Exhibition Highlights

Engineering the World: Ove Arup and the Philosophy of Total Design

Supported by Volkswagen Group

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Part of the V&A Engineering Season

18 June – 6 November 2016

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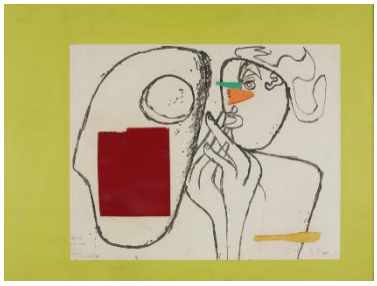
Portrait of Ove Arup by Le Corbusier, 1955

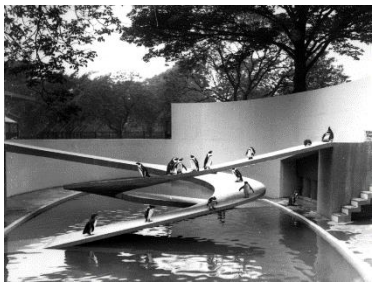


This portrait of Ove Arup has never been on public display before. It was made by the architect Le Corbusier and includes a handwritten dedication – a testament to the pair's friendship. Here, Ove is portrayed with his signature wispy hair and hands clasped in a bridge-like formation. Le Corbusier's 1923 book, *Towards a New Architecture,* which celebrated the importance of the engineer, had a profound influence on Ove. The portrait, which hung on Ove's office wall until his death in 1988, sparked a new line of research for V&A curators. They uncovered many never-before-seen documents that proved that rather than being just part of the same Modernist circle, Ove and Le Corbusier were in direct contact; that there was an intellectual exchange between them about their work and that they shared a similar philosophy of thinking.

Doodle by Ove Arup, 1950-80

Ove had a spirited personality and stood out as an unconventional engineer. His education in philosophy, mathematics and engineering, combined with a passion for the arts, was highly unusual at the time. He was a charismatic man known for his sense of humour, and his witty persona and artistic nature translated into a compulsion for doodling. Appearing on notebook pages, meeting agenda documents and accompanying his own doggerel (fanciful poems and notes), Ove's playful sketches express his lively imagination. The exhibition marks the first time that his doodles have been on public display.

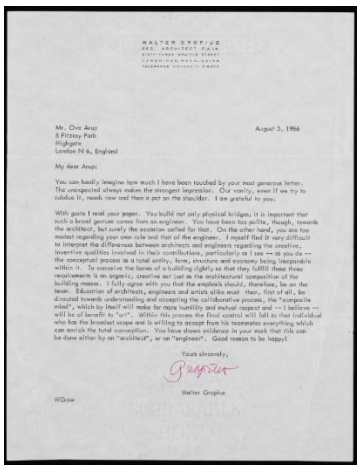
The Penguin Pool at London Zoo, 1934



Frederick William Bond, Zoological Society of London Library © ZSL London Zoo

Ove was interested in experimenting with reinforced concrete as a building material and became the go-to expert on this from the 1930s onwards. He partnered with fellow émigré and Tecton experimental architect, Berthold Lubetkin, on the critically-acclaimed Penguin Pool at London Zoo. Completed in 1934, Ove's contribution to the ambitious scheme included the gravity-defying spiralling ramps based on complex mathematical calculations. The ramp formations were inspired by behaviourist research that mimicked the penguins' natural habitat. The design, admired for its technical virtuosity, established Ove's reputation as a leading consulting engineer on the London scene. The Penguin Pool has been Grade I listed since 1970.

Letter to Ove Arup from Walter Gropius, 1966



WALTER GROPIUS

Mr. Ove Arup
6 Fitzroy Park
Highgate
London N 6, England

August 3, 1966

My dear Arup:

You can hardly imagine how much I have been touched by your most generous letter. The unexpected always makes the strongest impression. Our vanity, even if we try to subdue it, needs now and then a pat on the shoulder. I am grateful to you.

With gusto I read your paper. You build not only physical bridges; it is important that such a broad gesture comes from an engineer. You have been too polite, though, towards the architect, but surely the occasion called for that. On the other hand, you are too modest regarding your own role and that of the engineer. I myself find it very difficult to interpret the differences between architects and engineers regarding the creative, inventive qualities involved in their contributions, particularly as I see -- as you do -- the conceptual process as a total entity, form, structure and economy being inseparable within it. To conceive the bones of a building rightly so that they fulfill these three requirements is an organic, creative act just as the architectural composition of the building masses. I fully agree with you that the emphasis should, therefore, be on the team. Education of architects, engineers and artists alike must then, first of all, be directed towards understanding and accepting the collaborative process, the "composite mind", which by itself will make for more humility and mutual respect and -- I believe -- will be of benefit to "art". Within this process the final control will fall to that individual who has the broadest scope and is willing to accept from his teammates everything which can enrich the total conception. You have shown evidence in your work that this can be done either by an "architect", or an "engineer". Good reason to be happy!

