

Factsheet no. 2: SEGRO warehouse, Slough, UK



Relocated warehouse building – Slough, UK

Project summary

Client:	SEGRO
Contractor:	Francis Construction
Architect:	Langley Hall Associates
Structural engineers:	John Tooke & Partners
Steel fabricator:	Advanced Fabrications Poyle Ltd
Duration	56 weeks
Project value:	£2,500,000

Project description

SEGRO owns a large business park in Slough which is a town approximately 32km to the west of central London. As part of master-planning larger plots of land to regenerate the business park, the need was identified to remove and relocate this building to enable the construction of a new road bridge over the main western train line serving London. The new road bridge was opened in October 2015.



Original location (Leigh Road) – brick cladding



New location (Cambridge Avenue)

The relocated building was built in 2000 and relocated in 2015. It is a warehouse building with offices to the front elevation. Floor area is 3,320 m². The original building was brick-clad on three sides with full height curtain walling to the front elevation. The building was relocated to a new plot, on the same business park, 1.6km away. The new site for the building had poor ground conditions including potential ground contamination, close proximity to an aquifer and complicated underground services for the neighbouring power station. The new site was also narrower than the original site necessitating some changes to the access yards, loading door positions and soakways.

SEGRO state that the expected life cycle of this type of building is 30 years, i.e. two life cycles of a 15-year lease.



Original location of the building – Leigh Road, Slough



Plot for relocation of the building – 9 Cambridge Avenue, Slough

The brief for the main contractor, Francis Construction, was to relocate the building, reusing as much as possible of the original building. In addition, the project must cost less than an equivalent new build.



Internal view of the relocated building

Design process

The relocation project benefitted from having the same architect and structural engineer as for the original build. This was important in terms of having the original information, drawings, calculations, etc. available for the new building and particularly, in terms of deconstructing the floors within the office area of the building.

The local planning authority was helpful and had a good and long working relationship with the structural engineer and consequently did not require any new structural calculations for the new building.



Schematic of the relocated building (Sturgis carbon profiling)

In the relocated configuration the cores in the office areas were ‘flipped’ around; new sheeting rails were fixed to the re-erected steel frame and the plant room, which was internal, was moved outside in the relocated building.

Some problems were experienced with the as-built drawings not reflecting the actual construction. For example, circular hollow steel sections with internal downpipes were not shown on the as-built drawings and the levels shown on the drawings were not accurate.

The new building has different boundary fire conditions to the original building and therefore some of the column base plates had to be re-fabricated.

Deconstruction and Construction processes

The project was completed in 56 weeks. The value of the project, to the contractor, was £2.5m. The following elements were successfully recovered and reused:

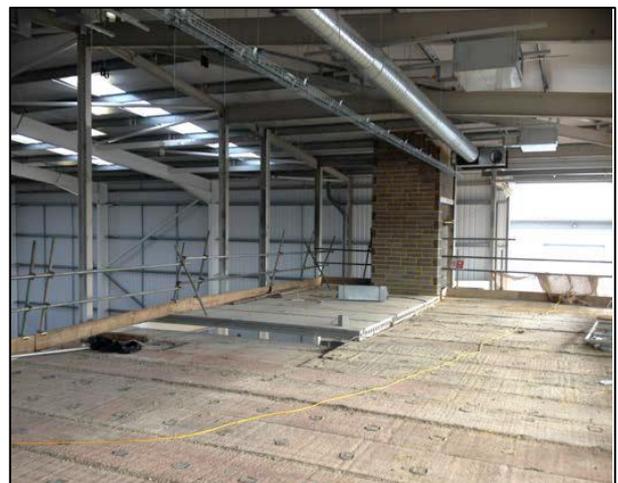
- Steel frame and balustrading
- Precast concrete ground beams
- Precast beams and planks (offices)
- Raised floor
- Staircases
- Curtain walling and glazing
- Fascia
- Roller doors
- Internal joinery
- Fencing and gates
- Loading doors
- Lift.

It was not possible to reclaim the bricks and it was too expensive to install brick work on the new building. Therefore the new building was clad in a new, composite steel cladding system. A new roof was installed on the relocated building because of the risks associated with reusing the old roof, particularly the roof lights.

Because of the relatively poor ground conditions at the site of the relocated building, vibropiles were used for foundations.



Reuse of the primary steel structure



Reuse of the precast floor slabs

Relative to other parts of the building that were reused, the primary steel structure was easy and were few problems. The contractor reported that no problems were encountered in undoing bolts but noted that pecking out column base plates was time consuming. In terms of the primary steel structure:

- The steel structure was left unprotected, following dismantling, for some time. (Other products were stored in vacant buildings on the trading estate; SEGRO reported that double-handling of products was wasteful)
- Cleats were welded onto the primary steel frame to fix the rails for the new composite cladding system.
- Originally the primary structure was coated with grey primer and was fire protected with intumescent coating. During deconstruction, the frame was left exposed for some time and the coatings got wet which made it easy to manually remove the intumescent coating. The re-erected frame was touched-up and repainted on-site.

