SHELTER STRATEGY

Leh Flood

SEEDS - LEDeG

August 22, 2010

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Vision

To build safe and comfortable and environmentally culturally suitable houses for affected families to help them survive the approaching winter.

Highlights

- Use of local material for low enviornmental impact and high safety.
- Local skills to reduce dependence on external aid.
- Improved building material such as stabilized compressed earth blocks to ensure safety from future floods.
- Simple and low cost technologies to reduce earthquake risks in this high seismic risk region.
- Traditional house design to preserve cultural heritage.
- Designs that keep the homes warm in winter and reduce energy consumption.
- Permanent structures, with scope for expansion.
- Participation of families in design and reconstruction of their houses.

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Purpose of this strategy document

The flash floods in Leh in August 2010 were unprecedented in nature and scale, and have left a large section of the affected population at the mercy of the harsh climate. One of the most critical needs is to restore houses within the next few weeks so that those rendered homeless can survive the extreme winter.

SEEDS has worked on post-disaster shelter response in most of the major emergencies in the recent past, including Gujarat earthquake, Indian Ocean tsunami, Kashmir earthquake, Rajasthan floods, Orissa floods and Bihar Kosi floods. It has in-house technical expertise on structural safety, architecture, environmental planning, community-based processes and construction work.

LEDeG has been active in the Leh, Ladakh region on the issue of environmentally appropriate shelter, and has established a rural building centre for research and propagating environmentally appropriate technologies. The building centre is located in Choglamsar, one of the worst-affected villages.

Together, SEEDS and LEDeG have developed a shelter strategy that combines the environmental, cultural, temporal and risk reduction needs in the current context. We share this with all stakeholders concerned , including government agencies, fellow organisations extending humanitarian assistance in Ladakh, and the affected families, to get feedback, and to move towards a jointly owned and unified shelter response strategy.

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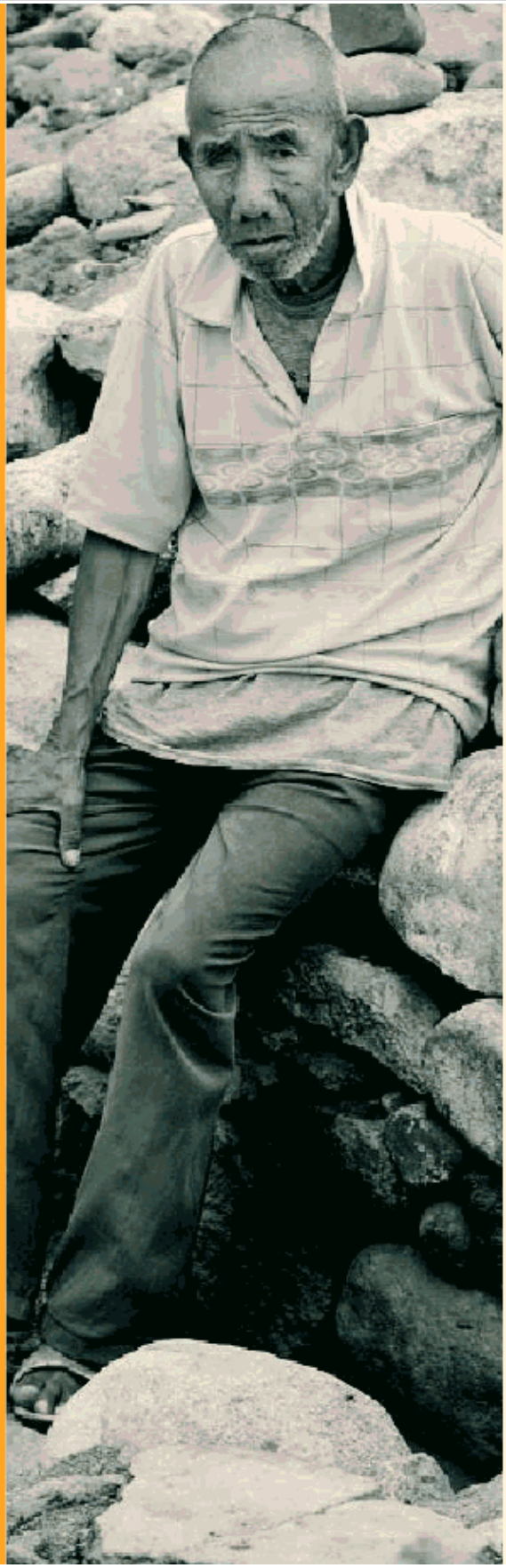

