DRASTIC IMPACTS OF 8TH OCTOBER EARTHQUAKE IN KASHMIR AND ROLE OF SUSTAINABLE DEVELOPMENT

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Abstract:
The main environmental loses from the earthquake to the environment were the heavy landslides, destruction of residential and commercial structures, destruction and rerouting of water bodies, etc. Due to the lack of sustainable planning and awareness, debris, building waste materials and misuse of other materials are seriously spoiling the sustainability of the area. Detail survey of the ruined areas of Kashmir due to 8th October earthquake after five years has been performed during this research. Present conditions of the study area are presenting the worst picture. Improper management of dumped construction waste is one of the serious issues. Environmental and sustainability conditions before and after earthquake are compared in this research work. It is concluded that infrastructure development and building construction during last five years after the earthquake are not fulfilling the sustainability requirement. Proper waste handing, recycling of materials, promotion of indigenous building materials and awareness among the local dwellers may help to improve the sustainability and environmental conditions in the study area.

Keywords: Kashmir, 8th October earthquake, sustainable development, infrastructure damages

1. Introduction

In October 2005, the Kashmir and northern regions of Pakistan were hit by a very drastic earthquake in the history of the country. These regions were quiet and prosperous tourism zones that were beginning to emerge as a perfect tourist destination for Pakistan. These regions are famous for their pleasant summer and attractive winter with a lot of snow falls. Kashmir region was becoming the ideal location for a stay at most beautiful valleys and green peaks. At 8th October 2005 early in the morning, these beautiful valleys were hit by a severe earthquake (RM:>7.5) that devastated the most of the parts of this region, rocked the countryside and killed thousands of the peoples. The epicentre of the 8th October earthquake is shown in Figure 1.

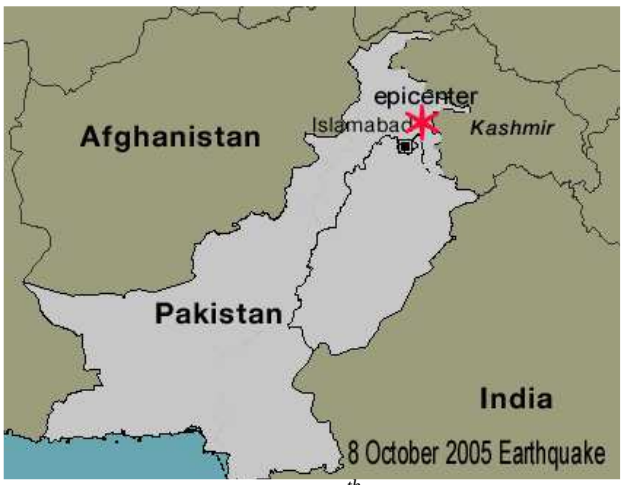

Figure 1: *Epicenter of the 8th October Earthquake*

The prevailing losses from the earthquake mostly occurred to humans and structures; this also results in drastic impact on the environment and sustainability [1]. The most visible consequences seen throughout earthquake hit areas of Kashmir are enormous amount of the debris and rubble resulting from damaged and destroyed structures. Disposal of rubble in rural areas, where structures are constructed of mud and stones, presented a different challenge than in urban areas, given that the amount of rubble is much less than in urban areas and it is spread out, making the task more complex [1-2]. Considering that there will be large quantities of material that can be salvaged for reconstruction, the disposal problem is far less significant that in urban areas [3-5]. There was evidence of haphazard dumping of debris and rubble in rivers adjacent to the cities in destructed areas of Kashmir. This has serious environmental penalty to water quality with potential downstream flooding impacts. In addition, there were signs of debris/ rubble being disposed of alongside roads, in fields, in open drains, in ditches and in forested areas. There is a practice of uncoordinated and unauthorized dumping which should be discouraged and a more systematic and planned approach be adopted.

