IX-World Bamboo Congress

Merksplas, Belgium - April 13th, 2012

Bamboo Training and Development Centre

Mbeya - Tanzania

Jaime Espinosa - UPM - 2010

WORLD BAMBOO CONGRESS
ANTWERP, BELGIUM APRIL 10-15, 2012

UNIVERSIDAD POLITECNICA MADRID

Bamboo Training and Development Centre in Mbeya, Tanzania... *...the Experience of an Architecture Student*

0.

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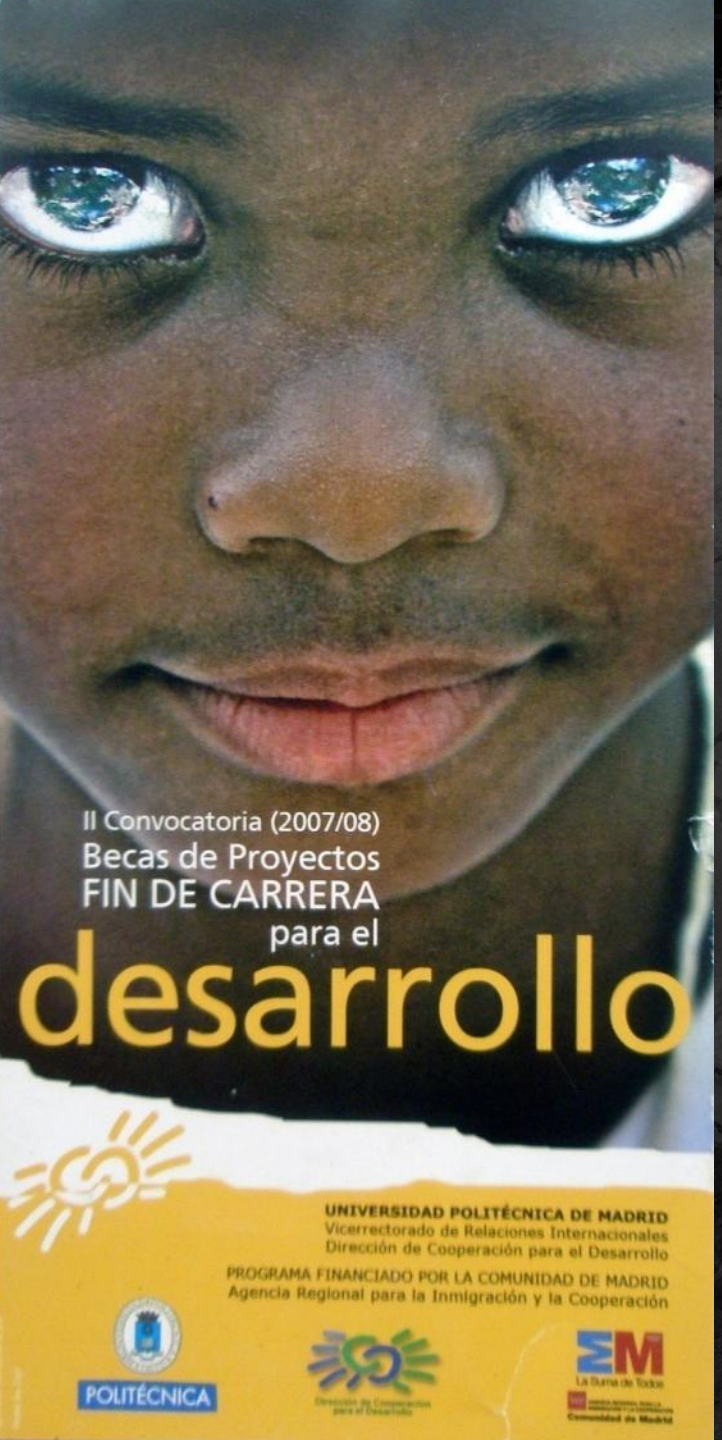


> Basics of the project:

- Grant by Polytechnic University of Madrid (UPM)

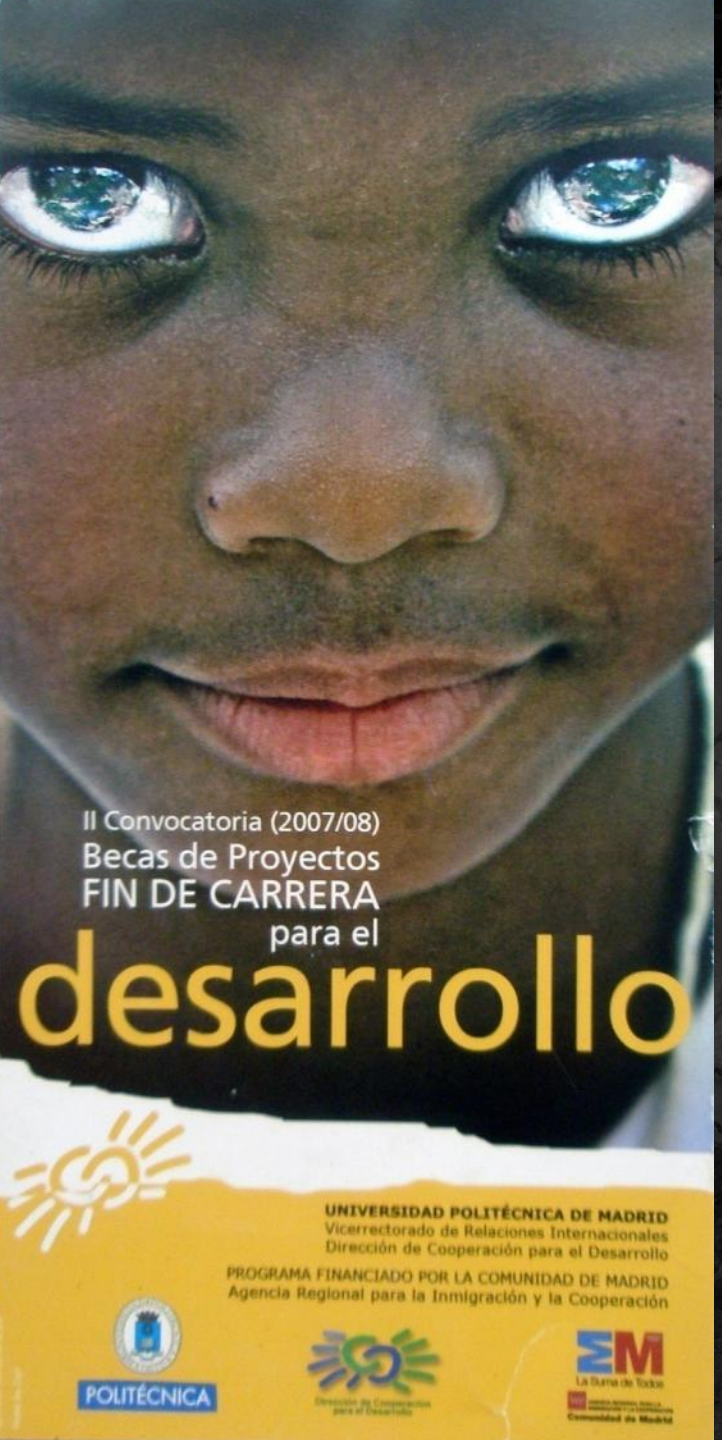
-'*Final Projects in Cooperation for Development*'

- Funding by Madrid Regional Government

-MoU: UPM (Spain) and ARU (Tanzania)

1.

