

SYDNEY
OPERA
HOUSE
UTZON
DESIGN
PRINCIPLES

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INTRODUCTION

“Since being completed twenty-five years ago, the Sydney Opera House has become an international icon, instantly recognisable to people all around the world.

It is one of the world’s great buildings of the twentieth century and a living testament to the creative mind of its architect, Jørn Utzon.

The Sydney Opera House Trust has decided to embark on a long-term program aimed at achieving two significant objectives.

The first is to safeguard the Sydney Opera House and its site for the benefit of future generations.

The second is to address the current effectiveness of the building’s function as a contemporary performing arts centre.

In establishing these two objectives, we are mindful that they must be achieved within the design principles established by Utzon.

The challenge now facing the Trust is to safeguard the integrity of Jørn Utzon’s vision, whilst assessing the functions of the building to ensure that it can continue to perform as the world-class performing arts centre that Utzon intended it to be.”

Extract from Media Release 1 September 1998 by the Chairman of the Sydney Opera House Trust Mr. Joseph Skrzynski.

This document prepared by Jørn Utzon outlines his vision for the building and its setting and his comments on the future. It is the first critical step in the process of establishing a long-term plan for the Sydney Opera House.

It is intended as a permanent reference for the conservation of the building and its setting. It can be used to clarify original design intent, to manage proposals for change and influence planning controls for the precinct.

The document is structured into three parts. Part one contains a recent text written by Jørn Utzon, describing his vision for the building. Part two outlines Utzon's approach to the future of the building, and Part three lists the fundamental principles underlying the designs.

01 THE VISION



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1.1 THE SYDNEY OPERA HOUSE

UTZON DOCUMENT, DATED 4 JUNE 2000

The programme for the new Opera House in Sydney was so unique that I felt I simply had to participate. This programme had all an architect could wish for. It had a fantastic site, with a beautiful and demanding position on Bennelong Point.

This caused me to start on the project immediately as I happened to live near the castle of Kronborg, situated in a similar position with similar surroundings between the two coasts of Denmark and Sweden, with the town of Helsingør on one side and that of Hålsingborg of the other.

With Kronborg in mind I was convinced that a new building in such a position as to be seen from all sides, had to be a large sculptural building.



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Another inspiration I got from seeing the naval charts over Sydney, on which were shown the sandstone heads at the entrance to Sydney Harbour. These heads slope upwards to the Gap, where they drop abruptly to the sea.

The same feature is often seen in Denmark, on a smaller scale, where you walk uphill as you approach the sea to the edge of an escarpment falling away to the beach and sea below. As you approach the edge you look up into the empty sky and only at the very last moment are you able to get a magnificent view of the sea.

This feeling of moving upwards, was a determining factor in the shaping of the large platform or plateau, which, within its mass, could house all the facilities for preparing the performances with stage sets etc. On top of this plateau the audience should meet the performers. In this way, the appreciation of the man-made performance landscape would be very strong. The audience and the performance itself, all taking place on top of the plateau, should be covered with a "light" sculptural roof, emphasising the heavy mass of the plateau below.

To emphasise the mass of the plateau in relation to the sea (harbour) and to the white roof-shells, it is very important that the exterior of the plateau remains with as few and as small openings in its sides, as possible. If the plateau is perforated by many windows it will change character and will soon have the appearance of an office building with an unbalanced white structure on top.

Another source of inspiration I got from an early visit to the Yucatan Peninsula in Mexico. The Yucatan Peninsula is flat with a jungle vegetation of approximately 8 metres in height. In this jungle lived the Mayan People. When they build their temples, these are often placed on a large platform with wide stairs leading to the top of the jungle canopy. From here you have a limitless view of the expanse of jungle, like a large plain. On this platform the temples were built.



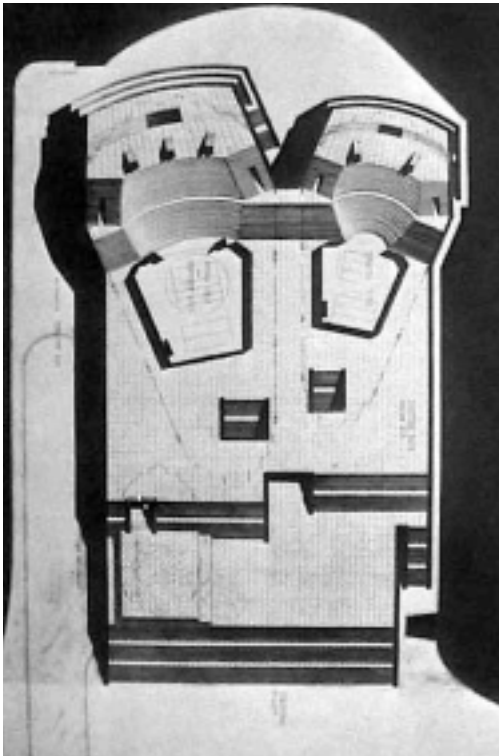
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The feeling you have when you sit on one of these grand staircases in Mexico is a feeling of liberation from daily life. Because I had seen this, the large staircase at the Sydney Opera House was made 100 metres wide and the plateau on top became a very important feature for the feeling of being in another world. This plateau also functions as a gathering place, a town square and outdoor auditorium.

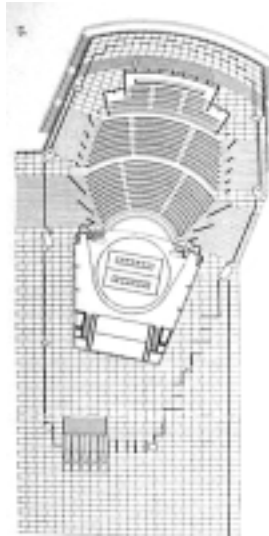
One functional problem arising from the size of the site was that it was impossible to place the large wings or side-stages at the same level as the stage itself. Therefore these were placed below, in the plateau, an arrangement also seen in a few other theatres in the 1960s.

From here the sets were transported to the stage with large elevators, arranged in a paternoster system, providing a continuous up and downwards movement of the sets for the smooth operation of the stage in the large auditorium or Major Hall. For the Minor Hall there were two sets of elevators, one set in the revolving stage and one set behind that.

The base or plateau was made 12 metres high, so it was possible to have the full stage height below the stage-level, for arranging the sets prior to their being sent to the stage. Because of this arrangement it was possible to place the two halls alongside one another and receive the audience via a grand staircase.



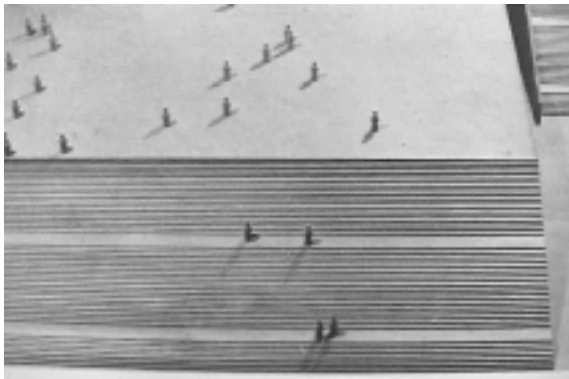
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When you enter the building you pass around the stage towers to enter the auditoria from the sides. During intermission you remain around the auditorium and can retain the feeling of being in another world.

It is very important that the audience does not enter, and walk through the building along dark corridors to a dark hall.

In the Sydney Opera House you are aware of your orientation at all times. It is important that each member of the audience has a simple, easily understood tour, from the entrance to his or her seat and out again.

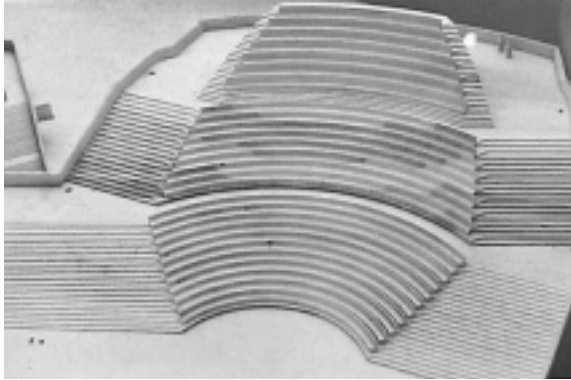
All problems regarding egress in case of fire and fire staircases are solved in a similar comprehensible manner.

Thus the house could function according to the competition programme.

The major items in the programme were a Major Hall for opera and concerts, a smaller Minor Hall for theatre and a Chamber Music Hall or room.

The question of how to cover the foyer, the auditoria, the stages and stage-towers was solved by covering these functions with large concrete shells, which follow the height of the various functions.

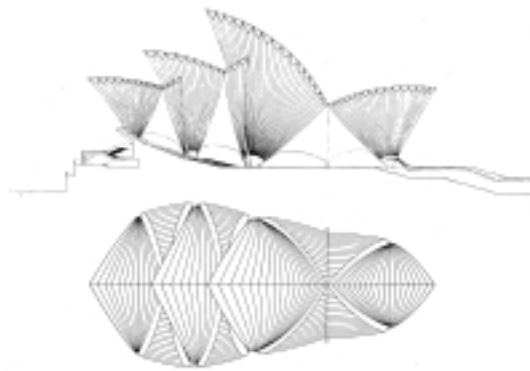
In this way very sculptural shapes were arranged side by side, so one gets a varied picture of the complex, according to which way you move in or around the structure.



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All parts play together in a rich variation of shapes, the exact feeling I enjoyed from seeing my native Kronborg.

If the work in producing the base and arranging all the functions in this lower part of the building had been a very difficult one, the work regarding the remainder of this building was no less so. Whenever an obstacle was encountered we often had to change tack completely to find another way to solve the problems. This happened a lot of times.

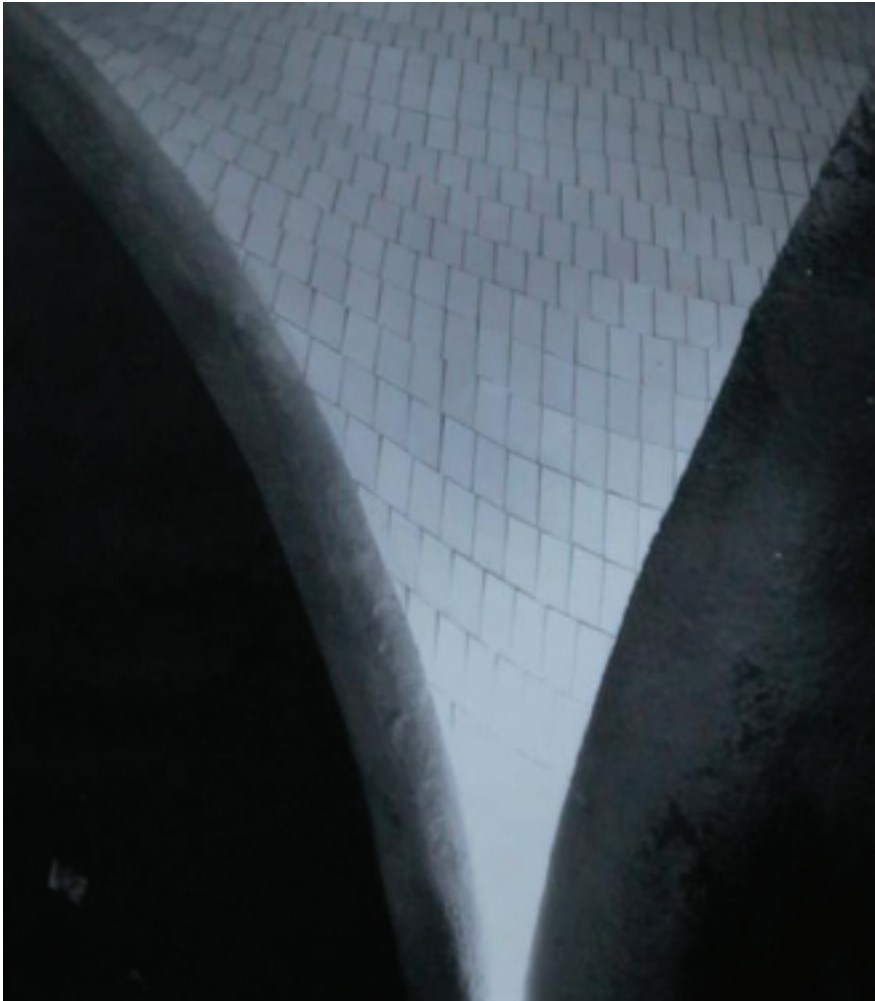
It was unlike making any other building. A parallel to the automobile industry would be, not to develop and produce another car-model, but rather to develop the first lunar landing module. For instance in the case of the exterior cladding of the shells, it was impossible to determine the geometry of the tiling, until full size mock-ups had been made.

We made full-scale mock-ups or models, which were important tools, which, together with the drawings, enabled us to solve specific problems.

