A NATIONAL OPERA HOUSE
FOR
SYDNEY AUSTRALIA

Submitted in partial fulfillment of the requirements for the degree
Master of Architecture

20th August 1956

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ABSTRACT

A National Opera House for Sydney Australia
by
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Submitted for the degree Master of Architecture in
the Department of Architecture and Planning, August 20th 1956

This thesis proposes a solution to the competition currently
being promoted by the Government of New South Wales, Australia, for
a National Opera House in Sydney.

The problem involves the design of a building comprising principally of two auditoriums, one to seat 3000-3500 and the other 1200 persons; each with fully equipped stages, to be used for a variety of purposes. Together with these there are all the usual ancillary facilities.

The site, Bennelong Point, a promontory in Sydney Harbour is in the words of the promotors "An outstanding site and should prove a worthy setting for an Opera House possibly unrivalled anywhere in the world".

Again in the words of the promotors "The competition is intended to select an architect and a design for the proposed new Opera House. Competitors should appreciate that it is unlikely that the winning scheme would be erected without variation and that in consequence, the promotors seek a sound basic scheme by a competent architect".
20th August 1956

Pietro Belluschi, Dean 
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Cambridge, Massachusetts 

Dear Sir,

In partial fulfillment of the requirements for the degree 
Master of Architecture, I herewith respectfully submit my thesis, 
"A National Opera House for Sydney, Australia."

Sincerely yours,

Derek Anthony Cobb 
216 Beacon Street 
Boston 16, Massachusetts
ACKNOWLEDGEMENTS

In submitting this thesis I would like to thank for their kind assistance and helpful criticism Dean Belluschi, Professor Anderson and the members of the staff of the school, Professor Robert B. Newman, Mr. Paul Rudolf, Mr. Minoru Yamasaki and Mr. Shirk of the Boston Symphony Hall.
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BUILDING REQUIREMENTS

1. There shall be two halls - one large hall and one small hall. The large hall to seat between 3,000-3,500 persons. The small hall should seat approximately 1,200 persons.

The large hall to be designed for the following purposes:
   a. Symphony concerts (including organ music and soloists)
   b. Large Scale Opera
   c. Ballet and Dance
   d. Choral
   e. Pageants and Mass Meetings

2. The small hall to be designed for use for the following purposes:
   a. Dramatic Presentations
   b. Intimate Opera
   c. Chamber Music
   d. Concerts and Recitals
   e. Lectures

The requirements under 1 and 2 above, have been listed in order of priority with respect to the attention which should be given to their specialized building needs. Ideal conditions to be provided as far as possible acoustically, visually and in connection with stage and orchestral facilities. Compromises which will prejudice the entirely satisfactory performance of a function with a higher priority in the above list should not be made.

In addition adequate accommodation as follows shall be provided:

1. A large organ for use in the main hall.
2. Rehearsal rooms for each hall.
3. Broadcasting centre, not less than 500 sq. ft. in area.
4. Full stage facilities for each hall.
5. Access to the small hall independent from the large hall.
6. Restaurant to seat 250, intended for use by the general public at all times.
7. Adequate light refreshment rooms and bars.
8. Two meeting rooms one for 200 persons and the other for 100 persons.
9. Necessary foyers and public areas, circulation, public amenities, stage and back stage facilities service rooms, ticket offices and administration offices etc. as needed for the satisfactory functioning of the building.
THE SITE

The site selected by the promotors is the promontory projecting into Sydney Harbour known as Bennelong Point. It is an outstanding site located 1/2 mile southeast of the Harbour Bridge with fine views to north, east and west, across the water and south across the Botanical Gardens towards Government House.

The city proper lies to the south of the site and all vehicular traffic will be from that direction either down Macquarie Street or along Circular Quay which discharges into lower Macquarie Street. There will be no vehicular access from the direction of Farm Cove to the east. Apart from this single vehicular access from the south, the east side of the point will be served by a ferry crossing from the north side of the harbour.

To all intents and purposes the site is a level one, maximum elevation above sea level 12 ft. and with rock a maximum of 13'-0" and a minimum of 3'-0" on below grade.

The actual site limits for the Opera House extend to the water on the north and east and to within 60'-0" of the water on the west. This space is at present occupied by wharf buildings and while the area is outside the scope of the competition the promotors state that it is intended to remove these wharf buildings in the future and build a boulevard connecting with Circular Quay and competitors are at liberty to offer suggestions here if they wish.
SITE REQUIREMENTS

The following requirements are requested by the promotors

1. The building may be located anywhere on the site but should not be placed right on the boundary of the site, either on the east or the west. (Answers to questions subsequently stated that building out to the north over the water was not permissible).

2. A landscaped forecourt or square with considerable paving forming an attractive setting and approach to the building from Macquarrie Street.

