

# REGENERATOR

Alternative Coastal Development & Protection of the wetlands  
Hangzhou, People's Republic of China

The project that you are about to see, is an example of a broader research that involves solutions to some of the main issues that our society will face throughout this century; Population Growth, Sea Level Rise and Scarcity of Resources.

Is expected a rapid population growth for the first half of the 21st century, propelled specially by the developing countries (from 7.2 billion to 9.6 billion people estimated in UN's "World Population Prospects" report).

With this growth, two main questions arose or this research:

What is going to happen with the coastal cities if there is a sea level rise?

How are we going to produce the necessary resources to sustain the world population?

## RWM

Resilient World Map

- Ecosystems in Danger
- Sea Level Rise Risk
- Urban Growth
- Boundary of ecosystems hotspots
- Flooded boundary with over 65m sea level rise
- Areas with cities & ecosystems most affected

## CAS

Case Study

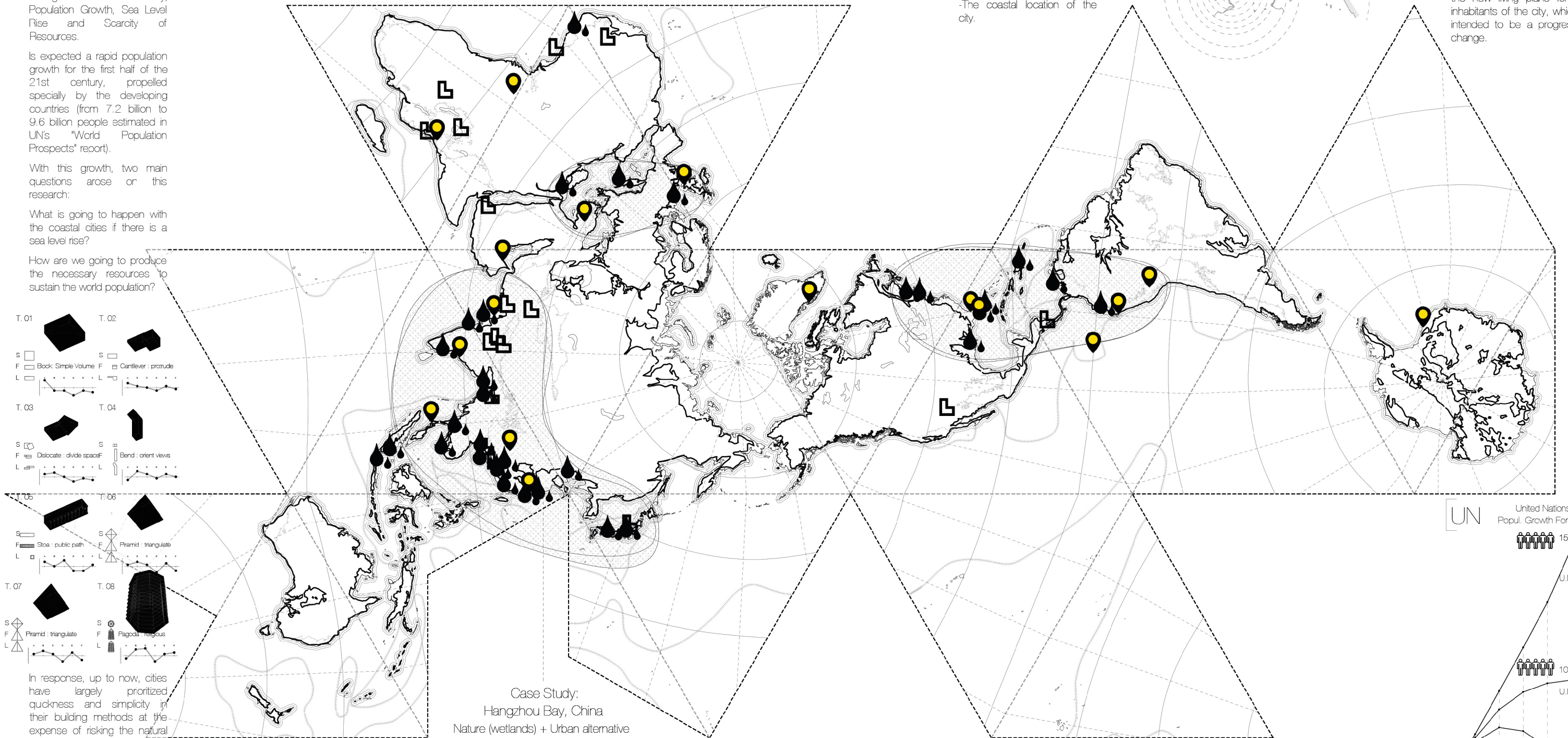
For this case, it is selected the city of Hangzhou, in China, for the following reasons:

- Its rapid population increase.
- The natural ecosystems that are being erased by the construction system used, the wetlands.
- The coastal location of the city.

## RUD

A Resilient Urban Design

The design of an elevated structure and the contribution of the wetlands will make of a city resilient to the sea level rise that it is forecasted to happen in this century by the Intergovernmental Panel on Climate Change. The net of cells and its connections will be the new living plane for the inhabitants of the city, which is intended to be a progressive change.

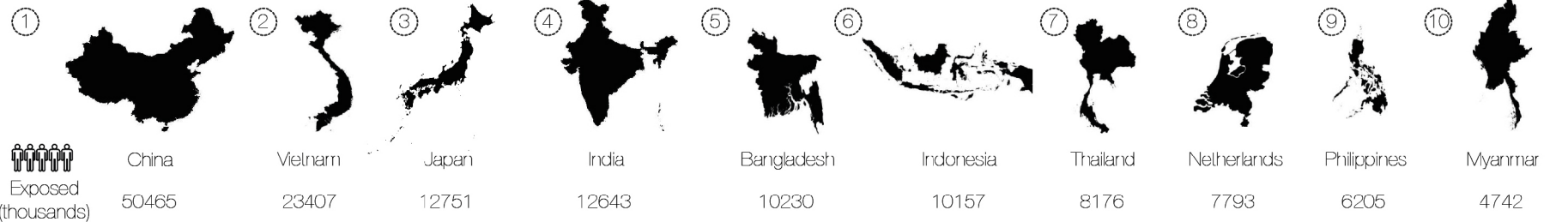


- T.01 T.02
- S S
- F F
- L L
- T.03 T.04
- S S
- F F
- L L
- T.05 T.06
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- F F
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- T.07 T.08
- S S
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- L L

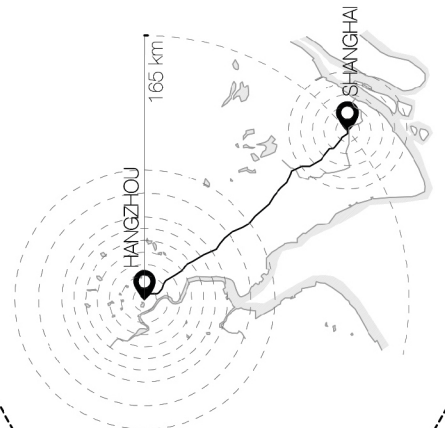
Case Study:  
Hangzhou Bay, China  
Nature (wetlands) + Urban alternative Solution

