



JOURNEES NATIONALES  
MACONNERIE

5ème édition – Bordeaux

12 et 13 Juin 2025



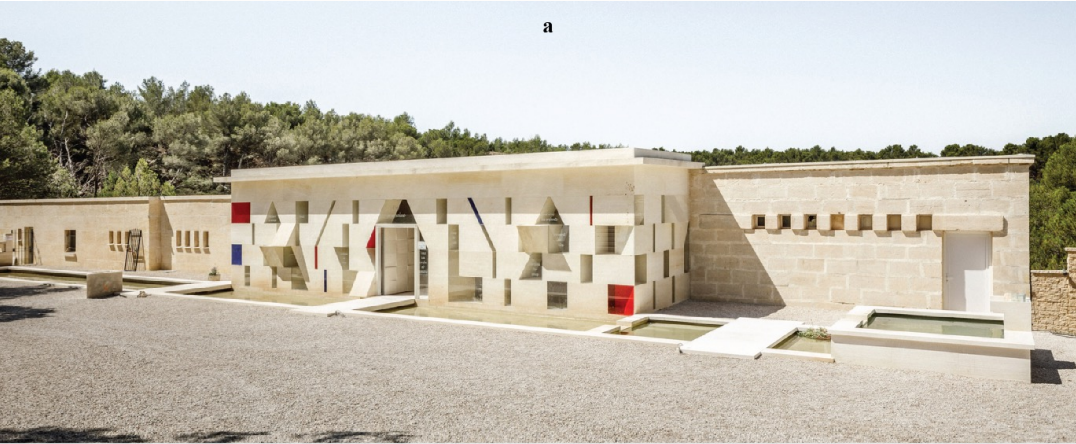
## Octa Mur

# Un système autobloquant pour le renouveau de la pierre en architecture

*MIRANI, A., ZARCONE, R., LE ROY, R.*



# Les enveloppes en pierre



Gilles Perraudin:

« Les contraintes qu'impose la technologie de la construction en pierres massives et cyclopéennes sont considérables. **Une seule opération est possible:**

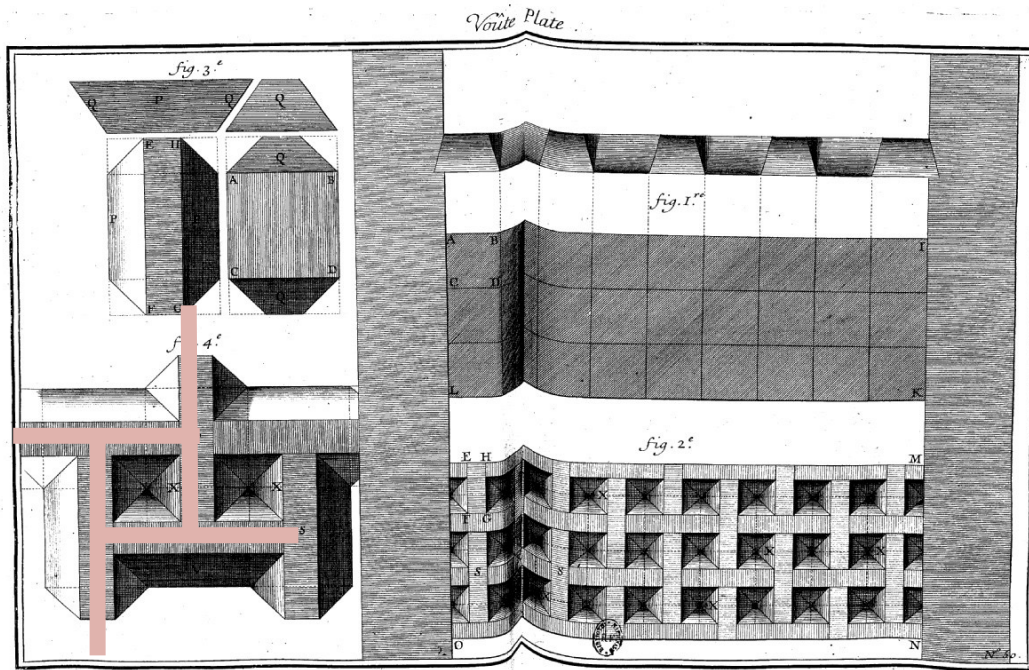
*Poser une pierre sur une autre. Puisque le « **poids** » de la matière, ses règles rigoureuses d'assemblage et son système implacable de **formes s'imposent** »*

Figure 1. a) Pavillon d'accueil de la carrière de Fontvieille du Fontvieille [17]. b) logements collectifs sociaux et extension d'une crèche VIème Paris [18]. c) logements collectifs sociaux du XXIème Paris [19]. d) 32 logements en accession libre et locatifs sociaux XVème Paris [20].

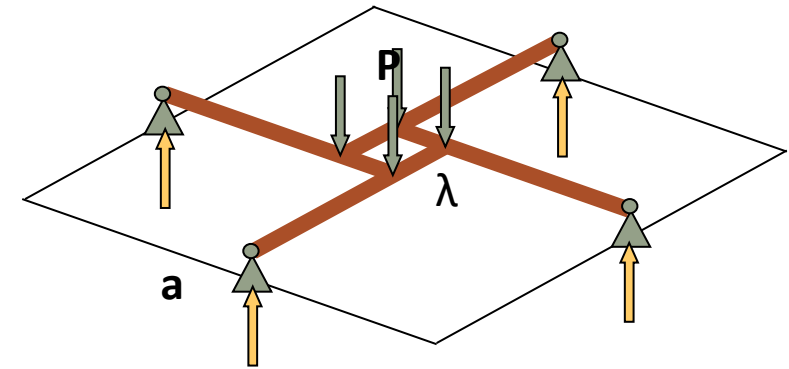
# Structure autobloquante



Joseph Abeille, Membre du Corps des ingénieurs, 1699

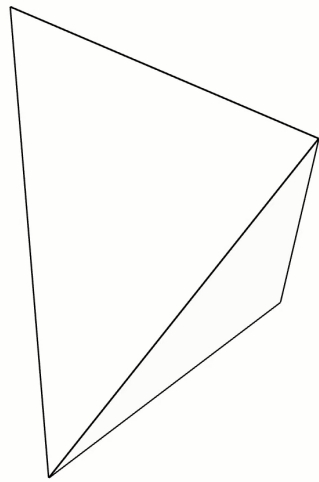


*Brevet de la voûte plate de Joseph Abeille publié en 1735 par Gallon in « Machines et inventions approuvées par l'Académie royale des sciences »*



Fonctionnement des structures réciproques  
Brocato et Mandarini, 2015

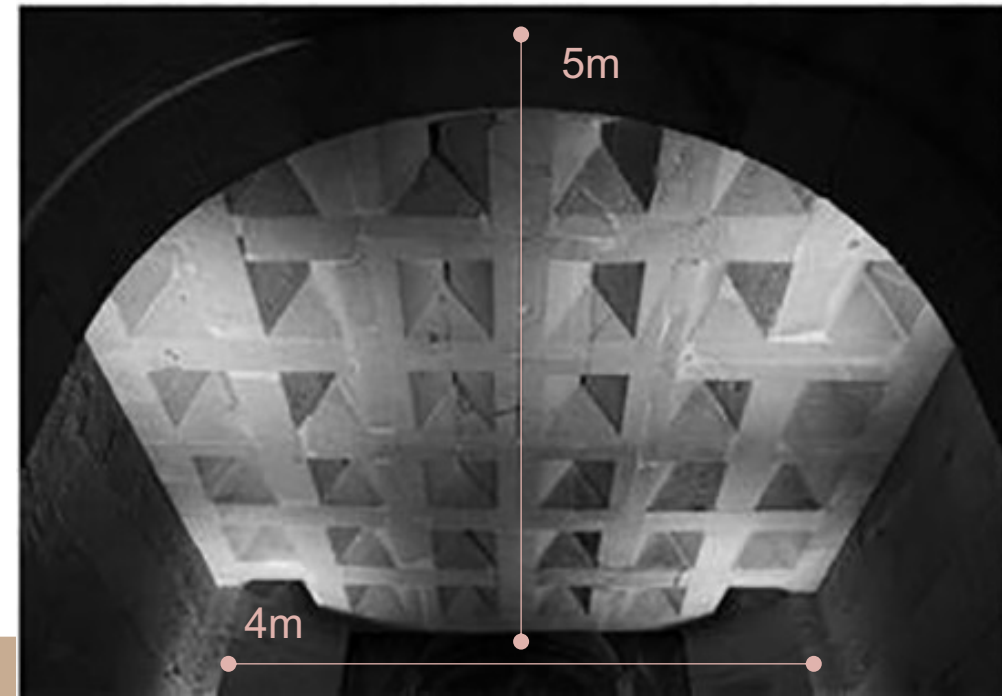
# Systeme autobloquant



## Cathédral de Lugo, 1769

Julián Sánchez Bort, L'ingénieur et architecte  
(1725-1785).

