Low-Cost Technology and Social Justice

- Exploring Monolithic Alternatives for Pakistan

Dr. Mohammad Ashraf Khan
Head of Department
Dept. of Architecture, City University, Peshawar

Dr. Amjad Naseer
Chairman
Dept. of Civil Engineering, UET Peshawar (Bannu Campus)

Introduction

- **Application of Social Justice Concepts**
  (right to dream vs the poverty pimp and pride of self-sufficiency vs loss of identity)

- **Relevance of Monolithic Forms**
  (Superadobe/TSS, potential cost savings, in-situ materials, constructability [speed/process/skill req.], energy efficiency)

- **Key Issue – Cultural Acceptability**
  (assessment, potential of 'novelty')

- **Design Challenge**
  (creating 'novelty via aesthetics)

Social Justice Concepts

A NEXUS OF SOCIAL JUSTICE, TRADITION AND DISASTER RISK REDUCTION INTERVENTIONS IN BALAKOT, PAKISTAN
– fostering independence or dependence?

by Mohammad Ashraf Khan and Dr. Lian Loke

What happens when traditional building practices are based on a particular material, and that material vanishes? And what if the context in question is a high seismic risk region – where traditional practices had offered vital protection from disasters? This is the backdrop against which the 2005 earthquake wreaked its havoc in Balakot, Pakistan. 70,000 lives were lost, including 20,000 children. This paper is focused on post-earthquake interventions. Mainstream initiatives have been fostering dependence by introducing costly technologies that rely on socio-culturally crippling financing regimes. There is a need to explore approaches that instead offer social justice through conservation of independence.

A major cause for the massive destruction witnessed during the 2005 earthquake in Balakot, Pakistan, was structural collapse of the built environment. Yet it has been revealed by a local NGO that some people are still using the same post and lintel construction technique that failed in the earthquake. Why do the people want to use an unsafe technology? What is preventing them from continuing their traditional practices of timber-based earthquake-resistant construction? Or, why don't they want to adopt other safe construction practices? Is this a simple gap in awareness or affordability, or the culmination of complex socio-political dynamics? This paper reports on visits to Balakot aimed at investigating the uptake of alternative low-cost technological systems in the wake of the introduction of high-cost solutions by the government and international aid agencies. Of particular interest is the case of the award-winning Cal-Earth model. This low-cost model was demonstrated by philanthropists through the construction of approximately 500 small emergency shelters in 2006, but was unable to capture the interest of the people. A key finding is that the lack of uptake is due to a gap between this model's actual and perceived benefits. It is recommended that this gap can be reduced through exploration of meaningful participation of the people in construction technology decisions. At stake is the social justice aspect of introducing alternative technologies in disadvantaged communities. Namely, what if such interventions foster dependence instead of independence?

Context

> *"…there is no such thing as a natural disaster…the contours of disaster and the difference between who lives and who dies is…a social calculus."* – Neil Smith[1]

This quote echoes the point raised over two centuries ago by Rousseau in a letter to Voltaire on the loss of life during Lisbon's 1756 AD earthquake: 'nature did not construct…[the]… houses'.[2] Together these words offer an apt backdrop for contemplating a response to the structural failures that occurred during the 2005 Balakot earthquake in Pakistan.[3] People of this region have almost a millennium-old tradition of earthquake-resistant construction, which was literally stolen from them in the last century and a half due to scarcity of timber caused by government-sanctioned indiscriminate deforestation.[4-8] Stripped of their tradition, and as yet lacking a commensurate alternative, the people of Balakot are indeed in need of a safe building practice solution. This may appear to be a

Social Justice Concepts

Right to Dream

2005 Convention on the Protection and Promotion of the Diversity of Cultural Expressions

"...the right to culture is limited at the point at which it infringes on another human right..."

Social Justice Concepts

Pride of Self-Sufficiency vs Loss of Identity

1994 Human Development Report

"... human security is not a concern with weapons —it is a concern with human life and dignity ..."

