

**Bhutan Earthquake September 21, 2009**

**Joint Rapid Assessment for  
Recovery, Reconstruction and Risk Reduction**

**A Report Prepared by  
The Royal Government of Bhutan, the World Bank and the United Nations  
20 October 2009**



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## Foreword

2009 has been a difficult year for Bhutan. In May, Cyclone *Aila* brought unprecedented rains and flooding to the country. A strong earthquake on September 21 - the most devastating in Bhutan's recent history - killed 12 people and damaged or destroyed a large number of houses, public buildings, and cultural and religious monuments. Approximately 7,290 people were left without adequate shelter.

With the support of the Royal Government of Bhutan (RGoB) at the central and dzongkhag (district) levels, His Majesty's welfare office and the Royal Bhutan Army, immediate relief assistance was mobilized. Damage caused by the earthquake was greater than initially estimated, thus exceeding the capacity of the Royal Government to respond on its own. On 25 September, the UN system, World Bank and other development partners were asked to provide support. In particular, the RGoB requested technical assistance for carrying out a needs assessment in line with international standards to provide a basis for planning short-, medium and long-term recovery and rehabilitation efforts, and to mobilize resources to implement them.

In response to this request, international and national expertise was mobilized. A joint rapid assessment of damage and loss was carried out collaboratively with officials from the Royal Government, UN agencies and the World Bank. In addition, support was provided by the Bank's Global Facility for Disaster Reduction and Recovery (GFDRR). The Joint Rapid Assessment mission conducted its work from September 30 - October 14, including three days of visits to affected villages in eastern Bhutan, and in-depth consultations with the Royal Government at the central and dzongkhag levels. Two sub-groups visited selected locations which, according to RGoB, were representative of damage and loss throughout the affected region.

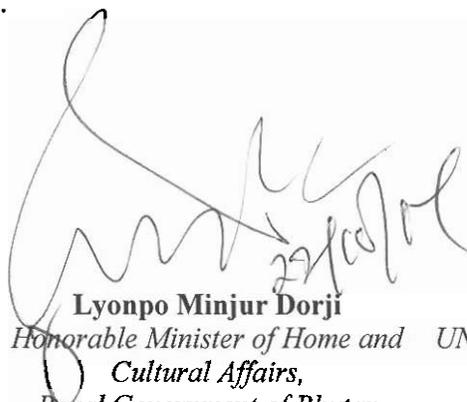
This Joint Rapid Assessment presents preliminary cost estimates for loss and damage as a result of the earthquake, and estimates recovery and reconstruction costs. It identifies priorities for early recovery, reconstruction and disaster risk reduction, and a time-line for addressing them. It presents long-term challenges for achieving improved building and planning practices, and draws upon considerable global experience of the UN system and the World Bank in supporting recovery and reconstruction programmes. Finally, it provides a basis for mobilizing external financial and technical support.

Given Bhutan's geographic location in the highly seismic Himalaya range, the country is exposed to serious earthquake risk. Seismic-resistant construction technology needs to be an integral dimension of disaster risk reduction. The scope of destruction indicates a need for comprehensive measures for "building back better" in order to make buildings more earthquake resilient. This should form the cornerstone of recovery and reconstruction efforts.

On behalf of the Joint RGoB-UN-WB Rapid Needs Assessment Team, we would like to sincerely thank all who contributed to this report, and offer a particularly debt of gratitude to the people in affected villages who welcomed the team with kindness and hospitality while they faced some of the most challenging days of their lives.



**Mark LaPrairie**  
*World Bank Representative to  
Bhutan*



**Lyonpo Minjur Dorji**  
*Honorable Minister of Home and  
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Royal Government of Bhutan*



**Claire Van der Vaeren**  
*UN Resident Coordinator Bhutan*

## **Executive Summary**

An earthquake struck the eastern region of Bhutan on September 21, 2009 at 14h53 local time. It is the most damaging disaster that Bhutan has experienced in recent times. According to the US Geological Survey, the quake registered a magnitude of 6.3 (later revised to 6.1), with the epicenter in Mongar Dzongkhag (district), 180 kilometers east of the capital, Thimphu. The earthquake had a shallow depth of 14 kilometers, lasted for 95 seconds and has been followed by near daily aftershocks.

According to updated reports of the Royal Government of Bhutan (RGOB), 12 people died and 47 were injured. A total of 4,614 households are reported to have been affected in 12 dzongkhags, representing approximately ten percent of all households in some areas. An estimated 7,290 people were left without adequate shelter. Aftershocks have caused further damage and created fear among affected communities, with many people preferring to stay outside their houses.

The earthquake caused destruction of infrastructure and institutions including 91 schools, 25 health centers and hospitals, 50 government offices, 281 monasteries, and 485 stupas (chortens) and 7 Dzongs (district administration centers).

### **Response and Relief**

The response by the RGOB and the international community was immediate. His Majesty the King directed the deployment of Royal Bhutan Army (RBA) personnel for immediate rescue and assistance in the affected areas. Dzongkhag officials were assigned to undertake rapid assessments of damage and to provide support to geog (sub-district) administrations for the provision of basic services and amenities. The presence on the ground in the affected area of the Minister of Home and Cultural Affairs has significantly enhanced government's ability to plan and coordinate relief and recovery efforts.

Among international agencies, UNICEF provided 1,000 blankets, 300 emergency family kits, 23 tents and 150 pieces of tarpaulin sheeting. In response to an urgent request from the Royal Government for 1,000 tents, 200 have been supplied and an additional 368 are being procured through OCHA, UNICEF and UNFPA fund. A consignment of tools and equipment to facilitate the removal of rubble and for salvaging building materials has been distributed by UNDP. UNFPA has provided 3,000 sets of dignity/hygiene kits. Further resources have been mobilized from OCHA's Central Emergency Response Fund (CERF) to meet the most immediate need for shelter and to reinstate critical services through the provision of tents and CGI sheets.

Following a request by the RGOB to the UN Resident Coordinator, planning was initiated for carrying out a rapid assessment of damage and loss. A Joint Assessment Team was formed, comprising of national and international experts from the UN system (OCHA, UNDP/BCPR, UNICEF), the World Bank and the RGOB<sup>1</sup>. In addition, support was provided by the Bank's Global Facility for Disaster Reduction and Recovery (GFDRR). The primary objective of the assessment was to conduct a rapid analysis of damage and loss to ascertain an order of magnitude for the cost of early recovery and reconstruction, clarify priority sectors, and delineate an implementation strategy.

The Joint Rapid Assessment mission conducted its work from September 30-October 14, including three days of visits to affected villages in eastern Bhutan, and in-depth consultations with the RGOB at the central, dzongkhag and geog levels. Two sub-groups visited selected locations which, according to the RGoB, were representative of damage and loss throughout the affected region.

Given the widespread geographical area affected and the remoteness of many communities, some of which are only accessible by foot, it was understood that the Joint Rapid Assessment would have to

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<sup>1</sup> A list of the members of Joint Assessment Team is available in annex.

rely on primary data on physical damage collected by the RGOB through its dzongkhag and geog administrations. Field work was carried out on a sample basis as a means of gaining a first-hand understanding of the magnitude of damage and the context in which recovery and reconstruction efforts will be carried out.

The initial draft of the report was shared with all concerned RGOB offices for clarification and review. This report, based on a combination of primary data and field observations and consultations, aims to provide a preliminary estimate of the value of loss and damage in all the affected sectors, and an estimated cost for recovery and reconstruction. It identifies priorities in terms of early recovery, reconstruction and disaster risk reduction, and a time-line for addressing them. It provides a basis for early recovery and recovery planning, with the understanding that the formulation of specific activities in some sectors will likely require additional, more in-depth assessment.

## **Damage and Loss**

The RGOB has classified structural damage in all sectors into four categories: (1) beyond repair; (2) major repair; (3) partial repair, and (4) minor repair. These were adopted by the assessment team after extensive discussion with the RGOB counterparts. In case of categories 1 and 2 (i.e. beyond repair and major repair), losses were calculated on the basis of 100 percent of the unit cost given that they will have to be reconstructed entirely. For categories 3 and 4 (i.e. partial repair and minor repair), 25 percent and 10 percent of the unit cost, respectively, was applied for calculating approximate asset losses in the absence of detailed information about each structure. Unit costs for each asset category were provided by line ministries.

In the shelter sector, as per the latest available figures, 446 houses have been classified as beyond repair, while 1,012 houses require major repair. The number of houses which require partial and minor repair are 1,749 and 1,407, respectively. The total cost of damage in the shelter sector is estimated to be Nu 1,118.8m (approximately US\$23.3 million)<sup>2</sup>.

The earthquake has damaged 91 educational institutions. These include all levels of schools (i.e. primary, lower secondary, middle secondary and higher secondary). The total cost of damage to school buildings is estimated to be Nu 593.6m (approximately US\$12.9m equivalent). The earthquake has also damaged 25 basic health units (BHUs) and caused minor damage to three hospitals. The total cost of damage to health facilities is estimated to be Nu 124 m (approximately US\$2.6m equivalent). A total of 50 local government offices, including Renewable Natural Resource (RNR) Centers and gups (village head) offices have been damaged, with the total loss estimated at Nu 13.9m (approximately US\$0.3m equivalent).

Bhutan is rich in terms of cultural and religious heritage, with numerous monasteries, temples (lhakhangs), monuments (chortens), and ancient fortresses (dzongs) containing valuable artifacts and paintings, which have endured for centuries. Damage to these heritage buildings and monuments represents a loss which cannot be measured in purely monetary terms. The total cost of damage to cultural property is estimated to be Nu 650.5m (approximately US\$13.5m equivalent).

The total approximate loss is Nu 2,501m (approximately US\$52m equivalent), with the largest component in the shelter sector.

## **Early recovery**

The Joint Rapid Assessment team ascertained early recovery priorities on the basis of discussions with affected people and through visits to houses, schools, BHUs, monasteries and Gup's offices in the villages<sup>3</sup> in two of the most affect dzongkhags of Mongar and Trashigang.

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<sup>2</sup> It is a dynamic figure. As the survey of damaged houses progresses, the figures are expected to change.

<sup>3</sup> Mongar: Thangrong, Walakthang, Ngatshang, Ropthankar, Boomjai, Chaskar, Drametse and Narang.  
Trashigang: Durung and Yangneer.

It is estimated that 2,000 semi-permanent intermediate shelters are required as soon as possible. This will require the provision of building materials of specified quantities to affected families. In line with local practices and to encourage self-reliance to the extent possible, it is proposed that the task of building intermediate shelters be entrusted to the affected households and communities.

Given the prevailing levels of poverty and vulnerability in much of the earthquake affected area, a package of livelihood assistance may be required to ensure people's basic welfare. Such assistance might consist of, among others, small grants for agricultural production, livestock maintenance and income generating activities.

Intermediate structures made of bamboo, wood, and CGI sheets should be erected pending the permanent repair and reconstruction of schools and BHUs. Urgent steps are required to restore the disrupted cold chain system, provide adequate public health and hygiene through the restoration of latrines and basic hygiene training. Psycho-social support is needed for those suffering trauma, which is being exacerbated by frequent aftershocks.

The estimated cost of early recovery interventions in each of these areas totals Nu 87.1 million (approximately US\$1.8 million).

### **Reconstruction**

The construction of permanent shelters is a matter of particular urgency. House designs should include earthquake-resistant features and technologies and constitute a "build back better" approach. The reconstruction program should be implemented following an owner-driven reconstruction approach, and avoid relocation and resettlement to the extent possible.

Schools, BHUs, and government offices also require repair and reconstruction. The cost of reconstruction has been calculated on the basis of unit cost provided by the authorities for each type of public building, the extent of damage and the need for repair/reconstruction. In the reconstruction of these facilities, it is important to include earthquake-resistant features, and improved construction specifications and standards. To the extent possible, houses and public buildings should include water supply for bathing and flush toilets.

An important feature of this category is the reconstruction and repair of religious and cultural heritage structures (e.g. temples, monuments). This will require specialized expertise, but should be viewed as a priority once shelter and other livelihood requirements are met, given the central role of religious and cultural structures in the life of rural Bhutanese.

The report provides an overview of sector-wise reconstruction costs, estimated at Nu 2,005 million (approximately US\$41.7 million).

### **Disaster Risk Reduction**

Bhutan is vulnerable to high impact disasters. The assessment provides a broad range of recommendations for improving disaster preparedness and risk reduction. These include in-depth identification and assessment of risks for the preparation of easily understandable, composite risk assessment reports. As concerns earthquake risk in particular, this may include the development of a seismic hazard map of Bhutan and the establishment of a seismic monitoring network in the country with appropriate instrumentation.

Preparedness measures include setting-up an inter-connected network of Emergency Operations Centers (EOCs) at the national, district and sub-district levels, developing a multi-hazard Early Warning System (EWS), and the strengthening of search and rescue teams and emergency medical response capacities. Bhutan may wish to consider the merits of establishing a national chapter of the International Federation of Red Cross/Red Crescent Societies.

A training and capacity-building program should be instituted to strengthen the capacity within the Department of Disaster Management, as well as among sectoral disaster management focal points, and field-level staff. Institutional capacity building will be enhanced by the provisions of the Disaster Management Act, scheduled for consideration by the parliament during an upcoming session.

It is recommended that seismic-resistant building specifications be developed for all public buildings, especially schools, BHUs and hospitals, which are enforced through appropriate legal and regulatory measures at the dzongkhag and/or geog levels. While a rural housing insurance program of the Royal Insurance Corporation of Bhutan has been in existence for a number of years, it could be improved by including risk mitigation incentives for policy holders.

### **Implementation**

An implementation strategy is required which includes resources for the program, institutional arrangements, a disbursement mechanism, and technical assistance for earthquake-resistant construction. The RGOB’s implementation strategy should be guided by principles of efficiency, transparency, and inclusiveness. Notional allocations of Nu 50m are proposed for each of the following cross-cutting areas: (i) disaster risk reduction and (ii) implementation overhead costs.

The Joint Rapid Assessment team estimates the cost of early recovery, reconstruction, and disaster risk reduction at Nu 2,192 million (approximately US\$ 45.6 million).

#### **Summary Cost of Financing Early Recovery, Reconstruction, Disaster Risk Reduction and Implementation Support**

<b>Sl</b>	<b>Head of Expenditure</b>	<b>Total Approximate Cost (Nu, Million)</b>	<b>Total Approximate Cost (USD, Million)</b>
<b>1</b>	<b>Early Recovery Activities</b>	<b>87</b>	<b>1.8</b>
<b>2</b>	<b>Reconstruction Activities</b>	<b>2005</b>	<b>41.7</b>
<b>3</b>	<b>Disaster Risk Reduction</b>	<b>50</b>	<b>1.04</b>
<b>4</b>	<b>Implementation Support</b>	<b>50</b>	<b>1.04</b>
<b>TOTAL COST</b>		<b>2192</b>	<b>45.6</b>

## **Introduction**

In recognition of the fact that the 21 September earthquake impacted different aspects of people's lives in twelve affected Dzongkhags (districts) of Bhutan, the two closest to the epicenter being Mongar and Trashigang, it was essential to ensure that the rapid needs assessment addresses damages, losses, human impacts and needs. Such an assessment would pull together the physical impacts of a disaster, the economic value of the damages and losses, the human impacts as experienced by the affected population, and the resulting early and long-term recovery needs and priorities.

It is important that the assessment is quick and timely, and provides the necessary information to the government and other stakeholders for planning and financing recovery and reconstruction. A number of stakeholders joining the assessment makes it a broad-based exercise and improves its ownership. Such an assessment should be in the public domain so that all the stakeholders can contribute to the formulation of policies and programmes based on them. It is also important to situate the assessment and its findings in the national context. Though the physical damages are empirically verifiable, the recovery and reconstruction policies are country-specific and reflect the priorities of the government. The report recognizes that it is the government's responsibility to prioritize the recovery needs and implement them.

The report has been organized in six sections. Section I, which is introductory in nature, presents the essential information on the disaster and its impact, the details of relief, the nature and composition of Joint Assessment Team, and the methodology for estimation of damages and losses. Section II provides the sector-wise analysis of damages and losses, and presents an aggregated financial figure of damages and losses.

Section III highlights key considerations for early recovery in eight selected sectors, and presents a cost structure of all the important early recovery interventions. Section IV provides a detailed outline of reconstruction programme and describes enabling mechanisms for its implementation. It also provides cost estimates of reconstruction in all the sectors.

Section V takes cognizance of the nationwide initiatives under way for disaster risk reduction in Bhutan since 2004, and suggests a Disaster Risk Reduction Strategy and Action Plan, particularly with reference to institutional capacity, risk mitigation investments and key risk financing considerations.