Yours sincerely,

Gropius

Walter Gropius

WGaw

Private Collection

Ove's ideas about design practice were informed by dialogues with contemporary leaders in the field of Modern architecture, including Le Corbusier, Berthold Lubetkin and Walter Gropius, founder of the Bauhaus school. Gropius shared Ove's concern for the need of greater unity between engineers and architects, as demonstrated by this letter. This issue would become central to Ove's understanding of what he would call 'Total Design'. For Ove, this meant to 'join all the professions right from the start' of a building project. His philosophy redefined the way architects, designers and engineers work together. This letter, from Ove's personal archive, is on display for the first time.

Ship docked at Mulberry harbour, 1944

© Imperial War Museum

In his early career, Ove gained experience in maritime structure design. This experience led to a major UK government commission during the Second World War. Working in secret, Ove was one of over 500 contractors involved in the design and making of the floating Mulberry Harbours used on D Day, and its aftermath, for the rapid deployment of troops and supplies. Ove's contribution was an ingenious design for one small but crucial element – a shock-absorbing fender that allowed ships to dock safely.

Pegasus Mark 1 computer, Ferranti Ltd, 1957

© Museum of Science and Industry

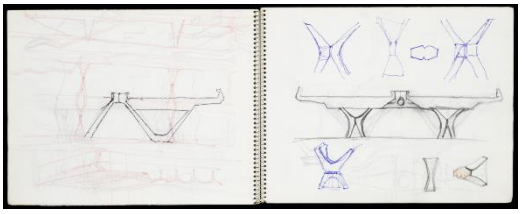
The Pegasus was the first computer used for calculations on the Sydney Opera House project – it also marked the first time computer-generated calculations had been used on a building project. The Pegasus was used by Arup engineers to help find a solution for the then unbuildable roof structure designed by architect Jørn Utzon. The computer was hired by the hour and not used on the premises. Arup engineers, with the help of specialist programmers, wrote their own software. Estimates of computer hours up to 1962 reveal that if done manually, the calculation work would have taken a further ten years to complete. The exhibition marks the first time the computer is reuinted with the original calculations for the scheme.

Demonstration model of Sydney Opera House roof geometry, 1961

Jørn Utzon, model made by Paul Gulberg © RIBA Archives and Drawings Collections

This model shows the breakthrough that the architect-engineering team made on the Sydney Opera House scheme in autumn 1961. The discovery of the 'spherical solution' was a turning point for devising the final, buildable version of the roof's design. In this scheme, the roof was based on the geometry of a single sphere. Each triangle that formed the outer surface of the roof was a portion of that sphere. The ingenuous engineering solution, demonstrated by this model, gave the roof the desired shape, and crucially, a geometric regularity that allowed parts to be prefabricated as repeating components.

Ove Arup's sketch studies for the Kingsgate Footbridge, about 1961



Private Collection

In 1961, 66-year old Ove took on the design of a small UK project – a new footbridge over the river Wear in Durham. Ove oversaw the project from concept to final construction, during a time when the Sydney Opera House scheme was in full-swing. The bridge exemplifies the essence of Ove's Total Design ideals. The elegant simplicity of its symmetrical design united aesthetic and construction concerns within one ingenious, cost-efficient scheme, fabricated on-site in two halves that were swung together in 40 minutes. On display in the exhibition are Ove's early sketches for the bridge that reveal that a symmetrical design was an idea from the outset.

Centre Pompidou, Paris – the gerberette solution

© Ian Dagnall Alamy Stock

A team of Arup engineers worked together with architects Renzo Piano and Richard Rogers from the start to realise an experimental vision for the Centre Pompidou in Paris, which was opened in 1977. Its central feature of vast interior spaces required an unconventional solution. The engineering team led the design process that put the structural frame and the pipework of the building's services on its exterior. This was achieved through what became known as the gerberette solution. These exposed elements would become the building's defining feature.

SolarLeaf© Algae Façade prototype panels (scale 1:1), 2016

The exhibition includes a series of full-scale SolarLeaf© Algae Façade prototype panels, as an example of how Arup continues to innovate the field of building design today. SolarLeaf© is a new experimental bio-reactive building façade system developed by Arup with Colt International. It uses microalgae to generate renewable energy to heat buildings as an alternative and environmentally-friendly energy source.

The exhibition and V&A Engineering Season is co-curated by Maria Nicanor and Zofia Trafas White from the V&A's Design, Architecture and Digital department.

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For further PRESS information about *Engineering the World: Ove Arup and the Philosophy of Total Design* or the V&A Engineering Season please contact Laura Mitchell in the V&A press office on +44 (0) 20 7942 2503 or email l.mitchell@vam.ac.uk (not for publication).

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