- Introduction and Background -



> Main agents involved:

1.- Polytechnic University of Madrid (UPM)

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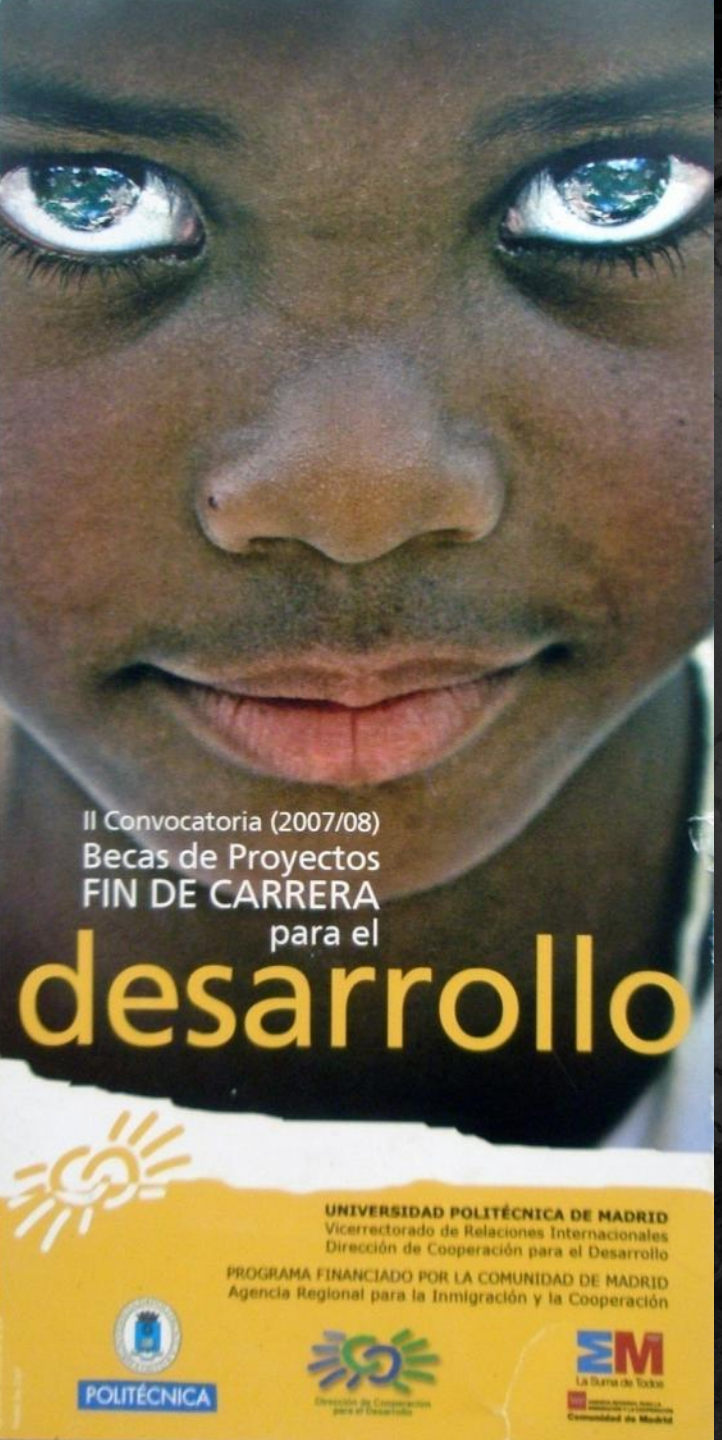

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1.- Polytechnic University of Madrid (UPM)

2.- Technical School of Architecture (ETSAM)

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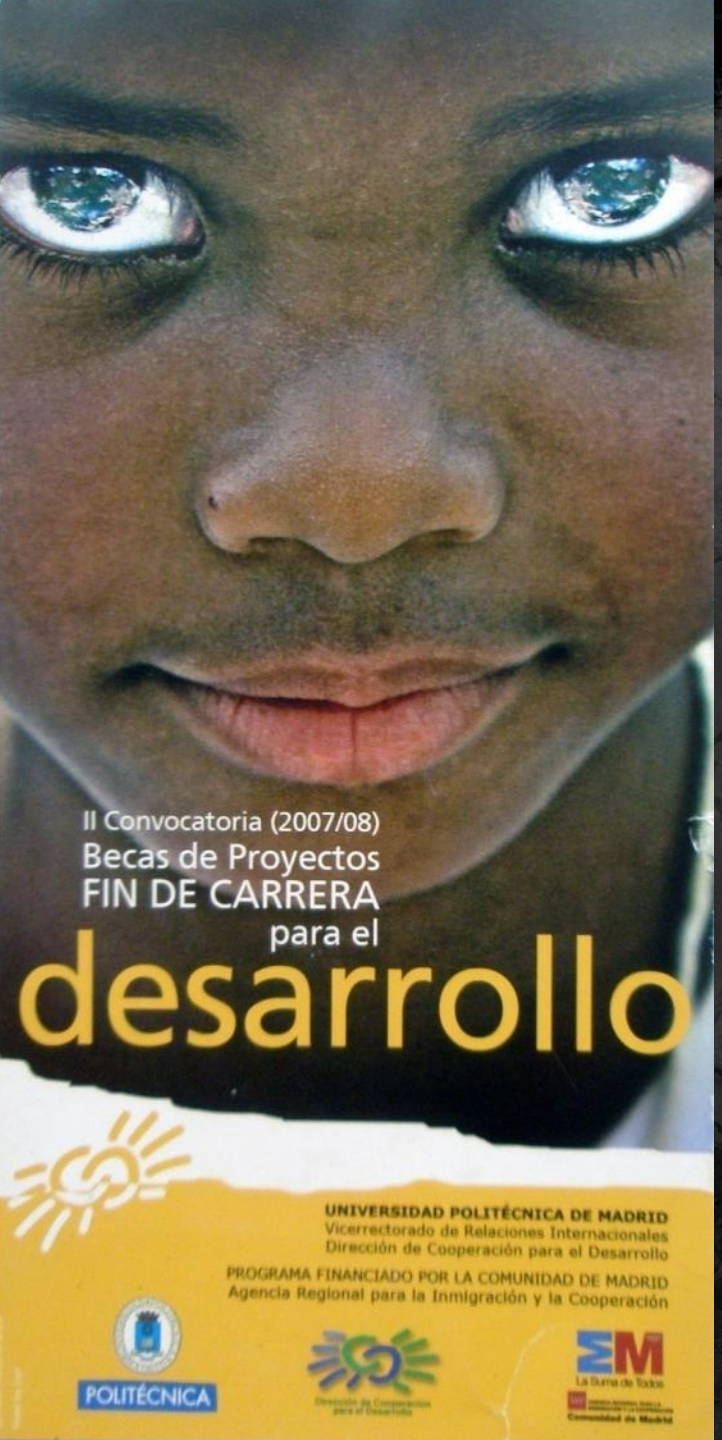

