Solar Decathlon – RevoltHouse

KIVI NIRIA 08-06-2011

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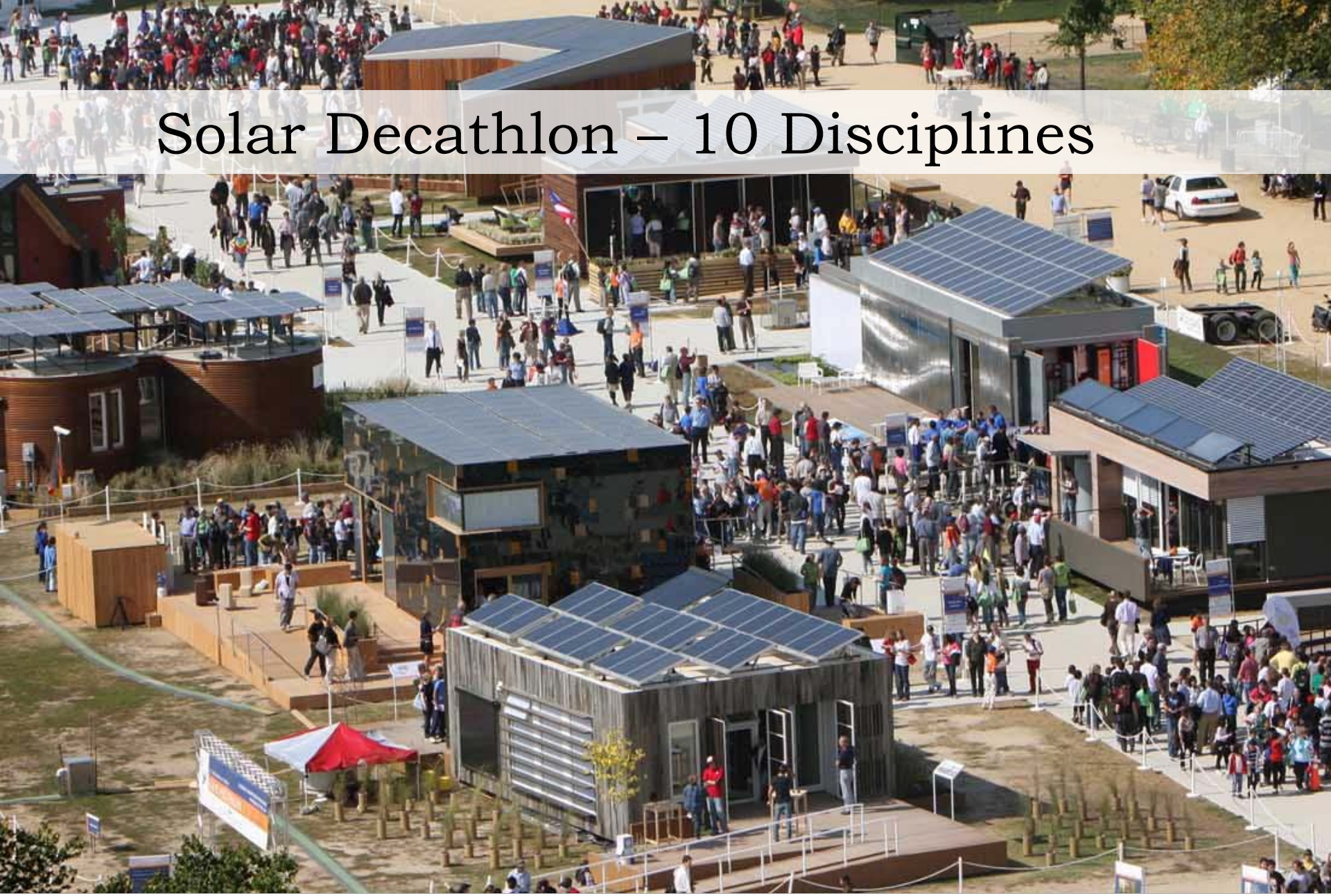
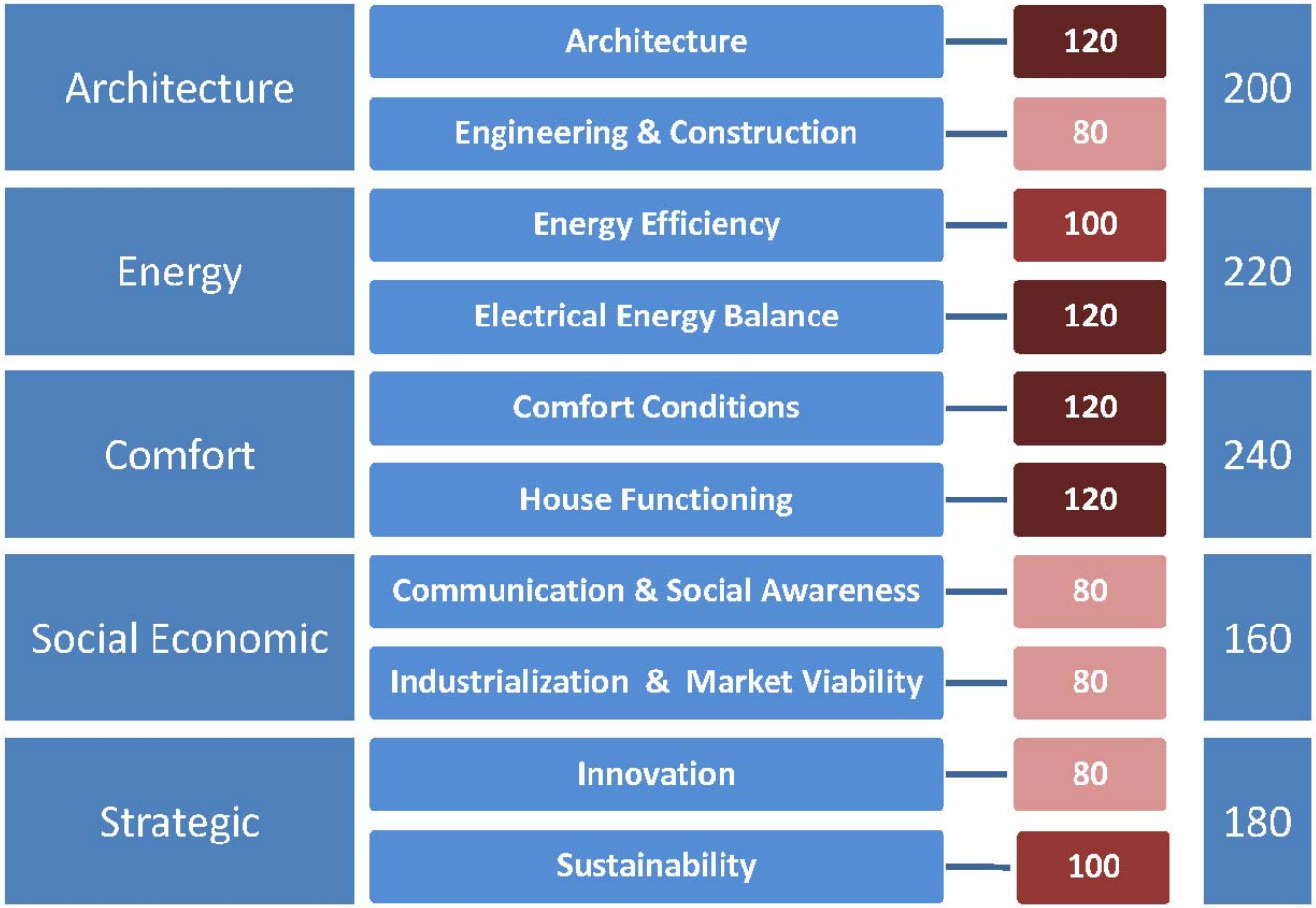
Architectural Engineering

Solar Decathlon – 10 Disciplines



Solar Decathlon – 10 Disciplines



Solar Decathlon

The Solar Decathlon competition has four main objectives:

1.To educate

… educate the general public … raise society's awareness …

2. To encourage

… use of solar technologies … architectural attractive …

3. To raise awareness

… awareness of students participating … renewable energy

4. To clearly demonstrate

… built without sacrificing comfort … attractive and affordable

Solar Decathlon Europe won the **"Sustainable Energy Europe Award Competition 2011"** prize in the category of "Communication", one of the most important international sustainable energy awards.

