Transforming Buildings

expedition

Grand new buildings may grab the eye and the headlines, but it is often in the transformation of existing buildings that the engineer can make the biggest difference – by helping to create something inspiring from a building which has outlived its use, or simply by making the building function more effectively.

As all of these examples from Expedition Engineering's portfolio demonstrate, it is the engineer's intervention which can unlock added value for clients, while saving them money, time and resources in the process. And frequently, the smartest engineering is all but invisible.

In all Expedition's work – but particularly when transforming buildings – engineers need not only to design well, but also at the same time to fully consider how the design can be built – what temporary works will be needed, making the build-sequence straightforward, how it will fit into the overall construction and phasing sequence.

Expedition's co-founder Sean Walsh, who can be found at the heart of most of the firm's transformational projects, believes passionately that designing things that cannot be built sensibly is bad engineering. This adds an extra dimension to the work, and requires close and early collaboration with other members of the team – client, designers and contractors.

Thanks to Sean's insistence, buildability has become part of the firm's DNA. Not all engineering firms share this approach.

Right: The redevelopment of 55 Baker Street.

Las Arenas

One of Expedition's earliest major projects was the Rogers Stirk Harbour + Partners designed conversion of Barcelona's Las Arenas bullring into a mixed use leisure and office complex. The bullring had lain derelict for decades, defying repeated attempts to transform the site while retaining the historic structure.

In the end, it was a simple engineering idea which provided the key to unlocking the development: by lowering the entrance level of the former arena to match the surrounding streets (and adding floors below), movement into and across the development could be made seamless.

Making this work was not quite so simple: the old and (at the time) decaying and dangerously listing 100-year-old circular masonry wall had to be perched 5m above the new ground level, while another five storeys of basement were excavated directly beneath.

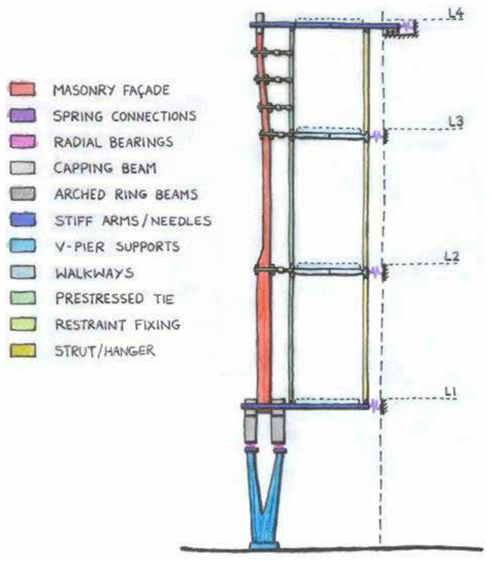
Right: Las Arenas is now a destination for Barcelona. Removal of the mound below the building while the facade was kept in place opened the ground-plane for public circulation. The new basement levels provide additional value.

The walls were clamped at the base by a pair of arched concrete ring beams, and the whole edifice delicately supported on a new system of steel V-piers, providing clear access beneath from every direction.

A series of new perimeter walkways at various levels reinstated lateral support to the original walls. Careful planning of the demolition and construction sequence, with safe support maintained at all times, was critical.

The new 18m-deep basement extends beyond the line of the existing bullring wall, which therefore had to be supported over the excavation during construction.

Diaphragm walls (concrete retaining walls) were sunk to form the perimeter of the basement before the ground between was excavated.



But first, the old walls were supported on temporary steel plunge columns – piles sunk from the old ground level to below the new basement, which supported the wall as the basement was excavated and eventually became permanent supporting columns within the basement.

