EARTHQUAKE HAZARD CENTRE
NEWSLETTER

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Editorial

Is it time for the Earthquake Hazard Centre to close?

The first EHC newsletter was published in July 1997, over 20 years ago! This is the 82nd newsletter, and like all previous newsletters, its aim is to raise the standards of earthquake engineering in Developing Countries. The main objective is to encourage those who are practicing earthquake engineering by providing them with appropriate technical information.

However, since the inception of the EHC much has changed regarding the ability of professionals to gain information. The internet has transformed our ability to gather material. Also, there is much more information available. For example, take the construction guidelines, manuals and other resources that can be downloaded from the World Housing Encyclopedia. Therefore, is the EHC newsletter still playing a useful role?

Another reason for questioning the future of the EHC, at least in its present form, is that I am retiring from my position as an Associate Professor at the School of Architecture at Victoria University of Wellington at the end of this year. Although I still intend to be active in promoting building seismic safety in Developing Countries it might be time to stop publishing the newsletter. However, if the newsletter is still considered of value to a reasonable number of readers, then I can investigate how it might continue. If there is little or no interest it will stop.

Therefore, to guide initiatives regarding the future of the newsletter I need to hear back from you. If you want the newsletter to continue please email me before 15th December 2017 and state the reason(s) why. You may also like to suggest changes for improvement. Send emails to andrew.charleson@vuw.ac.nz.

In the meantime, this issue continues with the Virtual Site visit, this time to the retrofit of an older RC building using RC shear walls. The next article is the second of two on ways forward for the World Housing Encyclopedia. That is followed by a report on an upgrading program of masons in India. The important of such grass-roots education without which seismic resilience will never be achieved cannot be underestimated.

Virtual Site Visit No. 47: Retrofitting a RC building using RC shear walls

The Bowen State Building, located in the Government Precinct, Wellington, is undergoing a seismic retrofit as well as a significant addition. Constructed in the early 1960s, this building was designed over a decade before the importance of ductility was recognized and codified. As seen in Figure 1 the floors are supported by RC columns and beams. RC floor diaphragms tie back to internal RC walls that form the lateral load resisting structural core. The core had insufficient strength according to the current codes of practice. Now the combination of the strengthened core plus the two new transverse walls provide enough strength for the existing building as well as an almost 50% gain in additional floor area. Most of the new area of floor plate is supported by steel posts and beams that themselves possess no strength against earthquake forces (Figure 2). Therefore these floors are tied back to strengthened existing floor diaphragms which transfer the inertial forces into the strengthened core and new transverse walls. In plan the existing core forms a "H' shape. In order to produce more reliable and predictable behaviour, its flanges were separated from the webs and all elements had some degree of strengthening.

In the longitudinal direction the walls of the structural core are longer and, after modest strengthening by way of steel strapping, are adequate to resist the seismic loads from the existing and new construction. As mentioned

Figure 1. Western elevation. The new facade has already been placed on the lower storeys. Reinforcing steel for a new transverse shear wall can be seen to the right.

Figure 2. Seen from the north, a transverse shear wall is nearing roof level. New floors supported on slender steel columns attach from the left. Further additional floor space will be supported by the steel framework in the foreground. The light-coloured storey-high walls either side of the shear wall are non-structural.

Figure 3. Reinforcing steel in the new shear wall. At each floor a strong connection between existing and new construction enables transverse forces to be transferred from floor diaphragms into the shear wall.

above, there are two walls, separated from their flanges. Figure 3 illustrates the reinforcing steel of a new shear wall. The steel is anchored into a pile cap or transfer beam spanning between two new tension piles. The beam that stabilizes the walls is 27 m long, 4 m deep and 1.5 m wide. It sits on 1.5 m diameter bored piles 30 m deep, with 3.6 m diameter bells to increase the vertical uplift resistance when the shear walls are sustaining their maximum bending moments. The vertical steel at each side of the wall is designed to resist the wall bending moments while the horizontal steel ensures that the shear strength of the wall will exceed the bending strength and therefore guarantee a ductile bending failure in the event of seismic overload.