3. A corresponding landscaped area on the northern promontory of Bennelong Point, overlooking the harbour, should the scheme so permit.

4. Facilities for a ferry service on the east side.

5. Service areas for kitchen and stage.

6. Parking for 100 staff and artists cars. No public parking will be allowed on the site. Roadside parking for 1000 cars is available to the southeast along Grove Crescent and within easy walking distance of the site.

7. Garage accommodation for the public within the building is not required.
CLIMATIC DATA

1. Average annual rainfall in Sydney - 46.93 ins.
2. Wettest months - April (5.27"), May (5.05"), June (5.05")
   Driest months - September to December
3. Average daily hours of sunshine vary between 7.6 in November
   and 5.3 in June.
4. Snow and frost conditions may be disregarded.
5. Lowest recorded temperature 35.7°F.
   Highest recorded temperature 113.6°F.
   Greatest diurnal range 42.2°F.
6. Average wind speed 8.2 mph.
   Highest gusts recorded 95 mph.
7. Prevailing wind for the year west, but varies between east and
   north-east from November to March.
GENERAL CONCEPT

The first decision that had to be taken in approaching the design of this complex of facilities was the general form they should take, standing as they would so prominently in the harbour entrance and in relation to the harbour bridge.

They are referred to in the plural, for with two auditoriums, two stage towers and several other major facilities they would seem capable of solution in two ways.

1. As a single powerful element.

There are successful and attractive precedents to both of similar buildings and site solutions but the important consideration here was the relationship to this particular site and location.

These considerations seemed to be principally three in number.

1. The views possible from the building.
2. The views possible of the building.
3. The building or buildings seen in relation to the Harbour Bridge.

One further consideration would be possible site limitations. From the building there would be excellent views across the water to north, east and west.

Of the building all views would be important. From the south would be the principal approach. From the east it would be seen in relation to the Harbour Bridge, with the latter it would be the symbol of home for the returning traveller. From the north it would be seen against the backcloth of the city and from the bridge to the west.

Finally there was the relationship of its form to the sweeping
curve of the bridge.

In discussing the advantages and disadvantages of the two solutions it is proposed to take the informal complex first.

Sketches 1, 2, and 3 show some possible variations on the theme. Due to the site limitations all would present the stark masses of the towers from one or two vantage points.

Secondly there was obviously going to be difficulty in resolving the duality of the two stage towers and thirdly there was the possibility of separating what might be combined facilities.

Perhaps it should be said that the promoters request for two fully equipped stages had from the start been interpreted to mean two fly-towers. While the second hall was smaller than the first, it was still a major sized theatre, probably to be the principal drama theatre in Sydney and hence a fly-tower was deemed essential.

This scheme and its variations seemed to have only one possible advantage, that of access. Further exploration of it with all the ancillary facilities proved that the size of the site was such that, other considerations apart, the degree of informality desirable, if it was to be approached in this way, would be difficult to attain.

Sketch 4 shows clearly the advantages of the first scheme, unrestricted views of and from the building in every direction. A single fly-tower, avoiding duality and making possible combination of certain back-stage facilities. Access might be a problem but should not be insoluble.

As a form in relation to the bridge and as a symbol it was obvious that the single unified building held greater possibilities and with its other advantages it was decided to attempt a solution in this way.

Moving from the general to the particular again suggested two
principal possibilities.

Firstly the subordination of all the facilities to one single or compound form and secondly the frank expression of the parts.

There are again interesting precedents in each category; the M.I.T. Auditorium on the one hand and the Royal Festival Hall in London the other; both have advantages and disadvantages.

The M.I.T. Auditorium has received varied criticism but perhaps the most important is whether it is right to subordinate all the parts in this way, resulting in a building, which while very beautiful in form, tells us little of her character.

The Festival Hall on the other hand while expressing something of her character fails to do so very eloquently and for various reasons to do it quite as successfully as was hoped.

The important consideration surely lies in the nature of an Opera House or theatre. It is primarily a place to go and see some form of dramatic presentation but at the same time it can be more than this. Dinner, intermission, viewing the lights across the harbour all play their part and deserve more than passing consideration. Frank expression of the important role they play should be aimed at. In turn they can form the framework for an exciting play of light and color and movement, particularly where a multiplicity of levels are concerned. Too little consideration is given to our buildings as stages in themselves on which we may watch the drama and comedy of life itself take place.

This is the great attraction of the Italian Piazza and our buildings should be capable of such interest. This is of course not new and has been attempted, a notable example that comes to mind being the Manufacturers Trust Building in New York. The Royal Festival Hall too captures something of this spirit at night and in that respect is very successful.
The second decision therefore was that this building should frankly express its parts. Exploration of the possibilities in this respect suggested three principal ones, the main thought being a desire to express to the maximum the auditoriums and stage tower and the interesting silhouette they might form on the skyline and as a foil to the bridge.

