Haberdashers' School

Occasional Papers Series

Occasional Paper Number Eighty-Six

Concrete Construction: history, future, and architectural identity

Theo Lewis

Mathematics Department

TLewis@habselstree.org.uk

August 2025

Haberdashers' School Occasional Paper Number Eighty-Six

August 2025

Concrete Construction: history, future, and architectural identity

Theo Lewis

Abstract

Concrete. Though it may, at first glance, appear a rather banal topic of study, concrete is a profoundly consequential material: technically complex, environmentally significant, and ideologically charged, with much of today's global infrastructure relying on its presence. Concrete's historical trajectory from its ancient cementitious form to the modern innovations of reinforced and pre-stressed concrete has coincided with a dramatic expansion in its structural capabilities and, in consequence, scale of consumption. The vastness of concrete's production causes profound environmental challenges, particularly centred around carbon dioxide emissions and resource depletion. Unfortunately, despite the unsustainability of its consumption, concrete remains socially, structurally, and economically indispensable to the modern world. Current research aims to address this by focusing on strategic reduction and decarbonisation through advancements like green concrete and 3D-printed construction. Beyond the material and environmental dimensions, concrete holds significant architectural and social meaning. This is particularly evident in the architectural style of Brutalism, which emerged from the principles of functional honesty, social idealism, and a pragmatic response to post-war demands, especially within the context of social housing and university infrastructure.

Concrete

Concrete is made from mixing a chemical binder (cement), water, fine aggregates (sand), and coarse aggregates (gravel or crushed stone) together.[1] The exact ratio of this mix, along with any admixtures it contains, determines the concrete's properties: its strength, workability, setting time, shrinkage, porosity, and so on.[2] The mix is poured into a formwork mould either in place (*in situ*) or off site before installation (*ex situ*).

Figure 1: Concrete being poured by a worker[3]

History of Concrete

Before the invention of concrete, as we are familiar with it today, primitive forms of cement were discovered and developed.[4] In 1300BC Middle Eastern builders found that when they added a damp layer of burned limestone (lime) to the outside of their houses it reacted with the air and formed a hard shell – one of the earliest known examples of lime-based cement.[5] Later civilisation added sand and water to the lime to form mortar, and the mix was iteratively improved upon, eventually evolving into early concrete structures. By 700 BC, Nabataea traders in southern Syria and northern Jordan were building concrete floors and underground cisterns to hold water.

[1] Occasionally there is terminological misuse whereby people use 'cement' and 'concrete' interchangeably instead of acknowledging that one is a constituent of the other. Likewise, another source of confusion is the term 'mortar' which refers to the mix of cement, water and fine aggregates – but no coarse aggregates or admixtures.
[2] Concrete Admixtures - InterNACHI®
[3] What is mass concreting? - Knowledge Center - Maturix
[4] The History of Concrete - InterNACHI®
[5] History Of Concrete | Marstellar Oil & Concrete

By 200BC, the Romans had begun to cultivate a reputation for their mastery with concrete; many of their structures still standing today attest this.[1] Arguably, the most monumental being the *Pantheon* in Rome. Completed in 125AD, its concrete ceiling reaches 43m in diameter, making it the largest un-reinforced concrete dome in the world. Tragically, most of the construction techniques implemented were lost with the fall of the Roman empire in 476AD and concrete use stagnated. It wasn't until the 18th century when John Smeaton, the so called '*father of civil engineering*' developed a modern method of producing hydraulic lime for cement that concrete production reenergised.[2] This progress was furthered by Joseph Aspdin, English bricklayer and businessman, who invented Portland cement which (after some refinement) continues to be the most used type of cement in the construction industry today.[3]

Figure 2: The concrete dome ceiling of Rome's Pantheon[4]

Material Properties

To understand why concrete is so widely used we must examine its material properties. Compared to other construction materials such as wood, stone, brick or metal, concrete is blatantly superior in at least one domain. Wood may have lower upfront costs, but concrete is fire and waterproof; stone may be more durable, but concrete is more geometrically flexible, and so on. Generally, the attraction towards concrete lies in its affordability, construction speed, strength, resilience to weathering and versatility. These properties have seen concrete play an integral role in global infrastructure, from roads to bridges, dams, and buildings of every kind.

The most relevant of concrete's properties, from an engineering perspective, is by far its strength. Unlike metals, which exhibit approximately isotropic behaviour, concrete has incredibly asymmetric material properties: ductile in compression and brittle in tension.

