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Vanj Shelter Programme

Construction of Seismic Resilient and Energy Efficient Houses

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Vanj Shelter Programme

Construction of Seismic Resilient and Energy Efficient Houses

Implementation Period: September 2010 - September 2011

Лоиҳаи Сохтмонии Ванҷ

Сохтмони хонаҳои ба заминларза тобовар ва гарминигоҳдоранда

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0. Summary

0.1. Background

In January 2010, right after the earthquake in Vanj, Gbao, Caritas got active in exploring possibilities to assist the affected families with house construction. The earthquake of January the 2nd left behind a total of 134 houses uninhabitable and 264 households partially damaged.

According to a social vulnerability assessment of UNDP conducted right after the earthquake 14% or 36 households were very vulnerable; 59% or 151 households vulnerable and 27% or 68 households were moderate vulnerable. The UNDP assessment team stated that the 151 vulnerable and especially the 36 very vulnerable households would not be able to build houses on their own.

A few months later, Caritas has followed up the UNDP assessment with three more evaluation visits, to observe progress in construction and evaluate the remaining needs. Though progress was visible and the government had taken a major action in building a new town for the victims, the allocated plot could not accommodate all the victims and also a big number of families still refused to relocate to the new plot. These families were the major focus of Caritas assessment, since our approach is to assist families in regaining their livelihoods if possible, rather than create a new livelihood in the new plot with no infrastructure or community culture. As a result a construction project started in September 2010. Initial plan was to build 23 houses, however, in the course of preparation it was clear that only 15 houses could be built due to drastic cost increase of construction materials, cost of transport to the very remote area of Vanj, and inability of the vulnerable families to contribute in labour or cash due to their extreme poverty.

0.2. Housing

Implementation of a shelter programme

Caritas Switzerland reconstructed 15 seismic resilient and energy efficient houses in Vanj district (Gorno-Badakhshan, Eastern Tajikistan) in favour of 15 local families (~ 100 persons) affected by an earthquake of magnitude 5.3 on 02 January 2010 in the western part of the Pamir range. By October 30, 2011 the construction activities on the houses were completed and all houses were legally transferred into ownership to the 15 beneficiary families.

0.3. Capacity building

Training on the job ("learning by doing")

Some 80 individuals, mostly locals from Vanj and Khorog districts, have been taken under contract as non-professionals and got an on-the-job training in practical work at the construction sites completed by theoretic technical apprenticeship and basic business training. The construction workers (self-builders) have learned earthquake safe construction implementation and methods. Two local companies have acquired the necessary skills to replicate the type of construction and have advanced their skills in the area. Local government officials learned of the importance for safe housing and have acquired two house technical designs that can serve as models, which can be easily replicated in future in case of need for house reconstruction. The project also introduced a new method of measuring energy efficiency, which will allow construction companies to measure the energy transfers of different materials and thus an assessment of the insulation of house components (roof, walls, floor). Additionally teachers, students, colleagues, partners and authorities followed the lectures in the universities of Dushanbe, Kulyab and Khorog.

1. Objectives

The main objective was to introduce earthquake resilient and energy efficient housing in the Pamir mountains. Caritas Switzerland supported with this project the recovery of the 260 affected households in Vanj and improved capacity of at least 10 governmental stakeholders in Energy efficiency and Earthquake safety and trained 200 persons in energy efficient and earthquake safe (re)-construction.

2. Technical Solution / Applied Method

Initially Caritas was planning to introduce 3-4 house design models, easy to replicate and low cost. The practice showed that in order to introduce new house models, a lengthy bureaucratic process needed to be passed. Approvals by the Institute of Seismology and Agency for Land management and architecture require in depth analysis and research with the involvement of the specialists of the respective agencies. Due to time constrains, it was decided to limit construction to two models and to train workers well in these two models. Regardless of these limitations, the selected two house designs introduced new adjusted designs and choice of materials in order to further enhance energy efficiency (EE) and earthquake resistance (EQR) and safety awareness and application of principles.

Four technical approaches planned to be followed-up at the beginning:

#1 Reinforced masonry (natural stone masonry reinforced with ferroconcrete seismic belts)
#2 Ferroconcrete framework with infill in bricks
#3 Bhattar masonry (natural stone masonry reinforced with timber inlay)
#4 Straw bale construction

Two technical approaches followed-up

Programme implementation started with

- approach #1, Reinforced masonry (Phase I – first 6 objects)

and completed by following-up with

- approach #2, Ferroconcrete framework with infill in bricks (Phase II – additional 9 objects)

Two technical approaches abandoned

- approach #3, Bhattar masonry: due to the limited implementation time available
- approach #4, Straw bale construction: due to lack of acceptance by the local population

In order to increase sustainability and potential for institutionalization of EQR and EE Caritas entered into close cooperation with the national technical university in Dushanbe, University of Central Asia, the seismological institute, national bureau for architecture using their capacities and enhancing them further by development of the new standards as well as development of training materials at university level.

During the first months the designs and options for improving energy efficiency and earthquake resilience was discussed with village population and the expert groups and received comments on design of the house.
Energy efficiency aspects aim at reducing in house emissions, improving livelihoods and contribute to environment protection. A new method of measuring energy efficiency was introduced by the expat architect that helps the local constructions to calculate the Lambda values of different materials and by this define how good a wall insulates.

