MATERIAL FOR EARTH CONSTRUCTION

Ecoconstruction International School

UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

ISABTP - Anglet - 29 septembre 2017

MecoPress

The best method to compress earth :

How a solution to a problem solved many others

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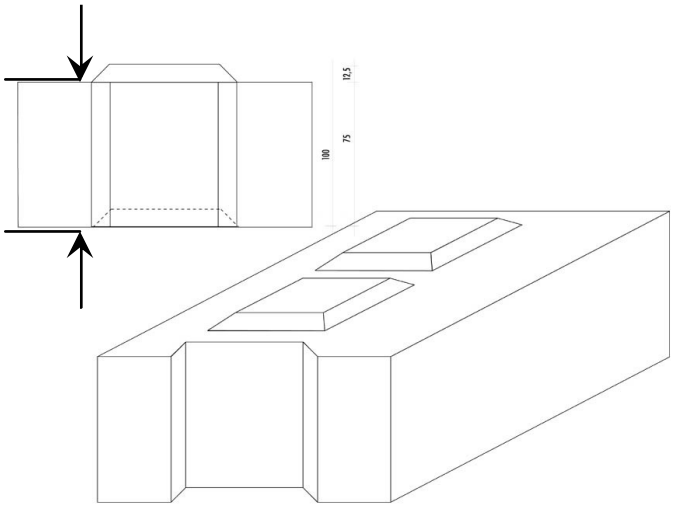
Summary

Goals :

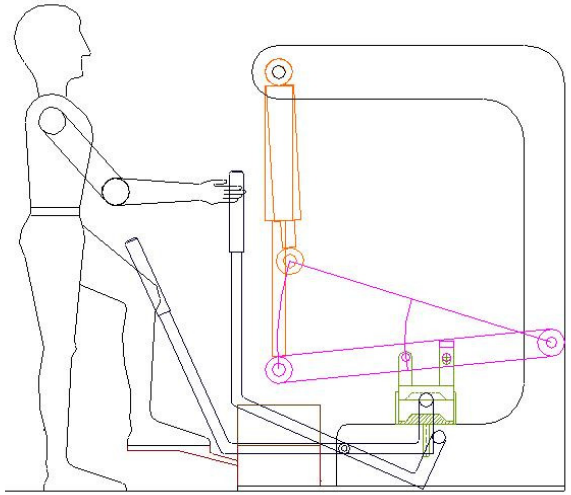
Bricks :

- Interlocking
- Compressed earth
- Constant strength



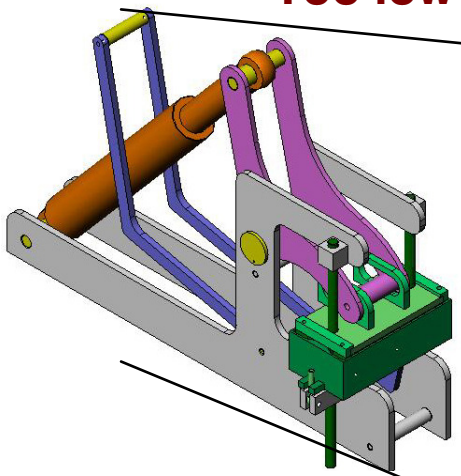
Press :

