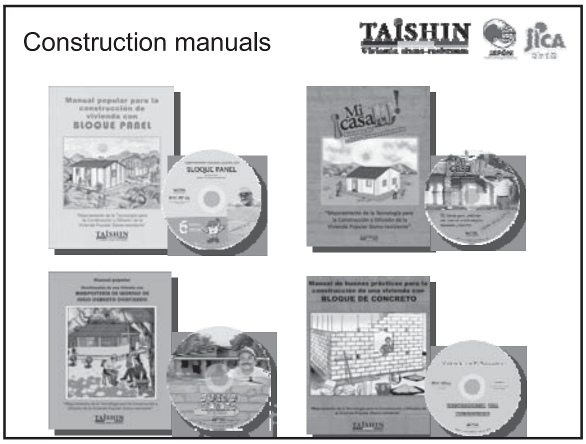
Soil Cement confined masonry

Concrete Block system

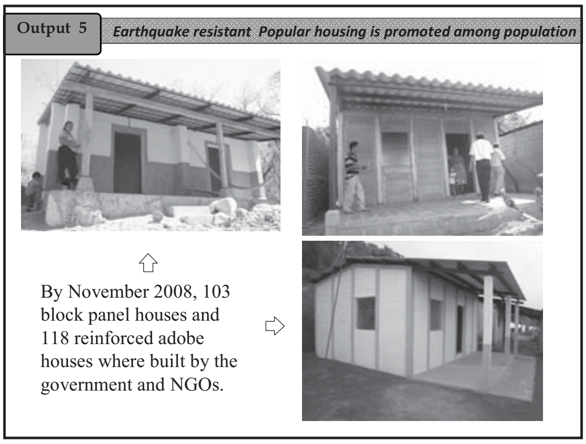

Output 3
Constructive systems investigated
Scientific research on Block Panel system
Model house built at Juayua using Block Panel construction system
Testing a adobe house on Tilting Table at UES
Model house built at Suchitoto using reinforced adobe


Output 3
Construction systems investigated
Scientific research on Soil Cement confined masonry
Model house built at San Julián using Soil Cement bricks
Scientific research on Concrete Block system
Model house built within VMVDU headquarters using Concrete Block system


Output 4
The strategy for dissemination has been developed and executed
adobe
4 easy-reading handbooks on each of the four construction systems investigated were produced
During implementation of TAISHIN project, a large number of community leaders where trained by project researchers.
Massive dissemination has been carried out through TV programs and radio spots.


Construction manuals
TAISHIN
JICA
BLOQUE PANEL
BLOQUE DE CONCRETO


Dissemination
TAISHIN
JICA
Display for dissemination
Workshop for technical transfer
VMVDU


Output 5
Earthquake resistant Popular housing is promoted among population
By November 2008, 103 block panel houses and 118 reinforced adobe houses where built by the government and NGOs.

TASHIN Phase II

TAISHIN phase I (December 2003 - November 2008)

- Strengthening of the Technology for the Construction and Dissemination of Earthquake-Resistant Popular Housing

TAISHIN phase II (May 2009 - April 2012)

- Enhancement of the Construction Technology and Dissemination System for the Earthquake Resistant Social Housing

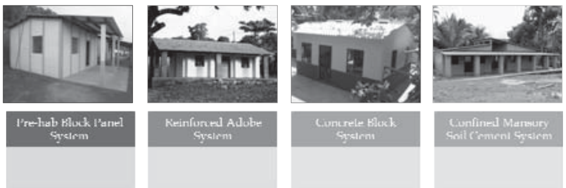
Goals

Overall Goal
A system to disseminate the improved earthquake-resistant social housing in El Salvador is developed

Project Goal
Government administration in the housing sector to promote dissemination of improved earthquake-resistant social housing is enhanced

Working group 1- Research

Scientific research will continue as important part of the project:
Reinforced Adobe, Soil Cement and Concrete Block systems will be instigated further.
A Block Panel technical manual will be elaborated and made official by the government .