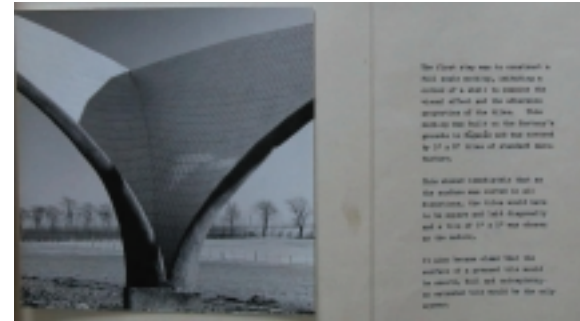
For instance the first mock up of the tiling clearly showed that our initial solution did not work.



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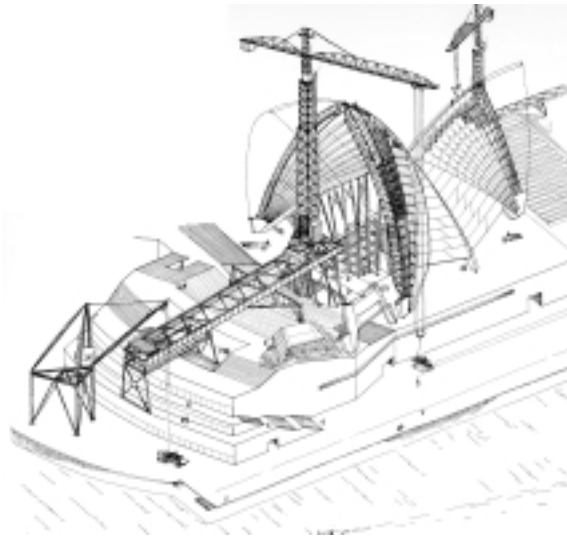


The first step was to construct a
full scale model, measuring a
total of 4.5m x 3.5m to ensure the
correct effect and the reflective
properties of the skin. This
model was built in the factory's
grounds in Harlow and the screen
is 17 x 17' area of stainless steel
panels.

This model demonstrated that in
the winter and spring the steel
structure, the skin would begin
to be heated and will expand by
and a rise of 17 x 17' was chosen
as the solution.

It was found that the
weight of a general skin would
be 100kg, but the corresponding
vertical load would be the only
weight.

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This caused us to rethink the problem and eventually come up with a solution, which resulted in the tiled elements covering the exterior of the shells today.

This solution was again depending upon the solution of how to construct the shells themselves. So as was often the case, one solution was depending upon others and vice-versa.

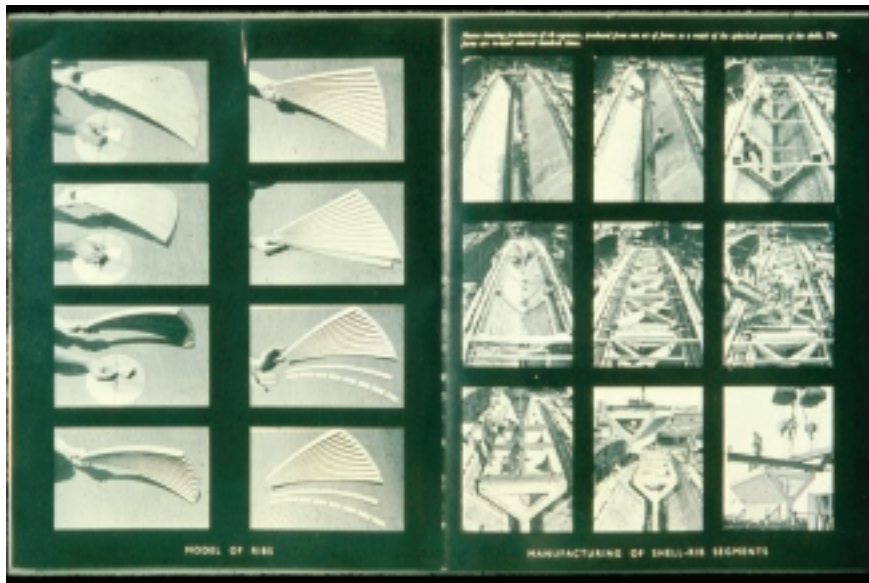
Initially, no definite geometry for the shells had been established, but, as work progressed, the shells were developed according to a spherical geometry and we suddenly had a common denominator, the same spherical surface to deal with, with a similar curvature throughout.

This was an elegant solution to a construction, which would otherwise have had to be done with a large amount of scaffolding and shuttering, both for the interior and exterior shape of the shells.

Now the shells could be sub-divided into ribs, which again could be divided into smaller elements, which could be cast within formwork representing the largest rib-entity. Thus it was possible to pre-cast the concrete-shells in smaller pieces and assemble these pieces on location.



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The elements were erected by very advanced methods and joined by post-tensioning to complete the shells, putting them together as building blocks.

This again gave way for a very logical and orderly geometry for the tile lids that were to cover the entire surface of the shells.

The tiles were a major item in the building. It is important that such a large, white sculpture in the harbour setting catches and mirrors the sky with all its varied lights dawn to dusk, day to day, throughout the year.

The citation from the American architect Louis Kahn: "The sun did not know how beautiful its light was, until it was reflected off this building", describes the importance of this surface and of the decision to make the surface white.

One of the judges, Eero Saarinen who was aware of this, told me at one stage, after the result of the competition was made public: "keep it white", because the Harbour (surrounding buildings) is dark, with all its dark, red or brown brick-structures.



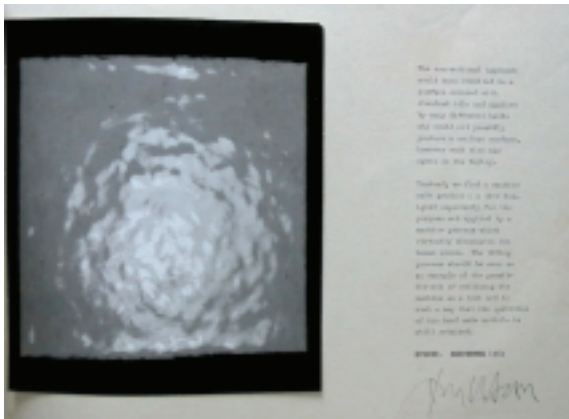
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To develop these tiles I worked with one of the best ceramic factories in the world, Höganäs in Sweden.

The Höganäs factory generally produced stoneware tiles for the paper-mill industry. In the paper-mills the boiling water with the pulp is channelled through huge ducts lined with this type of stoneware tile. The ducts are then flushed with ice-cold water from the rivers. This extremely harsh treatment puts any material through a tough test, and it was therefore natural that the people who could produce tiles, able to survive this treatment, should be involved in the development of the tiles for the SOH.

The factory, after many trials, came up with tiles made according to a certain technique, where the raw tile is painted with a sauce or slick of the same material, is fired, and overlaid with a glossy, transparent glaze before it is fired the final time.





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This gave a surface, which had a beautiful lustre or sheen, a surface that would retain its visual qualities even when the tile became dirty. A normal ceramic tile with a normal glaze has a relatively dull surface, as if it is made from white cardboard, and when dirty it completely loses its lustre.

By sub-dividing the tile surface into glossy tile lids, with matte tiles at the edges, I achieved my aim, to have the structure expressing the architecture and vice-versa. You find a similar situation in Gothic Cathedrals, where the structure is also the architecture. The same is seen in Chinese and Islamic architecture, although with different expressions. The architecture with the ribs is much more expressive than if the shells had been cast in-situ, with the resulting flat unstructured surfaces.

This effect was also developed for the base or plateau, where we structured the ceiling above the audience in the access areas, in the foyer and in the concourse areas. It spans completely without columns, as I wanted an open area with a ceiling of structural ribs. These ribs shaped so they elegantly express the forces within the structure. They express the harmony in the structure.

This resulted in a building where all spans are clearly expressed by ribs and folds. So you have a house where all the large surfaces are easily read or comprehended because of the geometrical order, and in the roofs the large amount of white tiles sub-divided into segments, are like the structure of a leaf which, with its ribs and infill, have an organic beauty of its own.



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The concourse area needs more light, in order for the area to have a more welcoming ambience. It is relatively dark space, due to the materials used and primarily due to the contrasting harsh sunlight at the eastern and western sides. One way to remedy this is to raise the light level in the area artificially. Another way could be to white wash the concrete surfaces of the ceiling above the area. Whitewash can be cleaned off again, or applied in such a way that it does not camouflage the concrete texture. Trials in selected areas would be needed to establish the correct procedure.

The base or plateau was clad in concrete elements with an exposed granite aggregate, which gave the base a brownish sand-like colour, as it was not possible to have such large amounts of natural stone cut from the same quarry for the surfacing of the base.

These concrete/granite elements were produced as prefabricated elements after a full sized mock up had been made, with various openings presented so that everything could be checked before final decisions were made. This is again an example of the importance of the full sized mock up as a tool for determining the best solution for the building.

We arrived at the various solutions for corners, materials, details and colours, through a combination of drawings, models, samples and mock-ups, always trying to select the finest solutions for this building and for my client.



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The fact that the engineers and we were open to new possibilities, even though that meant rejecting the old solutions was instrumental in making this a noble and harmonious building with a very forceful architectural expression.

This happened at a time where the reigning functionalism had not yet yielded to the idea of giving buildings a more humane expression. This is explained by S.Gideon in a remark he has in one of his books. He explains that the right to express oneself is back in architecture with this building.

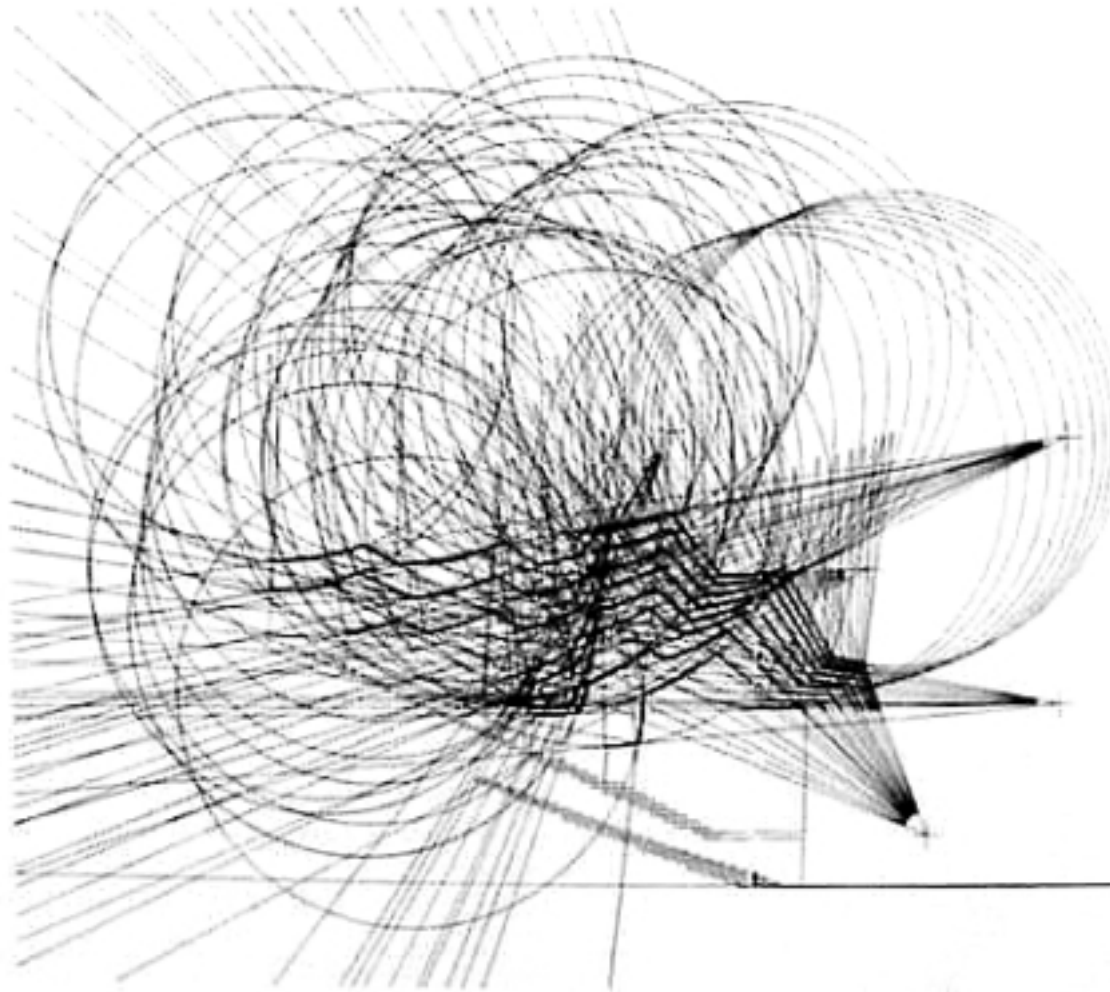
As in large cathedrals the Opera House is functional in the sense that people have a beautiful experience entering and walking up the stairs and entering the auditoria, while they are all the time oriented in the beautiful harbour and have the views of the spectacular Sydney Harbour setting.



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We had to commence building at a stage where the working drawings had not yet been completed or finalised, so construction began at the building site a long time before we had completed the drawings, and construction drawings were being produced just ahead of construction as the building grew.



