Protibesh © BUET
July 2008, Volume 12 Issue 2
pp. 47-54

Planning for School Safety: A Case Study of Earthquake Affected Bagh Town in Azad Jammun and Kashmir, Pakistan

Dr. S. Shabih-ul-Hassan Zaidi
Professor and Dean, Faculty of Architecture and Planning,
University of Engineering and Technology, Lahore
Email: shabih52@hotmail.com

Abstract
School children are the most valuable asset of a society. Schools play an ever increasingly important role in the life of communities throughout the world. Unfortunately, schools are also places of immense vulnerability when located in areas of high seismic activity. In national disaster risk management plans, however, schools have not been given adequate attention, and poor disaster management has too often left them isolated, inaccessible in times of disaster and away from relief and rescue efforts.

Previously, the Planning guidelines only placed emphasis on environmental and traffic hazards in selecting locations for Schools. Now a days, safety of schools is even more desired, since they are exposed to natural disasters such as earthquakes, floods, fire, heavy rains etc. In Pakistan earthquake of October 08, 2005 had caused a large number of casualties of the school children in Azad Jammun and Kashmir (AJK). This was mainly because of poor construction and bad location of schools. In order to safeguard school children from the above mentioned hazards, we need to plan our schools in such a way that they become safe buildings for children and they do not fall prey to these hazards. In this connection, the location, standard of construction, space standards and accessibility to the schools are the important issues to be considered while planning for safe schools. This paper, by taking the example of earthquake affected Bagh town in AJK, Pakistan, portrays the lessons learnt and attempts to present some recommendations for ensuring safety of schools through proper Town Planning.

Key Words: Earthquake disaster, School Safety, Seismic Resistant Buildings, Building and Planning Codes.

1. Introduction

Earthquake is a common phenomenon in certain areas of Pakistan and the authorities are concerned about emergency disaster management as well as for long term solutions. In this process, after the sever earthquake of 2005 in Bagh town of Azad Jammun and Kashmir, Pakistan, the Earthquake Reconstruction and Rehabilitation Authority (ERRA) was established by the Government of Pakistan. The ERRA, took a wise step to prepare the Master Plan for the Bagh town before starting the rehabilitation of people and reconstruction of all the damaged constructions. In fact, preparation of Master Plan for all affected cities was considered as a former step of rehabilitation as suggested by the donors in order to ensure an effective utilization of their assistance. The Governor of Punjab involved the City and Regional Planning Department of the University of Engineering and Technology, Lahore, to prepare the Master Plan of the Bagh town on a voluntary basis. The experiences gathered as part of the project are presented here to formulate the guidelines for School Planning in earthquake prone areas.

2. Earthquake and it's Vulnerability in Bagh Town of Pakistan

Earthquake is considered as a natural disaster by the general people. In technical terms, an earthquake is a sudden motion or trembling of the ground produced by the abrupt displacement of rock masses. The Earth's crust is actually made up of huge separate masses of rock called tectonic plates. These move very slowly and when they rub together, the movement forces waves of energy to come to the earth's surface, resulting in the tremors and shakes that we experience as an earthquake. It is the shaking motion which does the most damage, causing buildings and bridges to sway perilously or collapse. Every year, around half a million earthquakes affect some part of the planet's surface, but the majority of shakes are so small as to be detectable only by seismometer. Potentially headline-grabbing earthquakes occur, on average, twice a week and mega-earthquakes – with a magnitude of more than 8 on Richter scale – only once or twice a year [1].

On Saturday, the October 8, 2005, at 08:52 local time (03:52 GMT), a massive earthquake measuring 7.6 on the Richter scale — the most devastating to hit the region in a century — destroyed towns and villages in Azad Jammu and Kashmir (AJK) and the Northwest Frontier Province (NWFP) of Pakistan. The scale of the disaster was massive

covering over 30,000 square kilometers in the most rugged mountainous terrain — the Himalayas. The calamity struck heavily in Balakot, Mansehra, Muzaffarabad, Abbotabad, Shangla, Rawalakot, Bagh, Batgram, Neelam valley and Kohistan areas. The disaster caused death of more than 88,000 lives and made over 100,000 injured. Approximately, 23 percent of the total deaths were that of the school children. More than 10,000 cattle were destroyed. Nearly half a million houses were destroyed along with many hundreds of kilometers of roads and dozens of bridges.