2.1. Earthquake resistance (EQR) and Energy Efficiency (EE)

In order to achieve this result, a twofold process was undertaken. On one hand government officials at district and oblast level were involved in every step of the construction process, such as the discussion of the design, material use, monitoring and maintenance. On the other hand, a national platform on safe housing was initiated by Caritas and supported by UNDRMP (United Nations Disaster Risk Management Project) to involve actors active in construction to share opinions, techniques and design.
Regarding the first objective, to educate local authorities about safe houses, activities were conducted daily. The district architect participated together with Caritas specialists in developing a design that was appropriate for the region but also included new elements of earthquake resistance and energy efficiency. The architect together with other responsibles for the acceptance of newly constructed buildings evaluated the 15 houses and signed off the transfer documents. At the same time, these people participated in meetings and observed the on-going process, which helped them understand better the techniques.
Regarding the approach to involve stakeholders in construction, an open discussion related to quality on construction significant progress was held, especially in the 1st phase of the project. The idea behind this objective was to create a platform where all the structures involved in construction could meet and coordinate.
The first explored option was the existing "Shelter cluster" within which results of former Khoroson project were presented, but it soon proved that the mandates differed: "Shelter cluster" is focusing on emergency and recovery, whereas Caritas wanted something more related to long-term and global thinking. Thus came the intention of creating a new group. It could not be a "Cluster" as such, since UNDP procedures and terminology is strict on the topic, but a "workgroup". Furthermore, it was decided that it was much better if UNDP - who is the official structure in charge of the coordination of humanitarian actors - chaired this workgroup, and Caritas only supported UNDP.
The first - and very fruitful - session of this "Safe construction" workgroup was held on Monday the 31st of January 2011 in the main UNDP conference room, and the results were announced in the following reaction meeting on the 09th of February.
Caritas was highly praised for the initiative and is requested to keep on pushing things forward.
During the following sessions within the Shelter cluster, NGOs and government officials made a presentation about their practices in construction. Though the platform has not made significant decisions during the period of the project, its success still was in bringing together both government officials from institute of seismology and other agencies, implementing agencies such as NGOs and UNDP. Discussions helped in understanding the issues arising in rural civil construction. UNDRMP intends to continue the platform after Caritas projects ends.

2.2. Construction – two systems approach

2.2.1. Reinforced masonry: mud plastering (Phase I – 6 houses)

All walls (façades & partitions) in the same standard dimension and technique:

= Reinforced masonry
Natural stone masonry d = 50, armouring iron inlaid
Seismic belts (ring beams) h = 15 on the top of natural stone masonry,
concrete reinforcing steel Ø 10)
top level: ± 0.00 (foundation), + 0.90 (window sill), + 1.70 (mid window), + 2.45 (lintel)

All wall surfaces outside and inside (façades and partitions) mud plastered:
ground layer: plastering with a mixture of clay and hay (d = 10).
The sequence of layers from outside to inside reads as follows:

1. Coat of whitewash – exterior
2. Finishing coat in cement rendering (d = 3) – exterior
3. Ground layer: roughcast in mud plaster (d = 10) – exterior
4. Natural stone wall (d = 50)
5. Ground layer: roughcast in mud plaster (d = 10) – interior
6. Finishing coat in cement rendering (d = 3) – interior
7. Coat of whitewash – interior

CARITAS Vanj phase I

thermal transmission coefficient calculus

standard houses façades

U-coefficient

$$U = \frac{1}{\frac{1}{h_i} + \frac{d_1}{\lambda_1} + \frac{d_2}{\lambda_2} + \ldots + \frac{d_n}{\lambda_n} + \frac{1}{h_o}} \quad W/(m^2 \cdot K) \leq 0.3\ W/(m^2 \cdot K)$$

heat transfer coefficient inside		h_i	=	8,000 W/(m²•K)	$1/h_i$	=	0,125 (m²•K)/W
façade walls inside whitewash (lime)		d_1	=	0,001 m			
	thermal conductivity	λ_1	=	0,698 W/(m•K)	d_1/λ_1	=	0,001 (m²•K)/W
façade walls inside finishing coat (cement mortar)		d_2	=	0,030 m			
	thermal conductivity	λ_2	=	0,930 W/(m•K)	d_2/λ_2	=	0,032 (m²•K)/W
façade walls inside heat insulation (clay & hay plastering)		d_3	=	0,100 m			
	thermal conductivity	λ_3	=	0,151 W/(m•K)	d_3/λ_3	=	0,662 (m²•K)/W
façade walls - shell (natural stone)		d_4	=	0,500 m			
	thermal conductivity	λ_4	=	1,396 W/(m•K)	d_4/λ_4	=	0,358 (m²•K)/W
façade walls outside heat insulation (clay & hay plastering)		d_5	=	0,100 m			
	thermal conductivity	λ_5	=	0,151 W/(m•K)	d_5/λ_5	=	0,662 (m²•K)/W
façade walls outside finishing coat (cement mortar)		d_6	=	0,030 m			
	thermal conductivity	λ_6	=	0,930 W/(m•K)	d_6/λ_6	=	0,032 (m²•K)/W
façade walls outside whitewash (lime)		d_7	=	0,001 m			
	thermal conductivity	λ_7	=	0,698 W/(m•K)	d_7/λ_7	=	0,001 (m²•K)/W
heat transfer coefficient outside		h_o	=	25,000 W/(m²•K)	$1/h_o$	=	0,040 (m²•K)/W
					Σ	=	1,915 (m²•K)/W
					U = 1/Σ =		0,52 W/(m²•K)

