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## Acoustical Design of New Concert Hall in Mariinsky Theatre, St. Petersburg

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### ABSTRACT

Mid-size concert hall with 1,100 seats opened in St. Petersburg, Russia on November 29, 2006, as an extension of the Mariinsky Theatre. The new hall's configuration basically has a shoebox shape, but many seats are arranged around the stage and the slope of the main seating area is quite steep. The design direction was something like an amphitheatre in a shoebox shape. Acoustical design and characteristics of the hall are reported.

### SUMMARY OF THE PROJECT

On November 29, 2006, the Mariinsky Theatre Concert Hall in St. Petersburg, Russia held its official opening. The new, mid-size hall seats 1,100 and is part of a campus of buildings belonging to the Mariinsky Theatre, led by Artistic Director Valery Gergiev. The hall will primarily be the venue for orchestral music, chamber music, solo recitals and other concerts by the Mariinsky Theatre Orchestra (also known abroad as the Kirov Orchestra), which will use the new facility as its home hall. Guest performances by other ensembles and musicians are also planned. The concert hall's architect is the Paris firm of Fabre/Speller/Pumain Architects. The Russian general contractor NEVISS-Complex built the facility.

### FROM CALAMITY TO NEW CONCERT HALL

The Mariinsky Theatre Concert Hall project had its inception in an incident that occurred in September 2003. A Mariinsky Theatre warehouse located a few blocks from the theater caught fire, destroying almost all of the theater's sets and costumes. General artistic director Gergiev turned this calamity into a true "blessing in disguise" with his visionary idea to construct a concert hall on the site of the destroyed warehouse building.

The design period for Mariinsky 3 lasted eight months, from August 2004 to April 2005. The scheduled construction period of May 2005 to June 2006 provided a mere 14 months to complete the building, an aggressively fast timeline that usually would be considered out-of-the-question. Work proceeded with round-the-clock shifts, even during the winter months. Activity on the construction site could be seen 24 hours x 7 days, morning, noon and night. In June 2006, while the project was not fully complete, some 90% of construction was finished, and the orchestra was able to check the acoustics with a rehearsal on the hall's stage. Thereafter, five more months of "finishing touches" enabled the hall to hold its official opening in November, 2006.

## FEATURES OF THE NEW CONCERT HALL

The new concert hall's dimensions measure 22 m wide, 52 m long and 14.5 m from the stage floor to the ceiling. The total room air volume is approximately 12,000 cubic meters for 1,100 seats. Longitudinal and cross sections and plan of the hall are shown in Figures 1, 2 and 3, and perspective view in longitudinal section is shown in Figure 4. While the hall's configuration basically has a shoebox shape, many seats are arranged around the stage area and the slope of the first floor's main seating area is quite steep, two room design elements that distinguish this hall's configuration from the configurations of halls known throughout the world as the exemplars of the shoebox shape. The steep slope of the hall's first floor main seating area enables a large portion of the audience to view the entire stage. The sloped floor also creates a feeling of oneness between stage and audience areas and contributes to the sense of presence experienced in the hall.

The hall's interior uses wood throughout the hall, for the ceiling, walls and floor. From an acoustical perspective, the ubiquitous use of wood in the hall interior created a challenge to obtain the requisite surface mass. In particular, for the ceiling's wood material, the specified thickness of wood is approximately 20 cm.