The earthquake of October 8, 2005 caused the destruction or damage beyond repair of 8000 schools out of 9000 in the earthquake affected region i.e. AJK and Northern Areas of Pakistan. Over 18,000 school children died in the collapsed schools and over 20,000 more students suffered from serious injury [2]. The Bagh District and Town suffered heavy loss of life and property due to the earthquake. About 24,000 people died in the Bagh district. Almost all public buildings have been damaged and most of the houses have been either collapsed or suffered from major and minor cracks in the walls. In Bagh town alone, 703 people died (most of these were school children) and thousands of people were injured due to earthquake. Most of the houses (3364) were completely damaged and the dwellers were forced to take shelter in the tents and sheds. All of the 50 schools (100%) were also completely destroyed or damaged beyond repair [3]. The Boys Degree College and the Girls College were also completely destroyed. This damage, in general, was devastating because of the location of type of construction of the existing public buildings particularly that of the school buildings. The earthquake was a reminder of the need for policy and public and private sector engagement and investment to make schools more resilient to earthquake and other hazards. It is believed by the experts that much can be done to guide future school planning and construction and to reduce school vulnerabilities through proactive mitigation programmes. Fortunately, there now exists ample information in the form of knowledge and technologies for making schools safer well within the affordability of governments and communities alike. There is a need to apply this information in the construction of new schools and retrofitting of existing school buildings.

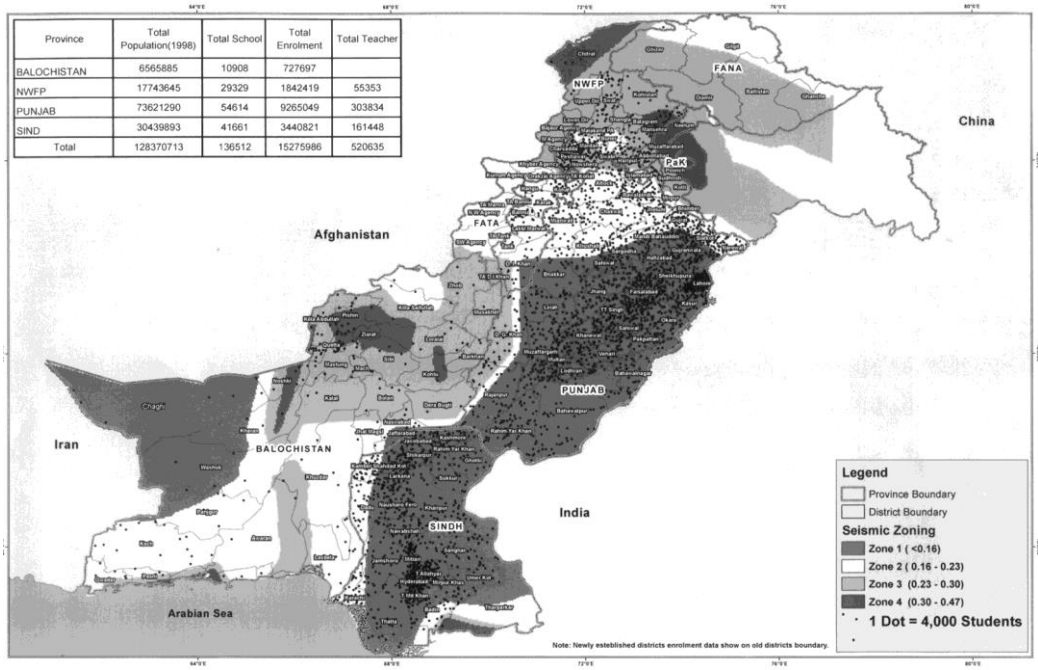

Figure 01: Map showing Seismic Zones and identifying number of the School Children at risk (1 dot on Map represents 4000 students). Map courtesy : Agha Khan Planning and Building Service, Pakistan

