2015

SUSTAINABLE

HOUSING RECONSTRUCTION

in the Eastern Democratic Republic of Congo

GNSH GLOBAL NETWORK FOR SUSTAINABLE HOUSING

UN HABITAT
FOR A BETTER URBAN FUTURE

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Cover picture: Women making compressed earth blocks. © Emma-Liisa Hannula/UN-Habitat

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Removing compressed earth blocks from the molds. © Emma-Liisa Hannula/UN-Habitat ↑

↑ *Traditional wattle and daub construction. © Emma-Liisa Hannula/UN-Habitat*

1 | Background of the UN-Habitat Green Affordable Housing Project in the Eastern Democratic Republic of Congo (DRC)

Due to a more stable phase in the prolonged conflict of the Eastern Democratic Republic of Congo, UN-Habitat recommends the initiation of permanent reconstruction and moving away from emergency shelter in the area. The reconstruction process is recommended to reflect the local political, socio-cultural and physical context of the area and build on sustainable use of local building materials. In addition, generation of employment and local economic development through participatory processes and capacity building of community members is a key objective.

1.1 The political development in the Democratic Republic of Congo

Following the colonization by Belgium, the Democratic Republic of Congo (DRC) was declared independent in 1960. For 32 years, political power was in the hands of the Mobutu regime during which time Congo was renamed Zaire. In 1998 the Mobutu regime was replaced by the Kabila regime which is still in power today. The majority of foreign armed groups that supported Kabila's regime in its rebellion phase retained in 2002. In 2003, a transitional government took power followed by a constitutional referendum in 2005. However, frequent attacks of militias representing different ethnic groups are still a reality in the DRC today. The regions of North and South Kivu have experienced continuous conflict since the early 1990s. In 2012, a militant group called "M23" took control of several towns in the region. The M23 movement was defeated in late 2013 by national military forces of the DRC assisted by the United Nations Stabilization Mission for the Democratic Republic of Congo (MONUSCO). Since then, the government has been in charge of the political decision making process in the region with a strong role given to the provincial government for the Eastern DRC.

1.2 Towards reconstruction

Several years of unrest in the Eastern DRC have resulted in a significant amount of Internally Displaced People (IDPs) as well as the destruction of most of the housing stock and infrastructure networks. In the border region between Rwanda and Uganda a large amount of IDPs will still be in need of housing in the near future. Following the defeat of the "M23" militant group and after their displacement, Eastern DRC residents have started to return to their former villages or safer locations such as along main roads. However, as most of the housing stock has been destroyed, the majority of returnees are living in tents. The majority of the United Nations Agencies and Non-Governmental Organizations are providing emergency shelter support to returning IDPs. However, there have only been a few permanent housing projects implemented in the area. The international community of the Eastern DRC is recognizing the need for permanent reconstruction and several agencies[1] are currently planning on strategies to start permanent reconstruction programmes.

1 United Nations Development Programme (UNDP), Food and Agriculture Organization of the United Nations (FAO) and UN-Habitat have developed a concept note and a strategy document on community resilience capacity. In this strategy, the use of local sustainable building materials is promoted instead of the current unsustainable practices, such as the use of plastic sheets as construction material. A working group from NFI-Shelter has also expressed interest in developing shelter solutions using environmentally sustainable local building materials.

1.3 Physical context in the Democratic Republic of Congo (DRC)

The population of the DRC is ca. 79 million people with an urbanization rate of 42.5 per cent (estimation in March 2016)[2]. The capital city of the DRC is Kinshasa and the provincial capital of the Eastern DRC is Goma which is located at the border to Rwanda. Roads inside the country are in bad condition and often unsafe. More traditional and widely used transportation means are boats and river transport. However, Goma is well connected to Eastern Africa due to its location on the Rwandan border.

The climate in the Eastern DCR is tropical, hot and humid but due to its high altitude temperatures can drop significantly. The largest natural hazard of the Eastern DRC is formed by the active volcanoes such as Nyiragongo, which erupted in 2002 covering 40 per cent of Goma under lava. There are also issues with water pollution, major deforestation with soil erosion in deforested areas and environmental damage related to mining.

1.4 Land and housing sector context in the Democratic Republic of Congo

The housing and infrastructure sector in the Eastern DRC has been underdeveloped during the past thirty years and there is very little national capacity relating to these areas. The building sector in the DRC is in bad condition due to decades of unrest and destruction. No sustainable housing strategy has been developed so far.

Since 2008 UN-Habitat has executed a comprehensive land mediation programme in the DRC to pave the way for future housing reconstruction. UN-Habitat has provided direct implementation through a land mediator; support for land administration, reconciliation, helped solve land disputes in the context of an institutional vacuum and supported capacity building of different stakeholders.

2 Central Intelligence Agency (n.d.) 'Congo, Democratic Republic of the', available from:https://www.cia.gov/library/publications/the-world-factbook/geos/cg.html, Accessed 23.3.2016

1.5 Sustainable Housing Practices in a Reconstruction Context: General Overview

The building sector is a major producer of greenhouse gas emissions contributing to climate change: it is estimate that the building sector is responsible for 40 per cent of global energy consumption, one third of global greenhouse gas emissions and a significant amount of other forms of pollution. At the same time, the building sector has a very high potential to affordably reduce the use of energy and greenhouse gas emissions in the near future.

Reconstruction is a good opportunity for improving the sustainability of the housing stock as large amounts of housing units are being rebuilt every year in different parts of the world. Housing reconstruction does not need to mean rebuilding houses exactly as before. Instead, the principle of "building back better" can be applied by, for instance, increasing the environmental sustainability and disaster resistance of buildings. In addition, reconstruction situations are good opportunities for decreasing the embodied energy of buildings by prioritizing the use of local sustainable building materials instead of imported materials. It is equally important to build the capacity of communities, local practitioners and authorities as well as civil society to use sustainable building materials and construction techniques by using participatory processes and holding construction trainings. This can generate local economic development and employment opportunities.

In addition to skill development, participatory reconstruction processes can help residents to cope with trauma and build up community networks. The specific needs of vulnerable groups such as the indigenous pygmy peoples in the context of the DRC should be acknowledged as they often face discrimination and thus deeper poverty and loss of cultural ties. It is also important to see housing development as an integrated process relating to land, finance, labor, infrastructure and basic services and the relationship of housing to other sectors (urban design/planning, economic development and job creation) in addition to the actual housing construction.

