A Unique Setting for an Opera Orchestra

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Abstract: The San Francisco Civic Auditorium served as home for the Opera for the 1996-97 season, requiring the creation of an orchestra shell behind the stage. Despite many complications and conflicts the design developed into an acoustically and visually appropriate performance shell.

BACKGROUND

San Francisco’s War Memorial Opera House was opened in 1932 and served as the home of the Opera and Ballet companies and, until 1980, the San Francisco Symphony. In 1946 it was the setting for the first United Nations General Assembly but its principal recognition derives from many great operatic triumphs. In 1989 it was damaged in an earthquake and it was closed for restoration in 1995. The location selected for the Opera’s 1996-97 winter season was the nearby Civic Auditorium, with local theatres used for the 1996 and 1997 summer seasons, prior to its return to the restored Opera House for the 1997-98 season.

The Civic Auditorium is a flat-floored arena with a U-shaped balcony, seating 4500 people. It has accommodated from indoor sports to orchestral and organ concerts but is considered poor for acoustically-sensitive events. The ventilation system is noisy, while the sounds of traffic can be heard in the hall. The auditorium is 252 feet wide, 232 feet long and 65 feet high above the flat main floor. The metal deck ceiling steps down to form three levels of U-shaped lighting galleries which couple the auditorium volume to that of the attic. The balcony seats are upholstered, while side and rear walls at main and balcony levels have a sound absorbing surface. Mid-range reverberation time values for the empty space are 2.3 - 2.6 seconds but the rate of decay is uneven. Background noise levels with the full ventilation system in operation vary from NC 38 to NC 41. Traffic noise from nearby Hayes Street is heard via the stage access doors, but a wider area of the city is heard through the exhaust air louvers at the peak of the roof. Traffic noise levels at the main floor are between NC 35 and NC 45.

OPERA CONFIGURATION

The Opera company used a large thrust stage with the orchestra 60 feet behind the stage front and 16 feet higher. Temporary seating was built on the main floor, stepping up to meet the front balcony seats. Curtained “walls” extended from the orchestra shell to cut off seating with a poor view of the stage. The orchestra shell was wide and shallower than acoustically desirable and was visually separated from the stage by a screen of black scrim. The main ceiling was 62 feet above the stage, with sections above the orchestra opened for rigging of stage sets. Three lighting trusses 40-45 feet high covered a half-circle above the stage. These set the height limits for any suspended sound reflecting elements.

NOISE CONTROL

Outdoor noise intrusion was noticeable, although not when the ventilation system was operating. Temporary vestibules were considered at the stage doors, but were rejected because of limited space. By careful scheduling it was found possible to keep the existing heavy doors closed, with edges fairly well sealed, during performances, so the attenuation was adequate for all but a few noisy vehicles.

Sound transmission tests indicated that the exhaust louvers were a path for intruding noise to the audience. Closing the louvers did provide some reduction of noise but their importance for exhausting area from a large audience was much greater, especially since the supply air system was itself noisy. Operable louvers at the lighting galleries were closed as much as possible but no further efforts were directed to control of outside noise.

The ventilation system consists of two equal parts served by mechanical equipment rooms on each side of the stage. The major duct systems supply air at the ceiling level while secondary systems serve the main floor from under-balcony diffusers. Since the major duct systems are noisy it has apparently been the custom to use only the secondary systems for performances. It was necessary to avoid use of the main systems during the actual performance.
ROOM ACOUSTICS CONSIDERATIONS

It was recognized that - because of the built-in limitations of the auditorium - maintaining singer-orchestra balance would be impossible without amplification. However, strong emphasis was placed upon naturalness of sound quality, including a firm ruling against the use of individual wireless microphones for any singer. Several design schemes were explored for sound-reflecting surfaces above the stage but lighting requirements for the thrust stage left no opportunity for reflectors at an appropriate height, leaving amplification as the only alternative. A computer model of the auditorium interior was studied to predict distribution and loudness of orchestra sound, as well as desirable modifications to sound reflecting surfaces. This study confirmed that adequate orchestra sound level could be attained by sound reflecting surfaces, but requirements for rigging and lighting limited reflector positions to the "cheek" walls and directly above the orchestra.

Design and operation of the amplification system for the singers was handled entirely by the Opera's sound consultant. It comprised an array of microphones roughly 20 feet above the stage feeding distributed and time-delayed loudspeakers. The use of high-quality components in a well conceived design - with careful balancing and adjustment of sound levels and time delays - resulted in excellent sound quality, a satisfactory balance between singer and orchestra, and a complete inability to distinguish between natural and amplified vocal sounds. In view of the uncooperative acoustical environment, this was a notable achievement.

ORCHESTRA CONFIGURATION

The change in orchestra/singer relationship created the need for cueing video monitors and adapting to the time lag from the orchestra. However, in adjusting to these conditions some singers apparently enjoyed the more direct contact with the audience. The acoustical challenges were more complex than for most orchestra shells. The orchestra space was very shallow with minimal side walls, while the main ceiling above and forward of the orchestra was largely open for lighting and stage set rigging. The initial concept for a highly-adjustable orchestra shell was prohibitively expensive. Finally, there was little time for experimenting with adjustments for singer-orchestra balance.

The initial design comprised convex plywood reflectors with added wall sound-diffusing elements and with ceiling panels adjustable for both height and tilt. Sound absorbing curtains could be lowered at the front and rear of the orchestra. In its final form, however, the orchestra shell comprised a wall of standard vertical convex reflecting elements with two relatively-adjustable ceiling sections. Sound absorbing curtains could be lowered to cover the upper back wall, but the front curtain was restricted by lighting. Orchestra lighting requirements also restricted adjustability of the ceiling reflectors. Prior to the opening performance, reflectors and curtains were adjusted for satisfactory projection, but very little adjustment took place afterwards.

The ability of the orchestra members to hear each other is difficult to satisfy in most spaces. Because of the many built-in limitations of this particular design, a concept derived from a performance space designed by the late Ted Schultz was explored. A simple 5 foot by 5 foot grid of narrow plywood strips forming a T-shape was suspended 18 feet above the orchestra floor. By all accounts heard to date, the result was quite satisfactory; in some cases it prompted an enthusiastic response from orchestra members.

The tight schedule left few opportunities for making acoustical measurements. However, near the end of the season, the Opera's technical director, Glenn Plott not only arranged a time for making recordings in the orchestra shell but also took park in the measurements. Immediately following the final curtain on 23 February 1997, as the closing party was getting under way, the stage crew began demolition of the entire opera configuration, quickly returning the Civic Auditorium to its original condition.

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