Social Justice Concepts

Poverty Pimp

…helping the poor to help one's self…

STRENGTH AND ENERGY AUDIT OF REINFORCED CONCRETE SANDWICHED PANELS (RCSPs)

Nouman Khattak[1,a], Asim Abbas[1,b], Mohammad Adil[1,c], Naveed Saeed[2,d], Bashir Ahmad[2,e], Pervez Saeed[2f], Asad Mahmood[3g]

[1]Civil Engineering Department, University of Engineering and Technology Peshawar, Pakistan
[2]NORWEST GROUP (Pvt) Ltd., Islamabad, Pakistan.
[3]ENERCON, Government of Pakistan, Islamabad, Pakistan.

[a]engr_nouman1@yahoo.com,[b]asimabbas12@yahoo.com,[c]adil@nwfpuet.edu.pk,
[d]engr.naveed@norwestgroup.com,[e]info@norwestgroup.com,[f]engr.pervez@norwestgroup.com,
[g]asadm_46@yahoo.com

ABSTRACT

This paper addresses the strength and energy audit of reinforced concrete sandwiched panels (RCSPs) A Reinforced Concrete Sandwiched Panel (RCSP) is composed of an EPS (Expanded Polystyrene) foam core surrounded by spray-on reinforced concrete skins on both sides. The Reinforced Concrete Sandwiched Panel (RCSP) building is more than 50 years old technology, which was not well studied until very recently due to the demand of energy efficient and earthquake resistant structural requirements have emerged as one of the basic needs of modern buildings. Based on these needs RCSP Panels were subjected to different loading conditions including flexure, Axial and shear loading tests. The results of these tests were quite satisfactory. It was found that these panels can be used to construct buildings that can behave efficiently in case of earthquakes. Also there was a need to evaluate the energy efficiency of these panels to evaluate that how much energy these panels can save in the form of saving heating and air-conditioning costs. Although, the thermal conductivity of composites can be calculated mathematically, in order to evaluate RCSPs for application in a variety of weather conditions a device called "Hot-Box" will be produced locally to measure thermal conductivity of RCSP panels experimentally. Based on the tests performed on individual elements of RCSP composites by previous researchers it has been concluded that RCSP panels are energy efficient both hot and cold weather.

KEYWORDS: concrete sandwich panel, thermal efficiency, energy efficient

1. INTRODUCTION TO RCSP

A reinforced concrete sandwich panel (RCSP) is composed of an EPS (Expanded Polystyrene) foam core surrounded by spray-on reinforced concrete skins on both sides. A schematic of a typical RCSP is given in Figure 1a.The Reinforced Concrete Sandwiched Panel (RCSP) building, also called Sandwich Concrete Insulated panel (SCIP), ThreeDee Panel and other proprietary names, is more than 50 years old technology (PCI committee report, 1997), which was not well studied until very recently. Due to the current hype of demand of energy efficient and earthquake resistant structural requirements, RCSPs have emerged as one of the must have technologies to be adopted in modern buildings. Also to cope with global warming, the reduction of carbon-footprint demands a control on building industry,

Experimental Investigation on The Characterization of Solid Clay Brick Masonry for Lateral Shear Strength Evaluation

Qaisar Ali[1], Yasir Irfan Badrashi[1], Naveed Ahmad[1,2,*], Bashir Alam[3], Shahzad Rehman[3], Farhat Ali Shah Banori[3]

[1]Earthquake Engineering Center, UET, Peshawar, Pakistan.
[2]ROSE School−IUSS Pavia, Pavia, Italy.
[3]Department of Civil Engineering, UET, Peshawar, Pakistan.
Corresponding Author: anaveed@roseschool.it, +393463029255