3. The Context of Bagh Town and It's Master Plan

The Bagh district is bounded on the north by Muzaffarabad district, on the east by Indian held state of Jammu and Kashmir and on the south by Poonch district and Indian occupied state of Jammu and Kashmir and on the west by Rawalpindi and Abbottabad districts of Pakistan. Topographically, the entire Bagh district is mountainous area, generally sloping from north-east to south west. The area falls in the Lesser Himalayas zone. The main range in the district is Pir Panjal. The Haji Pir pass is situated at the height of 3421 meters above sea level. The general elevation is between 1500 and 2500 meters above sea level. Mountains are generally covered with coniferous forests [4].

Bagh is the fifth largest town in Azad Jammu and Kashmir. The Bagh Municipal area has been divided into 23 wards with varied areas and populations. The town comprises of mostly hilly area with steep ridges and a very little flat area is available for development. Mahl River (Nullah) flows along the south-western side of the main town. The Bagh town has grown from a small settlement of 1810 inhabitants in 1972 to 18,886 in the year 1998. At a growth rate of 8.73 percent per annum the current population (in 2008) is estimated to be around 38000. Bagh was given the status of District Headquarter in April, 1987. It is said that a Bagh (garden) was set up by the landowner, where now the premises of the Forest Department is located. As a result, the area was named as Bagh [5]. The Bagh town has a Municipal Committee and a Bagh Development Authority (BDA) which are responsible for providing housing and other utility services to the residents of the town.

After the devastation earthquake of 2005, the process of Master Planning was lead by the Faculty of Architecture and Planning in which the role of the Project Manager was delegated to the Dean of the Faculty. The students and teachers of the City and Regional Planning Department conducted various field surveys, analyzed data, and developed a Master Plan for Bagh town using a Quick Bird Satellite imagery as a base map and the application of Geographic Information Systems (GIS) technology for analyzing data and developing proposals for a long term (25 years) Master Plan. The local community was fully involved in developing proposals at every stage of the Master Plan. A number of Public Hearings were held before the final approval and adoption of the Master Plan by ERRA.