The first of these was the possibility of placing the auditoriums and tower as more or less free standing forms on a large podium enclosing the bars, foyers and other ancillary facilities. This had one great disadvantage, the fact that all circulation particularly for actors to and from the stage and audiences at intermission time would be vertical. Some vertical circulation would be necessary in any scheme but it would seem preferable to keep it to a minimum rather than a maximum.

The second possibility seemed to be that of placing the bars and foyers for each auditorium towards the ends, with the dressing rooms between but completely separated, giving clear expression to the forms of the auditoriums. This had the disadvantage of breaking horizontal circulation, except possibly at the lowest level, between the service areas and fronts of house. It would also fail to make use of those areas from which some of the finest views were possible.

With these thoughts in mind it was decided that the bars, foyers, dressing rooms etc., must be completely rapped around the auditoriums and stage tower but that they should be kept as low as possible in order to give expression to the dominating forms of the latter.

The next decision that had to be made was the positioning of the respective auditoriums. It was felt as the south was the principal approach, the large hall should be in that location. This would also ease the traffic problem and by virtue of the small hall being considerably
narrower offer the possibility of placing the meeting rooms and restaurant to the north where they too would command excellent views. The meeting rooms are intended amongst other things for dances and an attractive setting would be important. This arrangement in fact enabled all the major secondary facilities to be placed on the north, east and west looking out across the water.

Lastly with regard to the building came the placing of the service areas, dressing rooms, workshops and so on. These obviously had to be adjacent to the stages and were placed on either side. To give some separation it was decided to place the main auditorium dressing rooms to one side and the small to the other, with rehearsal rooms and workshops under.

Two final decisions had to be made with regard to the site. Firstly, the problem of access and secondly the general treatment of what was left of the site surrounding the building.

With regard to the first the promoters stated that no parking would be allowed on the site with the exception of artists and officials cars. Automobiles arriving from Macquarie Street will disembark their passengers and proceed to the east along Grove Crescent where roadside parking for 1000 automobiles will be available.

Hence unless patrons of the small theatre were to walk the full length of the building some sort of ring road would be essential. This would be necessary anyway for servicing.

The problem it set was the divorce it might create between the building and the remainder of the site and particularly the water. It was therefore decided that if possible it should run within the perimeter of the building.

In order to separate pedestrian traffic it was further decided to create a pedestrian level above this running entirely around and again
within the perimeter of the building with direct access to the main foyers. Lower foyers would be provided for automobile passengers.

Finally with regard to the natural setting it became obvious very quickly that as the building was going to cover a major part of the site little would be left for gardens. Hence, it was decided if possible to raise these gardens onto the platforms of the building. The climate in Sydney permits sitting out of doors for six months of the year and so quick and easy access, particularly at intermission time, to attractive outdoor spaces would be desirable.

This system with large overhanging balconies would also have the advantage of solving some of the sun protection problems that would obviously be necessary. They also offered the possibility of an interesting link with the water if they were made to step down to general ground level on the north and by a series of platforms and ramps or stairs to the landing stage on the east.

The basic conception of the building therefore was that it might give the appearance of a great palace of entertainment which seem from the sea or the bridge would present a series of glittering platforms stepping up from the water, hanging with foliage and gay with color and movement, the whole dominated by the great mass of the tower and auditoriums silhouetted against the sky.
THE AUDITORIUMS

General

The first consideration that was given in the approach to the design of the auditoriums was the general form they should take.

There have been many controversial ideas put forward in recent years on the form of the theatre, the principal amongst these being "Theatre in the round".

The technical problems connected with designing an auditorium to suit the traditional and this new type of performance are immense and even if these are solved it would seem unlikely to be possible to make the auditorium visually an attractive space for either production. To attempt to contrive these two widely differing forms within one space would seem only to be suggesting that there is not sufficient interest in the theatre to justify catering for it completely. It would seem that if a completely separate experimental theatre is not an economic proposition, rather than compromise a conventional theatre it should be housed with those forms of entertainment whose character although widely differing have need for a similar central space, such as for instance, ice shows and the circus.

The majority of productions at the present time and probably for many years in the future will be of a conventional nature. Had the halls in this project been for exactly similar purposes it would have been justifiable to make one of an experimental nature, but one is primarily a concert hall and the other a drama theatre and to compromise either seemed wrong. Coupled with this was the already multi-purpose character of each hall and to add further complications seemed likely only to lead to still less satisfactory results.
With a conventional form therefore in mind the large auditorium has been designed to seat the minimum requirements of 3000 people. The reason for this was that 3000 reached to just about the limits of the generally accepted maximum dimensions of a hall for satisfactory hearing and seeing conditions, while 3,500 reaches beyond this.

It has been designed to seat approximately 1000 in the stalls, 1400 in the circle and 600 in the balcony.

