

## INFLUENCES ON ARCHITECTURAL FORM

Architecture is form. Yet there are so many forms now all about us: utilitarian and romantic forms, structural and arbitrary forms, sober and frantic forms. What influences them? What are the modern influences on architecture now that geographical, historical, geological, climatic and even many social differences have been levelled out by technology?

Well, the greatest modern influence on architecture is architects. This is an over-simplification of course. The availability or dearth of certain natural materials or of manufactured systems still influence a community's architecture pretty strongly, so that regional styles are still readily distinguishable, as between, for instance, Europe and Australia. Yet even then these influences operate through the architects. Again, we know that about 75 per cent of buildings are now built without architects, and we can guess that one day the profession of architecture will die out completely. Then all buildings will be made from computer-arranged assembly kits. Yet for the moment the generalisation holds,

because even the odious 75 per cent of non-architected buildings are copies consciously or unconsciously from architects' buildings of a few years back. Despite rumours of their death as a profession, architects are influencing form today even more than ever they did in the past.



Now, as we all know, there are many architects with many different backgrounds, talents and temperaments. The profession can absorb them all. It devours talents. What makes good architecture so difficult, so fascinating, and so rare, is that - unlike good engineering or good, say, poetry - it combines many problems in one. It is no hybrid art, yet even in its purest expression it has many faces. I'm not referring to legal or economic or other professional problems, though it incorporates enough of these. Even apart from them, even if you pick out of the complexity of architectural practice the single question of design, like a periwinkle out of its shell, still you have not isolated a single problem. This soft heart of architecture - design in the pure state, on the drawing board and in the creator's mind as it pours out of his 4B pencil - is still an amalgam. It involves taste - and her pretty young sister, fashion. It includes technique - and his seductive brother, 'detail', which has led whole nations of architects off the straight and narrow for generations at a time. But in the long run architecture is, as I've said, nothing if not form. Taste, fashion, technique and detail all contribute to the creation of form, but created form itself is the only artistic difference between architecture and cave-dwelling. And architectural form is a special sort of form, differing from the sculptor's and the engineer's in that it involves occupiable space, and differing again from the sculptor's but not from the engineer's because it involves function. It has in common with engineering form though not necessarily with

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sculptural form that its instrument is structure. And since it is created form it comes from a mind, an architect's mind. Function becomes form by being squeezed through the sieve of an architect's mind, and during this process it is shaped by many influences, including the architect's background (which sets down his style), his temperament (Does he want to remake the world with every building?), his creativity (or ability to focus on some formal order), his compassion (by which I mean his ability to sense human needs beyond the immediate functional requirements), and his structural vocabulary (or mastery of his medium: building). The first three - background, temperament and creativity - work involuntarily on the architect and are always present. The last two - his compassion and his vocabulary - are more or less voluntary and variable and can be cultivated.

Now let's imagine a typical case of an Australian architect, a conscientious and keen young man, facing a new client's problem: working on a clean slate.

First consider the background, the prevailing climates in which he has been brought up, and the one in which he now works. Isolated as we are from personal contacts with architects abroad, architects in Australia are chained nevertheless by historic and economic and social ties to the developing ideas of international architecture; so it is necessary to divert for a moment to look at this situation.



So much for the background at the moment when a client enters the office.

Now the temperament operates. In the first moment when the client sits down opposite him and introduces the subject of a new clubhouse (or whatever it is) for an instant the average architect has a vision of glorious spaces and inspiring masses - even if inevitably in brickwork - with his own name in effect up on top in lights. But then the client brings out an envelope on which his committee has sketched out the plan of the building they want ...or maybe it is later when the architect starts to examine the problem, the requirements, the budget, starts to understand the function ... At some stage, in most cases, the obstacles in the way of the inspiring shape begin to look too formidable. The architect's creativity deserts him. He manages a presentably functional plan while drawing on his experience of what is economically tenable in structure. Thus the vision deflates and finishes up nine times out of ten as two or three stories of brickwork with a steel deck roof. Disgusted with this collapse of the grand intentions, the smaller minded of us architects try to recapture a fraction of the dream by doing something clever with tiles or a flowerbox around the entrance: that is, temperament rears its head again, for the last time.