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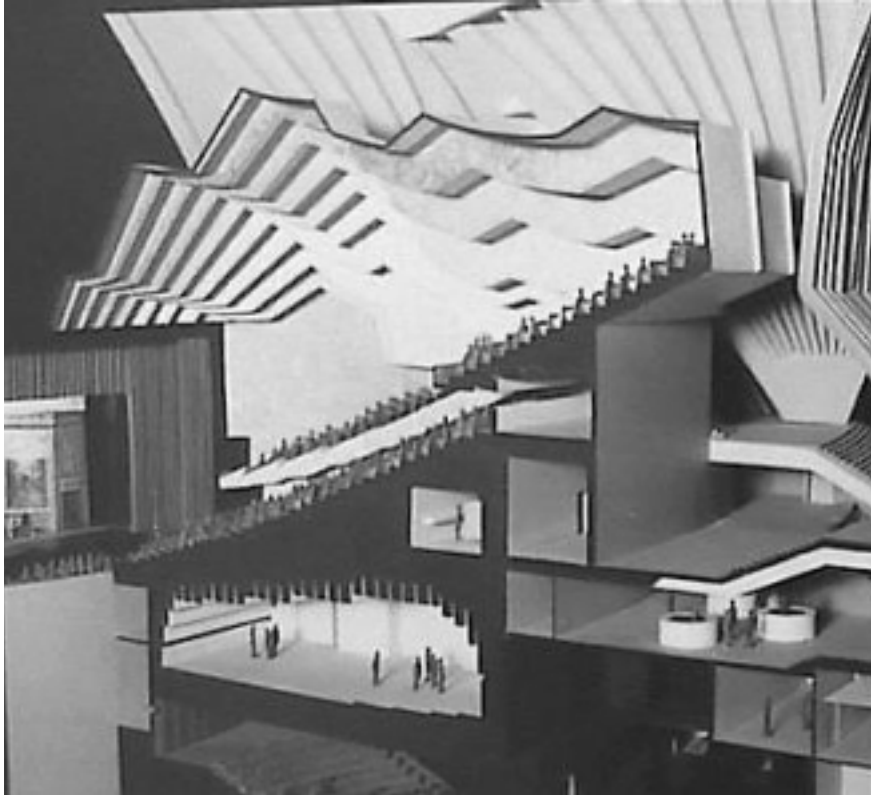
Regarding the acoustical properties for the halls, we started working on the acoustics in Europe with a Danish engineer - Jordon, and after that we tried an acoustic firm from Germany - Cremer and Gabler, who had already made more than 30 concert halls around the world, one of which was a famous hall in Berlin for Berlin's Philharmonic Orchestra.

They made models as had Jordon in scale 1 to 10 in their laboratory where they arrived at the shape which is the shape for the Sydney Opera House halls which was shown in a later scheme.

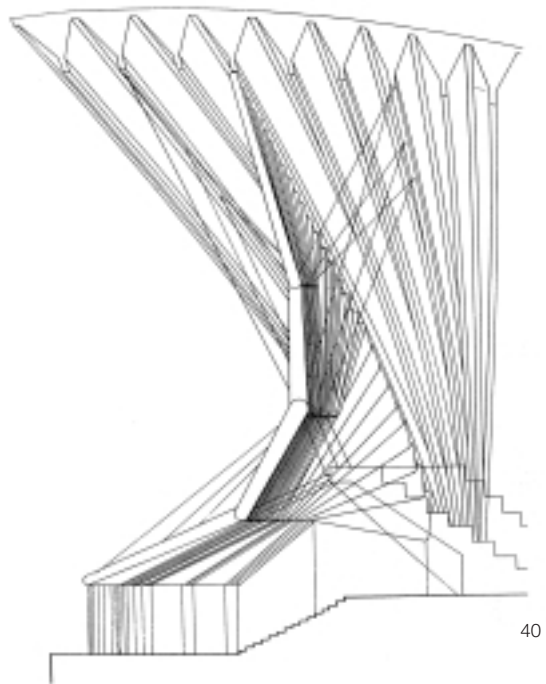
The acoustical shells were free of the covering roof - the shells. The halls acoustically had a shape that was oriented towards the stage. It was a large, plywood construction. We had arrived at a solution where we could rest all these convex slices on the underside of the acoustical shell, onto a frame around the proscenium opening, from which these acoustical members splayed out like a fan.

The acoustical shape was absolutely clear, both in sound and in the way that you would observe it as an audience. The smallest auditorium, minor hall, had been tested in a laboratory, and when I asked the acoustical experts if we should change the shape of the acoustical ceiling further they say "No, no don't do that because it is perfect, actually it is almost too perfect". The hall was in its way in the same evolutionary process along similar lines for the multipurpose hall used as a concert hall and an opera theatre.

Around this time the break came with a new government and a new Minister for Public Works and I was pushed aside as architect for the job. Luckily Ove Arup stayed on the job; otherwise it would never have been completed. But the two halls, as I had designed them, were scrapped by the new client and his architects. They had a new and different programme for the completion of the building, to the one I had been working on.



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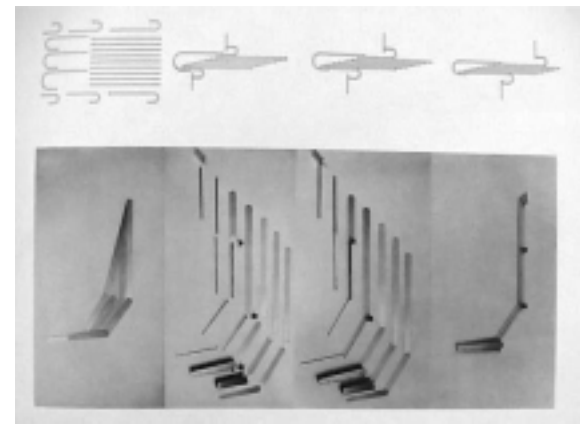
Another item that had taken considerable time was the glass walls enclosing the ends of the shells. We worked with ideas of various kinds as had Ove Arup's office. We worked for a long time with a solution where the mullions were plywood laminated with bronze but it turned out to be somewhat complicated.

At the last meeting I had with the engineer from Ove Arup's firm, Mick Lewis, I handed over the drawings for mullions made of twin pipes with a distance between them, which the sketches will show, which is somewhat similar to the solution which had been used. And upon seeing this Mick Lewis said, "Well now I can make the glass wall".

The glass wall, which has been built, is in family with the glass wall we arrived at with its feeling of its hanging from the shell, but the old solution was not playing it out, as it has been done.

According to our way of working, the glass panels were to be of equal size, facilitating production etc.

In both versions you have, as you walk around the foyer, the full unimpeded view of the Sydney Harbour. You get a fantastic feeling of openness of space after being inside the auditoria.



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REBUILDING

Recently there has been some talk about re-building and re-modelling the entire Sydney Opera House according to the plans I made then, back in the mid 1960s.

I really don't think it is a viable solution to remodel the whole building according to the old plans.

The Sydney Opera House has been built and it has been used in a certain way which satisfies the users and has satisfied the people of Sydney and a lot of people from abroad for many years, so it would not be correct to go back to the thoughts and ideas that were new in the early 1960's which were based on a different programme for the building.

It seems that most people love the building, and it is very difficult to imagine everything being changed, that the building should be closed down for a number of years, that work should go on at a construction site where nobody would be able to use the Opera House.

So I suggest that modifications can be made as the questions and needs arise - whenever somebody wants to remodel something, re-furnish areas you could look back at the ideas that were being developed, some of these might be viable today or at the time when the change is called for, and some of them have been outdated, because huge technological advances. So I really advise the future decision-makers to carefully contemplate all aspects of the intended modifications before changing the Opera House.

I understand from various statements that the Concert Hall has certain acoustical problems. But as it is an impressive auditorium, that the public is happy about, I suggest that an approach be made to an acoustical specialist who has made concert halls of a similar size and complexity with success. Because making an auditorium for 1200 people is not a very big problem as opposed to making one for 3000 people.

Ideally the person at the back row should have as good a sound reception and impression of what goes on the stage as the person sitting 10 rows back from the stage.

If the firm of Cremer and Gabler and their first man Nutsch are still in existence, I suggest that you approach these people as they were the acoustical experts on the Berlin Philharmonic Concert Hall, which has a similar layout as the concert hall in the Sydney Opera House, with a central stage, which was also the result of a request by the conductor Herbert von Karajan as he wanted to be seen from every side.

A part of the future considerations about the Opera House comes under the heading of general maintenance. This I feel is well documented in the report by the Minister of Public Works. But the inherent danger in large buildings, which have become popular, is that there is a tendency to want to fill too many functions and rooms into those buildings.

I have heard that the area below the stage of the major hall where elevators used to go has been turned into a studio stage/hall. This I find is a great idea because this can be seen as a necessary function in such a large cultural complex as the Sydney Opera House.

So in general I can say that I am very happy that so much with the Sydney Opera House has succeeded, and that the architects taking over the work after me, Hall, Todd & Littlemore, with the aid of Ove Arup's Company, has made the building function so well.

COLOURS

In my project for the Sydney Opera House I had what you could call nature's colours on the exterior. That was the general idea - concrete, granite and ceramics. Within this landscape you had the halls that were to be richly decorated in festive colours but all this was in the developing stage and had not yet been finalised.

The geometry in the construction is such that when you paint the different parts in the colours shown in the drawings, it would be as beautiful as, for instance a large flag fluttering in the wind, where you see the pattern of the flag repeating itself in succession behind one another in a way that suggests a flag but you don't see it as a whole. Or you see it in various cross sections of nature's elements - if you cut across an onion you see the different layers - it's the colours which again leads your thoughts back to the complete item, in the same manner of expression where the elements that are decorated in a certain way when put together

give more richly varied surface structure than would have been if it had been a simple smooth surface throughout with a single flat colour.

The idea was to see a spectacular building as you arrive and as you enter the foyers you see additional colours. You also get a more intimate feeling. As you enter the Minor or Major hall this explodes into a very rich expression of colours, which uplift you in that festive mood, away from daily life, that you expect when you go to the theatre, a play, an opera or a concert.

So you have a culmination of space, of colours when you are at the meeting place between the performers and the audience. So going to the Opera House is a succession of visual and audio stimuli, which increase in intensity as you approach the building, as you enter and finally sit down in the halls, culminating with the performance.



The Minor Hall was programmed primarily for theatrical productions, which require a relatively dark or subdued colour scheme for the auditorium. In the spirit of the below illustration:

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HALL INTERIORS

Ove Arup said at one stage “Why can’t the architect tolerate a steel construction instead of those hollow, plywood pipes for the acoustical ceiling”, and I responded, “I can accept to put the steel frames inside the hollow plywood tubes that make up the acoustical ceiling and thus satisfy the engineer’s requirement for strength. But we need to make full-scale models of parts of this structure to ensure that the proposed details and colours are correct.

The Major Hall was to be used for Grand Opera and concerts, with an optimistic, light colour scheme, in the spirit of the illustration at right:





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FURNITURE

Everything about furniture, details and so on will only be briefly touched upon, because we had not yet reached the stage where we had begun to go into detail with this.

We made the working drawings just ahead of the actual construction going on at the building site so therefore development was not very far ahead of what was actually going on at the site at any one time.

This of course is not the best way to do things but on the other hand, if the decision back in the late 1950s had been that the project should have been completed entirely and then sent out for tender, then the Opera House would not have existed today. So it is thanks to the political foresight of Joseph Cahill that the building was commenced on the loose grounds it was, and that Sydney has this useful landmark today.

The reason for the time it took to develop all these things around the Opera House was that everything was so totally different from what had been seen before: everything had to be developed more or less from scratch. We could not just put bits and pieces together from a catalogue.

When you build a building like the Opera House it is like an oil painting by one of the Masters where every time you add a brush stroke it should enhance the total painting, as soon as you put something wrong in this painting, a wrong colour, a wrong shape, then the total image is of a lesser value than it would have been if the same artist had been allowed to complete the picture.

A change happened in government. Of course this was something which was bound to happen sooner or later. Unfortunately my contract with the Opera House Committee was stopped, or was not renewed. I did not have the contract with the Minister of Public Works, but with the Opera House Committee, and this contract the new Minister of Public Works did not want to renew or take over.

The Minister didn't want to use the Committee or the Committee's great expertise built up over the years in developing the Opera House. The committee was the creative force behind the Opera House.

For me as the architect and for the engineers, the Opera House committee with Mr. Haviland as chairman together with the Minister of Public Works, Mr. Ryan, was the most stimulating and patient Client I have ever had.