Its shape was chosen as seeming to fulfill best the variety of purposes for which it would be used.

Some boxes have been introduced in an effort to link the stage and the rear parts of the house and so give some feeling of intimacy. It was decided however that the classic tiers of boxes to the sides of the stage with their poor seeing conditions would be avoided principally because it was felt that people no longer go to the theatre merely to be seen and while the audience-actor relationship is important boxes of this type if undesirable to patrons may hinder rather than help. Intimacy depends largely on the warmth and general feeling of the interior and not necessarily upon specific devices.

Two items which created something of a problem in the large hall were the organ and the Royal Box. While at the time of writing this report the position of the former still remains somewhat unsettled. The most suitable position would seem to be to one side and towards the front of the auditorium, similar to the arrangement in the M.I.T. Auditorium. A similar position on the opposite side would seem most suitable for the Royal Box, for the purpose of this box, as long as we have royalty, would seem to be primarily that they were clearly visible from all parts of the hall.

The same general concept was applied to the small hall for in its
varied uses it is very similar to the large. It should perhaps be stated that in each case the specific personality of an auditorium designed for one particular use has been definitely avoided as it was felt that to attend for instance a mass meeting in a hall that was quite obviously intended for opera was undesirable.

The general arrangement of seating in the small hall is for 900 people in the main body of the auditorium and 300 people in the balcony. No organ or Royal box are required here and so raise no problems.

In the case of each hall the necessary facilities for lighting control, projection, broadcasting, etc., have been provided in the roof space over the rear of each balcony.
Acoustics

The auditoriums will be dealt with in general together for from the point of view of acoustics, they are again very similar both being multi-purpose halls ranging from music to speech.

The use of these two auditoriums for such a wide variety of purposes is anything but desirable from an acoustic point of view. It would have seemed more sensible to have provided one hall solely for music, one with a fly-tower for stage productions and one small hall for chamber music, recitals and lectures. The financial saving on this scheme avoiding dual fly-towers would probably have covered a small hall placed under one of the larger auditoriums and produced three halls designed specifically for their distinctive needs.

However, these were the clearly stated requirements of the promoters and while it is possible to design for these varying needs compromises are inevitable.

Much has been published and is readily available on the acoustic design of Auditoria and beyond stating the general rules which have been followed in the design of these two auditoriums it is not proposed that the subject be dealt with in great detail.

As an auditorium is a place to hear and see some form of dramatic entertainment, it would seem an obligation on the part of the designer that its form should stem from these requirements.

Acoustically the requirements for good hearing conditions in such a space are

1. A minimum of background noise
2. Adequate loudness
3. Good overall distribution of sound
4. Correct reverberation time
Background noise can be of two types:

1. External
2. Internal

External noise should present no problem in this design. The only noise will be from shipping and aeroplanes and as there is nothing to suggest there are unusually large no precautions beyond good solid construction would be taken. The surrounding bars would provide added buffer effect against these noises.

Internal noise would require the consideration usual in all schemes of this type. Of particular importance would be adequate sound isolation between the two stages probably involving double wall construction. Rehearsal rooms would be rooms within rooms and the workshop would need adequate isolation being partially under the stage.

Ventilating equipment which in the case of each hall is above the suspended ceiling adjacent to the stage would again be carefully isolated. Ventilating ducting would be lined with acoustic material to avoid noise from this source.

To ensure adequate loudness the most important factors are

1. The proper shaping of the hall and stage enclosures
2. The floor and ceiling slope

In the case of 1 some problem arises as in each hall the respective stages will require conversion to concert platforms and precautions will need to be taken against the loss of sound up the fly-towers. Thought was given to providing a large apron and pit on elevators which could be converted into a stepped platform with the idea of completely closing off the stage in each case. As however, it would still be desirable to place the nearest seats some distance from the platform for good hearing in that area the consequent divorce of audience from stage
for stage productions would not have been good. Also it would increase the depth back to the front of the house beyond the desirable limits. Consultation with Professor Newman suggested that in fact the use of the stage itself was the more usual and sensible solution. In this case back, side and top reflectors would be used in the towers, and the stepped platform formed from the stage elevators, together with the small pit and apron elevators. This procedure has been followed in the case of each hall.

The halls themselves are splayed towards the front to assist the reflection of sound towards the rear seats. The rear sections of these walls for other than acoustical reasons are straight and parallel. They are not however important as reflective surfaces and have the advantage of avoiding those seats in the far corners of a complete splay which are never good.

In the case of the large hall intended primarily for symphony concerts it was decided to increase the floor slope beyond the minimum to ensure that the maximum direct sound would reach all seats. In the case of the small hall the ramp is not so great, the reason for this was principally due to a desire to gain some continuity of levels throughout the building. The ramp however is still good and would ensure adequate hearing.

The ceilings also have been designed to throw sound towards the rear of the house and in front of the proscenium would link up with the stage reflectors.

