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One thousand years or more: Reusing stones from the Thames river wall

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ABSTRACT: This paper asks whether re-imagining the conventional understanding of components as subsidiary to structures and architecture could open new avenues for the multiple cycling of components within the built environment. This presents demands and opportunities to evolve the relationship between structures, architecture and material resource ecologies in ways that can enrich our built environment and reduce environmental impacts. A stone reuse project in the City of London, involving large granite stones from Joseph Bazelgette's C19th Thames River Wall, addresses these issues. The project outcomes are evaluated, and the broader implications discussed.

1 INTRODUCTION

The current mainstream conception and practice of architecture is one in which the component parts that constitute the architecture are subsidiary to the whole, with the work of architecture taking primacy. The result is often that components do not outlast the architecture that they contribute to, and their lifespan ends when that of the architecture does. This is the case even when the component has the capacity to go on from its first use to contribute to another architecture lifespan. Component cycling such as this can bring multiple benefits, relating to circular material flows that can contribute to resource efficiency, the carrying forward and cycling of material culture, and the opening of new avenues for architecture language and aesthetics in ways that can expand inhabitational character. When considering the different materials that architecture components are made of, stone merits attention here for reasons including its durability and history of reuse. Stone can often contribute to numerous architecture lifespans as it cycles through the built environment. There is a long history of this, some of it falling under the practice of spolia, which shows ways that stone reuse can work in specific environmental and cultural contexts, and the architectural aesthetic and inhabitational outcomes.

The paper focusses on design *with* reuse, with reused stones. Equally important considerations regarding design *for* reuse are beyond the scope of this paper. There are two main sections, the first, One Thousand Years or More, asks if it is time to reconsider the interrelationship between architecture and its component parts. The focus is on stone reuse, and some historical examples are appraised in support of the development of the argument for stone reuse cycling. The second main section, The Stones of London, questions the status of stone in London and what it means to use and reuse stone in the city. The focus is on a simple stone reuse project titled From the Thames to Eternity (Figure 1) that reuses granite stones from the Thames river wall. The basis for the availability of the stones for reuse is explained and discussed, along with the formulation, implementation and current situation for the

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project. A short conclusion addresses the key points of argument and outcomes, includes some additional evaluative points and considers broader implications and applicability.

Figure 1. Reused granite stones from the Thames river wall in front of St Paul's Cathedral, part of From the Thames to Eternity.

2 ONE THOUSAND YEARS OR MORE

The current potential for material and component reuse is often limited by thinking about components as subsidiary to the architecture project, there primarily to contribute to the lifespan of that project. This can result in components tailored and assembled in ways that makes their recovery for reuse unviable. As a result, the component often 'dies' when the work of architecture does, with the end of the component and architecture lifespan concurring. The component is then often deemed waste, remanufactured or downcycled. Some components have the potential to greatly outlast a typical architecture lifespan and to pass through and contribute to the lifespans of many buildings and other structures. This latent potential is seldom exploited in contemporary architecture and doing so is one important aspect of moving from an architecture lifespan to an architecture lifecycle model and mode of practice. It is time to rethink the subsidiarity of architecture components to the architecture that they constitute, to liberate them to better fulfil their potential to cycle through the built environment. In a circular model of the built environment, it will often be the architecture components and not the architecture that cycles. This can bring resource efficiency benefits, lessening the pull of natural material resources into the built environment, and enrich material culture.

When aiming for component cycling, it is important to consider the greatly varying durability of the components. Stone merits particular attention, with some stone components having a lifespan potentially extending to one thousand years or more. Stone is typically formed and evolved in the ground for many millions of years before it is extracted for the purposes of building. So, it follows that stone components often have the potential to endure way beyond a single architecture lifespan of perhaps a century or two. Stone is the form of construction with a track record of great longevity. It is what our oldest extant architecture is made of, for example the megalithic structure of Göbekli Tepe, Turkey, inhabited from around 9500 BCE (Schmidt, 2011).

Stonehenge, a megalithic UK structure constructed starting around 3000 BCE, consists of over one hundred stones (Figure 2). Recent research (Pearson, M.P. et al., 2021) indicates that the Bluestones, numbering over forty, may have been dismantled from a previous stone circle in West Wales prior to transport to site. This would make Stonehenge an early example of the reuse of a simple componentised form of construction. This cyclable, reconfigurable kit of parts approach is just as applicable now, as we seek to reduce environmental impacts from the built environment, as it was then, when it was used for different reasons. The iconography and architectural language of these types of megalithic structures largely derive from the forms of the stones themselves. In this typology, the stone component is also the architectural element, the column or the lintel. Large megalithic stones like these are somewhat immutable and highly durable, due in part to their material character and geometry. Their large size gives a smaller surface to volume ratio than for smaller stones. So weathering, occurring at the surface, reduces the stones' volume more slowly than it would for smaller stones. Reusing large stones without recutting them into smaller components for reuse also maintains their entropy, the level of disorder, rather than increasing it by cutting the stones down into smaller components for reuse. Cutting stones down may also shorten their lifespans and hasten their eventual return to the ground or weathering to dust.

