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# ACOUSTIC DESIGN OF THE LYRIC THEATRE THE LOWRY, SALFORD

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## 1. INTRODUCTION

This paper describes the acoustic design of the new Lyric Theatre in the Lowry, Salford. It outlines the key acoustic design parameters and describes the integration of the architectural aesthetic with the acoustic requirements. The building will open on 28 April 2000.

## 2. THE LOWRY

The Lowry will accommodate facilities for both visual and performing arts in an exciting, stimulating venue for education and recreation. Bordered by the Manchester Ship Canal and facing a new triangular public plaza it will be the landmark focus of the redevelopment of Salford Quays. The Plaza will be a sheltered and lively venue for community activity, gathering together three primary approaches to the Centre, including the terminus of the new Metrolink light rapid transit system. A commercial development will enclose the remaining sides of the Plaza, and waterside promenades provide pedestrian routes from the building entrance to the Quayside.

The Lowry contains a 1730 seat Lyric Theatre, a 466 seat Adaptable Theatre with shared rehearsal and dressing facilities, Art Galleries to display the City's collection of L S Lowry paintings as well as changing exhibitions, artworks an interactive gallery covering the creativity of the arts, together with bars, café and waterfront restaurant.

The Adaptable Theatre, on an axis aligned with the Lyric Theatre, has a courtyard form to suit various performance arrangements and a curved enclosing foyer with dramatic views across the ship canal. Rehearsal space is provided above the Adaptable Theatre, with the administrative offices located at ground level.

The Lyric Theatre forms the heart of the building with stairs and balconies providing direct access to three auditorium seating levels. A perspective view of the Theatre is provided in Figure 1.

## 3. ACOUSTIC DESIGN OF THE LYRIC THEATRE

The Design Team's starting point for the development of the Lyric Theatre was a study of the Edinburgh Festival Theatre which has a similar layout and seating capacity. It also stages similar events and has a reputation for excellent acoustics (1). Other comparable theatres visited included Glyndebourne (1250 seats); the Theatre Royal, Glasgow (1566 seats); and the Grand Theatre, Leeds (1603 seats).

## 3.1 Client Requirements

The Lyric Theatre is intended to be a multi-purpose auditorium so as to serve a wide variety of needs. The Operational Report and Business Plan (2) proposes that key aspects of the programme for the Lyric Theatre should include the country's finest opera, ballet, dance and drama touring companies. Examples of companies envisaged include the Birmingham Royal Ballet, English National Opera, Northern Ballet Theatre, Royal National Theatre, Royal Shakespeare Company, Welsh National Opera, Glyndebourne Touring Opera and the D'Oyly Carte. The programme also includes children's shows, individual artists and commercial shows.

The Operational Report and Business Plan requires the acoustic of the auditorium to be suited to a wide range of uses. The report identifies that for this to be made possible the acoustic will need to be variable.

## 3.2 Variable Reverberation Time

Analysis of the projected uses of the Lyric Theatre, in terms of their duration over a typical year, and in terms of generally accepted RTs of auditoria for different uses, revealed that two acoustic conditions would be needed (3) (4). One condition is where the RT would be around 1.3 seconds, (suitable for opera etc) and one where a shorter RT of around 1 second would be more appropriate (for speech). The acoustic design of the Lyric Theatre therefore makes provision for the variation of the reverberation time.

The change in RT is achieved by the deployment or retraction of 600 $m^2$ of absorption in the form of curtains above the acoustically transparent ceiling line. The curtains are located on 6 separate tracks and are electrically operated. Curtain boxes are provided so that when retracted, no curtain area is left exposed to the theatre. The positions of the curtain tracks are indicated in Figure 2.

## 3.3 Auditorium Volume

The acoustic volume of the auditorium was determined using three different methods – a desk top exercise using scale plans and sections, a computer calculation using AutoCAD, and a laboratory estimation using a physical scale model which was filled with beads. The AutoCAD calculation was carried out by the architect and involved the summation of the volume of horizontal, one metre slices, through the auditorium. The three methods produced results which were within 10% of each other. A section through the Theatre is provided in Figure 3.