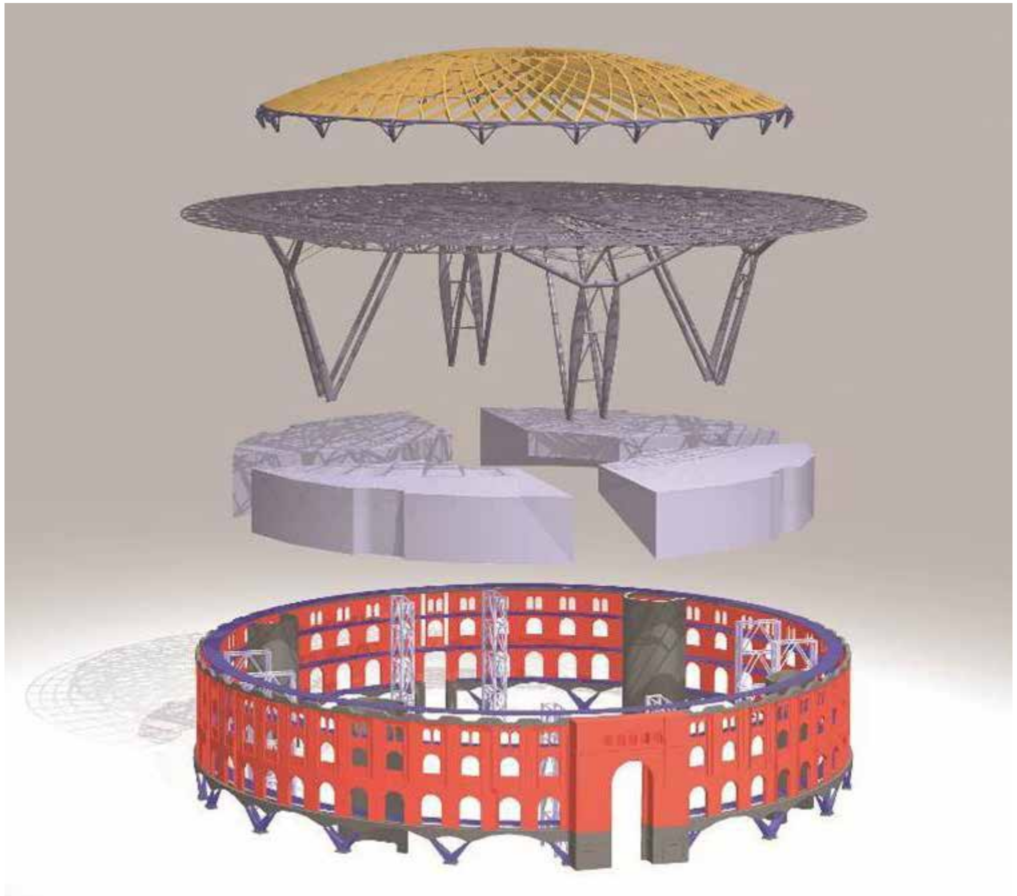
The process had to be carefully sequenced, with ingenious, adjustable temporary works providing essential support at each stage.

Without this inspirational engineering, the successful transformation of Las Arenas into an essential 'destination' in Barcelona could not have been achieved.

Right: The main above ground components of Las Arenas: a timber dome, a steel dish, retail pods and the retained facade.

Left: A section showing the arrangement for post tensioning the piers of the retained facade.

“The process had to be carefully sequenced, with ingenious, adjustable temporary works providing essential support at each stage.”



Selfridges

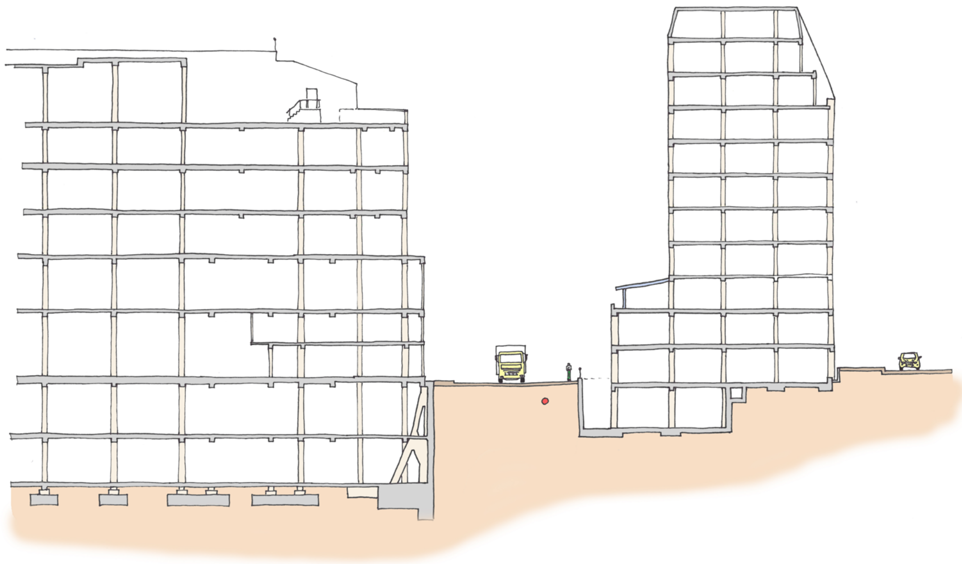
A decade later, an equally clever – and far less visible – engineering intervention has made possible a major transformation of Selfridges department store in London's Oxford Street.

