Wates

LIFE CYCLE ASSESSMENT (LCA) FOR...
THE SANDWELL AQUATICS CENTRE

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INTRODUCTION

This case study looks at the Life Cycle Carbon of the Sandwell Aquatics Centre for a period of 60 years. Both the embodied and operational carbon calculations for the case study was carried out using ECCOlab.

The project was into RIBA Stage 4 and was on site at the beginning of this study. The aim of the study was to understand the performance of the projects As-Designed and to explore alternative options with lower carbon impact. The report focuses on a comparative Life Cycle analysis study to aid decisions in construction methods and materials for future schemes. The analysis includes emissions from construction, use stage emissions arising from maintenance and replacement, operational emissions as well as end of life emissions. The alternative options, which were established in collaboration with Wates, are presented in the following chapters.

As part of this study a database of materials and assemblies was developed in ECCOlab that includes the As-Designed and the alternative options. The database captures detailed information on the thermal performance, carbon footprint and cost of each element. All information on the database is based on available EPD data from different manufacturers. The database is made available for use on future Wates ECCOlab projects.

PROJECT OVERVIEW

The Sandwell Aquatics Centre is a leisure facility for the people of Sandwell. At the time of the analysis the project was in Stage 4 and on-site construction had commenced. The analysis was undertaken for the 'Legacy Model' of the building, after the competition of a major sporting event due to take place in 2022.

The project includes a 50m competition pool and a dive pool with areas for spectator seating, a studio pool and a dry dive training facility along with all the necessary ancillary spaces for these uses. It also includes two 4-court sports halls that can accommodate a variety of sports (badminton, short tennis, gymnastics, 5-a-side football, netball, table tennis and handball), a fitness gym, studios and associated changing and stores. The complex also includes an entrance foyer, a cafe, meeting spaces, offices and staff accommodation.

The total number of permanent spectator seating is 1,000, including 10 wheelchair positions with companion seats. The wet changing and pool area provisions have been calculated for a total occupancy of 648 persons. The sports hall total occupancy is calculated as 64 persons and changing areas were calculated for a total occupancy of 160. The fitness gyms have a total provision of 253 people. In total, the occupancy of areas including staff, cafe, sports hall, fitness centre and dry dive is calculated at 570 persons.

SCOPE AND METHODOLOGY

The embodied and operational carbon calculations for the case study was carried out using ECCOlab. ECCOlab is a web-based tool that enables life cycle assessment of projects from the early stages of design to completed buildings enabling informed design decision making from the outset of the project throughout the project's development to assessment of the completed building.

The study analyses the carbon emitted throughout the life of the building. The building life cycle includes construction, use and deconstruction commonly termed 'cradle to grave'. It aligns with the relevant standard BS EN 15978 [2] which splits down the energy associated with construction projects into the following stages:

- Product stage (A1-A3)
- Construction process stage (A4-A5)
- Use stage (B4)
- Operational energy (B6)
- End of life stage (C1-C4)
- Benefits and loads beyond system boundaries (D)

Supplementary information beyond the building life cycle (D) is beyond the scope of this analysis. Following EN 15804 approach, any benefits of recycled materials that are currently taking place are included in product stage A1-A3.