[1] The History of Concrete - InterNACHI®
[2] Who Was The Father Of Civil Engineering? | Institution of Civil Engineers (ICE)
[3] History Of Concrete | Marstellar Oil & Concrete
[4] The Oculus and Dome of the Pantheon: Rome's Architectural

Concrete has a compressive strength of anywhere between 20 to 85 MPa depending on the mix parameters, while engineers will typically assume zero tensile strength for design calculations.[1] As a result, even minimal tensile loading can cause the collapse of a concrete structure. This property of concrete effectively limited the possible geometries of early builds. To explain this, consider the statics of a chain suspended between two fixed ends, hanging freely. Each individual link is in pure tension, and the chain experiences no compressive or shear stresses. By observation, the curve the chain follows is not parabolic, rather what is known as a '*catenary curve*'. When flipped upside-down, a structure following the curve experiences only compressive internal forces – ideal for unreinforced concrete or masonry with its high compressive strength and near zero tensile strength.[2] Hence, domes and arches which followed (or approximated) catenary curves were relied upon in early concrete construction to naturally channel forces in compression.[3]

Catenary curves are perhaps most famously seen in *Basílica de la Sagrada Família*, where architect, Antoni Gaudí, used an ingenious technique to aid his design process. In the absence of computer aided design tools, he made an inverted hanging model of his prospective Church using string and small weights.[4] By copying the resulting catenary curves, he was able to produce a structurally efficient design that overcame the construction material's inherent tensile weakness.

---

[1] Alongside more sophisticated computer programmes, engineers will use linear elastic models for hand calculations. These remain valid for small strains in uncracked concrete, so engineers make generous use of safety factors to ensure their builds don't stray far from this idealised condition.

[2] Catenary and Roman Empire. The catenary's role in Roman Empire—a… | by Marcus Araripe | Medium

[3] The catenary curve wasn't defined mathematically until the 17th century; however, the Romans still produced forms that closely approximated catenary curves by using empirical methods.

[4] Gaudí's Hanging Chain Models

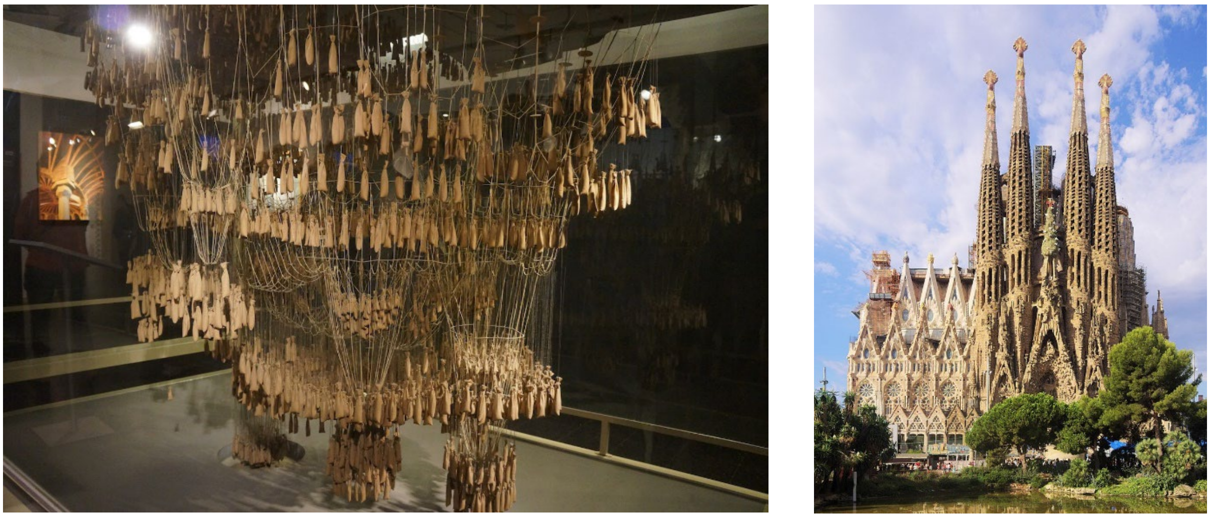

Figure 3: Gaudí's hanging model (left) of the Basílica de la Sagrada Família (right)[1]

Fortunately, the recent history of concrete construction is punctuated with several significant breakthroughs that fundamentally expanded the structural and geometric possibilities of the material. In 1892, French engineer François Hennebique patented a system of reinforcing concrete by setting steel reinforcement bars (‘*rebar*’ for short) inside the concrete.[2] The steel rebar effectively increased the specific strength (strength per weight) of the concrete, enabling structures to be built bigger and cheaper. Additionally, rebar had the fortuitous side-effect of increasing structural safety. Since steel is ductile in both tension and compression, reinforced concrete fails gradually and visibly (unlike plain unreinforced concrete’s sudden brittle failure), giving time for any occupants to escape a structure undergoing collapse.[3]

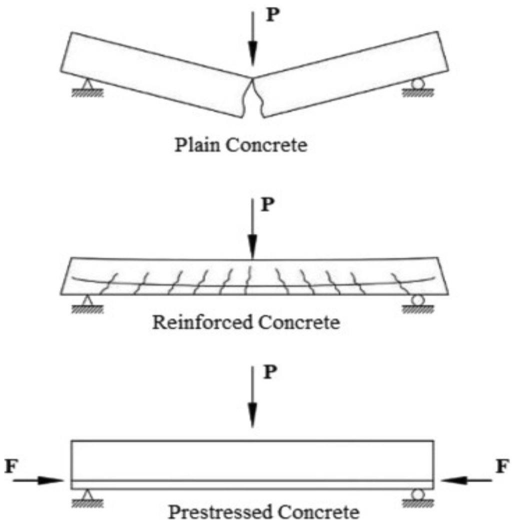

Figure 4: Strength inducing effect of reinforcing and prestressing concrete[4]