Image: (Perello,2020)

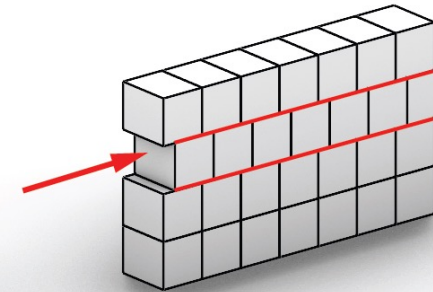
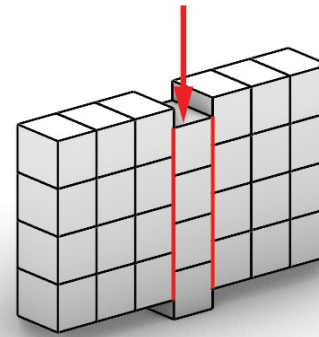
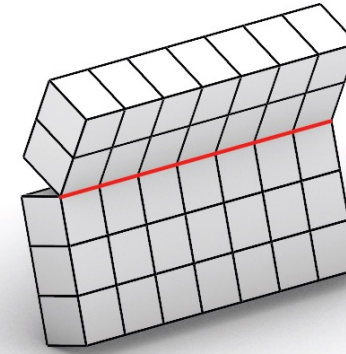
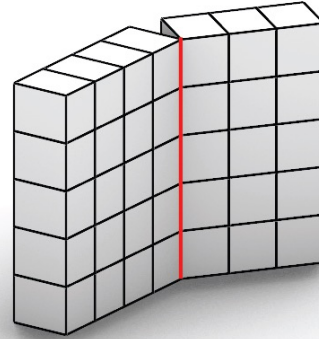
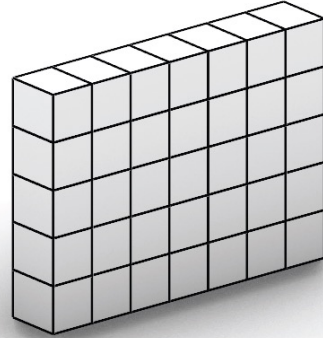


# Emboîtement



Mur sans harpage

Sans emboîtement

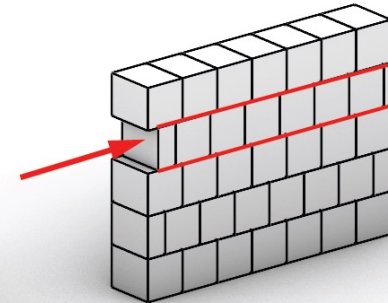
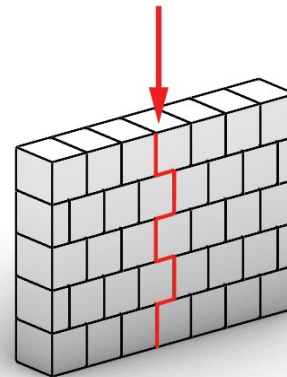
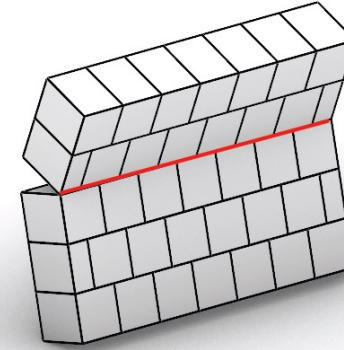
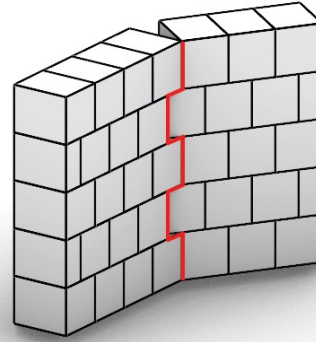
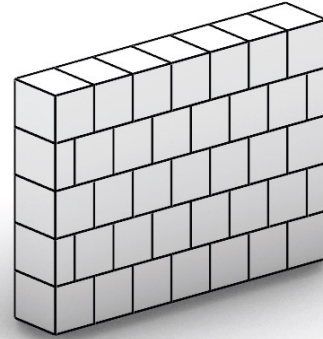


# Emboîtement

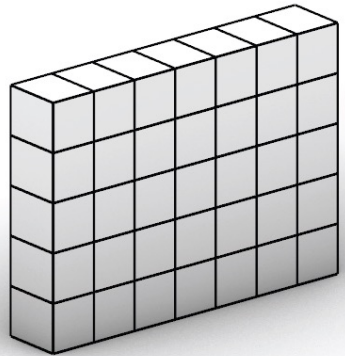


Mur d'empilement  
harpé

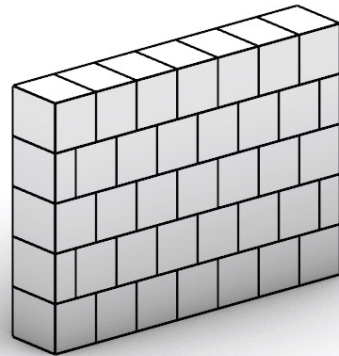
Emboîtement dans  
une direction



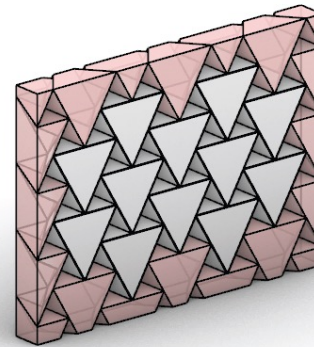
# Systeme autobloquant



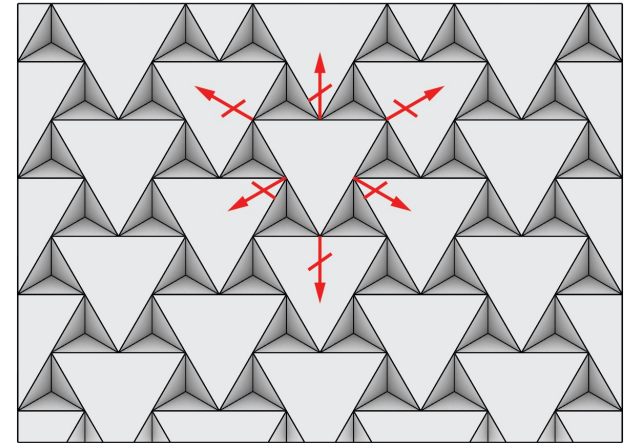
Mur sans harpage



Mur harpé



Mur autobloquant



Emboîtement dans toutes les directions

# Systeme de confinement



**Colle**

Prototype Stone Matters, Jericho, Palestine,  
Anastas et Brocato, 2017



**Cadre en Bois**

Astonyshine- Solar décathlon- France/Italie,  
Responsable scientifique; Maurizio Brocato  
2014



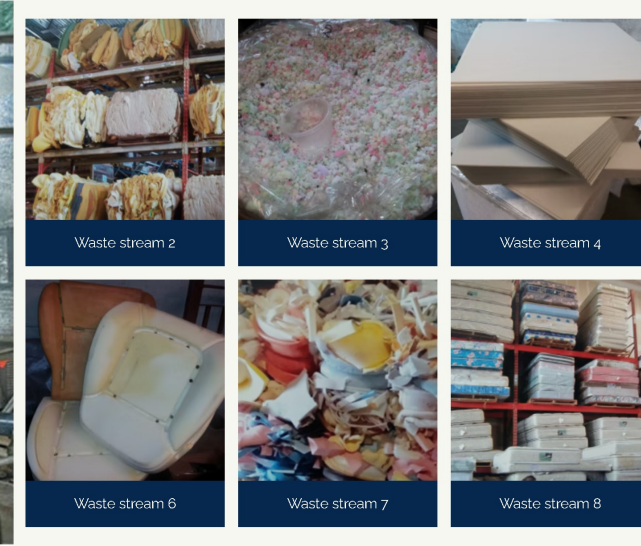
**Chaînage et Boulonnage**

Mur préfabriqué, Marios Vekinis, Gaia  
2023

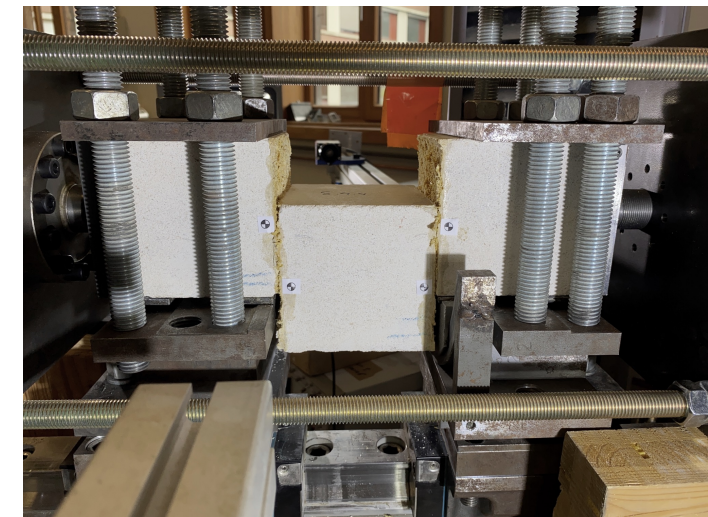
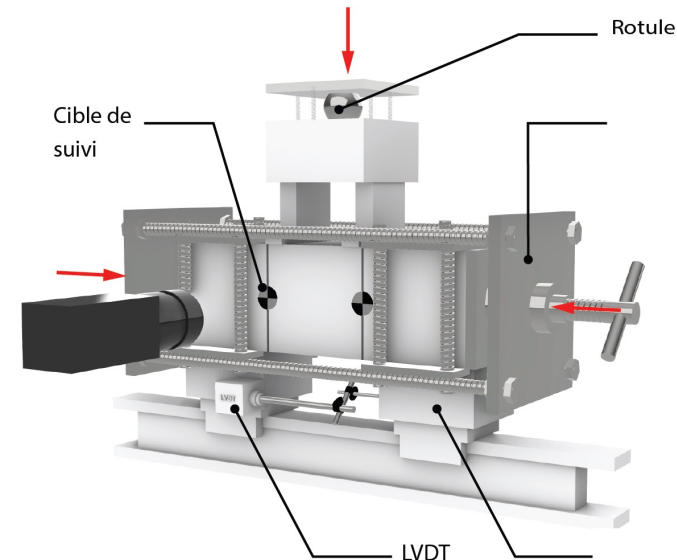
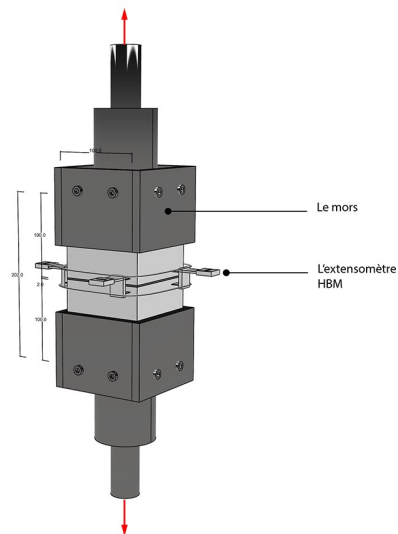
# Recyclopol™