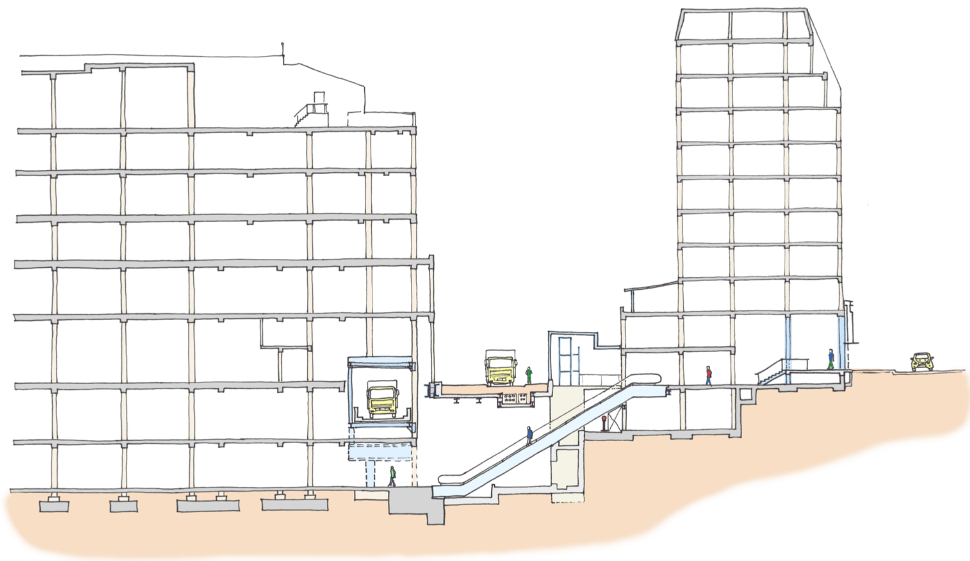
In May 2014 Selfridges announced an ambitious £300M redevelopment in phases to create a grand new Duke Street entrance on the east side of the store, and to create some 10% extra retail space. But in order to unlock these benefits, a major programme of enabling works was first needed.

At that time, deliveries were made to basement level via a down ramp in the north-west corner, with lorries exiting via another ramp in the middle of the store, emerging in the centre of the Duke Street frontage – and at once blocking movement within the shop, taking up valuable retail space and interrupting the Duke Street frontage.

Right: The major elements of the new works included a new lorry exit ramp, and a new escalator and lobby connecting the ground floor of the newly-acquired office building with the lower basement of the store, passing under the mews along the north side of Selfridges and under the new bridge.

See the full project on our website. Images by Expedition.





To unlock this area, the exit ramp had to be moved, to the north east corner of the site. Also Selfridges had purchased an old building immediately to the north in which to relocate offices, and a new pedestrian staff tunnel was needed to connect to the store – threading around the new delivery ramp.

And throughout, Selfridges' main priority was to maintain continuity of retail activities while minimising any disruption. The first challenge was to understand how the existing building worked, due to its sheer structural complexity.

Originally built in 1910, it has been extended both outwards and upwards in major improvement works approximately every decade until the 1980s, with modifications in between.

