Shelter prototype in Edea - Cameroon

Report
Tropical Equatorial Shelter Kit
Cameroon Mission

30 April 2019

International Federation
of Red Cross and Red Crescent Societies

Shelter Research Unit
Innovating shelter

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1. General Information

Project : Tropical Equatorial Shelter Kit
Region/Country: Humid Tropical Forest of Africa /Cameroon
Report date: 30 April 2019
Type of operation: Research and Development
Requesting Organization: AI-CRL

2. Context

National Red Cross and Red Crescent Societies in Africa are often called upon to take the lead in different crises. It is therefore necessary to equip them with effective shelter solutions designed in a participatory and innovative way.

In the context of countries with humid tropical forest, we have currently limited available emergency shelter solutions: the IFRC Shelter Kit (composed of Shelter Tool Kit and 2 tarpaulins) and the IFRC family tent.

These two solutions are poorly adapted and lead populations not to occupy shelters during the day because they are considered too hot or they are likely to be flooded regularly during rainy periods.

AI-CRL hereby request the IFRC-SRU to conduct a R&D study to develop a context based emergency shelter kit adapted to the predefined context of the humid tropical forest in Africa.

3. Outcomes

This R&D project intends to improve the future emergency shelter operations and the living conditions of the population affected.

The focus has been placed on the design and development of a contextualized Emergency Shelter Kit adapted to the humid tropical forest of Africa named Tropical Equatorial Shelter Kit (TESK).

4. Outputs

The following objectives were achieved during this R&D project and the Cameroon mission

- Documentation of context information based on State of the art (background research) field observation, market visits, interviews with Cameroon Red Cross and if possible with other shelter actors present in the country and the region
- Validation of the Shelter prototype with a participatory exchange with RC volunteers and local people
- Definition of the improvements/adaptations of the Tropical Equatorial Shelter kit based on the field information
- Documentation of the Tropical Equatorial Shelter Kit with the description of used materials, designs, BoQ, and assembly instructions

5. Activities

The project activities were performed in collaboration and with the support of AI-CRL and CRC following the agreed methodology and ToR for this project (ToR in the Annex).

5.1 Methodology

The proposed methodology is based on the following steps:

- Defining the requirements and context as the base of the design

In collaboration with AI-CRL, defining the criteria for the design of the shelter kit, including area, price and expected durability.

- Prototyping the Tropical Equatorial Shelter kit

Documenting context information based on field observation, market visits, interviews with Cameroon Red Cross and if possible with other shelter actors present in the country.
Empiric design and validation of the Tropical Equatorial Shelter kit prototype with a participatory exchange with the local staff.
Definition of the improvements/adaptations of the Tropical Equatorial Shelter kit prototype in collaboration with the Cameroon National Society.

- Verification workshop and monitoring period

To ensure the quality, performance and adaptability of the Tropical Equatorial Shelter kit, two prototypes were built in March 2019 (Edea – Cameroon). A monitoring period was defined to document the performance of the shelters in real conditions.

- Final design and documentation

Production of a set of final documentation including graphics, BoQ and assembly instructions to facilitate the sensitization and dissemination activities.

5.2 Defining the requirements

A participatory session using the basic concepts of the Functional Analysis procedure was conducted by the SRU together with AI-CRL. During the session, the activities where organized as follows:

- Limits: questions focussing on When? Where? and How? the TESK will be designed for
- Objectives: this session focussed on a wider mix of operational questions that include, the number of beneficiaries per unit, operation conditions (weather), logistics and materials and techniques to be used.
- Requirements: the last part of this participatory session focussed on the quantification of the predefined criteria's. Eg. Minimum shelter surface of 18m^2

The first output of this participatory session were the following design bases:

Predefined bases of design

- Limitations:
  Although the project was conceived with a regional scale, for operational reasons a country has been defined as a working base to then try to extrapolate/adapt the results to the different countries of the region. The cyclone prone region of East Africa is excluded from the objective of this project.
  AI-CRL appointed Cameroon as the country to begin the works and conduct a R&D mission.
- General:
  Durability: 6 months
  Surface area: 17,5 m2 (5 people according to sphere standards)
  Price: 200 €

- Materials:
  IFRC tarpaulins and other locally procured materials
- Construction technology:
  Inspired by the techniques of building temporary vernacular shelters in the humid forests of Cameroon
  Protecting from rain and soil moisture

5.3 Getting context information

Climate and background information

The Tropical-Equatorial region of Africa has two main different climatic zones.
While to the East African coast the "Grasslands" are predominant, the West coast is mostly covered by "Rainforest".

The focus of this project has been placed on the design and development of a contextualized Emergency Shelter Kit adapted to the humid tropical forest of Africa.

The image shows the distribution of the different major climate regions of Africa.

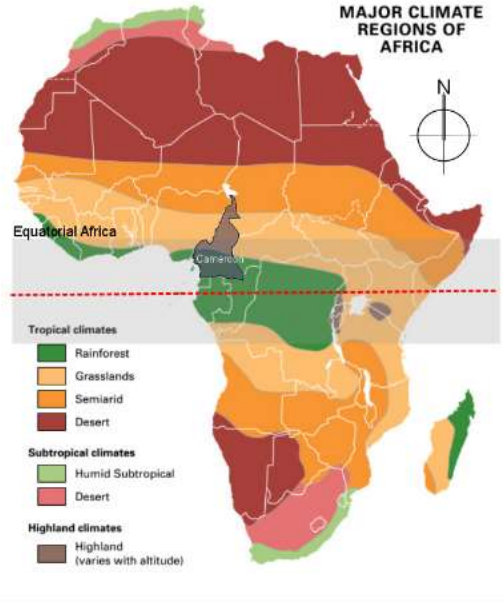


Image from Encyclopedia Britannica INC.

Cameroon is placed on the central region of West Africa and has a wide variety of vegetation and land profile with high and low lands. From Tropical climate with Sahel characteristics to Equatorial forest with heavy rain periods, the variety of climates in the country is representative of the sub region of West Africa.

Following the operation requirements and capacities of AI-CRL, the IFRC-SRU has undertaken the research and development mission to Cameroon with the aim of developing the Equatorial Shelter Kit and validating the solution with the participation of CRC volunteers.

CRC has designated a site for this mission with equatorial forest climate and periods of heavy rainfall. The selected site was Edea, in the region of Douala, 175 km from Yaoundé (3h by car approx.).

The next image shows the main climatic region in the country.

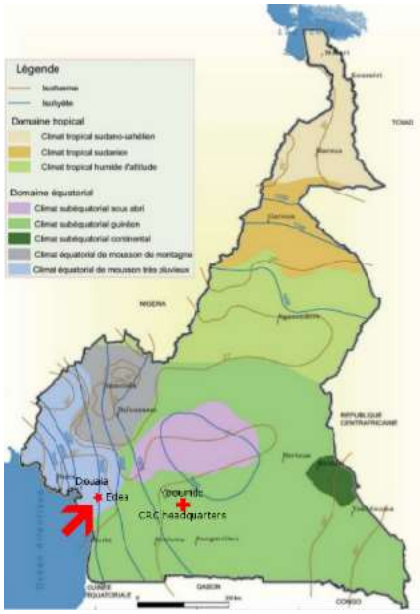


Image National atlas of physical development of (Cameroon).

Working in the context of equatorial forest and periods of heavy rainfall has provided the opportunity to develop, validate and monitor the shelter solution proposed by the IFRC-SRU in similar common conditions than in the West tropical region of Africa.

Vernacular architecture techniques and materials

The traditional/vernacular architecture is generally well adapted to the context and represents a source of technical solutions and a picture of the cultural preferences of the community. In order to record some of these solutions, constructions, techniques, and used materials, the IFRC-SRU has visited a set of representative villages recommended by the CRC in Edea.

To collect representative examples of the local architecture, three villages where appointed. Starting from Edea and moving in the south-west direction along the Sanaga River we visited the villages of Dizengue, Mouanko and Yoyo I & II.

The examples were documented by exchanging with the local people and taking pictures. Relevant construction examples were identified in beaten earth houses in Dizangue; temporary bamboo constructions in Maouanko, and semi-permanent constructions with wood structure and palm leave cladding in the Yoyo villages. Particularly interesting for the documentation was Yoyo II and the old fish market built with a stilt system (pile dwellings).

The next image shows the situation of the visited villages and summarizes some of the documented examples.

DIZANGUE	Beaten earth/Adobe houses with bamboo structure
MOUANKO	Extensive oil palm, bamboo and rubber plantations
YOYO I	Constructions with bamboo/or branches structure and palm leave cladding
YOYO II	Plaphitic constructions with wood structure and palm leave for roofing

Market visit and purchase

Correct implementation of the shelter prototype is directly linked to the tools and materials available in the local market. During the visit, we have identified architectural solutions that are linked to materials, tools and the correct implementation during the construction process. To ensure the availability of the selected materials for future shelter operations, the IFRC-SRU has visited Douala that is the economic center of the region. We have collected information from different suppliers including international stores, open markets, and small road shops.

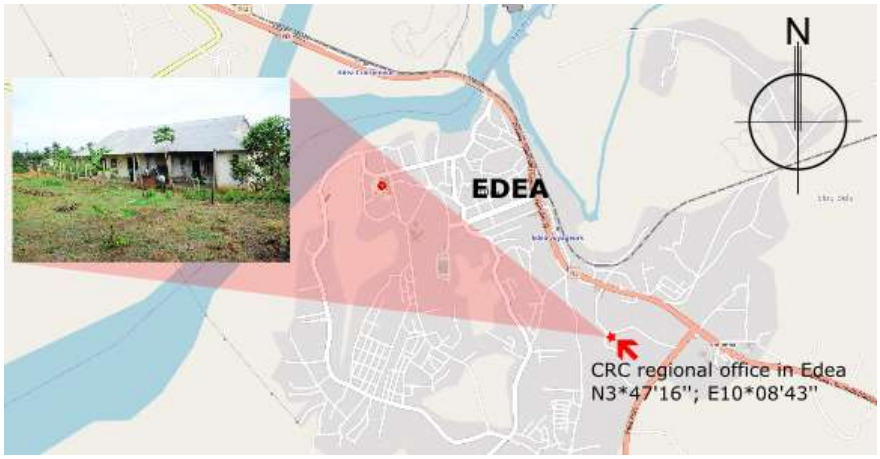
The direct purchase of construction tools including protection elements was done during the market visit. Construction materials to build the shelter prototypes were ordered. Due to the extended availability of "vegetal local resources" the materials such as bamboo, palm, raffia or others are commonly ordered from one day to the other. For bigger quantities, the order has to be done with the precaution of a few days before the construction date.

The following picture provides a view of the used tools during the workshops in Edea.

5.4 Workshops and prototypes description.

The IFRC-SRU conducted a participative workshop in collaboration with CRC to design and build two shelter prototypes. The activity took place in a plot of the CRC regional office in Edea.

The next image indicates the position of the CRC regional office.



The CRC office is located in the urban area of Edea with access by a secondary non-pavement road and family houses as neighbors. The space used for the workshop was in the backyard of the CRC offices. The ground was not regular with a maximum difference of 1,50m level, two trees, debris and a surface of 180m^2 approx. Drawings of the plot are available in the annex.

The next picture shows the space for the construction prior to the workshop.

The particular characteristics of this plot as well as the reduced space guided the reflection to work on the construction of two different shelter prototypes.

- First prototype

This shelter tempts to provide a solution for a plot with an intense difference of level in a reduced space. Taking inspiration from the Yoyo villages and the pile dwellings together with palm leaves as cladding material, this shelter provides a covered surface of 18m2 over a platform of 24m^2 (6x4m)

The chosen structural material was bamboo cane in different formats, 4 and 6 m long and 8cm diameter for poles, beams and main structural elements. The shelter roof and walls were done with the same bamboo cane but split into 4 or 6 pieces each.

The walls were inspired by the traditional houses with bamboo panels that are attached to the main house structure observed in Dizangue. However, in this shelter prototype, the finishing is done with palm leaves attached over the bamboo panels. Adobe was not used for the construction of this emergency shelter.

Finally, the roof was inspired on the pygmy constructions with a dome shape made with split bamboo arches, covered with a locally purchased tarpaulin and finished with green leaves.

- Second prototype

Before beginning the construction of this shelter, a surface of approx. 36 m^2 was prepared with ground excavation and removal of debris, wood, and fibro-cement pieces in order to receive a regular, clean and flat area.

This second shelter responds to a plot with a flat and regular surface in a reduced space. Inspiration has been taken from the Bamileke and Bamou villages with their characteristic construction with cone-shaped roof and grass claddings. The covered shelter surface is 20,25 m^2 with a central height over 4 m.

The main shelter structure is a bamboo pyramid over a framework placed directly over the ground. The ground projection is 4,5x5,5 m and the central height over 4 m. A secondary framework is placed at 2 m over the ground to facilitate the work and guide the wall pieces to come into the shape.

The structure of the walls is made up of 140 vertical pieces of cut bamboo, each 7 m long. The bamboo pieces fixed to the ground and mid-high frameworks. Finally, all bamboo pieces are joined together at the head of the pyramid.

Green panels of 2x0,6m made of palm leaves (raphia palm) were the material used for the cladding. Green panels are commonly used in traditional Bamileke construction. It is also a common material produced locally in the southern half of the country (forests). This material is much appreciated by volunteers. Each panel is made manually from the leaves of the Raphia palm. Therefore, the leaves of the Raphia palm must be green (freshly cut) to allow manual processing. The panels must be ordered at least 48 hours before use and depending on the amount requested the production time can be much more than a few days. The whole system was finished with a canvas purchased locally and attached with nylon ropes to the head of the pyramid (hat).

5.5 Monitoring period and comparative analysis

A monitoring period of 5 weeks was defined. The procedure was agreed with a weekly visit to document the condition of the prototype in a predefined matrix supported with pictures. All this information was transferred by email/WhatsApp every week.

The predefined parameters for monitoring:

- Climate – temperature, rain, wind and other relevant climatological events.
- Structure – visual inspection focussing on the general aspect of the shelter structure, joints, deformations and/or defect pieces.
- Cladding – identification of damaged pieces or elements, water proofing.
- Durability – insect attack or other damages.
- General comments

The following matrix summarizes the collected information during the monitoring period.

Prototype		Climate	Structure	Cladding	Durability	General comments
W1	P1	Very hot 2 days rain	Stable no deformation	No damages	No insect attack	Good ambience
	P2			Cladding panels stolen		General satisfaction
W2	P1	Hot, strong wind 4 days raining	Stable without visible damages	Split bamboo for the ground with small deformation	No insect attack	Good protection against rain and wind, feel safe
	P2			Small split bamboo deformation in the walls	Mud and water inside the bamboo framework over the ground	Only the bamboo deformation to highlight
W3	P1	Very hot with strong wind	Stable no deformation	No damages	No insect attack	Good ambience

	P2	during the week	Deformation on wall base bamboo	Same deformation than last week	No insect attack	Sand and mud inside the shelter
W4	P1	Heavy rains with strong wind, hot	Stable no deformation	Dry leaves on walls have flown	No insect attack	Bamboo change color to yellow, good ambience
	P2		No changes from last week	"hat" Tarpaulin has flown away	No insect attack	As tarp has flown away, rain inside the shelter
W5	P1	Extremely hot, light rain	No changes from last week	No changes from last week	No insect attack	Big rain season is about to start, would be a good idea to follow the shelters during this period.
	P2					

Preliminary comparison

Complementary to the monitoring period, a summary evaluation of the recorded data is carried out. This evaluation aims to identify the key parameters to define the design of the final model. The identified parameters are: building complexity; unit price; construction time; covered surface and model adaptability.

