



University of Wales
Trinity Saint David

REPORT

CONSTRUCTION

MATERIALS

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Concrete-Framed Building Report: Swansea Civic Centre

Academic and Technical Analysis of Design, Construction, and Material Performance

Objective

To get knowledge and analysis of the physical and mechanical properties of construction materials and the factors involved in their selection or specification.

Introduction



Figure 1. A view of Swansea Civic Centre from the Meridian Tower. Source: Autor's own photograph.

Concrete has been one of the most influential construction materials in the development of public-sector buildings across the United Kingdom during the second half of the twentieth century. Its structural versatility, durability, and capacity to form expressive architectural shapes made it particularly suitable for civic architecture in the 1960s-1980s (Neville, 2011). The Swansea Civic Centre, located on the seafront of Swansea Bay in Wales, is a representative example of this period. Constructed between 1979 and 1984, the building embodies the late Brutalist architectural style, and relies heavily on a reinforced concrete frame combined with prefabricated concrete cladding panels (Swansea Council, 2023).

Although the focus of this report is the original design and construction of the Swansea Civic Centre, it is relevant to acknowledge the building's current redevelopment plans led by Urban Splash and Swansea Council. The decision to retain and convert the existing reinforced concrete frame, rather than demolish and rebuild, demonstrates the long-term structural robustness and adaptability of the original construction (Urban splash, 2023). This contemporary context reinforces the significance of analysing the building's concrete frame, as its continued reuse highlights the durability and performance of the material over more than four decades.

This report examines the Swansea Civic Centre as a case study of concrete-framed construction. It provides an overview of the building's original design and construction method, followed by a detailed analysis of the performance of concrete as the primary framing material. The analysis is structured according to the assignment's required sub-sections, addressing strength and durability, programme and cost considerations, adaptability, integration of services, and end-of-life demolition challenges. The report also discusses the negative environmental and community impacts associated with concrete production (Chatham House, 2018).

The aim is to provide a comprehensive technical evaluation of concrete as a framing material within the context of a major UK Civic building.

1. Original Design and Construction Method

Architectural and Structural Concept

The Swansea Civic Centre was designed by the West Glamorgan County Council's in-house architectural department, led by County Architect J. Webb and Job Architect C. W. Quick. The building's architectural language is firmly rooted in Brutalism, a style characterised by the expressive use of raw concrete, bold geometric forms, and a strong emphasis on structural clarity (Illston & Domone, 2010). The Civic Centre's design comprises a series of horizontal blocks arranged parallel to the coastline. The council chamber projects outward as a prominent cantilevered volume. Exposed structural elements and a textured facade emphasise material honesty and structural expression.



Figure 2. Entire view of the Civic Centre. Source: Walesonline.co.uk

The structural system is based on a reinforced concrete frame. This consists of a regular grid of concrete columns that support in-situ cast concrete beams and floor slabs. The building incorporates reinforced concrete shear walls and service cores to provide lateral stability against wind loads. This is a particularly important consideration given the building's exposed coastal location. The use of concrete allowed the architects to create large internal spans, flexible office layouts, and sculptural external forms (Institution of Structural Engineers, 2018).

The building's exterior is clad in prefabricated concrete panels finished with white flint aggregate. The concrete cladding panels of this building rest on slab edges. This material choice was both aesthetic and functional: the light-coloured aggregate provides visual contrast to the grey structural frame, while the dense concrete panels resist the harsh marine environment (Concrete Centre, 2020).

Construction Method

Foundations

Given the building's proximity to the shoreline, the ground conditions consist of sandy and potentially unstable soils. It is therefore likely that the Civic Centre required deep foundations, such as reinforced concrete piles, to transfer loads to more stable strata. Pile caps and ground beams would have been cast in situ to tie the foundation system together (Institution of Structural Engineers, 2018).

In-situ Reinforced Concrete Frame

The primary structure was constructed using traditional in-situ reinforced concrete techniques. The process involved:

- Erecting formwork made of timber or steel
- Placing steel reinforcement according to BS 8110
- Pouring concrete delivered by ready-mix trucks
- Mechanical vibration to eliminate air pockets
- Adequate curing to achieve design strength

The use of in-situ concrete allowed for precise control over the building's geometry and facilitated the creation of the cantilevered council chamber (British Standards Institution, 1985)

Prefabricated Cladding Panels



Figure 3. Swansea civic Centre beginning to take shape. Source: Walesonline.co.uk

The external envelope consists of precast concrete panels manufactured off-site. These panels incorporate white flint aggregate to achieve a durable and visually distinctive finish. Once delivered to site, the panels were lifted into position using cranes and fixed to the structural frame using metal anchors and brackets (Illston & Domone, 2010).

