LOW COST HOUSE
RESEARCH AND DEVELOPMENT´S PROJECT

LUISA FERNANDA GÓMEZ CORREA
BT. INNOVATION
GERMANY-MAGDEBURG

AÑO 2016
ABSTRACT

“The low cost house is the solution for quick developments and poor sections of the population that need quality housing. Government and aid agencies, which in crisis regions many refugees come forward or after a natural catastrophe and depend on quick first response help, can produce a quality accommodation with the low cost house. The B.T. innovation developed a building concept of a solid concrete house and low cost housing, which is an affordable solution for the accommodation available to people in emergency. The creation of safe, stable, and cost effective living and emergency room can be accomplished quickly with the low cost house.”

This project takes the low cost house development done in B.T. innovation so far as lead and foundation for developing the concept even more, the new Low Cost House was designed to be produce in a smaller battery mould and to use some material that remains from the last prototypes such as the formwork butterflies for the slabs. The project aims to develop a prototype suitable to be replicated and built in larger quantities in countries where the quality housing shortage demands cheap and fast solutions for hosting low income communities The prototype was developed and produce by two architecture interns. This report shows the design and production process for the low cost house and the results obtained.
CONTENIDO

Design .................................................................................................................. 12
Design premises ................................................................................................. 12
Space efficiency .................................................................................................. 12
Construction and assembly ................................................................................ 12
Production process ............................................................................................. 13
Price .................................................................................................................... 14
multihouse building ............................................................................................. 15

Energy System ..................................................................................................... 16

Water System ....................................................................................................... 17
Water drain ........................................................................................................... 18
Rainwater Supply .................................................................................................. 18
Water main Supply ............................................................................................... 18

Concrete Elements .............................................................................................. 19
Elements' location and names .............................................................................. 20

Planning ................................................................................................................ 21
Planning process ................................................................................................... 21
Walls formwork construction .............................................................................. 22
clean steel panels in battery mould ................................................................. 22
Place wooden borders in steel "L" profiles ....................................................... 22
Seal wooden borders.......................................................................................... 22
Oil steel panels in battery mould ...................................................................... 22
Place nailplates and box anchors .................................................................. 22

Texture installation (matriza) (optional) ............................................................ 23
Vertically ............................................................................................................... 23
Horizontally ........................................................................................................ 23

Steel framing preparation WALLS ..................................................................... 24
Cut 6mm Ø meshes .............................................................................................. 24
Cut 8mm Ø steel bars ........................................................................................ 24
Bend and figurate 8mm Ø steel bars ................................................................. 24
Attach 8mm Ø steel bars to the 6mm Ø meshes ............................................... 24
Locate plastic spacers in the mesh ................................................................... 25
Place steel wire structure on the formworks ................................................... 25
Secure anchors with reinforcement to the meshes ......................................... 25

Electric installation ............................................................................................. 26
Arrange boxes ...................................................................................................... 26
Locate boxes ....................................................................................................... 26
Locate wires ........................................................................................................ 26
Seal boxes ........................................................................................................... 26

Hidraulic installation ......................................................................................... 26
Make water supply system outside ................................................................... 26
Insert water system in the mesh .......................................................................... 26

Steel framing preparation SLABS ..................................................................... 27
Cut 6mm Ø meshes ............................................................................................ 27
Cut KTRUSS steel girders .................................................................................. 27
Cut and bend 8mm Ø reinforcement bars for corners ..................................... 27
Put plastic spacers on the girders. .................................................................... 27
Arrange KTRUSS steel girders and reinforcement corners ............................ 27
Place 6mm Ø meshes ....................................................................................... 27
Place the foam element for the water drain system ........................................ 27

The battery ......................................................................................................... 28
Change plastic .................................................................................................... 28
Check anchors and dimensions ....................................................................... 28
Close and seal any possible hole in the battery ............................................... 28
Apply grease in battery’s bolts and screws ....................................................... 28
Transport steel formwork ................................................................................ 28
place butterflies in the battery ................................................................. 28
secure the battery ................................................................................ 28
close the battery .................................................................................. 28

**Assembly** .......................................................................................... 29
Order of assembly .................................................................................. 29
First House ......................................................................................... 29
Second House ....................................................................................... 29

**Assembly plans** .................................................................................. 30
Walls' location ......................................................................................... 30
Anchors' location ................................................................................... 30

