

# The New Stone Age

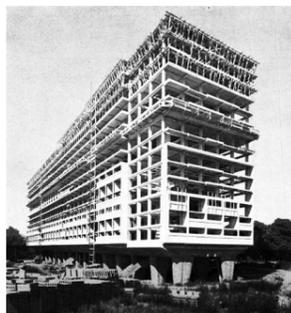
A public exhibition at the Building Centre from 27 February–15 May 2020



Luis Sullivan (1856–1924),  
Guaranty Building, Buffalo, USA, 1896



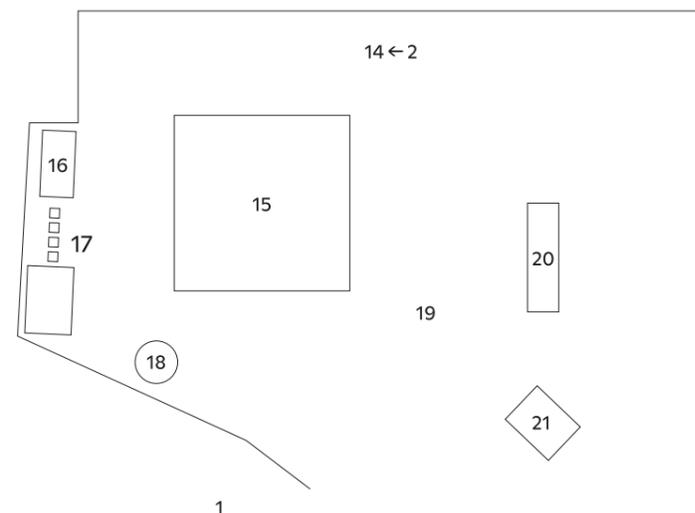
Auguste Perret (1874–1954),  
25 Rue Benjamin Franklin, Paris, 1902–03  
Reinforced concrete frame  
(Hennebique system)  
Image: Guilhem Vellut from Paris, France CC



Le Corbusier (1887–1965),  
Unité d'habitation, 1947–1952  
Reinforced concrete frame  
(rough cast / béton brut)  
Image: Wikipedia



Fernand Pouillon (1912–1986), Stade  
de Buffalo Apartment Block, 1955–58  
Stone superstructure and facade  
Images: Pouillon Foundation



## Contemporary Projects featured in the exhibition

### 1 Pretensioned Stone Floor Slab, 2020

2 Portcullis House, London, UK, 2001  
Architect: Hopkins Architects; Structural Engineer: Arup; Image: Alamy

### 3 Sheltering Under Marble Skies, Venice, Italy, 2018

Architect: Groupwork Architects; Engineers: Webb Yates Engineers; Stonework: Ateliers Romeo; Image: Groupwork Architects

### 4 30 Finsbury Square, London, UK, 2002

Architects: Eric Parry Architects; Roof & facade consultant: ARUP; Structural engineer: Whitbybird; Stone mason: Szerelmey; Image: Helene Binet

### 5 Logements Collectifs, Plan-les-Ouates, Switzerland, 2017–2021

Architect: Atelier Architecture Perraudin; Swiss Architect: Archiplein; Structural engineer: Perreten et Milleret; Image: Atelier Architecture Perraudin

### 6 Delas Frères Winery

Tain l'Hermitage, France, 2019  
Architect: Carl Fredrik Svenstedt; Structural engineer: Becamel Mallard; Curved stone wall engineer: Atelier Graindorge and Stono; Stone masons: Printemps de la Pierre; Image: Dan Glasser

### 7 Municipal Halls, Lamure-Sur-Azergues, France, 2017

Architect: Elisabeth Polzella; Image: Elisabeth Polzella

### 8 Clerkenwell Close, London, UK, 2017

Architect: Groupwork Architects; Engineer: Webb Yates Engineers; Stone mason: The Stonemasonry Company Ltd; Image: Groupwork Architects

### 9 Formby Stair, London, UK, 2016

Architect / Designer: The Stonemasonry Company Ltd / Webb Yates Engineers; Image: Agnese Sanvito