The following graph represents the values of each prototype according to the defined parameters.

Building complexity	Unit price	Construction time	Covered surface	Adaptability
Skills to build the shelter and security	Material price in the local market	Time during the workshop including exercises and exchange	Total covered surface inside the shelter	Shelter can be used in different context such as plot in pendent, or forest with dense canopy
Scale: 1 low 2 medium 3 high	Scale: *1x100€*	Scale: 1xday	Scale: 1x10m^2	Scale: 1 low 2 medium 3 high

Summary comments of the comparison

Building complexity: the process to build the prototype is mostly repetitive and the needed skills to do it (cut or split bamboo, and make simple joints) are similar. The main difference is regarding the risk to work at a height of 4 m that is needed for the second prototype at the head of the pyramid. The first prototype gets better performance with this parameter.

Unit price: the unit price obtained as the total price of the used materials to build the shelter. Men hours and tools are not included. The prototype number 1 is 45% less expensive than the second.

Construction time: the time for building the shelters during the workshops. This includes discussions with volunteers, particular explanations, testing different techniques among others. In real conditions, the construction time will be much less. The two prototypes demanded a similar time for the construction.

Covered surface: this is the direct measure of the covered ground surface inside the shelter. The second prototype has a bigger covered surface.

Adaptability: this parameter reflects the capacity of the shelter to be implemented in a different context i.e. plot with irregularities, low and dense canopy, floods. Due to the rigid platform that can be built over stilts the prototype 1 has more flexibility and would provide better adaptability.

Prototype 1after 5 weeks of monitoring

Prototype 2 after 5 weeks of monitoring

6 The Tropical Equatorial Shelter kit

6.1 Structure

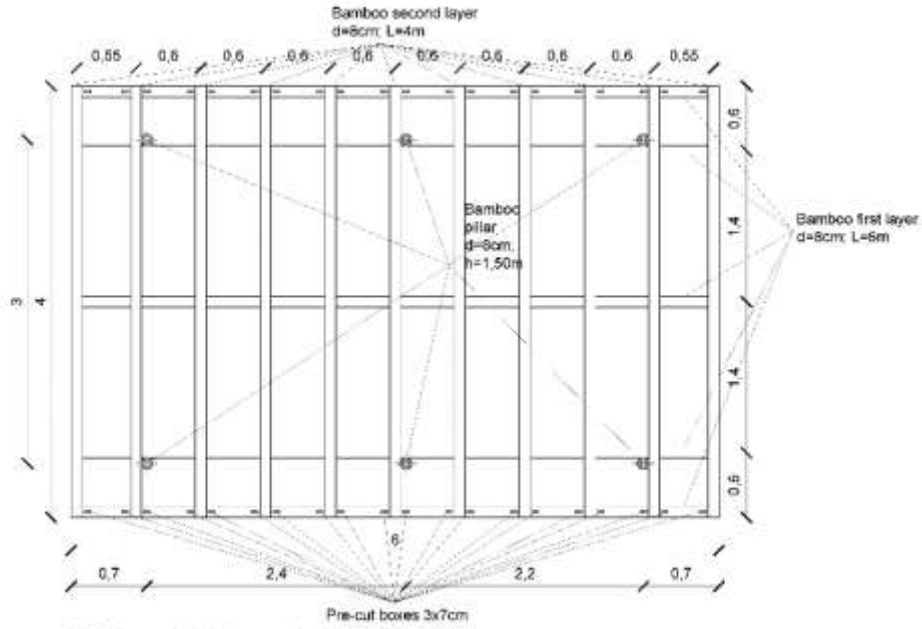
- Ground platform and Marking-out

The shelter design includes the concept of a semi-rigid ground platform of 6x4m. This platform has a footprint area of 24m^2 (4.8 m^2 person for a family of 5 - Sphere Standard 3,5m^2 per persons). The used material is bamboo cane with approx. D=8cm and two longitudes of 6 and 4m.

The first layer of 5 parallel bamboo pieces of 6m long are placed to start the ground platform: the two outer sides with a 4m distance between them, another two bamboo canes at 60cm offset from the border to the interior and the last bamboo placed equidistant from the borders (centred).

Construction of the semi-rigid platform during Edea workshop

Second layer of 11 equidistant and parallel pieces of 4m long placed perpendicular to the first one. All pieces are attached between them in each crossing point defining a grid of 6x4m.



TESK semi-rigid ground platform - plan view

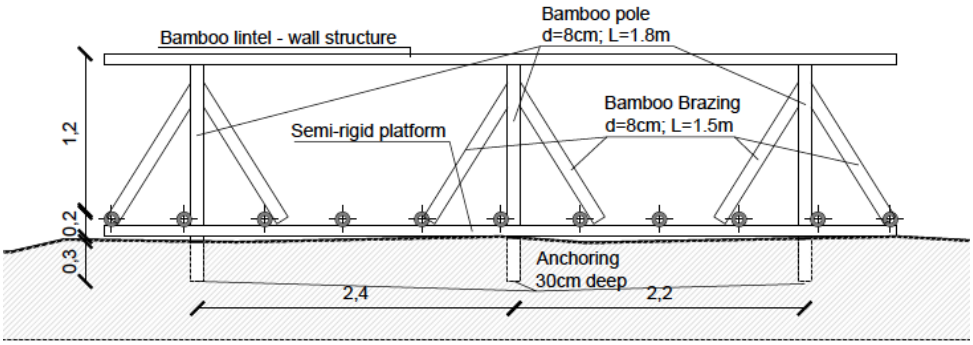
The rationalization of the dimensions of the shelter also facilitates the staking-out process. Using the basic method of "3;4;5" ensures the regularity and quality of the construction. A reduced variety of pieces also means simplified logistics and easier quality control.

- Anchoring points and wall structure

Six anchor points are placed to fix the ground platform. Vertical bamboo pieces of D=8cm and L=1,80m distributed uniformly are the designed elements to work as pillars for the walls and anchors to the ground. Each piece is buried 30cm into the ground, fixed to the ground platform in the crossing point and reinforced with two brazing pieces made with the same bamboo cane.


Construction of the anchoring points and walls structure during the Edea Workshop

One lintel piece of 6 m long and D=8 cm is placed over the pillar heads parallel to the long side of the ground platform. The structure of the two sidewalls will be finished with a 6 m long lintel at 1,30 m high.



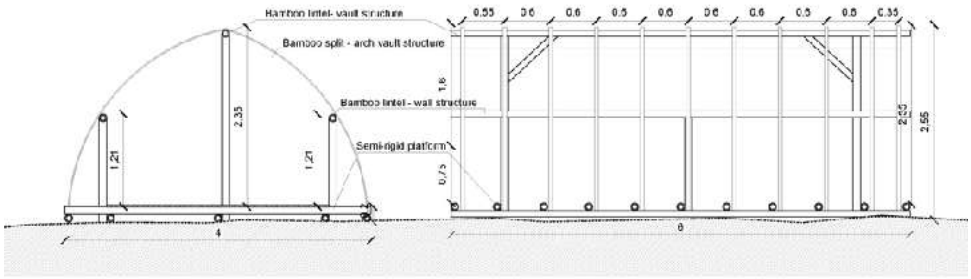
TESK design - anchoring points and walls structure

With the measures undertaken to stabilize the structure and make it self-supporting, the depth of the excavation will be in function of the soil context with minimum 30 cm deep for each pillar. Additional measures can be necessary to ensure the structural stability depending on the soil type and shelter exposition to the wind pressure.

- Roof structure

The design includes the vault concept for the shape of the roof. The vaulted shape is linked to the flexibility of the material used. This form requires the additional support of a central "bridge" or lintel beam located 2,35 m above platform level. This bridge is a 6 m long bamboo cane; D=8 cm on bamboo pillars. Each pillar is placed with a shallow foundation (approx. 30 cm) and fixed to the ground platform in its central axis. The bridge system should have a set of bamboo cane brazing elements D=8 cm max. to ensure stability in all directions.

Construction of the vault structure during the Edea Workshop



TESK design – Vault structure front and side view

The geometry of the vault was created through arches made of split bamboo cane. The arches fixed in a pre-cut space on the outer pieces of the ground platform. Each cut made with a small hand saw for green wood and a machete. All cuts were placed next to the heads of the short pieces of bamboo that formed the grid of the ground platform. Next to each bamboo head there would be two cuts on the left and right.

Construction of the vault arches during the Edea Workshop

The bamboo pieces are bent over the shelter and fixed over the side lintel. Each bamboo arch crosses over the lintel bridge and is finished by fixing the split bamboo pieces that join over the shelter perpendicularly to the vault axis. The central height of each vault arch is limited to 2,35 m over the ground platform.

- Structural variations and shelter flexibility

The described structure design responds to a ground that allows digging and presents a flat surface or gentle slope. The concept of a regional shelter kit requires a shelter design that can respond to different contexts.

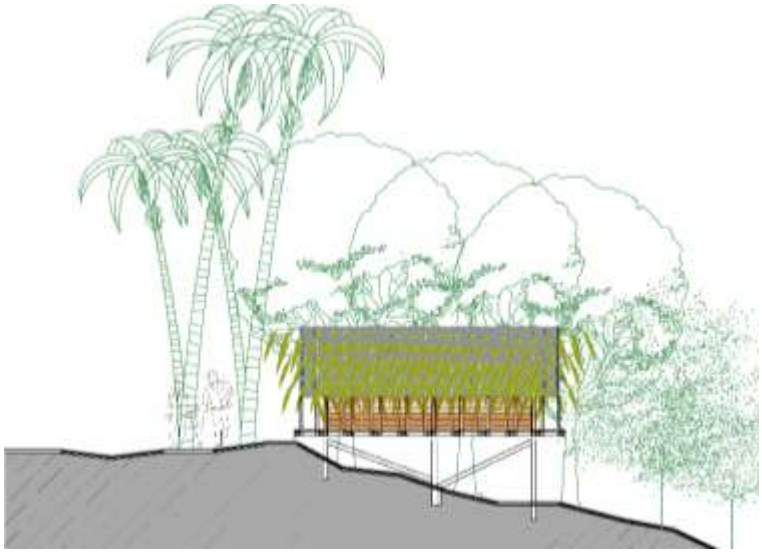
The semi-rigid ground platform together with some few measures to stabilize the structure, makes the shelter easily adaptable to different contexts.

The experience of the workshops in Cameroon shows that by adding small elements to the semi-rigid ground platform, the shelter would provide an effective response for a wide range of contexts.

Here a summary description of some of the common situations where the shelter can be implemented.

Sloping ground

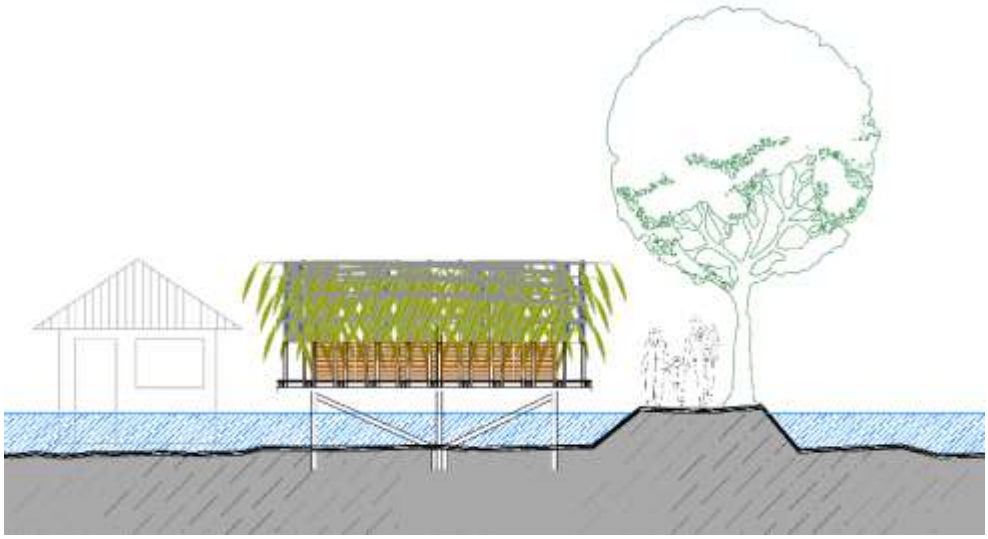
The workshop in Edea (Cameroon) has proven that the solution of a semi-rigid platform can be a good solution also in sloping ground. By extending the 6 pillars and adding a brazing (crossing) system between them, the shelter platform become a "raised platform". This solution appears as an effective alternative for positioning in a slope.



TESK design – with sloping ground

Floodable ground

Same concept and solution for slow floodable ground: extending the pillars and raising the platform the shelter would be over the flood level.

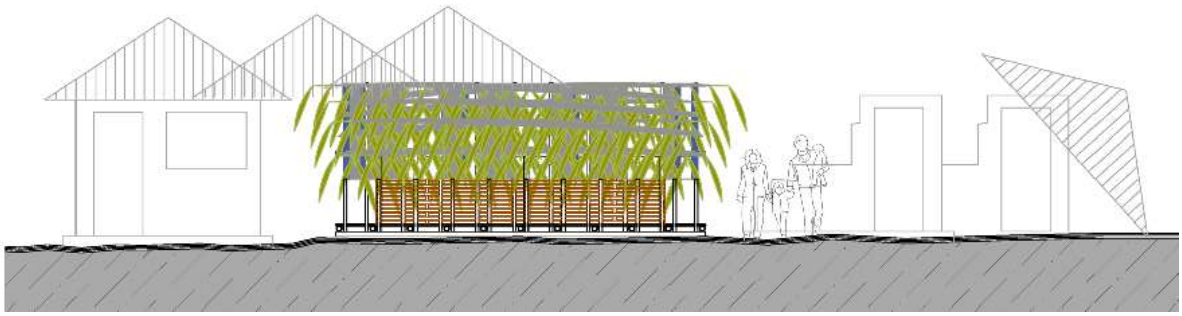


TESK design – Floodable ground

Hard ground no option to dig

It would be likely to face the situation of a rocky-ground or a pavemented plot to set up the shelter.

In this case, the proposed solution would include shortening the 6 pillars at the ground level (wall pillars of 1,50m for 1,30m walls). The brazing bars from the semi-rigid platform to the head of the pillars will ensure stability making the shelter operative also in this context.



TESK design – hard ground

Short durability (transportation)

A lightweight shelter without anchors would be easily transportable.

At the same time, a shelter without anchors will be a weak lightweight construction exposed to the wind. The use of ballast anchors to reduce the risk of uplifting would be a good alternative for these conditions.

TESK design – hard ground

- Roof variations

The shape of the vault structure depends directly on the flexibility of the available materials. The Tropical Equatorial Shelter Kit is a regional design and local markets condition the availability of materials. If flexible material such as bamboo is not available in the local markets, the shelter can be easily built with rigid materials.

In this scenario, the floor platform, the walls, and the lintel bridge have the same geometry, but the roof would have the shape of a gable roof with two slopes of 35 degrees and 2.50m in length from the bridge to the eaves.

6.2 Cladding systems and interior finishing

- Ground finishing

The semi-rigid platform offers a wider range of advantages, including the protection of the inhabitants from soil moisture that was a requirement for shelter development. At the same time, this solution requires a soil layer inside the shelter. The Edea workshop shows the good results of a continuous layer of split bamboo attached to the grid of the semi-rigid platform. During the workshop the material used was bamboo, but alternative materials can be used for this purpose, e.g. raphia palm, regular branches. Prefabricated panels would be an alternative for shelter operations with massive distribution of items.

Construction of the ground interior finishing during the Edea Workshop

- Vault cladding

The designed cladding system for the vault has two layers.