Yet it is not always like that. Some architects have more fire in their hearts. The great intentions sometimes keep alive despite the client, and the third influence - the degree of creativity in the architect's make up - has its opportunity to come into play.

Now then, let's assume that we have an architect with a certain familiar background, and with spirit, or productive temperament and with creative potential, and with a problem. In short we have an architect artistically primed and ready to create. Now for the introduction of function and structure - the last two of the five influences I have mentioned. Does his understanding of the function bow before his muse? Is his structural vocabulary adequate for the tasks suggested by his imagination? On what does he start to build his concept?

The object of architecture has not changed in more than two thousand years. The object of the design process, in which architectural form is created, is to find an order, a pattern of inevitability, for the building in hand. (Or it may be a series of buildings; the same rule applies if we are talking of a precious one-off design or a repetitive industrial system.) Once found, this order will embody simultaneously the timeless virtues of architecture.



There is not much doubt about what these are. The most rebellious member of the avant-garde today must agree, when he is being serious, with Vitruvius's statement, made in the Augustan age of Rome, that the three essentials of architecture are strength, utility and beauty. Again, we must today find it even harder to dispute Sir Henry Wotton's famous paraphrase of the Vitruvian triangle, made in 1624. Sir Henry renamed the essential qualities as "commodity, firmness and delight".

So the design process was, is, and ever will be a search for an order which will qualify on all three counts. Yet while it is possible for the three qualities to be equally balanced in a finished product - they are in all the world's greatest buildings - still it is hardly humanly possible, that all three are equally virile stimuli on the architect's mind. Because of differences of background and temperament one architect will respond first to a functional idea and another will respond first to a structural one, and another first to an aesthetic one. For instance, in facing the problem of an art museum in New York, Frank Lloyd Wright began with a functional, humane idea: walking downhill. A fraction of a second later no doubt, he integrated this with the structural idea of a reinforced concrete spring. Thus he came out with an original, not to say sensational, form. On the other hand at about the same time numerous architects, including Candela,



Catelano, Tange, were adopting the warped plane in shell or tensile structure as the main sheltering element for all sorts of functions - religious, domestic, sport (all could be made to fit) - because it attracted them first as an exciting new structural idea. Later, by adding a functional justification they transformed this engineering novelty into architecture, but there can be no question of the priority of structure over function in, say, a Candela church.

Few forms, however appropriate they may be, and appear to be, are created entirely new to the earth in the medium of architecture. Something in the continuously changing background of modern life provides the stimulus for the vision which leads the architect's designing hand. For instance once Mondrian and the cubist painters lent their shapes to architectural visions. There has been a good deal of cross fertilisation with sculpture. The Henry Moore style has never been translated intact into a building, but the penetration of open space through architectural solids is, of course, a congenital theme of the modern movement which has interacted with spatial themes in sculpture. The chunky rugged, top-heavy look that I have mentioned - the style of the modern movement in the mid-1960's - is reflected, and again encouraged to further exploration in the work of sculptors like Norma Redpath. Some architects are so attracted by the excitements of form when

it is uncontaminated by functional requirements that they desert architecture and embrace sculpture; for instance: Piotr Kowalski of Paris and later of New York, who left the practice of architecture to make shapes for architectural adjuncts by sticking explosive charges to sheets of stainless steel or by stuffing unlikely things behind elastic formwork to shape concrete like a boarding-house mattress. This sort of new freedom will be reflected sure enough in architecture now coming forward. Then again, some other architects desert architecture to make their shapes more exciting, but don't admit it. For instance, the great Le Corbusier at Ronchamp: he made a chapel on a hilltop which came close to being entirely original and pure form full of emotional overtones and expressed for the first time in the medium of architecture. It was original, pure enough, emotional and expressive, but it was hardly architecture, at any rate it was not architecture in the 20th century and progressive sense. The functional demands of the chapel were slight enough in the first place and what Le Corbusier did with his concrete was little short of outrage, although in the end he made the gross overdesign its own justification. The Ronchamp chapel was an outstanding success as a piece of gargantuan sculpture, yet it has hardly any more reference to the realities of everyday architecture than Miss Redpath's sculpture.