## 3.4 Auditorium Ceiling

Like other modern and well equipped theatres, The Lyric Theatre of the Lowry is a complex technical space where the integration of many requirements is essential. For example the architecture and aesthetic requirements must be co-ordinated with stage lighting, effects lighting, environmental comfort and of course the acoustic considerations.

The Lyric ceiling plays a key role in the integration of these requirements. It is particularly important in achieving the acoustic requirements specified in the client's brief and in delivering the architect's concept and intimacy for the space

The ceiling is a suspended perforated metal and mesh surface above the seating which is intended to provide a visual, but not an acoustic, barrier which hides the technological necessities of the theatre that are situated above it. It is a complex shape comprising many overlapping 'petals' each of which is designed to be a flat surface (see Figures 1 and 2). A lighting arrangement between the petals washes light across their surfaces, the result of which would be to make these acoustically transparent surfaces appear solid when lit. An orthogonal wire mesh in the central area towards the

proscenium is intended to provide a visual screen that would hide the lighting bridges above when light is shone across its surface. An area of the ceiling towards the back of the theatre is hinged to allow it to be raised to allow the follow spot above the ceiling surface to light the stage.

The percentage open area of the petals was of particular concern and we tested perforated metals sheets having varying degrees of openness (5) to see how they would behave in the frequency range of interest. For the reasons already mentioned the architect was keen to use panels having the lowest percentage open area compatible with the acoustic requirements.

Eventually we agreed that a perforated metal having an open area of 36% would be acceptable. However, the open area of the ceiling as a whole, ie that of the perforated metal petals and the mesh, would be substantially greater.

The large quantity of metal forming the ceiling gave concern over the possibility of rattling and resonances in the petals, mesh, support structure and interfaces. The contractor has been made responsible for ensuring that the ceiling does not rattle or produce any attention catching noise. To assist in achieving this, there should be no metal to metal contact - neoprene rubber forms a boundary layer.

To allay concerns over rattling even further, full size mock-ups of each element have been built and tested together with the support structure.

### 3.5 Reflectors

The architectural 'cheeks' on either side of the proscenium have been designed to maximise early reflections. The 'cheeks' are convex and extend full height.

Acoustic reflectors are also provided on the underside of the lighting bridges and above the forestage. These are all above the mesh and perforated metal ceiling and the intention is that they should not be visible from the seating area.

### 3.6 'Crinkle wall'

The rear wall at promenade level is referred to as the 'crinkle' wall due to its profiling. It is constructed from 200 mm thick lightweight precast concrete panels supported in a steel framework. It forms the boundary to the duct zone running around the rear of the theatre and the promenade. The reason for the shape of this wall is primarily architectural, although it will prevent any deleterious effects, such as focussing, by providing a diffusing surface. The profile of the crinkle wall is shown in Figure 4.

### 3.7 Orchestra Pit

Particular consideration has been given to the orchestra pit to ensure that excellent conditions are provided for the orchestra. The pit can be varied in size by the use of two elevators. At its maximum it will accommodate up to 90 musicians. Low frequency absorption is provided in the pit to control resonances, and the pit overhang is relatively small, being just 3 m.

## 4. MECHANICAL SERVICES

The background noise criterion for the theatre has been set at NR20. The mechanical services design employs a combination of underseat pedestal diffusers together with low velocity diffusers on the step risers. Extract is provided through the 'crinkle' wall above the visual ceiling line.

The main supply plant for the theatre is located on the top floor of the adjacent tower building, and is ducted through very large builderswork shafts into the underseat plenums. Extract plant is located at high level to the sides of the theatre and ducted behind the 'crinkle' wall.

Smoke extract is provided by a ducted mechanical extract system attenuated to maintain the sound insulation of the fly tower.

## 5. SOUND INSULATION

The current external noise environment is not excessively high, but the site is on a flight path. The predicted peak traffic flows on the new roads along the quayside are quite high and ships do occasionally use the adjacent canal.

The shell to the theatre is primarily 200 mm thick reinforced concrete. Around the theatre are buffer zones comprising quiet areas (such as storage rooms). Door lobbies to circulation areas are provided to maintain the sound insulation. The roof to the theatre is concrete with a heavy plasterboard skin supported off the bottom of the roof trusses.

