

**HERITAGE FOUNDATION'S
DRR-COMPLIANT SUSTAINABLE CONSTRUCTION**

**BUILD BACK SAFER WITH
VERNACULAR METHODOLOGIES**

DRR-DRIVEN POST-FLOOD REHABILITATION IN SINDH



INTRODUCTION TO HERITAGE FOUNDATION

Heritage Foundation established in 1980 is a Pakistan-based, not-for-profit, social and cultural entrepreneur organization engaged in research, publication and conservation of Pakistan's cultural heritage.

The Foundation has been instrumental in saving a large number of heritage treasures and, as UNESCO team leader 2003-2005, undertook the stabilization of the endangered Shish Mahal ceiling of the 16th c. *Lahore Fort World Heritage Site*.

The Foundation publishes monographs and documents relating to heritage and history of Pakistan as well as guides for heritage safeguarding aspects. It has published a series of inventories of historic assets as *National Register of Historic Places of Pakistan*. In the National Register series, in addition to several Karachi documents listing over 600 historic buildings, documents covering parts of Peshawar, the Siran Valley, Hazara District and Azad Kashmir have been published.

Since 2000, its outreach arm KaravanPakistan has involved communities and youth in heritage safeguarding activities. Since 2005, as part of *Heritage for Rehabilitation and Development Program*, in partnership with Nokia and Nokia Siemens Network, Heritage Foundation has carried out work of rehabilitation of communities, particularly women, affected by the Earthquake 2005 in Northern Pakistan. A 3-year program, supported by Scottish Government Fund, Glasgow University and Scottish Pakistan Association on disaster risk resistance (DRR) focusing on women is currently being carried out in the Siran Valley. The establishment of KIRAT, *KaravanPakistan Institute for Research and Training* in 2008 has helped in carrying out research and training on varied aspect of sustainable construction techniques drawn from traditional materials and vernacular methods. In 2009, the Foundation provided humanitarian assistance to Internally Displaced Persons (IDPs) from Swat; and in early 2010 in partnership with UNESCO-UK Aid, conducted livelihood program in post-conflict Swat based on craft skills for 500 women. The work for post-floods communities includes construction of 400 housing units - the Green KaravanGhar (sustainable low carbon footprint houses) in Swat and Sindh as well as public buildings on stilts in flood-prone katcha area in Sindh, which includes 5 green women's centres, two primary schools, and one health centre, supported by the Scottish Government Fund, Glasgow University, Swiss Pakistan Society, The Tides Foundation and Architecture for Humanity. Since October 2011, a total of 125 sustainable, DRR-compliant shelters and other structures have been built using mud walls and strong safe-haven bamboo KaravanRoofs, the details of which are included in this report.

Recent initiatives include conservation of endangered 19th c. Sethi House, Peshawar for KP Government, the conservation of the Denso Hall (1887), Karachi supported by KESC, saving records of Karachi Municipality dating to 1874 and the Karachi e-Library in partnership with the Consulate General of the Federal Republic of Germany. Other works in 2011 include UNESCO project for tomb of Jam Nizam al Din and a Damage Assessment Mission to World Heritage Site of Makli, Thatta, supported by the Prince Claus Fund, the Netherlands.

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DETAILS OF FINAL REPORT - December 2011

Final Report in pdf form is available from Heritage Foundation.

Section 1: Executive Summary - 8 pages

Section 2: Project Description - 11 pages

Section 3: Process - 11 pages

Section 4: Project Findings - 56 pages

Section 5: Way Forward - 9 pages

Section 6: Survey of Vernacular Methodologies -

Section 7: Analysis of Vernacular Construction - 59 pages

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1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The enormity of the disaster in the aftermath of the 2011 floods requires innovative solutions for providing shelter to a vast majority at an accelerated pace.

The latest figures indicate that at least 0.8 million houses are either fully or partially damaged (PDMA Sindh/OCHA). When viewed in the context of the background of 2010 floods, we know that last year only a fraction of the required housing units could be built due to various constraints. It is clear that conventional approaches are once again likely to prove inadequate in the face of a much greater calamity, where the devastation has spread over a vastly extended area with a much greater number of displaced households.

Clearly, it has become imperative to devise low cost alternative approaches to provide shelter options which would include maximum participation of affected households themselves. At the same time, in view of the danger of annual flooding, it has become increasingly important that DRR capabilities are built-in within the new structures to enable the communities to survive within their original habitat during the course of floods. The strategies and approaches to deal with the present crisis must be worked out with a view to enable the affected households to restart their lives immediately after the waters begin to recede, with minimum dislocation, least loss of life and minimum loss of livestock.

In collaboration with DFID and IOM, Heritage Foundation has undertaken the task of creating a training and implementation framework for innovative architectural/engineering solutions for speedy rehabilitation/reconstruction of shelters, based on DRR cross cutting theme. These methodologies have been developed to enable affected communities, donors and IPOs in undertaking shelter rehabilitation and shelter reconstruction at an accelerated pace. The framework thus developed maximizes participation of households including women by utilizing their own skills and capabilities.

1.2 BASIS OF PROPOSED STRATEGIES

The proposed strategies have been worked out by Heritage Foundation under the guidance of CEO Ar. Yasmeen Lari, in the light of research on construction materials and techniques carried out in various districts of Sindh, as well as experience gained in working in post-disaster communities since 2005

Earthquake in Northern Pakistan. The approach is based on provision of sustainable and low cost options derived from traditional techniques and participatory mechanisms that would lead to attaining immediate shelter by strengthening the capabilities and skills of communities themselves.

The following are the guiding principles:

- a. Utilize **HERITAGE AND TRADITION** for involvement of communities and for fostering pride and self-confidence.
- b. Use **SUSTAINABLE MATERIALS** to prevent environmental degradation.
- c. Use **LOCAL SKILLS AND TECHNIQUES** for speedy delivery.
- d. Incorporate **DRR-DRIVEN METHODOLOGIES** to withstand next flooding.
- e. Utilize **SHELTER PROVISION FOR ENTRÉE** into communities for larger benefits and for initiating women's economic empowerment strategies.
- f. Develop **HOLISTIC MODELS AIMING AT MDGs**: hygiene, WASH, food security, nutrition, literacy.
- g. In the long term **DEVELOP TRAINING MODULES** for Implementing Partners, volunteers, artisans, and communities.

Guidelines for scaling up and speedy implementation are as follows:

- Create an **IMPLEMENTATION STRUCTURE** for speedy delivery.
- Establish **CERTIFICATION PROCEDURES** for artisans for production of technically sound vernacular constructions.
- Form **MOBILE TEAMS** for ease of access to villages.
- Demonstrate **IMPROVED VERNACULAR METHODOLOGIES** through prototype/model units.
- Establish **REPORTING, MONITORING AND EVALUATION PROCEDURES** based on agreed-upon indicators.
- Establish **TECHNICAL BACK-STOPPER ARRANGEMENT** using internet and technology.
- Ensure that each unit has **CERTIFICATION AS A DRR-COMPLIANT STRUCTURE**.

1.3 FINDINGS BASED ON FIELD DATA

The project teams were organized to undertake field work for surveying existing local shelter typologies and vernacular construction methods. The cataloguing of traditional methodologies utilized in Lower Sindh has yielded rare data from all tehsils/talukas of 8 priority districts. The data consists of sketches, notes and photographs of different kinds of structures and other related information regarding selected villages. A brief database of the findings (strengths and weaknesses) of vernacular building



Vernacular construction damaged by standing water.



Partially collapsed mud structure selected by Heritage Foundation for rehabilitation.



Rehabilitated Demo/Model Unit completed during Stakeholders' Workshop.



Woman participating in plastering her own house.

methodologies and materials has been included in this report. From the study of field data it is clear that there are many similarities in the causes of failure, at the same time, the strength and durability of mud walls has also become evident:

- a. **EXTENSIVE USE OF MUD** - layered mud or sun dried brick walls is found throughout Sindh.
- b. **EFFECTIVE SURVIVAL OF MUD WALLS** during floods has been recorded . Most of the time **FAILURE IS DUE TO ROOF COLLAPSE** or disintegration of external mud rendering.
- c. **DISINTEGRATION AT BASE OF MUD WALLS** is among the causes of wall collapse.
- d. **REED WALLS HAVE SURVIVED WELL**, especially if they are treated with mud plaster.
- e. **CIRCULAR PLAN-FORM AND CONICAL ROOF HAVE SURVIVED WELL**, when they are well built.
- f. **ROOF CONSTRUCTION IS GENERALLY UNSATISFACTORY**. It is particularly **DANGEROUS WITH RSJ GIRDERS** when they are placed without due precautions.
- g. **UNSCIENTIFICALLY CONSTRUCTED ROOFS UNABLE TO PROVIDE REFUGE** during floods and are not strong enough.
- h. **SURVIVING ROOFS OFTEN CONSIDERED UNSAFE BY RESIDENTS**. Even the newly constructed roofs are not strong enough to withstand live load of people, thus adding to displaced population. Therefore a great deal of **EMPHASIS IS NEEDED TO MAKE ACCESSIBLE, SAFE ROOFS**.
- i. Considerable deterioration in skills has been noted particularly in Tharparkar's Chora roofs when these are built in other districts. Thus, **SKILL TRAINING IS REQUIRED IN VERNACULAR METHODS** of construction.

1.4 RECOMMENDATIONS FOR SHELTER

The shelter strategy, based on one safe room, to deal with the 2011 flood devastation, should aim for the following:

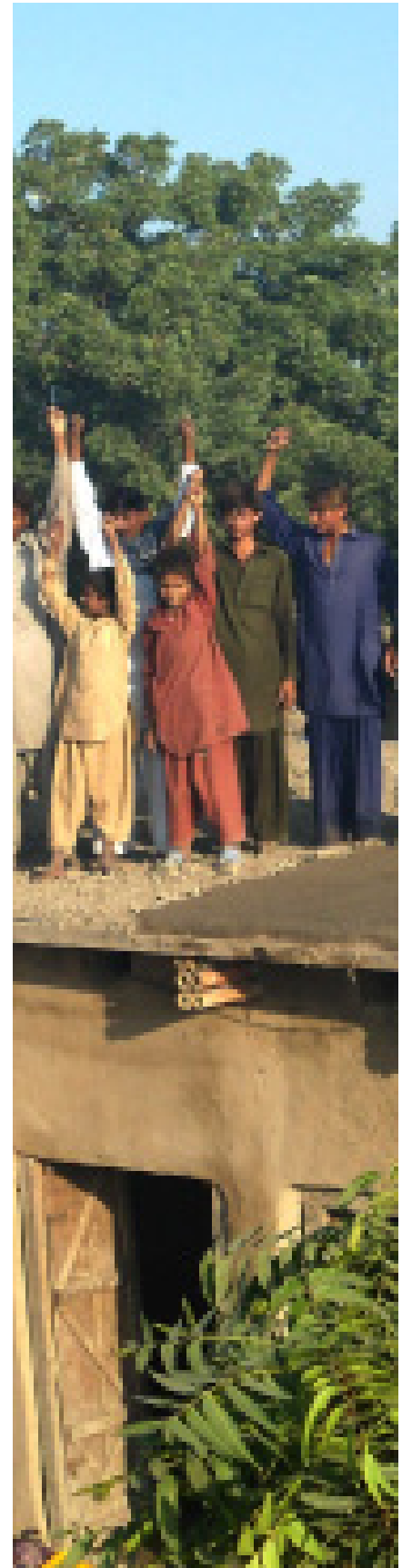
- a. **REHABILITATE SURVIVING MUD WALLS** as much as possible, with suggested treatments through provision of technical guidance.
- b. **Introduce Sustainable DRR-driven Roofs** for providing safe haven during floods by training local artisans.
- c. In the case of complete loss of structure, **USE SUN-DRIED BRICK OR LAYERED MUD WALLS** and DRR-driven KaravanRoof in readiness for next floods.
- d. **ENCOURAGE WIDESPREAD USE OF LIME** for weather resistant roof and wall renderings. This will prolong the life of all structures.

- e. **ENSURE ONE ACCESSIBLE DRR-COMPLIANT ROOF.** Households can build extra verandahs/rooms with the debris and salvaged material such as logs, timber and RSJ joists etc. along with provision of technical help.
- f. In view of lack of toilets, as a first step, **INCLUDE COMMUNITY TOILETS**, with mud walls and bamboo roofs.

