

ACBA4016

ASSIGNMENT FOR CONSTRUCTION MATERIALS

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INTRODUCTION

In this assignment we were asked to select two of the following buildings with different framing materials which are habitable. One is a steel frame building and the other is a concrete framed building.

The first building is The Chrysler building in New York which Is a steel frame building.

The second building is The Tower, Mederian Quay building in Swansea which is a concrete frame building.



A Steel framed building



(DESIGNINGBUILDINGS.CO.UK, 2020)

concrete framed building

THE CHRYSLER



(Staff Reporter, 2014)



(Androdl, 2021)

FRAMING MATERIAL CHOICE

The Chrysler was designed by architect William Van Allen and was completed in 1930. It was originally conceived as an office building. But in 1928 Walter P. Chrysler acquired the project financing its construction and started incorporating Automotive themed details into the design. (WikiArquitectura, 2020)

The building uses a steel frame construction with masonry infills allowing for quick assembly with 4 floors being completed a week. The Chrysler was completed in 21 months.

The Foundations were 21 metres deep reaching solid bedrock known as the Manhattan Schist. Which provide great foundations for a structure like The Chrysler. (Bressan)

Cassions were drilled down in to the bed rock which gave the building stability transferring the buildings load to a more secure foundation. (Aarush Borker, 2024)

The Skeleton of the structure is made by connecting horizontal and vertical steel beams connected together with rivets, welds and metal fasteners. Making a strong but lightweight structure which is ideal design for a building like The Chrysler. This method of construction has proven its integrity and is still used in construction today. (Aarush Borker, 2024)



(Aarush Borker, 2024)

ENVIRONMENTAL FACTORS

Being 319 metres tall the Chrysler faces strong wind loads. The steel frame allows for controlled sway and the tapered design helps redirect and break up wind forces. The way the building is design for controlled sway is by having a strong core at the centre of the building. The area around the elevator shaft is reinforced with steel trusses and braced with diagonal beams. It allows the building to be more rigid and also it helps protect the structure against earthquake damage. This allows the building to move as one so the skeleton isn't twisted or strained. (Harris, 2001)



(Reddit.com, 2022)

New York has hot summers and cold winters with heavy snowfall. Which can cause materials to expand and contract. The steel is painted in a protected coating and using 12,500 shimmering steel cladding which has required very little maintenance over the years showing its resistance to corrosion. (www.outokumpu.com, n.d.)

IMPACTS ON THE COMMUNITY

The Chrysler helped boost New York's economy by providing hundreds of jobs for the likes of steel workers, engineers and construction workers. The Production of steel was high in demand as sky scrapers were being built all over New York. The Chrysler was apart of the race to become the tallest building in the world which it held the title for 11 months before being surpassed by The Empire State building. The competition gives us an insight to the heavy steel production in the 1920s to 1930s. (Smith, 2017)



(Cox, 2011)

Although steel provided jobs it also came with a lot of negatives. Steel workers in mills faced a lot of dangers such as extreme heat and breathing in toxic fumes and dust which lead to lung disease. At the time workplace health and safety regulations were minimal which lead to many accidents and fatality. (Crawford, 2021)

Steel plants gave off a lot of pollutants which caused air pollution affecting residents causing respiratory illnesses. This also effected rivers which contaminated the water making it unsafe to drink and fish from (MFG Shop, 2024)

EASE OF ASSEMBLY

The Chrysler steel frame allowed for rapid assembly. The prefabricated steel was put together on site which helped reduce construction time and costs. The use of bolted connections helped the building process to be more efficient and secure. (Sesamo Restaurant - Italian Restaurant Hell's Kitchen NYC, 2024)

The steel skeleton provided more flexibility with the interior design as the building has been used for offices over time, this allowed for smoother transitions when changing office layouts. Over its lifetime the building has been used by many different businesses from car companies to financial industries the Chrysler has shown its versatility. (<https://www.facebook.com/mannumanhoos>, 2020)



(Pinimg.com, 2025b)



(Newyorkoffices.com, 2025)

The steel frame supported the buildings unique art decor crown which was constructed from Nirosta stainless steel. The structure of the crown is supported by the steel frame work which integrates with the buildings tapered design. (Sesamo Restaurant - Italian Restaurant Hell's Kitchen NYC, 2024)

THE TOWER, MEDERIAN QUAY



("The Tower at Meridian Quay - the Skyscraper Center")

The Tower at The Meridian Quay is the tallest building in Swansea. It is 107 metres tall with 29 stories.

The Tower was completed in 2009 and was designed by Latitude Architects. Designed as a beacon signaling the rejuvenation of Swansea.

