

# **INTERVENTION FOR CAPACITY BUILDING FOR EARTHQUAKE RISK REDUCTION**

**In Earthquake Affected Parts of Kashmir**

**By**

**National Centre for Peoples'-Action in Disaster  
Preparedness (NCPDP)**

**Jointly With**

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New Delhi**

**Confederation of Voluntary Agencies (COVA)  
Hyderabad**

**And**

**Building Materials & Technology Promotion Council,  
(BMTPC), Govt. of India**

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## 1. Background:

### ➤ **Recent Earthquake and Fallout**

The earthquake of October 8, 2005 in Western Kashmir once again demonstrated how vulnerable are the houses that people are building in different parts of the country. The earthquake with its magnitude of 7.8 on Richter Scale is one of the biggest in the subcontinent in recent decades. Although, the fatalities on India's side of the boarder were approximately 2000, the death score on the other side of the boarder reached around 80,000. A significant portion of these 80,000 accounts for the death of school children. The infrastructure buildings including schools, healthcare facilities, police stations, *Panchayat* houses etc. too performed poorly. Even the buildings occupied by armed forces suffered a lot of damage.

Needless to say, the death and destruction on this scale have severely disrupted the life of the people, causing enormous hardships, and have shaken their confidence. The house building activity has been most severely affected by this.

### ➤ **Traditional Building Technologies, economics, weaknesses**

The construction of houses and infrastructure buildings is commonly carried out using the most popular building technologies that primarily depend upon the locally available materials as well as the locally available skills. Barring some exceptions the structures are masonry with load bearing walls. Only in recent times people have started building RC frame structures for homes and small infrastructure buildings. The most common building materials are bricks, stone (rubble), mud, timber of different types, Galvanized Iron sheets, etc. In recent years cement and steel have also become popular with many. Lime once used for masonry is rarely used now on account of limited availability.

The technologies for roofing and walling could be listed as...

#### **i. Roofing**

1. Timber planks on timber understructure - pitched
2. Timber Shingles on timber understructure - pitched
3. Mud on timber understructure - flat
4. Corrugated Galvanized Iron (CGI) Sheeting on timber understructure - pitched
5. RCC Slab

Today timber planks and shingles are rarely used since timber has become very expensive. Mud as roofing material too is losing its popularity. Mud roofs are found, mainly where the accesses is severely restricted on account of distance and terrain such as, in the high elevation pastures where households with domesticated animals move to in summer to feed their animals. Such locations are not accessible by motorable roads. Mud had the greatest advantage of cost as well as of insulation against summer heat and winter cold. But mud is heavy and requires heavy timber understructure. Hence, mud is suitable only where timber is cheap or free.

On the other hand CGI sheets have become a common roofing material in the past couple of decades. Being light they require lighter understructure. The CGI roofing, being pitched and relatively smooth, does not permit much piling up of

the snow. This helps reduce the timber requirement. On the other hand CGI sheeting offers poor insulation. But on account of attic floor the living spaces under the attic are adequately insulated.

RCC roofing is still not very popular because (a) it is expensive, (b) it makes the interior colder in winter, and (c) it is very heavy.

## **ii. Walling**

1. Brick
2. Un-burnt Bricks
3. Un-Coursed Rubble (stone) Walls
4. Timber in combination with Stone or Bricks
5. Mud as a mortar
6. Cement as a mortar constituent

Bricks are most commonly used in the Kashmir valley where the soil to make bricks is most easily available. Those who cannot afford bricks opt for unbaked bricks. Often unbaked bricks are used for the interior walls. At times exterior walls are also made of unbaked bricks with cladding of baked bricks.

Stones are used in the hilly areas since there they are most easily available. Stone type varies greatly from one location to another. The quality of stone masonry greatly depends on this factor. Stones are typically excavated from local outcrops. At times such outcrops are very close to the construction site when the stones are hand carried to the site.

Wood is often used in combination with stone or bricks to construct walls that are very thin and light. This type of construction is called *Dhajji Diwar*. The system consists of wood frame made with posts, horizontal struts and diagonal bracings. The panels created within the frame are filled with stone or bricks. Typically the brick in-filled walls are made with cement mortar, and are used as exterior walls. If filled with unbaked bricks, then the wall is used as partition wall. Similarly, in stone area the infill is made of small stones and mud mortar to make walls that are used as partition walls.

Although, mud mortar is the most commonly used mortar, in recent times use of cement mortar has increased with bricks as well as stone.

## **iii. Intermediate Flooring**

1. Timber
2. RCC slab

Timber has been the most popular material for structural floor because it is versatile, easy to work with, maintains the interior warm in winter and the skilled required for it are easily available. In locations that are not easily accessible by vehicles it is only type of floor that is viable.

In past decade or so the RC floor has also made in roads. But this is viable only close to the motorable roads.

➤ **Performance of Building Systems in Earthquake**

It has been observed that the damaged buildings include those having stone masonry as well as brick masonry. The area of Kashmir that has been most severely affected is hilly, where stone is the predominant material of walling. Hence, many are of the opinion that only stone buildings have suffered. The stone buildings, nonetheless, have suffered more damage on account of inherent weaknesses. The damage and causes are listed in the table below.

No.	Damage Descriptions	Cause
<b>A</b>	<b>Walling</b>	
1	Corner vertical crack	Poor wall to wall connection, opening too close to corner
2	Diagonal crack	Too many wall openings including doors, windows, inbuilt cup-boards, spacing between openings too little
3	Horizontal crack	Excessive bending stresses caused by vertical bending resulting from inadequate lateral support to wall, extra high wall, pitched roof imparting lateral thrust on wall due to absence of truss action etc.
4	Vertical crack	Excessive bending stresses caused by horizontal bending resulting from excessive wall length, absence of strong connection between the exterior wall and the cross walls (including <i>Dhajji Diwar</i> , absence of diaphragm action due to low rigidity in attic timber floor, absence of anchoring of attic floor to wall etc.
5	Bulging in UCR wall	Poor interlocking between outer and inner wythes of wall and absence of through stones
6	Delamination in UCR wall	Poor interlocking between outer and inner wythes of wall and absence of through stones
7	Collapse of a portion of wall	Excessive local damage resulting in to instability of a portion of wall
8	Cracking at lintel bearing	Inadequate bearing length and absence connection between the lintel and the band
9	Falling off of stone infill in <i>Dhajji Diwar</i>	Absence of containment of infill material
10	Collapse of <i>Dhajji Diwar</i>	Poor connection between <i>Dhajji Diwar</i> and base as well as ceiling
<b>B</b>	<b>Roof &amp; Floor</b>	
1	Breaking of individual element	Rotten material
2	Collapse, partial or full	Lack of anchoring of roof to wall and collapse of support wall

As in the earlier earthquakes in the subcontinent, the poor construction quality and absence of earthquake resisting features are the prime reasons for the damage. The basic laws of masonry construction have been routinely violated. In addition while using new materials like cement and steel high level of

ignorance about the peculiarities of the materials and cautions that they warrant has also contributed significantly the vulnerability of the structures against earthquakes.