Solar Decathlon Europe 2012

Solar Decathlon Europe is not “only” a European competition, but actually it is the most internationally ever … (in 2012 20 teams from 15 countries/ 4 continents)

Solar Decathlon Europe 2010

SDE 2010 Team Virginia Polytech

SDE 2010 Team Rosenheim

SDE 2010 Team Paris

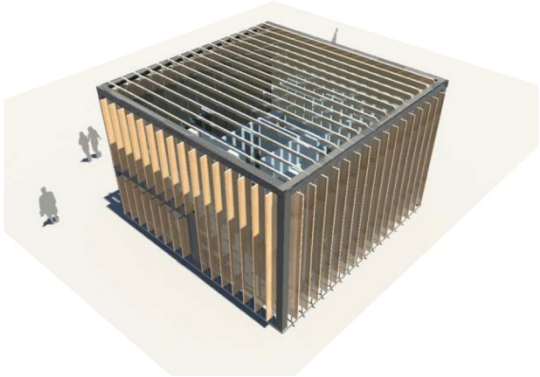
Team TU Delft

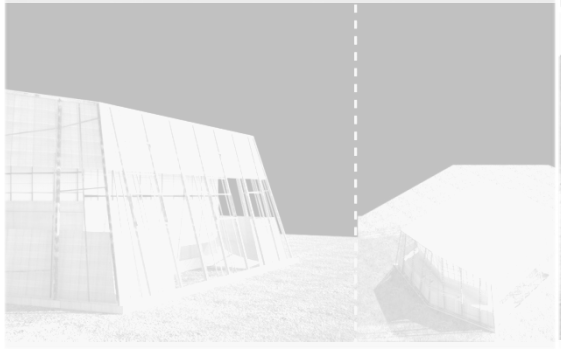
-Faculty of Architecture, Department of Building Technology
-Energy Club
-Delft Energy Initiative (DEI)

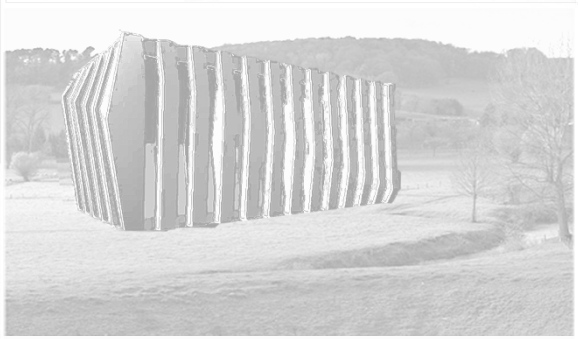
Further support
-Economische Faculteitsvereiniging Rotterdam (EFR)

Student team (17 different countries/4 continents)

