THE STONEMASONRY
COMPANY LIMITED

Genies de la Pierre. Symposium. Montpellier 2023.

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1 • **LA PIERRE ARMÉE**

2 • LA SOLUTION EST DANS L’ESCALIER

3 • **RECHERCHE APPLIQUÉE**

4 • CRIMES ET SEDIMENTS

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1

LA PIERRE ARMÉE
-
UN CONCEPT ANCIEN

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PIERRE AU MILIEU,
ACIER EN TRAVERS
SOUTIENDRA L’UNIVERS.

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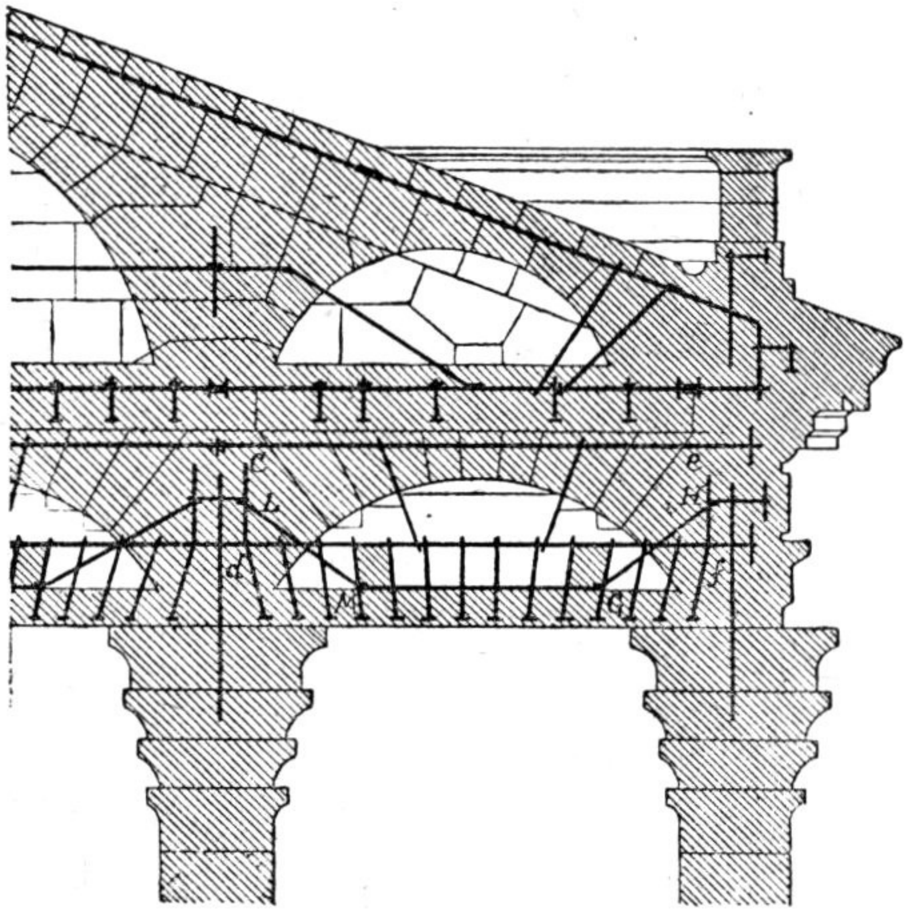
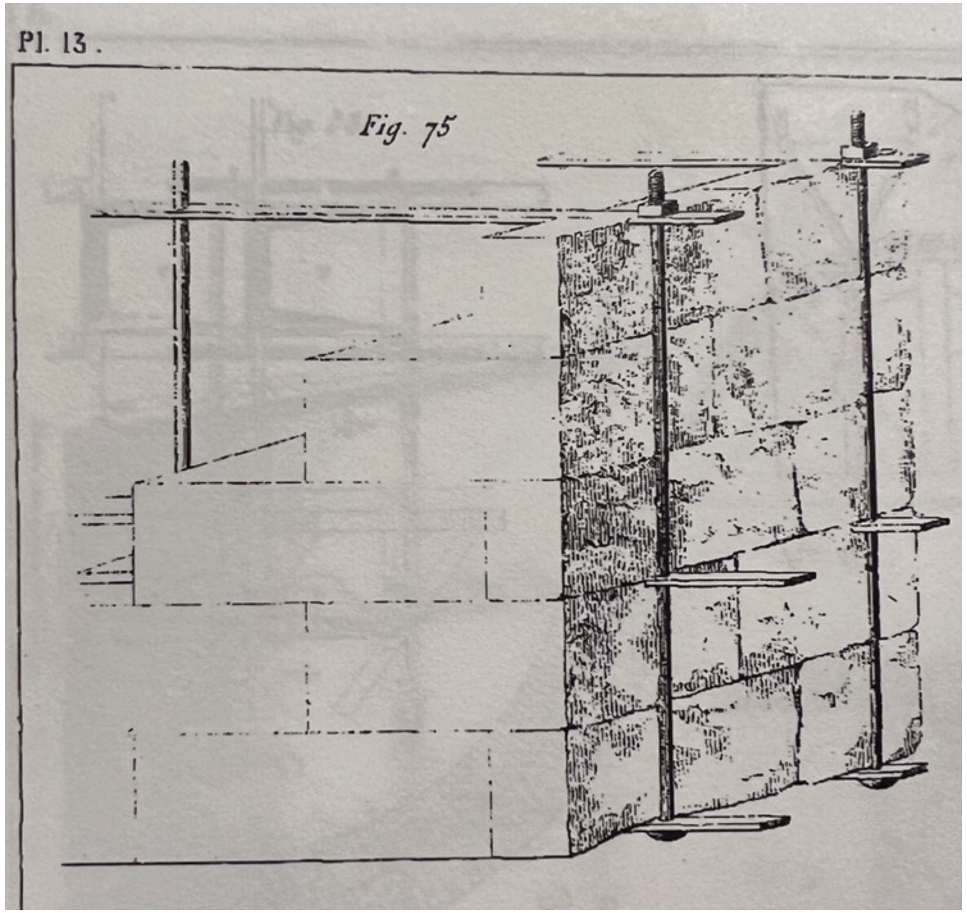
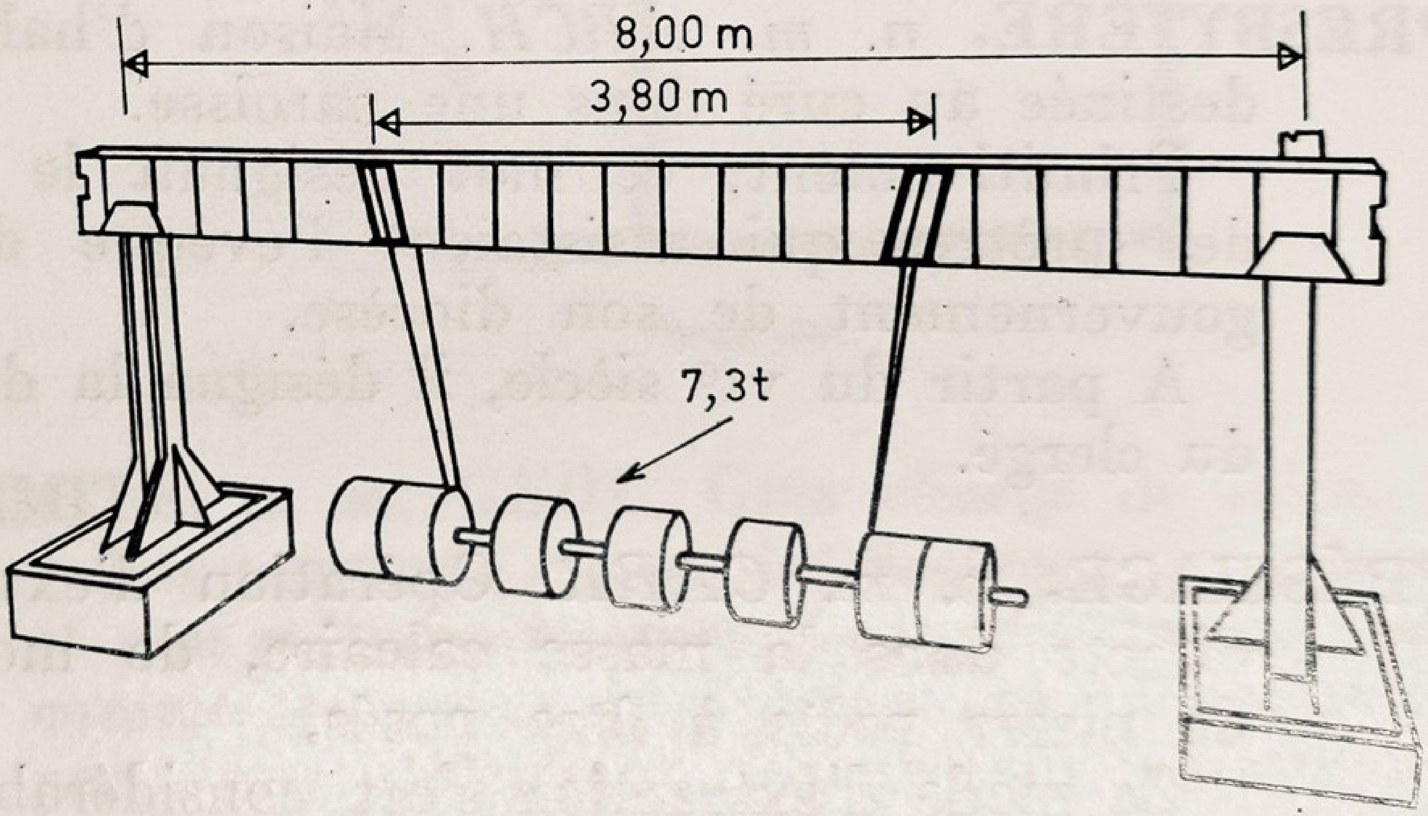



Pl. 13.
Fig. 75



Précontraint.