2. History of earthquakes in Pakistan

The earthquakes are very frequently hitting the northern areas of Pakistan in the past. The Indo-Australian and Eurasian plate boundaries are present in northern and north-western regions of Pakistan. Due to this reason, a number of faults have been identified in these areas. The most of the earthquakes occurring in the northern areas are attributed to the energy release at the interface of these two boundaries. Only in a limited period from November 2002 to March 2003 there have been five major shocks measuring 5.3 to 6.5 on Richter scale. On 14th February 2004 an earthquake measuring 5.7 on the Richter scale again struck the northern areas damaging mostly Battagram and Mansehra districts and claiming 24 lives. An earthquake measuring 7.6 on the Richter scale struck Mansehra, Muzaffarabad, Garhi Habib Ullah, Balakot, Islamabad, Lahore, etc. on 8th October, 2005.

The epicentre of the earthquake as shown in Figure 1 was located at latitude of 34.402 and longitude of 73.560. The earthquake has by now claimed over 22,288 lives and left 50,575 injured and caused heavy damage to many buildings in that area. The heaviest damage was observed in Muzaffarabad area where entire villages were destroyed. Buildings were also collapsed in Gujranwala, Gujrat, Islamabad and Lahore. The earthquake was also felt in Chakwal, Faisalabad, Jhang, Sargodha and even up to Quetta.

3. Structural damages caused by the 2005 earthquake

So many residential, commercial and institutional structures were damaged by this severe earthquake. Hazara and Muzafarabad universities were mostly effected institutions in the region. Hazara University is located on the famous and historical Silk Route now known as Korakaram Highway (KKH) in Mansehra Hazara Division. It is about 40 km towards North from Abbottabad, 13 km from Manseehra and only 3 hours drive from the capital. In the East of Hazara University is Naran Kagan Valley and Azad Jammu & Kashmir while in the West is Oghi black mountains. Unfortunately on 8th October 2005, this campus was badly shaken and damaged by the most intensive and devastating earthquake of Pakistan History measuring 7.6 on Richter Scale. The old stone masonry structures could not withstand the severity of the earthquake and almost all the Department buildings suffered from severe structural damages. This research encompasses the effect of the earthquake on the structure and provides the recommendation for their future fate while considering the sustainability. Some of the structural damages at Balakot city are shown in Figure 2, 3 and 4