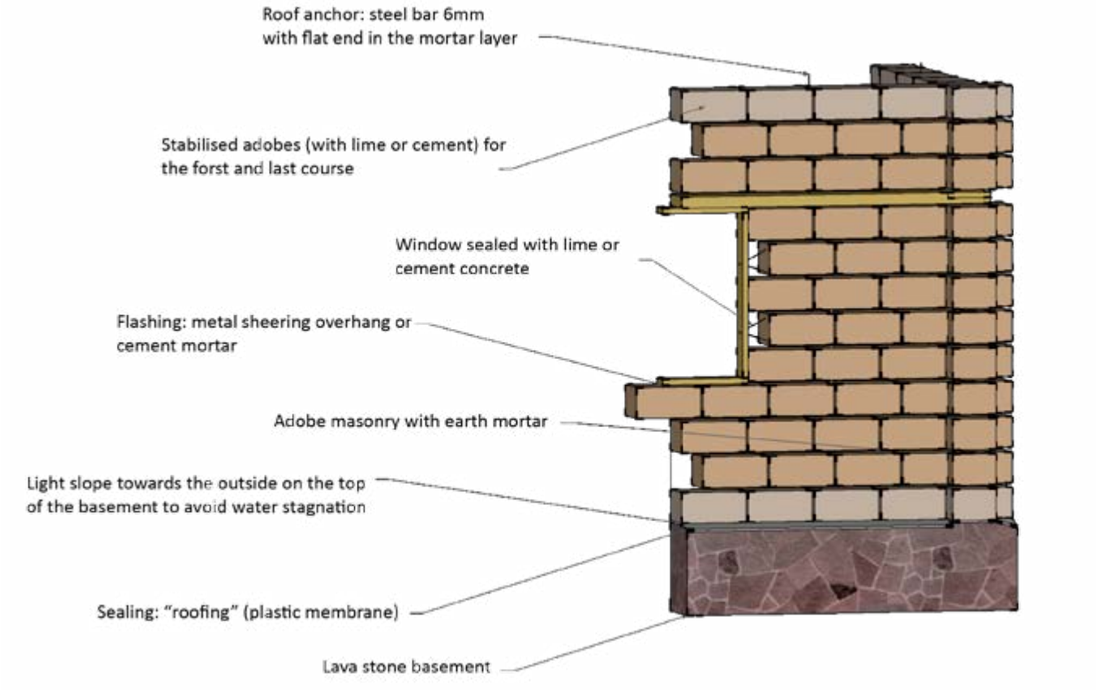
1.6 Specific context of the reconstruction areas: Masisi and Ruthshuru

Building tradition in Masisi

The Masisi area has been hit hard by the Eastern Congolese conflict. The UN-Habitat Goma office has been involved in land mediation in the area since 2008. Even if the majority of the people in the Masisi area are still living in temporary shelters, some villages have been active in building their own permanent houses. Many houses in the Masisi area are constructed with mud construction especially adobe blocks (Figure 1) or wattle and daub (Figure 2). Thatch roofs are the most common roofing solution. Foundations are often made with wooden poles or stones. There are natural spring water sources in the area.

In some areas of Masisi projects relating to reconstruction have already been implemented by United Nations agencies and NGOs. For example, the Norwegian Refugee Council conducted a project which provided building materials to a beneficiary family whereas the actual construction of the house was the responsibility of the beneficiary herself. The building was made up of a wooden structure with soil infill, sand and earth plastering and metal sheeting for the roof.

Figure 1:Adobe wall



Building tradition in Ruthsuru area including Kibati and Buvira[3]

The Rutshuru area was a major scene of the conflict between the government and the "M23" militant group that ended in late 2013. During the conflict, the majority of inhabitants fled but many have now returned to their original housing sites. The housing conditions in the area are very poor: most of the community members live in temporary shelter such as tents or quickly built structures made of any building material available.

When approaching Rutshuru from Goma, differences in traditional housing constructions can be observed between villages depending on the kind of building materials that can be found locally. The most common traditional way of building is using "sticks" (10 to 20cm in diameter). Often the bearing structure of the "stick structure" is poles that are either placed on the ground or dug into it. As preservation treatments such as oil are usually not available, the wooden poles are often rotten. A common way of protecting the sticks/poles from water in the foundation of houses is to use stone masonry or piled up stones 30 to 80cm high.

In the villages close to Goma such as in Buvira where a demonstration house of UN-Habitat has been built, most houses have stick or timber structures. These structures are commonly enclosed with any material locally available such as planks, banana or eucalyptus leaves, small stones, earth, metal sheets, plastic bags or tent covers obtained as emergency aid.

Due to the eruption of the volcano Nyiragongo in 2002, lava stone is largely available with little or no cost. Lava stone walls are therefore a common practice in the area, either used for the entire wall or built up to a height of 60 cm as a joint foundation and wall solution. A few concrete structures with various infill materials such as hollow concrete blocks, burned bricks and adobes can be seen. The most common roofing material is metal sheeting.

When advancing further from Goma in the direction to Rutshuru, for example in the area of Kibati and in Rutshuru town itself, plank houses become rarer while wattle and daub houses (Figure 2) become more common. Sometimes bamboo is used on top of earth in wattle and daub houses as a protective outer walling material.

There is a lime production site in the area and lime blocks are commonly used as construction material especially around the lime production site. Houses made of adobe blocks are also common. Roofs are most commonly made of thatch or metal sheeting.

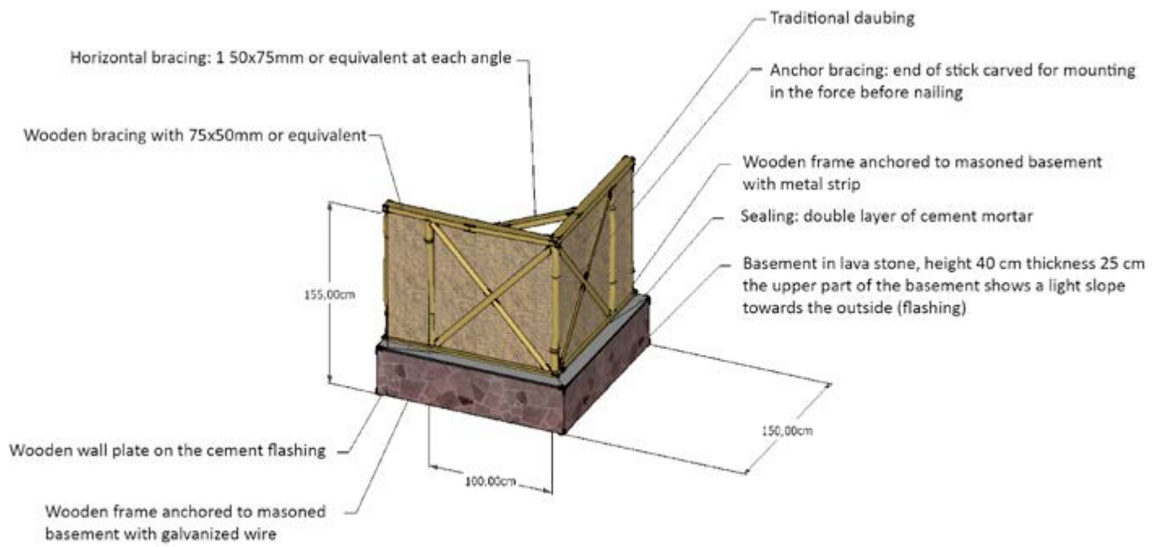
In the Rutshuru area from Goma up to Rutshuru town, finding water is an issue making water harvesting systems an essential part of any reconstruction programmes. There are still land mines in the area which makes securing the area before any housing reconstruction of crucial importance. There are already some reconstruction projects implemented by NGOs in the area, many of them timber structures.