1.5 ADVANTAGES OF THE APPROACH

The following are the advantages of this strategy:

- a. This approach makes people part of working out their own solution with added benefits in fostering pride and encouragement to take charge of their own lives.
- b. The involvement of communities in construction of their own shelter on the one hand fosters pride, on the other hand engages them in productive work, forestalling a culture of apathy and dependence.
- c. Since indigenous materials or locally produced items are being utilized, this results in quick economic regeneration within affected communities.
- d. The main material, the clay soil, is available in abundance. It is at no cost and can be used either as layers of mud or sun dried brick, both of which can be made by families themselves.
- e. Lime is available in abundance in Haiderable region.
- f. The bamboo for DRR-driven KaravanRoof is a fast growing reed, and is widely available in Sindh at a reasonable cost. By training local artisans the production of these roofs will provide local workforce with livelihoods.
- g. The DRR-driven KaravanRoofs, because of their strength have been designed for refuge during floods. At the time of writing over 50 roofs have been tested in District Tando Allahyar and another 69 roofs in various talukas of Lower Sindh - all tested with 15 persons each or more than 750 kg load.
- h. Partially collapsed houses with mud walls can be rehabilitated within one-day-and-a-half. Those that are begun from scratch require 3-4 days in construction.
- i. The resultant product is economical and will help in providing shelter to many times more than possible through conventional methodologies.
- j. Mud structures, especially with the use of lime renderings become well insulated and provide comfortable habitat.
- k. The use of local materials ensures that women are able to continue to contribute in home-making. Thus, each house is personalized and acquires its own identity.
- l. Extensive use of lime, bamboo and mud provides eco-friendly habitat, providing comfort in Sindh's extremely hot climate.



A newly stabilized house, being tested by the family for strength to use as refuge during floods.



Retrofitted and rehabilitated houses with strong DRR-driven KaravanRoofs.

1.6 IMPLEMENTATION

Emphasis on training and capacity building will be essential for successful implementation of the programme. The following training programmes are envisaged:

- Workshops for master trainers, master artisans, and artisans.
- Workshops for Mobile Barefoot Karavan Teams.
- Workshops and mentoring arrangement for other partners.
- Workshops for Heritage Control Centre Personnel

Awareness in DRR measures and sensitivities towards gender empowerment and conflict resolution measures will be built-in in the learning outcomes of the training programme.

Throughout the programme, a mechanism of quality control and certification will be put in place, for which **MOBILE BAREFOOT KARAVAN TEAMS (MBKT)** will be trained for field work and monitoring, in coordination with **HERITAGE CONTROL CENTRE (HCC)**. HCC will develop training modules, technical guidance and information, as well as liaison with CSC, MBKT and Implementing Partners.

For smooth functioning of the project and transparent procedures, the disbursement of funds will be the responsibility of the Implementing Partners, and will be distinct from training, monitoring, evaluation and certification, which will be the responsibility of Heritage Foundation.

We are confident that based on improved vernacular construction techniques incorporating DRR methods developed by Heritage Foundation over the years, these sustainable and economical options will provide the critical direction for communities to become strong, self reliant and resilient. The implementation procedures through a process of certification and several monitoring tiers will ensure that all shelters constructed using Heritage Foundation methodology will have strong walls and safe haven KaravanRoofs for safety during next floods. In addition to safety of life, other DRR methodologies being recommended by Heritage Foundation, will provide safety of rations, potable water, livestock and fodder. Such interventions, comprising raised earthen platforms, will also provide the much needed sports and cultural nodes, which we are confident, will lead to transformation in the lives of village communities.

YASMEEN LARI, S.I.

Chair & CE, Heritage Foundation

Hon. Project Director, HF-DFID-IOM Shelter Project for Sindh
Karachi, December 2011

2.0 PROJECT DESCRIPTION

2.1 THE NEED FOR DRR

The 2011 floods have caused great devastation in the Indus Basin. A total of more than 9 million people have been affected by the floods, of which 0.8 million homes have been reported to be fully or partially destroyed.

It is evident that the current methods of disaster management do not give enough emphasis on participatory methods of rehabilitation and disaster resistance. Thus, many interventions from previous disasters have not proven to be effective enough during 2011 floods, with loss of both lives and livestock.

In addition to the reports from the NDMA, the Temporary Settlement Support Unit's assessment of rehabilitation efforts corroborates the fact that disaster management continues to be focused on immediate solutions, rather than long term strategies.

In consultation with project partners, the Heritage Foundation took up the task to demonstrate its DRR driven model to *Build Back Safer with Vernacular Methodologies*, in all 35 Tehsils/Talukas of 8 priority districts of Sindh.

2.2 PROJECT CONCEPTUALIZATION

The shelter project has come about as a result of the experience gained by Heritage Foundation over last several years in responding to the needs of post-disaster communities.

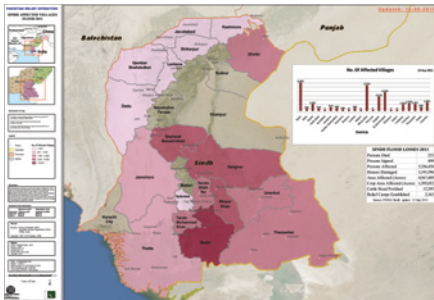
The situation for communities became aggravated due to the large number of people that were displaced by the 2010 and 2011 floods in Pakistan. Of those displaced in 2010, less than 15% of families have been provided with shelter and there has been much suffering with growing deficits in health, literacy and livelihoods.

Due to DFID's interest in Heritage Foundation's DRR driven strategy: *Build Back Better with Vernacular Methodologies*, IOM, being the lead in shelter, provided the necessary support that enabled HF to carry out an extensive review of the kind of vernacular structures prevalent in Southern Sindh. Deriving its design philosophy from heritage and traditions, Heritage Foundation was able to promote its low cost improved vernacular methods for shelter construction with DRR cross cutting theme. Thus, model/demo units in 35 tehsils of 8 priority districts were constructed to propagate the value of strengthened mud walls and safe haven KaravanRoof.



Above. Destruction caused by flood waters.

Right. Table listing the names of districts and tehsils/talukas comprising the project area.



Map of Sindh by PDMA-OCHA.

2.3 PROJECT AREA

The project area consists of 8 districts that have been declared as being the most affected by excessive rains in 2011. Where in most parts due to lack of drainage this resulted in flooding, there were some areas where the rains played havoc with the house structures. In both cases, people were displaced from their homes.

The table below shows the tehsils/talukas where the work of survey of vernacular methodologies and construction of model/demo units was undertaken during the project period from October 10 to 27 November, with report finalization by 8th December, 2011.

District	Tehsil
BADIN	Badin, Matli, FazliRahu, Talnar, TandoBago
MIRPURKHAS	Mirpurkhas, Husain Baukhsh Mari, Sindhri, KotGhulam Mohammad, Digri, Jhuddo
BENAZIRABAD	Benazirabad, Qazi Ahmad, Sakrand, Dour
SANGHAR	Sanghar, Sinjhora, Tando Adam, Khipro, Shahdadpur, Jam Nawaz Ali
TANDO ALLAHYAR	Tando Allahyar, Chambar, Jhando Mari
Tando M. Khan	Tando M. Khan, Bulri Shah Karim, TandoGhulamHyder
Tharparkar	Chachro, Nagarparkar, Diplo, Mithi
Umerkot	Umerkot, Samaro, Kunri, Pithoro

2.4 PROJECT DESIGN & PROCESS

The two distinct stages of the project were carried out by two separate field teams, while the data and report compilation was completed by a team in HF’s Karachi office.

The survey of vernacular methodologies that was carried out by the Survey Team while the Workshop (DRR Awareness) and Building Demonstration was conducted by the Construction Team. Both teams were lead by their own team leaders who were responsible for identifying one village in each tehsil. Since all villages had been devastated, it was a difficult task to identify one as being the most representative.

The **SURVEY TEAM** consisting of student volunteers, was lead by Architect Zulfiqar Noor. The team documented the existing

conditions of the site and structures, through filling out a survey form. In addition through sketches and photographs, defects were recorded in greater detail to allow more in-depth analysis of the correlation between structural systems and damage. An extensive library of images has been developed during this seed project, so that surveyors could be trained on how to identify structures and defects

THE CONSTRUCTION TEAM consisted of student volunteers accompanied by a team of artisans and was lead by the Project Manager Mr. Naeem Shah. The Construction Team was responsible for conducting Stakeholders Workshops and Building Demonstration at selected villages. Workshops have created awareness for DRR, and building demonstration has educated villagers how to strengthen mud walls and incorporate safe haven roofs so that they are resilient to disasters. These are described in greater detail as part of a description of the HF approach to DRR.

2.5 TIMELINE

From 10th October, Heritage Foundation organized mobilization of human resources and resolving field logistics. Arrangements for student volunteers, building artisans and transport and accommodation were completed within a week. After a workshop conducted by Ar. Yasmeen Lari, the Survey Teams began work on the 17th of October. The field survey of all 8 districts, covering 35 tehsils was completed in a period of two weeks. Compilation of data and its analysis was carried out throughout the project period.

Through daily communication with the Head Office, data collection and organization of the database was an ongoing process. From the beginning work was undertaken on developing DRR techniques for post-flood communities, mobilizing master artisans as well as procurement of material for construction.

Armed with a complete set of drawings and after a training workshop conducted by Ar. Yasmeen Lari, the Construction Teams were dispatched to begin demonstrating DRR driven vernacular methodologies for rehabilitation and construction. Villages were strategically selected to conduct stakeholders workshops and for the making of two HF Demo/Model Units as part of shelter construction demonstration.

Findings, analysis and project updates were also compiled in a speedy manner for the first Interim Report that was presented to



Student Volunteers participating in discussions with the Team Leaders.



View of safe-haven KaravanRoof being installed.



Placement of bamboo purlins on bamboo joists.



View of another KaravanRoof under construction.



Community members examining posters during workshop, Chachro, Tharparkar.



View of a Stakeholders' Workshop held in Mithi, Tharparkar.



A large number of women attending a Stakeholders' Workshop, Kunri, Umerkot.



Gathering in Stakeholders' Workshop in Jhando Mari, Tando Allahyar.

IOM on 28th October, 2011. A second Interim Report was submitted on 7 November in order to present findings for large-scale distribution to shelter cluster by IOM. At the completion of the all aspects of the project, the final report was presented on 15th December 2011. The present document is based on the findings and analysis presented in the final report.

The Project was thus successfully started and completed within the stipulated time. Altogether 170 homes were surveyed, 35 workshops were conducted and 68 units were rehabilitated and 1 built from scratch as part of the HF Demo/Model units. This far exceeds the target number that was proposed in the funding proposal to IOM and has been managed well within the time and allocated budget.

It is important to note that the Heritage Foundation commenced work in the first week of October in village Mohak Sharif where one house was built using IOM funding, while another over 50 units and experimentation for DRR Methodologies has been carried out through the Foundation's own resources. In addition to the input by the Foundation, the good will of volunteers, local landlords and villagers has contributed greatly to the success of the endeavour. The project has successfully demonstrated the willingness of all stakeholders to collaborate for early response and relief for post disaster communities.

WORKSHOPS AND MODEL UNITS WERE COMPLETED IN A 7-WEEK PERIOD – THEY ARE MENTIONED IN MORE DETAIL IN PARAGRAPH 2.7.3: STAKEHOLDERS' WORKSHOPS & BUILDING DEMONSTRATION.

2.6 HF'S DRR-DRIVEN PROCESS

The **HERITAGE FOUNDATION DRR-DRIVEN MODEL FOR REHABILITATION** has been devised in order to provide speedy assistance to households returning to their homes. The greatest need at this time is to help families build their shelters as quickly as possible that are also safe with accessible roofs through provision of required technical input. Among the important aspects is that funding should be directed towards DRR aspects enabling communities to survive the next floods and to remain safe in their own homes without being displaced.

In order to provide fast and effective shelter components, an understanding of local techniques of construction and locally available construction materials is essential to devise methodologies

for improved vernacular construction.

The HF model for DRR has been developed and tested through interventions since the 2005 earthquake, 2010 floods and again in the 2011 floods. The model proposes a holistic solution to disaster risk resistance for vulnerable communities by providing timely, appropriate and sustainable means for rehabilitation and reconstruction.

The aim of Heritage Foundation is to provide technical solutions which will result in improved vernacular building techniques, and to engage and train skilled artisans in order to maintain, repair and build improved vernacular structures. In order to engage the community, workshops and demonstrations have been conducted, to create awareness and pride in local building materials and methodologies. In addition, over the years of humanitarian work, the Foundation has proved that once having made an entree through shelter construction, it has been able to bring about large-scale improvements in community life through a holistic approach encompassing clean water supply, hygiene and health, literacy, permaculture and livelihood through crafts.