Figure 2. Left, detail of megalithic Sarsen stones at Stonehenge (Photographer: Toby Editor, CC BY 4.0) Right, Reuse of columns at the Great Mosque, Cordoba (Photographer: wsifranics CC BY-NC-ND 2.0).

The Great Mosque of Córdoba, Spain, original structure built in the 8th century CE, incorporates over one thousand columns reused from Roman and other eras (Hidalgo Fernández, 2020). This is one of many examples of the reuse of monolithic Roman columns, which were reused for several reasons, not least because of the lack of availability of other such columns at the time, due to the difficulty in cutting them from quarried stone and transporting them to site. The Great Mosque shows the implications of reusing monolithic stones in this case. It demonstrates one kind of spolia thinking and practice, where the reused columns are not simply subsidiary to the architecture but rather somewhat jewel-like. They are not recut but reused as artefacts that contribute to the architectural language and are one of its determinants. The mosque has a high ceiling supported on semicircular, Roman-style arches. The columns are relatively short and a second, lower level of arches, of a horseshoe, Visigoth style, is incorporated. These tie the structure together giving lateral stability. Some reused columns vary in height, with shorter ones standing on pedestals to give a common datum from which the horseshoe arches spring. The Great Mosque is an example of creative reuse of massive stones, with the double arch typology emerging from this and enabling a high ceiling with the relatively short, reused columns.

3 THE STONES OF LONDON

3.1 *From the Thames to Eternity*

Following on from the last section, that makes the case for the reuse cycling of large stone components, this section explains and evaluates a live stone reuse project in the City of London. 58 monolithic granite stones, each around one tonne in weight, are reclaimed from their first use in Joseph Bazalgette's 19th century Thames river wall at Victoria Embankment. The stones are temporarily installed at seven sites across the City, on route to their next, 'permanent', homes. The title of the project reflects the potential of these stones to cycle through the built environment for many centuries, contributing to numerous works of architecture along the way.

3.2 *London has no native stones*

London is a city built on clay and gravel, with no native stones of its own. So, stone has always been a precious architectural commodity, with carefully selected building stones flowing into the capital for continuous use and reuse for at least the last two millennia. This is the context when stones become available for reuse in the capital today. There are some parallels to the Venetian condition as described by Ruskin (1921). Stone has historically been imported into London from across the UK and beyond. London Wall is an early partly extant example of stone construction in London; it was one of the largest construction projects undertaken in Roman Britain. Constructed around the year 200 CE and originally around four kilometres long, it utilised in the region of 85,000 tomes of Kentish Ragstone, a hard grey limestone. Portland Stone, a limestone from the Isle of Portland, is the stone most closely associated with the city today, used for buildings including St Paul's Cathedral, The Bank of England and The British Museum. Many of these buildings have Cornish granite lower stories and foundations, used for its superior strength and water resistance.

3.3 *The Thames river wall, past and present*

In 1858 London suffered from a Great Stink, an unbearable stench caused by the sheer quantity of raw, untreated sewerage flowing into the Thames, bringing with it a Cholera outbreak (Penner, 2013). In response, engineer Joseph Bazalgette was commissioned to design an intercepting sewer to capture the raw sewerage and pipe it further downriver.

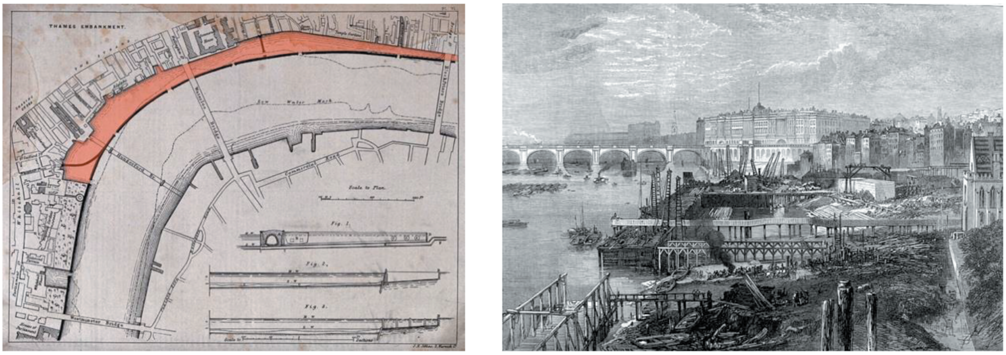

Figure 3. Left: A plan of the Thames Embankment (J. R. Jobbins after Sir J. Bazalgette) Right: Illustration of the Victoria Embankment under construction in 1865 (Source: The Illustrated London News, 4 February 1865, p.112).