Around half a decade after Hennebique’s patent, another French engineer, Eugène Freyssinet, invented pre-stressed concrete – the ingenious yet simple evolution of reinforced concrete.[5] Before the concrete was poured, steel tendons were tensioned inside the formwork. After the concrete had set and bonded with the steel, the tendons were released from their fixtures, squeezing the concrete inwards. The residual compressive stress enabled concrete

[1] Gaudí's Hanging Chain Models
[2] A Brief History of Reinforced Concrete Buildings – The Historic England Blog
[3] Study on various properties of reinforced concrete – A review - ScienceDirect
[4] Chahar, Pal, Study on various properties of reinforced concrete – A review, 2022, https://doi.org/10.1016/j.matpr.2022.03.193
[5] Eugene Freyssinet

members to be subjected to much greater tension before failure. Consequently, engineers could span even larger gaps and reach greater heights whilst using less concrete.

Figure 5: One of the earliest prestressed concrete bridges, designed by Eugène Freyssinet, completed in 1946, spanning 55 metres[1]

Scale & Environmental Impact

The human brain is infamously bad at conceptualising massive quantities, making it difficult to truly appreciate the scale of global concrete consumption and its significance.[2] Simply, concrete is the lifeblood of the modern construction industry. It is second only to water as the most widely consumed resource in the world.[3] In 2020, 14 billion cubic metres of concrete was poured, equivalent to 5.6 million Olympic swimming pools or 12,700 Wembley Stadiums filled to the roof.[4]

Elhacham et al. insightfully compare global biomass (organic matter from living or recently living organisms) and anthropogenic mass (human-made, inanimate mass) to highlight the immensity of human impact on the Anthropocene epoch. They estimate that anthropogenic mass overtook biomass in 2020.[5] This means that there is currently more plastic, metal and concrete in the world than trees, shrubs, and animals. Concrete is estimated to account for

---

[1] The History of Freyssinet – 75 years of innovation & excellence - FreyssinetUK

[2] There are several reasons for this. Evolutionarily, this was a product of our environment – we dealt with low numbers, often which were immediately relevant for our survival (Why your brain struggles with big numbers : Short Wave : NPR). To some extent, massive numbers continue to lack a tangible connection to our everyday experiences – the average person is not concerned how many drops of water are in the ocean or stars in the sky. Consequently, our brains are wired to think logarithmically: the difference between 0kg and 10kg seems a lot, but 1,000,000kg and 1,000,010kg negligible.

[3] Climate change: The massive CO2 emitter you may not know about - BBC News

[4] Cement and concrete around the world

[5] Elhacham, et al., Global human-made mass exceeds all living biomass. 2020, https://doi.org/10.1038/s41586-020-3010-5

43% of this anthropogenic mass. Evidently, it is no overstatement to conclude that concrete's transformation of our habitat is of truly unfathomable scale.

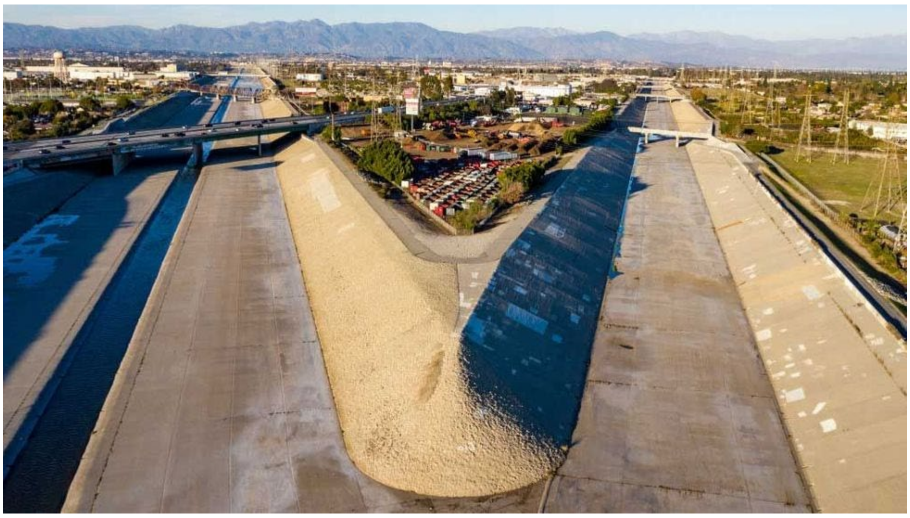

Figure 6: Concrete channel of the Los Angeles River[1]

As you may imagine, this unbelievable scale of consumption entails massive environmental impact – and the dominant cause can be explained simply by the chemistry behind cement production. To make cement, limestone and clay are first quarried and crushed into a homogeneous powder. The mixture is then heated in a rotating kiln at approximately 1000°C, causing the calcination of limestone into calcium oxide (quicklime) and carbon dioxide[2]:

$$CaCO_3 \rightarrow CaO + CO_2$$

Figure 7: Cylindrical rotary kiln used to make cement[3]