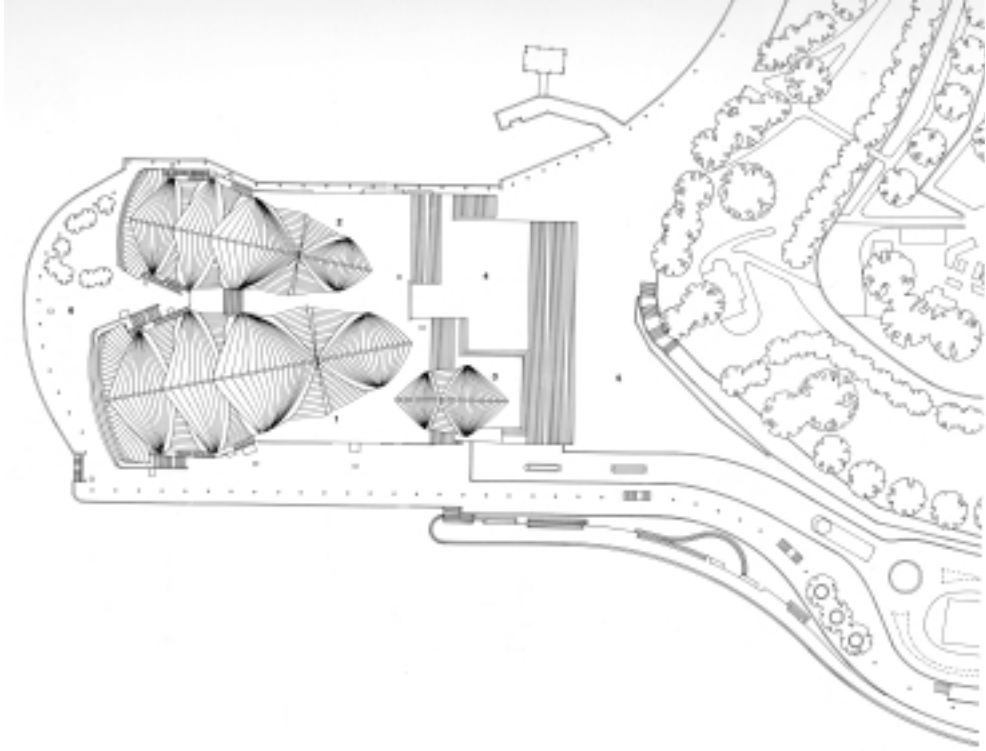
Everyone was working hard to fulfil the wish of Premier Cahill, to give a marvellous cultural centre to the citizens of Sydney.

Concerning the remodelling and maintenance of the Opera House I feel there are a number of people who have known and followed this building throughout its existence. I think it would be a good idea to place in the hands of these people and their companies the maintenance and the possible renovations, as they know the Opera House intimately through their work on the building.

These people could be used as consultants before decisions are made. Another idea was that they could come forward and tell what could be problems arising from doing this and that when you want to do something to the Opera House. Usually things that are constructed have some sort of logical history and when you know that it is easier to take the right decisions at any one time. And in this respect, Arups office is of course of key importance as they know where things are, what parts of the building can take certain loads, what has been hung in different places, the way the walls, materials etc, which are important for the total structure of the house, have been constructed and applied.

This should all be coordinated with Richard Johnson as the coordinating architect.

The Opera House today is of course not my or our building, it is as much a building made by Hall, Todd & Littlemore and it is not something which we can add on or patch up by doing this and that.



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As the present conductor of the Opera House has said the acoustics of the concert hall was very fine at the time it was built. The Sydney Symphony Orchestra came from the Town Hall to the Opera House which of course was much better but since then the Orchestra has had an opportunity to play in various great halls around the world and have seen and heard that there are possibly other and better solutions for creating a better acoustical surrounding, also for the Opera House. So what was good back in the 60's was okay then, but as people develop and as music develops, as our perception of music and place develops, our demands become higher and this development will probably in the future change a lot of features of the Opera House simply because you need to adjust to instruments, as such.

With the words of the acoustical engineer, Cramer, I would like to say that the ideal concert hall is a hall which is shaped in such a way that you do not have to adjust the sound with absorbents. By doing so you kill off some of the sound energy, whereas if you retain the brilliance you have much more sound energy travelling to the audience.

So rather than changing the acoustics by absorbing certain unwanted sounds or frequencies, it is better to adjust the physical shape of the hall in such a way that you achieve the perfect acoustical properties. It is like a violin - it has its shape because of its long evolution and it has attained that shape, through evolution toward perfection. It has not changed very much in the past couple of hundred years because it has reached the capacity or the best possible solution for this particular instrument at a certain stage in its development.

Another matter, the conservation report from the Minister of Public Works on the Opera House is very good because it goes into great detail about how to treat the Opera House from electric lights switches, to handles, to treatments of different surfaces (how to clean them etc.) and it is necessary as part of the whole picture, to contemplate all of these things. I had a letter from a person in Australia who said he was amazed and that he had never before seen a building 25 years old which was maintained so well. This was very nice for me to hear.

THE SPACE WITHIN

One thing is important to remember, the Opera House, like any other building, is like a bottle - you can fill it with so much water but you cannot fill more water into the bottle than the space within.

So it is not a good idea to try and fit more rooms inside the building. If more space is needed, it should not be squeezed into some of the open spaces in the building or below the building, but the functions should be moved somewhere else in the city. I'm sure that there are many functions today, which, with the modern technological equipment that we have, might just as easily be placed elsewhere.

For instance many of the theatres and performance houses around Europe and the United States have outgrown their envelope and they have taken the consequences of this, and hired or built facilities elsewhere.

For instance for stage equipment, for all the lighting, for storage, for the workshops for rehearsal rooms and what have you, such arrangements can be found everywhere in the world, and I think, especially for the Opera House, it would be very bad for the house, and subsequently for the area around the Opera House, if it was decided to fill too many functions into the house, more functions that it can hold.

It might still be possible to locate functions underground, under the eastern part of the Forecourt. At the time of the construction of the Opera House, a large stormwater drain was encountered under what was to become the plateau for the building. This drain then had a purpose, and might still be in use, and could pose an obstacle to further expansion underground.

For the purpose of defining the area(s) to be modified in and around the building, it is necessary to relate to drawings. The drawings should represent the existing layout and situation, in plans, sections and elevations.

Some reference may be made to the drawings from the original scheme (Utzon).



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Exterior photographs can be used to illustrate ideas about signage and lighting etc.

This Design Brief does not present a number of solutions to specific design questions; these will be developed at a later stage, but tries to give the reader an idea of the architects work and working method, in creating the drawings and documents necessary for building the unique and complex structure of the Sydney Opera House.

Perhaps the Design Brief could be left 'open', in such a way that ideas and items from the past and present can be added over a number of years, as long as I can continue to work with this wonderful project in Sydney.

Jørn Utzon

02 THE FUTURE

2.1 APPROACH

The approach of Jørn Utzon to change of the Sydney Opera House is clearly stated in his letter to the chair of the Sydney Opera House Trust dated 19 August 2000.

Dear Mr Skryznski

“As the architect of the Sydney Opera House, as the creative force behind its character, I sincerely believe that a large multipurpose structure such as this building, in time will undergo many natural changes.

The ideas as they were developed in the sixties, evolved as the result of the needs and technique at the time.

As time passes and needs change, it is natural to modify the building to suit the needs and technique of the day.

The changes, however, should be such that the original character of the building is maintained.

That is to say, I certainly condone changes to the Sydney Opera House. Both changes due to general maintenance and changes done due to functional changes.

Had I completed the Sydney Opera House as the architect in charge, the building would have developed and changed with the time ever since.

I am certainly happy to have been asked to be a consultant to this development. I hope that my role and involvement can be a guidance to the decision makers at the Sydney Opera House, in such a way that the maintenance, the alterations and the development can take place in such a manner that my presence in the team will assure that the character of the Sydney Opera House is emphasised.”

**Sincerely yours,
Jørn Utzon**

2.2 PRINCIPLES

The following quotations by Jørn Utzon establish a clear set of principles for managing the future of the Sydney Opera House.

These quotations have generally been drawn from part one of this document or from private transcripts of recent discussions with Jørn Utzon.

His comments are made in the context of his understanding of the House and its current and future needs.

Keep the approach, the openness and fluidity of movement

“One of the great features of the Opera House is the approach, the openness, the fluidity of people’s movements through the house, and once you clutter this you have a problem.” (1)

New structures close to Sydney Opera House diminish its role as icon/ landmark

“One adverse effect could be from placing large new structures closer and closer to the Opera House, thereby diminishing its value as an icon for Sydney and Australia.” (2)

“If you clutter the new spaces around such a significant building then you obscure the building, and can obscure it to an extent that it no longer retains its value in the city or its character... it will lose its importance as an icon or as a landmark for the city.” (1)

New structures placed close to the Sydney Opera House will diminish its value as an icon by disturbing its chief characteristics of being free in the centre of Sydney Harbour. (1)

Need to take a long-term view

There is a need to take a long-term view of important sites. (1)

Forecourt should not be cluttered

“Forecourt should not be cluttered with new buildings at any size.” (1)

Accommodate new approach and back of house for events under Forecourt

“It might still be possible to locate functions underground under the eastern part of the forecourt.” (2)

“If needed some functions could be sunk below the forecourt level, in such a way as to be accessible from the forecourt, but without disturbing the visual impact of the original layout.” (1)

“...an approach from the underground parking in the Botanical Garden could emerge via an opening in or near the Tarpian wall. Facilities like dressing rooms or rooms for temporary catering for activities in the forecourt could be placed under the forecourt surface

Access from carpark through a hole in the forecourt. Space could accommodate back of house and storage for outdoor events. (4)

Solidity of base is important

“If you open the sides of the base to create day-light... then suddenly the base becomes an office building, and that will reduce drastically the dramatic expression of the Opera House.” (1)

Danger in too many functions - building has limited size

“But the inherent danger in large buildings, which have become popular, is that there is a tendency to want to fill too many functions and rooms into those buildings.” (2)

“It is not a good idea to fit more rooms inside the building... more functions than it can hold.” (2)

Relocate non-essential functions

“If more space is needed, I'm sure that there are many functions today, which with the modern technological equipment that we have, might just as easily be placed elsewhere.” (2)

Concourse was intended as foyer

The idea of the drop-off was that it was a foyer “you could increase the overall lighting.” (4)

Under cover car drop-off is important and should be kept. (4)

Future treatment of finishes

Refers to folded concrete beams of concourse:

“Some form of treatment of these surfaces as a whole or in parts will be necessary to conceal the defects and bring it up to a uniform and acceptable standard.” (3)

Conservation Plan supported

The Conservation Plan:

“Is very good because it goes into great detail about how to treat the Opera House from electric lights switches, to handles to treatments of different surfaces and it is necessary as part of the whole picture to contemplate all of these things.

Look back to past - some ideas might be viable, some outdated

“Whenever somebody wants to remodel something, re-furnish areas you could look back at the ideas that were being developed, some of these might be viable today or at the time when the change is called for and some of them have been outdated by the time that has gone by as the evolution results in high technological advances.” (2)

Refers to furniture designed for Sydney Opera House:

“I must say we can now look at it with other eyes and it might be possible that we can use some of these systems.” (4)

Care needed before change

“So I really advise the future decision-makers to carefully contemplate all aspects of the intended modifications before changing the Opera House as such.” (2)

Need to adjust to changing standards

“So what was good back in the 60’s was okay then, but as people develop and as music develops, as our perception of music and place develops, our demands become higher and this development will probably in the future change a lot of features of the Opera House simply because you need to adjust to instruments, as such. (2)

Local history important

“Usually things that are constructed have some sort of logical history and when this is known it is easier to take the right decisions at any one time.” (2)

People with knowledge of the building important

“Concerning - the remodelling and maintenance of the Opera House. I feel there are a number of people who have known and followed this building throughout its existence. I think it would be a good idea to place in the hands of these people and their companies the maintenance and the possible renovations, as they know the Opera House intimately through their work on the building. (2)

“Arups office is of course of key importance as they know where things are, what parts of the building can take certain loads, what has been hung in different places, the way the walls, materials etc, which are important for the total structure of the house have been constructed and applied. (2)

Difficult to imagine everything being changed

“It seems that most people love the building, and it is very difficult to imagine everything being changed, that the building should be closed down for a number of years, that work should go on at a construction site where nobody would be able to use the Opera House.” (2)

Modifications made progressively

“I suggest that modifications can be made as the questions and needs arise.” (2)

Can't go back to ideas of 1960s - based on different brief

“It would not be correct to go back to the thoughts and ideas that were new in the early 1960's which were based on a different programme for the building.” (2)

Not viable to re-model whole building according to old plans

“I really don't think it is a viable solution to re-model the whole building according to the old plans.” (2)

Consider long-term costs

Refers to original edge tile detail not executed:

“This is an example of the misunderstood idea of saving and then finding out afterwards that it is a costing a lot of money in the long run”

Quotation references

1. Jørn Utzon, 'Sydney Opera House, The Setting' 5 May 2000
2. Jørn Utzon, 'Sydney Opera House' 4 June 2000
3. Jørn Utzon, 'Descriptive Narrative, Sydney Opera House' January 1965
4. Jørn Utzon, Jan Utzon and Richard Johnson, 'Private Records of Discussion' Mallorca, April, October & November 1999

03 DESIGN PRINCIPLES

3.1 OBJECTIVES

The production of a definitive statement of the fundamental principles underlying the design by the original architect achieve the following objectives.

- a) It is a permanent reference for the conservation of the building and will be incorporated into the conservation plan.
- b) As part of the conservation plan it will be used to manage any proposals for change.