Roof insulation:
Cold roof with thermo insulated ceiling
The sequence of layers from outside to inside reads as follows:

1. Roughcast in mud plaster (d = 10)
2. Rubberoid roofing cardboard, one layer (d ≈ 2 mm)
3. Ceiling planking (d = 3): timber planks (600 x 12 x 3)
   on a girder grid of timber beams (600 x 15 x 5); dimension between axes 60 cm

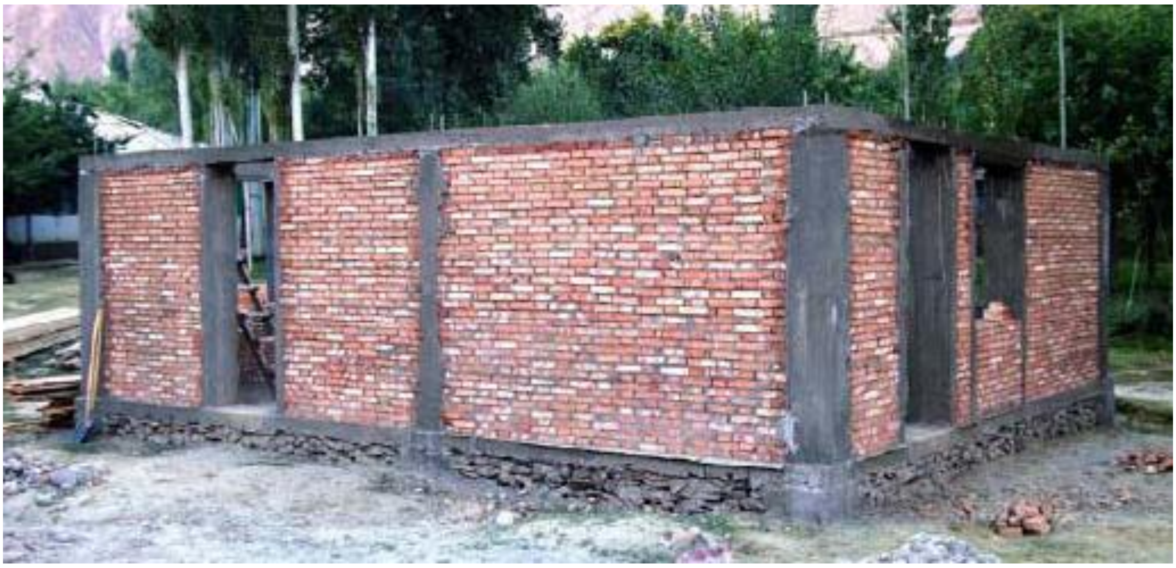
Floor construction:
The sequence of layers from the natural ground to indoors reads as follows:

1. Bottom: natural ground
2. Sand and gravel, mixed (d = 7)
3. Gravel (d = 7)
4. Sand, compacted (d = 40)
4. Rubberoid roofing cardboard, one layer (d ≈ 2 mm)
5. Floor planking (d = 3): timber planks (600 x 12 x 3)
   on a slatted frame of square timber (600 x 5 x 5); dimension between axes 60 cm;
   empty space: closed air chambers between the laths (d = 5)

Joinery:

- Windows in timber (d = 5): double glazed
- Doors in timber (d = 5): lintel panel single glazed

2.2.2. Ferroconcrete framework with infill in bricks: cross bricklaying (Phase II – additional 6 houses)



All walls (façades & partitions) in the same standard dimension and technique:

= Ferroconcrete framework with infill in bricks
Brickwork d = 40 in burnt bricks (25 / 12 / 5^6) as infill into ferroconcrete framework;
"Cross Bricklaying" technique with steel reinforcement every 5^{th} layer
Seismic belts (ring beams) h = 15 on the top of brickwork
(concrete reinforcing steel Ø 10)
top level: ± 0.00 (foundation), + 2.45 (lintel)
Columns 40 x 40 at the corners, mid-wall and at the door and window openings
(concrete reinforcing steel Ø 12)

All wall surfaces outside and inside (façades and partitions) single plastered.
The sequence of layers from outside to inside reads as follows:

1. Coat of whitewash – exterior
2. Coat in cement rendering (d = 3) – exterior
3. Brickwall (d = 40) in “Cross bricklaying” technique creating closed air chambers
4. Coat in cement rendering (d = 3) – interior
5. Coat of whitewash – interior