The design is a concrete framed structure using reinforced concrete walls and reinforced concrete slabs for the floors. The building is also made up of glass curtain walls with precast concrete panels as cladding. (Architecture.com, 2025)

FRAMING MATERIAL CHOICE

Since the structure is located along Swansea beachfront it is exposed to strong winds, moisture, and salt-laden air coming from the sea. The reinforced concrete frame provides a good balance of structural integrity and long term resilience. Concrete is brilliant at withstanding compression with the use of steel reinforcement to enhance tensile strength, it makes sure that The Tower remains stable under vertical and lateral loads. The combination of materials ensures that the building can withstand the weight of multiple floors while resisting external forces such as heavy winds. (Mosley, Bungey and Hulse, 2012)

Reinforced concrete provides a long term performance with minimal maintenance compared to a steel frame building. One of the biggest advantages of concrete in a coastal environment like Swansea is its natural resistance to corrosion. Unlike steel concrete provides a protective alkaline environment that reduces the risk of reinforcement rusting. Concrete structures are highly fire resistant making the building safer and increasing the longevity of the build. (Andrew Hamilton Buchanan and Abu, 2017)

ENVIRONMENTAL FACTORS

The climate of Swansea has a crucial role in what materials are being used. Being a coastal city Swansea experiences high humidity, strong winds and salt exposure. All of these factors can contribute to materials degrading. Additionally, its high thermal mass help regulate indoor temperatures by absorbing and slowly releasing heat. The Tower's deep pile foundations adds to its stability in Swansea bays soft coastal ground, preventing settlement and damage to the structure over time. (Mj Tomlinson and J Woodward, 2008)

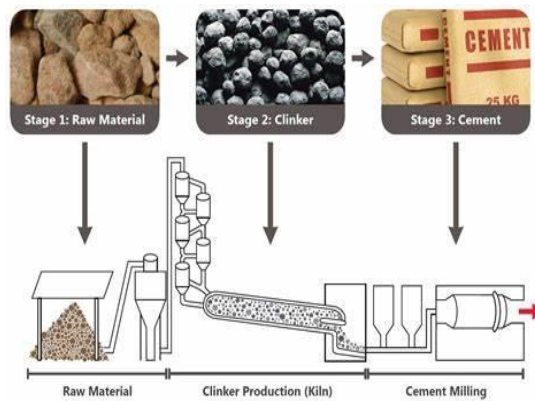


(Staticflickr.com, 2025)

The materials used building The Tower were likely manufactured outside of Swansea but the carbon footprint of the materials used definitely had an affect on the local communities especially ones near the cement sites and steel manufacturers. Areas near cement and concrete factories face high level of dust, noise pollution, and strain on local water supplies due to the intense production of the cement/concrete.

The use and production of concrete can be hazardous to health if the correct ppe is not worn. Breathing in concrete/cement dust can lead to serious lung problems as it contains silica which is the key ingredient. Also concrete/cement contains calcium hydroxide which can cause skin irritations burns and allergic reactions. Many workers who work with cement or concrete suffer from dermatitis. (Captain, 2025)

Cement production produces 8% of the world's CO₂ emissions (Rodgers, 2018). The cement industry is the third industrial energy consumer and the second largest CO₂ emitter globally. (IEA, 2018) The process of calcination releases a lot of CO₂ into the atmosphere along with the high energy demanding kilns using fossil fuels to make cement clinker which is used to make cement which is a key binder for concrete. (Vikström, n.d.)



(Cement.org.au, 2025)

The transportation of the heavy materials such as concrete, reinforced steel and shuttering, would have increased traffic in Swansea contributing to congestion noise and wear on local infrastructure. Dust and emissions from construction activities using steel and concrete can also reduce air quality, particularly affecting nearby residents and those with pre-existing health conditions.

EASE OF ASSEMBLY

The Tower utilizes a concrete frame, It is a popular choice for high rises due to its structural efficiency and flexibility in design. One of the main benefits of this construction method is that its ease of assembly on site. Especially when combined with precast concrete panels, which were used for part of the towers cladding. Using precast cladding off site under controlled conditions will improve health and safety on site by reducing noise and waste on site. This style of construction allows for fast installation of large structural panels. It is a crucial factor when building high rise projects.