In view of the fact that the RGoB has not implemented in the past any large-scale recovery and reconstruction program and that a number of recent emergencies have indeed invoked national concerns more alarmingly (Thimphu River Floods, Cyclone Aila impact, Mongar Earthquake, Trashigang fire etc.), Section VI outlines key elements to be addressed while implementing recovery and reconstruction programme in Bhutan.

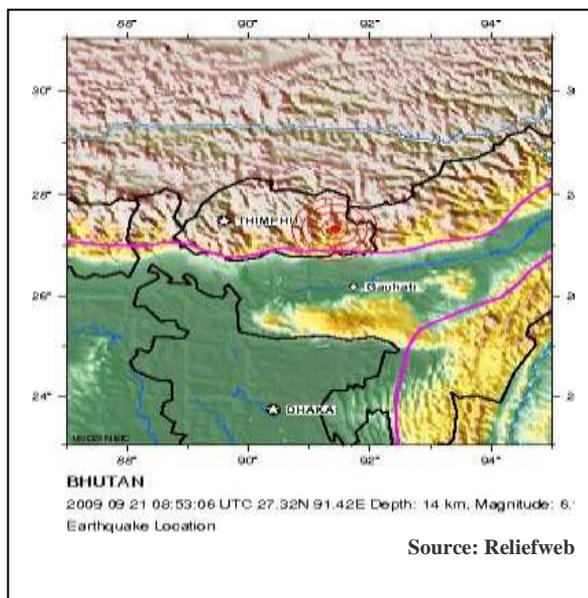
## Section I: The Disaster

### 1.1 The Earthquake

An earthquake struck the eastern region of Bhutan on September 21, 2009 at 02.53 pm local time. According to the US Geological Survey, which initially put the quake at 6.3-magnitude before revising down to 6.1, the epicenter was located, 180 kilometers (115 miles) east of Thimphu, in Mongar district. It had a shallow depth of 14 kilometers, and lasted for 95 seconds. The earthquake was felt in the north-east states of India, including Assam, Arunachal Pradesh, Bihar, Meghalaya, Sikkim and West Bengal. It was also felt in Bangladesh and Tibet.

The earthquake has been followed by a number of aftershocks occurring almost on a daily basis. These aftershocks, though common after a major earthquake, have created a scare amongst the population, with many preferring to stay outside their houses. Recurrent aftershocks seem to have increased the extent of damages.

The earthquake has caused no ruptures on the surface except for localized tension cracks where the slope angle suddenly increases to almost vertical. No major landslides or ground subsidence has been observed in the affected area. However, rocks slides have been observed along the highway, district roads, feeder roads and farm roads.



### 1.2 Deaths and Injuries

The earthquake caused 12 deaths, which occurred in Trashigang (2), Mongar (6), and Samndrup Jongkhar (4) Dzongkhags. All the reported 47 injuries are concentrated in three Dzongkhags: Trashigang (18), Mongar (26), and Pema gatshel (3). People died as they got trapped following the collapse of houses. The earthquake happened in the afternoon at 2.53 pm when the people were out working and were not at home. This considerably reduced the mortality and injury rates. It was also a day preceding a holiday, and the schools were closed. As a result, despite the collapse of several schools, no school children died. In some of the villages the assessment team visited, it was reported that children were released just half an hour before the earthquake.

In view of recent earthquakes in China and Pakistan, where thousands of children died due to the collapse of schools, this was certainly heartwarming and fortuitous. No livestock death was reported as well.

### 1.3 Bhutan's Seismic Risk Profile

Bhutan is located in the Himalayan Mountains, along the boundary between the Indian and Eurasian tectonic plates. The Indian plate is moving northwards relative to the Eurasian plate, pushing the Himalayas upwards as the plates collide. As a result, large earthquakes are frequent in the area. Earlier, a moderate earthquake had struck Bhutan on 24 February 2006. It had a 5.8 magnitude and caused some damage to property near the epicenter, not far from the epicenter of the present earthquake. Between 1937 to 1998 a total of 30 earthquakes have been recorded in Bhutan of which an earthquake on 21<sup>st</sup> January 1941 with the magnitude 6.75 on the Richter scale was the most powerful according to the department of geology and mines. A magnitude 8.5 earthquake occurred nearby in the Indian state of Assam in 1950. Another Assam earthquake destroyed Punakha and Lingshi Dzongs in Bhutan in 1897.

Bhutan has no independent seismic zoning map. However, according to the seismic zoning map of India, Bhutan falls under zone V, which is described as seismically very active. Arunachal Pradesh and Sikkim which are adjoining Bhutan also fall under Zone V.

#### **1.4 National Emergency Response**

Immediately following the earthquake, a special meeting of the Lhengye Zhungtshog (RGoB's Cabinet) was held on 22 September which discussed the initial report on casualties and damages. The Lhengye Zhungtshog decided to provide the affected families with cash grants, medical assistance as well as temporary shelter material. Project Dantak<sup>4</sup> was requested to undertake road clearance urgently. The Minister of Education was in Mongar when the quake hit and made an early request to UNICEF for relief supplies to address the urgent needs of two schools in the affected area.

As an immediate response to the disaster, His Majesty the King has declared Kidu grants (ex gratia) of Nu. 20,000 to each bereaved family, Nu 5,000 each to the injured, and tarpaulin sheets and other relief kits and assistance to all affected families. His Majesty is also scheduled to tour Eastern Bhutan beginning October 12, 2009.

His Majesty also directed the deployment of Royal Bhutan Army (RBA) personnel for immediate rescue and aid in the affected areas. Immediate relief and response efforts were launched from all eastern Dzongkhags, Dasho dzongdags, Dzongkhag administrations and geog administrations of affected areas. The Dzongkhag Officials were assigned to the affected areas for quick assessment of damages and necessary support to the local government for restoration of basic amenities.

The Government asked the Royal Insurance Corporation of Bhutan (RICB) to release the life and rural insurance compensations as soon as possible. The People's Welfare Office of His Majesty (Gyalpoi Zimpon's office) responded immediately by visiting the affected areas and mobilizing relief items.

The Honourable Prime Minister, accompanied by the Minister of Home and Cultural Affairs, Cabinet Secretary, the Gyalpoi Zimpon and Members of National Assembly and National Council visited six affected districts (Mongar, Trashigang, Pemagatshel, Lhuentse, Trashiyangtshi and Samdrup Jongkhar) during 23-30 September.

The Prime Minister of Bhutan briefed all the development partners in Bhutan on the aftermath of the earthquake Oct 2, 2009. The briefing followed his visit to the most affected districts. The Prime Minister informed that the Armed Forces together with college and school students had played an important role immediately after the earthquake. Temporary shelters have been constructed, and thanks to UNICEF, and the RBA, emergency family kits and blankets were distributed rapidly in the affected areas.

An Emergency Operations and Relief Camp was set up in Trashigang, headed by the Home Minister who has been personally present in Trashigang immediately following the earthquake. The Home Minister has been coordinating and spearheading relief and recovery operations. The Home Minister's presence in Trashigang has been a strong rallying point for the entire local administration and communities.

The Department of Disaster Management (DDM) officials contacted all 20 Dzongkhags about the impact of the earthquake. It has been collecting situation updates from various Dzongkhags, and providing regular updates to different agencies of the RGoB. As a coordinating agency, the first preliminary report was issued by DDM at 0900hrs on 22 September. DDM was immediately engaged

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<sup>4</sup> It is a unit of the Border Road Organization (BRO), Government of India, which has been assigned the responsibility for maintenance of certain highways in Bhutan.

in the distribution of tents and tarpaulin sheets, mobilization of emergency family kits and ensuring information flow from the dzongkhags.

The UN Country Team (UN agencies, Funds and Programmes, and the World Bank) made an offer of assistance to the RGoB soon after the earthquake on 22 September. On 25 September, a stakeholder meeting was conducted with the United Nations Resident Coordinator in Bhutan, chaired by the Home Secretary to discuss how the UN Country Team and the World Bank could support relief and early recovery in the earthquake-affected areas. UNICEF started providing tents on 27 September. Since then, the UN System has provided 200 tents and an additional 368 tents are being procured currently. A consignment of tools and equipment to facilitate clearing and removal of rubble and in salvaging of building materials has been distributed by UNDP. UNFPA is providing 3,000 sets of dignity/hygiene kits to the affected families. Further resources have been mobilized from the OCHA Central Emergency Response Fund (CERF) to meet the most immediate need for shelter and to reinstall critical services through provision of tents and CGI sheets.

The Honourable Prime Minister briefed the Development Partners on Oct 2, 2009, where he requested them to support the Government in addressing short term needs (related to urgent relief work) and long term needs (related to disaster management and mitigation measures). The Prime Minister also thanked the World Bank and the UN for deployment of the Joint Assessment Team and urged the team to produce a professional assessment of the earthquake damages and losses as well as provide recommendations for disaster risk reduction on a long-term basis.

### **1.5 Joint Assessment Team: Its Composition, Field Visits, and Meetings**

Following a request by the RGoB to the UN Resident Coordinator, it was decided that the UN system in collaboration with the World Bank will deploy a joint assessment team to conduct a rapid assessment of damages and losses caused by the earthquake. The UN Resident Coordinator requested the UN OCHA and BCPR, UNDP to provide experts for conducting the assessment. The World Bank Representative to Bhutan organized the participation of two experts from the Global Facility for Disaster Reduction and Recovery (GFDRR) (one each from Washington DC and New Delhi) for the purpose of the Joint Assessment. The team also included experts from the UNICEF Bhutan office, in the field of health, water supply and sanitation, and psychosocial support. The Joint Assessment Team assembled in Thimphu on 30 September 2009.

The Joint Assessment Team met a number of officials from various line Ministries to review data and information already collected by the Royal Government of Bhutan (RGoB). It also had a meeting with the UN Country Team as well as the development partners. The Team also attended a briefing on earthquake provided by the Prime Minister of Bhutan. In this briefing, the Honourable Prime Minister provided detailed information on earthquake relief as well as outlined the priorities of the Government in terms of recovery and risk reduction.

The Joint Assessment Team expanded as it was joined by a number of agencies from the RGoB-- Department of Disaster Management (DDM), Department of Youth & Sports (DYS), National Commission for Women & Children (NCWC), and the Department of Urban Development & Engineering Services (DUDES). The names of Joint Assessment Team members are provided in the Annex 7.4.

In consultation with DDM officials, a mission program was prepared to visit six villages in Mongar and Trashigang Dzongkhags. The Mission Program is annexed at Annex 7.2. A number of other villages - Drametse, Yangneer and Walaktang - were added to the mission program at the advice of the RGoB.

A Terms of Reference was prepared for the international experts on the Joint Rapid Assessment Team. For the details of the Terms of Reference, see Annex 7.1. Its primary objective was to conduct a rapid assessment of damages and losses in order to prepare an outline of early recovery and reconstruction program and provide a strategy and approximate cost structure for its implementation.

The mission also endeavoured to respond to the request of the Department for Disaster Management (DDM) for on-the-job transfer of knowledge, wherever possible.

The joint rapid assessment mission conducted its work from 30 September to 14 October, including 3 days of field visits and extensive consultations with all concerned RGoB organizations in Thimphu and in the dzongkhags. To maximize time and cover a greater number of locations, the team was divided into two sub-groups. Taking into account and the remoteness of many affected villages which could only be reached on foot, and recognizing the detailed primary data collection on physical damages undertaken by the RGoB through dzongkhag and gewog administration staff, the joint rapid assessment team, in consultation with the Department for Disaster Management, made the decision of relying on the primary data provided by the RGoB for damages and losses. Thus it concentrated its field work to get first hand information on the damages and losses and validate the data provided by the RGoB.

The methodology adopted by the Joint Assessment Mission for its field work consisted of physical visits to earthquake-affected areas followed by focused discussions with the affected population. In view of the widespread geographical area affected (12 out of 20 dzongkhags), a difficult mountainous terrain, accessibility challenges and disperse nature of villages and individual dwellings, which involved considerable walking and given the tight timeframe, it was agreed that the field visit would target the areas closest to the epicenter. For the same reasons the Team also decided to use questionnaires as a general guide, rather than administering them systematically to affected households and government officials. The Rapid Assessment Team took adequate care to visit a representative sample of households, public buildings, and cultural and heritage monuments and elicited information through structured interviews with several groups which included village elders, women, and teachers. Provision of temporary shelter, water and sanitation, and food security were some of the issues discussed during the visits. A list of questions addressed during the interviews is provided in Annex 7.3. UNICEF team conducted detailed interviews with children and women in order to assess the level of trauma they suffered. The NCWC also checked upon the incidence of sexual violence during the earthquake.

The Assessment Team had meetings with senior government officials at the dzongkhag levels and with the Home Minister upon reaching Trashigang. The field visit concluded with a very constructive meeting with the Home Minister, where he shared his vision of recovery and reconstruction with the Assessment Team.

The Team also had a detailed meeting in Thimphu attended by senior government officials from various line ministries including the Cabinet Secretary and the Finance Secretary of the RGoB, for interpreting data and developing the implementation strategy.

The initial draft of the report was shared with all concerned RGoB Ministries before the departure of the team, for their further clarification and vetting of data. The rapid assessment report that has emerged from this combination of primary data, field work and consultations provides a realistic cost estimate of losses and damages in all the affected sectors, and the cost of recovery and reconstruction. It also identifies critical priorities in terms of early recovery, reconstruction and disaster risk reduction, and a time-line for accomplishing these critical tasks. As such it provides a solid basis for early recovery and recovery planning, with the understanding that the formulation of specific activities in some sectors may require additional, in-depth investigations.

## **1.6 Damage and Loss Assessment Methodology**

As regards the methodology for carrying out the damage and loss assessment, the Assessment Team has drawn upon the established methodologies -- ECLAC's DaLA and PDNA<sup>5</sup>-- and provided an

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<sup>5</sup> The United Nations Economic Commission for Latin American and the Caribbean developed the Damage and Loss Assessment (DaLA) in 1972, which was revised in 2003. The Post-Disaster Needs Assessment builds upon

estimate of the value of destroyed assets. It also identified the overall financial needs for post-disaster recovery and reconstruction, as well as long-term disaster risk management. It has quantified damages and losses at the sectoral level. An aggregation of sectoral effects has enabled the quantification of total damage and losses for the entire affected area of the country.

The assessment takes damages and losses as the replacement value of totally or partially destroyed physical assets that must be included in the reconstruction programme. The Assessment Team estimated the damages and losses on the basis of unit cost of different categories of houses and buildings. The unit cost of asset category was provided by Government agencies. For different categories of asset losses, certain percentages of unit cost were applied in consultation with the government officials. In case of **beyond repairs** and **major damages** category, losses were calculated on the basis of 100% of the unit cost, as they would have to be reconstructed. In the **partial repairs** and **minor repairs** categories, 25% and 10% of the unit cost was applied for calculating asset losses, respectively. The determination of 25% and 10% of the unit cost for losses and damages in these categories has been done on the basis that the total value derived through these percentages would be adequate for repairing these damages.

The methodologies followed for valuation of properties differs from one country to another. In many countries, it is based on property valuation sheets maintained by governments. In some other countries, the value recorded in a number of property registration is taken as the baseline. In rural Bhutan, where property transactions are very low, the average value of the cost of construction of different asset categories offered the most practical way of estimating the damages and losses. It provides an approximate basis for calculating damages and losses, but in the absence of a detailed survey, it represented the best approximation.

The methodology employed here has several limitations. It has not collected the baseline socio-economic data. In view of the scale of disaster, this exercise was not critical. Similarly, it has not estimated indirect impacts, which arise due to disruptions in the flows of the economy. The affected area has a largely informal rural economy, and the earthquake has not led to output losses of any significance. The earthquake has no macro-economic or fiscal impact of any significance, except to the extent that the RGoB would have to allocate some of the resources for recovery and reconstruction.

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DaLA as it stresses the identification of human impacts and recovery needs. The assessment has utilized certain elements of these methodologies, but has not followed these methodologies in great detail.

## Section II: Damage and Loss Assessment

### 2.1 Damage and Loss – Overview

Bhutan is a mountainous country. According to Bhutan’s 2005 census, the country has a population of 672,425. Bhutan’s population density is low. Based on the 2009 estimate, the country has 15 persons per sq km (38 per sq mi) on average. About 69 % of the people live in rural areas. Due to the low density of population and dispersed settlements in rural Bhutan, the earthquake has not resulted into large-scale destruction. Losses are scattered across the different dzongkhags<sup>6</sup>, although most of the major damages are concentrated in Trashigang and Mongar dzongkhags, close to the epicenter. Some vivid examples of the damages and losses are annexed at Annex 7.8.

As per the latest estimates provided by the RGoB, a total of 4,614 households are affected by the earthquake.<sup>7</sup> The distribution of earthquake impacts has been uneven, with some villages being more affected than others. The RGoB has classified structural damages in all the sectors into four categories: a. beyond repairs; b. major repairs; c. partial repairs, and d. minor repairs. The scheme of classification has evolved after considerable discussion within the Government of Bhutan, and could broadly be represented as in the following table. This report presents its assessment on the basis of the RGoB’s classification of damages.