It also contains along one side a three-storey basement, at the time one of London's deepest. Operationally, this piecemeal construction created obstacles to movement within the store, and many changes in level. Structurally, it made the engineers' work far more challenging.

A forensic analysis of the building was the first task. Historic records were searched, and the building codes contemporary with each phase of construction were scrutinised in order to understand how it should have worked at the time it was built.

Then the engineers had to think how it was actually working now, taking account of all the subsequent alterations. It was painstaking, time-consuming work.

Each beam, column, wall and joint had to be examined carefully and analysed, with regard to both its immediate function and its wider role: for example, a wall inserted for local strengthening may later (through subsequent alterations) have acquired a role in the stability of the whole building.

The major elements of the new works included the design and build-sequence for a complex steel truss forming a 50m-long sloping, underground bridge which carries the new lorry exit ramp, and a new escalator and lobby connecting the ground floor of the newly-acquired office building with the lower basement of the store, passing under the mews along the north side of Selfridges and under the new bridge.

But the real challenge came in the hundreds of small structural interventions required to enable these changes, each one a challenging piece of engineering which had to be carried out in a 'live' retail environment.

In each case the engineers had to consider not just what needed doing but how it could be done, how it would fit into the complex construction sequence, and how to avoid any interruption or disturbance to the retail business operating sometimes less than a metre away behind a temporary partition.

For example, a column needed strengthening by breaking out concrete encasement and welding steel plates as reinforcement in a live retail zone, with work carried out at night in 3-hour shifts, with no craneage and all materials sized to fit in a passenger lift. And this was multiplied many times over.

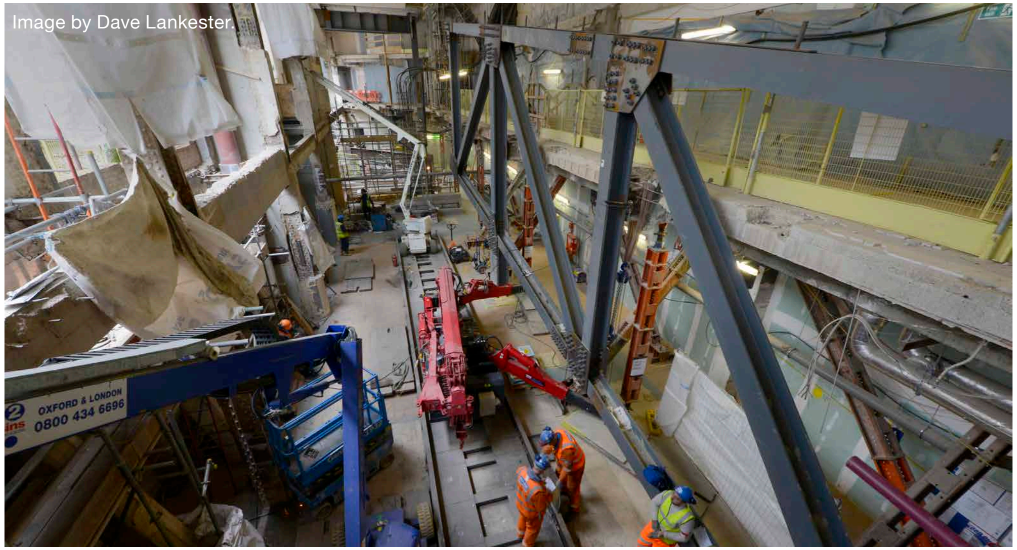


Image by Dave Lankester.

