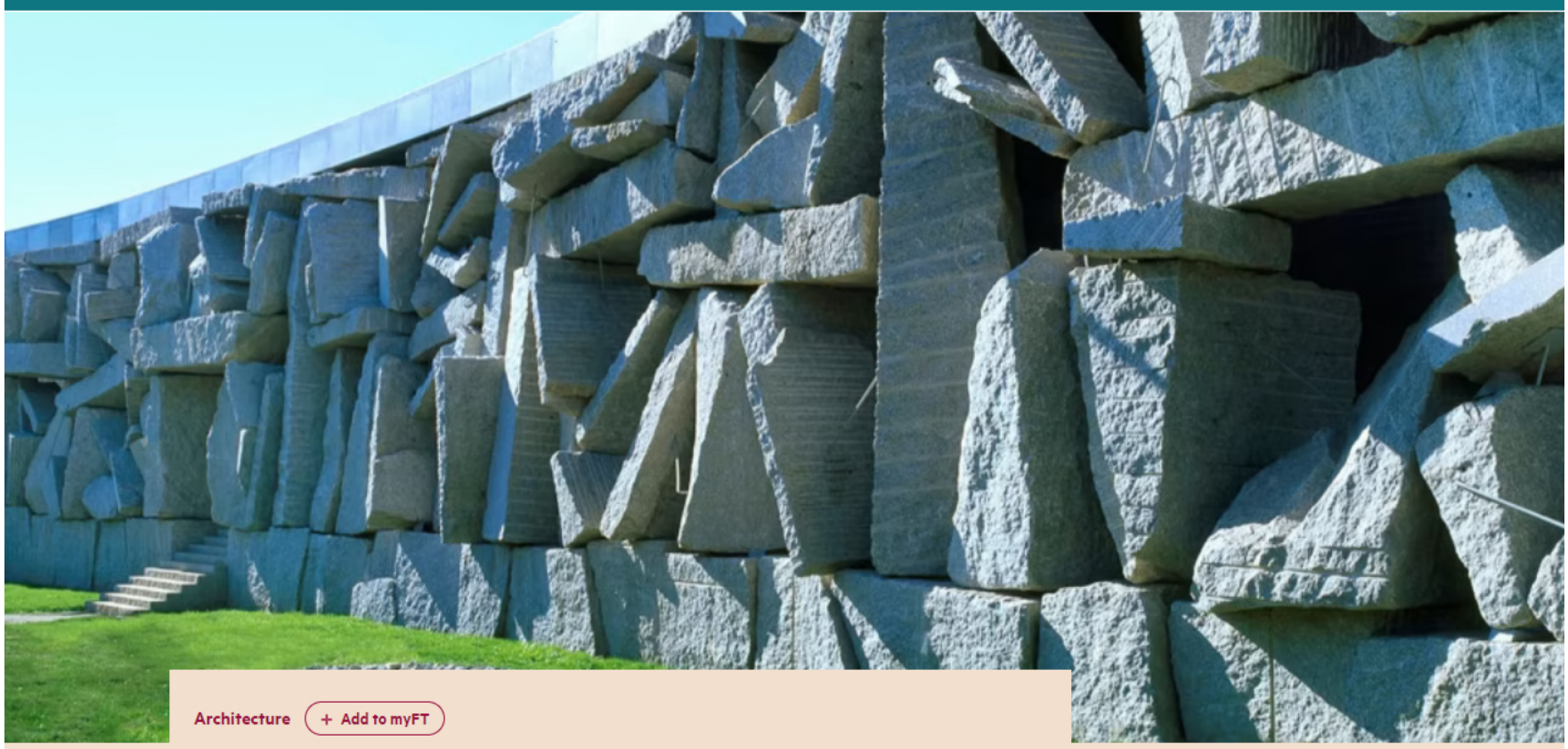

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The pros and cons of stone buildings

'Massive stone' can be better for the environment than concrete and steel but detractors question the impact of quarrying

Paul Miles AN HOUR AGO

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Quarrying generally has a poor environmental reputation. Stone extraction can destroy habitats and pollute waterways. It creates noise and dust, which can harm the quality of life of people living nearby. The dust can smother crops, while disused workings leave visual scars.

But a growing movement among some architects and engineers is championing the environmental benefits of building with large blocks of quarried stone that form an integral part of buildings' structure. Using such "massive stone" can result in a fraction of the carbon emissions produced by the conventional choices of concrete and steel, according to the material's advocates. Building with massive stone can also be quicker and cheaper, they insist.