## L'adhésif polyuréthane bi-composant

### POLYCHEM Solution



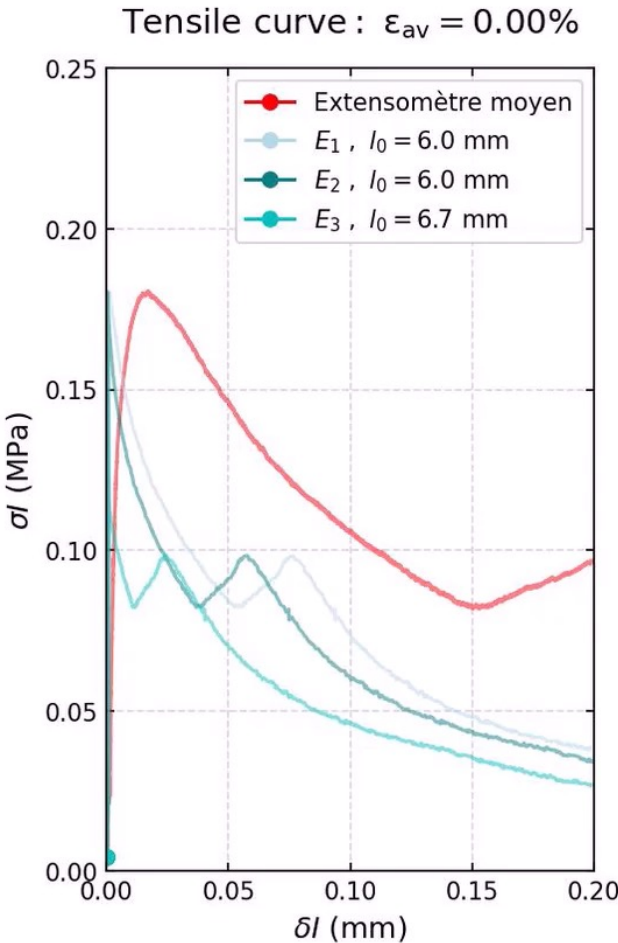
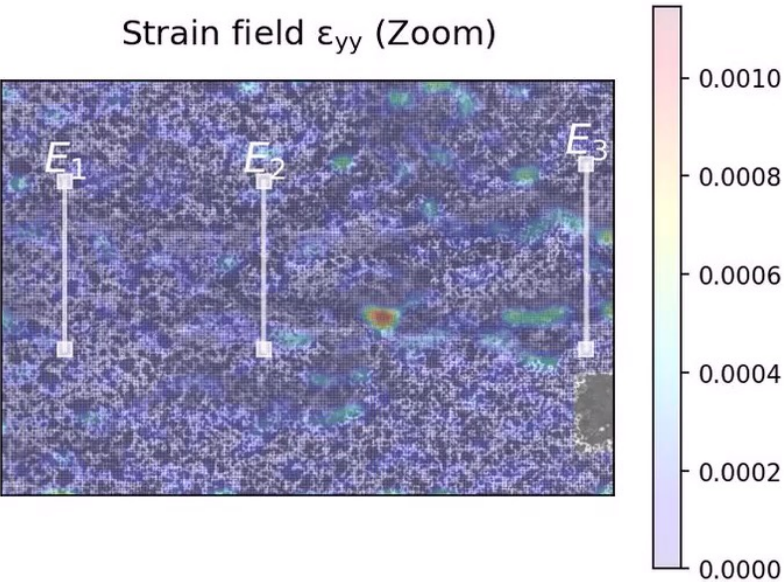
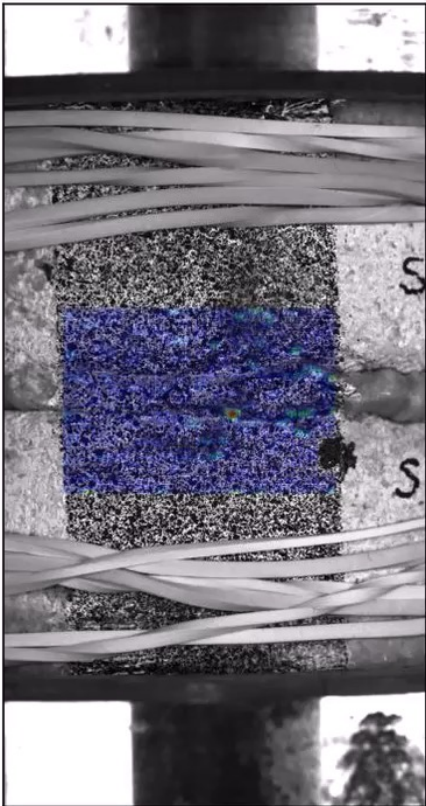
## Caractérisation de l'interface pierre-adhésif



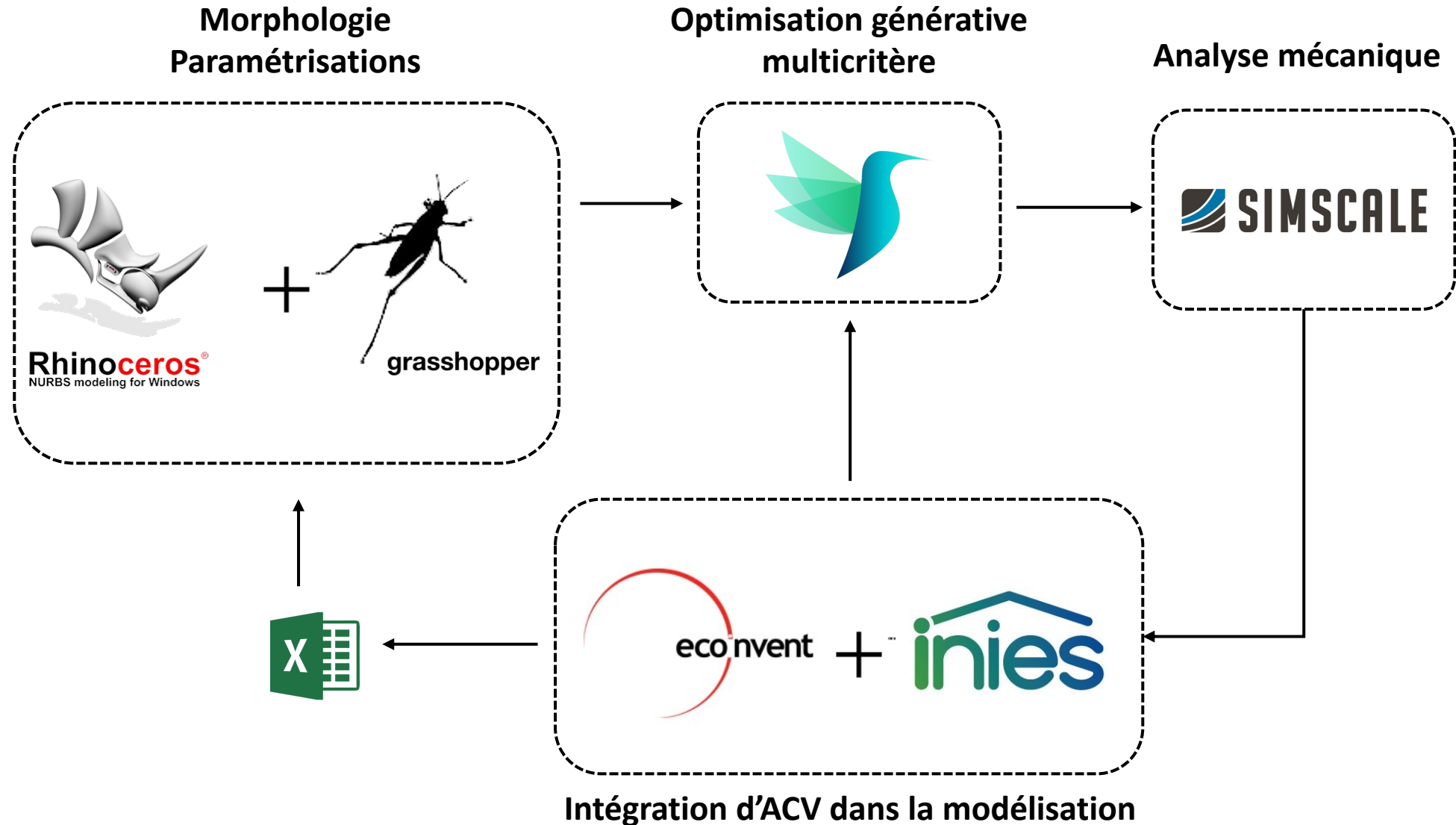
laboratoire I2M, la plateforme XYLOPLATE, Université de Bordeaux