**Slabs First House** ............................................................................ 31
Foundations .......................................................................................... 31
Placing slabs ......................................................................................... 31
Drill missing anchors ........................................................................... 31
Screw missing anchors ........................................................................ 31
Arrange boxes and anchors .................................................................. 31
Adjust height ......................................................................................... 31
Install anchors ...................................................................................... 31
Check slope ........................................................................................... 31

**Walls** .................................................................................................. 31
Transport walls ..................................................................................... 31
Place elements ....................................................................................... 31
Fix base anchors ................................................................................... 31
Secure first elements ........................................................................... 31

**Second House, middle slabs and Roofplates** .................................. 32
Slabs protection ...................................................................................... 32
Middle Slabs ......................................................................................... 32
Walls second house .............................................................................. 32
Roofplates ............................................................................................... 32
Anchors' misplacement ........................................................................ 32
Waterproving ......................................................................................... 32
Place second wall .................................................................................. 32
Anchors tought the walls ...................................................................... 32
Spannschloss .......................................................................................... 32
CURRICULUM

Sobre Mí

Nombres: Luisa Fernanda Apellidos: Gómez Correa  
Documento: 1.037.627.509  
Nacionalidad: Colombiana  
Nacimiento: 03 de Julio/1993  
Lugar: Bello, Antioquia

Contacto

Dirección/Ciudad:  
Teléfono fijo/Celular:  
Correo Electrónico:  
Skype:

Cll 45 Sur Nº 42a-01 (Apt 402)  
3347131/ 3137038630  
gclf93@gmail.com / luisaf.gomez@upb.edu.co  
luisa.gomez1993

Formación Básica

2005 / Primaria  
2010 / Bachillerato

Estudios Universitarios

2009-2010  
Tecnica de redes alambricas e inalambricas  
2011 - Semestre 1  
Arquitectura  
2015  
Concurso Solar Decathlon

Colegio Panamericano Colombo Sueco  
Instituciòn Liceo La paz - Envigado  
Instituciòn Universitaria de Envigado  
Envigado, Antioquia, Colombia  
Universidad Pontificia Bolivariana, Medellin  
Actualmente cursando octavo semestre  
Universidad Pontificia Bolivariana, Medellin  
Arquitectura principal - Equipo Arquitectura
Formación Construcción

2012
Formación Básica-SENA
Centro de hábitat y desarrollo constructivo

Habilidades Laborales

2013- Semestre 2
Universidad pontificia bolivariana

Idiomas

Español: Idioma nativo.
Inglés: Escritura y conversación B1

Programas Digitales

Arquitectura
AutoCAD
Revit Autodesk
Google Schetchup

Representación
Adobe Photoshop
Adobe Indesing
Power Point-Word-Excel

Intereses

Jugar Tenis de Campo
Cine
Leer Temas de arquitectura
Viajar
Salir de Compras
Escuchar Música
Cantar

Teórico / Práctico
- Construcción básica: 2012
- Asistencia Técnica: 2013
- Básico en instalaciones técnicas: 2014

Taller Vivienda Colectiva/ Reconocimiento de desarrollo para la exposición de acreditación al RIBA

Creatividad
Investigación
Trabajo en equipo
Propositiva
Ordenada
Disciplinada
Experiencia Laboral

Empresa:
BT Innovation, Alemania
Cargo:
Arquitecta (Practicante)
Período:
Funciones:
Diseñar, programar y construir dos viviendas de bajo costo, haciendo uso de los sistemas innovadores patentados de la compañía BT Innovation.
Jefe inmediato:
Eike Grabert
Teléfono:
+49 01775191953

Empresa:
Universidad Pontificia Bolivariana
Cargo:
Project Architect
Período:
Diciembre 07 /2014, hasta Diciembre 19/2015.
Funciones:
Diseño arquitectónico y constructivo de la casa Yarumo, para el concurso Solar Decathlon Latin America & the Caribbean 2015.
Jefe inmediato:
Verónica Henriques
Teléfono:
3006531306

Referencias Personales

Ingeniero Civil - Alemania

Nombre: Eike Grabert
Teléfono: +49 01775191953
+49 039155870679
E-mail:
inggrabert@yahoo.de

Arquitecta-Profesora

Nombre: Verónica Henriques
Teléfono: 3006531306
E-mail:
veronica.arquitectura.sostenible@gmail.com