Roof Construction

The roofs are flat reinforced concrete slabs finished with bituminous waterproofing membranes. Given the building's exposure to driving rain and sea spray, the waterproofing system required careful detailing and regular maintenance (Concrete Centre, 2020).

Construction Phasing

The project was delivered in two main phases between 1979 and 1984. Phase 1 focused on the administrative block, while Phase 2 extended the building towards the seafront and completed the public-facing facilities.

Structural Systems Overview

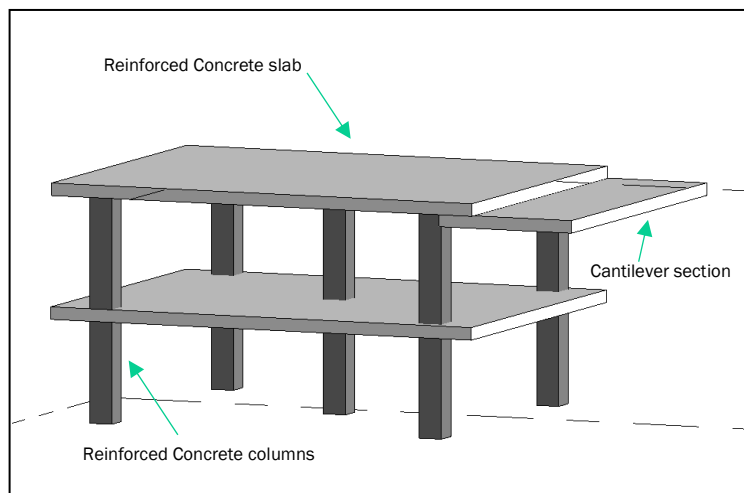


Figure 4. The structural system of the building is illustrated in figure on the left, showing a reinforced concrete frame consisting of slabs, columns and cantilevered elements. Source: Author's own work.

2. Analysis of the Framing Material (Concrete) in the following areas:

A. Strength, Durability and Climatic Resistance

The Swansea Civic Centre utilises reinforced concrete as its primary framing material, valued for its high compressive strength, typically ranging between 25-50 MPa in standard structural applications (Neville, 2011). This made it suitable for supporting multi-storey office loads and structural features such as cantilevered elements.

However, its coastal location exposes the structure to aggressive environmental conditions, including chloride ingress from sea spray, carbonation, freeze thaw cycles, and wind-driven rain. These factors significantly increase the risk of reinforcement corrosion and long-term deterioration.



Figure 5 Coastal exposure of the Swansea Civic Centre, highlighting its vulnerability to adverse weather conditions. Source: Geograph Britain and Ireland.

To address these challenges, designers likely incorporated measures such as increased concrete cover, low-permeability mixes, and durable materials. Despite this, many buildings of this period require ongoing maintenance and repair, highlighting limitations in durability when exposed to harsh marine environments (Concrete Centre, 2020).

As Critical point we can say that while concrete offers durability, its long-term performance in coastal conditions depends heavily on design quality and maintenance.

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



Figure 6. In situ concrete construction process showing formwork and labour-intensive methods, illustrating longer construction time compared to steel framing systems. Source: Walesonline.co.uk

Concrete construction is generally slower than steel due to the need for formwork, curing time, and sensitivity to weather conditions. In contrast, steel frames allow rapid erection and reduced construction programmes.

However, during the period in which the Civic Centre was constructed, concrete was often preferred for public-sector buildings due to lower material costs and availability of local labour (Institution of Structural Engineers, 2018). Additionally, concrete required less reliance on imported materials compared to steel.

Concrete construction is also more labour-intensive, which aligned with economic and employment conditions at the time.

As Critical point we can say that although slower, concrete was economically and socially advantageous during the building's construction period, whereas steel would likely be preferred in modern projects due to speed.

C.Ease of Assembly and Adaptability

In-situ reinforced concrete allows for complex architectural forms, including large spans and cantilevered structures, which are evident in the Civic Centre design (Neville, 2011).