(1) Le procès-verbal des essais, dressé par le Centre expérimental peut être consulté, à l'U. N. I., rue Alfred-Roll; il porte le n° 412-6-068; ou à l'Association ouvrière des compagnons du devoir, 82, rue de l'Hôtel-de-Ville, Paris, IVe.

2

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LA SOLUTION EST DANS L’ESCALIER.

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UNE STRUCTURE DEMANDEUSE.

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QUE DANS CHAQUE ESCALIER
ON RETROUVE LA FORCE ELEGANTE
DE LA PIERRE.


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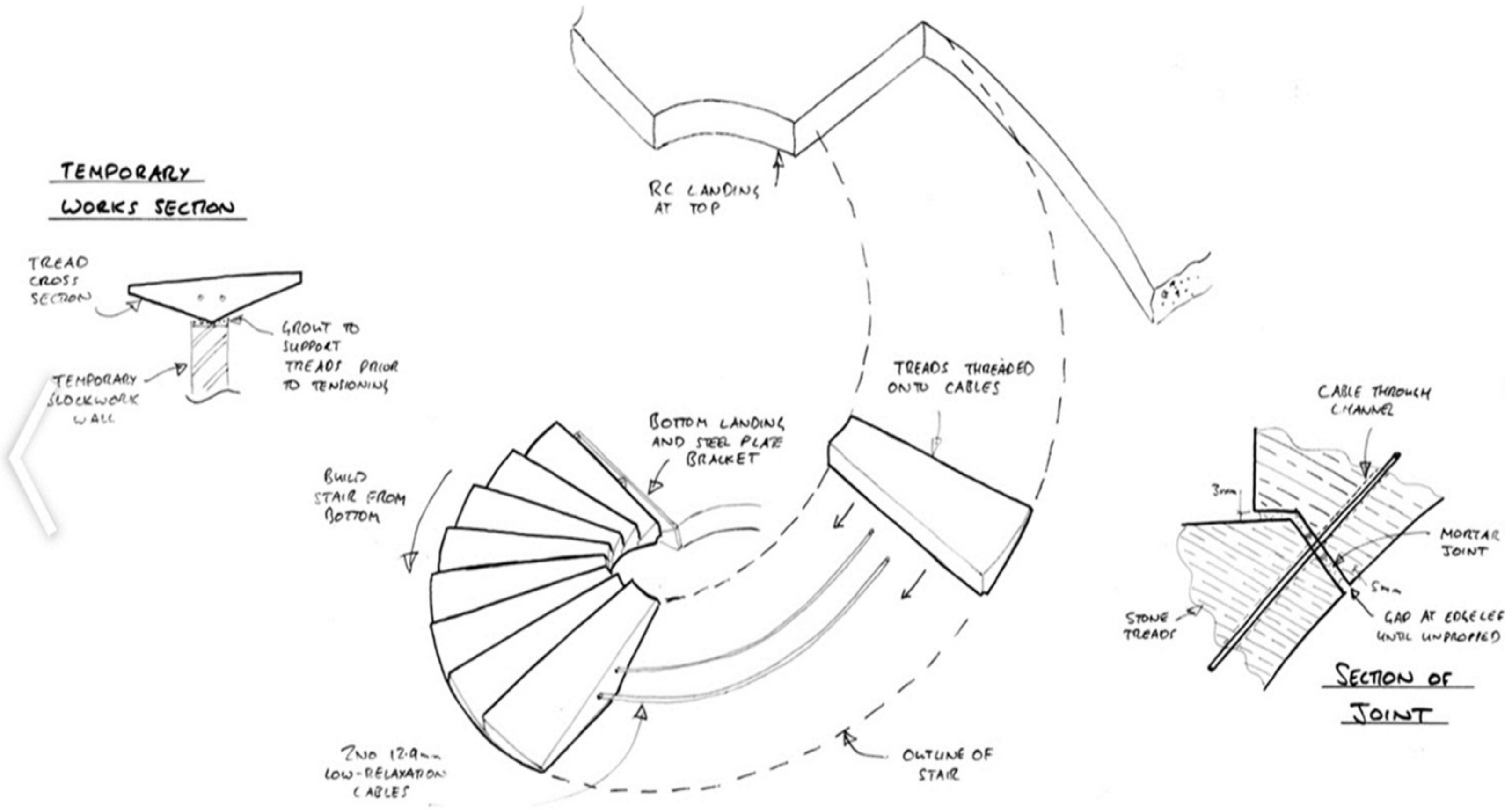

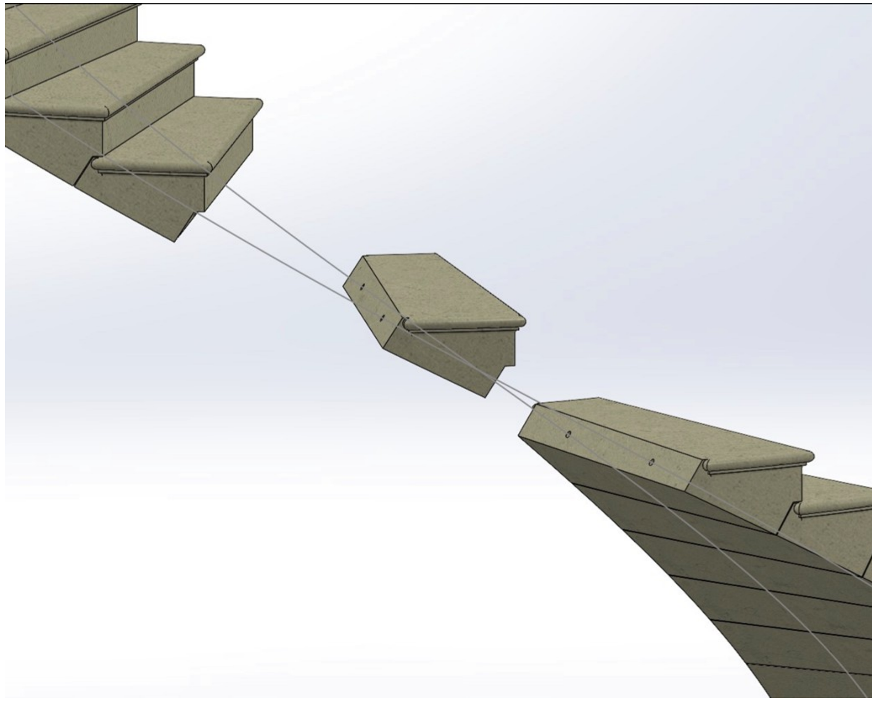

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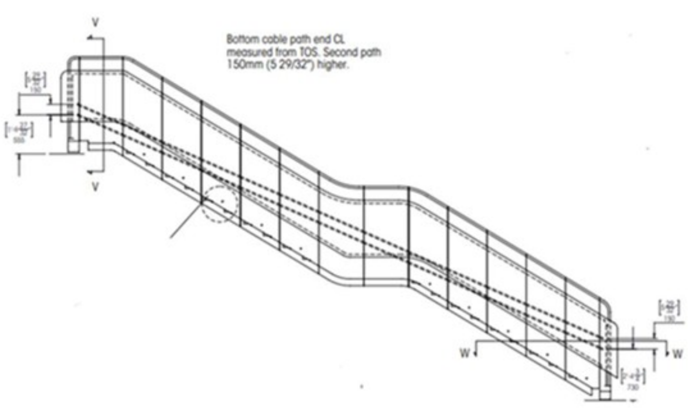
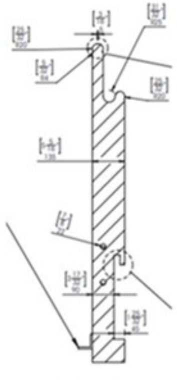
<u>The Problem:</u> Spanning 8m (>26 feet) in solid stone while keeping things elegant and inkeeping with the design house

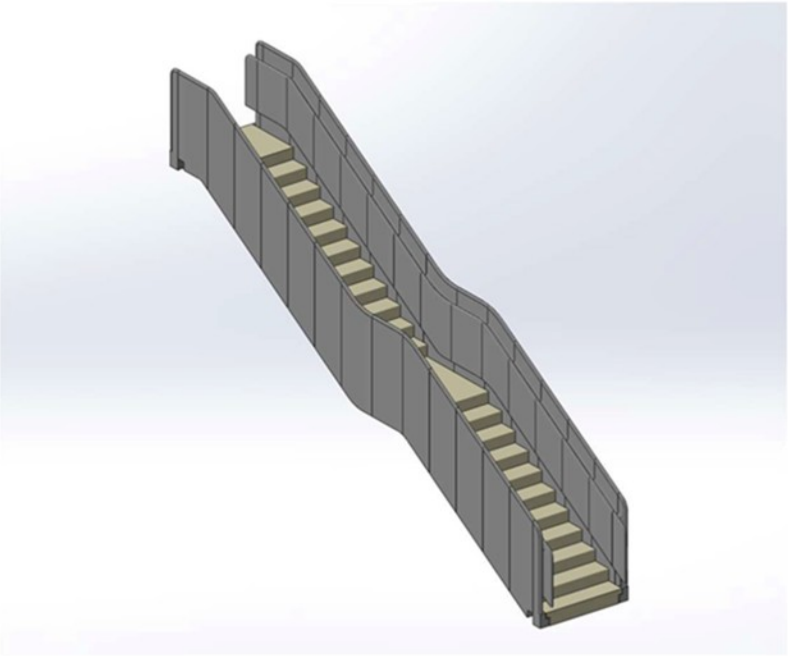
<u>The Solution:</u> 10tonnes of Pontval (flights 2 and 3) tensioned through intricate sections of balustrade, with treads bridging the gap. Flight 1 had a few more details tied in!





