Rapid Screening Procedure for Buildings Damaged by Earthquakes: The Need for Retrofitting

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Abstract. Right after an earthquake disaster, many universities and or “experts” were performing rapid screening of buildings / facilities damaged during the earthquake. Many of the buildings, houses, were tagged with red labels, which means that those buildings are dangerous, cannot be occupied and should be demolished. Demolishing buildings without thorough analysis is an irresponsible act. The rapid screening of buildings damaged by earthquakes shall be done repeatedly by experts with track records in the field of structural earthquake engineering, utilizing the same criteria and subsequently converting the findings into a well-established scoring system. The damaged buildings must be evaluated, analyzed by acknowledged structural earthquake engineers with track records prior to the final decision. If the analysis showed positive results, the buildings should be retrofitted, and not demolished. Retrofitting of buildings damaged by earthquakes shall be made a culture in Indonesia.

1 Introduction

In the medical profession, there is a term "triage" that is used during the emergency response in hospitals as well as on site in disaster-stricken areas. In a disaster, hospitals are usually flooded with large number of casualties, and therefore, the medical personnel, and facilities available are not adequate to handle all the victims at the same time. For this reason, “triage” is needed. “Triage” means sorting and prioritizing among many casualties, which patients should be handled first based on the severity of the case, the availability of medical staff and equipment and the probability that the casualties can be saved. In the medical profession, the criteria for screening, sorting, and prioritizing casualties during emergency response is clearly defined since it is related to saving human lives and must be done within seconds and minutes, not days, weeks, or even months. The above is just an illustration what is the standard procedures in the medical profession during emergency response. Severely wounded casualties that must be handled immediately will be given a red label/tag, patients that can wait several hours will be labeled with yellow tag, and casualties which do not belong to emergency category will be labeled green tag.

One other important aspect is who must perform the triage during emergencies in hospitals? Should it be newly graduated medical doctors, co-assistants, nurses, or very experienced medical doctors / nurses that has a very clear track record? Apparently, triage must be performed by experienced medical doctors / nurses and not by newly graduates with inadequate actual experience.

Similar to triage in the medical profession, right after an earthquake disaster, several universities and or “experts” were also performing rapid screening of buildings / facilities damaged during the earthquake.

Buildings that are considered dangerous for further use are given a red tag, buildings that need to be repaired are given a yellow tag, and buildings that can be used immediately are given a green tag. Based on the evaluation of the screening team, many of the buildings, houses, were tagged with red labels, some even put a police line with the danger warning or paint the walls with a red X-mark which meaning that those buildings are dangerous.

The rapid screening team should consist of experts with track records in the field of structural earthquake engineering. In Indonesia, after a damaging earthquake, all the rapid screening that were performed but not accompanied by analysis or explanations and therefore, the community / government officers always interpreted that red tagged buildings / houses shall be demolished without any further clarification nor consideration. While on the contrary the prevailing practice in the world is, that rapid screening of buildings damaged by earthquakes shall be done repeatedly by several rapid screening teams utilizing the same criteria and subsequently converting the findings into a well-established scoring system.

Based on the scoring results, supposing that the building has a low score, meaning is considered dangerous, it does not automatically mean that the building / house should be demolished since there are additional requirements that must be evaluated, analyzed by acknowledged structural earthquake engineers with track records prior to the final decision. Therefore, if the

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track record of whoever made the evaluation analysis is not clear, it will be dangerous and can cause tremendous loss if the buildings / facilities are demolished without correct justification.

All over the world, buildings damaged by earthquakes, particularly belonging to the government are evaluated, analyzed by competent structural earthquake engineering professionals. If the analysis showed positive results, the buildings should be retrofitted, and not demolished, particularly buildings that suffered non-structural damage.

2 Assessment of Damaged Buildings

As it is known, there are 2 major categories of damage in a building, namely damage that occurred to non-structural components and damage that occurred to structural components. Non-structural damage among other ceilings, doors, windows, cracked / collapsed of walls, crack / collapsed of partitions, M / E equipment, such as air conditioning, piping and installation and building contents, etc. In hospitals, non-structural components also include very expensive diagnostic equipments. Structural components are the main elements of a building that withstand most of the vertical as well as horizontal loads. However, for the residential / people houses, the walls act as load bearing walls and this is different from the high-rise buildings. The design of structural components must follow the Indonesian concrete and earthquake codes. If built appropriately, it can be expected that whenever stricken by earthquakes, the damage level will be minor.

In this paper, the author provides actual examples of buildings that shall be retrofitted and not demolished for 2 most recent earthquakes, namely Lombok earthquakes (M 6.4 on July 29, 2018, M 7.0 on August 5, 2018, M 5.9 on August 9, 2018, M 6.3 and M 6.9 on August 19, 2018) and Palu earthquakes (M 7.5 on September 28, 2018). The author visited Lombok and below are some of the buildings, schools, hospitals that were surveyed (Fig. 1.). In the author's opinion, the surveyed buildings (which unfortunately were already red tagged by various rapid screening teams) can be easily retrofitted and there is no need to demolish, particularly RSUD Tanjung. From the pictures it can be seen that most of the damage in that hospital are non-structural components, such as poorly constructed ceiling frames, cracks in walls that can be repaired very easily while the structure is still intact.

