Tipu Sultan Merkez (TSM) is a privately-initiated school and development project in Jar Maulwi, a small village near Lahore, Pakistan. TSM has been assisting underprivileged rural girls for ten years now. Having won widespread acceptanc in the region, the school requires seven additional classrooms to accommodate its growing student population. The new classrooms measure around 40m², making them ca. 10m² larger than the existing ones. The new structure will be two storeys tall, both to minimize land use and to demonstrate the potential earth and bamboo have as building materials for load-bearing constructions. Following earthquake design strategies, the building will be divided into two parts which are connected by a wide multipurpose veranda area.

Glassed windows to the south will collect solar energy to regulate building temperatures in wintertime. In the hot summers, the earth will naturally absorb humidity from night-time cross-ventilation and then release it into the air during the day. This process will cool the interior air to around 8 °C below outside peak temperatures, providing a comfortable indoor environment. The ground floor will be built out of massive 60cm-thick cob walls (a mixture of earth and straw). For this technique, earth is piled up on the brick foundation without using a formwork. The walls are left to dry, and then the excess is trimmed off with a spade until they have the desired thickness. This project will draw upon local earthen building traditions and resident craftsmen’s abilities to update the existing method, resulting in a more solid, durable construction. Among other modifications, an underground brick foundation and a horizontal damp-proof course will protect the earthen walls against rising damp and splashing rainwater.

As deforestation is an important issue in the region, the simple construction method will incorporate bamboo in order to reduce wood consumption. The first-floor walls will be built using the wattle-and-daub method: light bamboo frame structures will be constructed and then filled in with earth. The ceilings and roofs will be constructed using a system of triple-layer bamboo beams joined with simple knots and steel rods, then covered with a layer of earth. The bamboo will be treated with Borax, a natural salt which protects against parasite infestations. The main ideas of the project are to promote local traditions, reduce reliance on fossil fuels and expensive products from outside the region, and develop natural material and economic cycles. The school is a pilot project for a transformed building method, one which can be adapted for different uses.
Research on traditional local building culture

Innovation and transferability – Progress

In the rural areas of Punjab, earth is a common building material, and earthen building techniques are still widely used. However, buildings without proper foundations and horizontal damp-proof courses require constant maintenance, and typically last just 8-10 years. Area residents thus often dream of having brick or cement-block homes.

The new building system transforms the existing techniques, creating very durable structures with high load-bearing capacities. Numerous local artisans will be trained and certified in the new techniques during the building phases of the two pilot projects, equipping them to set up their own businesses in the future. TSM is preparing a proposal for a long-term training and maintenance program which could be implemented during the second building phase in fall 2011: TSM and other partners in Pakistan are considering forming an umbrella organization which would support and develop the system under its own trademark in the future.

1. Double Story Building

In a densely populated country like Pakistan, where families have just limited space, a double story building helps solve the problem.

2. Window Openings

Bigger window openings, which are not exposed to direct sunlight, provide better inside comfort and enable a proper air circulation to cool the building down especially at night.

3. Bamboo Roof Structure

Instead of using timber or steel beams, the massive roof is fully constructed of locally grown bamboo. A damp proof course on top of the earth filling guarantees that no water comes in:

4. Bamboo Frame

The facade of the light bamboo frame construction of the second floor has an overhang to the earth walls of the ground floor. Rain running down the bamboo facade can drop down in front of the earth wall.

5. Cob Wall

The addition of straw and a horizontal bracing in all corners improves the strength of the monolithic earth walls, especially in the case of an earthquake. Furthermore the straw makes the earth wall more rain resistant.

6. Waterproof Foundation

Brickwork in combination with two moisture barriers prevents damages caused by upraising humidity. Raised more than 60 cm from the ground, the earth walls are protected in the case of a flood.