The inner layer covering the vault structure is made of waterproof IFRC tarpaulins (4x6) placed over the bamboo arches. The long side of the canvas extends over a piece of split bamboo that helps

stiffening the edge. From this edge, four fixing points per side help to tension and secure the canvas to the shelter structure with a 4mm rope.

Construction of the first cladding layer over the vault during the Edea Workshop

To ensure that the system stays in place, the second set of bamboo arches is placed over the canvas using the same technique as before. The canvas will pass over and under each of the bamboo arches, avoiding the "sail" effect and providing additional strength to the entire system

Construction of the second set of bamboo arches over the tarp during the Edea Workshop

The second, outer layer is made with palm leaves fixed to the bamboo arches on the canvas. The palm leaves protect the shelter from UV radiation, reduce the noise of rain on the canvas and finally provide an effective thermal insulation layer. In addition, depending on the type of palm leaves used, it would be possible to climb over the shelter.

Construction of the second cladding layer over the vault during the Edea Workshop

- Wall cladding

Wall cladding with panels made of split bamboo pieces fixed to the pillars and lintel structure. The walls can be finished with vegetable leaves (palm or others) depending on availability.

Interior view of wall with bamboo panels during the Edea Workshop

This system allows a fluid circulation of air (ventilation) that helps to reduce the sensation of intense heat and at the same time provides the necessary privacy inside the shelter.

6.3 Logistics

The proposed design for the TESK is an emergency shelter that have proven good results in terms of resistance, cultural acceptance and market availability. The different variations for the local material verified the adaptability of the proposed solution.

It is pertinent to flag that the use of new materials that are not well known by beneficiaries can negatively affect the acceptance and change the cultural approach of the TESK.

The conception of the improved shelter solution includes the flexibility in terms of selected materials. The bamboo cane used for the structure can easily be changed to local sourced wood or raphia palms, and the IFRC tarpaulin on the vault can be changed for vegetable panels.

The concept of the proposed TESK offers the possibility to distribute an item combination or complete solutions or just the key elements such as tools for construction and tarpaulins.

Furthermore, this kit conception facilitates the distribution in logical phases of the building process and seasonal requirements.

The following table presents the cost of the TESK, using the best value for money prices for 1 prototype and from local suppliers in Edea - Cameroon (as of 2019.03).

Tropical Equatorial Shelter Kit				201,94 €
Material	XOF	Euro*	Quantity	Price
Bamboo L=6m D=80mm	450	0,69	30	20,7
Bamboo L=4m D=80mm	350	0,53	20	10,6
Oil palm leave L=4m	300	0,46	20	9,2
Deco Palm leave L=3m	300	0,46	30	13,8
IFRC tarp (4x6) 25000	19650	30	2	60
Rope 6mm/ 100m	6000	9,16	2	18,32
Rope 10mm/ 100m	15000	22,90	1	22,9
Metallic wire (roll)	1000	1,53	3	4,59
Subtotal Materials				160,11 €
Tools	XOF	euro	Quantity	Price
Machete	2500	3,82	1	3,82
Hand saw (green wood) TRI saw TS32	16375	20	1	20
Spade Shovel	3500	5,34	1	5,34
Combination pliers	1500	2,29	2	4,58
Digging bar	1800	2,75	1	2,75
Hammer 1500g	3000	5,34	1	5,34
Subtotal tools				41,83 €
The total price for one TESK in Euros (*1Euro=655XOF)				201,94 €

6.4 TESK (SPC) Specifications

- Tropical Equatorial Shelter kit - General information

The Tropical Equatorial Shelter Kit (TESK) was designed as a context base emergency shelter solution in the Tropical Equatorial region of Western Africa.

With this regional approach, supporting the strategy of a common concept with a stable structure, and specific technical solutions can be easily implemented into the particular Tropical Equatorial predefined context with the good performance.

Requirement	Value
Shelter footprint	Min 24m2
Approx. price per unit in the local market	201,94 €
Construction time	1 to 2 days
Target durability of the shelter in predefined conditions	Min 12 months
Warehousing tools & tarp	Yes
Construction with local materials	Yes

The TESK is specifically designed for distribution after a disaster in which the shelter capacities of the population have been affected.

It is designed for a family unit of five persons and one kit per family.

The full version of the TESK includes tools and materials.

. TESK list of material

TESK after Edea Workshop Cameroon

Tropical Equatorial Shelter Kit		
Material for local purchase (livestock)	Unit	Quantity
Bamboo L=6m D=80mm	Cane	30
Bamboo L=4m D=80mm	Cane	20
Oil palm leave L=4m	Unit	20
Deco Palm leave L=3m	Unit	30
Tools and Materials for Prepositioning	Unit	Quantity
IFRC tarp (4x6) 25000	Unit	2
Rope d=6mm	Roll 100m	2
Rope d=10mm	Roll 100m	1
Metallic wire	Roll 3kg	3
Machete	Unit	1

Hand saw (green wood) TRI saw TS32	Unit	1
Measuring tape	Unit	1
Spade Shovel	Unit	1
Combination pliers	Unit	2
Digging bar	Unit	1
Hammer 1500g	Unit	1

- Tool and Material Specifications for prepositioning

Tarpaulin - General Information

Reinforced flexible tarpaulins for temporary shelter or personal protection.
For individual shelter purpose, it is recommended to use the 4m x 6m tarpaulins.
A pre-cut piece of 4m x 8.5m from a roll of, 4m x 60m rolls can be used.
The sheet has six reinforcing bands to provide reinforced attachment points.
The side bands are provided with pre-punched holes. Attachment systems, such as ropes, nails, etc, should take advantage of the reinforcing bands and the pre-punched holes.
Expected life span of 2 years minimum in the strongest tropical condition.

This product was developed in an inter-organisation research project, and its specifications are more adapted to our use compared to the usual plastic sheets available on the market (in terms of durability, waterproofing, sheltering capacities, usage versatility, re-use and recycling, etc).
It is not recommended to use other types of plastic sheets.

The life cycle of the material is long lasting through recycling and can be used as second-hand raw materials for other products. Many usages have been observed, such as bags for recycled waste collection, car tarpaulins, raincoats, personal bags, etc.
The rolls are packed individually and loaded with special pallet based cradle. The tarpaulins are packed in bales of 5 units, without individual packaging.
Plastic tarpaulins and sheeting are subject to International Purchase Frame Agreements with validated manufacturers. Refer to your HQ before purchasing.
Attachment point examples, and typical use in: "Plastic Sheeting" booklet from IFRC/Oxfam on http://www.plastic-sheeting.org/

DETAILED SPECS ITEM CODE: HSHETARPW406

Rope - General Information

Different types of ropes used in the SSK to attach and stitch cladding materials.
Recommended material according to the practice:
Nylon or polypropylene are commonly available and cheap, serving general purposes.
Very sensitive to UV. Dark colour ropes, in particular black, resist UV far more than light colour ropes.
Sisal and hemp are natural fibres, they resist UV very well, but rot easily.
Choosing cheap ropes when rotting is not a problem, or when natural fibres are mandatory.

Standard minimum breaking strength, and the limit of use for PP rope
Nylon / Polypropylene rope : D= 4 mm - 200kg minimum – D=6mm – 350kg minimum
Black and blue ropes are recommended for outdoors long-term use for their resistance to UV.

Note: Some specifications may vary with national standards and local market conditions. For locally sourced items, check the relevant national standards or specifications. Any important variation from the EIC standard needs to be approved by a specialist.

Specifications

Diameter	D= 4 to 6 mm for knots and tarp fixation D= 1 to 2 mm for stitching
Number of strand	3 or 4 for twisted ropes, according to the diameter of the rope
Type	Twisted for all polypropylene and natural fibres Braided for nylon
Material	Sisal or hemp, Polypropylene, Nylon (polyamide), no recycled fibres, UV stabilised
Colour	Black, Blue, recommended Orange, red can be used with approval Natural for sisal or hemp
Marking	Suggested with a permanent label, showing: Type of rope, material, manufacturer, length, tensile strength, standard of reference, inspection certificate reference.
Standard	Specifications should conform to ISO9554

DETAILED SPECS ITEM CODE: HSHEROPE06N ; HSHEROPE01N

TIE WIRE - General information

Steel wire to reinforce, attach, fix, etc., all kind of possible usage in building and repairing.

Some specifications may vary with national standards and local market conditions. For locally sourced items, check the relevant national standards or specifications. Any important variation from the EIC standard needs to be approved by a specialist.

Material	In low carbon steel, 40g/m2, binding /tie wire.
Quantity	roll of 3 kg.
Dimension	diameter 1.5mm to 2 mm
Tensile strength	minimum 340 N/mm² to maximum 500 N/mm²

DETAILED SPECS ITEM CODE: EHDWWIRETR151

Machete - General Information

A general purpose or agricultural tool, for beneficiary distributions. Forged iron tools, strong and durable.

Local customs and basic tool shapes vary worldwide. Check the appropriateness of the tool''s shape prior to purchasing. The way in which the tool''s head is secured to the handle also varies (e.g., sunken eye, raised eye, spike).
Generally, cast iron tools are more fragile than forged tools. Some manufacturers produce very low-quality tools. Test several samples to their breaking point prior to purchasing. Refer to strength testing procedures in Specifications.
The terms "cast" and "forged" refer to the manufacturing process used to form the head of the tool. Casting involves turning metal into its molten liquid state, which is then poured into a mould to form the head of the tool.
Forging involves pounding or compressing metal, in its solid form (cold or hot red), into the desired tool shape; thereafter, a number of other machining steps are necessary to complete the production.
Handles are often purchased separately from wood suppliers, or can be made locally by the beneficiaries. Where purchased, specify the required minimum length, diameter and type of wood.
Some specifications may vary with national standards and local market conditions. For locally sourced items, check the relevant national standards or specifications. Any important variation from the EIC standard needs to be approved by a specialist.

Specifications

Blade	Curved blade, 405mm or 16″, lacquered. Overall length 55cm Blade thickness 2.5mm with 3 grooves running the full length of the blade, into which the handle is keyed.
Handle	Wooden handle with 3 steel rivets plus washers.
Material	Hot-forged carbon steel, hardened and tempered; hardened throughout the entire blade, but normalized past the first rivet hole
Quality	No dents on the cutting edge.
Rockwell hardness C (HRC):	45 minimum to 50 maximum near cutting edge.
Carbon content:	0.6% to 0.65%
Manganese content:	0.6% to 0.8%
Silicone content:	0.30% maximum
Phosphorus and Sulphur:	0.03% maximum

DETAILED SPECS ITEM CODE: RAGRTOOLMAC1

HANDSAW, green wood TRI saw TSR32

Specifications

Type & dimensions:	Handsaw for green wood, 320mm blade,With offset teeth and spacers for optimal removal of sawdust

Weight:	205g
Blade thickness:	1mm +/- 0.05mm, protected against oxidation
Blade protection:	Protective cardboard, teeth protection with hard, plastic cover.
Seal type:	laminated carbon steel, hardened and tempered
Teeth width:	4 mm
Quality of make:	Soft edges, no dents, cracks or broken teeth
Handle:	Wooden dismountable handle, minimum 3 fixations, polished varnish hardwood, large opening for hand comfort when wearing gloves.
Strength testing:	With the blade inserted into a 10mm-wide slot to a depth equal to 1/3 the blade's length, but not exceeding 150 mm, a deflection of 90° is applied 25 times in each direction without breakage or permanent set to the blade.

Measuring Tape

Type:	Flexible measuring tape, 20m long
Material:	PVC coated polyester or steel
Quality of make:	Minimum thickness according to the market availability
Weight	Minimum weight according to the market availability

DETAILED SPECS ITEM CODE: EMEATAPMLT20

Spade Shovel - General information

A general purpose or agricultural tool, for beneficiary distributions. Forged iron tools, strong and durable.
Local customs and basic tool shapes vary worldwide. Check the appropriateness of the tool, prior to purchasing. The way in which the tool's head is secured to the handle also varies (e.g., sunken eye, raised eye, spike).
Generally, cast iron tools are more fragile than forged tools. Some manufacturers produce very low-quality tools. Test several samples to their breaking point, prior to purchasing. Refer to Strength testing procedures in Specifications.
The terms "cast" and "forged" refer to the manufacturing process used to form the head of the tool.

Casting involves turning metal into its molten liquid state, which is then poured into a mould to form the head of the tool.
Forging involves pounding or compressing metal, in its solid form (cold or hot red), into the desired tool shape; thereafter, a number of other machining steps are necessary to complete the production.
Handles are often purchased separately from wood suppliers, or can be made locally by the beneficiaries. Where purchased, specify the required minimum length, diameter and type of wood.
Some specifications may vary with national standards and local market conditions. For locally sourced items, check the relevant national standards or specifications. Any important variation from the EIC standard needs to be approved by a specialist.

Specifications

Quality:	No excess of metal, no dents, no cracks.
Rockwell hardness C (HRC):	35 minimum to 48 maximum
Carbon content:	0.4% to 0.5%
Manganese content:	0.5% to 0.8%
Silicone content:	0.25% maximum
Phosphorus and Sulphur:	0.06% maximum
Dimension, full piece:	295 x 225 mm
Hole diameter:	front side 36 mm, back side 40 mm
Weight:	1kg +/- 50g, without handle

Strength testing:

- Fitted with a standard hardwood handle and clamped by the blade, near the handle, in a horizontal position, a load of 45kg is gradually applied and maintained for 2 minutes. This results in no damage to the blade or loosening of the handle and no permanent set in excess of 25mm.
- With one centimetre of the end of the blade fixed in a clamp, the handle is moved back and forth 30 degrees. No permanent set greater than 25mm results.
- With the shovel held in a digging position, a piece of wood 37mm in diameter is hit hard against it. The blade does not buckle or break.

Handle:
Smooth surface: no chips, rough surfaces, holes or knots. Dry, strong flexible wood. Handle adjusted to head in order to protrude through the other side of the eye, where it is secured with a metal nail.
The other end of the handle is made in a Y-shape with same quality of wood. The branches of the Y handle in one piece only, of good quality iron securely fitted to the handle.

DETAILED SPECS ITEM CODE: RAGRTOOLSHO3

Construction multipurpose pliers

Type:	Final cut, plier and attach up 2mm hard wire
Make:	each blade and handle forged as one piece, symmetrical blades
Capacity:	up to 2mm hard wire
Material:	hot forged carbon steel, hardened and tempered, special treatment applied to the blade edge
Rustproof:	protected against corrosion with special paint
Dimensions:	overall length: 180mm

DETAILED SPECS ITEM CODE: ETOOPLIECO18

Digging bar - General information

It is frequently used for digging small holes in earth.

Digging bar manufactured from high-grade heat treated steel bar with one chisel point and one tamper head.
The post whole digger has a 60mm mushroom head at one end and a 63mm bevelled chisel edge at the other.
Length:1,75m
Shank: D=25mm
Weight: 7.7 kg +-5%

DETAILED SPECS ITEM CODE:

Hammer 1500g - General information

Standard hammer for carpenter and most of general building and maintenance work.