**Table 1: Classification of Damages to Masonry Buildings**

Category of Damages	Structural Details
a. Beyond Repairs	Destruction; total or near collapse of the building
b. Major Repairs	Very heavy structural and non-structural damage; serious failure of walls, inner wall collapse; partial structural failure of roofs and floors
c. Partial Repairs	Moderate structural damage, heavy non-structural damage; large and extensive cracks in most walls. Roof tiles detached. Chimney fracture at the roof line; failure of individual non-structural elements (partitions, gable walls)
d. Minor repairs	Slight structural damage, moderate non-structural damage; cracks in many walls, fall of fairly large pieces of plaster; partial collapse of smoke chimneys on roofs.

### 2.2 Shelter Sector

In the shelter sector, as per the latest figures made available to the Joint Assessment Team, 446 houses have been classified as beyond repairs, while 1,012 houses require major repairs. Similarly, the numbers of houses which require partial and minor repairs are 1,749 and 1,407 respectively.

Almost all the damaged houses are non-engineered.<sup>8</sup> These houses are predominantly made of random rubble masonry with mud mortar, and are of rectangular regular shape. Stone is the locally available material in these rural areas of Bhutan. Unshaped stone blocks collected in the field have been used for most of the construction, mainly in the form of uncoursed (random) stone-rubble construction. In some cases, the stones have been shaped for being used as cornerstones.

Most of these houses are single family dwelling units. The length of a typical house is six to ten meters, and width 4 meters. A large number of houses are two-storied, though the Assessment Team

<sup>6</sup> ‘Dzongkhag’ is a Bhutanese term for sub-national district.

<sup>7</sup> Disaggregated data on the affected households is not yet available. An Analysis by the National Institute of Statistic could be undertaken to compare census data with affected areas. Further disaggregated data is expected to be compiled as part of more detailed livelihood recovery needs assessments

<sup>8</sup> Non-engineered construction can be defined as "those buildings spontaneously and informally constructed in various countries in the traditional manner without any or little intervention by qualified architects and engineers in their design."

came across single-storied houses as well. Typically three openings are provided on the ground floor, one for door and rest for windows. The openings on the first floor are just one or two. Front façade has more openings than the back. Openings are limited in size. Openings constitute some 15-20% or even less of total wall length. Most of the houses have shallow foundations.

The typical span of the roofing / flooring system is five meters. Most of the houses have used Corrugated Galvanized Iron (CGI) sheets as the roofing material. Almost all the houses have wooden attics which function as storage space for food grains and other household goods. The roof diaphragm is not rigid and is not expected to maintain its integrity, i.e., shape and form, during an earthquake.

In all the houses, binding material (mortar) for walls is very weak (mud mortar) or there is no binding material at all (dry stone masonry). Stone units (boulders) are irregular, and there is generally an absence of header stones at wall junctions and corners, and through stones in walls. In most of the houses, which have suffered damages, no timber bands have been provided at the foundation / lintel / roof levels. There is inadequate beam-column and beam-wall connection, which has weakened the anchorage between walls and foundation.

Overall, there is a lack of integrity between different structural elements of the houses. Uncoursed stones, poor mud mortar, thick walls, and absence of wall-floor and wall-roof connections have led to structural failure of most of the buildings. The quality of workmanship is generally very poor. It could be said that the skill of constructing robust traditional stonemasonry houses in the rural areas has most certainly deteriorated. Since there is no applicable building code for the rural areas, these poor construction practices have not received much policy attention.

The Assessment Team has attempted to assess the monetary value of shelter losses. The methodology followed for the valuation is based on the preliminary estimate of the cost of houses provided by the Ministry of Works and Human Settlement. The cost estimates for the single and double storied houses are Nu 0.391 million and Nu 0.686 million respectively. Since the data for the number of single and double storied houses are not available to the Assessment Team, it is proposed than an average of both the cost estimates is worked out as the unit value of a house. It would approximately be Nu 0.55 million for each house.

The cost of those houses which are in **beyond repairs** category could be arrived at by multiplying the number with the unit cost of Nu 0.55 million. Even those houses which would require **major repairs** would fall into a category for which the feasibility of retrofitting or repairs is weak. Almost all the houses in this category would need to be dismantled safely and then reconstructed. Therefore, the value of houses in **major repairs** category would be estimated on the same basis as the category of **beyond repairs** houses. The value of houses in **partial repairs** category has been arrived at by estimating 25 % of the unit cost, while the value of houses in **minor repairs** category is calculated on the basis of 10 % of the unit cost. These percentages have been determined in consultation with the government. The total value of the damages on the basis of total number of houses in each category and applicable percentages could thus be shown in the following table:

**Table 2: Estimated Value of Damages and Losses in Shelter Sector**

Categories of Damages	Number of Houses	Unit Cost in Nu million (% Applicable)	Estimated value of each house in Nu million	Total cost (Nu million)
<b>Beyond Repairs</b>	446	0.55 (100%)	0.55	245.3
<b>Major Repairs</b>	1012	0.55 (100%)	0.55	556.6
<b>Partial Repairs</b>	1749	0.55 (25%)	0.137	239.6
<b>Minor Repairs</b>	1407	0.55 (10%)	0.055	77.3
<b>Total</b>	<b>4614*</b>			<b>1118.8</b>

\*Government figures as of Oct 18,2009.

The total cost of damages in the shelter sector is thus estimated to be Nu 1118.8 million on an approximate basis.

### 2.3 Education Sector

The earthquake has damaged a number of educational institutions. These institutions include primary school, lower secondary school, middle secondary school, and higher secondary school. As in other sectors, the damages to these institutions have been classified into four categories (beyond repair, major repair, partial repairs and minor repairs).

It is problematic to estimate the value of asset losses in this category as a number of schools have been constructed through community efforts, and these schools had a much lower cost. However, since these schools would be constructed now with government funding, the unit cost of schools as suggested by the RGoB is being taken into consideration.

The schools constructed through community efforts suffered from the same deficiencies which characterized individual houses. These were non-engineered structures, and suffered from a lack of structural integration. However, there is a serious concern about major damages to the government-built schools. These schools have been constructed following a proper engineering design, and have been technically supervised. It was expected that these buildings should have performed better during the earthquake. Extensive damages to schools points to an urgent need for improving school construction practices throughout the country.

As for the specific damages, in the category of community primary school (CPS) and Primary Schools (PS), there are 6 buildings which are **beyond repairs**, while 14 buildings are in **major repairs** category. The category of **partial repairs** includes 40 buildings, and 13 buildings need **minor repairs**. The unit cost of a CPS day school is Nu 12 million and with boarding facilities, it is Nu 15 million.

In the category of lower secondary school (LSS), there are 2 buildings which have suffered damages in **major repairs** category, while the number of buildings in **partial repairs** and **minor repairs** categories are 2 and 4 respectively. The unit cost of a LSS day school is Nu 35 million, and with boarding facilities, it is Nu 50 million.

In the category of middle secondary school (MSS), there is just one building which has suffered damages in **major repairs** category, while the number of buildings in **repairs** and **minor repairs** categories are 1 and 3 respectively. The unit cost of a MSS day school is Nu 50 million, and with boarding facilities, it is Nu 75 million.

In the category of higher secondary school (HSS), there is one building which has suffered damages in **partial repairs** category, while 4 buildings are in **minor repairs** category. The unit cost of a MSS day-school is Nu 60 million, and with boarding facilities, it is Nu 85 million.

Since the Assessment Team could not access the data related to the number of boarding schools damaged, the loss estimates have been arrived on the basis of unit cost of day schools. The loss estimates as well as the cost of reconstruction and repairs are likely to increase when the data on boarding schools are made available. It is also important to mention that in view of the disbursed settlements in Bhutan, boarding schools are extremely important for providing education to children from a large number of villages.

The total value of the damages to different types of schools, on the basis of different categories of damages and unit cost of these schools, could be shown in the following table:

**Table 3: Estimated Value of Damages and Losses to School Buildings**

Categories of Damages	Number of buildings	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
<b>Community Primary School</b>				
Beyond Repairs	6	12 (100%)	12	72
Major Repairs	14	12 (100%)	12	168
Partial Repairs	40	12 (25%)	3	120
Minor Repairs	13	12 (10%)	1.2	15.6
<b>Sub-total</b>	<b>73</b>			<b>375.6</b>
<b>Lower Secondary School</b>				
Beyond Repairs		35 (100%)	35	
Major Repairs	02	35 (100%)	35	70
Partial Repairs	02	35 (25%)	8.75	17.5
Minor Repairs	04	35 (10%)	3.5	14
<b>Sub-total</b>	<b>08</b>			<b>101.5</b>
<b>Middle Secondary School</b>				
Beyond Repairs		50 (100%)	50	
Major Repairs	1	50 (100%)	50	50
Partial Repairs	1	50 (25%)	12.5	12.5
Minor Repairs	3	50 (10%)	05	15
<b>Sub-total</b>	<b>5</b>			<b>77.5</b>
<b>Higher Secondary School</b>				
Beyond Repairs		60 (100%)	60	
Major Repairs		60 (100%)	60	
Partial Repairs	1	60 (25%)	15	15
Minor Repairs	4	60 (10%)	06	24
<b>Sub-total</b>	<b>5</b>			<b>39</b>
<b>Grand Total</b>	<b>91</b>			<b>593.6</b>

The total cost of damages to different types of school buildings is thus estimated to be Nu 593.6 millions on an approximate basis.

## 2.4 Cultural Heritage Properties

Bhutan is extremely rich in terms of cultural and religious heritage. Its cultural wealth is represented by monasteries and lhakhangs<sup>9</sup>, chortens<sup>10</sup>, and dzongs<sup>11</sup>, which have existed in the country for centuries. A severe damage to these heritage buildings and monuments represents a loss which cannot be measured in purely monetary terms. Apart from the structural damages, a number of cultural artifacts and paintings in these heritage monuments have been damaged. It would be difficult to ascribe value to these damages, and they could be restored only through years of assiduous conservation.

<sup>9</sup> A Lhakhang is a temple, which is regarded an institution of respect and veneration in every village. Social and cultural life of the village revolves around Lhakhangs.

<sup>10</sup> A chorten is a small Stupa, a Buddhist monument. Chortens are an essential part of every village settlement.

<sup>11</sup> Dzongs represent the most important religious and temporal institution at the level of dzongkhag. It is the seat of the government at the dzongkhag level as well as living quarters of Buddhist monks. Certain major Buddhist monasteries are also classified as dzongs.

As per the latest figures made available to the Assessment Team, 485 chortens have been damaged. Of these, 149 chortens are **beyond repairs**, while 145 are in **major repairs** category. Chortens requiring **partial repairs** and **minor repairs** are 99 and 92 respectively.

For the purpose of damage assessment, small monasteries have been included in the category of lhakhangs. A total of 281 lhakhangs have been damaged, out of which 36 are **beyond repairs** and 93 lhakhangs require **major repairs**. Of the remaining, 104 lhakhangs are in **partial repairs** category, and 48 lhakhangs in **minor repairs** category.

Dzongs embody the most impressive architectural and building tradition in Bhutan. The monastery at Drametse is considered among the most important heritage structures in the country, and is categorized as a dzong. There are three dzongs which are in **major repairs** category. It needs to be stated that due to their historical importance, these dzongs cannot be brought down, and would have to be retrofitted. Four dzongs are in **partial repairs** category.

The estimated value of losses to these heritage monuments has been shown in the following table:

**Table 4: Estimated Value of Damages and Losses to Culture and Religious Heritage Buildings**

Categories of Damages	Units	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
<b>Chortens</b>				
Beyond Repairs	149	0.4 (100%)	0.4	59.6
Major Repairs	145	0.4 (100%)	0.4	58
Partial Repairs	99	0.4 (25%)	0.1	9.9
Minor Repairs	92	0.4 (10%)	0.04	3.6
<b>Sub-total</b>				<b>131.1</b>
<b>Lhakhangs</b>				
Beyond Repairs	36	3 (100%)	3	108
Major Repairs	93	3 (100%)	3	279.0
Partial Repairs	104	3 (25%)	0.75	78.0
Minor Repairs	48	3 (10%)	0.3	14.4
<b>Sub-total</b>				<b>479.4</b>
<b>Dzongs</b>				
Beyond Repairs		10 (100%)	10	
Major Repairs	3	10 (100%)	10	30
Partial Repairs	4	10 (25%)	2.5	10
Minor Repairs		10 (10%)	10	
<b>Sub-total</b>				<b>40</b>
<b>Grand Total</b>				<b>650.5</b>

The total cost of damages to cultural properties is thus estimated to be Nu 650.5 million on an approximate basis.

## 2.5 Health Infrastructure

The Ministry of Health sent a team from 27th September to 7th of October 2009 to assess the impact of the earthquake on health care facilities and the provision of health services in the affected six eastern dzongkhags. The team also decided to survey the impact of the earthquake on rural water supply and sanitation (RWSS), and the possibility of disease outbreak in the aftermath of the earthquake. A detailed separate report has been prepared by the Ministry.

The earthquake has damaged Basic Health Units (BHUs), though most of these damages are concentrated in Trashigang. Altogether, 25 BHUs are damaged in the area, out of which 2 are in **beyond repairs** category, and 6 are in **major repairs** category. Of the remaining, 3 BHUs are in **partial repairs** category, and 14 are in **minor repairs** category.

The collapse and major damages to BHUs reflect the poor construction of these buildings. These are engineered structures which should have withstood the earthquake impact. While the Assessment Team observed that building materials used in the construction met the specifications, the design of these buildings left a lot to be desired. The BHUs, mostly stone masonry buildings had poor binding features. Lack of bands in these buildings showed a basic design deficiency.

The unit cost of Basic Health Units in remote areas is Nu 6 million. The total value of the damages to different types of BHUs, on the basis of different categories of damages and unit cost of BHUs, could be shown in the following table:

**Table 5: Estimated Value of Damages and Losses to Basic Health Units**

Categories of Damages	Basic Health Units (BHUs)	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
Beyond Repairs	2	6 (100%)	6	12
Major Repairs	6	6 (100%)	6	36
Partial Repairs	3	6 (25%)	1.5	4.5
Minor Repairs	14	6 (10%)	0.60	8.4
<b>Sub-total</b>	<b>25</b>			<b>60.9 or 61</b>

Damages to hospitals have been limited. However, according to an assessment by the Ministry of Health, the Mongar, Pemagatsel and Samdrup Hospitals have developed minor cracks which might require minor repairs. Staff quarters attached with the Mongar hospital have also suffered minor damages. Although the cost of the Mongar hospital is much higher, the average cost of construction of a hospital, Nu 46 million, has been used to calculate the losses.

**Table 6: Estimated Value of Damages and Losses to Hospitals**

Categories of Damages	Number of Hospital structures	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
Minor Repairs	3	46 (10%)	4.6	18.4
Minor Repairs	1 (Mongar Hospital)	441(10%)	44.1	44.1
<b>Sub-total</b>	<b>4</b>			<b>62.5</b>

The total cost of damages to health facilities is thus estimated to be Nu 123.5 million on an approximate basis.

## 2.6 Government and Public Offices

A number of local government offices got damaged in the earthquake. These government offices are in two categories: Renewable Natural Resource (RNR) Centers and Gup Offices. RNR Centers are located at Gewog levels, and somewhat less affected by the earthquake. A total of 22 RNR Centers are damaged by the earthquake, out of which 3 are in **major repairs** category, 10 are in **partial repairs**, and 9 in **minor repairs** category.

Gup Offices are far more damaged. Since they are located in villages, they more or less had the same building features as private houses. They are largely stone masonry buildings with thick walls and poor binding features. The Assessment Team observed a number of Gup Offices which were completely damaged. Of 28 Gup Offices, 4 are in beyond repair category, while 6 are in major repair, 8 in partial repair, and 10 in minor repair categories.

The unit cost of RNR Centers is Nu 0.25 million and Gup Offices is Nu .15 million. The cost of damages to these buildings has been worked out on the basis of the unit cost and extent of damages as shown in the following table:

**Table 7: Estimated Value of Damages and Losses to RNR Centres**

Categories of Damages	RNR Centers	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
Beyond Repairs		0.25 (100%)	0.25	
Major Repairs	3	0.25 (100%)	0.25	0.75
Partial Repairs	10	0.25 (25%)	0.625	6.25
Minor Repairs	9	0.25 (10%)	0.25	2.25
<b>Sub-total</b>	<b>22</b>			<b>9.25</b>

**Table 8: Estimated Value of Damages and Losses to Gup Offices**

Categories of Damages	RNR Centers	Unit Cost in Nu million (% Applicable)	Estimated value of each structure in Nu million	Total cost (Nu million)
Beyond Repairs	4	0.15 (100%)	0.15	0.6
Major Repairs	6	0.15 (100%)	0.15	0.9
Partial Repairs	8	0.15 (25%)	0.375	3.0
Minor Repairs	10	0.15 (10%)	0.015	0.15
<b>Sub-total</b>	<b>27</b>			<b>4.65</b>

The total cost of damages to RNR Centers and Gup Offices is thus estimated to be Nu 13.9 million on an approximate basis.