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Thus we arrive at the central question of the architectural art, the question that has disturbed architects all this century usually without their knowing or naming it. It is this: in order to achieve the perfect harmony of architecture, which of the three key elements should call the time: commodity, firmness or delight? Or, in modern terms: function, structure, or emotion? The answer of course is that they should all be of equal weight in a perfect balance. While this is irrefutable, we must remember that architects are human and it is not humanly possible for an architect to conceive of a building simultaneously in the three terms. The best he can do is to keep his mind alert to the three impulses and never let one run too far ahead of the others. As soon as one races ahead to a solution he must press the other two into keeping up, and if they cannot keep up he must swallow disappointment and drag the unruly one back.

I have referred to three classic modern examples: the Guggenheim, a Candela church, and Ronchamp. Each of these in the end result has a reasonable balance of the three key elements, but one - Frank Lloyd Wright's - was led by a functional order, one - Candela's - by a structural order, one - Le Corbusier's - by an emotional order. Now we must ask: which is the best architecture?

I have no hesitation in answering: ~~is~~ the Guggenheim Gallery. Despite Wright's disdain for the paintings being housed, which

led to the practical disadvantages of this gallery, it comes closer than either of the others to a convincing balance of the three qualities. It will continue to convince as a real building, I suggest, in a hundred years or when one of the others may tend to look like an interesting engineering novelty of its time and the other like a piece of overgrown or overblown sculpture. Here then is a rule:

Architecture is a functional order realised in terms of structure.

This rule does not ensure or imply that every building will have the high excitement of a Guggenheim Gallery. An architect with a low creativity quotient may make a pedestrian plan to suit a routine function and may find for it an appropriate routine structure - like brickwork, or concrete framing with a curtain wall - and still his building will never raise the spirit of a single occupant or viewer. It can be an uninspired and unexciting form. Yet it is far less likely to be bad architecture than if the same architect started with a structural idea and later tried to fit the function into it; and certainly it is infinitely less dangerous than if the same architect tried to be a Le Corbusier for a day: tried to start with an emotional or aesthetic idea and attempted to graft structure on to it and to jam function into it.



When the architect has a high creativity quotient, the rule may be even more salutary. Such an architect can be counted upon to inject excitement at the drop of a hat. His problem is not how to make a building interesting but how to make the interest meaningful, or how to discipline his creativity into channels that run towards permanent values. If such an architect starts solving his problem on the basis of a poetic idea it is almost inevitable that the emotional cup will run over, and make rather a mess on the floor for future generations to mop up. Again, if such an architect starts with a structural idea it will still be charged with emotional content, and function will have to count itself lucky if it can find anywhere to fit in.

So it seems clear to me that for any architect, undercharged or overcharged with creative impulse through he may be, the way to satisfaction can only begin with a functional concept. Yet if that is so, where best can the qualities of structure and emotion enter? If we could agree to follow the above rule, would every building be a brick box, or a glass box, or a concrete box - some dumb and deadly shape depending only on the region's material resources and social economy? Emphatically no; every building would not have to be dull. The structural imagination and the emotional excitement can enter, and they must enter, immediately following and integrally with the functional concept. Now, here is a difficulty in semantics. The word functional when applied

to architecture changes meaning, thanks to the theorists of the late 19th and early 20th centuries. It takes on a visual image, of a concrete box, rather stained with mossy overflows from a leaking flat roof. In the past decade or two, since it has been discredited, it has become virtually a synonym for anti-aesthetic behaviour.

All this is emotial reaction to an emotional action - the first strong action of the Functionalists in declaring a revolution upon styles and ornament and pretence and fake. So there was fault on the side of the revolutionary Functionalists. They were carried away by the blinding flash of light of the truth they had seen: one corner of the lid over the creative mystery had been lifted for them. They were naive. In our puny wisdom we can see that now. But still they were a lot closer to the truth than those who reacted against them and brought back romantic allusions in a shallow search for beauty. We should not be reacting against early Functionalism. We should be trying to rid it of its naivete.

In every problem the architect should be searching for a sense of order that will rule his design. This sense of order should be based on function. It must be based on function or the result will be something other than architecture. To say this does not mean the same as to say 'Form Follows Function'. If form



always followed function all building would be honest, though often dull. If that was the worst that happened we would not have much to worry about. However, we would get architecture only rarely, by coincidence, and it would be Primitive Architecture. Indeed the ancient world and the rural countryside is filled with such functional architecture of the strongest naive charm.