In both Masisi and Rutshuru it was identified that logistics and costs could present problems for the sites furthest away from Goma thus making the use of locally found building materials especially important.

3 This subchapter is written by Emma-Liisa Hannula and Gregoire Paccoud.

↑ *Traditional house in Ruthsuru area. © Emma-Liisa Hannula/UN-Habitat*

Figure 2: Wattle and Daub wall



↑ *Preparing soil for making compressed earth blocks. © Emma-Liisa Hannula/UN-Habitat*

2 | Goal of the UN-Habitat Green Affordable Housing Project in the Eastern Democratic Republic of Congo (DRC)

2.1 Moving from emergency shelter to sustainable permanent reconstruction

The Buvira pilot house, funded by the UN-Habitat in the Eastern Democratic Republic of Congo aims to showcase the importance to move from emergency shelter to permanent housing re-construction in the Eastern DRC and to facilitate the reconstruction in a way that supports local economic development processes, is economically feasible for returning Internally Displaced Persons (IDPs), does not harm the local environment, supports local socio-cultural ideas of living and fulfils needs related to housing.

The goal of the project is to showcase a sustainable process for reconstruction including consultations and needs assessments of local populations; construction trainings aiming to build the capacity of local communities to build permanent housing themselves, maintain housing themselves and potentially gain opportunities for construction related employment. Additionally, the project aims to showcase to community members, locally active organizations and authorities environmentally sustainable and affordable ways of building in the specific context of the Eastern DRC, in order to pave the way for sustainable reconstruction in the region.

2.2 Specific objectives of sustainable reconstruction in the Eastern DRC

The housing reconstruction aims to reflect the four sides of housing sustainability:

- Environmentally sustainable: Built out of local natural building materials, reconstructed houses have a low embodied energy and low pollution levels. Their construction and design fulfill the climatic and local disaster resistance requirements. Using alternative building materials other than timber is relevant as the area is suffering from major deforestation.

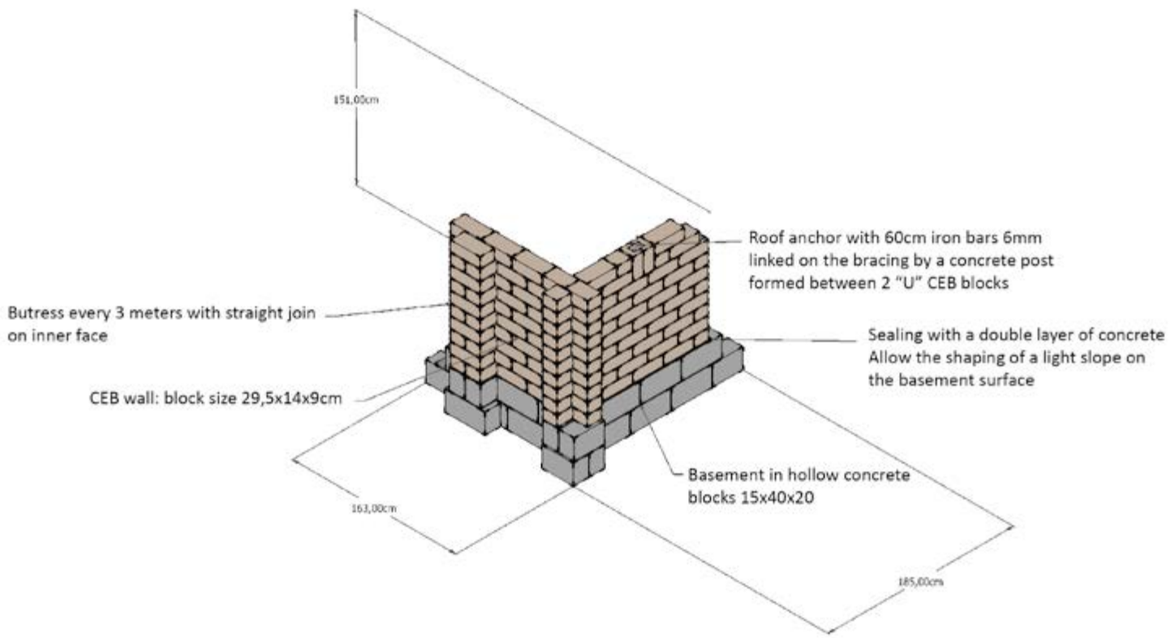
- Socially sustainable: Reconstructed houses are designed according to the needs of the target community based on consultations and needs assessments. The reconstruction has a strong training and capacity building component.

- Culturally sustainable: The selected building technologies are based on the building history and heritage of the Eastern DRC area with necessary technical improvements. Houses are built according to existing traditions related to the use of space, family structures and cultural preferences.

- Economically sustainable: The cost of reconstructed houses remains low to allow returning IDPs to build independently. When residents are involved in the construction process, the cost decreases. Using local building materials instead of imported building materials further lowers the cost. The estimation of the price of a house is based on a scenario where the monthly repayment amount of a housing mortgage does not exceed 30 per cent of the monthly income of the residents. The houses should allow incremental expansion to allow for

↑ *Finished building blocks made from compressed earth. © Emma-Liisa Hannula/UN-Habitat*

Figure 3: Stabilized compressed earth block wall



3 Project process

3.1 Scoping mission

The project began with a scoping mission that was undertaken by UN-Habitat in 2013. During the mission UN-Habitat met with all major UN agencies to discuss priorities for reconstruction and synergies to work together to start an effective joint reconstruction project. UN-Habitat undertook an in-depth analysis of potential local building materials for reconstruction and met potential local implementation partners to work on a demonstration house.

During the mission UN-Habitat visited different potential implementation sites in Masisi and Ruthshuru for a demonstration house and consulted village elders and inhabitants to assess their needs and priorities.