- Calibration of the bricks
- Low carbon system
- Affordable

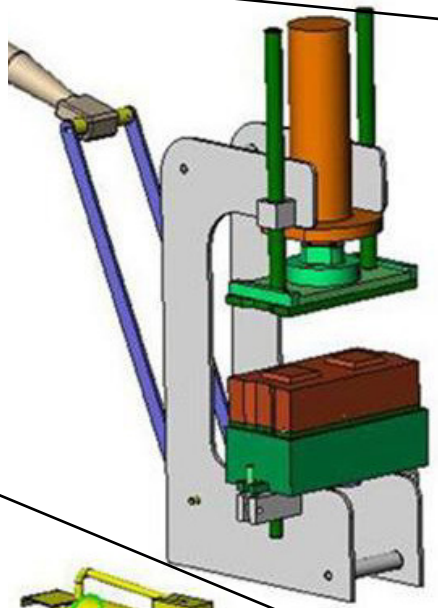


Sketching up the first ideas

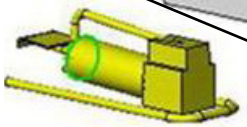
Too low



Too weak

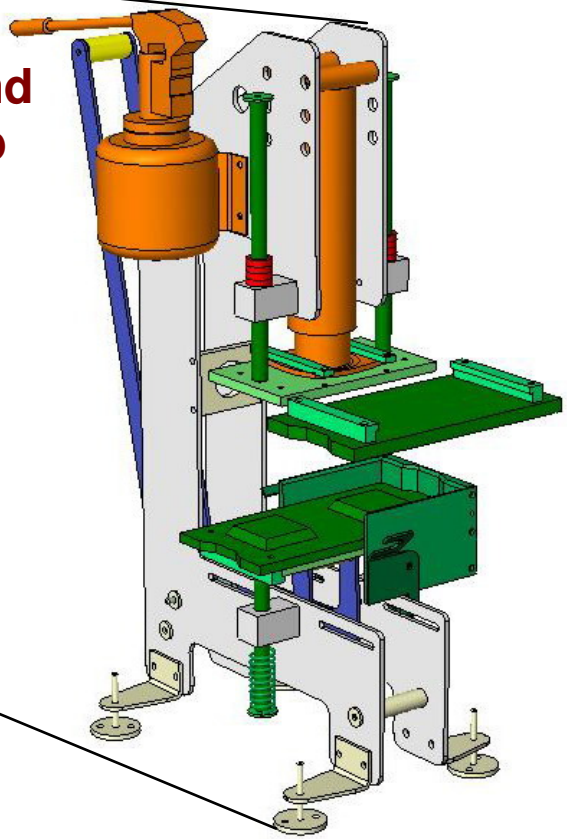


With Foot pump



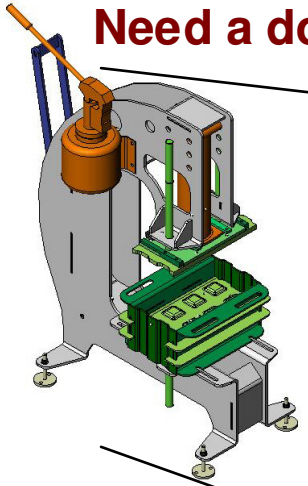
Too slow

With hand pump

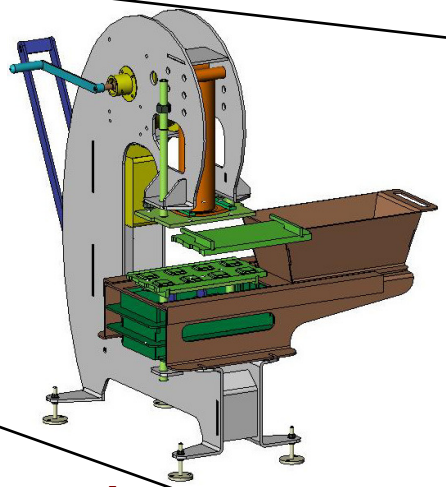


From a sketch to a design

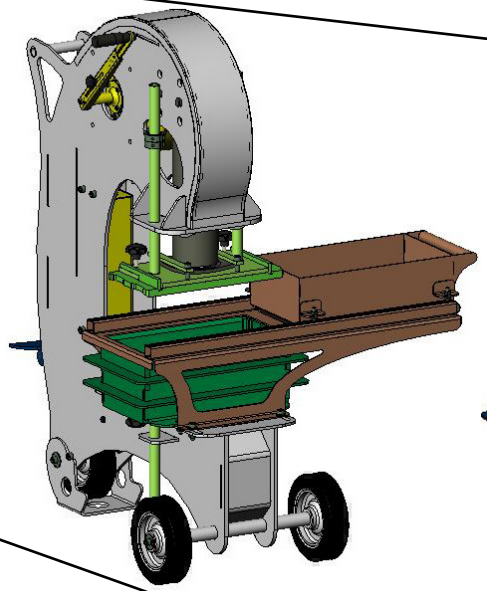
Need a dosage system



Need to move

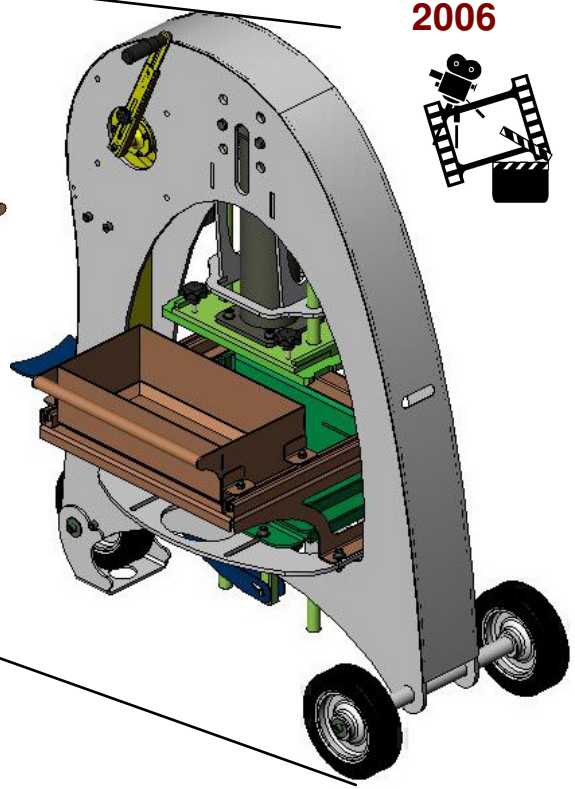


Need more strength



Not that bad…

2006



Human energy version:

- Hydraulic pressure
- Unmolding by hand

…now we need money!

incubateur MIDI-PYRENEES

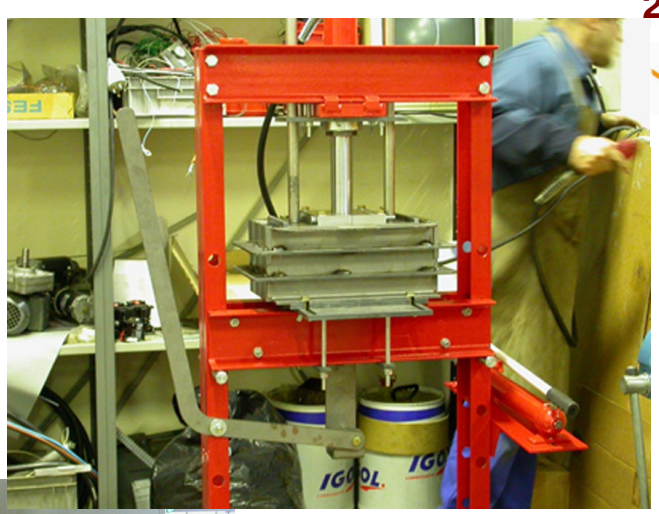
Genesis of the MecoPress

From a design to pressing model

2007

The first Mecobriq was born!

Trial model



Pressing

Unmolding

But…

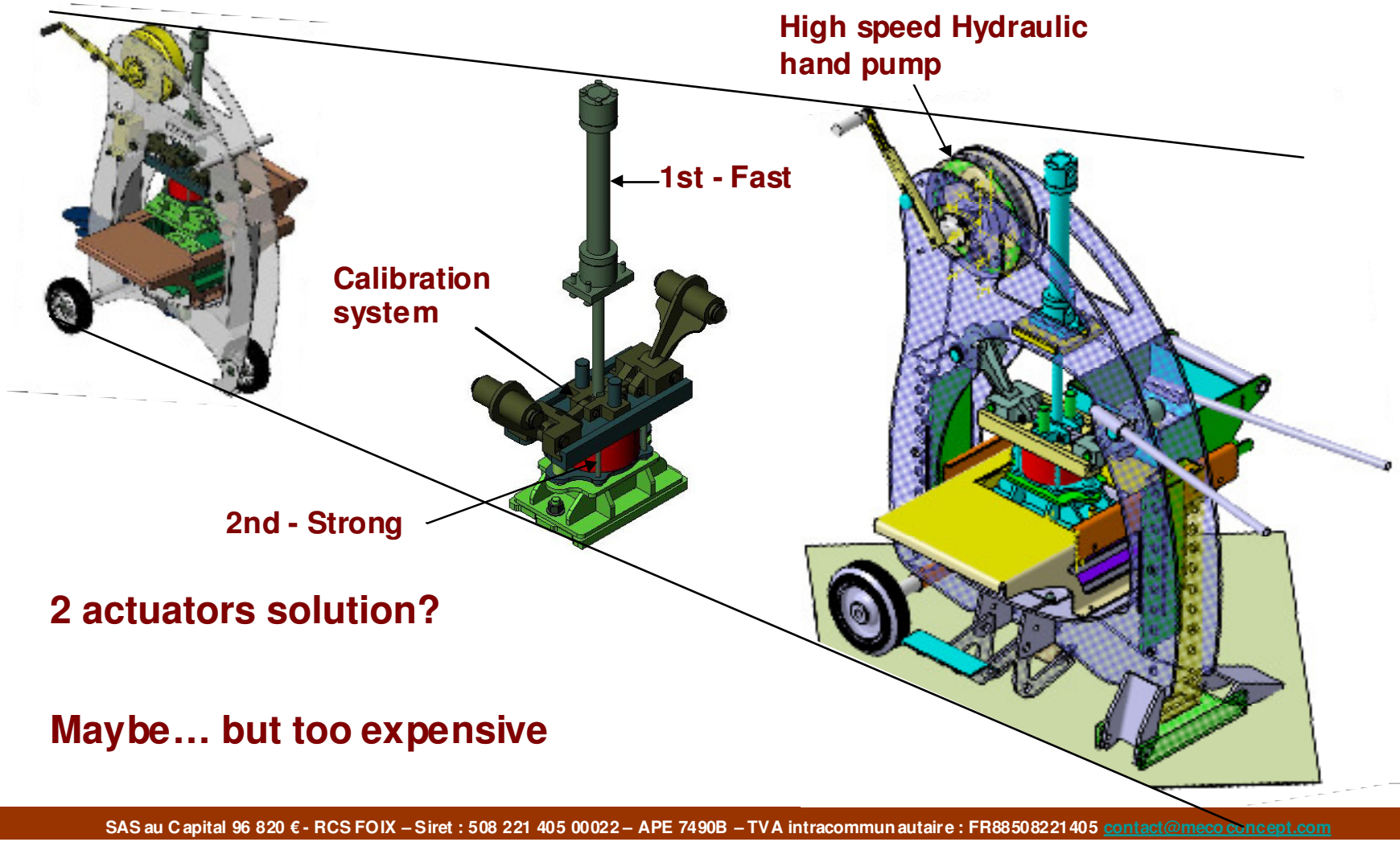
But…

- Unmolding by hand was almost impossible
- Pressing by hand was too slow
- The main problem: Thickness was not constant
- And the machine was broken

At least we had 3 bricks to show…

…not that bad!