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Locally-manufactured cob and bamboo school building, Jar Maulwi, Pakistan

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Environmental quality and resource efficiency – Planet

People in Jar Maulwi have very ecological lifestyles: they build using natural resources, grow their own food, etc. However, residents dream of having more durable concrete and brick homes, even though these are less comfortable and more expensive. This project is designed to promote the area’s traditional, ecologically-friendly construction culture by keeping the benefits of the traditional methods while making buildings more durable. The system can be used to construct rooms spanning nearly 6 meters, making it suitable for many modern purposes. The land saved by building a two-storey construction can be used for village gardens. Earth and bamboo are natural, adaptable materials which can be returned to nature at the end of the building’s lifespan, creating a closed natural cycle. Earth’s natural humidity activity provides climate control and thus a healthy indoor environment. The use of fast-growing bamboo instead of wood counters deforestation is an important topic in this area.

Climate adapted design
– Earth and its humidity activity is conditioning the building
– Glassed openings to the south are heating the building passively in the winter and protecting it in the summer against the sun and heat
– Cross ventilation is cooling the building down at night

Earth is conditioning the spaces through its humidity activity

Economic performance and compatibility – Prosperity

Using natural local materials is very economical and saves residents money. More durable buildings provide two advantages: they require less intensive maintenance than traditional buildings, and last a long time with proper upkeep. Trained craftsmen can start businesses using the new system, and farmers can earn money through bamboo cultivation. Economic cycles are small and locally-based, and rural residents can generate local income by selling their products and services to the cities.
Locally-manufactured cob and bamboo school building, Jar Maulwi, Pakistan

**Ziegert | Roswag | Seiler Architekten Ingenieure**

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**Project data**

**Client / NGO**
Tipu Sultan Merkez (TSM)

**Place**
Jar Maulwi, P.O.
Ajnawala, Dist.
Sheikupura, Lahore
Pakistan

**Design**
Ziegert | Roswag | Seiler Architekten Ingenieure

**Architectural Design**
Roswag Architekten GvA mbH

**Local Architect Profile**
Prof. Architectural Consultancy und
Ghayyoor Syed Obaid

**Structural Design**
Ziegert | Seiler Ingenieure GmbH

**Expert Earthen Building**
Geflecht und Raum, Emmanuel Heringer

**Expert Bamboo Construction**
Roswag Architekten GvA mbH
with support by Ghayyoor Syed Obaid

**Realization**
20-30 locale Artisans from the villages around
with TSM support

**Site Supervision**
Roswag Architekten GvA mbH
with support by Ghayyoor Syed Obaid

**Status**
Raw construction, Phase 1

**Intervention**
New construction

**GFA**
650 sq m

**GV**
4550 cu m

**Site area**
950 sq m

**Footprint area**
325 sq m

**Building height**
7 m

**Building depth**
14 m

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**Phase 1 Ground floor / Elevation south**

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Locally-manufactured cob and bamboo school building, Jar Maulwi, Pakistan

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Ethical standards/social equity – People

The school will be built by residents of surrounding villages, most of whom are directly involved with the centre through their children. TSM is a regional social hub, and the new school will demonstrate the potential for future projects in other regions. By promoting local building traditions, the new system will help reinforce rural identity and work against migration to the cities. The method will support healthy living conditions by creating comfortable, safe and durable habitats.

Building process
A building manual is supporting the training process and is the written knowledge for the trained artisans.

Work process

- Building manual is supporting the training process and is the written knowledge for the trained artisans.

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- Wazir Hussain, 30
  - Job: Bamboo builder, bamboo treatment
  - Village: Jhar Moulvi (ca. 1,5 km distance)
  - Background: Never had the opportunity to go to school
  - Married, 2 little daughters
  - One sister is visiting TSM school in higher grade
  - Usually working as daily laborer in the fields
  - Experiences as wood worker
  - Interests: Having a good feeling for the material bamboo he is the right man when precision is required or complex bamboo connections have to be build. He is building a bamboo construction firm with friends from the team and offers his services even in Lahore.