TU Competition







ReVolt House®

ENERGY ADAPTIVE FLOATING UNIT

TU Delft

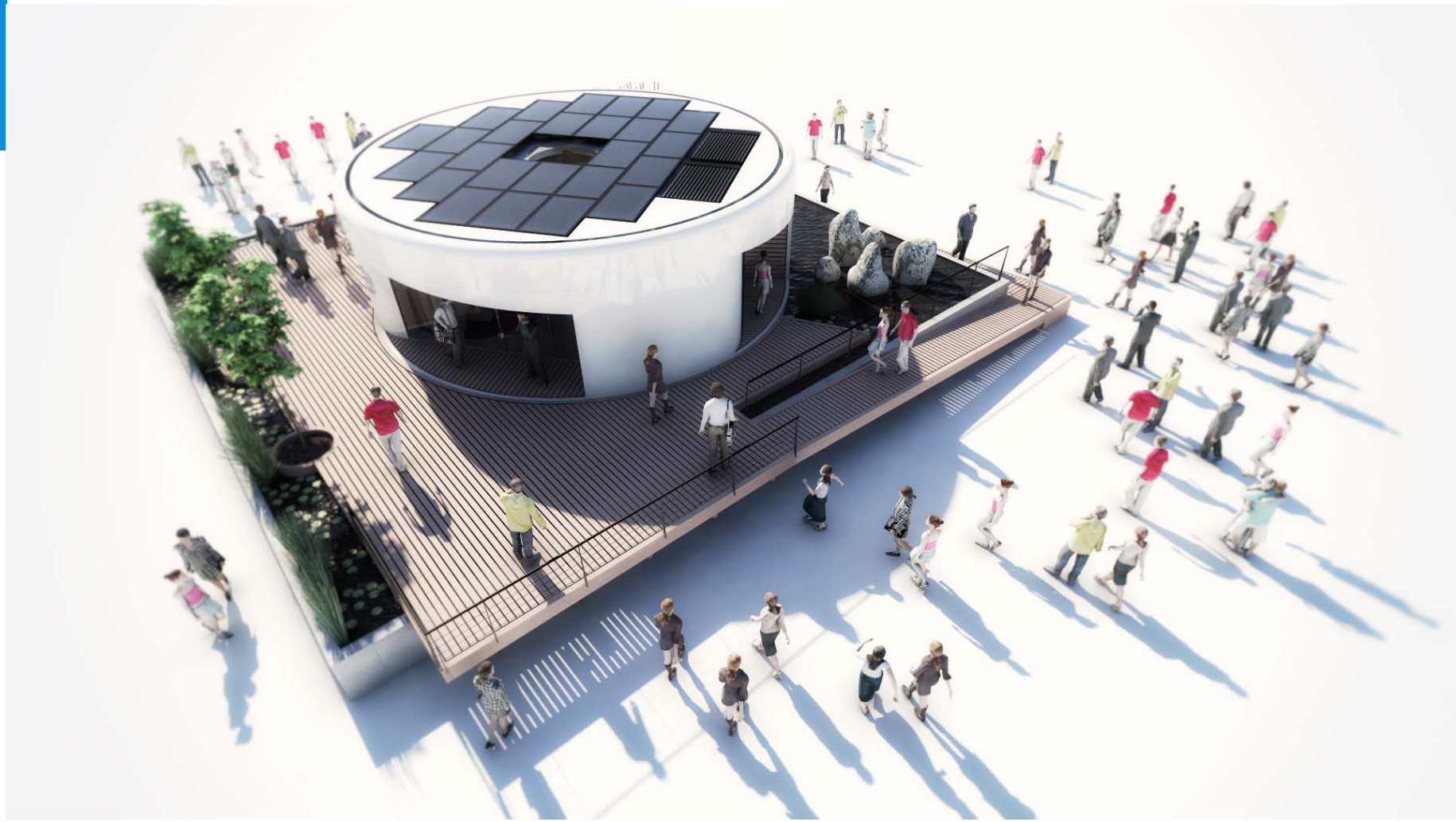
Solar Decathlon 2012

Schedule

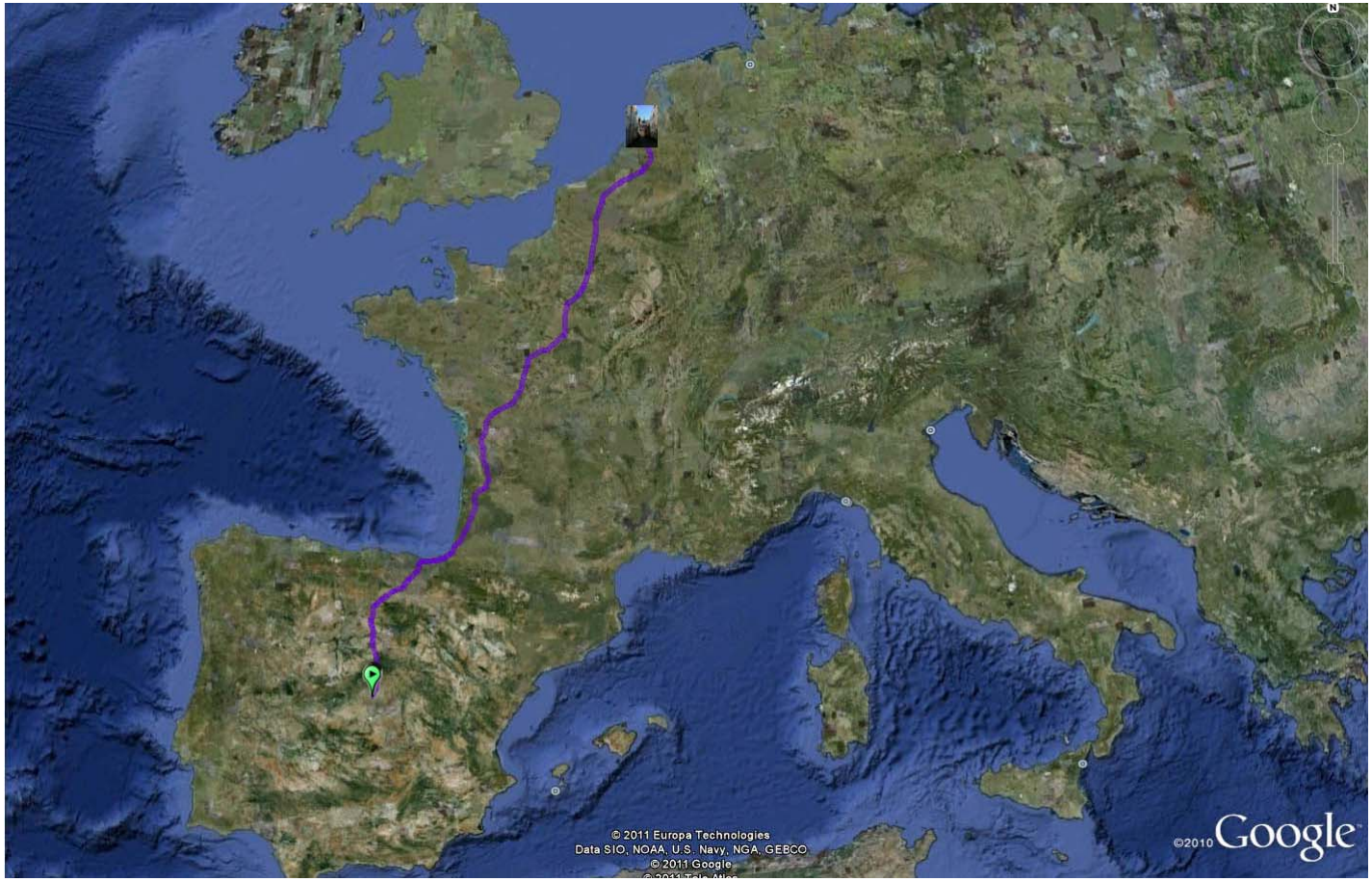
– Summer 2010	Preparing proposal and visit to Madrid
– October 2010	Technical proposal submitted
– November 2010	Student competition (TUD internally)
– December 2010	Decision about acceptance
– Spring 2011	Design development
– **Summer 2011**	**Final design**
– Autumn 2011	Construction documents
– Spring 2012	Production and manufacturing
– September 2012	Competition in Madrid