Section V-V
SCALE: 1 : 15

Side elevation showing all hidden lines – cable paths, notches in the balustrade for light fixings and tread locations as well as connecting dowels



The above model shows two colours purely for a contrast of where balustrade ends and tread begins. The final results was seamless, with Pontval being chosen for its excellent properties for this application, while remaining strikingly beautiful with its visible bedding.

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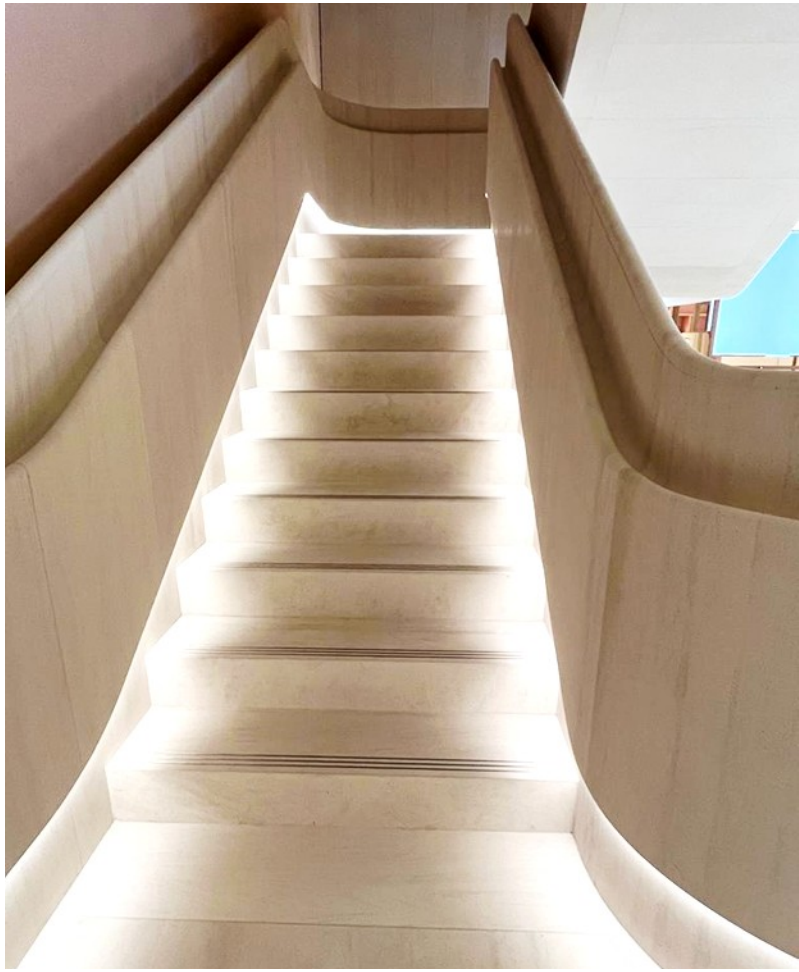


A Short History of Self Supported Natural Stone Staircases
POST-TENSIONED
2022
2021 - Market Building Longest Post Tensioned Straight Span in UK - 6.5M
2021
2020 - San Francisco 1st Post Tensioned Staircase in the USA - with PSI incorporation
2020
2020 - 1st Low Cost Prefabricated Reinforced
2020 - Georges Mews 1st Reinforced 2 flight Staircase
2019 - Loewe 1st Post Tensioned Commercial Staircase
2019 - Lennox 1st Single Cable Post Tensioned Staircase
2019
2018 - St Tropez 1st Post Tensioned 3 Flight Staircase in Europe
2018 - Sweden 1st Post Tensioned Staircase in Marble
2018 - Turkey 1st Post Tensioned Staircase Built in a Seismic Zone
2018
2017 - Pembridge Villa 1st Post Tensioned Staircase with a Quarter Landing
2017
2016
2016 - Luttrell Road 1st Reinforced Long Span Staircase with Quarter Landing
2016 - Tregunter 1st Staircase Reinforced Off Site
2016 - Ennismore Garden Reinforced Staircase
2015 - Camp End Manor 1st Post Tensioned Staircase with a 220° Rotation
2015 - Formby 1st Post Tensioned Staircase with a 300° Rotation
2015
2014
2014 - Burnsall Street Reinforced Small Span Staircase
2013
2012
2012 - Hill Top 1st Staircase Reinforced On Site
2012 - Upper Brook St Reinforced Small Span Staircase
2011 - Addisson Road 1st Post Tensioned Staircase in the United Kingdom
2011
2010
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REINFORCED
www.thestonemasonrycompany.co.uk
Email: admin@thestonemasonrycompany.co.uk

3

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RECHERCHE APPLIQUÉE SIMPLIFIÉE

-

CAPITALISE, RE-UTILISE, MUTLIPLIE

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LA PIERRE, UNE COMMODITE ET PAS UN LUXE

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IN FRANCE IN 1950 YOU NEEDED

225Kg COAL

→ TO PRODUCE

1 CUBIC METER OF CONCRETE

10Kg COAL

→ TO EXTRACT AND CUT

1 CUBIC METER OF STONE

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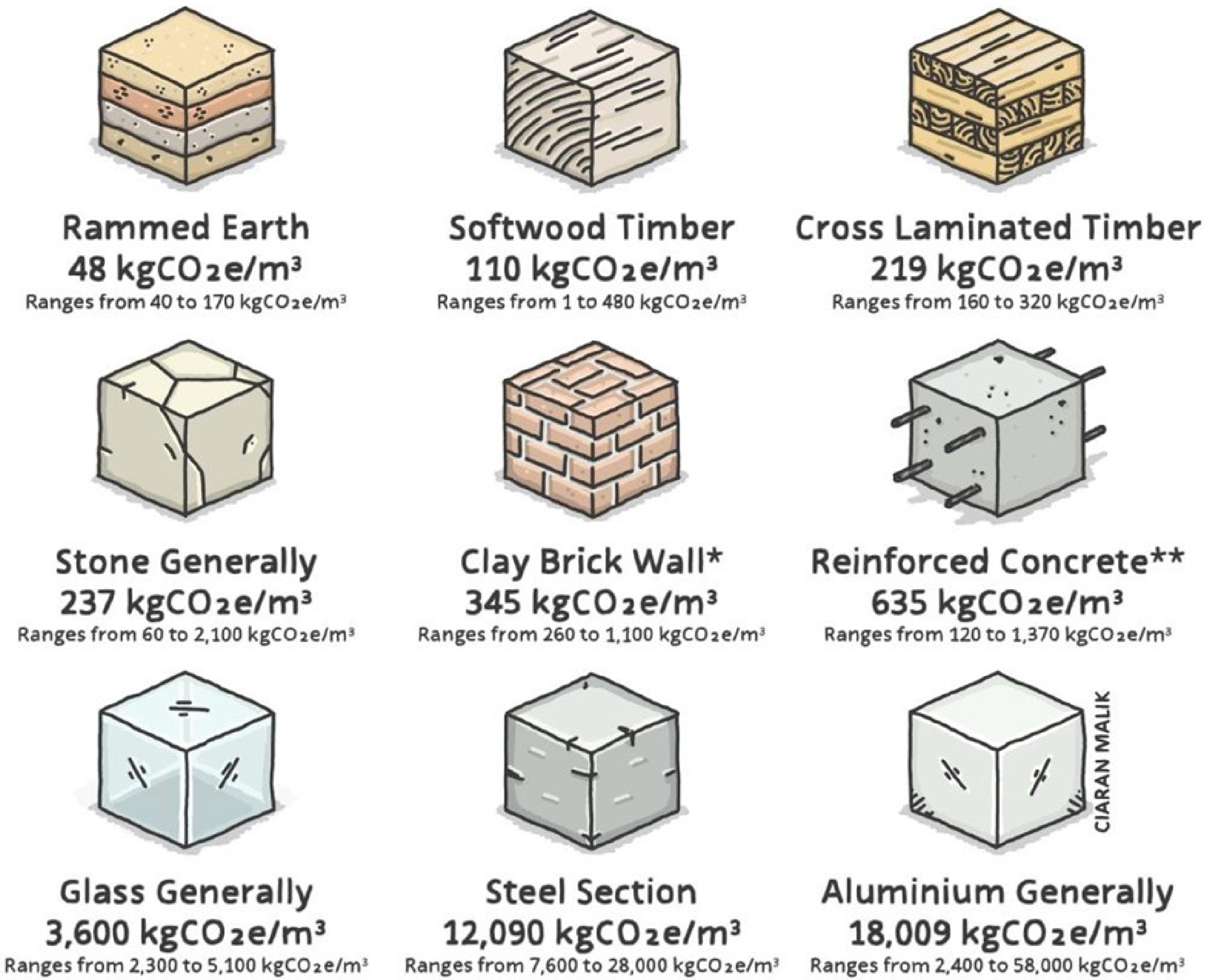
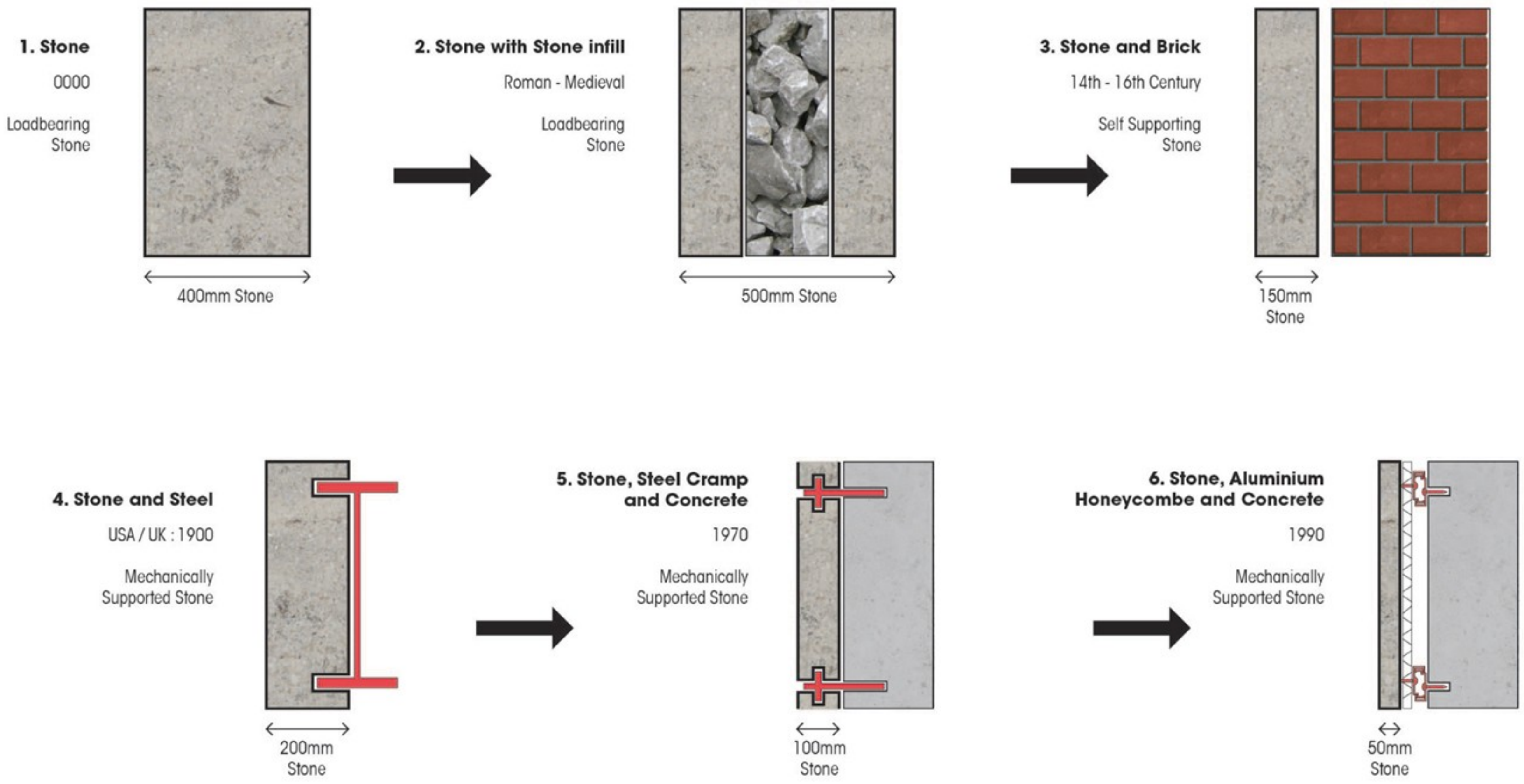
Cradle to Gate Embodied Carbon A1 - A3