Specifications

Type	Construction hammer, head and handle. two sides flat.
Material	High-carbon steel head, treated to achieve a martensitic structure, with dressed striking faces.
Quality of make	No dents, no cracks, smooth surface and edges.
Weight of the head	1500g +/- 1%
Rockwell hardness C (HRC)	50 minimum to 58 maximum on striking faces.
Applicable standard	ISO15601.
Handle:	No chips, rough surfaces, holes, or knots. Smooth polished varnished surface. Dry, strong, and flexible wood. Handle adjusted to head in order to protrude on other side of the head, and be blocked with a metal wedge
Applicable standard	Moisture minimum 10%, maximum 15%, under ISO3130
Pull apart test:	After two series of 25 vigorous blows with varying delivery angle, apply a traction of minimum 50kg trying to pull out the handle, head being fixed in a jaw, this should not create any damage to the hammer head and the handle, and the handle should remain firmly attached to the head.
Bending test:	For claw hammer only, apply a load perpendicularly to the axis of the handle and close to the end, so as to obtain a 125 N.m torque, irrespective of the size of the hammer. The load shall start at zero and be applied gradually, without jerking. The test load shall be held for at least 10s. This should not create any damage the hammer head and handle.

DETAILED SPECS ITEM CODE: ETOOHAMMRI15

7. Conclusions

7.1 Climatic and geographic context

The Tropical-Equatorial region of Africa has two main different climatic zones.
To the east African coast the “Grasslands” are predominant while the west coast is mostly covered by “Rainforest”.
The TESK kit design is inspired by the Cameroon experience and responds to the rainforest region of Tropical Equatorial Africa. Therefore, the TESK would respond to the requirements of a regional shelter solution adequate to Tropical Equatorial contexts of the West Africa region.

7.2 Shelter response

Accumulated experiences illustrate that there are no standard shelter solutions for an effective global response. Therefore, the development of a "Regional Shelter Solution" required a particular strategy.

The TESK appears as a flexible shelter solution. The concept proposes a series of technical solutions that, combined, respond adequately to the identified context. These solutions are independent of the materials available. This provides great flexibility to the requested regional response. Expecting effective results in different contexts, from semi-rural zones to tropical forest, from flat plots to steep slopes. With adequate training and awareness, the TESK will provide a flexible and effective emergency shelter response.

7.3 Operational flexibility

The concept of the proposed TESK offers the possibility to distribute a full combination of items including construction materials or simply organize the distribution of the tools for construction. This complementary approach would facilitate the response to different requirements for a wider geographical zone in Tropical Equatorial contexts of the West Africa region.
Furthermore, this kit conception facilitates the distribution, in logical phases of the building process and seasonal requirements.

8. Operational challenges

8.1 Timeframe

The time for the project and the mission in particular, far from being ideal, was the result of long coordination process with AI-CRL CRC and IFRC-SRU. This period of exchange and coordination unfortunately, had a direct impact on the time available for project implementation.

8.2 Geographic limitations

The reduction of project time has a direct implication in the methodology used. The original proposed regional project (early 2018) was designed with missions to different countries and a monitoring period of an entire rainy season. After discussion, the project was changed to a short mission in one country and a monitoring period of 5 weeks.

8.3 Inside country restrictions

The mission was from Yaounde to Edea (Duala). All places allowed the proper function of the mission and team in a safe context. Following the security recommendations, and based on the available time for the mission, other regions of the country that could be interesting according to the project requirements were not visited. The collected information about traditional architecture or available materials was partially restricted to the visited area.

9. Recommendations

9.1 Replication and adaptation

Previous experiences like the Sahel Shelter Kit showed that a regional shelter solution demands small key adaptations to be effective in the different countries in the region. The proposed TESK inspired on the Cameroon workshops would provide an effective response in a similar context of Tropical Equatorial West Africa. Specific measures within future small projects including field missions shall be undertaken to ensure the effectivity of the TESK to the different shelter operations and context. The TESK is not designed to be implemented in a cyclone prone area. Therefore, shelter operations in the cyclone-prone area of East Africa will require a different shelter solution than TESK.

9.2 Training packages

The design of the TESK proposes an innovative and flexible approach in which the shelter kit is the combination of different technical solutions. With the flexibility to adapt to the materials available, the TESK concept would provide an effective response for the operation of emergency shelters in the identified context. The experience gained during the implementation of other shelter kits shows that the delivery of specific and tailored training packages is a key factor for the success of the operation.

The TESK concept would require a set of training packages including workshops, presentations, and adapted documentation.

Therefore, in order to support future shelter operations in which TESK will be implemented, a set of face-to-face training packages should be delivered. Alternatively, these training courses/workshops would be completed with online modules.

9.3 Regional expansion

The context of the east African coast where “Grasslands” are predominant is completely different from the one used in the TESK design. Therefore, in order to achieve the expected good results in this East African region, it is recommended to start the process of developing a specific shelter kit. The African Grassland Shelter Kit (AGSK) can be implemented for an effective emergency shelter response on the tropical east coast of Africa.

10. Annexed documents

1. Service agreement

International Federation
of Red Cross and Red Crescent Societies
Shelter Research Unit
Innovating shelter

10, Cite Henri Dunant
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Web www.ifrc-sru.org

SERVICE AGREEMENT

for the design of a "Tropical Equatorial Shelter Kit"

This Service Agreement (hereafter the Agreement) is stipulated as of signing date between:

The **ASBL Aide Internationale de la Croix-Rouge luxembourgeoise** (hereinafter the "AI-LRC"), based in Luxembourg, at 44, Boulevard Joseph II and hereby represented by **Mr. Christian Huvelle**, Director

And

the **ASBL International Federation of Red Cross and Red Crescent Societies- Shelter Research Unit** (hereinafter the "IFRC-SRU"), based in Luxembourg, at 44, Boulevard Joseph II and hereby represented by **Mr. Marc Crochet**, Chairman of IFRC-SRU's Board of Directors

WHEREAS the IFRC-SRU has been established upon initiative of the Benelux Red Cross Societies in collaboration with the IFRC Shelter and Settlements Department in Geneva and Turkish Red Crescent. The aim was to enhance the technical capacities and resources in sheltering within the Red Cross Red Crescent Movement to reduce shelter related vulnerabilities and risks of people affected by disasters through improved humanitarian shelter interventions. IFRC-SRU focuses on context specific material and technical aspects of humanitarian sheltering and settlement solutions;

Whereas, the AI-LRC is a subsidiary organization of the Luxembourg Red Cross, which is an auxiliary to the Luxembourg Government in the humanitarian sector and one of the currently 190 National Red Cross and Red Crescent Societies that compose the International Federation. Amongst others, the AI-CRL aims to come to the assistance of victims of catastrophes or widespread disasters and to support other National Societies in this mission. The AI-CRL's operational focus is in the field of Shelter and Settlements;

WHEREAS the AI-LRC wishes to mandate the IFRC-SRU for the development of a Context base Emergency Shelter Kit named "Tropical Equatorial Shelter kit" addressed to support future shelter operations in Cameroon;

WHEREAS the AI-CRL and the IFRC-SRU (individually a "Party" and collectively the "Parties") share a mandate to assist in the mitigation of suffering throughout the world, and share a mission to provide assistance to vulnerable people around the world;

AND WHEREAS each Party carries out its mandate and mission abroad in cooperation and collaboration with entities that form the International Movement of Red Cross and Red Crescent Societies;

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NOW THEREFORE IN CONSIDERATION of the mutual covenants, agreements and indemnities contained herein and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the Parties hereto agree as follows:

1. OVERVIEW

National Red Cross and Red Crescent Societies in Africa are often called upon to take the lead in different crises. It is therefore necessary to equip them with hosting solutions designed in a participatory and innovative way, both before the production of the materials and after the end use.

The Luxembourg Red Cross is actively working in the Sahel region of West Africa, but also in other African regions with hot and humid climates.

In the context of a country with heavy rainfall, we currently have only two possible solutions: the Shelter Kit (composed of Shelter Tool Kit and 2 tarpaulins) and the family tent.

These two solutions are poorly adapted and lead populations not to occupy shelters during the day because they are considered too hot or they are likely to be flooded regularly during rainy periods.
The current proposed project focuses on improving the living conditions of the population affected by the development of contextualized emergency shelter kits.

AI-CRL hereby request the IFRC-SRU to conduct a R&D study to develop a context base emergency shelter kit adapted to the tropical equatorial predefined context.
AI-CRL appoint Cameroon as the country to implement this project.

2. OBJECTIVES

Overall objective

Develop an emergency shelter kit adapted to the humid tropical context of Cameroon

Specific objectives

- Define context and requirements for the shelter kit (climatic zone, type of materials, covering surface, warehouse requirements.
- Work on the design of the kit in collaboration with the Cameroon National Society.
- Document the kit with material specifications, designs, BoQ and instruction manual.

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3. ACTIVITIES

Following the AI-CRL request, the activities agreed will be undertaken according the following table and based on accessibility if the sites suggested by AI-CRL within the project timeframe so that the project can be ended by 30th April 2019. Delays due to accessibility will be not be considered responsibility of IFRC-SRU.

Activity	Action	Duration
Performed in Luxembourg		
Preliminary work	• Definition and approval of mission ToR	**2 days**
Design in Luxembourg	• In collaboration with AI-CRL, define the criteria for the design of the shelter kit, including area, price and expected durability. • Basic research on traditional shelter kits materials.	**2 days**
	• Preliminary design of the kit.	**10 days**
	• Design and definition of procedures and tools for field monitoring. • Mission design and coordination including pedagogic material and workshop structures	**3 days**
Coordination	• Team coordination and external communication	**2 days**
Administrative follow-up	• Budgetary follow-up of subcontractors' invoices • Project financial reporting to AI-LRC	**2 days**
Documentation and reporting	• Documentation of monitoring activities and data analysis • Finalization of the design, including the BoQ.	**7 days**
Final manual layout	• Reporting and information sharing	**3 days**
Performed in the field (mission)		
Participatory design with the local team	• Participatory exchange with the local shelter team focusses on the adaptation and tuning (if necessary) of the proposed shelter kit (participatory methodology). • Visit the local markets (price research, material description, availability and purchase)	**3 days**

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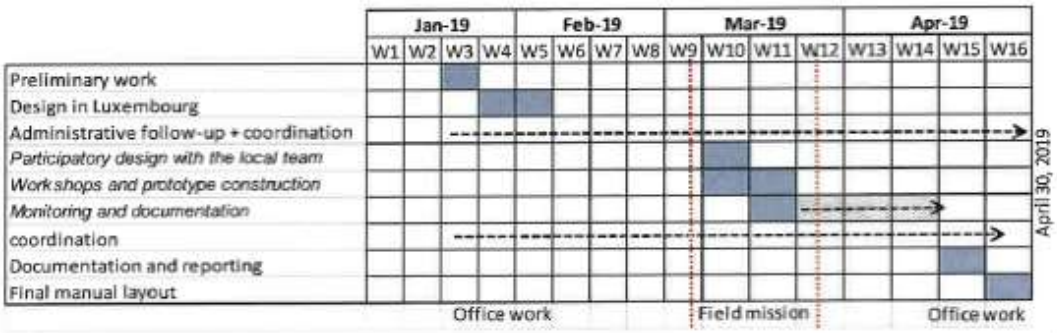
	• Warehousing, plot identification, tools setup, and other preliminary works before the construction start	
Workshops and prototype construction	• Workshop, prototypes construction (number of prototypes to be defined) with volunteers and the NS shelter team.	**5 days**
Monitoring and documentation	• Collect feedback from the volunteer team and the NS shelter team • Monitoring: setup tools and equipment, training the local team to collect the requested information and monitoring the shelter adequacy (monitoring time to be defined) • Develop a setup guide in close collaboration with local graphic designer (draftsman) and the NS	**3 days**

NOTE: Operation support for the mission will be responsibility of AI-CRL

4. OUTPUTS

Document	Content	Format
Report "Tropical Equatorial Shelter Kit"	Main sections: - Methodology and performed activities; - Tropical Equatorial Shelter kit design including BoQ; - Setup instructions	- A4 document (with annexes and references) - Layout in line with IFRC-SRU report standards - Digital format - English language - A4 tables landscape format

5. DURATION



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This agreement will be effective from January 2019 until April 30th 2019. Upon specific request from AI-LCR, this service agreement will have 1 field missions and duration of 14 weeks with 42 allocated working days distributed in the total

6. COSTS AND FEES

The following budget is based on costs estimation. Any additional services, or modifications of the services described by this Service Agreement, such as the request for additional staff time, will be communicated to the Head of IFRC-SRU and will be undertaken following the amendment of this Service Agreement.

Description of cost	Unit cost	Factor/Duration	Total cost
IFRC-SRU's consultancy fee			***42000 €***
Preliminary work	1.000 €	2 days	*2000 €*
Design in Luxembourg	1.000 €	15 days	*15000 €*
Administrative follow-up	1.000 €	2 days	*2000 €*
Documentation and reporting	1.000 €	7 days	*7000 €*
Final layout	1.000 €	3 days	*3000 €*
Field mission fees	1.000 €	11 days	*11000 €*
Coordination	1000 €	2 days	*2000 €*
Operational fees (mission)			***7205€***
Airplane	900 €	1	*900 €*
Transport in Luxembourg	100 €	1	*100 €*
Insurance	200 €	1	*200 €*
Hotel	90 €	11 nights	*990 €*
Perdiem IFRC-SRU staff	65 €	11 days	*715 €*
Perdiem volunteers	600 €	1	*600 €*
Visa	100 €	1	*100 €*
Materials for construction	1000 €	1	*1000€*
Driver + transport (car + gas) in the field	100€	11 days	*1100 €*
Local shelter team allowance (Perdiem)	300€	1	*300 €*
Venue rental (office, warehouse, construction site)	500 €	1	*700 €*
Local draft man (construction guide)	500 €	1	*500€*
Contingency			***795€***
Total			**50000 €**

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Signed on behalf of the IFRC-SRU

Antonella Vitale, Head of Unit — Date: 25.01.19

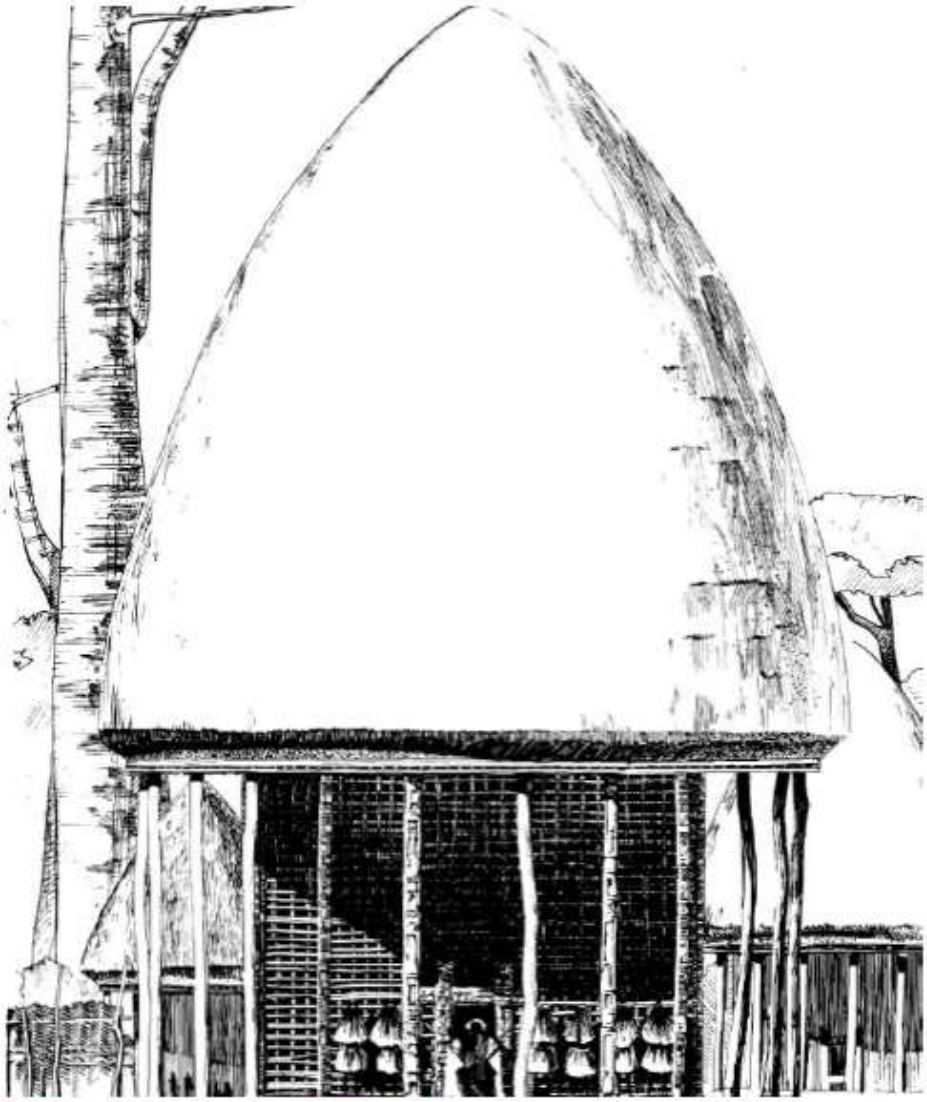
Marc Crochet, Chairman — Date: 1.02.2019

Signed on behalf of the AI-LRC

Christian Huvelle, Director — Date: 29/01/2019

2. Terms of Reference

International Federation of Red Cross and Red Crescent Societies -Shelter Research Unit
Mission ToR Tropical Equatorial Shelter Kit – Cameroon mission



Terms of Reference
Tropical Equatorial Shelter Kit – Cameroon Mission

Cameroon 7th to 18th of March 2019

International Federation of Red Cross and Red Crescent Societies
Shelter Research Unit

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International Federation of Red Cross and Red Crescent Societies -Shelter Research Unit
Mission ToR Tropical Equatorial Shelter Kit – Cameroon mission

Tropical Equatorial Shelter Kit

Testing mission – Cameroon 7th to18th of March 2019

Overview

National Red Cross and Red Crescent Societies in Africa are often called upon to take the lead in different crises. It is therefore necessary to equip them with effective shelter solutions designed in a participatory and innovative way.