[1] Concrete: The material that's 'too vast to imagine' - BBC Future
[2] The Chemistry Behind Concrete - Concrete Decor
[3] Cement Kilns: Design features of rotary kilns

Comparatively, the remaining steps in cement production are much less carbon intensive. Equally, the final reaction between cement, water and aggregates does not directly produce any emissions: it is the calcination of limestone and the heat energy it necessitates that accounts for concrete contributing to 8% of global CO_2 emissions.[1]

Aside from emissions, there are other dimensions to concrete's environmental impact. Notably, the extraction of sand and gravel for aggregate imposes widespread ecological and hydrological disruption. Sand is typically sourced from riverbeds and beaches as the angularity of its grains produces stronger concrete than the more rounded particles found in deserts.[2] The removal of this sand can lead to rapid landscape erosion and a loss of biodiversity. Moreover, there is a blatant unsustainability to the practice: it is estimated we are extracting sediment twice as fast as nature is producing it.[3]

In defence of their product, concrete producers are quick to declare that concrete is recyclable. This is true in theory but overlooks a few important caveats. Notably, the recyclability of a material does not guarantee, in practice, that it will be recycled; indeed, only around 5% of concrete is recycled globally.[4] A study by Badraddin et al. highlights thirteen reasons for this, with the main challenges centring around time and budget constraints and lack of recycling regulations.

Challenge	Rank
Increased project duration	1
Lack of national programs on concrete recycling	2
Lack of comprehensive rules and regulations on concrete recycling	3
Increased project cost	4
Low demand for recycled concrete	5
Low cost-effectiveness of concrete recycling	6
Increased transportation cost	7
Lack of technical knowledge in concrete recycling	8
Lack of knowledge on the value of concrete recycling	9
Tight timeframes between project activities	10
Lack of cooperation between project team members on concrete recycling	11
Lack of guidelines for concrete recycling	12
Current practice in treating concrete waste	13
Lack of knowledge in using concrete recycling technologies	14
Insufficient space on-site to concrete recycling	15
Lack of support to concrete recycling	16
Insufficient time to develop plans for concrete recycling	17

Figure 8: Challenges associated with recycling concrete ranked by significance[5]

1 Making Concrete Change: Innovation in Low-carbon Cement and Concrete | Chatham House – International Affairs Think Tank
2 The battle to curb our appetite for concrete - BBC News
3 OECD Web Archive
4 Badraddin, et al., M. Main Challenges to Concrete Recycling in Practice. 2021,
5 https://doi.org/10.3390/su131911077

In Defence of Concrete's Use

Understandably, a poor environmental reputation can paint a rather bleak image of concrete construction. While concrete clearly exhibits unrivalled building properties – reflected in the immensity of its industry – its production is incredibly carbon intensive and unsustainable. Yet, despite this environmental burden, concrete's role in improving human welfare remains a vital and often underappreciated dimension of its use. For example, concrete is often used to rapidly provide emergency housing in disaster zones, giving safety to those displaced by extreme weather or wars.[1] Additionally, its impermeability and chemical stability makes concrete ideal for sanitation and water supply systems worldwide, which can greatly increase the standard of living in developing countries.[2]

But even developed countries have historically benefited. As explained by a director of Cemex: '*cement was arguably the single biggest factor in ensuring that the UK and the West were able to make the leap forward in the Victorian era,*' allowing the construction of infrastructure that '*eradicated everyday diseases, which incapacitated or killed people, especially children*'.[3] Whilst we should be aware that a director of one of the largest cement companies in the world will have some inherent biases towards his product, his connection between cement (more accurately, *concrete*) and improved sanitation is a fair one.[3]

A compelling example of this comes from Mexico's social programme, '*Piso Firme*', meaning '*hard floor*'.[4] Starting in 2000, the governor of Coahuila provided 34,000 homes in the state with concrete floors to replace the existing parasitic dirt. This dramatically reduced cases of parasites in children under six, and, ultimately, lead to greater household well-being. The programme's success led to President Felipe Calderón's involvement, and a further 2.7 million concrete floors being installed before 2012.[5]

Figure 9: Felipe Calderón, 63rd President of Mexico, marking a message in wet concrete to celebrate the Piso Fime programme[3]

---

[1] Humanitarian Aid – Combat Concrete
[2] How can cement ensure clean water and sanitation for the world's growing urban population?
[3] Company Profile | CEMEX UK
[4] The hidden strengths of unloved concrete - BBC News
[5] Mexico's "Piso Firme" Program

You may argue that these humanitarian examples, however compelling, do not reflect the reality of most concrete construction. Most of the world's concrete is not poured in the service of social uplift, but in commercial real estate, industrial expansion, and private development – domains often shaped less by altruism than by capital. Unfortunately, this does not diminish the truth of concrete's necessity. Whether its use is sometimes driven by profit or pragmatism rather than humanitarian need, halting its use is fundamentally unfeasible.