Among the most enthusiastic users are Amin Taha, founder of Groupwork, a London-based architecture firm, and Steve Webb of Webb Yates Engineers, a London-based structural engineering practice. The pair's latest collaboration is on 317 Finchley Road, a 10-storey block in Hampstead, north London, due for completion next year.

The building, which will feature retail space and 22 flats, is being constructed with vast blocks of basalt. The 36-metre-tall structure, which is already rising from the ground by the busy trunk road, will be “the tallest load-bearing stone building in the UK since the age of the cathedrals”, according to Taha.

Such buildings are innovative, Taha says, because they use stone to bear loads in the underlying structure, rather than merely on the exterior.

“For the past 90 years or so almost all new ‘stone’ buildings are nothing more than a veneer of stone tiles,” the architect says, adding that such cladding typically goes over a concrete or steel framework.

Taha dismisses the standard technique as “cumbersome and expensive”, saying it is much easier simply to use solid stone columns and beams. He already has experience of the sometimes mixed reception that the new technique can receive.

He designed 15 Clerkenwell Close, a striking, six-storey block in Islington, north London, completed in 2017. The building — also a collaboration with Webb Yates — features a French limestone “exoskeleton” that provides structural support and acts as a facade. Fossils are visible in the stone’s rough, unfinished surface, as are the scars from the stone’s extraction from a quarry in Normandy.

A CGI of 317 Finchley Road, London, by Amin Taha and Steve Webb

Taha’s Clerkenwell Close, in north London © Timothy Soar

The effect was so striking that in 2018 the local council, amid a prolonged legal battle, issued a later rescinded demolition order for the building. The council claimed, in an argument rejected by planning inspectors, that the planning application had not properly documented the external appearance.

damage. The block was nevertheless one of six buildings shortlisted last year for the Stirling Prize, the UK's most prestigious architecture award.

The approach at 317 Finchley Road is similar. The building will be constructed from 400 cubic metres of brick-red volcanic basalt quarried in Sicily, weighing a total of about 1,000 tonnes. Blocks as large as 1 metre square and 3 metres tall, some still bearing the quarry workers' drill-splitting marks, will form the exoskeleton.

Inside this will be a rendered wall of fireproof boards and 280mm-thick rock wool insulation with triple-glazed windows. The floors will be concrete. The building will be the tallest of its type ever erected in the UK, according to Webb. The structure should prove naturally strong, he adds.

"Finchley Road's natural stone structure carries not only the weight of the building but also stabilises it against wind," he says.

> **Fossils and extraction scars were strikingly visible in the stone. The local council issued a demolition order**

The structure's resilience comes partly from a technique known as "post-tensioning" — small-diameter, taut steel cables will link the blocks. "A post-tensioned stone beam is as strong as steel," says Webb, whose company started out designing eye-catching stone staircases with no obvious means of support.

Joe Duirwyn, a natural materials specialist at Architects Climate Action Network, a coalition of architects who are concerned about the environment, says that massive stone is "absolutely 100 per cent better than concrete and steel" and a "fantastic companion as part of a palette of other natural materials".

He nevertheless expresses concern about some of quarrying's impacts. "There are other factors that need to be taken into account, such as impacts on biodiversity and poor working conditions in quarries in some countries," he says.

The British practitioners are drawing partly on models from continental Europe. Taha cites as one inspiration the work of Ensamble Studios, a Spanish firm that designed cultural centres in blocks of raw granite and boulders 20 years ago. In France, the architect Gilles Perraudin has been building blocks of flats, public buildings and private homes in massive stone for more than 25 years, following the lead of Fernand Pouillon, a groundbreaker in the field in the years following the second world war.

A musical studies centre, Santiago de Compostela, Ensamble Studio © Roland Halbe

and another in Plan-les-Ouates, Geneva. Another French practice, Barrault Pressacco, has designed an elegant six-storey apartment block for rue Oberkampf, Paris. Separately, in Paris's 13th district, it is working on a 19-storey apartment block — "as far as we know, the tallest [modern] building of massive stone in France", say the architects — due to be completed in 2025.

The French are leaders in the quarrying techniques necessary to produce such stone, according to Taha. "The quarrying industry here has deskilled and de-tooled over the last three generations," he says of the UK. "All they do now is make kitchen worktops and tiles."

It was the lack of suitable, UK-quarried stone that forced Taha to turn to an Italian quarry for 317 Finchley Road. Transport of the stone has increased the building's carbon footprint. Nevertheless, Taha says, based on calculations by Eight Consultants, a sustainability consultancy, that the building's embodied carbon — the emissions from mining, transport and construction generated in building it — will be 60 per cent less than if the building had been built in reinforced concrete with a stone veneer. Some French stone producers are further reducing their emissions by using machinery powered by renewable energy, he says.