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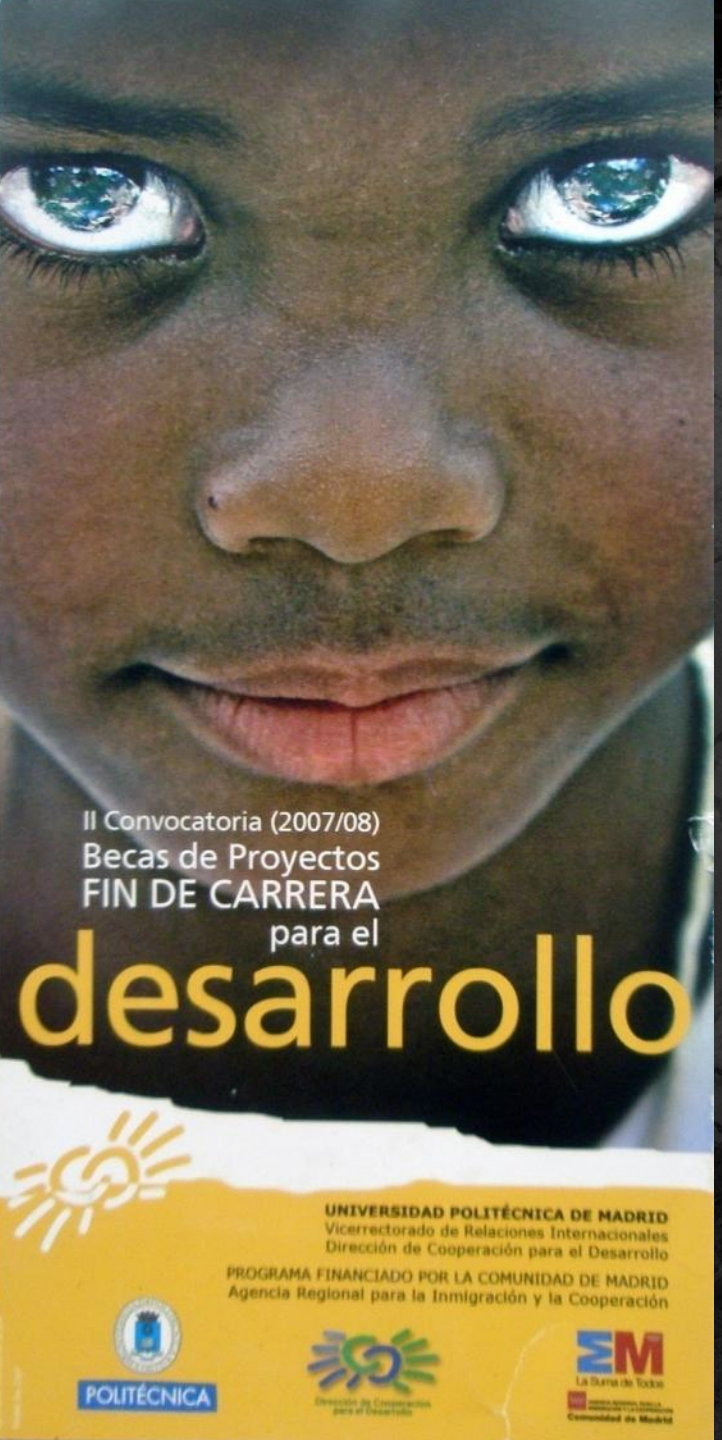
3.- Mbeya Bamboo Women Group (MBWG)

MBEYA BAMBOO WOMEN



> Main agents involved:

1.- Polytechnic University of Madrid (UPM)

2.- Technical School of Architecture (ETSAM)

3.- Mbeya Bamboo Women Group (MBWG)

4.- Ardhi University (ARU)

MBEYA BAMBOO WOMEN

- Introduction and Background -

1.

AFRICA

- Introduction and Background -

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1.

- **Introduction and Background** -

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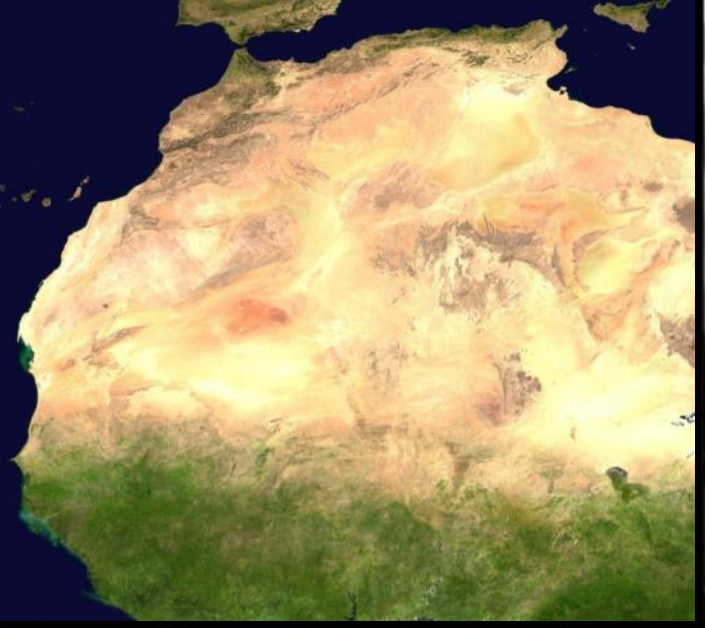

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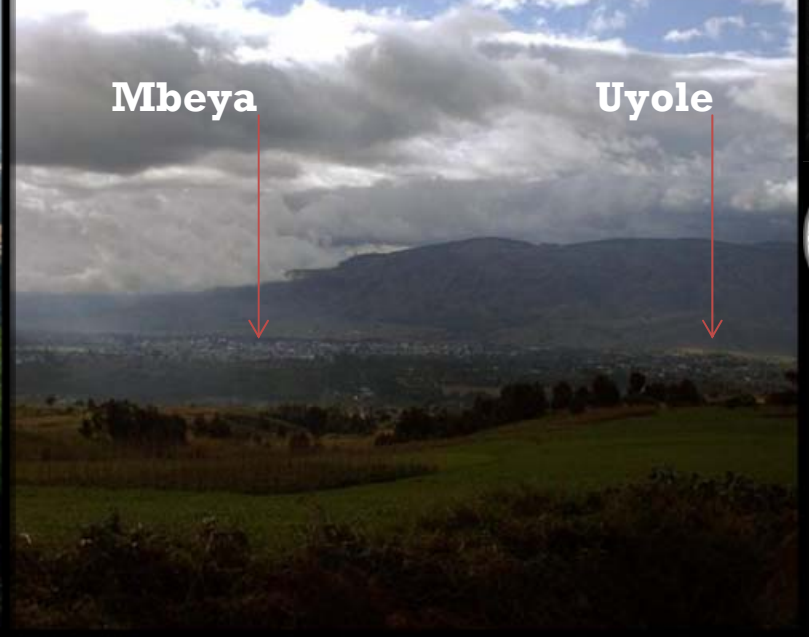