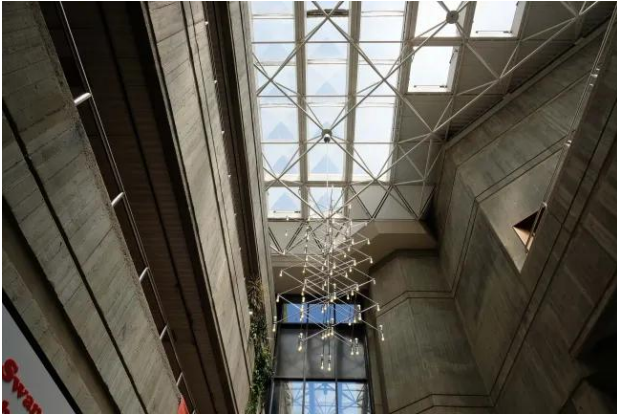


Figure 7. Open plan internal spaces within the Swansea Civic Centre, demonstrating the structural capability of reinforced concrete to create flexible layouts. Source: www.reddit.com

However, this construction method reduces flexibility after completion. Structural modifications are difficult due to the monolithic nature of concrete, fixed floor heights, and limited allowance for new openings. Despite this, the building benefits from relatively open-plan floor layouts, which support internal reconfiguration.

The ongoing redevelopment of the Civic Centre, which retains much of the original concrete frame, demonstrates a degree of long-term adaptability (Urban Splash, 2023).

As critical point we can say that Concrete offers design flexibility during construction but limited adaptability over the building lifecycle.

D. Integration of Services Provision

The integration of building services within reinforced concrete structures can be challenging due to the rigidity and density of the material. Retrofitting services is particularly difficult once construction is complete.

Key challenges include:

- Limited space for service routing within slabs
- Coordination with reinforcement
- Difficulty in making structural penetrations

To overcome these issues, designers typically use:

- Pre-formed openings
- Vertical service risers
- Suspended ceilings
- Raised floors in refurbishments

As critical point we can say that compared to steel or lightweight systems, concrete structures are less flexible for service integration, particularly in retrofit scenarios.

E. End-of-Life Demolition Challenges

Reinforced concrete structures present significant challenges at the end of their lifecycle. Demolition is complex due to the material's high strength, density, and the presence of embedded reinforcement. This results in:

- High energy consumption during demolition
- Dust, noise, and environmental disruption
- Large volumes of waste

Although concrete can be crushed and reused as secondary aggregate, this often leads to downcycling rather than full reuse (Chatham House, 2018). In contrast, steel offers a more efficient recycling process, and timber provides better reuse potential.

Additionally, the Civic Centre's urban and coastal location introduces further constraints related to environmental protection and site access.

As a critical point we can say that concrete has a significant environmental burden at end-of-life compared to alternative materials.

3. Negative Impact of Concrete Production on Community and Environment

The Swansea Civic Centre primarily utilises reinforced concrete as its framing material, providing high compressive strength, durability, and fire resistance. However, despite these advantages, the environmental and social impacts associated with concrete production are significant and increasingly scrutinised within the construction industry.

One of the most critical concerns is the embodied carbon of concrete. Cement production alone is responsible for approximately 7-8% of global CO₂ emissions, largely due to the calcination process and high energy consumption (Li and Unluer, 2025), (Historic England, 2022). This makes concrete one of the most carbon-intensive construction materials currently in use.

The extraction of raw materials, particularly aggregates obtained through quarrying, contributes to environmental degradation. This includes habitat loss, biodiversity reduction, dust and noise pollution, and landscape alteration (UK Green Building Council, 2023). These impacts can negatively affect both ecosystems and local communities.

Concrete production is also highly water-intensive, placing pressure on natural water resources, particularly in large-scale construction projects (UK Green Building Council, 2022).

In terms of local air quality, cement plants emit particulate matter and other pollutants that can pose risks to human health, especially respiratory conditions (Scrivener et al., 2024). These emissions are a key concern for communities located near production facilities.

4. A Sieve Analysis on all in aggregate used for Concrete Production.

The original sample size was 1250 g.

a) % Passing each sieve

Sieve Size (mm)	Mass (g)	% on sieve	% Passing
125.0	0	0	100
75.0	0	0	100
63.0	0	0	100
37.5	120	9.6	90.4
20.0	137	11.0	79.4
10.0	143	11.4	68.0
6.3	105	8.4	59.6
3.35	45	3.6	56.0
2.0	130	10.4	45.6
1.18	63	5.0	40.6
0.6	105	8.4	32.2
0.3	102	8.2	24.0
0.212	109	8.7	15.3
0.15	98	7.8	7.4
0.063	55	4.4	3.0

Table 1. % Percentage passing for each sieve.

b) Percentage of fine and coarse aggregate in the mix.