2.7 COMPONENTS OF THE PROJECT

The following components of the project have been developed and implemented as part of the response to the 2011 floods;

- Recording existing vernacular methodologies to form the basis for shelter construction recommendations.
- Retrofitting and remedial measures to incorporate disaster risk resistance components.
- Stake-holders Workshops & Building Demonstration to include awareness campaigns. Construction of demo/model units to demonstrate the techniques for strengthening of mud walls and safe haven roofs for taking refuge during floods.
- DRR-driven community structures to provide life safety, food safety, water safety, livestock and livestock feed safety in preparation for next flood disaster.

2.7.1 RECORDING VERNACULAR METHODOLOGIES

The focus of this survey was to document local building techniques in rural areas to assess the efficacy of vernacular construction. A survey of intangible heritage, e.g. folklore, folk dance, oral histories, should be included as part of future studies to develop a



Prefabrication of bamboo joists in progress..



Demonstrating mixing and use of lime.

HERITAGE FOUNDATION BUILD BACK BETTER WITH VERNACULAR METHODOLOGIES			
SURVEY OF VERNACULAR BUILDING METHODS IN SUDAN			
VILLAGE INFORMATION		VILLAGE NAME	
VILLAGE NAME	NO. OF HOUSES	GOVT	COMUNITY NAME
VILLAGE NAME	NO. OF HOUSES	GOVT	COMUNITY NAME
2. BENEFACTORY INFORMATION			
NAME		ADDRESS	DATE OF VISIT
NAME		ADDRESS	DATE OF VISIT
3. HOUSEHOLD INFORMATION			
LOCATION	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
LOCATION	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
4. BUILDING INFORMATION			
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
5. MATERIAL USED			
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
6. WATER & SANITATION			
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE
HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE	HOUSEHOLD TYPE

Survey forms with sketches and photographs of vernacular construction, duly filled and digitized for analysis.



Collapse of ill-built roof structure.



Above. Major crack in the supporting mud wall due to the point load of a steel girder.

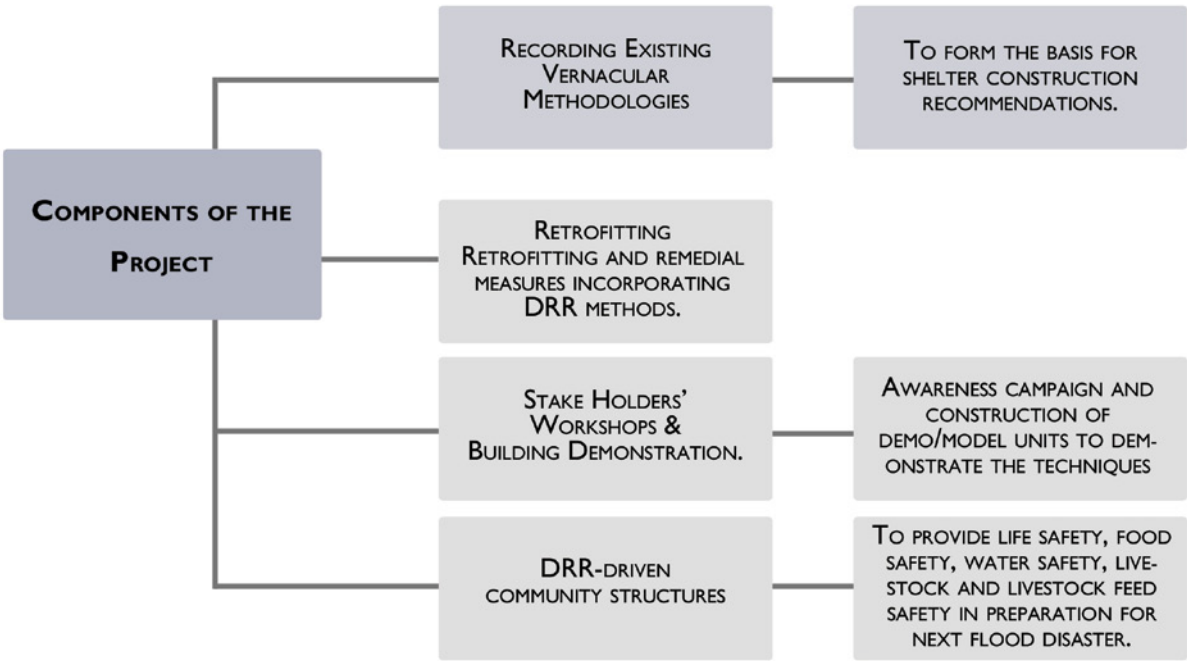
Below. Diagram showing components of the Project.

comprehensive understanding of the communities in the area. As part of creating awareness and appreciation for national heritage, Heritage Foundation believes in engaging the youth while working for rehabilitation of post-disaster communities. To this end, the Foundation has built up networks with local universities.

The project has provided a rare opportunity to student volunteers to gather valuable information from largely inaccessible areas. It has also facilitated their interaction with rural communities to develop a greater understanding of issues that confront them.

At the outset, a workshop by Hon. Project Director, Ar. Yasmeen Lari and the carefully designed form provided them with the procedures to be followed when working with communities. Care was taken to provide a framework for qualitative data obtained in the field to be documented as part of data collection on the condition of vernacular structures, consisting of sketches, photographs and notes. The completed forms were reviewed by the team leader before being sent to the Head Office for compilation and evaluation.

The main purpose of the field survey was to record those vernacular elements that have survived as well as record of other structures, both old and new, that have collapsed. These surveys have formed the basis for analysing the strength and weaknesses of various types of vernacular structures, as well as those structures that have been built in the recent past. The surveys also show the inappropriate use of steel girders, causing failure of many of the roofs and supporting structures.



2.7.2 REMEDIAL MEASURES WITH DRR METHODS

Heritage Foundation believes in following the heritage principle of retaining and preserving all that is valuable. Along with methodologies for the preservation of remains, ways of retrofitting through interventions have also been detailed in order to stabilize surviving structures.

It has been established that most communities are skilled in the use of vernacular materials for construction of their dwelling: a skill that has been acquired over several centuries. After the flood waters receded it was observed that many damaged mud walls have survived. This led to the conclusion that structurally stable mud walls must be repaired and strengthened as well as protected through weather resistant lime mortars.

A. RETROFITTING/REHABILITATION PROCEDURES

For walls that have been damaged but have survived, and are structurally stable, methods for retrofitting procedures, including crack repairs in mud walls and strengthening their base has been effectively demonstrated.

B. NEW DRR-DRIVEN ADOBE CONSTRUCTION

Where walls have entirely collapsed and are completely irretrievable, 18" thick sun dried brick walls or layered mud walls are recommended to be undertaken for immediate construction. Detailed drawings indicate the care that needs to be taken in construction to make them strong and able to withstand future flooding.

C. DRR-DRIVEN SAFE HAVEN/KARAVAN ROOF

The reason behind the collapse of many houses is the unsatisfactory and unscientific construction of roofs. Most roofs were found unable to take their own load let alone the load of family members during floods. The surveys proved that mud walls are strong enough to take the load of a DRR-driven roof. This finding is important since it is essential to provide a roof which can form a safe haven during flooding. For this purpose tried and tested bamboo roof, the KaravanRoof, is being recommended.

The Karavan Roof has been developed by Heritage Foundation through a lot of experimentation and practical application in Northern Pakistan. Almost 300 houses built in Swat have withstood the load of 3'0" of snow. In over 50 shelter units built in Village Mohak Sharif in Tando Allahyar, all these roofs have been tested with the load of 15 persons, thus making them entirely accessible and suitable for refuge during flooding.



Procedure for rehabilitating a highly damaged wall.



Crack repairing procedure using bamboo lattice being demonstrated.



Fixing of bamboo lattice on the damaged area of the wall.

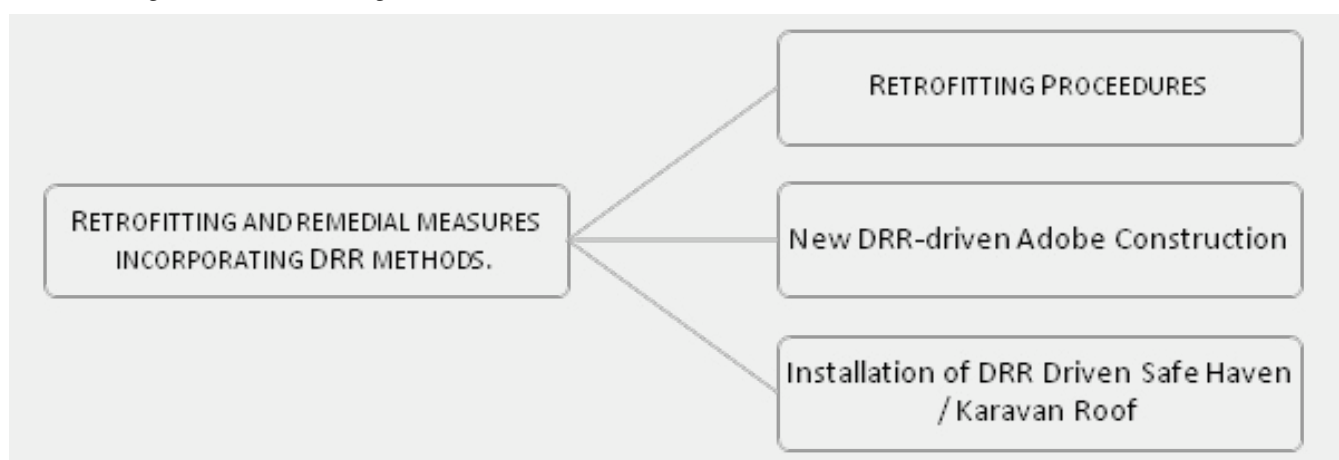


Mud plaster being applied over bamboo lattice, thus saving a damaged wall.

Each time a roof is installed, the family is encouraged to assemble on the roof to test it for loading. The activity of demonstrating construction materials and methodology has provided pride and confidence in communities in rural areas. The act of participating in construction reinforces faith in traditional techniques and skills providing them with a safe haven during floods.

Heritage Foundation has trained a number of master artisans in the fabrication of the KaravanRoof, and continues to undertake the training of local artisans for income generation through building activity.

Below. Process of DRR-compliant construction using vernacular methodologies.



Stakeholders Workshop conducted in Mohak Sharif, Tando Allahyar.

2.7.3 STAKEHOLDERS' WORKSHOPS & BUILDING DEMONSTRATION

AWARENESS CAMPAIGN & CONSTRUCTION OF DEMO/MODEL UNITS TO DEMONSTRATE TECHNIQUES FOR REHABILITATION AND NEW CONSTRUCTION.

In each tehsil efforts were made to choose one through which a widow, orphan or a disabled person could get a house. A preliminary schedule of workshops was issued after the field surveys for the sites where stakeholders' workshops and building demonstration would be carried out.

The first workshop was held on Thursday 27th October 2011 in TandoAllahyar in Village Mohak Sharif. The schedule for workshops and building demonstration was widely circulated through Google groups and shelter cluster. It was attended by approximately 150 men and 70 women comprising the local community, area notables, neighbouring villages as well as Board Members of Heritage Foundation from Karachi, and representatives of UN Habitat and a political party as well as student volunteers. Stakeholders Workshop and Building demonstrations were con-

ducted in all 35 tehsils of the 8 priority districts. For Building Demonstration the Construction Team built a HF Demo/Model Unit to demonstrate the techniques for DRR driven rehabilitation and new construction.

During the workshop the background and methodologies being adopted were explained to the audience. Demonstration of joints was given and construction methods used in the almost finished reconstruction of a house were also explained. Before the workshop was held, the structures were completed up to roof level and some of the bamboo joists were also placed in position. At the time of the workshop the remaining bamboo joists were placed and the process of completion of the roof was demonstrated.

For construction of demonstration units, Heritage Foundation has brought together master artisans and artisans from various parts of Pakistan who have been previously trained by the Foundation in the construction of Green Karavan Ghar in Swat, Mansehra, Siran Valley, Mardan and Khairpur. The trained artisans act as team leaders while local artisans are being engaged on daily wages to be involved in construction of model units. Mohak Sharif Village was also the site for the first HF Demo/Model Unit construction, from ground up, to provide an example of new build in sun-dried brick with all DRR factors built in, in order to make the house flood and weather resistant.

Construction work included a slaking pit for lime at each village. Soil samples were also collected in each village for soil analysis.

The demonstration of techniques to make the structures strong and flood resistant has encouraged others to begin making mud walls with the suggested precautions. It has been noted that villagers have spread the word by mouth and other residents have come to observe and learn from the construction of HF Demo/Model Units. Some villagers have travelled to adjacent villages to instruct in reconstruction. Convinced by the strength of construction and encouraged by the ease and low cost of construction the HF Demo/Model Unit has brought about confidence in mud walls that are now being taken up for construction by villagers themselves. This has been heartening to see, but must also be monitored and checked for quality in the operation of this scheme. It is therefore Important that training units are established as soon as possible to instruct and certify local artisans. This is to ensure that the houses being built follow prescribed DRR-driven methodologies.