A beneficiary in Mugerua village in Kibati close to Rutshuru, a widow with three children, was identified. She had a large plot but lived in a small tent in the corner of the plot and her children were still in displacement as her house had been destroyed in the war. The concrete foundation of her old house was in place and it was agreed that the foundation could be used for the prototype house. Preparatory work for starting the housing construction was conducted. However, the site and beneficiary needed to be changed due to conflicting land claims that emerged after the start of the project. Thus, a 70 year old widow living with her two grandchildren in the village of Buvira was chosen as the final beneficiary of the pilot house project.

3.2 Selection of the construction material: earth

In the context of the Eastern DRC earthen architecture was identified as suitable for reconstruction as it is a traditional building technology in the region and a sustainable alternative to the other traditionally used building material - timber - which should be avoided due to deforestation issues. Earthen construction methods have low embodied energy and are suitable for the climate in the region and cultural traditions. In addition, earth is readily available at little or no cost in the region.

Earthen structures should be adequately protected from rain and proper ventilation should be provided through design. It was agreed to use stones and adobe construction (sun dried mud blocks) as much as possible and stabilized compressed earth blocks (SCEBs) with 5 per cent of cement reinforcement in the parts of the construction that needed additional strength or weather protection (Figure 3).

3.3 Design of a demonstration house

The development of the demonstration house began with a detailed needs assessment that was conducted within the target community. The partner organizations CRAterre, a French NGO specializing in earth construction, and Amicor, a local construction company based in Goma also specializing in earthen construction technologies were selected and the design process of the prototype house was initiated.

The initial drawings of the demonstration house were adapted to the new site in Buvira. The design was further developed together with all stakeholders during the implementation of the house and the details of the house were decided on-site between UN-Habitat, CRAterre and Amicor.

3.4 Training week in earth construction and implementation[1]

A 5-days' construction training in earthen architecture was facilitated by UN-Habitat with the support from CRAterre and Amicor for fifteen (15) community members of the Buvira village (ten men and five women), seven representatives from major NGOs and UN agencies of the Eastern DRC such as IOM, SKAT, CAAP, NRC, UNCHR and ADRA and the provincial ministry of Urbanism and Housing of the Eastern DRC. The participants were trained in the use of local earth based building materials and construction technologies.

During the training week, theoretical presentations on conception and good practices related to earth construction were given to ensure a proper understanding of the key issues in earthen buildings and to ensure the durability of the structure. Practical demonstrations followed on the nature of earth as a building material in conjunction with, field tests. These were followed by presentations on how to produce and build with Stabilized Compressed Earth Blocks (SCEBs), adobe blocks and micro concrete roof tiles together with demonstrations on how to select suitable soil for brick making.

Fundamental principles to be taken into account when constructing with earth were presented relating to the basement, foundation, roofing, walls, openings as well as the roof construction. The participants were taught how to build durable earthen walls and were testing building methods in practice.

At the end of the training the provincial minister for Urbanism and Housing visited the training/ prototype site where the details of the house as well as the construction technologies were explained. The community members had gained a significant sense of ownership for the project and described to the minister their newly gained construction skills. The training week also included field trips to visit houses built of earth in the region and a local lime production site.

The implementation of the prototype house started during the training week. Community members were actively involved in the building of the house which was facilitated by Amicor in coordination of UN-Habitat. This was a very good opportunity for the community members to work together and feel recognized as a community. Several evolutions of the initial design proposal and technical details were done on-site during the construction.

Placing earth into the molds. © Emma-Liisa Hannula/UN-Habitat ↑

1 This subchapter is written by Emma-Liisa Hannula and Gregoire Paccoud.

Figure 4: Incremental house plan, North Kivu

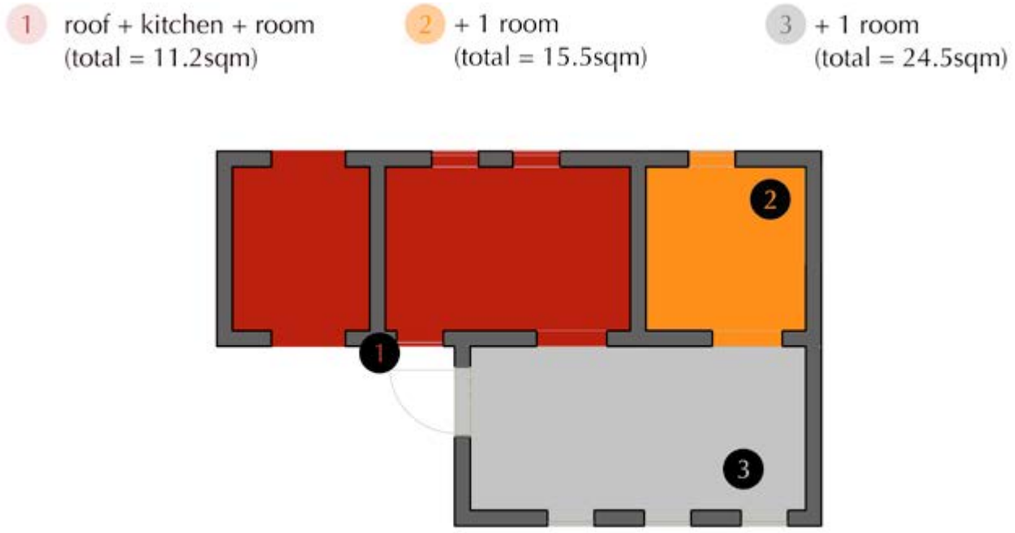
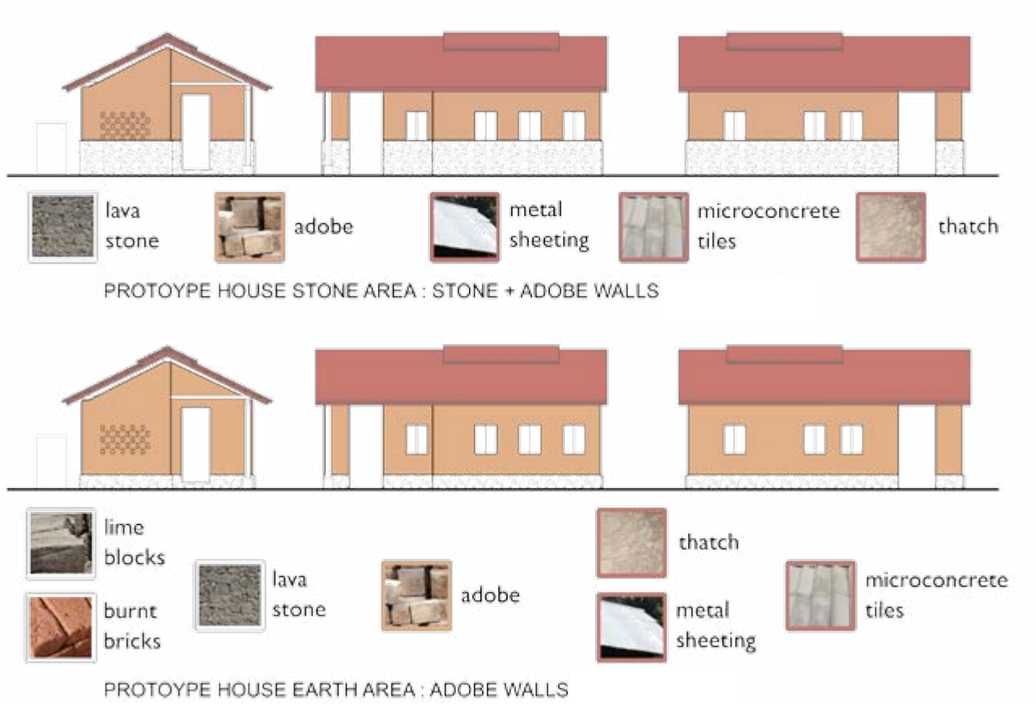