The Ambitious developer aimed to complete a floor every 10 days as it raced to its 29 storey goal. The build was on track until a tragedy happened in January 2008. A scaffolder with 15 years experience fell to his death falling from four storeys. There were also issues with the tower as a fire broke out on the 20th floor as scaffolding boards caught on fire. This did not put off any buyers. (Thefreelibrary.com, 2015)

In terms of adaptability, concrete framed structures offer a fair amount of flexibility. The regular grid of columns and flat slab construction, typical of concrete framed buildings like The Tower. This allows for open floor plans that can be redesigned for different uses. Such as converting residential units into service apartments or office spaces. While concrete is not as adaptable as steel when it comes to big changes, non load bearing walls can be moved to suit the design. The durability and long life span of concrete ensures that the tower remains structurally safe for future. Concrete Centre. (n.d.)

The Tower has had some small changes in the last 10 years once known as Grape and Olive is now known as the Altitude. Opened in November 24 the building went under a small refurb to meet the requirements of the new establishment.

Characteristics	Steel	Concrete	Analysis
Price per m2 & m3	£250-£350	£100-£160	Steel is more expensive than concrete per metre.
longevity	100 years	50-100 years	Steel and concrete have a similar longevity
Carbon Footprint	0.813 Tonnes of Co2	1.859 Tonnes of CO2	Concrete produces 2x the CO2 emissions than steel
Fire resistance	15 minutes	2 hours	Concrete has a higher fire resistance
Recycleability	fully	20%	Steel is fully recyclable leaving less waste
Skills Required	Rigging, welding & Hse	NVQ level 2 or 3	Concrete requires less skill level compared to steel
Weight Per m3	7,850 kg	2,400kg	Steel requires heavier lifting aid than concrete
Installation time	1-3 weeks	3-6 weeks e.g	Weather has less impact on building steel frame
Strength to weight ratios	50-255 kN·m/kg	8-21 kN·m/kg	Steel handles tension much better than concrete

(SteelConstruction.info, 2016) (Concretecentre.com, 2020)

Reference list

Aarush Borker (2024). *5/27 Today in History: The Chrysler Building*. [online] Eco Urban Journals. Available at: <https://www.ecourbanjournals.com/post/today-in-history-the-chrysler-building>.

Andrew Hamilton Buchanan and Abu, A. (2017). *Structural design for fire safety*. Chichester, West Sussex, United Kingdom: John Wiley & Sons Inc.

Androdl (2021). *Chrysler Building New York*. [online] Blogspot.com. Available at: <https://alamyimg.blogspot.com/2021/04/chrysler-building-new-york.html> [Accessed 20 Feb. 2025].

Architecture.com. (2025). *Meridian Quay by Latitude Architects and Designers Ltd*. [online] Available at: <https://find-an-architect.architecture.com/latitude-architects-and-designers-ltd/london/meridian-quay?> [Accessed 28 Mar. 2025].

Artincontext.org. (2025). Available at: <https://artincontext.org/wp-content/uploads/2022/08/Chrysler-Building-Architecture-768x1101.jpg> [Accessed 22 Mar. 2025].

Bressan, D. (2020). How Geology Shaped New York City's Skyline. *Forbes*. [online] 27 May. Available at: <https://www.forbes.com/sites/davidbressan/2020/05/27/how-geology-shaped-new-york-citys-skyline/>.

Captain, T.C. (2025). *Is Concrete Hazardous To Health? Understanding Risks And Safety Measures - ConcreteCaptain.com*. [online] ConcreteCaptain.com. Available at: <https://concretecaptain.com/is-concrete-hazardous-to-health/> [Accessed 27 Mar. 2025].

Cox, S. (2011). *Paper Town*. [online] Pinterest. Available at: <https://uk.pinterest.com/pin/174584923024462278/> [Accessed 22 Mar. 2025].

Crawford, J. (2021). *How factories were made safe*. [online] The Roots of Progress. Available at: <https://blog.rootsofprogress.org/history-of-factory-safety>.

Harris, T. (2001). *How Skyscrapers Work*. [online] HowStuffWorks. Available at: <https://science.howstuffworks.com/engineering/structural/skyscraper4.htm>.

<https://www.facebook.com/mannumanhoos> (2020a). *Hot Jazz in Stone and Steel: The Chrysler Building - The Arch Insider*. [online] The Arch Insider. Available at: <https://thearchinsider.com/hot-jazz-in-stone-and-steel-the-chrysler-building/?utm> [Accessed 24 Mar. 2025].

<https://www.facebook.com/mannumanhoos> (2020b). *Hot Jazz in Stone and Steel: the Chrysler Building - the Arch Insider*. [online] The Arch Insider. Available at: <https://thearchinsider.com/hot-jazz-in-stone-and-steel-the-chrysler-building/?utm> [Accessed 24 Mar. 2025].

Huyssteen, J. van (2023). *Chrysler Building - The Architecture of the Art Deco Building*. [online] artfilemagazine – Your Online Art Source. Available at: <https://artfilemagazine.com/chrysler-building> [Accessed 20 Feb. 2025].

