A number of test performances enabled further fine-tuning of the space

# WOODWORK THEATRE

## The interior of a new venue at Russia's Mariinsky Theatre has been lined with wood for an optimum acoustic effect. *Kaye Alexander* investigates

In September 2003 fire destroyed the warehouse containing all the costumes and sets for the Mariinsky Theatre in St Petersburg, Russia – a world-famous opera and ballet venue. General artistic director of Valery Gergiev saw the potential of the ruined buildings as a site for a concert hall.

This new building provides an alternative cultural focus from the theatre and, at just a few blocks from the historic venue, a performance space for use during its renovation. The final decision to proceed with the project was made in June 2004 and the tender was won by architect Fabre Speller Pumain of Paris, which had already been working on the restoration of the Mariinsky Theatre.

The team, joined by consultant Dr Yasuahisa Toyota of Nagata Acoustics, faced an aggressive work schedule to complete >>

the 1,100-capacity theatre: an eight-month design period from August 2004 to April 2005, followed by just 14 months on site: a timeline that Dr Toyota said 'would usually be considered out of the question – activity on site proceeded 24 hours a day'.

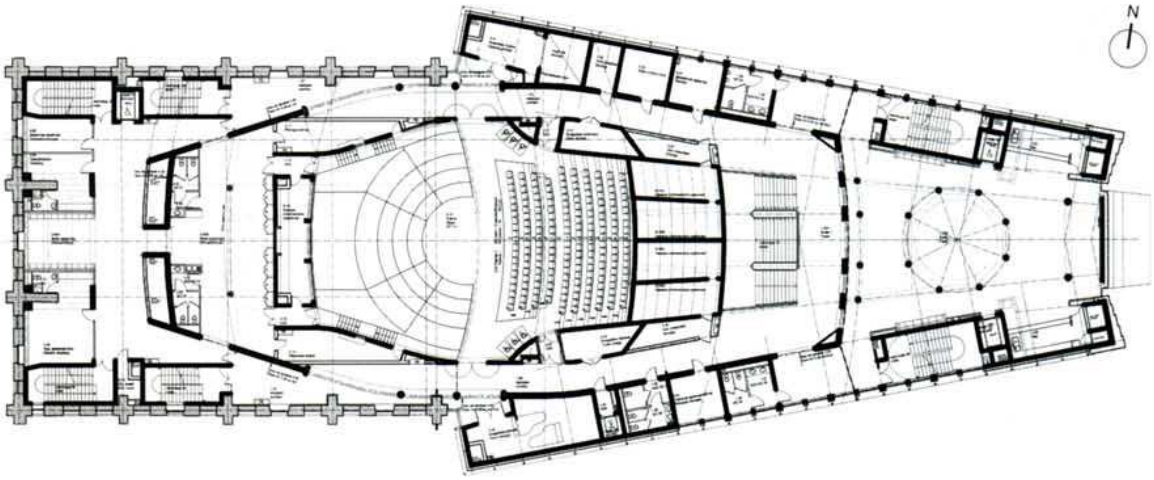
By June 2006, 90 per cent of the construction work was complete and the orchestra was able to check the acoustics and rehearse on stage. A further five months of finishing touches enabled the hall to hold its official opening in November 2006.