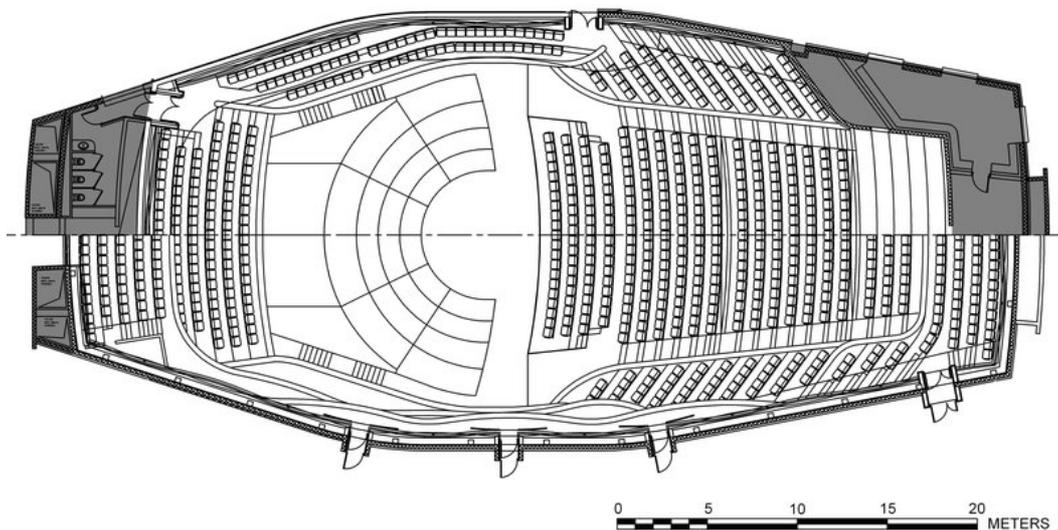


Figure 1.-Plan

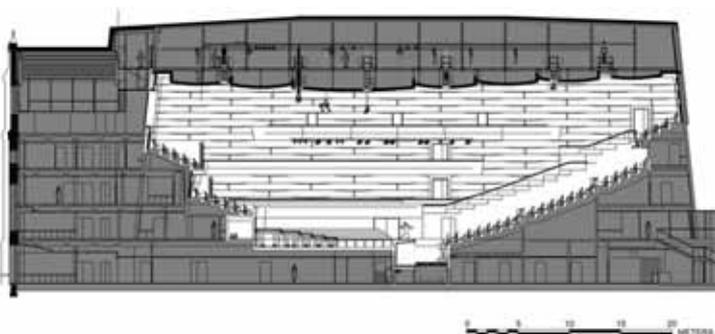


Figure 2.-Longitudinal section

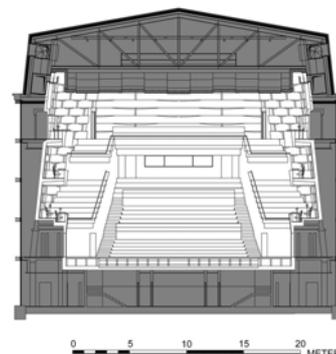


Figure 3.-Cross section

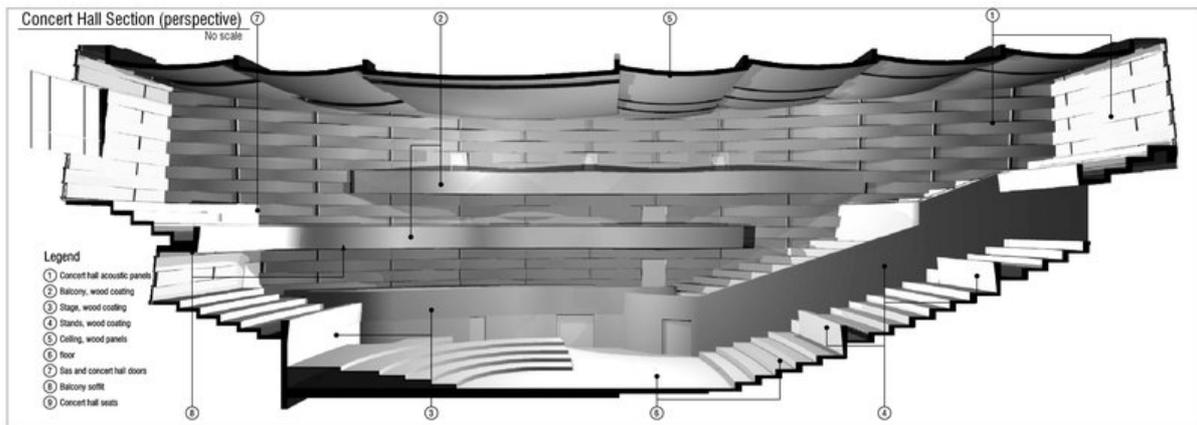


Figure 4.-Perspective view in section

## ACOUSTICAL CHARACTERISTICS

### Distribution of early reflections

Room shape and dimensions were studied with the computer simulation in terms of distribution of early reflections for different time periods (0-30ms, 30-60ms, 60-90ms,.....). Figure 5 shows the distribution of the early reflections in the hall.