Luisa Fernanda Gómez Correa
LOW COST HOUSE
RESEARCH AND DEVELOPMENT’S PROJECT

LUISA FERNANDA GÓMEZ CORREA
LAURA MARIA ESTRADA D´AMATO
This portfolio shows what has been developed in BT. Innovation, Magdeburg, Germany.
This full report was created by:
-Luisa Fernanda Gómez Correa
-Laura María Estrada D’Amato

Each image and information belongs to the company BT. Innovation.
**Design**

**Design premises**

**Space efficiency**

The design of this house has been developed to be build for low income communities in developing countries, to supply the demand of quality housing for poor families. The prototype provides a home that covers the basic necessities for a small family or group without any extra commodities. The space is arranged to be more efficient, in just 36 m². It holds a kitchen, dining room, living room and a place to do laundry instead of just dining room and bathroom and 2 bedrooms. The design can be rearrange in order to fullfill different neccesities using the same production system and the same area.

![Floor Plan](image)

**Construction and assembly**

In order to obtain a house that is fast and easy to build in site in emergency situations the construction technique should be dry, simple and precise. Therefore, the prototype has been design as simple as possible and it's made of a small number of big precast elements, which can be joined in an easy way without special construction tools or joining material.

The precast house could be used right after it is installed, the concrete’s finished is smooth and the walls contain all the electrical and water system required.

![Images of construction](image)
Production process

The manufacture of the pre-cast concrete components is carried out using a special portable and space-saving battery mould. This technology makes it possible to produce building components in the direct vicinity of the building site in a mobile field factory. This type of production presents the following benefits as compared to the traditional approach:

The production is simple and easy to use.
The surfaces are smooth on both sides so that no further finishing is required.
A large amount can be produced in a relatively small area (one house per mould)
It provides flexibility in terms of the appropriate production site.

In addition to that, this prototype was produced in a new, smaller battery mould, where it is possible to use the butterfly formwork system, which allows to precast 2 concrete elements in one cell instead of just one.

In order to make the precast panels fit inside the smaller battery mould, the house was designed using 7 concrete panels that can be arranged in 6 battery formworks of 6,00m width by 2,40 height and 6 slabs (3 baseplates and 3 ceilingplates) that were arranged in 2 butterfly formwork (6,00m width by 2,00m or 2,15m height)

With only a battery mould with 6 cells and 6 butterflies is possible to produce an entire house, using less space in the production of the precast panels.
Price

The project aims a low income market in developing countries.
Multihouse building

The Low cost house is designed as single cell from a larger multihouse complex. A group of houses together could be build without compromising the individuality of each one; building a second house for instance wouldn’t require to modify anything for a first house previously constructed. for this reason the desing has some features to allow the construction of several house units grouped:

- The east and west facades are completely close, in this way, two houses can be built side by side without blocking any door, window or vent.
- The ceilingplates for a first floor house are as thick as a baseplate and also have anchors to attach walls on top of them so they can be use a baseplates for a second floor. To build this second house it is not necessary to modify anything in the first floor.
- The water and electrical system can be connected vertically to supply houses above.

![Diagram showing single house, two houses on a row, second floor house, and multihouse building]

There are multiple ways to group housing units. with pigmented concrete mixes it is possible to give diversity to the group. extra stairs should be added. The prototype will test the possibility to build in a third floor on top.
Energy System
The prototype’s electrical system is designed to be built inside just two interior walls which are located strategically to illuminate all interior spaces of the house in a more efficient way. The wire connections and fixtures are embedded in the walls, this helps to make the assembly time shorter, saving time in electrical installations in situ.
Water System

The water system is divided by:
- Water drain
- Rainwater supply
- Water main supply

Each system it’s thought in a way efficient and sustainable in the Low Cost House, since all the system it’s locate in one wall (W2) and a part it’s designed a Schacht where is a space only for the water system, permitting that the water be distributed for all the houses.
**Rainwater Supply**

The use of Rain water is a theme important in the sustainability, since it can be reduced the spending potable water, and do a change for the environment. The rainwater supply pass per the schacht and is deflected embedded to the wall W2 supplying to the wash machine and toilet.

**Water main Supply**

The water main supply is pure water, and this pass per the schacht and is deflected embedded to the wall W2 supplying to the wash machine, toilet, handwash and shower.
Concrete Elements

- **Facade Wall panels**
  Attached to base plates and ceilingplates, they provide the basic structural system for the house acting as a box. They have Spannschloss in the upper and lower part.