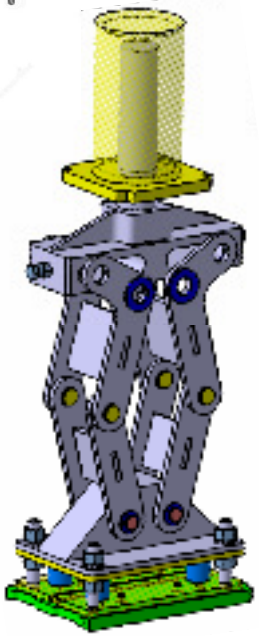
So we need to find a way to calibrate…



2 actuators solution?

Maybe… but too expensive

THE Solution !



First prototype 2008

The Pantograph

Advantage of the pantograph

- Low energy consumption
- Calibration
- Strength multiplication

WOW!

Results on the bricks

- Wow effect!

The job was done…

… not

The solution was there, but a long way remained to be operational in the field

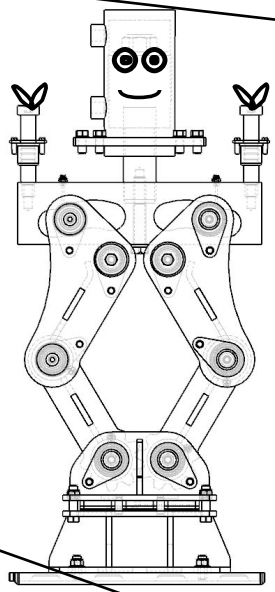
Genesis of the MecoPress

From prototype to industrialisation

2009

2011

2014



I'm mature

… and 3 kids

Easier

Stronger

Faster

Reliable

Cheaper

3 more generations, 10 different evolutions…

were needed to reach the maturity of the machine and the compression process

And a lot of help!

In Research, Development and Industrialisation

And fundrising

5 innovations awards

=~1M€

The MecoPress

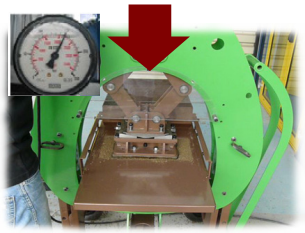
Cycle time

< 20 seconds

➢ *3 gestures are enough*

1 - Loading

2 - Pressing



3 – Mold release

Basic model:

- 220V alternating
- MecoBriq mold 36x18x9

Points about the MecoPress

➢ *Advantages*

- ✓ *Variety of molds*
- ✓ *Precise and solid*
- ✓ *Low consumption*
- ✓ *Easy to use*
- ✓ *Brick quality*
- ✓ *Solar power*
- ✓ *Mobile et transportable*

➢ *Sources of savings*

- ✓ *Low power consumption*
- ✓ *Not a lot of maintenance*
- ✓ *Less stabiliser*
- ✓ *Fast wall assembly*
- ✓ *Little mortar*
- ✓ *No qualifications required*

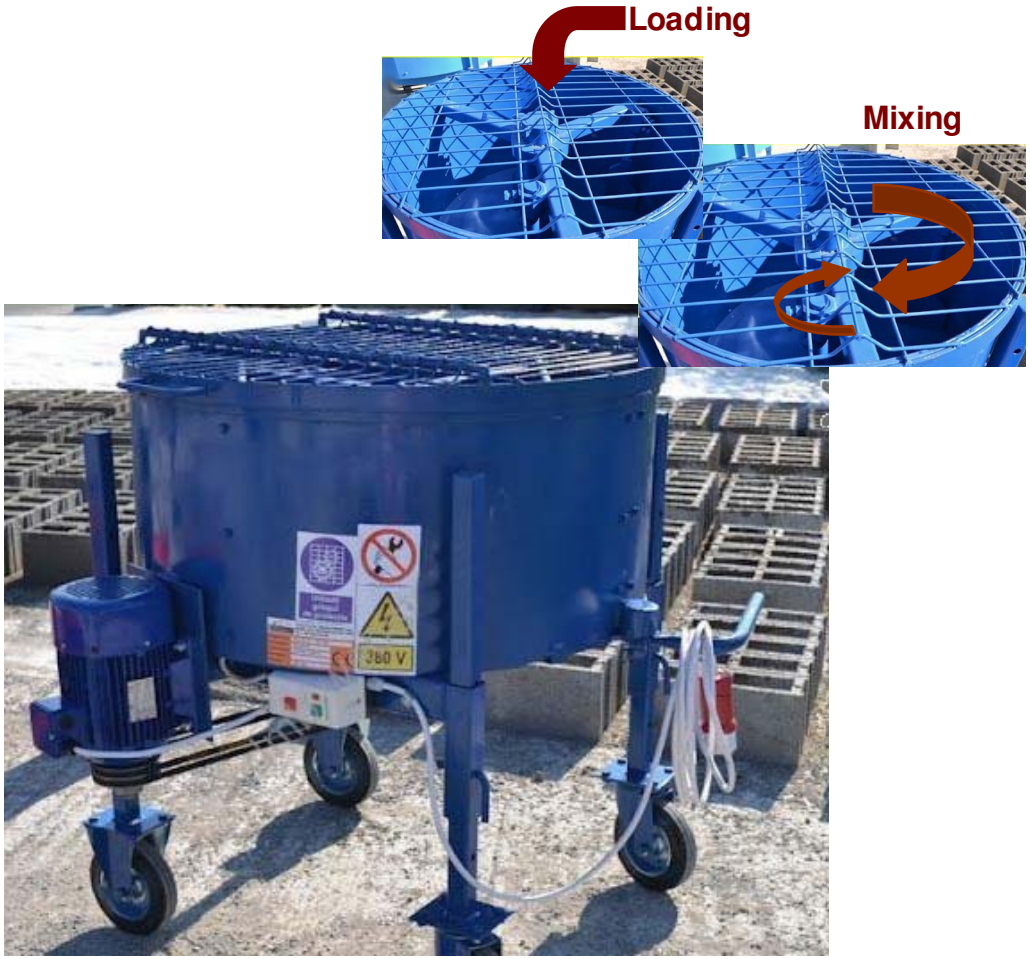
- compression strength : 30 tons
- weight : 295 kg

Granularity

Points about the MecoTri

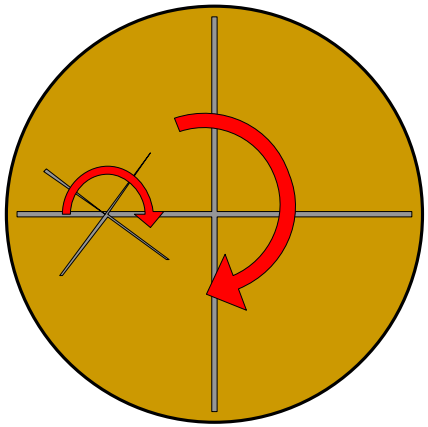
- ✓ *Soil calibration*
- ✓ *Time saving*
- ✓ *Less fatigue*
- ✓ *Easy to use*
- ✓ *Fewer refusals*

Adding moisture



Which mixer to choose?

