

MODERN AND TRADITIONAL CONSTRUCTION

**Report on the GSK Carbon Neutral Laboratory for Sustainable
Chemistry – University of Nottingham**

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Glossary of Terms

- CLT (Cross Laminated Timber)
- Glulam (Glued Laminated Timber)

1. Introduction



(Nottingham.ac.uk, 2017)

In this report I will be analysing and discussing the GSK carbon neutral laboratory for sustainable chemistry which you can see above, the building is located in the University of Nottingham.

I will be discussing the materials that have been used on the building and why they have been chosen over alternative options, this will include discussing design, structural strength, stability fire safety, aesthetics, sustainability and environmental impact. I will also be looking at the foundation requirements of the building considering the locality of the building, as well as these I will be analysing the building as a whole and giving background knowledge of the building and the surrounding area of the building to get a feel for the area as a whole.

2. Background information on the Building

The building is located on the Universities award winning innovation park which is on campus, the building is 4500m² spread between a ground floor and a first floor which accompanies 100 researches at the University. It has the latest in technology to allow it to be carbon-neutral across the entirety of its lifetime. (Nottingham.ac.uk, 2017)

The building cost the University £15.8 Million with a £12 Million fund made by GSK which is a British multinational pharmaceutical and biotechnology company after they agreed to help fund the project in 2012, the building which opened on the 27th of February 2017 and was gifted the BREAM outstanding and LEED platinum certificates in April of the same year. (Nottingham.ac.uk, 2017). These awards really goes to show how incredible the building really is and the effort that went into making the building carbon-neutral for the University. Getting the timber which was German Spruce, Austrian Spruce and American Red Cedar shipped across the world shows the efforts that were made to be able to achieve LEED requirements for the building. (Nottingham.ac.uk, 2017)

GSK the funders of the building in collaboration with Nottingham University used this building to show the progress they have made on GSK's 'Green Chemistry' commitment which was firstly announced in 2010. (GSK, 2012). GSK wanted to produce a carbon-neutral laboratory in the UK. Which would incorporate design features which would comply with green building standards and could eventually be seen in other laboratories internationally, (Nottingham.ac.uk, 2017)

Construction began on the building in spring of 2013 with Morgan Sindall Group the main contractor on the project which was due to be complete during 2014, but due to delays and problems along the way the project was finally complete in 2017. (Nottingham.ac.uk, 2017)

The building also won awards such as 2016 structural timber awards – client of the year, 2017 building magazine – sustainability project of the year and the 2018 RIBA regional award, these were all down to the design, material choice, the architecture and many more elements which made this building so great.

3. Choice of materials

The building was designed to minimise environmental impact during construction and after the building was complete with the intention of the building becoming carbon neutral over its 25-year lifetime. (bmtrada) With this in mind the architect, Fairhurst's Design Group decided to use timber throughout the building for the structure, walls, floors and also the cladding of the building (bmtrada), as you can see from the outside of the building the American Red Cedar and single fired terracotta panels really makes the building pop and is very aesthetically pleasing to anyone that passes the building and really makes going to the building for any time of activity worth it just to see the building (bmtrada), that's not all that draws your attention to the building, it's sustainability aesthetic is also clear with the four clad ventilation towers stand at the highest point of the building, which is also used as a place for PV panels to sit facing the south, this is an interesting way of using a ventilation tower as they are normally ugly, useless and not pleasing to look at, but these are quite the opposite with them drawing your attention to the building but in a good way. Also, by using them for PV panels to be placed on is a very smart move by the architect as its making use of an otherwise useless piece of kit which would have no other use, and as they are so high, they are great at attracting the sun, this is another way the building is carbon-neutral by making its own power and electricity, which also saves cost. With the panels on the south side this allows for a green roof to occupy the north side of the towers.



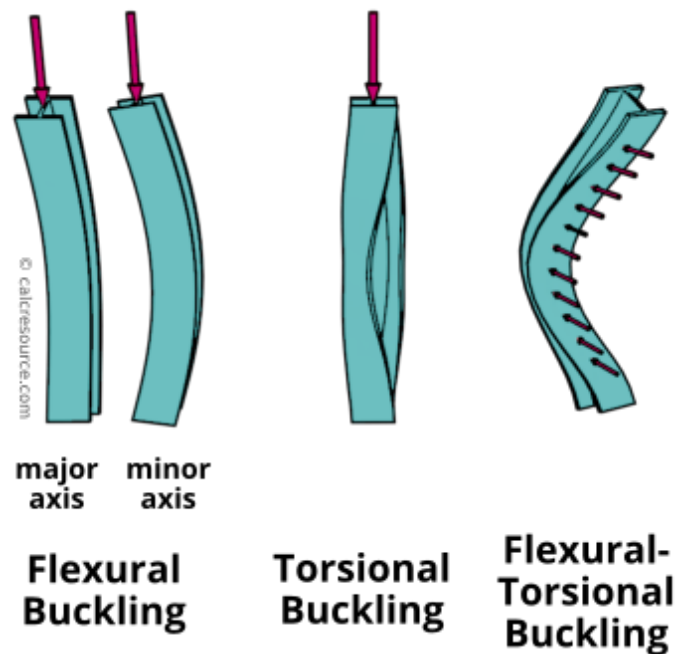
This image best shows the roofing system, which in no way is a eye-sore for people passing by, it's quite the opposite with the red cedar, green roofing system and the shape of the ventilation towers which would normally by a shape which people would not associate with a modern building. The towers also sit at a 45-degree angle which is great for allowing air to to be directed into the labs below and to provide heat recovery to all the labs.