All proposals will be reviewed in the context of their impact on the design principles and the conservation plan.

c) It will be used to clarify original design intent particularly in the context of the many publications, and comments by those who are not authorised to speak on behalf of the original architect.

d) It will be a prime document to influence planning controls for the precinct, to preserve views, vistas, and approaches, and provide for future long-term improvements to the setting.

3.2 FUNDAMENTAL PRINCIPLES

There are two principles that are fundamental to the architecture of Jørn Utzon and set him dramatically apart from most of his contemporaries.

He draws inspiration from nature for organic form and creates an architecture that is predominantly experiential in character.

The following quotations drawn predominantly from part one of this document and from private transcripts of recent discussions elegantly illustrate these fundamentals.

INSPIRATION FROM NATURE

Organic Beauty

“and in the roofs the large amount of white tiles sub-divided into segments, are like the structure of a leaf which, with its ribs and infill, have an organic beauty of it's own.” (2)

Naval charts and headlands

“Another inspiration I got from seeing the naval charts over Sydney, on which were shown the sandstone heads at the entrance to Sydney Harbour. These heads slope upward towards the gap, where they drop abruptly to the sea.” (2)

Nature's colours

“I had what you would call nature's colours on the exterior. That was the general idea - concrete, granite and ceramics.” (2)

Reflection of sunlight

“The citation from the American architect Louis Kahn: “the sun did not know how beautiful it's light was, until it was reflected off this building.” (2)

Hall like cloud in sky

“The overall shape of the hall, a free form hanging like a cloud in the sky.” (3)

Glass wall ribs like bird's wings

“Approaching one will notice the bronze covered vertical plywood mullions hanging as the folds of a birds wing.” (3)

Cross-section of nature's elements

“The geometry in the construction is such that when you paint the different parts in the colours shown in the drawings, it would be as beautiful as... you see it in various cross sections of nature's elements-if you cut across an onion you see the different layers.” (2)

Early morning and sunset colour

“I had a marvellous painter friend and he saw the morning sun, every morning and the evening sun at sunset. These moments are short and in the openings of my mind, I thought in a different way than daily colour.” (3)

HUMAN EXPERIENCE

Emotional response, functionalism and human expression

“This happened at a time when the reigning functionalism had not yet yielded to the idea of giving buildings a more humane expression.” (2)

Objective is to bring joy

“The architects’ gift to society is to bring the people a big joy from the surroundings that architects create.” (1)

Beautiful experience/oriented in Harbour

“...People have a beautiful experience entering and walking up the stairs and entering the auditoria, while they are all the time oriented in the beautiful harbour and have the views of the spectacular Sydney Harbour setting.” (2)

Succession of visual and audio stimuli, culminating with performance

“So going to the Opera House is a succession of visual and audio stimuli, which increase in intensity as you approach the building, as you enter and finally sit down in the halls, culminating with the performance.” (2)

Being in another world

“The large staircase at the Sydney Opera House was made 100 metres wide and the plateau on top became a very important feature for the feeling of being in another world.” (2)

“I also have had so many reactions the moment I put a foot on a staircase with steps a hundred metres wide something happens to you, something like climbing a mountain.” (4)

“This feeling of moving upwards was a determining factor in the shaping of the large platform.” (2)

“The patrons will receive on their way to the theatre halls an impression of restful and dignified surroundings with a generous spacious layout.” (3)

Concourse area should have a welcoming ambience with more light and reduced glare.

Consideration of details like doors

“So if you open that butterfly door it opens, much faster than this door, it’s closed but halfway, and then you open it, giving you a feeling of easier access.” (4)

“I am going to make a building, here you came in and up the staircase, you are in a darkened room but the staircase is obvious for the staircase is well lit...a period passes and you came up and in front of you, you see a big tapestry by le Corbusier.” (4)

Festive mood

“As you enter the Minor or Major hall this explodes into a very rich expression of colours, which uplift you in that festive mood, away from daily life, that you expect when you go to the theatre, a play, an opera or a concert.” (2)

Feeling detached from the city

“During intermission you remain around the auditorium and can retain the feeling of being in another world.” (2)

“After the performance the bars and lounges will present for the patrons a second opportunity to enjoy these views and will underline their feeling of being detached from the city in a world of its own.” (3)

“As we move through the glass doors and arrive at the foyer, we are introduced to the back wall of the stage, reminding us of the purpose of our visit.” (3) 1

Ornamental curtain

The ornamental curtain for the Minor hall visible from the foyer will enable the patron “during the approach to get the feeling of what they will find inside.” (3)

At the cloak room level there is access for the performers.

Patrons/performers meeting

“Unlike the normal theatre, where one literally goes to the back door for social intercourse, the patrons and performers can mingle together in the cloakroom area.” (3)

Role of colour optimistic

“When we meet for performance when we are together to be moved, in our minds and in our soul and experience what comes into our minds. Colours would support that.” (4)

“The idea was to see a spectacular building as you arrive and as you enter the foyers you see additional colours. You also get a more intimate feeling.” (2)

“To give life to the skin and hair on the human form in much the same way as the light from candles.” (3) 67

Lights in the W.C.'s and basin areas

“Give a uniform indirect light to the rooms which can be dimmed just before the curtain goes up in the theatre.” (3)

Neutral and restful atmosphere

“The materials internally will serve to underline the ideas in the planning ...and these surroundings will give a neutral and restful atmosphere for the patrons as well as for the people working in the building.” (3)

“The halls will form another world-a make believe atmosphere, which will exclude all outside impressions and allow the patrons to be absorbed into the theatre mood.” (3)

“The Major hall was to be used for Grand Opera and concerts with an optimistic, light colour scheme.” (2)

3.3 SYDNEY OPERA HOUSE DESIGN PRINCIPLES

Within the broad framework of drawing inspiration from nature and seeking an architecture that is experiential in character, a set of design principles specific to the Sydney Opera House can be identified.

The following principles are described in quotations by Utzon and illustrated where appropriate.

THE BUILDING AS SYMBOL

THE BUILDING AS SCULPTURE

FORM AND FUNCTION

ORIENTATION AND MOVEMENT

COUNTERPOINT

ADDITIVE ARCHITECTURE

- **ELEMENTS**
- **PRE-FABRICATION**
- **GEOMETRY**

STRUCTURAL EXPRESSION

MATERIALS

COLOUR

LIGHT

ACOUSTICS



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THE BUILDING AS SYMBOL

Cultural symbol

“Everyone was working hard to fulfil the wish of Premier Cahill to give a marvellous cultural centre to the citizens of Sydney.” (2)

“The conception and the design of the Sydney Opera House is based on... the desire to create a building which will form a home for those activities essential to the cultural life of a big city.” (3)

Symbol of the Australian Spirit

“The Australian spirit is actually mirrored in their creation of the Sydney Opera House: this could not have taken place anywhere else in the world. It is the drive behind the ‘We want to do things our own way’.” (1)

“The people of Sydney have made the Opera House a signature for Sydney, which you see everywhere in the world in different editions...”

...but nobody is ever in any doubt that this means Sydney and this means Australia.” (1) “In my opinion, a situation such as this, where a new building is having a great impact on a city is a very rare thing.” (1)

Inspiration to artists

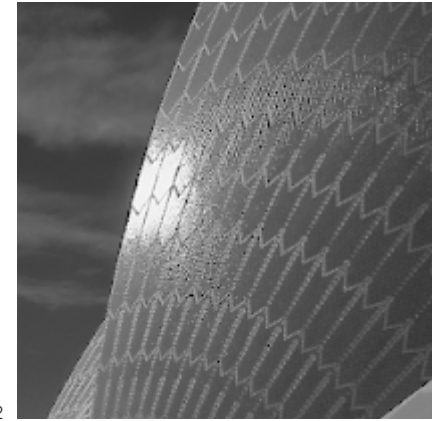
“When completed, the Sydney Opera House will serve as a home for the cultural activities of the city and will inspire artists and technicians to present to the public the highest quality performance for many years to come.” (3)



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THE BUILDING AS SCULPTURE

Iconic presence being free in Sydney Harbour

“The character which is most prominent about the Opera House is it’s being free in the centre of the Sydney Harbour, free from all sides, visible from all sides.” (1)

“Helsingør and Sydney are in the same situation where you have a distance between the city centre and the landmark building.” (1)

“...I happened to live near the castle of Kronborg, situated in a similar position with similar surrounding between two coasts of Denmark and Sweden.” (2)

Large sculptural building seen from all sides

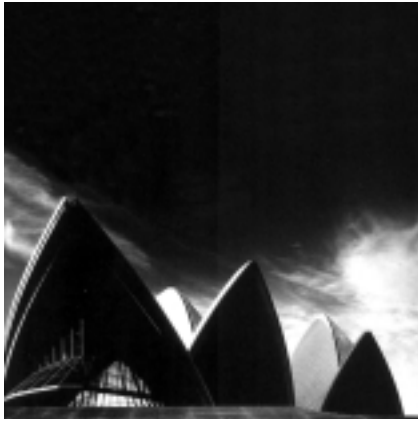
“With Kronborg in mind I was convinced that a new building in such a position as to be seen from all sides, had to be a large sculptural building.” (2)

Sculpture in contrast to surrounding buildings

“The position on a peninsula, which is overlooked from all angles makes it important to maintain an all-round elevation...the building must form a free-standing sculpture in contrast to the square buildings surrounding it.” (3)

Sculpture captures and mirrors the sky

“It is important that such a large white sculpture in the harbour setting catches and mirrors the sky with all its varied lights, dawn to dusk, day to day, throughout the year.” (2)



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Sculpture of dynamic forms

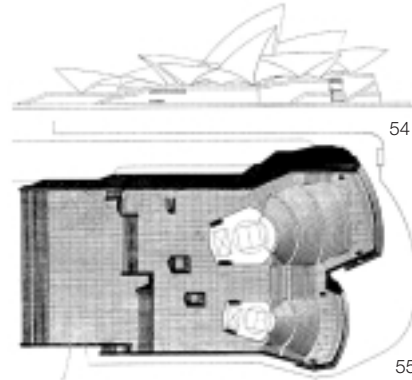
“In this way very sculptural shapes were arranged side by side, so one gets a varied picture of the complex, according to which way you move around in or around the structure.” (2)

“The patron or tourist will see the shells from below as an expanse of curved wall changing constantly.” (3)

Experiences

Referring to ascending the staircase:

“Then you see only the tops of the shells you look into the sky then you come up, and more and more you read the shells and it’s a very beautiful thing you don’t have skyscrapers on the other side.” (4)



FORM AND FUNCTION

Functional concept of base and shells

“The separation between the two components (base and shells) is also dictated by the functional conception.” (3)

“The mechanical parts of the theatre and the patrons areas, where they can move about freely without any stage interfering with or even being aware of the existence of the other part.”

“Within its mass (the plateau), could house all the facilities for preparing the performances with stage sets etc.”

“The audience and the performance itself, all taking place on top of the plateau.” (2)

Possibilities for all types of cultural performances

“The Sydney Opera House with its three theatre stages offers a possibility for all levels of cultural performances. There are only a few houses in the whole world which are similarly designed.” (3)

Plateau 12 metres to House stage set

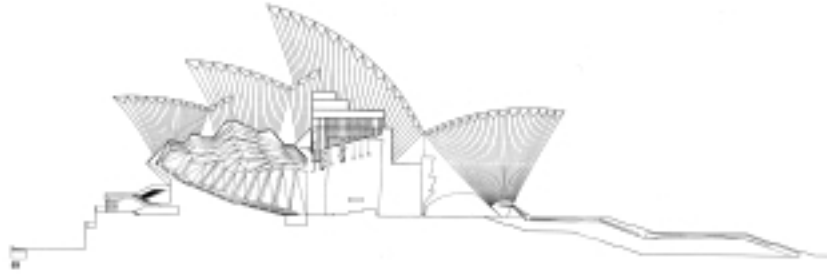
“The plateau was made 12 metres high so it was possible to have the full stage height below the stage-level, for arranging the sets prior to their being sent to the stage.” (2)

Plateau functions as meeting place and auditorium

“This plateau also functions as a gathering place, a town square and outdoor auditorium.” (2)

“Another source of inspiration I got from an early visit to the Yucatan Peninsula in Mexico.

When they build their temples, there are often placed on large platforms with wide stairs leading to the top of the jungle canopy.” (2)



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Shell follows height of various functions

“The foyer, the auditoria, the stages and stage towers were solved by covering these functions with large concrete shells, which follow the height of the various functions.” (2)

Acoustic shape determined by sound and how audience would see it

“The acoustical shape was absolutely clear, both in sound and in the way that you would observe it as an audience.”