Figure 5: Different options to use local building materials



4 | Design aspects of the prototype demonstration house

4.1 Main housing design idea

The main design idea of the prototype house is the possibility to build it incrementally (Figure 4). The construction of the house starts with the erection of a large roof that allows for the incremental addition of rooms. The unit initially consists of a living room of 9m², two bedrooms of 4,3m² and 6,6 m² and a terrace area of 7m². The design includes an outside cooking area, as requested by the community members during the needs assessment. The cooking area outside lessens the residents' exposure to smoke during cooking and supports better air quality within the other spaces of the house. This is further supported by the planned natural methods of cross-ventilation of the spaces that is considered in the design. The choice of building materials was made according to what materials can be sourced locally.

4.2 Building materials[1]

Due to this two different directions are proposed for future reconstruction of houses (Figure 5):

1) Areas where earth materials are easily available: The first option has a low foundation and can be used in areas where soil is easily accessible and water resistant materials such as lava stone are difficult to obtain. The foundation materials could be burnt bricks, lime blocks or stabilized soil blocks preferably stabilized with local lime. These areas include especially Masisi and some areas of Rutshuru far away from Goma where lava stone is not as common as in the areas close to Goma. It was observed that in the areas where there are no lava stone available, thatch is usually available for roofing. Therefore the first option includes a low soil based foundation, adobe walls and a thatch roof (Figure 6 and Figure 7).

2) Areas where lava stone is easily available: The second option has a raised foundation up to 1 m made of lava stone with earth mortar above the first 40 cm. Lava stone is easy to find at little or no cost in many of the areas undergoing reconstruction. The remainder of the wall is constructed with adobe blocks. When there is a lack of local thatch, the proposed roofing material would be micro-concrete tiles due to the local economic benefits that their production can generate. Alternatively, metal sheeting could be used (Figure 9 and Figure 10).

Using plasters can be relevant for certain parts of the walls that are most affected by weather events. Different possible plasters can be sand -based or white ash.

4.3 Multi-criteria analysis

A multi-criteria analysis on economic, environmental, social and cultural aspects was conducted during the programme process. It reveals the benefits of using specific building materials. The analysis covered different basement, wall, and roofing options separately to allow an evaluation of all possible combinations with the selected techniques. Data provided remains an estimate,

