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# A Celebration of the Life and Work of Ove Arup

PETER RICE

*Director, Ove Arup & Partners*

*Delivered to the Society on Wednesday 1 March 1989, with Sir Denys Lasdun, CBE, FRIBA, in the Chair*

THE CHAIRMAN: Ladies and gentlemen, it is a very great personal pleasure for me to be with you on what is, judging by the size of the audience, clearly a very important occasion. Before introducing the speaker to you I want very briefly to say one or two words about Ove, because I knew him and worked with him in the fifties and had many discussions about architecture with him. You may know that he nearly decided to study architecture and not engineering. In the event he became 'engineer extraordinary'. I have very little doubt that history will see him in a long line of succession of great engineers from Brunel to Paxton.

I want to touch on two issues which I know Peter Rice will be elaborating on later. The first concerns the profound contribution he made to his profession. He changed their perception of engineers vis-à-vis architects, and probably vice versa as well. In my view, he could only have done this because he really understood the meaning of architecture which, as Corbusier said, 'is a thing of art, a phenomenon of the emotions lying outside questions of construction, and beyond them' or in Geoffrey Scott's words, 'the art of architecture studies not just structure itself but the effects of structure on the human mind'. He would have been aware of these sayings and he would have experienced just what that meant by his early working relationship with Lubetkin.

The second issue concerns that elegant footbridge in Durham which, in its simplicity, embodies everything that he cared about: how to make, how to assemble, how to express with an economy of means and how to organize execution on site.

He attracted brilliant engineers and they sought him out, in order to be inspired, guided and developed by his genius. I am thinking of the first generation – people like Ronald Jenkins and Peter Dunican – as well as the second generation, Hobbs and Zunz, for example. And then he created his own architectural firm led by Philip Dowson, and a third generation of engineers came under his influence – Emmerson and our speaker this evening, Peter Rice.

Peter Rice studied aeronautical engineering in Belfast. A born mathematician, he could have been a physicist, but switched, for reasons which are obscure to me, from aeronautical engineering to civil engineering. He specialized in non-conventional lightweight structures, cable-supported, air-supported, demountable and shells. He spent an unforgettable five years with Ronald Jenkins as the senior engineer on Utzon's Sydney Opera House. I say unforgettable, because I can think of no other project where the problem of reconciling the measurable demands of structure with those immeasurable demands of architecture would have been so intense.

As a pure engineer, Peter Rice is not obsessed with engineering, but has a feeling for architecture which tends to express itself through structure. He has therefore had fruitful working relationships with Richard Rogers, Norman Foster, Renzo Piano and I. M. Pei. He is a very busy man, but not too busy to teach at the Architectural Association, the Royal College of Art and at Cambridge. Last year he was elected an honorary Fellow of the RIBA.

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When I joined Arups in 1958 Ove Arup was already the Old Man, a vague and venerable figure, who floated above and around a young, aggressive, ambitious organization.

For a young engineer, lost in the vastness of London and cocooned in layers of seniority, the name evoked a sense of myth. I saw him occasionally, at the Christmas party, at the summer outing, a tall patrician figure,



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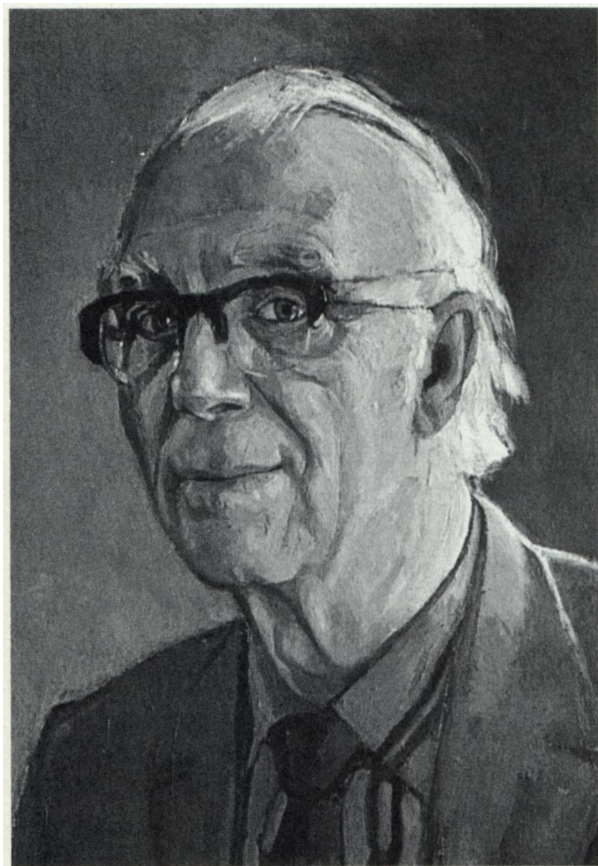

*Ove Arup: a portrait by Benedict Rubbra.*

detached and kindly, watching benignly as the young ones enjoyed themselves. You could feel a sense of fun, an impishness that belied his position. It was the time of Hemingway's *The Old Man and the Sea*, a book which had impressed on me the remoteness and detachment of age, the distillation of wisdom and purpose which old people embody. It all seemed to fit.

I had joined Ove Arup & Partners because I had heard that it was a place where an oddball could fit. Engineering then was a very serious profession. Perhaps it still is. Engineers were expected to know what they were about, to have a natural feel for their profession. I was an engineer by accident, tentatively feeling my way to a career, without any natural instinct for engineering. The atmosphere of Arups helped me to survive. Where then did this atmosphere come from? Clearly the Old Man was the fountain, but how? Why? One of the real pleasures of giving this talk has been the opportunity to find out, to discover the real Ove Arup, beneath the myth that he had become in my mind.