## TCS

TCP 10 Countries  
Sea Level Rise Risk

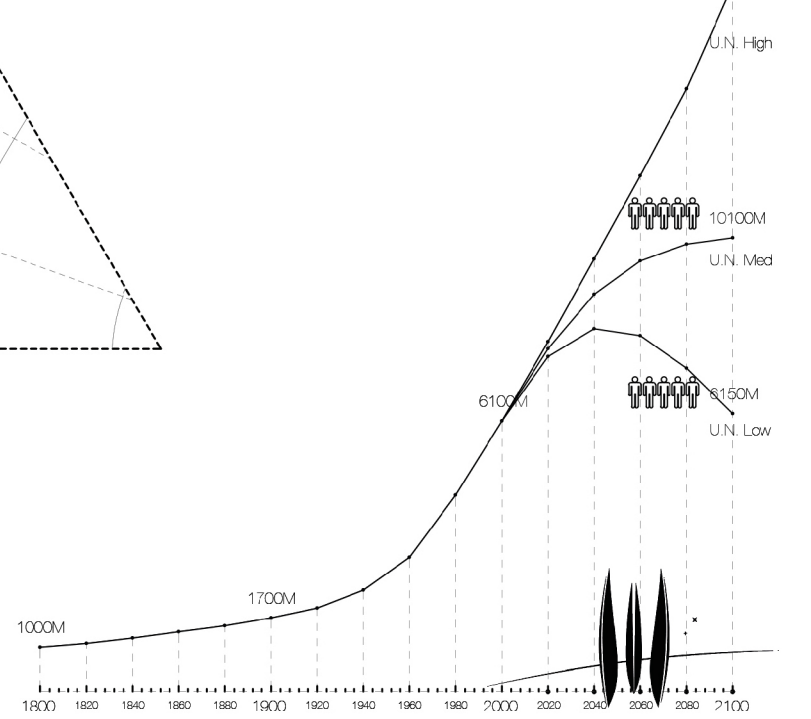


The following project is an exercise to represent an alternative solution to the issues forecasted. It is developed a urban system based on a social and natural sustainability



## UN

United Nations  
Popul. Growth Forecast



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NRC Net of Regenerating Cells

★ STRUCTURAL CELL REPRODUCTION & REGENERATION OF WETLANDS

SRC Structural Regenerative Cell

## COD Construc. Objectives of the Dome

HANGZHOU DESCRIPTION  
Actual: It is built on a bay which has allowed the location of large wetlands, these being a very important ecosystem of our nature.

## IMO Incompatible Models

ECOSYSTEM // WETLANDS



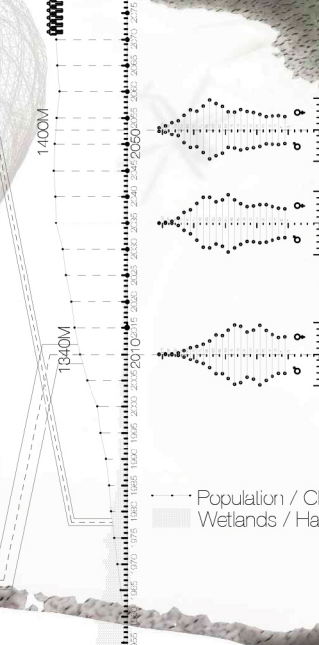
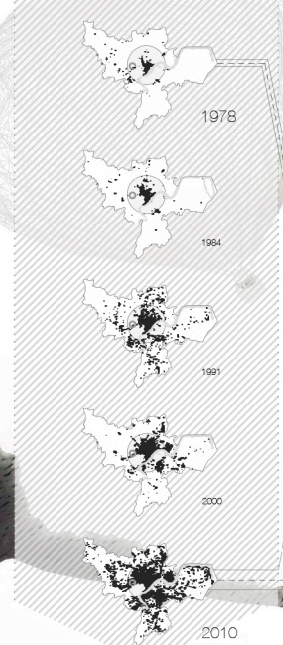
CITY GROWTH



Problem: The construction method used is not sustainable with the ecosystems of the place. It destroys them by building on top of the wetlands.

CITY GROWTH VS WETLANDS

RELATIONSHIP POPULATION / WETLANDS



REGENERATIVE CELL  
It is proposed a structural cell capable of regenerating the wetlands that have been destroyed. This cell will be located on an elevated plane above the ground, allowing the recover of wetlands in its lower level.



REPRODUCTION / EXPANSION



FEEDING / ACCESS, ENERGY

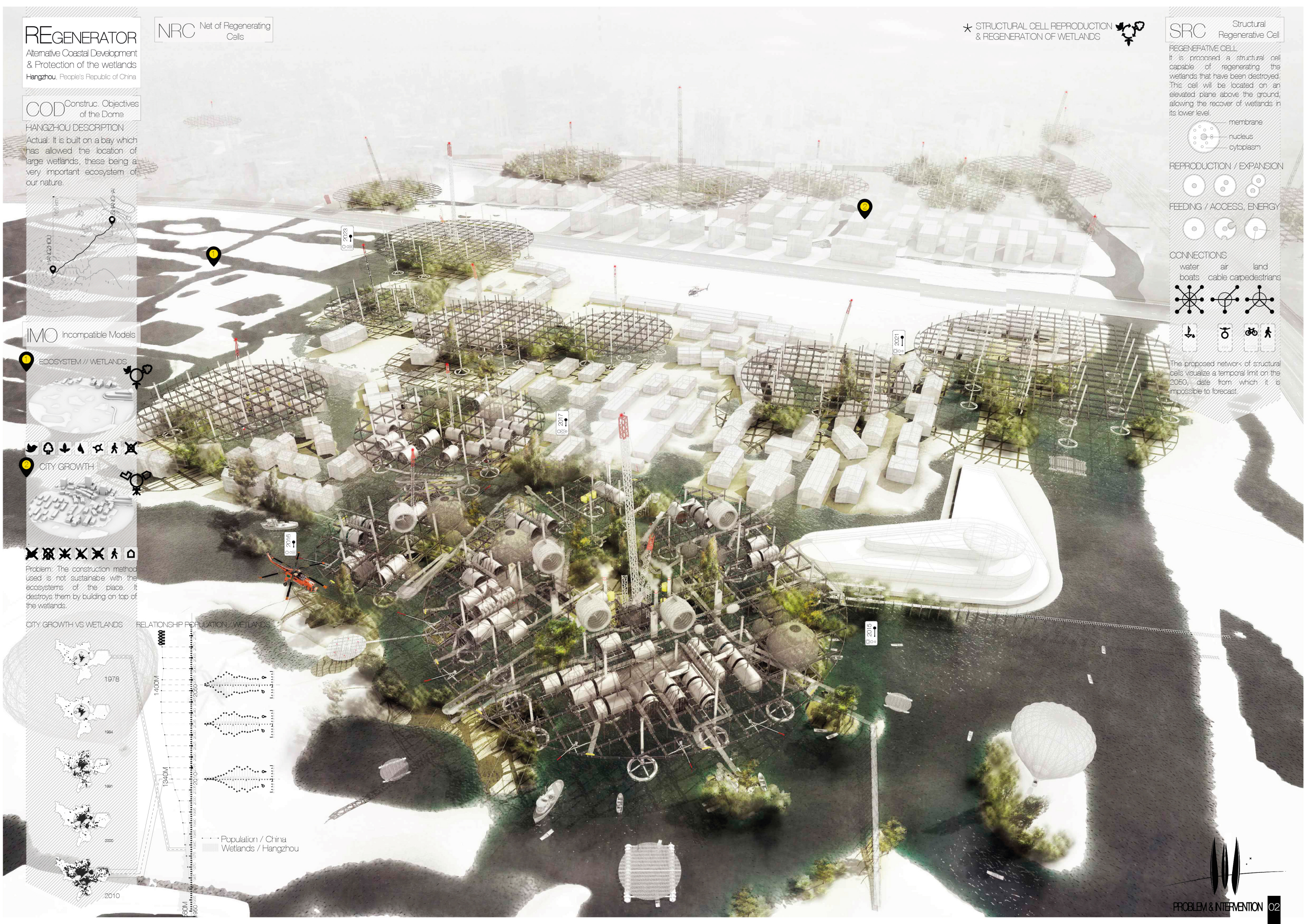


CONNECTIONS

water air land  
boats cable capedestrians



The proposed network of structural cells visualize a temporal limit on the 2050, date from which it is impossible to forecast.