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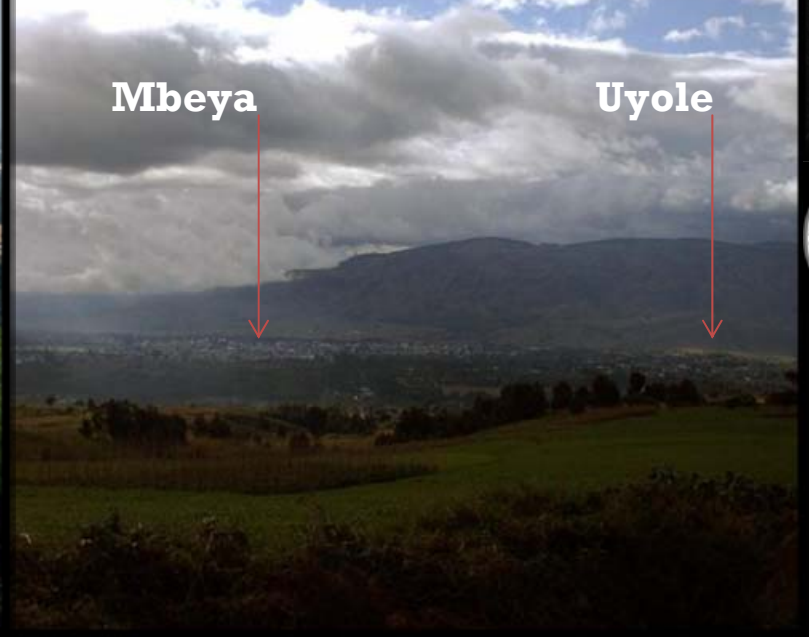

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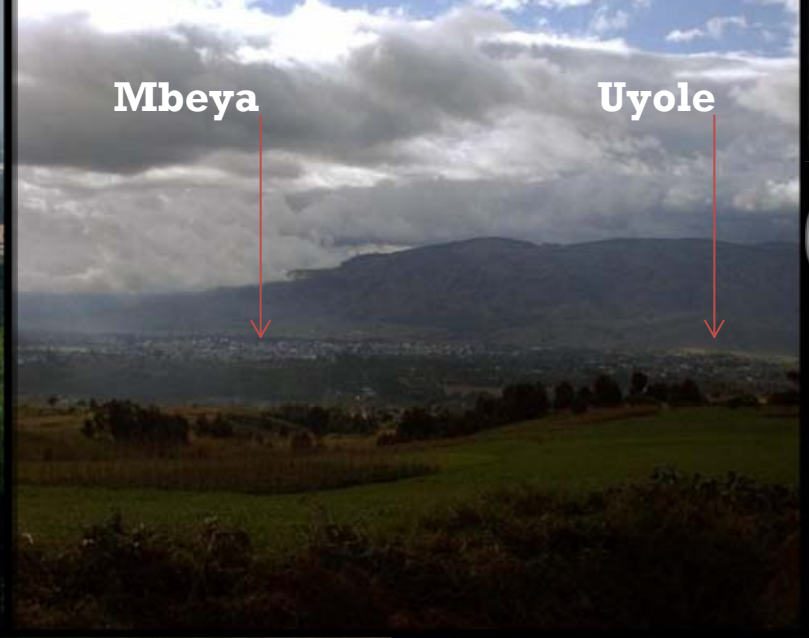

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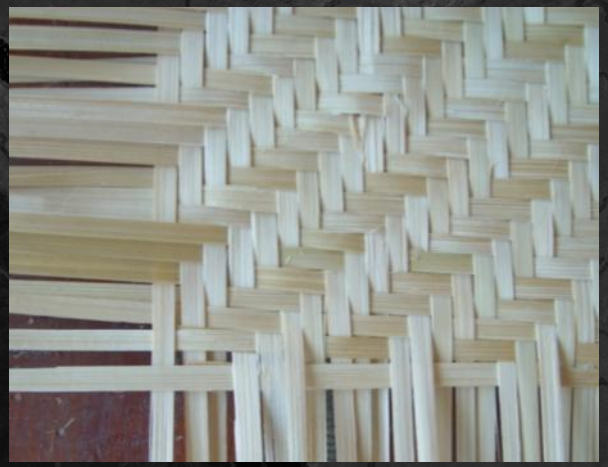

- Introduction and Background -

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www.bambooafrica.com

1.

- February 2010 > August 2010-

MBWG & Jaime Espinosa

- Goal:

To produce bamboo furniture prototypes.

- Activities:

> Preservation process

> Build up drying shed

> Furniture prototypes

- Introduction and Background -

Species: *Arundinaria alpina*
(African mountain bamboo)

- Raw Material: Cut, Seasoning, Preservation and Drying -

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Namna ya kukata mianzi
kwa ujenzi na vyombo vya nyumbani

1. Chukua panga lako na uende polini baada ya saa sita mchana. Kwa sababu, utomvu wa mianzi asubuhi hupanda juu,hivyo si vizuri kukata mianzi muda wa asubuhi.

2. Tafuta mianzi ya miaka mitatu, minne au mitano. Mianzi midogo hupoteza majani yake. Mianzi mikubwa huwa na madoa meupe mengi. Mianzi bila majani lakini ikiwa na madoa machache inafaa.

3. Ukikata mwanzi angalia kukata juu ya fundo kwa sababu szahina halitachukua maji kwa mvua, hivyo litafaa sana.

4. Kutengeneza mwanzi juu ya shina lake simamisha wima, hivyo maji ndani ya udongo hayawazi kuingia katika mwanzi.

5. Subiri wiki tatu kwa sababu utomvu ni mtamu hivyo unavuta wadudu; baada ya wiki tatu utomvu unakuwa mchungu, hivyo wadudu hawaharibu mwanzi.

a.) Cut:
- Mature specimens, over 1st or 2nd knot

'How to cut bamboo for building and furniture'
(in swahili)

2.

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- Raw Material: Cut, Seasoning, Preservation and Drying -

b.) Seasoning:

- 3 weeks in the forest, leaning on its own stem

2.