- Amir Maseeh, 18
  - Job: Earth builder
  - Village: Jhar Moulvi (ca. 1,5 km distance)
  - Background: Went to TSM as student
  - Not married yet
  - As oldest son bearing responsibility (besides his father) of feeding the family
  - Interests: Looking forward to becoming a professional master builder for earth construction. Wants to participate in the planned TSM Training Program to become a certified earth artisan

- Waris Ali, 42
  - Job: Bamboo builder
  - Village: Dara sharm singh (ca. 2 km distance)
  - Background: Never got the chance to go to school
  - Married, 5 daughters
  - All daughters went or still go to TSM school
  - One daughter is a teacher trainee on TSM campus
  - Usually working as daily laborer or tractor driver
  - Has his own little farm with some cattle and a couple of small fields
  - Interests: He wants to plant bamboo and use it as a cheap building material for his and his brother’s farms. He has the plan to adapt the new bamboo techniques for his own needs on his farm.

- Abu Bakar, 16
  - Job: Bamboo builder, foreman ceiling
  - Village: Jhar Sikkhan (ca. 3 km distance)
  - Background: Still going to school; just working on site in school holidays
  - One sister currently visiting TSM school
  - His uncle is working as a driver for TSM
  - Interests: He is interested in all technical things. He would like to build bamboo houses as a new building concept. With his good understanding of drawings and a distinct spatial sense he was the right person to lead the construction works of the bamboo ceiling.
Locally-manufactured cob and bamboo school building, Jamauwli, Pakistan

Ziegert | Roswag | Seiler Architekten Ingenieure

Symposium “Natural Building Future in Pakistan”

30th of November 2011, National College of Art, Lahore

GIZ and the Institute of Architects Pakistan (IAP) organized a symposium “Natural Building Future in Pakistan” in Lahore hosted by Tipu Sultan Merkez and Ziegert | Roswag | Seiler Architekten Ingenieure. The event has been an open workshop with input through statements and lectures by experts and potential local contributors - NGOs, local architects, representatives of construction industries, local craft collectives etc. It was the start of a discourse and dialogue between professionals, with a view towards economy, ecology, and technology also on a strategic and social level. The symposium promoted earth and bamboo building systems with natural materials and a new job prospect in this field. The exchanges of knowledge and experience as well as defining local partners have been the main objectives of the symposium.

Topics Topics of the symposium:

“Existing”
- Discuss the relevance of natural building materials and building traditions in Pakistan
- Analyze local earth-and-bamboo building tradition in Pakistan today and related issues (technical issues, image, comfort and sustainability aspects etc.)
- Collect, discuss and document local experiences and best practices

“TSM strategy”
- Present to and discuss with attendees the training concept and the TSM earth and bamboo school project
- Establish the strategy and project on a long term basis in the region and/or Pakistan

“Economics of sustainability”
- Assess the potential of the local market and networks for the construction system
- Promote bamboo construction to representatives of construction industries

“Capacity Building”
- Discuss conditions for professional training as earth and bamboo artisan
- Collect, discuss and document local experiences with trainings in the building sector

Gayyhoor Syed Obaid

Arne Tönnesen

Maria Scheicher

Kaukab Usman, Title?

Aga Khan Development Network, and other NGOs.

Khadija Jamal-Shaban

Ziegert | Roswag | Seiler Architekten Ingenieure and

Ali Raza

Eike Roswag Dipl. Ing. Architekt, BDA

Khalid K. Habib

Gulzar Haider, Ph. D., B.Arch, M-PCATP

Aga Khan Development Network, and other NGOs.

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Training as earth and bamboo artisans

The training program is divided into theoretical education, hands-on training and on-site implementation. The training will be implemented in two modules (split screens and regular phase). Each module takes about three months, within this period 90 hours of theoretical education and hands-on training are undertaken.