# Comportement d'interface et le mode de rupture en traction

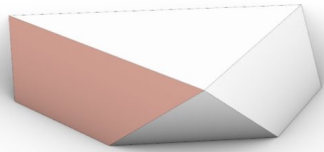
100 % recyclage



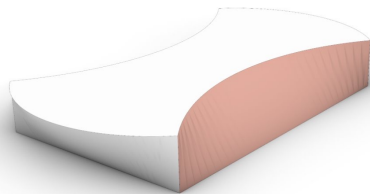
# Méthode de conception et fabrication des enveloppes en pierre



# Topologies des systèmes autobloquant

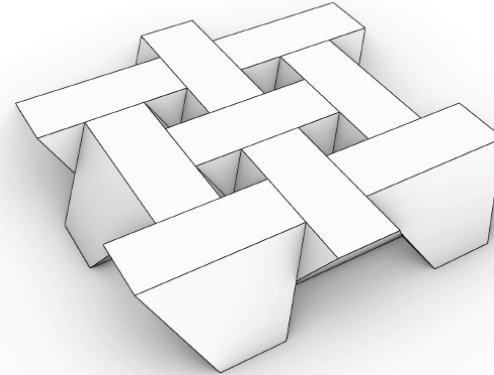


*Surface de contact plane*



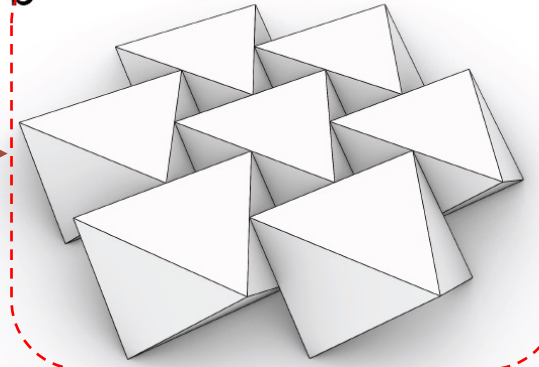
*Surface gauche réglée et non réglée*

a



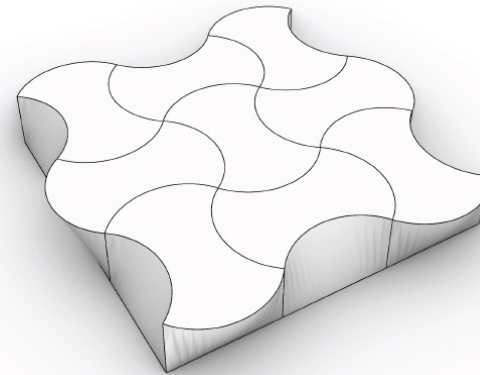
*Abeille*

b



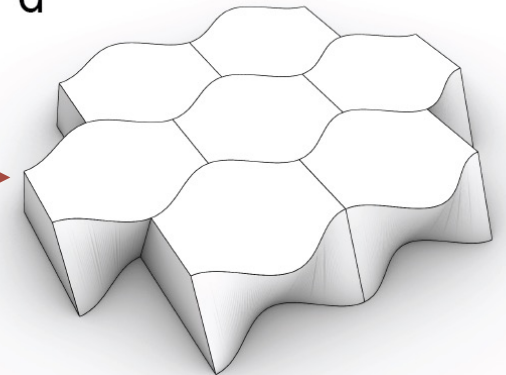
*Solide de Platon*

c



*Truchet*

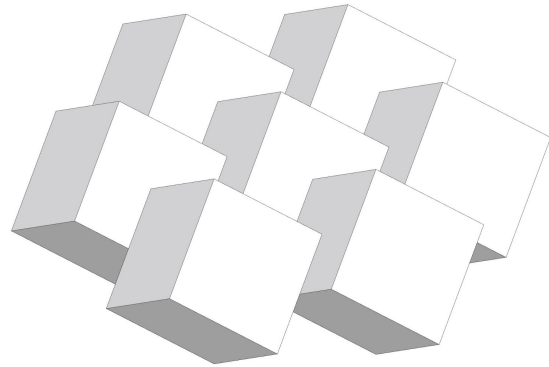
d



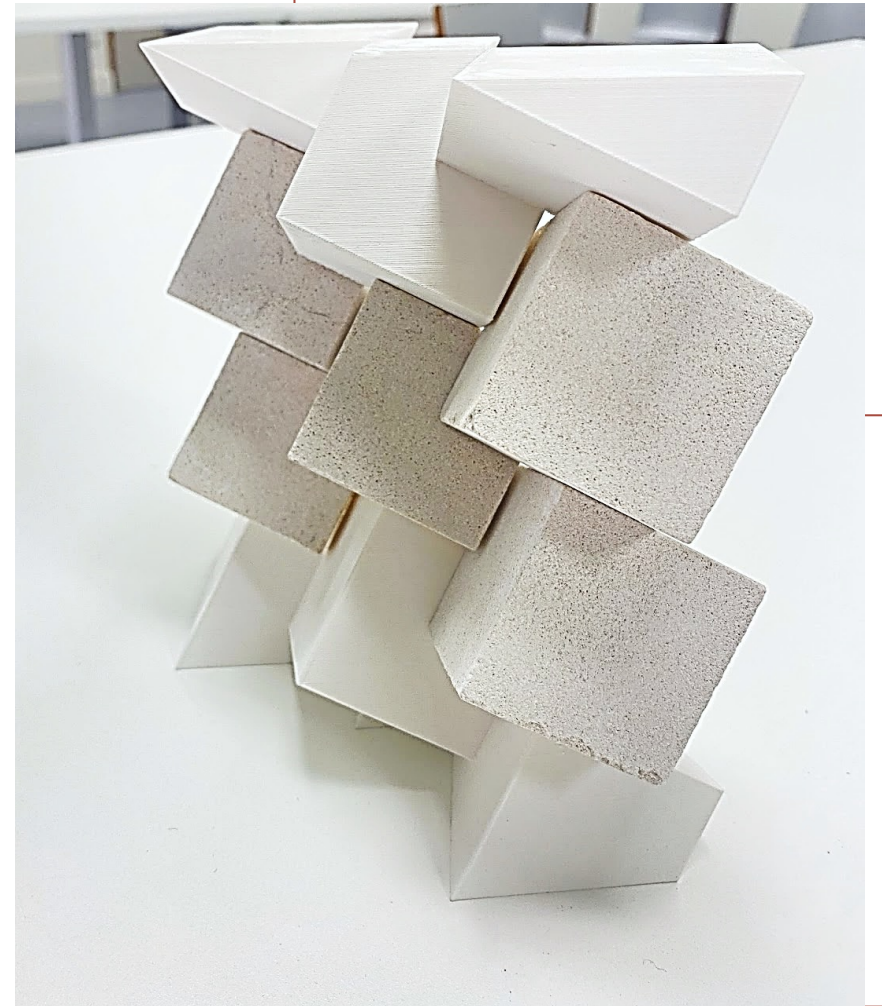
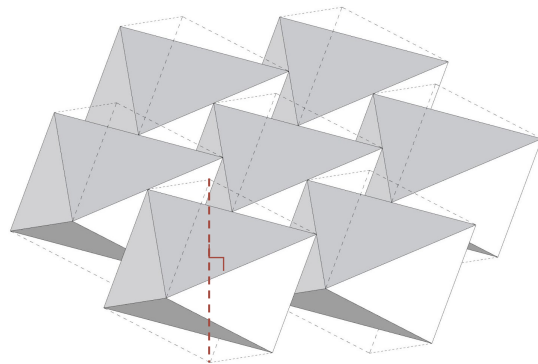
*Ostéomorph*