What we must search for today in the sophisticated modern building industry is not a return to naive charm - making a modern rustic style, for instance, from overburnt bricks or deliberately brutish concrete or undressed timber - but a valid super-functionalism. By this I mean that we should search for an order that characterises or averages out the functions of the building. Then we should allow form to follow this order of function. That is the only way to architecture; it always has been and it always will be. Nevertheless there is a major difference between the ancients and ourselves. Architecture passed through an aesthetic barrier about sixty years ago into the realisation that purely visual effects as typified by ornamentation were not only unnecessary to good architecture - they were an affront to it. We can learn from past styles when they exhibit the essential architectural order and when they compose with space, but we cannot expect to carry analogies between the past and present too far, for the world changed once the constructivist and anti-ornament ethics were stated. From

that point on the integrity of the man-made object was recognized and it could never again be permitted to dissemble about its nature or to wear degrading trinkets.

The spirit or the poetry or the art of architecture enters in at the point when the architect, led by his background and his society and all his private personal pressures, selects what he perceives to be the functional order of the building. If you like, he perceives the function in an emotional light. Yet at the same time, even in his mind at this early stage, he must be building - he must be picturing the functional - emotional concept in structural terms. When he was a Roman he saw it in masonry and concrete terms. Today if he is, say, a Mexican, he sees it in reinforced-concrete terms; if a San Franciscan domestic architect in timber terms; if a Melburnian in terms of the Uniform Building Regulations - and so on: everyone limited by his society and the height of his personal aspirations.

The height of a man's aspirations is limited by personality factors and by his knowledge of the capabilities of his society. Many potentially great architects in the past have been limited because the society in which they lived had strictly limited constructional potential, and others no doubt have been limited because they have failed to understand their society's constructional potential. Yet however wide an architect's



experience of available techniques may be, it is not in his competence to assess constructional potential. He can only guess how much further engineers can go on the strength of what he has seen them doing in the past. The man to assess the potential and to push construction out to new territory is the engineer. We can thus see how essential the structural engineer is to the architect - essential artistically, that is - quite apart from the mathematics. At the very moment of conception the engineer's knowledge of what is possible should be available to the architect so that the functional order - the super-functional theme which he extracts from the program - will be as expressive and as appropriate as is possible. Thus not functional nor structural nor emotional considerations will dominate, dragging the other two after it; but all three will be nicely balanced and will move forward together.

The need, then, is clearly defined. It is for sympathetic cooperation between the structural engineer and the architect at the very moment of conception.

One man cannot possibly embrace the competence of both architect and engineer; Wright and Le Corbusier believed they could, but they were the last to do that. Therefore the idea of cooperation at the conceptional level sounds a little like asking a committee to design a building, and it is in human fact impossible. Yet

while the architect must go away to a private cave to fulfill that moment, there can be conversations around the problem before the moment, and consultation immediately after it. At the least such cooperation can avoid difficulties like those encountered by the Sydney Opera House. At the best such cooperation leads to the only really thoroughly progressive building - thus to the only truly creative architecture.



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Consider two everyday man-made objects safely outside the building industry: an ordinary suburban electric light pole and an aeroplane. Both are Functionalist in style. The designer of the former solves each problem on a functional-constructivist basis as it comes to him. The most practical and economical post is a tree trunk. The wires have to be kept apart, so cross bars are added. These have to be held rigid, so diagonal braces are attached. More wires are needed so another bar, a bit shorter, is added. Then another brace, then another droop of wire.

Is it beautiful or ugly? And if we answer ugly does it disprove the Functionalist theory?