The theoretical element will create an understanding of the building system, methods and materials while strengthening a positive perception of traditional materials, especially earth and bamboo. Trainees will understand the advantages as well as the problems of the construction method and how to create high quality buildings resistant to weather and natural hazards. They will learn to read simple plans and numbers and make measurements. In order to record this information a manual will be written to function as a reference for the exam and for future work. It will follow the curriculum and contain a description of the basic theoretical and practical elements of the training. The manual will be translated into Urdu but will also use diagrams and photographs enabling those who are illiterate to understand and make use of it.

The hands-on training will reinforce the lessons learned in the theoretical sessions with the help of 1:1 samples and first-hand experimentation. Simultaneously the participants will be involved on the construction sites within the TSM Campus. This will reinforce their knowledge and allow them to get involved with a tangible building process. Additionally the build-up will prove the sustainability of the construction method and showcase the potential of the materials for high quality design, comfort and cost efficiency. When the project is complete, the curriculum including training materials and methods will be available to use repeatedly in many different locations throughout the region. A local architect will assist with the training and supervise construction works. In parallel he/she will obtain all the necessary skills and knowledge to continue the training in the future.

Development and expansion of earth and bamboo constructions

At the symposium in Lahore hosted by the Institute of Architects Pakistan (IAP) a discussion on constructions out of natural materials, especially earth and bamboo in Pakistan, was introduced. In April, this topic will be further discussed at a symposium in Karachi. The TSM building system will also be an issue then. First discussions with developers have already taken place, who are planning to test this system on housing constructions for their use. Architects who had attended the symposium have adopted the TSM system for their own projects and hope to implement this in cooperation with TSM.

The goal is to use this type of construction in different projects with local architects and to train more and more artisans in different regions. In 2013, TSM plans to build a kindergarten on their campus and with that, longer-term job opportunities for artisans are created. Furthermore, TSM plans to build bamboo plantations on sample fields, to draw farmers’ interest to do the same in that region, since the need of bamboo in Pakistan today can already be barely covered.

Locally-manufactured cob and bamboo school building, Jar Maulwi, Pakistan

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Outcomes and Outcome

<table>
<thead>
<tr>
<th>Phase</th>
<th>Curriculum/Manual</th>
<th>Training</th>
<th>Training/Exams</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Phase</td>
<td>Theory Lenses</td>
<td>B2.1 Basics of Construction</td>
<td>260 Building weeks</td>
</tr>
<tr>
<td>First Regular</td>
<td>Construction</td>
<td>B2.1 Basics of Construction</td>
<td>45 Trainers</td>
</tr>
<tr>
<td>Regular Phase 1</td>
<td>Design</td>
<td>B2.13 Construction</td>
<td>60 Trainees</td>
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<tr>
<td>Second Regular</td>
<td>Training</td>
<td>25 Bamboo - not filled</td>
<td>30 Building weeks</td>
</tr>
<tr>
<td>Finalisation</td>
<td>Partners</td>
<td>1 Bamboo + filled</td>
<td>3 Month Finalisation</td>
</tr>
<tr>
<td>Evaluation Phase</td>
<td>Exams</td>
<td>1 Bamboo + filled</td>
<td>3 Month Finalisation</td>
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<tr>
<td>First Evaluation</td>
<td>Partners</td>
<td>1 Bamboo + filled</td>
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<td>Second Evaluation</td>
<td>Partners</td>
<td>1 Bamboo + filled</td>
<td>3 Month Finalisation</td>
</tr>
</tbody>
</table>

Training Manual

A manual with every factor will serve as an artefact in the hands of the trainees.

Construction principle: Wattle & Daub – filled / not filled

Spatial motive: Transformation courtyard

Kindergarten

School & development project

TSM

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Residential House

A residential extension in the locality of Marja, Punjab, Pakistan

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Locally-manufactured cob and bamboo school building, Jar Maulwi, Pakistan