SUMMARY OF SUSTAINABLE ASPECTS OF CIVIL AND STRUCTURAL ENGINEERING

WWF-UK LIVING PLANET CENTRE

DATE: 07 NOVEMBER 2013

WWF is a building that has been designed to be green….. we have worked closely in a team driven to develop a design that balances the client's operational needs, a challenging site and of course the overriding intent that the building be a showcase championing sustainability in the modern office building. As structural and civil engineers, our role is to find the best structural and civil engineering solutions that balanced client's needs while minimising the embodied energy of the structure. On this project especially, our role also included helping to facilitate the design of areas of the building where substantial embodied and operational energy savings could be made. This included providing foundation and drainage solutions that work around the building's earth tubes and designing a roof structure that can provide direct support to arrays of PVs yet can also allow swathes of natural light through the roof and walls.

Carbon Counting

An example of where simple (but not simplistic) carbon counting was utilised was in the development of the foundation design for the building. Driven piles were proposed and confirmed to be the preferred solution for embodied carbon content because:

- Groups of short driven piles could be installed providing a similar load capacity of a single conventional bored pile using a similar volume of concrete, however the pile group inherently provides more stability for a column support than a single bored pile
- Pile group stability allowed us to remove concrete ground beams from the scheme which conflicted with other sustainability features (earth pipes, drainage attenuation conduit), as well as saving the materials associated with the beams and additional excavated earth
- Driven piles do not generate arisings to be removed from site and disposed of, *and in the case of an existing car park likely to be contaminated*
- Further savings in embodied C02 of driven piles from reduced wastage in the casting process, use of cement replacement, and the use of recycled aggregates are likely to occur and were not accounted for in the carbon comparison

Efficient Structural Design

The structure has been designed to be a balance of flexibility, robustness and efficiency appropriate for the needs of a world leading charity. This has been achieved through an optimised concrete frame supporting the building over the local borough council owned car park and grid aligned from roof to parking space. Reinforced concrete provides the level of robustness required for supports within the car park and in the podium slab. Inside the building concrete walls and slab soffits are beautifully exposed eliminating the need for secondary finishes while providing thermal mass and excellent acoustic and fire separation properties.

Minimising waste on site

The design of the timber grid shell roof was conceived around the idea of a kit of parts with high degree of repetition. The geometry was defined so that the arch cross section is pulled along the building length providing repetition on each structural bay.

Specifying sustainable materials

The timber used to construct the grid shell roof was FSC certified. At least 50% cement replacement (GGBS) has been achieved over the entire building, and recycled aggregates have been used extensively throughout the concrete frame.

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Sustainable Drainage Strategy

Likely to pass unseen or unnoticed, is the design of a system for the management of the surface water drainage. Early investigation revealed low site permeability due to clay close to the surface of the ground, the necessary interventions to make infiltration drainage work would be difficult, intrusive and extensive. Instead, we designed a system that allowed us to meet the exacting requirements of the Environment Agency, Basingstoke Canal Authority and Natural England and discharge surface water into the adjacent Basingstoke Canal, no mean feat given the location is upstream from a Site of Special Scientific Interest (SSSI).

This strategy significantly reducesthe volume water entering the foul sewer system in order to minimise energy used in treating foul. It required a large amount of attenuation, around 250m^3, to restrict prevent flooding and surge effects, particularly during a storm event where the attenuation is designed to hold back over 95% of water falling letting out the flow from a row of taps that run into the canal.

Our system is designed around minimum intervention comprising a combination of three low intervention strategies:

- Store water for 'free'. Over a third of the total requirement is incorporated into structure that is already required, the deep podium floor void needed for services provided an opportunity around the external perimeter to incorporate roof rainwater attenuation tanks at 1st floor level
- Make water interventions multifunctional. We replaced in-ground pipework required to carry surface water across the site avoiding the central car park by providing capacity under ground level. We replaced conventional subbase material with interlocking crate units which provide a direct conduit, instead of the traditional pipes which require protection, while at the same time providing a significant proportion of the site storage required. The inclusion of a unit containing petrol munching enzymes prevents even the accidental ingress of hydrocarbons into the watercourse.
- Use water to improve the quality of the surrounds. The final step was the creation of a swale in the landscape, a sort of engineered water feature which acts as a balance pond further attenuating the flow, and, through appropriate planting also as a tertiary water filtration system. The main feature however is the variety of wildlife that will be attracted to the water, providing a genuine improvement in site biodiversity.