These are meaningless questions. It is not ugly in itself; yet it is ugly in an otherwise proud and pretty suburban street where, like dirt, it is matter out of place. The important point here is that the pole, like numerous, buildings that grow out of expediency, is not a conceived thing, not a work of higher intelligence or art. It is an accident. An aeroplane on the contrary is conceived and built as an exercise of the highest technological intelligence. So many functions have to be considered. Stresses on materials, weights, aeronautics, power, not to mention economy, payload, comfort and the other practical things. The designer as he works on begins to gain an all-encompassing comprehension of the problem. He must, or his machine won't get off the ground. He begins indeed in some crude human way to act as Nature does, when she designs anything, organic or inorganic, which is not an accident: with total understanding. He draws from all the known problems a single solution, or theme, or order. He extracts and celebrates the essential or characteristic function of the thing from a deep knowledge of all its complex and conflicting functions.

The architect of any building can aspire to such all-encompassing understanding of the problem before him. He can achieve it only rarely, but in the search he is likely to discover all the interest



in form and space that he needs to make his building a living design, without calling on nostalgia or gilding to escape from the box of naive Functionalism.

The need, then, is clearly defined. It is for the fullest possible understanding of every problem. One essential to this is the most sympathetic cooperation between the structural and mechanical engineers and the architect at the very moment of conception.

One man cannot possibly embrace the competence of architect along with that of structural and mechanical engineers; Wright and Le Corbusier believed they could, but they were the last to do so. Therefore the idea of cooperation at the conceptional level sounds a little like asking a committee to design a building, and it is in human fact impossible. Yet while the architect must go away to a private cave to fulfill that moment, there can be conversations around the problem before the moment, and consultation immediately after it. At the least such cooperation can avoid difficulties like those encountered by the Sydney Opera House. At the best such cooperation leads to the only really thoroughly progressive building - thus to the only truly creative architecture.

The Sydney Opera House was conceived in 1956 at the height of the avant garde's reaction to naive Functionalism. The proud

uselessness of the giant pointed sails was half their attraction to some people. Sigfried Giedion, the man who did most to teach the second generation of modern architects about the principles of Functionalism, was tremendously impressed by the opera house. He wrote a new chapter to his monumental Space, Time & Architecture called: Jorn Utzon and the Third Generation. In it he discussed Utzon and the opera house as exemplars of the new wave of controlled freedom that was sweeping away the unnecessary dogma of revolutionary modernism. He recognized that his own aesthetic delight in the shells or sails raised a question. It was a question of conscience, he put it, that our period must answer again and decide. 'Are we', he asked, 'prepared to go beyond the purely functional and tangible as earlier periods did in order to enhance the force of expression?' And he firmly answered 'Yes'. He recognized that the shells were physically superfluous, Yet 'after half a century of development, contemporary architecture demands, he stated, 'something more than this. The autonomous right of expression must again assert itself in building, over and above the purely utilitarian.'

So Giedion justified and approved Utzon's sails. He warned that the independence of expression from function is only for master hands as yet and not for minor talents, but even with this proviso his statement seemed to take us round full circle back to the beginning of Giedion's great story in the voluptuous Baroque's breakaway from the stiff classical aesthetic.



The sails of the Opera House are the most flagrantly unfunctional elements that came forward in that naughty decade of delinquent architecture: the 1950s. Many other critics were shocked into silence by them. Since they fitted no pigeon holes and obeyed no rules, and were so preposterous and so stunningly attractive, an easy way out was to call them sculpture, not architecture. Thus they, and the critic, were free of practically all discipline and the need to rationalize. Sculpture was how the Opera House was categorised by one of the greatest prophets of flamboyant structure in the twentieth century, Buckminster Fuller. "I'm glad it has been done," he said. "It will give the people great simple pleasure. It will never be done again."

I like this explanation a little more than Giedion's rather desperate attempt to justify the sails. I suggest that Giedion went further than necessary to be with it. I think it is early yet for the modern movement in architecture to renounce the most important of its former ethics. It is too early yet to admit that our practitioners are too ignorant, insensitive or feeble to achieve the inspiring expression we all want to see - and to build sensibly at the same time. I prefer another explanation altogether for the errant oper house.