On the basis of sector-wise damages and losses as described above, an aggregated picture of total damages and losses has been presented in the table below. Bhutan has suffered a total loss of Nu 2,501 million or US\$52 million due to this earthquake. It is the most expensive disaster which the country has suffered in its recent history.

**Table 9: Total Sectoral Damage and Loss Statement**

Sl	Sector	Approximate Loss (Nu, Mil)	Approximate Loss (USD, Mil) <sup>12</sup>
1	Shelter	1119	23.3
2	Education	594	12.3
3	Cultural Heritage	650	13.5
4	Health	124	2.6
5	Government and Public Offices	14	0.3
<b>APPROXIMATE TOTAL LOSS</b>		<b>2501</b>	<b>52</b>

<sup>12</sup> USD 1 = Nu 48 at current exchange rates.

## **Section III: The Way Forward – Early Recovery**

### **3.1 Current Situation Analysis**

The Assessment Team visited a number of villages which included Thangrong, Walakthang, Ngatshang, Ropthankar, Boomjai, Chaskar, Drametse, Narang, Durung and Yangneer in the affected areas. The Assessment Team carried out a survey of houses, schools, Basic Health Units (BHUs), monasteries and other Gup offices<sup>13</sup> that had been affected by the earthquake. The Team ascertained the early recovery priorities on the basis of its visits to households and discussions with the affected people. Early recovery activities should start immediately and continue for the next 6-12 months.

Following the collapse or damage of a large number of houses, which have left thousands of people with no adequate shelter, the RGoB distributed tarpaulin sheets to affected families in the Dzongkhags of Mongar, Trashigang, Yangtse, Zhemgang, Pemagatshel, Lhuentse and Samdrup Jongkhar Dzongkhags. UNICEF facilitated immediate supply of 1000 blankets, 23 tents, 100 tarpaulin sheets for the affected schools in Mongar and Trashigang on Sept 25, 2009. The RGoB requested the UN system to provide additional 800 tents for the affected families. Of this, 368 have been procured. A consignment of tools and equipment to facilitate clearing and removal of rubble and in salvaging of building materials has been distributed by UNDP. UNFPA is providing 3,000 sets of dignity/hygiene kits to the affected families. Further resources have been mobilized from the OCHA Central Emergency Response Fund (CERF) to meet the need for temporary shelter and to reinstall critical services through provision of tents and CGI sheets. Further relief efforts by the government, UN agencies and donors are ongoing. On 9th October, Department of Disaster Management has written to the MoFA seeking donor support for some further relief items.

Families have used tarpaulin sheets to build make-shift shelters just beside their damaged houses. Three weeks after the disaster, most affected families have been living under the tarpaulin sheets and are fearful of entering and/or living in damaged houses.

On September 29, 2009, a wind storm caused further damage to some structures and caused further hardships to families under tarpaulins. In the week of October 5<sup>th</sup>, unprecedented and unseasonal rainfall for 72 hours caused enormous misery to families surviving in temporary tarpaulin shelters. These shelters have been effective for the first two weeks as an immediate response. However, they cannot be seen as durable shelter solutions beyond the immediate response phase.

In view of the vulnerable conditions to which the affected people are exposed, the RGoB has now reviewed the situation and determined that the affected people require more durable temporary shelter. It has therefore requested the UN system to provide Corrugated Galvanized Iron (CGI) sheets instead of tents. The UN system has complied with the request and will procure CGI sheets to be used for temporary shelter through the CERF.

As the schools have collapsed, the Government has taken immediate measures to resume the functioning of these schools. Tents and tarpaulin sheets have been used to develop makeshift structures. The Assessment Team observed that classes had been resumed in all affected areas. Some classes are being conducted as temporary learning arrangements. However, the Team also observed that the makeshift structures for schools are not strong enough for protection against natural elements. Rains damaged these structures, and the students had to be sent home. A sturdier solution has to be found for continuity of education in these villages.

A smaller number of BHUs have been damaged, but restoring them on a makeshift basis has become critical to the provision of health care to the affected community. As the diarrheal cases have increased fivefold after the earthquake, the people need immediate health care support. A strong

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<sup>13</sup> Gup office represents the government at the village level.

temporary structure for these collapsed BHUs as well as the provision of water for their hygienic operations would help resume the provision of health services in the affected villages.

Though water supply is available in almost all the households, the level of hygiene and cleanliness in temporary shelter is poor, which could give rise to a number of health issues. Women's health requires urgent attention, and a certain amount of external support in the most affected villages is indeed a critical need.

Microbiological contamination can lead to outbreak of diarrhea in any emergency situation. As most of the toilets have collapsed or rendered unusable, villagers in the badly hit areas are forced to resort to open defecation. Villagers especially at Narang, Durung and Yangneer are at risk of consuming contaminated water and getting afflicted with diarrheal diseases. The health statistics maintained at Narang Basic Health Unit show that diarrheal cases have gone up by 5 times since the earthquake. However, the total number of cases is too few to be considered to be an outbreak yet, but the possibility of an outbreak exists.

Most of the households affected by earthquake have agriculture and livestock rearing as their main sources of subsistence livelihood. The main crops are maize, potatoes, paddy and vegetables. Most of the farming is for the purpose of subsistence as it does not generate substantial marketable surplus. Since there is no organized dairy industry, livestock rearing does not contribute significantly to household income.

Though the earthquake has not damaged income-earning assets, it has made an indirect impact on livelihoods. Most of the affected families have not been able to pay much attention to livelihood activities. The people are trying to cope with the situation, leaving them with little time to attend to agricultural operations. People have also not been able to earn wages through labour employment elsewhere. It has made a resource-poor household economy even more fragile. Though it may not be the immediate case, it will have an impact on food security in the next few months. A certain amount of livelihoods assistance for the most affected people, largely by way of agricultural inputs and small grants, would be an important form of assistance.

Women are very adversely affected by the earthquake. The Assessment Team came across a number of woman headed households during its visit. They face the burden of salvaging household goods, cooking for the family, caring for children, and attending to cattle rearing and agriculture. They are aware that they would have to rebuild their houses, but not sure how to go about rebuilding these houses. Women seem to have suffered from a sense of loss and anxiety, and are struggling for an appropriate response to the situation they are in. They need considerable support in terms of counseling, livelihoods assistance, and health and hygiene care.

The Assessment Team also conducted a psychosocial assessment of youth affected by the earthquake. It visited 11 schools and engaged 103 respondents in focused group discussions. The major findings are that children are affected by a sense of shock, grief, anxiety and trauma. Both the teachers and children are fearful of another earthquake, and they find it difficult to focus on studies. A large number of students have lost their textbooks. As they live in shelter with poor living conditions, they find it difficult to carry their day-to-day work and studies. The earthquake has dislocated their life, and caused anxiety and sleeplessness among them.

In view of the situation that exists in the affected villages, following early recovery interventions are recommended to take place in the next 6-9 month:

### **3.2 Intermediate Shelter:**

The limited durability of the tarpaulin shelters and the ensuing winter season necessitate provision of intermediate shelter which can last up to two years, the expected time-frame for the reconstruction and retrofitting of permanent shelter for the earthquake-affected people.

The proposed intermediate shelter would serve the following functions:

- Provide temporary housing during periods of risks to permanent shelter;
- Protect against the natural elements;
- Enable proximity to their income earning assets (land, shops, livestock); and
- Serve the needs of emotional security and privacy.

In a disaster situation where houses have collapsed on a large scale, a reconstruction program for private housing is generally expected to extend for a period of two years. The people will necessarily have to live in intermediate shelter for a considerable length of time. The temporary shelter must therefore provide space, facilities and protection which sustain them during this period. It is an essential housing arrangement between phases of humanitarian relief and permanent rehabilitation.

It is proposed that the intermediate shelter, a semi-permanent structure, should have a main dwelling unit of 15' x 15' with a detached kitchen and food storage unit of size 6' x 9'. Communities can use salvaged stone from damaged houses for rebuilding the foundation. The superstructure frame and walls should be of locally available wood and/or bamboo. Corrugated Galvanized Iron (CGI) sheets are recommended as roofing material for both the dwelling and kitchen units. Effort must be made to converge water and sanitation facilities at the intermediate shelter unit by provision of water transportation and storage devices like cans and low-cost latrines.

The Technical Assessment Team comprising structural and geotechnical engineers from the RGoB have proposed a design for intermediate shelters. The Joint Rapid Assessment Team had an opportunity to discuss the design and specifications with the Technical Team of engineers of the RGoB. The Assessment Team is of the view that a somewhat lower cost structure for temporary shelter would be a more feasible option which would also free up resources for superior permanent reconstruction/retrofitting/repair of collapsed/damaged houses.

The construction of intermediate shelter would involve providing building materials of specified quantities to all the affected families – wooden poles/planks, bamboos, CGI sheets and certain fixtures. Wooden poles and bamboos provide the frame while the CGI sheets could provide roofing. The families can also use plastic sheets for setting up internal partitions. It is proposed that the task of building intermediate shelters should be entrusted to the affected families. The RGoB may consider procuring the building materials and provide them to the families.

Owner-driven construction strategy for intermediate shelters is recommended as the most cost-, time- and quality-efficient. The RGoB should enable the owner-driven construction by way of providing assistance with major building materials (CGI Sheets, Bamboo and Wood Permits) and small cash assistance for erecting the structure. The assistance could consist of a provision of Nu 10,000, for the procurement of CGI sheets (approximately 20 Sheets @ Nu 500 each) , Nu 5,000. for wooden poles and bamboos (approximately 30 cft @ Nu 150 each) and Nu 5,000. as cash assistance for fixtures and cost of wood/stone mason labor charges. In view of the Assessment Team, an assistance of Nu 20,000 would therefore be adequate for building an intermediate shelter as proposed, though it is for the RGoB to consider and approve the scheme of assistance as per the availability of resources. The Assessment Team recommends that the CGI sheets may be procured centrally by the RGoB and made available to affected families through the concerned dzongkhag and gewog. This will ensure standardization of quality and cost-effectiveness through economies of scale.

A limited assistance for intermediate shelter is recommended with a view to spend less money on the provision of intermediate shelter and allocate more resources for construction of permanent shelter or retrofitting of existing shelter on the basis of 'build back better' principle.

It is further estimated that not more than 2000 such intermediate shelters may require to be erected. This will cover the households occupying the 446 'beyond repair' houses and the 1017 'major repair' houses. The provision of intermediate shelter will also include shelter for school and BHU staff who have lost their living quarters due to the earthquake. Therefore, the net resource requirement for the intermediate shelter construction for the affected families is expected to be in the range of Nu 40 million.

### **3.3 Livelihoods:**

In view of the conditions of poverty and vulnerability that the Team observed, it is extremely important that a package of livelihoods assistance be provided to the affected families. The assistance could consist of providing inputs and small grants for agricultural operations, livestock maintenance and any other income-generating activities. A Rapid Livelihoods Assessment could be conducted for the purpose of ascertaining household needs. It is also important that certain community level facilities such as a village-level warehouse be created which improves the local economy.

It would also help if targeted cash for work program is introduced to support a number of early recovery and reconstruction activities such as rebuilding of community assets and repairs of local infrastructure. For the families affected, this initiative may require a financial commitment of Nu 15 million (5000 workers for 30 person-days @ Nu 100 per person-day). This intervention will be implemented as a social protection programme whereby the people can find some employment and earn wages. Apart from increasing liquidity in the local economy, it will also present an opportunity for mobilizing community efforts for recovery and reconstruction.

### **3.4 Education:**

The Assessment Team recommends the same Early Recovery Strategy for schools as for private houses. Intermediate structures should be set-up, pending permanent reconstruction/retrofitting. The intermediate structure should use bamboo, woods, and CGI sheets for its construction. Classes could be held in these intermediate structures. As the teachers are currently living in temporary tents that are unsuitable for extreme weather, intermediate structures could also be set up for teachers' living quarters.

It has been estimated that for early recovery of 24 'beyond repair' and 'major repair' schools, a total approximate outlay of Nu 12.5 million would be required at the rate of Nu 500,000 each. For the 43 partially damaged schools, early recovery would cost Nu 5.4 million at the rate of Nu 125,000 each. For the 21 minor damage schools, the early recovery cost would be Nu 1 million at the rate of Nu 50,000 each. Therefore, the total outlay requirement for early recovery of the education sector would be approximately Nu 18.9 million.

In addition, following materials may be provided to ensure restoration of normalcy:

- blankets for boarding students, teaching and non-teaching staff;
- 100 numbers of School-in-a-box kits;
- 30 numbers of Recreation kits.

Restoration of water and sanitation facilities in schools, especially for girls and female staff, is of utmost urgency and importance, and should be prioritized.

### **3.5 Health:**

The Basic Health Unit (BHU) of Narang gewog in Mongar-- built only in 2007-- completely collapsed. The only Basic Health worker posted to the BHU was affected himself and not able to provide services. The army personnel salvaged drugs and equipments from the collapsed BHU and

shifted it to the gewog office. As help arrived from Dramitse BHU and also from Mongar Dzongkhag, a room in the gewog office was used for providing medical care to the injured. The victims who required further treatment were evacuated to Mongar Regional Referral Hospital. At present the OPD service is being provided from the gewog office and outreach services have been suspended. Two health workers from Dramitse BHU have been deputed to Narang to help, which were replaced by one Health Assistant who has been transferred temporarily to Narang gewog. In Trashigang, the Yangner BHU has been destroyed including equipment such as refrigerator and spotlights. A three unit temporary structure has been constructed using timber and CGI sheets.

It would take time to reconstruct BHUs, pending which an early recovery program should support the restoration and continuity of health services. The Assessment Team therefore recommends that the health services should be urgently restored in the places where BHUs are beyond repairs or damaged by erecting intermediate semi-permanent BHUs with adequate water supply. Health activities such as Outreach clinic should resume in Yangneer and Narang Gewogs as soon as possible.

The Assessment Team found that the cold chain system in the two 'beyond repair' BHUs in Narang and Yangneer was damaged resulting in the immediate need for kerosene mode refrigerators to ensure the continuation of the routine immunization. Further assessment of damages to the cold chain system in other affected areas, which could not be covered through the Assessment Team, is required.

There does not seem to be any food insecurity and malnutrition at the moment. However, it is likely to appear in the future if appropriate measures are not taken to address food shortage that might result from improper storage facilities and insufficient food production due to their time devoted to reconstructing their shelters or houses.

An immediate provision of the equipment is recommended for maternal, neonatal and child health (e.g. examination table, delivery beds, height and weight measuring scales, etc) with the objective of restoring the MNCH services in these damaged BHUs.

The two 'beyond repair' BHUs and six 'major damage' BHUs would require intermediate semi-permanent structures @ Nu 5,00,000 and would approximately cost Nu 4 million. The 3 BHUs with partial damage would require approximately Nu 3, 00,000 each and a total of Nu 9, 00,000. The 14 BHUs that have suffered minor damages would require Nu 1,00,000 for repairs and would cumulatively require Nu 14, 00,000. In addition, funds would be required for restoration of water supply to BHUs, equipment and medicines, and the total cumulative cost for Early Recovery interventions in the Health sector would be in the range of Nu 10 million. The damages to the three hospitals are minor in nature and do not require immediate repair. Hence, the cost of minor repairs has been included in the reconstruction section.

### **3.6 Water and Sanitation:**

The main objective of water supply and sanitation programmes in emergencies is the reduction of health risks related to poor sanitation and the provision of safe drinking water. The minimum water requirement for drinking, cooking, and personal hygiene is 15 liters per person per day.

The Assessment Team observed that water supply in the affected areas was not affected by the earthquake. However, in some schools and villages like Thangrong, Narang and Yangneer, where children are housed in temporary shelters, the issue of safety in reaching water sources at night exists.

There is requirement for safe water storage tanks at schools, villages and BHUs. For the boarding schools that suffered major damages and where school children are living in temporary shelters, there is a need to provide water storage tanks with capacity of 1500 litres (with at least 200 meters of pipe length) for every 50 children, and the tanks are to be located near the temporary shelter. 3,000 litres capacity tank should be provided for each of the collapsed and major damaged BHUs

The affected population especially the farmers whose houses have been damaged have lost their water containers in addition to other belongings. Containers like jerry cans are needed for safe transportation and storage of water. For details of per head per day water requirements and contamination levels, see Annex 7.5.