Abstract

The aim of the paper was to carry out the mechanical characterization of solid fired clay brick masonry through experimental investigation, essential for structural evaluation under lateral loads due to winds and earthquakes within the context of design and assessment studies. The basic material properties of masonry including compressive strength, diagonal tensile strength, shear strength, masonry bond strength, Young's and shear moduli are obtained through laboratory testing on masonry prisms (48 samples), triplets (96 samples) and wallets (48 samples). Standard brick unit prevalent in Pakistan is considered, similar to units that can be found also in neighboring countries like India, Iran and Bangladesh amongst others. Three types of mortar ─ cement-sand, cement-sand-khaka and cement-khaka are used as bonding material for masonry assemblages. Khaka is obtained as a byproduct of stone crushing process, employed in mortar preparation to produce relatively workable and economical mortar. The effect of mix proportions of mortar is also investigated. Empirical relationships are developed herein whereby basic mechanical properties of masonry are correlated with the mortar strength, mortar type and mix proportions. An attempt is made to correlate mechanical properties between each other and establish simplified relationships to help facilitate their use in future applications for design and assessment of unreinforced masonry wall structures under wind and earthquake induced lateral loading.

Keywords: shear, diagonal tensile strength, compression, elastic moduli, mortar, khaka, unreinforced brick masonry.

1 Introduction

Masonry material is largely practiced for construction of structures and infrastructures e.g. buildings, bridges, retaining structures, etc., in most of the underdeveloped and developing parts of the world. It is due to the traditional construction practices employed in these countries, motivated also by the regional climatic conditions . Brick masonry construction employing solid clay units and cement-mortar can be found in many urban exposure of Pakistan and so also in neighbouring countries like India, Iran, Bangladesh among others. Most of the structures in these urban exposures are subjected to frequent lateral loads due to heavy winds and earthquakes that consequently induce shear stresses in the structural walls. The behavior of masonry material under lateral loading is dramatically different than its counterpart materials - concrete and steel, due to high non-homogeneity and composite nature of masonry components. The different mechanical properties of masonry units and mortar and their interface makes the masonry system behavior difficult to predict using simple hypotheses as adopted for concrete and steel. The masonry mechanical characterization can be best performed through experimental investigations, which can help facilitate development of analytical tools for future applications.

Masonry structures are often composed of several load bearing walls for carrying both gravity and lateral loads. In building construction, when the connection at wall intersections and at floor-to-wall is achieved through proper means, with controlled out-of-plane deflection of the floors, the building primarily resist lateral loads by in-plane response of walls (Magenes, 2006; Tomazevic, 1999). The provision of reinforced concrete slab with deep spandrels, presence of tie rods, ring beams at floor levels and efficient floor-to-wall connections favours the integrity of masonry walls. It enables the structure respond in a box like action to lateral

Advanced Materials Research Vols. 255-260 (2011) pp 319-323
Online available since 2011/May/31 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.255-260.319

Experimental Behavior of Full Scale URM Building Retrofitted with Ferrocement Overlay

Mohammad Ashraf [a], Akhtar Naeem Khan[b], Qaisar Ali [c], Khan Shahzada[d] and Amjad Naseer [e]

Department of Civil Engineering, University of Engineering and Technology, Peshawar, Pakistan

[a] engineerashraf@yahoo.com, [b] drakhtarnaeem@nwfpuet.edu.pk, [c] drqaisarali@nwfpuet.edu.pk, [d]shah_civil2003@yahoo.com, [e] amjad_naseer@yahoo.com

Key words: Retrofitting, Steel welded wire mesh, Seismic performance, Unreinforced masonry, Ferrocement overlay

Abstract.

Introduction

( )

( )

( )

( )

EXPANSIVE SOIL STABILIZATION USING MARBLE DUST AND BAGASSE ASH.