The Lyric theatre is separated from the Adaptable theatre by two sets of large 55 dB doors either side of a shared scenery store. There is a structural movement joint in the floors and walls separating the two sides of the building. The level of sound insulation provided between the two theatres will allow for the simultaneous use of both with no disturbance in either.

## 6. SUMMARY

| Parameter | Value |
|---|---|
| Volume | 11500 $m^3$ |
| Seats | 1730 maximum or 1650 plus maximum<br>90 musicians in the pit |
| Volume/seat | 6.7$m^3$ / seat |
| Distance from proscenium to furthest seat | 31.5 m |
| Balcony overhangs: depth/height ratio | first tier 1.7<br>second tier 2.0 |
| Design RTs | 1.0 second for speech related events<br>1.3 seconds for operatic events |

## REFERENCES


1 Haslam, L. G., The Acoustic Design of the Edinburgh Festival Theatre, Proc.I.O.A. Vol 17 Part 1, 1995

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4 Beranek, L., Concert and Opera Halls: How they Sound, Acoustical Society of America, New York, 1996

5 Acoustical Uses for Perforated Metals, Industrial Perforators Association Inc.


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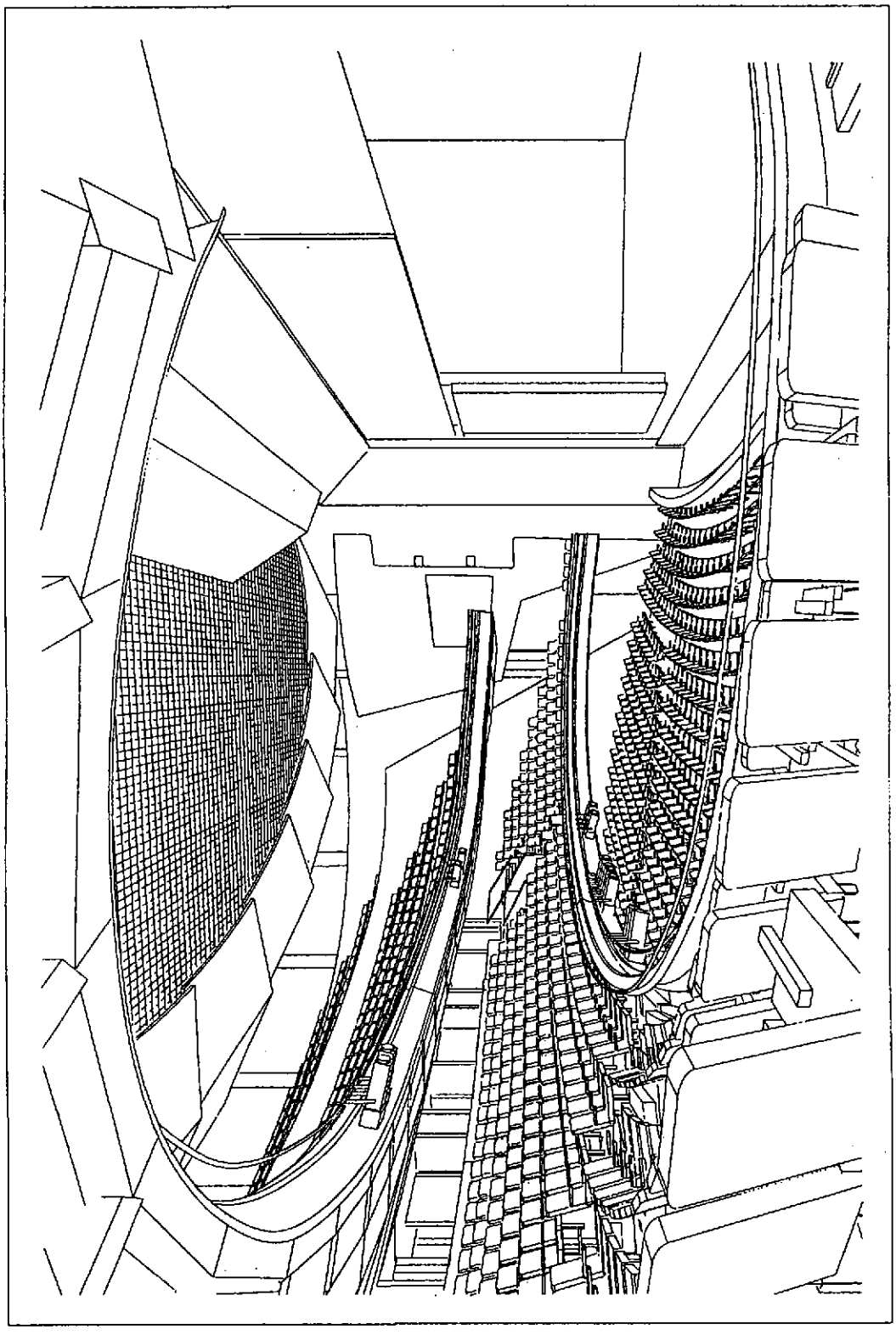