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## COS Constructive Solution

CELL AS A NEW CONSTRUCTION LEVEL  
As a solution to the problem of the expansion of the city facing the wetlands is to provide the city of Hangzhou with a NEW CONSTRUCTION LEVEL where the inhabitants of the city will live



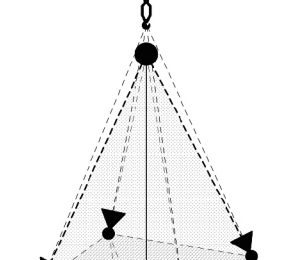
### NEW LEVEL CONCEPTS

- Lightness / Low impact
- Permeability / Water Cycle
- Transparency / Sun cycle

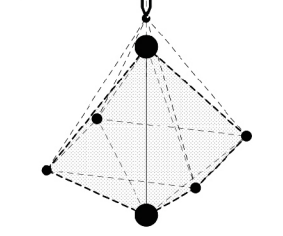
### TENSEGRITY BLOCK RESEARCH

- Standard tensegrity
- Reciprocal prism
- Constructive feasibility
- Economic feasibility

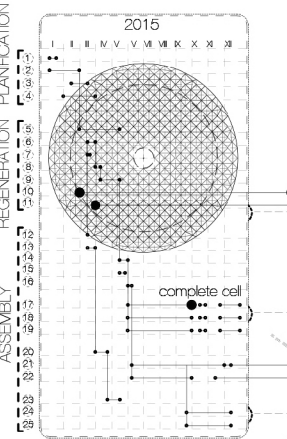
### [BSU1 support]



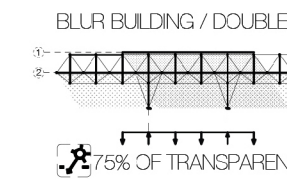
### [BSU2 span]



## TSC The Structural Cell



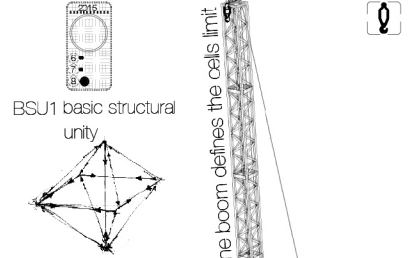
### STRUCTURAL ADAPTATION



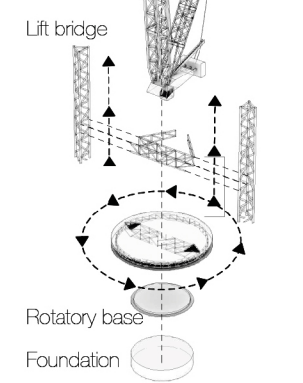
75% OF TRANSPARENCY

## MSC Mutability of Structural Cell

CRANE FOR THE CELL ASSEMBLY



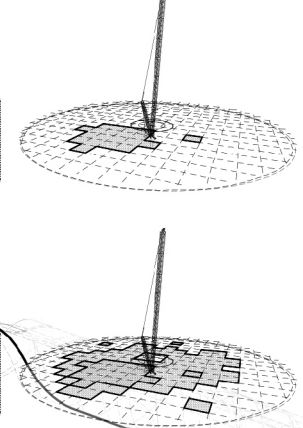
The length of the boom defines the cells limit



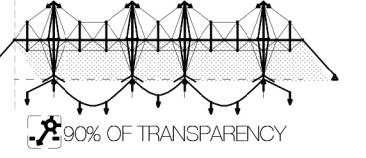
The mutability is designed in order to adapt to the different situations of each time.



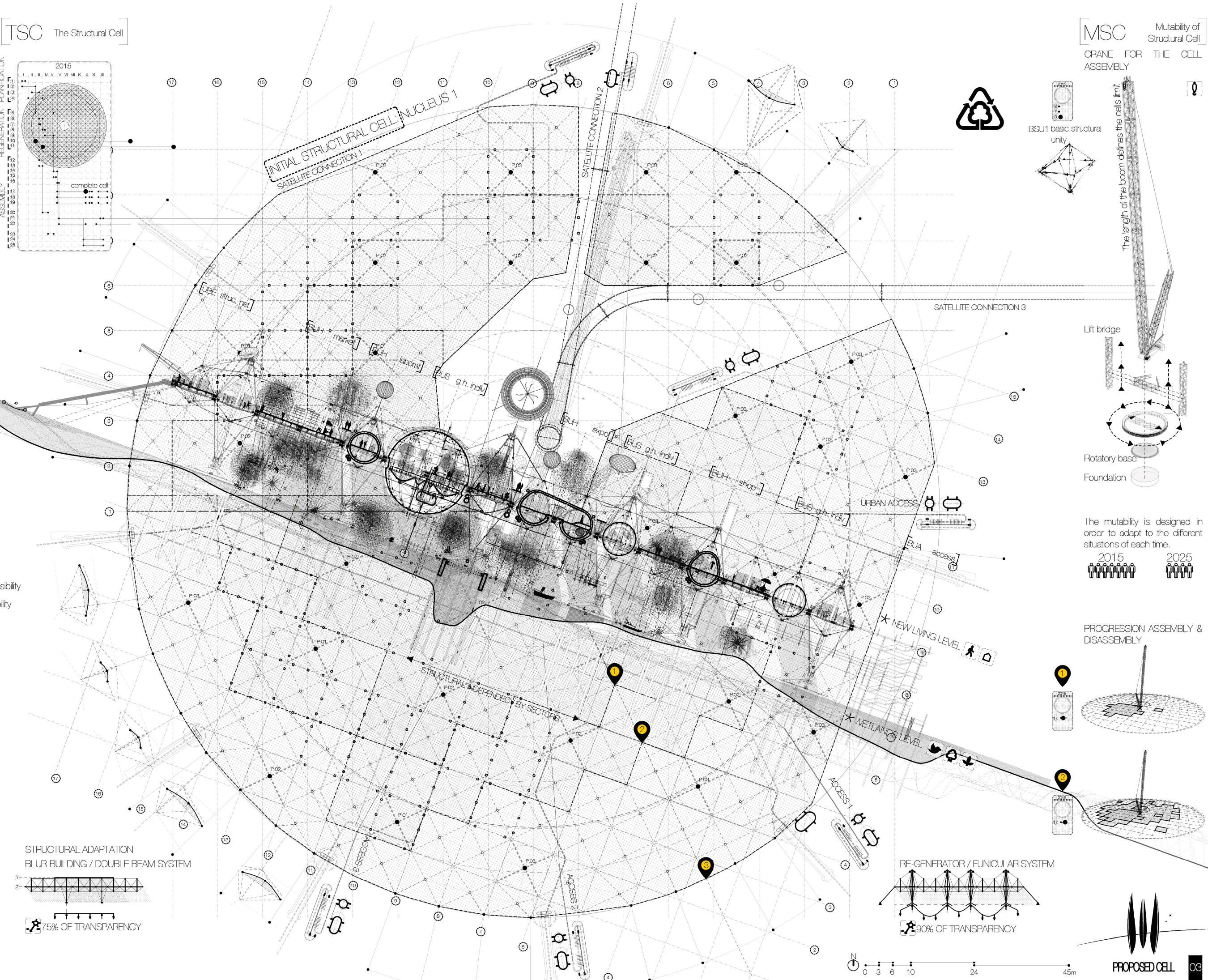
### PROGRESSION ASSEMBLY & DISASSEMBLY



### RE-GENERATOR / FUNICULAR SYSTEM



90% OF TRANSPARENCY



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## PCE Parameters for the Cell Expansion