R. Ali[1], H. Khan[2], A. A. Shah[3]

[1]Rahmat Ali,

Student of civil engineering, Sarhad University of Science and information technology, Peshawar, Pakistan.
Email:engrrahmatali@gmail.com

[2]Engr. Hassan Khan

Lecturer, Department of Civil engineering, SUIT Peshawar, Pakistan.
Email: engrhassankhan@yahoo.com

[3]Engr. Prof. Dr. Abid Ali Shah,

Chairman, Department of Civil Engineering, SUIT Peshawar, Pakistan.
Email: drabidali@gmail.com

ABSTRACT:

This research is an attempt to investigate the effect of marble dust and bagasse ash on the stabilization of expansive soils. Expansive soils are always characterized by their high expansion, high moisture content, high compressibility, high shrinkage on drying along with wide polygonal cracks and sufficient swelling on wetting. Expansive soils (problematic soil) are present in different parts of the world and extensively found in many locations particularly in Pakistan. In KPK province we select five different sites and collect soil sample and determine their index properties. While selecting sites we visually inspect the soil and collect soil sample from area having wide cracks in soil in dry condition. From the index properties of all the soil samples, district Bannu soil were classified as expansive soil having liquid limit greater than 50% and plasticity index greater than 30%. Currently different techniques are in use for improvements of expansive soil but most of them are uneconomical. For expansive soil improvement we use marble dust and baggase ash which are already burden on our natural environment. Utilizing these wastes for the improvement of expansive soil will be the best alternative. Different lab tests on expansive soil without the addition of these waste and with the addition of these waste were performed and their effect on swelling and other properties were determined. Finally, marble dust and baggase ash can be utilized to treat and stabilize the expansive soil as economical alternative to Portland cement and other (expensive) chemical stabilizers. The use of baggase ash and marble dust for stabilization applications is an economical and environmental solution of the problems associated with its disposal process.

KEYWORDS:

Expansive soil, Expansive index, Swell pressure, Bagasse ash, marble dust.

Construction and Building Materials 77 (2015) 154–159

Contents lists available at ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Economical stabilization of clay for earth buildings construction in rainy and flood prone areas

I. Alam [a], A. Naseer [a], A.A. Shah [b,*]

[a] University of Engineering and Technology, Peshawar 25000, Pakistan
[b] Sarhad University of Science and Information Technology, Peshawar 25400, Pakistan

HIGHLIGHTS

- This research is aimed at finding desirable and effective means of construction material.
- Cement, lime, gypsum etc. were used as stabilizers in this study.
- The samples were tested under compression and tension.
- It was found that using 4% cement with 1% straw would show excellent results.
- Construction using such stabilizers will be more resistant to weather and economical.

ARTICLE INFO

Article history:
Received 27 March 2014
Received in revised form 18 October 2014
Accepted 24 December 2014

Keywords:
Cement
Compression
Earth buildings
Durability
Stabilization
Straw
Tension

ABSTRACT

About one half of the total world's population resides or works in buildings made of earth. It is a cheap and thus one of the oldest building materials known to mankind. Water is the worst enemy of raw earth buildings. To make it water resistant and durable, different stabilizers are added to the clay in building construction. Cement, lime, bitumen, fibers (natural and synthetic) and certain other chemicals are used worldwide. This research is aimed at finding desirable and effective means of construction material, which is economical as well as easy to handle. For this purpose, protecting earth buildings from the ill effects of rain and flood, cement, lime, gypsum and natural straw from wheat (all in different combinations) were used as stabilizers in this study. The samples produced were subjected to two different non-standard and relativity based tests in order to examine the durability of the materials used under rain and flood. The samples were also tested under compression and tension and the results obtained were compared with the published data. From the test results analysis and comparison, it was found that using 4% cement with 1% straw would show excellent results for construction in rain and flood prone areas and appeared economical as well. Therefore if a house is constructed with this combination of stabilizers in rainy and flood prone area, will be more resistant to weather and would be economical as well.