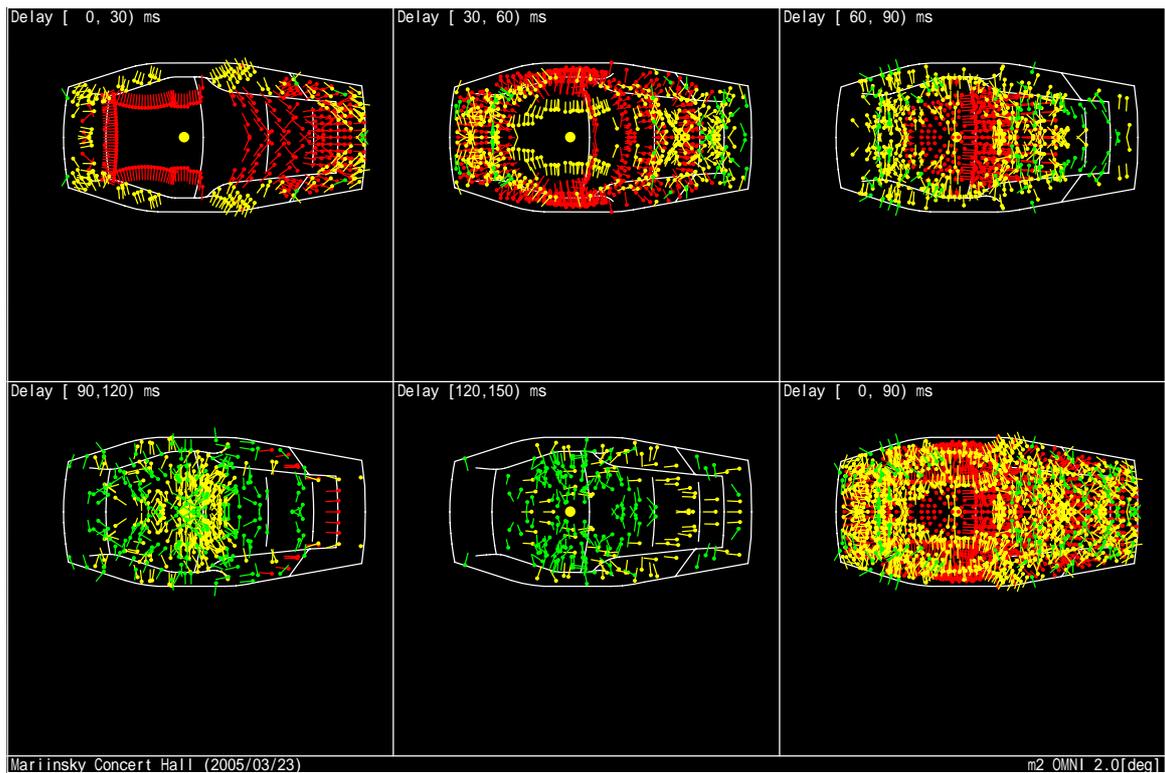


Figure 5.-Distribution of early reflection (Computer simulation study)

**Reverberation time (RT60)**

The reverberation times (RT60) measured when completed are shown in Figure 6. RT60 at 500Hz is approx. 2.2 sec. (Unoccupied) and 1.9 sec. (occupied). (The data in occupied was estimated from the data measured in the empty hall.)

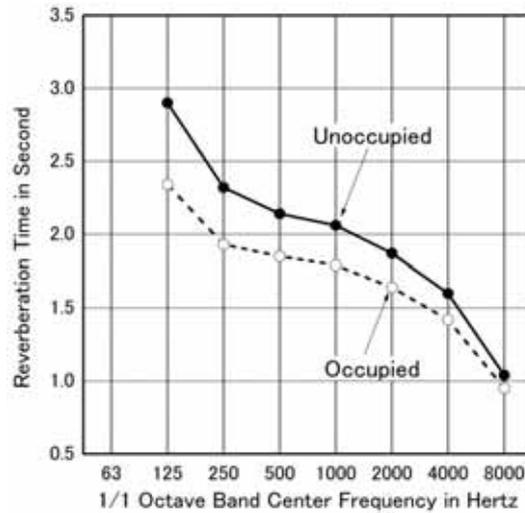


Figure 6.-Reverberation time (RT60)

**Miscellaneous room acoustical parameters**

Miscellaneous room acoustical parameters, such as EDT, Clarity (C80), D50, were measured at several measuring points over the auditorium. The averaged results are shown in Table 1.

Table 1.- Room acoustical parameters

Parameter\Frequency	250	500	1000	2000	4000
EDT (s)	2.2	2.1	2.1	1.9	1.5
C80 (dB)	-1.0	-0.3	-0.6	0.8	1.7
D50 (%)	33	35	33	41	46

**Noise criteria**

HVAC noise was measured in the hall. The results are shown in Figure 7. The noise level over the entire auditorium is below than NC-15.

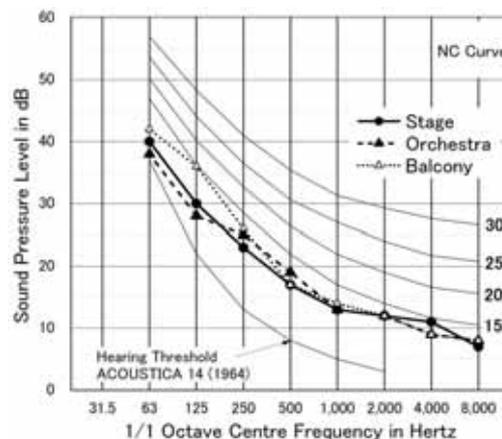


Figure 7.-Noise level (NC) from HVAC

### **PRE-OPENING LISTENING**

In advance of the hall's official opening, a full range of test performances, including string instrument, wind instrument and piano soloists, male vocalists and female vocalists, ensemble performances and then full orchestra performances were conducted. Through these listening opportunities, it was confirmed that from the solo pianissimo of a harp or string instrument to the full orchestra's fortissimo, and for every variation of ensemble configuration in between, the hall exhibits a high level of acoustical performance both in terms of the sound volume produced in the hall and the its overall appropriateness as the venue for a wide variety of instrumental and vocal configurations.

The hall's fundamental ability to resonate means that the music robustly reaches every audience seat, and while the hall's sound gives the sense of richly and warmly filling the hall's space, the sound produced by ensembles has clarity, with every instrument distinctly heard. On stage, as well, the musicians report that they can hear themselves and their fellow players well.