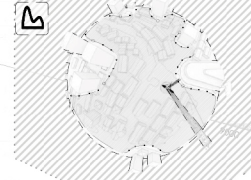
### WATER CONNECTIVITY



### FREE SPACES



### URBAN DENSITY

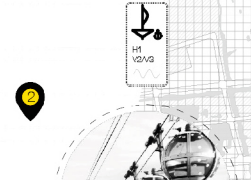


## STI Sustainable Transports for Inhabitants

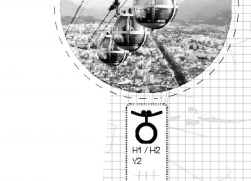
RE-GENERATOR integrates three types of sustainable transportation, by water, by air and by ground.



WATER\_Connectivity between UDUs will be done through the channels of hangzhou



AIR\_Connectivity between cells will be done by a funicular system that reaches the height of the project



LAND\_For the wetlands plan, there will be bike paths and pedestrian paths.



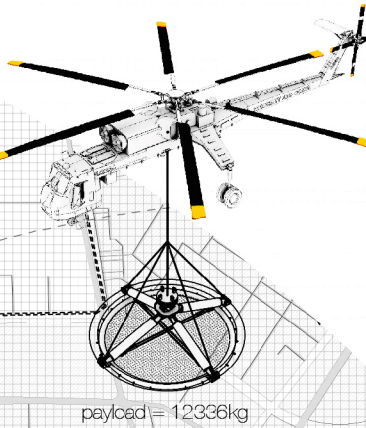
## USE Use in the cells

The use of each cell depends on the economic situation of its location. If in that place works right, the Cell will copy its existing use. If it does not work good, a new use will be proposed to fix the economy of the place.



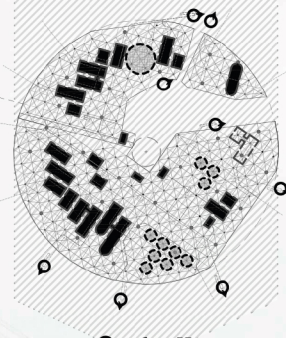
## TOM Transport of Constr. Mat & Parts

Sky Crane Sikorsky S-64 F  
Due to the diversity of the areas of intervention, we opt to transport the materials & cell parts by air. By this way it is avoided punctual planning for each structural cell.

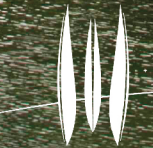


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- Basic Units of Habitation
- Basic Units of Service
- Permanent Access



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## LEA Levels for Energetic Advantage

RE-GENERATOR, by being an intervention that aims to raise above the ground the habitability level, it is left between several potentially energy levels given by nature.

## PLACES: NATURAL PLANE

This plane is tries to take advantage from wind energy by incorporating some balloons with built rotors manufactured by the company "Altaeros", chosen by it lightness

## INHABITANTS PLANE

There is a change in the plane of habitability so it is allowed the natural development of the wetlands. Here we take advantage of the SOLAR POWER

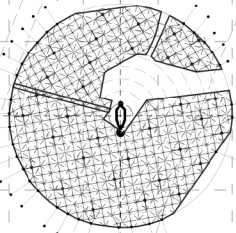
## FACILITIES PLANE

This space is used for the development of the facilities, as it is not an inconvenient for the habitability.

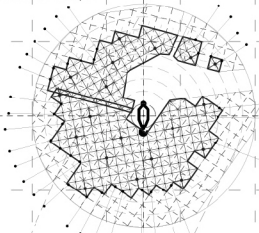
## WETLANDS PLANE

This plane is left almost intact so it makes possible the development and natural regeneration of this ecosystem. It takes advantage of the WAVE ENERGY by the system of energetic supports.

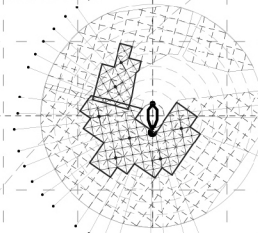
Cell to 95%



Cell to 80%



Cell to 30%



## BUH Basic Unit of Habitability

### CONCEPTS

#### Lightness:

It is a concept that is associated with the structure. To this end, it is studied some aeronautical structures

#### Permeability:

Because the concept of regenerating the wetlands project, the surfaces that compose it have to be as permeable to water cycles

## BUR Basic Unity of Regeneration

### CONCEPTS

#### Self-sufficiency

These units serve food support to the inhabitants of the cells, acting as a common and individual greenhouses.

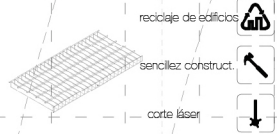
#### Lightness

It is a concept that is associated with the structure. To this end, it is studied some aeronautical structures

#### Greenhouse

These units serve food support to the inhabitants of the cells, acting as a common and individual greenhouses.

TRAMEX de malla = 42 x 100mm; portante = 60 x 3mm; "RELESA"



RED DE RETENCION frente a la caída de objetos 15x15mm de alta resistencia "CATAP"

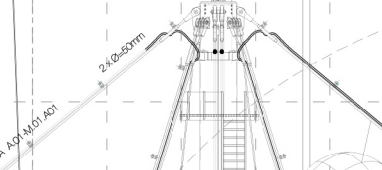


Panel sandwich compuesto por doble lámina plana POLIESTER con capa aislante de "silica x-AEROGEL" flexible y translúcido corte láser



### GLOBO EQUICO:

Todos los elementos propuestos y diseñados se basan en la LIGEREZA. Por lo tanto, integro en esta estructura un globo equico diseñado por la compañía ALTAEROS.



CORROON CÁNTERA A01-A01/A02-A02 2 x Ø=50mm

CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

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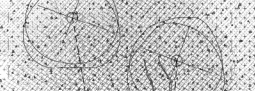
CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm

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CABLE TENSORADO A01-A01/A02-A02 2 x Ø=20mm



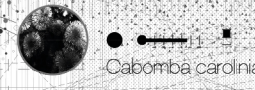
Salix humboldtiana



Polygonum



Cabomba caroliniana



Utricularia foliosa



Victoria cruziana



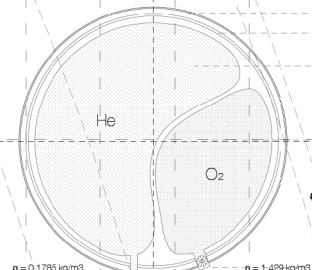
Myriophyllum aquaticum

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## CGL Componentes de Globos

COMBINACIÓN DE GASES DE LOS GLOBOS



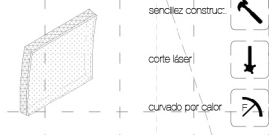
$p = 0,1785 \text{ kg/m}^3$   $p = 1,429 \text{ kg/m}^3$