CARITAS Vanj phase II

thermal transmission coefficient calculus

standard houses façades

U-coefficient

$$U = \frac{1}{\frac{1}{h_i}+\frac{d_1}{\lambda_1}+\frac{d_2}{\lambda_2}+\dots+\frac{d_n}{\lambda_n}+\frac{1}{h_o}} \ W/(m^2 \cdot K) \leq 0.3 \ W/(m^2 \cdot K)$$

heat transfer coefficient inside	h_i	=	8,000 W/(m²•K)	$1/h_i$	=	0,125 (m²•K)/W
façade walls inside whitewash (lime)	d_1	=	0,001 m			
thermal conductivity	λ_1	=	0,698 W/(m•K)	d_1/λ_1	=	0,001 (m²•K)/W
façade walls inside finishing coat (cement mortar)	d_2	=	0,030 m			
thermal conductivity	λ_2	=	0,930 W/(m•K)	d_2/λ_2	=	0,032 (m²•K)/W
façade walls - shell (bricks, cross bricklaying)	d_3	=	0,400 m			
thermal conductivity	λ_3	=	0,440 W/(m•K)	d_3/λ_3	=	0,909 (m²•K)/W
façade walls outside finishing coat (cement mortar)	d_4	=	0,030 m			
thermal conductivity	λ_4	=	0,930 W/(m•K)	d_4/λ_4	=	0,032 (m²•K)/W
façade walls outside whitewash (lime)	d_5	=	0,001 m			
thermal conductivity	λ_5	=	0,698 W/(m•K)	d_5/λ_5	=	0,001 (m²•K)/W
heat transfer coefficient outside	h_o	=	25,000 W/(m²•K)	$1/h_o$	=	0,040 (m²•K)/W
				Σ	=	1,141 (m²•K)/W
				U = 1/Σ =		0,88 W/(m²•K)

Roof insulation:
Same technique and dimensions as for para. 2.2.1 Reinforced masonry: mud plastering (Phase I – 6 houses)

Floor construction:
Same technique and dimensions as for para. 2.2.1 Reinforced masonry: mud plastering (Phase I – 6 houses)

Joinery:
Same specification as for para. 2.2.1 Reinforced masonry: mud plastering (Phase I – 6 houses)

3. Results

The project of assistance to the families in the settlement Vanj, that were most affected by the earthquake, has started July 1st, 2011. After the January 2010 earthquake, the Vanj Khukumat produced a "first list" of damaged houses, which included 47 severely damaged units. A social vulnerability assessment was conducted in July by Caritas specialists as a first step in preparing for undertaking this project. A criteria for identification of the most needy out of the 47 vulnerable families was developed and applied in assessing the situation. See attached the questionnaire in Annex 1.The assessment also looked into the beneficiaries’ needs regarding the design and structure of houses. The assessment showed that all 47 interviewed families wanted earthquake safe houses, and regarding structure and size the votes distributed as follows:

	3-4 rooms	5 rooms	Kitchen in the house	Kitchen outside	Undecided about kitchen	New house on old plot	House in new plot
Families	46	1	26	15	5	47	0

A serious challenge was the selection of location where new houses would be built. Local government's initial decision was to move out all affected families to a new allocated plot. Given the fact that the new location had no infrastructure, and most likely the government had no resources to provide these in a fast and duly manner, negotiations were held with the head of local government to allow Caritas to build houses in the old plots, by demolishing the damaged houses and building new ones. Negotiations resulted in mutual agreement and a MoU was signed with the local government on 18 August 2010 in the presence of Caritas Luxembourg visitors to Vanj.

Based on the beneficiaries' selection report and the agreement of local government to build right in the district center, a first six (6) families were selected in September, and work commenced. The remaining nine (9) families were selected in April 2011 with corrections of two families, who needed to be replaced due to impossible access to the plot in August 2011.
Constructions of seismic resilient and energy efficient houses were completed using traditional construction methods such as stone masonry and concrete based method with fired brick.

3.1. Progress reporting

3.1.1. Start of reporting period – 1st status of completion update

CARITAS programme Vanj René Edward Knupfer - KRE						1st status as on 02 May 2011 CARITAS Vanj - 2011.05.04	
beneficiary	percentage of completion						
	foundation excavation concrete backfilling ruberoid	walls masonry seismic belts	roof carpentering covering ceiling pediments	joinery doors windows glazing	flooring substructure planking plinths setting	plastering ground layer finishing coat whitewashing	total
percentage of total work	15	20	25	15	10	15	100
1 - Lambaev Zinat	100	100					35
2 - Shakharov Hakim	100	100					35
3 - Fakhmaev Sarabek	100	100					35
4 - Gayratshoev Azamat	70						11
5 - Shonazriev Zgher	100						15
6 - Pakaev Jamshed	100	100					35
average completion today	95	67	0	0	0	0	28
+ 9 additional objects							0
average completion today	38	27	0	0	0	0	11

3.1.2. Programme – selected intermediate completion rates:

- as on 30 June 2011 (6th status)
  - 26% (phase I + II, all 15 objects)
  - 66% (phase I, first 6 objects)
  - 0% (phase II, additional 9 objects) – phase II just started

- as on 10 August 2011 (10th status)
  - 45% (phase I + II, all 15 objects)
  - 100% (phase I, first 6 objects) – phase I just completed
  - 8% (phase II, additional 9 objects)