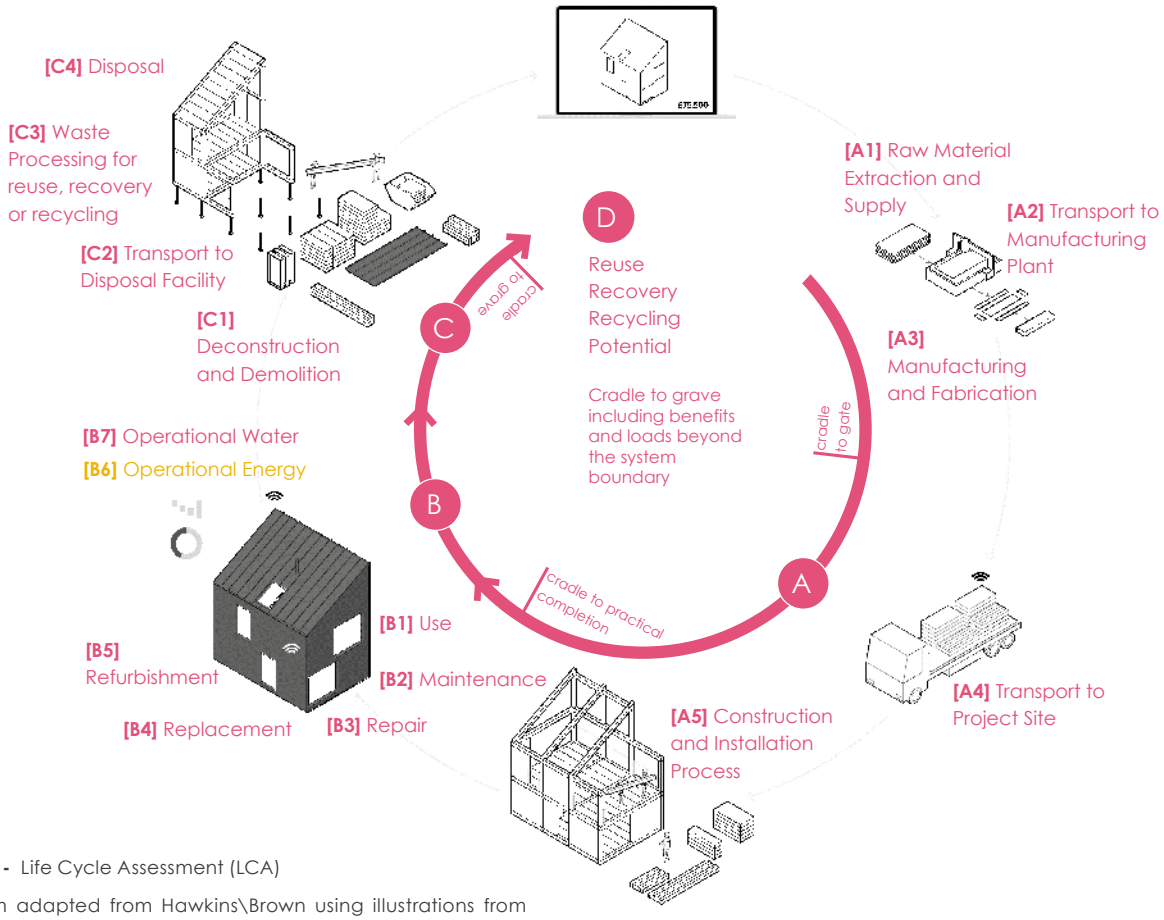
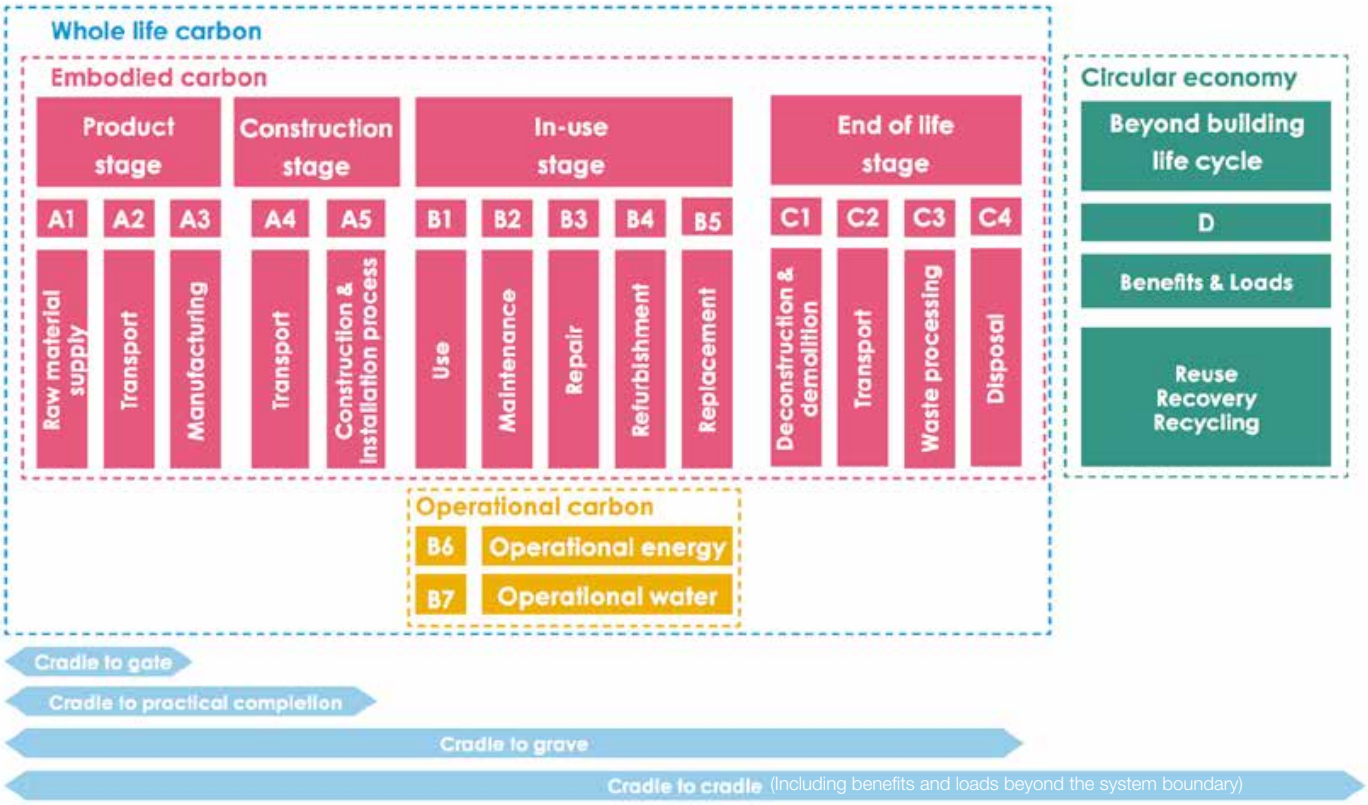