## THE RELATIONSHIP BETWEEN ARCHITECT AND ACOUSTICIAN

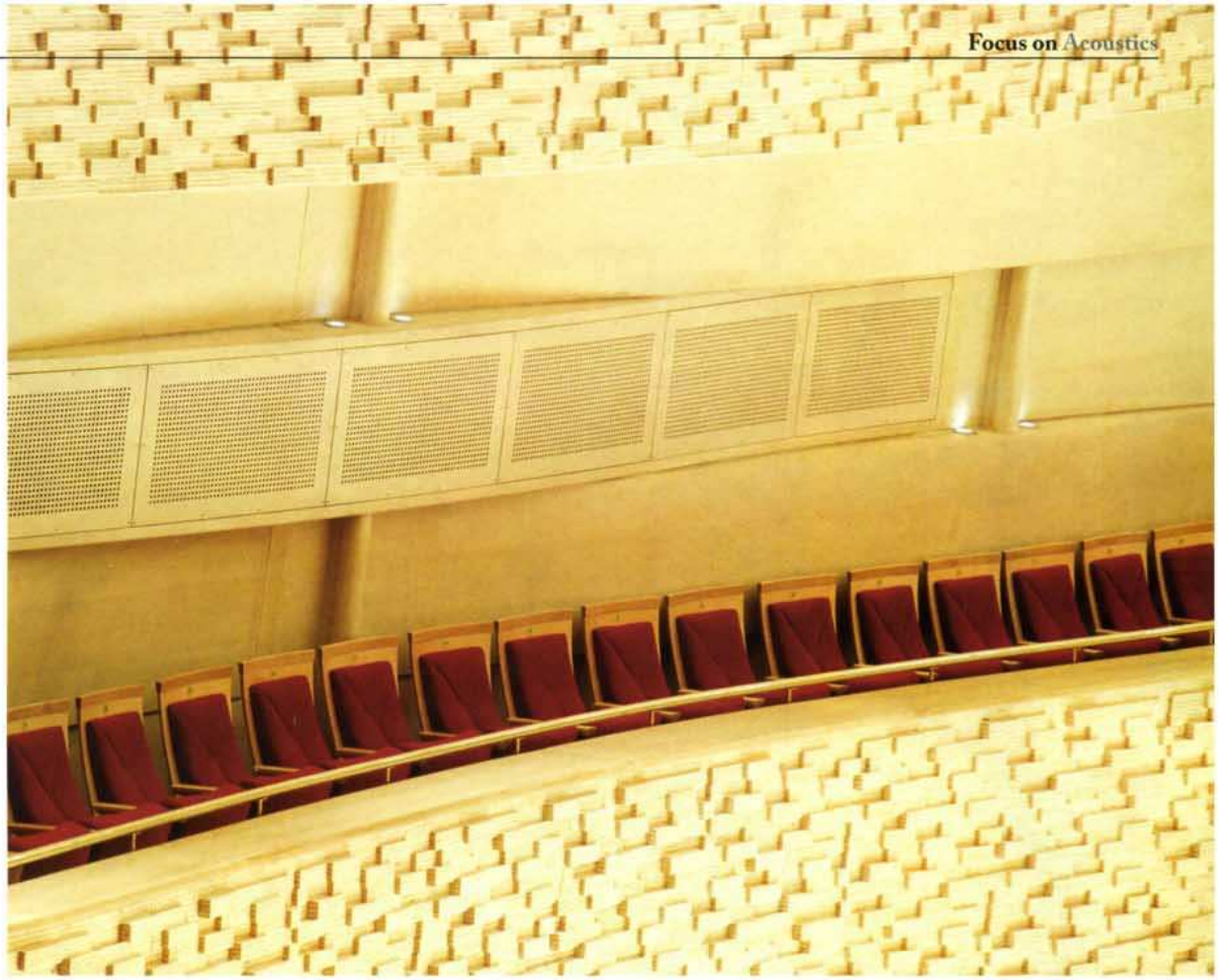
A combination of site restrictions and a desire for optimum acoustic design led to the shape described by the architect as 'a stretched cradle – a synthesis between the Classical shoebox design and a storeyed audience configuration surrounding the orchestra'. Fabre Speller Pumain's Philippe Pumain says: 'The interior model is close, in proportion, to the concert halls of Vienna and Amsterdam; around 20 x 45m, but with a reduced ceiling height of around 14m'.