- **Electrical Wall panel**
  This wall has electrical wires and boxes embedded in it

- **Electrical+Plumbing Wall panel**
  This wall has electrical wires and boxes embedded in it and it holds all the water supply system.

  *The house only has water and electric installations on 2 elements, in this way it is easier to install, it uses less material and it can reach all the rooms organizing the systems in a simple way*

- **Simple Wall panel**
  With Spannschloss connecting to the Facade walls and simple wavy anchors to the electrical wall

- **Slabs plate panel**
  They provide support to the house. Each one has beams located right under a wall is laying. For the base plates the thickness is 15cm and for the ceilingplates is 11cm. They all have connection with the facade walls.
Elements' location and names
Planning

Planning process

The Low Cost House´s search to create a stable and secure area for families with low resources or in an emergency situation, therefore it seeks to be constructed in the shortest time possible.

Initially a first schedule was developed and it was planned to lasts for two months, but during the production of the precase pannels it had to be rearranged to lasts 3 months since some changes occurred in the production process.

Finally a new schedule was proposed taking in account the right procedure. This last schedule aims to be more efficient and fast in the productions process.

In this chapter is possible see the different programs:

1. Planned Schedule
2. Real Schedule
3. Proposed Schedule
**Walls formwork construction**

**clean steel panels in battery mould**

With piece of cloth, clean up and down of each face of the battery, remove rests of concrete, mud or any previous kind of dirt.

**Place wooden borders in steel "L" profiles**

Arrange wood planks and attach them in the steel profiles with screws. Check the following characteristics:
- They should be the same width as the desire walls. Be sure that they are even (no space between the steel panel and the wood)
- No space between 2 pieces of wood
- The formwork measurement should be taken from the inner sides of the formwork and it should be the same as in the plans; if it is necessary, add bigger wood blocks to the "L" profiles on the sides and attach them with longer screws (the wood may be drill in advantage).
- The sides are closing fine.

**Seal wooden borders**

There should not be space between the wood planks and the panels of the battery. Apply silicon on the bottom part and adhesive foam tape on the sides, then close them and try to close the steel "L" with the wood and foam completely.

**Oil steel panels in battery mould**

Spray release agent from the tank, then rub it against the steel plates with a clean piece of cloth. The plates should be smooth and oily but without big oil spills.

**Place nailplates and box anchors**

Nailplates can be located in advantage before putting the meshes on the formwork. Take the measurement in the plans and place the plastic plates on the wooden bordes, attach them using nails, NOT screws, and do not put the anchors in until the mesh is on.

The boxes for the M12 anchors can also be located before the mesh but they have to be checked after because they can be moved while putting the mesh on.
Texture installation (matrizza) (optional)

Vertically
The matrizza roll was lifted using a crane with a tire underneath to unroll it along the battery fourm panel.
The sheet has an autoadhesive cover so it is not neccesary to use extra material to attach it to the steel panel.

Horizontally
The texture can be place horizontaly on a butterfly formwork and work in a vertical way when is concreting inside the battery, this way the installation is easier and it can be done by unrolling the matrix or lifting it with a steel bar with a crane as seen in the pictures.

- Clean the steel panel, specially on the bordes where the matrix borders will be, the surface should be free from oil, dust or any kind of dirt.
- Mark the exact place where the texture will be apply. Place the matrix’s first border precisely on previous mark, unroll the sheet on the magnetic side along the steel panel. make sure there are no air bags between the matrix and the panel.
- Clean the surface with special wax using a special wax, rub it among the surface with a piece of clothe.
- Seal the borders of the matrix with sylicon, pass a wet finger a few minutes after aplying it. this will prevent the concrete from getting iside

Matrix dimensions ref. 2/240 Bâli (from Reckli)
Concrete hardem in formwork mould with matrix
Concrete element with textured surface ready
Steel framing preparation WALLS

Cut 6mm Ø meshes
The meshes have to be at least 3 cm apart from the edge of the wall on each side

door and windows to far from the crossing points on the mesh make it hard to locate the reinforcement properly

door and windows to arranged according to crossing points on the mesh make it easier to place and fix the reinforcement.

Cut 8mm Ø steel bars
Plan ahead how to have the least waste material as possible. use the rest of one element in another one.

Bend and figurate 8mm Ø steel bars
Bend the bars as accurate as possible following the plans, try to make the corners match the meshes crossing points.