View of Stakeholders' Workshop being conducted.



Demonstration of vernacular building methodologies for artisans and villagers.



Training Workshop attended by volunteering students.



Women's interest in Stakeholders' Workshops.



Safety of food and drinking water - DRR-compliant raised earthen platform, Mohak Sharif, Tando Allahyar.



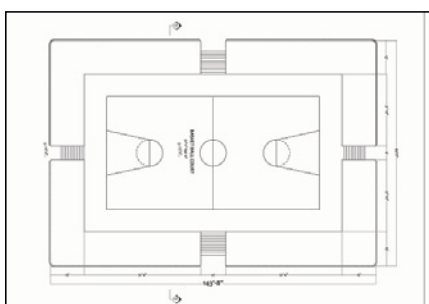
Safety of fodder - elevation of raised earthen platform as cultural activity area.



Earthen platform as a cultural node, to provide safety for livestock feed.



Elevation of basket ball court on an earthen platform - safe haven for l



Basket ball court designed as an elevated earthen platform - safe haven for livestock.

2.7.4 DRR-DRIVEN COMMUNITY STRUCTURES

In her writings Ar. Yasmeen Lari has spelt out the essential DRR-driven community structures to provide safety of life, food, water, livestock and livestock feed in preparation for the next floods. Clearly, in flood-prone areas, it is imperative to provide human security and security to assets, food and water sources to enable families, particularly women and children, to avoid displacement.

Following are the necessary components that need to be built-in to any strategy that is being formulated for early recovery and/or rehabilitation of disaster prone communities.

A. SAFETY OF LIFE

By introducing DRR-driven roof structure – the KaravanRoof – the households can find refuge on the top of the roof during the next flood. At the time of rains additional components can be added, for example, bamboo posts and tarpaulin to provide protection from rain on top of the roof.

B. SAFETY OF FOOD RATIONS

Among the most tragic aspects of floods has been the loss of meagre food rations that the communities possessed. The rations must be saved from being washed away or spoilt during floods. Normally, the family stores its grain in silos. These used to be made of clay but are now available in steel cylinders. Grain must be protected from standing water by placing the silos on a higher level, on earth platforms.

C. SAFETY OF DRINKING WATER

During flooding, water borne diseases are among the chief causes of disease and mortality, especially child mortality. Earthen platforms need to be built to keep water pots or containers well above the flood water level. Water should additionally be treated with chlorine, aqua tab or other purifiers. The Heritage Foundation is actively collaborating with Swiss Pakistan Society (SPS) to bring sustainable and safe methods for water filtration and purification to rural areas.

D. SAFETY OF LIVESTOCK – ELEVATED SPORTS GROUNDS

The worst tragedy in any rural family's life is the loss of their livestock. For this purpose dual purpose elevated sports grounds are being proposed. The ground serves as a place to provide refuge to livestock in case of floods as well as serve as a level playing field for children. In most villages there are hardly any sports grounds, and such a spatial intervention additionally serves to strengthen community spirit. Such recreational spaces will bring about a transformation in the lives of villagers and particularly the youth.

E. SAFETY OF LIVESTOCK FEED – ELEVATED CULTURAL NODES

Along with livestock it is also important to save the straw and other feed that is necessary for the survival of the livestock. A smaller platform is suggested that may be used to safeguard fodder in floods, and otherwise be used as a stage for performance or gathering space.

Usually, there is no space in the village that may work as a public square for the gathering of people. If mud platforms can be erected, they can act as stages for performances and as assembly spaces for the community, thus making them into cultural nodes.

F. COMMUNITY BUILDINGS - PRESERVE HERITAGE & CULTURE

Throughout our work in post disaster communities, Heritage Foundation has responded to the needs of women and communities by building special centres where assemblies could take place. These become the basis for women's empowerment and enabling community activities. In Khairpur Heritage Foundation has built several centres e.g. women's centres for crafts, school and dispensary have been constructed on stilts after the 2010 floods. These elevated, floating buildings have become a source of pride and have provided refuge to the vulnerable groups during the 2011 floods.

2.8 LOGISTICS

2.8.1 LIAISON WITH LOCAL UNIVERSITIES

An invitation was sent out to architecture departments in universities in Sindh and there was very good response received. It was decided that two universities who have earlier taken part in Heritage Foundation activities should be invited at this stage, that is, University of Karachi and Mehran University in Hyderabad. Since time was short, those who had experience in working in remote areas and with disadvantaged communities with Heritage Foundation were likely to get acclimatized more quickly were more likely to carry out this demanding assignment.

2.8.2 LIAISON WITH NOTABLES & COMMUNITIES

Even before undertaking the joint HF-DFID-IOM Shelter Project, on invitation of the notable landlord of the area, Mr. Mahmood Shah, the Heritage Foundation had begun to work on the rehabilitation of housing units in the minorities' communities residing in village Mohak Sharif, where the water had receded after three weeks. This had provided the base where not only experimentation could be carried out but some of the solutions could also be tested. The first workshop for artisans, volunteers were held



Community building on stilts built by Heritage Foundation in village Darya Khan Shaikh, in katcha area, Khairpur.



A view of stilts, ground floor of community building being utilized by children, Darya Khan Shaikh, Khairpur.



The village of Mohak Sharif. Festivity on the occasion of Stakeholders' Workshop.



Construction Team helping villagers, during construction process.



Model shelter constructed with sun-dried brick and KaravanRoof.



Review of work by Hon. Project Director, village Mohak Sharif, Tando Allahyar.



Team leaders and student volunteers with Hon. Project Director, Mohak Sharif.

here, and the first HF Demo/Model Unit was constructed from scratch in the village.

Safe accommodation for volunteers and artisans, although by no means lavish, was arranged through hospitality of Mr. Mahmood Shha and the villagers in Mohak Sharif. Beyond this point, Survey and Construction Teams had to make arrangements for lodging as they moved to different tehsils that were too far away.

2.9 CONSTRAINTS FOR SURVEY & CONSTRUCTION TEAMS

The law and order situation in the interior of Sindh was a cause for concern. This was particularly worrying since the teams consisted largely of young people among whom were five girl students. We had hoped that the strategy of operating in a low key manner would provide the necessary security.

Among other major problems was the lack of adequate accommodation in all tehsils/districts, for which solutions had to be found by the team leaders. Clearly, the accommodation located was quite modest but turned out to be safe.

The area to be covered was also vast. The most difficult to cover were the remote areas such as Umerkot and Tharparkar districts. It is important to note, that these areas are so remote that they are rarely visited and the findings in vernacular building methodologies were exciting and illuminating.

Because of the remoteness of most of the areas and lack of internet connectivity, the information had to be sent through special couriers to the Heritage Foundation's Karachi office who were tasked with speedy compilation. Thus, the time for the work was extremely short, which was all the more strenuous due to loss of several days because of the Eid holidays.

2.10 CONSTRUCTION OF MODEL/DEMO UNITS

2.10.1 SOURCING MATERIALS

Among the first tasks that was to assess the availability of and use of materials such as lime for better weather resistance on walls and roof and of bamboo for constructing strong DRR-driven roofs. As important components which form the basis of the proposed shelter construction, availability was explored in local markets before undertaking construction work. From investigations that were carried out by the Heritage Foundation, in District Tando

Type of Construction	Safe Haven / Karavan Roof	Time / Unit	Cost / Unit PKR	Cost / Unit USD
Rehabilitation / Retrofitting	Yes	1.5 Days	Rs. 16,000/-	\$ 180/-
Rehabilitation / Retrofitting	Yes	3.5 Days	Rs. 30,000/-	\$ 348/-

Allahyar in early October 2011, it became clear that bamboo is widely grown in Southern Sindh. It has also been noted that lime factories abound in the region. In addition to local clay soil, these are the two main elements in achieving the required quality of construction, clearly construction work could proceed speedily and without any hindrance.

Compared to burnt brick (cost of second and third quality is Rs. 4 each), the mud brick could be made locally by the families themselves or if bought, would cost only Rs. 1 each.

2.10.2 DEMO/MODEL SHELTER UNITS

To reconstruct houses that have collapsed entirely, drawings have been prepared with details of construction with sun-dried brick or layered mud. It is suggested that such houses should also use the DRR-driven Karavan Roofs in order to ensure that each family has a safe haven in case of floods. All HF Demo/Model Unit have been constructed with sun dried bricks.

2.10.3 REHABILITATION PROCESS

It is estimated that the walls of at least 30% of the houses are partially standing which can be rehabilitated. In some villages this proportion is higher than in others.

In the work that Heritage Foundation has carried out in the village Mohak Sharif in Tehsil Tando Allahyar, these houses were rehabilitated within a day and a half through guidance and help. A whole rehabilitated house including the DRR-driven Karavan Roof can become safe haven at a maximum cost of Rs. 16,000 (cost of material and labour is estimated at Rs. 13,000, with extra provision for transportation).

2.10.4 FABRICATION OF KARAVANROOFS

In view of the low cost and strength required for accessibility on the roof it was decided to use DRR-driven KaravanRoofs for demo/model units. The methodology being followed by Heritage



DRR-compliant rehabilitated unit with lime rendering, ground toe and Karavan-Roof.



Damaged wall that is structurally stable and can be rehabilitated.



Prefabricated bamboo joists being transported to other locations for use in demo/ model units.



Top. A collapsed structure after floods.
Above. The same house after rehabilitation through DRR-driven interventions by Heritage Foundation.

Below. A highly damaged structure.
Bottom. The same house after rehabilitation.



Foundation ensures that the quality and standards are maintained in the production of the main roof members.

The **JOISTS FOR THE ROOFS** were all prefabricated into correct sizes at the workshop established at Tando Allahyar.

KITS FOR EACH HOUSE were prepared that include the following:

- Required numbers of 4-bamboo or 6-bamboo joists
- Required numbers of pre-cut purlins
- Required number of bolts, plates and other hardware
- Matting and plastic sheet for roof covering
- Lime
- Necessary tools and implements

2.11 REPORTING AND MONITORING

Reporting was done directly to the Heritage Foundation's Karachi Office on a day to day basis so that information collected could be shared and analysed quickly to develop appropriate building techniques.

In addition to this direct reporting allowed the Office to monitor the progress of the field teams and to facilitate where possible in any logistical problems encountered in the field.

As internet coverage was weak and inaccessible in most flood affected areas messengers were used to periodically carry filled survey forms and the collection of photographs in CDs and USBs to the Karachi Office.

2.12 DATA COLLECTION AND ANALYSIS

The work of compiling the data collected from completed Survey Forms and collection of photographs was an ongoing process during field survey and continued well after the field survey was completed.

A series of databases were made that summarized findings and analysis of roof and wall systems as well as interventions proposed.

3.0 FINDINGS & RECOMMENDATIONS

3.1 PROJECT ASSESSMENT

The findings and recommendations are based on the results of the field survey of vernacular techniques used in the different districts of Southern Sindh. Due to the time and resource constraint, one village in each tehsil was visited. These findings represent the general construction techniques and forms utilized in different villages visited in the respective districts.

The work of compiling the data collected from completed Survey Forms and collection of photographs was an ongoing process during field survey. The final report comprises a series of catalogues and databases compiled through data cleaning process.

A. CATALOGUE OF VERNACULAR BUILDING METHODOLOGIES

The catalogue is a record of tehsils and villages and the number of houses surveyed. Care was taken to include photographs for individual dwellings in the Catalogue that would illustrate the context of the structure, important structural detail and roof system.

B. ANALYSIS OF VERNACULAR CONSTRUCTION

This catalogue showcases the various types and combinations of roof and wall structural systems found. In addition to this, a brief analysis of the damage caused by the rains and flood has also been included. Structures that have survived well in the disasters have been included as an example of good practice in vernacular building methodology.

C. STAKEHOLDERS WORKSHOPS

This section records the construction of demo/model units and beneficiaries in each village, building demonstration, the number of people who attended the workshops and general observations about living conditions in the villages.

D. DATABASE OF FINDINGS

This section is a record of findings and analysis of wall, roof and community structures. The detailed list of findings has been illustrated by photographs and includes an analysis of the strengths and weaknesses found in existing vernacular building methodology for different structural elements.

E. DATABASE OF INTERVENTIONS

This section is based on recommendations for dealing with structural and non-structural defects comprising a database on appropriate interventions. Sketches and technical drawings illustrate the process of rehabilitating and improved vernacular construction.

3.0 PROJECT FINDINGS / RECOMMENDATIONS



Excavation & tamping for firm ground.



Laying mud brick in mud mortar in plinth.



Sun-dried brick wall construction.



Making a mud toe at base of mud wall.