Building up 1 week, competition 2 weeks, taking down 1 week

Madrid location

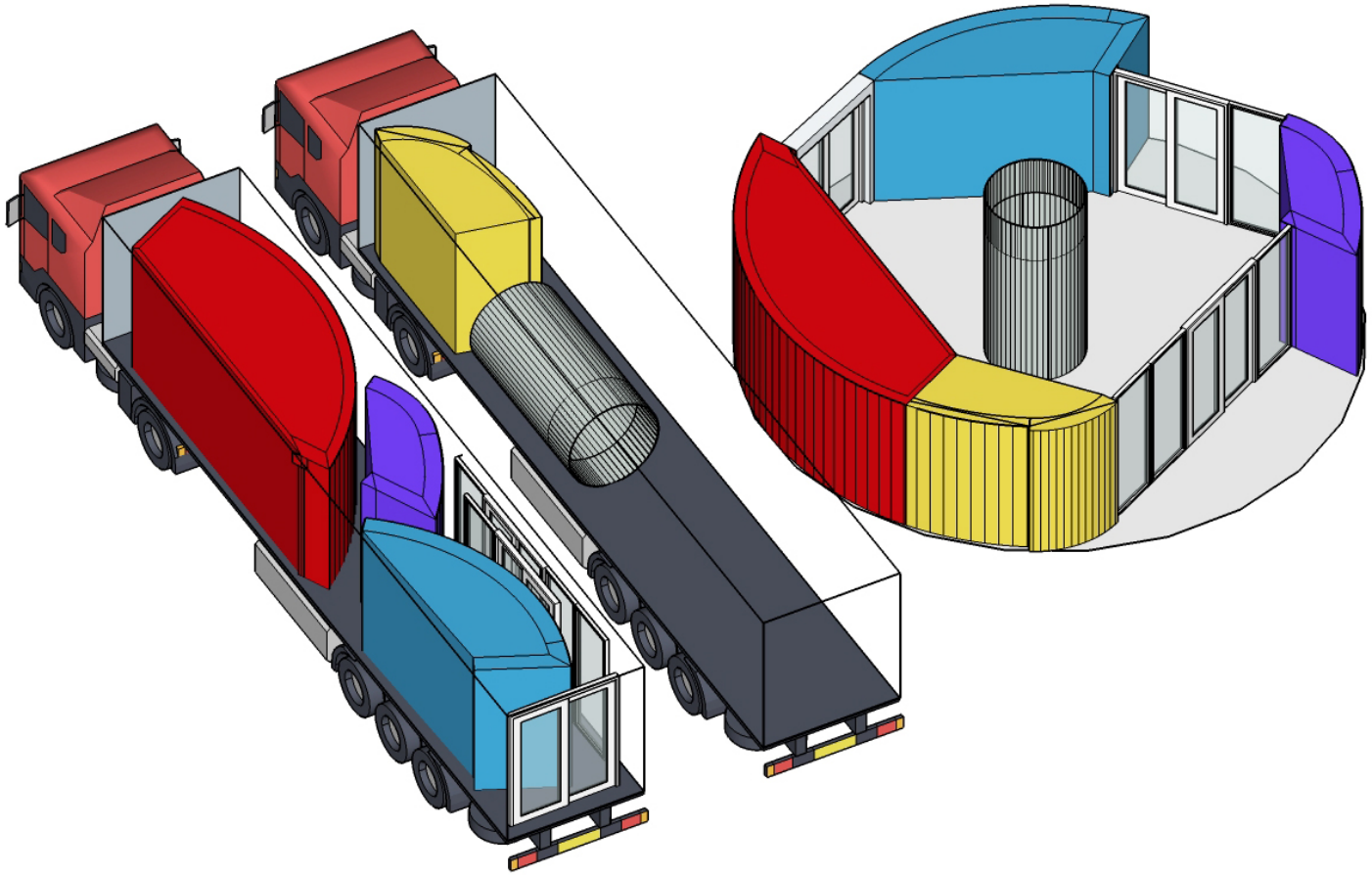


Transport to Madrid and back again



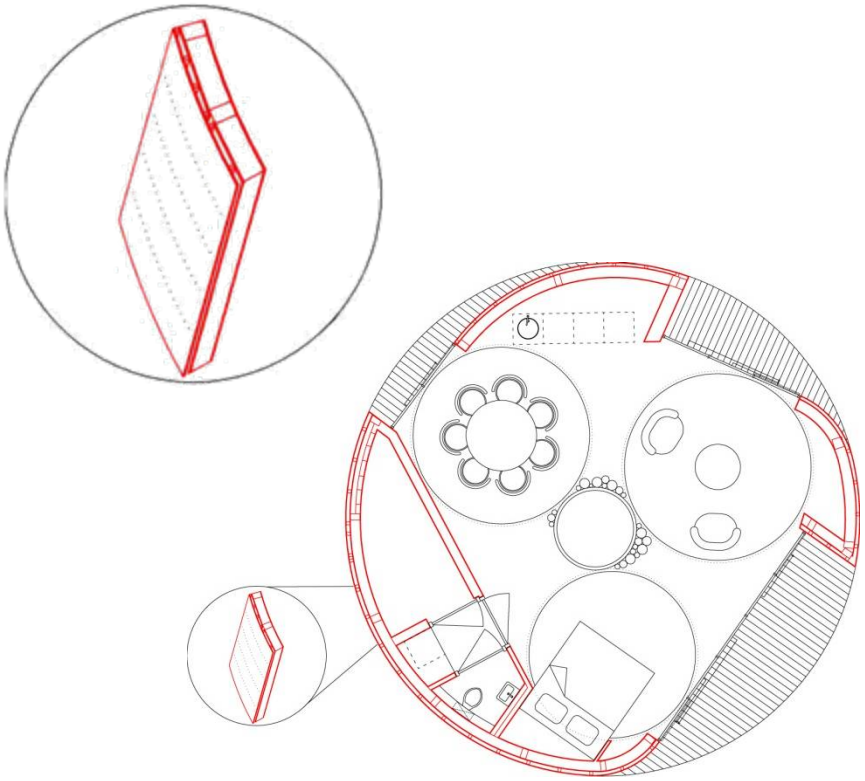
1740km

Transport to Madrid and back again

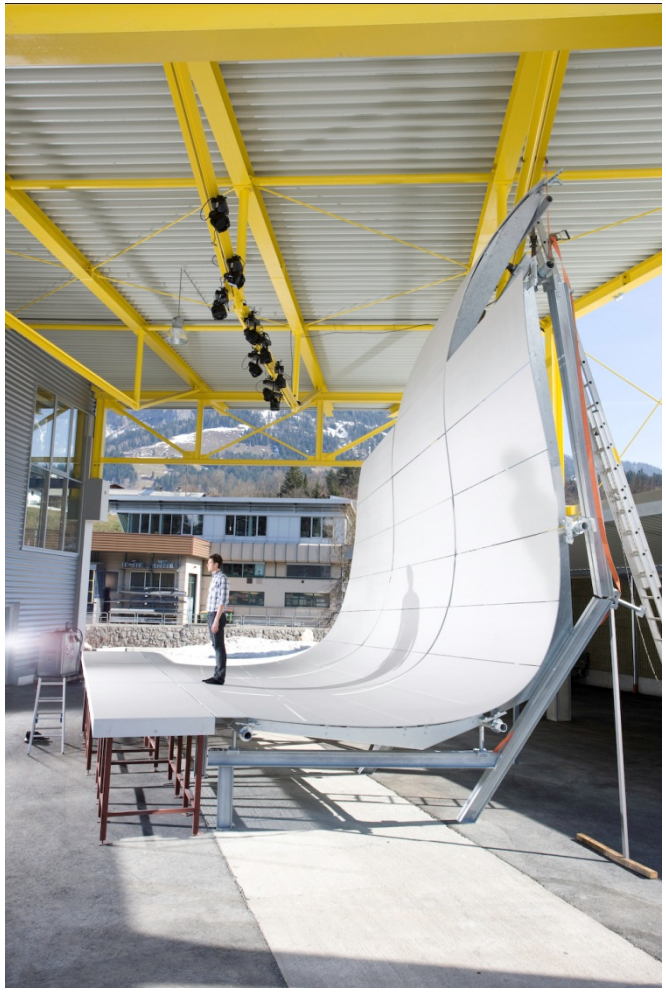


Prefabrication

Frame construction



Example: Category I- Exterior Walls

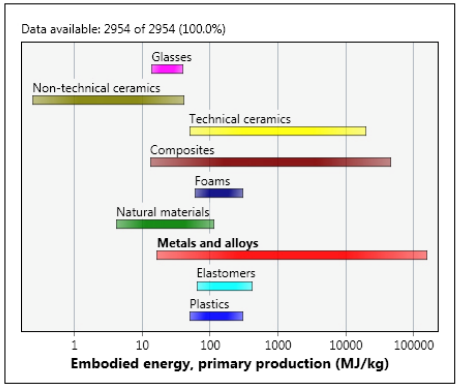


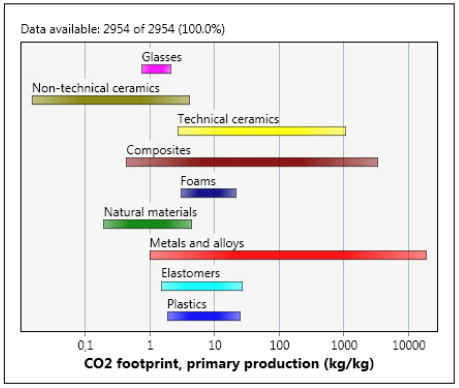
Fibre C

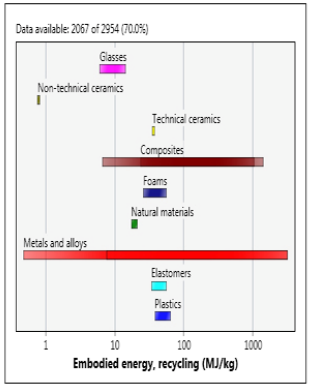
Materials

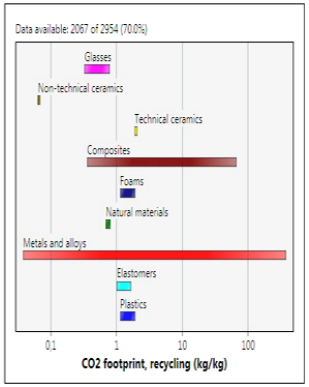
End of Life option	Environmental burden
a. Reuse	**Lowest**
b. Re-engineer	
c. Recycle	
d. Downcycle	
e. Combustion	
f. Landfill	**Highest**

