



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

Name:	James Gadd
Student Number:	2510906
Student Email:	2510906@student.uwtsd.ac.uk
Module:	Construction Materials
Module Code:	ACBA4016
Submission Date:	26/03/2026
Assignment Title:	Properties of Framing Materials

Title Page

Introduction	page 3
Original Design and Construction of the Building	page 4-5
Analysis of Concrete Framing Material	page 5-8
a. Strength, Durability and Climatic Resistance	
b. Time, Labour, Programme and Cost vs Steel	
c. Ease of Assembly and Adaptability	
d. Integration of Building Services	
e. End-of-Life Demolition Challenges	
Environmental Impact of Concrete Production.....	page 9
Aggregate Particle Size Distribution.....	page 9-10
References.....	page 11-12

Introduction



Author: ED REEVE. Taken from <https://www.archdaily.com/933169/kingston-university-town-house-grafton-architects>

The Town House building at Kingston University in London, is a relatively modern take on a concrete framed structure. The building was completed in 2020, designed by Grafton Architects, and has received international recognition for its open architectural design.

The structure is an academic environment, which includes libraries, teaching facilities, dance studios, and other performance spaces.

The use of reinforced concrete framing was the primary choice, because it provides structural stability, is highly durable and has a high compressive strength. Concrete framing also enables creation of large open spaces by distributing the weight through multiple columns, beams and slabs rather than relying on load bearing walls.

This particular structure uses reinforced concrete columns that supports the building but also gives it a distinctive look with open terraces and facades (*Pintos, P. 2020*).

This report looks at the original design and construction methods used for this building and assesses the properties of reinforced concrete as a framing material. I will be specifically looking at durability, adaptability, cost efficiency, and how services are integrated. The report will also evaluate the environmental impacts of concrete production and usage and analysing sample aggregate grading used in concrete production.

Original Design and Construction of the Building

The Town House building was designed using a reinforced concrete structural frame, which consisted of columns, floor slabs and core walls. The nature of the requirements for the end users were that around 50% of the space required, was to be open plan, hence the openness of the architecture designed to support this.

The structure and layout of the building enables the building to maintain stability, whilst also allowing the open interior spaces for educational purposes, ensuring a comfortable thermal, visual and acoustic environment.

The building provides a transparent look, recessed on three sides which form gardens and other areas to unwind. The facades are open at the lower levels, allowing plenty of natural light into the building, but more solid at the higher levels, where shading is more of a requirement (*Grafton Architects 2019*).

The concrete frame supports floor plates that are extended out creating terraces and covered external areas, boosting natural light and ventilation.

Often for concrete framed buildings, the reinforced concrete columns are cast in position. This method involves placing steel reinforcement within the casing and then pouring the concrete to create the columns. The process is the same for creating the floor slabs and overhead beams. Once the concrete has cured, it forms an extremely strong material, which is capable of resisting high levels of both compression and tension. It usually required around 16-48 hours to cure enough to enable the formwork to be removed but typically needs 7 to 14 days to cure fully the reach sufficient structural strength to bear significant loads.

In the construction Town House project, they primarily used pre casting rather than in situ casting. The casting of the concrete being pre-fabricated off site, mean disruption was kept to a minimum and speed up the construction schedule. Given the location of site, being in the middle of London, this significantly reduced vehicle movement in the area. (*Gill, R. 2022*)

Concrete cores within the building provide lateral stability resisting wind loads acting against the structure. The cores contain staircases and prevent building movement.

Using concrete for the core is very common in buildings of this nature, due to its rigidity and fire resistance (*TOTALICF 2025*).

Analysis of Concrete Framing Material

A. Strength, Durability and Climatic Resistance

Concrete is widely used for building structural framing due to its high compressive strength. Reinforced concrete is made by combining concrete and steel, so each material supports one another. Concrete with high levels of resistance to compression and steel has a high capacity to resist tension. The composition of these materials allows concrete frames to support heavy loads and maintain structural integrity for many years. In the case of the Town House Building, the reinforced concrete enables the buildings' structure to support multiple levels, and large internal areas.



Photo taken from www.constructor.net.au
www.ancon.com.au

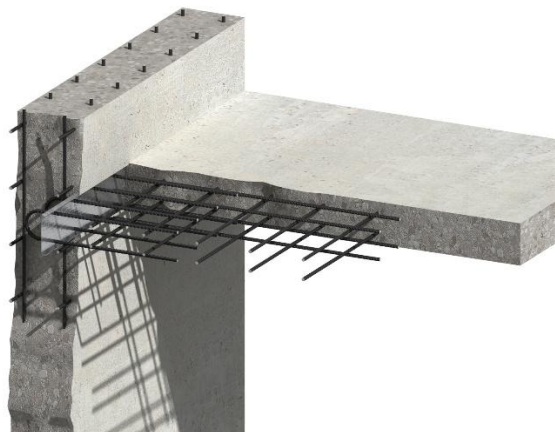


Photo taken from:

Durability is another key element of reinforced concrete. When constructed correctly, concrete structures can last for decades, with a minimal amount of maintenance. Concrete is highly resistant to weathering, it's moisture resistant, and fire resistant (*Baghabra Al-Amoudi et al 2009*).