3.1.3. End of reporting period – the two latest statuses of completion updates

CARITAS programme Vanj							16th status as on 14 October 2011
René Edward Knupfer - KRE							CARITAS Vanj - 2011.10.18
beneficiary	percentage of completion						
	foundation excavation concrete backfilling ruberoid	walls bricklaying framework	roof carpentering covering ceiling insulation	joinery doors windows glazing	flooring substructure planking plinths setting	plastering wall plaster whitewash	total total total
percentage of total work	19	24	16	1	3	37	100
Vanj phase I, object #1-6	100	100	100	100	100	100	100
7 - Khochaev Sharif	100	100	100		90	72	88
8 - Yorov Sulaymon	100	100	87			48	75
9 - Korvonov Molvon	100	100	100	60	100	84	94
10 - Tutishoev Zoirsho	100	100	100	60	100	89	96
11 - Khailoev Nikmatullo	100	100	100	60	100	92	97
12 - Zaripova Gulsimo	100	100	18				46
13 - Davlatov Yormakhmad	100	100	100	60		80	89
14 - Galchaev Mahmadislom	100	100	100	28		52	79
15 - Kamarov Davlat "self-help"	100	100	75	17		15	61
Vanj phase II, object #7-15	100	100	87	32	43	59	80
Vanj phase I+II, object #1-15	100	100	92	59	66	75	88

CARITAS programme Vanj							17th (final) status as on 28/29 October 2011
René Edward Knupfer - KRE							CARITAS Vanj - 2011.10.31
beneficiary	percentage of completion						
	foundation excavation concrete backfilling ruberoid	walls bricklaying framework	roof carpentering covering ceiling insulation	joinery doors windows glazing	flooring substructure planking plinths setting	plastering wall plaster whitewash	total total total
percentage of total work	19	24	16	1	3	37	100
Vanj phase I, object #1-6	100	100	100	100	100	100	100
7 - Khochaev Sharif	100	100	100	100	100	100	100
8 - Yorov Sulaymon	100	100	100	100	100	100	100
9 - Korvonov Molvon	100	100	100	100	100	100	100
10 - Tutishoev Zoirsho	100	100	100	100	100	100	100
11 - Khailoev Nikmatullo	100	100	100	100	100	100	100
12 - Zaripova Gulsimo	100	100	100	100	100	100	100
13 - Davlatov Yormakhmad	100	100	100	100	100	100	100
14 - Galchaev Mahmadislom	100	100	100	100	100	100	100
15 - Kamarov Davlat "self-help"	100	100	100	100	100	100	100
Vanj phase II, object #7-15	100	100	100	100	100	100	100
Vanj phase I+II, object #1-15	100	100	100	100	100	100	100

3.2. Capacity building

3.2.1. Construction trainers trained

Comprehensive training courses for the construction workers were developed based on international standards and lessons learned from Khuroson 1&2 construction projects undertaken by Caritas in 2009-2010. Trainers learned by doing, through peer training and master consulting training. The project leader, architect, and a volunteering French architect together conducted 15 trainings on construction of seismic resilient and energy efficient houses to labourers in the 1st phase of the project. A total of 45 (43 male and 2 female) were trained as construction master trainers. Though the overall number of persons that received partial training would reach over 80, 45 stayed as a core group till the end of the project. In the 2nd phase, workers received training by doing and had the possibility to apply the knowledge and skills in real life on the houses.

At start the recruitment of Construction Master Trainers proved to be a more challenging process than anticipated, mostly for the following reasons:

- Budgeted salaries were not sufficient to cover the cost of master trainers. Firstly, due to additional costs such as accommodation, food and transport, since about half of master trainers were from outside of Vanj.
- Second, the possibilities of construction projects abroad (Russia) offered better remuneration and thus the package offered by Caritas seemed to them not too attractive.
- And thirdly, the motivation to learn new technologies was not attractive enough. Despite lack of employment in Tajikistan, masters did not see it rewarding to learn additional techniques. Additionally Vanj was considered remote and unfashionable by anyone who was not from there. But Caritas had the ambition to train Construction Master Trainers from all over the country and insisted to get participants from elsewhere. A balance of not more than half of the team being from Vanj was set and respected.

Therefore, the team growth in early steps was extremely slow: one Construction Master Trainer the first day, then three for a while, then eight as our reputation increased, and eventually and steadily thirteen up to the end of the construction season. More applicants from Vanj were accepted as long as people from other parts would not join in.

By January 2011 the recruitment was over, and a team of twenty-four Construction Master Trainers (as originally planned) could be recruited rather easily, comprising of one third of Vanj People, one third of other-Gbao people, and one third of all-over-Tajikistan people.

This was assessed as a great result given all the difficulties.

In terms of training, the Construction Master Trainers were not expected to be competent at once: a training process was scheduled to provide them with tools in both construction expertise and teaching capabilities. Therefore, two types of background could be accepted during the recruitment:

- Persons from the construction world (masons and carpenters mostly) who were to learn teaching, and
- Persons from the teaching world (school teachers mostly) who were to learn construction.