This was one of the grand projects of the era and incorporated significant land reclamation along the banks of the Thames at Victoria Embankment, shaded in orange in Figure 3 and completed in 1870. The project included a new river wall constructed with thousands of monolithic granite blocks from several UK quarries, mostly Cornish and Scottish (Siddall et al., 2014). The historic section in Figure 4 shows the wall highlighted in orange, and the reclaimed land accommodating the new sewer, what was then the Metropolitan Line and other below-ground services, with Charing Cross station shown in the background.

Moving to the present day, London has now outgrown the capacity of the Bazalgette sewer system, and the Thames Tideway Tunnel has been constructed to help address this. This is a £4bn deep-level super sewer running for 25km under the tidal Thames. Part of the project has involved removing a few sections of the historic river wall to connect the new sewer to the old. This includes the removal of around 500 stones at Victoria Embankment, see Figure 4. These stones were made freely available by Westminster Council in 2021 for reuse in suitable public projects, subject to an expression of interest process. The stones have been used in several public realm projects, including Squaring Corners on the Beacontree Estate by NimTim Architects (Wilson, 2023) and the one described here.

Figure 4. Left: Historic section through the newly constructed Victoria Embankment, June 1867, with the river wall highlighted in orange (Source: The Illustrated London News). Right: Image showing removal of a section of the river wall, highlighted in orange.

3.4 *Formulating the brief*

So, here were some handsome and substantial granite stones (Figure 5), a part of London's material culture, that it would be great to retain and cycle in the city, and it was just a question of figuring out where their next home would be. The authors teamed up with the City of London Corporation as project partners and set about formulating a simple brief to incorporate some of the stones into the public realm across the City. The timeframe to formulate a project, from the point where the stones were made available to the point where they needed to be collected, was months rather than years and so a proposal was developed for an interim, temporary use of some of the stones, for perhaps a year or two, to enrich the City whilst permanent homes for them could be sought. The idea was to use the City as a de facto stone storage yard, in ways that could add another layer to the richness of the flow of stones through London and bring benefits of providing a place to rest or congregate plus tell the story of the stones and encourage public discussion on stone reuse in London. A particular stone type was selected for use, the stretcher stones from the wall, being around 1400x540x450mm in size and weighing around a tonne each. The plan was to reuse the stone without recutting, to carry them forward as a part of London's cultural heritage and also so as not to diminish their future potentiality.

Figure 5. Left: The Victoria Embankment stones in storage in Gravesend in 2021. Right: A playful sketch design workshop using 1:20 cork constructional model of the stones.

3.5 *Design development*

Moving forward from the relatively open brief, a playful design development method was used to establish where and how the stones might be deployed. As a part of this, several sketch design workshops were run with various parties using a 1:20 scale set of cork constructional model (Figure 5) to investigate ways that the stones could be configured and stacked to provide resting and gathering spaces. Some more elaborate options included simple amphitheatre arrangements, which had a primitive monolithic character in the way in which they expressed each stone. As design investigations proceeded, it became clear that the weight of the blocks was such that they would need to be deployed in the City's paved areas at a single course height, which would load the paving up close to the permitted limit. To stack the stones would necessitate concrete or other foundations, which made no sense for a project with an interest in economy of means and minimising carbon emissions. So, design development then proceeded on this basis.

Figure 6. Full size templates of the stones were used to test various fits across a range of sites.

A range of potential sites across the City were identified and 1:1 fabric templates of the stones were set out on them to get a sense of how various configurations would work in relation to the existing uses of the spaces and views, etc. (Figure 6). Alongside this, much work was done in liaison with a range of stakeholders to ascertain the viability of using the different sites. After much to-ing and fro-ing, seven sites were selected for installing a total of 56 stones (Figure 7). These trace a path from St Peters Hill, by the Thames, up into the heart of the City by Smithfield Market, the new site for the Museum of London. The stone configurations range from a relatively grand arc of twenty stones in front of St Paul's Cathedral to a modest array of three stones nesting next to a statue of Rowland Hill on King Edward Street.

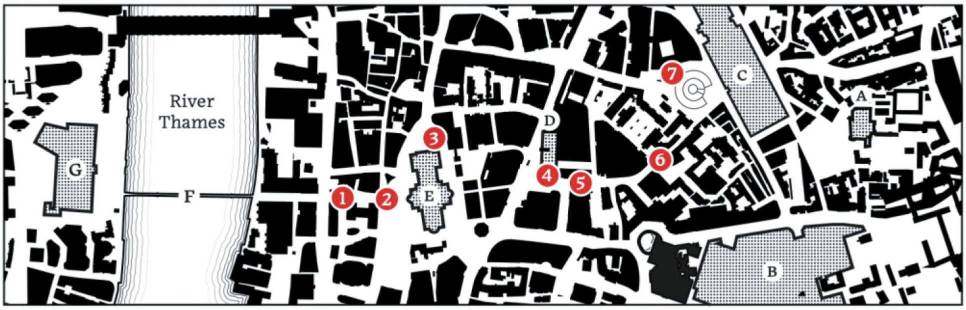

Figure 7. A plan of the final seven sites for stone installations, tracing a path from the Thames into the City.