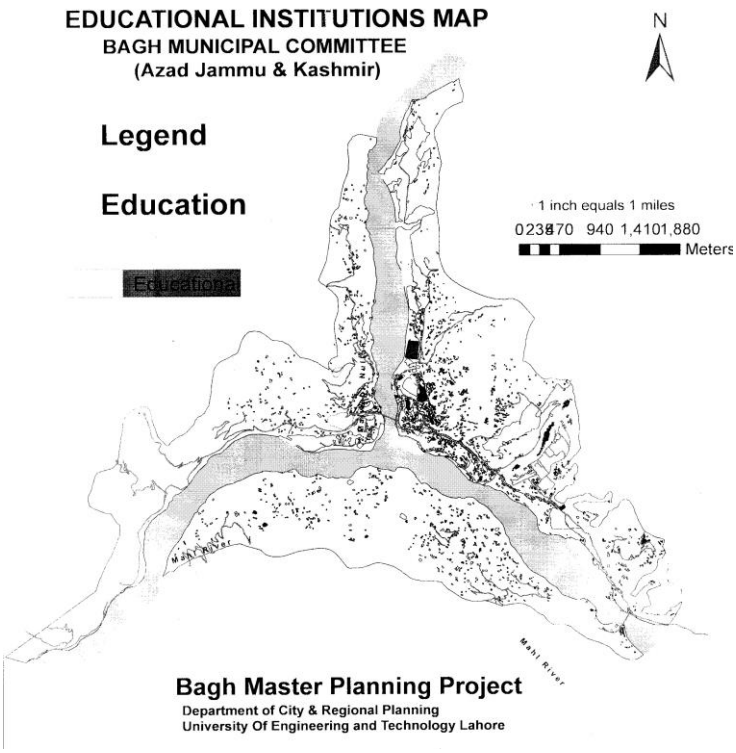

Figure 02: Location of Educational Institutions in the Master Plan of Bagh Town

4. State of Educational Institutions in Bagh Town after the Earthquake

At present, the overall condition of government sector educational institution buildings is unsafe. All of the schools and college buildings were constructed with stone masonry which could not withstand earthquake shocks (Fig: 3). After the earthquake, some 50 percent of the destroyed schools are being run in dilapidated buildings heavily damaged due to the earthquake and the rest are being run in open air (Fig: 4) and in the tents (Fig: 5). The present condition of private sector education institution buildings (20 in total) is somewhat akin to that of government buildings. Although, about 50 percent of the private school buildings have had some component of reinforced cement concrete but their present condition is recorded as bad or dangerous during the survey. It means about half of the private schools are working within cracked double storey buildings. This is more frightening situation and may lead to loss of innocent lives in future [6].

Figure 03: Destruction of a School in Bagh Town during the Earthquake in 2005

5. Lessons Learnt from the Earthquake Disaster in Bagh Town

It is shocking to note that all of the Government Buildings (Offices, Police Station, Jail, Hospital etc.) and all of the schools (government and private schools) were completely destroyed or damaged beyond repair during the earthquake of 2005 in Bagh town. In contrast, it was found out that all of the houses built by the residents' themselves were not destroyed completely on the same catastrophe. This indicates that the large buildings such as that of schools and Government offices had some general faults, therefore, need special consideration for seismic resistant construction. It has been noticed that the great loss of life was caused basically not by the earthquake, but due to faulty construction and bad location of buildings. Therefore, the following observations are made from the study of earthquake disaster in Bagh town from the point of view of safety of schools [7]:

1. The schools were constructed using poor building material i.e. locally available stones. Usually walls were made of stone masonry while the roofs were made of RCC lintels or wood and tin.
2. The construction of schools was not according to the earthquake resistant structural design i.e. seismic resistant frame structure.
3. Due to the absence of any Master Plan for the Bagh town, the entire city developed in the form of a huge slum. Therefore, the schools were located along narrow, zigzag streets which caused a great problem in movement for the rescue work after the earthquake.
4. Some schools were located in the areas of land sliding, which were marked as "highly dangerous areas" (red zone) in the seismic map for Bagh prepared after the earthquake (included in the Bagh Master Plan 2006-31).
5. Safety measures and safety equipment such as fire fighting equipment, first aid kits etc. were not available in the schools. This made the relief and rescue work difficult and a number of children died because of non-availability of emergency medical help.
6. The schools' children and their teachers were not prepared for dealing with the disaster of any kind. No safety drills or any other preparedness exercises were made by school authorities or local municipal authorities.
7. The school buildings were inadequate in size and lacked basic facilities such as water supply, sewerage etc. The congested class rooms with little space for circulation caused a great difficulty in immediate evacuation during earthquake.
8. The municipal authorities were unprepared, un-trained and ill-equipped to face a catastrophe of the 2005 earthquake. They did not have any cranes, or excavators for rescue operation for school children trapped in the collapsed buildings.

Figure 04: Open Air class after earthquake - an impromptu solution

6. The Need for School Safety

Safety for the school children is a crucial issue for every parent all over the world. However, these target groups are frequently exposed to serious physical threats resulting from natural and manmade disasters, particularly in some parts of the world like Pakistan where attention is rarely paid to this vulnerable group. Today, it is agreed that building of 'safe schools' needs to be a high priority throughout the world. In regions facing earthquake threats on a regular basis, it is imperative to build schools that provide a safe environment for the children [8].