Coarse aggregate > 4.7 mm

Fine aggregate < 4.7 mm

6.3 mm → 59.60% passing

3.35 mm → 56.00% passing

Interpolate the values:

$$\frac{X-56}{4.7-3.35} = \frac{59.6-X}{6.3-4.7}$$

$$X = 57.65$$

4.7 mm → 57.65% passing

Fine aggregate = 57.65% and Coarse aggregate = 42.35%

c) Plot the particle size distribution on the graph handout.

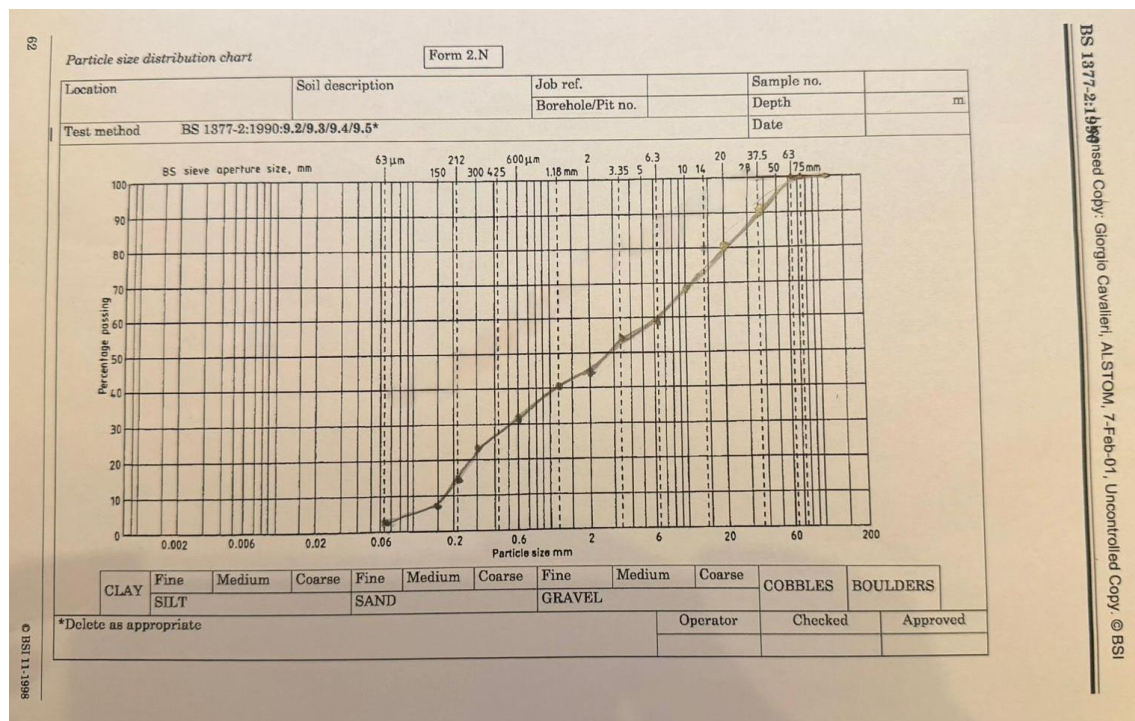


Figure 8. Particle size distribution chart. Source: Course handout provided by Module Lecturer.

d) Comment on size distribution and suitability for use direct as aggregate.

The aggregate shows a well-graded particle size distribution, which is beneficial for good compaction, reduced voids, and improved concrete strength. Approximately 57.65% passing the 4.7 mm sieve indicates a slightly higher proportion of fine aggregate. This can improve workability but may increase water demand, requiring careful mix design. The low percentage of fines (3% passing 0.063 mm) is advantageous, as it avoids potential issues related to excessive fine material.

Overall, the aggregate is suitable for concrete use, although minor adjustments in the mix design may be needed to optimise performance.

Conclusion

The Swansea Civic Centre provides a valuable case study of concrete-framed construction in a late twentieth-century UK civic building. Its reinforced concrete frame enabled flexible internal spaces, expressive architectural forms, and a robust structure capable of withstanding the harsh coastal environment. Concrete offered economic and practical advantages at the time of construction, though it also presents challenges related to construction speed, service integration, and end-of-life demolition.

The building's ongoing redevelopment, which retains the original concrete frame, demonstrates the long-term durability and adaptability of the material. Despite the environmental impacts associated with concrete production, the Civic Centre's continued reuse highlights the potential for extending the life cycle of concrete structures through thoughtful refurbishment rather than demolition.

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