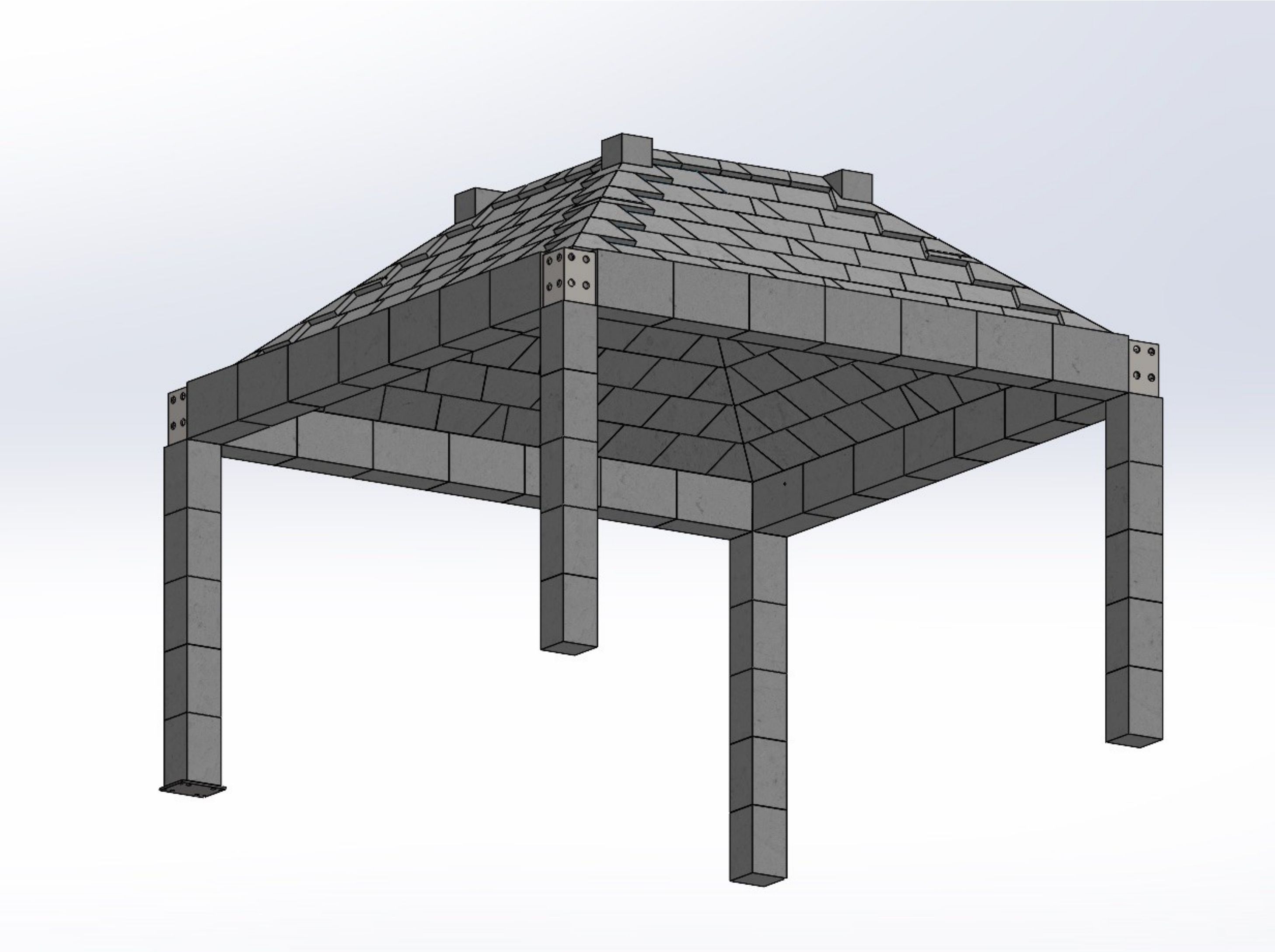
Source: http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html
Using database summary values for product stage, does not include construction, use, end of life or benefits stages.
Ranges are presented to show how values can vary, and require interpretation based on source and analysis method.
*Based on values for brick walls, which use 1,500 bricks for 1m^3 of mortar
**Based on C32/40 concrete with 2% reinforcement, maximum based on 4% reinforcement