Attach 8mm Ø steel bars to the 6mm Ø meshes
Follow the plans and structural calculations and static. in general be careful with:
• Always have reinforcement in the upper and lower edges of every wall
• Always use reinforcement to protect all the corners (of the element and whether is a door or window corner)
• On top the doors and windows have extra steel bars.
• Extra reinforcement if there will be a heavy element such as a water tank supported by the concrete wall.
• On the lower part of a door frame always put a thicker steel bar for extra reinforcement for transportation.

Use connecting wire loops to attach the bars to the meshes.
Locate plastic spacers in the mesh
The wheel plastic spacer keep the mesh in the middle of the wall, allowing it to give more structural support. Place them around every 45 cm en both ways.

Place steel wire structure on the formworks
with the crane lift the structures one by one and place them on the formworks. put plastic spacers at the bottom to keep the mesh separated from the wooden planks. Make sure there is enough space between the steel and the formwork, the door frames or the windows.
Hung the steel structure with wires and magnets attached to the top of the formwork´s panels.

Secure anchors with reinforcement to the meshes
Place the remaining anchors and put reinforcement for each one. Attach the anchor, the reinforcement and the mesh using connecting wire. Each anchor has to have at least one reinforcement bar on front and one on the back, try to use the mesh or add extra steel if needed. examples:
1. **Lifting anchors:** Anchor screwed to a plate attached to the magnet place at the top of the battery panel.
2. **Plastic tubes:** DB magnet with 20-22 mm bolt + adhesive foam tape + 50mm plastic tube + isolating foam.
3. **Waved anchors (with nailplate):** extra steel needed
4. **Waved anchors (with DB magnet):** no extra steel bar needed
5. **Plate anchors:** reinforcement bar under the plate.
6. **M12 box with anchor:** cut mesh if it is necessary to make space for the box.
The anchors help to hold the mesh and keep it in place. make sure not to change the position of the devices while fixing/arranging them.
There should always be 1cm minimum between the battery steel panel and the steel structure (mesh, bar, anchors etc)
Electric installation
All the wiring system is embedded in 2 walls, a special kind of wire is used which holds all the required cables inside one bigger insulation cover that protects the electrical system from the humidity of the concrete.

Arrange boxes
the electrical boxes have to be prepared with the magnets and the connection tubes required in each case.

Locate boxes
Follow the plans, be careful on which side of the box the magnet should be, the mesh can be cut at some points if it is necessary.

Locate wires
Leave enough wire on each box to work with afterward. the cables be attached to the meshes with connecting wire.

Seal boxes
Use some insulation foam, rubber material or innoelast to seal each box. this should prevent the concrete from getting inside

Hydraulic installation

Make water supply system outside
Fix the pipes and the water outlets together following the measurements on the plan. keep it as simple as possible.

Insert water system in the mesh
the plumbing pipes and fixtures should be twined along the mesh.
Steel framing preparation SLABS

Cut 6mm Ø meshes
The meshes have to be at least 3cm apart from the steel edge of the formwork on each side and also from the top border.

Cut KTRUSS steel girders
Cut them 5-10cm smaller than the plan’s measurement for each girder, so it is possible to arrange them and connect the corners without touching the formwork’s borders.

Cut and bend 8mm Ø reinforcement bars for corners
The corners should be at least 60 cm to each side, follow the plans. The reinforcements for the corners are very important to the structure.

Put plastic spacers on the girders.
For Floorplates: 6cm radchen spacer in the bottom, 1,5cm spacer on the sides.
For Ceilingplates: 1,5cm spacer in the bottom, 1,5cm spacer on the sides.

Assign KTRUSS steel girders and reinforcement corners
Overlap one girder over the other one in the corners, make sure the structure is not higher than the formwork (specialy on the ceiling plates) and that the steel elements don’t touch the formwork borders. Fix tight everything with connecting wire.

Place 6mm Ø meshes
Put the meshes over the girders, place plastic radchen spacers to separate the from the wooden elements (10cm Ø for baseplates and 6cm Ø for ceilingplates, fix the mesh tight using connecting wire.

Place the foam element for the water drain system
Follow the plan. Screw the schacht to the wood elements using long screws.
The battery
Change plastic
Put a new clean protecting plastic foil under the battery

Check anchors and dimensions
It is very important to make sure that every elements has the anchors in the right location and fixed correctly and all the dimensions are ok.