One observation that is peculiar to Kashmir earthquake is that the roofs have suffered little or no damage in many houses. The walls collapsed bringing the roofs down. Even today, nine months after the quake, where the debris is not removed, intact roofs consisting of triangular boxes of tin clad timber framework are sitting atop heaps of rubble. In other words the roofs have been solid as against the walls that were found to be highly vulnerable.

➤ **Desired Remedial Actions for New Buildings**

Basically the two problems mentioned above need to be addressed while arriving at the list of remedial actions while constructing anew. These could be listed as...

- i. Improved quality
- ii. Introduction of earthquake resisting features

**Table 2: Measures for Preventing Damage in a Future Earthquake in a New Construction**

No.	Damage Descriptions	Remedial Action
<b>A</b>	<b>Walling</b>	
1	Corner vertical crack	Build all walls at same time ensuring proper wall to wall connection, install seismic bands at lintel and/or eave levels, keep openings away from corners
2	Diagonal crack	Reduce number of openings and their sizes, install lintel level band or connect lintels to eave level band, increase gap between openings
3	Horizontal crack	Install vertical reinforcing bars at each wall to wall junction, anchor attic floor and intermediate floor to walls
4	Vertical crack	Ensure proper connection between walls including <i>Dhajji Diwar</i> , install eave and/or lintel level continuous bands in all walls, improve diaphragm actions of attic floor and intermediate floor by proper nailing of floor planks, installing floor planks in different diagonal directions in different parts of floor, anchoring floors to walls, improving the in-plane shear strength of <i>Dhajji Diwar</i> by installing proper bracing & strut system.
5	Bulging in UCR wall	Ensuring proper interlocking between outer and inner wythes by proper placement of stone and using adequate through stones
6	Delamination in UCR wall	
7	Collapse of a	Overall improvement in the structure as

No.	Damage Descriptions	Remedial Action
	portion of wall	mentioned above
8	Cracking at lintel bearing	Adequate bearing length and connecting lintel and the band
9	Falling off of stone infill in Dhajji Diwar	Providing containment of infill material with chicken wire mesh nailed to wall faces
10	Collapse of <i>Dhajji Diwar</i>	Ensuring proper connection between <i>Dhajji Diwar</i> and bands
<b>B</b>	<b>Roof &amp; Floor</b>	
1	Breaking of individual element	Better maintenance, anchoring of elements to wall bands
2	Collapse, partial or full	Better maintenance, anchoring of elements to wall bands , Installing minimum two nails at each joint between floor plank and floor joist.

Note: All these measures must be carried out in accordance with the Technical Guidelines Issued for J & K State by the Ministry of Home Affairs, Govt. of India

#### ➤ Desired Remedial Actions for Existing Buildings

In case of existing buildings the remedial measures are as follows

- Proper restoration of damaged portions to ensure proper connection between the cracked portions or between the old and the reconstructed portions in order to bring the structure back to its pre-earthquake condition
- Identify the weaknesses in the structure and implement measures to tackle each weakness.

**Table 3: Measures for Preventing Damage in a Future Earthquake in an Existing Construction**

No.	Damage Descriptions	Remedial Measures
<b>A</b>	<b>Walling</b>	
1	Corner vertical crack	Install seismic belt at lintel/eave level, install vertical reinforcement at each wall to wall joints
2	Diagonal crack	Install seismic belt as lintel/eave level, and incase all openings with seismic belt, close off extra openings with masonry.
3	Horizontal crack	Install vertical reinforcement at each wall to wall corners, anchor attic and other floors to walls, install collar beam across two top chords of truss
4	Vertical crack	Ensure uninterrupted seismic belts on all walls, anchor floors to walls, improve floor diaphragm action by installing diagonals and adding nails to the floor planks, install anchors between exterior walls and <i>Dhajji Diwar</i> , install bracings and struts in <i>Dhajji Diwar</i> and improve internal connections.
5	Bulging in UCR wall	Install adequate cast in-situ RC Stitching elements

No.	Damage Descriptions	Remedial Measures
6	Delamination in UCR wall	Install adequate cast in-situ RC Stitching elements
7	Collapse of a portion of wall	All the above measures
8	Cracking at lintel bearing	Installation of lintel and/or eave belts
9	Falling off of stone infill in Dhajji Diwar	Provide containment of infill material with chicken wire mesh installation
10	Collapse of <i>Dhajji Diwar</i>	Install bracings and struts in <i>Dhajji Diwar</i> , improve internal connections, and anchor it to floor and ceiling.
<b>B</b>	<b>Roof &amp; Floor</b>	
1	Breaking of individual element	Replace rotten elements
2	Collapse, partial or full	Improve diaphragm by installing diagonals

Note: All these measures must be carried out in accordance with the Technical Guidelines Issued for J & K State by the Ministry of Home Affairs, Govt. of India

### ➤ Peoples' Response to Tackle Shelter Needs

The past experiences of NCPDP have shown that after a destructive earthquake much fear prevails about reconstruction of houses using same materials as before the quake. Due to lack of scientific outlook in our societies myths too quickly take roots. All this brings the traditional housing process to standstill and new trends come up and soon gain momentum. But not every new trend is sound, technically and economically, since they generally lack scientific basis.

In Kashmir too such development have taken place. For Kashmiris this was the first big earthquake in a long time. Hence, they had never imagined such a disaster. The developments worthy of mention are as follows.

- i. People have lost confidence in their stone construction. But they do not have any objection to mud mortar!
- ii. After the earthquake in order to survive the winter all the households constructed mid term shelters with walls and roofs made of CGI sheets, plywood and timber. These shelters have been made quite livable by proper flooring, construction of bathroom inside, installation of *Bukhari* for space heating in winter etc. Typically these shelters have two rooms including kitchen. Since after winter many households have added additional space, especially to cater to guests. At this stage these shelters seem to have taken care of the peoples' need of shelter against harsh winter while ensuring safety against a possible earthquake.
- iii. At this point in time, nearly nine months after the earthquake, people are simply not ready to rebuild permanent houses on account of a variety of reasons. These could be listed as follows.
  - A myth that "like in Gujarat, in Kashmir too one more earthquake could occur within the first year after the quake". As a result people feel that they should wait for a year to get over before reconstructing a house.