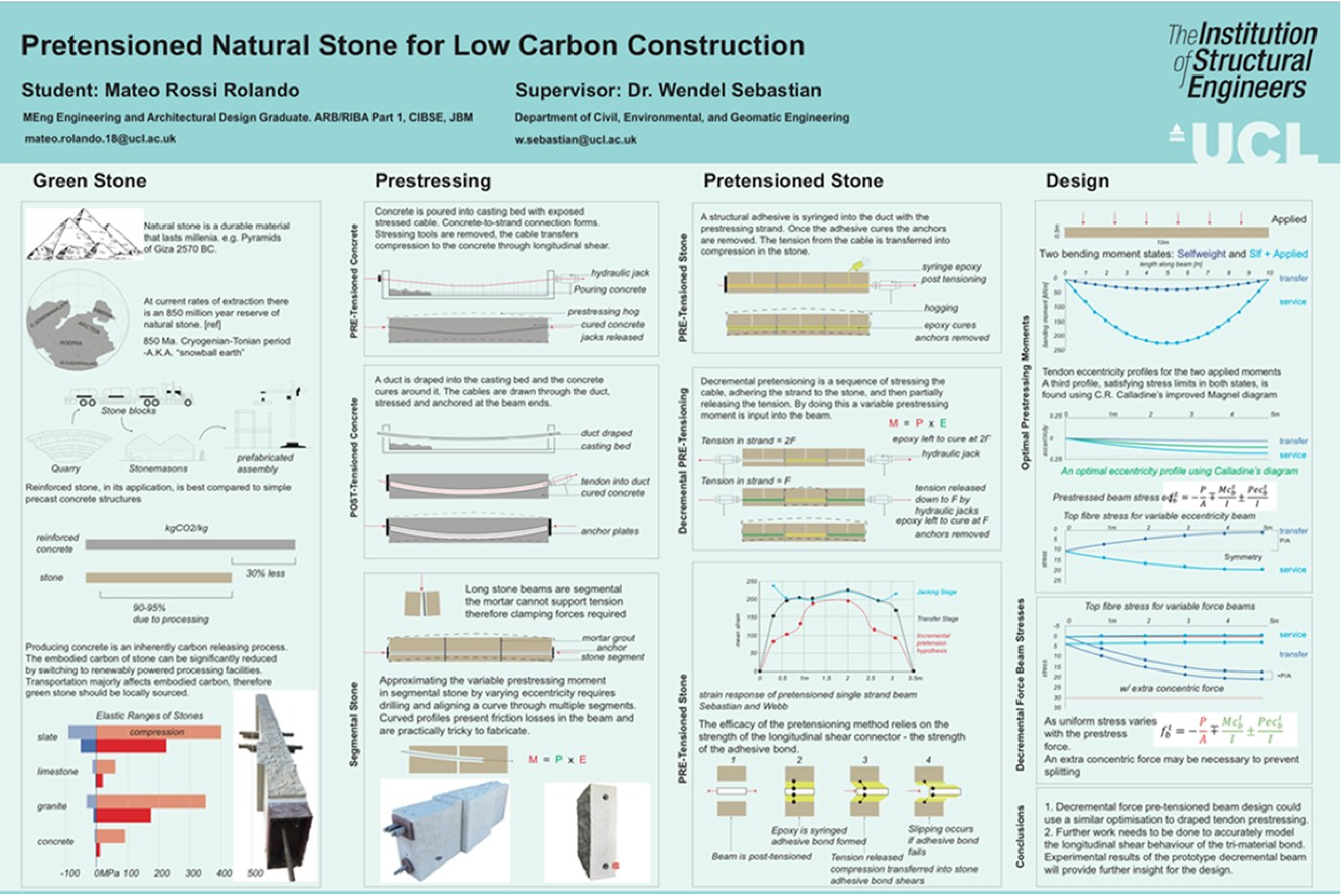
Stone Walls

The changing role of stone within wall construction




HARRY & CAROL DJANOGLY GALLERY



Pretensioned Natural Stone for Low Carbon Construction
Student: Mateo Rossi Rolando
MEng Engineering and Architectural Design Graduate. ARB/RIBA Part 1, CIBSE, JBM
mateo.rolando.18@ucl.ac.uk
Supervisor: Dr. Wendel Sebastian
Department of Civil, Environmental, and Geomatic Engineering
w.sebastian@ucl.ac.uk
The Institution of Structural Engineers
UCL
Green Stone
Natural stone is a durable material that lasts millenia. e.g. Pyramids of Giza 2570 BC.
At current rates of extraction there is an 850 million year reserve of natural stone. [ref]
850 Ma. Cryogenian-Tonian period -A.K.A. "snowball earth"
Stone blocks
Quarry
Stonemasons
prefabricated assembly
Reinforced stone, in its application, is best compared to simple precast concrete structures
kgCO2/kg
reinforced concrete
stone
30% less
90-95% due to processing
Producing concrete is an inherently carbon releasing process. The embodied carbon of stone can be significantly reduced by switching to renewably powered processing facilities. Transportation majorly affects embodied carbon, therefore green stone should be locally sourced.
Elastic Ranges of Stones
compression
slate
limestone
granite
concrete
-100 0MPa 100 200 300 400 500
Prestressing
PRE-Tensioned Concrete
Concrete is poured into casting bed with exposed stressed cable. Concrete-to-strand connection forms. Stressing tools are removed, the cable transfers compression to the concrete through longitudinal shear.
hydraulic jack
Pouring concrete
prestressing hog
cured concrete
jacks released
POST-Tensioned Concrete
A duct is draped into the casting bed and the concrete cures around it. The cables are drawn through the duct, stressed and anchored at the beam ends.
duct draped
casting bed
tendon into duct
cured concrete
anchor plates
Segmental Stone
Long stone beams are segmental the mortar cannot support tension therefore clamping forces required
mortar grout
anchor
stone segment
Approximating the variable prestressing moment in segmental stone by varying eccentricity requires drilling and aligning a curve through multiple segments. Curved profiles present friction losses in the beam and are practically tricky to fabricate.
M = P x E
Pretensioned Stone
PRE-Tensioned Stone
A structural adhesive is syringed into the duct with the prestressing strand. Once the adhesive cures the anchors are removed. The tension from the cable is transferred into compression in the stone.
syringe epoxy
post tensioning
hogging
epoxy cures
anchors removed
Decremental PRE-Tensioning
Decremental pretensioning is a sequence of stressing the cable, adhering the strand to the stone, and then partially releasing the tension. By doing this a variable prestressing moment is input into the beam.
M = P x E
Tension in strand = 2F
epoxy left to cure at 2F
hydraulic jack
Tension in strand = F
tension released down to F by hydraulic jacks
epoxy left to cure at F
anchors removed
PRE-Tensioned Stone
Jacking Stage
Transfer Stage
Incremental pretension hypothesis
strain response of pretensioned single strand beam Sebastian and Webb
The efficacy of the pretensioning method relies on the strength of the longitudinal shear connector - the strength of the adhesive bond.
1 2 3 4
Beam is post-tensioned
Epoxy is syringed adhesive bond formed
Tension released compression transferred into stone adhesive bond shears
Slipping occurs if adhesive bond fails
Design
Applied
10m
Two bending moment states: Selfweight and Slf + Applied
Optimal Prestressing Moments
length along beam [m]
transfer
service
Tendon eccentricity profiles for the two applied moments A third profile, satisfying stress limits in both states, is found using C.R. Calladine's improved Magnel diagram
transfer
service
An optimal eccentricity profile using Calladine's diagram
Prestressed beam stress eq $f_b^t = -\frac{P}{A} \mp \frac{Mc_b^t}{I} \pm \frac{Pec_b^t}{I}$
Top fibre stress for variable eccentricity beam
transfer
Symmetry
service
Decremental Force Beam Stresses
Top fibre stress for variable force beams
service
transfer
w/ extra concentric force
As uniform stress varies with the prestress force.
$f_b^t = -\frac{P}{A} \mp \frac{Mc_b^t}{I} \pm \frac{Pec_b^t}{I}$
An extra concentric force may be necessary to prevent splitting
Conclusions
1. Decremental force pre-tensioned beam design could use a similar optimisation to draped tendon prestressing.
2. Further work needs to be done to accurately model the longitudinal shear behaviour of the tri-material bond. Experimental results of the prototype decremental beam will provide further insight for the design.

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CRIMES ET SEDIMENTS

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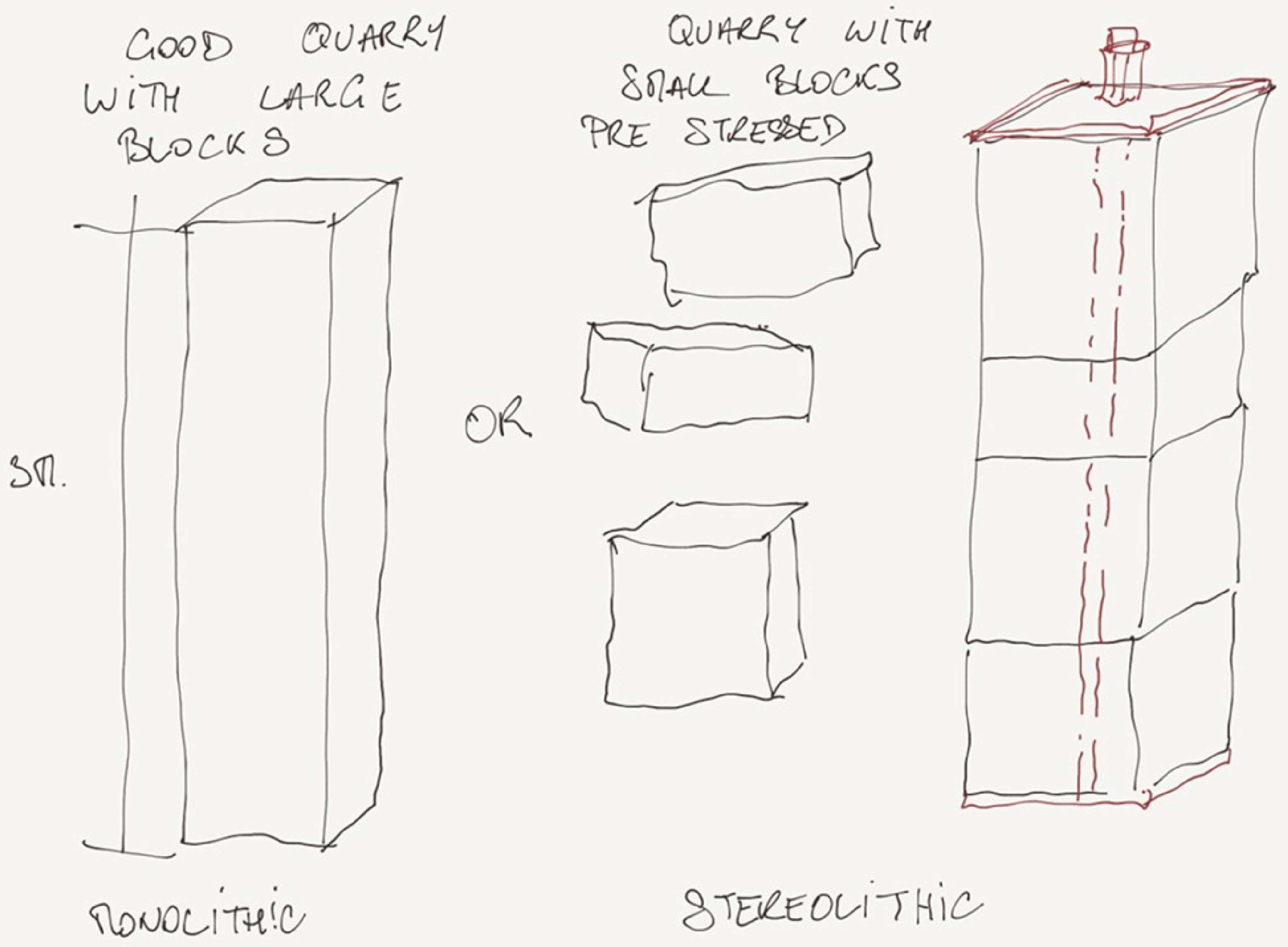
SOLIDITÉ, PÉRENNITÉ, FRUGALITÉ