Source: CES 2011 Educational version- sustainability strategy definition







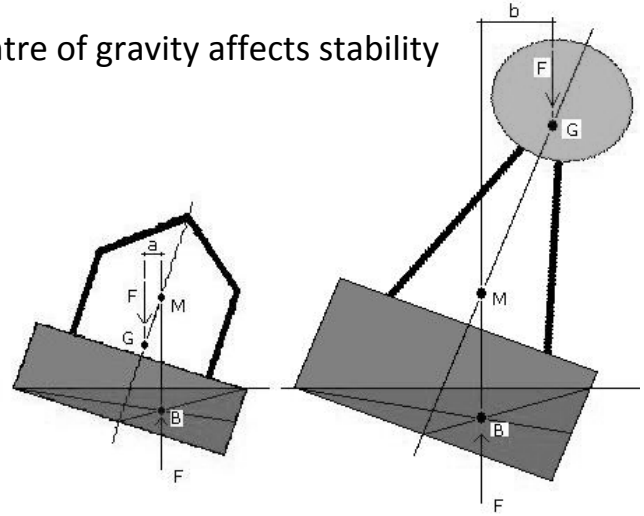


'Sustainability' can be relevant, depending on the life -cycle point chosen for strategy

Floating Principles

stability

Centre of gravity affects stability



$M_{righting} = \phi * \rho * g * I_w = M_{acting}$

ϕ = rotation
I_w = Moment of inertia of the water-plane

$\sin\phi = M_{acting} / (F*GM)$
$GM \simeq BM = I_w/V$

Period of roll: $T = (2*\pi*k)/\sqrt{g*GM}$
K= radius of gyration

Floating Principles

Floating concept A: Composite modules

Based on the eps-concrete system

+

- unsinkable system
- low density = high buoyant capacity = small draught
- high durability/low maintenance
- construction on water
- variety of shapes
- insulating

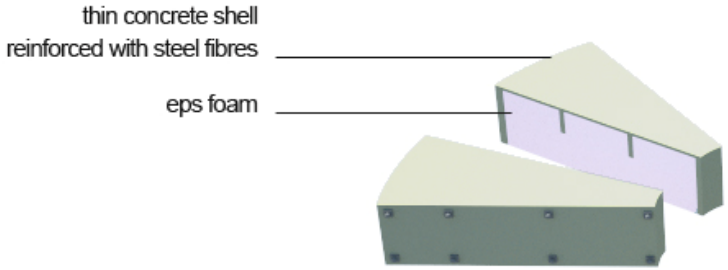
-

- non-demountable
- eps: non-eco-friendly
- total weight still high

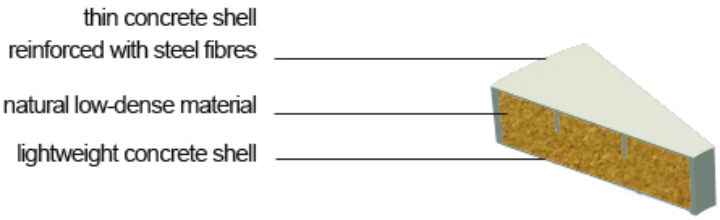
Floating Principles

Floating concept A: Composite modules

Sustainability: Choose natural low-dense materials for the core



eps, density*: 15-22 Kg/m^3



straw bale, density: 100 -110 Kg/m^3

expanded cork, density: 110 -120 Kg/m^3

–

balsa foam, density: 80 Kg/m^3

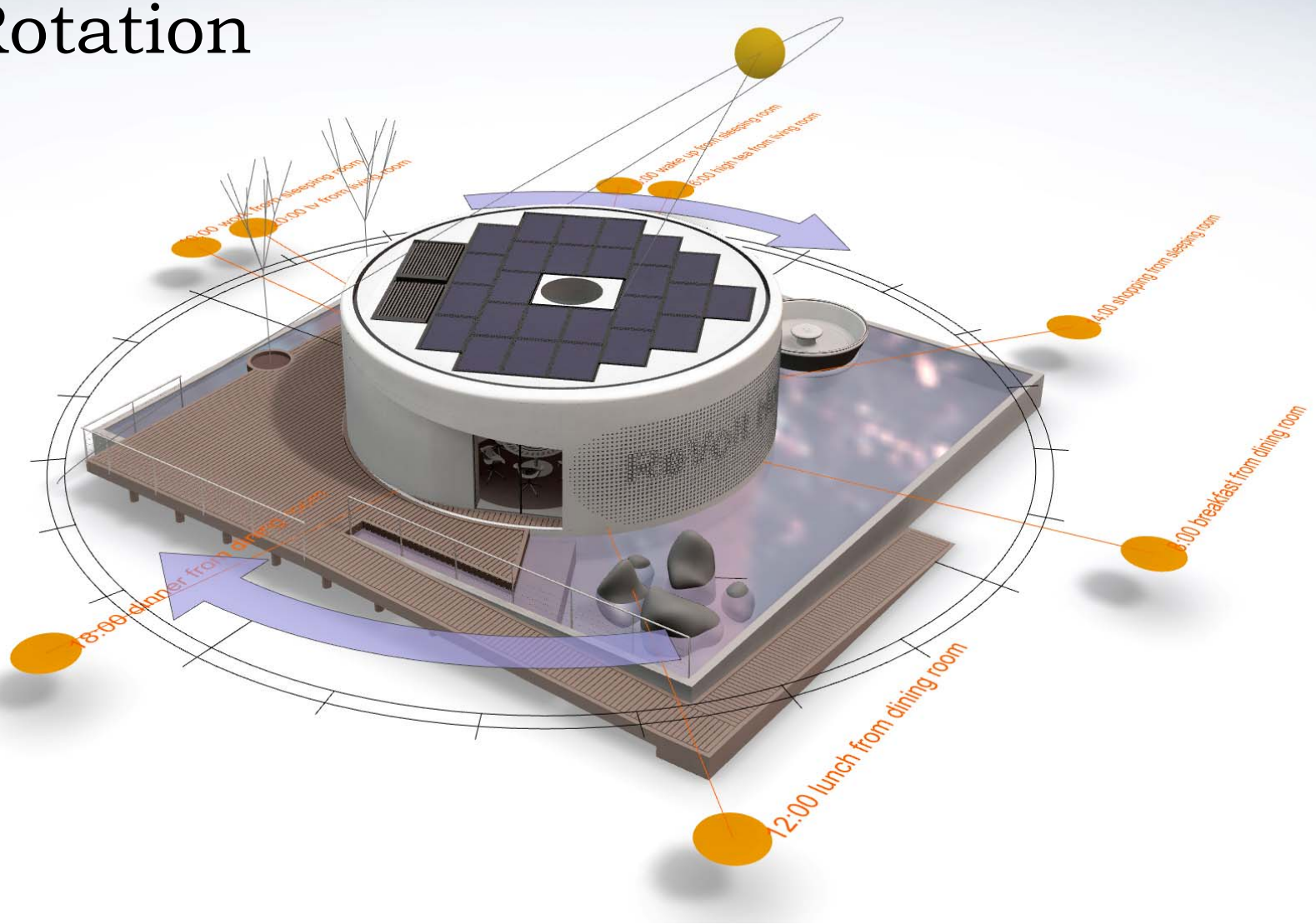
Floating

A possibility is to use sectional storage tanks for making a dismountable water basin for the Solar Decathlon 2012.