### 10 Plainfaing Tourist Office, Plainfaing, France, 2019–present

Architect: Studio Lada; Stone supplier: Carrière de Champenay; Manufacturer: Altan

### 11 Finchley Road, London, UK, 2016–present

Architect: Groupwork Architects; Engineer: Webb Yates Engineers; Stone mason: Ateliers Romeo; Image: Groupwork Architects

### 12 The Flat Vault, Abu Gosh, Palestinian Village, 2018

Architect: AAU ANASTAS; Image: Mikaela Burstow

### 13 Ca'n-Terra, Menorca, Spain, 2018

Architects: Ensamble Studio; Image: Ensamble Studio

### 14 SGAE Central Office, Santiago de Compostela, Spain, 2007

Architect: Ensamble Studio; Image: Roland Halbe

### 15 Reciprocating Stone Floor, 2020

Structural engineer: Webb Yates Engineers; Stone masons: The Stonemasonry Company Ltd; Stone provided by Polycor

### 16 Post Tensioned Stair, 2019

Stone masons: The Stonemasonry Company Ltd; Engineer: Webb Yates Engineers; Architect: Foster + Partners; Model is made of Combe Brune Limestone.

### 17 Stone types and quarrying stone

Image: Polycor

### 18 CNC Stone Footing

Designers: Groupwork Architects and The Stonemasonry Company Ltd

### 19 Stereotomy Drawing

### 20 Clerkenwell Bench, 2017

Architect: Groupwork Architects; Engineer: Webb Yates Engineers; Stone masons: The Stonemasonry Company Ltd

### 21 Thirty-storey Tower, 2020

Cost Consultants: Jackson Coles; Sustainability: Webb Yates Engineers; Structural Engineering: Webb Yates Engineers; Construction Methodology: The Stonemasonry Company Ltd; Architect: Groupwork Architects

*The New Stone Age* is a celebration of the sustainability, practicality and inherent beauty of structural stone, and the interdisciplinary collaborations it fosters.

In the light of the climate crisis the materials that make up our built environment need more than ever to prove their worth. Stone has significant sustainability credentials with the ability to dramatically reduce a project's embodied carbon. Curated by stone mason Pierre Bidaud, architect Amin Taha and engineer Steve Webb – who collaborated on the landmark building 15 Clerkenwell Close, an award-winning exemplar of structural stone – the exhibition introduces a new generation of international designers and architects pushing the boundaries of building with stone.

The three curators of the exhibition are stone mason, structural engineer and architect whose ever more specialist disciplines over the past years are perhaps to blame for the lack of integrated understanding. Working together on projects they gradually interlocked their knowledge and relearned what we have known for millennia.

The New Stone Age is an exhibition and associated public programme curated by Amin Taha and Alex Cotterill of Groupwork Architects, Pierre Bidaud of The Stonemasonry Company and Steve Webb of Webb Yates Engineers, with the Building Centre.

Exhibition installation: Install Archive  
Building Centre exhibitions team:  
Vanessa Norwood, Jenny Watt,  
Harriet Jennings and Mathilde Savary

In that sense the exhibition should perhaps be called *The Stone Renaissance*. Applying contemporary engineering software to such a material, in order to optimise cost in quarry extraction, cutting and erection on site, was a revelation to the industry's cost consultants. That a building's superstructure could be erected in stone at potentially 25–75%\* of the cost of concrete or steel frames and save 60–90%\*\* of its embodied CO<sup>2</sup> is still not widespread knowledge. While inevitably the market cannot be expected to supplant steel and concrete with stone, it can only be a benefit to rediscover the material for reasons of sustainability, if not to help define an authentic aesthetic for our age.

[buildingcentre.co.uk/stone](http://buildingcentre.co.uk/stone)  
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\*complexity of cladding systems being replaced by using a load bearing frame  
\*\*quantity of energy used in extraction, cutting, applying finishes, transportation

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#NewStoneAge

## The History of Stone

Stone has for millennia been instrumental in the creation of robust shelters, memorials to those passed and emblematic of cultural ambitions for longevity. Over the past 7,000 years we have continued to apply our ingenuity to this material with only a recent 100-year break.