The above considerations would not of course ensure adequate loudness for speech in the large hall and possibly not in the small, for lectures differ somewhat from dramatic presentations in method.
of delivery. To cover these requirements in each hall a sound amplification system would be installed.

Many of the considerations for good distribution are covered by those for adequate loudness and merely require more care in the placing of the reflective surfaces to see that all seats get an adequate and correct share.

Other considerations with regard to distribution which need thought are in the avoidance of echoes, flutter, focussing and interference. But here again these need present no problem. The splaying of the walls and the avoidance of parallels in floor and ceiling slope should ensure against flutter effect.

Focussing again need be no problem as the basic consideration of the auditorium shapes was that they should avoid concave surfaces which would lead to trouble in this respect.

Interference should have been adequately taken care of in the precautions for noise control while echoes can be avoided by the concentration of sound absorption materials for reverberation control in areas from which these eminate. Particular consideration would be given in this respect to the main balcony fronts and rear wall.

The only serious acoustical problem would seem to be on this question of reverberation time and here some compromise would be necessary.

The large hall is approximately 800,000 cu. ft. in volume and below are set out the generally accepted most suitable reverberation times for the various uses to which it would be put.

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
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<tbody>
<tr>
<td>Organ Music</td>
<td>2.2</td>
</tr>
<tr>
<td>Symphony Concerts</td>
<td>1.9</td>
</tr>
<tr>
<td>Opera</td>
<td>1.8</td>
</tr>
</tbody>
</table>
Speech 1.2 seconds

As opinions vary somewhat on these times the guidance of the actual uses would be followed on this question. All that can be suggested at this stage is that a figure of 1.8 - 1.9 seconds would appear to be a good compromise, giving the optimum to symphony concerts and opera, first and second on the priority lists.

The small hall is approximately 300,000 cu. ft. in volume.

Reverberation times for the various uses here would be:

<table>
<thead>
<tr>
<th>Use</th>
<th>Time (seconds)</th>
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<tbody>
<tr>
<td>Drama</td>
<td>1.1</td>
</tr>
<tr>
<td>Opera</td>
<td>1.55</td>
</tr>
<tr>
<td>Concerts</td>
<td>1.7</td>
</tr>
<tr>
<td>Lectures</td>
<td>.9</td>
</tr>
</tbody>
</table>

The differences between the major items in this case are greater and present more of a problem. It would seem however as drama is the first priority, the figure should be down in this region and 1.2 - 1.3 would probably be the best compromise.

While it has not been possible so far in this project to explore the idea it would not seem to be an impossibility by the use of double sided moveable panels to make these halls readily tunable and increase the range of reverberation. The important consideration would be whether in fact reverberation was so important as to warrant this.

In the application and distribution of absorption materials care would also be taken to see that the full frequency range was covered and also that the halls were not impaired by the number of audience present at performances.

In detailing briefly the acoustical problems, it has not been the intention to underestimate them. A large volume could be written alone on the considerations necessary on a project of this size. It
has merely been the intention to show an awareness of what these considerations are. That the basic ones have received consideration and that the more detailed ones would do so at the appropriate stage.

Visual Considerations:

Visual conditions in each hall particularly in the large with its steeply raking floor should be good. Care has also been taken in the large hall and was the main reason for deciding on a maximum seating capacity of 3,000, that no seat should be so far distant from the stage as to diminish the actors to insignificance.

The seating in each is laid out concentrically and rows would be staggered to give optimum conditions.
THE STAGES

The multiplicity of uses which have created problems in the design of the auditoriums have likewise raised problems in the design of the stages.

This is particularly true of the larger of the two the use of which will range from the relatively small area required for an orchestra to the very large necessary for Grand Opera.

Burris Meyer in "Theatres and Auditoriums" suggests in the case of Grand Opera a proscenium 80 ft. wide with wagon space similar to either side as most ideal. With adequate space for cyclorama between and storage space beyond this would result in a stage approaching 300 ft. in width. Such a width was quite impossible on this site.

Revolves were not considered for this stage as one to accommodate the acting area required would have been enormously large and two raised problems in connection with rehearsal rooms and workshops.

It was finally decided to use half wagons and to set the proscenium width at 75' with sliding sections to reduce this when required.

The whole of the central stage area has been trapped with elevators. The apron and pit are on similar elevators and as previously stated these would be used to form the stepped concert platform. Side, back and top reflectors for this orchestra enclosure being flown in the tower.

The stage is 80 ft. from proscenium to rear wall with a cyclorama fixed at the rear and flying at the sides.

The proscenium itself is 30' high and provision is made for lowering this when the side panels are in use. It is provided with the usual fire-curtain.

The fly-tower is 125' in width and although it does not cover the
full width of the stage those areas beyond and partially accommodating the wagons are of adequate height for scenery. A limited amount of storage space is provided beyond the wagons and an elevator to the workshop level for movement of scenery and props.