- ✓ *a vertical mixer, does not « break » the granularity*
- ✓ *250L minimum capacity*
- ✓ *a second turning arm*

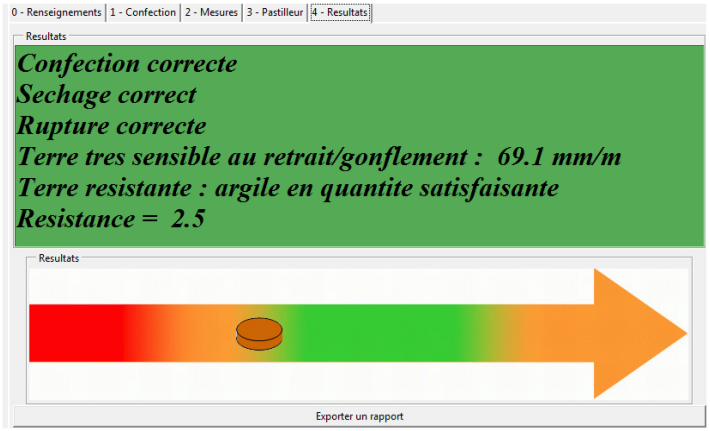


...Still pending

Soil qualification

Points of the MTT

- ✓ *Secures the work*
- ✓ *Autonomous analysis*
- ✓ *Personal database*
- ✓ *Knowledge accelerator*
- ✓ *Income generator*
- ✓ *Other applications*



Results are shown on a simple and instructional graphical interface.

Other problems to solve

The final result

To make bricks with ease, MecoConcept offers :

- **Soil analysis** to determine the best brick for your soil.
- **A sifter** to separate stones, gravel and earth quickly and without fatigue .
- **A mixer** for a quality blend and a solid brick.
- **CEB presses**, for compressing compact and calibrated bricks.
- **Trainings** for a quick handling of the entire process.

A few references


Daviet – Vendée - 2011

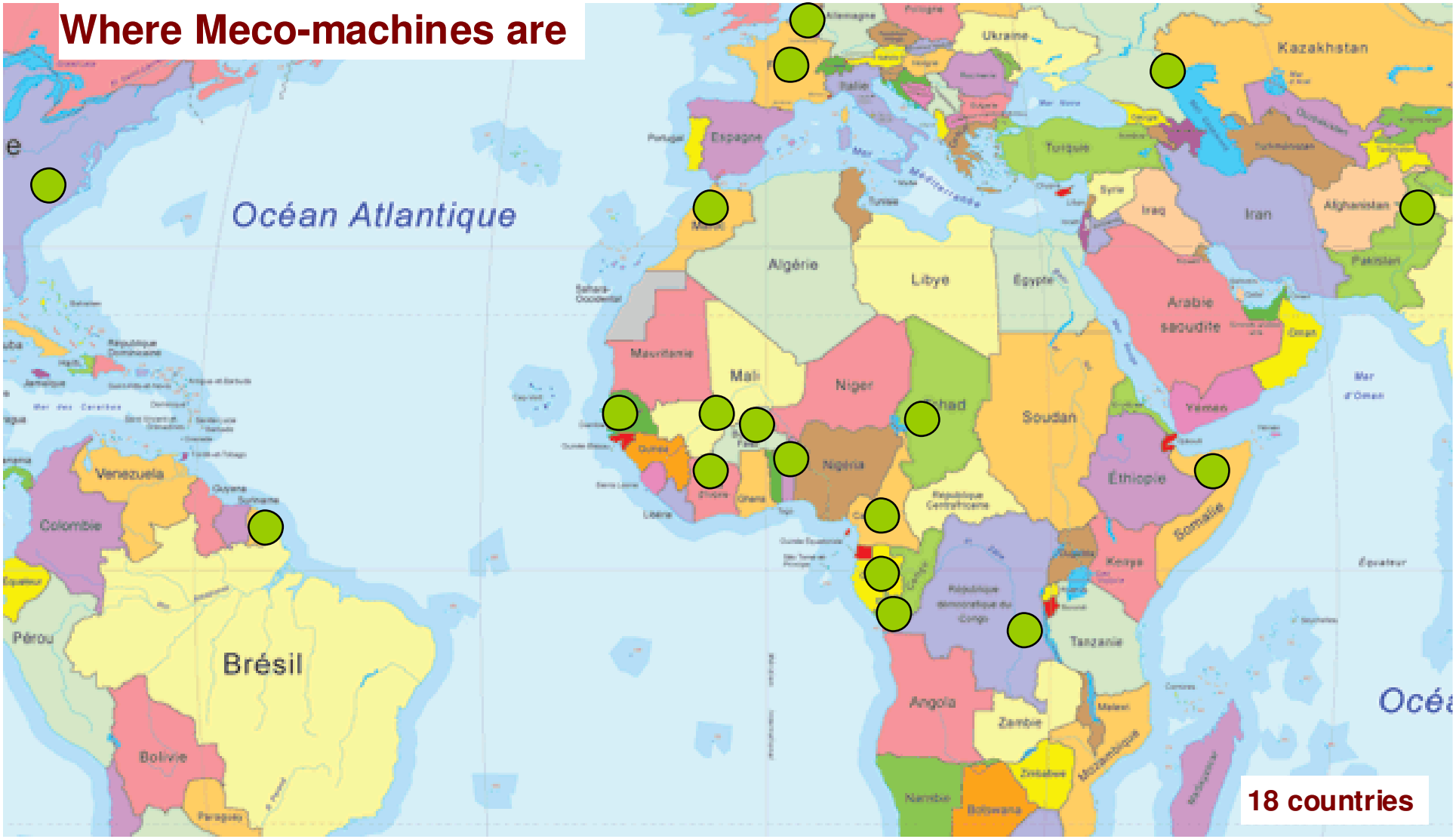

Ars et labor – Corse - 2012


Norman Foster – Venice - 2016

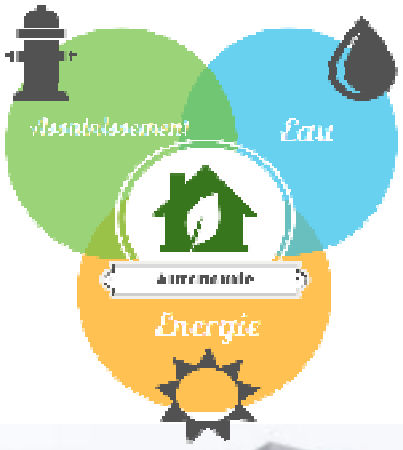

TerrA-B-Congo – Libreville - 2011

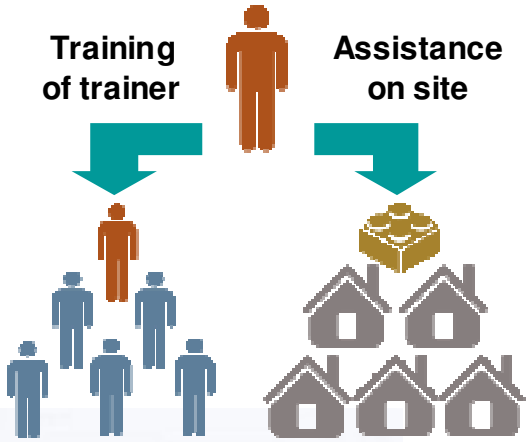

WORK Sarl – Abidjan - 2017

Where Meco-machines are



The African market : the eco-sustainable neighborhood





Operational process

1. Analyse du dossier
2. Cahier des charges
3. Recherche de financement
4. Études
5. Construction
6. Remise des clés

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But a question is still pending…

Why do our bricks look better than the others?