Fuerza que ejercen los globos:  
Según fuerza de las turbinas  
Fuerza  $(G) = V \times \rho$   
Por lo tanto para que 1 litro de agua fluya  
Fuerza  $(G) = 1 \text{ litro} \times \rho$   
se forma espacio lo queda  
Mesa  $(G) = V \times (\rho_{CO_2} - \rho_{He})$   
donde  
 $\rho_{CO_2}$  = densidad del aire  
 $\rho_{He}$  = densidad del helio  
 $V$  = volumen del globo.  
Mesa =  $G$

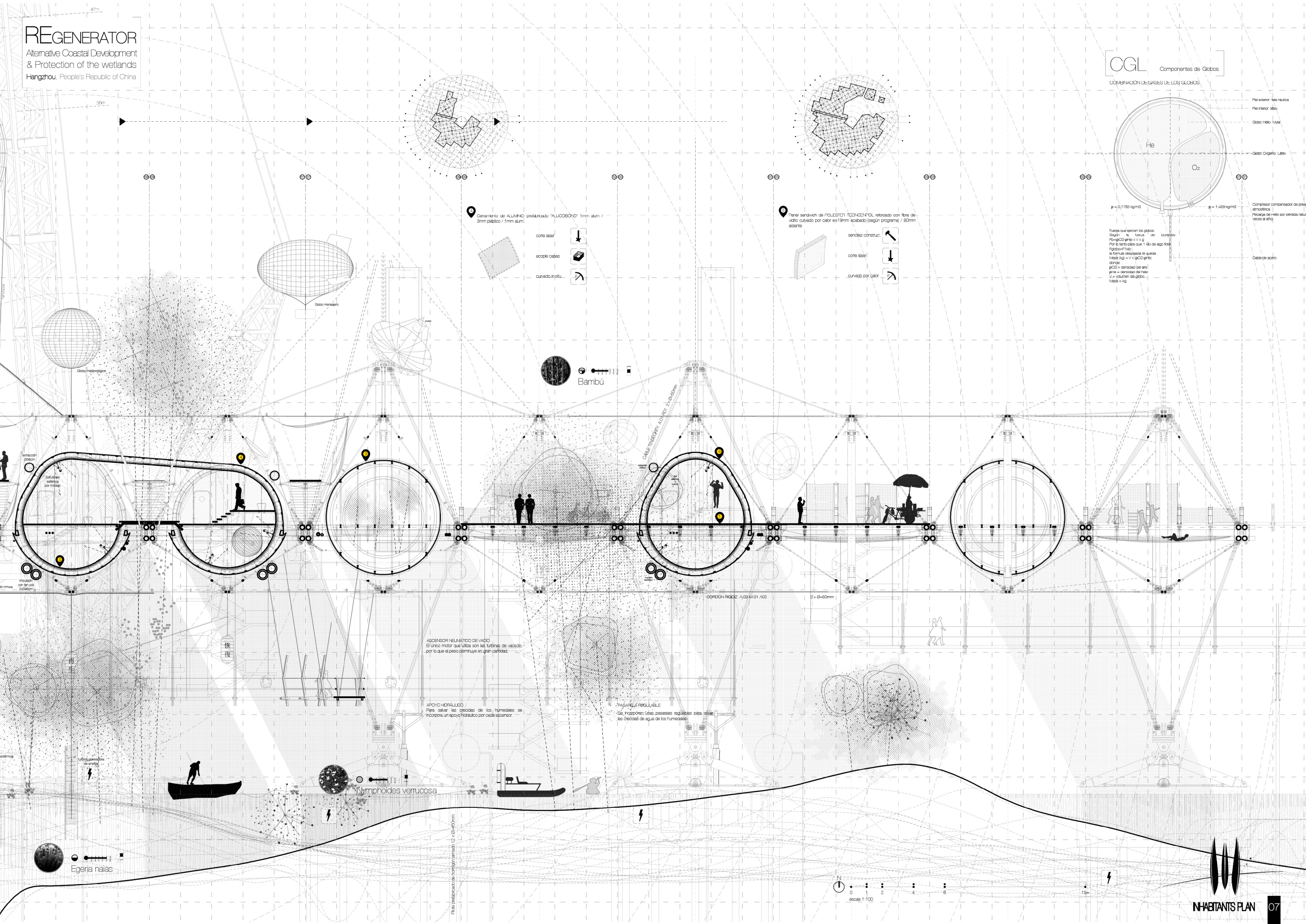
Centenario de ALUMINIO prefabricado "ALUCOBÓN" 1mm alu / 3mm plástico / 1mm alu



Panel sandwich de POLIESTER TECNOCENTOL reforzado con fibra de vidrio curvado por calor e=19mm lacado (según programa) / 50mm aislante



Bambú



ASCENSOR NEUMÁTICO DE VIENTO  
El único motor que utiliza son las turbinas de viento, por lo que el peso disminuye en gran cantidad.

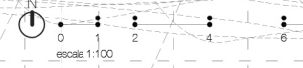
APYOY-HORALUDO  
Para salvar las crecidas de las humedales se incorpora un apoyo hidráulico por cada ascensor.

PASARELA REGULABLE  
Se incorporan unas pasarelas regulables para salvar las crecidas de agua de las humedales.

Lymphoides verrucosa

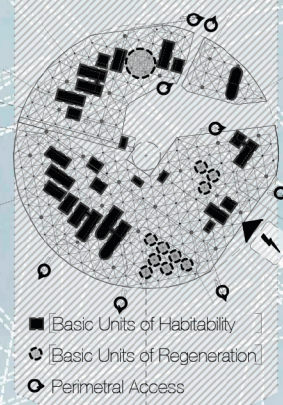
Plano prefabricado de aluminio armado 12 x 60x60mm

Egeria nalis



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## BUH Basic Unit of Habitability

### CONCEPTS

- Lightness
- Habitability



★ Prefabricated ALUMINIUM enclosure  
1mm alum / 3mm plastic / 1mm alum

- laser cut
- layer join
- on-site bending

★ Sandwich panel of POLYESTER reinforced with fiberglass

- construct simplicity
- laser cut
- heat bending

## WFR Water & Flora Regenerating

The Basic Units of Regeneration at it first cycle it will serve as a water cleaner and a flora producer. When the inhabitants arrive to the cell, it will serve again as a water cleaner and a greenhouse.

\*F.V

\*S.CC  
+4.00m

## WMT Waste Management & Treatment

### COLLECTION: MINI CRANES

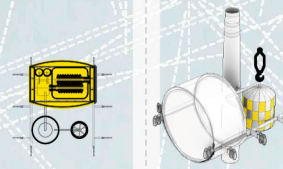
These consist of a series of trawls and cranes for the collection of residues. The treatment is carried out by the crushers and plant biomass included in the project.



### TREATMENT: CRUSHER

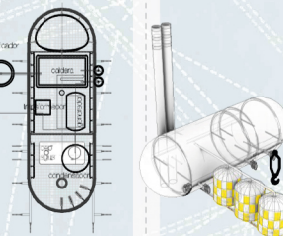
Located near the nucleus, serve as common waste containers and crushes the waste that will serve as fuel for Biomass Central

3 x 162,03kg/día



**BIOMASS CENTRAL** e: 1/900  
By combustion of the residues previously crushed, electricity is obtained from a generator.