The sails, which have become so important to the building, are not sensible. Functionalism aside, it is downright silly for anyone to argue that millions of dollars should be spent on erecting such huge aimless vaults just because they look nice. Imagine the feast of real sculpture, the dozens of Henry Moores, not to mention two or three Michelangelos, which Sydney could have bought for the same price. Yet Jorn Utzon is a sensible as well as a sensitive man; so how could he do such a thing? The answer is of course that he was forced by the circumstances into doing it against his grain, - as I see it - the grain of his whole career. Never before did he design anything so irrelevant as this. It is not part of Utzon's pattern. Yet the idea with which he won the competition was entirely Utzon. It was also - and this is the essential point we must never forget when we look at the huge wayward sculpture that eventually appeared on the harbour edge - it was also at heart a functional scheme. The motivating idea, that caught Saarinen's eye, that caught Giedion's imagination, that sent half the architectural world into raptures when first published, was no external aesthetic dream. It was an intellectual, sensible, functional order: a realistic physical solution to the complicated problem set in the competition conditions. As Giedion pointed out, Utzon and others of his generation had long been fascinated with the horizontal plane or platform as a major element of planning, and composition. He wrote an article on the subject in Zodiac in 1959 and referred to the horizontal plane as a means of architectonic expression, calling it a 'fascinating feature'.



'I first fell in love with it in Mexico,' he wrote, 'on a study trip in 1949, where I found many variations both in size and idea of the platform...A great strength radiates from them.' 'They are,' he decided, 'the backbone of architectural compositions.' Giedion made a characteristically valuable search through Utzon's sketch-books and brought out little drawings which gave evidence of a repetitive theme of space: a strong horizontal line with a great mass suspended freely just above it. Thus a sketch of a Japanese house was a floor line with a roof floating over it - a caricature of the reality in which a heavy tiled roof is raised on sticks and paper - thin shojis. Another sketch of the ocean shows a mass cottonwool clouds floating above a limitless horizontal plane of water. And an early scribbled study for the opera house shows vaults of a lazy S shape floating above a wide flat floor. So it was not the shape of the floating mass that was important to the concept of the architect, it was the plane below: the stage, the functional element.

'The idea,' Utzon wrote in that Zodiac article of 1959, some two years after he designed the building, 'the idea has been to let the platform cut through like a knife, and separate primary and secondary function completely. On top of the platform the spectators receive the completed work of art and beneath the platform every preparation for it takes place.' Of course in order to present the completed work of art in a way that would allow a fair number of spectators simultaneously to receive the work of art the platform

could not be flat as in the conceptual sketches. It had to slope up from one end, where two stages stood side by side, up past tiers of seating to the high rear of the gods. The platform was in effect tilted to become a hillside, a hollow hillside under which all the practical and dull but necessary functions could be stuffed: rehearsal rooms and restaurants, lavatories and stores and all the rest of it. The two separate audiences side by side on the hill had to be acoustically isolated from each other, and so the next element of the design was added: lightweight acoustical screens gathered around each audience and its respective stage. The acoustic engineers eventually would dictate the shape that these screens would have to take, multi-facettted forms to fragment reflections. Now at this conceptual stage not even ~~an~~ acoustic engineer freed of all other considerations could say precisely what shapes he would later demand. So it was clearly wise of the architect, and nothing if not realistic, to leave these screens free of the architecture; just as one would not presume at a conceptual stage to determine the precise details of the seating or lighting. Indeed Utzon called the enclosing screens of the auditoriums 'acoustical furniture'.

There were to be numerous gaps in the sides of these screens so that the audience could come and go from the auditorium to the concrete hillside outside almost as freely as if it were indeed at an openair theatre. All the complexity of escapes and tortuous stairways that bugged most of the other competition entries were thus eliminated.



This was the heart and essence of the Utzon concept. Certainly the design at this juncture was not yet weatherproof. The hillside and acoustical screens still had to be covered from the rain. A hood - a hovering cloud - was necessary. Thus Utzon in 1956 finally threw a few sails over it all. He thought lightly of featherweight concrete shells such as Felix Candela was building galore in Mexico and as Eero Saarinen had just done at M.I.T. He made a lighthearted, spontaneous gesture exploiting the new technology of concrete to the full.