- Raw Material: Cut, Seasoning, Preservation and Drying -

c.) Preservation:

c1.- Washing bamboo stems

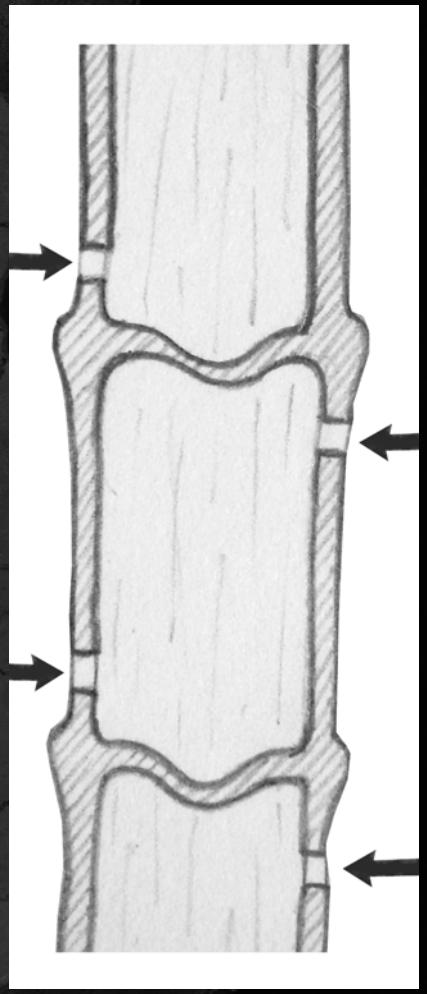
2.

- Raw Material: Cut, Seasoning, Preservation and Drying -

c.) Preservation:

c2.- Open up every cell between 2 knots

2.



- Raw Material: Cut, Seasoning, Preservation and Drying -

c.) Preservation:

c3.- Immersion in borax + boric acid solution

2.

- During 5 days, 4% concentration

- Raw Material: Cut, Seasoning, Preservation and Drying -

d.) Drying
- 20 days

2.

- Raw Material: Cut, Seasoning, Preservation and Drying -

a.) Capacity building

3.

a1.- Explanations

a2.- Practice

- Construction of Bamboo Drying Shed -

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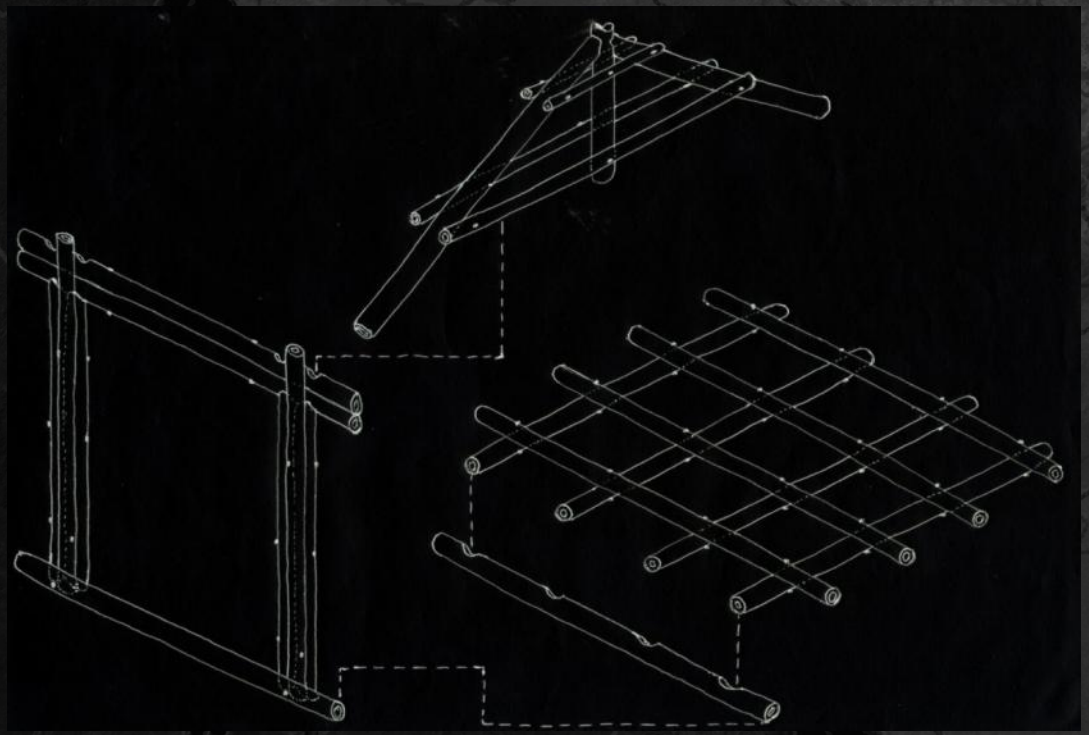
b.) Principles of design

3.

- Limited length of bamboos

- Prefabricated elements

- Basic tools available:
  - Hand saw
  - Hammer
  - Span
  - Splitter
  - Electric drill and drill bits



- Construction of Bamboo Drying Shed -

c.) Foundations

3.

- Precast reinforced concrete
- Plastic buckets as shuttering
- Reinforcement: 2 feet-length corrugated steel bar

- Construction of Bamboo Drying Shed -

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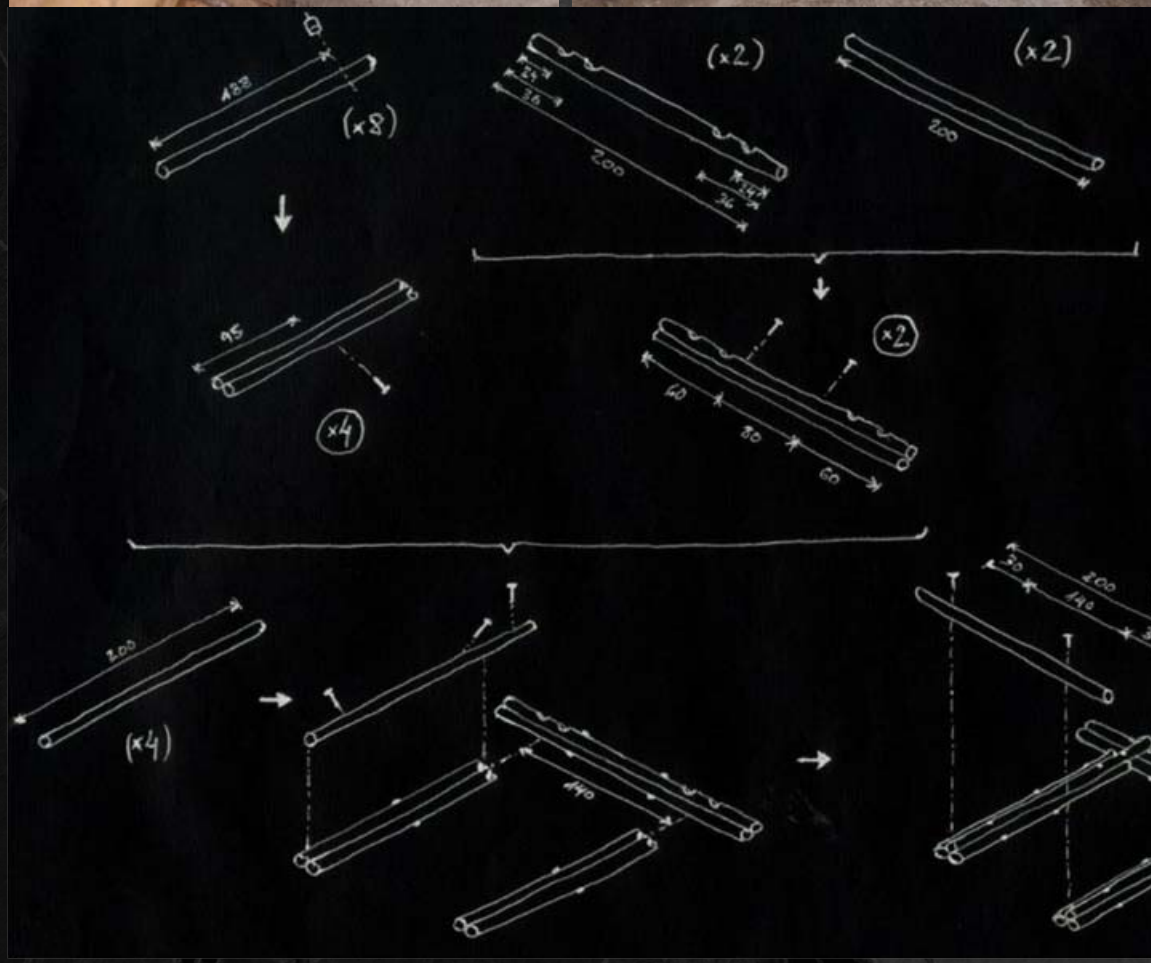
d.) Prefabricated elements
d1.- Vertical frames