Rotation

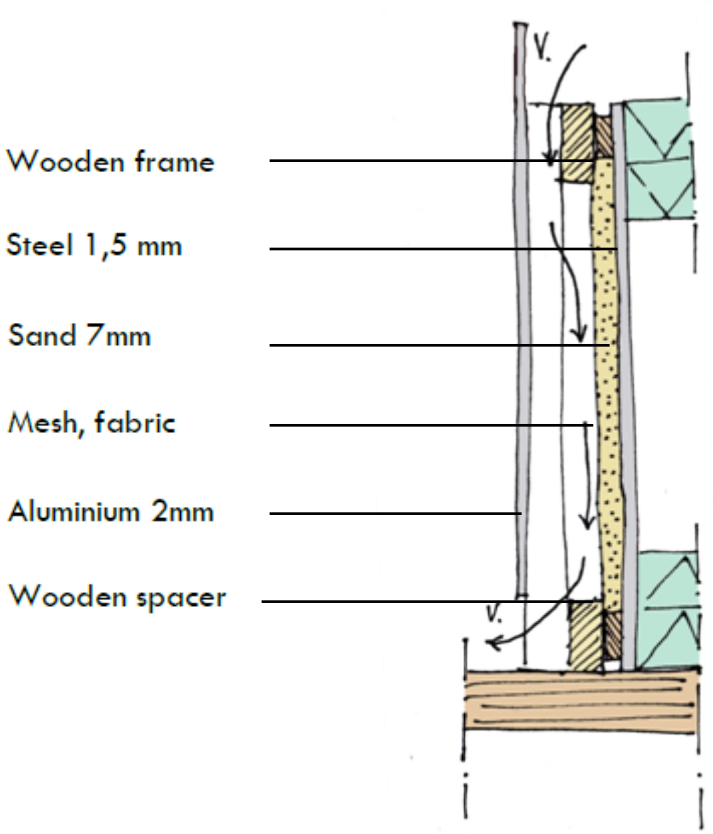
Device	Energy Efficiency	Manufacturing	Transport	Control	Visibility	Advantages	Disadvantages
Mechanical Devices							
Gears 	- High efficiency (95 - 98%)	- Difficult and expensive to manufacture in large dimensions.	- Heavy weight. - Main gear can't be cut into smaller pieces.	- Very easy to control. - Accurate positioning. - Easy to change direction of rotation	- It cannot be underwater - It can be easily cover.	- It can be a spur, helical or bevel gears. - Suitable for low speed applications. - Good for heavy loads.	- Needs alignment. - Needs lubrication. - Some noise and vibration problems.
Worm Gear 	- Lower efficiency (90-95%). - High friction losses.	- Difficult and expensive to manufacture in large dimensions.	- Heavy weight. - Main gear can't be cut into smaller pieces.	- Very easy to control. - Accurate positioning. - Easy to change direction of rotation	- It cannot be underwater - It can be easily covered.	- Good for large loads.	- Needs alignement. - Needs lubrication. - Not good for low speed ratios. - Some noise problems.
Transmission belt 	- Poor power transmission. - Heat generation. - Efficiency of 95%	- Cheap to manufacture. - Difficult to manufacture in very large dimensions.	- Low weight. - Easy to transport since belt is flexible. - Pulleys can be divided into smaller pieces.	- Easy to control. - Good accuracy for positioning. - Easy to change direction of rotation.	- It can be underwater	- Simpler system than gears. - No lubrication needed. - It can be replace easily. - It can cope with minor misalignments. - No noise.	- It has slipage and stretch problems. - Not suitable for high torques. - Short lifetime. - Not very suitable for low speeds.

Rotation


4:00 stroopling from sleeping room
8:00 breakfast from dining room
12:00 lunch from dining room
18:00 dinner from dining room