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ORIENTATION AND MOVEMENT

Oriented in harbour setting

“People approaching, walking up the stairs and entering the auditoria are all the time oriented in the beautiful harbour.” (1)

Simple, easily understood tour

“In the Sydney Opera House you are aware of your orientation at all times. It is important that each member of the audience has a simple, easily understood tour, from the entrance to his or her seat and out again.” (2)10

“All problems regarding fire and fire staircases are solved in a similar comprehensive manner.” (2)

Entrances face city

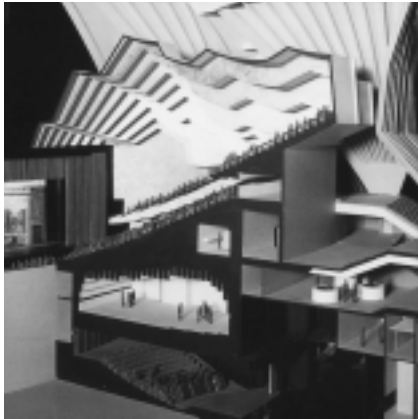
“Two halls, placed side by side, to avoid the necessity of passing one hall to get to the other. Both entrances are facing Macquarie Street and the city.” (2), (3)

Outdoor auditoria with city backdrop

“This outdoor auditorium created by the grand staircase is of course part of the townscape and is also very dependent upon what goes on elsewhere in the city. Because as you sit on these stairs you look towards the city, and you have the city and its buildings as a background to whatever happens on the forecourt.” (1)

Ornamental curtain defines separation of stage and auditorium

“For the Minor Hall, the ornamental curtain for the stage is rolled vertically in a large glass cylinder, which can be seen from the foyer. This way the patrons will be able to actually see the separation between the stage and the auditorium.” (3)



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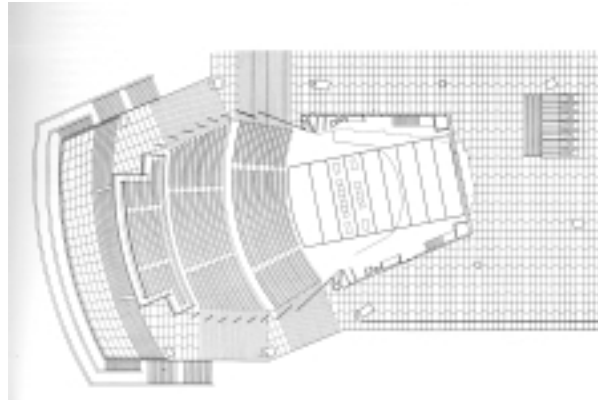
Hall shape oriented to stage

“The halls acoustically had a shape that was oriented towards the stage.” (2)

“The layout of the halls consists of a series of radial sections all fanning out from a focal point in the stage area.” (3)

Approach, openness, fluidity of peoples' movement

“One of the great features of the Opera House is the approach, the openness, the fluidity of people's movement through the house.” (1)



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Succession of visual and audio stimuli

“So going to the Opera House is a succession of visual and audio stimuli, which increase in intensity as you approach the building, as you enter and finally sit down in the halls, culminating with the performance.” (2)

Podium headland influence

Referring to Sydney Sandstone headlands:

“Where you walk uphill as you approach the sea to the edge of an escarpment falling away to the beach and sea below. As you approach the edge you look up into the empty sky, and only at the very last moment are you able to get a magnificent view of the sea.” (2)

Human experience

“As in large cathedrals the Opera House is functional in the sense that people have a beautiful experience entering and walking up the stairs and entering the auditoria.” (2)

Imaginary tour

“In order to fully appreciate the outside appearance of the building as well as the materials and the reasons for selecting them, it is proposed to undertake an imaginary tour around the structure as completed.” (3)

Walk in open up to entering auditoria

“The ideal way of approach and exit would be by ferry.” (3)

“For patrons arriving on foot, it is possible to walk in the open right up to the moment they will enter the foyers of the Auditoria.” (3)

“It is very important that the audience does not enter and walk through the building along dark corridors to a dark hall.” (2)

“We now pass beyond the back stage wall around the stage proper and up flights of stairs to the Major Hall and to filter back into the hall itself.” (3)

Spacious car access

“For those arriving by car, there will be a spacious area under the concourse with 6 driving lanes. The patrons will be discharged on to the curb under cover to the 4-stair access leading into the building.” (3)

Disabled access

“For patrons unable to walk, there will be provided special elevators to take them direct to the auditorium level in the vicinity of the seating.” (3)

“A total of ten lifts will service the Opera House, each lift being carefully located for a specific purpose. Lift No.1 with landings at the 12', 30' and 42' levels has a primary function of transporting disabled persons from ground floor level to the auditorium level. (Major Hall).” (3)

“Lift No.2 in the stage area (Minor Hall) has the primary function of carrying a total of 16 disabled persons from ground level to auditorium level with one intermediate stop.” (3)

Flow of corridors reflect movement

“Aesthetically we get the flow of the corridors reflected in the rhythm of the movement of the elements.” (3)

“Here again, we see the architects philosophy and if humans circulate around a building through corridors, so also your services do the same thing, and instead of making a door access from a corridor to a room for humans only and a separate hole pierced in a wall for access of services. The door is extended above the functional height for humans to accommodate the services.” (3)



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COUNTERPOINT

Building and surroundings

“It is the interplay between the building and its surroundings... that is important.” (1)

Contrast white with brick and tile structures

“Keep it white”, because the Harbour (surrounding buildings) is dark, with all its dark, red or brown brick structures.” (2)

Sculpture and square buildings

“The building must form a free-standing sculpture in contrast to the square buildings surrounding it.” (3)

Plateau and shells

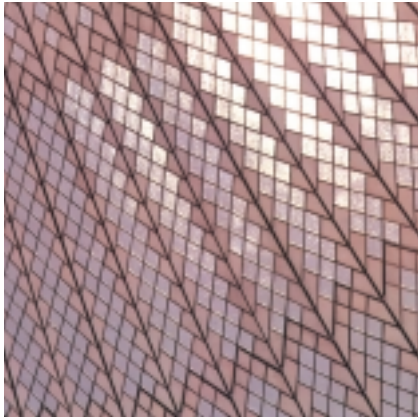
Counterpoint between the plateau and the roof is strong. The heavy mass of the plateau and the light sculptural roof. (2)

Heavy and light

“The difference in character of the two components forming the building, the massive and imposing base, and the light and graceful shells on top of it...” (3)

Referring to the paving:

“...its uniformity with the cladding will help to give the rock-like character desired for the base, as a contrast and anchor to the soaring roofs.” (3)



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Matt and gloss

The precast granite elements are needle hammered to give a slightly matt surface in contrast with the shiny roof tiles. (3)

Neutral and rich colours

Exterior colours were nature's colours. Within this landscape you had the halls which were to be richly decorated in festive colours. (2)

Open and closed

"As you walk around the foyer you have the full unimpeded view of the Sydney Harbour. You get a fantastic feeling of openness and space after being inside the auditoria. (2)

Exterior shells and acoustic shells

"The acoustic shells were free of the covering roof - the shells." (2)

Dark and light

"Minor Hall was programmed for theatrical productions which require a relatively dark or subdued colour scheme and the Major Hall was to be used for Grand Opera and concerts with an optimistic, lighter colour scheme." (2)

"The theatre darker and warm the concert hall more cold and light plywood." (4)

Outside and inside

"Each rehearsal room is treated in the same way as the hall, that is, we have the structure withholding the outside elements and inside we have a complete box to retain the sounds produced internally." (3)

Building and furniture

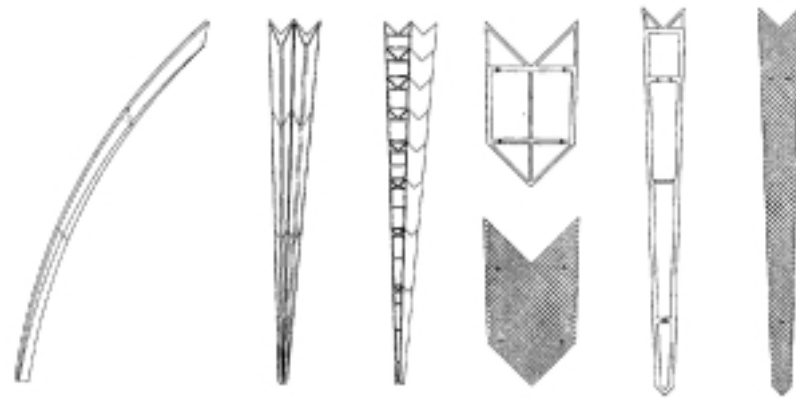
Referring to plywood panels surround the whole of the stage tower:

"This emphasises the stage tower as being part of the machinery a piece of furniture placed under the shell." (3)

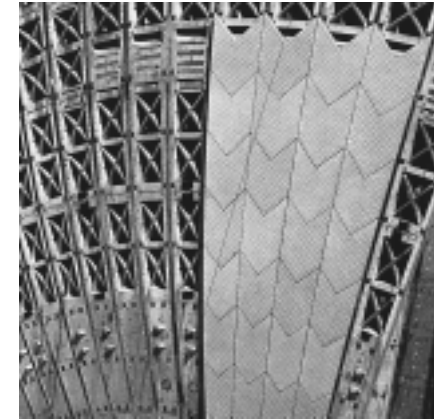
Concrete and ply

"The walls will show the concrete as it was constructed, contrasting with the moulded plywood panels which form the components of the furniture and fixings." (3)

"The cubicles themselves for coats and toilets are made of moulded plywood panels in contrast to the impression of severity left by the structure." (3)



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ADDITIVE ARCHITECTURE - ELEMENTS

Expression of elements, produced industrially

"The exteriors of the building stand as an expression for something basic in the concept - the idea of dividing the various parts up into equal components, which can be produced industrially and afterwards put together to form a structure of the desired form." (3)

Shells sub-divided into ribs

Referring to spherical geometry:

"Now the shells could be sub-divided into ribs, which again could be divided into smaller elements, which could be cast within formwork representing the largest rib-entity." (2)

More richly varied

"Where the elements that are decorated in a certain way when put together give much more richly varied surface structure than would be if it had been a simple smooth surface." (2)

Reference to nature

"Or you see it in various cross sections of nature's elements - if you cut across an onion you see the different layers." (2)

Geometry

"The wall cladding elements are nominally 4' wide and of varying lengths to 30'... over doors, windows and ventilation openings, there are special elements forming hoods for sun and weather protection. There are other variations of the basic element type forming sills, jambs, parapets, and stair balustrades." (3)

Same form - harmony and uniformity

“These dimensions are important... kept the same throughout all plywood elements used in the buildings, giving the necessary uniformity and harmony.” (3)

Colour in harmony geometric concept

“In the plateau, the ceiling of structural ribs are shaped so they elegantly express the forces with the structure. They express the harmony in the structure.” (2)

“By using this same form we have harmony and uniformity throughout giving the intrinsic whole to the building.” (3)

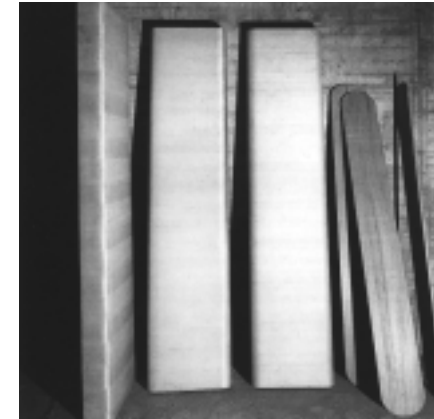
“The plywood construction will be decorated according to an idea which will bring the changing colours into harmony with the geometrical concept.” (3)

Harmony/uniformity giving intrinsic whole to building

“We can see the use of the same tools for the forming of the curves but extended or reduced as required to obtain the physical size of the panel. By using this same form we have harmony and uniformity throughout giving the intrinsic whole to the building.” (3)



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ADDITIVE ARCHITECTURE - PRE-FABRICATION

Machine-made components basic in concept

“The exteriors of the building stand as an expression for something basic in the concept... in other words the use of machine made components in the building industry.” (3)

Concept in control of machine

“As he works with a machine that has no intrinsic thinking capacity, he must devise a manufacturing process for the machine.” (3)

Modular coordination/ standardisation

“According to our way of working the glass panels were to be of equal size, facilitating production.” (2)

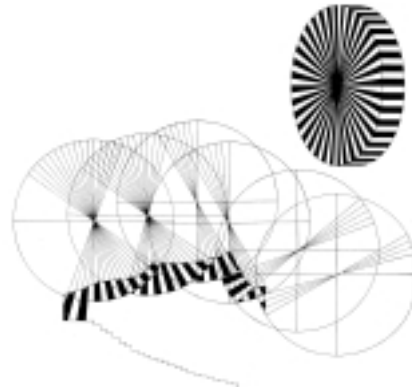
“We must find the machines to make our components and devise some means to put these elements together only limited to the size and weight of our mechanical age to erect them.” (3)

Practical limits (size and weight) commercially produced dimensions

Referring to ply cubicles, ply beams, over rehearsal rooms, ply panels in corridors, canopy part of glass walls:

“Therefore a system was developed which made it possible to make all the glass walls within a certain module and with glazing panels in commercially produced dimensions.” (3)

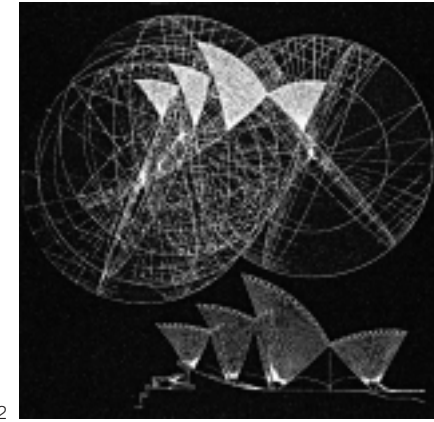
“The cubicles themselves for coats and toilets are made of moulded plywood panels...the form of the individual cubicles is within the scope of the maximum and minimum capabilities of manufactured moulded plywood panels.” (3)



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ADDITIVE ARCHITECTURE - GEOMETRY

Common geometric determinant

"Initially, no definitive geometry for the shells had been established but, as work progressed, the shells were developed according to a spherical geometry and we suddenly had a common denominator, the same spherical surface to deal with, with a similar curvature throughout." (2)

Under control by strict geometry

"...the only way to attack the ...major parts of the building would be to bring them under control by a strict geometry and then divide them into uniform components, which can be produced by machine under strict control both as regards dimensions and quality." (3)

Surfaces comprehended because of geometric order

"All large surfaces are easily read or comprehended because of the geometric order." (2)

Simple living geometric forms

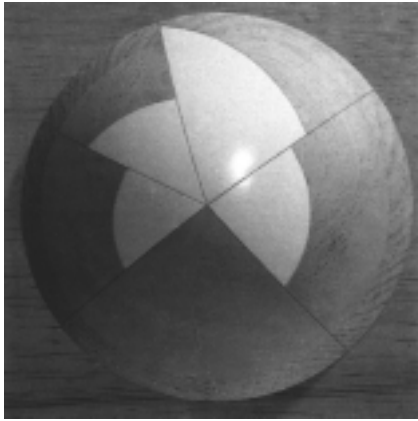
"The shapes of the shells give the building its character, which is emphasised by the fine lines defining the form of the curvature as the seams in a billowing sail."