Figure ii - Life Cycle Assessment (LCA)

Diagram adapted from Hawkins\Brown using illustrations from Open Systems Lab 2018 licensed under Creative Commons CC-BY-ND

Source: LETI



LIFECYCLE STAGES

The main metrics to consider will be:

- Embodied lifecycle carbon refers to the carbon dioxide equivalent emissions from EN:15978 building stages A1-A5, B1-B5, C1-C4. This omits operation energy carbon and is essentially the emissions from the building materials and their maintenance.
- Operational carbon refers to the carbon dioxide equivalent emissions from EN:15978 building stages B6. This is the carbon emissions from regulated and unregulated energy use.
- Lifecycle carbon refers to the carbon dioxide equivalent emissions from EN:15978 building stages A1-A5, B1-B6, C1-C4. This is the whole life cycle emissions which includes operation energy carbon.

BENCHMARKING

RIBA has developed targets for operational energy use and embodied carbon in Non-Domestic buildings. These were used to provide some benchmarking for the Sandwell Aquatics Centre.

The targets take into account the latest recommendations from the Green Construction Board, and have been developed by the RIBA in consultation with other UK professional bodies. The targets are progressive yet realistic, and a vital first step to ensure the construction industry has delivered the significant reductions necessary by 2030 in order to have a realistic prospect of achieving net zero carbon for the whole UK building stock by 2050.