Proportion in the team was about two thirds of the former and one third of the latter. The title of construction masters is referred to construction masons with some experience. The scheme used for the project was a setting where brigades were composed of master trainers (more knowledgeable and skilled workers) and beginners – new workers who were new to construction but wanted to learn and who had the opportunity to do so by doing and learning from their peers (masters trainers).

The 2010 trainings focused on the construction aspects. The 2011 trainings consisted in revision of the previous ones and developing competences in teaching and training, including drawing capabilities.

Caritas had the ambition of demonstrating that construction was not a male's privilege, but thought it a dream more than an actual objective. Therefore, it was a surprise indeed to manage a quarter of a team to be feminine masons - three out of thirteen in the 2010 setup, and six out of twenty-four in the 2011 one.

This effort to gender-balance must be praised and encouraged.

At the same time, through this project Caritas looked at further sustainability of the trained masters. An effort was made to help masters understand and plan a future of their profession. Two options were offered to the group of masters: to register a construction company which would continue the principles of safe housing construction, and a second option was to incorporate these principles in the culture of an existing company. In a series of workshops conducted by two Hungarian consultants in organizational development and business planning, a group of masters decided to continue their professional growth and application of acquired skills through an existing company, currently owned by one of the engineers. A series of workshops were conducted to introduce the group into business planning, corporate management and other related issues. See attached in Annex 2 the package of materials of coaching workers for further professional growth.

Training on roof construction

Training on business planning

3.2.2. Training program for students

A first training at the Faculty of Architecture (technical university Dushanbe, Central Asian University) was issued on Friday,28th of January 2011 with Russian translation. See Agenda in Annex 3.
During the session there were present teachers, students, colleagues, partners and authorities. The training was very well perceived and was an opportunity to expose Caritas' views and ambitions regarding Earthquake Safety and Energy Efficiency.
Similar trainings were repeated in the following universities:

- Kulyab Technical University
- Technical University of Khorog.

Collaboration with the University of Central Asia was held separately. The University of Central Asia is the only entity training masons and carpenters (and electricians, plumbers and others, which are of lesser interest to Caritas): we share the same aims and ambition of training constructors on modern methods. A training session and presentation was made in February at the University of Central Asia. An ambitious plan was to use students from University of Central Asia for an internship on the construction site. Unfortunately, due to high costs (accommodation, food and stipend) that this activity required, it was impossible to accomplish the task.
Attempts were made to incorporate new technologies in construction into the University curricula. Since changes in the curricula require a set of permissions from ministry of education and other appropriate bodies, the project did not manage to accomplish fully this tasks. However, interaction was done with Agha Khan Network specialists in the area of construction, who are keen to take up the issues for further development.

3.2.3. Cooperation with CDE

Caritas has a very close relation with Camp Kuhistan, the representation of CDE (Centre for Development and Environment, University of Berne) in Tajikistan. Caritas has also provided several examples for the WOCAT data collection. In the area of energy efficiency, insulation, the partners in Tajikistan were informed about our project.

4. Impacts

1st impact: the "hardware" component of the programme – housing programme:

15 vulnerable families (about 100 individuals) whose homes have been seriously damaged or destroyed during the Vanj earthquake on 2nd January 2010 and living under precarious conditions in temporary accommodation since then got a durable housing solution.

2nd impact: the "software" component of the programme – capacity building:
Approximately 80 locals got a solid basic formation in construction techniques and upgraded thus substantially their professional skills. Moreover a personal pool of construction professionals has thereby been established ready to be deployed as expert staff in future reconstruction projects of humanitarian organisations (Caritas for example or others). Additionally teachers, students, colleagues, partners and authorities followed the lectures in the universities of Dushanbe, Kulyab and Khorog.

5. Future Prospects

The Caritas housing programme realised 2010/2011 in Vanj can be regarded as a kind of a pilot project to be followed by potential future shelter programmes in Tajikistan or elsewhere in Central Asia: two fundamentally different technical approaches (#1 reinforced masonry – natural stone masonry reinforced with ferroconcrete seismic belts and #2 ferroconcrete framework with infill in bricks) have been applied in practice and can be tested on their practicality now.
Unfortunately, Tajikistan does not know yet the clean development mechanism. The government neither has shown interest to develop this. Caritas Switzerland has not insisted, as this is to continue by an organization that is engaged in the policy dialogue.
The knowledge gained from this project has been carried on in the Universities. This is even more sustainable, as in Tajikistan all craftsmen and professionals are trained in the universities. It is of course common for the rural population building their homes themselves, but through the involvement of professionals, EQR and EE methods can also be included. Through the Caritas Project the knowledge is available in universities and masters and construction companies can rely on experience of colleagues.
With this project, the earthquake resistance was defined as a minimum standard for the reconstruction in Tajikistan. With the EE components, the insulation is as well part of a sustainable construction and reconstruction. In the future, thermal insulation should be standard for reconstruction projects in areas where people have to protect against cold or heat. Especially international organisation involve in reconstruction after natural or human made hazards should include these two standards.