(Ike, 2016)

Moving inside the building where the beautiful architecture does not stop as when you get in the front door as an elegant timber staircase takes you to an open mezzanine where the Glulam and CLT structures are exposed (bmtrada) which creates a warm, non-clinical ambiance in the building which makes you feel like you are with the nature instead of being stuck in a boring, cold commercial building which this building could have been without the architects behind it. The walls inside yet again are clad in American Red Cedar and terracotta panels which both were chosen for their low-embodied energy (bmtrada) which gives them an advantage over other timber which could have been used such as pine, oak or mahogany. Timber was also chosen over plasterboard, sand & cement or any other alternative as an extra finish was not needed as it was finished it did not need anything else which resulted in a cost-saving and a nicer cleaner looking area.

As for timber as a whole in this building it was chosen for many reasons, one being that it would be easy to meet any future changes to the building as it is easy to fix timber to timber, and saves knocking down walls etc. The structure was made from pre-fabricated braced glulam timber frame beams and columns (bmtrada), this saved on construction time and helped with being less dependent on what the weather was like throughout the project.

Continuing with the structure, the floors were chosen to be made from CLT as it met stringent vibration criteria required for the laboratories, (bmtrada) which are supported by the glulam frame of the building, CLT and glulam is also a lightweight material compared to steel which could have been used, it also does not buckle under increased load which can happen with steel as seen in the below diagram,



(Lemonis, Phd, 2020)

Timber was also chosen as it is more environmentally friendly compared to steel or concrete which are alternatives which would have been used. The timber also allowed for service voids to be pre-planned and then cut out in the factory (bmtrada) which reduces construction time in a way as it reduces the time people have to be on site which is a big advantage with timber as off-site construction can be done.

From an environmental and sustainability point of view timber was also the way to go with the structure and general arrangement of the building as all the timber together contained almost 1.6 thousand tonnes of carbon which was extracted from the atmosphere (bmtrada) through the process of sequestration and tree growth, which obviously aids the environment, and from a sustainability point of view timber was chosen as adaption to the building would be easy if needed any time down its 25 year carbon-neutral lifetime.

For fire protection to the structure the steel dowels which were used to fix the timber frame together were plugged with oak dowels (bmtrada) which is a very difficult material to burn, it also accommodates construction tolerances.

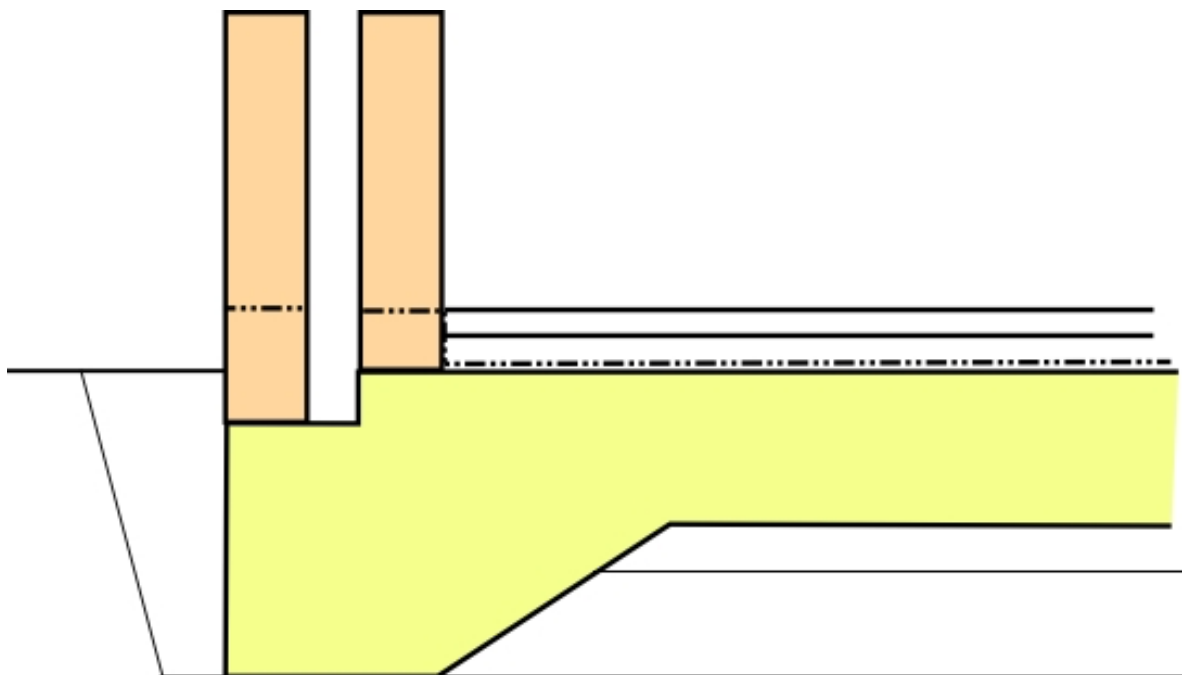
Although timber was picked for its ease to be adapted in the future, steel also has its advantages as it is the most recyclable material on the planet, as it can be melted down and used again to create other beams, columns or sheets which can be used again in the construction of a building., but with this advantage comes the disadvantage of polluting the air we breathe further, and with this building the aim of becoming carbon neutral, using too much steel would result in this not being able to happen.