Al-Aziziyah Islamic Boarding School

Junior High School - SMPN 6 Mataram

Elementary School - SDN 2 Jenggala

North-Lombok Regent Office

Tanjung Hospital

North-Lombok Public Health Office

Mosque at Tanjung

Desa Salut

Desa Salut

Desa Salut

Houses at Desa Sambo

Desa Wisolo

Desa Wisolo

Non-structural damage at RSUD Undata

Desa Balongga

Desa Ramba

Structural damage at RSUD Undata can be easily retrofitted

Desa Ramba

Structural damage at Ramayana Plaza can be retrofitted

Desa Ramba

School building that can be retrofitted – Ramba

Desa Sibalayan

Desa Baluase

Houses at Desa Sambo

Puskesmas Baluase

Puskesmas Baluase

Fig. 2. Some of the buildings in Palu that were surveyed by the author that can be retrofitted.

3 Retrofitting Strategy

The author also surveyed Palu and below are some of the buildings that can be retrofitted and not demolish (Fig. 2.). Unfortunately, so far (when this paper was written, July 2019) no directives from the authorities of whatsoever with regard to retrofitting those buildings. Also, the author did not see any rapid screening being performed in Palu.

For Indonesia, the author introduced retrofitting back in 1992 publish a manual “Manual Perbaikan Bangunan Sederhana yang Rusak Akibat Gempa Bumi” after the December 12, 1992 [1] Flores earthquake and tsunami. The author started retrofitting many school buildings in Bengkulu after the June 4, 2000 Bengkulu Earthquake (Fig. 3.).

Subsequently, after the West Sumatra earthquake of September 30, 2009, the author in cooperation with the Civil Engineering Department of Andalas University retrofitted many non-engineered houses, school buildings, mosques, a heritage church, a 9-story hotel etc. (Fig. 4.). For Indonesia, to date, the most buildings retrofitted after damaged by earthquakes can be found in West Sumatra.

Right after the West Sumatra earthquake of September 30, 2009, the author publishes a booklet “Cara Memperbaiki Bangunan Sederhana Yang Rusak Akibat Gempa Bumi”, and in 2010 was reviewed by Andalas University, University of Indonesia, ITB, UII Yogya and UGM and republished [2]. Therefore, manuals and booklets for retrofitting are already available in Indonesia since 1992 [1] in English as well as Indonesian.

One-story school building

Two-story school building

Retrofitting works

School buildings before and after retrofitted (left: damaged due to June 4, 2000 earthquake; right: after retrofitted and shaken by the September 12, 2007 earthquake)

Fig. 3. School building in Bengkulu that has been retrofitted by the author after the June 4, 2000 Bengkulu earthquake

Retrofitting SMAN10, Padang

Retrofitting SDN13 Batu Gadang (Indarung), Padang

Retrofitting SDN43 Rawang Timur, Teluk Bayur

Retrofitting SDN14 Blanti

Retrofitting SDN07 Ampang

Retrofitting PGAI Abdullah Ahmad Padang

Retrofitting SLTP Frater

Retrofitting Masjid Al-Munawwarah, Padang

Retrofitting a heritage church, Kapel St. Leo, Padang

Retrofitting BumiMinang Hotel, Padang

Retrofitting BumiMinang Hotel, Padang

Retrofitting house at Balai Baru

Retrofitting house at Tanjung Basung, Pariaman

Retrofitting house at Gadur, Pariaman

Fig. 4. The damage buildings that were retrofitted due to September 30, 2009 earthquake

4. Concluding Remarks

The author is of the opinion that demolishing buildings without thorough analysis is an irresponsible act particularly demolishing government owned buildings without valid justification is violating the Government Regulation of the Republic of Indonesia No. 36 of 2005 concerning the Implementation Regulation of Law no. 28 of 2002 about buildings especially Section 4. However, in Indonesia, the prevailing decision by almost all authorities in areas stricken by a damaging earthquake is to demolish

damaged buildings, while no body assures that the new buildings to be constructed will be earthquake resistant. In many cases, history repeats itself and the newly constructed buildings were not earthquake resistant. Such practice shall be discontinued since it is irrational and causes tremendous loss to the society.

It is strongly suggested that the subject retrofitting of buildings should be disseminated among the government offices and the authorities must be held accountable for their decisions. Retrofitting of buildings damaged by earthquakes shall be made a culture in Indonesia, therefore, the subject retrofitting should be included in the syllabus of civil engineering departments in all universities.

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