Placing bamboo reinforced lime concrete ring beam to receive bamboo joists.

3.2 OUTCOME OF CONSTRUCTION

3.2.1 REMEDIAL MEASURES | SUCCESS

The Heritage Foundation began carrying out implementing technical improvements in the Village Mohak Sharif in early October 2011. This allowed the HF technical input to be tested and developed before being implemented as a safe building method. The experience has been gratifying in a truly marginalized community consisting of 125 Hindu and 25 Muslim families.

This entire work has been carried out under the guidance of Ar. Yasmeen Lari with engineering input from Engr. Amin Tariq to ensure that architectural and engineering aspects are fully incorporated for the sake of safety and stability. The process of improvement and testing of interventions is continuing to be carried out even at the time of writing of this report. Extensive architectural and structural drawings have been prepared for all remedial measures and interventions for strengthening and safety of mud structures in order to make them flood and disaster resistant.

Initially, there was some hesitancy on the part of the community members, as they did not know what to expect. However, as soon as the first house was rehabilitated, confidence grew rapidly. Once 15 persons were asked to mount the DRR-driven KaravanRoof, there has been no looking back. During the project period Heritage Foundation was able to complete the construction of over 30 units in village Mohak Sharif (at the time of writing over 50 families have been rehabilitated in the village), at the same time successfully demonstrated the rehabilitation of 68 units and construction of 1 newly built unit. In 35 locations in 8 priority districts

Continued support from the local landlord Mr. Mahmood Shah in Tando Allahyar has made it possible to test interventions and gauge their results for application elsewhere. Other positive aspects of intervention are the great deal of pride that has come about among the inhabitants themselves. Very soon they became busy cleaning up the area, removing debris and decorating their rehabilitated and newly built houses, reflecting their newly acquired pride in their handiwork.

As the project is extended, more manuals and guidelines will be developed to facilitate field teams and to allow local residents to encourage and facilitate greater participation in the rehabilitation and construction of their homes.

3.2.2 REMEDIAL MEASURES | CONSTRAINTS

Data cleaning and compilation was done simultaneously as information was received from sites. Due to the volume of data received this was an intensive task. However, this was considered necessary to quickly develop appropriate retrofitting methodologies for implementation. Drawings and photographs had to be compiled to illustrate successful and weak or damaged structural components in order to develop appropriate techniques.

The problem of lack of internet connectivity was an additional impediment in the process of issuing drawings. A messenger was used to send hard copies of the completed Survey Forms and collection of photographs in the field through electronic media such as USBs and CDs.

3.2.3 CONSTRUCTION OF DEMO/MODEL UNITS | SUCCESS

One of the key components of the project has been the construction of Demo/Model units in 35 tehsils in Sindh. This has been a success story for the Foundation as well as the community.

At the inception of the project it had been decided to build either one complete unit from scratch or rehabilitate 2 units. As part of building demonstration two structures were rehabilitated in each village to the prescribed building requirements of the HF Demo/Model Unit, except In Mohak Sharif here one Unit was constructed as a new build which demonstrated the procedures to be adopted for constructing new walls. The KaravanRoof workshop set up in Tando Allahyar trained local artisans in producing and fabricating sustainable and DRR-driven roofs.

Master artisans have successfully trained local artisans in the use of lime in mud renders as well as crafting of strong earthen/mud walls including corner jointing, crack repairs, treatment of bases with extended toes and use of ring beams. The use of local materials and building methods has been a source of pride and encouragement for the local community in taking ownership and actively participating in the rebuilding process.

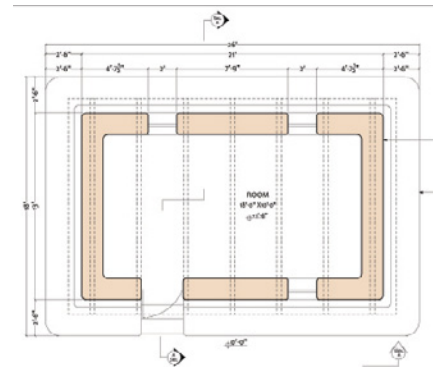
The Foundation is keen to have the role of women acknowledged in rural construction. Women have been instructed and have actively participated in the plastering of walls and their decoration. There are beautiful examples of decorative patterns in lime and mud plaster. In addition, creating an opportunity to express creativity and individuality has uplifted the morale of villagers.



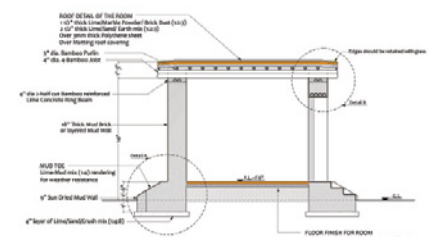
Installation of KaravanRoof in place.



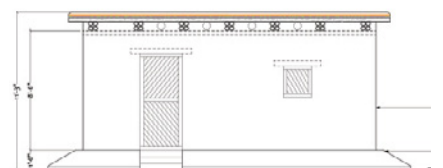
A completed unit with lime-mud rendering.



Plan of a unit with 18" thick mud walls.



Section showing precautionary measures.



Elevation of a sun-dried brick structure.



A model/demo unit with mud walls, mud toe base and KaravanRoof.



Family outside its rehabilitated house.



Woman participating in the construction process - mixing lime in a lime pit.



Printed banners used as educational material for rehabilitation.

Encouraging participation in the building process has had a spin off effect in adjacent areas where villagers have been both observed and reported to have begun the repairing of their mud walls after the field teams have demonstrated the methodology of strengthening them, and by dispelling the notion that mud walls are unsafe. The community has been actively involved in rebuilding instead of waiting for an alien or more hi-tech solution. This is yet another example of the resilience of rural residents in the face of disasters and difficult conditions.

3.2.4 DEMO/MODEL UNITS | CONSTRAINTS

During construction of Heritage Foundation Demo/Model units, the main problem encountered are described below.

- a. Spread out nature of the sites on which they were constructed. A great deal of time was required for construction, conducting workshops and to travel to remote areas.
- b. The selection of villages to conduct a workshop and building demonstration units. Because of standing water in many locations, sometimes a whole day had to be spent in identifying the right location.
- c. Constrained time for carrying out construction. Initially, it was planned that one workshop per day will be held. Due to the above reasons and the long Eid holidays further cutting short construction time, it was decided to conduct two or three workshops on most days to be able to meet the target. Extra travelling time as well as expenses needed to be arranged for those who conducted the workshops and building demonstration.
- d. Due to resource constraint, the workshop procedures were simplified. For example PowerPoint presentations were replaced by printed banners that show the techniques as well as site demonstrations of what needed to be done.
- e. In order to ensure quality of strengthened mud walls and strong bamboo roofs – the Karavan Roof – all possible monitoring mechanisms are required to ensure that the work is carried out according to laid down principles and guidelines. Since these methodologies have been worked out by Heritage Foundation, the Foundation is keen that all quality control measures are built into the production and monitoring systems. This is essential so that the final built product is up to a standard which can be certified as having fulfilled the requirements for safe and DRR driven structures.

3.3 PROJECT FINDINGS | WALL & ROOF SYSTEMS

Findings that have been described are based on the select villages that were visited in each district. Most of the beneficiaries for whom homes were rehabilitated are farmers. Unable to hire skilled labour for construction most houses are built by the resident or with the help of experienced members of the community. As an exception, a few cases in the village at Sanghar and Nawabshah were noted, where the local landlord had intervened and assisted by providing building materials such as steel girders. In such cases, labour might have been out-sourced too.

Steel girder construction that was found had been poorly administered. In most cases due precautions had not been taken, with point loads being inflicted on walls. Inadequately supported steel girders have caused the collapse of mud walls that have been otherwise observed to be strong enough to withstand the rains and floods. Steel girders are also a greater hazard in the case of collapsed roofs and in the current situation there is no case for the promotion of steel girders in the rural environment.

The typology of vernacular roofs noted is as follows:

- a. **FLAT ROOF CONSTRUCTION:** Observed predominantly at District Tando M. Khan/Nawabshah/TandoAllayar/Sanghar, as well as other districts except Tharparkar.
- b. **PITCHED ROOF:** Few examples are found in Districts Mirpurkhas, Umerkot, Tharparkar, Sanghar and Nawabshah, with the majority found in Badin.
- c. **CONICAL ROOF (CHORA):** It is native to Tharparkar District, while some examples are found in Mirpurkhas/Badin/Umerkot.

Another interesting structure was found in Tehsil Chachro and Nagar in District Tharparkar. It is a large enclosed compound constructed of Khippo and wood Interlacement for keeping livestock safe at night. Typically, though in all areas, livestock share living space with the family with little or no consideration for hygienic conditions for the family.

Due to a shortage of water, the traditional practice of creating water reservoirs was found in some places. At Chachro, Thar District the traditional technique of building a reservoir has been recorded. In district Umerkot the largest human-made reservoir in the area was seen, reported to be over 100 years old.



Collapsed wall and roof due to use of heavy steel girders.



Usual rural flat roof construction.



Usual pitched roof construction supported by poorly laid burnt brick walls.



Well finished conical roof construction.



Proud owners of a rehabilitated model/ demo shelter unit completed in District Tharparkar.

Women travel large distances to work out of their Tehsil and District to work in cultivations. They are otherwise busy in handi-crafts, decorating their homes, repairing plaster and floor finishes. They are active in the collection of kippo (thatch). Women also aid in the construction of mud walls. The women in Tharpakar are seen to be more engaged in community life than other villages.

Generally, it has been found that literacy levels are extremely low, sometimes going down to zero literacy. There is a lack of primary schools and other educational facilities, and hardly any healthcare units.

Observations about each village in which building demonstrations were done, have been added as part of the Record of Stakeholders Workshops.

3.4 RECOMMENDATIONS

There are two sets of recommendations proposed. The first is for retrofitting or remedial measures and new construction. The second is a general set of recommendations for designing and implementing a DRR project that have been included as part of the strategy proposed for Way Forward.

3.4.1 REMEDIAL MEASURES FOR MUD STRUCTURES

A. USE OF MUD IN STRUCTURES

- a. Mud Wall construction is widespread and common techniques for building in adobe are layered mud or sun dried mud bricks.
- b. Mud Plaster is commonly used, as well as for plastering burnt brick and reed walls.
- c. Mud plaster is also typically used as the final later on roof structures, above thatch or other structural systems.
- d. Plastering with mud is commonly carried out by women, who have become skilled in this practice.
- e. Mud is used for insulation. The temperature change between indoor and outdoor environments has been noted to be several degrees.

B. PRECAUTIONS FOR MUD CONSTRUCTION

Mud is an extremely versatile material and can be used effectively for the purpose of building speedy shelters. It is a sustainable material that is locally available and all villagers are familiar with its use. It can be utilized very well for walls, whether in layers or by making sun dried bricks, the production of which is also very fast. The sun dried bricks are laid in mud mortar.

Mud plaster provides protection from normal rains; however, once the plaster is lost the wall become vulnerable. Thus, the wall is prone to disintegration if it loses its external rendering.

In the construction normally carried out in villages, it has been found that there are no bed plates or ring beams that would distribute the load of the roof evenly over the top of the wall. Often it has been found that heavy steel or wooden joists are placed directly on the walls, resulting in failure.

The following precautions are recommended for mud walls to provide a long lasting and a satisfactory option for shelter construction. As has been mentioned earlier, this methodology is based on enabling methods for widespread community participation:

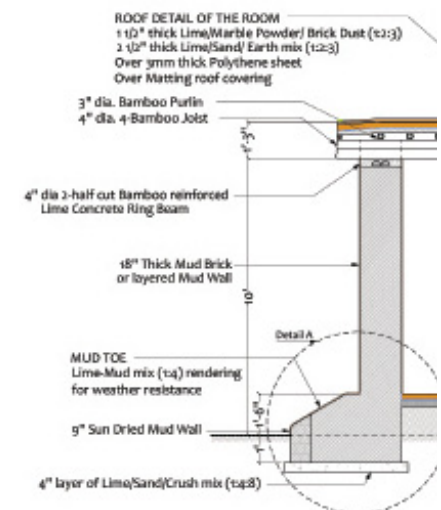
- a. Mud walls should be at least 18" thick.
- b. In new construction, the walls should rest on firm soil; if the soil is loose, the mud layers should be tamped to ensure a firm footing for the walls.
- c. Old and damaged walls can be rehabilitated through the use of bamboo lattice over cracks, and finished with mud plaster.
- d. Use of lime concrete ring beam reinforced with split bamboos can provide a firm bed for placement of joists.
- e. The base of existing walls requires special care. Through the placement of extra plinth in the form of a toe helps keep the flood water away from the base of the wall, helping to avoid disintegration of walls.
- f. If the stipulated precautions are taken in construction of mud walls, there is no requirement of standard foundations.
- g. The use of lime is essential in making the walls weather resistant. A mixture of lime and mud as well as bhoosa (straw) well mixed and fermented for 24 hours will provide a layer that will make the mud fabric of the wall safe from rains and flooding.
- h. Most lintels have been found to be in a deflected state. It is important to remove them and replaced by 4-bamboo lintels that can take the load of the wall above them. The removal of lintel will also allow the possibility of raising the floor.
- i. Precautions must be taken to ensure that bamboo joists are not placed above door or window openings. If necessary, door and/or window openings should be moved to provide a solid wall all the way from ground up for taking the load of bamboo joists.
- j. All floors should be at least 6" above the ground level for rehabilitated units. In the case of new units, the floor level should be raised to 1'-6" above the adjacent ground level.