Fauad Bendimerad [9] argues that there is a need for a global Field Act mandating strict seismic resistant construction standards for school building. He pointed out that since the adoption of the Field Act after the 1933 Long Beach Earthquake in California (USA), not a single school has collapsed or experienced extensive damage, and not a single child or adult was killed or injured in any School in California, which were built under the Field Act. The question arises that why we cannot do this in Pakistan and elsewhere in the world. Fauad Bendimerad points out the following:

1. School safety requires necessary Regulations and Laws that ensure adequate codes and strict quality control and supervision; as well as accountability.
2. Building safe schools makes economic sense. It means spending money on construction of safe schools proves to be economical in the long run.
3. The implementation of the laws and regulations requires training and certification of professionals (planners, engineers, architects, builders, building inspectors).
4. Knowledge (technology) to make safe schools exists for at least 3 decades. Therefore, unsafe schools are an avoidable error and sending children to unsafe buildings is an unjustifiable practice.

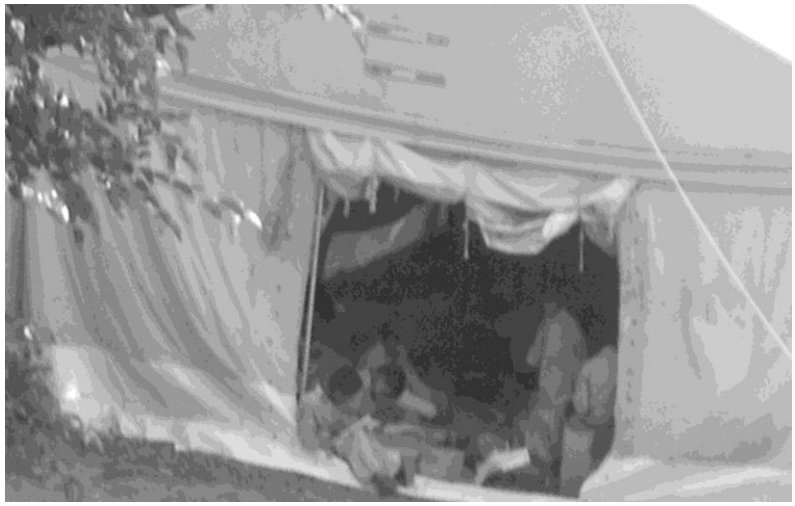

Figure 05: School in a Tent after Earthquake in Bagh Town

6.1 Recommendations for Safe School Construction

The following recommendations are made to ensure the development of safe schools in the disaster hit Bagh town and elsewhere in Pakistan:

6.1.1 Site Selection and Town Planning:

Our schools, particularly those located in rural areas and small towns are more vulnerable to natural disasters such as earthquakes, floods, fires, heavy rains, and wind storms. This is mainly due to unplanned street design and poor site selection for the location of school buildings. The narrow streets in the unplanned areas, along which most of these schools are located, cause hindrance in the rescue work after the collapse of buildings due to earthquake, floods or any other natural disaster. Therefore, it is recommended that the school site should be stable and safe enough to withstand the total building load, their occupants and their belongings. The schools should not be constructed on fault lines, unstable slopes, river banks, marshy lands, fills and areas marked as red zone in the seismic map. These issues should be considered while preparing a Master Plan of the city. The detailed local planning or area development schemes' should be designed in such a way that it ensures suitable layout pattern according to the topography of the area and adequate width of streets and roads along which the school buildings are constructed.

6.1.2 Architectural Design of School Buildings:

The shape, size and proportions of a building are important for its seismic safety. Buildings with asymmetric plan and elevations are more vulnerable to earthquakes than those having symmetrical ones [10]. Therefore, buildings with frame structure having square shape design should be preferred for schools. The C, E, or H shape designs may be avoided.

6.1.3 Foundations:

The schools should have a proper solid foundation and the base on which the foundation rests should be compact. The foundation should be built according to the recommended seismic resistant design by the structural engineers and suggested in the ERRA guidelines [11].