Beyond the proscenium opening is a small apron stage and an orchestra pit for 100 musicians.

Access to this stage from the dressing rooms is from one side only, circulation across the stage would be via a passage behind the fixed back section of the cyclorama.

The small hall is provided with a stage considerably narrower and somewhat smaller back to front, equipped with a 56' revolve which would seem to be ideal for dramatic productions. This stage is more ideal in fulfilling its requirements than the larger, for here its use is the first priority.

The proscenium is a maximum of 50' wide and 25' high and is again capable of reduction by the use of sliding panels.

Back to front the stage is approximately 70' and like the large hall is provided with an apron and pit on elevators. The revolve would also be equipped with trapped elevators for the formation of a small concert platform.

In placing the towers back to back some decision had to be made as to their ultimate combined height. As previously stated the drama stage being a first priority and the opera stage only a second priority it was considered justifiable to give the former the maximum ideal conditions and the latter the minimum. This resulted in a tower 100' high from stage level allowing 3 times the height of proscenium plus space for grid-iron and access over for the large stage and approaching four times proscenium height for the drama stage.
Each tower would be provided with all the necessary flying equipment for its satisfactory functioning.
DRESSING ROOMS

The actual amount of space for artists was left entirely to the discretion of the competitor in the conditions. It would seem however in the large hall to cater for maximum conditions, which would be for Grand Opera, and to design the rooms for multiple purposes would adequately cover the requirements.

Burris Meyer suggests the maximum number of artists for Grand Opera would be 10 principals and 100 extras. Allowing 120 sq. ft. per person for principals and 40 sq. ft. per person for extras this would require 5,200 sq. ft. In fact on the three floors allocated there is a total of 7,600 sq. ft., which allows for Green rooms, baggage and toilet facilities etc., and rooms for producers and directors. In addition there is approximately 2,000 sq. ft. of unlighted area for costume storage, costume workshops, etc.

Facilities for opera orchestra changing and storage and for back stage hands are placed below stage level.

The arrangements for the theatre are similar except that only two floors are allocated to this purpose. Allowing for a maximum of 20 principals and 30 extras this would require 3,600 sq. ft. 5,000 sq. ft. has in this case been allocated again allowing space for Green rooms etc., plus 1,200 sq. ft. of costume storage.

Access to the dressing rooms for actors will be from the ring road at ground level and elevators have been provided to facilitate the movement of baggage and bulky instruments.
ADMINISTRATION

It is impossible without knowledge of the general and detailed set up of the administrative organization to do more than allocate what would seem an adequate area to this section. As the promoters do not yet know quite what this may be except to suggest that it will most likely be joint, this is all that has been done.

In fact the whole upper floor above the theatre dressing rooms has been allocated to this use allowing a total of 3,000 sq. ft. 1,000 sq. ft. of this area approximately would be used for a caretakers apartment leaving 2,000 sq. ft. for office use. It is well placed for such use having direct access to the fronts of each house and with the whole of the stage area.
REHEARSAL ROOMS AND WORKSHOPS

The workshops and rehearsal rooms raise something of a problem. The most suitable position for these generally is between the stages. The site however, in this case would not allow this and also would have meant separation of the towers, the combination of which is one of the basic concepts of the building.

Space was also needed in the case of the workshop where it could run up through at least two floors. Such a space was possible to the side of the stage partially beneath it and the dressing rooms. It raised one serious problem for while easily accessible from the ring road unloading by means of a conventional loading platform would be impossible. It was decided, however, that this was not insoluble by unconventional means and did not warrant drastic alteration of the scheme. The solution considered most satisfactory was to have a rolling power driven platform with hydraulic elevator to the floor of the workshop.

The necessary elevators from workshop level to stage have also been provided.

Movement of the different types of equipment on multi-purpose stages of this type can raise innumerable difficulties and would seem only capable of completely satisfactory solution, with close and detailed thought, taking each problem separately and solving it as satisfactorily as possible within the limitations set.

The equivalent space to that occupied of the workshop on the opposite side of the building has been allocated to rehearsal rooms. There are four altogether, two of equivalent size to the large stage acting area and two to the small.

The space immediately under the stage between workshops and rehearsal rooms is occupied principally with the stage elevators, there
are also however, small rehearsal rooms, instrument stores and rooms for stage hands.

The area at ground floor level beneath the stage elevators has been allocated to heating equipment and general storage.
FOYERS AND BARS

General:

As stated early the basic concept of the building envisaged a pedestrian platform of the second level with the main foyers at this level. It was desired that at night it would become a platform crowded with color, light and movement, like the boat deck of a great liner, reflecting in the water and clearly visible to people across the harbour. At this level therefore all the public amenities, cloak rooms, toilets, etc., it is intended that people should linger here, look out across the water and wait for their friends.