Heavily eroded base of a mud wall, making the structure vulnerable.



Extra plinth in the form of a toe to provide protection to the base of a mud wall.



Section showing details of a sun-dried brick wall and correct placement of safe haven KaravanRoof.



Beneficiary family in front of its rehabilitated shelter.



Raised floor from the ground level provides protection from flood waters.



Student Volunteers interacting with the community.

3.4.2 REMEDIAL MEASURES FOR FLAT AND PITCHED ROOFS

A. FINDINGS

Most of the roofs are found to be flat; however, sloping roofs are also encountered in many places. As has been indicated earlier, the weakest portion of almost all structures is found to be the roof and which has been the cause of collapse of many of the structures. The construction of flat or sloping roof is usually constructed in the following manner:

- Joists are found in the form of rough wooden logs and even RSJs. However, no evidence of proper bed plates, levelling the top of walls or other measures for spreading the load have been found. The point load of heavy members such as the RSJ has resulted in major cracks in mud walls.
- The purlins are found to be either of tree branches or even bamboo that are usually found in a deflected state due to the weight above.
- Some times clay tiles are found above purlins; however, in most cases, the purlins are spanned with reed matting. This matting seems to have survived well in most cases in spite of the ingress of water.
- Reed matting is often covered with thatch with or without a layer of mud plaster.
- Due to lack of water proofing the rain lashing on the roof makes it extremely dangerous. Additionally, in a mistaken hope of stopping leakage of water, several mud layers are added, that increase the dead weight and result in making roofs even more unsafe.
- There is a lack of projection and slope in the roof to shed rainwater effectively. This allows water to collect on the roof, gradually seeping in the roof finish and adding extra weight, which results in collapse of the structure.

B. PRECAUTIONS REQUIRED FOR FLAT & PITCHED ROOFS

So far no vernacular roofs have been found that are strong enough to allow accessibility and take the live load of people.

Technical assistance needs to be provided so that even the roofs that are usually built can be made safer with the following safety factors:

- Levelling the top of the wall with water level.
- Introduction of a bamboo reinforced lime concrete beam at the top of the wall.
- Proper jointing of joists with purlins.
- Arranging for eaves or roof projection to avoid collection of water on the roof.

- e. Use of lime in the final layer of mud covering as well as introduction of a layer of tarpaulin sheeting.

3.4.3 REMEDIAL MEASURES FOR REED STRUCTURES

Among some interesting findings is the construction technique of walls and roofs made with reeds and Lou wood. Although further studies are needed to work out ways for strengthening them; however, the following preliminary findings will be useful.

A. REED WALLS

Most of the reed walls are found constructed in a circular form, although rectangular rooms constructed with this technique have also been found. Many of the reed walls, particularly if they are well built, seem to have survived the flood onslaught and as such appear to be resilient structures.

Those that had a covering of mud seem to have fared better. However, in the case of many the onslaught of floods has resulted in loosening of the reed wall due to damage to the reed rope that encircles and ties the vertical reed formation.

There are reports of the structure being affected by termite which shortens the life of the walls.

B. PRECAUTIONS REQUIRED FOR REED WALLS

The following precautions in construction will prolong the life of such structures:

- a. Since the damage is found largely at the base, it is therefore important that the floor and the base of the reed structure is fully covered by providing a toe like mud base.
- b. The damage to the reed rope that encircles the vertical reed structure shows that the fastening arrangement has to be much stronger. Studies need to be carried out in fastening methods for the reed rope with the vertical reeds structure.
- c. The disintegration of the outer mud plaster cover results in damage to the main reed wall structure. The use of a lime-mud mix for plaster will provide the necessary protection to the inner reed structure.
- d. Since the reeds directly touch the earthen surface, it is important to treat the base of the reed wall with termite treatment. Since it can be an expensive proposition, the soaking of the bases with lime, will prolong the life of these structures.



Seepage of water through badly constructed roof making the structure vulnerable.



Extra dead weight on a roof causes the collapse of the entire structure.



Reed wall construction. Eroded mud plaster render and lack of protection at the base.



Picturesque reed/ conical roof structure, that has survived well.



Disintegration of mud plaster on walls. The base is entirely vulnerable.



Local soft wood joists prone to termite damage, and unable to carry extra load.



Conical roof structure with well plastered reed walls.

C. REED / CONICAL ROOFS

The reed roofs are mostly conical and are used with circular plan form. If well built they are beautiful to behold and add to the character and picturesque setting of the place. The construction in this form is complicated, but very interesting. Wooden logs are utilized in a concentric fashion and that terminate at the apex of the cone. Many a time reed ropes are used as structural members. These are then spanned with matting and finished off with thatch. The quality of thatch varies; sometimes it is carried out with a great deal of care and is very tight in its implementation. When loose, it tends to get damaged easily.

The structure consists of the following







- a. 4 Joists placed on the wall with centrally key joint tied on the top where Joists meet called *math* locally
- b. These Joists are tied with "*dhori math*" on the upper part of the wall where this roof rests.
- c. In the middle of these joists, 3 battens are placed that are tied with *dhori math*.
- d. These battens are called Kaya of Akh wood, and are used to create the primary surface of the roof.
- e. The final covering of 4" thickness called *khipo* (thatch) is laid, which is tied / held together with *naridi* (*dori*/Thread).

D. PRECAUTIONS REQUIRED FOR REED ROOFS






The well built and well thatched roofs need to be studied with greater attention. Although this roof is not accessible and as such does not provide safety during floods, however, these roofs are quite strong and if well built can survive flood disasters. The techniques used for thatching should be promoted for water proof conical roofs. Since they cannot be used for refuge during floods, but the form and technique are so remarkable, that it is important to find ways to use this form for community buildings. Such forms will add colour and identity to the character of communities.

The data that has been collected can be used to build many kinds structures for many purposes, especially for community use, that are based on the vernacular construction techniques.







ANALYSIS OF VERNACULAR METHODOLOGIES

FINDINGS		IMAGES
A	ROOF – OVERVIEW	
1.0	EXTRA DEAD LOAD	
1.1	Accumulated straw bale or other discarded household items on the roof.	
1.2	Extra layers of mud plaster applied to the roof over the course of time.	
2.0	DETERIORATION OF MUD PLASTER	
2.1	Exposed structural members to rain and moving water.	
3.0	ROOF CONSTRUCTION FAULTY	<i>Over loaded roof structure.</i>
3.1a	The selection of the size, form and weight of structural members demonstrates little know how in the making of vernacular buildings. In addition to this, there is often no clear structural grid in which roof elements have been laid out.	
3.1b	There are some dwellings in which the order and organisation of beams, joists and purlins has been skilfully made.	
3.2a	Joists and purlins are not tied together. Especially in flat and pitches roofs, there were few cases in which more than one or two main members were tied or braced.	
3.2b	Where the roof has been successfully braced it has survived.	
3.3a	The roof structure is often not tied to the wall. This causes water damage at the top of the wall and allows water to seep into the interior of the dwelling. Without adequate tying the roof has caved, and/or shifted.	
3.3b	Where necessary connections between the roof and the wall are skilfully made, both structures have survived.	
3.4a	Use of new materials such as the RSJ girder without necessary structural support from walls.	
3.4b	More successful use of RSJ with wood, bamboo bracing and thatch and reed cover. It is evident that mud walls, if well constructed, are strong enough to support the RSJ girder.	
3.5	Even for those flat, single or double pitched roofs that have survived, they are not structurally strong enough for residents to take refuge during floods. There is an inadequate transfer of knowledge and skill in building.	
3.6	Beams are not adequately supported by walls. Walls show signs of deflection and cracking. No proper bed plates, levelling of top or measures for spreading the load.	
4.0	OVERHANG OF ROOF STRUCTURE	
4.1	No overhang of roof structure to protect the top of the walls from weathering and deterioration	
4.2	No overhang above openings to prevent water from coming in, or lentils from weathering and deteriorating.	
5.0	WEATHERPROOFING	
5.1	Water seepage through roof thatch. There is no clear understanding of weatherproofing.	
5.2	Residents often apply extra layers of mud plaster to the roof in an attempt to waterproof the structure. Without adding a layer of lime this is an ineffective measure. This activity also adds to the dead weight of the structure.	
5.3	Tarpaulin been used in some homes. Incorrect installation has rendered this intervention for water proofing useless.	
		<i>Collapse of roof and wall structure.</i>







ANALYSIS OF VERNACULAR METHODOLOGIES

FINDINGS		IMAGES
B	ROOF – MATERIALS	
1.0	BAMBOO - USED FOR BOTH THATCH AND FOR STRUCTURAL SUPPORT IN ROOF SYSTEMS.	 <p><i>Inaccessible and weak bamboo roof.</i></p>
1.1	In most bamboo roofs, there is a deflection in bamboo purlins. This is due to a number of reasons observed; overloading the roof structure, incorrect tying of members, absence of grid in laying down elements and water damage.	
1.2	Bamboo roofs have generally survived better than other materials used for structural members.	
2.0	REED, WOOD INTERLACE, STRAW OR THATCH	 <p><i>Loss of mud plaster.</i></p>
2.1	Where thatch laying is unsatisfactory, there is often a displacement of the roof structure, in addition to water ingress	
2.2	Growth of mold and fungus where thatch has soaked up and retained water.	
2.3	Has survived despite the floods and poor quality of construction.	
3.0	FABRIC	
3.1	Woven rope	
4.0	MATERIALS USED FOR TYING	
4.1	Cloth, cane rope, rope	
C	ROOF – FLAT AND PITCHED ROOF STRUCTURES	
1.0	LACK OF RING BEAMS OR BED PLATES Resulted in increased load concentrations at support points causing local crushing and damage to mud or masonry walls.	 <p><i>Weak and inaccessible roof structure.</i></p>
2.0	In most cases PURLINS are spanned by reed matting.	
3.0	MATTING is often covered and jointed to the structure by mud plaster.	
4.0	UNABLE TO TAKE THE LIVE LOAD of people, livestock or belongings	
D	ROOF – CONICAL ROOF STRUCTURES	
1.0	CONICAL ROOF STRUCTURES. Survived well and withstood rain water seepage.	 <p><i>Conical roof structure - skilfully built.</i></p>  <p><i>Poorly woven thatch.</i></p>
1.1	The roof itself is usually skilfully built and, when thatched properly, it has survived well and withstood rainwater seepage.	
1.2	Buildings are not erected on elevated ground. As the roof is conical in shape it does not provide a solution for refuge in times of flood.	
1.3	Badly constructed thatch has deteriorated.	