1. Introduction and background

Raw earth, as a construction material, is one of the oldest and very first building material man has ever used. Currently, in developed countries, like Western Australia and the south-west areas of the United States, rammed earth is widely used in buildings construction [1]. Though earth building construction has now been suppressed by the modern construction materials that show much better performance, in many countries where modern techniques are too costly to implement, it is still an important building construction practice [2]. It is estimated that one third of the total world's population reside in buildings made of earth [3]. There are about 500,000 earth buildings in the UK, mostly constructed before the 20th century and are still occupied [4]. In India, the walls of 55% of homes are still constructed from raw earth [5]. The earth building is strong when it is dry but become non-durable when exposed to moisture content. The main ill effect of raw earth is its affinity for water. Chemical additives like cement, bitumen and lime are added into the soil mix to protect the adobe brick from moisture decomposition and deterioration [5].

Additives such as cement, lime or bitumen, are added to raw and unfired earth to improve particular properties [6]. Cement is mostly used to improve the characteristics of unfired clays [7]. Compressive strengths ranging between 0.6 and 2.25 MPa were obtained by Jiménez Delgado and Cañas Guerrero for unstabilized

* Corresponding author. Tel.: +92 91 5230931; fax: +92 91 5230930.
E-mail address: drabidali@gmail.com (A.A. Shah).

http://dx.doi.org/10.1016/j.conbuildmat.2014.12.046
0950-0618/

Relevance of Monolithic Forms

Right to Dream

2005 Convention on the Protection and Promotion of the Diversity of Cultural Expressions

"...the right to culture is limited at the point at which it infringes on another human right..."

Need for Alternatives *(paper accepted for publication)*

- Disappearance of traditional technologies
- Causes for the vacuum
- Urgency and significance

award-winning sustainable option for disadvantaged communities of Pakistan

…a self-sufficient Pakistan…

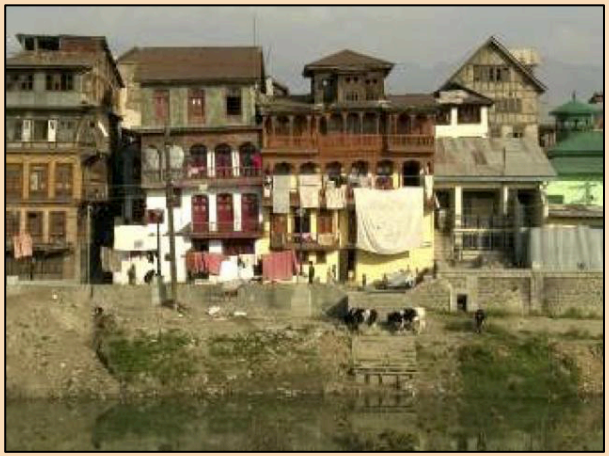
Need for Alternatives

- Disappearance of traditional technologies
- Causes for the vacuum
- Urgency and significance

Traditional Technology

1. Baltit Fort
Hunza
800 years old

2. Kashmir
Timber-frame
Houses
300 years old



3. Kalaash
Timber-frame
Houses
100-500 yrs old

Need for Alternatives

- Disappearance of traditional technologies
- Causes for the vacuum
- Urgency /significance

1. Deforestation

2. Resulting scarcity of timber supply and increased price of timber (1 lakh for one room)
3. Only safe alternative known to the people is RCC, but it is 3 or 5 times more expensive

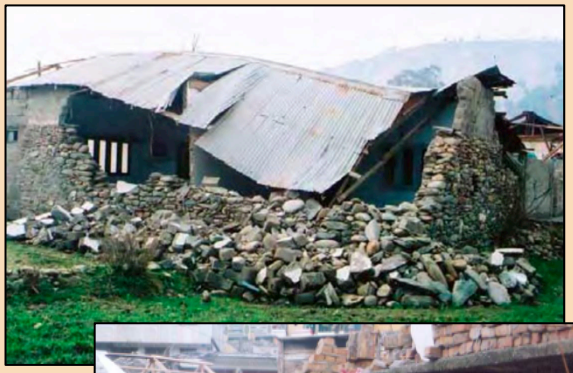
… self-sufficient disadvantaged communities means…a self-sufficient Pakistan…