The precast concrete planks used for the floors in the office areas, were 300mm thick and 12m long. There was concern that these would be difficult to remove, transport and re-erect because of their fragility but this was not the case. The planks had 50mm gaps between them, no rebar and were grouted together with a relatively dry-mix which was easy to rake out. Two or three new, small planks were required to fit around the cores in the reconfigured building. [Note the structural engineer reported that some of the recast planks were damaged during removal and required repair.]

The secondary steelwork was more challenging to reclaim given the number of members and their relative fragility. All secondary members had to be carefully labelled and documented. Fortunately SEGRO were able to provide a large 'set-down' area which made storage and sorting easier. All purlins were reused in the reconfigured building.

The staircases were reused but because the regulations have changed since 2001, required some rework, including closing the treads and extending the balustrades.

Reclaiming and reusing the curtain walling was complex and challenging. Of the 80 units, six cracked in stillage following deconstruction. These units were disassembled and reglazed before being reused.

Block paving was recovered and reused and low energy (low boiling point) tarmac was used. The fencing was also repainted and reused. The switch gear was also reconditioned and reused.

The 1,860 m² new floor slab was cast using GGBFS and PFA concrete.

Warranties were provided on the new roof and cladding.



Careful reclamation of the curtain walling



Raised access floor panels in storage

Whole life carbon study

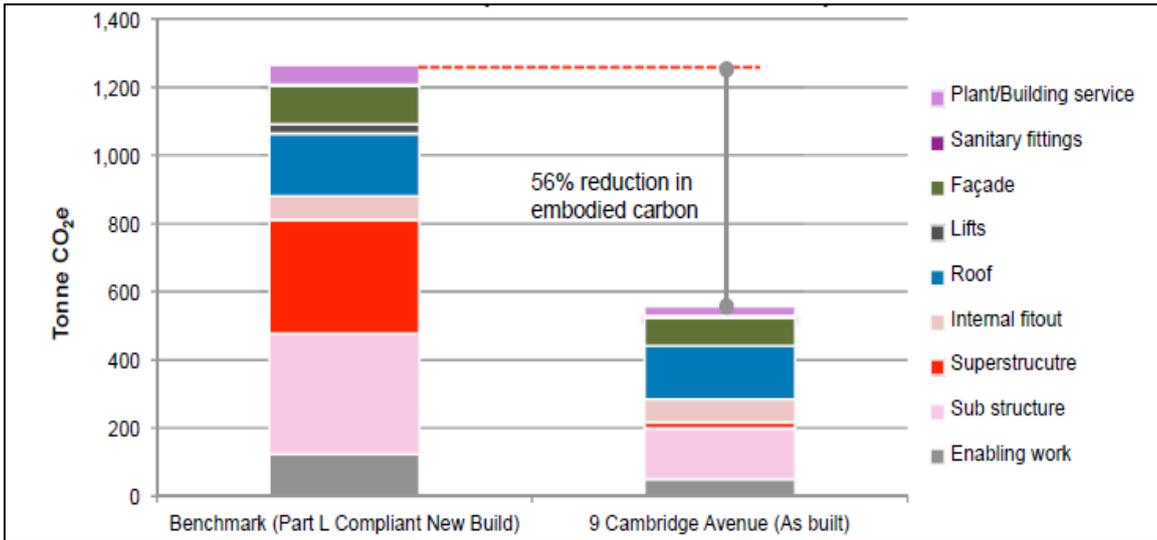
A whole life carbon study of this reuse project was undertaken by Sturgis carbon profiling in 2014. The study covered:

- Whole Life Carbon Assessment (at Practical Completion and Over 60 Years)
- Whole Life Carbon Comparisons with Benchmark Building (Part L compliant new-build)
- Identification of Embodied Carbon Reduction Options for future projects.

[Note Part L refers to the section of the UK Building Regulations relating to the operational energy/carbon performance of buildings.]

This scope of assessment included carbon emissions throughout the building's life cycle, including the main building elements required to support the building as well as doors, windows, internal finishes, mechanical and electrical components, etc. It also takes into consideration the impact of transporting any re-usable components from the old site to 9 Cambridge Avenue at the onset of the project and replacement impacts of all components over the life cycle. The study claims to be compliant with EN 15978, which is based on the CEN/TC 350 calculation methodology for implementing European standard EN 15804. It is noted that 'no 'credit' is taken for any future carbon benefit associated with the reuse or recycling of a material into new products'.