# Octa Mur

Agencements des cubes

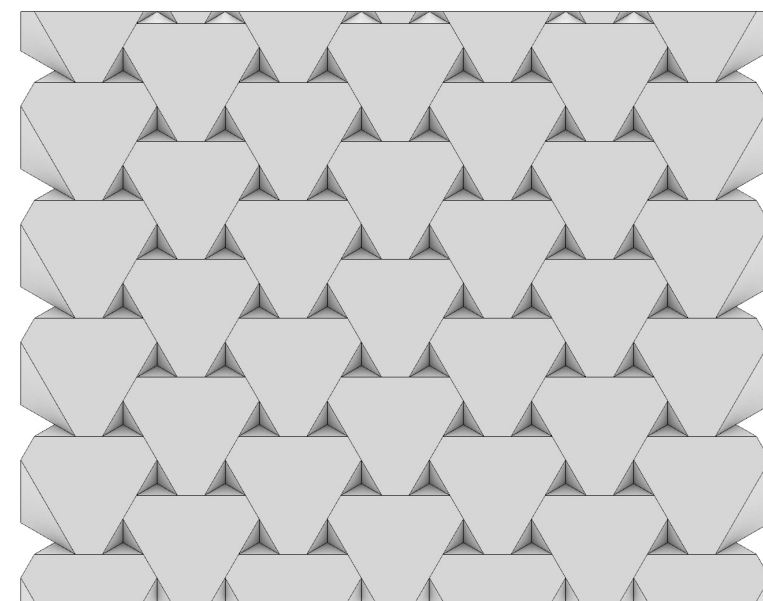
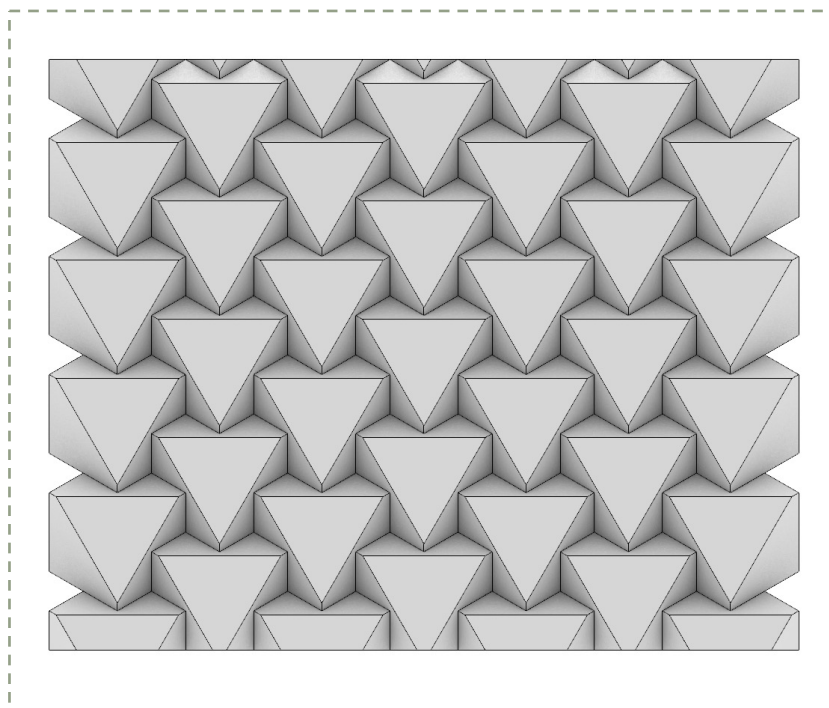
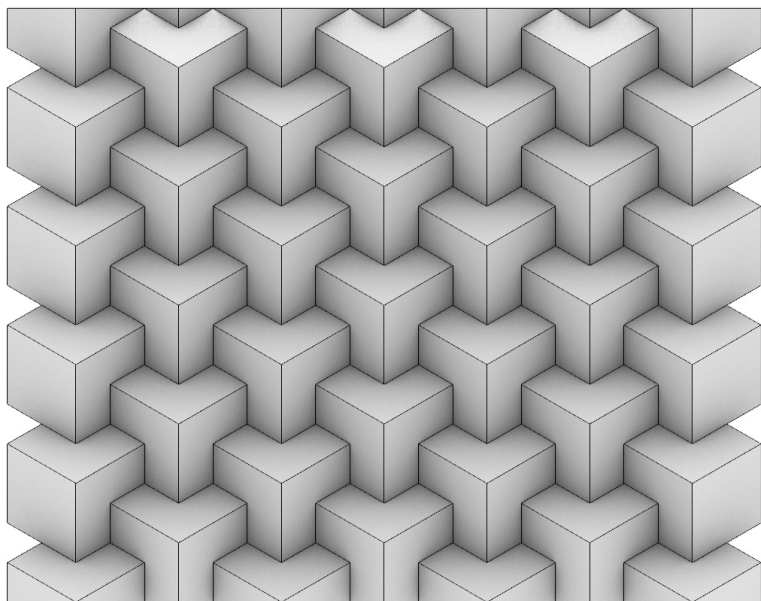


Coupe par un plan perpendiculaire aux diagonales des cubes pour obtenir les blocs **octaèdres**



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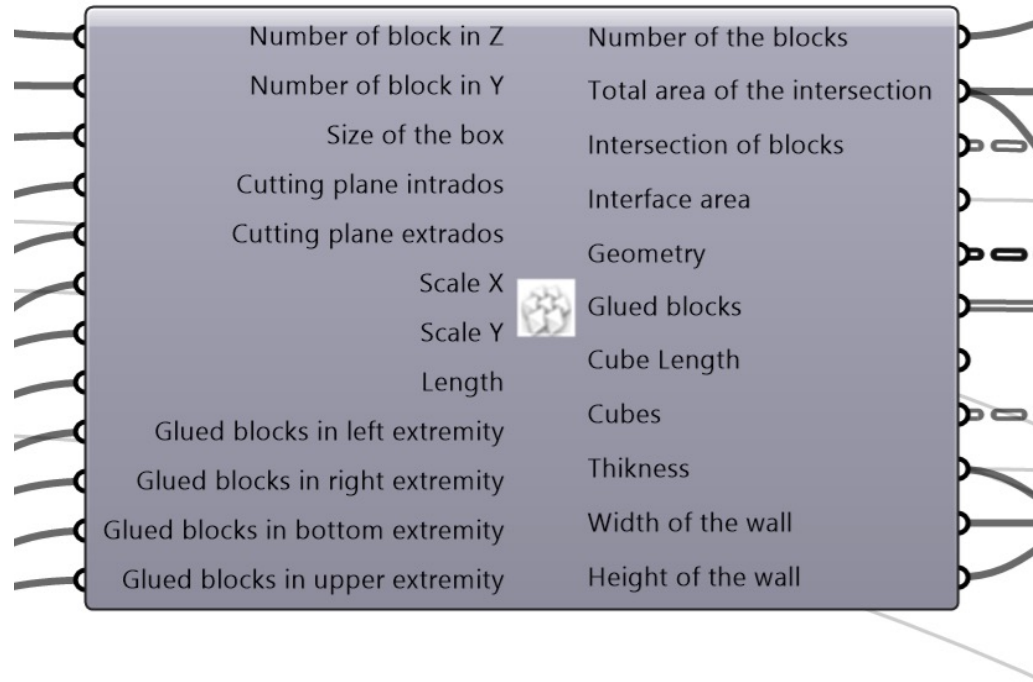
# Octa Mur



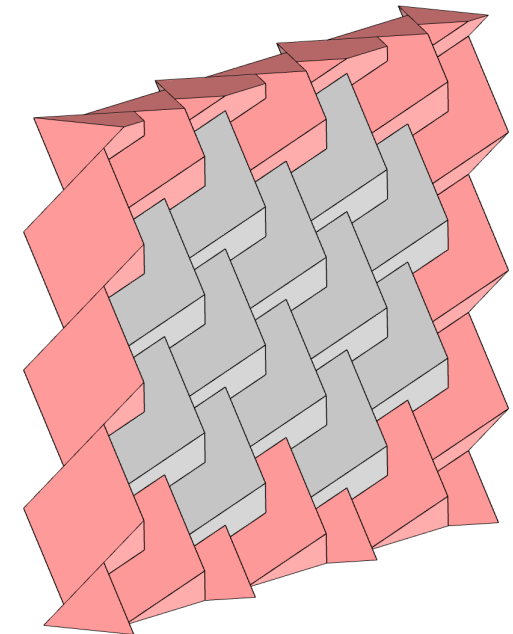


# Octa Mur Modélisation

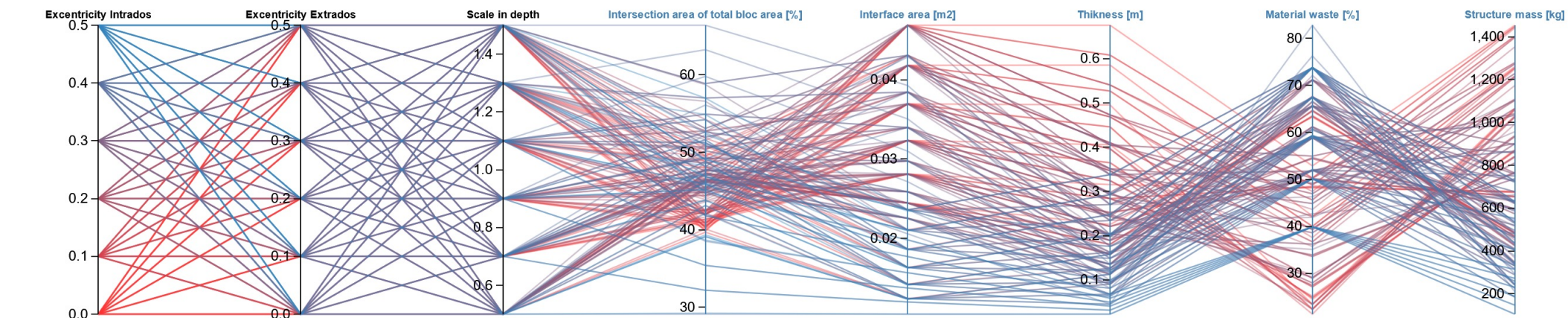
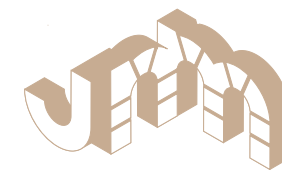
## Paramétrisation