Fig 1 Perspective view of theatre

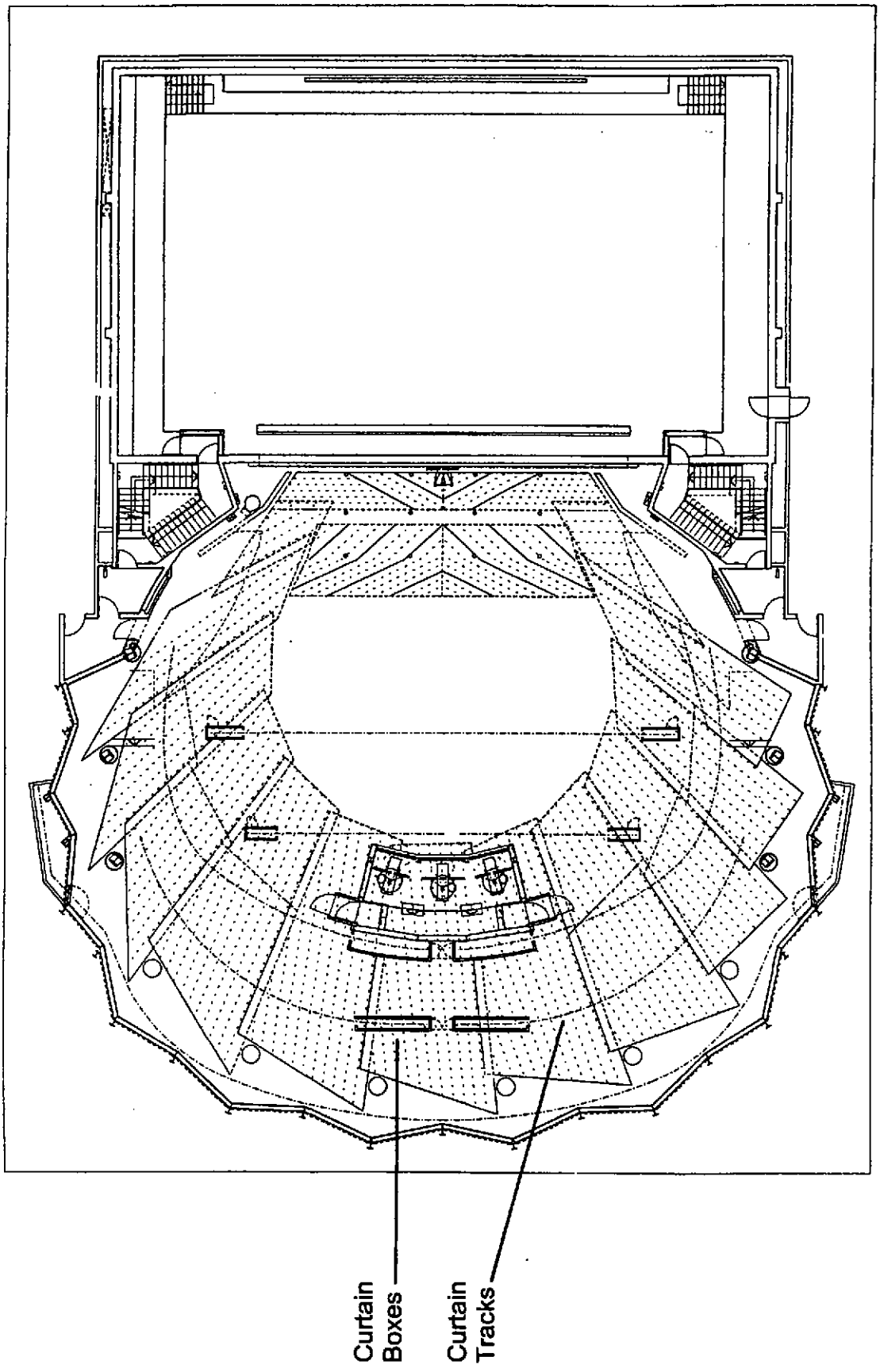


Fig 2 Reflected