- The other issue for many is the mental preparation that is required for rebuilding the house after having seen one's house simply falling apart in the quake.
- Third hurdle for many is the huge cost of new construction. For almost all of them constructing house was a once in a lifetime event in which the life-time's savings were invested. With that what people had built for themselves was rather lavish in size. Many have given up on building something so large.
- Finally, a seemingly simple hurdle is the absence of knowhow. People want some one to tell them how exactly they should build. People do realize that they have to do something different. But what, they do not know.

Hence, the masons are busy building more tin houses.

#### ➤ **Intervention Envisaged by NCPDP**

The state of peoples' response to tackle their shelter needs warrants the following intervention. It is based on the experience of past 12 years since Latur Earthquake, with special lessons drawn from the past successful earthquake rehabilitation. It states that the **reconstruction has to be people driven with some facilitation by NGOs as well as government**. In other words it is the people whose capacity must be built up so that the housing process restarts and moves in the right direction.

- Technology Demonstration:** Take up demonstration construction primarily to demonstrate what the official Govt. of India Guidelines recommend for building an affordable basic earthquake resistant construction using predominantly the local materials. Such a demonstration could also help establish the economics of the improved technologies. It would also help prevent confusion that could arise out of different types of construction that comes up through the interventions by different outside agencies.
- Training of *Wastukar* or Building Artisans:** Hands on training of building artisans is the greatest need of the hour since it is they who are going to help people rebuild their houses. Unless and until these artisans are intensively trained in earthquake resistant new construction as well as restoration and retrofitting of existing houses they would not be able to respond appropriately to the need of the hour. Such training could be given at the technology demonstration sites. These training programs must expose the artisans to...
  - Ways for ensuring adequate earthquake resistance in the vernacular construction system through adherence to the basic rules of good construction practice and through introduction of special features that help increase the earthquake resistance
  - Techniques for restoration and retrofitting of existing vernacular buildings so that the damaged buildings can be restored to their pre-earthquake condition using scientifically sound method and the earthquake resistance of the existing structures can be increased to prevent high degree of damage in a future quake.
- Awareness Building:** The effectiveness of technology demonstrations and artisan training could be ensured only through the simultaneous awareness creation in the communities. Unless the people know of the ways to reduce the risk they will not demand from the building artisans the use of earthquake resisting building technologies, and if the people do not demand for it then the artisans will find the new knowledge redundant. An awareness program

must keep the fear of a future earthquake alive but at the same time prepare the people by bringing them the affordable options for reducing that danger. The awareness program should also help the people in taking right decision about the actions that need to be taken on their existing houses, damaged or otherwise. People could save scarce resources saved over their lifetime. The awareness raising could be done through taking information to the people through...

- (a) Printed media such as posters, booklets etc.
- (b) Video
- (c) Radio / TV
- (d) Meetings – group and individuals
- (e) Visit to demonstrations etc.

## 2. NCPDP & Other Agencies: Collaboration for Vulnerability Reduction

With all necessary know-how and information on hand, NCPDP had decided to make a short term intervention in the quake affected areas of Kashmir with the primary objective of taking the affordable and replicable earthquake resisting technologies to the people. The plan was to go back to Kashmir at the end of winter.

Subsequent to the visit to Kashmir in December 2005 NCPDP was approached by **BMTPC, of Ministry of Urban Employment, Govt. of India** to take up seismic retrofitting of Sub-district Hospital at Kupwada town in Kashmir Valley for vulnerability reduction and demonstration. In addition they asked us to design posters for awareness on earthquake safety for Kashmir. At the same time NCPDP was given a task of making a user friendly “Field Guide to Restoration and Retrofitting of Vernacular Rural Buildings” in the quake affected areas of Kashmir by **UNESCO**. As a result months of January, February and March were spent on making these items as well as preparing to go to Kashmir. At the same time two videos were also made as earlier in case of Kutchch and Uttaranchal that could be used for awareness generation.

In March, just as the planning was under way, NCPDP was approached by two organizations. These were **Confederation of Voluntary Agencies (COVA)**, Hyderabad based NGO, and **Aga Khan Building and Planning Services (AKBPS)**, Bombay based NGO.

Through, our interaction with COVA, its executive director was able to appreciate the concern of the meaningless dismantling of existing buildings by the people out of fear, and, hence, sought NCPDP’s technical assistance in taking up a program of awareness to prevent such destruction. AKBPS and its parent organization Aga Khan Foundation (AKF) were keen to take up mason training, to enable the people to re-house themselves in a safer house. Through our preliminary interaction we were able to share our past experience of technology transfer in several earthquakes through the hands-on mason training at the construction of demonstration models as well as at the restoration and retrofitting of existing public buildings.

### ➤ **Collaboration with BMTPC**

Working with BMTPC was not new, having done numerous projects in the past 12 years.

- i. As earlier in the aftermath of Uttaranchal Earthquake of 1999 we took up the task of preparing booklets and posters for creating awareness on affordable building technologies for earthquake risk reduction. After having made materials in Gujarati, Marathi and Hindi, this time we made it in Urdu and English. Working with Urdu was exciting but difficult since we could understand the spoken language but not the script. A set of 10 posters and a 16 page booklet were made. For once our products were polished and colored, departing from our usual practice of keeping our material very simple and cheap. Both the items came out very nice and attractive. We felt obliged to BMTPC since without their desire to make them so attractive this would not have been possible.
- ii. The plans and estimates for retrofitting of hospital were finished well before we left. That was the easiest part. The identification and appointment of appropriate and willing contractor took us over a month since most reliable and resourceful contractors had their hands full and were unwilling to get in to something new. The other major hurdle, the most frustrating one, was to procure galvanized welded wire mesh required for seismic belts in retrofitting. It was not available in Kashmir. No material supplier was willing to procure the material for us. No shipper from Delhi was willing to handle it for us. A trip had to be made to Delhi, after trying in vain for nearly a month in Kashmir. Even after that trip it was fifteen days before the mesh finally reached Kupwada and the work could be begun. All this took us nearly two months. These were two months of frustration, helplessness and anger.  
The work on hospital progressed smoothly, barring a few days of curfew in Kupwada following firing and killing by CRPF while controlling an unruly mob. There were few days of anxiety. Fortunately, there were no other mishaps and by the end of July the work was completed.