Cairn de Barnenez in France dates from the fifth millennia BC and, as at Dolmen de Menga in Spain and Stone Henge in the UK, the unadorned 20 ton stones are a feat of megalithic engineering. Equally extraordinary are the lengths to which Greek masons refined entasis and perspective correction in their stone abstractions of older timber temples.

Stonemasons, through the exchange of knowledge across borders, reached an apotheosis in stereotomy (the projection and cutting of stone) during the late C18th and early C19th. This is perhaps best illustrated by French engineer Joseph Abeille's patents for reciprocal flat stone vaults and the staircases and floor plates at the Monastery of Notre de Dame, Le Mans. Interlocking blocks of asymmetrical stones form large and complex geometrical spans, some virtually flat. Projected, cut and built to take their load path to ground level without the engineering formulas and software we have today.

Stone has and continues to be used for structural purposes without dictating any architectural style. The Megalithic to industrial age saw stone replaced with steel and concrete and, in the post-war period, conflated with the past and seen as anachronistic and anti-progressive. So much so that in spite of Fernand Pouillon's efforts to demonstrate it was faster and cheaper at rebuilding France, it was ignored in favour of the new emblematic materials.

The stone buildings and structures featured within The New Stone Age exhibition are all loadbearing. Some external of the thermal envelope, others tied to double skins, or experimental vaults using today's software to parametrically reform Abeille's reciprocal vaults.

## The Last Hundred Years

The late C19th saw architects in the United States, such as Louis Sullivan, pioneer the separation of structure and façade, suspending precast iron and terracotta fascia panels sometimes in combination with brick and stone. Driven principally as a result of the country's doubling of population and per capita income demanding more and taller buildings, the innovation enabled ever cheaper steel frames

to be erected faster while sidestepping a shortage of skilled stonemasons and bricklayers whose ground bearing self-supporting facades were already too slow to keep up. Across the Atlantic and following the turmoil of their unsuccessful Prussian campaigns, France's new Third Republic also saw a period of economic growth and innovation. For the young architect Auguste Perret, Joseph Monier's original patents for reinforced concrete were an opportunity to experiment with a superstructure from which, like Sullivan terracotta, brick and stone could be hung.

As with the early years of most material innovations reinforced concrete initially visually mimicked existing forms driven by older structural technologies. Perret's work first appeared Belle Epoque before gradually exploiting the plastic qualities of reinforced concrete. While one young employee, Le Corbusier saw the future in the new material going on to help define Modernism with his manifesto *Vers une Architecture*. Another contemporary, Fernand Pouillon, remained sceptical the future could be wholly solved by one material alone. Pouillon maintained this position and after WW2 proved multi-storey housing was faster and cheaper to build in stone than concrete or steel – most notably rebuilding houses and shops at Marseilles waterfront for a fifth of the cost of Corbusier's *Unité d'Habitation*. Going on to win tenders across France, he and his troupe of stonemasons stood somewhat adrift from what was then seen as a time for change needing emblematic new structures of concrete, steel and glass. Finding himself imprisoned under an unused but extant law for acting as both architect and contractor, the period of stone as a widespread and combined structural-aesthetic building material seemed to come to an end.

The influx of Modernists during and after the war overwhelmed the ambitions of Louis Sullivan and Frank Lloyd Wright for an American architecture. However, in many respects Mies Van der Rohe, Walter Gropius et al took their host country's steel frame innovation to define the USA anew, as a land of glazed skyscrapers, of progress. It was a model emulated across the world but, gradually over one or two generations, the conflation of material with progressive politics has slipped. At first still seen as anachronistic, if not reactionary, a perhaps liberated generation with few taught prejudices for specific materials at first used stone for cladding, going on to relearn its broader properties. If stone has structural, cost, sustainability, tactile and aesthetic advantage why not? If it can save between 60–90% of a structure's embodied CO<sub>2</sub> there would have to be a good reason to use steel or concrete.