TAILLE SANS CONSCIENCE N‘EST QUE RUINE DE TA LAME


GOOD QUARRY WITH LARGE BLOCKS
5m.
MONOLITHIC
OR
QUARRY WITH SMALL BLOCKS PRE STRESSED
STEREOLITHIC

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SPRINT
B5-19

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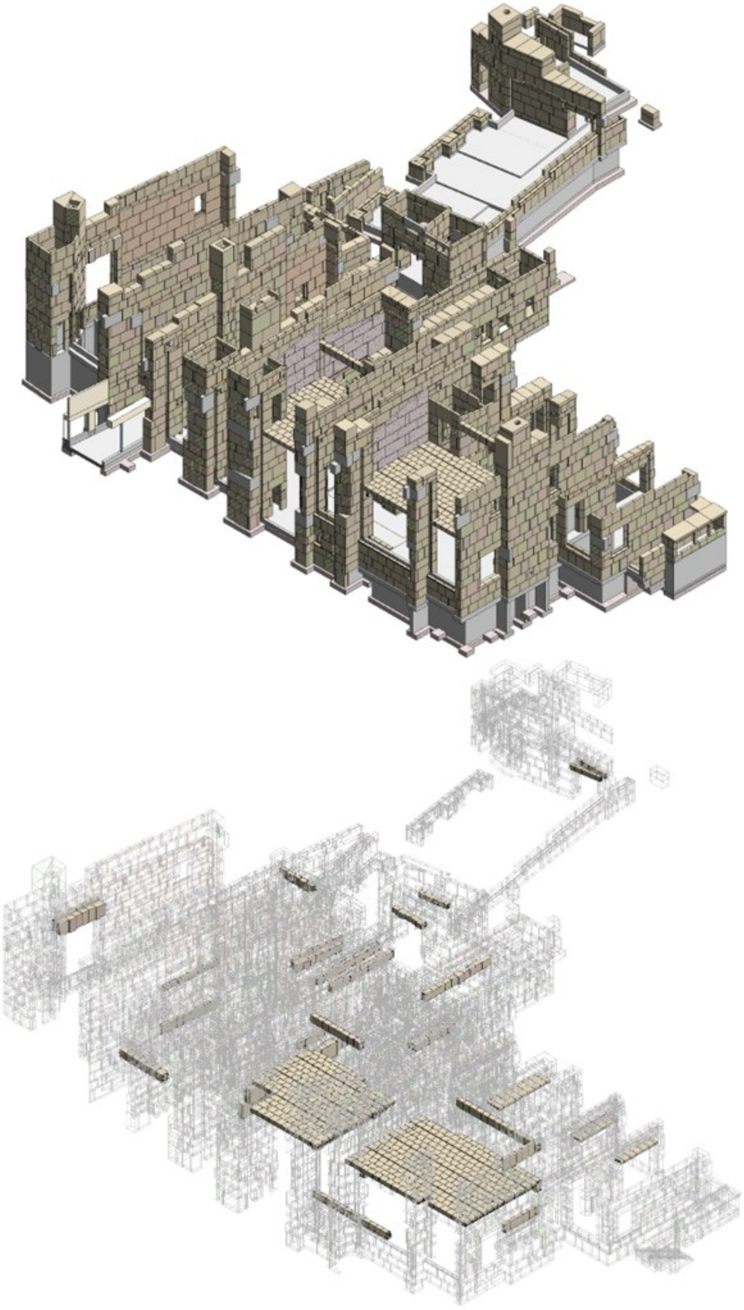


ATELIER BERTRAND


K45



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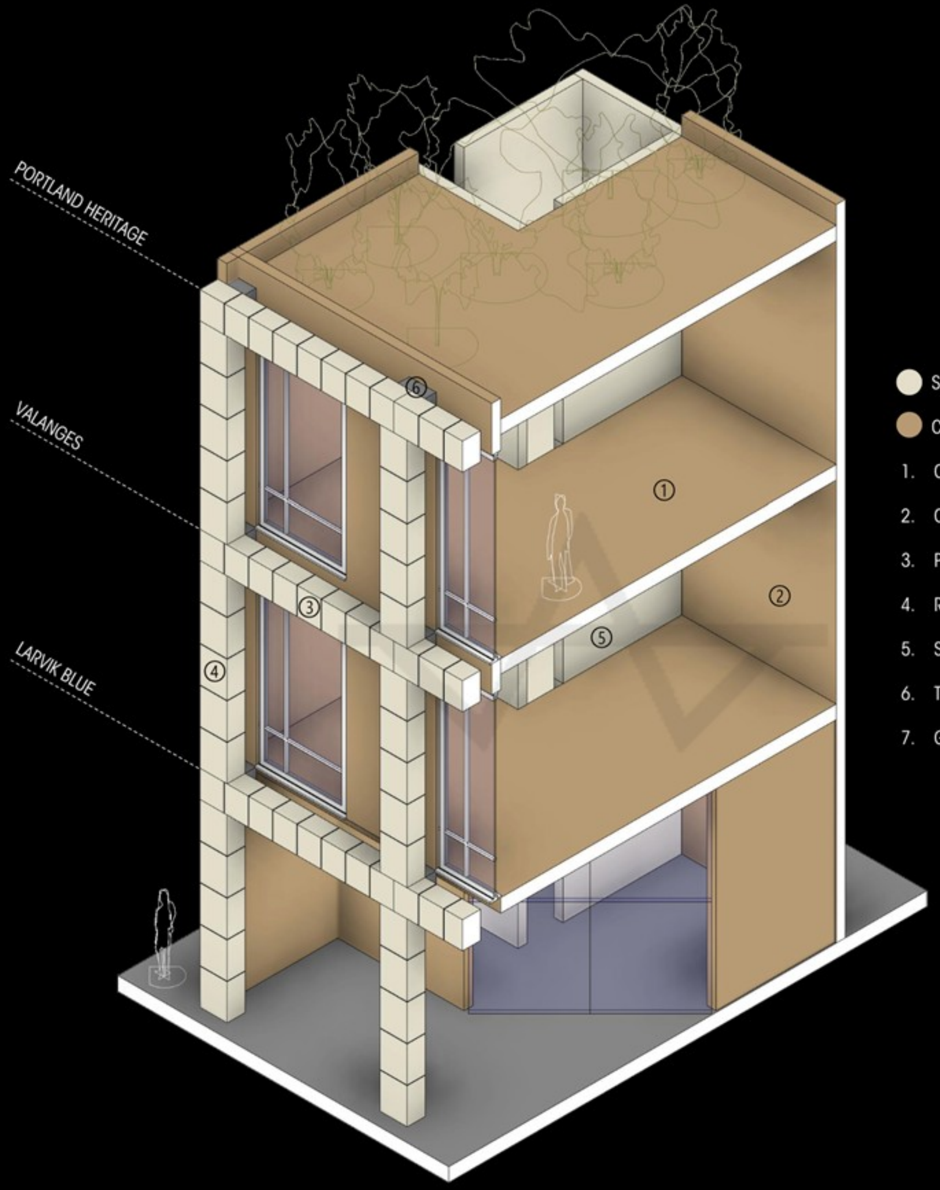
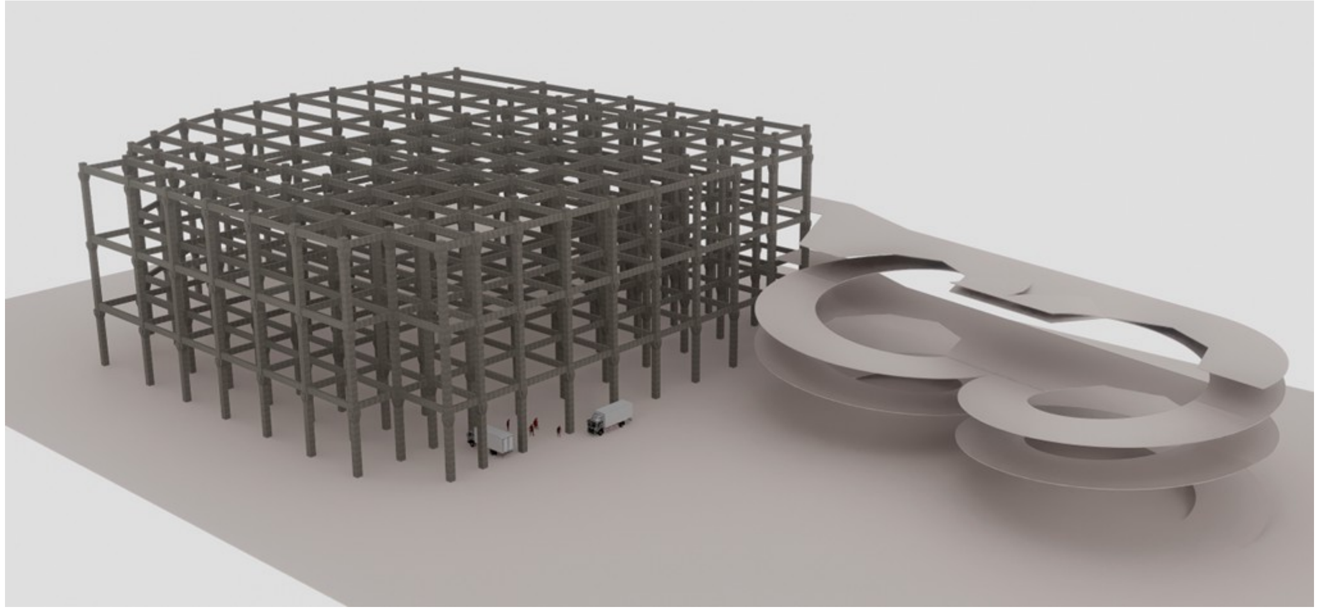
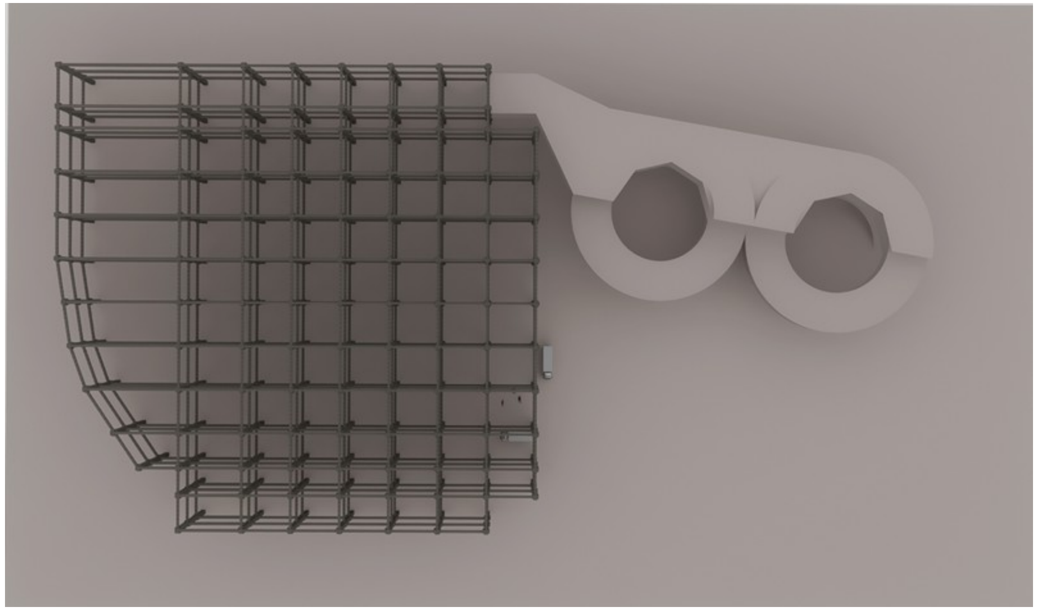