Mecobriq 4x2

Standard 29x14x9

Pivot W18

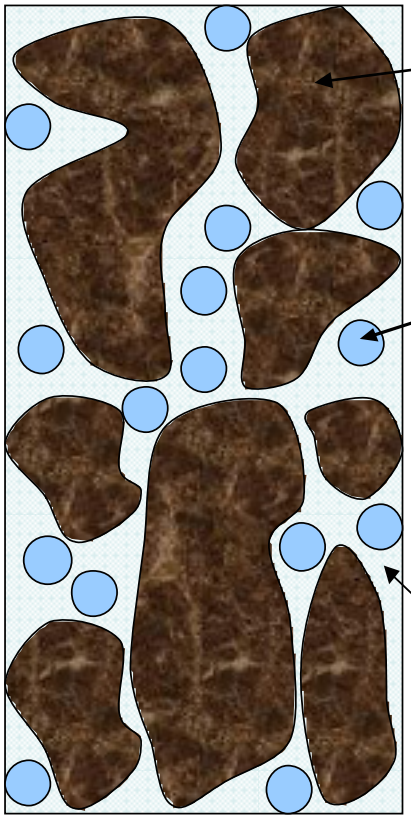
Manual 29x14

22x11 canal

22x11 interlock

What is soil?

Natural state of the soil



The three parts of soil:

Solid : resulting from the mechanical degradation (particles> 2µ) and chemical (particles <2µ: clay) of the rocks

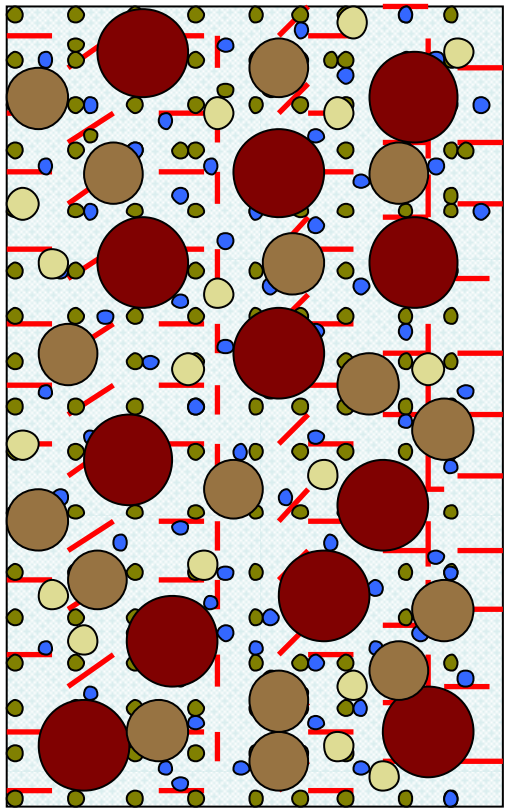
Liquid : water, 3 types

- Interstitial water (evacuation: T ° <300 ° C)
- Bound or absorbed water (evacuation: T °> 300 ° C)
- Constitution of water (chemistry of the layers of clay: evacuation T °> 900 ° C)

Gas : if there is no more air => saturated soil

CEB : Compression principle

Overrun soil ~1.2kg/dm³



air

water

clay

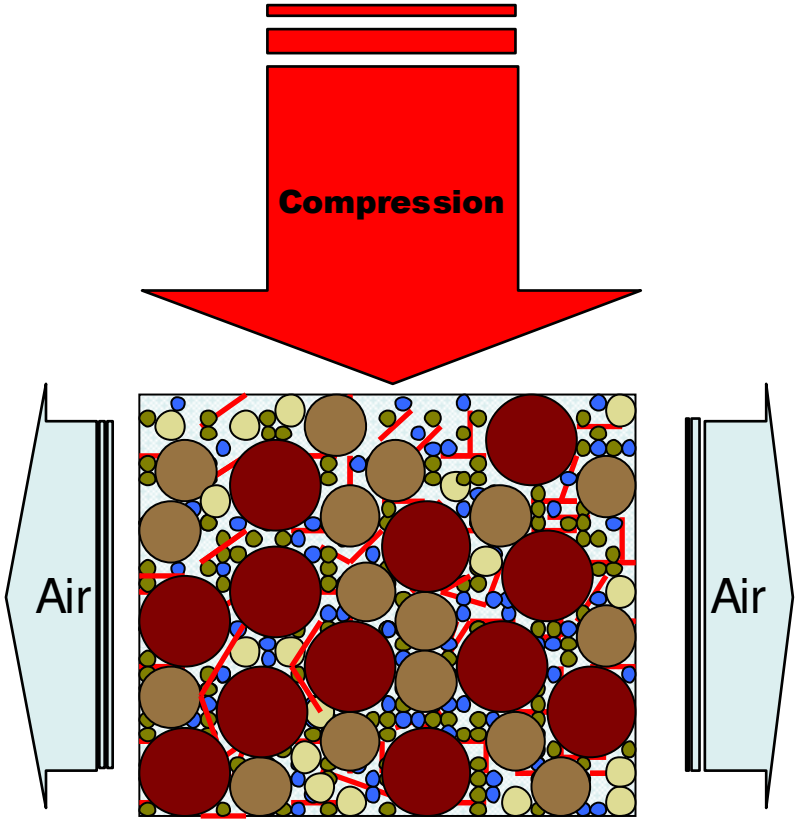
lime

fine sand

coarse sand

gravel

Compressed soil ~2kg/dm³



Compression limits of materials

Pebbles < 20cm
Gravel <2cm
Coarse sand < 2mm

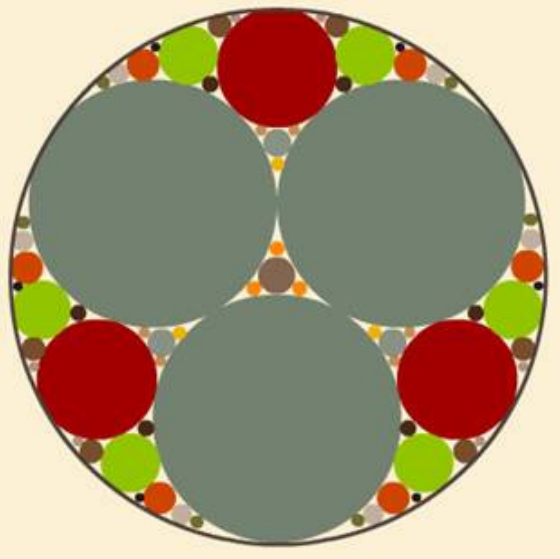
} Grainy soil

Fine sand < 0,2mm (200µm)
Silts < 0,02mm (20µm)
Clay <0,002mm (2µm)