### ➤ **Collaboration with COVA**

This was a week-long intervention to train volunteers with engineering background in restoration and retrofitting of existing buildings. COVA had planned to invite engineering students and engineers to work as volunteers in the quake affected villages in order to provide guidance to the villagers about what action they could take with their existing houses. Immediately upon arrival in Srinagar on April 1, a series of workshops were held at Government Polytechnic College, National Institute of Technology (NIT) and SSM Engineering College to orient approximately 130 individuals with engineering background in classroom in basic earthquake engineering with a special focus on restoration and retrofitting.

This was followed by a trip to a few quake affected villages east of Uri, between Uri and Baramula, to identify damaged structures that could be visited by students during the field training. Subsequently, all 130 participants were taken to these villages in bus loads for field orientation and training. Subsequent to this several participants were posted in a large number of quake affected villages that were covered under the network of COVA. The participants included boys as well as girls, almost all Kashmiris. During the field programs NCPDP members were able to interact with the villagers and give them advice on what

they could do. These workshops provided opportunities to us to enhance our understanding of the local buildings as well as peoples' perceptions. We were also able to meet enthusiastic engineering students as well as faculty members of the colleges. This intervention was over by April 8.

➤ **Collaboration with Aga Khan Development Network (AKDN) – *Wastukar* Trainer's Training Program**

From the beginning AKDN was keen to initiate the **building artisan training by mid-April in the villages west of Uri town as a part of an integrated rehabilitation program**. An unexpected intervention, however, evolved in the form of *Wastukar* Trainer's Training Program having potential for significant area level impact before the village level program was taken up.

- iii. Around April 14 the first trip was made to Uri area with Feroze Ahmed (retired IAS of Kashmir cadre), Kashmir Program Manager of AKDN. The director of technical education accompanied us since he wanted to show us the *Wastukar* training program sites. *Wastukar* Training program was taken up by the Directorate of Technical Education, Govt. of J & K in order to train approximately 1300 unskilled youth to make new building artisans in order to meet the shortfall while providing employment.
- iv. Before reaching Uri we visited sites at Buniyar, Chandanwadi and Lagama. During these brief visits we had observed that faulty masonry techniques were being taught by the trainers to raw candidates. This simply implied that the techniques that were responsible for the death and destruction were being advertently promoted through this program.
- v. A quick meeting with the Divisional Commissioner called at the behest of Feroze Ahmed led to a decision to conduct crash training programs of the trainers with full ground support from State Directorate of Technical Education and funding from AKDN.
- vi. Two programs were scheduled. One was conducted on April 19, 20 and 21 at Lagama ITI approximately 4km east of Uri in Baramula District. The other was conducted on April 24, 25 and 26 at Tangadhar in Kupwada District. Each of these programs had approximately 45 participants consisting of masons and carpenters. Thus approximately 90 artisan trainers were trained. Since both locations were functioning as the center of training, the basic materials and infrastructure were available. Special materials such as the Galvanized Weld Mesh, etc. had to be arranged for. The training focused on the earthquake resistant new construction as well as restoration and retrofitting of existing structures.
- vii. The training of new construction was done through mockups. At Lagama ITI the restoration and retrofitting training was carried out on a portion of damaged administration building that existed at the site. Similarly, at Tangadhar this training was carried out at a Veterinary Hospital building. The training had three major components which were (a) Class room lecture on basic earthquake engineering, (b) Hands-on training, and (c) video viewing for recapitulating the major items of training as well as for confidence building with the help of shock table program. The training also attempted at targeting the common myths as well as poorly understood new materials like cement and steel. Through a dialogue that got established between us and the participants, doubts were cleared in a friendly atmosphere. Confidence in local material was also restored.

- viii. Training was received very well by the participants. They left feeling happy and confident. In both the locations the local residents showed much interest wanting to get their houses inspected by us. During Tangadhar training one night was spent at Tithwal situated on the Line of Control separating Indian side of Kashmir from Pakistan side of Kashmir. To our surprise a large number of houses were found standing, although, damage. A number of house owners approached us seeking our advise about repairing their houses.

### **3. Collaboration with Aga Khan Development Network (AKDN) – Mason Training Program & Demonstrations**

Ground work for this program began on May 4 only after the AKF team met in Srinagar on May 3. On May 4 Sultan Daki village on Uri – Kamalkot road was visited with the objective of assessing the potential of mason training. During this trip the school visited by us earlier in December was revisited to explore the potential of taking up reconstruction, restoration and retrofitting. We had our first meeting with Sheen Mohamed, a senior school teacher most knowledgeable about the village as well as the area. From him we got names of several masons and met for the first time Nazir Ahmed, the senior most mason of the village. We learnt during that trip that Sultan Daki had a large number of masons and that its masons were well known for their high level of skill. Another trip was made on May 5, Friday so that we could address a gathering of the villagers at the *Jamiya Masjid* after Friday prayer. During the address the people were told why AKDN and NCPDP teams were there. They were there not to give anything free but to teach them about the earthquake resistant construction. The response was positive. There were masons in the crowd who too responded positively. Things looked very optimistic and exciting. It should be noted that in the past several months since the earthquake a number of organizations have visited the village, made promises but not returned. So the villagers have become skeptical about the agencies coming in to offer assistance. On the same day a group also made a brief visit to Shahadra village not too far away.

#### ➤ **Sultan Daki Training Program**

Sultan Daki village is approximately 13 km. from Uri town along a motorable unpaved road. The road crosses Jhelum River at Salamabad village and then steadily climbs past several quake affected villages along a meandering road. The village has around 450 households with a population of 2,400 inhabitants. The village is spread over a moderately steep terrain with the houses surrounded by terraced fields. A footpath descends steeply approximately 800' to a suspension bridge over Jhelum River. There is high school and a primary school in the village. The earthquake had claimed several fatalities while destroying all but one house. The water supply, which used to be abundant, has been seriously disturbed by the earthquake as the springs that used to bring water have been damaged.

#### ➤ **Program Development & Mobilization**

- i. On Sunday May 7 one more trip was made to hold a meeting with the masons as a first step towards the training program that we planned to undertake. In addition to Nazir Ahmed that we had met earlier we met two more senior artisans. The most encouraging aspect of the meeting was the fact that one of them said that even if we did not pay anything to them

they would participate in training since they were eager to learn. They wanted to understand why the walls built by them collapsed and what could be done about preventing such collapse in future. So it was decided by us to set May 20<sup>th</sup> as the deadline for initiating the training program.