Need for Alternatives

- Disappearance of traditional technologies
- Causes for the vacuum
- Urgency /significance

Immediate Danger

1. Unavailability of timber causes lack of bracing



2. High cost of RCC causes compromise in quality

3. Result is unsafe construction and loss of life

Why
superadobe ? *(paper accepted for publication)*

- Existing options
- Merits of superadobe
- History of introduction of superadobe

… self-sufficient disadvantaged communities means…a self-sufficient Pakistan…

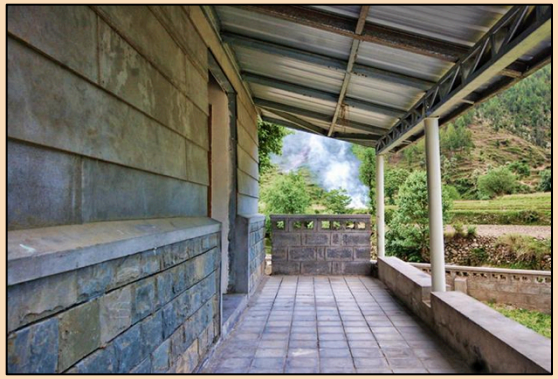
Why superadobe ?

- Existing options
- Merits of superadobe
- History of introduction of superadobe

Acknowledgement of Other Efforts

1. TCF (Prefabricated)

Disadvantage: Creates dependency on Foreign Aid



2. Heritage Foundation (local technology)

Advantage: Creates self-sufficiency for infrastructure needs

…a self-sufficient Pakistan…

Why superadobe ?

- Existing options
- Merits of superadobe
- History of introduction of superadobe

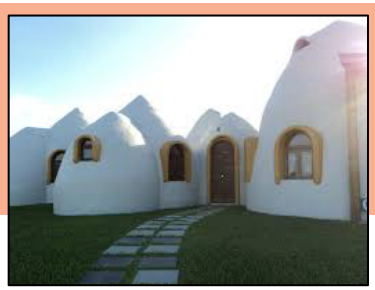
Internationally well-known Technology

1. Tested in USA (California) maximum use of local materials

2. Recipient of Aga Khan Award for Architecture

Aga Khan Award for Architecture
Prémio Aga Khan para Arquitetura

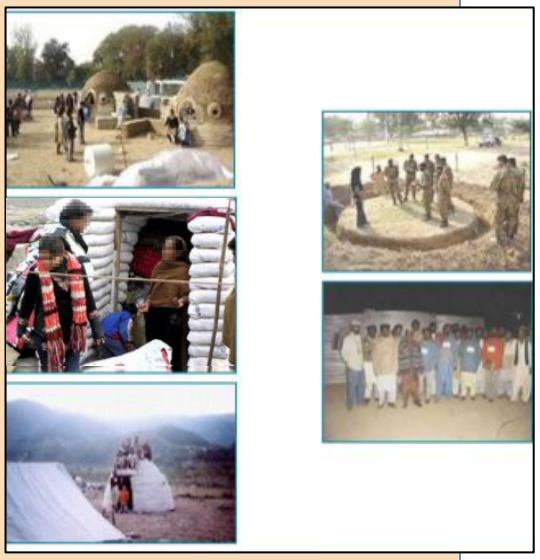
LOW-COST / LOW-TECH / SAFE / AESTHETIC QUALITY



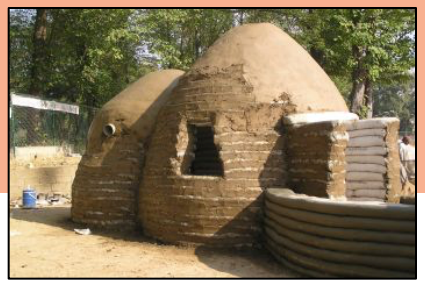
Why superadobe ?