In the context of a country with heavy rainfall, we currently limited available emergency shelter solutions: the IFRC Shelter Kit (composed of Shelter Tool Kit and 2 tarpaulins) and the IFRC family tent.

These two solutions are poorly adapted and lead populations not to occupy shelters during the day because they are considered too hot or they are likely to be flooded regularly during rainy periods.
The current proposed project focuses on improving the living conditions of the population affected by the development of contextualized emergency shelter kits.

AI-CRL hereby request the IFRC-SRU to conduct a R&D study to develop a context base emergency shelter kit adapted to the tropical equatorial predefined context. AI-CRL appoint Cameroon as the country to implement this mission.
In order to further develop this emergency context base shelter solution, the IFRC-SRU will undertake a mission to Cameroon from 7th to 18th of March 2019.

Mission Objectives

"Develop an emergency shelter kit adapted to the humid tropical context of Cameroon"

Specific objectives

- Document context information based on field observation, market visits, interviews with Cameroon Red Cross and if possible with other shelter actors present in the country.
- Validation the Shelter Prototype with a participatory exchange with RC volunteers and local people.
- Work on the improvement/adaptations of the Shelter Prototype (TESK) in collaboration with the Cameroon National Society.
- Document the Shelter kit with material specifications, designs, BoQ and instruction manual.

Mission Outcomes

- Validation of the design assumption
- Validation and if needed, update the Shelter Prototype with RC team and local volunteers
- Workshop to build Shelter Prototypes including construction documentation, list of materials (BoQ), and feedback recorded
- Induction session to the local team for monitoring Shelter Prototype over 3 weeks.

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Methodology

The proposed methodology is divided in to 3 steps

1. Draft design prior to the mission - IFRC-SRU office in Luxembourg
2. Testing mission to Cameroon
3. Distant Monitoring

Minimum criteria for design

The expectations defined by AI-CRL for the shelter design are:

- General:

Durability: 6 months

Surface area: 20 m2 (5 people according to sphere standards)

Price: 200 €

- Materials:

IFRC tarpaulins

Locally procured materials

- Construction technology:

Inspired by the techniques of building temporary vernacular shelters in the humid forests of Cameroon

Protecting from rain and soil moisture

Search for simplified construction (with a limited number of parts)

Mission activities

	Planned mission activities (7th to 18th March 2019)
07.03	- Arrival to YAUNDE
08.03	- YAUNDE: - AI-CRL head of mission + Cameroon Red Cross contact and project presentation - Introduction session with the local focal point (reference for this project) - Visit other shelter actors in the country
09.03	- Travel to Bafoussam - Visit to the local Red Cross office and local team - Overnight in Bafoussam
10.03	- Field visit direct observation and local population exchange - Itinerary suggest Bafoussam, , Bangangle, N'kongjok and, Bafang and, Dschang - Including testing site identification (Suggested by AI-CRL N'kongjok) - Overnight Dschang
11.03	- Project presentation to local volunteers - Participative session on shelter design - Visit to the local university (to confirm) - Overnight Dschang
12.03	- Market visit and material purchase (Dschang/Bafoussam) - Overnight to confirm
13.03 14.03 15.03	- Workshop, prototype construction - Overnight place to confirm
16.03	- Induction session on the monitoring tools including simulation - Participatory session with volunteers and local people to collect feedback - Prototype fine tuning - Overnight place to confirm
17.03	- Travel to YAUNDE - Overnight YAUNDE
18.03	- Debriefing AI-CRL + Cameroon RED CROSS - Travel to Luxembourg

International Federation of Red Cross and Red Crescent Societies
Shelter Research Unit
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10, Cite Henri Dunant
L-8095 Bertrange
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International Federation of Red Cross and Red Crescent Societies -Shelter Research Unit
Mission ToR Tropical Equatorial Shelter Kit – Cameroon mission

- Note: Overnight places may be changed according security situation

Ground support

The ground support and security umbrella will be provided by AI-CRL including:

Operational level

Reference person in the field (focal point) for support the different project activities
Expected support from the focal point:

- Accompany the visits in the field to the villages, university, local markets, and others under request.
- Support and advice during the purchase of equipment and tools, the organization of transport and storage on site.
- Support and advice for internal travels, driver and response upon request.
- Direct participation and support on the workshop, participatory activities, building exercise and other activities described before.
- Ensure the follow-up and monitoring of the built prototype.

Translate on the local language with volunteers, market, local people.

The workshop, construction, and monitoring

- A list of people, identified to participate in the construction of the prototypes including beneficiaries, volunteers, Red Cross team members, will be provided.
- Recommended balanced participation of English and French speakers volunteers.

Logistic level

- Support to find accommodation at different places
- Identification of a location for prototype construction and arrangement with owners.

Note: This is an emergency shelter with a particular focus on temporary structures built in tropical forests in Africa

- Transport in the country, possible options and costs with driver and fuel
- List of villages, places to visit to exchange with the local population and collect information on vernacular architecture. On the list of activities, there is a suggestion of these villages that need to be confirmed.

Safety and security

- Mission under AICRL security procedures (documentation and or Briefing at arrival?)
- During this mission, the IFRC_SRU will NOT access to a conflict area.

The NO-GO Zone and conflict areas will be defined by AI-CRL in accordance with the ICRC recommendations.

Upon the suggestion of AI-CRL the identified region for the testing is: Nkondjok the place is pending the approval of the Cameroon Red Cross and base on the ICRC security recommendations.

Contacts

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Postal address
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3. List of contacted people

	Name and surname	Title	Organization	Phone number	Email address
1	Anna Soravito	Head of mission	AI-CRL	+237691120595	Anna.soravito@croix-rouge.lu
2	Renauld Bodiong	Point Focal CRC	CRC	+237696596816	Dircab-crc@croixrouge.cm
3	Jerome Fontana	Head of operations	ICRC	+237699415945	jfontana@cicr.org
4	Ernest Marcelin	CRC region president	CRC	+237696123682	Ernestmarcelien,nyemb@yahoo.fr
5	Simmon Pierre Tonye	CRC shelter focal point	CRC	-	Tonyesimonpierre7@gmail.com
6	Jacques Lionel Ntamag	Researcher	MIPROMALO	+237694172207	Lionelville2002@yahoo.fr
7	Oumar Ali Taiga	Adjoin researcher	MIPROMALO	+237690860152	Oumar.alitaiga@esprit.tn

FICHE DE DECHARGE DES VOLONTAIRES / SUPERVISEURS / LEADERS COMMUNAUTAIRES

Région / Département / Localité : LITTORAL – SANAGA Maritime – EDEA
Nature de l'activité : Atelier de montage des Abris
Période : du 03 Mars au 16 Mars 2019

N°	Noms et Prénoms	N° CNI + Date de délivrance	Per diem journalier	Nombre de jours	Per diem total	Téléphone	Signatures
1	Cecile DIPENDE	2018023760	5000	01	5000	—	
2	MOUANDJO Pierre	117162035	5000	01	5000	675030 29	
3	BELL BELL Thomas	116284411	5000	01	5000	[illegible]	
4	MANG Jean Pascal	LT 173511515	5000	01	5000	1	
5	NGO DIH Therese	114529703	5000	01	5000	—	
6	NDONG NDONG P	116565155	5000	01	5000	697838614	
7	BIJIMI Esther	201803459636105514	5000	01	5000	—	
8	SOULE MANOU	115994.57	5000	01	5000	699A35629	
9	NWAHA YEDE	105075000	5000	01	5000	690520937	
10							
TOTAL (FCFA)					30000CFA		

PAYE COMPTANT

Arrêté le présent état à la somme de (en lettres) FCFA :
.....
.....