Concrete is deeply embedded in our global construction industry; not only is no other material functionally equivalent, but no alternative exists that can be scaled to meet the demands that concrete does. While timber and steel structures may have lower embodied carbon, their ability to fully replace concrete is hindered by scale, availability, and performance limitations. Simply, to abandon concrete is to stall development – which introduces its own cascade of problems. Ironically, despite the unsustainability of its production, the abandonment of concrete would dramatically delay progress towards several of the UN Sustainable Development Goals (notably, 6,7,8 and 9) which rely heavily on its use.[1]

Clearly therefore, our focus should not be abandonment, rather reduction and decarbonisation. Governments and leading companies must invest into innovative technologies and practices that enable smarter, more efficient, lower-carbon use of concrete. Aptly described in an article by GLOBE: '*within the next 30-50 years, the global demand for development of housing and new infrastructure poses a substantial challenge to the global community.*' '*Immediate action is needed to implement the best knowledge and technology we already have at our disposal today. A paradigm shift in construction to adopt new best practices must be implemented at global scale*'.[2]

The future of the concrete construction

Understanding the mounting pressures on the construction industry, academic institutions worldwide are investing substantially into promising areas of research. Current literature is rife with new innovative ways to either decarbonise concrete or simply use less of it. Two particularly compelling developments in the field are '*green concrete*' and '*3D-printed construction*'. The former aims to make concrete production more sustainable, while the latter aims to reduce the amount of concrete required by building more efficiently.

Broadly, green concrete defines any concrete designed to reduce environmental impact. Whilst this definition is conveniently vague for cement producers, allowing them to claim their new cement recipe is 'green' despite only modest reductions in emissions compared to previous products, it also encompasses some genuinely impactful technologies. Often green concrete is created by integrating industrial by-products or recycled materials as admixtures, helping to reduce embodied carbon and divert waste from landfills. However, another approach targets the chemistry of cement production itself, particularly the calcination reaction, which is responsible for most of cement's emissions. For example, the company *Brimstone* has found a way to produce cement from calcium silicates rather than traditional

[1] THE 17 GOALS | Sustainable Development
[2] 221109-GlobePolicyAdviceDocument-revised-new-1.pdf

calcium carbonates – thereby eliminating the release of carbon dioxide during calcination.[1] Another approach, taken by *BioMason,* is to develop '*biocement*' by injecting microorganism into sand, which induces a mineralisation process similar to coral formation. Alternatively, a different strategy exemplified by the company *CarbonCure* focuses on carbon capture. Their method involves injecting carbon dioxide directly into wet concrete, where it reacts, mineralises, and becomes permanently sequestered.[2]

The emerging field of 3D-printed construction offers a promising response not only to the industry's environmental impact, but also to its failure to keep up with the pace and scale of global demand. Rapid urbanisation, labour shortages, and rising material costs, have contributed to a growing housing crisis, with millions worldwide lacking access to affordable, high-quality housing. Whilst this is a global problem, it is strongly exemplified in the UK, with a nationwide housing deficit of 4.3 million homes.[3]

Figure 10: Apis Cor's building site, Dubai, with 3D printer mid construction[4]

3D-printed construction involves using large-scale 3D printers to build concrete structures layer by layer from a digital design. This can be done either on or off-site, often in a modular fashion. 3D-printed construction offers designers an unprecedented level of creative freedom since the geometric complexity of a design is largely independent to its print time. By eliminating the need for formwork and reducing concrete usage, 3D-printed construction offers a more environmentally sustainable approach, with a 47% reduction in global warming potential compared to traditional methods.[5] Likewise, from an economic perspective, the reduced material usage coupled with fewer workers required onsite and shorter construction

[1] Technology | Brimstone
[2] How to make concrete green! - YouTube
[3] The housebuilding crisis: The UK's 4 million missing homes | Centre for Cities
[4] Apis Cor builds world's largest 3D-printed building in Dubai
[5] Abdalla, et al., Environmental Footprint and Economics of a Full-Scale 3d-Printed House. 2021, https://doi.org/https://doi.org/10.3390/su132111978

times result in 3D-printed houses costing around 49% less to build.[3] Additionally, 3D-printed construction can be used on dangerous sites, where there are risks to workers' safety.

The feasibility of this technology has been proven by multiple companies across the globe. American companies including *ICON*, *Madco3d* and *Apis Cor* are pushing the boundaries of 3D-printed construction, each successfully completing both commercial housing projects and more experimental ventures. Notably, in 2019 *Apis Cor* printed the world's largest 3D-printed building with a floor area of 640 square metres.[1] In a more ecologically driven application, *Madco3d* has begun producing 3D-printed concrete coral reefs for use in marine restoration, aiding biodiversity in endangered underwater habitats.[2]

Figure 11: Apis Cor's finished structure, the largest 3D-printed building in the world[3]

European companies such as *PERI Group*, *Incremental3D*, and *XtreeE* are also pioneering advancements in the field. *Incremental3D's* Bridge, '*Striatus*', is described by the Block Research Group as '*a new language for concrete*'. The structure, built in 2021, is unique in its modularity, constructed from 3D-printed concrete blocks assembled without any reinforcement or adhesives, challenging conventional construction methods.[4]

Currently, we are at a critical time in the development of 3D-printed construction, as it begins to mature into a viable method for mass construction. However, key challenges must first be addressed with research. An absence of uniform guidelines across companies complicates regulatory approval, making it challenging for governing bodies to certify a building's structural safety and ultimately limiting the technology's wide-spread adoption. Additionally, more research is required into optimising reinforcement techniques and connection designs.