Continuation of "Improving Housing Seismic Safety in Developing Countries: The World Housing Encyclopedia"

By A. Charleson, S. Brzev, K. Jaiswal and M. Greene. Presented in Paper No. 1239 from the 16th World Conference on Earthquake Engineering, Santiago Chile, January 9th to 13th 2017.

In 2008, the WHE group introduced a new initiative called the Confined Masonry Network, in collaboration with the National Information Center of Earthquake Engineering (NICEE) in India and with the initial sponsorship of the World Seismic Safety Initiative (WSSI) and Risk Management Solutions Inc. The network has two major objectives: to improve confined masonry design and construction practices where it is currently in use, and to help introduce it in areas where it can reduce seismic risk. A web site (www.confinedmasonry.org) was created to provide a growing repository of resources related to confined masonry construction, including training materials, guidelines, and research papers. The members of the network have developed several global guidelines for the design and construction of confined masonry buildings. The network provides a platform for discussion on issues related to confined masonry design and construction in seismic areas.

Over the last 16 years, the WHE repository has experienced significant expansion in terms of the worldwide coverage of the housing types included, and through the WHE tutorials. Riding this wave of success, which is predominantly based upon volunteered contributions, it is timely to reflect upon the directions which the WHE should be taking into the future. To assist this process, we examine two recent publications in the following section that focus upon seismic safety in developing countries.

Literature Review

Both publications that this section reviews are relevant to ensuring that the WHE engages in activities strategic to achieving a seismically safer world. The first publication we review is 'Saving lives in earthquakes: successes and failures in seismic protection since 1960' by Robin Spence. After showing how most deaths during earthquakes are due to just a few events in developing countries, Spence reports on a survey of earthquake engineering experts from 22 regions and countries. The two questions (of a total of four) in his survey most relevant to this paper are, first, a request for a list of the most significant local successes and failures of earthquake protection during the past 50 years. Secondly, the experts were asked to note any success in implementing new codes of practice in the design and construction of new buildings, and comment upon major obstacles. He presents three conclusions that are particularly relevant for developing countries. First, that improved seismic safety is more likely to be achieved through public awareness rather than law: 'an informed public is necessary to ensure that building control does get applied'. Secondly, it is essential that professionals are registered, and adequately educated and trained. And finally, preparations to change regulations and construction practices need to be made prior to those 'windows of opportunity' created by damaging earthquakes.

To some degree the WHE is engaged in education and outreach through the publication of various tutorials. However its role to date has been passive. Tutorials have been completed and made available on-line but without significant face-to-face engagement with those who would benefit from them, such as tutors and students in tertiary institutions or building inspectors, contractors and even building owners. A more active programme of disseminating these materials would ensure their wider use.

'Building regulation for resilience – managing risks for safer cities', published by the World Bank Group (WBG) and the Global Facility for Disaster Risk Reduction (GFDRR) is the second document particularly relevant to this paper. By analysing the current rather dysfunctional situation and looking towards the future, this report can function as a

lens through which to focus the WHE strategy. The basic premise of this report is that poor quality construction is the main contributor to increasing disaster risk, and that reformed and pro-active building regulatory approaches are the way forward. It is noteworthy that the report 'is a resource to assist policy makers, governments, and donor entities in leveraging good-practice building code regulation into effective disaster risk reduction (DRR) strategies.'. As such the report can be expected to be relevant for non-governmental initiatives like the WHE.

Speaking to the situation of many developing countries, the report begins by identifying the reasons for the failure of regulatory policy and implementation. While acknowledging the impact of poverty, the following factors are identified:

- ineffective land use systems,
- weaknesses in building code administration and institutional capacity,
- insufficient legislative foundations,
- unaffordable compliance costs for the poor,
- insufficient recognition of prevalent building practices,
- dysfunctional regimes of building controls, and
- corruption and regulatory capture where, for example, industry reduces safety standards for its own benefit.