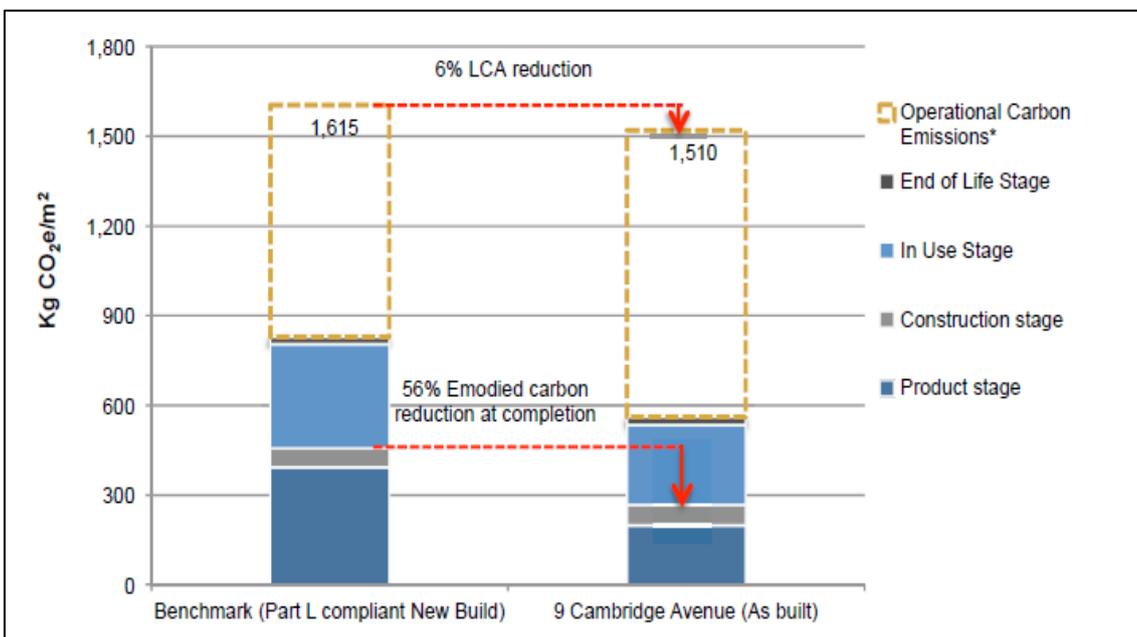
The graph below shows the embodied carbon savings achieved by reusing and relocating the elements of the building described above. According to the authors of the report, the overall embodied carbon saving at completion is 56% and the cost saving was 25%.



Embodied carbon comparison at practical completion

‘Whole Life Carbon’ is the combined assessment of both embodied and operational emissions over the life of the building (assumed as 60 years), including the original construction and final disposal. The Whole Life Carbon footprint of 9 Cambridge Avenue based on ‘As-built’ information is about 4,820 tonnes. The Carbon footprint is split between embodied emissions, which are 1,770 tonnes and operational emissions, which are 3,050 tonnes.

The operational energy emissions of 9 Cambridge Avenue are 23% higher than a Part L compliant new build (as at 2014). This is because the building fabric fails to meet the 2014 performance standards, mainly due to the reused curtain walling façade. However, over the whole life cycle of the building, this negative impact is offset by the benefit of having a much lower embodied carbon footprint. The overall carbon footprint is 6% less compared to the benchmark new build, a saving equivalent to 330 TCO₂e, achieved with no financial cost.



60-year whole life carbon footprint comparison

Lessons and conclusions from the project

The following lessons and conclusions are drawn from this case study:

- Despite the success of this relocation project, SEGRO are not designing any new buildings with an eye on design for future deconstruction and relocation.
- From SEGRO's perspective having the right plot of land to relocate existing buildings is key. Another building on the trading estate had been taken down with a view to re-erecting it but no appropriate plot had become available and therefore the steel frame was recycled rather than reused.
- According to the main contractor, warranties, time and costs constraints are the biggest challenges for projects of this nature.
- On the contrary, SEGRO see no problems with warranties for this new building. It is their building, the structural calculations have been done by the same engineer (as the original) and the only new warranty is for the new steel fixings to the primary structure to support the new cladding system. Warranties have also been provided for the new cladding and roof.
- A challenge to reusing buildings of this type are changing client requirements. For example, for this building, the eaves height is just 6.5m whereas 8 to 10m is the current norm for modern racking systems. Also the building has too much office space (relative to the warehouse space) and, on the new site, the yard is too small compared to current requirements. Air-conditioning is also now generally required for this building type.
- Other regulatory changes can also prove problematic. In this project, regulatory changes between 2000 and 2014 affected the reuse (in terms of both difficulty and cost) of the staircases, the cores and the lift.
- Equipment, particularly building services and plant, improves over time with older models becoming obsolete. On this project, the inability to replace a broken boiler part prevented their reuse and the age of the lift made reuse difficult and costly.
- The project benefited from using the same engineer, architect and steelwork erector as for the initial build. Despite this, and having good information and drawings, the as-built drawings did not reflect the actual construction.
- As shown in the carbon study, although reusing building envelope elements saves embodied carbon, there is generally a price to be paid in terms of higher lower operational carbon impacts.

Further information

The information in this case study is based on interviews with the following organisations involved in the project:

- SEGRO
- Francis Construction
- John Tooke and Partners

Information on the whole life carbon assessment was obtained from the following report:

- *9 Cambridge Avenue – Whole life carbon: Post completion report, Sturgis Carbon Profiling LLP, August 2014.*