ceiling plan showing 'petals', curtain boxes and curtain tracks

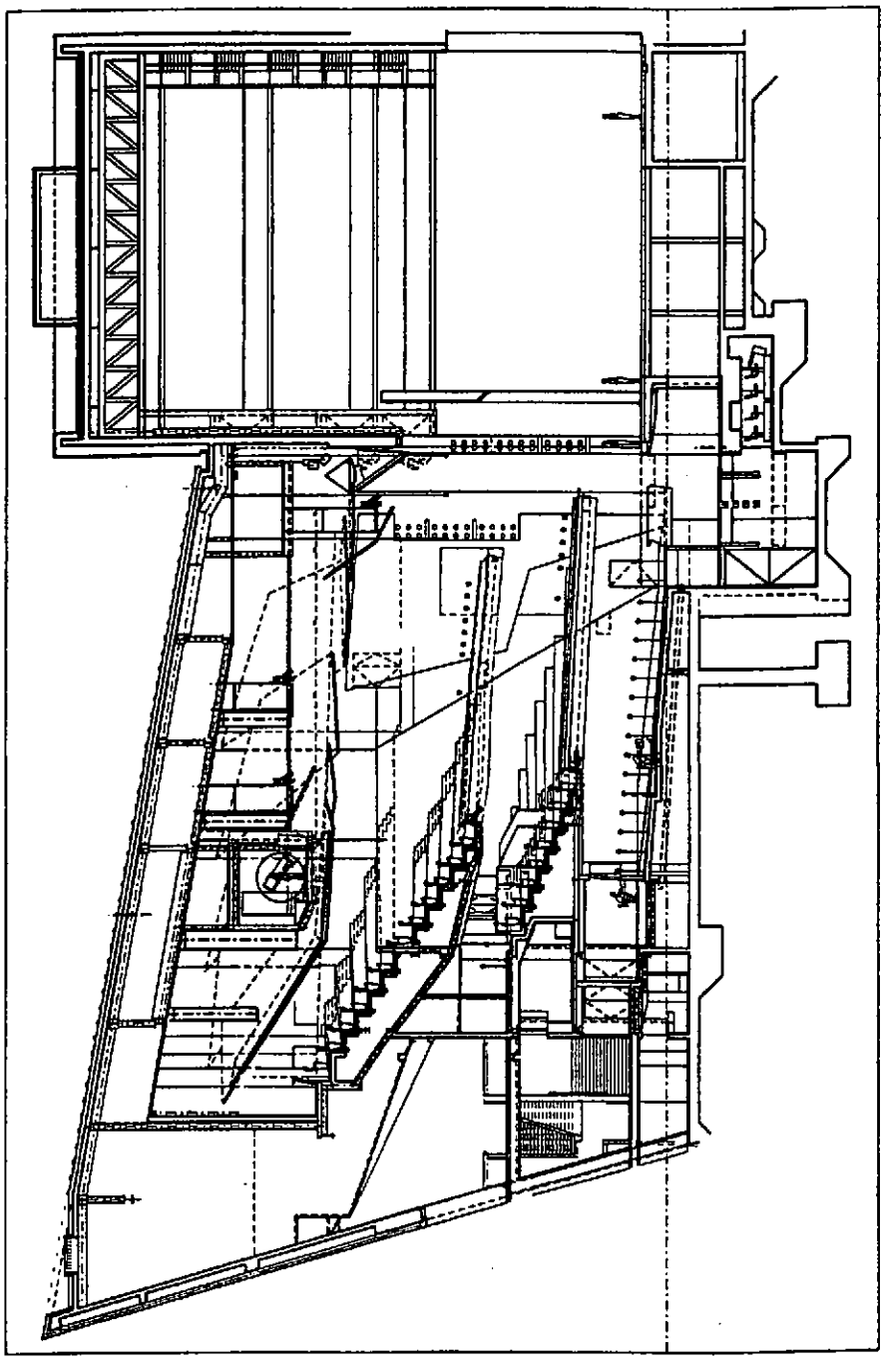