- ii. It had been decided by AKDN in response to our suggestion that for the purpose of demonstration and training two houses would be built for two vulnerable individuals such as widows. Two widows were identified by Sheen Ahmed, which were acceptable to most in the village. One of them lived some 50' below the road and the other lived some 300' above it. Both had several very young children and, hence, were not in the best position to fend for themselves. Each widow was instructed to get the site cleared and get foundation excavated. Getting the materials delivered to the upper site seemed to be the most daunting task. Based on the suggestion of Sheen Ahmed, an ex-mason called Masood Ahmed was given the task of facilitating the site clearing, excavation and ferrying of materials, especially to the upper site since it was not accessible by any vehicle. With the training dead-line being only 12 days away it seemed advisable to assign the task to some one local, since no such manpower was available with AKDN.
- iii. As days passed, no progress was visible at either site. This showed the helplessness of the widows, since they were not able to respond to a lifetime's opportunity. Masood Ahmed also seemed to be evasive and illusive. Unfortunately no manpower was available to pursue this on behalf of AKDN. With barely four days to go, Rupal and Rajendra arrived on the 15<sup>th</sup> with a plan to spend a couple of nights in the village with a hope of making some rapport with the people. In the evening we met the *Sarpanch* for the first time and talked to him about our plans. He was found to be supportive and offered his help. Next morning a meeting took place with several village elders at the lower site when we explained to them what we had set out to do. Every one saw the need for it and whole heartedly supported it. The Sarpanch called the old father of the lower widow and scolded him for not responding. We gave one thousand rupees in advance to make sure that the work moves ahead. Old man left with promise to start the work. Sarpanch promised to do the needful for the upper site. In the evening we had one more meeting with the three senior masons, the "*ustads*". We shared the house plan with them, which they rejected as not popular, and recommended alternate plan. Rupal readily accepted the plan since it appeared to be in conformity with the vernacular buildings. We also discussed with them the building system that we were going to use and told them to ponder over it. Finally, we asked them about the list of masons who were certain to attend the training. We got some 11 names, who according to them were interested in learning. We nonetheless requested them to pursue the masons to get a larger presence.
- iv. **Peoples' Suspicion:** Yet another obstacle that we were facing was the local peoples' perception that we were Christian Missionaries and our mission was to spread Christianity. Local *maulavi* (Muslim priest at mosque), a young bearded chap with skull cap and horned rim glasses tagged along with us in the village for a number of days to find out what we were really up to. As he learnt more about us his confidence in us grew. One day he told Rupal that if we do not talk about the religion then

in a few days time everything will be fine and people will be with us. He also told us that he is with us and that if we need any help he will be most happy to do so.

- v. **Mason's Willingness to Participate in Training:** It was envisaged that 20 masons would participate in training, 10 at one site and 10 at the other. From each group everyday two would be sent to work at the school retrofitting site. Thus all masons would get to work on all the items. Just two days before the training date, three more team members, including two engineers – Harshad and Lalit – and community mobilizer – Ajaybhai – arrived. With all them we moved back to Sultan Daki since visiting from Srinagar took four hours one way and left little time and energy to produce anything worthwhile. The mason count remained at around 10. List of masons received from various sources proved to be worth little since as per *Ustads* only certain masons that they knew were interested in learning. They also cautioned about the names of laborers that were submitted in place of masons.
- vi. **Accommodation Problem:** It had become clear that it would be best if we stayed in the village rather than commute from Uri town since spending nights in the village was the best way to build rapport. But two constraints did not allow that to happen. These included unavailability of sleeping space, especially for the male members of our team, total dependence on the people for all the meals. Rupal and I as a couple were welcome in any house. Rupal as a female too was. Since in daytime there were few man folks around, people were uneasy about male members around their houses. Hence, staying at R&B Guest House in Lagaamaa was the only option. All other structures were damaged or destroyed, unless we moved East another 20km. or so. At the Guest House we could get night meals that suited our palate.
- vii. **Local Politics:** Just a day before the training date of 20<sup>th</sup> a new complication cropped up when the school head-master refused to give permission for retrofitting. New local politics had surfaced. It was one day before the training, but the primary materials had not reached Sultan Daki. With all these uncertainties including mason's list we decided to postpone the training by at least one day. Next morning the head-master was taken to task by Rupal. She finally managed to get his full support for retrofitting. The lower site had begun to clear and foundation excavation began. Masons were instructed that the training would finally start on 21<sup>st</sup>. On the 20<sup>th</sup> Rajendra, Rupal and Ajay went around the village, talking to people about the program, climbed around 500' to the top of the village where all seniors including Panchayat members were busy working on the water line. They too were informed about the program. They were preoccupied with the serious water problem that the village had been facing since earthquake. The *maulavi* accompanied us to give us any assistance that we needed.

The circumstance demanded high level of dedication, commitment and persistence from the NCPDP team. Irrespective of degree of support from the community the groundwork had to move ahead. The first major challenge came when the first load of materials consisting of cement bags and nearly 4 quintals of steel arrived. After much persuasion a little manpower was secured to unload the materials. Cement bags were unloaded with an NCPDP engineer lending his hand for several hours. At the end of that when laborers were tired the steel was simply dumped in the road. It was already evening. Rather than leaving the steel there, four members of NCPDP team along with two school kids picked it all up and carried it to safe place. Few days later when the second load of timber came with a large number of planks and joists the NCPDP engineer took lead in getting it unloaded in pouring rain while many watched. It was this commitment that ultimately convinced the villagers about our intentions.

➤ **Training Program:**

- i. **Beginning:** On 21<sup>st</sup> the work started on the lower site with only nine enthusiastic masons and a couple of laborers. No masons indicated in the lists received for Basigran and Sarai villages showed up, as was predicted by the “*Ustads*”. The masons joined hands to finish off the excavation for foundation. Rajendra conducted four hour long session in one of the classrooms classroom. Towards the end, the *Sarpanch* too arrived. *Ustaad* Nazir Ahmed got up and told the *Sarpanch* how happy they were with the training, and how much they had learnt in just a few hours. He requested the *Sarpanch* to take a lead and tell all those masons who were not participating. On the 22<sup>nd</sup> one more mason arrived, but labor count remained at mere two. The house owner had saved some water to allow the construction to proceed. In afternoon the army tanker delivered the water. The work at the upper house simply did not progress for some reason unknown to us and there was no one else willing to do anything about it. There seemed to be some internal politics between the upper village and lower village.
- ii. The number of masons steadily increased for a few days with final tally at 14. Two of these were from Basigran village and two were from Sarai village. It was observed that the skill level varied significantly among them. Some of the were specialists, some had more masonry experience and some more carpentry experience. Since we had some five masons who were really good it was observed that the quality and speed, both could be maintained in the work. The more experienced ones were able to take lead, especially when something new was to be done. While the work was going on the *ustads* taught the junior masons. In this region the tradition of “Master and Disciple” (*ustaad* and *shagird*) is still alive among the building artisans. Masons openly talked about their *ustaad* and what they had learnt.