6. Conclusions

As any construction projects, Vanj project was not an exception in its challenges and complexity. From the start there were very ambitious goals, where the humanitarian aid approach (provide shelter to victims) was combined with the approach of sustainable education and development. Though the two are compatible, the limited time, low capacity of the first project leader to manage multifaceted projects proved that not all objectives could be completed fully. Therefore, the objective of house construction was set as the prime one and by end of project all efforts were directed towards this. The 15 houses were completed, under high pressure and with high cost, but the quality of the objects were maintained throughout the whole process. The quality was the best possible within the conditions and available materials.
At the same time, the project did not manage to have a ready to act construction company, which evolved from amongst the workers. However, an optimum solution was sought, where one of the engineers proposed to revitalize his construction company and to invite the other workers join for promoting further earthquake safe construction methods.
A big challenge was the low support from the local government. In spite of the promises and big support at the start, the local authorities did not manage to mobilize the community, to support as promised with low cost or free materials, and provide accommodation and food for workers. As a result, the project had to apply to extra sources to cover some food costs, by negotiation with the WFP food for work programme for workers residents in Vanj. Thanks to that, several thousand Euros could be saved within the budget and allocated for finalization of houses rather than food for workers. The tax issue was not supported by the local authorities, and as a result the project was faced with liabilities for high amounts of taxes (income tax and other taxes for over 50 workers). In the 2nd phase the pro-

ject managed to convince the authorities to accept a simplified solution to tax – by purchasing patents for all the workers, which includes a tax fee that the project paid at the start.
The project evolved in the economic crisis situation, which heavily hit Tajikistan. Prices of fuel increased more than double (from 3.5 TJS to 7.5 TJS), that led to cost of transport being unexpectedly high because of the remoteness of Vanj. The solution was to purchase most materials locally, which were not available at high variety. At the same time, the cost of materials increased approximately by 35% as compared to Khuroson construction project, which served as basis for price calculation for this project. The enormous increase in costs led to rethinking of the house design and making all houses with 3 rooms as opposed to 4 room houses as initially planned. That was accepted by beneficiaries with no problems.
Beneficiaries did not contribute to the construction greatly. At start there was no contribution at all. In the 2nd phase a few beneficiaries could accommodate and feed some of the workers. This could be explained in two ways: first, the culture of contribution is missing. People have been getting humanitarian aid in various forms ever since the civil war and even before GBAO was heavily depending from subsidies from Soviet Union, and it is understood that any foreign intervention shall be for free and second, the beneficiaries were very poor indeed, and a healthy strong male force was missing in most cases. Thus no labourer for carrying stones or digging or other works was available.
Vanj is a remote area in all respects. Infrastructure is poor or inexistent, local labour is missing, transport to and from is not always available. Due to this, workers were coming and going, and only towards the end it was possible to maintain a more or less core group of trained workers. That made it difficult to train people and have them apply skills on the job. Recommendations from staff was to not choose such remote areas for future projects unless very big investments are possible.
And a final challenge was rooted in the management of the project. The first project leader proved that he did not have the strong management skills to manage a project of this magnitude. He had good facilitation and networking skills, however the technical side was rather theoretical and that led to a big delay in construction and a misbalance between construction expenditures and training/networking expenditures. He resigned in April 2011. The new project leader managed to get the project back on track, to bring the finances in a tight but efficient regime and to finalize the project with great success by October 30, 2011.

6.1. Lessons learned

6.1.1. Location of the programme

Remoteness of the location

The isolation of Vanj far away from any urban centre was perhaps the main reason for the extraordinarily high costs of the programme implementation: we had to manage with huge expenses for material transports and staff accommodation. The disproportion between financial input and physical output is significant. The implementation of future additional housing programmes under comparable preconditions should not be reconsidered.

6.1.2. Lack of support by the authorities

Tax exemption

The realization of any prospective humanitarian programme in Tajikistan should be linked to a complete exemption from any tax liability. No humanitarian assistance without tax exemption as a strict guideline.

Office premises & staff accommodation supply

All costs for the premises of the temporary field office and for the accommodation of the administrative and technical staff on site should be fully borne by the local community benefitting from the programme.

Power supply

All costs for power supply inclusive the costs for the operation of the current generators at the office premises and at the construction sites too should be fully borne by the local authorities.

Assistance in logistics

The local administration should be engaged to assist in building material transport to construction sites inaccessible by transport vehicle: provision of free manpower. The local authorities should be committed to make facilities available for the safe storage of material and equipment free of charge as well.

6.1.3. Construction

Programme approach

The structure of the programme as a “combi programme” with the two main components “hardware” (housing programme) and “software” (capacity building) was definitely a very creative approach with good chances for sustainability: a long-term impact in the sense of “help to self-help” seems to be achieved.

Technical details

Roofing:

After completion of phase I of the programme a change of the roof construction in terms of carpentering and covering has been agreed for phase II of the programme:

- roof carpentering: change from gable/saddle roof (with 25º gradient) to hip roof (with 40º gradient) – the steeper slope makes the snow slide down: load reduction as a very welcome result;
- roof covering: change from concrete roof tiles to corrugated steel roof sheets covering – the light construction reduces the risk of a roof collapse in this seriously earthquake affected area.