The report then presents three basic components of a successful building regulatory framework, namely, 'a legal and administrative framework at the national level, a building code development and maintenance process, and a set of implementation mechanisms at the local level.'. Regarding the building code component, mention is made of the "ecology" of supporting institutions and activities like building professionals' and labour force education programmes, the contribution of professional societies and licensing for building professionals. These are areas where the WHE can continue to contribute.

Discussion

It is worth noting the degree of agreement between the two primary documents reviewed above. Although Spence highlights the importance of public education over the use of law, which is currently largely ineffective in reducing disaster risk, the WBG and the GFDRR publication focuses on reforming the building control sector so that it functions actively and in a supportive fashion. The passivity that Spence is rightly critical of, is thereby diminished.

The magnitude, complexity and difficulty of the reforms identified in both documents represent a huge challenge. Even if seriously addressed in just one local area, the implementation of these reforms would require considerable financial and other resources expended over many years. And just as importantly, it would require the input and unprecedented collaboration of national government, local government, building officials, consulting engineers and architects, as well as input, advice and support from NGOs and other supportive agencies. Bearing these factors in mind, together with the analyses and suggestions from the two documents above, we can begin to address the specific questions posed in the abstract of this paper.

- *What are the pressing needs for improving the seismic safety of buildings in developing countries that could benefit from involvement by the WHE?*

Given that the WHE currently draws upon the resources of skilled and experienced professional volunteers, the DRR needs that the WHE is best suited to assist with are related to the further development of its published resources as well as the maintenance and broadening of its building database.

- *Where are the gaps in the current resources offered by the WHE?*

No doubt there are many building types for which tutorials or construction guidelines need to be prepared in order to improve seismic safety. Most of the WHE resources developed to date have been proposed by the contributors rather than being solicited by the WHE leadership.

While there *are* gaps in the current list of the WHE publications, the bigger problem seems to be a lack of dissemination and penetration of the WHE materials into those sectors and individuals whom we expect to benefit from these materials. Although all resources are available free of charge, there is no proactive effort to disseminate them in specific communities. This is certainly not a small task since the WHE targets the entire world.

Perhaps the WHE needs to take more initiative and become more pro-active. Initially it needs to work more closely with its supporters in developing countries and find out what is needed. Maybe existing materials need to be reworked? For example, if local authorities in some countries knew what we have already published including possibly one or more housing reports from their own geographical area might some be interested in partnering with the WHE to customise our materials for their own situation? This is particularly true for post-earthquake situations, where the WHE efforts could be integrated with post-earthquake Learning from Earthquakes (LFE) missions by EERI and other organizations.

• *The WHE publications fall in the category of technical guidelines. Are there other areas of focus that might be as, or perhaps, more effective, such as preparing materials that raise public awareness, for example for the need of better building standards?*

The lack of penetration of the WHE materials in areas of the building sector is mentioned above. Perhaps a series of more general and simple publications to communicate with the general public are also required. Their purpose would be to challenge entrenched attitudes regarding seismic risk, including fatalism, that result in inaction. These publications could also be designed to make the public more aware of the value of safe building in a way that leads to improved building regulatory processes. In order to be able to create these publications the WHE can draw upon its database of housing reports in order to explain potential seismic vulnerabilities in the houses the intended readership is familiar with. Then professionals with the required skill sets related to preparing non-technical publications need to be involved.

• *What other forms of assistance might the WHE be able to provide to improve seismic safety in developing countries?*

To date, the WHE's contribution to seismic safety could be described as largely passive. Already some suggestions towards more active strategies have been mooted. But what other options are there?

Summary of "Brief Annual Report on Building Artisan Up-gradation Program of Good Quality and Hazard Resistant Construction for Reduced Hazard Vulnerability and Longer Lasting Buildings in India"

On-going Program of NCPDP-CEDAP Since 2006.

Time period of this report: 1 April 2016 - 31 March 2017.

By the National Centre for Peoples' Action in Disaster Preparedness, Ahmedabad, India.