Climate – passive cooling

Climate – passive cooling



Climate – passive cooling

TEST 1:
T = 19 °C
RH = 49%

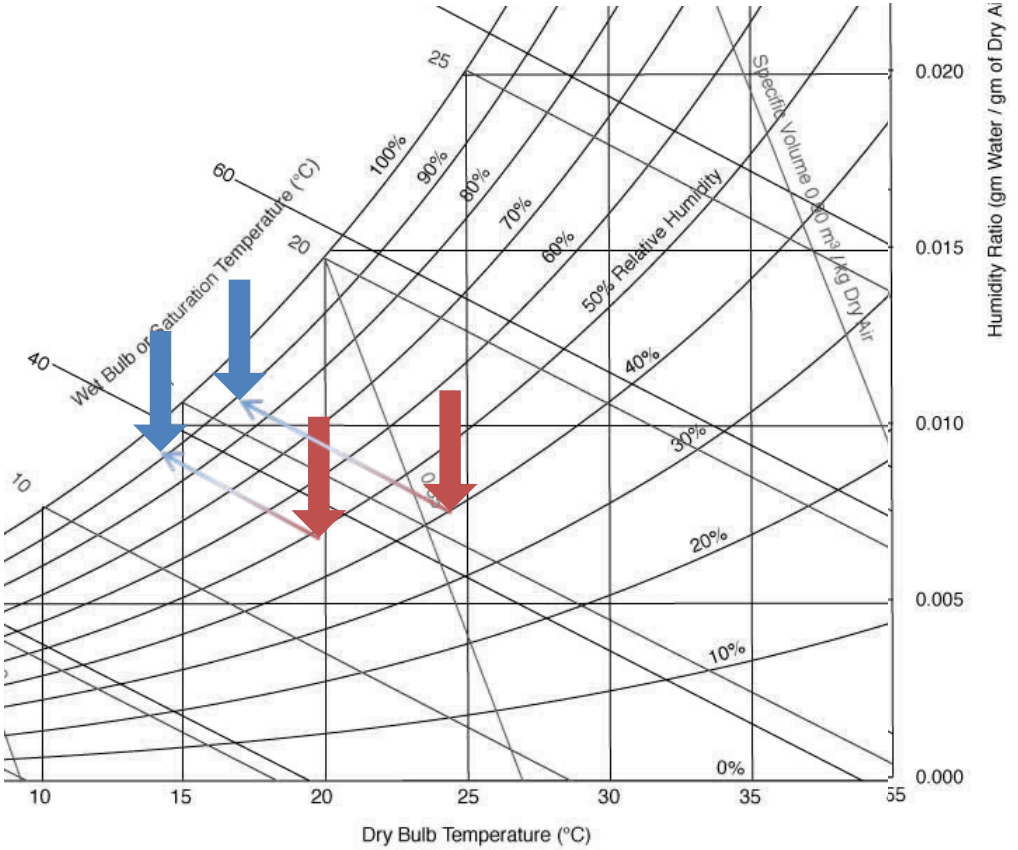
T = 13,8°C
RH = 93%

16,1 W/m²

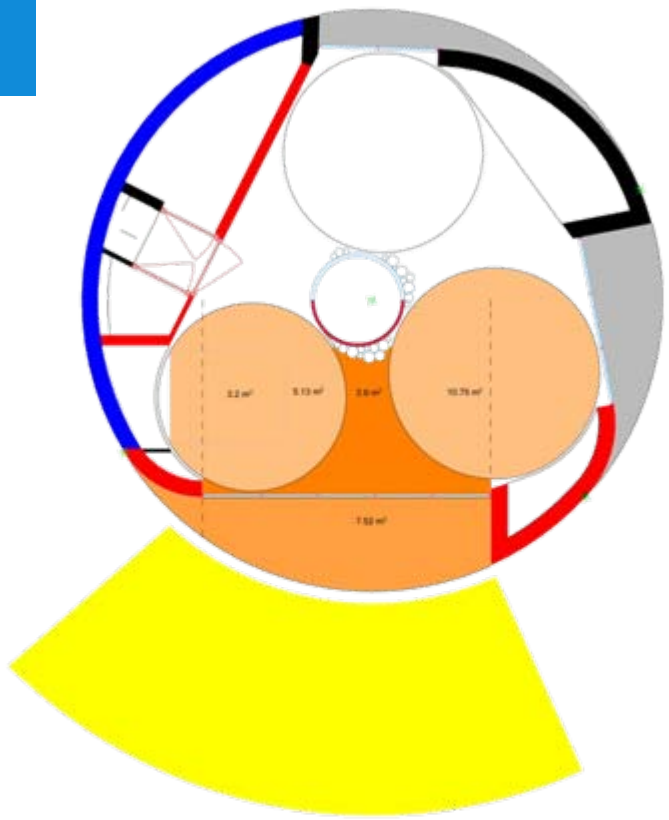
TEST 2:
T = 24 °C
RH = 39%

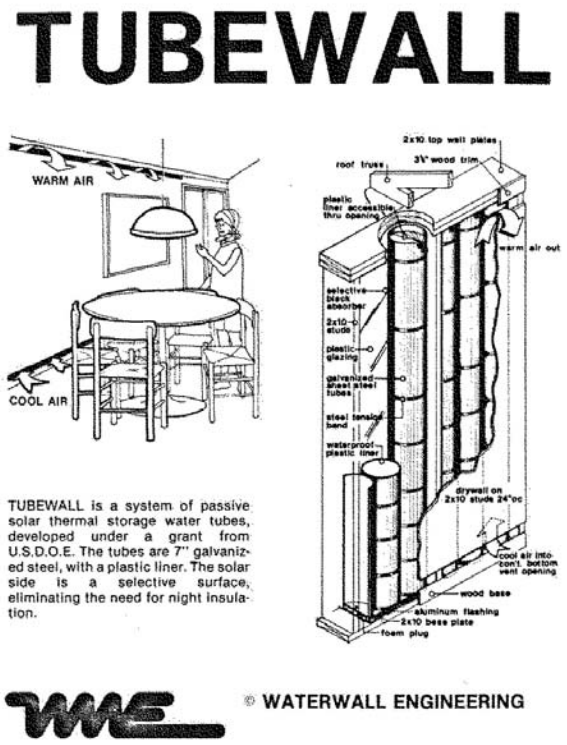
T = 17,0°C
RH = 87%

23,3 W/m²



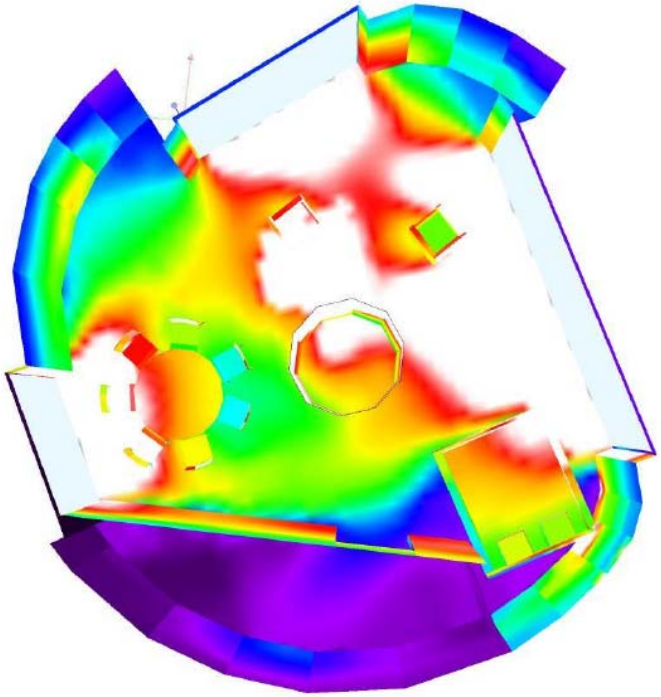
Climate – passive heating



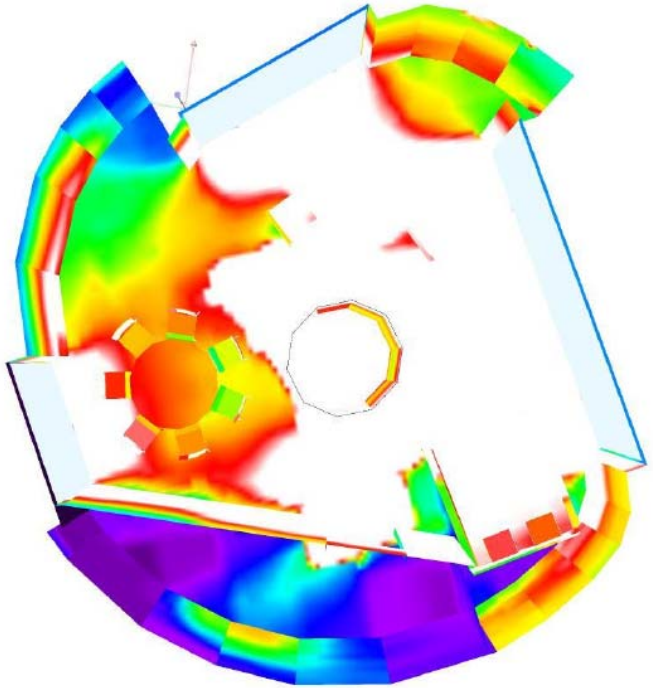


Use of water as thermal mass (water-wall)