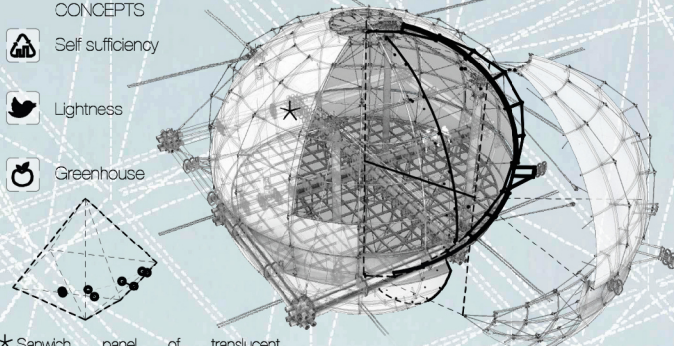
1 x 486,09kg/día



## BUR Basic Unit of Regeneration

### CONCEPTS

- Self sufficiency
- Lightness
- Greenhouse



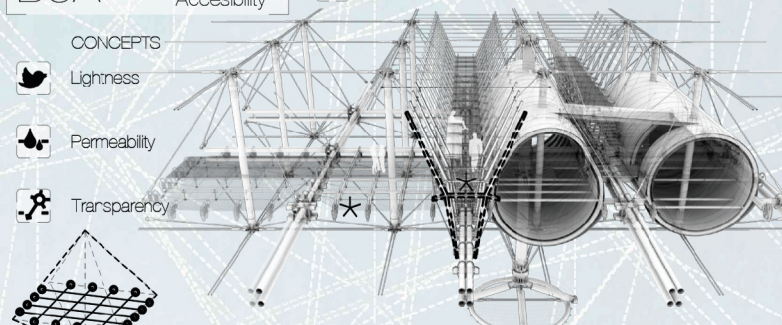
★ Sandwich panel of translucent POLYESTER with layer silica x- AEROGEL

- laser cut
- heat bending
- aerogel applic.

## BUA Basic Unit of Accessibility

### CONCEPTS

- Lightness
- Permeability
- Transparency

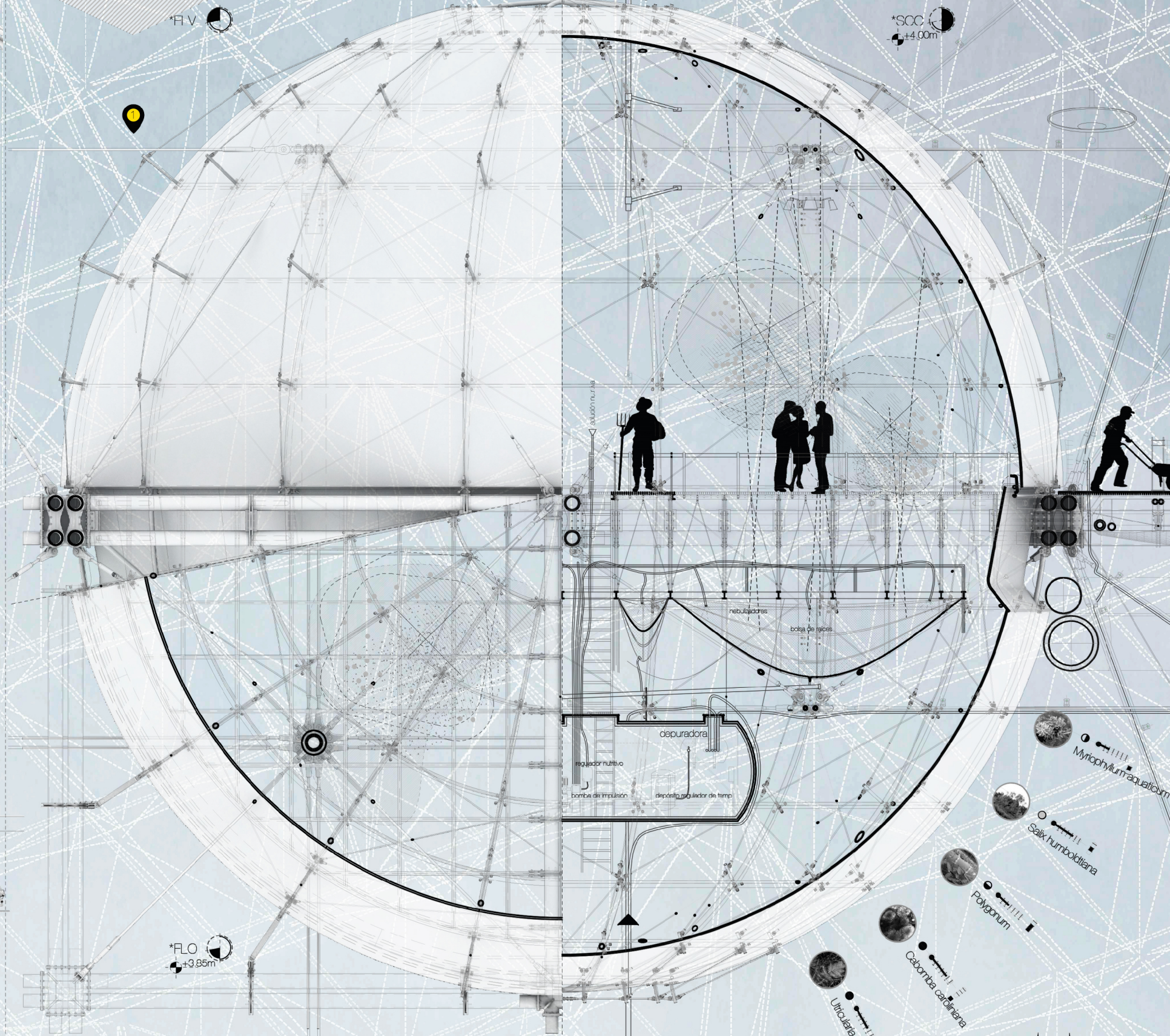


★ TRAVEX with mesh = 42 x 100mm; carrier = 50 x 3mm;

- recycling of buildings construct. simplicity
- laser cut

★ RETENTION NET against falling objects 15x15mm high resistance

- recycling of buildings construct. simplicity
- yarn with machine



WATER FILTRATION



# REGENERATOR

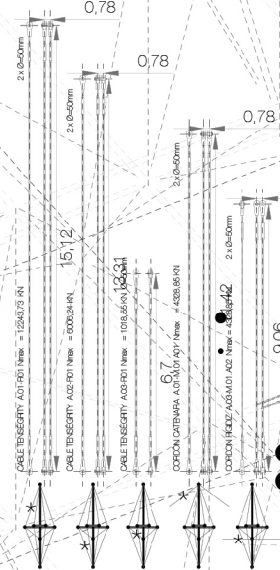
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## BSU1 Basic Structural Unit 1 support

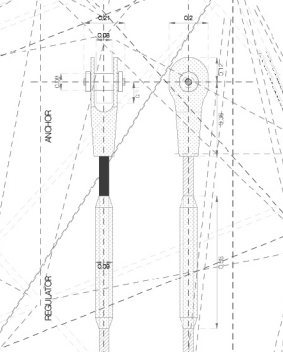
DEFINITION & STANDARDIZATION OF TENSION CABLES e: 1 / 200

1 X 6x19 (1+6) AF (alma de fibra)

Due the amount of cable used, it is standardized the diameter of the cable by duplicating them in order to support the biggest tensions.