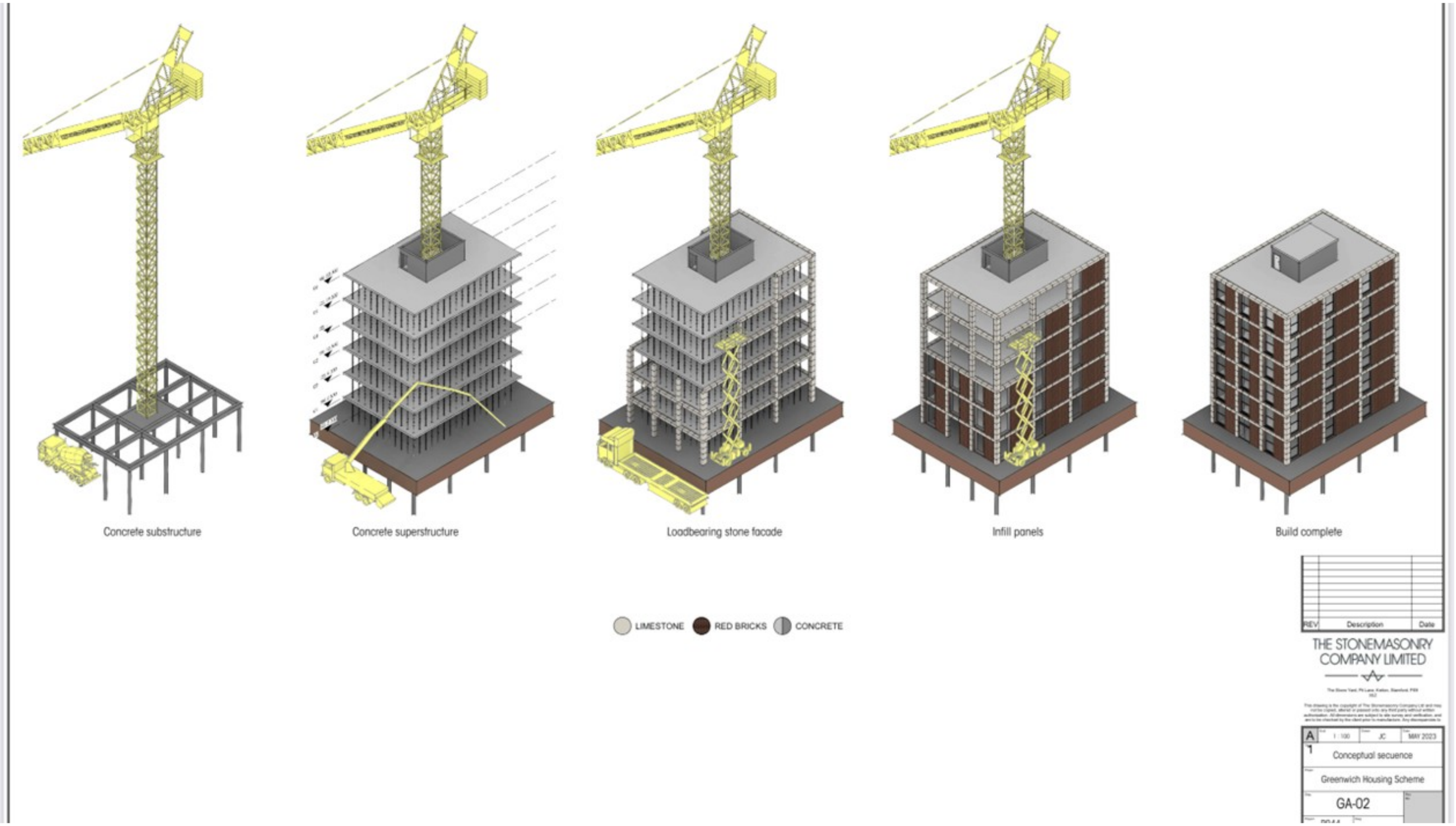
STONE

CROSS LAMINATED TIMBER (CLT)

1. CLT STRUCTURAL FLOOR
2. CLT WALL PANEL
3. PRETENSIONED STONE BEAM
4. REINFORCED STONE COLUMN
5. STONE STRUCTURAL CORE (WALL PANELS)
6. THERMAL BREAK BETWEEN EXTERNAL STONE AND INTERNAL STRUCTURE
7. GLAZING






Concrete substructure
Concrete superstructure
Loadbearing stone facade
Infill panels
Build complete
LIMESTONE
RED BRICKS
CONCRETE
REV
Description
Date
THE STONEMASONRY
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A
1 : 100
JC
MAY 2023
1
Conceptual secuence
Greenwich Housing Scheme
GA-02

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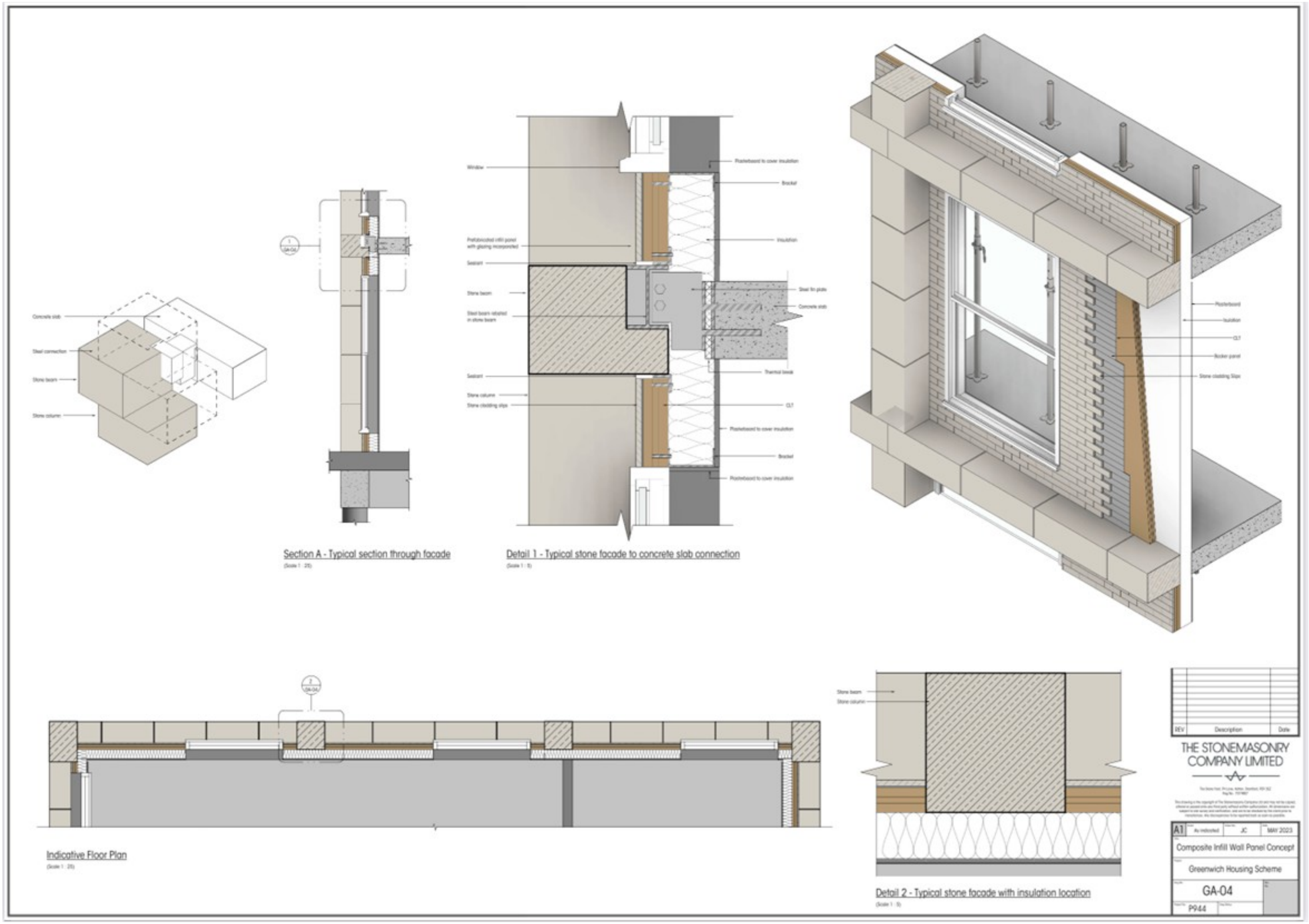