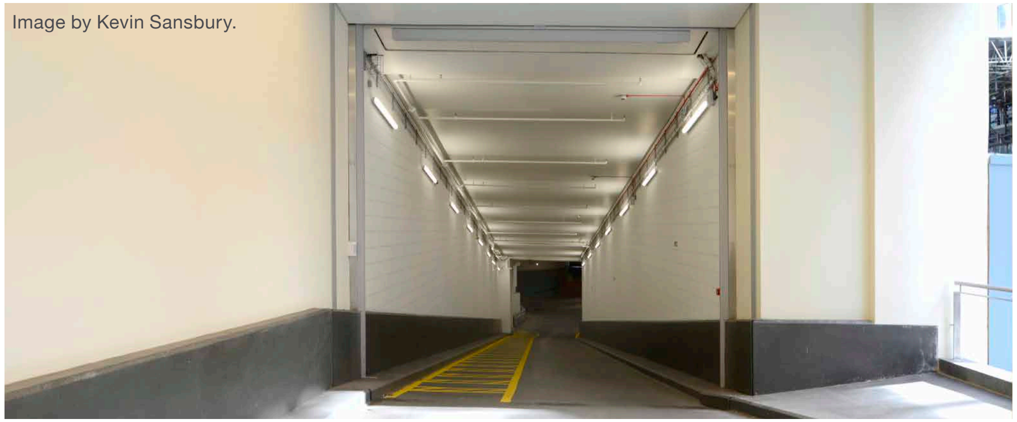


Image by Kevin Sansbury.

This required not only thinking about constructability from the start, but also working very closely with the demolition/temporary works and building contractors.

It also meant that Expedition needed to have a representative on site most of the time, to spot immediately if anything uncovered by the works was found to be other than expected.

Top: The 50m bridge supporting the new goods ramp in construction.

Above: The new goods ramp completed.

55 Baker St

See the full project on our website. Images by Make Architects (also featured on the front cover).

Less than half a mile away and some years earlier, another retailer – Marks & Spencer – was selling its old headquarters building at 55 Baker Street.

The 1950s building had a low floor-to-floor height unattractive to modern commercial tenants, and a developer planning to bid for the site expected to demolish and rebuild, but first consulted their engineer.

Expedition suggested an alternative: since the old reinforced concrete frame was judged to be good quality, why not save as much of it as possible, and build round?

This offered massive potential savings in cost and time (and hence an earlier let and faster pay back), and was a much more sustainable solution. The developer's tender was successful (all the competitors proposed demolition and rebuild) but could the transformation be undertaken without compromising the appeal to potential tenants?

Right: 55 Baker Street before and after renovation.

This meant working with the low 2.45m floor-to-soffit height of the old frame. The engineering solution was to propose the thinnest services solution possible, in this case Europe's largest chilled ceiling, which enabled the height taken up by services on each floor to be kept down to a mere 125mm.

The old building's distinctive 'H-block' was transformed into a figure-of-eight design with three seven-storey atria. Around 70% of the original structure was retained, and targeted demolition made way for large expanses of new offices, adding 30% to the original floor area.

A grand entrance was required, which was inconsistent with the close-spaced columns of the old building carrying the seven stories above. Expedition's solution was to remove twelve of the reinforced concrete columns at ground level, and replace them with a slim, elegant, angular steel transfer structure which also forms a sculptural feature of the lobby.

This meant temporarily propping the concrete structure above, removing the twelve columns, installing the new steel, and then transferring the load onto the transfer structure, which rests on two existing columns at basement level.

Design of the steel transfer structure was not straightforward. It also incorporated sliding bearings borrowed from bridge engineering to maintain the conventional movement joints of the old building at this location.

Due to its innovative engineering, the project went from initial concept to an occupied building in less than three years, and achieved the biggest pre-let in London for five years: it was almost fully let a year before completion, allowing the client to achieve the fastest possible return on investment. Also, the client's own offices are now located on the top floor.

> "The project went from initial concept to an occupied building in less than three years."

Left: The new steel transfer structure replaced 12 of the original columns and forms a sculptured feature in the entrance lobby.

Clifton House

With rising property values, clients frequently want to increase the value of their plot by building upwards from their existing building.

Viability usually depends on designing a lightweight structure on top and – critically – accurately assessing the existing structure and foundations to check they can carry the increased vertical and lateral loads, with minimal costly stengthening works.

At Clifton House in London's Euston Road, the challenge was to add three floors of grade A office space to an existing seven storey steel structure, built as a warehouse in 1936 and subsequently converted to offices and retail.

See the full project on our website. Image by Robert Partington Architects.

Right: Architectural render of Clifton House viewed from Euston Road, showing the three additional floors.