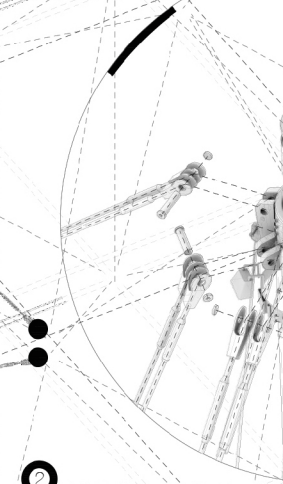


## "OPEN SPLITTER SOCKET" FOR TENSEGTY e: 1 / 30

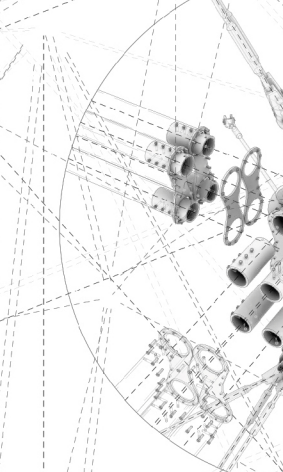


## SOK Standardization of Knots

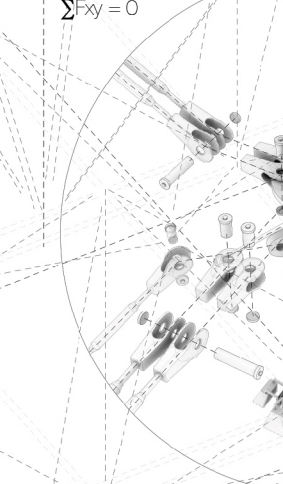
P.01.A01 / Articulated Standardization of fixed points and articulated with tension cables.  $\sum F_{xy} = 0$



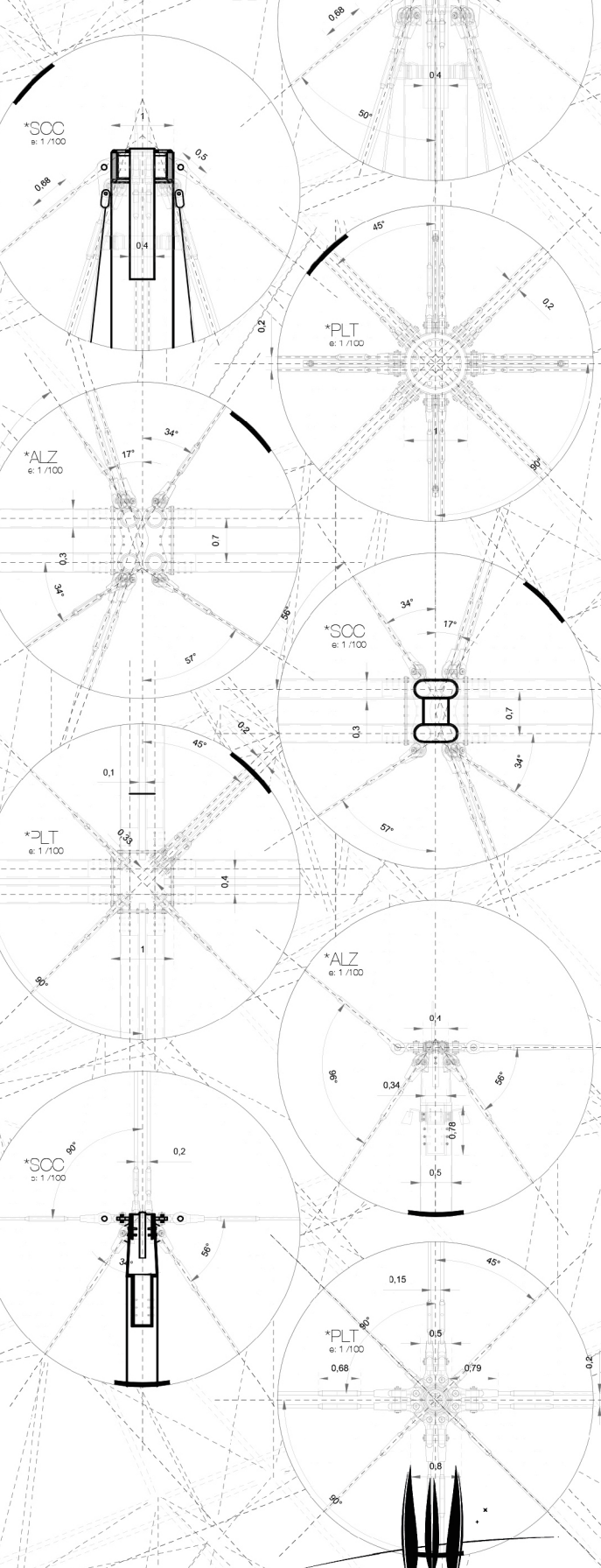
V.01.R01 / Rigid Standardization of rigid nodes to establish a continuous behavior of the beam



M.01.A01 / Articulado Standardization of fixed points and articulated with tension cables.  $\sum F_{xy} = 0$



STRATEGIES FOR STANDARDIZATION  
reciclaje de edificios  
hot laminated / formed in cold  
laser cut

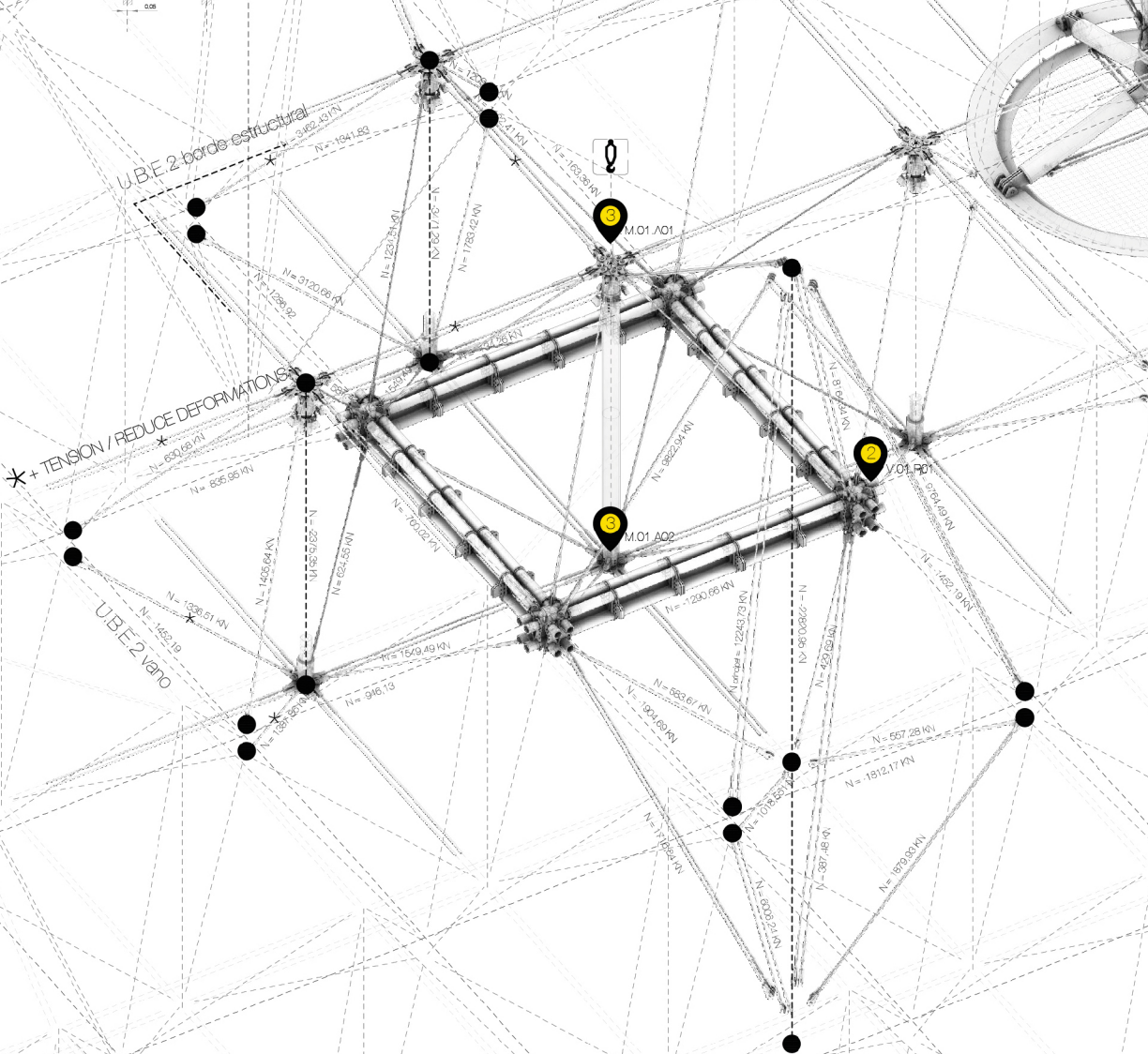
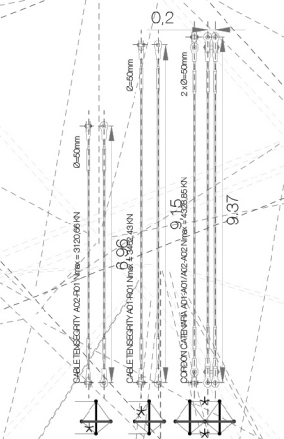