- Existing options
- Merits of superadobe
- History of introduction of superadobe

As a Relief Shelter during 2005 Earthquake



This introduction was unsuccessful because it was done in an emergency and without taking the people into confidence.



Proposal for

Pilot Demo ***(to test the design in Pakistan)***

- Action Plan
- Budget
- Consultancy

… self-sufficient disadvantaged communities means…a self-sufficient Pakistan…

Proposal for Pilot Demo

- Action Plan
- Budget
- Consultancy

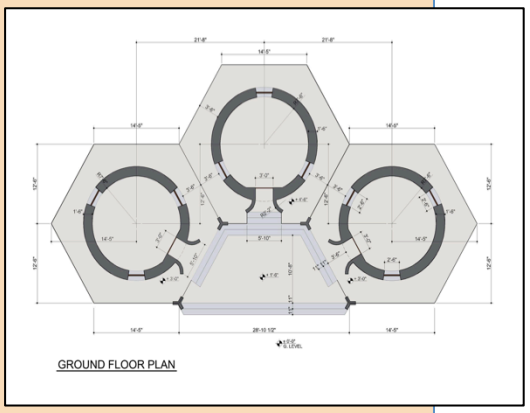
FOUR (4) Schools – 2 in Balakot, 2 in Baluchistan

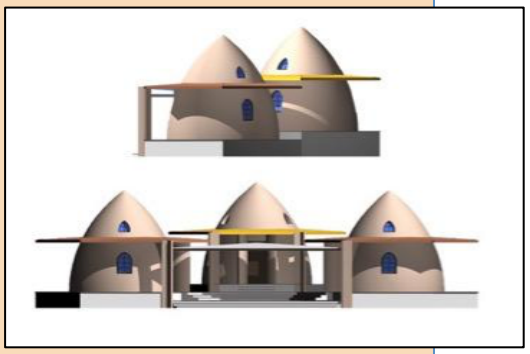
1. 3-Room Basic Unit
6 months for 2 sites [x2]= 1yr

2. Base superadobe
   Roof plus attic room
   bamboo w/ ferro-cement

3. Agreements completed
   at 2 Balakot sites
Villagers will contribute
land/unskilled labour

4. Engin. support: UETNWFP





Proposal for Pilot Demo

- Action Plan
- Budget
- Consultancy

Each 3-Room Building: AUD 10,000 / PKR 1.0 mil.

1. Base structure: 1000bags[Rs10/]x3 = 30K
   jute bags w/ in-situ soil filling
2. Roof plus attic room
   Bamboo: 24pcs[Rs1K/]x3 = 72K
   Ferro-cement panels/tiles 0.2sqm:
   500[Rs100/]x3 = 150K
   Metal clamps/plates/fixing: [Rs50K]x3 = 150K
3. Woodwork plus glass panes
   20items[Rs3K/]x3 = 90K
4. Plaster/water-pr./husk: [Rs.25K/]x3 = 75K
5. Patio/cable-net for shade: 1unit = 50K
6. Misc.[toilet/heaters/furniture/playgr.] = 300K

TOTAL [incl. Rs83K for contingency] = 1000K

…a self-sufficient Pakistan…

Proposal for Pilot Demo

- Action Plan
- Budget
- Consultancy

First-time Demonstration Requires a Consultant
[careful supervision needed at every stage,
In order to ensure low-cost and safe construction,
can be performed only by the original designer]

1. Cost
   Design/Supervision/Management = 1.6mil.
   Engineering component = 0.4mil.
   TOTAL [details given in Annexure-1] = 2.0mil.

2. CONSULTANT APPROPRIATENESS
   - Qualification: PhD / Publication [accepted] in journal based at Berkeley [copy Annexure-2]
   - Experience: Project Architect for AKDN Schools Constr. Progr. [copies Annexure-3]

… self-sufficiency for the disadvantaged …