Expedition's ingenious solution was to extend and hence increase the capacity of the existing foundations without undermining them – saving time and money – and to demolish the top storey and rebuild four stories, to maximise the value of the building – all while maintaining the ground floor retail throughout.

In this case the existing structure did require some strengthening to take the increased lateral loads. This was achieved by a pair of slender and elegant steel pylons forming an architectural feature at the rear of the building.

A mile and a half further north in Jamestown Road, Camden, the client wanted to add two floors to an existing four storey reinforced concrete building, originally constructed in the late 1980s as a pharmaceutical laboratory.

Here Expedition found that, by designing the extra floors as a lightweight steel frame using composite floors, no significant temporary works or expensive strengthening of the structure and foundations was necessary.

Above: The new 7th floor office space.

Right: Clifton house viewed from Euston Road.

Clere Street

An unusual verson of a similar challenge came when the client – who happened to be the son of one of Expedition's long-term collaborators, the architect Richard Rogers – wanted to build a new two-storey six-bedroom family home on top of an existing five-story late Victorian building in Clere Street, East London – without disturbing the occupiers of the converted flats and offices below.

Here as so often, the engineering divided into two parts: the visible and the (often more challenging) invisible work.

The latter – accounting for around 80% of the engineering design work – involved a painstaking assessment of the existing masonry structure and foundations, complicated by evidence of wartime bomb damage.

The new structure added around 10% to the vertical loads but – much more significantly – wind on the new upper storeys added 70% to the lateral loading.

See the full project on our website. Image by Richard Bryant.

Right: The completed extension stands tall above the existing building, allowing some of the best views over London in the area.

Left: Building up opened a new view across the city.

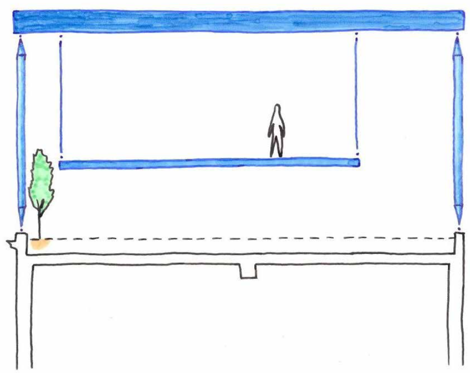
Below: Careful thought of the new structural system was required, oversailing the existing columns and using the exterior masonry walls for support, both for the roof and the mezzanine level.

Trial pits round the foundations gave confidence that these could take extra loads, as could the masonry walls: careful checks were done to ensure that the high wind loads would not lead to significant cracking in the masonry.

But the internal cast-iron columns could take no additional load. This meant all the weight of the new apartment had to be transferred to the external masonry piers and walls, and the engineering solution was a new slender steel roof structure supported on equally slender columns resting on the perimeter masonry – with the new intermediate floor suspended from the roof.

This also enabled the architect to achieve what he wanted: a façade which was relatively unobstructed (and cut back on two sides allowing a balcony to be included) ensured maximum natural light and ventilation, and provided extraordinarily good views over London.

> “The engineering divided into two parts: the visible and the (often more challenging) invisible work.”



Bastwick St

The commission to engineer the renovation of a 1960s building close to the City of London as the new headquarters for the Institution of Structural Engineers came as something of an honour, perhaps influenced by the fact that the firm had won IStructE's most prestigious award twice in the previous few years.

The most dramatic feature of the development is a new staircase which appears to float up the long wall of the building's newly-created ground floor entrance area.

The design pays homage to ancient stone cantilevered staircases (one of which adorned the Institution's old HQ), but is a modern interpretation, taking advantage of modern materials.

But as so often, much of the smartest engineering is concealed. The four-storey building has a concrete-encased steel frame with precast concrete floor units.

See the full project on our website. Image by James Brittain.

Right: The new entrance hall of the Institution of Structural Engineers Headqaurters.

Adjusting the floor system to support heavy book storage and to allow substantial openings for new air ducts and the new atrium involved some novel engineering to keep the works within budget and to avoid impinging on the already tight floor-to-ceiling heights.