Climate - Daylight

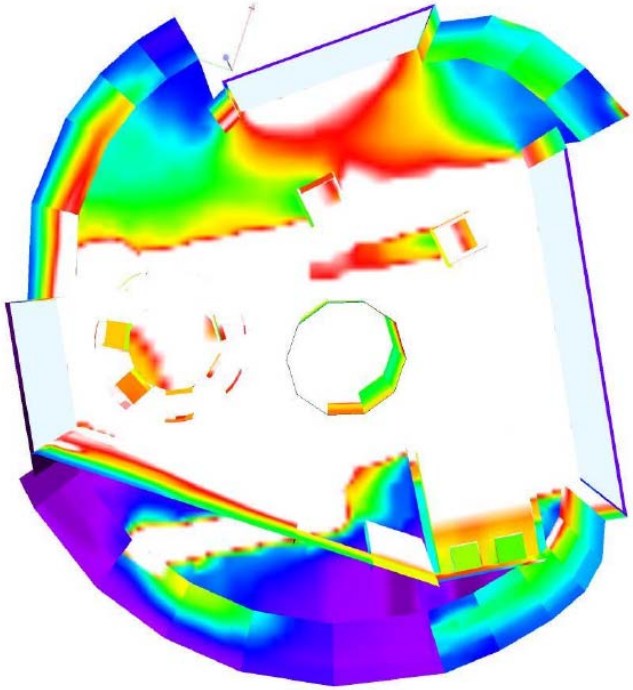


Summer, Mad, 12:00, Clear sky

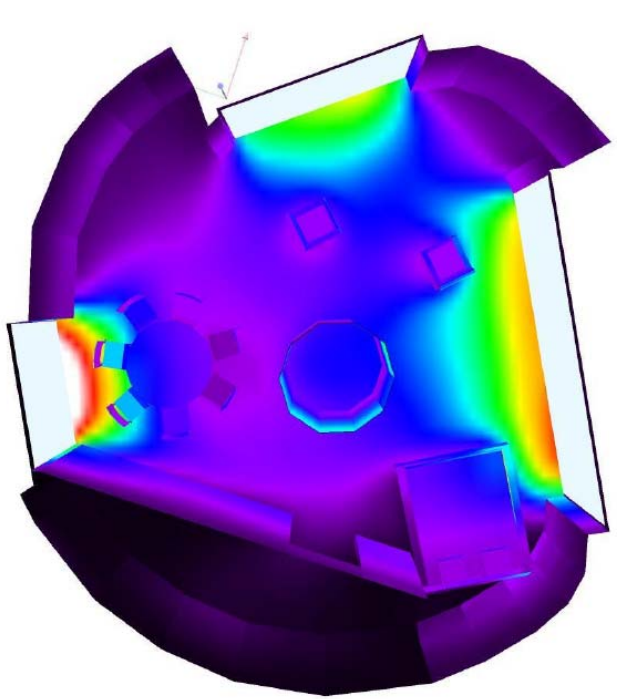


Winter, Mad, 12:00, Clear sky

Climate - Daylight



Winter, R’dam, 12:00, Clear sky



Winter, R’dam, 12:00, Overcast

“After Life”

Possibilities include

- TUD campus
- RDM campus
- Main sponsor’s site
- …

Sponsorship

Confirmed …

Kingspan
Duurzame Bouwsystemen

WNF

Orca3D

deltasync
WATERBASED URBAN DEVELOPMENT

Antenna-Men
GRAPHIC DESIGN AND MEDIA ARCHITECTURE

or to be confirmed …

SOLAQ
SMART SOLAR SOLUTIONS

Schneider Electric

FARO

Eneco

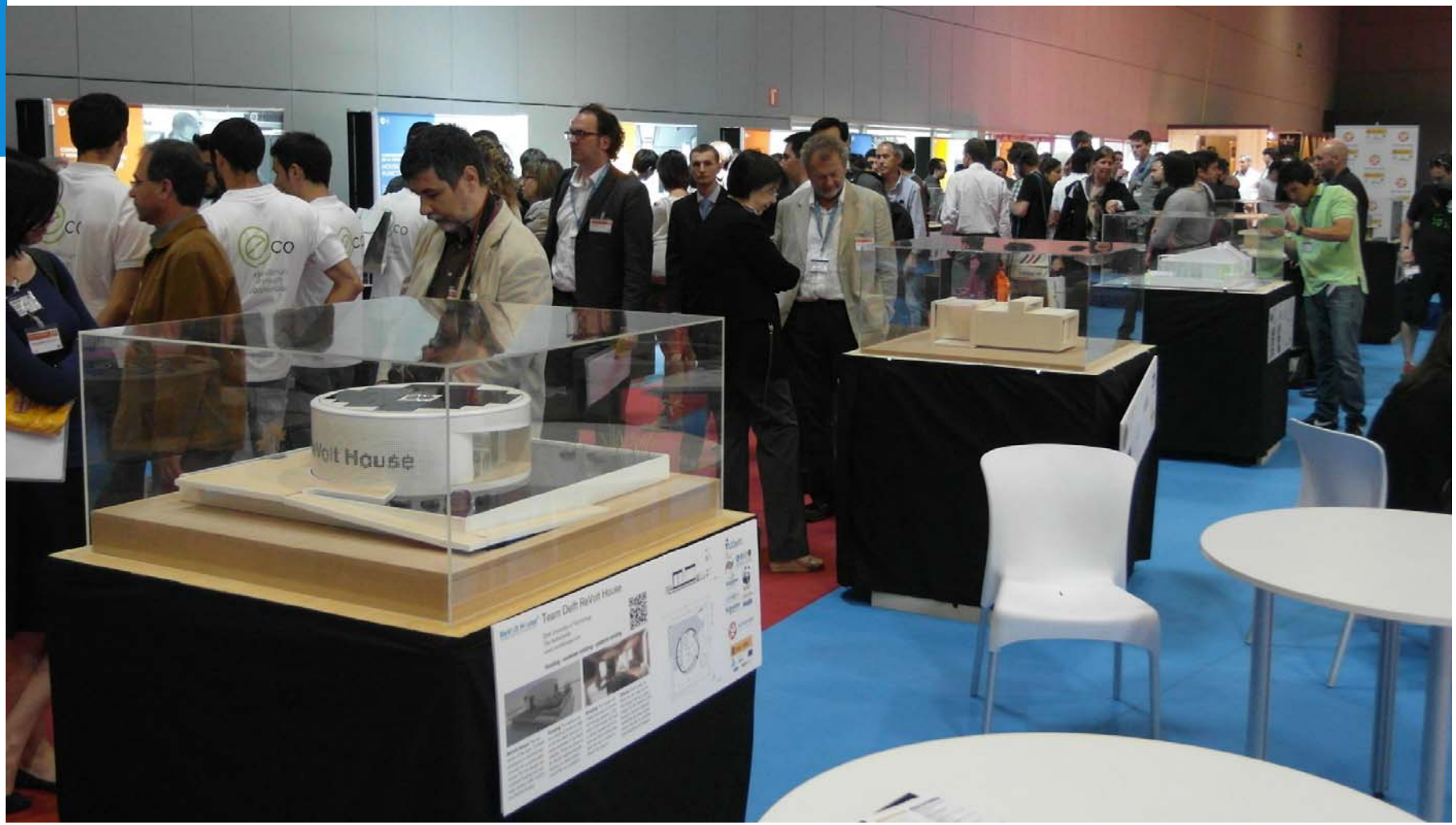
profine

FlexBase

Press

Het ReVolt House is de inzending van studenten aan de TU-Delft voor de Solar Decathlon die in september 2012 in Madrid wordt gehouden. In het ronde huis, dat in het water ligt, draait alles om het gebruik van passief en actief opgewekte zonne-energie. Het ontwerp behoort bij de laatste twintig uitverkorenen van deze wedstrijd tussen een groot aantal internationale

Construmat Barcelona 2011



Llowlab @ Lowlands in August 2011