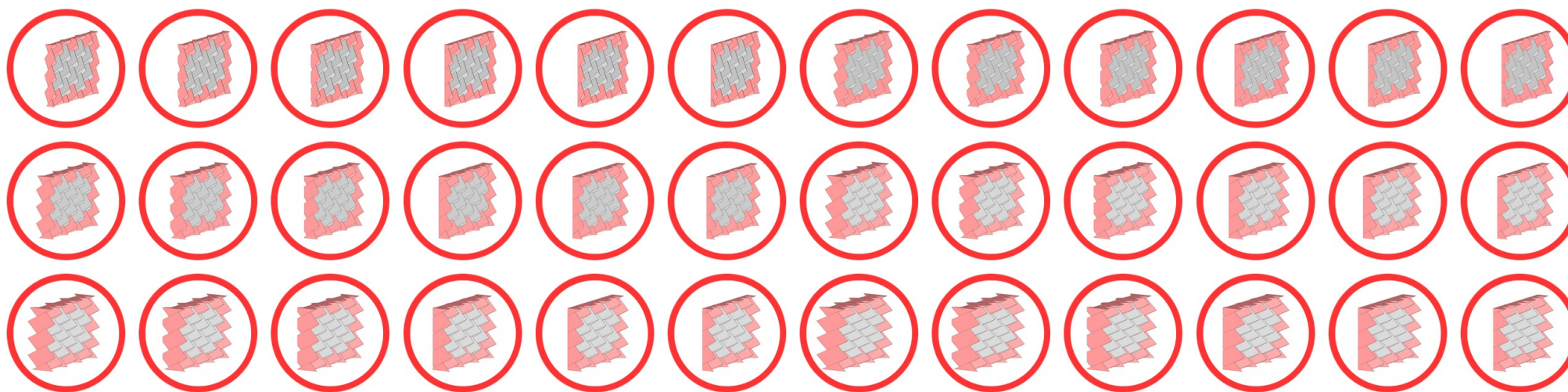
## Itérations



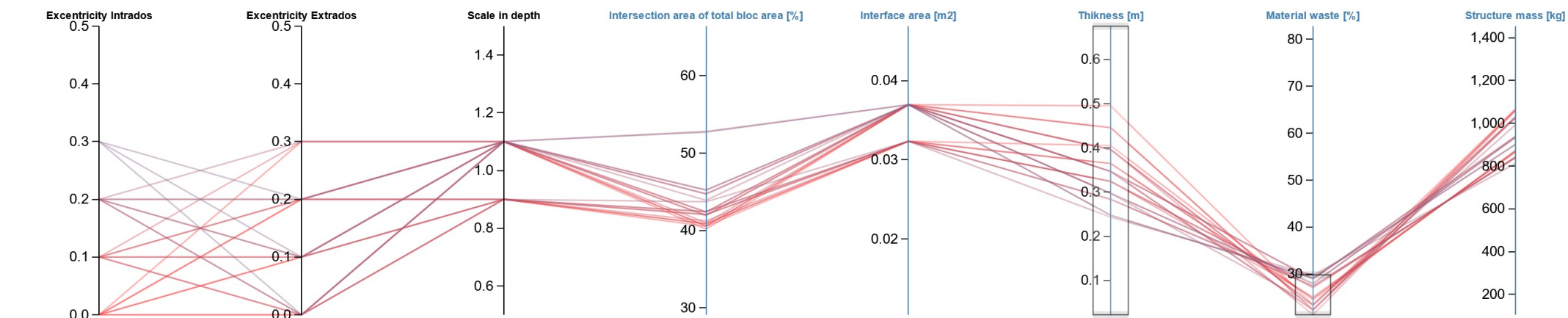
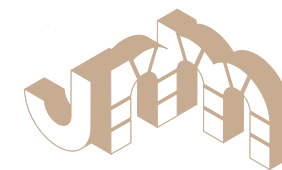
# Octa Mur Optimisation multicritères



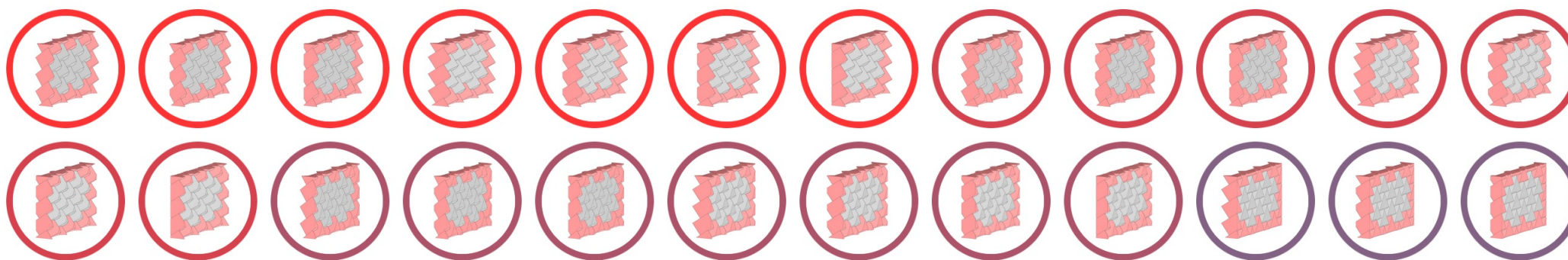
Sort by:



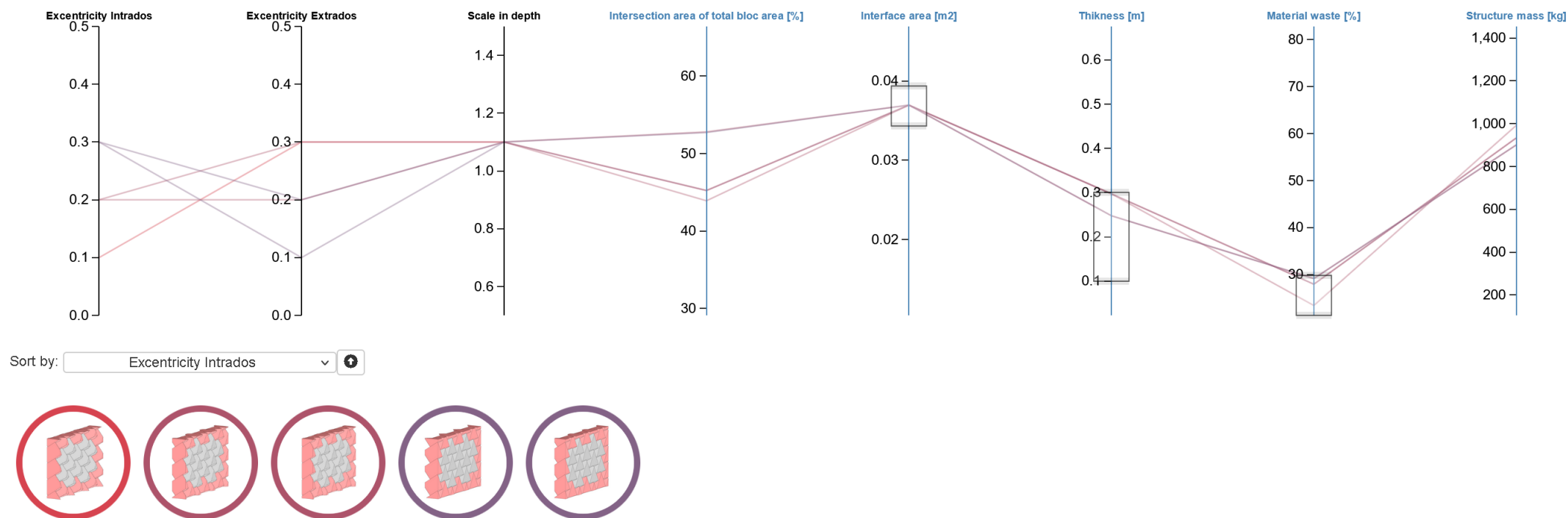
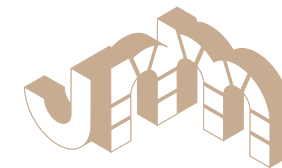
# Octa Mur Minimisation des déchets



Sort by:

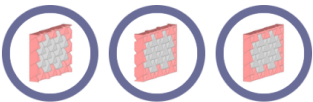
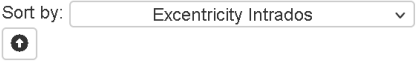
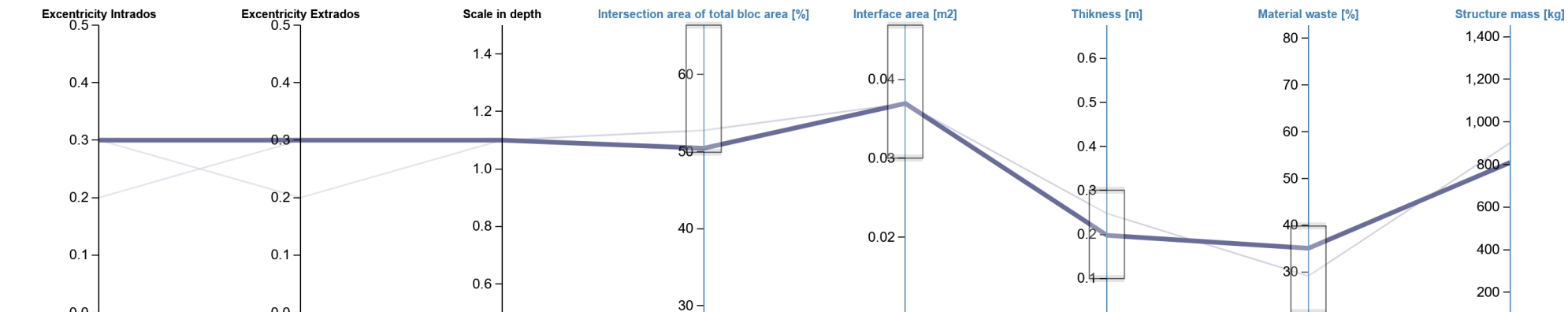