Fait à : EDEA le : 11 – 14 MARS 2019

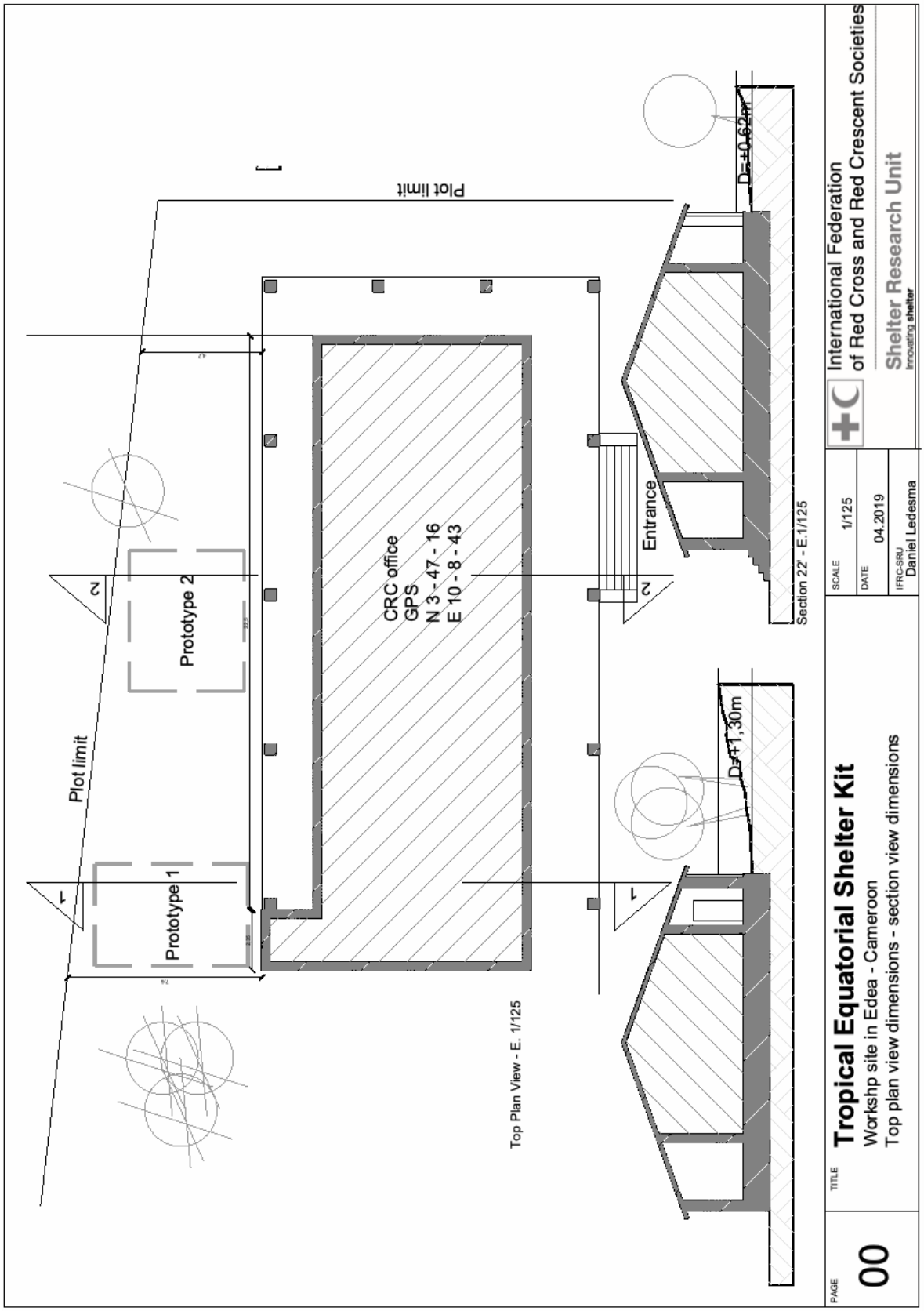
PAYE PAR IFRC-SHELTER RESEARCH UNIT POUR ASBL

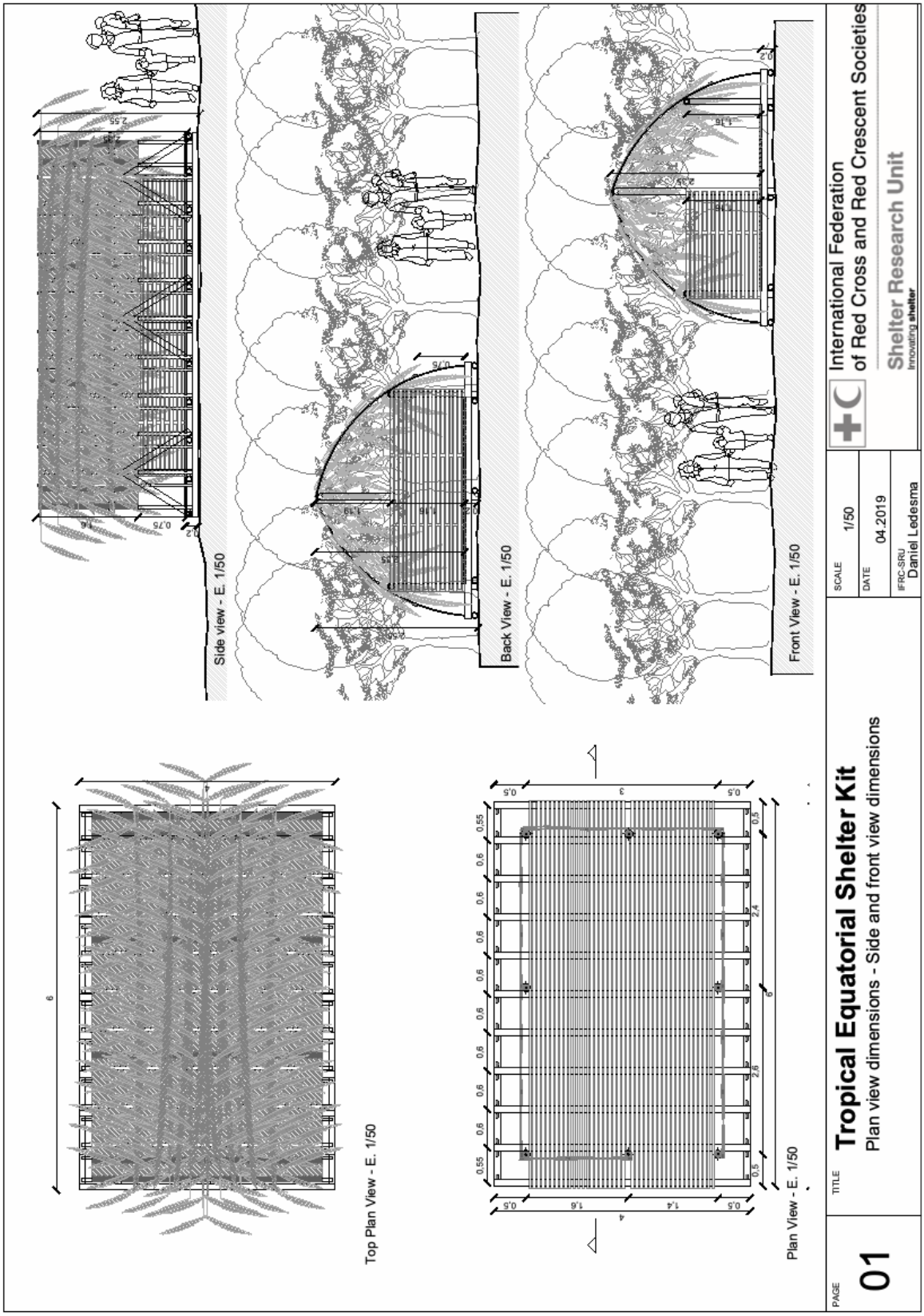
Nom, Signature

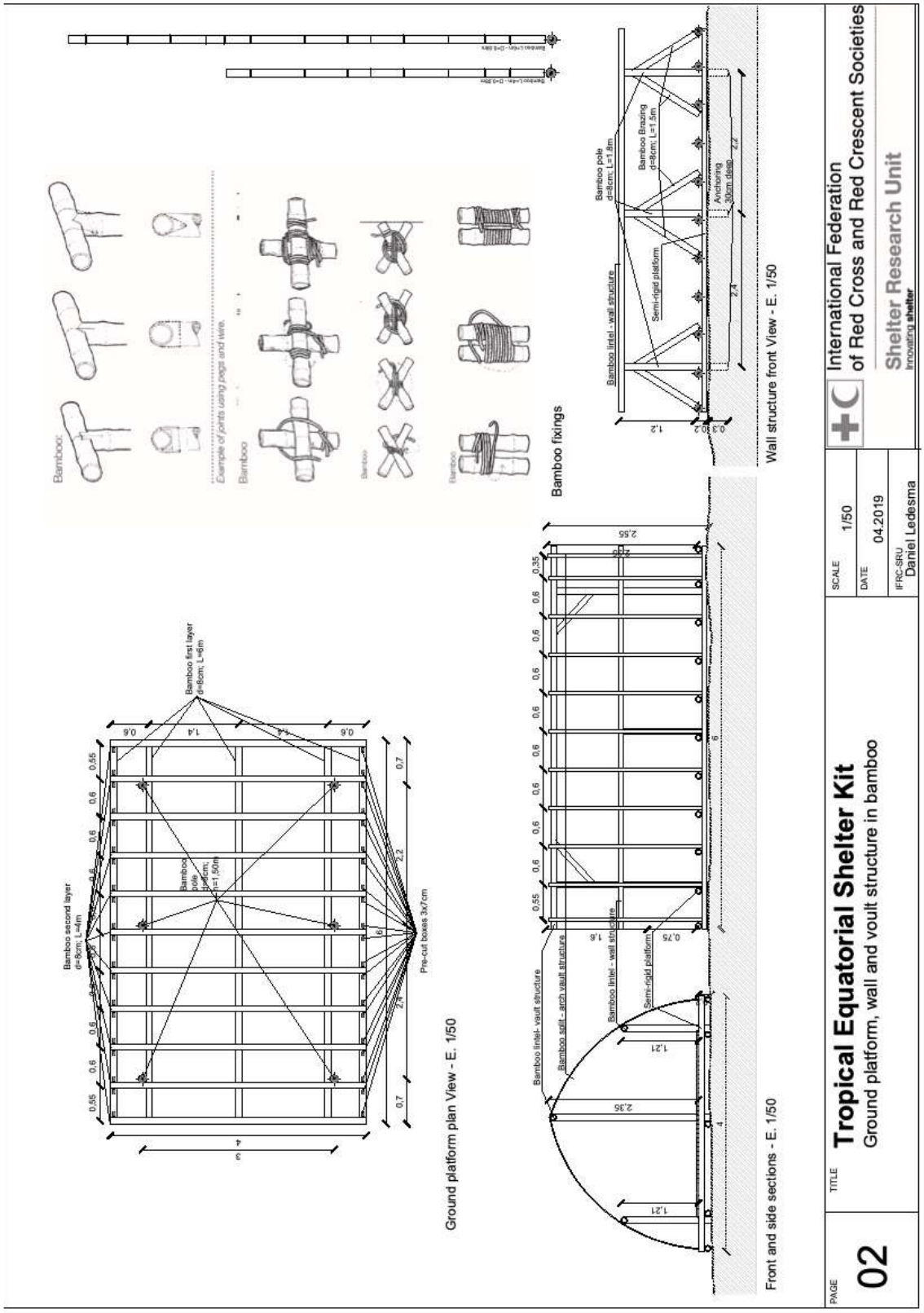
NB : Joindre photocopies CNI

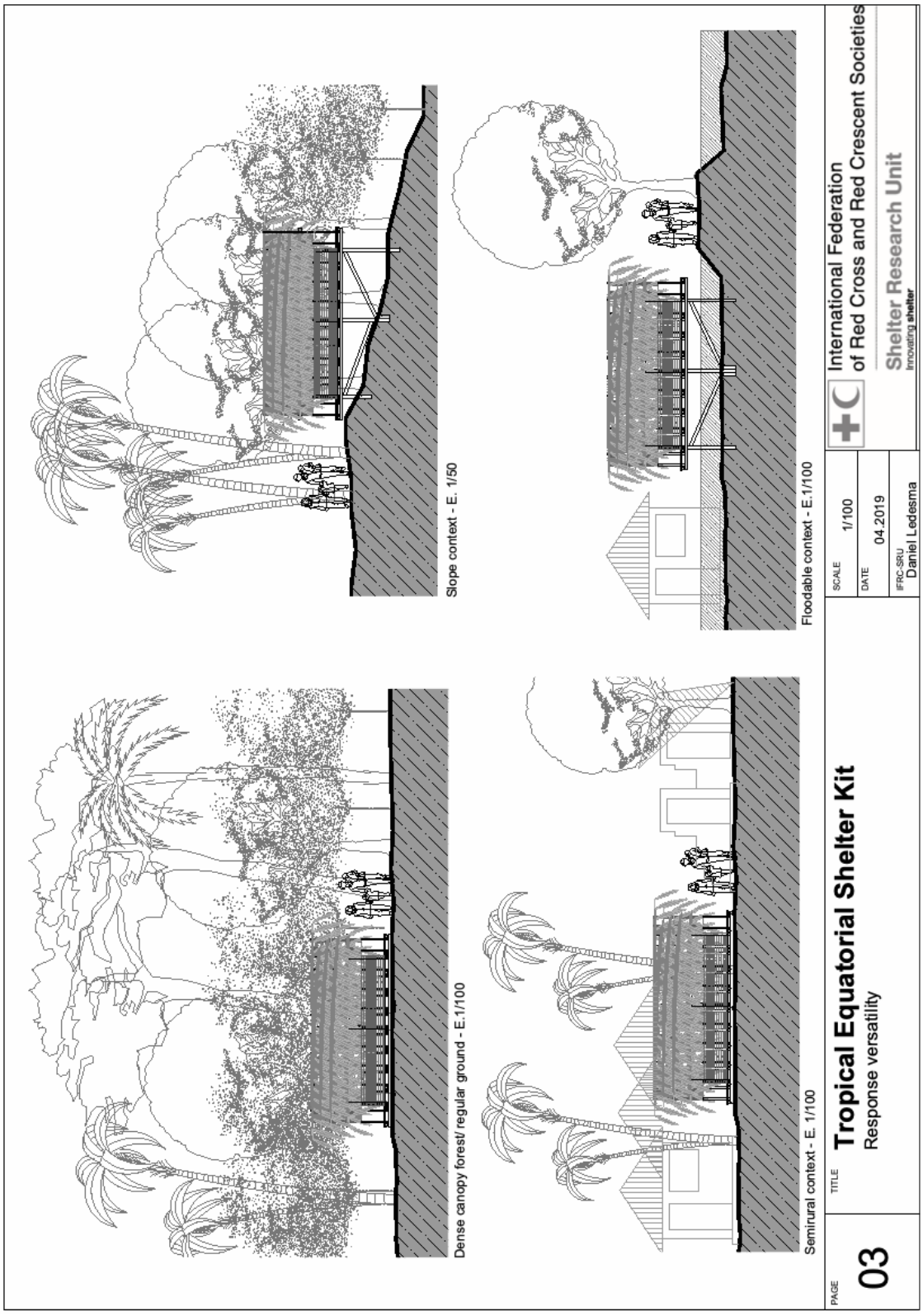
Devise :	CFA
Montant :	30000
Date :	11/03/19
Code comptable :	6428000000
Ligne financement :	7101
Bailleur :	99
Projet :	24L032
Signatures :	
Terrain	
Siège	
Directeur	

5. TESK drawings

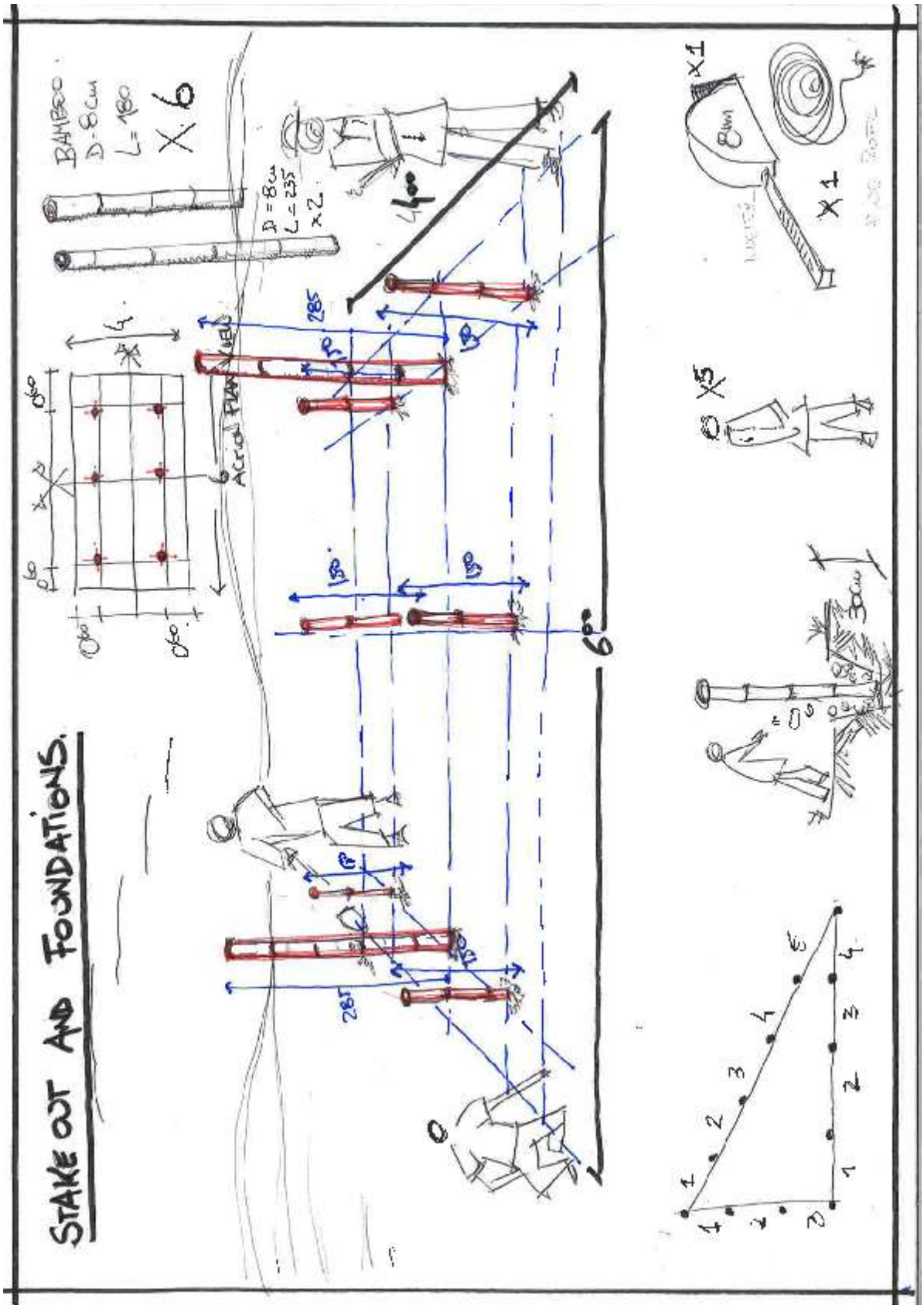


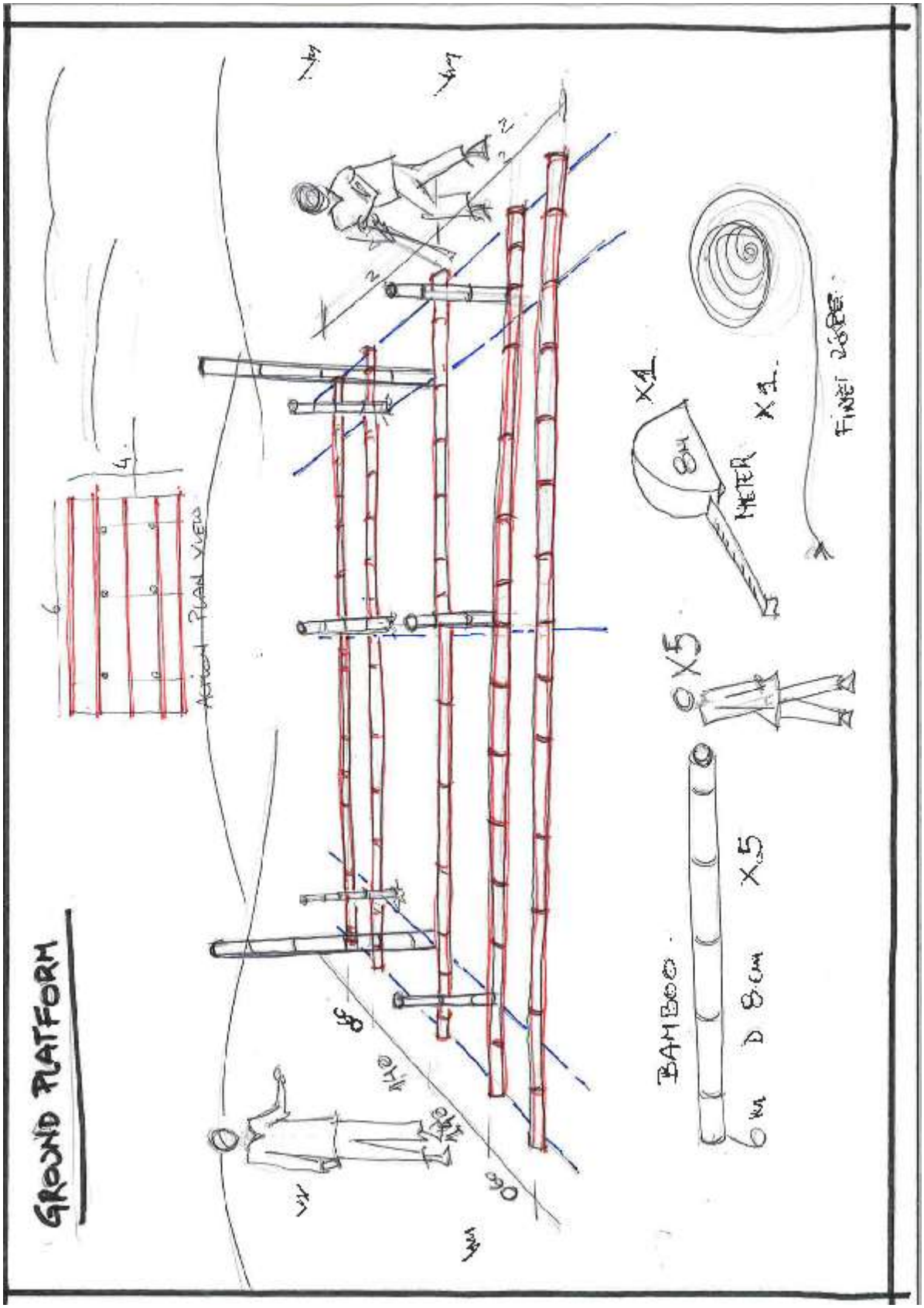

Side view - E. 1/50
Back View - E. 1/50
Front View - E. 1/50
Top Plan View - E. 1/50
Plan View - E. 1/50
International Federation of Red Cross and Red Crescent Societies
Shelter Research Unit
Innovating shelter
TITLE
Tropical Equatorial Shelter Kit
Plan view dimensions - Side and front view dimensions
SCALE 1/50
DATE 04.2019
IFRC-SRU Daniel Ledesma
PAGE 01