Thermal insulation:

The façade walls construction of the two seismic resilient and energy efficient houses built in Vanj show a thermal transmission coefficient U = 0,52 W/(m²•K) [phase **I** - Reinforced natural stone masonry] and U = 0,88 W/(m²•K) [phase **II** - Ferroconcrete framework with infill in bricks] respectively. The energy efficiency of the two Caritas developed types of houses is therefore significantly superior in comparison with the houses built corresponding to the traditional local techniques with quite high thermal transmission coefficients between U = 1,36 and 1,70 W/(m²•K).

6.1.4. Cooperation with sister organisation

Extremely useful physical support by sister organisation:

Auxiliary side programme sponsored by World Food Programme WFP:

on 23 October 2011 – food supply in favour of Vanj construction staff and their families:

wheat flour	8,000 rations	=	15,996	kg	
vegetable oil	8,000 rations	=	600	kg	(≈ 600 lt)
salt	8,000 rations	=	200	kg	
pulses “garogh”	8,000 rations	=	1,600	kg	

7. References

7.1. Programme status updates (progress reports)

- CARITAS programme Vanj – 1st status as on 02 May 2011
- CARITAS programme Vanj – 2nd status as on 18 May 2011
- CARITAS programme Vanj – 3rd status as on 24 May 2011
- CARITAS programme Vanj – 4th status as on 08 June 2011
- CARITAS programme Vanj – 5th status as on 22 June 2011
- CARITAS programme Vanj – 6th status as on 30 June 2011
- CARITAS programme Vanj – 7th status as on 15 July 2011
- CARITAS programme Vanj – 8th status as on 21 July 2011
- CARITAS programme Vanj – 9th status as on 30 July 2011
- CARITAS programme Vanj – 10th status as on 10 August 2011
- CARITAS programme Vanj – 11th status as on 15 September 2011
- CARITAS programme Vanj – 12th status as on 19 September 2011
- CARITAS programme Vanj – 13th status as on 22 September 2011
- CARITAS programme Vanj – 14th status as on 05 October 2011
- CARITAS programme Vanj – 15th status as on 10 October 2011
- CARITAS programme Vanj – 16th status as on 14 October 2011
- CARITAS programme Vanj – 17th (final) status as on 28/29 October 2011

7.2. Construction sites: plots assessment reports

- CARITAS programme Vanj – phase II sites assessment 19/20 May 2011
- CARITAS programme Vanj – phase II alternative sites assessment 22 June 2011

8. Annexed documents

- PowerPoint presentation "Vanj Housing Programme" (CARITAS Lucerne – Debriefing on 24 January 2012)
- Annex 2a Vanj 1.deliverables_2011-04-04
- Annex 2b Participants Vanj Workshop 24-25 March 2011
- Annex 2c Training report day 1-2 v2011-04-02
- Annex 3 2011 01 26 Public lecture at University

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8.1. Anhang 1: U-coefficient – thermal transmission calculation

Façade construction – thermal conductivity comparison:
CARITAS Vanj programme versus traditional local techniques

U = thermal transmission rate — **comparison**

		--- outside ---	façade walls construction: finish			insulation	shell				insulation	finish			--- inside ---
			λ = 0,698 W/(m•K)	λ = 0,930 W/(m•K)	λ = 0,470 W/(m•K)	λ = 0,151 W/(m•K)	λ = 1,396 W/(m•K)	λ = 0,440 W/(m•K)	λ = 0,910 W/(m•K)	λ = 1,100 W/(m•K)	λ = 0,151 W/(m•K)	λ = 0,470 W/(m•K)	λ = 0,930 W/(m•K)	λ = 0,698 W/(m•K)	
			d = 0,001 m	d = 0,030 m	d = 0,030 m	d = 0,100 m	d = 0,500 m	d = 0,400 m	d = 0,400 m	d = 0,400 m	d = 0,100 m	d = 0,030 m	d = 0,030 m	d = 0,001 m	
			façade walls outside whitewash (lime)	façade walls outside finishing coat (cement mortar)	façade walls outside finishing coat (clay plaster)	façade walls outside heat insulation (clay & hay plaster)	façade walls - shell (natural stone: granite)	façade walls - shell (burnt bricks - cross bricklaying)	façade walls - shell (non-burnt mud bricks: adobe)	façade walls - shell (concrete blocks)	façade walls inside heat insulation (clay & hay plaster)	façade walls inside finishing coat (clay plaster)	façade walls inside finishing coat (cement mortar)	façade walls inside whitewash (lime)	thermal transmission rate U
Vanj CARITAS 2011 programme	reinforced natural stone masonry (phase I)		X	X		X	X				X		X	X	U = 0,52 W/(m²•K)
	concrete framework with bricks infill (phase II)		X	X				X					X	X	U = 0,88 W/(m²•K)
Vanj local traditional construction	reinforced natural stone masonry	1					X					X		X	U = 1,70 W/(m²•K)
		2			X		X					X		X	U = 1,53 W/(m²•K)
	adobe blocks masonry	3			X				X			X		X	U = 1,36 W/(m²•K)
	concrete blocks masonry	4								X		X		X	U = 1,68 W/(m²•K)
		5			X					X		X		X	U = 1,52 W/(m²•K)