ANALYSIS OF VERNACULAR METHODOLOGIES

FINDINGS		IMAGES
E	WALL – OVERVIEW	
1.0	TOP OF THE WALL EXPOSED AND UNTREATED.	 <p><i>Deterioration of mud plaster.</i></p>
1.1	Absence of over hangs exposes the top and the face of the wall to weathering and deterioration.	
2.0	NO SUPPORT FOR DISTRIBUTING THE LOAD OF THE ROOF.	
2.1	No bed plates or ring beams found that may distribute the load of the roof evenly. Structure placed directly on adobe and reed walls has caused structural failure.	 <p><i>Cracking of wall due to weight of beam.</i></p>
2.2	Cracking in walls due to point load of roof structure. Top of the walls are not levelled. Beams are often propped up by an external wooden post.	
3.0	POOR CONSTRUCTION OF WALLS	
3.1	Walls built in adobe, reed and wood construction and survived considerably well.	 <p><i>Exposed top of the wall vulnerable.</i></p>
3.2	Although the structures have survived, they are not strong enough to take the load of accessible safe haven roofs.	
3.3	Innovation in the selection and combination of materials in building walls	
3.4	Connections between building elements (roof, foundation) as well as openings (windows, doors, ventilators) are not watertight or strengthened.	 <p><i>Well constructed mud wall.</i></p>
4.0	BASE OF THE WALL EXPOSED & UNTREATED.	
4.1	Disintegration of mud walls at the base is among the causes of wall collapse.	
4.2	Where toe or footings are found they are often not built well enough to protect the base of the wall.	 <p><i>Dampness at the base of walls.</i></p>
4.3	There is no foundation for the building or practice of compressing the soil in preparation for wall construction.	
5.0	MUD PLASTER USED WIDELY AND INADEQUATE FOR WEATHERPROOFING.	
5.1	Mud plaster is widely used and washes away easily in rain or flood water leaving the structure of the wall exposed.	 <p><i>Displaced building structure.</i></p>
6.0	GROUND FLOOR LEVEL LOWER THAN ADJACENT GROUND LEVEL.	
6.1	In almost all cases the floor levels of the houses are found to be lower than the adjacent ground.	
7.0	LINTELS	
7.1	The log or wood plank used for making openings is too weak to support the weight of the roof.	
7.2	There are no chajas (over hand & projection) over lintels and lintels are not adequately protected.	
8.0	USE OF LOCAL MATERIALS ALLOWS VILLAGERS TO EXPRESS CHARACTER AND AESTHETICS IN THE ORNAMENTATION OF DWELLINGS	
8.1	The community expresses art and craft through the finishing and ornamentation of local materials such as mud plaster and jafiris.	
9.0	INVOLVEMENT OF WOMEN IN CONSTRUCTION & FINISHING	
9.1	Provides opportunities for employment and engaging women in community life and decision making	
10.0	EASE OF AND SPEED IN PROCURING MATERIAL	
10.1	All of these are procured locally and at minimal cost. In addition to this, there is little time taken to prepare these materials for construction.	

ANALYSIS OF VERNACULAR METHODOLOGIES

FINDINGS		IMAGES
F	WALL – MATERIALS, MUD	
1.0	WIDESPREAD	 <p>Well constructed mud wall.</p>
1.1	The use of mud in walls is widespread in almost all areas.	
2.0	STRUCTURALLY STRONG	
2.1	Well constructed mud walls have not only survived, but have supported the weight of RSJ girders.	
3.0	INSULATION	
3.1	Mud walls are a source of good insulation.	
G	WALL – MATERIALS, WOOD	
1.0	TERMITE DAMAGE	 <p>Reed rope used to tie roof and wall structure.</p>
1.0	Reed walls are susceptible to termite damage	
2.0	MOLD GROWTH	
2.1	Standing water has caused mold growth in reed and wooden structures	
3.0	REED WALL CONSTRUCTION	
3.1	Skilfully woven reed walls that have survived water damage, but are not strong enough for accessible roofs	 <p>Unsafe placement of RSJ girders.</p>
3.2	Poor weaving of reed, both vertically and horizontally, has led to structural collapse.	
3.3	The reed rope, that encircles the vertical reed structure, has mostly been found in a damaged state.	
3.4	Reed walls are found in circular and rectangular construction.	
4.0	WOOD INTERLACE	
4.1	Wood interlace, made with branches or reed, has survived but has generally been found to be damaged by the floods.	 <p>Good use of wooden fretwork jafri.</p>
5.0	BAMBOO	
5.1	Used as structure for walls, or supporting structure in reed walls.	
6.0	WOOD FRAMES & JAFRI	
6.1	Wooden frame construction is not commonly used due to the availability and cost of wood.	
6.2	Painting geometric patterns on wooden jafris as a way to express identity and as building ornamentation.	 <p>Disintegration of mud plaster.</p>
7.0	MUD PLASTER	
7.1	Disintegration of mud plaster results in damage to wood, reed and mud Walls	
H	WALL – MATERIALS, BRICK	
1.0	BURNT BRICK HOUSES WERE FOUND IN CLUSTERS	 <p>Unsafe burnt brick construction.</p>
1.1	Although mud plaster has washed away, generally brick walls have survived.	

4.0 WAY FORWARD

4.1 HERITAGE FOUNDATION APPROACH TO DISASTER RISK RESISTANCE

The goal is to make communities strong and resilient and able to deal with the next flood disaster in an efficient manner. Accordingly, all methodologies for construction require that all structures are capable of withstanding anticipated disasters. That disaster risk reduction and disaster management must be an inherent and irrevocable part of any shelter, reconstruction or rehabilitation strategy requires no elaboration.

In the present situation, many believe that the flooding will be a recurring theme. Therefore, all funding should be directed towards enabling communities to be safe themselves as well as to build in safety factors to achieve safety of life, food rations, drinking water, livestock and livestock feed. These aspects can be built into community life as interventions that will improve their quality of life, foster pride, and engage youth and community into productive activities such as sports and cultural events. The Heritage Foundation's model for DRR ensures:

- a. Appropriate and timely mobilization of human and monetary resources for relief. Strategy for systems and networks to facilitate organization in case of emergency.
- b. Rehabilitation and construction should be strong enough to withstand future disasters (rain, flood and standing water). Method to include the installation of Safe Haven or Karavan Roof units, to provide an elevated platform for refuge during floods. DRR driven community structures for food, water, livestock & fodder (asset) and community buildings.
- c. Strategy for community and cultural support. Strategy to allow for further modules to be plugged in to the emergency response. Modules maybe delivered through collaboration with specialists. Currently modules for literacy, health, permaculture, forestation and community and cultural support have been designed into the HF Model for DRR for vulnerable communities.

4.2 PROJECT DESIGN & IMPLEMENTATION

4.2.1 RESOURCE MOBILIZATION

Appropriate and timely mobilization of human and monetary resources for relief. The more time communities spend displaced there is an increasing risk posed to their security and health.



Local community participating in rehabilitation, tamping the soil well to create a firm base.

Therefore, care must be taken to ensure that DRR response is quick and provides early recovery for post disaster communities. Foreign aid or funding must be supplemented to reduce dependency in the case of emergency. Local organisations have the advantage of interacting with communities with greater ease. This understanding and appreciation of local culture and heritage must not be lost in programme design and implementation.

The Heritage Foundation has developed a DRR model that incorporates an extensive training programme. The training programme is to disseminate local skills and knowledge in building, through the training of master artisans, local artisans and villagers.

4.2.2 DESIGNING AND IMPLEMENTING DRR PROJECTS

The project must be designed so that it is sustainable. An important part of sustainable models is the strategy to scale up the project. Scalability strategies need to be carefully executed. Low cost methods are urgently required for mass deployment through mobilization, training and implementation. To reach the enormous number of households dispersed in a vast area stretching from S. Benazirabad and Mirpurkhas to Tharparkar, the usual methods of partnerships and contractor-driven deliveries are unlikely to provide speedy results.

As mentioned earlier, today's emergency requires innovative procedures that are based on the concepts such as the Heritage Foundation's mobile Barefoot Karavan Teams, composed of university student volunteers, local trained artisans and villagers as social mobilizers. By marshalling the highly motivated youth of the country and placing reliance on enterprising community members including women, the entire effort can be scaled up and deliveries ensured in a surprisingly short period of time.

In addition to this, considering the insufficient funding so far available through national allocations and international donor response, the unprecedented disaster requires a combination of approaches for fund mobilization:

- a. International funding if limited to US\$ 200-300 can double the number than was originally envisaged.
- b. Matching grants by international donors/government for landlords can double the number of units in the village – for example, 20 units underwritten by the landlord can translate into 40 units.
- c. Partnering with Chambers of Commerce and Industries to encourage adoption by corporate sector. A large number

of affected villages can benefit from CSR (Corporate Social Responsibility) programmes taken up by all reputable corporations and multinationals.

- d. Matching grants for households – 50% cost provided by households through labour or material to be matched by international donors/government.
- e. New bamboo roofs for old steel girders – because of insufficient knowledge in its use, the steel girder did not translate in to a safe house during excessive rains and flood. Thus, sale of two or three girders could purchase an environmentally friendly entire safe haven roof.
- f. With elections round the corner, all political parties can multiply their votes by helping their potential voters build strengthened mud walls and safe haven roofs.

A crucial part of the design of DRR projects is to provide an appropriate framework for interaction with the community.

- a. All personnel should travel in low-key vehicles, so as not to attract attention.
- b. As in the case of the Barefoot Karavan Experts of Heritage Foundation teams should wear coordinated uniforms or clearly identifiable markers. This aids the spirit of teamwork as well as provides a face of the organisation that the community can relate to and identify.
- c. To show solidarity with the people, all possible care will be taken not to in any way hurt or harm the sensibilities of the local people.
- d. Through workshops urban residents should learn to respect traditions and norms of communities which are visited or are helped.
- e. To help aid community and cultural regeneration in post disaster communities, teams must be educated about the diverse issues and problems that the communities are faced with. Through this teams are not only able to understand the context and people, but also engage in informally imparting some correct knowledge about issues.
- f. The spirit of caring and sharing will be instilled among all those who have elected to work.
- g. Impart the importance of living values, conservation of environment and heritage, and respect for rule of law.

4.2.3 SHELTER UNIT

Rehabilitation strategies should incorporate the use of elevated/floating structures to provide refuge during future disasters. The biggest issue today is how to provide families with shelter that



Student Volunteers interacting with the community.



Mode of transport for HF field teams.



Trained HF artisans demonstrating fabrication of bamboo elements.



Children proudly showing clean hands, in HF project in Khairpur.



Families in HF project in Khairpur growing their own vegetables.



Children communicating information about the natural and built environment through drawings, in HF project in Khairpur.

provides safety from rising waters in their homes. Another important aspect is to motivate communities to drive the process of shelter construction themselves. As soon as communities feel that they are able to make safe shelters, they stop waiting for other agencies to intervene and thus, transform their outlook from a culture of dependency to a culture of self reliance.

Bringing about this change in mindset will itself make communities strong and resilient and enable them to make all the preparations required to combat the next flood disaster. This change in mindset can be brought about through a motivational campaign coupled with provision of technical information. The details of this campaign will be discussed as part of community and cultural support.

It is clear from the recent activities that have been carried out by Heritage Foundation that rehabilitation of houses can be achieved at the rate of a day and a half each. The ease of construction and the understanding developed by watching the methods for strengthening their mud structures encourages others to undertake various works themselves. The community has also understood the efficacy of strong roofs that can provide them refuge. Thus, if 30% of houses are partially standing, they could be stabilized and rehabilitated at an extremely fast pace.

4.2.4 COMMUNITY AND CULTURAL SUPPORT

Other aspects such as forestation, literacy, clean water, health and hygiene as well as livelihoods aspects need also to be built as a sequel to the implementation of this project. As in the case of the Foundation's other projects, this holistic approach can be pursued after communities build a relationship of trust with Heritage Foundation through implementation of successful examples of rehabilitation work being carried out. Once the community is engaged other activities for the benefit of the community can easily be undertaken.

Mobile Karavan Barefoot Teams with diverse specialisations will be trained to provide advice on hygiene, health, literacy, family planning, economic empowerment of women through crafts and agro-based products, vegetation and plantation, creative and performing arts etc, which are necessary to make communities strong. As a methodology for DRR, cultural support in the form of playgrounds, performance stages and cultural nodes for gathering have been proposed. This provides the community, particularly youth and women with recreational spaces as well as for them to develop systems and networks for interaction and development.

4.2.5 APPLICATION OF GIS IN DRR

Participatory mapping is being proposed as an activity to help communities better understand resources and networks in their natural and built environment. This will allow communities to share relevant and important information about the terrain, including mapping resources, hazardous sites, income generating activities (such as agricultural fields, business centres) and land-based or environmental concerns for the community. This activity will facilitate accessing and analysing the area for emergency response in disasters and post disaster rehabilitation efforts.

By identifying high risk areas through remote sensing satellites, villages can be evacuated well in time to higher and safer ground so as to minimize loss of life and livestock.

MITIGATION / PREPAREDNESS

Through participatory GIS, communities can help identify important existing resources and facilities in the region that may need to be accessed or protected in case of flooding. An example of this might be a hospital or detention facility. In addition to this, communities can identify potential sites that can aggravate the damage and devastation caused by a flood. Thus, effective management would be possible in protecting a source of potable water or preventing communities from using it in the case of contamination.

RELIEF RESPONSE / RECOVERY

Having an effective DRR GIS system in place can facilitate coordination between organizations involved in relief work as well as the appropriate allocation and effective distribution of resources, even without an effective internet connection. Spatial data collection through participatory mapping can also enable communities to help relief workers navigate into otherwise inaccessible areas.

ACCESS TO INFORMATION

The activity will help communities to better understand their own terrain and the availability of resources.

4.3 SCALABILITY OF HERITAGE FOUNDATION'S DRR MODEL

Heritage Foundation DRR Model is built on the principles of participatory action and the use of local materials and methodologies in interventions. Thus by nature the basic framework of the model is easily scaled up from villages to tehsils and districts to provinces. Based on our experience, we believe



Vernacular techniques allow widespread participation of family members.