3.6 *Project implementation*

As the project proceeded to implementation in 2023, questions remained about the detail of what treatment, if any, was needed for the stones and how best to orient and support each stone. The stones as stored after disassembly from the river wall each had one dressed face, which previously faced the river, and five more roughly cut faces that had been buried in the wall and now had varying amounts of different types of mortar adhered to them along with the the occasional steel or slate pin protruding from them. There was a sense of them as precious cultural artefacts that needed careful treatment. After a range of initial tests by the stone contractor, it was determined that the best treatment for the stones was sandblasting to remove any loose mortar (Figure 8) cutting back of any protruding pins and then some gentle jet washing. The intention was to clean up the stones and remove any sharp edges whilst still retaining the character of the stones, including the patina to their faces from a century and a half of weathering in the river wall.

When considering how to lay the stones in their temporary locations, the simplest arrangement was to lay them dressed face down, sitting on a recycled rubber mat. Any other orientation would have required careful wedging and propping to stabilise the craggy geometries, or else risk crushing people's feet. The stones were quickly lifted into place using a telehandler (Figure 9). It was immediately obvious that the stones would be a welcome place to rest as people started nesting on them straight away during installation. One stone per site was

Figure 8. Left, sandblasting a stone to remove loose mortar. Right, jet washing a stone to clean it.

displayed with the dressed patinated face upwards, visible in all its glory. This was cradled and stabilised in a bespoke oak frame cut from recycled timber and accompanied by an information board with map and QR code so that inquisitive passers-by could find out more (Figure 9).

Figure 9. Left, a face-down stone being lifted into place in front of St Paul's Cathedral. Right, a face-up stone in its oak cradle with information board at King Edward Street.

3.7 *Inhabitation and next steps*

Circumstantial evidence, from the authors several visits to the installations, is that people welcome a chance to take a minute's rest or read more about the stones on the information boards (Figure 10). Those in front of St Paul's Cathedral provide a seat with one of the best views in London (Figure 1). Some other locations are simply just a place to enjoy a conversation (Figure 10) or a sandwich, or just to rest tired legs. One unanticipated thing is how comfortable the uneven stone surfaces are when you take a moment to find a comfortable seat, more so than the flat smartly dressed surfaces. The craggy character of the stones catches the attention of passers-by, in their smart City settings. A survey of over 600 passers-by has also provided the design team with a lot more feedback on how the project has been received.

Figure 10. Left, people deep in conversation, with the ruins of Christchurch Greyfriars behind. Right, passersby reading about the project at Peter's Hill, on the route from the Thames to St Paul's Cathedral.

Since the commencement of the project, next uses have been identified for all the stones, including the intention to reuse some at St Edwards Square, a new public space being created right next to Christchurch Greyfriars. The aim is now to disassemble the seven sites at different times to allow the stones to be moved directly from their current homes to their next ones, to minimize the cumbersome movement of these heavy stones and the associated carbon emissions.

4 CONCLUSION

This paper has argued that it is time to rethink the subsidiary relationship between architecture components and their constituent architecture, to enable them to make a full contribution to the built environment unconstrained by the lifespan of any one work of architecture. The focus has been on massive stone components and the case for cycling them in the built environment. Historic case studies have indicated some of the dynamics involved in this approach, relating to ways that the reuse of massive stones needs to be accounted for in the development of the architecture and how it can inform and contribute to architecture typology and aesthetics. The live stone reuse project addressed here has shown and reflected on using the city as a temporary storage ground for monolithic stones to retain them as they cycle through the built environment. It has demonstrated how temporary public projects such as this can enable the cataloguing and storage of stones on route to their next permanent use, avoiding their removal from the city and potential downcycling, such as crushing for use as road subbase, or fall from the human use cycle. Some further benefits of cycling architecture components through the public realm in this way including adding amenity and encouraging public discourse on urban reuse in relation to resource efficiency and cultural heritage. A part of what has been learned from reusing these large stones, with a methodology that differs markedly from current architecture practice, is that there has been a sense of care for the stones as artefacts. There has been an investigation of the stones and careful consideration of their treatment, to carry them forward into the future. This differs from typical approach of material resources being fair game, to be shaped to the architects will for the purposes of a specific project, using plentiful cheap energy, regardless of what might come beyond that project. It points to a form of practice that can be more efficient in its use of material resources and energy, carrying forward material culture and enriching architectural aesthetics.

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