4. Foundation Choice/ Requirements

The building is located in the village of Lenton which is in Nottingham, the land in which the GSK building lays on was once coal mining land and was mined for years to depths of 265 yards and at one period there was a worry that the land might sink below the present sea water level (www.nottshistory.org.uk, n.d). The area was then industrialised in the late 1800s to early 1900s with many factories opening and people moving to Lenton to work.

The GSK building in Nottingham has a floor area of 4,200m², and with the weight of the whole building the foundation would have to be something quite substantial to hold the weight of the timber structure, cladding and internal fixings which are in the building, with all this in mind I would predict a raft or piled foundation to be used as, as the local area has a history in mining and industrial background with factories being built here in the early 1900s. A raft is typically used in a commercial building as strength is the number 1 priority as the foundation is the base if that fails then the whole building will go with it therefore it is necessary to get it right before putting a bucket in the ground, piles are also used in commercial builds when the ground is very weak and needs extra support, this often occurs where there has been previous work done in the area such as factories or mining which this area has experienced, a piled foundation would be more useful when the ground is made up, meaning the pre-existing ground level has been built up using artificial deposits which has been brought on to site, this has used back in the 1900s when there was less regulations to building meaning anything could be put into the ground to build it up.

For the depth of the foundation, it depends on the size of the building, foundation type and the frost level in the area, as we know the building is 4,200m², and the best suited foundation will be a raft, the frost level is also known as a maximum of 450mm below ground level, meaning the foundation to the GSK building must at a depth of 450mm below ground level or lower, this is to avoid risk of the bearing strata freezing and causing damaging movement. A raft foundation would have major excavation works as the foundation is linked with the ground floor slab meaning a large quantity of material would have to be excavated before the shuttering and concrete can be poured, with a area of 4200m² and at a minimum depth of 450mm from the ground level would mean around 1900m³ of material would have to be removed from site, but before anything is removed a soil test has to be done to see if it is contaminated or not therefore a decision where the material goes can be made.



(Designing Buildings Wiki, 2015)

The sketch above shows a typical raft foundation detail, the corners as you can see above have more concrete under them, this is to support large columns which tend to get fixed to the foundation which beams are then fixed to, which then creates a large structure which we have in this case with the GSK building in Nottingham University.

Under the foundation of the building is a DPM/Gas membrane (BMTRADA) which helps with keeping out the harmful gases and moisture coming under the building and inside which could create damp in the future which would then have catastrophic consequences.

From information gathered on the surrounding area and evaluating the building, it does require a high strength foundation such as a raft as explained, but a piled foundation could also be used, but the way the building was built it would not best suit a piled foundation as the piles would act as legs to the slab which would go on top of it, therefore a raft would better suit the area, a strip foundation is another type of foundation but I decided not to go into detail about it as it would not be suitable for this type of building as it is commonly used in residential buildings such as houses and extensions.

5. Conclusion

To conclude on this report, this building was built to a specific design by wanting to be carbon neutral and environmentally friendly, therefore for the choice of material there was not much choice which would still align with the specification, as steel would have created hundreds of tonnes of carbon in to the environment, it also needs a large input of coke which is a type of coal where is extremely damaging to the environment, which emits harmful gases such as naphthalene in to the air, further polluting it.

In this report I have used references and my own knowledge in the construction industry to discuss many different elements of the building to a standard which can be portrayed as detailed, there were many other things I could have spoken about but decided to stay on track with the most important details to talk about, as this building had many from design to material choices and foundation types which I have all spoken about.

6. Reference List

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