Fig 3 Long section

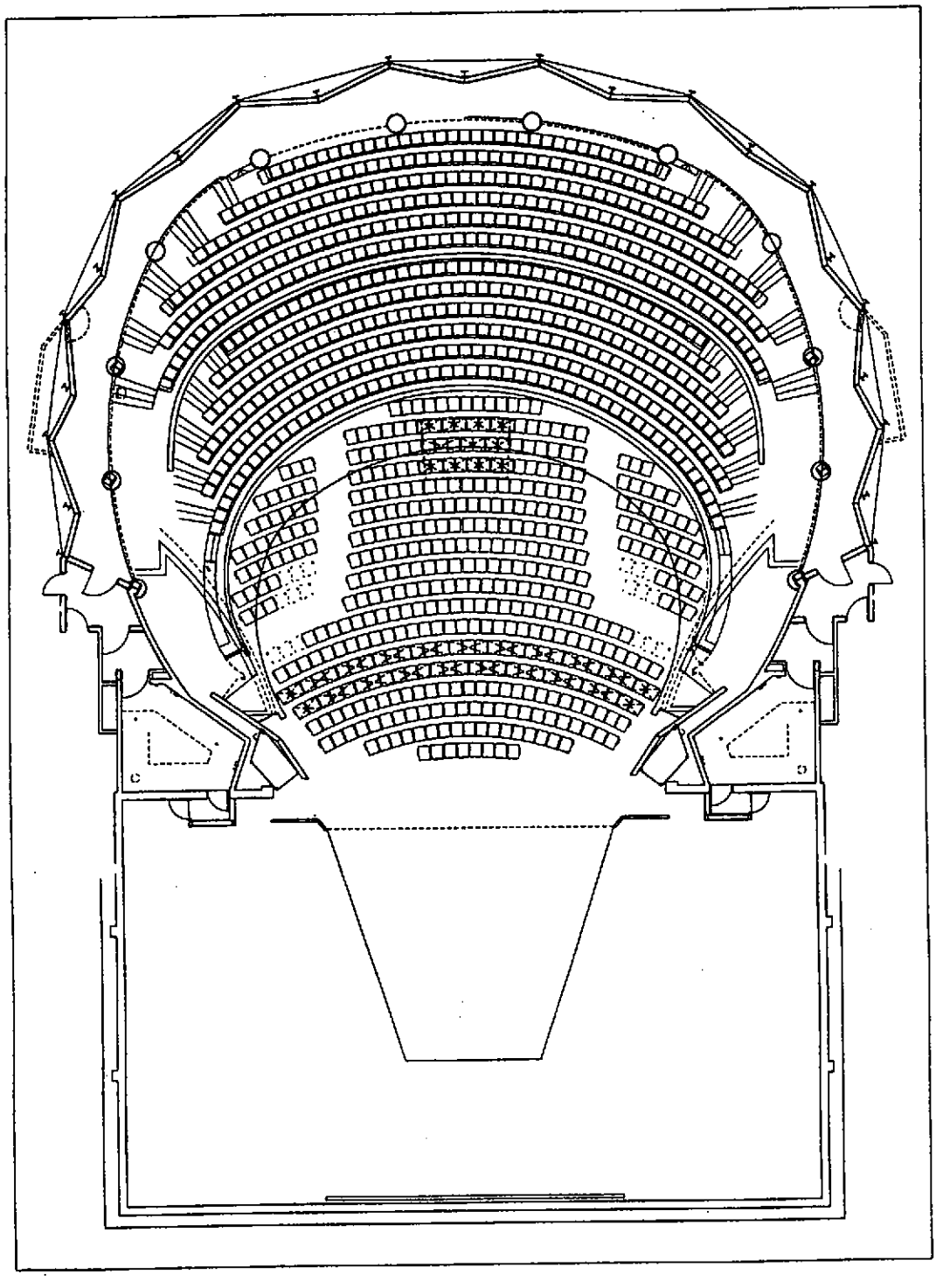

Fig 4 Seating plan