1 This subchapter is written by Emma-Liisa Hannula and Gregoire Paccoud.

↑ *Preparing the foundation. © Emma-Liisa Hannula/UN-Habitat*

Figure 6: Prototype house design for earh areas

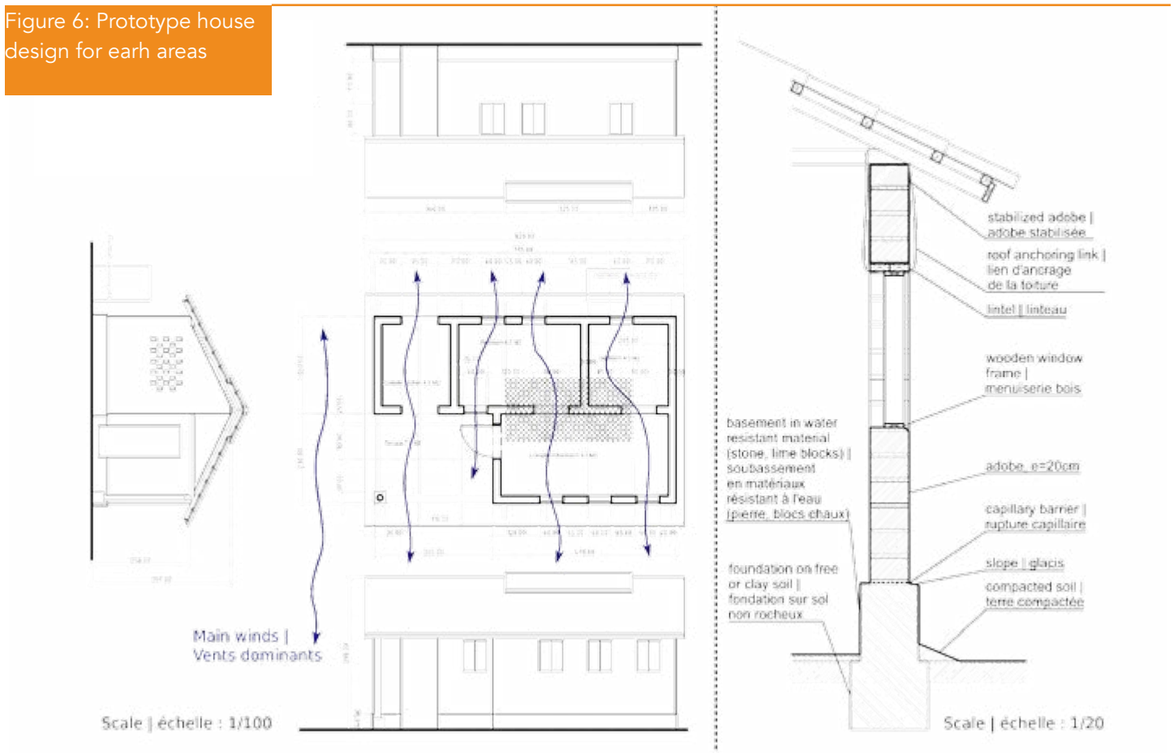
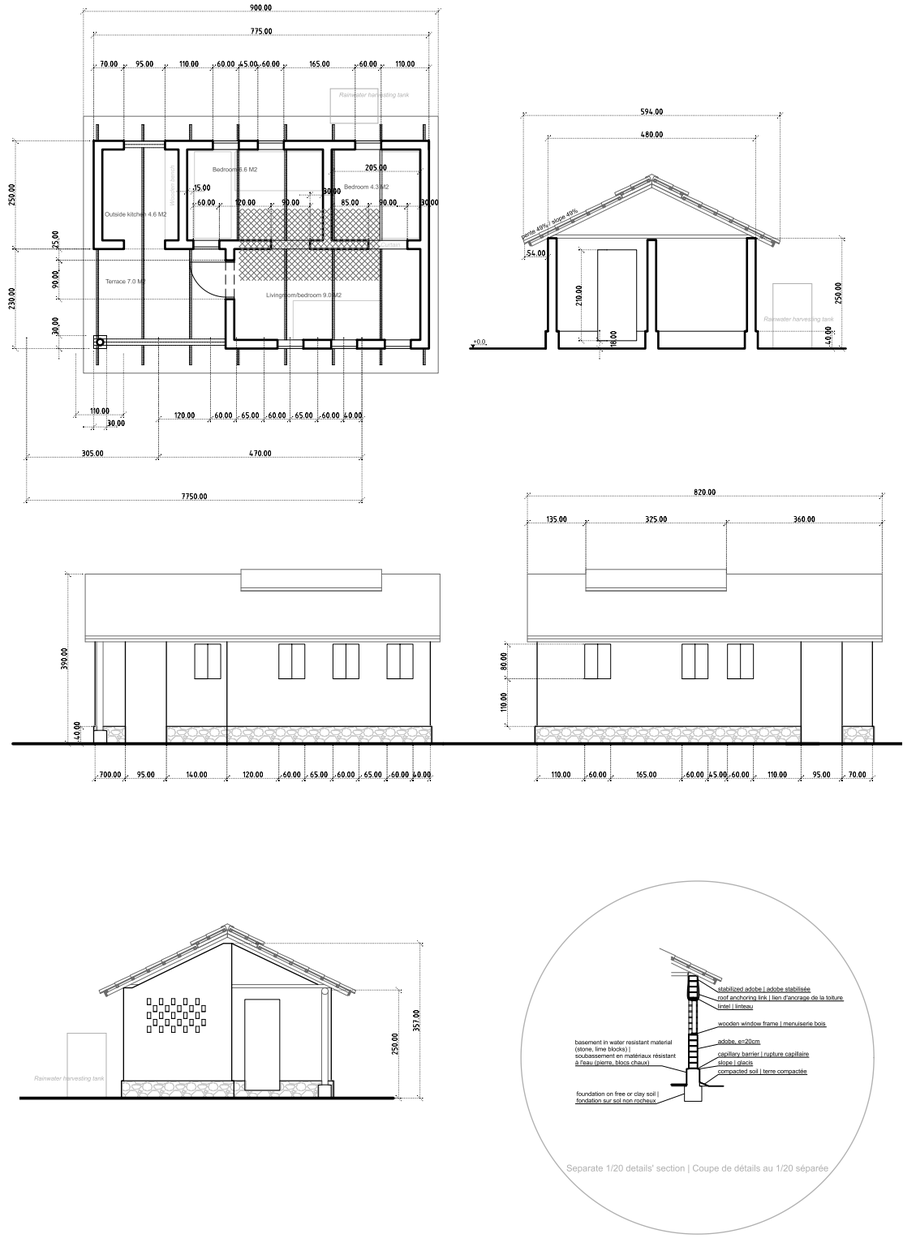


Figure 7: Prototype house earh areas



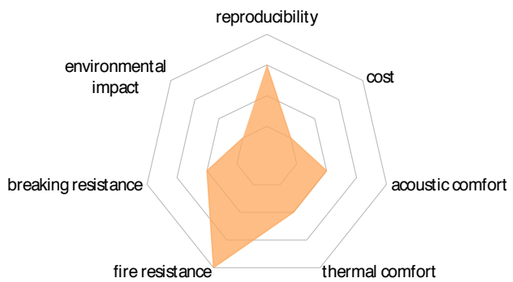
as transport of materials can significantly affect both economic and environmental variables.[2]

The criteria used were: cost ($), proportion of labor and materials in the cost (%), proportion of money invested in local economy for each option (%), and Green House Gas emissions (kgeqCO2). A cultural analysis was introduced to support the choice of the technical solutions analyzed.

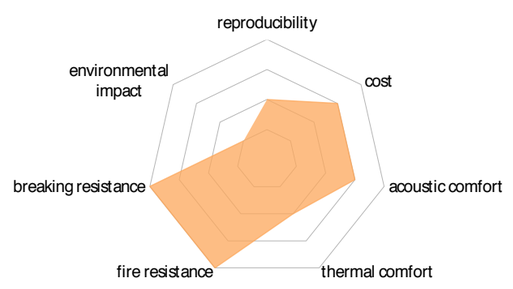
Costs were calculated on the basis of materials and labor costs. Environmental impacts were calculated using impact factors applicable to DRC when available (such as truck transport), global figures (such as steel and cement production and boat transport), and estimates calculated from local production figures (lime and burnt bricks production). As the reconstruction area suffers from high deforestation, potential emissions of wood and vegetal products used for the construction were included in the GHG calculations. This means that the CO2 stored in the wood used for the building was counted as emitted which is contrary to European practice where wood resources are well managed and the use of wood is therefore considered a CO2 storage. Acoustic insulation, safety and moisture management were also analysed as the result of exchanges with the beneficiaries. The resulting figures provide an overview of the main factors considered in the choice of a constructive solution (Figure 8). [3]

Figure 8: Multi-criteria analysis, Gregoire Paccoud

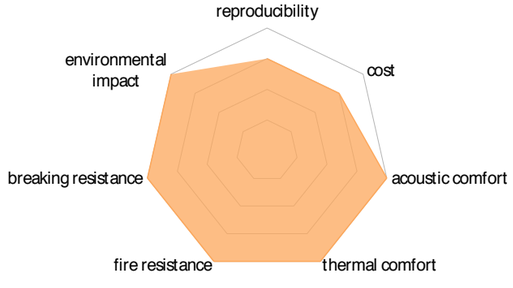
Cement block



Burnt brick



Stones, Adobes, and Lime



2 The paragraph is extracted from a report of CRAterre written by Gregoire Paccoud for UN-Habitat following the training week in Buvira in March 2014

3 The paragraph is extracted from a report of CRAterre written by Gregoire Paccoud for UN-Habitat following the training week in Buvira in March 2014