These are all key factors that would have been taken into account when constructing the Town House, given the environmental conditions in the UK. Our climate consists of frequent rain, moderate temperatures, and occasional freezing conditions.

Concrete performs very well in all of these areas, however, it is important that cover is provided to protect the reinforced steel from corrosion. The Town House however, has exposed precast concrete columns giving it a raw finish (*Gill, R. 2022*).

Concrete also has very good thermal mass, which helps control buildings temperature. It absorbs heat well during the day and slowly releases the heat throughout the night. This helps keep large temperature changes within the building to a minimum. So overall, reinforced concrete framing supports both the buildings structural and environmental performance (*Neville, A. 2011*).

B. Time, Labour, Programme and Cost Compared with Steel Framing

When comparing reinforced concrete framing to steel framing, there are several factors to consider, such as construction time, labour requirements, overall cost. Steel framed buildings are generally quicker to erect because the bulk of the components can be manufactured and built off site and then assembled in a quicker timeframe using nut and bolt connections. Concrete though, requires more time to set up the formwork, and curing times need to be considered before loads can be applied.

Labour requirements also differ for the two construction styles. Concrete construction requires skilled labour to install the formwork, properly position the reinforcement, and the actual concrete finishing itself. Steel construction needs skilled work in terms of the fabrication and manufacturing process, but when it comes to assembling the structure, it often doesn't require as much.

Concrete frames are generally more cost effective for certain building types. Materials for concrete are usually cheaper than structural steel, and concrete is usually more readily available in the local area. Concrete also has more fire-resistant properties, which would therefore negate the need for any additional fire protection systems that are usually needed for steel buildings.

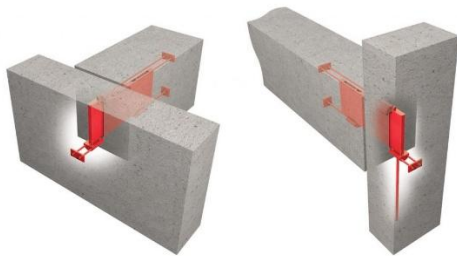
The project requirements will define the need for concrete or steel, depending on building height and span, any project constraints, and obviously cost considerations (*Boyan Stanilov 2026*).

C. Ease of Assembly and Adaptability

Concrete framed buildings can be adapted over time, although it's less easy to modify than steel, it's still possible to alter, such as cutting openings, installing partitions or even strengthening the existing elements.

The column system for the Town House building creates large open spaces that can accommodate various internally layouts as required. This is a particularly important feature in the educational setting, as spaces often need to be changed for various different functions over time.

The pre-cast concrete columns and beams used BSF concrete connectors (Beam/Slab to Column/Wall Connectors), giving the concrete a seamless finish to achieve the architects design. This simplified the detailing, manufacture and transportation of the materials to site (*Taylor, M. 2021*).



(Author Taylor, M. 2021).

The load bearing capacity and durable nature of concrete frames means that buildings can often be repurposed without a need to completely change the structure of the building (*I Olteanu et al 2024*).

D. Integration of Building Services

When thinking about integrating building services within a concrete structure, this can often be quite challenging. Services such as electrical and fire alarm cabling, ventilation and air conditioning and plumbing systems need to be carefully planned and coordinated. Once concrete has been cast in place, it is far more difficult to modify post construction.

Usually, engineers and designers would discuss service routes during the design stage. The openings are often incorporated into the concrete slabs walls etc. before the concrete is even poured. Often suspended ceilings or raised floors are used to accommodate and hide services without the need to interfere with the structural frame (*Jonnyhough 2025*).

BIM technology (Building Information Modelling) is often used to coordinate these systems and reduce issues that arise with structural and service components (Ashton, D. 2025).

E. End-of-Life Demolition Challenges



Photo taken from www.ny-engineers.com



Photo taken from www.clearawayasbestos.co.uk

At the end of a building's life cycle, concrete structures are usually demolished and taken back down to the ground in order for new structures to be built. Demolition of reinforced concrete structures bring complications. Concrete can be very heavy and difficult to dismantle, often needing specialist plant and equipment, such as hydraulic breakers and would be undertaken by trained demolition contractors. The presence of the embedded steel also adds complications given the fact that it would need to be separated from the concrete for recycling purposes (Elgendy, M. 2023).