3.



- Construction of Bamboo Drying Shed -

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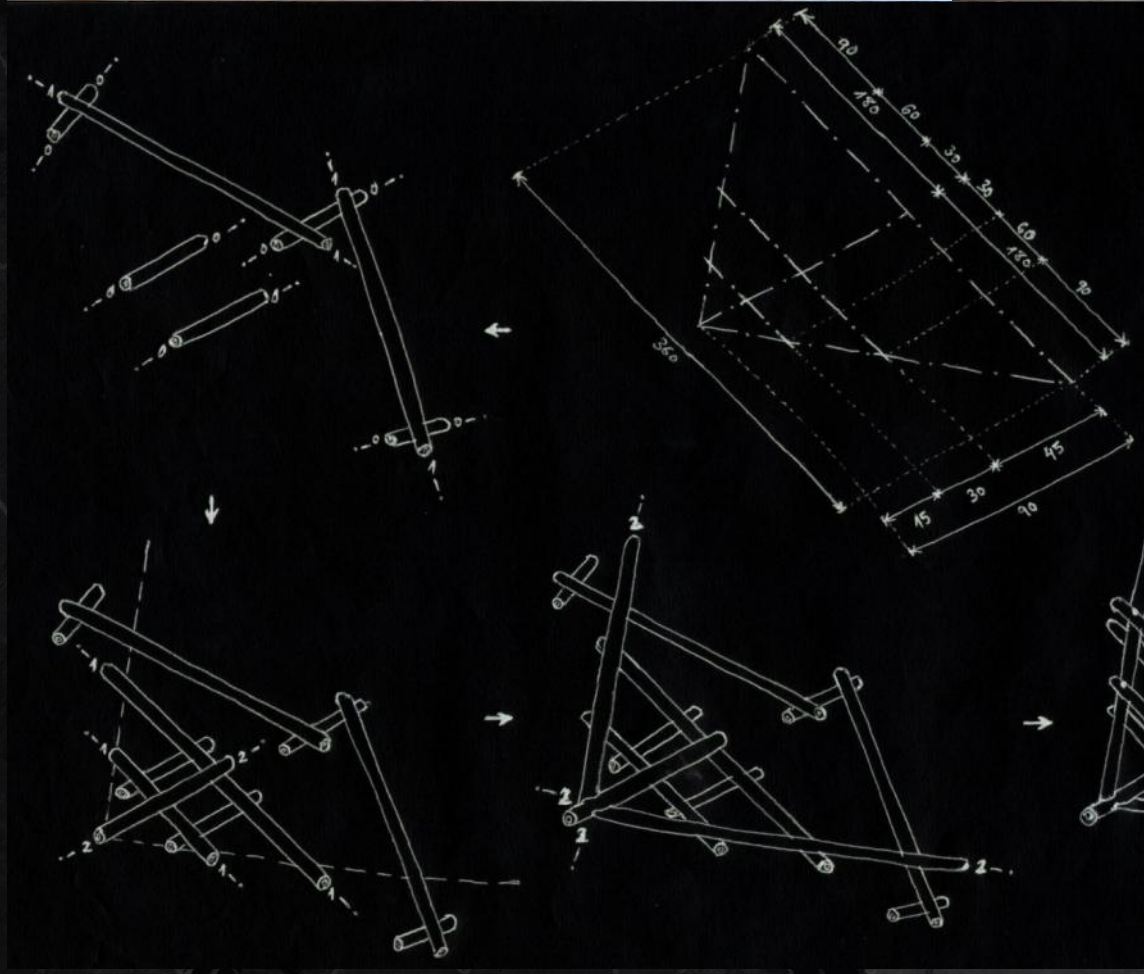
d.) Prefabricated elements
d2.- Roof trusses

3.



- Construction of Bamboo Drying Shed -

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3.

- Construction of Bamboo Drying Shed -

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a.) Principles of design:

- Limited length of bamboos

- Modular frames

- Easy making

b.) Production phases:

- Cut bamboo pieces

- Frames and joinery

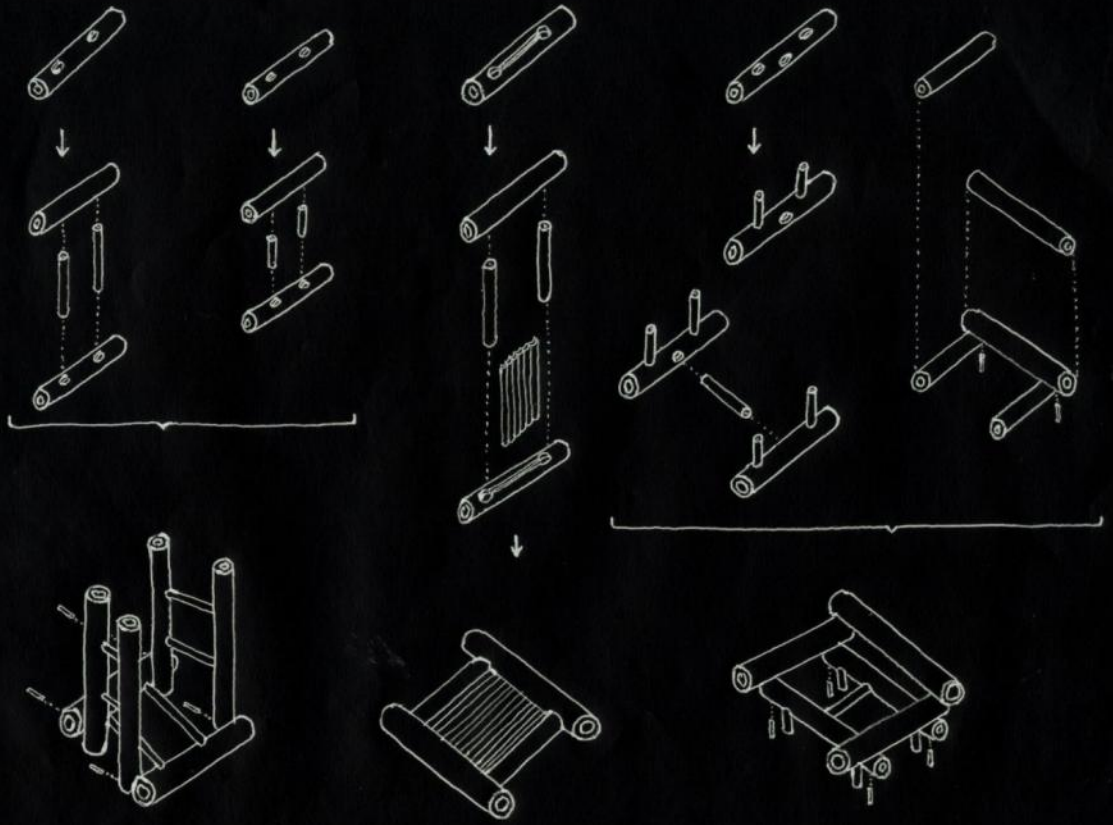
- Bamboo mat covering

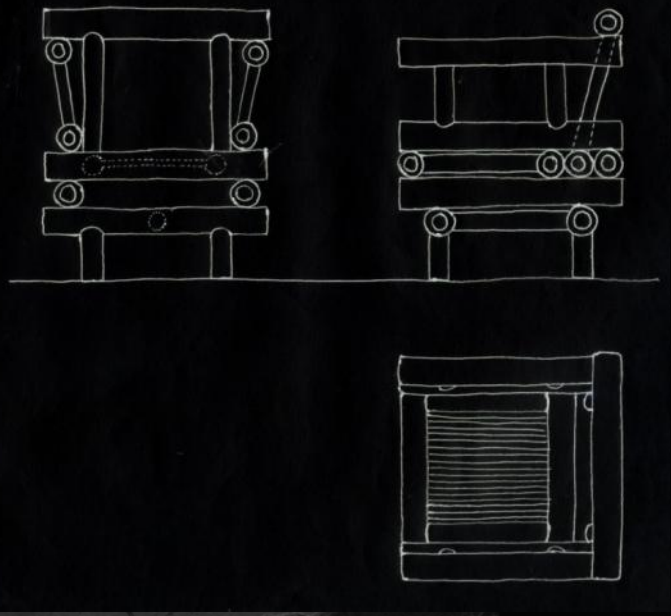
- Finishing with linseed oil

- Furniture Manufacture -

> Single armchair

4.





- Furniture Manufacture -

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- **Sitting room set**

> Single armchair

> Triple armchair

> Low table

4.

- Furniture Manufacture -

- Dinning room set

> Standard chair

> Dinning table

- Furniture Manufacture -

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> School desk

4.

- **Furniture Manufacture** -

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NHBRA
National Housing and Building Research Agency

5.

Headquarters at Mwenge
(Dar-es-Salaam)

- Technical Research -

Specimens taken from treated bamboo in Mbeya
36 samples, from 18 different bamboo stems

5.

- Technical Research -

5.

	Wall thickness (mm)	Ext. Ø (mm)	Int. Ø (mm)	Ext. Area (mm2)	Int. Area (mm2)	Height (mm)	Volume (mm3)	Compr. Effect. A (mm2)	Shear Effect. A (mm2)
1.	9.00	70.00	52.00	3,848.45	2,123.72	90.00	346,360.52	1,724.73	1,620.00
2.	7.00	50.00	36.00	1,963.50	1,017.88	90.00	176,714.55	945.62	1,260.00
3.	6.00	56.00	44.00	2,463.01	1,520.53	90.00	221,670.73	942.48	1,080.00
4.	6.00	53.00	41.00	2,206.18	1,320.25	90.00	198,556.47	885.93	1,080.00
5.	11.00	58.00	36.00	2,642.08	1,017.88	90.00	237,787.10	1,624.20	1,980.00
6.	9.00	56.00	38.00	2,463.01	1,134.11	90.00	221,670.73	1,328.89	1,620.00
7.	7.00	56.00	42.00	2,463.01	1,385.44	90.00	221,670.73	1,077.57	1,260.00
8.	6.00	49.00	37.00	1,885.74	1,075.21	90.00	169,716.65	810.53	1,080.00
9.	6.00	58.00	46.00	2,642.08	1,661.90	90.00	237,787.10	980.18	1,080.00
10.	5.00	52.00	42.00	2,123.72	1,385.44	90.00	191,134.46	738.27	900.00
11.	5.00	55.00	45.00	2,375.83	1,590.43	90.00	213,824.61	785.40	900.00
12.	6.00	50.00	38.00	1,963.50	1,134.11	90.00	176,714.55	829.38	1,080.00
13.	6.00	55.00	43.00	2,375.83	1,452.20	90.00	213,824.61	923.63	1,080.00
14.	5.00	57.00	47.00	2,551.76	1,734.94	90.00	229,658.23	816.81	900.00
15.	6.00	53.00	41.00	2,206.18	1,320.25	90.00	198,556.47	885.93	1,080.00
16.	6.00	55.00	43.00	2,375.83	1,452.20	90.00	213,824.61	923.63	1,080.00
17.	8.00	73.00	57.00	4,185.39	2,551.76	90.00	376,684.73	1,633.63	1,440.00
18.	7.00	49.00	35.00	1,885.74	962.11	90.00	169,716.65	923.63	1,260.00