- iii. Masons were divided in to three batches with one *ustaad* in each batch. Every day a new batch worked on retrofitting of school. The batches were rotated in such a manner that each batch got to do all the important steps. An activity chart was prepared to manage this.
- iv. Efforts were made continuously to initiate the construction of the upper house. But finally it was decided to leave it for later so that the trained masons would take it up.
- v. All in all the main issues that were covered under the training are as follows.
  - Basics of earthquake engineering
  - Adherence to basic rules of stone masonry
  - Improved understanding of cement and steel based technologies
  - Improved *Dhajji Diwar* with proper connections to plinth and lintel bands, and to the main wall
  - Proper wall to wall connections
  - Earthquake resisting features including RC bands, encasement of opening, Vertical single reinforcing bars, anchoring of roof to walls
  - Restoration of damaged building including simple grouting and splicing
  - Retrofitting of masonry structure having timber ceiling and CGI roof with focus on random rubble masonry and timber deck
- vi. The training ended on June 9. The principle issues in wall construction got covered in time as planned. The training in roof construction was delayed by a few days since some of the materials had not reached the site in time. In case of retrofitting the actual work and the training proceeded well until the time when the weld mesh got finished and more had to be procured from NCPDP's Kupawada site. Once, however, the training was over and the masons dispersed the work on school slowed down, especially since the finishing of lower house also was being done and construction of the upper house had commenced. As a result the available manpower at the school dwindled very much. Later when it was planned to have the handing over of the buildings on the 28<sup>th</sup> of June the painting of the buildings had to done on war footing so that by the 27<sup>th</sup> the school building was visibly finished. The installation of retrofitting elements in the roof deck was not carried out up to that point. The house could not be finished in all aspects by 28<sup>th</sup> June since the labor on hand for plastering was simply inadequate.
- vii. Towards the end of training around the 7<sup>th</sup> and 8<sup>th</sup> Rajendra and other engineers talked to each of the participants to gauge their understanding of concepts and their ability to explain. The results were satisfactory.

### ➤ **Shahadra Training Program**

Shahadra village is 2 km. away along a footpath from Sarai village where the motorable road ends. Half way down the road comes village of Chhappad. Sarai is approximately 2km. from Sultan Daki. Shahadra is situated in a wide gully spread along moderately sloping hillside that is full of trees. The houses are interspersed with fields where corn is grown. The bottom of the village is around 500' above the bed of river Jhelum. A historic footpath descends from the village to a suspension bridge across river.

### ➤ Program Development & Mobilization

Subsequent to the visit made by AKDN team to the village, NCPDP team began visiting the village once the Sultan Daki training program picked up momentum.

- i. The very first meeting brought up a number of critical issues. The people in Shahadra were happy that a house would be built in their village. But the Chhappad people also demanded a house. The masons of Chhappad said that only if a house is committed for their village they would participate in training. There are approximately six masons in Shahadra and about the same in Chhappad. All of them are *shaagirds* (students) of a master mason of Shahadra called Khadim Hussain. It became apparent that if the training program has his blessings then all the masons would participate. Nonetheless the number would not be more than about twelve. Meetings also took place with the Sarpanch of group *Panchayat* that covers both the villages as well as with the *Lumberdaar* who is an influential village level government functionary.
- ii. Several more meetings took place while the beneficiary in Shahadra got selected. The selection process drove a wedge in the community and the master mason Khadim Hussain decided to opt out. There was little that we could do but we were concerned about the participation of the masons. Six masons were assured from Shahadra but there was nothing certain about Chhappad masons. Two days before the training Rajendra went specially to Chhappad to talk personally to their senior most mason. This meeting proved to be critical. Two days later when the training began all but one mason of Chhappad came. The head mason confided in us that but for that meeting he and his groups would not have joined!
- iii. In few days time the Chhappad beneficiaries was selected by Chhappad people in an official manner, resolution was passed and signed by all including Panchayat member. Khadim Hussain happened to approve of it and indicated that he would participate at that site. The site was identified, measured, and the house owner was given instructions to clear it. Just then the local politics again surfaced. The Sarpanch took objection saying that he was not asked. This created much disturbance. Two days later the masons of Chhappad told him that they would be willing to build house only for that particular beneficiary who had already been selected. That finally settled the issue.

### ➤ Training Program:

- i. **Beginning:** On 10<sup>th</sup> June the training started with 10 masons including 4 from Chhappad, 5 from Shahadra and 1 from Dwaraan. For us our daily commuting duration increased by one and a half hour since this involved over half an hours of walking. One major difference that was observed between this site and those in Sultan Daki was that this particular family was not as helpless as the earlier ones. The widow had two brothers who were very much capable and resourceful. Hence, the site clearance and excavation work was carried out very fast in timely manner. This was indeed a plus point since it helped in staying right on schedule for the training program. An irrigation feeder stream flowed within 200' of the site and, hence, water was no problem for the site.
- ii. Logistics became complicated and exasperating since everything had to be carried over 2km. distance from Sarai roadhead. Bringing cement, sand and aggregates, although expensive, was not a problem since there were nearly adequate mules. But we saw all other items like rebars, door

window frames and shutters, and timber in terms of head-loads and this meant delays on account of inadequate labor. Getting things to the road-head had been a problem to begin with. But now we had one more hurdle in the logistics. At times just one little item held things up and a labor had to be sacrificed to bring that item over.