"...from these viewpoints (broadwalk) the lines will assist his appreciation of the simple, yet living geometrical forms which otherwise might escape his comprehension." (3)

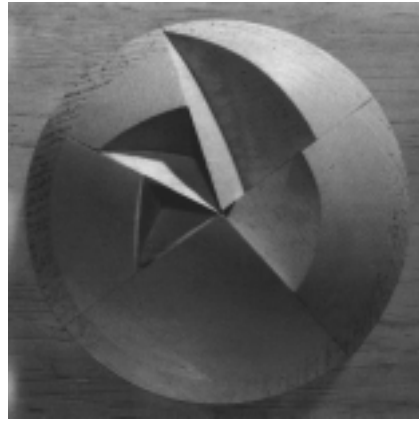
Layout of halls based on strict geometric system

"Like the other components - the shells, the glass walls etc. - the layout of the halls is based on a strict geometrical system. The layout consists of a series of radial sections all fanning out from a focal point in the stage area." (3)

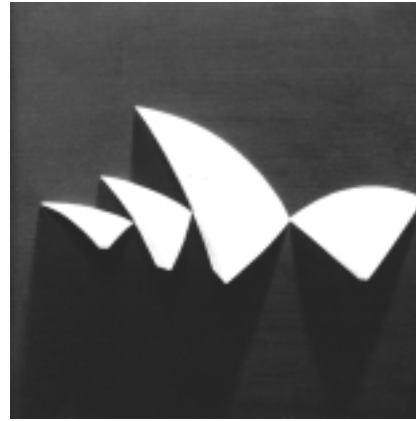
"On the northern glass walls the sweeps are controlled by the geometry of an intersecting cone-system." (3)



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Opens possibility for mass production

Referring to spherical geometry:

“Was an elegant solution to a construction, which would otherwise have had to be done with a large amount of scaffolding and shuttering, both for the interior and exterior shape of the shells.” (2)

Pre-fabrication

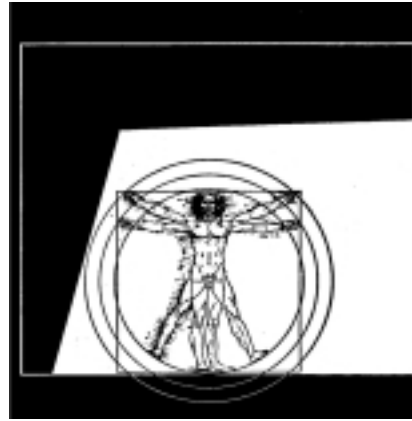
“The clearly defined geometry of the hall opens the possibility for producing all the components in mass-production”. (3)



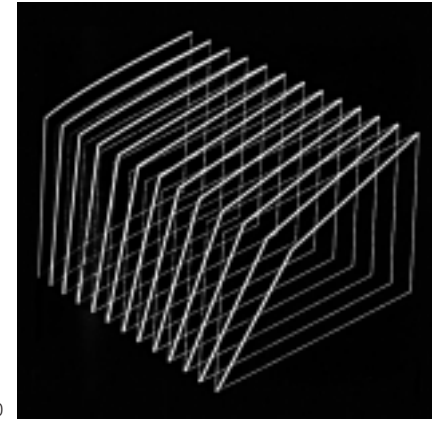
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Geometry opens possibilities for mass production

“The ceiling is suspended from the roof structure in the middle but instead of using straight infilling panels as in Major hall, the Minor Hall ceiling is made of plywood panels moulded to a standard curvature, a part of a cylinder with a constant radius this construction lends itself equally well to prefabrication.” (3)

“The clearly defined geometry of the hall opens the possibility for producing all the components in mass-production, in other words, the whole hall can be manufactured in small units to pre-determined tolerances and be assembled afterwards inside the building like a 3-dimensional jigsaw puzzle.” (3)

Referring to Minor Hall:

“The furniture for the Minor Hall will be designed on the same basis as for the Major Hall so as to take maximum advantage of the prefabrication.” (3)

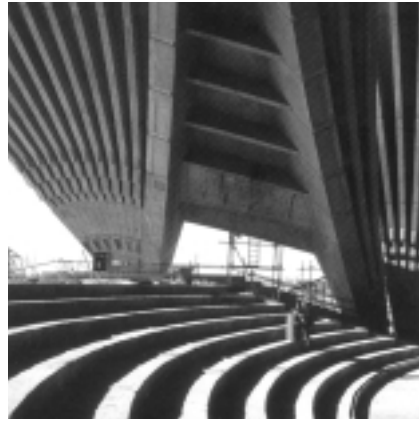
“This construction lends itself equally well to prefabrication, since one mould will be able to produce all the panels to the required length.” (3)

Referring to plywood panels to corridor walls:

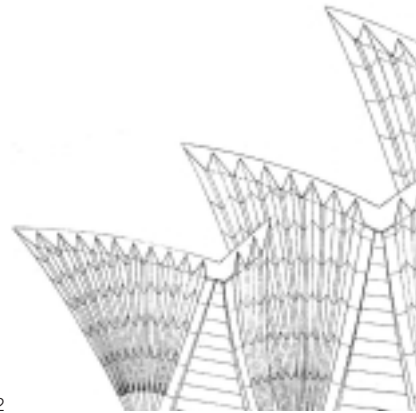
“These panels are approximately 16 inches wide returning around a 2 inch radius approximately 5 inches. These dimensions are important, as they are the limit of the manufacturing process, which is kept the same throughout all plywood elements used in the building. Giving the necessary uniformity and harmony.” (3)

Referring to ply corridor lining:

“Thus mass manufacturing production of simple elements gives an economical solution providing the required aesthetics and with ease of access for maintenance.” (3)



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STRUCTURAL EXPRESSION

Structural expression and architecture

“The Architecture with the ribs is much more expressive than if the shells had been cast in-situ, with the resulting flat constructed surfaces.” (2)

“The top surface of the shells is covered with a weatherproof membrane, a series of precast panels matching the rib segments and covered with white glazed tiles.” (3)

“By sub-dividing of the tile surface into glossy tile lids, with matte tiles at the edges. I achieved my aim, to have the structure expressing the architecture and vice-versa. You find a similar situation in Gothic cathedrals.” (2)

“The Sydney Opera House has the same ambience as large cathedrals.” (1)1

“You find a similar situation in Gothic Cathedrals, where the structure is also the architecture. The same is seen in Chinese and Islamic architecture, although with different expressions.” (2)

Plateau beams express forces

“This effect was also developed for the base or plateau...as I wanted an open area with a ceiling of structural ribs. These ribs are shaped so they elegantly express the forces within the structure.” (2)

Sculptural effect

“The soffit of the podium will form the first impression of the building from this approach. This surface... shows the marked sculptural effect of the concrete folded beams spanning 165’.” (3)

Spans expressed by ribs and folds

“This resulted in a building where all spans are clearly expressed by ribs and folds.” (2)

Exposing materials

Referring to the patrons' way to the halls:

"Exposing all the time the carefully selected materials, which it is built of." (3)

Acquire patina without changing character

Referring to external materials:

"All the materials are non-corrosive, weather resistant, durable and will age and acquire a patina without changing their character. Thereby preserving the character of the whole building through the ages." (3)

Weathering

Referring to the finish on precast granite panels:

"A process of needlehammering is carried out, giving a slightly matt surface which should also have the advantage of weathering evenly." (3)

Materials define geometric concept

"The concrete stands with an even and precise surface and the sharp and straight edges clearly define the geometric concept." (3)

"We can see through the glass to the underside of the concrete ribs of the first shell... finished in smooth concrete with sharp arrises, emphasising the towering form of the high shell and requiring no further treatment or maintenance." (3)

Retain visual quality

Regarding tiles:

"This gave a surface which had a beautiful lustre or sheen, a surface that would retain its visual quality even when the tile became dirty." (2)

Natural materials

"...the raw tile is painted with a sauce or slick of the same material, is fired and overlaid with a glassy, transparent glaze before it is fired the final time." (2)

Natural colours and modular

"The walls will be covered wholly or in part by modular sized moulded plywood panels, finished in the natural colour of the wood." (3)

Simplicity in number of materials

"The finish on paving steps and skirting is identical with the finish on the cladding. It is a fine non-slip and durable finish entirely suitable for pedestrians and traffic..." (3)

Materials serve to underline ideas in planning

"As in the exteriors, the materials internally will serve to underline the ideas in the planning." (3)

COLOUR

Natures colours

“In my project for the Sydney Opera House I had what you would call nature’s colours on the exterior”

That was the general idea-concrete, granite and ceramics. (2)

White shell as contrast

Refers to the shell colour:

“Keep it white because the Harbour (surrounding buildings) is dark, with all its dark red or brown brick structures.”

Colour reinforcing human spatial experience, movement

“So you have a culmination of space, of colours when you are at the meeting place between the performers and the audience. So going to the Opera House is a succession of visual and audio stimuli.” (2)

“The idea was to see a spectacular building as you arrive and as you enter the foyers you see additional colours. You also get a more intimate feeling.” (2)

“As you enter the Minor or Major Hall this explodes into a very rich expression of colours, which uplift you in that festive mood, away from daily life, that you expect when you go to the theatre, a play, an opera or concert.” (2)

Counterpoint major/minor inside out

“The theatre darker and warm, the concert hall more cold and light plywood.” (4)

Lighting compatible precinct

“The Major Hall was to be used for Grand Opera and concerts with an optimistic, light colour scheme.” (2)

“The Minor hall was programmed primarily for theatrical productions, which require a relatively dark or subdued colour scheme for the auditorium.” (2)

Colour in transition different from daily colour

“These moments are short (early morning and sunset) and in the openings of my mind, I thought in a different way than the daily colour and when we meet for performances we are together to be moved in our minds and in our soul and experience what comes into our minds. And these colours would support that, and it would be oriental.” (4)

Referring to Chinese art:

“Look here, these kinds of colours are very different from outside, only inside you have it in the caves and in the temples colours which are always on the edge of being cream to yellow and red to orange.” (4)

“The Chinese Buddhists paintings, here’s one that gives me a feeling of what it would be like to be inside the theatre. There is also the tradition in Europe of red velvet seats at that period.” (4)

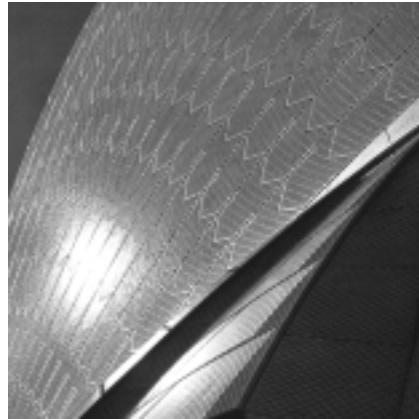
Colour expressed geometry and function

Referring to painting different parts of geometry of construction:

“If you cut across an onion you see the different layers-it’s the colours which again leads your thoughts back to the complete item, in the same manner of expression when the elements that one decorated in a certain way when put together give more richly varied surface structure than would have been if it had been a simple smooth surface throughout with a single flat colour.” (2)

Practical glare

“I agree (white outdoor furniture is wrong because only the sails should be white). Because white is no good for outdoor furniture as my eyes can’t tolerate white when I eat.” (4)



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LIGHT

White sculpture - catches the sky's varied light

"It is important that such a large white sculpture in the harbour setting catches and mirrors the sky with all its varied lights, dawn to dusk, day to day, throughout the year." (2)

Light to accentuate architectural form

"You can light a sphere in such a way that you accentuate its form, or you can light it so it will appear to be flat." (4)