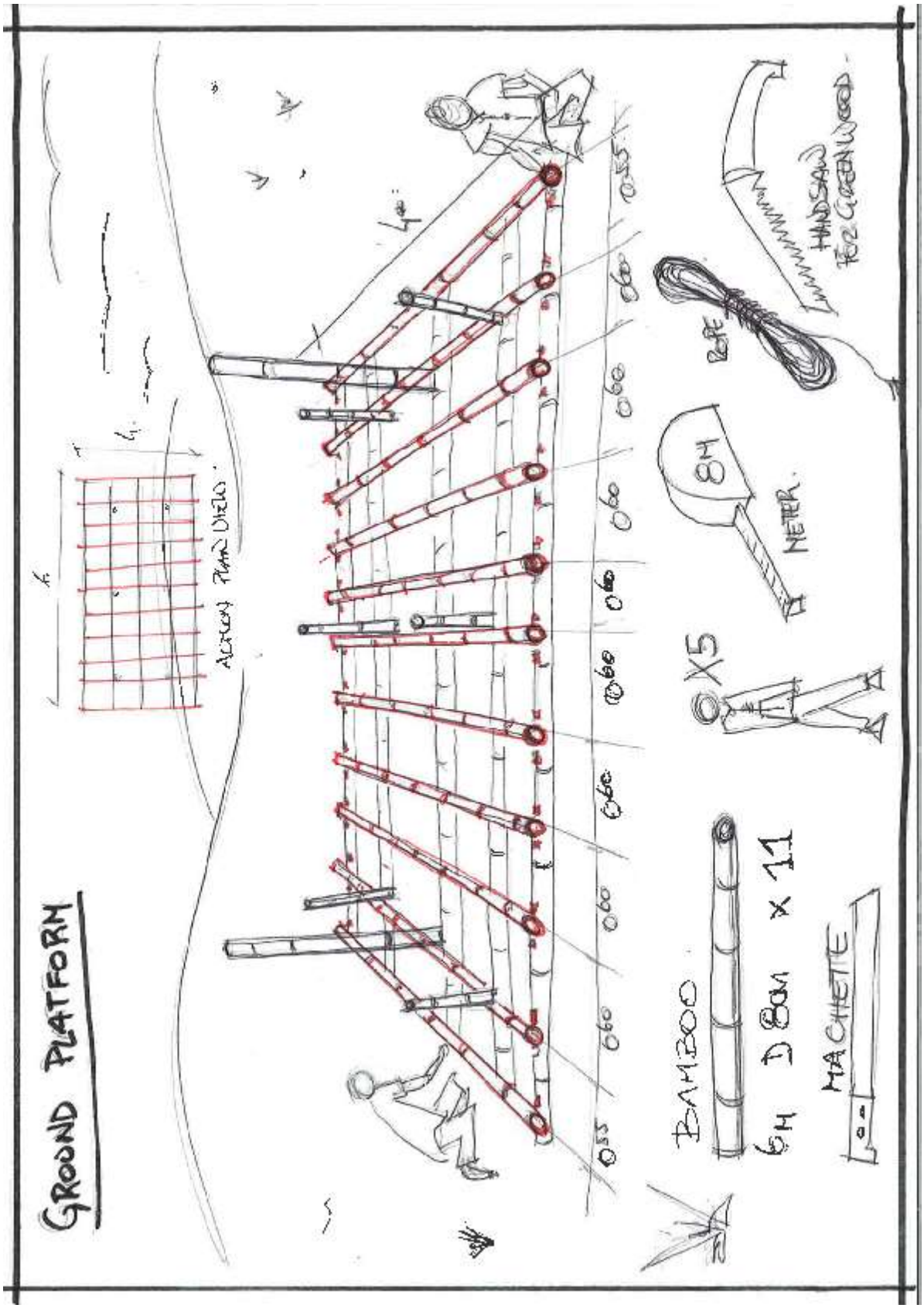

Bamboo:
Example of joints using pegs and wire.
Bamboo
Bamboo fixings
Bamboo pole d=8cm; L=1.8m
Bamboo Brazing d=6cm; L=1.5m
Bamboo lintel - wall structure
Semi-rigid platform
Anchoring 30cm deep
Wall structure front View - E. 1/50
Bamboo first layer d=8cm; L=6m
Bamboo second layer d=8cm; L=4m
Bamboo pole platform d=8cm; L=1.50m
Pre-cut boxes 3x7cm
Ground platform plan View - E. 1/50
Bamboo lintel- vault structure
Bamboo split - arch vault structure
Bamboo lintel - wall structure
Semi-rigid platform
Front and side sections - E. 1/50
International Federation of Red Cross and Red Crescent Societies
Shelter Research Unit
Innovating shelter
SCALE 1/50
DATE 04.2019
IFRC-SRU Daniel Ledesma
TITLE
Tropical Equatorial Shelter Kit
Ground platform, wall and vault structure in bamboo
PAGE 02

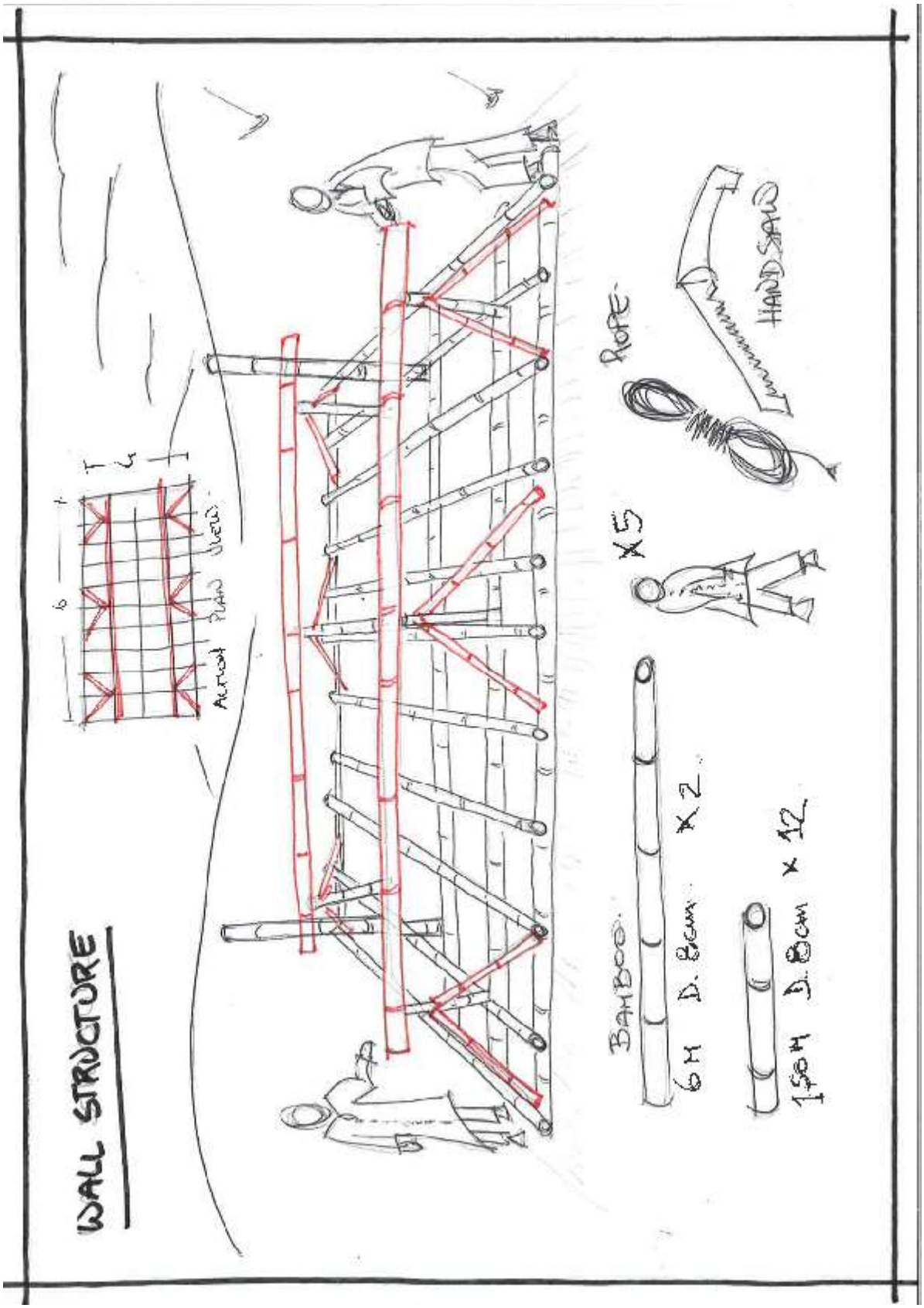

Slope context - E. 1/50
Floodable context - E.1/100
Dense canopy forest/ regular ground - E.1/100
Semirural context - E. 1/100
PAGE
03
TITLE
Tropical Equatorial Shelter Kit
Response versatility
SCALE
1/100
DATE
04.2019
IFRC-SRU
Daniel Ledesma
International Federation
of Red Cross and Red Crescent Societies
Shelter Research Unit
Innovating shelter