As much as clean water, safe excreta disposal is also important to reduce the transmission of diseases. Therefore, it is important to prevent open defecation by providing access to latrines. Before the earthquake, up to 95% of the households in Ngatshang, Chaskar, Yangneer, Durung and Narang had access to pit latrines. In these areas, most of the pit latrines had collapsed. Villagers are compelled to resort to open defecation in the maize fields and other open areas. The health statistic at Narang Basic Health Unit show that diarrheal cases have gone up 5 times since the earthquake. While the total number of cases so far is too few to be considered to be an outbreak, the risk is there. Urgent steps are required to be undertaken for ensuring adequate public health and hygiene by restoration of latrine facilities in the damaged dwelling units to maintain rural health. Though these latrines are external to the house and provided collectively, they will be installed for the use of individual households. For details of possible options of toilet types, see the working drawings in Annex 7.6. For the schools, it is important to provide enclosures with plastic sheeting and timber plank around latrines and bathing units to ensure privacy, especially for girl students and female teachers.

The Basic Health Units with support from the gewog must carry out hygiene promotion programmes on safe disposal of feces, hand washing before handling food and after using toilet, safe water use, storage and transport.

The estimated cost for Early Recovery in the water and sanitation sector would cumulatively be Nu 1.4 million. For details, see Annex 7.7.

### **3.7 Support to Women:**

Women need to be supported in several ways. First, livelihoods assistance aimed at women-headed households should help them in improving their economic conditions in the interim. Improved access to water and sanitation facilities and better hygiene in intermediate shelter would also improve their health. So construction of toilets is an important priority for women. Similarly, some education and counseling related to life in intermediate shelter, coping with earthquake, etc. would also improve their mental and emotional condition.

### **3.8 Psychosocial Assessment:**

The Assessment Team also conducted a psychosocial assessment of children and youth affected by the earthquake. It visited 11 schools and engaged 103 respondents in focused group discussions. The major findings are:

- Shock, grief, anxiety and trauma among the students and the community.
- Intense fear of earthquake.
- Nervousness among the students and teachers.
- Inability to concentrate on studies.
- Inability to carry out regular work.
- Superstitious beliefs on doomsday.
- Sleeplessness and insomnia due to fear and improper shelter.
- Lack of textbooks as it got destroyed.
- Alcohol consumption increased among adults to cope with stress.
- Worry of having to sleep and study in temporary shelter for long duration.
- Difficulty in adjusting in the temporary shelter as such is affecting the day to day work and studies.

People traumatized by the earthquake and continuing tremors need to be counseled and emotionally supported. Such counseling could be provided in a number of ways. The most effective way this could be addressed in Bhutan is through the positive intervention of religious personalities and institutions. The earthquake and its impact should be discussed with the Buddhist monks, and a program could be developed through which the monks discuss it with the people to control the fear psychosis. Seismicity of the area, the need for greater preparedness, and better construction practices could be discussed with the people as part of earthquake education.

The RGoB may also consider training and educating local professionals, volunteers, and teachers about the earthquake and its impact. They could act as counselors and discuss the earthquake with affected men, women, and children. They could talk about how people recover from the shock and get over the anxiety and uncertainty arising due to collapse and destruction of their houses and other community buildings. Organizing discussions in schools would also help in understanding the earthquake and coming to terms with its impact.

The psychosocial early recovery initiative involving training for teachers and caregivers would cost Nu. 6,00,000. The RGoB may consider an immediate training followed by two refresher trainings over the next two years. The total financial cost on this initiative would be Nu 1.8 million.

### 3.9 Cultural Heritage Structure

The Assessment Team does not recommend a two-stage recovery and reconstruction process for the damaged Cultural and Religious Heritage Structures. The RGoB might expeditiously undertake the one-time permanent reconstruction/repair of the damaged cultural and religious structures which will be a Government-funded and executed activity. This has been dealt in detail in the Reconstruction Chapter.

On the basis of early recovery recommendations made by the Assessment Team, a cost structure of these interventions has been presented in the table below. The total cost of early recovery has been estimated at Nu 85.4 million.

**Table 10: Total Approximate Expenditure on Early Recovery Measures**

Sl	Head of Expenditure	Total Approximate Early Recovery Cost (Nu, Million)	Total Approximate Early Recovery Cost (USD, Million) <sup>14</sup>
1	Temporary Shelter/ Private Dwelling Units	40.0	0.83
2	Livelihood Support	15.0	0.31
3	Education	18.9	0.39
4	Health	10.0	0.2
5	Water and Sanitation	1.4	0.03
6	Psychosocial Measures	1.8	0.04
<b>TOTAL EARLY RECOVERY COST</b>		<b>87.1</b>	<b>1.8</b>

Note 1: Gender support activities have not been separately budgeted as they would form components of each of the above heads of expenditure and should be earmarked for specific implementation.

Note 2: Cultural Heritage monuments do not figure in the table above as the Team has proposed a single-phase reconstruction strategy for them. Please see Chapter V on Reconstruction.

## Section IV: The Way Forward – Reconstruction

A longer term reconstruction program would involve the construction of permanent shelter for the affected households, retrofitting of partially damaged houses, and repairs of minor damages. In addition, the reconstruction program would also include rebuilding/repair/retrofitting of the collapsed

<sup>14</sup> USD 1 = Nu 48 at current exchange rates

or damaged schools, Basic Health Units (BHUs) and Government offices. A significant component of the reconstruction program would comprise retrofitting and repairs of cultural and heritage buildings and monuments including chortens, monasteries, lakhangs and dzongs. The reconstruction program would be developed on the basis of damage assessments carried out by the RGoB.

#### **4.1 Shelter Reconstruction – Overview**

While all the components of reconstruction program are important, the construction of permanent shelter for the affected households has acquired a sense of urgency. The Assessment Team found a considerable sense of anxiety among the people about rebuilding plans and they clearly expected a certain level of assistance from the RGoB. The need for shelter assistance was also emphasized by the senior government officials, local officials and community representatives.

As a first step, all the damaged houses have been divided into four categories. The scheme of assistance for reconstruction is generally linked to this classification of damages. Those houses which are in beyond repairs category would require support for complete reconstruction. In addition, a large number of houses have suffered major structural damages of such a nature that it would be difficult to retrofit or repair them. These houses would need to be safely dismantled and reconstructed following the same strategy as prescribed for collapsed houses. Therefore, the Assessment Team recommends that the same scale of assistance should be applicable for the ‘beyond repair’ and the ‘major repairs’ categories of damaged structures.

A second category of assistance would be provided for those houses categorized as ‘partial repair’, which require structural retrofitting and repairs. Such retrofitting and repairs would be undertaken in accordance with prescribed technical guidelines and closely supervised.

The third and final category of assistance would be applicable to those houses categorized as ‘minor repair’ which require structural repairs. The scheme of assistance could be decided by the Government as per the reconstruction needs and availability of resources.

Across the affected villages, the Assessment Team had a few important observations regarding the building skills and practices. First, it could be said that in the past, there existed considerable local skills and craftsmanship for building in stone and wood. These skills and craftsmanship have deteriorated over the last few decades. The lack of knowledge on random rubble masonry is one of the most important reasons of severe damage, leading to collapse in most cases. Second, the masons were well-respected members of the community who at one time commanded a lot of respect and authority. Over a period of time, their social standing has suffered, which has a direct impact on decline in the quality and strength of construction. Third, the construction of building was a community-based process. People came together and contributed their labour to construction of houses. The community-based process has eroded. Construction of a house is a rather individual effort now. In view of changing dynamics in the community, the older processes of house construction are no longer viable now. There is a need for evolving new design and specifications, while ensuring the basic continuity of traditional architecture.

The Assessment therefore recommends that the following processes guide the reconstruction programme:

- All the houses need to be reconstructed in a way that enhances their seismic resistance. Necessary structural features to strengthen walls and roofs such as bands, beams and use of corner stones and through-stones need to be integrated into the design. Considerable attention needs to be given to the strength of the foundation.
- A number of working designs and drawings for houses should be prepared for providing alternatives to house-owners. The house design should promote earthquake resistant features in non-engineered houses.

- Adequate training should be provided to stone and wood masons to improve building techniques and quality.
- The engineering capacity at the national and local levels needs to be augmented. In the curriculum provided for civil / structural engineering, a modular course in earthquake engineering needs to be introduced.

### **In-situ reconstruction**

Almost the entire reconstruction should be undertaken in-situ. Only in those cases where the existing locations are very hazardous (exposed to recurrent landslides, land subsidence), proximate relocation of houses might be necessary. In certain cases, however, a certain level of assistance should be considered for improving the existing site. In-situ reconstruction would obviate the necessity for acquiring land, conversion of arable land for homestead use and ensure continuity of social and cultural life.

### **Minimum Living Space**

The house design should be developed in a way that provides a minimum carpet area of 300 Sq.ft. in the house. It would provide the minimum living space for a standard household. The house would include a living room, a small kitchen (or a separate kitchen structure as was noticed in most rural houses), sanitation facility and some open space. The house-owners would be free to add to this area as per their needs and resources. To the extent possible, houses and public buildings should include water supply for bathing and flush toilets.

### **Owner-Driven and Executed Reconstruction**

The entire shelter reconstruction program should be implemented following an owner-driven and beneficiary-executed reconstruction approach. An owner-driven reconstruction has been found to be a cost-effective and efficient solution for post-disaster housing in South Asia.

This approach has many advantages. First, it allows house owners greater flexibility in designing and constructing their houses. Second, the amount meant for reconstruction is directly transferred to the house owners which would ensure a greater accountability in the utilization of assistance. Third, it allows house owners to contribute their own savings and family labor to the process of construction. Finally, the house owners maintain their own supervision over the quality of house. As a result, an owner-driven program results into a more quality-conscious reconstruction.

### **Transfer of Assistance to Households**

The entire assistance for the reconstruction could be transferred to the households in two or three installments. The first installment should necessarily be a bigger one (50%) as it should enable the house- owners to mobilize building materials. The release of second installment should be linked to the progress of construction at a particular stage (40%). The release of third installment (10%) should act as an incentive for the timely completion of the house and should follow satisfactory completion.

The Assessment Team would prefer a banking mechanism for transfer of assistance. However, in view of the limitations of the banking system in Bhutan, a credible and efficient cash transfer mechanism needs to be devised at the dzong level so that the assistance is made available to the house-owners in a timely manner.

### **Technical Assistance and Supervision**

A supervisory structure should be set up for close monitoring of physical progress of reconstruction as well as compliance with earthquake-resistant stipulations. It would consist of several levels of

inspection and project engineers from national to local level. A random quality audit should also be integrated into the reconstruction process.

It needs to be pointed out that Bhutan has a limited number of engineers to support the reconstruction programme. As per the information provided to the Assessment Team, there are just three structural engineers working as part of the Division of Engineering Services, Department of Urban Development and Engineering Services (DUDES). The Standard Quality and Control Authority (SQCA) which works under the Ministry of Works and Human Settlement employs 17 engineers of different specialization. It is clearly a small number for providing regular technical support and supervision over a large-scale reconstruction. Some external engineering support from other countries in the region would therefore be necessary to augment the existing technical capacity in the country.

### **Box 1: Reconstruction and Retrofitting of Stone masonry Buildings**

Retrofitting and reconstruction of stone masonry houses need to address many constraints, such as limited financial resources, relatively low level of locally available artisan skills and tools, and scarcity of building materials. One of the challenges involved in the reconstruction programme is to evolve a cost-effective technology for reconstruction and retrofitting of stone masonry houses on a large scale. Some of the main elements of building technologies for these structures could be recommended as follows:

1. Unless properly designed, stone masonry buildings in mud mortar should be constructed only up to one storey and that too with proper precautions.
2. Wall thickness should not be more than 45 cm. Wherever feasible, replacement of a lean (1:6) cement / sand mortar with proper curing is recommended to ensure improved seismic performance in new houses.
3. Bond or through stones along the wall thickness at regular interval and lintel band should be provided. In addition to lintel bands, corner vertical reinforcement should be provided. Roof bands should also be provided with pitched roof. Roof should be property tied to the walls.
4. Stones dismantled from the existing house could be recycled; however, beneficiaries need to be given guidance regarding the selection and cleaning of adequately shaped stones.
5. In those cases where timber frames are being used, it is essential to use knee-braces at the beam-to-post junctions. Several simple and cost-effective options of steel and timber knee-bracing can be used.
6. House-owners could salvage and utilize the door and window frames to the extent possible.

A detailed technical guidelines needs to be developed for the reconstruction and retrofitting of stone masonry buildings

### **Incentives for Local Pool of Construction Professionals as well as Volunteers**

Masons and carpenters in the eastern districts are available but it is difficult to hire them as remuneration, as per government-approved rates are meager. Certain incentives - such as higher remuneration, training, certification, etc to attract local masons and carpenters during recovery and reconstruction phase could be considered. Moreover, volunteerism with the involvement of Vocational Training Institutes, colleges, schools, NGOs, CSOs, individuals, businesses, and private sector should be encouraged, especially in the reconstruction of community infrastructure.

## **4.2 Shelter Reconstruction - Cost and Financing**

### **4.2.1 Regional Perspective**

In a number of earthquakes in South Asia, governments have provided assistance to house-owners. In Latur earthquake, Maharashtra (India), the state government provided four packages of assistance, which consisted of complete relocation of villages (free core houses to all), in-situ reconstruction of villages (Rs. 62,000 per house), repairs and strengthening (Rs. 34,000 and Rs. 17,000) depending upon the categories of damages. In Bhuj earthquake, the state government provided five different packages of assistance, starting from the minimum assistance of Rs. 2000 in case of minor repairs to Rs. 90,000 in case of collapse. It also provided for complete relocation of villages, if the residents so decided. In Kashmir earthquake (Pakistan), Government of Pakistan provided a uniform assistance of Rs. 175,000 to house-owners for rebuilding their own houses in-situ. In the same earthquake on the Indian side, the state government distributed Rs. 75,000 to each earthquake-affected family for reconstruction and rehabilitation. Governments and NGOs provided free core houses to the tsunami-affected families in India and Sri Lanka.

The scheme of assistance therefore varies from one earthquake to another. It is decided by the governments in accordance with the reconstruction needs, local economic conditions and most importantly, the availability of resources. The RGoB should take these considerations into account while deciding upon the scale of shelter assistance.

### **4.2.2 Cost and Financing**

The total loss in the housing sector has been estimated at Nu 1120 million. The cost of reconstruction/repair of the 4,614 affected dwelling units cannot be exactly estimated as various affected persons may adopt different designs and may decide to construct smaller/bigger units. Only a small amount of the cost would be covered by insurance, as the pay-out is linked to extent of damages. Only those houses which have collapsed completely would get 100 % payout of a maximum insured amount of Nu 100,000. A number of house-owners defaulted on the payment of premium which could reduce the insurance payout further.

As a general principle, it is assumed (on the basis of similar post-disaster experience in the South Asia region) that 65% of the cost of reconstruction will be self-recovered through the following means:

- Kidu Grants from His Majesty's Relief Fund;
- Royal Insurance Corporation of Bhutan pay-outs of insurance claims;
- Individual Savings and Mobilization;
- Salvaged building materials like stone, wood and CGI Sheets;
- Partial labour cost contribution through family effort and community co-operation.

The Government assistance could therefore be around 35 % of the total cost of reconstruction. Hence, it is estimated that the cost of shelter reconstruction for rural beneficiaries would be approximately Nu 391 million (35% of the loss estimate). This does not take into account the budget support that the RGoB may provide to the Royal Insurance Corporation of Bhutan on account of rural house insurance claims settlements.

## **4.3 Reconstruction - Educational Institutions**

The responsibility for the construction of schools would lie with the Ministry of Education. There is a technical unit within the Ministry of Education which develops the design and specifications of the school buildings. This technical unit needs to play a more proactive role, developing a plan for reconstruction of all the collapsed and damaged buildings. It should also develop guidelines for retrofitting and repairs. There is need to cover both structural and non-structural aspects of mitigation.

An enormous amount of work has been done in the area of seismic retrofitting of schools in the South Asia region, and Bhutan needs to draw upon them.

The cost of reconstruction of 73 primary schools that have been damaged in varying degrees (details in Section 1 on damage and loss) has been estimated at Nu 375.6 million. The cost of reconstruction of the 8 lower secondary schools has similarly been estimated at Nu 101.5 million. The cost of reconstruction of the 5 middle secondary schools has been estimated at Nu 77.5 million. The cost of reconstruction of 5 higher secondary schools has been estimated at Nu 39 million. Thus, the total cost of reconstruction of damaged educational institutions is approximately Nu 593.6 million. The Assessment Team proposes that an additional 10% may be added to the total cost for introduction of earthquake-resistant features in construction. Thus, the total outlay requirement for this category of reconstruction would be Nu 653 million.