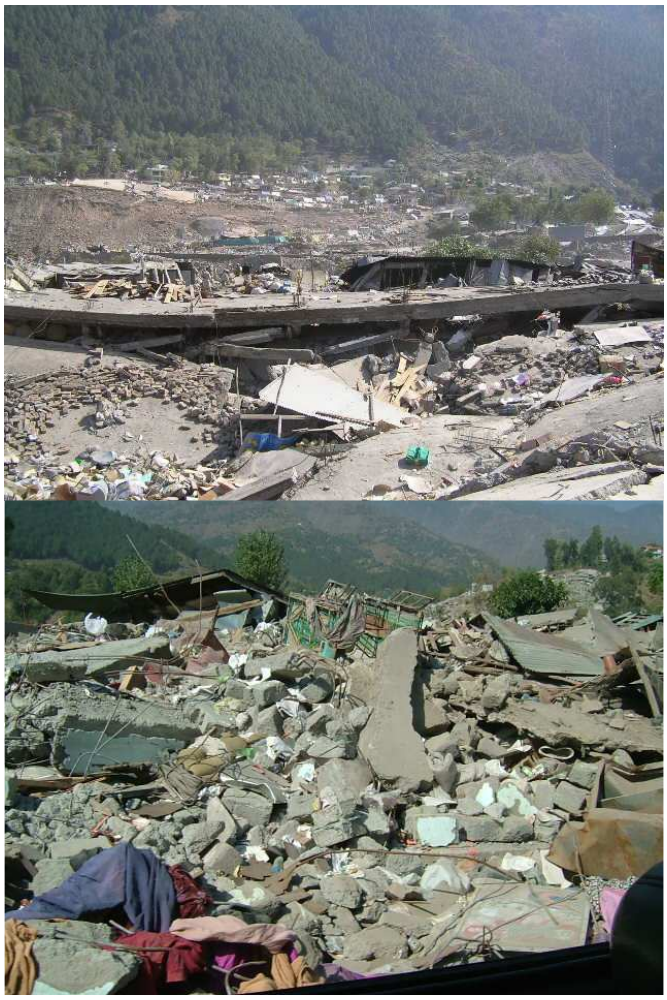

Figure 2: *Major destruction due earthquake at Balakot City*

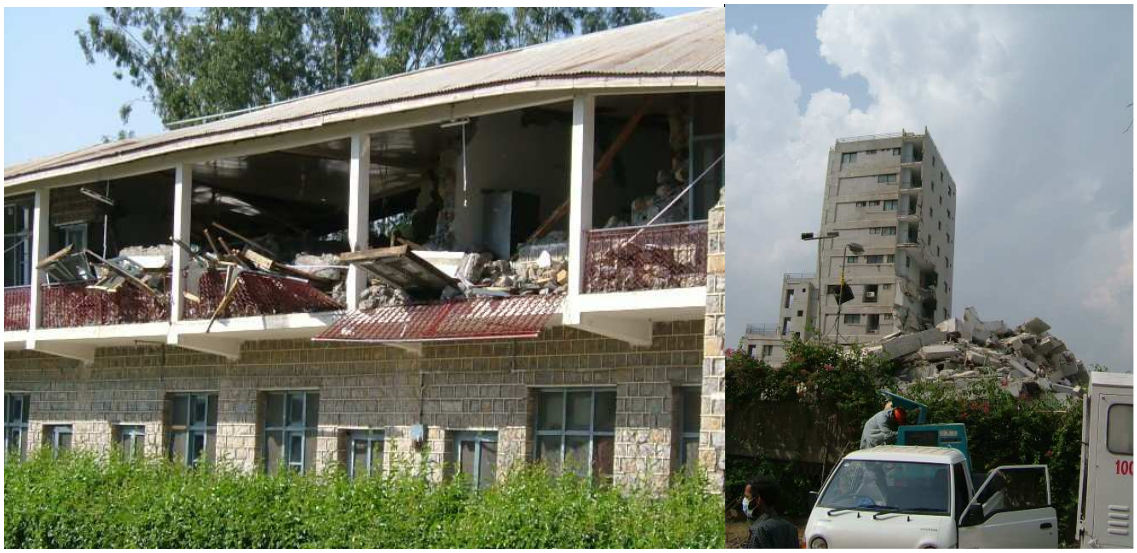

Figure 3: *Destruction due earthquake at Islamabad and Abbottabad*

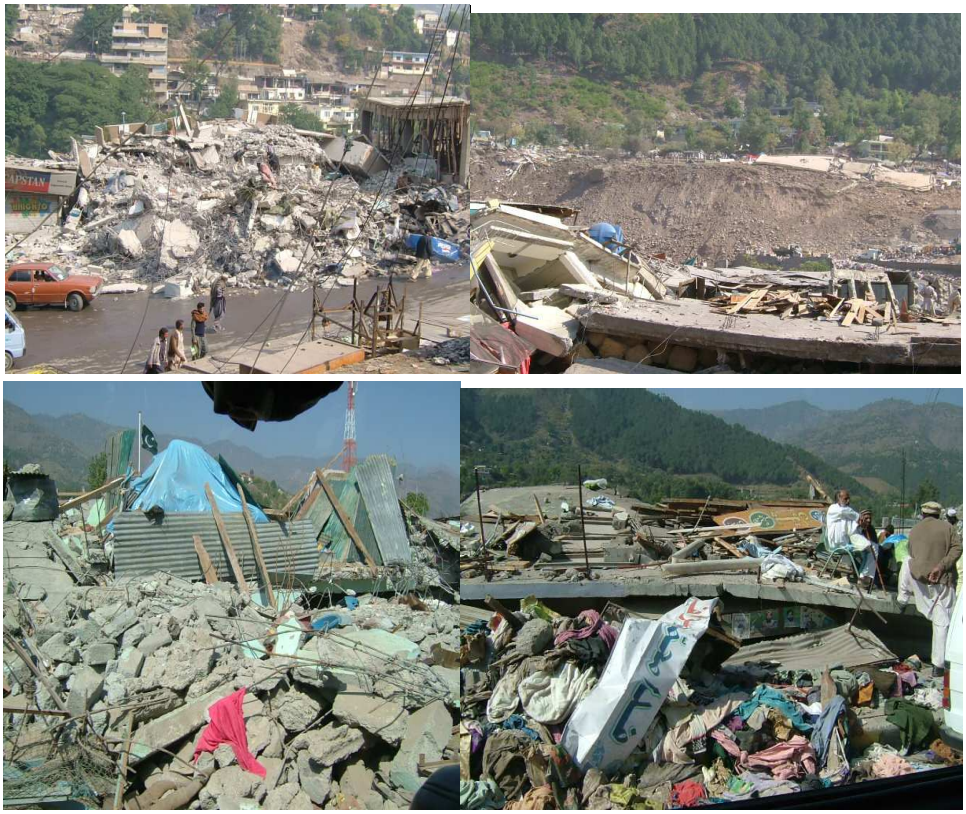

Figure 2: *Structural damages due earthquake*

4. Methodology & analysis

During this research work, the earthquake affected areas were visited to assess the role of sustainable development in rebuilding. The data was collected by using questionnaire, personal survey and oral discussions with the indigenous peoples during the field visits. This study helped to identify the role of sustainable development during the reconstruction phases.

The survey consisted of five demographic questions (sex, age, religion, birthplace, education level), four questions used to determine socio-economic status (do you own a television, car or phone; do you smoke), and two questions designed to assess general earthquake historical knowledge and role of sustainability in new construction (when was the last large earthquake; if and when will another quake occur in Kashmir, do you agree with the idea of sustainability in new construction)

5. Results & discussion

Some of the results from more than 200 respondents after successful interviews and surveys were predictable and are presented in Table 1.

The most notable results in this preliminary survey were found in the differing perceptions between education, technology, gender, and age, in addition to the general lack of belief in the use of seismic forecasting. This was not divulged in the simple responses but in the correlations between demographics and scaled responses. Especially interesting and statistically significant were the relationships found between education levels attained, age, television ownerships, and sex and many of the scaled response questions.

Table 1: *Questionnaire Response*

Sex:	Male: 89%	Female: 11%			
Age:	<20yrs: 10%	20-29yrs: 40%	30-39yrs: 16%	40-49yrs: 30%	50-70yrs: 4%
Birthplace:	city: 24%	Village: 76%			