In particular, creation of a two-storey atrium (including the new stair) at the heart of the building required a large opening to be cut in the first floor, which could affect the building's stability: the solution involved bonding carbon-fibre strips to the top and bottom surfaces of the retained sections of floor which effectively reinstated the diaphragm effect of the original floor.

The Institution is delighted and the new stair – as intended – provides a source of lively conversation when members gather in the entrance area.

> "Adjusting the floor system involved some novel engineering to keep the works within budget."

Right: The hidden floor and column strengthening work allowed the entrance hall to be formed.

Top Right: Carbon fibre floor strengthening hidden in raised floor.

Bottom Right: Detail of the new stair.

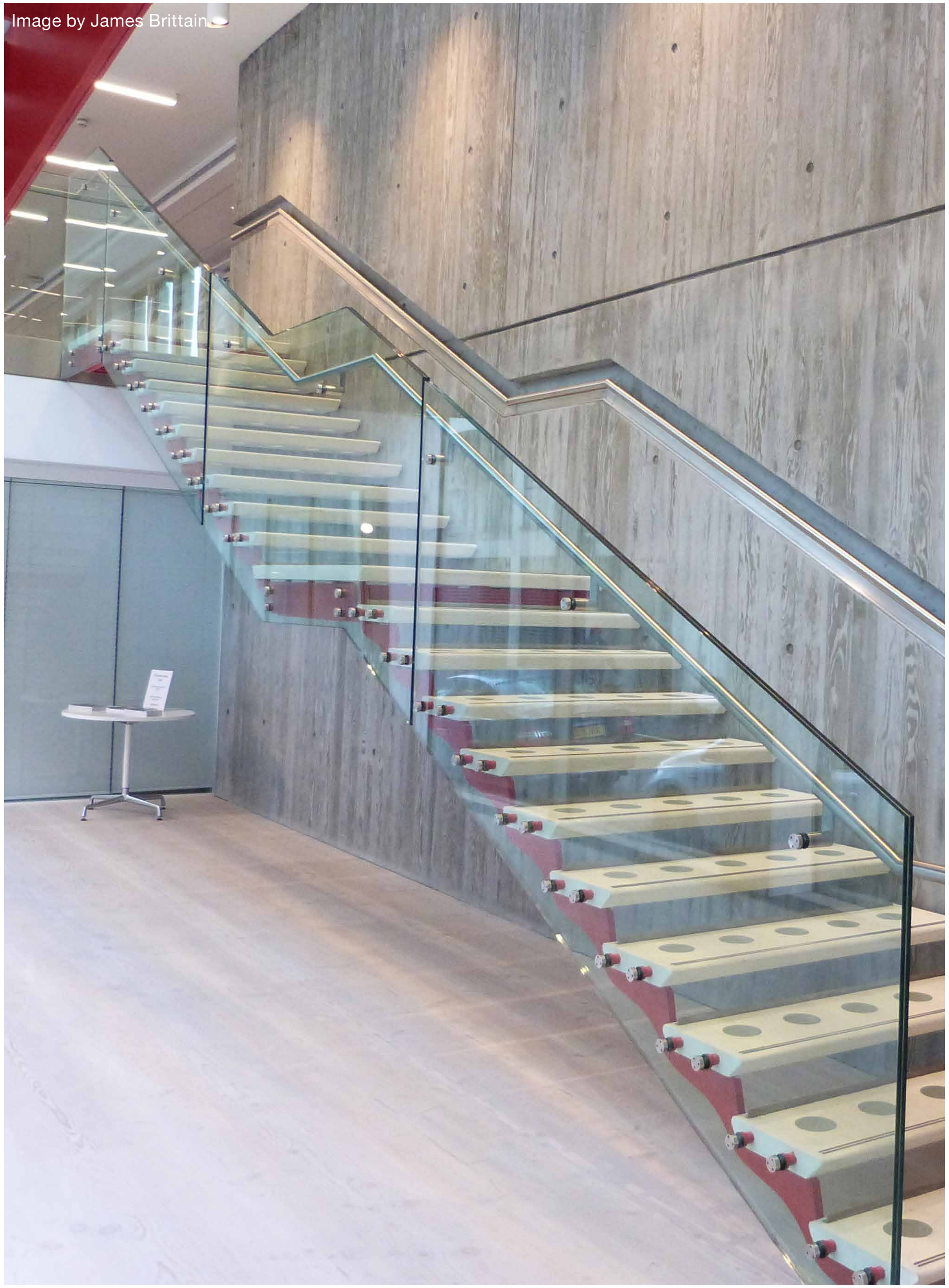


Image by James Brittain.