#### **4.4 Reconstruction – Health facilities**

The responsibility for the reconstruction and repairs of BHUs should lie with the Ministry of Health. As some of the BHU buildings which collapsed were recently constructed, it calls for a major review of design, specifications, and execution of these buildings. Such a review should lead to improved design of the BHU buildings, with better structural integrity and reinforcement. These designs should be made applicable to entire Bhutan. Further, technical supervision over the construction of these buildings needs to be improved.

The cost of reconstruction of BHUs that are fully damaged and beyond repair has been estimated at Nu 6 million each. The two ‘beyond repair’ BHUs and six ‘major repair’ BHUs would require Nu 48 million to reconstruct. The 3 ‘partially repair’ BHUs would require Nu 1.5 (25% of the unit cost) million each or Nu 4.5 million to repair and the 14 ‘minor repair’ BHUs would require Nu 600,000 each (10% of the unit cost) to repair or a cumulative Nu 8.4 million. Therefore, the approximate cost of reconstruction/repair of the 25 damaged BHUs would be Nu 61 million. The minor repairs to the 3 hospitals plus 1 staff quarters would require a total of Nu 62.5 million. The Assessment Team proposes that an additional 10% may be added to the total cost for introduction of earthquake-resistant features in construction. Thus, the total outlay requirement for this category of reconstruction would be Nu 136 million. This will be a direct Government expenditure.

#### **4.5 Reconstruction – Government offices (RNR Centers, Gup offices etc)**

The construction of government offices would be undertaken by the local dzongkhag administration. Reconstruction of these offices provides an opportunity for developing improved prototypes of these buildings. These could also be used as demonstration buildings for dissemination of earthquake-resistant technology. While promoting traditional architecture and local building materials, these buildings could also show how these local traditions are consistent with earthquake risk reduction.

The 3 RNR centers with major repair needs would require Nu 6 million each to reconstruct/repair while ten RNRs with partial repair needs would require Nu 1.5 million each (25% of the unit cost) to be repaired. Minor repairs in the 9 RNR Centers would cost approximately of Nu 60,000 (10% of the unit cost) with an approximate outlay of Nu 5.4 million. Therefore, the aggregate cost of repairing 22 RNR Centers would be Nu 38 million.

Similarly, the 10 ‘beyond repair’ and ‘major repair’ gup offices would require Nu 60 million to rebuild/repair. The eight gup offices with partial repair needs would require Nu 12 million to rebuild while the 10 with minor damages can be repaired with Nu 600,000 each. Therefore, the total approximate cost of repairing/rebuilding gup offices would be in the range of Nu 78 million. The Assessment Team proposes that an additional 10% may be added to the total cost for introduction of earthquake-resistant features in construction. Thus, the total outlay requirement for this category of reconstruction would be Nu 128 million.

#### **4.6 Reconstruction – Religious and Cultural Heritage monuments**

Reconstruction, retrofitting, and repairs of religious and cultural monuments require specialized skills and expertise. An expert group of architects, conservationists, and craftsmen need to be constituted at the national level for developing a general approach to retrofitting and repairs of these heritage buildings. Each structure would then require a distinct effort at restoration. While implementing the restoration, it is necessary that local artisans and craftsmen be involved, as these represent huge learning opportunities for them.

It has been estimated that the repair of 149 ‘beyond repair’ and 145 ‘major repair’ chortens would require Nu 118 million (at Nu 0,4 million each). The repair of 99 chortens with partial damage and 92 with minor damage would require Nu 10 million and Nu 4 million respectively. The total cost of chorten repair would be Nu 132 million.

It has been further estimated that the repair/reconstruction of 36 ‘beyond repair’ and 93 ‘major repair’ lhakhangs would require Nu 387 million (at 3 million each). The 104 lhakhangs that require ‘partial repair’ (at Nu 0.75 million each) and 48 needing minor repair (at the rate of Nu 0.3 million) would require an additional Nu 92 million. The total cost on lhakhangs repair would be approximately Nu 479 million.

The 3 dzongs requiring ‘major repair’ would require Nu 30 million at Nu 10 million each. The 3 requiring ‘partial repair’ would cost approximately Nu 10 million. The total cost of dzong repair would be approximately Nu 40 million.

Thus, the total approximate cost of reconstruction/ repair of religious and cultural heritage monuments would be Nu 651 million. This will be direct government expenditure and the RGoB could consider scheduling it over a few financial years according to relative importance of the monuments and severity of damage.

The reconstruction and repair of religious and cultural heritage buildings and monuments should be viewed as a priority once shelter and other livelihood requirements are met, given the central role of religious and cultural structures in the life of rural Bhutanese.

## **Box 2: Retrofitting of Religious and Cultural Heritage Buildings**

Bhutan has one of the richest treasures of religious and cultural heritage buildings and monuments. They do not just contribute to the preservation of its culture and traditions; they also represent a potential source of revenue and a nucleus for socio-economic development.

Various countries have defined their heritage buildings and monuments, and have prepared a National Register of such historical and cultural places. They have also developed elaborate legislative provisions for their preservation, regulation, and development. It is necessary that Bhutan develops a national legislation for preserving its religious and cultural buildings and monuments. Such legislation includes mandatory provisions for rebuilding, retrofitting and repairs. International assistance could be made available for preparing the legislation for heritage preservation.

In view of extensive damages to these buildings and monuments, a large-scale retrofitting programme would be an essential part of the reconstruction programme. The retrofit process of these buildings and monuments could consist of a variety of treatments, including: preservation, rehabilitation, restoration and reconstruction. Preservation is defined as the process of applying measures to sustain the existing form, integrity, and materials of a historic property. Rehabilitation refers to the process of creating new application for a property through repair, alterations and additions while preserving those features which convey its historical, cultural, or architectural values. Restoration is the process of accurately restoring a property as it existed at a particular period of time. Reconstruction is described as the act of replicating a property at a specific period of time. Selecting the appropriate treatment strategy is a great challenge involved in the retrofit process and must be determined individually for each project.

As is the case in all the construction in Bhutan, stones and wood are the most important building materials in these religious and cultural heritage monuments. A retrofitting programme would continue to use these building materials. However, a stronger mortar and reinforcements would provide more resistance and continuity to buildings made of stone. Similarly, the strength of wood as a building material could be enhanced through strength grading methods, wooden panel products, preservation treatment process, and wood protection.

Older design concepts mostly focused on the effects of gravity loads, and they did not dedicate enough attention to provide adequate lateral resistance and ductility. Most of historic buildings provide limited ductility and continuity, especially when subjected to seismic loading. Retrofit process requires local modification of components, minimizing structural irregularities (in mass and stiffness), structural stiffening, structural strengthening, mass reduction and seismic isolation to improve the structural performance. In view of these requirements, it is very important that Bhutan develops its own building codes for retrofitting of its religious and cultural heritage buildings. The Indian Standard (IS) codes for heritage structures provide a very strong precedent for the development of such a code in Bhutan.

## **4.7 Reconstruction – Water and Sanitation**

Water and sanitation represent the softer aspects of recovery. It improves the quality of life, and contributes to societal well-being. Improving water and sanitation facilities promotes health and hygiene for the community, particularly for children. Women also reduce their work load if these facilities are easily available. In rural Bhutan, water and sanitation interventions should be looked as development activities.

It has been estimated by the Assessment Team that approximately 500 schemes for rural water supply rehabilitation for households, schools, BHUs, Gup offices and other public offices at the rate of Nu

50,000 each would be required to be undertaken. This will cost Nu 25 million. In addition, building of 60 units of bath houses and reconstruction of flush toilets for boarding schools at the rate of Nu 100,000 each would cost approximately Nu 6 million. Toilet reconstruction for affected households (approximately 1000 units) at the unit cost of Nu 15,000 would cost Nu 15 million. Therefore, the total cost of reconstruction in the water and sanitation sector would be Nu 46 million. This will be direct government expenditure and the RGoB could explore community labour contribution as partial support to the total cost.

The aggregated cost structure of sector-wise reconstruction has been estimated to be Nu 2005 million or US\$41.7 million. It has been represented in the following table:

**Table 11: Total Approximate Expenditure on Reconstruction Measures**

Sl	Head of Expenditure	Total Approximate Reconstruction Cost (Nu, Million)	Total Approximate Reconstruction Cost (USD, Million)
1	Permanent Shelter/Housing	391	8.14
2	Cultural Heritage Monuments	651	13.56
3	Education	653	13.6
4	Health	136	2.83
5	Water and Sanitation	46	0.96
6	Government Public offices (RNR, Gup offices, etc)	128	2.67
<b>TOTAL RECONSTRUCTION COST</b>		<b>2005</b>	<b>41.7</b>

## Section V: Disaster Risk Reduction (DRR)

### 5.1 Strategy and Action Plan for DRR

The earthquake has once again shown that Bhutan is vulnerable to high impact disasters. Just before this major disaster, Bhutan had experienced flash floods in May 2009, attributed to the after-effects of cyclone Aila. The flash floods affected nearly fourteen districts in western, southern and northern areas of the country, while this earthquake affected seven districts in eastern Bhutan. These may not appear large-scale disasters in comparison with what many countries in Asia-Pacific region have faced in recent times, but it has a very serious impact on the assets and livelihoods of the people in a small country like Bhutan.

Bhutan has a rich and diversified eco-system of the Himalayas. The global climate change is very likely to affect the country. In a landlocked country, if the cyclone storms cause flash floods, it is an indication of disasters induced by climate change. The RGoB has also shown a great concern for reducing the impact of climate change on the country.

The Joint Assessment Team has considered the larger context of disaster preparedness and risk reduction in Bhutan. It has taken its brief from the suggestions made by Honourable Prime Minister in his briefing on 2 October 2009 for improving Bhutan's earthquake preparedness and implementing regulatory changes in building practices. The Assessment Team would recommend a number of preparedness and risk reduction measures in key strategic areas, which builds upon the National Disaster Risk Management Framework (NDRMF) adopted by the RGoB in 2006.

## **5.2 Risk Identification and Assessment:**

The multiplicity of natural hazards and risks in Bhutan, both of geological and hydro-meteorological origin, necessitate in-depth identification of risks and their assessment. It could begin with the preparation of easily understandable composite risk assessment report and hazard map for Bhutan. The risk assessment report and map will address all hazards viz. earthquakes, landslides, floods, flash floods, GLOFs, and forest fires. A database of past disasters, inventory of glaciers, river morphology, and fault maps would provide necessary inputs for risk assessment and hazard map. The preparation of the hazard map should be undertaken through a capacity building activity of the Department of Geology and Mines.

As part of this exercise, a seismic risk map of Bhutan needs to be prepared. It should be developed on the basis of available geological and seismological data. A more detailed seismic map for urban centers like Thimphu and Phuntsholing should also be undertaken as part of this exercise. Maps related to settlements, population density, land-use etc. should be overlaid on micro-level hazard maps to develop zonation plans. These maps should serve as an important tool for improving settlement planning in these urban centers. The Assessment Team recommends that the accomplishments of the Thimphu Valley Earthquake Risk Assessment project be extended further through this exercise.

The activity should also lead to setting-up of seismic monitoring network in the country with appropriate instrumentation. A network of seismometers needs to be installed across the country for monitoring seismic events and micro-tremors. The network should be operated and maintained by the Department of Geology and Mines.

The seismic zonation / mapping will also feed into the process of land-use planning in the country and help formulate a land-use policy to support long-term urban and rural development. This will sensitize policy-makers, legislators, and local governments for adopting a risk-sensitive development planning.

## **5.3 Strengthening and Enhancing Emergency Preparedness and Management:**

In view of mountainous topography of Bhutan, scattered habitations, and challenges of accessibility, it is essential to build a strong emergency preparedness, response and management capacity. In this regard, an UNDAC Disaster Preparedness Mission had reviewed the DM systems in Bhutan in early 2008 and made specific recommendations for improving response capacity and preparedness in Bhutan. Further, in August-2008, at the request of DDM, a Table Top Simulation Exercise conducted for five Ministries also highlighted some of the main issues. The Assessment Team would recommend a number of measures, based on these recommendations of UNDAC Mission and discussions with the DDM officials.

The program should involve setting-up an inter-connected network of Emergency Operation Centers (EOCs) at national, district and sub-district levels. The EOCs need to be properly equipped and capacitated to respond to any emergency situation at short notice. The EOC will be established in the Department of Disaster Management, Ministry of Home and Cultural Affairs (MoHCA) and connected to district administrations and would require a meaningful and increased participation from various sectors and relevant agencies. These facilities will be supported by trained professional staff, backed by requisite communication and data processing equipments. Establishment of standard procedures and clear command and control lines are a necessity for the effective utilization of these facilities.

In view of the tough terrain and poor accessibility, it is necessary to create search and rescue and first medical response capacity at dzongkhag level as well as among the communities. There is a need to set up adequate response capacity at dzongkhag (district) level so that the local administration could organize a quick response to any crisis or disaster. Such a response capacity could be set up through constituting first responder teams at the dzongkhag levels as well as a group of community volunteers at the gewog levels.

Generally, the first responder agencies like the Fire Brigade, Police, Military, Ambulance, etc. are called upon to respond to emergencies. The Assessment Team recommends that an effort needs to be made to strengthen and augment their capacity for disaster response through specialized trainings in search and rescue and provision of necessary equipments. At the national level there should be a team consisting of doctors and other health workers who will provide backup service in case the scale of disaster is so large that the district or regional referral hospital is not able to cope with the emergency health services after a disaster.

In the event of a larger scale disaster -- such as a stronger earthquake resulting in major catastrophic damage to its main cities -- immediate access to additional material and financial resources, particularly for the purposes of search, rescue and short-term relief, would be necessary in order to mitigate loss of life and suffering. To that end, Bhutan may wish to examine the merits of establishing a national society of the Red Cross and Red Crescent. The Government of Bhutan could negotiate with the International Federation of Red Cross and Red Crescent (IFRC) for setting up the national society. Building the capacities of volunteers and training leaders and managers for disaster response are the vital elements of the national society's responsibility.

The need to set-up a reliable Early Warning System (EWS) to address multiple hazard scenarios in Bhutan has been highlighted by NDRMF and the UNDAC mission. The existing EWS in the country needs to be reviewed and appropriate system(s) needs to be developed due to multiplicity of hazards. The Department of Energy (DOE) and Department of Geology and Mines (DGM) have the mandate to look after EWS and GLOF mitigation measures related to floods and GLOF events, which are currently limited to the Lunana and downstream areas. Such measures also need to be implemented in the other river basins. The Assessment Team recommends that the EWS needs to be built upon the existing national capacities and augment them to ensure real-time monitoring and tracking of events and timely generation of actionable warnings. The EWS should be given a greater community orientation through involvement of communities in maintenance and operation of local early warning systems. Guidelines for dissemination of warning and interpretation of these warnings at community levels need to be formulated.

#### **5.4 Institutional Capacity Building**

A lack of skilled and trained pool of human resource in disaster management poses a stiff challenge to promoting disaster risk management in the country. The capacity of national nodal department viz. the Department of Disaster Management (DDM) needs to be enhanced to disseminate the agenda of disaster risk management across the Ministries and sector-specific agencies. The Assessment Team strongly recommends that the DDM should have enough human and technical resources to formulate and implement comprehensive risk management initiatives involving different agencies and stakeholders. It is also important to support capacity-building of other sector agencies like DGM, DOE, SQCA with respect to risk reduction, preparedness and response.

Institutional capacity-building will be enhanced by the provisions of the Disaster Management Act, scheduled for consideration by the Parliament during an upcoming session. The Assessment Team is of the view that its enactment would provide a much-needed impetus to all the agencies dealing with disaster management in Bhutan.

Bhutan has already embarked upon the process of setting-up requisite institutional mechanisms at national and district level for disaster management. The success of these institutions will largely depend upon the availability of technically qualified personnel. A training and capacity-building program need to be developed for building the capacity of DDM and dzongkhag-level staff. The training will focus on disaster preparedness and response, risk reduction, and recovery. As an essential part of this capacity-building, the DDM staff should be trained to undertake rapid assessment of post-disaster losses and needs.

In this regard, the Assessment Team recommends that a national academic institution be identified which can support training activities. The program can also seek the assistance of regional training institutions for supporting the process.

### **5.5 Risk Mitigating Investments**

A high vulnerability profile of Bhutan is likely to get even further enlarged due to the impacts of climate change and variability processes. The nature, pattern of occurrence, frequency and severity of existing hazards is likely to change and newer risks are likely to get introduced. In order to meet the emerging needs of a changing hazard-profile, it will be prudent to undertake sector-specific risk mitigation programmes to safeguard precious socio-economic and development gains. This will also build a culture of risk reduction and promote development planning through suitable mitigation measures.

The activities under this component could involve initiating hazard-specific risk mitigation programmes targeted at floods, landslides, GLOF, etc. Investments in hazard-specific risk reduction programmes should be made, in the first instance, in vulnerable areas/sectors identified on the basis of priorities identified through seismic and hazard zonation / mapping exercise. The prioritization process will also factor in the impacts of climate change and variability and include implementation of adaptation programmes for climate-sensitive sectors like agriculture, water, environment, health etc.

