Projet de reconstruction suite au tremblement de terre du 8 Octobre 2005
Construction techniques - PAKISTAN

The program is dealing with several construction techniques taught to the beneficiaries, according to the field needs, as well as ERRA recommendation.

I.1.1 Reinforced Masonry

The Reinforced Traditional Masonry is the first technique ERRA approved for earthquake resistant construction on July 2006; which means after that date Partner Organizations were officially allowed by ERRA to teach about this technique.

This technique reinforces traditional masonry (brick, stone or blocks) with concrete bands every three or four feet (plinth, sill, lintel and top level) and vertical steel bar. The whole structure works as piled "rings" (such as for well cement rings), each "ring" being stable and continuous.

It is very important to emphasize on the continuity of the rings, exceptions are accepted only for doors. The Reinforced masonry, in the area, has been developed by ERRA to provide all rural populations with a simple construction frame. Unfortunately, it has been not well accepted and understood, since it was not clearly explained. Other techniques have been asked for acceptance.

Confined masonry is neither perfect nor bad regarding to earthquake. It is a clever compromise between varied concerns such as local building traditions, cost of materials and skill availability. If it had been more clearly defined and taught at the beginning, it could have had a much broader impact.

I.1.2 Dajji

The Dajji (Timber Frame) is the 2nd technique ERRA approved on October 2006 for earthquake resistant construction; which means Partner Organizations were officially allowed by ERRA to teach the Dajji technique in the field.

Dajji is a very efficient technique against earthquake. The principle combines lightweight structure and absorbing joints: semi-articulated timber frames are filled with a non-rigid mix of wood, stone and mud. Thus, the energy of the earthquake is both reduced (less weight implies less stress) and absorbed in the non-rigid joints. It is the most resistant to earthquake among the techniques approved by ERRA.

Originally, Dajji comes from Cashmere, where it is traditional. It has been adapted and developed to respond to the frequent earthquakes or aftershocks in the area. It is made of local materials (wood, stone and mud) easily available; the concepts are simple to understand and to build for skilled carpenters. No steel or cement is needed.

It took long time before ERRA approved Dajji, it has been a good response to Kashmeree needs and tradition; unfortunately in the North West Frontier Province of Pakistan (our area of intervention) Dajji thin walls do not respond to the cultural situation of the area, without facing local needs (insulation and protection against shooting frequent in family conflict).
I.1.3  Confined Masonry

The confined masonry is the 3rd technique recently (March 2007) approved by ERRA for earthquake resistant construction; which means Partner Organizations are officially allowed by ERRA to teach the Confined Masonry technique in the field.

This technique is a masonry structure framed with reinforced concrete post and beams. While the walls are erected (bricks, cement blocks or stones) corners and space for concrete pillar are left empty. Pillars and beams are caste afterwards. Confined masonry is simple to construct, as well as strong and resistant.

This technique was commonly used before the earthquake although it didn’t have all the requirements to be an earthquake resistant structure. It is a convenient way to build resistant concrete houses, especially in this area where skilled labours and engineer are not easily available. Confined masonry is widely used in valley and easy access areas.

Since the beginning ERRA did not encourage research on this technique. Only one technique was approved, the Reinforced Masonry (cfr. I.2.1). The Reinforced Concrete Construction technique developed by ERRA was for long the response for reinforced concrete, but requires precise studies, only possible with available full skilled builders.

The Information Center (cfr. I.5) in collaboration with the Suisse Development Cooperation has developed a Confined Masonry manual to face the community’s needs. The manual has been submitted to ERRA for approval, which recently has been given.

Because of the necessary heavy materials this technique is widely used in the lower part of the valley where the access is possible by vehicles.

Gradually, ERRA is no longer reluctant to respect the housing construction community’s needs approving techniques which are in harmony with the tradition and the culture of the area of intervention.

Strong advocacy, aiming to spread housing construction techniques adapted to the field needs, has been done by all the Partner Organizations working in the affected areas since the beginning of the post emergency phase.

Although it represent a widely spread technique in the area, changes to make it earthquake resistant and proximity with Reinforced Concrete Construction structure contribute to confuse people. Effort must be done to clarify its specificity. The new manual made within the IC will help.

I.1.4  Battar

This technique is the most commonly used in the Battagram District, especially in hilly areas it has been used since centuries; but still has been not approved by ERRA.

More than 70% of the houses in the Union Council of Gijbori, Tarand and Kuzabanda (where we are running the reconstruction program) are constructed in Battar. This technique is an evolution of stone and mud construction which cannot resist earthquake; but houses built with good technical approach have been resisted to the disaster. Which means Batar houses built by skilled people can be reliable in resisting to earthquake; even if any scientifically studies have been done yet.
Battar use local material, therefore is the cheapest solution for constructing houses, especially up in mountains where material transportation is high costly. Being the local technique skilled person and knowledge is already present among self builders, masons, carpenters.

The Battar System is a dry stone masonry structure reinforced with wooden rings. Those rings regularly spread among the structure avoid stone masonry to fall apart. It strengthens corners connections and gives length rigidity to walls. The loads of the wide stone masonry combined with the strength of wood insure a very stable structure.

Battar construction traditionally have flat mud roof held by a secondary wood structure inside the wall structure; which makes the roof heavy and CGI sheet roofing is more recommended. Old, well built, constructions show the effectiveness of this technique over earthquake and time.

The Battar since the beginning of the program is the main subject raised by people and Village Reconstruction Committee. The opposition of ERRA has been seen as a misunderstanding of culture and respect of the tradition.

ERRA has long been opposed to this technique although validation was requested since the very beginning by beneficiaries and many Partner Organizations. The Dajji guideline has been proposed as the solution to this request, because it also uses stone and wood material (Cashmere technique).

Recently, ERRA showed more interest in the Battar technique. Studies done by the Partner Organizations working in this area (French Red Cross/A&D, Belgian Red Cross, Suisse Development Cooperation, Army) have been submitted to ERRA.

Battar have to be approved to respect the housing tradition needs of the Batagram district. The next step will be a finalized manual for ERRA Battar approval.

The level of attention received by the participants during the field training on others techniques have been affected by this matter; informally advices on Battar constructed houses increased the confidence between the Mobile Team and the communities. Housing reconstruction techniques which do not respect the local tradition are not suitable for a re-construction process.

I.1.5 Gabion

The Gabion uses stones enclosed in a wire mesh basket. This technique widely used in retaining wall especially in road work is not a common structure for housing. Combination of stone masonry friction and wire mesh elasticity offers great ductility in absorbing effort of earthquake.

This technique is quick to set up but we have no proper studies to validate those theories. Gabion originally comes from civil work for retaining walls (road, rivers banks...); in Pakistan it has no history in housing and Batagram district is a mountainous area where inhabitants are simple and traditional.

Except from the wire mesh it uses only local material (stones) and therefore would not be too different from actual construction. Nevertheless it implies changes in the shape of the house and requires skills in wire mesh realization. Availability and cost of wires strong enough to last for years do not play in its favour.

The first contact with ERRA concerning gabion was not reluctant although they would have not considered it until technical studies would have been done; and studies
represent important economical efforts compare to the guarantee of a successful implementation in the field.

The written proposal mentioned to provide communities with trainings on the Gabion technique (cfr. Annex 2. Reconstruction Program Proposal). We didn’t go further in implementing this activity, because we decided to give priority to local techniques. Housing reconstruction techniques which do not respect the local tradition are not suitable for a re-construction process.

In addition, many new techniques are promoted in the area, which make self builders, carpenters, or masons confused.