Humidity content:	8-10%

Characterization of the specimens

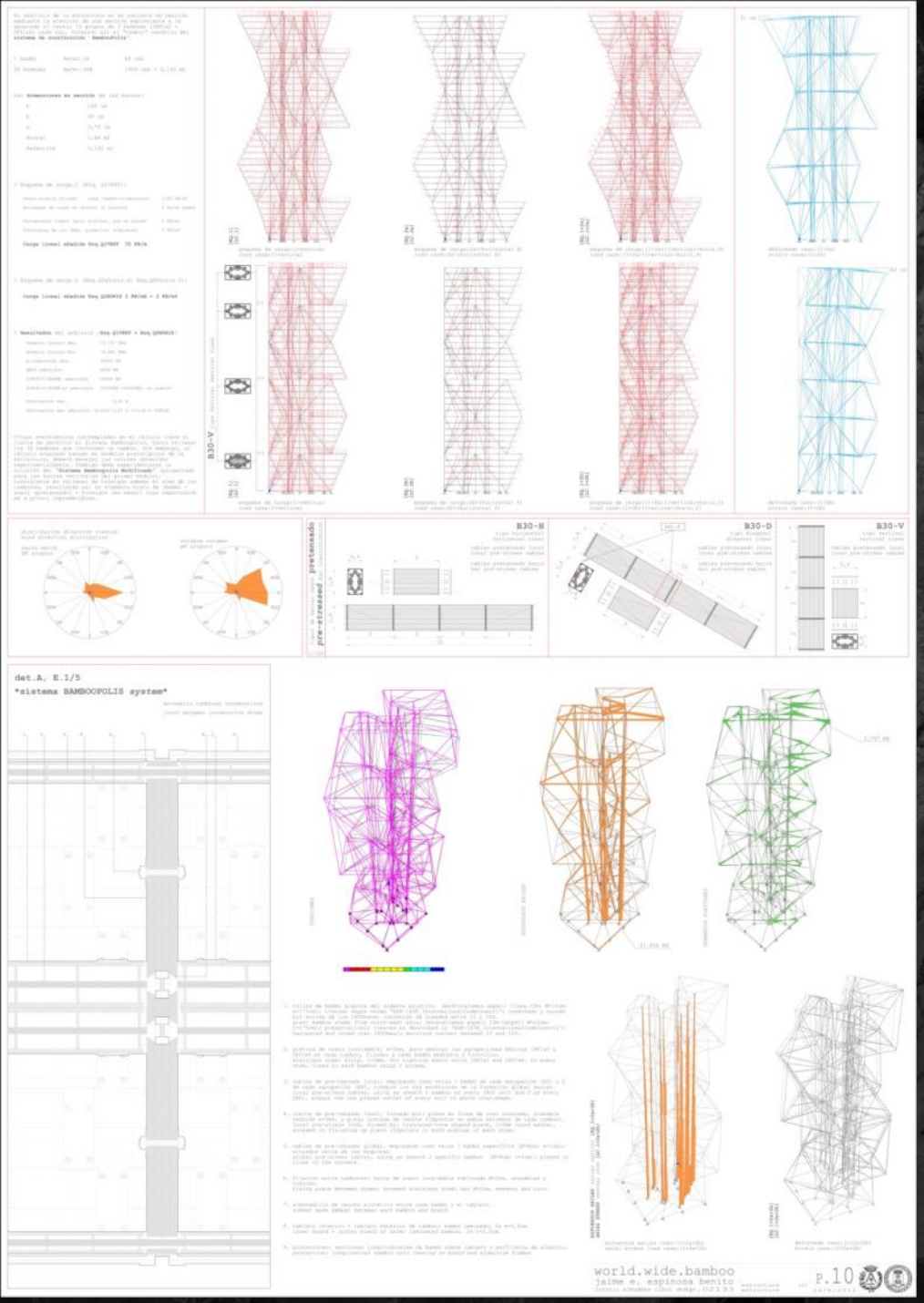
- Technical Research -

	Compression Strenght (N)	Effective Area (mm2)	Stress (N/mm2)	Total Area (mm2)	Stress (N/mm2)
1.	80,000.00	1,724.73	46.38	3,848.45	20.79
2.	50,000.00	945.62	52.88	1,963.50	25.46
3.	55,000.00	942.48	58.36	2,463.01	22.33
4.	60,000.00	885.93	67.73	2,206.18	27.20
5.	80,000.00	1,624.20	49.26	2,642.08	30.28
6.	75,000.00	1,328.89	56.44	2,463.01	30.45
7.	50,000.00	1,077.57	46.40	2,463.01	20.30
8.	65,000.00	810.53	80.19	1,885.74	34.47
9.	50,000.00	980.18	51.01	2,642.08	18.92
10.	45,000.00	738.27	60.95	2,123.72	21.19
11.	60,000.00	785.40	76.39	2,375.83	25.25
12.	45,000.00	829.38	54.26	1,963.50	22.92
13.	40,000.00	923.63	43.31	2,375.83	16.84
14.	60,000.00	816.81	73.46	2,551.76	23.51
15.	55,000.00	885.93	62.08	2,206.18	24.93
16.	40,000.00	923.63	43.31	2,375.83	16.84
17.	100,000.00	1,633.63	61.21	4,185.39	23.89
18.	55,000.00	923.63	59.55	1,885.74	29.17
		Effective stress =	57.95	Total stress =	24.15

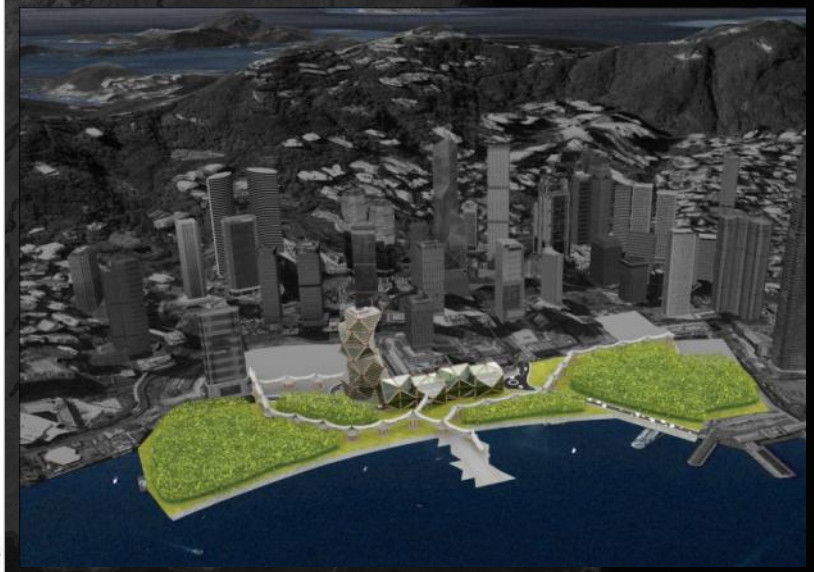
Compression test results

	Shear Strenght (N)	Effective Area (mm2)	Stress (N/mm2)	Total Area (mm2)	Stress (N/mm2)
1.	20,000.00	1,620.00	12.35	3,848.45	5.20
2.	15,000.00	1,260.00	11.90	1,963.50	7.64
3.	15,000.00	1,080.00	13.89	2,463.01	6.09
4.	5,000.00	1,080.00	4.63	2,206.18	2.27
5.	10,000.00	1,980.00	5.05	2,642.08	3.78
6.	15,000.00	1,620.00	9.26	2,463.01	6.09
7.	20,000.00	1,260.00	15.87	2,463.01	8.12
8.	15,000.00	1,080.00	13.89	1,885.74	7.95
9.	15,000.00	1,080.00	13.89	2,642.08	5.68
10.	15,000.00	900.00	16.67	2,123.72	7.06
11.	10,000.00	900.00	11.11	2,375.83	4.21
12.	10,000.00	1,080.00	9.26	1,963.50	5.09
13.	15,000.00	1,080.00	13.89	2,375.83	6.31
14.	10,000.00	900.00	11.11	2,551.76	3.92
15.	10,000.00	1,080.00	9.26	2,206.18	4.53
16.	10,000.00	1,080.00	9.26	2,375.83	4.21
17.	10,000.00	1,440.00	6.94	4,185.39	2.39
18.	20,000.00	1,260.00	15.87	1,885.74	10.61
		Effective stress =	11.34	Total stress =	5.62

Shear test results



Final degree project, 2011



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Thank you very much