- iii. Steel bars if left uncut could be carried in bundles of 4 to 6 depending upon the diameter. But if cut then lesser quantity of bars got carried by an individual. There was also a problem of equipment. Since we were executing the construction without any contractor's involvement we had to have all the required equipment. But at this stage we had four sites going including 3 in Sultan Daki. For example, there was only set of the equipment for steel cutting and bending. So on several occasions the bars were unloaded at Sarai, were cut and bent by our Sarai masons and then only brought to the site. But these resulted in to slowing down.
- iv. Once again, the right fixtures such as anchor for *Dhajji Diwar* not arriving on time to the site created problems that could be solved only by improvisation. But this had the potential of sending mixed signals to the masons. Door frames also did not reach the site on time, nor the timber posts of the *Dhajji Diwar*. This too added to the delays.
- v. Work going on in two distant villages added to the complication of manpower management. The absence of telephone link between the two sites did not help the situation. From Shahadra one had to walk up about 200' and back to a shop in Chhappad village where weak cell phone signal could be received. The chances of verbal communication remained slim but the SMS had a little better chances of going through, sooner or later. On the very first occasion the army surveillance team arrived on the spot only a few minutes after our team at Shahadra talked to our team in Sultan Daki. They had spotted a new cell phone in the area with conversation going on an alien language.
- vi. At this site the skill level was found to be distinctly lower than that at Sultan Daki. As a result the going became a little difficult and slow. There were only two full-fledged building artisans. It seemed that the rest were in the building trade on a part time basis. One of them was a shopkeeper for example. As a result it was also appeared that they were not as serious at learning as those at previous sites. So we decided to be realistic and keep our expectations lower. In order to strengthen the building process, we invited the Sarai mason who was already trained at Sultan Daki to provide support. This way we had three proper teams of masons, with each team having one adequately experienced mason.
- vii. This site had larger stone that was a little hard to break but faster to build with. We still had to be persistent about reminding masons about the cavities that were being left in the stone masonry on account of the old habit. The walls came up fast as expected. At this site also the labor availability was even more serious problem. We had three laborers from West Bengal and one from Dwaraan village. Occasionally a couple of more showed up. Some times the mule keepers worked as laborers, especially in afternoon after the mules had made their scheduled load trips. Masons too disappeared from time to time, especially since there was a serious concern of sawing of crop.
- viii. The training was conducted in a same manner as at Sultan Daki. The only difference was that this team could be taken to work at retrofitting site of

Sultan Daki for only a day on account of the distance as well limited time. Since the school had to be handed over on the 29<sup>th</sup> of June more masons were put on that site and work executed so that only one day's worth of work was left for this group. The feedback, however, indicated that even a day they grasped the technique quite satisfactorily.

- ix. At the end of training on the 27<sup>th</sup> and 28<sup>th</sup> Rajendra and other engineers talked to each of the participants to gauge their understanding of concepts and their ability to explain. The results were satisfactory.

#### 4. Important Training Issues

##### ➤ **Special Emphasis in Training:**

Based on our earlier interactions with the masons in Gujarat, Uttaranchal and Maharashtra this interaction continuously focused on the weaknesses of the masons as well as their ability to convince their clients as well as other masons. The issue of a single vertical bar versus RC column like elements in corners was given a lot of attention. The concept of ductility induced in masonry walls by the embedded reinforcement was systematically drilled in to their minds so that when a client demands the corner columns the masons would be in position to effectively argue the case of single rods. Poor quality stone masonry was another area of special focus. Many weaknesses were identified from damage buildings but a few more were identified during training. Continuous drilling on this issue was required to help the masons get rid of their old habits.

##### ➤ **Development of technologies jointly with master masons:**

This program was different from earlier training programs since we were working in a new area with no construction experience in that area. The objectives were two fold. First was to evolve the **improved viable vernacular system** and the second was to **transfer the new technology to the artisans**. Hence, there was need of continuous learning of nitty-gritty in the vernacular construction techniques at the site. As we learned more, new weaknesses were observed and the ways to eliminate them were evolved. In other words steady improvement were made as construction went on and as more demonstration models were built. This called for continuous interaction with the *ustads*.

While we were designing the structure we had made it a point to include the *Dhajji Diwar* (stone & timber interior wall) since we knew that they were commonly used as a space saving measure and that they had weaknesses. Measures were evolved to eliminate these weaknesses. But their execution was done only after adequate interaction with the *ustad* Nazir Ahmed and concurrence from him. The area that required most trial and error was the interface of the old and new building system. The installation of RC Bands, vertical reinforcing bars, anchoring of roof walls or walls to plinth etc.

There were a number of components where interaction was required while making changes and improvements. These were...

- x. Thickness of *Dhajji Diwar*
- xi. Anchoring of *Dhajji Diwar* to plinth band
- xii. Anchoring of *Dhajji Diwar* to exterior walls
- xiii. Anchoring of *Dhajji Diwar* to top band
- xiv. Improvement of internal connections in *Dhajji Diwar*
- xv. Confining *Dhajji Diwar* infill with chicken wire mesh

- xvi. Mechanical anchors for attic floor wood elements
- xvii. Spacing of Roof Trusses

➤ **Responses:**

The responses that we were most concerned were of the artisans participating in the training. The most satisfying response was when a master mason said that he was confident of his roofs but now he could give guaranty for the walls that they would not collapse like the last time. Another masons said that now they will accept work only if good quality stones are given to them and there will be no RC columns in corners. Instead he would build walls with single vertical rods.

Although, the responses that we received in person were mostly very positive what was interesting was things that were happening behind our back. A well-known school teacher in Sultan Daki said that now the house that he is going to get built will be exactly same as the one we built during training. Some masons who were not able to participate in training told our trainees that they would learn the new things from them. Our trainees told us that many people visit the site in the evening to see what was getting built and most seem to like what they are seeing. The structure that we were building was leaving little doubt about its performance in an earthquake.

One client who is known for being nasty wanted the *ustad* to build his shed rather than go for training. But after visiting he told the *ustad* to go through full training before returning to construct his house.

The response towards retrofitting work that was going on in the school too were encouraging. Most everyone was of the opinion that the building will not collapse even in a very large earthquake. With encasement of wall openings with weld wire mesh the masons became confident that diagonal cracks simply will not develop in an earthquake.

➤ **Problems Encountered During Training:**

There were a number of problems that dogged the program from beginning to end.

- i. With passing of days the problem of adequate number of artisan disappeared. But labor availability continued to remain a major problem. This was primarily on account of agriculture labor demand at that point in time. It was the time of sowing of corn and paddy. After a few days when we started paying Rs.150 per day (instead of local rate of 100) in response to a demand of one of the three laborers working at the site the number shot up to 13 in no time. But on account of heavy rain one morning when it was decided to have no laborers the following day the attendance dropped drastically. All through the training labor crunch adversely affected the output and caused too much delay.
- ii. Since all building artisans are also agriculturists the sowing season compelled them to go to their field at one time or another. In addition, in the aftermath of the earthquake, artisans were obliged to finish the work taken on their hands to prevent undue hardship to the people. As a result from time to time some participants were compelled to take a day of two off.
- iii. Material procurement was another major bottleneck. Training program requires execution of various activities in right sequence. Unavailability of a

material at a particular instant tends to disrupt the sequencing and thus adversely affects the training program. For example with the absence of special brackets that were to be used to anchor *Dhajji Diwar* to the RC plinth band some other means had to be improvised while the band was being cast. With timber for *Dhajji Diwar* not present at the site the construction of *Dhajji Diwar* as well as the connecting walls could not be carried out while adjacent walls were being constructed. Most important was the right way of connection between exterior wall and *Dhajji Diwar* that we wanted to demonstrate as an important part of training. Inadvertently long delay in this timber brought the work on the walls, the most important part of construction and training, to a screeching halt adversely affecting the moral of the trainees and the trainer.