RIBA Sustainable Outcome Metrics	Current Benchmarks	2020 Targets	2025 Targets	2030 Targets	Notes
Operational Energy kWh/m²/y	225 kWh/m²/y DEC D rated (CIBSE TM46 benchmark)	<170 kWh/m²/y DEC C rating	<110 kWh/m²/y DEC B rating	<0 to 55 kWh/m²/y DEC A rating	UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes (CCC)
Embodied Carbon $kgCO_2e/m^2$	1100 $kgCO_2e/m^2$ (M4i benchmark)	<800 $kgCO_2e/m^2$	<650 $kgCO_2e/m^2$	<500 $kgCO_2e/m^2$	RICS Whole Life Carbon (A-C) 1. Whole Life Carbon Analysis 2. Using circular economy Strategies 3. Minimum offsetting using UK schemes (CCC)

COMPARISONS

The following cases were analysed:

Case 1_As Designed

This option shows the lifecycle carbon performance of Aquatics Centres 'As Designed'. It is used as the baseline for comparison with alternative options

Case 2_GGBS

In this case, the typical concrete mix was replaced with 40% GGBS (Ground Granulated Blast-furnace Slag)

Case 3_Zinc Roof

In this case the roof finish was changed from aluminium to zinc to quantify its impact on embodied carbon.

Case 4_Passivhaus

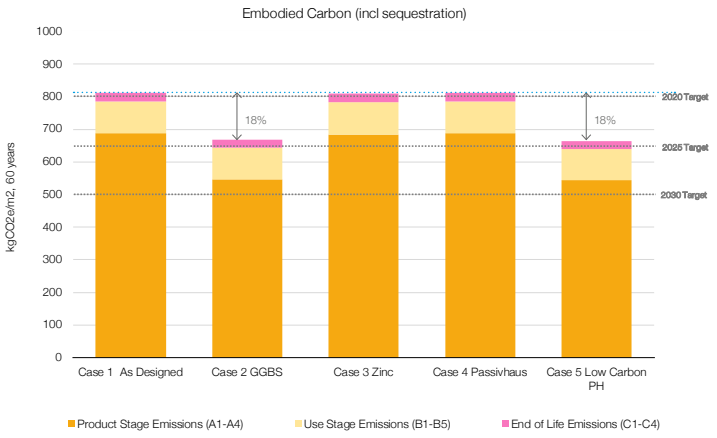
For this option it was assumed that the current design, as captured in Case 1, achieves Passivhaus performance.

Case 5_Low Carbon Passivhaus

This case combines all the strategies tested in Cases 2, 3 and 4 in order to quantify their combined impact.

CONCLUSIONS

- The As-designed case at 813 kgCO2e/m2 only narrowly misses the RIBA 2020 target for Embodied carbon of 800 kgCO2e/m2
- All design cases failed to meet the RIBA 2025 Embodied carbon of 650 kgCO2e/m2
- All design cases failed to meet the RIBA 2020 Operational Carbon of 170 kWh/m2/y
- All Cases start their life at Year 0 with similar emissions, around 700 kgCO2e/m2, but then as a result of Operational Carbon the Passivhaus options (Cases 4 and 5) accumulate 24% emissions less compared to the other options over a period of 60 years.
- The Low Carbon Passivhaus cases offers a 25% reduction in Life Cycle emissions when compared to the As- Designed case.
- Findings show that reducing operational energy can significantly reduce Life Cycle Carbon emissions. This effect is even greater the embodied carbon of the big structural elements is reduced.
- Sandwell Aquatics Centre never set out to achieve any specific carbon targets so arguably the baseline design performs resonantly well however it is clear that there is a significant gap to be closed before the RIBA 2025 and 2030 targets can be achieved for a building of this typology.



Graph 38 / Embodied Carbon (A, B, C) comparison. (RIBA Targets for non-domestic buildings for reference only)