Ove Arup's honours came late in life. He was 76 when he was knighted and 91 when he became a Royal Academician, the honour which gave him most pleasure. Earlier he had first become Chevalier in 1965, then Commander (First Class) in 1975 of the Order of the Dannebrog. This honour was a rare tribute, because it was seldom given to a foreigner. He had taken British nationality before the War, once he realized he was going to make his life here. He was given the Gold Medal of the RIBA in 1966 and the Institution of Structural Engineers' Gold Medal in 1973, a double which has been achieved by only one other man, Pier Luigi Nervi. He also received five honorary degrees from universities including Durham, Heriot-Watt and City. All these honours and the many special invitations he received to talk to learned societies are a testimony to the quality of his work and the high regard in which it was held by his peers and in the public mind.

His university career began in Copenhagen in 1913, when he studied philosophy. He had previously attended Soro Academy, often called the Danish Eton, and before that had been to a preparatory school in Hamburg. In fact he had been born in 1895 in England – in Newcastle, which has always had a sizeable Danish colony resulting from the dairy trade between Denmark and Britain. His father was a veterinary commissioner to the Danish Government, and before Ove Arup was a year old, the family moved to Hamburg.

Ove Arup's study of philosophy did not satisfy him and in 1916 he transferred to the Polytechnisk Laereanstalt, Denmark's Technical College, and in 1922 graduated as a civil engineer and became a Member of the Danish Society of Engineers.

His first job was as a designer in the Hamburg office of the Danish firm of Christiani and Nielsen, who were designers and contractors. Joining Christiani and Nielsen at this time was the objective of every young graduating Danish civil engineer. It was a time when Danish engineering led the world, particularly in concrete construction, and Christiani and Nielsen was its brightest star. To have joined them straight from university shows that he had the highest engineering credentials, together with a good degree.

Christiani and Nielsen built mostly harbour structures, such as jetties, piers and bridges, and had made a



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speciality of the then new material, reinforced concrete. Ove Arup often recalled later how important it had been for him that he had started work in a contractor's office. He had been transferred from the theoretical world of the university to the practical, real world of construction. He saw that concrete was made by a couple of buckets of sand and cement, by people on site who mostly did not understand. From those early years on, he knew that to design you had to know how to build. For Ove Arup the two went hand in hand.

His actual work was designing and estimating, which he did in Hamburg for a couple of years before being moved to the firm's office in London in 1924. In London he was promoted to Chief Designer, but we read in his own reminiscences in the 1968 Maitland Lecture how frustrated he became because he was not able to put into practice his many ideas for using reinforced concrete. He was also frustrated because, as a contractor, he was not able to get his clients to try new methods.

It is important to realize that at this time Ove Arup was a *Continental* engineer. He did not feel the classic Anglo-Saxon separation between thinking and doing. He was interested in everything. He read widely – in German, as well as in English and in Danish. Art, music, philosophy and architecture: all interested him, and he was aware of the changes in art and architecture then taking place in Germany and France. It was natural for him to be reading about art one minute and solving some construction problem in a jetty the next.

In the early thirties Ove Arup met architects of the Modern Movement, among whom were Bertholdt Lubetkin and the partners of Tecton, who were planning an eight-storey block of flats in Highgate called Highpoint. The project was in reinforced concrete, and Ove Arup had many ideas about how it could be built. Christiani and Nielsen were not interested in the project. They were, after all, civil engineering contractors, so in 1934 he moved to Kiers, a firm of civil engineering contractors willing to work in the construction of buildings. He accepted an offer of a job as Chief Design Engineer and a directorship, in return for an undertaking that they would endeavour to take on jobs with modern architects. Olaf Kier was also Danish and he and Arup had been friends. At this time there was still a big distinction between civil engineering and building contractors. Civil engineering contractors engaged only in large-scale construction which required considerable engineering skill, whereas building contractors were craft-based and often did not employ engineers at all. This distinction, which has now largely disappeared, meant that the switch which Ove Arup and Kiers made was quite unusual.

Arup and Lubetkin had already worked together on the gorilla house at London Zoo, and now at Kiers he helped Tecton and Lubetkin create the intertwining spirals for the penguins at the Zoo in reinforced concrete. The penguin pool structure, small and simple though it was, was a great success. It helped to show the public what was possible, what an exciting material reinforced concrete could be.

Highpoint pioneered reinforced concrete wall and slab construction in Britain and this, together with the first prize in the 'Working Men's Flats' competition for the Cement Marketing Company, brought Arup to the notice of other engineers and architects. The 'Working Men's Flats' project was never built, but it was of great significance. Most of the well-known engineers of the day had entered, and it established the method of construction using concrete crosswalls as viable and correct.

It seems that Ove Arup realized by this point that he still did not have the freedom he sought. In 1938 he and his cousin Arne set up the design and construction firm of Arup & Arup and he also worked on a variety of projects mainly concerned with the war situation. He designed deep air-raid shelters for Finsbury Council, which became quite controversial but were never built, and published several reports and papers on 'Safe Housing in Wartime'. He collaborated on these with Cyril Sjostrom and Ernö Goldfinger.

In addition to his work for Arup & Arup, he worked during the War on the design of the Mulberry Harbour pontoons with Ronald Jenkins, later to be his senior partner in Ove Arup & Partners.