6.1.4 Structural Design:

The building should behave like a single unit for earthquake resistance. Therefore, the school building should be built according to a frame structure with beams at each level and RCC columns connected to the horizontal beams properly as indicated in the Frame structure building in Fig.06. Special attention should be given to the type and quality of the bond within the walling (infill) units which are the main contributors to the integrity and strength of the buildings.

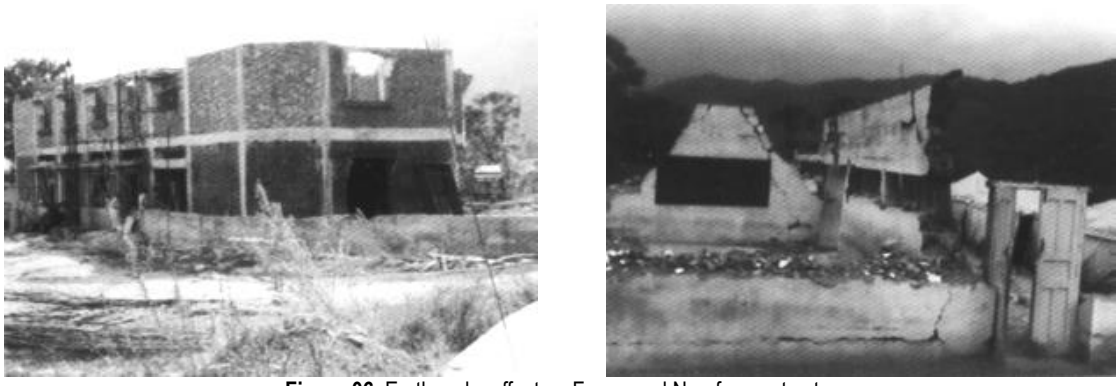

Figure 06: Earthquake effect on Frame and Non-frame structure

6.1.5 Building Material and Workmanship:

The building material used for construction of schools should be according to the specifications provided by Earthquake Reconstruction and Rehabilitation Authority (ERRA), Pakistan [12]. The bricks should not be over or under burnt, deformed or undersized. Solid Cement Blocks should be of regular shape, and free from broken edges or any type of deformation or cracks. Concrete blocks should be at least 1:3:6 mix with crushing strength of 2000 psi. The blocks should be cured properly before use. Deformed steel should be free from heavy rust and scale. Plain steel bars are not recommended for use. Cement should be carefully stored to avoid moisture intake. Good quality sand and stones crush are recommended to be used in concrete mixtures. Proper shuttering and form work is also recommended. The masons should be properly trained to construct seismic resistant buildings for schools safety.

7. General Recommendations for Making Schools Safer:

Some general recommendations emerged as an outcome of the study of schools in Bagh town and various conferences on school safety are given below:

1. The schools should be planned as one of the most important public facility in all human settlements. Their size and location should be clearly marked in a Master Plan or Local Plan (Area Development Schemes) so as to have a suitable size of the schools according to established space standards and they are adequately located to serve their catchments areas. For example, the primary schools should have an area of 1.5 to 2.5 acres and they should be located at 5-10 minutes walking distance from the residences of the school children [13].
2. The construction material and standards of construction of school buildings should be such that they are seismic resistant. Normally, a concrete frame structure with burnt brick or cement block with cement mortar should be used for construction of schools. The guidelines for construction of school buildings provided by Earthquake Reconstruction and Rehabilitation Authority (ERRA) should be followed for construction of schools, particularly in the earthquake zone. The federal government should enact a Universal Building Code for construction of seismic resistant schools on the pattern of Field Act in the USA.
3. Accessibility to schools should be improved by widening the streets or roads along which they are located so that at the time of emergency, the fire-brigade, ambulances and other rescue vehicles can reach the school buildings [14].
4. Ensure schools can function as post disaster shelters including consideration for adults, people with disabilities, and provide alternative sites for educational continuity with school based disaster management planning and training. Emergency drills should be regularly held in all schools to train the students' attitude at the time of emergency.
5. Strengthen accountability mechanisms and advocate for the creation of national programmes for school safety, where needed, to ensure that all new and existing, public and private schools are safe from all hazard threats. The existing school buildings should be strengthened through retrofitting and the new schools must be constructed according to new building code to be seismic resistant.
6. Trained personnel for multi-hazard disaster resistant schools planning, design, monitoring, maintenance, inspection, and approval at community – and all levels of government.
7. School safety is an opportunity to establish innovative and effective partnerships between national government policy and state, local government and community to ensure implementation of priority actions. Civil society and private sector organizations are critical partners in school safety action plan implementation through their provision of technical and project management expertise and financial support to national and local governments, and community groups [15].
8. Use national budget and infrastructure protection resources to make schools safe, with no funding cut from education sector.
9. All schools should be equipped with fire-fighting equipment such as fire extinguishers, sand buckets and fire hydrants at school site and first aid equipment. The use of this equipment should also be taught to the teachers and students.
10. The communities should represent continuity and sustainability for school safety and through training of trainers programmes to scale-up awareness, develop information, instruct evacuation plans, maintain safe havens and apply improved local technologies to broader community built environment. Therefore, local communities must be involved in all efforts to build safe schools.
11. The school curriculum should include lessons about disaster awareness, disaster management and coping with the earthquake situation during and after the earthquake.
12. Local skills development and training of masons about construction of seismic resistant buildings should be carried out through Non Governmental Organizations (NGOs) [16].

8. Conclusion

Earthquake is an unpredictable natural disaster, but the loss of innocent lives of the school children and property is mainly caused by man-made buildings which are non-resilient to the earthquake shocks. This loss can be avoided if the Government, NGOs, and the communities join hands in planning, financing, and construction of earthquake resistant buildings, particularly for schools. In general, the planning and design of School buildings needs to follow the standards of building construction and physical planning. In this process, the regional guidelines like those presented here for Bagh town are necessary to follow in order to save the children, particularly in the earthquake vulnerable parts of the world.

References:

1. APELL (Awareness and Preparedness for Emergencies at the Local Level) for Earthquake Risk: A Community-based approach for disaster reduction; A brochure, prepared by UNEP (United Nations Environment Programme) and UNESCO (United Nations Educational, Scientific and Cultural Organization), 2008.
2. UNCRD (United Nations Center for Regional Development), Reducing Vulnerability of School Children to Earthquakes, Disaster Management Planning Hyogo Office, 2008, p.3.
3. ERRA (Earthquake Reconstruction and Rehabilitation Authority, Pakistan), official records and newspaper reports published in.
4. District Census Report of Bagh District, 1998.
5. ibid.
6. Bagh Master Plan, 2006-2031, Prepared by the City and Regional Planning Department, University of Engineering and Technology, Lahore. 2006
7. ibid.
8. Roland Wesley Hare and Judit Deilinger, "Building Safe Schools – the Community Oriented Approach", a Paper presented in the International Conference on Schools Safety held in Islamabad from 14-16 May, 2008.
9. Fauad Bendimerad, "School Safety: Moving Beyond the Rhetoric", a Paper presented in the International Conference on Schools Safety held in Islamabad from 14-16 May, 2008.
10. School Safety: Protecting Vulnerable Communities, A brochure by International Federation of Red Cross and Red Crescent Societies, 2008.
11. Guidelines for Construction of Schools in the Earthquake Affected Areas: A Report prepared by National Engineering Services Ltd. Pakistan (NESPAK), for ERRA, 2005.
12. ibid.
13. Bagh Master Plan, 2006-2031, Prepared by the City and Regional Planning Department, University of Engineering and Technology, Lahore, Pakistan. 2006
14. ibid.
15. Islamabad Declaration on School Safety issued at International Conference on School Safety, Islamabad, Pakistan held on 14-16th May, 2008.
16. Bangkok Action Agenda, Outcome of the Asia-Pacific Regional Workshop on School Education and Disaster Risk Reduction, held on 8-10 October, 2007 at Bangkok, Thailand.