Education:	none: 34%	Primary: 35%	secondary: 16%	baccalaur: 8%	4yr college:7 %
Smoke?	yes: 27%	no: 73%			
Telephone?	yes: 27%	no: 73%			
Television?	yes: 83%	no: 17%			
Car?	yes: 2%	no: 98%			
Last quake?	<10yrs: 18%	20-30yrs: 13%	40-60yrs: 34%	>100yrs: 1%	exact date: 34%
Quakes frighten you?	no: 32%	a little: 16%	somewhat: 6%	alot: 8%	yes a lot: 38%
Kashmir structures safe?	yes very: 21%	yes a bit: 16%	somewhat: 7%	not much: 20%	not at all: 35%
Is your house safe?	yes very: 24%	yes a bit: 15%	somewhat: 2%	not much: 20%	not at all: 39%
Kashmir earthquakes dangerous?	no: 0%	a little: 0%	somewhat: 2%	yes some: 5%	yes a lot: 93%
Role of sustainability in new constructions?	No idea: 23%	a little: 7%	somewhat: 20%	yes some: 16%	yes a lot: 34%

6. Conclusion and recommendations

During the field visit it was observed that most of the buildings were deteriorated due to old age, weathering effect and lack of maintenance. Wooden structures in the study area were severely deteriorated due to lack of maintenance and termite attack. The stone masonry structure behaviour is always brittle and it does not possess sufficient ductility which caused major damage in the study area.

The general direction of Hazara-Kashmir earthquake in the region is from North to South. The direction of earthquake has very significant effect on the performance of any structure. So, considering the sustainability factor of the structures should be oriented properly in future. The disposed of building materials are creating environmental hazards in the region. For the environmental sustainable point of view it is recommended to reuse the same stone with stronger mortar. For any future construction symmetrical and simple plan should be made to minimize the effect of any future earthquake. In case of new construction, the structures with more ductility and having good seismic performance should be considered. For the purpose it is recommended to consider the provision of reinforced masonry / stone structures having better ductile behavior.

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