↑ *Constructing the first corner of the house. © Emma-Liisa Hannula/UN-Habitat*

Figure 9: Prototype house design for stone areas

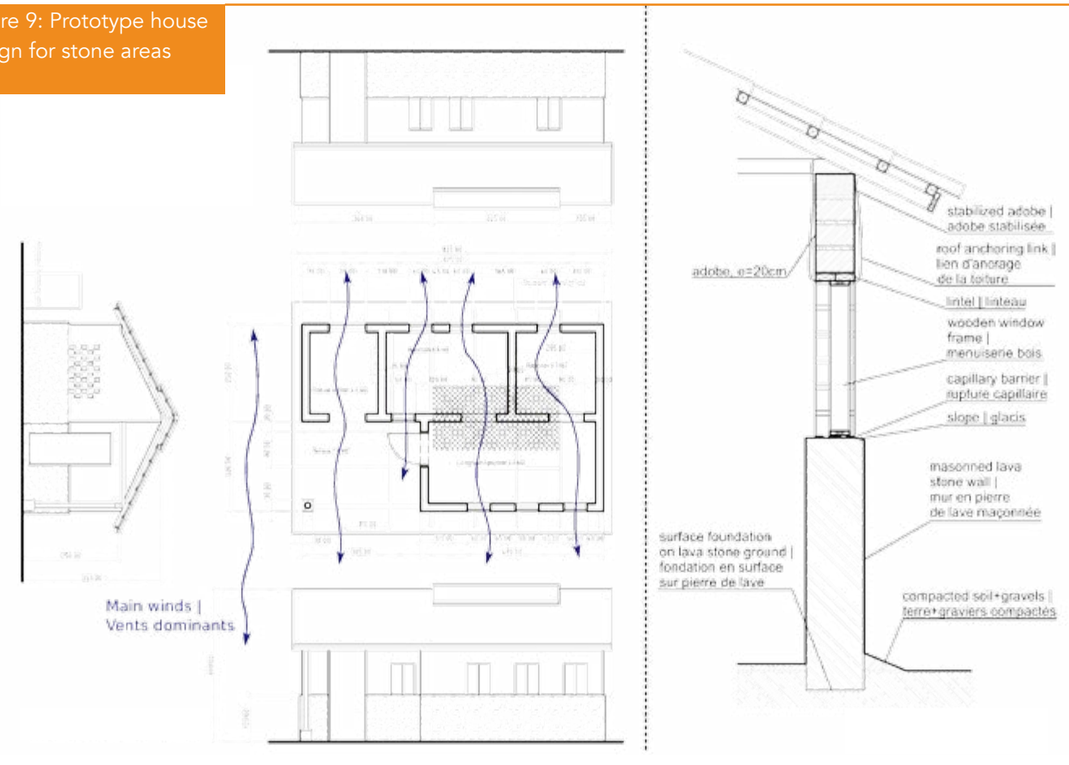
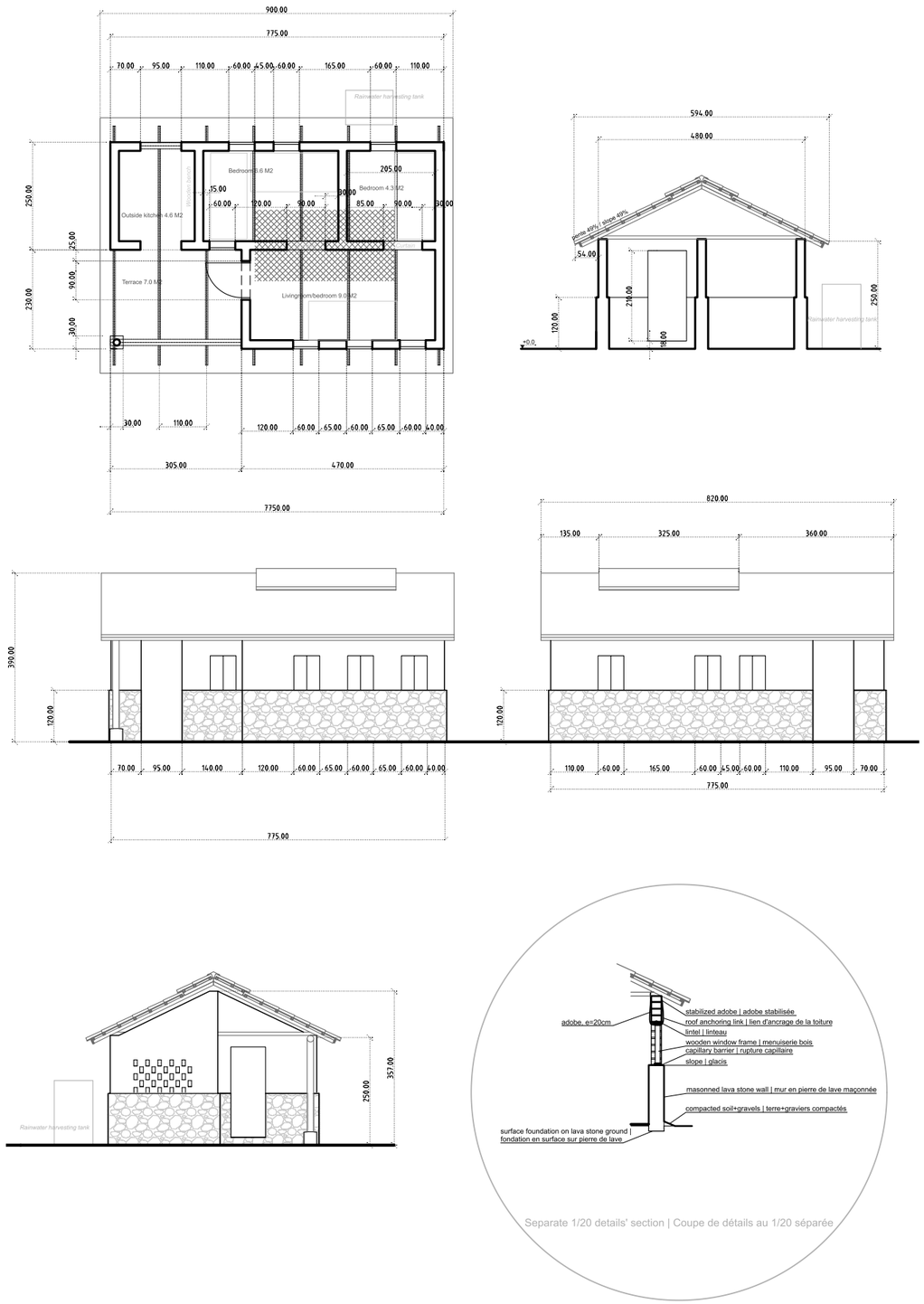


Figure 10: Prototype house stone areas



Erecting the earth block wall on top of the foundation. © Emma-Liisa Hannula/UN-Habitat ↑

5 Key findings

5.1 Utilizing local building materials

It is recommended that housing reconstruction in the Eastern DRC would use local building materials due to their lower cost; links to local building practices and easily learned building technologies; availability without long transportation distances by car; and for environmental reasons. For example lava stone can be obtained at little or no cost in many reconstruction areas in the Eastern DRC and it is easy to use in construction. It is important to point out that local building materials in the Eastern DRC are different from region to region and within regions. Therefore this report presents several design options for the reconstruction of residential housing, which are optimally using local natural building materials that are available in the different regions.