Working group 2 - Institutional strengthening

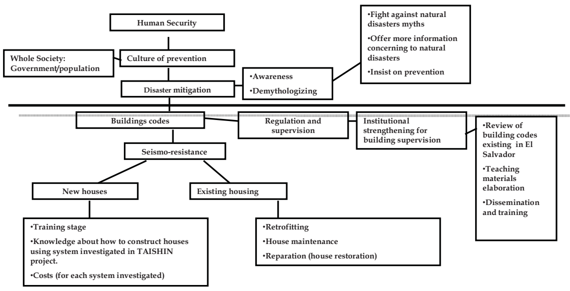
VMVDU Staff and technical personnel of local branches will receive training concerning earthquake resistant social housing, construction approval procedures and supervision.

Main activities are:

- Officialization of 3 construction norms
- Officialization of a technical manual
- Elaboration of a training program for pilot offices
- Training of official regarding operational guides

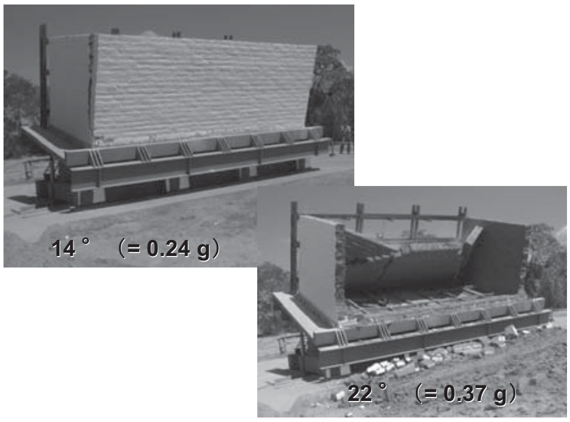
Working group 3 - Dissemination

Dissemination team has developed a plan which is geared to institutional strengthening and human security.



Future directions

1) Develop the simple & effective model of earthquake resistant mechanism
2) Propose the effective methods on seismic safety improvement of houses without changing its original structural types
3) Investigate the structural performance of the proposed safety improvement methods by tests
4) Develop the seismic safety evaluation methods based on the resistant mechanisms
5) Develop the construction manual based on the evaluation methods
6) Establish the supervision system for construction quality control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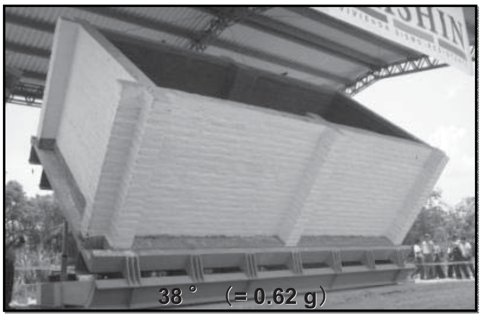
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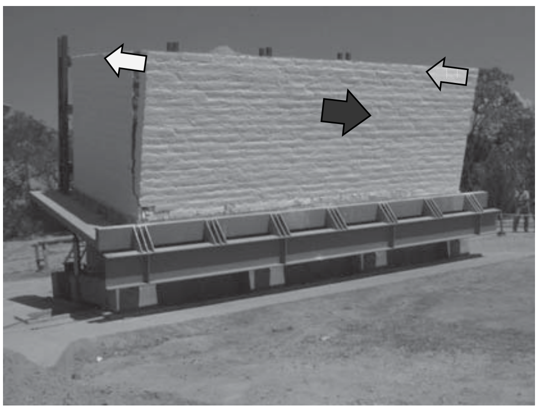

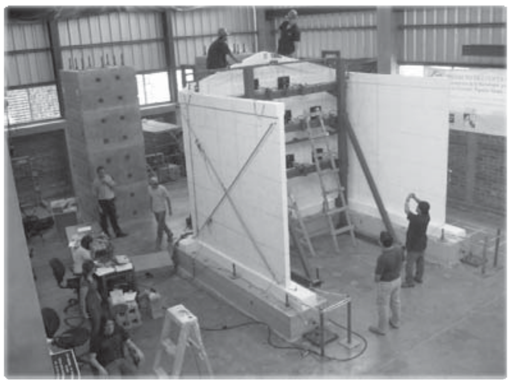

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