

GOLDEN GATE PARKING GARAGE, SAN FRANCISCO

System solution makes underground parking garage undetectable in urban park



Above: Golden Gate Park and de Young Museum, San Francisco

Vibro-Acoustics performed a full system analysis for the underground parking garage, meeting a strict noise criterion of 45 dBA and, with the Integrated Systems Approach, overcame restrictions on space and static pressure drop.

Project Achievements

Value Stream (out of 5 stars)

Noise Criteria ★★★★★
 Project Risk Minimization ★★★★★
 Improved Energy Efficiency ★★★★★
 Space ★★★★★

Highlights

- » Met stringent noise level of 45 dBA
- » Eliminated any noticeable garage fan noise in park setting
- » Overcame pressure drop limitations
- » Tight space restrictions overcome

SITUATION

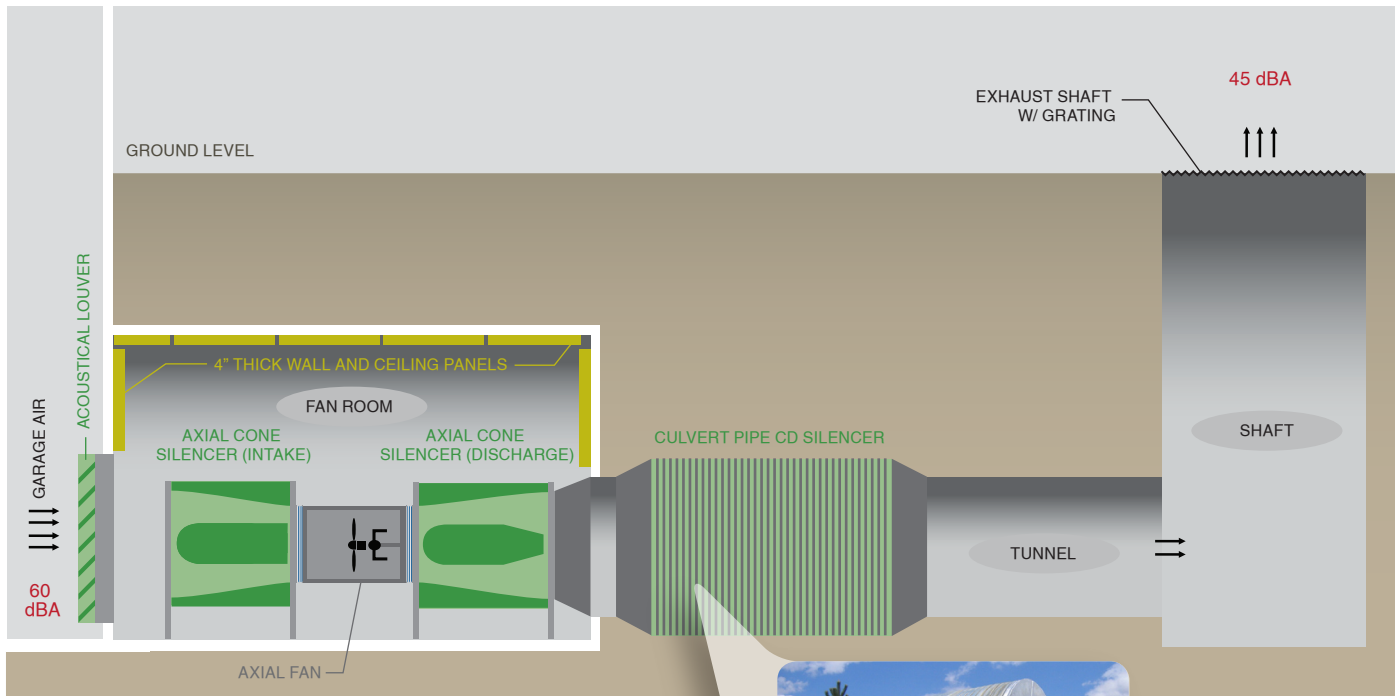
The Golden Gate Park Music Concourse underground parking garage is integrated tightly between the de Young Museum of Fine Art and the California Academy of Sciences, wrapping around the Music Concourse itself. This 800-car garage is virtually invisible within San Francisco's 1,000 acre Golden Gate Park.

To address the buildup of toxic fumes, the garage relies on two exhaust ventilation systems, each of which includes its own 200,000 CFM axial fan, as well as a number of smaller propeller fans. Set in mechanical rooms, the two fans work to draw air out of the parking garage. In the early phase of the project, two 10 ft long standard "low frequency" silencers were specified based on an acoustical analysis for noise control. These silencers were to be installed on both the intake and discharge sides of the fans to control noise within and outside of the garage.

PROBLEMS

As a result of revisions to the fan rooms, the rectangular straight silencers originally specified became unsuitably large for the allocated space. Even if these silencers had been able to fit, the pressure levels still would have been less than ideal. Changing the fans in an attempt to address the pressure drop issue would have raised horsepower requirements, increasing energy consumption and cost.

While a noise criterion of only 60 dBA was required inside the garage, the outdoor requirement presented a greater challenge. Based on an agreement to keep existing background noise levels from increasing near the exhaust discharges during the garage's peaks hours of operation, an outdoor noise criterion of 45 dBA was established. The political backdrop around the project added greater pressure to meet the noise criterion. Concerned by the effect the garage and other noise sources may have on park events and wildlife, the local community put the project under close scrutiny with an aim to halt its construction.



SOLUTION

Vibro-Acoustics partnered with both the acoustical consultant and mechanical engineer, and using the Integrated Systems Approach, performed a system analysis and helped redesign the noise control solution. As guaranteed, the new solution met the required noise criteria of 45 dBA (outdoor) and 60 dBA (indoor) and overcame the space and static pressure drop restrictions.

On the intake side, acoustical louvers were installed to help reduce noise entering the garage, improving safety in the parking area. Absorption material was added in the fan rooms to control sound level buildup. For the exhaust fan intake, Vibro-Acoustics provided dissipative silencers to reduce noise and ease fan airflow.

On the discharge side, 9 ft axial cone silencers were selected to facilitate the airflow through the two systems. To address the noise in the underground tunnels, Vibro-Acoustics provided a circular tunnel silencer design and used a culvert pipe casing to meet the structural requirements. These silencers were suitable for direct burial and prefabricated for low pressure drop, completing the attenuation required to meet the noise criterion.

This system solution helped the design and construction teams meet all system requirements, thereby allowing the garage to obtain an occupancy permit to open for use.



Above
System solution
for underground
ventilation system

Left
Completed section
of culvert pipe CD
silencer

The circular tunnel silencers were prefabricated for low pressure drop and underground application.

Aerodynamics Losses for System Solution

	in wg		63	125	250	500	1k	2k	4k	8k
Louver	0.55	IL	5	7	11	12	13	14	12	9
Mech Room	0.25									
Inlet Sil w/ System Effect	1.3 ¹	IL	14	25	40	43	55	42	23	15
Fan										
Cone Sil	0 ²	IL	5	7	11	13	13	8	8	7
CD Silencer	0.65	IL	12	33	45	55	55	55	42	29
Tunnel & Shaft	0.6									
Total PD	3.35	(vs. Fan TP: 3.73)								

1. PD includes inlet losses due to extremely high air velocity.
2. Silencer internals designed to match fan characteristics, improving fan performance.