In *Code Name Mulberry* by Guy Hartcup we read:

> Jenkins and Ove Arup (now the celebrated structural designer) designed a fender 2ft long and weighing 2 tons, crank-shaped so that when it was pushed back and upwards the ship's side would not bear on the bracket. Screwed rods were passed through sleeves in the brackets and hooked into the back of each unit, so preventing the sides of the pontoon from being damaged during towage.[1]

In 1946, having realized that to control design you had to be a consulting engineer, he left the firm of Arup



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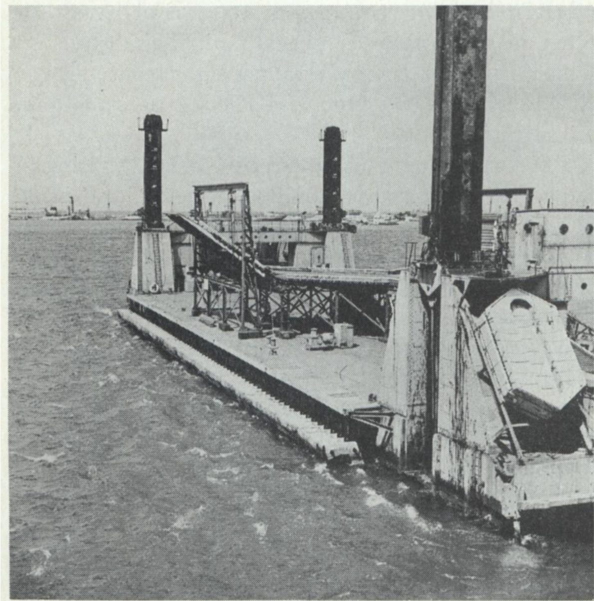

*Construction of floating port at Mulberry Harbour.*

& Arup and a new firm, Ove N. Arup Consulting Engineer, emerged. In 1948 he took Ronald Jenkins, Geoffrey Wood and Andrew Young (who resigned later) into partnership, and later in 1956 Peter Dunican. The partnership which was to grow and spread throughout the world had been started.

In 1953 Philip Dowson, an architect, joined Ove Arup. He did so because he believed in Ove Arup's desire to integrate architectural and engineering design. The collaboration led in 1963 to Arup Associates, a firm of architects and engineers practising integrated design, with Ove Arup, Philip Dowson, Ronald Hobbs and Derek Sugden as partners. This practice was the tangible culmination of Ove Arup's philosophy.

Ove Arup and Partners, consulting engineers, and Arup Associates, architects and engineers, have become two of the most influential practices in the construction industry in this country and abroad. Their importance does not stop there however. In spite of their size, one could say that the most important contribution of Ove Arup and Partners has been to change the way we think of engineering in architecture. However, the story of Ove Arup and Partners and Arup Associates is a separate story from the story of Ove Arup's own life, and cannot be pursued here.

Ove Arup the man, Ove Arup the engineer and designer, Ove Arup the philosopher and lecturer: who were they? What was his central force? To understand Ove Arup and the influence he had, one must find out about the man. He was a man of great charm and total honesty, as all who met him will testify. The charm and honesty meant that he was easy to believe. He had the capacity to articulate simple, honest statements, without pomposity, and thereby he disarmed those who were critical. He was a perfectionist, but a somewhat disorganized and haphazard one. He was curious; anything and everything could interest him, so that he would always respond positively to any idea or proposal, and then see the other side.

But the most striking thing about him was his humanity. He wanted always to see the context of any proposal and to check its effect on the people concerned. In engineering he wanted to know how a structure was built, in architecture he wanted to know how the people would respond, how it would affect them. It was this humanity, this concern for the effect of our actions which made him so influential on those he knew. He was difficult, exasperating, even-handed to the point of indecision. 'On the other hand' was probably his favourite phrase. He was also tough. When action was really needed he could take it. Usually this action was taken in the name of honesty. And he was as honest and tough on himself as he was with others.

At a personal level he was kind and courteous. He loved music: Bach was his favourite composer. He composed himself, improvising constantly on the piano to help him relax. He would not let these improvisations be recorded. That, he felt, would be too serious. He liked to cook, particularly when he was younger. Indeed, he had a kitchen built alongside his office when new premises were built for Ove Arup and Partners in Fitzroy Street in 1959. When he cooked, the perfectionist in him would come out. John Martin, an Arup Partner who worked with him on the Durham footbridge, tells the story of helping him prepare an omelette with chives. He asked John to cut the chives into short lengths. When he had finished he was told they were too long. They had to be done again.

He enjoyed clothes. He was more than six feet tall, handsome, and could wear anything well. His casual nonchalance was carefully constructed and he was addicted to his French berets. Every five or six years he would go to France to get a new beret. I remember well the problems he created when he visited Beaubourg,



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looking for the right type of Breton beret. I think that was really why he went.

Ove Arup enjoyed playing chess. He played well, but as a gifted amateur, not reading about it, not following standard moves. He would analyse the game as it went along, without allowing his opponent to make silly moves. It was the game, not winning, that counted. In later life he designed a chess set, and with it a new system of notation. It was stimulated by the publicity in 1972 for the Fischer-Spassky World Championship. He remembered camping in a forest with his brother when he was young. They wanted to play chess but had no chess set, so they invented the pieces, based on how they moved. The memory convinced him that he should do it again. He was old by then, about 77, and he did not like being dependent on others. Designing and making the chess set was something he could do without help. The resulting set was ingenious and very clear, but too unconventional to be accepted in such a conservative world.

This unconventional and rebellious spirit remained with Ove Arup all his life. Even when tamed by success, he retained an independence of mind and a certain scepticism towards the many honours he received.

Irrespective of any other qualities Ove Arup may have had, his reputation was founded on his engineering ability. The first evidence of this ability was his design project at the University of Copenhagen. This was a 3-span, continuous-beam bridge, in steel, detailed and formed to resemble a series of arches. The devising of this project was meticulous and logical: a model engineering thesis.

As we have seen in the chronology of his career, he started working in a conventional civil engineering company. Christiani & Nielsen, when he first joined them in Germany, and later in Britain, were building harbours, jetties and bridges. The problems were exclusively engineering ones: aesthetic considerations did not apply. These engineering problems were complex: the designer had to design a structure to resist the forces, and to understand how that structure performed in the various tidal and ground conditions which might arise. Ove Arup took nothing for granted. From the beginning he sought to understand and to re-examine the nature of the loading which jetties must carry, and to find the most appropriate structural form to resist them.