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On 6th August a cloudburst hit the area of Leh, Ladakh. Buildings were destroyed, communication lines broken and highways were washed away. A week after the ill-fated night the death toll stands at 187 and 400 are still missing. Thirty-four villages have been affected by the disaster and with some areas still inaccessible the number of dead and missing is expected to rise as more information trickles in from far flung areas.

On August 5 and 6, Leh recorded 12.8 mm of rainfall in 24 hours, which is almost 90% of the total rainfall normally received by the region in the whole month. The damage to community infrastructure has been extensive.

Of the thirty-four affected villages, Choglamsar, situated 6km from Leh, was worst hit. A mudslide passed through the village either flooding the buildings or wiping them out. Most of the other villages have isolated pockets of devastation.

Due to the prolonged winter, scanty rainfall, rugged terrain and limited availability of time and productive land, the sparse population of Leh lives along the river banks surviving on sustenance agriculture and cattle rearing. The rivers that swelled due to the cloud bursts wiped out everything that came in the way. In many places the rivers changed their course and completed the destruction.

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2 Damage to houses

The two main reasons for the damage to houses are –

1. The excessive lateral force exerted by the rushing mixture of water, mud and rocks

2. Use of mud as the only material for walls. Mud loses it ability to bind and eventually dissolves once it comes in contact with water.

The houses have been damaged to varying degrees and forms depending upon the location and the techniques and material used. The damage suffered can be broadly classified into three categories:

a) Damage to the corners of the house: This was due to the absence of any lateral load resisting features in the house

b) Complete failure of walls: This was due to the excessive outward pressure exerted by the rushing mass of mud, rocks and water on the plain mud walls, which are further weekend due to absence of any

c) Damaged openings: Due to the force of rushing mud, rocks and water funneled through small openings

Special comments

a) Complete failure of some RC frame buildings: Lack of know-how and absence of quality control led to poor construction, which caved in under the extra stress exerted by flood waters.

b) Excessive damage to schools and other community buildings.

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3 Approach

Drawing from our experience, we have followed a holistic approach towards combining both technical as well as social aspects. The few key areas are:

- **Building back better**
  - People-centric approach
  - Being culturally relevant
  - Being locally sustainable

HOUSING STRATEGY

- → **Community Participation**
- → **Culturally appropriate and locally relevant house**
- → **Environmental-friendly materials**
- → **Resistant to future disasters**
- → **Training of local construction workers**
- → **House design based on IS-CODES and SPHERE Standards**

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4 Traditional houses

Traditional local houses in Ladakh have evolved over the centuries, the harsh climate and a thriving Buddhist culture being the two main influences. Over the centuries these houses have allowed Ladakhis to lead a self-sufficient and comfortable life with limited local resources. An understanding of the traditional house, and how it responds to social and environmental factors, is key to any successful shelter initiative.

Orientation

a) Three storeys high
b) East facing (considered auspicious)
c) Clustered to reduce heat loss

Layout

Ground level: The ground floor is animal shelter (helps to warm upper levels of the house). Courtyards around the house act as pens for animals.
First Floor: Consists of kitchen, bedrooms (husband and wife sleep separately from children), food storage area, toilets and washing area
Top Floor: Roof courtyard, family chapel (elevated position important, steps up), guest room/bedroom and summer room

Walls

a) Up to 3 feet thick (generally 30 to 40 inches)
b) Four feet deep foundations (not verified)
c) White washed with limestone

Materials Used
Ground level: Stone
Upper levels: Sun dried mud bricks plastered with fine clay 'markala'

Roof and Floors

a) Constructed from *poplar* beams, willow branches, yagdzas (similar to heather) mud and earth
b) Flat roofs (generally little rain, snow can be removed easily)
c) Grass piled on roof over walls (protects from any precipitation)
d) Prayer flags displayed on roof (signifying Buddhist households)

Traditional construction styles have evolved over generations using local material and providing protection from cold climate. Surviving the harsh winter was the primary motive.