Acoustic design informed the architectural process at every stage of the this project. >>

Work on site continued around the clock – even in the Russian mid winter – in order to conform to the tight time frame




Detailed plan – the narrow site lends itself to the conventional shoebox design but the tiered seating gives the orchestra and audience a sense of intimacy



**Above** 'Acoustic roughness' reflects sound waves in all directions, preventing the sound from being flat while avoiding echo

**Below** The size and distribution of the perforations in the panels determine which frequencies are absorbed, and which reflected

The hall's interior was the key element of the design with regards to acoustics, and the material specification for this part of the project was hugely influential on the scheme's success.

While a concrete shell provides the concert hall's structure, wood was used to line the entire interior space, as it combines advantageous physical and textural properties to promote aural, tactile and visual comfort for hall users.

*Gergiev conducts regularly at all-wood opera halls in Finland*

Kerto by Finnforest was specified because of the architects' familiarity with the product and the positive experiences of artistic director Gergiev, who conducts regularly at the new wooden Lahti and Savonlinna opera houses in Finland, both of which are also finished in Kerto.

The product is formed by the rotary peeling of logs, producing 3mm-thick veneers glued together to form a continuous 1.8m-wide billet. Total thickness can range from 27mm upwards with a maximum length of 26m.

The billet is then hot pressed and cut to size to produce beams, planks, posts or panels. It is this versatility that meant the product could be a solution to the various requirements of the Mariinsky Theatre project. In this instance, the Kerto was finished with a veneer of birch. >>

## DETAILED DESIGN

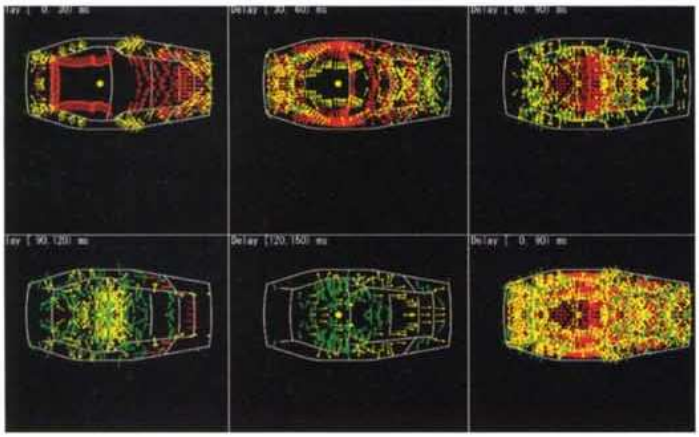
In order for the ultimate acoustic performance to be accurately predicted, every orifice had to be carefully designed and form part of the acoustician's calculations and computer simulations. There could be no open joints or gaps and so the 'woven basket' motif was constructed with joints sealed by thin vertical columns.

Due to their arched shape and resultant spectrum of depth of air gap behind, these perforated panels can absorb sound of different and specific frequencies. Initially, glass-fibre matting was introduced behind the wall cladding to increase absorption, but this was removed in all walls other than the rear after testing sessions with the orchestra – illustrating Toyota's description of the space as 'an acoustical tuneable area'.

The use of wood was not without its challenges. Toyota says: 'It was difficult for us to obtain the requisite surface mass. In particular for the ceiling's wood material we resolved this by specifying a thickness of as much as 200mm'. The curved ceiling acts to reflect and disperse sound to the entire audience, who are seated in a complex of layers and balconies at different levels.

The random relief cladding provides 'acoustic roughness' on the front surface of these tiers, which acts to diffuse sound rather than absorb by reflecting it evenly in all directions. This creates a lively sounding space as the sound energy is not lost but distributed evenly. Early and lateral reflections give a reverberation time (the time it takes for a sound to decay after the source has stopped) of 2.2 seconds unoccupied and 1.9 seconds occupied – ideal for a concert hall. ■

*Relief cladding provides 'acoustic roughness' which acts to diffuse sound rather than absorb it*



**Above** The floor, walls and ceiling are all clad in Finnforest Kerto, but the different ways in which the material is handled lends an experiential quality without being distracting

**Left** Acoustic simulation showing early reflections