In a detailed monograph published in 1935 he outlined the results of this research. He proposed the use of full-depth bracing and raking piles as more efficient and a more correct engineering response than the conventional solutions than in vogue. The monograph examines these conventional solutions of the stiff deck on vertical piles, and compares the failure modes of the different structural forms. This document is interesting, because it is not a complex analytical treatise, but a series of pragmatic arguments justifying a clear engineering choice made, I suspect, instinctively. It is the work of a true engineer, not that of an intellectual playing with engineering. He was working in an environment dominated by the classic engineering values: practicality, simplicity, adequacy and cost. His proposals are interesting from another point of view. Every proposed solution is related to, maybe even derived from, the construction method. And the construction method that most interested him was building in reinforced concrete. The advantages in durability and flexibility of form were properties that could be exploited to improve on the structures then being built.

The psychological importance of this early work was that it was real engineering. It was the kind of engineering other engineers respect. Engineering mixed with architecture is not really the same. To design straightforward primitive structures with large forces in hostile conditions is the essence of engineering. It is what an engineering education prepares you for. And the structures he designed at that time are clear, well-thought out examples of the genre. They are not fussy or over-detailed. This work gave Ove Arup a platform from which he could confidently embark on the more delicate problems of designing structure in architecture.

Ove Arup believed in the simple engineering virtues, but they were not enough. He was aware from his reading and observations of the Modern Movement in art and architecture and that this was based on exploiting the true engineering properties of modern materials, and he longed to participate. He sought out the few architects interested in the Modern Movement and helped them as much as he could. When this conflicted with his work at Christiani & Nielsen he left. As stated above, he joined J. L. Kier as Chief Design Engineer and Director, a role which enabled him to explore the possibilities of working directly with architects. Working as an engineer with architects became the core of Ove Arup's life.





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*Canvey Island Café.*

That this move was part of an inevitable progression is evident from a number of early articles and his recollections of later years. While working with Christiani & Nielsen in the early 1930s he designed the café at the seafront on Canvey Island, a simple concrete structure clearly influenced by modern thinking. He did not consider this a particularly satisfactory project, but it shows where his thoughts were heading.

The structure of the Highpoint Flats was in some ways the clearest example of a marriage of architecture, engineering and construction that Arup achieved. The concept is simple. Walls are load-bearing, and when openings are required underneath to facilitate the architectural planning they act as beams. There are no columns or beams as such, just walls and slabs. The architecture demanded some engineering compromise, but the concept works, and works well. The construction method was developed from silo construction, with sliding shutters for the vertical walls.

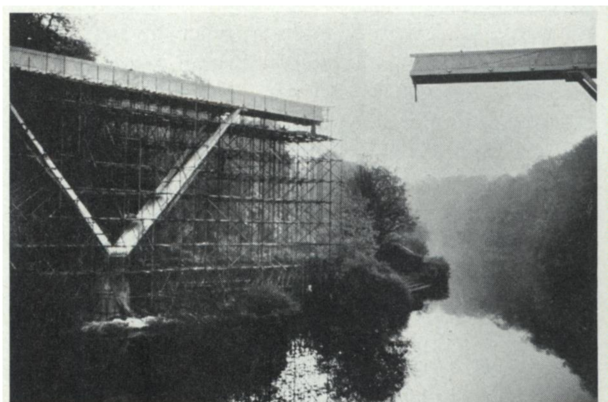
When he became a consulting engineer in 1946, the idea that an engineer should devote himself to working with architects was at least odd, if not faintly ridiculous. It was considered a marginal activity, one which you did in your spare time. It set Arup apart from the real engineers, a foreigner on two counts. It was an enormous affirmation of his beliefs.

As the firm he had started grew and prospered, Ove Arup's role as the engineering leader changed. He became a figurehead, defining the standards. Certain projects and architects attracted him. Two projects in which he had a deep personal involvement exemplify his contribution, his way of working. One was the footbridge over the River Wear in Durham; the other was the Sydney Opera House.

The Kingsgate footbridge, Durham was the engineering jewel of his later life. He received the commission in 1961 and worked on it for about a year before going to tender. The proposal was to build a link between the University and Dunelm House across the River Wear. The commission was a direct one to Ove himself, and the client, who had a small budget, gave him as much time as he needed to develop the right design. From the beginning Ove asked himself: how would he build it? That became the motor of his ideas. He produced a whole series of ideas, which he finally reduced to six. (The originals of these have unfortunately been lost.) These six ideas were then developed to assess their value as architectural solutions for the space. Finally, the solution with two swinging panels was chosen. The development of this solution into a proposal fit to built took eight months. In reality he never stopped designing right up to the time the concrete was poured. The design could always be improved. He behaved like the most fastidious architect.

The concept has two panels, each constructed parallel to the river bank and then swung into position. This simple construction idea is allowed to dictate the architectural detailing and to become the finished form of the bridge. The precise form of each leg, the nature of the hand-rail, the relationship of the bridge to the embankments, were painstakingly researched and improved. The whole endeavour was treated with enormous attention to detail, a perfectionist seeking perfection, but within the framework of an engineering concept drawn from the most basic principles.