Bhutan adopted building codes in 1997. In 2003, it has developed its own Bhutan Building Codes, which mandates inclusion of earthquake-resistant design features in engineering structures. It has no codes yet for non-engineered construction, which has suffered the most during this earthquake. It is necessary that the Bhutan Building Codes be expanded to cover all types of buildings, including non-engineered structures and heritage buildings and monuments. The implementation of these codes should be supported by an appropriate legislation and building by-laws and a system of incentives linked to compliance.

The Assessment Team recommends that a national training and capacity building program be initiated for developing skills and familiarity with earthquake-resistant design and features among engineers, architects, and masons. The program should be implemented immediately for supporting the recent earthquake reconstruction. However, in the broader context, the program should be implemented for orienting all the municipal and dzongkhag-level engineers and strengthening enforcement mechanisms at these levels.

The Assessment Team also recommends that strict specifications be developed for all the public buildings, in particular schools and hospitals, so that seismic performance of these buildings improve. Enforcement of these building codes in the construction of schools and hospitals should be mandatory.

Risk reduction programmes will incorporate retro-fitting and structural/non-structural mitigation of key facilities such as hospitals, schools, administrative structures, and monuments associated with cultural and religious heritage. Adequate expertise needs to be developed in retrofitting of seismically vulnerable structures. There is urgent need to carry on the assessment of all school buildings to see how safe the schools are should an earthquake of similar or higher magnitude strike in future. One fifth of the entire population of Bhutan is in the school system and indoors most of the time which makes them highly vulnerable.

The success of any disaster risk management program is measured by the level of sensitization and preparedness at community level. The Assessment Team therefore recommends that community-based disaster risk management program should be undertaken to build capacity among communities to safeguard their lives, livelihood and individual assets through contingency planning, preparedness and mitigation measures. A number of existing programmes could be utilized to support community-level preparedness and mitigation programmes.

## 5.6 Risk Financing

A well-designed risk financing program enables a disaster-prone country to avoid major economic disruptions following natural disasters by meeting its post-disaster funding needs without resorting to major budget reallocations, additional taxation, or external borrowing. Risk financing instruments are even more relevant given the increased vulnerabilities and uncertainties due to climate change.

The Royal Insurance Corporation of Bhutan (RICB) was founded by royal charter in January 1975. It is the only insurance company in Bhutan and covers all classes of insurance. It administers a rural housing insurance program, which is unique in South Asia. It provides protection to house-owners against a number of hazards and risks. The program has consistently increased its coverage of rural houses. In 2005-06, the program covered 57,652 houses, which has increased to 66,306 houses.

Insurance program provides a maximum payout of Rs. 100,000 based on the assessment of damages. It charges an annual premium of Rs. 150 per household, which is a subsidized rate. Its annual payout has always exceeded the collection of premium, as could be seen from the following table:

**Table 12: Executive Summary of Rural Housing Insurance for the Last Five Years**

Year	House Holds			Premium Amount	Claim Paid Amount
	Permanent	Semi-Permanent	Total		
2005 - 2006	34,955	22,697	57,652	6,620,680	14,703,050
2006 - 2007	35,729	22,618	58,347	6,768,680	8,685,600
2007 - 2008	37,152	22,042	59,194	6,930,595	9,065,600
2008 – 2009*	37,621	22,424	60,045	6,990,316	8,079,450
2009 – 2010**	39,400	26,906	66,306	7,385,840	7,650,000

\*As of December 2008. \*\* As of Oct 6, 2009

The insurance program has been in existence for a number of years, and it provides an excellent example of social insurance. However, the program has matured to an extent that certain innovations could now be introduced to improve it further. The program could be incentivized in the sense that both premium and payout could now be linked to certain identified mitigation measures. These could include application of building codes and fire safety provisions. Those policy holders which have followed these housing safety standards could get an insurance coverage for higher amount. The Assessment Team recommends that a technical study of the rural insurance program should be commissioned which provides recommendations for strengthening the insurance program and linking its coverage to mitigation measures.

The Assessment Team hopes that most of the recommendations made above will be translated into time-bound and actionable programmatic interventions and would support the RGoB's efforts to strengthen disaster management systems and capabilities. The earthquake recovery and reconstruction program provides the necessary context for these interventions, but resources for implementing these initiatives may come from several other initiatives related to climate risk management and earthquake risk reduction which are under implementation in Bhutan.

The Assessment Team recommended Nu 50 million towards the cost of implementing the disaster risk reduction programme.

## Section VI: Implementation Framework for Recovery and Reconstruction

The RGoB has not implemented a large-scale recovery and reconstruction program in the past. There are not many government agencies which have the technical or managerial capacity to implement the interventions suggested above in a well-defined time-frame. There are other constraints as well. The program implementation would require a steady fund flow. It needs to be implemented in an area which is not easily accessible. The local government would require considerable capacity support to organize the logistics and improve community outreach. Technical assistance needs to be provided on a regular basis at the level of beneficiaries. An implementation strategy is required which includes resources for the program, institutional arrangements, a disbursement mechanism, and technical assistance for earthquake-resistant construction. The RGoB's implementation strategy should be guided by principles of efficiency, transparency, and inclusiveness. The following issues need to be considered for developing the implementation strategy:

**Financing:** As the total cost of reconstruction has been indicated in the report, the RGoB needs to develop a financial plan for implementing the program. It would consist of domestic budgetary provisions, overseas development assistance, borrowings, and insurance payouts. As the program would be implemented over a period of time, the annual fund flow could be worked out, and resources could accordingly be mobilized.

**Institutional Arrangements:** An inter-ministerial empowered mechanism should be set up to provide a general oversight to supervise the recovery and reconstruction program. It would coordinate with all the line Ministries and dzongkhag administrations and ensure that different components of the program are implemented on a prioritized basis. It should have the necessary financial authority and technical capacity to provide an effective oversight of the program.

**Implementation Time-frame:** A recovery and reconstruction program in the South Asia region generally has the implementation time-frame of four to five years. As the scope of this recovery and reconstruction in Bhutan is much lower, a realistic time-frame is two years for private housing and three years for cultural and religious heritage buildings and government offices.

**Financial Disbursements:** The program should consider developing a mechanism for financial disbursement to the beneficiaries. It should be designed in a way that the assistance is efficiently transferred to the beneficiaries. It is necessary that financial disbursement is timely and linked to the progress of construction.

**Earthquake-Resistant Construction:** The entire reconstruction needs to be organized in a way that incorporates and promotes earthquake-resistant technologies. The inclusion of seismic features needs to be included through prescribed design stipulations and necessary technical support. It should also provide the context for application and enforcement of building codes at the national level.

**Building Materials:** A successful reconstruction would depend upon the adequate provision of building materials such as CGI sheets, cement, and iron and ensuring that they are of good quality. The specifications and quantities of building materials need to be determined. The RGoB may consider procuring these building materials through its own agency or making them available at a pre-determined rate.

**Technical Assistance:** The reconstruction program would require continuous technical assistance. Necessary expertise in structural engineering needs to be made available so that the people and government offices can in fact 'build back better'. Technical audit of the reconstruction also needs to be included in the component of technical assistance.

**Socio-economic Recovery:** Along with the hard aspects of reconstruction, there should also be a socio-economic recovery program which could consist of livelihoods assistance, provision of water

and sanitation, improvement of health and education facilities in the area, and a certain amount of counseling. It would improve the overall effectiveness of recovery and reconstruction program.

**Capacity-building of Local Governments:** As the program needs to be implemented through the dzongkhags administration, a significant amount of capacity-building is required in the affected dzongkhags. It could mean providing a small dedicated team of engineers, architects, and financial staff which would support the dzongkhag administration in providing assistance to the people and coordinating with various line departments at the local level. A training component could also be very useful for building capacity at the dzongkhag level.

**Strengthened DDM:** The Department of Disaster Management (DDM) should be strengthened for promoting disaster risk reduction in Bhutan. The DDM should have the necessary facilities and qualified technical staff to coordinate with a number of departments and agencies. It should be able to work with the first responder agencies for organizing effective response. At the same time, it should also be able to implement technical programmes targeted at different hazards.

**Community Outreach:** The program benefits should reach the people. Also, the technical lessons need to be disseminated among the people. The recovery and reconstruction program should therefore consider how best it could communicate with the people. It should consider identifying local religious institutions for communicating with the people and disseminating messages. There should be a special focus on reaching out to the women-headed households.

**Information, Education and Communication (IEC):** An IEC plan also needs to be part of the implementation framework. Information booklets about the recovery and reconstruction, risk reduction measures, and family and community preparedness need to be disseminated widely. Local radio and television also need to be used for disseminating key messages to the people of Bhutan.

The Assessment Team recommended Nu 50 million towards the cost of implementing recovery and reconstruction programme.

### 6.1 Overall Cost of Early Recovery, Reconstruction, Disaster Risk Reduction Programme

The Assessment Team estimates the total cost of the recovery and reconstruction at Nu 2192 million (approximately US\$45.6 million). It is a large investment in view of Bhutan’s limited fiscal resources, and would therefore require a strategic financing plan and strategy. The RGoB needs to consider various alternatives for raising these resources. It also needs to be pointed out that these resources are not required all at once, but need to be raised and spent over a time-frame of two to three years. On the basis of these projections, a detailed recovery and reconstruction programme needs to be formulated and supported through various stakeholders. Following this Assessment Report, the formulation of such a programme would be the next step.

**Table 13: Summary Cost of Financing Early Recovery, Reconstruction, Disaster Risk Reduction and Implementation Support**

Sl	Head of Expenditure	Total Approximate Cost (Nu, Million)	Total Approximate Cost (USD, Million)
1	Early Recovery Activities	87	1.8
2	Reconstruction Activities	2005	41.7
3	Disaster Risk Reduction	50	1.04
4	Implementation Support	50	1.04
<b>TOTAL COST</b>		<b>2192</b>	<b>45.6</b>

## Annex 7.1: Terms of Reference for International Experts

<b>I. Position Information</b>	
TITLE:	Needs Assessment Specialist
LOCATION:	Bhutan
DURATION:	3 weeks
SUPERVISOR:	UNRC
LANGUAGE:	English

<b>II. Background &amp; Organizational Context</b>	
<p>An earthquake of magnitude 6.3 on the Richter Scale struck eastern Bhutan on 21st September afternoon. As of 25th September, the Government of Bhutan has reported 12 deaths and 22 people injured. 9 Districts have reported extensive damages to social infrastructure including schools, basic health units, offices, dzongs, monasteries and chortens. Overall, it is reported that over 1,000 houses have been affected by the earthquake.</p> <p>The Royal Government of Bhutan has made a general request for assistance to the UN System in Bhutan. The disaster is deemed to be the most catastrophic that Bhutan has experienced in recent times. While no estimate is yet available, the cost of reconstruction is anticipated to be extremely high and will divert resources from the 10<sup>th</sup> Five Year Plan. Assessment of damages caused by the earthquake is being undertaken by the Government in consultation with the district authorities. However, efforts to carry out a comprehensive assessment are hindered by the relatively large size of the affected area on the scale of Bhutan, difficult road access and remoteness of some of the affected communities.</p> <p>The UN Country Team (i.e. the UN Agencies, Funds and Programmes and the World Bank) have offered support in terms of: a) technical assistance for needs assessment and recovery planning; b) reprogramming of existing resources to meet immediate needs (this has been availed so far by the Ministry of Education for support to schools from UNICEF); c) mobilization of additional resources. The request for assistance from the Government has come as a response to this offer.</p>	

<b>III. Functions/Key Results Expected</b>	
<p>1. Under the auspices of the UNRC Office provide technical expertise to the Government and the UN Country Team for a well articulated and coordinated assessment of needs for relief, early recovery and reconstruction. Specifically</p> <ul style="list-style-type: none"> <li>a) Conduct needs assessment missions to the most affected areas in close coordination and collaboration with concerned Government administrations/teams, the UNDEMT and the UNCT.</li> <li>b) Prepare a needs assessment report for use by the Government and Development partners to help prioritize assistance and serve as a basis for the mobilization of resources.</li> </ul>	
<p>2. Provide technical support to the government in the application of inter-agency needs assessment tools, including for the incorporation of cross-cutting issues into the assessment processes (gender, child, environment, etc.).</p>	
<p>3. Facilitates the conversion of the assessment findings into instruments for early recovery advocacy and intervention</p> <ul style="list-style-type: none"> <li>a) Provide assessment input into the formulation of the interagency early recovery strategic framework</li> <li>b) Provide support to the preparation of the early recovery resource mobilization and</li> </ul>	

planning for early recovery implementation.

**1. Deliverables**

- a) Draft needs assessment report (requirements, resources and processes for implementation)
- b) Debriefings with UNCT and Government leading to final report and priorities
- c) Debriefings with Development Partners
- d) On-the-job technical support to Department for Disaster Management
- e) Documentation on the conduct of the needs assessment
- f) Resource mobilization and implementation plan

**2. Competencies and Critical Success Factors**

**Corporate Competencies:**

- Demonstrates integrity by modelling the UN’s values and ethical standards.
- Promotes the vision, mission and strategic goals against the context of UN and WB operation in Bhutan.
- Displays cultural, gender, religion, race, nationality and age sensitivity and adaptability.

**Functional (UN) Competencies:**

Knowledge Management and Learning

- In-depth technical knowledge of interagency needs assessment on relief, early recovery and reconstruction
- Seeks and applies knowledge, information, and best practices from within and outside of the early recovery cluster

Coordination Effectiveness

- Ability to lead the design and implementation of interagency needs assessment
- Ability to build and sustain effective partnerships with the Government, UN Agencies, the WB and other main constituents, advocate effectively, communicate sensitively across different constituencies

Management and Leadership

- Focuses on impact and result for the disaster-affected people.
- Capacity to gather comprehensive information on complex problems or situations; evaluates information accurately and identifies key issues required to resolve problems
- Consistently approaches work with energy and a positive, constructive attitude
- Demonstrates excellent oral and written communication skills.
- Builds strong relationships with clients and external actors.
- Manages conflict and stress, remaining composed and working as a mediator in crisis or antagonistic situations.
- Demonstrates openness to change and ability to manage complexities.
- Responds positively to critical feedback and differing points of view, and solicits feedback when needed.

**3. Recruitment Qualifications**

Education:	Advanced university degree in political science, sociology, law, international relations, public administration, or other relevant field; or the equivalent combination of education and the extensive relevant professional experience in a related area.
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Experience:	At least 10 years of progressively responsible professional experience in humanitarian affairs and/or development, including at least 8 years of experience at the international level. Part of that experience must be in the field involved with needs assessment and early recovery. Professional experience in Asia/Pacific would be a strong asset.
Language Requirements:	Fluency in written and spoken English
Other Skills:	<input type="checkbox"/> Familiarity with early recovery issues particularly with regard to contemporary assessment tools and methodologies. <input type="checkbox"/> Demonstrated experience in humanitarian and/or development coordination. <input type="checkbox"/> Excellent proven skills in analysis, negotiations and leadership and overall diplomatic skills. <input type="checkbox"/> Proven ability to carry out representation at the interagency forums. <input type="checkbox"/> Familiarity with the Humanitarian Reform, IASC systems, and UNRC / HCT tools and procedures. <input type="checkbox"/> Experience in preparation of written reports prepared in an accurate and concise manner, and public presentation skills. <input type="checkbox"/> Experience in project design and planning <input type="checkbox"/> Computer literacy, including familiarity with spreadsheets, and power point presentations.