How glorious it was to live in the middle of the twentieth century, when any giant shape could be made in the new miracle shell concrete technique with hardly any trouble at all! What shape shall it be? A glass box like Mies's? A funny dome like Saarinen's? No. Because Jorn Utzon was what he was, he chose something quite unexpected and different. Because he was at work in the decade of engineering excitement, the days of shell and tension, he chose dashing plastic multi-curved forms. Because he was a third phase man, he chose not one but a fragmented series, a closely related family of shapes. Because he knew the building was to be beside a deep harbour and he had seen pictures of sailing boats cutting up crisp white foam on dark water under a big bridge, he thought of the shapes of billowing sails. Because he had the huge embarrassing loft above the stage to contend with he thought in terms of a main sail, high enough to encompass this, and jib sails

and wrapping over the lower acoustic furniture of the auditoria and building up to the main sail. Because he was a Dane, the sails got pointed rather like Viking helmets.

Thus, I believe, grew the conceptional form of the Sydney Opera House. A plan concept, a margin of flexibility left for acoustical engineering, and finally an overcoat conceived in a broad gesture, a grand sweeping statement of the freedom of the new technology. Whatever you think of the outcome, you might allow at least that it was not the non-intellectual, non-functional, and purely sculptural concept that many said it was. At the time of its birth it was a functional thing. However, before long the concept struck difficulties. As Utzon carried the shell concrete problem to the best engineers round the world, and received one negative reaction after another, he had to face a crucial decision: to hold or to drop the difficult vision? Very many architects arrive at this point sometime during all but the most inevitable of projects. Utzon began to accept the advice that the pointed sails could not be made of shell concrete. It was those damned Danish viking ridges. Imagine a hens egg with knife-edge styling; the strength is gone. Imagine a really stiff wind blowing on the side of a Viking helmet two hundred feet high. It would crack along the ridge, of course. So of course one must strengthen the ridges of the opera house. But then what becomes of the shell principle?



It disintegrates like a cubic egg. All this is easy to see now. You can't raise any sort of a weal on a hen's eggshell and expect it to be as strong as ever. You can't combine a beam and a shell in a continuous structure. This is very clear to anybody, after the event. But it was by no means clear at the time. It took some fifteen months of research by the master engineer, Ove Arup, who eventually accepted the job, before the final pronouncement of impossibility could be made with absolute certainty.

At that point most ordinary architects, including thousands far less perceptive and pragmatic than Utzon, would have thrown in the dream. Clearly Utzon would have been tempted to do it numerous times. But really he was in no position to allow the vision to melt away. His sails had been accepted by this time by the mass of Sydney people, who had seen the vision in Time magazine and the art books. They wanted the sails now. In ordinary circumstances Utzon, or any other sensible architect, would have been driven at the point to confess to his client: 'It was a wonderful idea, but it can't be done. Let's scrap it and start again.' But these were not ordinary circumstances; the sails were set; Sydney had adopted them already; there was no turning back.

How, then, to build them? It was Utzon himself who finally came up with the answer. By changing the shapes, not drastically

but quite perceptibly, he remoulded the free flying sails into the discipline of spherical geometry. This was achieved only after painstaking study of the original dashing shapes. First he defined the centres from which all the various curves had sprung. Then, by pushing them around a bit, increasing some curves and straightening some others, he was able at last to fix on a common radius that suited all of them, more or less. Applying this constant radius now to all the shells and infill pieces, he reconstructed the vision. It was roughly the same combination of shapes as before, but naturally it was noticeably stiffer; the difference between a hen's egg and a ping-pong ball. But here was a way to save the greater part of the vision while making it practicable, for once Utzon had reduced all the wild curves to parts of the same theoretical sphere he had translated them into a language which the modern building industry could understand. Now he was able to subdivide each part of the broken sphere into a certain number of units of a single standardised element of construction. Utzon, not Ove Arup, his engineer, devised this change and Utzon was proud of the fact. He was critical of Arup for not having come up with some such solution, for having indeed said that the sails could not be built. But then it was not Arup's, the consultant's, place to change the shapes in order to find a solution. Only Utzon, the architect, the vision-keeper, could do that.