This mixture is clearly reflected in the central point,



*The Kingsgate footbridge, Durham, under construction.*



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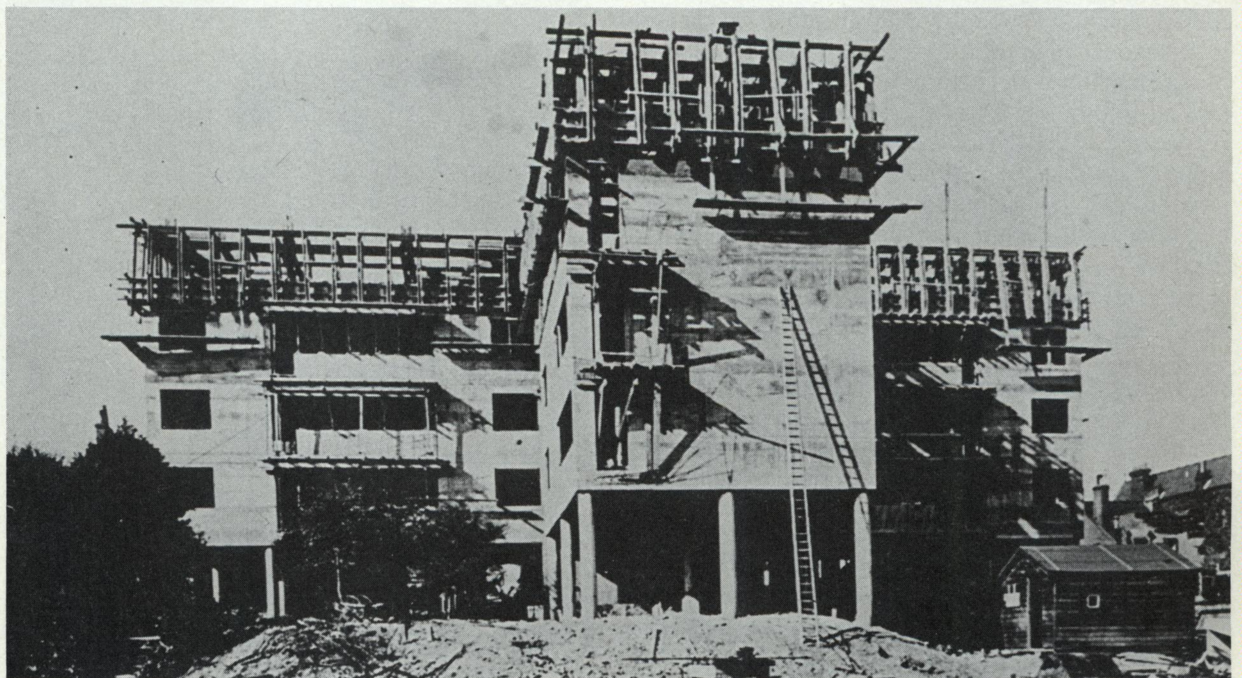

*Highpoint Flats, showing (below) the sliding shutters.*



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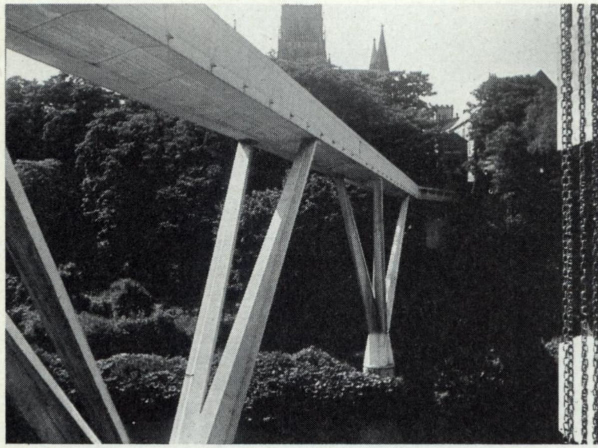
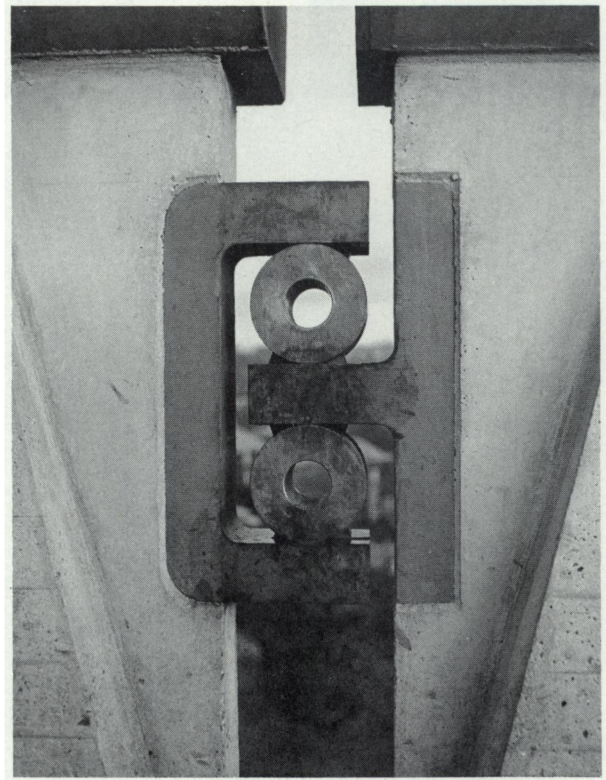


*The Kingsgate footbridge, Durham, after completion.*

a symbolic and graphic link which expresses the separate nature of the two parts, their necessary jointing. It is visible to everyone using or seeing the bridge, a permanent reminder that the form is a product of the process of construction. This intellectual rigour is, I believe, the epitome of the work of Ove Arup the engineer. He has not just solved the engineering problem; he has insisted that the logic of the construction solution should constitute a challenge to everyone who uses the bridge. This quality of mixing intellect with engineering pragmatism is a very rare quality in engineers, and has led many to doubt whether he was really a natural engineer. Engineers are supposed to have an instinctive feeling for the right solution, and good engineers know naturally what the best and most correct solution is. Ove's intellectual curiosity would not allow him this luxury. He had to explore. He had to know he was right, because he had already tested most of the alternatives.

I would now like to look at the role Ove Arup played in the development of the roof of the Sydney Opera House. His association with this project was the synthesis of all he believed in. How he was awarded the project is not quite clear. Suffice it to say that for him it was natural and inevitable that he should be the engineer; after all, Jørn Utzon, the winning architect, was Danish. The translation of the ephemeral, evocative competition sketches into the building was slow and complex. It took place in three parts: the design of the base or podium structure, the roof structure, and the inside of the building, including the glass walls. Construction started very quickly after the competition announcement, and the design of the podium overlapped with the construction. Three and a half years were allowed for this work, before construction of the roof began on site. The early development of the roof design had been done by his partner Ronald Jenkins, who saw the structures as shells, structures getting their strength from their curvature, which could be constructed as a single structural skin. The early shell forms did not have enough curvature to work properly as shell structures. Furthermore, the geometry of the shells was non-uniform, and it would have been extremely difficult to construct them accurately.