Lower foyers in the case of each hall have been provided at ground level for access for car passengers.

The staircases in each building have been specifically designed so that movement of them is clearly visible from the foyers and becomes part of the drama of theatre going. At the same time those ascending may look down on the gaiety and color in the foyer below.

Each hall is provided with two elevators. These are not intended to be the principal means of access but only for old people and others who might have difficulty climbing the stairways.

The Main Hall:

Access to the main hall is from four levels. One basic idea in providing access to both auditoriums was that this should always be from the side. Access to a large hall through a hall in the floor seems always to be a most unsatisfactory experience. The entrance itself from without is usually mean and on entering the hall all one is confronted with are the backs of the audience. This contrast strikingly with the dramatic view from the side, of the tiers of gay and laughing people,
which bursts upon the new member of the audience as he enters part of the performance.

The first point of access therefore to the main auditorium is at the third level, to the side and front near the stage. It is approached by an ample foyer from the main staircase which opens out onto a wide open air terrace, freely planted, where the audience, if they do not wish to visit the bar, may walk at intermission time.

The second point is approximately midway up the main ramp of the auditorium, again from the side and approached by a similar wide and spacious foyer. At this level on either side of the building are the principal bars. There are long and relatively narrow, providing very long counters where quick and easy service will be possible and allowing maximum number of people to take the advantage of the fine views while enjoying their drinks.

The third point of access is to the rear of the auditorium and at this level snack bars are provided.

It was felt in the provision of bars and snack bars that in general the bars would be most used by the lower and most expensive seats in the house, while the higher and less expensive would probably be composed of younger people to whom a snack bar might be of more appeal.

The final level of access is at the lowest point of the balcony. At this level there is a small bar on either side of the building, while the whole roof of each dressing room block, accessible from this level is formed into an open air terrace and garden.

In all these foyers adequate escape is provided in the corners. These escapes received considerable thought. They are a major problem in a large theatre and it would seem that it is impossible to place them without blocking something of the view from the building or blocking the views within the building of the principal stairways. The former
position was chosen as adequate views seemed possible and left the stairways and foyers free. The escapes discharge onto the pedestrian platform and from there via external stairways to ground level.

Toilets are placed for both men and women on either side at each level. The contrivance of toilets one above the other at the various levels is perhaps the cleanest and most satisfactory solution. They would however have taken one more full bay off the perimeter of the building. The changing conditions of the auditorium wall makes such a system difficult in this position. With these changing conditions, however, new spaces are opened up at the different levels and it was decided that these would be used for toilet facilities.

The Small Hall:

Access to the small auditorium, like the large, is from the sides at three levels, front and rear of the main slope and at lowest balcony level.

Access foyers are generally narrower than for the large hall as there will be a smaller flow of people. Bars are located in this case at the lowest and highest levels with a snack bar in between and all on the north side of the building. They share with the restaurant below perhaps the finest views of all. Again there are adequate outdoor terraces readily at hand where those who do not wish to use the bars may stand and look across the harbour.

Escapes are provided in a similar position to the large hall and toilet facilities on each floor and to each side for men and women.
MEETING ROOMS

The spaces to either side of the theatre foyer, extending to the general perimeter of the building, have been utilized for the two meeting rooms, one for 200 people and the other for 100.

While these are accessible from the theatre itself, principal access will be from small separate entrances and ground and platform level. Each is provided with a spacious foyer at meeting room level and with a bar or lounge above. The rooms themselves run through two levels with small balconies along one side and each have open air terraces. They are provided with the necessary cloak rooms and toilet facilities.
THE RESTAURANT

Like the other parts of the building the restaurant raised considerable problem, particularly as regards position.

The conditions stated that while it was associated with the Opera House, it was also intended that it should form a separate revenue producing element and an amenity to the general public for day to day use.

Hence it was felt that two requirements were necessary. That it should be readily accessible from ground level and in order to be a particular attraction to the general public, should have a fine view. The latter it must also do without prejudice to the Opera House.

The position most readily fulfilling these requirements was the extreme north end of the building at platform level. It may be said that it is necessary to walk to the farthest point of the promontory but it was felt that the view once there, right round the harbour, would be worthy of that walk.

Separate access from either side at both platform and ground level is provided as well as access to the small theatre. At these points of access at platform level, on either side, are lounge bars with toilet and cloak rooms adjacent.

One final point on this restaurant, patrons of the large auditorium have no direct access to it beyond the pedestrian platform. It is not however been envisaged as an amenity that the audience would use except before and after a performance and hence this factor is not considered important.

Beyond the restaurant is an outdoor terrace which steps down by a succession of levels to the general ground level. It is intended that these levels should be in the form of terrace gardens forming an attractive
link with the water.