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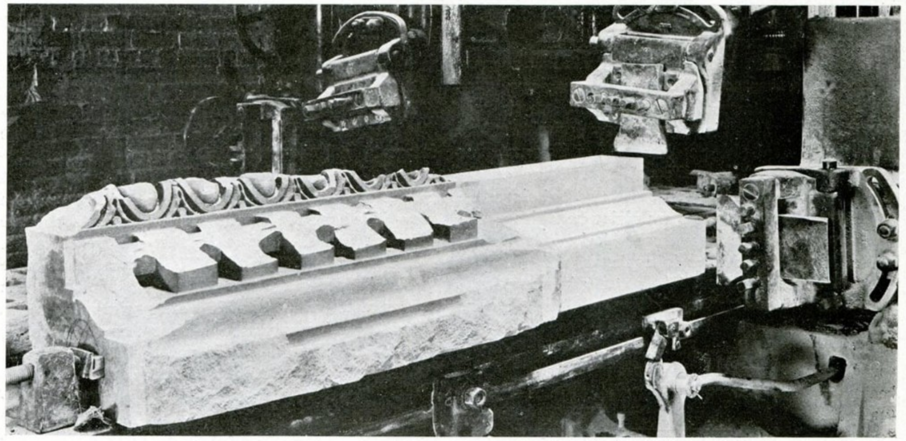
TOUTE CONSTRUCTION EN PIERRE
EST UNE CARRIÈRE EN DEVENIR

Recutting Stone from an Old Building

WE have no means of knowing when men first began to work stone, but we do know it was very shortly after the scattered, wandering tribes ceased to be nomadic and settled down to build themselves into nations. Indeed, there was a certain working of stone long before this, for in immemorial ages past the rudest savages chipped flint pebbles into weapons and implements. What we term the Stone Age, with its two divisions of Paleolithic and Neolithic, has, properly speaking, no relation to chronology, but is merely descriptive of the stage of development of any people. Ingrained in every human creature are two closely related traits, one an insatiable curiosity as to the past of the race, and the other a desire to leave some imperishable record of his own existence for the ages to come. To gratify this latter whim, he naturally turned to the great imperishable tablets that Nature spread before him, the living rocks. Before written language was invented, the savage scratched on the walls of caverns rude representations of his battles with men and beasts. As his hand grew deft, he progressed from flat outlines to carvings in the round, and instead of contenting himself with caves for shelter, he built up walls of hewn stone. Entire races have perished from the earth and left no records save those that they cut in stone. We should know nothing of the prehistoric nations of Easter Island were it not for the monster heads they carved in volcanic lava. Pyramids, temples and monuments, covered with elaborate carving, still standing in good repair in the jungles of Mexico and Central America, tell of a strange civilization that flourished on our continent long before the coming of Columbus, but all the rest is dark. The greater part of the history of Egypt is written in carven stone, and has come down to us in no other form. It is true that one of the greatest gifts of Greece to humanity, epic poetry, was saved to us at first by oral tradition, but the other priceless heritage, Grecian art, would have perished utterly had not its media been the marbles of Pentelikos and Paros.

The civilization of the world today is due in large part to what mankind has been able to dig from the bowels of the earth. The various metals have made possible our material advancement, while two of the most important of the arts, sculpture and architecture, have depended almost wholly upon stone for their expression. For thousands of years, marble, granite, limestone and sandstone, have been hewn into form, cut with loving care, perhaps, in elaborate ornamentation, and laid up in humble houses or princely palaces, heathen fanes or christian churches, public memorials to conquering heroes or simple head-stones for the household dead. Because these things were wrought in imperishable stone, they have survived for the wondering admiration of succeeding ages.

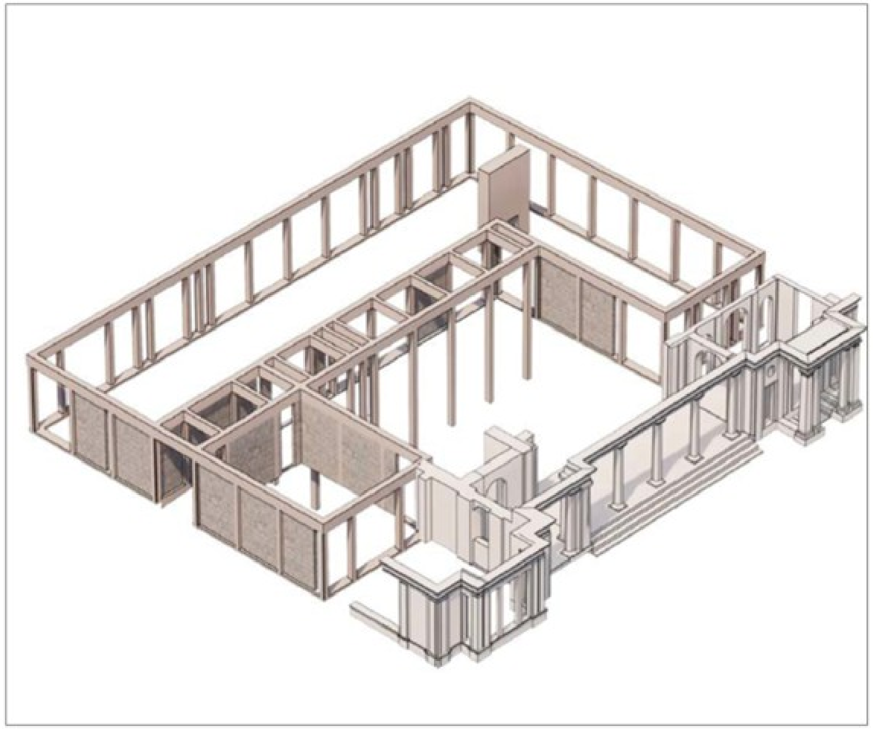
It is the durability of stone, as well as its natural beauty, that has commended it as the choicest material for architecture. Stones cut hundreds and even thousands of years ago still stand as the master craftsmen laid them up, and time has but softened the outlines and mellowed the colors. Indeed, it has been the prac-



BLOCK OF STONE FROM AN OLD BUILDING BEING RECUT

Indiana limestone from a twenty-one-years-old residence dressed for use in a new commercial building

REIMAGINING THE SECTION: TRABEATED STONE FRAME AND WALLS AT UPPER LEVEL



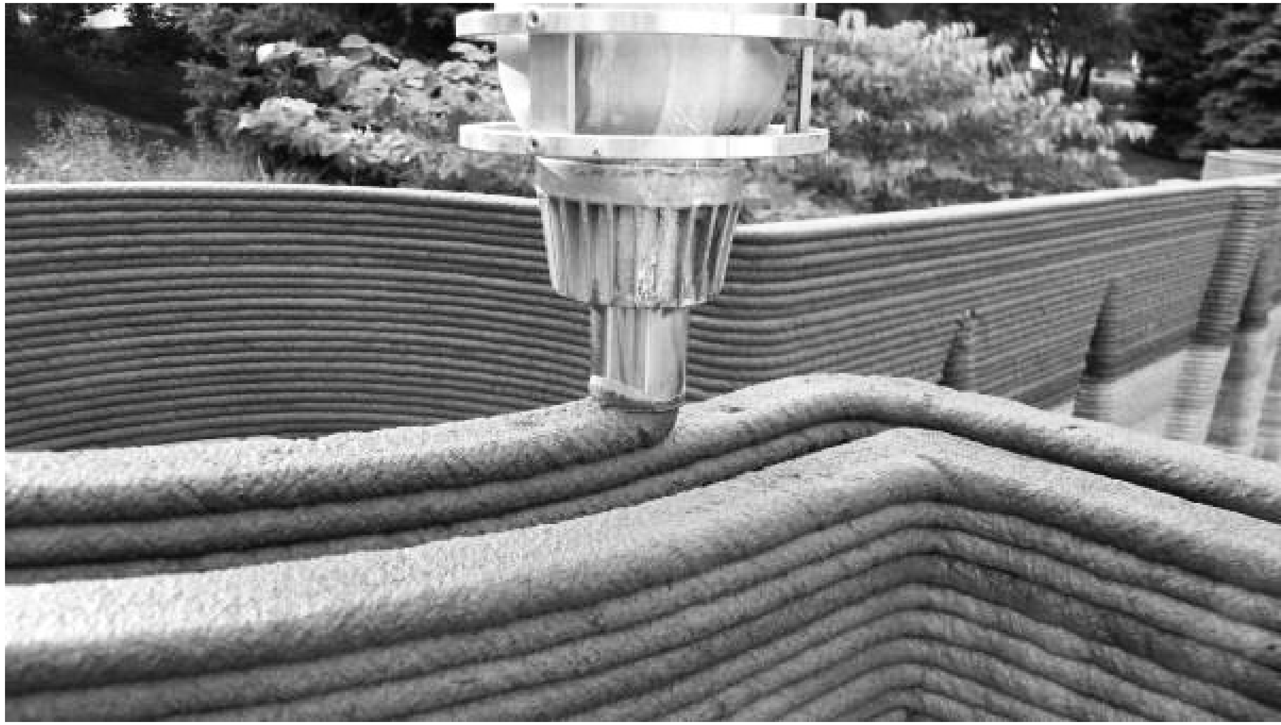
STONE FRAME AT UPPER GROUND
The language of stone frame and stone infill panel is used for the whole structure of the upper ground floor (left), an historical reference which is particularly clear in the relationship between the old colonnade and the new entrance loggia in the courtyard (below).

Trabeated stone ruins of the colonnade (left),
and view from the same section of the colonnade in a
late 19th century photograph by Bedford Lemere (right)


CAFE


The Energy
Centre


BM



UN MATERIAU SACRÉ

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