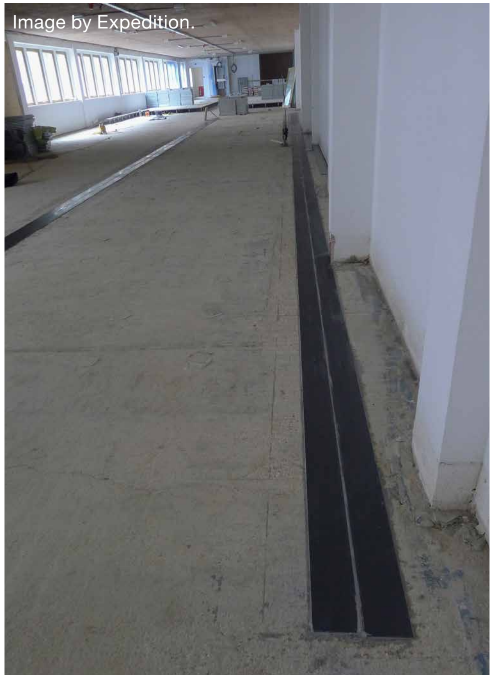


Image by Expedition.


Image by James Brittain.

The lesson from all these projects is that there are many structures out there which appear to be nearing the end of their lives but which can be transformed into attractive modern buildings – faster, more economically and far more sustainably than demolishing and rebuilding.

Or, as in the case of Las Arenas, a decaying building which is worth preserving for historical or cultural reasons can be turned into a world-class ‘destination’. All it needs is some imagination, and some very good engineering.

Words by Hugh Ferguson.

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55 Baker St.
Make Architects
Skilful interventions overcame the drawbacks of an existing office, saving the structure from demolition. See page 7.
Image: Make Architects.

265 Tottenham Court Road
ESA with Quinian and Francis Terry
A new mixed-use development replacing a semi-derelict Victorian hotel.
Image: ESA.

Berkeley Hotel
Rogers Stirk Harbour + Partners
Statement entrance extending the Blue Room bar and Collins Room restaurant.
Image: Expedition.

Selfridges Phase I
Gensler
Some 10% of the store’s capacity is unlocked by a series of complex enabling works, and hundreds of small interventions. See page 5.
Image: Dave Lankester.

Bewlay House
Ben Adams Architects
Detailed analysis allowed two lightweight steel storeys to be added without strengthening works.
Image: Ink Workshop.

Clere St
Tonkin Liu
A new view of London is opened up, thanks to much ‘invisible’ engineering and investigation. See page 11.
Image: Expedition.

Clifton House
Robin Partington Architects, Dinwiddie MacLaren, David Morley Architects
Avoiding expensive foundation strengthening, Expedition found a way to replace one storey with four. See page 9.
Image: Expedition.

81 Dean St. and 3 Richmond Buildings
Robin Partington Architects
Two adjacent offices linked together and vertically extended, creating restaurant space and 18 high specification apartments above.
Image: Robin Partington Architects.

Shakespeare’s New Place
Fielden Clegg Bradley Studios
Sensitive extension of Shakespeare’s grade I listed home to provide additional exhibition space.
Image: Expedition.

6–12 George St., Oxford
Project Orange
The reconstruction of a high specification building in a sensitive area behind an historic façade, adding an extra storey in the process.
Image: Project Orange.

IStructE
Hugh Broughton Architects
A feature stair floats up the wall of a new entrance, all enabled by a series of elegant interventions to an old office. See page 13.
Image: James Brittain.

Selfridges Accessories Hall
David Chipperfield Architects
The first phase of the transformation of Selfridge’s Ground Floor retail – including the delicate glass screens that divide the concessions.
Image: Lewis Ronald for Selfridges.