## BSU2 Basic Structural Unit 2 span

DEFINITION & STANDARDIZATION OF TENSION CABLES e: 1 / 200

1 X 6x19 (1+6) AF (alma de fibra)

Due the amount of cable used, it is standardized the diameter of the cable by duplicating them in order to support the biggest tensions.

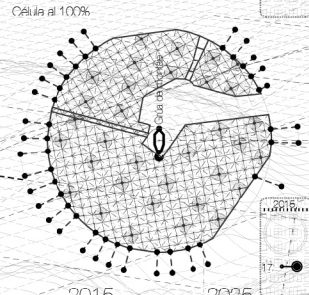
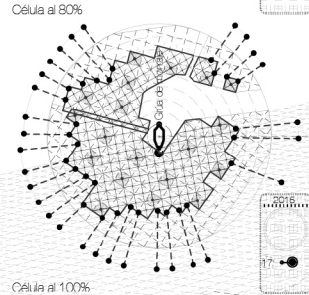
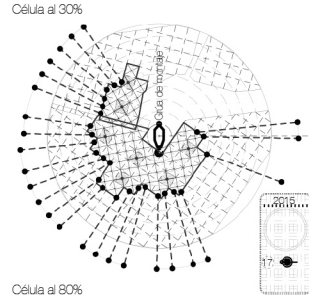


# REGENERATOR

Alternative Coastal Development & Protection of the wetlands Hangzhou, People's Republic of China

## MSC

Mutability of Structural Cell



2015 2025   
The structure adapts to each moment by changing its dimensions to support a certain amount of people.

UB1 apoyo

UB2 vano

## ICC Loads Considered to Calculate

CONSIDERED LOADS

- |           |  |  |
|-----------|--|--|
| Permanent | 1 Dead Load  | PP   |
|           | 2 Constructive parts Dead Load 1 kN/m <sup>2</sup> | p1   |
|           | 3 Load of facilities 1 kN/m <sup>2</sup>           | p2   |
| Variables | 4 Use Load   | a) Total q1.a<br>b) Irregular q1.b                             |
|           | 5 Wind   | a) North q2.a<br>b) South q2.b<br>c) East q2.c<br>d) West q2.d |
| Variables | 6 Termic actions                                   | a) Summer q3.a<br>b) Winter q3.b                               |
|           | 7 Snow   | q4   |

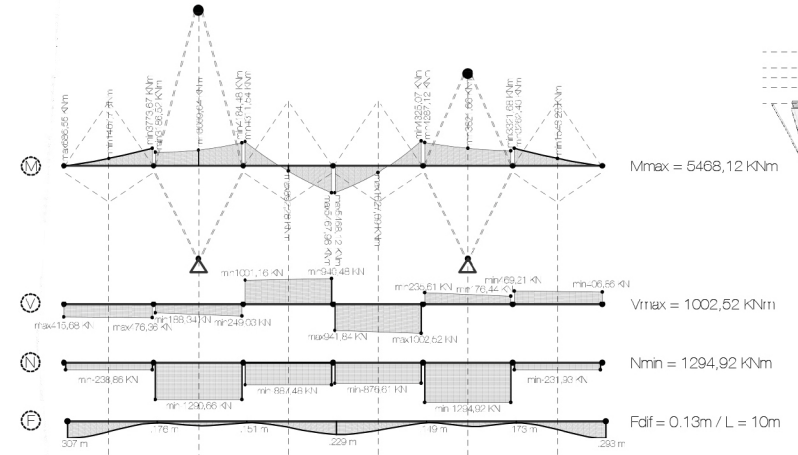
COMBINATIONS

### HYPOTHESIS

- $PP + p1 + p2 + c1.b + q3$   
 $PP + p1 + p2 + q1.a + q3$   
 $q1.a + q3$   
 $q2.b + q3$   
 $PP + p1 + p2 + c3$   
 $1.35(PP + p1 + p2) + 1.5(q1.b) + 1.35(q3)$   
 $1.35(PP + p1 + p2) + 1.5(q1.b) + (q3)$   
 $1.35(PP + p1 + p2) + 1.5(q1.a) + 1.35(q3)$   
 $1.35(PP + p1 + p2) + 1.5(q1.a) + (q3)$   
 $1.5(q1.b) + 1.35(q3)$   
 $1.5(q1.b) + 1.35(q3)$   
 $1.35(PP + p1 + p2) + 1.35(q3)$   
 $1.35(PP + p1 + p2) + (q3)$

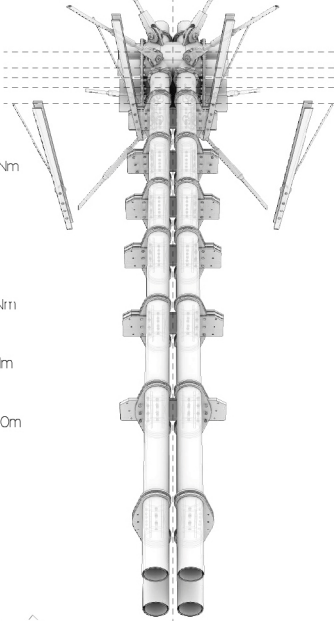
## EKB Efforts of the "Key Ring" Beam

EFFORTS OF A "KEY RING" BEAM



## APB Assembly of Plate on Beam

"KEY RING" BEAM



With the system of a beam formed by four tubular profiles mounting plates allows the assembly of parts as the reuse of them.

"KEY RING" BEAM e: 1/50

ADICIÓN U.B.E

ADICIÓN U.B.E

APROXIMACIÓN DE MONTAJE

- UA2
- UBH
- UA1
- UA2
- UBS
- UA1
- UBH
- UA1
- UA2
- UA1
- UBS
- UBH
- UA2

★ REPRESENTACIÓN CÉLULA AL 20%



7,5m