Concrete is often crushed and re-used for aggregate and hardcore in new construction projects. This recycling technique reduces the amount of waste sent off to landfill, therefore helping to minimise the environmental impact of concrete structures at the end of their life cycle (Teamvalleymarketing 2025).

Depending on the age of the building, a costly implication to consider when demolishing a building could potentially be Asbestos. The Town House was built in 2020 would not have any asbestos included in its construction. Asbestos use in construction in the UK was prohibited in 1999. Any building built prior to this date, would likely contain asbestos. A specialist licenced asbestos removal contractor may need to be utilised to assist with removal of hazardous waste prior to demolition of the building. The building should have a R&D Survey (Refurbishment and Demolition Survey) which would define what and where asbestos materials would be found within the building (HASpod 2019).

Environmental Impact of Concrete Production

The production of concrete has significant environmental impacts and is a contributor to greenhouse gas emissions. The manufacturing process of cement involves heating materials at high temperatures which releases a large amount of carbon dioxide into the atmosphere.

The production also uses large quantities of natural resources, such as limestone, sand and aggregates. Extraction of these materials can cause environmental disruption, causing landscapes to change, loss of habitat for wildlife, as well as increased dust and noise to the local area and community. The transportation of raw materials as well as the finished product also contributes to air pollution. Town House using pre-cast concrete columns and beams massively reduced transportation costs, especially given there was no need for raw materials being delivered to site.

To try and reduce the impact of these issues, the industry has taken on practices such as, using recycled aggregates for example, to try and reduce the carbon footprint of concrete manufacturing, but at the same time, maintaining performance (*Aidan 2024*).

Aggregate Particle Size Distribution Analysis

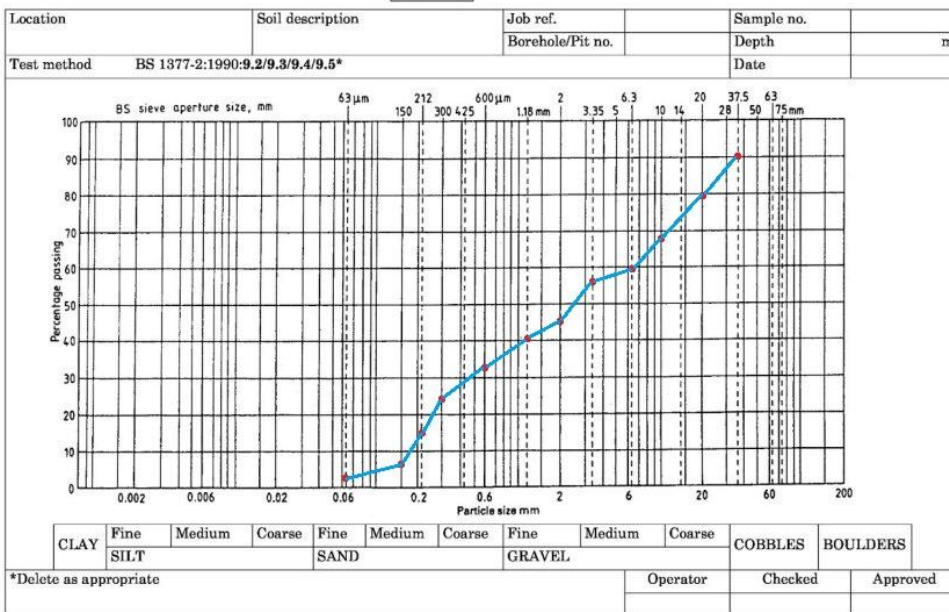
The following particle size distribution was obtained from a sieve analysis on an 'all-in' aggregate used for concrete production. The original sample size was 1250g.

Sieve Size (mm)	Mass(g)	% on sieve	% Passing
125	0	0	100
75	0	0	100
63	0	0	100
37.5	120	9.60	90.40
20	137	10.96	79.44
10	143	11.44	68.00
6.3	105	8.40	59.60
3.35	45	3.60	56.00
2	130	10.40	45.60
1.18	63	5.04	40.56
0.6	105	8.40	32.16
0.3	102	8.16	24.00
0.212	109	8.72	15.28
0.15	98	7.84	7.44
0.063	55	4.40	3.04

Percentage of fine and coarse aggregates in mix	
Fine aggregate <4.7mm	40.40%
Coarse aggregate >4.7mm	56.56%
Silt <0.63mm	3.04%

Particle size distribution chart

Form 2.N



The results of the sieve analysis tell us that there is an even distribution size of fine and coarse aggregates. 56.56% of the material consists of coarse aggregates larger than 4.7mm, and 40.40 % of fine aggregates smaller than 4.7mm. The remaining 3.04 % is made up of silt particles smaller than 0.063 mm.