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Openings

a) Small windows and doors (to reduce heat loss)
b) No openings on north elevation (reduces heat loss)
c) Entrance door with high threshold (to cope with snowfall)
d) Ornate carving on timber lintels and window surrounds

Kitchen

Heart of house – The family spend most of their time here, a place for family gatherings and celebration
Size: Large (6.5m x 4.5m in the case study house, anecdotally informed that this is not much larger than average)

Contains:

a) Low tables and mats for sitting
b) Wooden shelving for elaborate display of pots
c) Stove: focal point of kitchen and elaborately decorated (wood burning stove considered preferable to gas in winters for its space warming properties, even in more modern houses)
d) Timber floor
e) Screen at door prevents drafts

Storage

- Large storage spaces are required due to long winters. Items stored are *chang* (local brew), spices, milk, yoghurt, barley and wheat.
- The kitchen storeroom is on the north side of kitchen with thick walls (keeps cool in summer).
- Grain storage tanks are placed under the kitchen floor.
- Roofs are used for drying apricots and other fruits and vegetables on blankets in the sun (summer), stacked with alfalfa grass for animals and dung or shrubs for fuel.

Besides controlling the heat loss, the housing design also catered to the gathering of the family around the bukhari in the kitchen area

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5 Shelter Options: Indigenous vs Mainstream

One of the main reasons for the damage to existing houses is mud coming in direct contact with water a causing complete collapse. It is important to protect the mud blocks from direct contact with water. Based on materials and skills locally available, different options for shelter are explored. Every option has its pros and cons in terms of economy and safety. Primarily two methods of construction can be followed –

a) Load bearing construction (Indigenous)
b) Reinforced Concrete frame construction (Mainstream)

Load bearing construction

In this type of construction, the main load carrying elements are the roof and walls. The entire load is transferred from walls to the foundation. There are various options for walling materials available, which can be used as explained below:

a) Mud blocks with cement plaster

One simple solution is to provide a good mix of cement plaster on the external walls of the houses. This reduces the risk of damage during floods. It also allows keeping mud as a basic material for construction, mud is the traditional material of construction in Ladakh. The costs involved are less, but the disadvantage is that in case of heavy floods this can collapse because of low compressive strength of mud.

b) Stabilized compressed earth blocks (SCEB)

Stabilized compressed earth blocks can be the best option here. They are formed by combining cement with mud and then compressed under pressure. The cement stabilizes the earth block increasing its strength and water resisting properties. The primary material still being mud, the cost remains low but the durability increases manifold. This method also helps retain the heat retention capacities of mud.

(For details on SCEB refer to chapter10 on pg.12)

Reinforced Concrete frame structures give significant strength, but raise costs and carbon footprints of buildings

RC frame construction

In this type of construction the main load carrying elements are the columns and beams of the frame. The walls play the role of infill. Even though this construction is safer, the costs are high. Also the material will need to be sourced from outside. Moreover RC frame construction requires a high level of expertise, locally unavailable. This will make future repairs or additions difficult and expensive, and can also compromise the strength of the building.

a) RC frame with mud blocks as infill wall

RC frame forms the basic structure of the building, which is filled with mud blocks. Mud blocks are available locally reducing the costs.

b) RC frame with Stabilized Compressed Earth Blocks

Similar to the one above, in this the mud blocks are replaced by SCEBs, further strengthening the structure. Sturdiest of the lot but the most expensive and time consuming.

Use of mud as basic construction material will keep time, cost and environmental impact low, and thermal comfort high. Mud blocks with cement plaster, or cement stabilized mud blocks will increase resistance to future floods.

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