#### **4. Management arrangements**

- a) The assignment is 3 weeks from 29 September to 20 October 2009.
- b) Operating in and from UNRC Office the Specialist will report to the UNRC while maintaining a multiple reporting structure to:
  - a. the UNCT
  - b. the sponsoring agency/office

## Annex 7.2 Mission Program

### Wednesday, 30 September 2009

12noon Check-in at Thimphu  
1300-1400 Lunch Meeting with UN Resident Coordinator  
1500-1800 Meeting with UN Country Team, DDM and WB

### Thursday, 1 October 2009

0930-1115 Meeting with Director, DDM  
1130-1210 Meeting with DUDES, Min of W&HS  
1235-1330 Ministry of Health  
1345-1415 Informal lunch with Donors at UNDP  
1415-1435 Meeting with UN Resident Coordinator  
1445-1530 Ministry of Education  
1545-1620 Department of Culture  
1745-2025 Internal meeting of the Assessment Team

### Friday, 2 October 2009

1030-1140 Meeting with SQCA  
1210-1230 Ministry of Agriculture

### Saturday, 3 October 2009

0900 Departure to Bumthang  
1630 Arrival at Bumthang and overnight stay

### Sunday, 4 October 2009

0800 Departure for Mongar  
1700 Arrival in Mongar  
1830-2030 Meeting with Governor of Mongar and overnight stay

### Monday, 5 October 2009

0730 Team A leaves for Village Walaktang  
Team B leaves for Villages Ngatshang, Ropthangkar, Boomjai, Chaskar  
1630 Team A & B leave for Trashigang and overnight stay  
1900 Meeting with Hon. Home Minister at Trashigang

### Tuesday, 6 October 2009

0730 Team A leaves for Drametse  
Team B leaves for Narang  
1730 Team A returns to Trashigang  
1830-2000 Team A meeting with Architects & Geotechnical Engineer of SQCA  
2130 Team B returns to Trashigang

### Wednesday, 7 October 2009

0730 Team A leaves for Durung  
Team B leaves for Yangneer  
1700 Team A returns to Trashigang

### Thursday, 8 October 2009

0630 Both teams leave for Bumthang  
1615 Arrival at Bumthang and overnight stay  
1930-2030 Team internal meeting on tasks for report writing

### Friday, 9 October 2009

0800 Leave Bumthang for Thimphu

1700 Arrive at Thimphu  
1830-2130 Team preparations for Consultative Meeting with line Ministries

**Saturday, 10 October 2009**

0930-1300 Consultative Meeting with Line Ministries  
1600-2200 Team works on Report

**Sunday, 11 October 2009**

1000-2200 Team works on Report

**Monday, 12 October 2009**

0900-1200 Team works on Report and presentation  
1500-1600 Report presentation to UN Country Team  
1600-1700 Report presentation to the RGoB

**Tuesday, 13 October 2009**

0900-1200 Team works on finalizing Report  
1400-1500 Briefing for Development Partners  
1530-2000 Team works on finalizing Report

**Wednesday, 14 October 2009**

0630 Team leaves for Paro airport

## **Annex 7.3: List of Assessment Questions**

### **Situation Overview**

- Location of village, access related constraints
- Availability of electricity, water supply and sanitary services
- What all has been damaged in the village?
- Numbers of affected persons
- Categories and types of damage to structures
- Nature and extent of relief assistance received
- Impact on Community services (health, agricultural extension, education)

### **Gewog Administration/Gup's Office**

- Immediate response delivered
- Emergency and routine communication practices: Gewog-Dzongkhag-National
- Plans for mobilizing resources
- Voluntary efforts
- Impact on village economy
- Human resource availability
- Assistance to Royal Bhutan Army (RBA) and other assessment teams of RGoB

### **Impact on Households**

- Deaths and Individual injuries
- Type, nature and extent of damages to shelter
- Age of shelter structure
- Possibilities of salvaging material from damaged shelter
- Size of household, members' occupation and sources of income
- Impact on livelihoods, health, education
- Food security and protection
- Assistance received from the Government and other sources
- House insurance
- Resources available for recovery and reconstruction
- Plans for reconstruction
- Expectations, doubts, and fears

### **Basic Health Units**

- Type of structure, number of staff
- Nature of damages to facility
- Interruption of services
- Residential facilities for staff
- Services provided
- Assistance received
- Temporary arrangements made
- Plans for recovery
- Resources available

### **Schools**

- Type of school, number of students
- Residential facilities for students and teaching staff
- Services available
- Damage to classrooms, hostels, staff quarters
- Assistance received
- Temporary arrangements made
- Plans for recovery
- Resources available

### **Cultural and Religious Structures**

- Type of cultural and religious structure
- Nature and extent of damage
- Assistance received
- Plans for recovery
- Resources available
- Assessment by Department of Culture

### **Annex 7.4: Joint Assessment Team Members**

#### **Royal Government of Bhutan**

- 1 Tshering Wangchuk, DDM
- 2 Chenso Tshering, DDM
- 3 Sonam Chuki, NCWC
- 4 C.M. Tamang, DUDES
- 5 Sonam Jamtsho, DYS

#### **UNDP/BCPR**

- 6 Krishna S Vatsa

#### **World Bank/GFDRR**

- 7 Prashant
- 8 Saurabh Dani

#### **UNOCHA**

- 9 Rajan Gengaje

#### **UNICEF**

- 10 Chandralal Mongar
- 11 Kencho Namgyel

The mission was also accompanied by Claire Van der Vaeren, UN Resident Coordinator and Mark La Praire, World Bank Representative to Bhutan.

## Annex 7.5: Minimum Water Requirements

Table 1.0 Minimum Water Requirements

Consumer type	Consumer rate
Villager/Staff Qtr/	45 ltr/day/person
Day School	10 ltr/day/student
Boarding School	65 ltr/day/student
BHU/Hospital	500 ltr/day/bed
Office	10 tr/day/offices

### 1. Microbiological Contamination level.

Concentrations are usually expressed per 100 ml of water. As a rough guide,

0–10 faecal coliforms/100 ml = reasonable quality

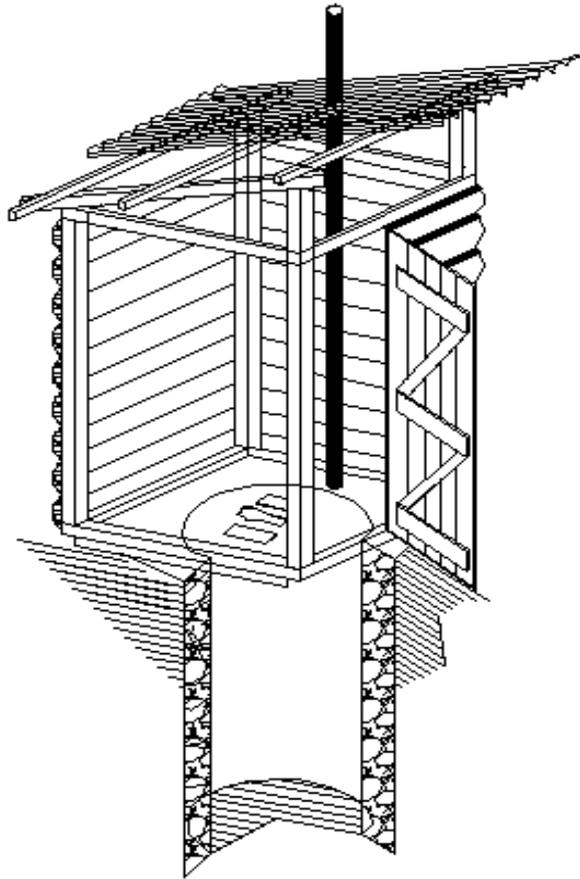
10–100 faecal coliforms/100 ml = polluted

100–1,000 faecal coliforms/100 ml = dangerous

1,000 faecal coliforms/100 ml = very dangerous.

## Annex 7.6: Working Drawings of Toilet Types

Sketch of Different Types of Toilets

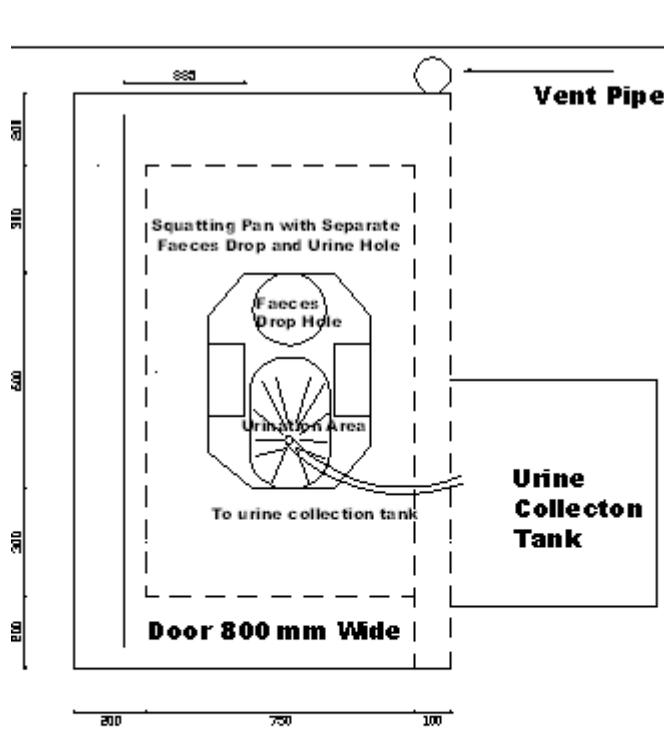


VENTILATED IMPROVED  
PIT (V.I.P)

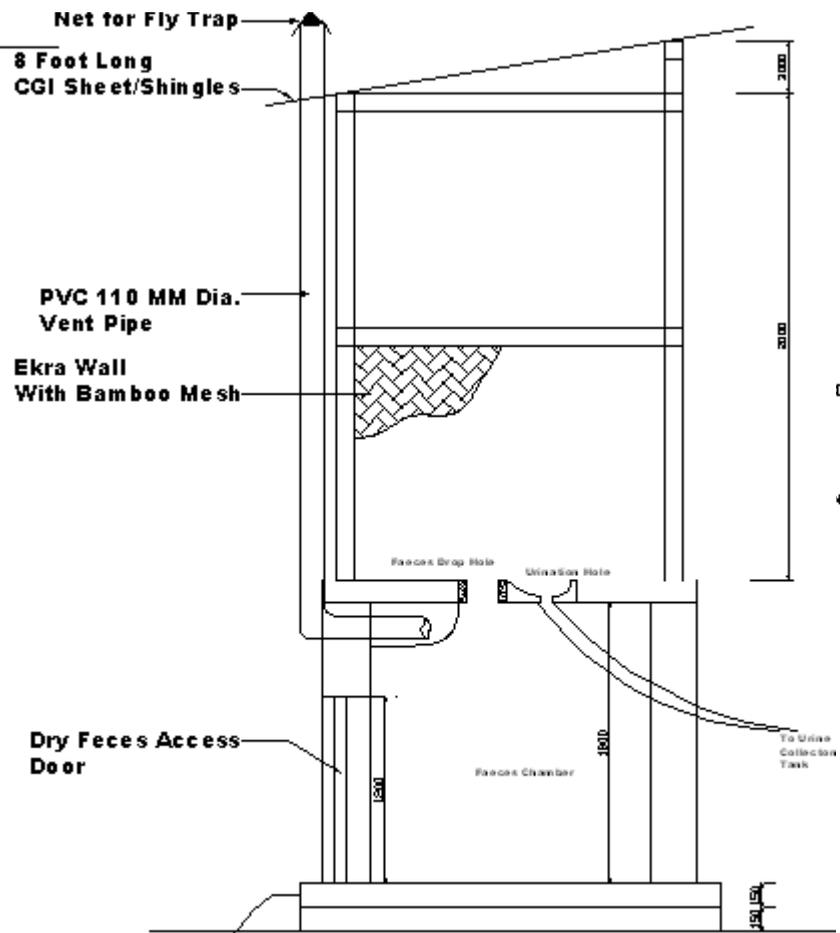
MATERIALS	QNTY	UNIT
* STORE MATERIALS		
1. CEMENT	2.00	BAG
2. GAY SHEET 3'6"X4' 2"X36"X1/2"	2.00	SHEET
3. CHOSEN WIRE MESH	3.6	MTR
4. P.V.C VENT PIPE 100MM DIA	3.0	MTR
5. VENT PIPE CLAMP	1.0	NOS.
6. WIRE MESH (1.5X 1.5MM OPENING)	1.0	NOS.
7. ROOFING NAIL	24	NOS.
8. WIRE NAIL 4"	15	NOS.
9. WIRE NAIL 3"	0.75	NOS.
10. BUILT UP JOIST 4"	2.00	NOS.
11. TRUSS BOLT 6"	1.00	NOS.
12. JOIST HANGER 4"	1.00	NOS.
13. SLIDING JOIST BOLT 8"	1.00	NOS.
14. NUT HOLDING DOWN BOLT 10MM DIA	4.00	NOS.
* 3" LOCAL MATERIALS		
1. SAND AND GRAVEL	4 & 2	CFT.
2. STONE	160.00	CFT.
3. JAWN TIMBER (BLUE PINE)		
(Ø) 4" x 4"	32.00	RFY
(Ø) 4" x 3"	120.00	RFY
(Ø) 4" x 2"	36.00	RFY
(Ø) 3" x 2"	26.00	RFY
(Ø) 6" x 3" (PLANE)	160.00	RFY
4. BUCKLE ØMM 8" WIDTH	2.00	RFY
* C * SKILLED & UNSKILLED LABOUR		
1. MASON	5.00	MD
2. CARPENTER	12.00	MD
3. MALE LABOURER	15.00	MD
4. FEMALE LABOURER	6.00	MD

### IMPORTANT NOTE

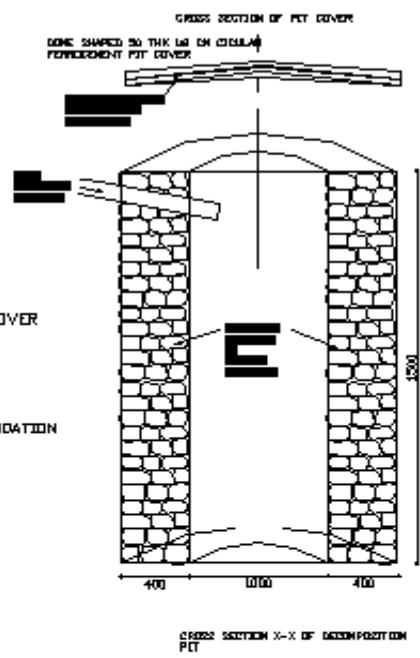
1. PIT LINING SHOULD BE CONTINUED 10CM ABOVE THE GROUND LEVEL TO PREVENT SURFACE WATER FROM HEAVY RAINS FROM ENTERING THE PIT.
2. THE UPPER COURSES OF THE PIT LINING 20-30 CM FROM THE GROUND LEVEL NEED TO BE MORTARED.
3. 5 CM THICK 1:4:8 CEMENT CONCRETE RING CAN BE PROVIDED ON TOP OF THE PIT LINING FOR BETTER PLACEMENT OF THE SQUATING SLAB.
4. STONE SHOULD ATLEAST BE HAMMER DRESSED.



**Plan Slab Level**



**Section**



TWIN PIT POUR FLUSH LATRINE  
 ALL DIMENSIONS IN MM  
 DRAWING NOT TO SCALE

**Sketch of Ecological Sanitation Toilet**

### Annex 7.7 Budget Estimate Early Recovery and Reconstruction WASH

#### Budget Estimation for Early Recovery and Reconstruction on WASH

Activity/Planned Result	Unit Cost (Nu)	Qty		Amount	Remarks
		Qty	Unit		
<b>A. Early Recovery</b>					
1 14 liters capacity Water Buckets and Jerry cans for 1,500. Households	200	1400	nos	280,000	3 nos of 14 liters capacity per family; about 1,500 families
2 Water Storage tanks for schools and BHUs; Gross Capacity of 69,000 liters capacity	6	69000	Liters	414,000	
3 12 packets of 33 mg water purification tablets, pack of 50, per household for 12 months	200	1000	nos	200,000	
4 Tarpaulin Sheet for constructing temporary toilets (4x25m Roll)	350	1000	nos	350,000	
5 Crow Bar ( 1 for every 10 H/H) for constructing latrines	400	150	nos	60,000	
6 Shovels (three for every 10HH)	250	450	nos	112,500	
<b>Subtotal A</b>				<b>1,416,500.00</b>	
<b>B. Reconstruction</b>					
1 Water Supply Rehabilitation for atleast 500 schemes ( households, schools, BHUs, Gups offices and other govt. building)	50,000	500	nos	25,000,000	
4 Building bath-houses and reconstruction of pour flush toilets for the boarding schools.	100,000	60	units	6,000,000	Average cost for Nu. 100,000 per school (2 units for boys and 2 units for girls)
4 Toilet Reconstruction at the rate of Nu. 15,000 for every H/H	15,000	1000	units	15,000,000	Average cost for a unit of pit latrine, ventilated improved pit, Ecological Sanitation Toilet and Twin pit pour flush latrine
<b>Subtotal B</b>				<b>46,000,000.00</b>	
<b>Grand Total (A+B)</b>				<b>47,416,500.00</b>	

**Annex 7.8: Photographs from Affected Areas**



**Drametse: Earthquake damage to inner statues as well as exterior Monastery walls**



**Drametse: Damaged Stupa and inner Monastery walls separating from wooden framework**



**Durung: Total collapse of a house killing one and major cracks to another house**



**Durung: Wall and roof collapse; Families organizing own recovery**



**Walaktang: Major collapse; Temporary family shelter under tarpaulin sheet**



**Drametse: Temporary School;**

**Narang: Seriously damaged dwelling**





**Yangneer: Three BHU buildings which were severely damaged beyond repair by the quake.**

**Narang BHU**



**The Narang BHU Grade II buildings completed in 2007, consist of 4 buildings which have collapsed due to the quake.**



**BHU Main Building**



**Toilet and Bath room**



**No proper joints between walls**