The analysis indicates that this is a well graded aggregate mixture, containing a variety of particle sizes that go together efficiently aiding to reduce the number of voids in the mix. This helps to improve the density and reduces the amount of cement paste to fill gaps between the aggregate. Due to this, the mix will reach a higher strength and improved workability (*Brown, M. 2024*).

The silt level is fairly low at 3% which is typically an acceptable limit for structural concrete. If there was too high a percentage of silt fines, this could increase the need for water in the mix, which would weaken the bond between cement and aggregate. Assuming this aggregate is clean and free from any contamination, it should perform well for reinforced concrete (*Barrowmix Ready Mix Concrete Manchester 2025*).

Reference List:

- Aidan (2024). *The Environmental Impact of Concrete Production*. [online] City Pumping - Pumped Concrete. Available at: <https://citypumping.co.uk/the-environmental-impact-of-concrete-production> [Accessed 11/03/2026]
- Ashton, D. (2025). *What is BIM (and how does it work)?* University of the Built Environment. Available at: <https://www.ube.ac.uk/whats-happening/articles/building-information-modelling> [Accessed 10/03/2026]
- Baghabra Al-Amoudi, O.S., Al-Kutti, W.A., Ahmad, S. and Maslehuddin, M. (2009). Correlation between compressive strength and certain durability indices of plain and blended cement concretes. <https://www.sciencedirect.com/science/article/pii/S0958946509000833#:~:text=The%2028%2Dday%20compressive%20strength,9%5D%2C%20%5B10%5D>. [Accessed 19/03/2026]
- Barrowmix Ready Mix Concrete Manchester. (2025). *Optimising Concrete Strength Through Aggregate Gradation - Barrow Mix Ready Mix Concrete Manchester*. [online] Available at: <https://barrowmixconcrete.com/optimising-concrete-strength-through-aggregate-gradation> [Accessed 11/03/2026]
- Boyan Stanilov (2026). *Is a Steel Frame Extension More Expensive? - BAS Frames*. Available at: <https://basframes.co.uk/is-a-steel-frame-extension-more-expensive> [Accessed 9 Mar. 2026].
- Brown, M. (2024). *Different Types of Aggregate, Their Uses, and Sizes*. [online] Tensar.co.uk. Available at: <https://www.tensar.co.uk/resources/articles/types-of-aggregate> [Accessed 11/03/2026]
- Elgendy, M. (2023). *How and Why Do We Recycle Concrete?* [online] AZoBuild.com. Available at: <https://www.azobuild.com/article.aspx?ArticleID=8644> [Accessed 24/03/2026]
- Gill, R. (2022). *Mies and Stirling Prize Winner Town House is the University's Centrepiece*. [online] Construction View Online. Available at: <https://www.constructionviewonline.co.uk/2022/05/09/mies-and-stirling-prize-winner-town-house-is-the-universitys-centrepiece/> [Accessed 16/03/2026].

- Grafton Architects (2019). Town House, Kingston University London - Grafton Architects. <https://www.graftonarchitects.ie/Town-House-Kingston-University-London> [Accessed 09/03/2026]
- HASpod (2019). *The Deadly Risks Of Asbestos In Demolition*. [online] Haspod.com. Available at: <https://www.haspod.com/blog/asbestos/asbestos-in-demolition> [Accessed 19/03/2026]
- I Olteanu, Anton, C-I. and G Țăranu (2024). Case study on reinforced concrete frame structure adaptability. IOP Conference Series Materials Science and Engineering, Available at: https://www.researchgate.net/publication/379633205_Case_study_on_reinforced_concrete_frame_structure_adaptability [Accessed 09/03/2026]
- Jonnyhough (2025). *Integration of building services | Concrete Society*. Concrete Society. Available at: <https://www.concrete.org.uk/fingertips/integration-of-building-services> [Accessed 10/03/2026]
- Neville, A. (2011) Properties of Concrete. Pearson Education.
- Pintos, P. (2020). *Kingston University Town House / Grafton Architects*. Available at: <https://www.archdaily.com/933169/kingston-university-town-house-grafton-architects> [Accessed 09/03/2026]
- Taylor, M. (2021). Invisible Connections BSF connectors used at Stirling Prize Winner, Town House Kingston University. [online] Invisible Connections®. Available at: <https://www.invisibleconnections.co.uk/news/kingston-university-town-house-wins-2021-riba-stirling-prize> [Accessed 19/03/2026].
- Teamvalleymarketing (2025). *Our sustainable concrete waste disposal practices explained | Titan Concrete*. Available at: <https://www.titanconcrete.co.uk/our-sustainable-concrete-waste-disposal-practices-explained> [Accessed 10/03/2026].
- TOTALICF (2025). <https://www.totalicf.co.uk/when-should-concrete-formwork-be-removed-from-slabs-beams-columns> [Accessed 09/03/2026].