The architect contrasts the emissions benefits of massive stone with the very large carbon emissions related to the manufacturing of cement and concrete. Cement is produced by heating crushed limestone to 1,400C, he points out. Concrete is made by mixing cement with an aggregate.

A building in Geneva by Gilles Perraudin © Florent Michel

Flats in rue Oberkampf, Paris, by Barrault Pressacco © Giaime Meloni

"The irony is that 1 cubic metre of concrete has 40 per cent of the strength of the original block of stone," Taha says. "This is really stupid."

Concrete is “so cheap and so ubiquitous” that builders use it “without thought”, he adds. The choice of concrete for the floors in 317 Finchley Road was a compromise, Taha says. The firm originally specified that they should be made with a material called cross-laminated timber, made of multiple layers of wood.

The problems with brick construction are no less intense. Webb calculates that manufacturing the 2bn bricks a year used in the UK generates 1.8mn tonnes of carbon emissions.

“Now, with the climate crisis, we need to be building with stone and timber rather than steel and concrete,” Taha says.

The combination of a rough, unclad stone exterior and a timber interior can under some circumstances make a building carbon negative, Taha adds. While the precise definitions are still under debate, a carbon-negative building would be one where the carbon generated in the mining, growing and construction processes, as well as its eventual demolition, was outweighed by the carbon stored from the atmosphere in the construction products. The definition excludes the carbon emitted during use of the building.

The Normandy quarry from which the stone for Amin Taha’s Clerkenwell Close was extracted © Timothy Soar

Webb insists that it makes more sense environmentally to build in stone than to use renewable — and apparently more sustainable — alternatives such as timber. “We’re in a climate emergency,” the engineer says. “Using stone has an immediate carbon saving whereas it takes over 20 years for a tree to reach maturity.”

Quarrying also uses space more efficiently than forestry, Webb argues. “A tree has approximately 1.5 cubic metres of useful timber but the patch of ground below the tree has much more material,” he says. “Having extensive monocultural forestry everywhere is not the answer. Stone, meanwhile, is kind of inexhaustible.”

Nearly all the sandstone used to construct buildings in the centre of Edinburgh was extracted from a single quarry at Craigleith on the city’s north-western edge, Webb points out. A modest-sized retail park now covers the whole area that was excavated. Redundant quarries can be used for landfill or to create new habitats for nature, he adds.

Taha, meanwhile, insists that stone buildings — especially ones left "undressed", like the Clerkenwell Close building — offer significant cost benefits over alternatives. The Finchley Road tower is budgeted to cost £1,950 per square metre, well below the London average of £2,500.

Groupwork has calculated that homes could be built 24 per cent more cheaply using solid stone than breeze blocks with stone veneer cladding — a popular current choice.

'With the climate crisis, we need to be building with stone and timber rather than steel and concrete,' says Taha

"Stone foundations and stone basements are cheaper than concrete," Taha says. Groupwork has approached a volume housebuilder to build a prototype, solid-stone home, Taha says. The firm recently won a design competition with Bristol council for a 30-storey load-bearing stone tower with a 10-storey neighbour, providing 200 homes.

The benefits of building in stone also extend to the end of the structures' lives, the architect says. The stone from his buildings will be reusable after the structures are demolished in a way that concrete and steel are not.

"In 30 or 200 years' time, a stone building can simply be disassembled and the stone used elsewhere," Taha says. "With steel-reinforced concrete it's nigh impossible to reuse. The best that can be done is that it's crushed and used for aggregate."

> **In 30 or 200 years' time, a stone building can simply be disassembled and the stone used elsewhere**

Webb puts stone's carbon benefits particularly starkly, pointing out that one of the mainstream solutions currently being presented for the climate crisis is to build more nuclear power plants. He criticises the approach for failing to address the need to reduce emissions, rather than simply meeting current demands via cleaner methods.

"It's as if we've realised our boat is sinking but rather than plugging the hole, we've decided we'll build a bigger pump," he says.

Investment in technology to build more in stone would reduce reliance on the

carbon-intensive steel and concrete industries, he says.

Webb suggests that people who object to the opening of new quarries should be challenged on that point. “What would you prefer, more quarries or more nuclear power plants?” he asks.

Meanwhile, the pair’s work faces a more familiar challenge. As at Clerkenwell Close, there has been controversy over Groupwork’s preference for undressed — and relatively low-carbon — stone for the facade. The building was criticised as a “big ugly block” during the planning application process.

As a concession, decorative carving will be added to the facade at ground and first-floor levels. Taha regrets this. “Anything new to the eye and established aesthetic tastes may at first disquiet,” he says.

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