The single skin series of solutions was replaced with a set of double skin solutions, i.e. two continuous structural skins joined by structural ribs. Structurally these worked, but they had a number of serious disadvantages. The geometry was still non-repetitive, so every element was different, which was an enormous



*The link in the Kingsgate footbridge, Durham.*



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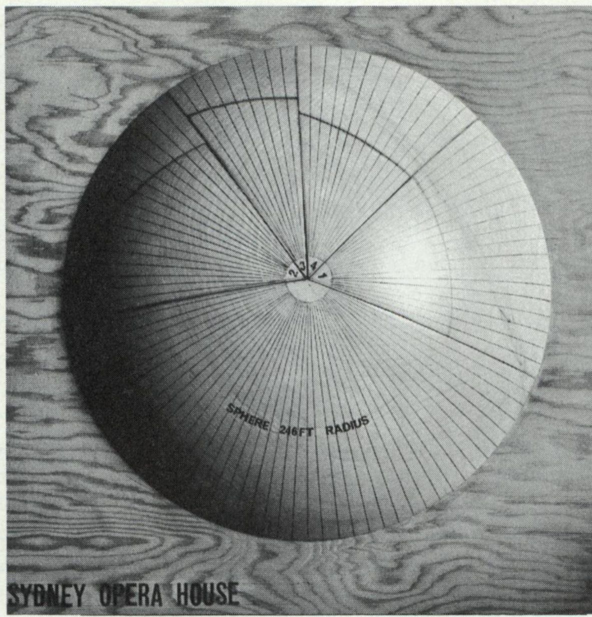


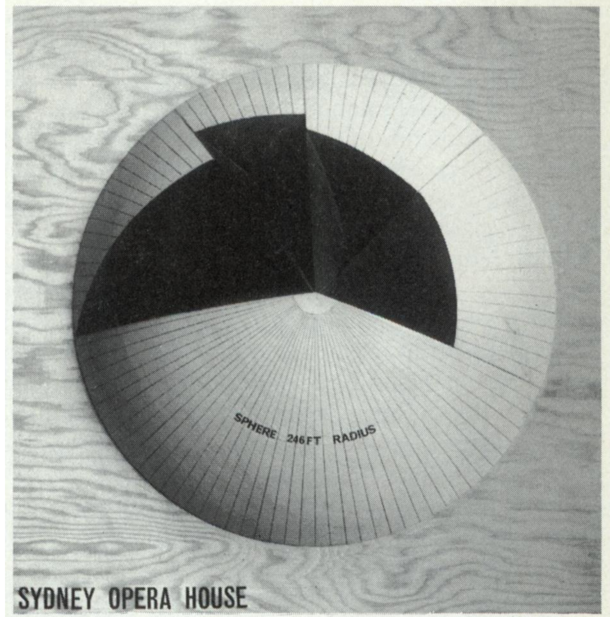


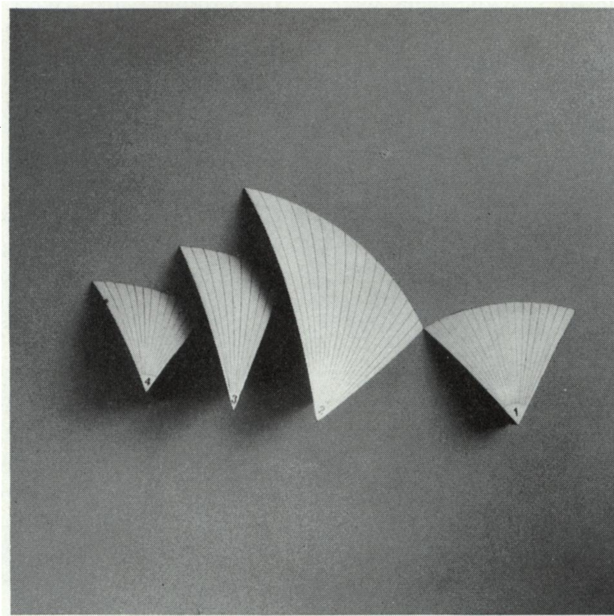

*The Sydney Opera House: the spherical solution.*



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problem of construction. It was also difficult to see how the external tiles could be arranged on the surface. All this development work had taken three years, and the need for a simpler solution was critical. It was planned to start construction of the shells at the end of 1961, and already it was spring of that year. To provide an independent assessment of the problem and of where an appropriate solution might be found, Jack Zunz, who had just returned to London from overseas, was asked to look at the problem. Suitable geometrics for repetition were identified, in discussion with Utzon. Utzon returned to Denmark. After some time Utzon phoned Arup. He had discovered that the shells could be taken from a single sphere. Utzon and Arup met, and for a period worked together. What emerged was the solution which was built.

The early geometrical solutions had been based on the seductive elegance of Utzon's competition sketches. By comparison, this new geometry was tough, aggressive and simplified. All of the shells were taken from segments of the same sphere, bounded and defined by great circular planes. This meant that the shells were constructed from a series of precast concrete ribs, each identical except for their length. The tiles too were laid on the surface of a sphere, and identical precast elements were used. A complicated and uncertain design had been transformed into a detailed proposal for construction and solution where every element had a simple, logical and necessary existence. There is no doubt that much of the motivation came from Utzon. He was the architect: only he could initiate change. But Arup was the catalyst. The result has all the hallmarks of his obsession with how to build it. It was in its way a clear example of a maturing relationship between an architect and an engineer. The result reflects the preoccupations of each, and provides a proper solution to all of their joint concerns. This proposal was developed into the built solution over the next one and a half years in conjunction with the Australian contractors, Hornibrook. Ove Arup did not participate in a detailed way in this work. He was a presiding presence, overseeing the work and available to guarantee that the central idea was preserved in its development. After 1963 Utzon moved to Sydney, and with him the centre of design. When in 1966 the rupture came between Utzon and his client, the Government of New South Wales, Arup had lost contact with Utzon and was unable to help.