5.2 Decreasing the use of timber to slow down deforestation

In the context of the Eastern DRC finding alternatives to timber construction prevailing in many areas is crucial in terms of slowing down rapid deforestation. Deforestation is especially harmful for the Virunga national park. As timber is still needed for some parts of buildings such as roof trusses, doors as well as door and window frames, reforestation (preferably using eucalyptus) should be part of any project. Reforestation should be based on an analysis made by an environmental specialist.

it is recommended that the use of fired bricks would be replaced by adobe or stabilized soil blocks as burning bricks also consumes a major amount of wood. Building a kiln that would use alternative fuels for brick burning such as vegetative fuels could be an option but there is a risk that it would encourage communities to use whatever fuels they could find for brick burning including fire wood.

5.3 Respecting local building traditions[1]

It is recommended that necessary attention is given to respect local ways of life and traditional building practices to ensure the success of the selected design solutions. Time should be allocated to learn and collect information about the specific context to adapt the proposed design options to local practices. It is important that a participatory approach is used to change the design during the implementation process.

Existing practices can be developed and/or used in alternative ways. The change should remain easy enough to be implemented without additional expertise and if it does not imply higher costs in materials or labor. Proposed changes in common practices can be made visible through a sample wall/roof/foundation which can help convincing local stakeholders. It is recommended to spend as much time as possible on site with local stakeholders in case changes are proposed to current building practices.

1 This sub chapter is written by Emma-Liisa Hannula and Gregoire Paccoud.

5.4 Full participation of local communities[2]

It is recommended to include local community members in the design process, construction trainings and the actual construction of buildings. During the implementation of the first demonstration building in Buvira, the community members of Buvira were involved in the construction of the initial parts of the house under the supervision of technical staff. As these parts of the building will remain visible by all, they will become a proof for the ease of constructing with earth.

The community participants showed both a personal and economic interest in earthen building technologies for the purpose of developing an income generating activity. The community members expressed their will to start a community association aimed at going further with earth building in their community. Establishing community associations in similar projects is important for building material distribution, quality control, further education in building with earth and help to build other houses. Full participation of local dwellers is crucial for scaling up earth construction practices, for adopting the designs to local practices and for ownership of the project.

5.5 Creating employment options through reconstruction

It is recommended that all reconstruction programmes in the Eastern DRC would have a training and capacity building component transferring skills to local communities and stakeholders that they can use later for employment generation. Earth construction is labor intensive and therefore suitable for this purpose.

5.6 Decreasing the use of cement in construction

It is recommended to decrease the use of cement in construction in the area. A major part of the programme is to train community members in construction technologies that are realistic for them to scale up. Cement is beyond the economic reach of most community members and its use should therefore be minimized in construction in the area. In addition, cement production consumes much energy and contributes significantly to GHG emissions and pollution. Transporting cement from other countries adds to its considerable environmental footprint. It is recommended to use Compressed Stabilized Soil Blocks (CSCBs) only in certain parts of the construction including in the first layers of the outer walls that are erected on low foundations. CSCBs can be used as foundations also in some areas where lava stone cannot be found and in some cases as stabilized "lintels" of door and window openings. Stabilization with cement is not needed for the inner walls or for the outer walls which are well protected from rain (upper parts of the walls that are protected by the roofing and walls not directly exposed to winds).

It is recommended that local lime is used instead of cement in the parts of the building that need stabilization.

2 This sub chapter is written by Emma-Liisa Hannula and Gregoire Paccoud.

↑ *Placing of window and door frames. © Emma-Liisa Hannula/UN-Habitat*

6 | Ways Forward

6.1 Priorities of reconstruction

It is crucial to move away from emergency shelter towards permanent reconstruction in order to provide adequate long-term housing options for the inhabitants of the Eastern DRC. Future reconstruction of the DRC has a potential for creating a sense of security for residents, especially women exposed to sexual and other forms of violence. Protecting communities from possibly returning militias will also be of high importance together with providing equal assistance to different ethnic groups and creating local economic opportunities.

Similarly, building the capacity of communities to rebuild houses themselves in a sustainable manner is essential in case of repeated destruction by returning militias and for scaling up of permanent reconstruction processes. The capacity development of communities related to sustainable construction also has a peace-building dimension as people gain skills that they can utilize for sustainable employment generation. This, in turn, decreases the pull of joining militias for income generation and can boost local economic development processes.

6.2 Scaling up reconstruction in a coordinated way

It would be recommended that the organizations and local stakeholders involved in reconstruction would try to find synergies in their work and create joint programmes either through the MONUSCO operations or as separate cooperation programmes. This would help create programmes that integrate housing with employment generation, infrastructure and basic services as well as environmental protection and security.

Cooperation can also support coordinated reconstruction response without duplication or diverging philosophies. For this purpose, activation of the Shelter Group of the Eastern DRC would be beneficial. Also the network that was created during the UN-Habitat training week in March 2014 can play a major role in the establishment of quality reconstruction in the area, and in the development of the local economy as local authorities and major international organizations expressed their willingness to keep actively participating in the network.

Earth construction could be scaled up to be a part of the restoration of authority by constructing police stations and other public buildings. This could be similarly linked with training and capacity building of locals and support employment generation as well as local economic development goals.

6.3 Continuous training and building material distribution

For scaling up sustainable reconstruction practices in the Eastern DRC it would be recommended to establish continuous training centers in earth construction and in other relevant building technologies that would simultaneously work as distribution centers for building materials and as quality controllers of building processes.

It would be recommended to support local lime production activity as an alternative binder to cement. At the moment, lime is burned without a kiln over an open fire, making the process highly inefficient. However, burning of local lime in improved kilns would still have a direct effect on already strained wood resources. Such a development should be supported with specific programs for the management of local lime production and the preservation of local wood resources. The best way forward would be to sensitize local practitioners to use alternative fuels based on vegetative materials for lime burning instead of firewood. For this purpose an efficient kiln could be introduced for the lime burning process.

Finished pilot house. © Emma-Liisa Hannula/UN-Habitat ↑

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