Executive Summary

NCPDP-CEDAP continued its course of Hazard Vulnerability Reduction through the promotion of good quality in construction and application of hazard resistant features in construction in India during the past year. It took up a number of activities related to the capacity building of the building artisans. It also utilized for the same purpose the opportunities provided by projects of building construction or seismic retrofitting that it undertook.

Achievements

• Under the project titled **Mason Skill Up-gradation Program 620 practicing masons** successfully attended the three day intensive training programs held in **32** villages and aimed at improving the construction quality and teaching the disaster resistant construction

technology in the villages of Central and North Gujarat, and Saurashtra regions of Gujarat State. These 32 training programmes are inclusive of **two training programmes of Bar Benders** comprising of 40 artisans in Eklara and Umari villages of Junagadh and Gir Somnath districts respectively.

• As a part of the follow up to the training programs mentioned above **20 refreshers courses** covering **341** masons (many trained in the last year), and 5 certificate awarding events covering **412** masons were also organized.

• The total expenditure of this project was **Rs. 21,51,426/-** (details given in **Annexure A**). This was carried out with the support received from the friends of NCPDP-CEDAP including individual donors in India as well as in the USA in addition to the funds from its own kitty. Utilization Certificate issued by Auditors is placed in **Annexure B**.

• The year saw some interventions with inspiring responses and some with disappointing ones.

Chitroda Training Programme – Taluka Idar, District Sabarkantha (October 13, 2016)

Mason training was arranged in village Chitroda in Taluka Idar District Sabarkantha, on 13th October 2016. In all there were 24 masons who registered their names. Almost all of them were contractors. The participants were rather eager to join the training programme. All of them were

Figure 4. Teaching masons with the help of model at Limbuda village.

Figure 6. Engineer explains right method of forming a pocket in masonry for vertical reinforcement at Talod mason training.

Figure 5. Barbenders trying to complete the task given to them during training at Umari village.

Figure 7. Certificate awarding programme at Badoli Ta. Idar.

well to do and had lots of work on hand. Even then they were keen to attend the training and for all the three days.

In fact on the first day of training, unlike what is generally observed in most villages, 30% more participants than the number of registrations came. All were punctual and always well equipped with the tools required for practical training. We had never witnessed such response in twenty years that we have been training.

The masons who were attending the training programme were from the villages adjacent to the place of training. They did not want to lose even a second of training programme and therefore, to save the time they would spend on going home for lunch they made arrangements for the lunch of all the participants at the place of training itself by hiring a cook/caterer. They saved a lot of time that generally gets wasted by other participants.

The response and co-operation of the masons as well as the village people was outstanding. All were very enthusiastic. The number of participant remained constant all through the training.

For the first time, after conclusion of the training programme, one of the participants visited our office to understand what is NCPDP. All of them appreciated the quality of our training programme and tried to gain the most they could. These people also took initiative in arranging training programmes in the cluster villages.

Opinions and Feedback from trainee artisans

This forms an important part of monitoring of the program. To make the program more effective, successful and acceptable among the community of building artisans, it is important to know what they feel about various aspects of the program. The program and its team have been receiving some very positive and encouraging feedback from the participants.

Village - Chitroda, Taluka-Idar District - Sabarkantha

- *How did you find the training?*

We found the training very good and we could learn something new.

- *What did you learn?*

How to make earthquake resistant construction with bare minimum cost. We liked the system of putting band in every corner of house with pitched roof. We also observed that by putting steel bars adjacent to doors and windows the construction becomes stronger.

We learnt the following:
Bar bending in RCC work
Corners binding
Installation of T shape bars
Grouting
Putting of GI wire net
New system of excavation
Exact understanding of preparing mortar
Fixing of doors and windows
Construction of different types of steps

We completed our training on 22 Feb 17. Normally we are doing masonry work traditionally but by attending this training we really learnt many new and useful things. This will help us in our future work. We will keep in mind what has been taught to us and apply the same.

Earthquake Hazard Centre
Promoting Earthquake-Resistant Construction in Developing Countries

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