[1] Apis Cor builds world's largest 3D-printed building in Dubai
[2] The Coral - MADCO3D
[3] Apis Cor collaborates on world's largest 3D printed building - 3Dnatives
[4] https://www.striatusbridge.com/

An Architectural and Social Lens

Today, concrete features in nearly all large-scale construction projects worldwide, however, the extent to which it is aesthetic rather than structural varies massively between architectural styles. Arguably, concrete found its most iconic architectural expression in Brutalism, a subcategory of Modernism. Characterised by bold, geometric shapes, massive proportions and exposed concrete, Brutalism was founded on the idea that buildings should be honest to their construction materials and clear in their function. Hence, brutalist architects tended to reject the use of facades and ornamentation, instead designing by the inherently utilitarian principle of '*function over form*'. While the word itself connotes feelings of harshness and brutality, Brutalism's etymological origins are not from the word 'brutal' but from the French '*beton brut*' meaning '*raw concrete*'.[1]

In the 1950s to 60s the combination of the destruction of housing from WW2, post-war population boom and a shortage of skilled labour created a significant housing deficit in the UK (and across Europe). Simultaneously, changing social views placed emphasis on a greater standard of living for all.[2] To embark on the monumental undertaking of reconstructing Britain, a new generation of rebellious, young architectures emerged, who challenged traditional architectural conventions – particularly those that saw the aestheticization of architecture at the expense of its function. Reinforced concrete, widely used and refined during WW2, offered a cheap and effective building material and provided the fertile ground for Brutalism.

Figure 12: Le Corbusier's revolutionary social housing building, Unité d'Habitation, which was massively influential over Britain's Brutalist movement[3]

[1] Brutalism: How unpopular buildings came back in fashion - BBC Culture
[2] A Brief Introduction to Brutalism – The Historic England Blog
[3] Concrete: The material that's 'too vast to imagine' - BBC Future

Figure 13: Trellick Tower looming behind a busy London street, 1975[2]

The style was catalysed by Le Corbusier's '*Unité d'Habitation*', a radical social housing building that strongly influenced British architects. However, there were subtle differences between British Brutalism and its French counterpart. Le Corbusier's architecture was socially utopic, physically and ideologically isolated from existing infrastructure, whereas, very broadly speaking, early British Brutalism was rooted in the social realism of post-war demands.[1] Famous examples include Goldfinger's Balfron Tower and Trellick Tower (London), and Smith and Lynn's Park Hill Estate (Sheffield).

Equally, it is reductive to say that all British Brutalism was born from rational socialist intent. Whilst immediate post war years saw little commercial construction, the 1960s brought changes in building legislation which were quickly exploited by a growing group of commercial architects. Among them, Richard Seifert, described as the '*most prominent of Britain's unashamedly commercial architects*,' saw his primary duty to optimise profits for his clients, owing no loyalty to his building's future inhabitants.[3] Today, cheerless offices blocks, carparks and shopping centres largely define the prevailing perception of brutalist architecture – driven more by opportunistic monetary pursuit than selfless social intent.

It is no surprise then to learn that public sector architects were eager to differentiate themselves from their commercial counterparts. Equally, many institutions and critics willingly endorsed this distinction. While brutalist architects of the Welfare State were celebrated through art journals and public awards, commercial architects were largely ostracised by the architectural community. Even today, the most prominent and celebrated brutalist buildings continue to be those of the Welfare State.[4] Unfortunately, the collapse of the building industry in the 1970s forced many public sector architects to take commercial work. Shortly thereafter, the combination of changing architectural trends and poor public perception saw a decline in

[1] As an aside, Brutalism is often associated with soviet architecture during Khrushchev's post-Stalin thaw. Whilst early Soviet Brutalism was inspired by its western counterpart, it was not a direct offshoot, evolving independently into a distinctly different style. Both architectural styles were categorised by massive scale and raw concrete, but while western Brutalism was built on honesty of expression, Soviet Brutalism's values centred more in the rejection of Stalinist neoclassicism and aimed to project state power and progress. The ideological differences go much deeper than this, but perhaps that is a subject for a separate article. In the meantime, I encourage readers to enjoy some captivatingly utopic images of Soviet Brutalism found on the following webpage: Soviet brutalist architecture explored: the ultimate guide | Wallpaper

[2] A Tale of Two Towers: Trellick Tower turns 50

[3] Raw Concrete, The Beauty of Brutalism, Barnabus Calder

[4] A notable exception being the National Theatre which emerged from a complex interplay of social, political, and artistic forces. Supported by both Labour and Conservative governments, it cannot be neatly categorised as entirely social or commercial architecture.