**Dolmen de Menga, Antequara, Spain, Around 3500–3000 BC**

Located near Antequara in Spain, this Dolmen (a megalithic tomb) is one of the largest and most complete megalithic structures in Europe. The tomb is almost 30m in depth, with four gigantic capstones weighing around 250 tonnes each. The entire Menga is located under a tumulus (burial mound) and is accessed via its iconic post and lintel entrance. The structure demonstrates a simplistic and powerful use of stone, which resonates with many of the modern projects featured in *The New Stone Age* exhibition. Image: Ángel M. Felicísimo from Mérida, España CC



**Egyptian Columns: Pixabay**  
Image: Parthenon Steve Swayne CC



**The Stairs of Reconciliation, Graz, Austria, 1438**

These advancements in the use of structural stone were reflected in many daring staircases of the period, not least the double spiral staircase of the Burg in Graz, Austria. This cantilevered stair achieves its twisting ascent through the building without any tensioning of the stone and derives its nickname from how the stairs diverge and recombine between each landing. Image: E.mil.mil CC

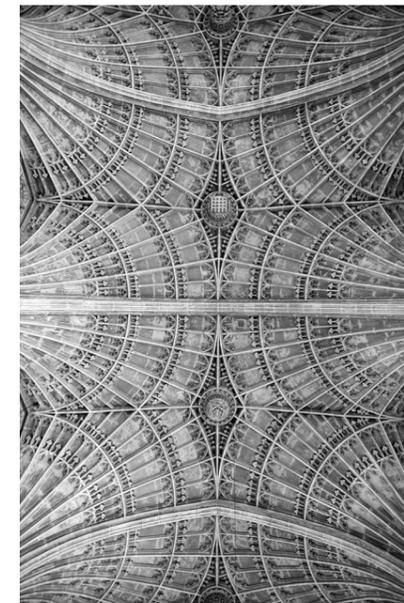
## Medieval mastery of stereotomy

Stereotomy (meaning 'the cutting of solids') is the principle of cutting one solid to interlock with a partnering solid, in turn transferring load through each block to the ground, providing strength through its shape as a whole.



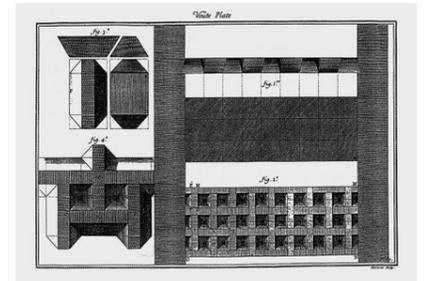
**Notre-Dame de Noyon, Chapelle de l'Assomption, Noyon, France, 1528**

Image: Giuseppe Fallacara, Marco Stigliano



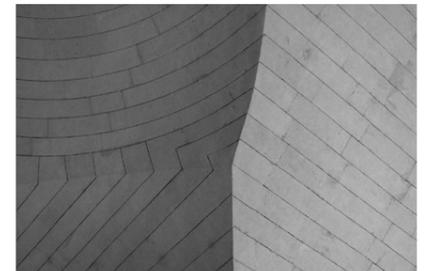
**Kings College Chapel, Cambridge, UK, 1515**

Featuring the largest fan vault in the world, Kings College Chapel demonstrates the mastery of stonemasons of the English Perpendicular Gothic period such as John Wastell. Developed skills in stereotomy allowed structures to be built higher than ever before through the use of segmented arches and the movement from load-bearing walls to load-bearing pillarwork. This allowed medieval builders to achieve gigantic window apertures, exemplified at Kings College Chapel. Image: Giuseppe Fallacara, Marco Stigliano



**Joseph Abeille (1669–1752), 1699**

Patent for a flat vault using ashlars (cut stone) in a polyhedron form whose two axial sections, in the shape of an isosceles triangle, have opposite directions. Image: Giuseppe Fallacara, Marco Stigliano



**Jules Hardouin-Mansart, with Jacques Peytret, City Hall, Arles, France, 1673–74**

Vaulted entrance vestibule  
Image: Giuseppe Fallacara, Marco Stigliano, Philibert Delorme



**Hôtel Bullioud, Lyon, France, 1536**

Image: Giuseppe Fallacara, Marco Stigliano



**Monastery of Notre-Dame de la Couture, Le Mans, 1720–39**

Image: Giuseppe Fallacara, Marco Stigliano