IEA (2018). *Technology Roadmap - Low-Carbon Transition in the Cement Industry – Analysis*. [online] IEA. Available at: <https://www.iea.org/reports/technology-roadmap-low-carbon-transition-in-the-cement-industry>.

MFG Shop. (2024). *Environmental Impact of Steel Production: A Detailed Analysis - MFG Shop*. [online] Available at: <https://shop.machinemfg.com/environmental-impact-of-steel-production-a-detailed-analysis/>.

Mj Tomlinson and J Woodward (2008). *Pile design and construction practice*, 5th ed. London: Taylor And Francis.

Mosley, B., Bungey, J. and Hulse, R. (2012). *Reinforced concrete design to Eurocode 2*. 7th ed. Houndmills: Palgrave Macmillan.

Newyorkoffices.com. (2025). Available at: <https://newyorkoffices.com/wp-content/uploads/2024/01/furnished-chrysler-building-office-7.jpg> [Accessed 28 Mar. 2025].

Pinimg.com. (2025a). Available at: <https://i.pinimg.com/originals/74/ec/a3/74eca3f0c418520c1b5a6ce378a97a1b.jpg> [Accessed 20 Feb. 2025].

- Pinimg.com. (2025b). Available at:
<https://i.pinimg.com/originals/95/95/38/9595382e04989e8272387b872ba6650f.jpg> [Accessed 22 Mar. 2025].
- Reddit.com. (2022). *Reddit - The heart of the internet*. [online] Available at:
https://www.reddit.com/r/TheWayWeWere/comments/tcqfhi/the_chrysler_building_under_construction_nyc/?rdt=42552 [Accessed 22 Mar. 2025].
- Rodgers, L. (2018). Climate change: The massive CO2 emitter you may not know about. *BBC News*. [online] 17 Dec. Available at:
<https://www.bbc.co.uk/news/science-environment-46455844>.
- Sesamo Restaurant - Italian Restaurant Hell's Kitchen NYC. (2024). *The Chrysler Building: A Timeless Symbol of the Manhattan Skyline*. [online] Available at: <https://sesamorestaurant.com/news/the-chrysler-building-a-timeless-symbol-of-the-manhattan-skyline> [Accessed 17 Mar. 2025].
- Skyscrapercenter.com. (2019). *The Tower at Meridian Quay - The Skyscraper Center*. [online] Available at:
<https://www.skyscrapercenter.com/building/the-tower-at-meridian-quay/4982> [Accessed 20 Feb. 2025].
- Smith, N. (2017). *Classic Projects: the Chrysler Building, New York City*. [online] Engineering and Technology Magazine. Available at:
<https://eandt.theiet.org/2017/03/21/classic-projects-chrysler-building-new-york-city>.
- Staff Reporter (2014). *On top of the world at the Chrysler Building, New York*. [online] BOOMSbeat. Available at:
<https://www.boomsbeat.com/articles/1423/20140319/on-top-of-the-world-at-the-chrysler-building-new-york.htm> [Accessed 20 Feb. 2025].
- Staticflickr.com. (2025). Available at:
https://live.staticflickr.com/1866/43942165504_d61cf7a2bb_b.jpg [Accessed 27 Mar. 2025].
- Thefreelibrary.com. (2015). *The tragic, dramatic and controversial story of Wales' tallest residential building; There were doubts whether the Meridian Tower in Swansea would ever be built, followed by questions over if it would be completed - and that was just the start. - Free Online Library*. [online] Available at:
<https://www.thefreelibrary.com/The+tragic%2C+dramatic+and+controversial+story+of+Wales%27+tallest...-a0609996832> [Accessed 27 Mar. 2025].
- Vikström, A. (n.d.). *Separate Calcination in Cement Clinker Production A laboratory scale study on how an electrified separate calcination step affects the*

phase composition of cement clinker. [online] Available at: <https://www.diva-portal.org/smash/get/diva2:1562287/FULLTEXT01.pdf>.

WikiArquitectura. (2020).  *Chrysler Building - Data, Photos & Plans - WikiArquitectura*. [online] Available at: <https://en.wikiarquitectura.com/building/Chrysler-Building> [Accessed 20 Feb. 2025].

www.designingbuildings.co.uk. (2020). *Concrete frame*. [online] Available at: https://www.designingbuildings.co.uk/Concrete_frame.

www.outokumpu.com. (n.d.). *What if beauty lasted for centuries*. [online] Available at: <https://www.outokumpu.com/en/expertise/2016/what-if-beauty-lived-for-centuries>.