Brutalism’s prominence in Britain, signalling the close of a transformative epoch in the nation’s architectural and social history.[1]

Most man-made definitions fail to categorise the messy world we live in as neatly as we may hope. Brutalism, despite its socialist origins, evolved into a multifaceted movement that is not defined by a single building. For some architects it represented a commitment to expanding accessibility to education and affordable social housing. For others, however, the partnership of concrete and brutalist aesthetic provided a convenient excuse to build oppressive edifices designed to maximise profits, whilst remaining under the guise of architectural fashion.

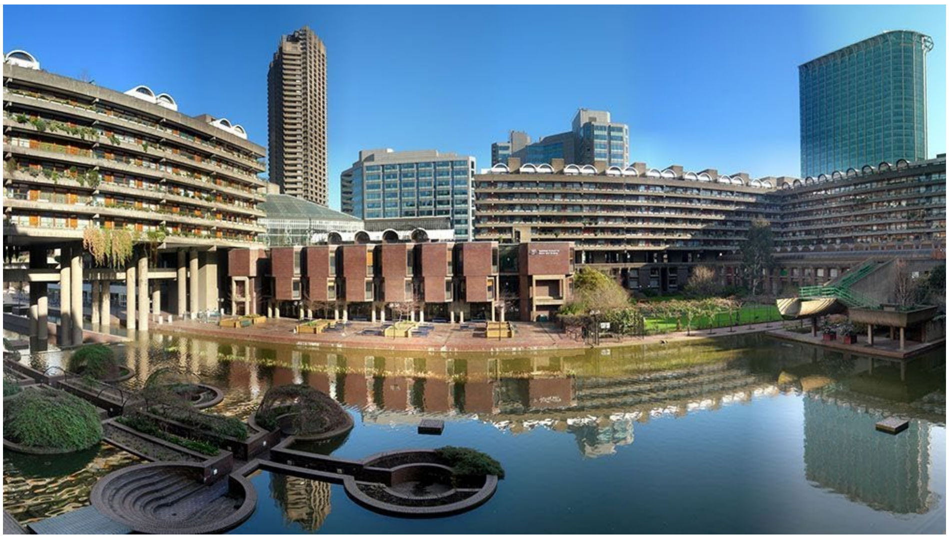

Figure 14: The Barbican Estate, London[2]

It is this difficulty to neatly categorise Brutalism that is partly responsible for the breath of emotional responses it evokes. Admirers will cite the Barbican Estate and Trellick Tower and exclaim that Brutalism is a bold and beautiful style rooted in socialist realism, which challenges the more materialistic aspects of modernism. By contrast, detractors will point towards their nearest neglected office block and declare that Brutalism is a manifestation of architectural laziness, responsible for producing soulless, dehumanising monstrosities. Ultimately, truth lies in both arguments.

Despite Brutalism’s divisive reputation, one thing remains clear: it was responsible for an architectural revolution. Brutalism’s use of raw concrete was both aesthetically and ideologically transformative. Suddenly, concrete had evolved from a hidden structural necessity into a deliberate aesthetic statement – albeit with mixed response. By transcending its engineering purpose, concrete became vehicle for philosophical provocation, raising profound questions: Who is architecture for? What is its role in society? And is beauty objective or ideological?

[1] Raw Concrete, The Beauty of Brutalism, Barnabus Calder
[2] [Brutalism: How unpopular buildings came back in fashion - BBC Culture]

University Anecdote

The University of Oxford's so called '*Keble Road Triangle*' describes the awkward area squeezed betwixt Banbury Road, Parks Road and Keble Road. It houses Physics, Computer Science and Engineering faculties in an interconnected complex of imposing brutalist buildings. Notably, the Physics Department's Denys Wilkinson Building has stood assertively over Banbury and Keble Road since its completion in the 1967.[1] Its raw concrete faces fortify its ground level, with stocky columns holding a mesh of concrete beams, which in turn support the cantilevered third floor. Tinted cubic windows evoke a sense of secrecy and self-importance, alienating its inhabitants from the pedestrians below. The design is clean, efficient, and quietly elegant. Quintessentially brutalist. Fittingly, it's design mirrors the character of the physicists it houses: stern, precise, and rational. And yet the choice of concrete as a construction material was not merely an architectural choice, it was a functional one. The research into particle physics conducted inside the building required the background radiation to be as low as possible, thus demanding thick concrete for the lower-level walls.[2]

Figure 15: The University of Oxford's Denys Wilkinson Building (foreground) and Thom Building (left, background), Banbury Road[2]

From Keble Road, a solitary concrete staircase leads to a labyrinth of elevated walkways that connect the Denys Wilkinson to the first floor of the Engineering Department's Thom Building. During my undergraduate studies, my daily walk to 9am engineering lectures navigated through this network, allowing me to go from my Keble College bedroom to lecture seat in approximately 4 minutes.[3] The Thom Building, completed in 1963, rises eight storeys above