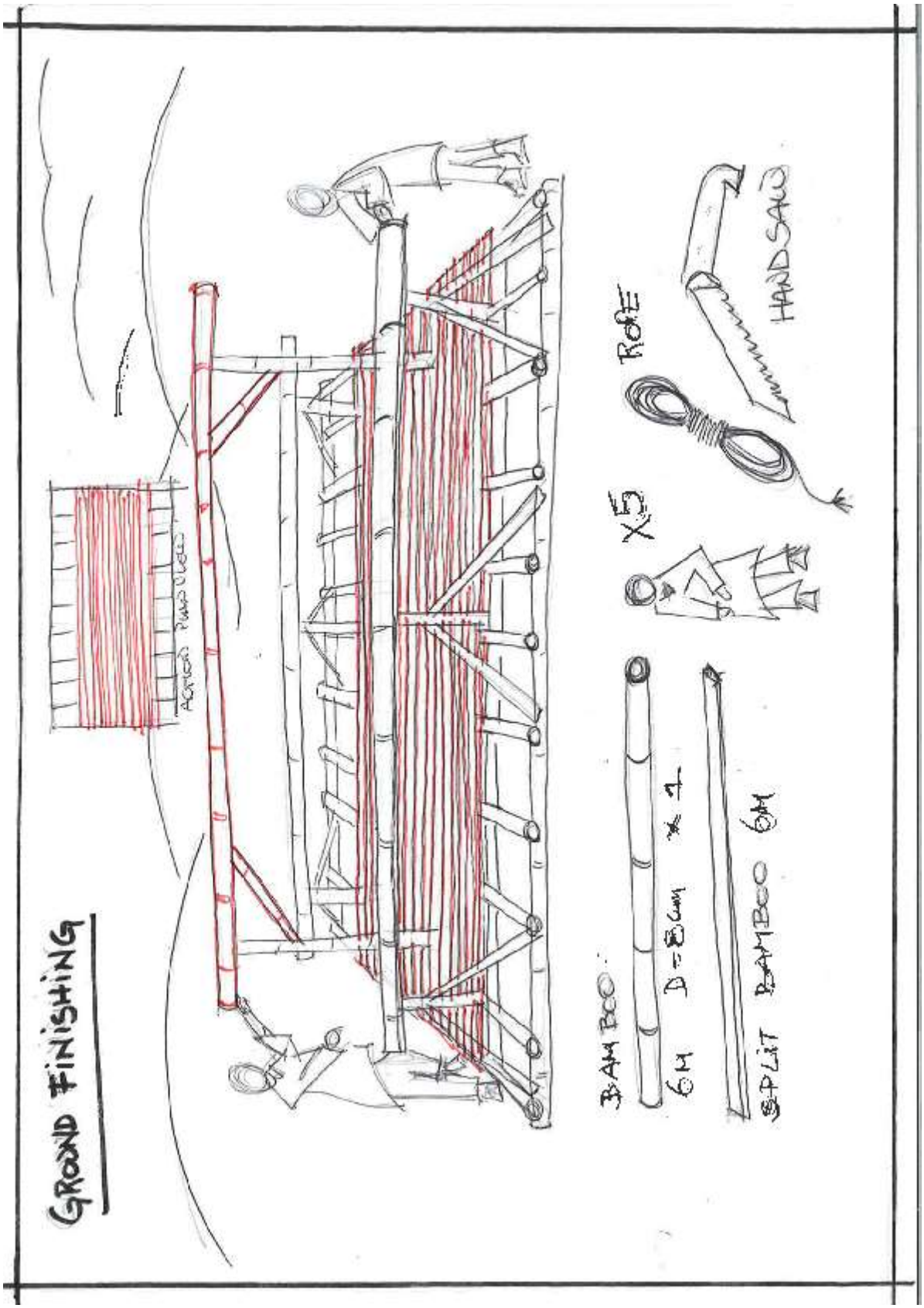
6. Assembly instructions

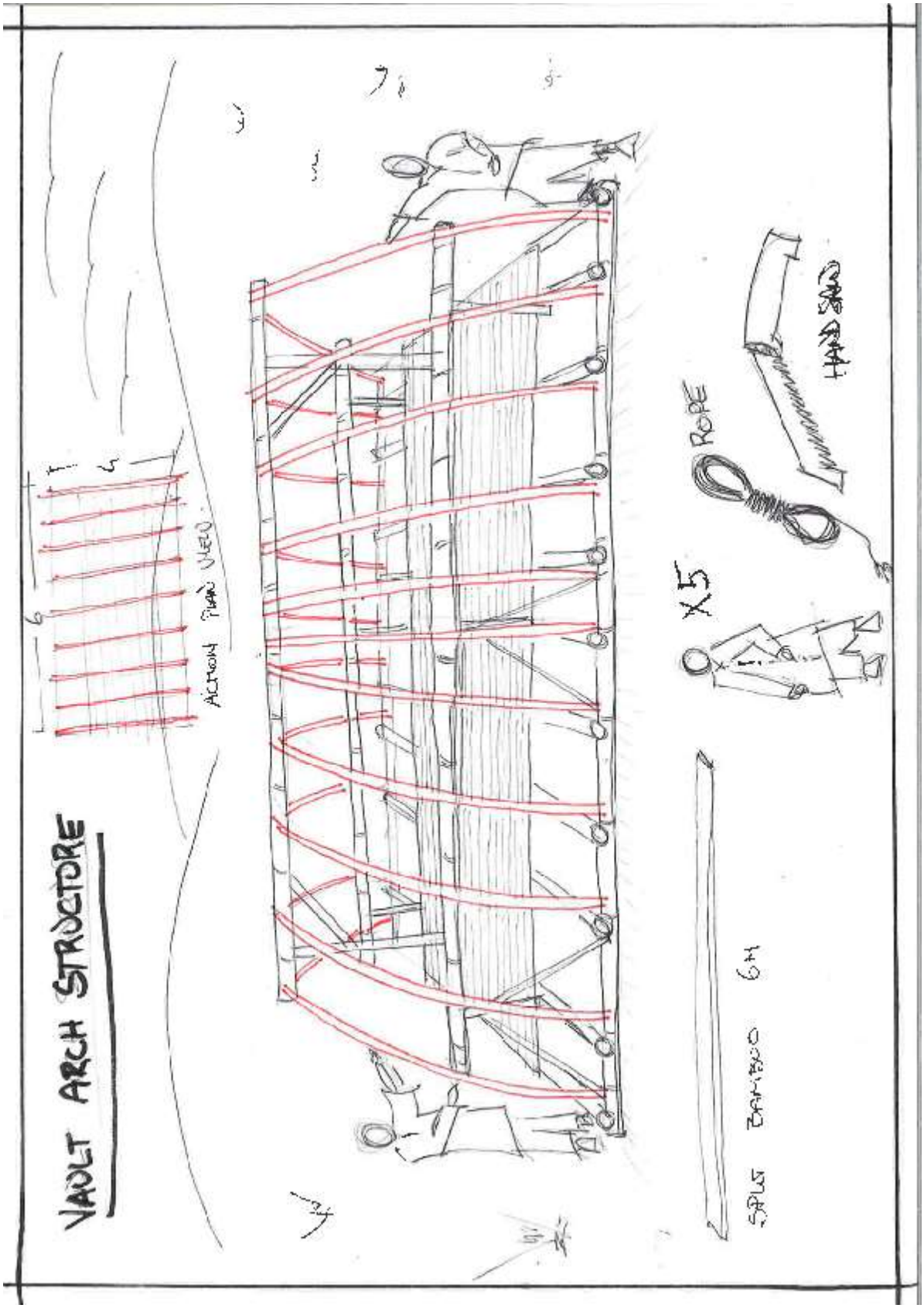


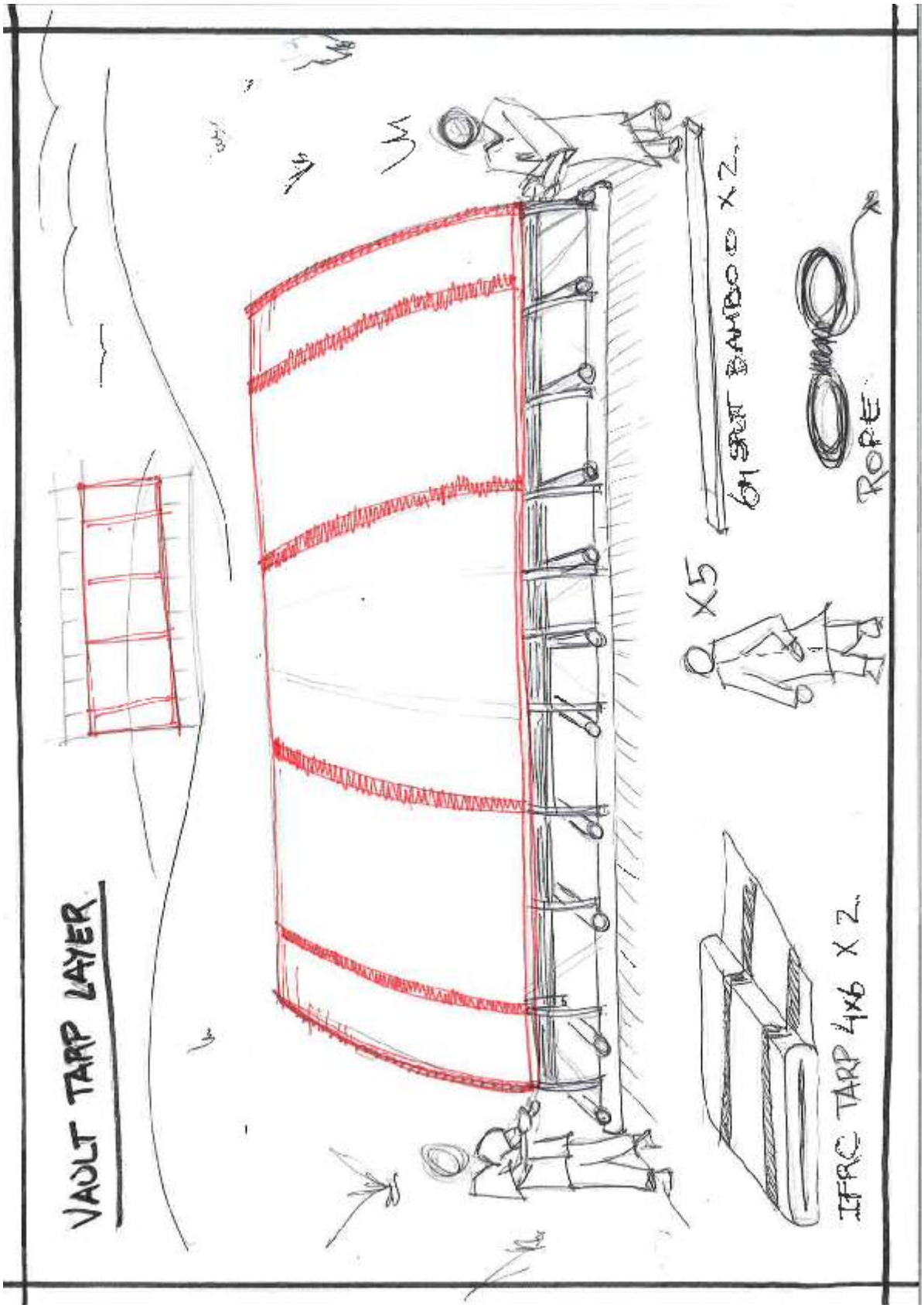

GROUND PLATFORM
Aerial Plan View
BAMBOO
X5
X4
METER
FIXING LOOPS

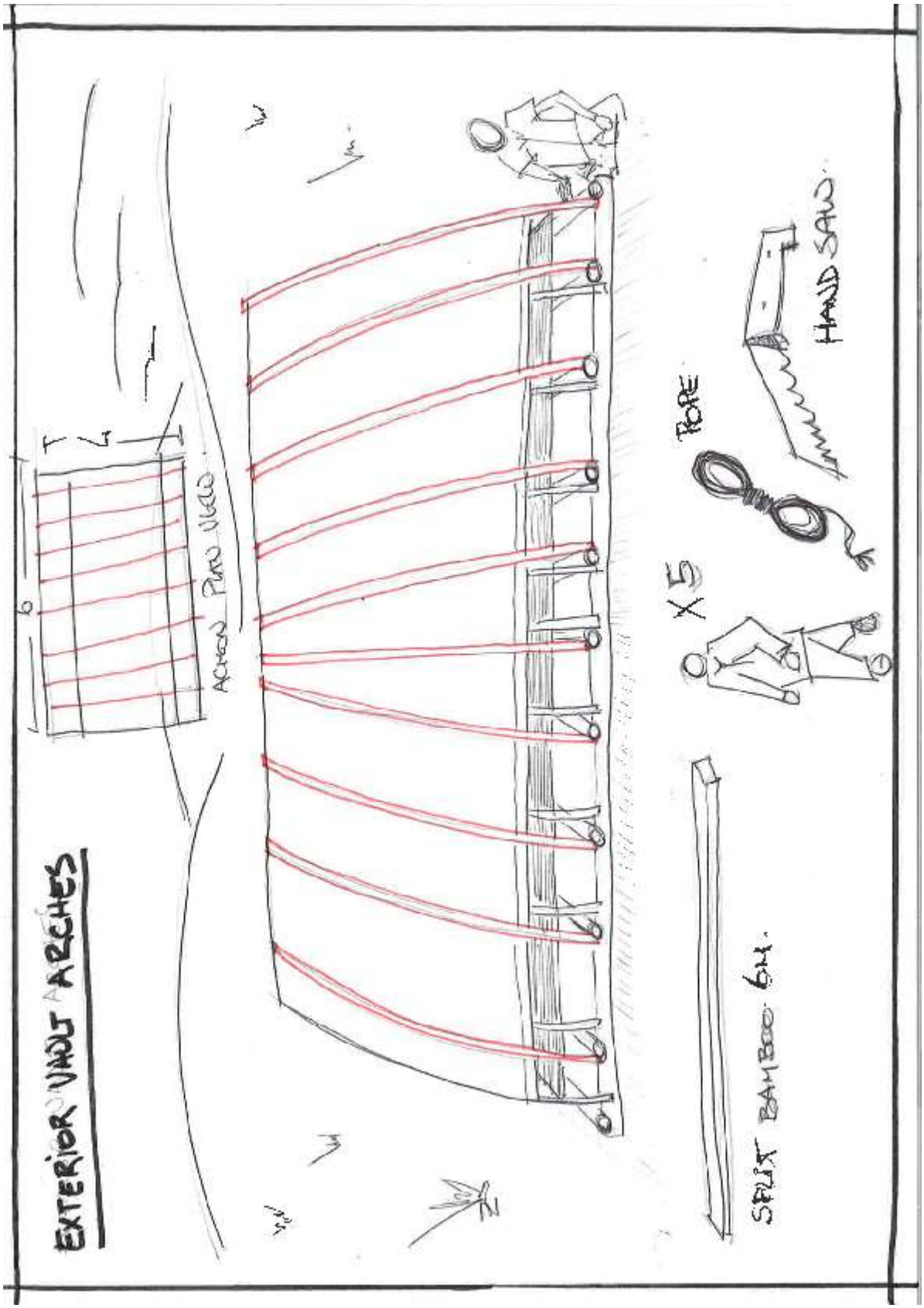

GROUND PLATFORM
ROPE
HANDSAW
FOR GREEN WOOD
8M
NETTER
X5
BAMBOO
6M Ø8M x 11
MACHETTE

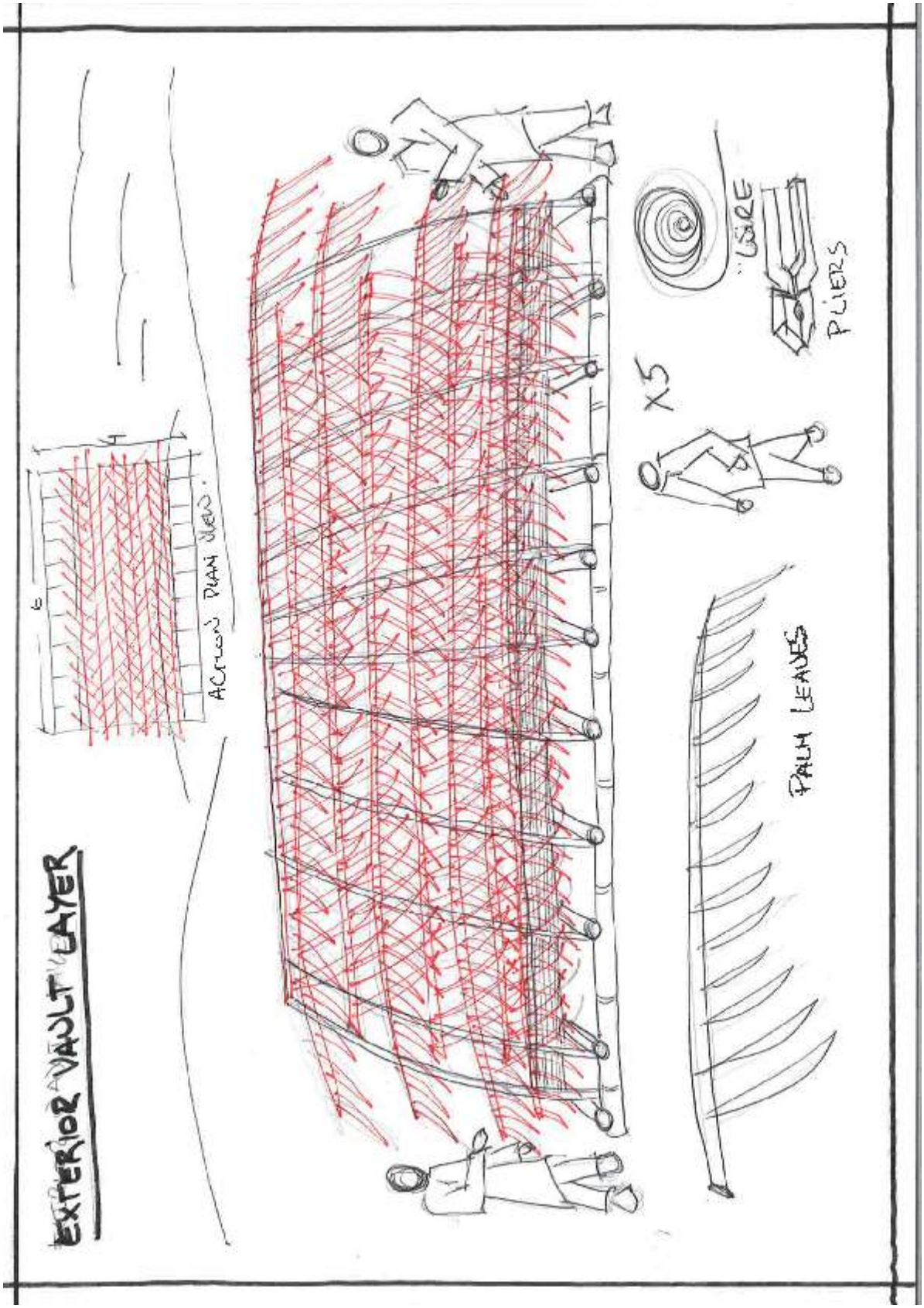

WALL STRUCTURE
ROPE
HAND SAW
X 5
BAMBOO
6M D. 8cm X 2
1.50M D. 8cm X 12


GROUND FINISHING
ROPE
HANDSAW
BAMBOO
6M
SPLIT BAMBOO 6M


VAULT ARCH STRUCTURE
ROPE
X5
SPLIT BAMBOO 6M


VAULT TARP LAYER
6m SPLIT BAMBOO x 2.
ROPE
x5
IFRC TARP 4x6 x 2.


EXTERIOR VAULT ARCHES
ROPE
HAND SAW
X 5
SPLIT BAMBOO 6M.


EXTERIOR VAULT LAYER
ACROSS PLAN VIEW
x5
PLIERS
PALM LEAVES