# Octa Mur Augmentation de la surface de contact





# Octa Mur



Attributes

Excentricity Intrados : 0.3

Excentricity Extrados : 0.3

Scale in depth : 1.1

Intersection area of total bloc area [%] : 50.446383

Interface area [m2] : 0.036959

Thikness [m] : 0.198147

Bounding box dimension a [m] : 0.272465

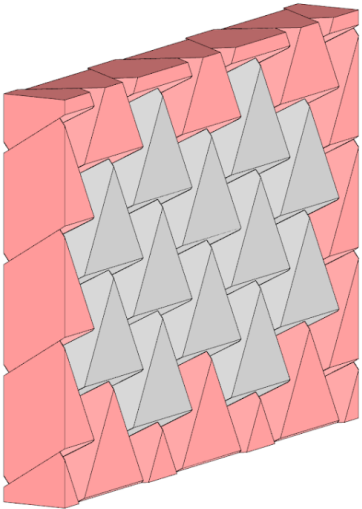
Bounding box dimension b [m] : 0.267864

Bounding box dimension h [m] : 0.284849

Material waste [%] : 35.093799

Structure mass [kg] : 809.610611

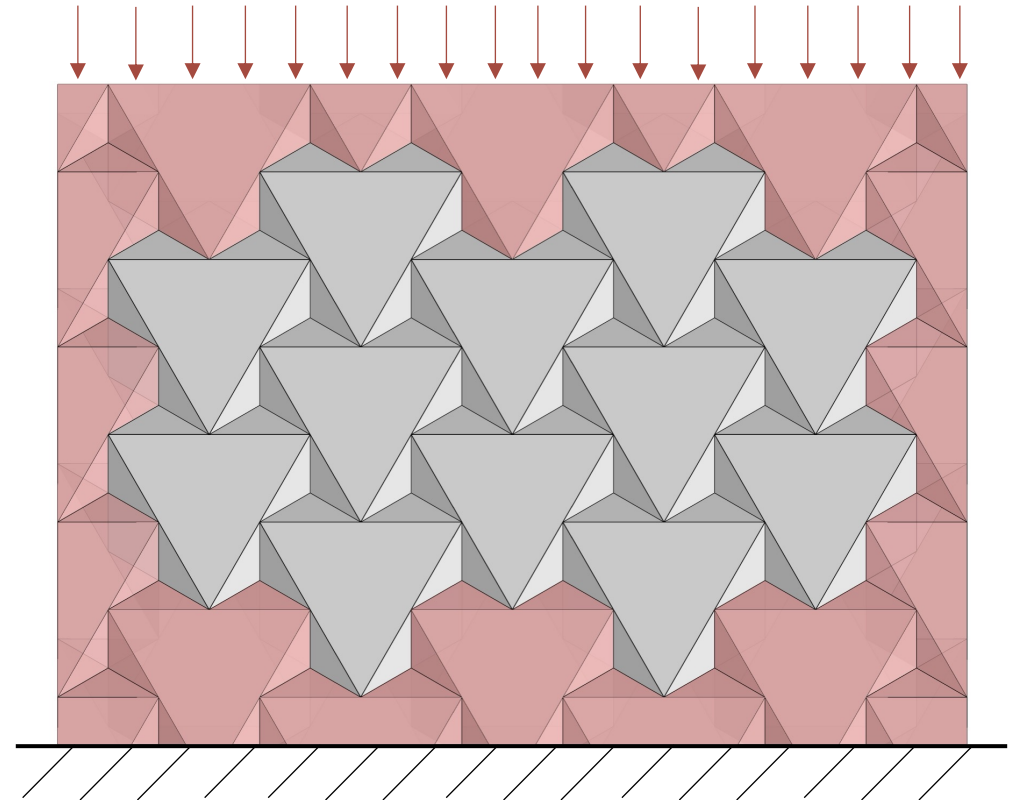
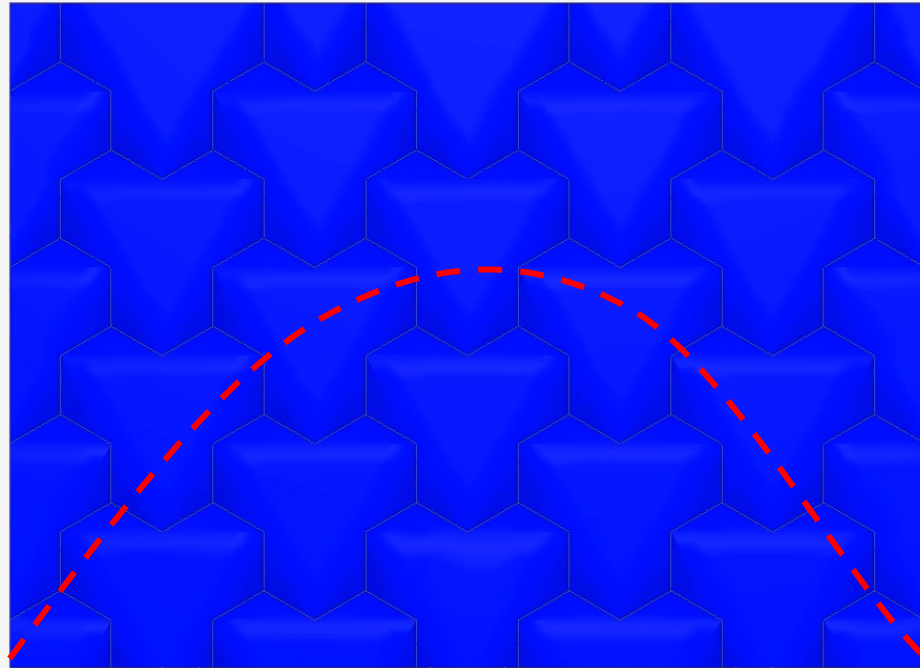
Rating : 0





# Comportement mécanique



0 - 10 Mpa

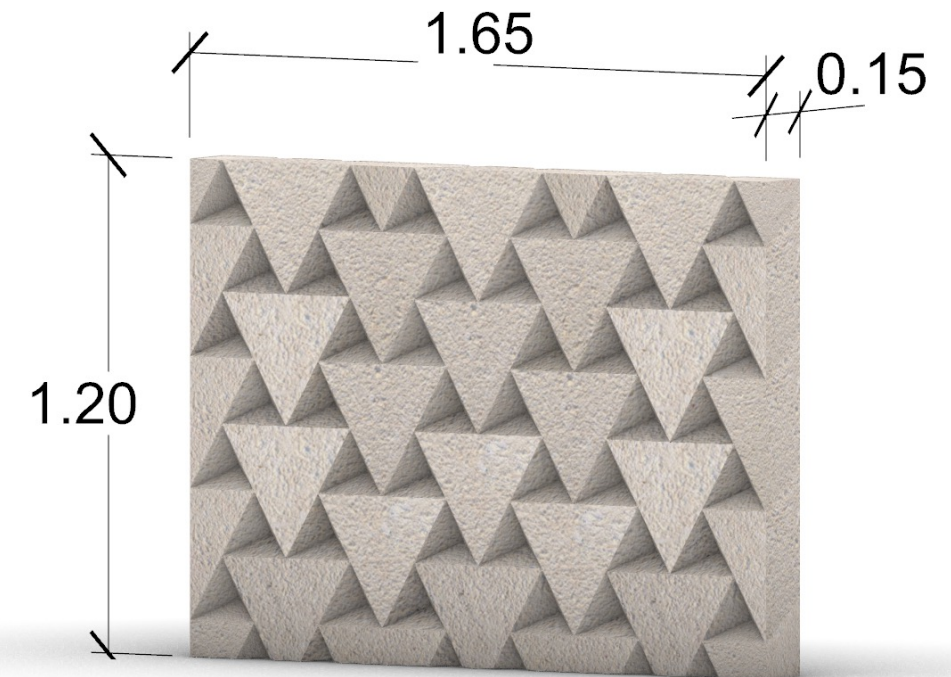


-  Blocs collés
-  Blocs à joint sec

# Prototypage Octa Mur



La pierre de Fontvieille, 9 Mpa résistance en compression

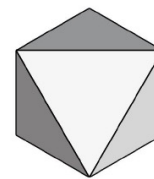


# Optimisation des impacts environnementaux

Réduction de matériaux primaires par la conception

12% moins de déchets par la méthode de taille par rapport à la méthode de taille traditionnelle

24 Blocs



3 Blocs



3 Blocs



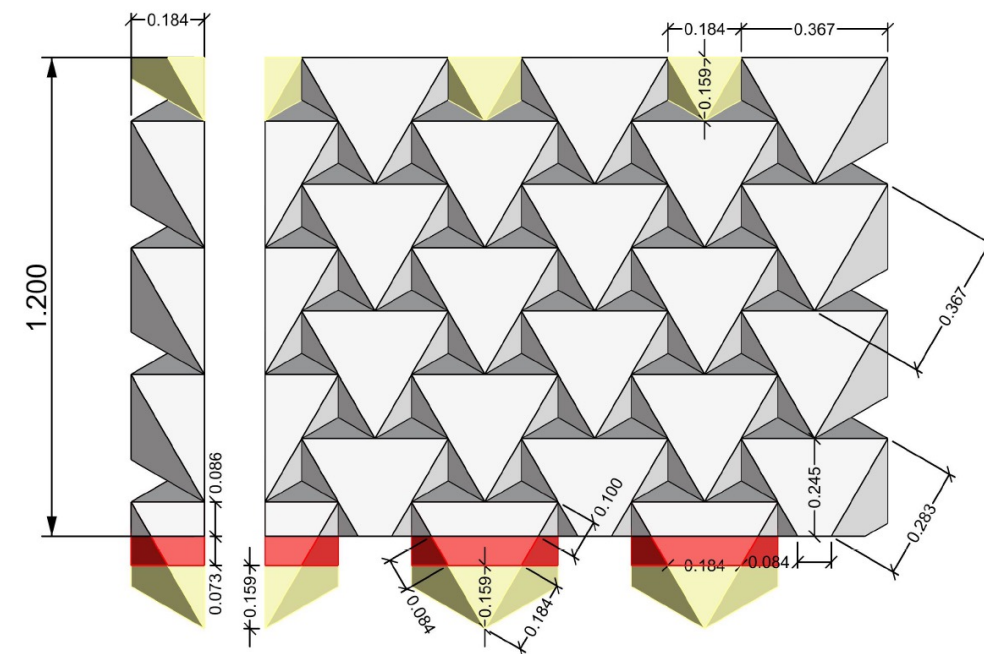
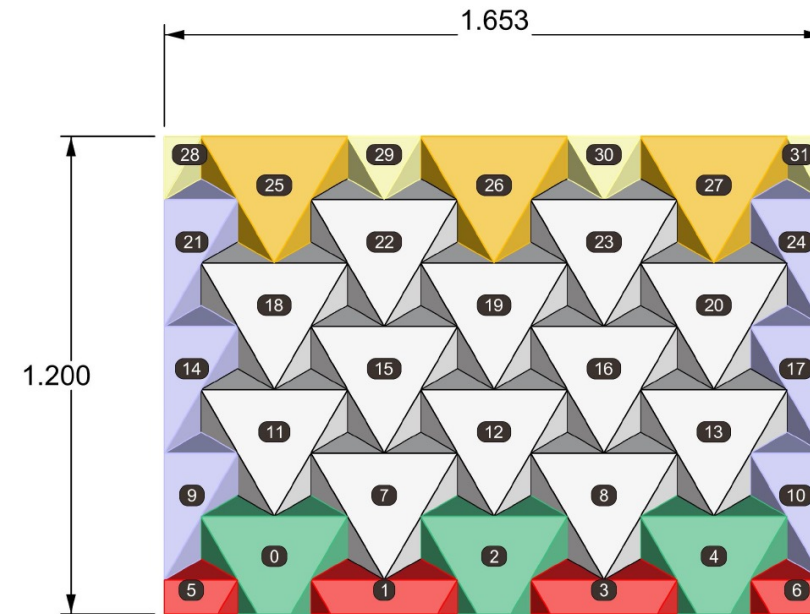
3 Blocs