} Fine soil

If we fill all the empty spaces, Density = 2,65

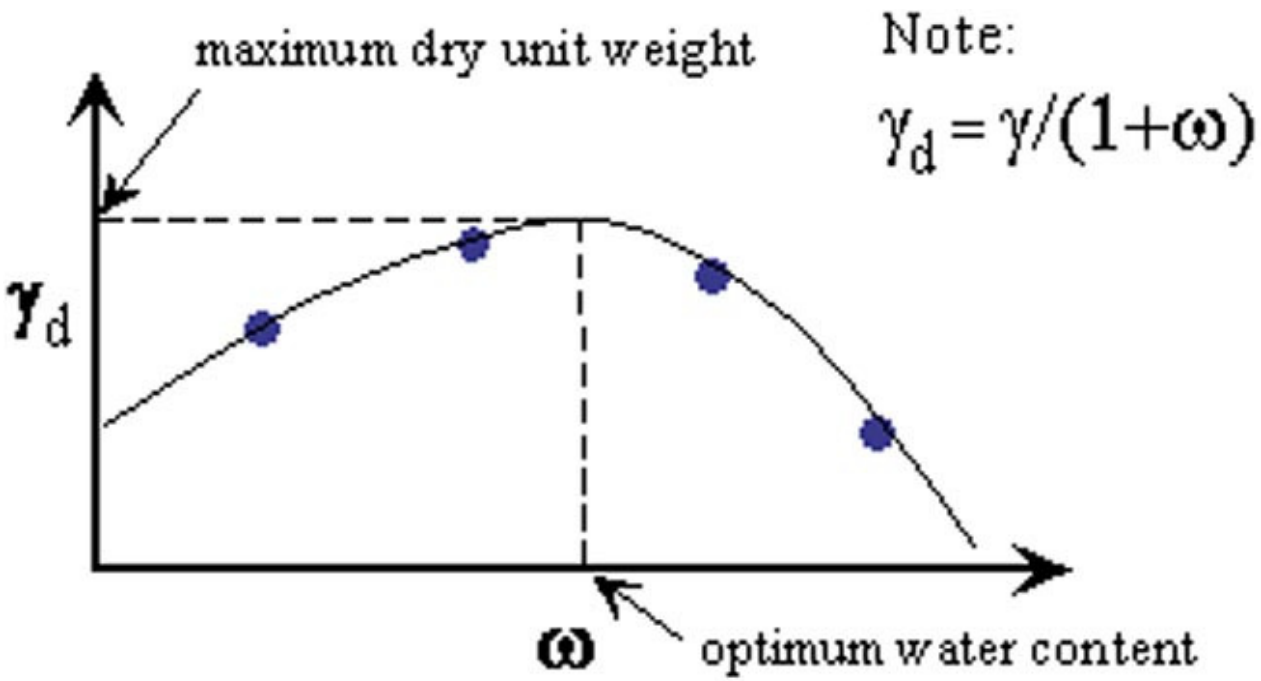
Grain theory



(Apollonius of Perga
-265 to -190 BC)