During this time Ove Arup the engineer made way for Ove Arup the thinker, teacher and prophet. He increasingly allowed his time to become dominated by his writing and speaking. He accepted many opportunities to lecture. Between 1947 and 1984, when he was 89, at least 180 talks and articles are recorded. He used these occasions to develop his views on many subjects. In one way, even more than his contribution to engineering, these were his life's work. With his engineering he could lead, inspire, influence and persuade others. His personal magnetism was enormous; you could resist his demands only by avoiding them altogether. And in the end the engineering was done by others. His writing he did himself. He wrote well, with a simple clarity which gave direct access to his mind. As with his engineering design, it was painfully perfected through much rewriting in the pursuit of simplicity and directness.

He treated many subjects philosophically and pragmatically, usually with a simple earthiness which left no doubt of where he stood. Reading his lectures and articles now, one has the impression of a kind, generous and ordinary man, who liked home truths and who could express them without conceit or pomposity. Never, in days of reading, did I find a sentence I did not understand or a word which needed the dictionary. The writing is infused with a concern for people and the planet on which we live. He had a way of writing and speaking which was seductive, gently persuading you to come along, to listen, and gradually, once he had your attention, making a clear unambiguous argument and proposition with which it was impossible to disagree. Each individual article was a coherent statement. Each was in fact a response to a demand by someone else.

You can see that the articles were difficult to write. The quality of effortless simplicity does not come easily. But as you read you want to read more, to hear him talk of other problems. The nice, honest man with so much to say beguiles you. But there is a problem, which highlights the dichotomy and irony of Ove Arup's life. His very success as a writer and lecturer meant that he was always responding to others, never to himself. In a way he never developed a coherent philosophy. About individual subjects he was of course very coherent, very astute – about architecture and architects and engineers, for instance. But somehow you feel there was more, a complete philosophy which might have shed light on a larger part of the human predicament. For a man who wrote so much it is



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strange he never wrote a book, that he never progressed beyond the carefully written reflection on a particular theme.

There are three broad subjects treated in his articles and lectures. The first is engineering. Then there are his thoughts on the relationship and division of responsibility between architects and engineers, and within this the need for engineers to understand aesthetics and for architects to respect engineers. The final subject concerns the nature of architecture and the responsibility of engineers and architects for the environment in the nuclear age. He also wrote a number of addresses to the leaders of his firm, in which he propounded a philosophy to guide the way the firm should develop.

His public lectures and articles show a gradual change of emphasis from concern about the mechanism of design in the built environment, to a profound unease at the responsibility engineers in particular carry for what he saw as the rapidly deteriorating condition of the environment, and the need for engineers to accept that responsibility squarely and act upon it.

In his first writings in 1926 we already find him seeking co-operation between engineers and architects:

> It is only natural that the best treatment of reinforced concrete at this stage is to be seen in the domain where the knowledge of reinforced concrete is most advanced, where the properties of reinforced concrete are of most value, and where the architectural proposition is the simplest possible. This, however, does not imply that a collaboration between architects and engineers is not highly desirable in the case of engineering structures. Most structures would profit immensely by such a collaboration, provided of course that the architect treats the reinforced concrete structure as such and does not try to apply ornaments and decorations taken from quite different domains.[2]

This early passage shows that his later writing was not post-rationalization but the development of themes which were present from the beginning of his professional career. Again in 1926, and in 1927 and 1935, he developed his theories on the use of reinforced concrete, and in particular the need for the use of concrete in building to reflect more clearly the nature of the material.

> Besides the characteristics which can be traced back to steel or stone, reinforced concrete has a special quality which is shared by neither of them, and which is of the greatest importance, especially in the case of many of the engineering structures just mentioned. I am referring to the monolithic character of reinforced concrete. In this material, all the various elements of the structure can be connected in such a way that they form one unit, the joint being as strong as the rest of the structure. This is not possible with stone, nor with timber, and only partly with steel . . . It seems to me that the slab, curved or plain, acting as wall, roof, floor or canopy is the natural expression of reinforced concrete construction, rather than the column and beam. Of course, columns and beams are necessary in many cases, but they only express the structural function of the material, not its capability of being moulded into any desired architectural form, and it is this latter capacity which makes of reinforced concrete such a pliable medium for architectural expression.[3]

In 1958, in a talk entitled 'Structural Honesty' given at the 'AA' School of Architecture, we find him describing the role of the engineer in architecture:

> It happens to be my job to design the structure of buildings under the guidance of various architects. A very interesting job, if one happens to be interested both in structure and in architecture. Now if an engineer is put to design a structure which has to satisfy certain conditions, he knows exactly what to aim for, namely to find the most economical solution to the problem. Not so if he is collaborating with an architect, or receiving instructions from an architect. In that case the right structural solution is only part of a wider problem, the right architectural solution. The two are completely mixed up. Economy is still an aim, but not the only one. The effect on the architecture must also be considered, and here the architect has the last word. This means that there is a kind of dual control exercised in the design of what I might term as 'architectural' structure. The engineer designs, but the architect decides what he is to aim for. The architectural guidance varies from case to case, both in intensity, quality and kind. This is only natural, for architects have different personalities and have different views on architecture. At one end of the scale, some architects know exactly what they want, and they exercise strict control to get it. They may even require the structure to suffer the most unnatural contortions in order to produce