Flood light through experimentation

"It is proposed to flood light the shells...successful flood lighting can only be achieved through experimentation on the surfaces concerned." (3)

Light to flatter human form of skin and hair

"To give life to the skin and hair on the human form in much the same way as the light from candles." (3)

Generally indirect with custom designed fittings

Referring to public and working areas:

"Lighting in these areas will be generally of an indirect nature although there will be situations where specially designed direct lighting fittings will be necessary." (3)

Sculptural effect accentuated by light

“Here, the soffit of the podium will form the first impression of the building from this approach, this surface emphasised by lighting, shows the marked sculptural effect of the concrete folded beams.” (3)

Concealed handrail lights

“The podium and podium steps will be lit through a system of lights concealed in the handrails.” (3)

Referring to roadway under podium:

“A special system of low level lighting has been developed which will produce a safe and attractive system of lighting to enable the mixing of pedestrians and vehicles.” (3)

Lighting compatible precinct

Referring to Major Hall:

“the broadwalk lighting of necessity must be compatible with the lighting in approach roads.” (3)

“Fittings for indirect lighting will be placed in the ceiling.” (3)

“Light fittings for Auditoria and Rehearsal Rooms must be of necessity designed in close collaboration with the acoustical engineers.” (3)

Minimise reflections/ maximise view

“Before lighting in the public lounges and bars can be finalised experiments must be carried out to ensure that internal lighting reflections on the glass walls do not destroy the night view of the harbour.” (3)

Concealed fittings - wall panels

Referring to bar and lounge areas:

“The walls will be covered wholly or in part by modular sized moulded, plywood panels, finished in the natural colour of the wood. The panels are stopped short of the ceilings and the floors, where they form a continuous fitting for concealed lights.” (3)

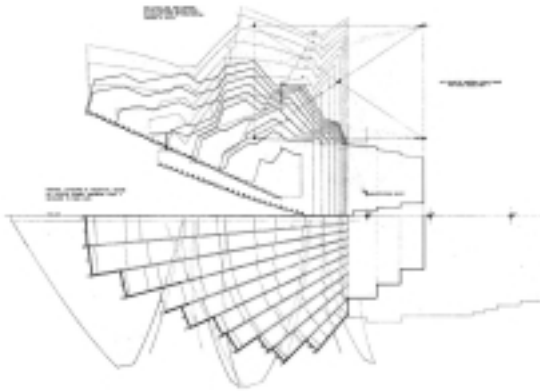
Lights integrated module of panels

Referring to toilet areas:

“The 3” gap between the ceiling and wall elements are partly for ventilation and partly for lighting. Light tubes are fixed above, giving a uniform indirect light to the rooms which can be dimmed just before the curtain goes up in the theatre.” (3)

Referring to corridor lighting:

“By the use of a dark colour above the slats and high intensity of lighting between the slats combined with their depth one will not normally be able to see any of the services above.” (3)



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ACOUSTICS

Two purposes - exclude noise/reflect sound

Referring to the overall shape of the hall:

“The walls and ceilings serve two purposes, namely: -

- a) to exclude all noise from the outside
- b) to reflect the sound from the orchestra. (3)

Acoustic shape clear both in sound and in the way you would observe it

“The acoustical shape was absolutely clear, both in sound and in the way you would observe it as an audience.” (2)

Halls oriented toward stage

“The halls acoustically had a shape that was oriented towards the stage.” (2)

Person in back row should have as good a sound reception as in front

“Ideally the person at the back row should have as good a sound reception and impression of what goes on the stage as the person sitting 10 rows back from the stage.” (2)36

Multi-purpose

“The hall serves several functions, as a concert hall it will hold 2800 people with the musicians (110) positioned in the fore-stage area and with a plywood sound reflecting shell above. This shell can be dismantled, and stored away when not in use.” (3)

Ideal not to adjust sound

“That the ideal concert hall is a hall, which is shaped in such a way that you do not have to adjust the sound with absorbents. By doing so you kill off some of the sound energy, whereas if you retain the brilliance you have much more sound energy travelling to the audience.” (2)

Like violin - evolution toward perfection

Referring to the concert hall:

“It is like a violin - it has its shape because of its long evolution and it has attained that shape, through evolution towards perfection...” (2)

Relationship sound and plywood length

“So rather than changing the acoustics by absorbing certain unwanted sounds or frequencies it is better to adjust the physical shape of the hall in such a way that you achieve the perfect acoustical properties.” (2) .

Box within structure principle

“The sound reflecting effect is achieved by using large unsupported membranes of plywood which have proved superior to the conventional small size panels since the latter do not reflect the deepest notes from orchestral instruments.” (3)

Advanced plywood technology

“It therefore eliminates any convected noises through the building and allows the ceiling to reverberate in harmony with the sound produced within the room. It can be seen then, acoustically these light long spanning elements are ideal...moulded to the shapes required by the geometry, and laminated with almost any material to obtain the desired density for sound absorption and reverberations.” (3)

Each rehearsal room is treated in the same way as the hall, that is, we have the structure withholding the outside elements such as rain and sound etc. and inside we have a complete box to retain the sounds produced internally.” (3)

Referring to the Major Hall:

“The sound dampening effect will be achieved partly by the weight of the trusses or ceiling panels themselves, increased if necessary by laminations of lead, and also by filling in the open space between the sheets with mineral wool or other sound deadening material.” (3)

Movable ply screens and acoustic screens for flexibility

Referring to reducing the stage opening when hall is used for Opera:

“...Sight-lines for some of the seats in each side of the hall will be impeded. These seats will therefore be cut off by means of plywood screens rising from the floor to a certain height, at the same time serving acoustically as a sound reflecting screen.” (3)

“For the purpose of congress, the foremost part of the stage area can be brought into use of seating and the hall will seat more than 3000 people. In this case, the acoustical screen used for symphony

3.4 PROCESS



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Jørn Utzon's process of design integrating drawings, model samples, prototypes, materials research and close collaboration with manufacturers is central to our understanding of his work.

The following quotations illustrate this point.

One solution dependant on another

"This solution (the tiling) was again depending upon the solution of how to construct the shells themselves. So as was often the case, one solution was depending upon the other and vice-versa." (2)

Lateral approach - harmonious building

"Whenever an obstacle was encountered we often had to change tack completely to find another way to solve the problems." (2)

"The fact that the engineers and we were open for new possibilities, even though that meant rejecting the old solutions, was instrumental in making this a noble and harmonious building with a very forceful architectural expression." (2)

Design and construction in parallel

"...so construction began at the building site a long time before we had completed the drawings, and construction drawings were being produced just ahead of construction as the building grew." (2)

"We made the working drawings just ahead of the actual construction going on at the building site so therefore development was not very far ahead of what was actually going on at the site at any one time." (2)

Background of ship building

"I of course had the marvellous thing that we had the shipyard adjacent... You see big ships being built with the ribs etc. In the shipyard small men made one big steam ship every six months and you would see the whole process." (4)

Referring to the major events in the manufacturing of the mullions

"Cutting the layers to shape and placing them after the architect's set-out drawings-an operation similar to the technique used on a shipyard." (3)

Research into capacity of machine

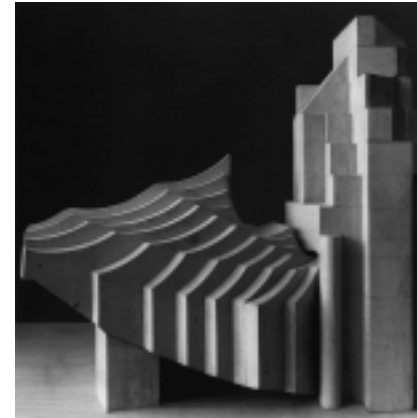
“The architect therefore has researched into the maximum capabilities for economical reasons of factory production and having found the scope of minimum and maximum capacity of the machine, he works within this discipline.” (3)

Materials research

“Even very well known materials have been subject to several years of special research before the architect was satisfied that the resulting product was the best possible for its use.” (3)

Full-size mock-ups - as both design and construction tool

“These concrete/granite elements were produced as prefabricated elements after a full size mock-up had been made, with various openings presented so that everything could be checked before final decisions were made. This is again an example of the importance of the full sized mock-up as a tool for determining the best solution for the building.” (2)



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Models

“The planning comprises even the smallest detail and is carried out in an unorthodox manner, where the maximum use of models and prototypes secures that nothing is introduced into the scheme, before it has been carefully investigated and has proved to be the right solution to the problem.” (3)

Mock-up to solve problems

Referring to hall interiors

“...we need to make full-scale models of parts of this structure to ensure that the proposed details and colours are correct.” (2)

“It was impossible to determine the geometry of the tiling until full-size mock-ups had been made.” (2)

“Mock-ups were important tools which, together with the drawings, enabled us to solve specific problems.”

“For instance the first mock-up for the tiling clearly showed that our initial solution did not work.” (2)

“We arrived at the various solutions for corners, materials, details and colours, through a combination of drawings, models, samples and mock-up, always trying to select the finest solutions for this building and for my client.” (2)

Work in collaboration with manufacturer

Referring to wall cladding:

“These construction and finishing techniques were developed in collaboration with a manufacturer over a period of 18 months and involved the preparation of many samples and the construction of full size mock-ups, before a result suitable to the rigorous requirements of the architect could be achieved.” (3)

Referring to glass walls...

“...mock-ups of vital connections and details have been and one still being produced in cooperation with specialist manufacturers.” (3)

Running in period

Referring to Major Hall:

“The main shape will be fully tested in a model and necessary variations in respect of surface reflection can later be made by changing the surface materials during the 6-months running-in period after the completion.” (3)

“...these lights will be installed in carefully selected places based on knowledge gleaned from experimental work.” (3)

Experimentation

“Successful flood lighting can only be achieved through experimentation on the surface concerned.” (3)

Quotation references

1. Jørn Utzon, ‘Sydney Opera House, The Setting’ 5 May 2000
2. Jørn Utzon, ‘Sydney Opera House’ 4 June 2000
3. Jørn Utzon, ‘Descriptive Narrative, Sydney Opera House’ January 1965
4. Jørn Utzon, Jan Utzon and Richard Johnson, ‘Private Records of Discussion’ Mallorca, April, October & November 1999

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- 52 Panoramic View of the site at the time of Utzon's Departure, 1966, photo.: Max Dupain
- 53 Vault Cladding, detail, photo: Dennis Wolanski Archive of the SOH, Sydney Opera House Trust
- 54 Sculptural Form, Roof Shells, photo: Dennis Wolanski Archive of the SOH, Sydney Opera House Trust
- 55 East elevation and Concert Plan, 1956, Jørn Utzon, Competition Entry, Yellow Book, Mitchell Library, State Library of NSW.
- 56 Aerial view, Opening of SOH, 20 October 1973, photo: Dennis Wolanski Archive of the SOH, Sydney Opera House Trust
- 57 Longitudinal Section, Major Hall with Timber Ceiling, Jørn Utzon, Yellow Book, Mitchell Library, State Library of NSW.
- 58 Presentation model, Concourse view, 1964, photo: Max Dupain
- 59 Opera House On Bennelong Point, photo: David Moore
- 60 Sectional model of Major Hall, 1965, photo: Max Dupain
- 61 Upper Floor Plan, Major Hall, Jørn Utzon, Yellow Book, Mitchell Library, State Library of NSW
- 62 Sydney Opera House on Bennelong Point, photo: Max Dupain
- 63 Clouds over the sea, Jørn Utzon, illustration for 1962 essay, Platforms and Plateaus, 'Zodiac No. 14', Mitchell Library, State Library of NSW
- 64 Preliminary sketch of vaults of the SOH, Jørn Utzon, illustration for 1962 essay, Platforms and Plateaus, 'Zodiac No. 14', Mitchell Library, State Library of NSW
- 65 Detail of Roof Tiles, 1994, photo: Anthony Browell : Dennis Wolanski Archive of the SOH, Sydney Opera House Trust
- 66 Longitudinal Section, Major Hall with Timber Ceiling, Jørn Utzon, Yellow Book, Mitchell Library, State Library of NSW
- 67 Precast Spheroidal lid element principles of the vaults, Jørn Utzon, Yellow Book, Mitchell Library, State Library of NSW
- 68 A partially-tiled vault, photo: Max Dupain
- 69 Storage of pre-fabricated tile lids, 1964, photo: Max Dupain, Zodiac No. 14, Mitchell Library, State Library of NSW
- 70 Panel types, photo: Max Dupain, Zodiac No. 14, Mitchell Library, State Library of NSW
- 71 Geometric Principles for Acoustical Reflectors, Minor Hall, Jørn Utzon, Zodiac No. 14, Mitchell Library, State Library of NSW
- 72 Geometric Principles for Acoustical Reflectors, Minor Hall, Jørn Utzon, Zodiac No. 14, Mitchell Library, State Library of NSW
- 73 Final shell geometry, 1961, Jørn Utzon, Yellow Book, cover, Mitchell Library, State Library of NSW
- 74 Presentation model of spherical solution, Dennis Wolanski Archive of the SOH, Sydney Opera House Trust
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- 88 Minor Hall, wooden model of the solid volumes, photo: Max Dupain