So now the problem of construction went back to Arup and the backroom boys, although now it was a different problem altogether. It was a question of how best to build fragmented sections of a single ball. This was solved logically and easily enough by making each unit a vertebrae in a rib and building the ribs up one beside the other as in your torso. Now the vision which Sydney had glimpsed when the competition results were announced could at last be built. Or something close to it. Utzon had been pressed by a political and social necessity to fulfill the vision, and he had finally succeeded in preserving it all but intact. Yet even if the external appearance was close enough to keep the political critics at bay, the sails were no longer the free swinging exclamation of joy in the new technology. The pre-cast ribs were in some parts feet thick where once they had been inches. They had been so disarmingly lighthearted, and now they were so much more ponderous, solemn and expensive. Gradually, as the work of making the precast units grew in immensity, by trial and error, they became the focus of the vision instead of a fine gesture on the periphery. And this made all the difference in the world, if not to their appearance at least to their intellectual justification.

It is not really necessary to justify the sails of the Sydney Opera House. Let us say with Bucky Fuller that they will give great pleasure to simple people - or simple pleasure to a great many people; I forget the way he put it, it was a casual passing comment.

Let us not try to justify the Opera House sails. But also let us not denounce the whole of the great concept underneath them because the inflexibility of competitions, and governments commissions, and politics, did not permit a basic rethinking of the roof after the early disappointment. Rather, condemn the competition system, which puts architects in a temporary, false and unsafe ivory-veneer tower, insulating them from users of the building and often enough from engineers and all technical consultants. Let us appreciate the essential greatness of the opera house concept, remembering that its greatness grew out of an initially sensitive, super-functionalist idea. In trying to justify the sails let us not renounce the struggle of 20th Century architecture against all bogus forms. Especially let's not try to rewrite the history of the struggle to allow the sails a cosy nest in it. We don't have to retreat from the Functionalist plateau in the continuing search for a sound basis for architectural creation. We have to push on up to the next stage of Super-functionalism.

In the best work of the present phase of modern architecture one can sense the promise of success in this thrust forward. What does this mean in visual terms? Can we expect more shells or more tensile excitement? More random pylons, or more funny roofs? More arches or more zig-zags? Who can anticipate the next swing of taste and be the new star architect for a few months?



To the concept of Super-Functionalism such questions are of course irrelevant. Any of those shapes may be the basis of a Super-Functionalist order. We may see more of them and we are bound to see entirely new ones. But the shapes in themselves are not important. Only the way they combine, the sense of order they create, ~~x~~ and the relevance of this order to the human occupation of the building, are important. And who will be the star engineer of tomorrow, to replace Nervi, Candela, and Fuller? What will be the 'in' structural system of the coming decade? Will there be more tension, more shells, more prestressing or poststressing, more folded planes, more lift slab or slip-form or bearing wall, more trabeation or more vaults or back to curtain walls? These also are meaningless questions if you accept the prospect of architecture as order based on function. The fascination of a structural system for its own sake belonged to the second phase that is past, just as the fascination with the machined look belonged to the first phase. All known structural systems and any more that come to light should be welcomed by the creative architect to increase his vocabulary, but the novelty of new structural shapes is gone. What could be flatter next morning than a hyperbolic parabaloid?

What the architect will be searching for is not engineered excitement but engineered order that fits his functional order, that dissolves into it, so that the two are indivisibly one.

Brick and timber will do, if they answer up, as well as prestressing and pneumatic envelopes. Any structure is acceptable, provided it obeys a functional order rather than inflexibly dictating it, provided it is clear and unconfused and has its own undeviating logic and order.

After two false starts the best modern architecture is back on the path of an essentially rational architecture that will transcend simple functions. The theories are settling down to some sort of consensus.

To put it all another way, function is still, and must be, in control of architecture, but not as a deposit; rather as a constitutional monarch. While this is so there is order. When either of the other two elements of the triumvirate of architecture - structure or aesthetics - rules, there is sterility or chaos respectively.

It may be argued that the period of lone artistry in architecture is dying and anonymous technology has all but supplanted the artist. Yet so long as function rules constitutionally, an overall order in the man-made environment is possible. Building projects fall into a natural hierarchy. Most everyday functions may be served fully and adequately by technology without reference necessarily to an architect or to architectural form. Yet any special function, any activity that calls man to raise his eyes for a moment above



the drains and the cash registers, any higher function of mankind will now and always call for form: expressive, architectural form. It will call for the highest possible creative idea from the mind of some architect. What we may hope for is that the minds of our oncoming Australian architects are no more imperfect, prejudiced or ill-informed than they need be.