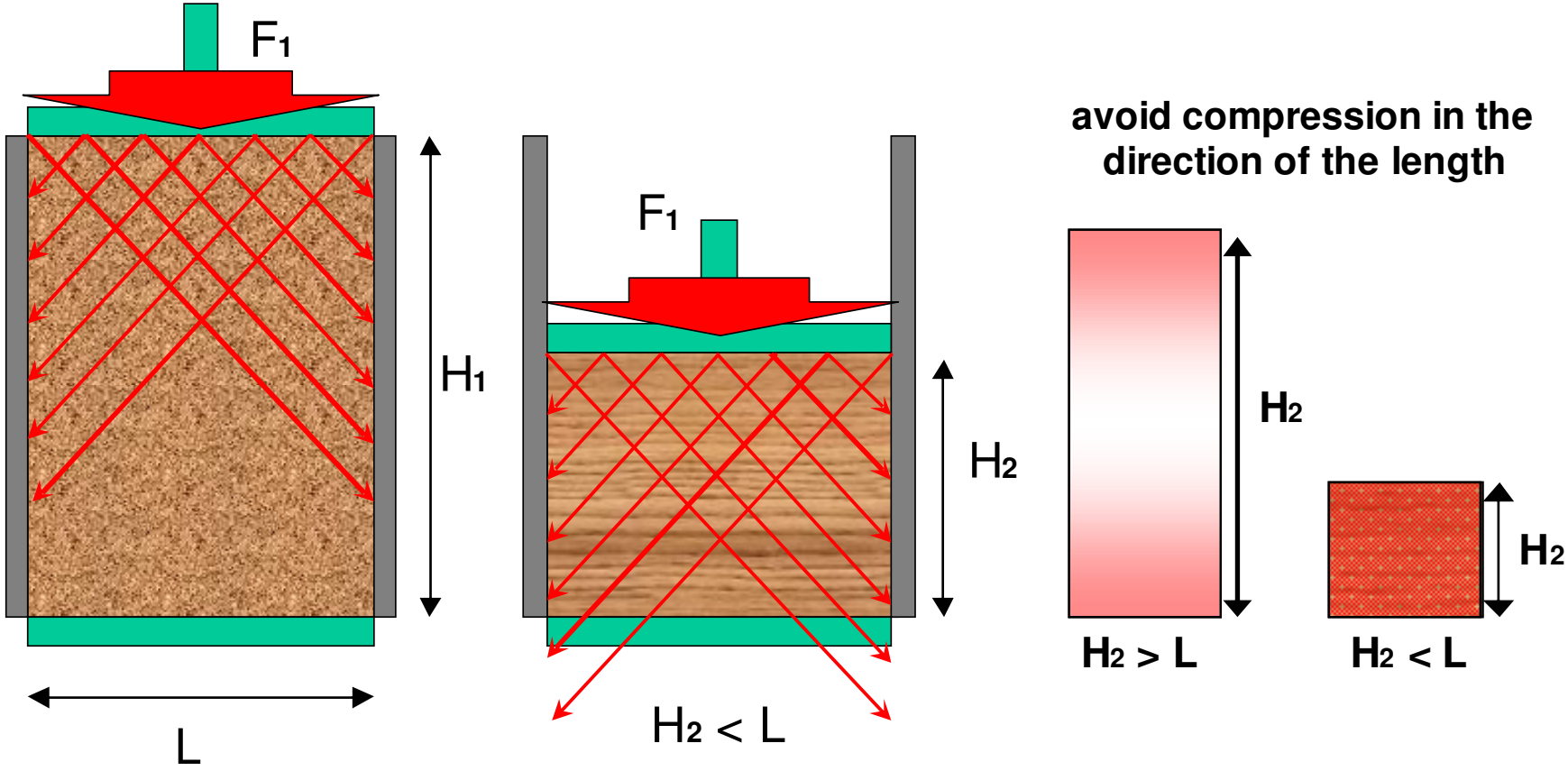
Importance of Humidity

Proctor Optimum



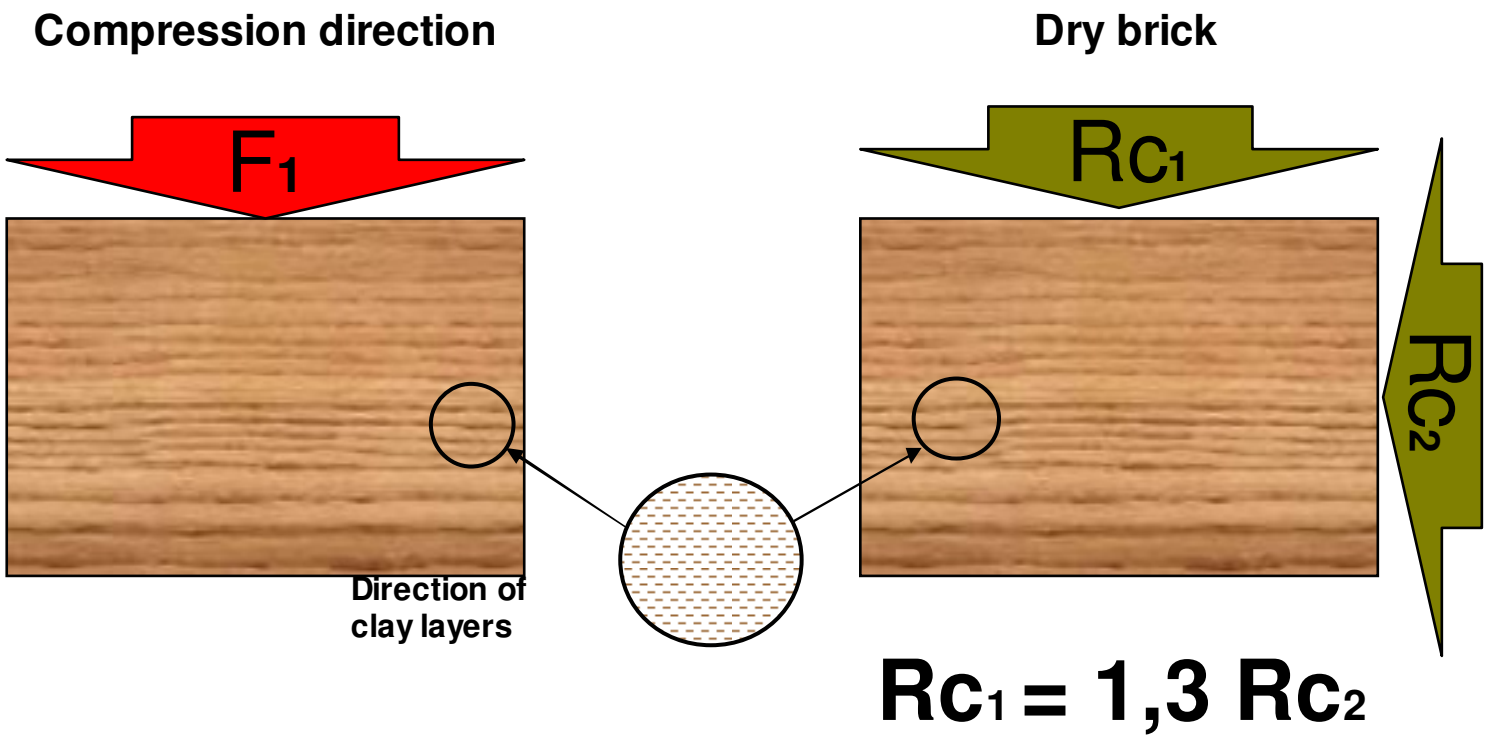
Each earth has a specific optimum

Transfer of compression forces



For optimum quality, the brick must be taller than it is wide.

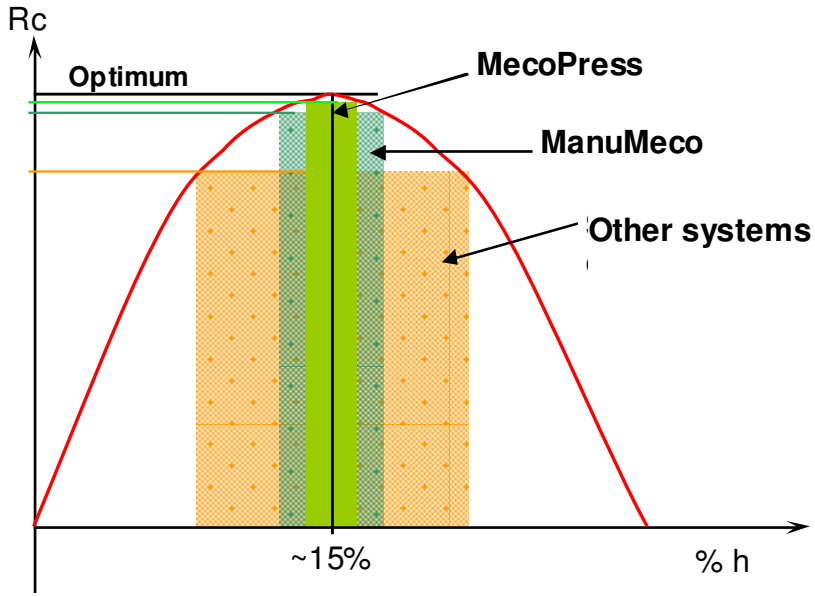
Direction of brick compression



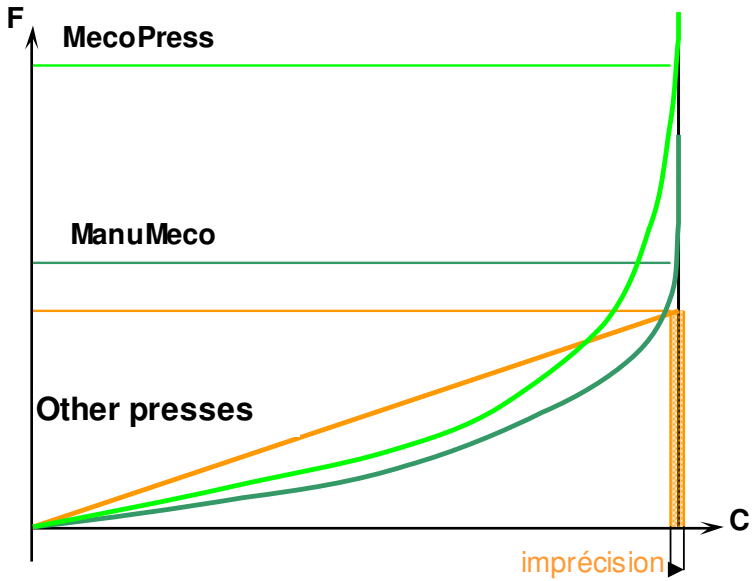
For better wall strength, the brick must be compressed in the direction it will be laid

Application to the MecoPress

Optimum proctor



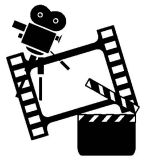
Rc : Brick resistance to compression
%h : Level of humidity