- iv. Material delivery to the site also posed a major problem in the construction of two houses. In Sultan Daki, where one site was 300' above the road, the materials had to be carried by laborers since fields blocked access for mules or vehicle with corn already planted in them. Lack of understanding of local means of material transport as well as unavailability of labor led to delays in the construction of the upper house in Sultan Daki. At Shahadra too, the material ferry from road-head resulted in to delays. Proper knowledge of the system and timely ferrying could have reduced these delays.

In a tightly planned training program where it is aimed to finish the training as well as construction in mere 20 days timely availability of materials is most crucial.

### ➤ **Mobilization Along Kamalkot Route**

During the period starting May 21 and ending June 28 some of the team members of NCPDP made visits to villages of Kamalkot, Bandi, Basigran and Dachchi.

- i. Kamalkot visit was made since it was well-known that Kamalkot had most number of masons in the area. It was important for the people in Kamalkot to know about the training and demonstration program that was going on in villages not far from theirs.
- ii. Since Kamalkot is not included in the list of target villages of AKDN and since Bandi, which is adjacent to Kamalkot, is, it was logical to target Bandi for the demonstration and training program. A few visits were made. One of the visits on Friday after the afternoon prayer at the mosque. During the visit the NCPDP team met with the *Sarpanch* and other senior villagers. The people in the meeting had unanimously selected an old lady as a beneficiary. The *Sarpanch* had assured the presence of masons. Further groundwork needs to be done to ensure the mason's participation as well as to clarify our requirements from the villagers and the beneficiary.
- iii. The *Sarpanch* of Basigran had visited our Sultan Daki site and was greatly impressed. He requested us to conduct similar program in his village. The participation of two masons from Basigran in Sultan Daki village further enhanced the interest in the training since these masons talked to other masons in their village. A meeting took place after a Friday prayer. Once again the response of the villagers was positive. The beneficiary was also identified. In addition a school building has also been identified in close vicinity of this site which could be retrofitted.

- iv. In the village of Dachchi where an NGO is already building RCC frame houses for the people, we observed that there were a number of pre-earthquake houses that were still standing unlike the upper villages. We conducted a few group meetings with the people. When we told the people that they could save the existing houses and also strengthen them against a future earthquake they responded very positively. We learnt from them that there were some 25 houses still standing. They requested us to conduct a training program in Dachchi to teach their masons retrofitting. Unfortunately due to shortage of time we could not pursue our initiative further.

➤ **Visit to Nava Runda Villages**

On June 18 Rajendra and Rupal visited Nava and Runda villages situated on the south side of Jhelum across from Kamalkot along with AKDN team members to observe the rehousing process going on in the area. During the visit they met the *Sarpanch* as well as *Lambardaar* of the village. In these villages unlike on the opposite side of Jhelum there are several pre-earthquake buildings that are still standing in various state of damage. In regards to the reconstruction it was observed that the people are building substantially large “tin houses” which measure much more than a couple of hundred square feet. What was note worthy was that these houses are different from those seen along Kamalkot road in one respect. These houses do not have plywood on the inside face of the wall but instead have stone and mud infill between the wood posts as in *Dhajji Diwar* that greatly increases the thermal insulation of the walls. Apart from this aspect the houses appear as vulnerable to earthquake and high winds as the other ones. Improvements could be made to make them better earthquake and wind resistant, as well as for greater longevity.



Checking masonry level with tube level



Plinth level training in progress



Connecting *Dhajji Diwar* post to masonry wall



Installing Chicken Wire Mesh on *Dhajji Diwar* frame



Filling in stone and mud in *Dhajji Diwar*



Installing connector bracket on top of *Dhajji Diwar*



Concreting of lintel RC band



Installing MS angle connectors for roof structure anchoring in lintel band



Installation of attic floor framing



Erecting roof trusses



Installation of CGI roof sheeting



Shahadra mason trainees in attic



Sultan Daki mason trainees



School building before retrofitting



Typical G2 level through cracks



Stitching of corner crack with WWM



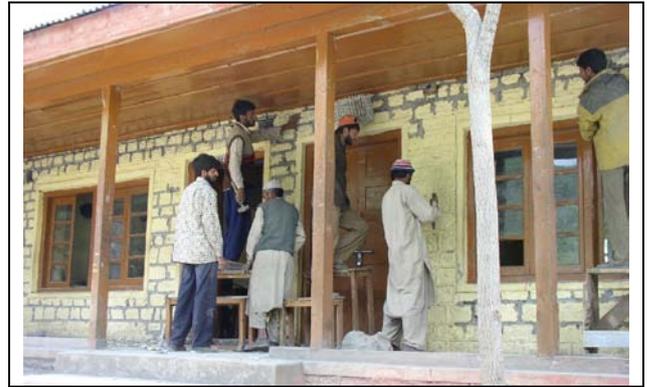
Cleaning G3 level crack



Grouting of G3 crack



Concreting of stitching element



Installing Seismic Belt



Installing Seismic Belt



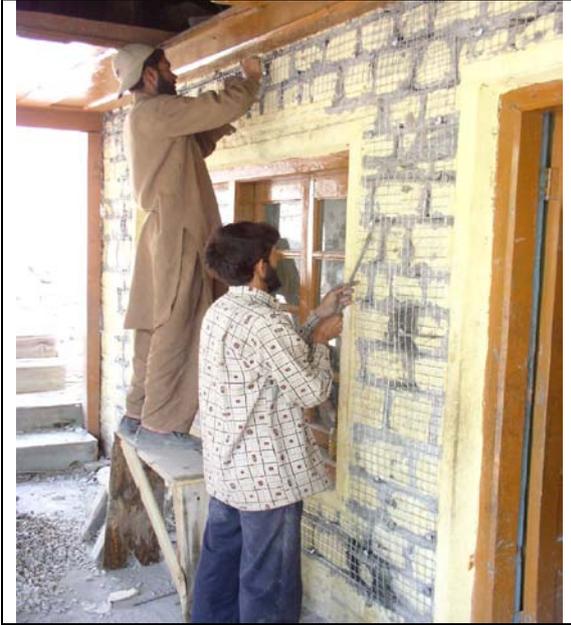
Removing plaster for vertical reinforcement



Installed vertical bar with part concreting



Top end of vertical bar anchoring wall plate



Installing opening encasement WWM



Finishing of opening encasement belt



Installing bolts in seismic belt for roof anchoring



Installing MS anchor bracket



Tightening nuts of roof anchor



Restored and retrofitted school