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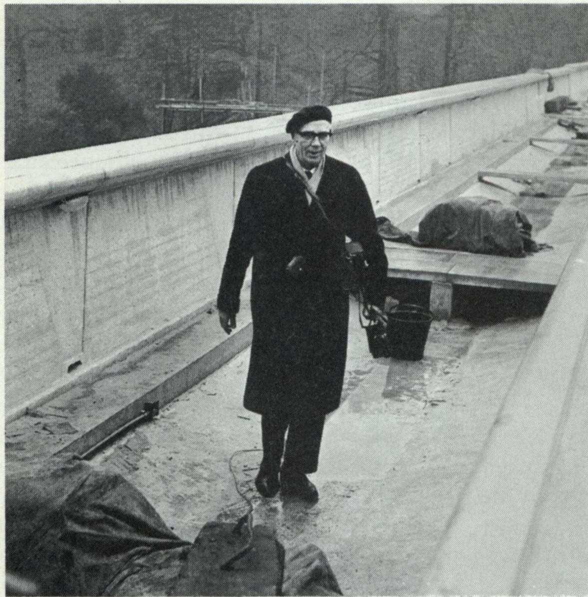

*Ove Arup on the Kingsgate footbridge, Durham.*

> the desired architectural effect. At the other end of the scale, there may be architects who do not think that the structure should be interfered with at all.[4]

This lecture was heard by a very distinguished audience, including our Chairman tonight, who proposed the vote of thanks. Sir Hugh Casson, Felix Samuely and R. T. James also spoke that evening. Can we wonder that Ove Arup was an influential figure?

In the Alfred Bossom lecture entitled 'Architects, Engineers and Builders', delivered at the RSA in March 1970, he expanded on the nature of the building industry and on how, with its almost unlimited power to change and dominate the environment, it needed to be controlled rather than encouraged.

> In the past the environment, the landscape in all its natural and urban forms, just happened. It was never before deliberately created by man, except in small patches. The technological revolution is changing all that. Man's battle with nature has been won. Whether we like it or not, we are now burdened with the administration of the conquered territory. Nature reserves, landscape, townscape: they will all be wantonly destroyed, to the ultimate ruin of man, or they must be deliberately planned to serve his need. Much has been destroyed already and more will be destroyed, but the alarm has sounded. Pollution, population explosion, etc is news. The battle is on, and it is a crucial battle for mankind. Those who long to return to the good old days must be told firmly that that road is now closed.[5]

This lecture embodies Ove Arup's developing philosophy, as succinctly relevant today as when it was written. The lecture has that self-deprecating, ironic wit so typical of Ove Arup the person. Parts of it are pure Ove:

> The Modern Movement . . . discovered that the work of bygone engineers was in fact architecture. It is now accepted that bridges and factories and all that are architecture. So is housing; in fact everything built is architecture. And the same spirit which is supposed to be moving architects is behind town-planning and landscaping as well as interior design and furnishing. Everything made by man for man's use now has to be designed. And in all these spheres dedicated engineers are trying to conjure forth that mystical spiritual quality which is the essence of art.[5]

As he grew older he became more and more concerned with the predicament of man at the end of the twentieth century. Perhaps he realized that the lesson of his early years had been learned, and that of course it had not solved the problem. An even greater challenge lay ahead, the challenge of the environment, a challenge whose magnitude had only just become visible. The definition of this challenge pre-occupied his last years. Where and by whom must it be met? As engineers, are we but innocent followers of others or truly responsible? This was the theme of a statement made to the Fellowship of Engineering in September 1983, when Ove Arup was 88.

> It is my conviction that whilst we have become very clever at doing almost anything we like, we are very backward in choosing the right things to do. This is, of course, taking a global view of the behaviour of mankind and that, I submit, we are simply forced to do in view of the tremendous power for good and evil conferred on us by our sophisticated technology. It has brought us tremendous blessings, and it has also done tremendous damage to our planet and its inhabitants . . . And as mentioned, the decision about how to use it is not generally made by the engineers. But engineers are world citizens as we all are, and as they are largely represented on the



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> design teams preparing the designs which determine *what* is made, they are in a good position to judge the consequences for mankind of proceeding with doing what we are about to do. Would it not be a good thing if they had a say in what we should do, and have they not a duty as citizens of the world to warn us of any dangerous consequences which would result from our actions?

And he ends with a plea. It is remarkable that at 88 all the passion of his youth is still there.

> My only hope is that this well-educated minority will swell to include the less well-educated majority so that even governments can start to think about how to alter course without creating world-wide chaos. It will be extremely difficult. It must be a slow and controlled process and its success depends on whether we can convince a majority of our leaders and their followers that we need to alter course. Doing a 'U-turn' in the mid-stream of traffic is dangerous: we can hardly avoid severe trouble and hardship. We are not helped by fanatic peace-mongers, feeding on simplistic slogans, who think they can achieve universal peace by hate and destruction. Pulling down is easy, building up is difficult. We have to employ slogans which the great mass of people can understand and support, but they should appeal to their good instincts, not their bad ones. This is a source which is not so often tapped by our politicians, but I believe its power could be overwhelming if our leaders had the courage to build on it. Ideals must be tempered by realism but should not be poisoned by cynicism or hate. In the end all depends on our own integrity.[6]

Ove Arup did not rest on his laurels. He did not stop and survey the kingdom he created. He worried on our behalf. He was true to himself to the end, a remarkable achievement for such a long and varied life.

Ove Arup – what a magical name – influenced people, and by influencing people he brought about a great change in the way buildings can be designed. Architects and engineers have learned to work together, not everywhere, not always, but sometimes, and that has made possible some very fine buildings. It has also changed things, and the message will go on spreading until it will no longer be possible for architects and engineers not to work together as a team. He was a fine engineer himself, who pioneered the use of reinforced and pre-stressed concrete in this country. Above all he was a man of integrity, and that integrity he made the hallmark of his dealings with everyone throughout his life, not always without pain, but with humanity.

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