In the treatment of the remainder of the site in general an attempt has been made to echo the platforms of the building in a series of diminishing terraces linking it with the water.
TECHNICAL CONSIDERATIONS

Structure:-

While structural considerations have been left until the end of this report there were integral part of the basic conception of the building.

The plastic forms of the auditoriums, the deeply overhanging balconies and the flying staircases were both suggested by and suggested themselves the use of a completely reinforced concrete structure.

The auditoriums themselves would be formed of single skin 12" R. C. walls and 5" double skin heat insulated shell roofs. These roofs approximate in shape to the suspended ceiling of the auditoriums, except adjacent to the towers, where they are canted to accommodate ventilation equipment.

The main balconies are reinforced concrete torsion tube with cantilevers back and front carried at the sides of the auditorium, their loads distributed about three columns on either side.

The surrounding bars are of R. C. column and 2 way ribbed and prestressed slab construction covering the 25' square bays upon which the building has been designed. In those areas where intermediate columns have been dispensed with prestressed beam and one way slabs would be used.

As stated under acoustical considerations, care would be taken in the design of this structure to discontinue and isolate it where necessary to avoid sound transmission from the noisy areas.

Foundations create no problem in this building as a maximum of 13' below grade is solid rock with a bearing capacity of 15 tons per
square foot.

External Finishes:-

The position, size and boldness of this building would suggest a certain boldness in the handling of the external detail and therefore it is proposed to use rough textured light gray granite, available in the Blue Mountains 100 miles north of Sydney, for all vertical surfaces of the low encircling block, both above and below platform level. The detailing of this stone would be in sympathy with its general character.

The solid wall surrounding the stage at platform level would be treated with gaily colored mosaics, to add to the general atmosphere that is hoped of this level.

Circular columns would be formed of concrete with a aggregate of granite chippings and bush hammered to a rough texture.

The auditoriums and tower would be left in naked concrete frankly expressing the rough timber of the formwork and the horizontal and vertical lifts and finished with a transparent coating of acrylic plastic.

Internal Finishes:-

At this stage it has been possible only to think in very generalized terms of the internal finishes but again the idea would be to exploit the boldness of the building. Simplicity would be the keynote, using as much as possible the natural materials of the area and with a bold use of color.

It is intended that the people with their gaily colored apparel, moving about the building, should give scale and enrichment.

As previously stated considerable use of planting would be made both on the terraces and within the building.
Heating and Ventilation:

Heating and ventilation is a highly important consideration in any theatre and it is impossible to deal with all its aspects here.

Each auditorium is provided with its own air conditioning plant located in a carefully isolated chamber adjacent to the tower and capable of effecting eight air changes per hour. Heating would be by means of coils in the system fed from the main heating plant in the basement.

Each system would be equipped with the necessary humidifying, cooling and sterilization equipment, controlled to meet the varying weather conditions and use of the building.

Air would be pumped into the houses through grilles in the suspended ceiling and extracted beneath the seats.

The remainder of the building would be air conditioned, where necessary with two separate systems located on the roof of each dressing room block. Heating in the case of these areas would be by means of heating coils in the floors.

Without detail knowledge of the most economic system of heating available in the area the actual type of plant most suitable is difficult to assess and beyond the provision of ample space for these services has not been done.

Lighting:

Lighting again is a major aspect, consideration of which could fill this whole report. In the time available and at such a stage and without the assistance of specialists, only the most generalized considerations are possible.
are possible.

There are three basic considerations that require study.

1. The functional aspect of the lighting for the stage and auditorium and other spaces.

2. The general atmosphere desired of this lighting in the public spaces.

3. The use of lighting external to the building

The latter will receive considerable thought as it could add enormously to the general effect of the building seen at night across the harbour. Thought would be given to effective ways of lighting the terraces and planting which are important factor in the building. Also to use the floodlighting for use after performances at night.
CONCLUSION

It has only been possible in this large and complex project to give scant attention to many important problems and some have been possibly missed altogether.

It was felt that as in practice the design of such a project can span over several years and the research alone many months, that at this stage only the really basic considerations were of importance.

Perhaps it could be said that such a project was unsuited to competition amongst architects not specializing in the field and handicapped by the lack of a client upon whose experience they can readily call. On the other hand, lack of too much knowledge can free the designer from inhibitions.

The project has been tackled in the spirit in which it was felt the competition was being held, to explore the various possibilities.

Many possibilities were considered and later rejected. The final solution offers nothing startlingly new, for the author feels that radical change is not necessarily a perquisite of good architecture.

A real attempt has been made however to think of this building in relation to its site and location and to produce the basis of what could be developed into an interesting building. All along the main thought has been of the people who will use it and of the appearance of life and gaiety that it might create to the onlooker from outside.

It has been a difficult project but at the same time an exciting one and as a preliminary exploration prior to thinking again of some of the basic issues, before the competition entry, has been invaluable.
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