Learning to place bamboo posts.



Making mud-lime mix for wall rendering, allows participation of women in rehabilitation of their houses.



Understanding vernacular building construction.



HF Team documenting vernacular structures.



Women in villages participating in rehabilitation of their mud walls after being assured safety of mud walls.

that much of the arrangement for combating the disaster can be achieved by the communities themselves. What is always missing is technical advice which if available will improve their own capability. Heritage Foundation has worked out the concept of building **DISASTER RISK RESILIENCE AND MANAGEMENT** in all structures that are constructed in the future. In addition to this a **TRAINING AND MENTORSHIP PROGRAM** has been designed to allow the program to be scaled up quickly.

In view of the experience in working in post-floods communities in Sindh, the following aspects need to be considered:

- a. Even though marginalized and largely non-literate, they are able to comprehend critical aspects of self protection. Advice on building correctly, adopting better hygiene practices or other possible improvements, is taken seriously when and if it is conveyed in a sympathetic manner.
- b. Although the disaster area is spread over a vast expanse, it would be possible to reach out to each village and indeed each house through a well worked out stratagem.
- c. The provision of technical information to all households is essential, which needs to be provided in the form of workshops, demonstrations and advisory sessions.
- e. It is important to create teams for providing supervision and monitoring of the works being carried out.
- f. Training and capacity building of all groups and institutions interested in providing shelter is essential.

4.4 TRAINING AND CAPACITY BUILDING BY HERITAGE FOUNDATION

4.4.1 COMPONENTS OF THE PROGRAM

The extensive task requires detailed planning for effective delivery. Developing and investing in training and mentoring programmes are essential in order to scale up the model for extensive delivery. Detail of components are as follows:

COMPETENCY & SERVICE CENTRES (CSC)

These will be run by Certified Entrepreneur Artisans with an important role in regeneration of local economy. They will act as a roof and lime hub in the area, and as business ventures for production, selling, installation and support for sustainable construction.

MOBILE BAREFOOT KARAVAN TEAMS (MBKT)

Throughout the project period, a mechanism of quality control and certification will be provided by MBKT in the field, in coordination with Heritage Control Centre.

HERITAGE CONTROL CENTRE (HCC)

HCC will develop training modules, technical guidance and information, as well as backstopping arrangement and liaison with CSC, MBKT and IPs. It will maintain all records and track progress as well as evaluation of performance by CSC and CEA Teams.

For smooth functioning of the project and transparent procedures, the disbursement of funds will be the responsibility of the Implementing Partners, and will be distinct from training, monitoring, evaluation and certification, which will be the responsibility of Heritage Foundation.

4.4.2 OUTLINE OF TASKS AND ROLES

The following roles are envisaged for implementation.

TASKS FOR IMPLEMENTING PARTNERS

- Identifying regions for shelter construction.
- Mobilizing communities.
- Listing eligible households.
- Arrangement for disbursement of Cash for Work programme.
- Settling price with Competency/Service Centres for supply and shelter completion.
- Payment against vouchers to Competency/Service Centres.
- Controlling, Measuring and Evaluation of their part.

TASKS FOR HERITAGE FOUNDATION

- Training Master Trainers (MT). A detailed set of drawings will be provided as technical guidance.
- Training Certified Entrepreneur Artisans (CEA). Assisting in venture support and on going training to the head of each CSCs, including maintaining close rapport with CSCs.
- Setting up Mobile Barefoot Karavan Teams (MBKT) for design/technical input, monitoring and evaluation, and issuance of completion certificate.
- Setting up Heritage Control Centre (HCC) for training module development, technical guidance, liaison and feedback.
- Controlling Measuring and Evaluation of their part.

4.4.3 TRAINING PROGRAMS BY HERITAGE FOUNDATION

CERTIFIED MASTER TRAINERS (CMT) TRAINING PROGRAM

- Each team will comprise two Master Artisans and one architect/engineer.
- CMT Teams will continue to guide and check quality of work in Competency/Service Centres.



Artisans being trained in prefabricated bamboo joist production.



Master Artisans' training session conducted by Saad Khan and Naheem Shah.



Modules for Master Artisans' Training.



Barefoot Karavan Team - Coordinated Uniforms.



Audience listening with rapt attention how to rehabilitate their own collapsed houses.

CERTIFIED ENTREPRENEUR ARTISANS (CEA)

- Workshops to be held in all tehsils by CMTs.
- Each workshop to be attended by artisans and helpers.
- Awareness in DRR measures and sensitivities towards gender empowerment and conflict resolution measures will also be built-in in the learning outcomes of the training programme.

MOBILE BAREFOOT KARAVAN TEAMS

- Arrangement for student volunteers, village mobilizers and artisans teams to be made. MBKT to continue throughout the project.
- Workshops Student volunteers to be mobilized in batches for 3 weeks/batch.
- Workshops to be conducted for each new batch.

MENTORING PROGRAM FOR IMPLEMENTATING PARTNERS

- Monthly workshops to be conducted for training, liaison and information sharing procedures

4.5 AWARENESS-RAISING THRU MASS MEDIA

Mass media such as radio and television should be used to spread awareness of DRR driven building methodologies, cultural renewal activities and to instil a sense of pride in the community. Media such as radio and television can be used effectively;

- a. As an early warning system to alert communities of the risk of disasters and how to better prepare themselves.
- b. Promoting information about hazards in disasters. For example electrocution, water borne diseases etc.
- c. Disseminating information about good practice in building DRR compliant structures.
- d. Creating community support action, such as sharing interviews of households that have demonstrated courage, resilience and innovation in times of severe loss and distress.
- e. Helping villagers locate training centres, roof production hubs or emergency centres in the area.

Television should be used to air programs:


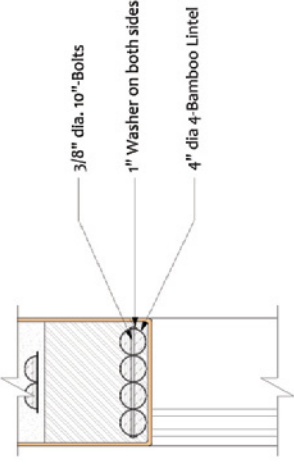
1. Incorporate characters that villagers can relate to, to discuss issues, impart knowledge and promote living values.
2. Demonstrate vernacular methodologies for rehabilitation as well as impart practical information for community and cultural support.

DRR-COMPLIANT VERNACULAR CONSTRUCTIONS

PROBLEMS

INTERVENTION

DRAWINGS / IMAGES

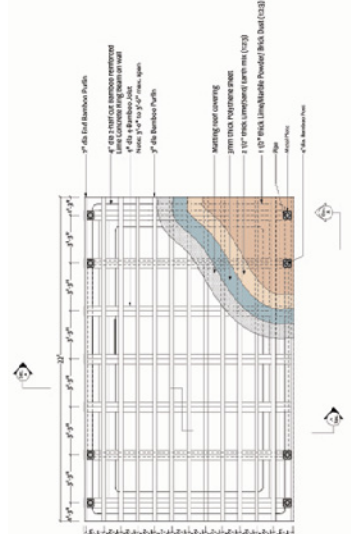
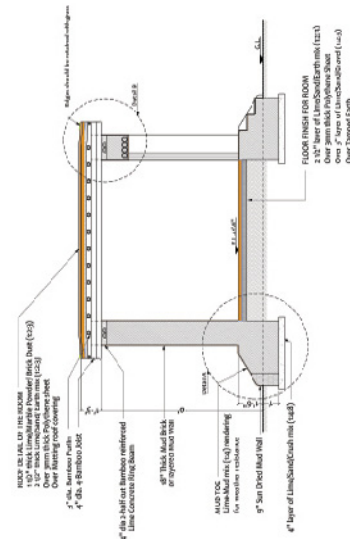
1.1	<p>Absence of roof overhang. Exposes walls to weathering.</p>	<p>The Heritage Foundation has built in an overhang into the HF Safe Haven / Karavan Roofs.</p> <p>OVERHANG / EAVES</p> <ul style="list-style-type: none"> No roof should be built without eaves. Eaves overhang in roofs essential to provide protection to openings. Safe Haven / Karavan Roofs have a 15" prescribed overhang. 	
1.2	<p>Deflection in lintels or collapsed lintels.</p> <p>- In many cases wooden plank or logs as lintels are found to be too weak.</p>	<p>DRR driven rehabilitation and new built construction ensures the correct construction of lintels so as to prevent collapse of openings, wall and roof structure.</p> <p>LINTEL CONSTRUCTION</p> <ul style="list-style-type: none"> Strong lintels to be constructed to support the load of masonry above openings. The use of wood in lintels should be minimized/discontinued. Low wall height i.e. 8'6" with 1'6" eaves above door/window openings provide sufficient protection from rain. Use of 4-bamboo lintels bolted & tied together provide sufficiently strong support for the masonry above the opening. 	

DRR-COMPLIANT VERNACULAR CONSTRUCTIONS

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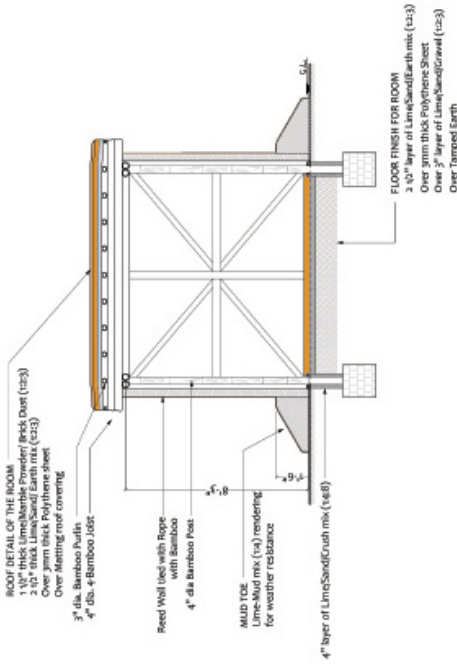

1.3	<p>Water seepage into the interior of the building</p> <ul style="list-style-type: none">- Deterioration of mud plaster of roof.- Poorly woven thatch.	<p>HF Save Haven / Karavan Roof has prescribed waterproofing layers and finishing to prevent seepage.</p> <p>TARPAULIN</p> <ul style="list-style-type: none">o Water seepage in the structure causes deflection of structural members as well mould over time.o Tarpaulin is installed in both rehabilitated structures as well as new builds. <p>LIME / MUD PLASTER</p> <ul style="list-style-type: none">o Wall finishing by introduction of lime/ mud plaster as a finishing layero The top layer of mud & lime mix 1:2:3 must be added to make the entire roof weather resistant, & stop ingress of rain water. <p>THATCH WEAVING</p> <ul style="list-style-type: none">o Reed and thatch structure should be well woven to prevent water seepage.	
1.4	<p>Construction of roofs is unsatisfactory and unscientific.</p> <ul style="list-style-type: none">- Leading to collapse of roof structure.- Is not suitable for providing refuge in floods or rain.	<p>DRR SAFE-HAVEN KARAVAN ROOFS - construction & installation</p> <ul style="list-style-type: none">o Mud walls can be strengthened to take the load of a DRR-driven roof.o The strong safe-haven HF Karavan Roof which can provide refuge during floods.o DRR-driven Karfavan Roofs are built with 4-bamboo or 6-bamboo joists. These have been tested in Tando Allahyar with a load of 15 persons.o The Karavan Roofs should be laid with minimum 6" slope (ratio of 1 in 12), along with a layer of tarpaulin, chik (reed) panels, and finished with a lime/mud layer.o DRR-driven Karavan Roof can be added above the local wood and reed walls by erecting a bamboo cross-braced inner frame, tied with bamboo plinth and ring beams at the bottom and top of walls.	

DRR-COMPLIANT VERNACULAR CONSTRUCTIONS

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2.7	<p>Reed Walls</p> <ul style="list-style-type: none">- Damaged reed rope that holds roof and wall structure- Poorly woven thatch	<p>REED ROPES</p> <ul style="list-style-type: none">o Encircling reed walls or conical roofs must be skilfully made.o Strengthened Reed Walls can support a Safe Haven / Karavan Roof.o Replacement of wood vertical members with bamboo should also be considered.		
2.8	<p>Exposed wood is vulnerable to termite attacks.</p>	<ul style="list-style-type: none">o TERMITE PROOFING FOR WOOD.		



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*Front cover: Barefoot Karavan Team Training Centre, Mohak Sharif, Tando Allahyar: sustainable structure built with bamboo, mud and lime.
Back Cover: Kanta, in her rehabilitated DRR-compliant sustainable shelter, lovingly decorated by herself, Oct. 2011.*



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