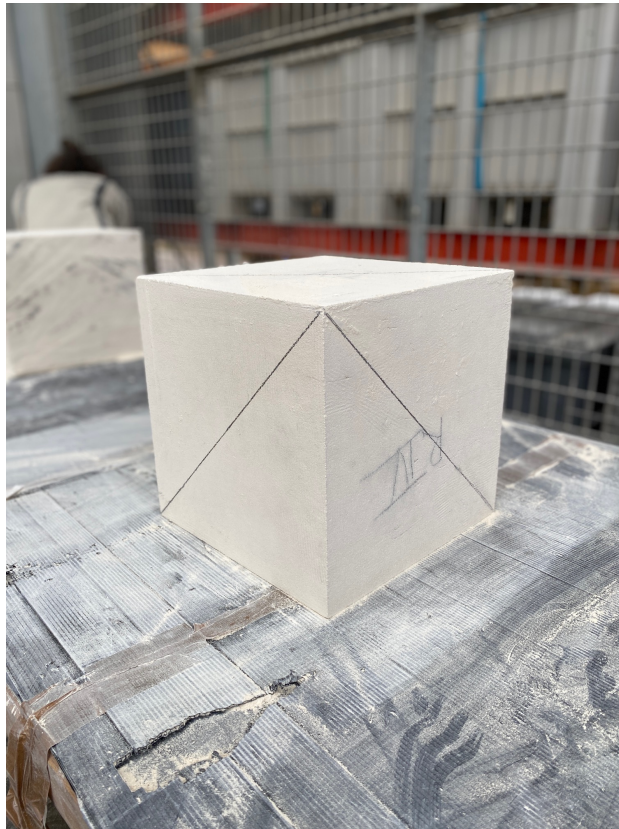
4 Blocs



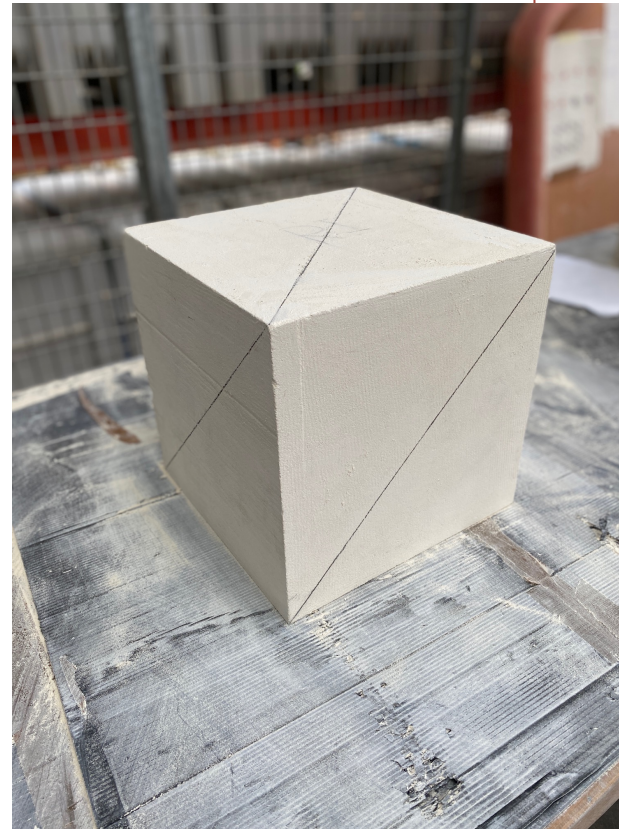
1 Blocs



## Validation de fabrication



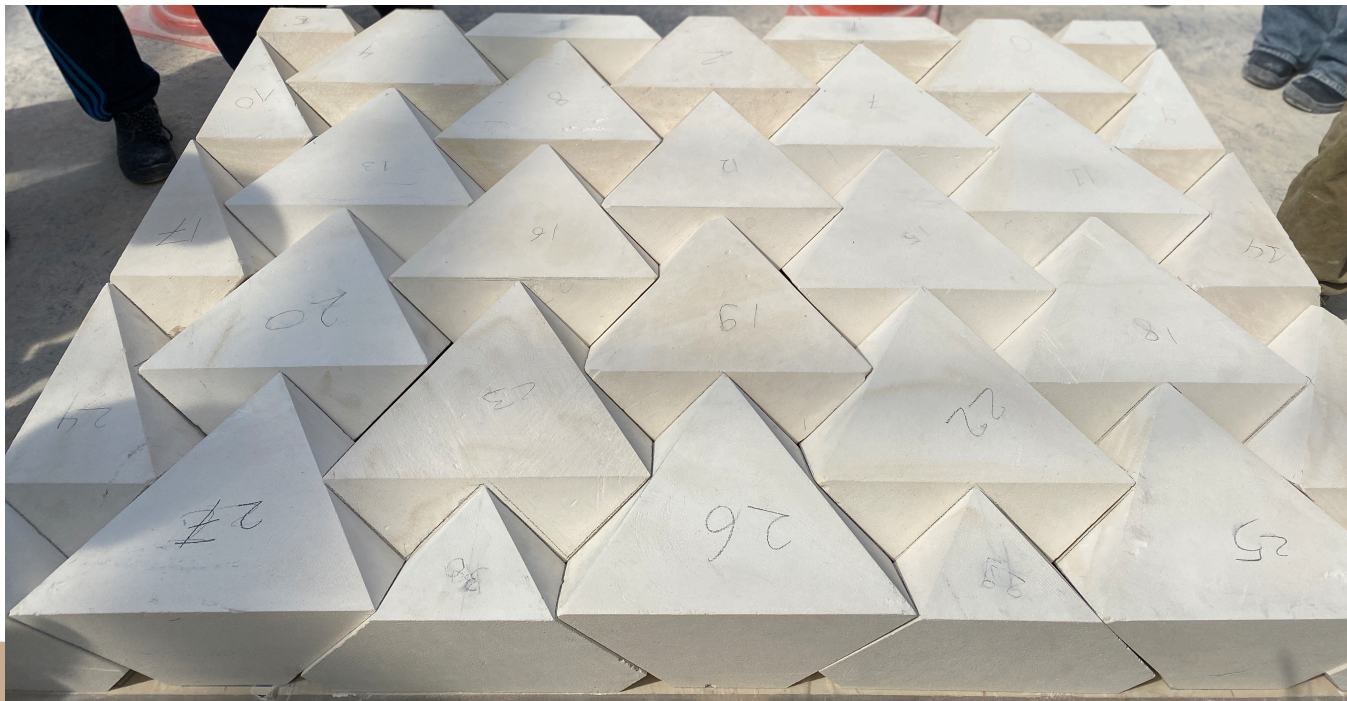
Tracer les diagonales



## Méthode de taille



Extraction les deux pyramides



## Assemblage séquentiel

# Validation de stabilité

Charge de 40 kg



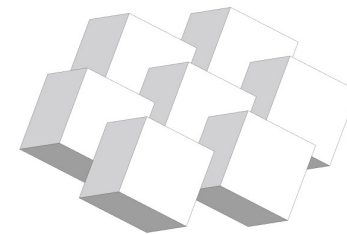
Charge de 840 kg



Charge de 2 tonnes



# Prototypes

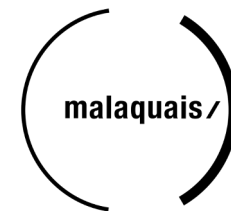
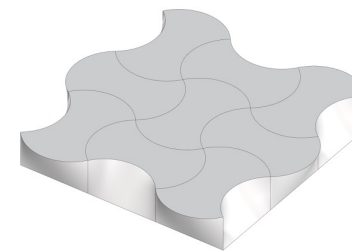


OctaMur



TOS vault conçu par Paul Nougarede, Anahita Mirani, Aly Abdelmagid, Paul Vergonjeanne, Gaia 2022

# Prototypes



Minimal stone, Réalisé à Gaia avec Des compagnons du devoir et ENSA Paris-Malaquais, conçu par Anahita Mirani, Paul Vergonjeanne, 2024



# Merci de votre attention

Contact :

Anahita Mirani

[anahita.mirani@paris-malaquais.archi.fr](mailto:anahita.mirani@paris-malaquais.archi.fr)

Journées Nationales de la Maçonnerie

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