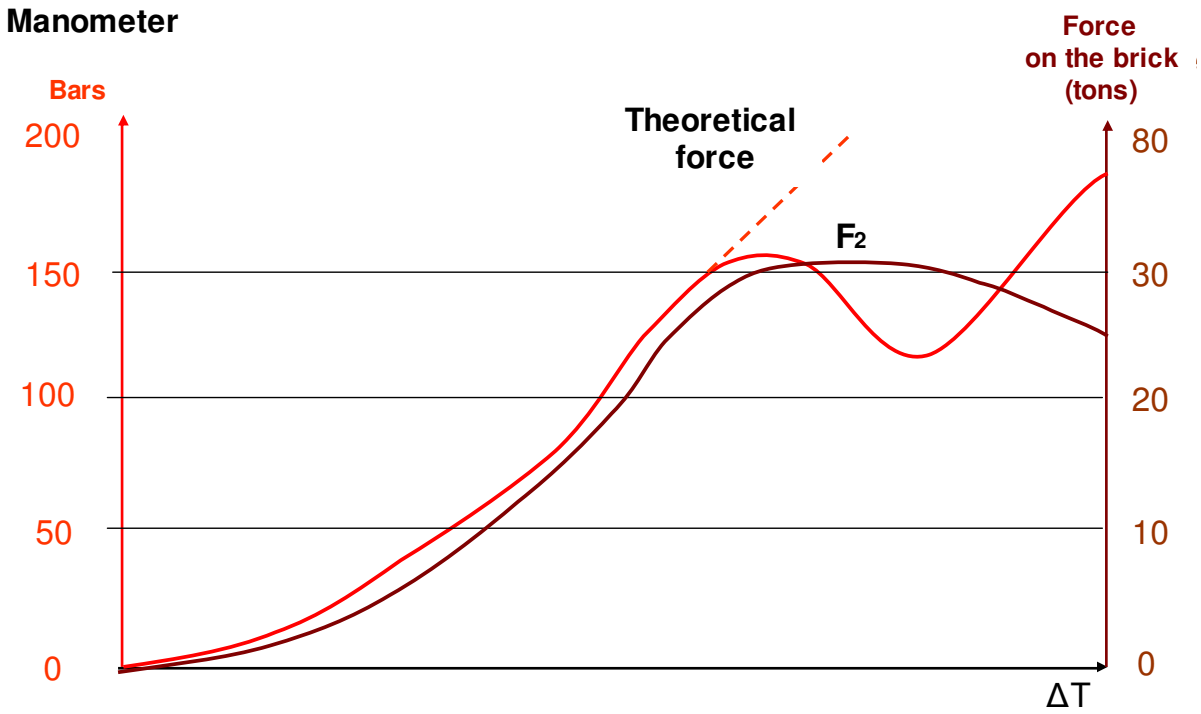


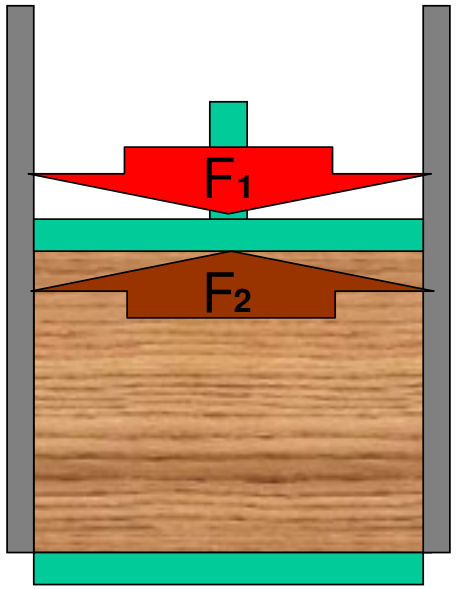
F : Piston Force
C : Piston movement

Consequences : quality control and quality assurance

Application to the MecoPress







F1 : Machine Force

F2 : Soil résistance

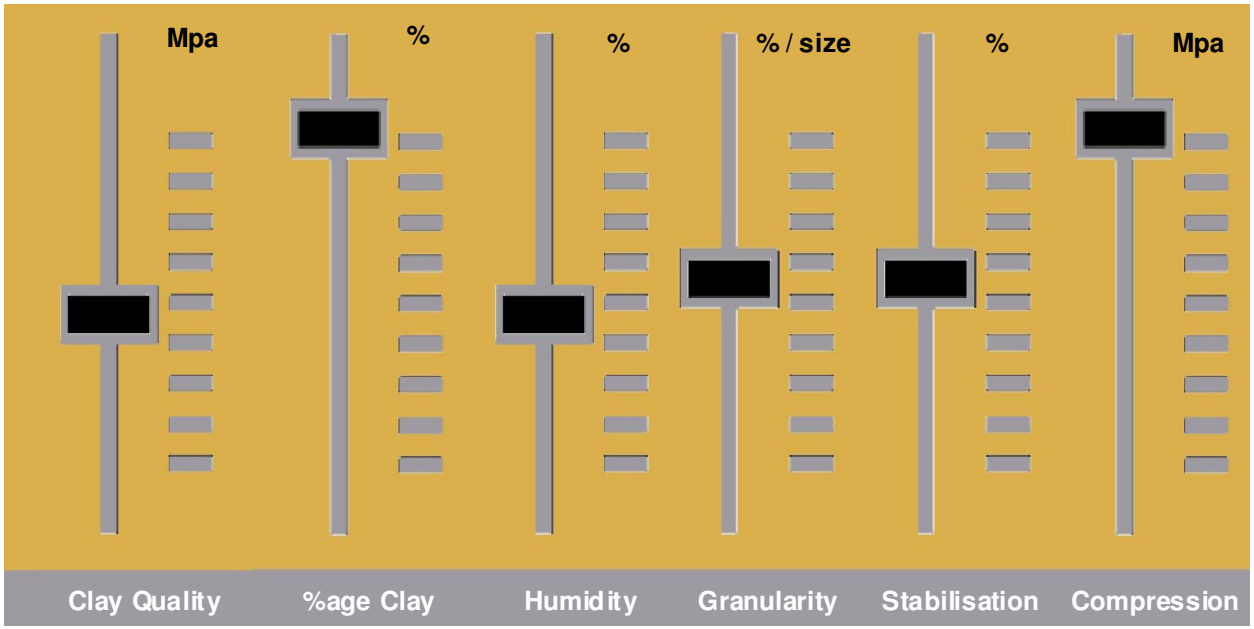
Maxi Compression Force
F1=F2

Consequences : reproducibility of the brick

The drier the soil,
the higher the F2

What makes the best brick

- The soil that is used
- The quality of the clay
- The adequate granulometry
- The humidity ratio
- Stabilization (lime, cement …)
- The respect of compression principle



Each parameter is important

What did we solve with Mecopress?

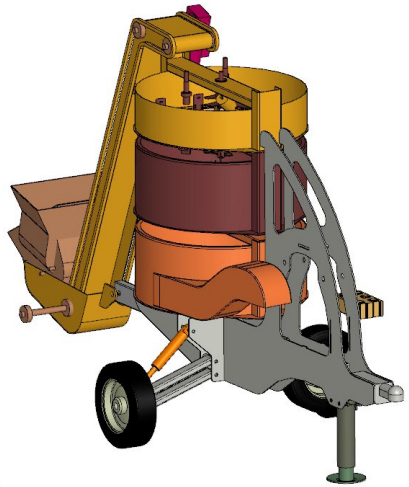
- Brick precision
- Very low energy consumption

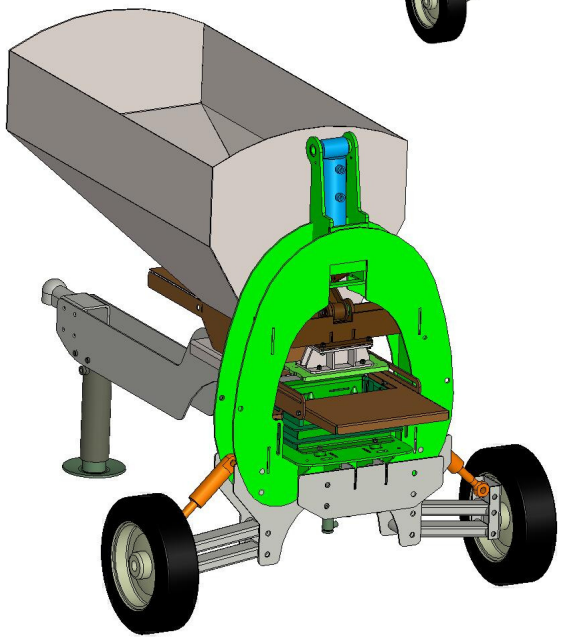
and

- Possibility to press at proctor optimum
- Low stabilisation ratio
- Reproducibility of the bricks
- Only one parameter to check for the operators
- Almost no qualification needed to use it
- Social impact

What remains to be done

- A better understanding of the compression system and its possibilities
- Relationship between the proctor and the press
- Control of moisture content
- Development of field analysis tools
- Link between construction site and the lab



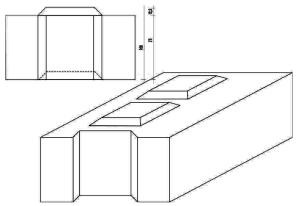


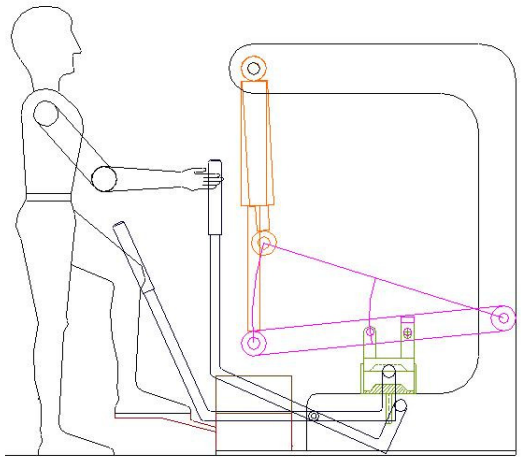
In the future:

- Soil database
- Automation of the process

Thank you !

2006





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