[1] Denys Wilkinson Building, Oxford University
[2] Denys Wilkinson Building - Wikipedia
[3] Any readers considering applying to Engineering Science at Oxbridge I strongly recommend Keble College, Oxford. It has a longstanding reputation as being the 'Engineering College' and the quality of its tutorial fellows reflects this. But if not for anything else, its proximity to the Thom Building is unrivalled by any other college.

ground and two below.[1] It was among the first examples of high-rise Modernism in Oxford and remains one of the tallest university buildings in the city. As with the Denys Wilkinson Building, the structure is unapologetically functional: defined by its strong vertical lines, utilitarian fenestration, and exposed concrete.

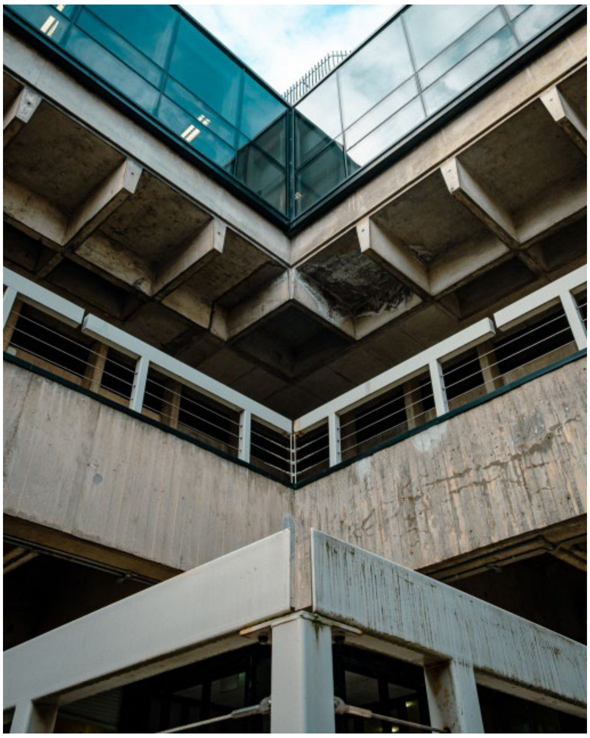

Figure 16: Concrete walkways surrounding the Denys Wilkinson Building, Oxford[3]

Figure 17: The Engineering Department's Thom Building shortly after completion[4]

The imposing scale and stylistic contrast to Oxford's pre-existing Gothic and Neoclassic architecture saw the Thom and Denys Wilkinson buildings face public backlash. A 2019 report by the city council highlight the Thom and Denis Wilkinson as '*the dominant buildings*' of the Keble Road Triangle and acknowledges that '*their impact on the townscape of Oxford … has long been divisive*'.[4] Of the two, the Thom building was the most fervently decried, mainly because its height rendered it inescapably visible across the city.[5] Its insertion into the cityscape was so contentious that it prompted the city council to introduce height limits to '*preserve the City's skyline*'. A report by the Oxford Preservation Trust explicitly cites the Thom Building (along with the now demolished Hans Kreb Tower) as a key driver behind the creation

---

1 Thom Building, Oxford University
2 Oxford Brutalism – Where is Phil now?
3 The history of The Department of Engineering Science
4 Appendix 1 Conservation Area Boundary Review Consultation Document.pdf
5 Engineers would commonly joke that the Thom Building housed the best view in Oxford – but only because it was the only viewpoint in which the Thom Building itself did not feature in the skyline.

of the '*Carfax Rule*' which denies planning permission for any structure taller than 18.2 metres to be built within 1.2 kilometres of the city centre's Carfax Tower.[1]

The Keble Road Triangle serves as a particularly illustrative example of the tensions between Brutalism's form, function, and public reception. However, it is by no means an isolated case – nearly all of the university's departments and colleges feature similarly contentious brutalist buildings (as do other universities throughout the UK). The construction boom of the 1960s coincided with a rapid expansion in higher education, both in the physical sense of university infrastructure and in the shifting social philosophy of increased accessibility. To accommodate this, architects and like-minded university administrations turned to Brutalism, commissioning functionally driven, materially expressive buildings.[2] Unlike the profit-driven commercial architecture of dreary office blocks and car parks, the rise of Brutalism in the education sector was inherently ideological, firmly rooted in the philosophy of accessibility and inclusivity.[3] And yet, as exemplified by the Keble Road Triangle, the resulting architecture still clashed sharply with public perception. Of course, distaste of Brutalism's aesthetic severity is completely valid, but arguably knee-jerk criticisms often overlook the ideological intentions behind the style. To reduce Oxford's Brutalism to mere eyesores is to ignore their role in the respectable mission of expanding educational access.

[1] oxford-view-cones---chapter-1
[2] In defence of Oxford's ugliest architecture - Cherwell
[3] Oxford's Eyesores: Brutalism's Place among the Dreaming Spires - Cherwell