Close and seal any possible hole in the battery
Look for the lifting holes in the panels, tape or cover them with a plastic lid. also, any other space where the concrete might get in should be seal.

Apply grease in battery’s bolts and screws
check all the bolts for the battery’s steel profiles and also for the anchors. Any exposed bolt, screw, nut, etc should be covered with grease in order to prevent the concrete to get inside the loops.

Transport steel formwork
The butterfly steel formworks for the slabs have to be taken one by one to the area next to the battery and the place the in pairs, making the lifting poing match.

place butterflies in the battery
The butterflies have to be layed on the battery mould and the lifted with the smaller traversa (when the production plant’s height demands it).
With the simpler butterflies (for the slabs) it is necessary to place wood chunks on the battery’s cell panels in order to lay the butteryfly, use steel rectangular tubes to support the elements.

secure the battery
Use steel hooks and slings to secure the battery.

close the battery
Place the 9 tension steel bars with their respective screw heads. thight each one as hard as possible, repeat this around 6 times until the battery is completely close and hermetic sealed.
Assembly

Order of assembly.

First House
Plan ahead the sequence of assembly; this will give instructions of how the elements shall be arranged in the place to make the assembly process more efficient.

Second House
For the walls is better to set up first an angle with 2 facade walls to give stability to the structure, this will give support to the internal walls that are not attached to the baseplates.
Have a plan in hand at the moment of installing the concrete elements. this plan has the measurements for the spaces inside the house and this should be followed when building the house.

The boxes for the M12 and the anchors should be in the same location. it should be as exact as possible, if there is a small (<1,5cm) misplacement of an anchor the spannschloss can solve it.

Walls' location

Anchors' location
Slabs First House.

Foundations.
Set the 3 concrete beams on the ground where the precast panels will lay.

Placing slabs.
Place the first slab over the foundation beam very precisely. check the slope for each slab.

Drill missing anchors.
if the placement of any anchor is forgotten in the production should be drill in place.

Screw missing anchors.
install self-expanding bolts matching the boxes for spannsclhoss if any anchor was forgotten.

Arrange boxes and anchors.
When placing the next elements, arranged the anchors to fit together. try to make the space between slabs as tight as possible.

Adjust height.
If one slabs is higher than the one next to it, place some plastic plates or spacers in the lowest one to lift it until they are equal.

Install anchors.
Put the spannschloss in every box with their respective bolts. fix them tight.

Check slope.
Make sure every slab is placed without slope and there is not unevenness between two horizontal elements.

Walls.

Transport walls.
Walls shall be transported vertically. place them in transporting trailer and fix them tight.

Place elements.
Take walls by the lifting anchors, move them always vertically, pace them over the slabs following the plans and matching the boxes with the anchors.

Fix base anchors.
Put the spannschloss in every box with their respective bolts attaching the walls to the slabs

Secure first elements.
The first vertical elements wont be stable enough to stand by them- selves, this is why additional support steel bars should be installed temporarily until all the remaining walls are in place.
**Place second wall.**
The first two installed walls should form an angle. they will give structure to the assembly process.

**Anchors tought the walls.**
Place the anchors that go through the walls, use 9cm long bolts to fix it.

**Spannschloss.**
The spannschloss help to solve some differences in the anchors displacement.

---

**Second House, middle slabs and Roofplates**

**Slabs protection.**
Place some rubber protection stripes at top of the walls in order to avoid cracks in the concrete elements caused by the surfaces' unevenness that break the material.

**Middle Slabs.**
Place the baseplates for the second house following the plans and matching the connection anchors with the M12 boxes on the walls. locate the elements matching the beam in the bottom with the top of the walls arrange the Concrete elements with the least possible space between them.

**Walls second house**
Follow the same procedure as in the first house. make sure that the vertical elements above are exactly over the ones in the house under so the structure has continuity. mind the height and be extracareful.

**Roofplates**
Place them following the same procedure as in the middle slabs.

**Anchors' misplacement**
If there are mistakes in the anchors placement; it would be necessary to drill new holes that pass through the roofplates and match the boxes on top of the walls.

**Waterproving.**
This prototype (for testing purposes) was not waterproved but if the house is ought to be for permanent use all the joints shall be sealed with RubberElast® which suits very fine for this dry building system. this will give protection inside the house against water, dust, insects, small animals etc.
Teléfono: +49 391 7352-0
Fax: +49 391 7352-52
E-Mail: info@bt-innovation.de