

GOLDEN GATE PARKING GARAGE, SAN FRANCISCO

System solution for underground parking garage prevented noise control disaster



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

Above: Golden Gate Park, San Francisco

Project Achievements

Value Stream (out of 5 stars)

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

Highlights

- » Stringent noise level of 45 dBA met at property line
- » Noise control disaster avoided
- » Pressure drop limitations met
- » Tight space restrictions overcome

SITUATION

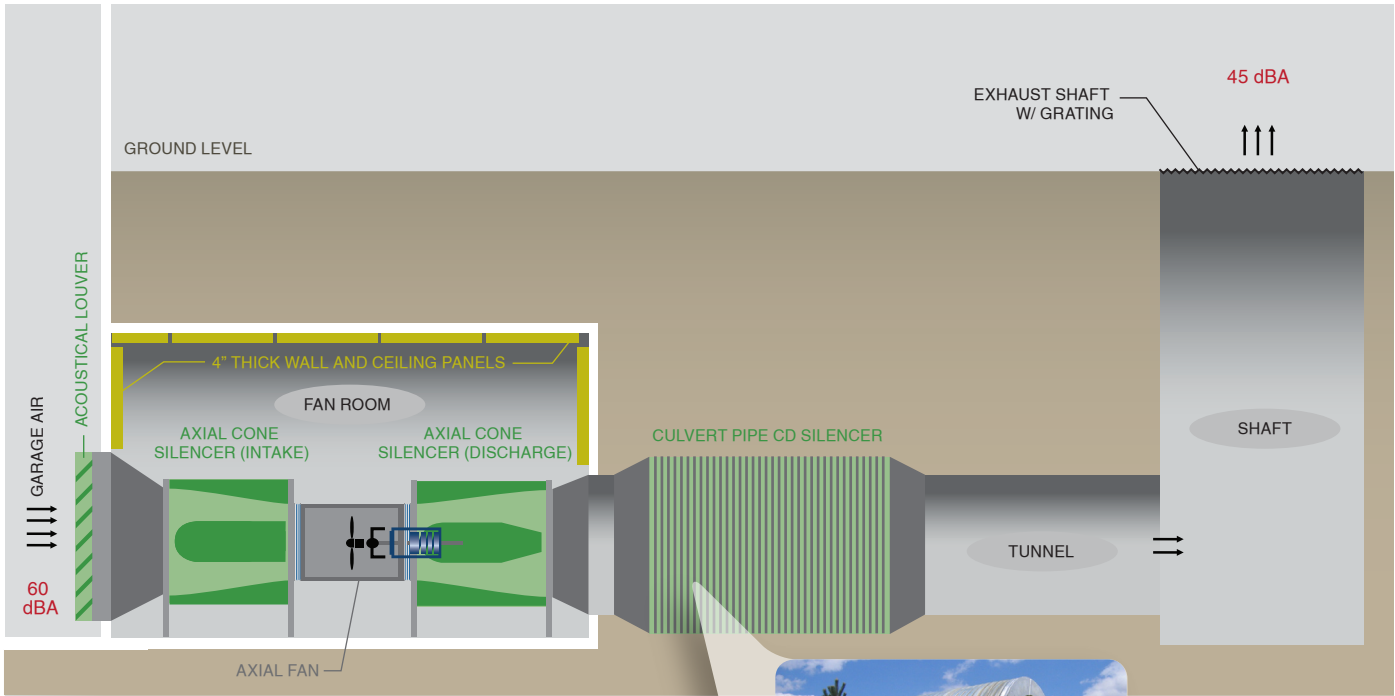
Adjoining the DeYoung Museum, the Golden Gate underground parking garage resides in the 1000-acre Golden Gate Park in the heart of San Francisco.

To address the buildup of toxic fumes, the Golden Gate garage relies on two exhaust ventilation systems, each powered by its own 200,000 CFM axial fan. Set in mechanical rooms, the two fans work to draw outdoor air into the ventilation system. 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

If they had been installed, the specified rectangular silencers would have resulted in undesirable pressure losses and space conflicts. First, the silencers were specified based on insertion loss without consideration for the aerodynamic design of the fan systems. Second, the resulting pressure drop would have been too high for the fans to overcome. Third, the 10 ft silencers were too large to fit the allocated space. Changing the fans to address these issues would raise horsepower requirements, increasing energy consumption and cost.

While the inside of the garage required a noise criterion of only 60 dBA, the outdoor requirement presented a greater challenge. Due to the garage’s proximity to the amphitheatre, the local government imposed a strict noise criterion of 45 dBA at 10 ft from the ventilation shafts. The political backdrop around the project added greater pressure to meet the noise criterion. Concerned by the garage’s effect on park events and wildlife, the local community put the project under close scrutiny with an aim to halt its construction.



SOLUTION

Using the Integrated System Approach, Vibro-Acoustics performed a full system analysis for the engineer and redesigned 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 replaced the standard architectural louvers to help reduce noise entering the garage, improving safety in the parking area. Absorption panels were added inside the fan rooms to control sound level build-up. And instead of using standard rectangular silencers, two 9 ft diameter axial cone silencers were selected to facilitate the intake and discharge airflow through the systems. These silencers reduced noise and improved the overall performance of the fans.

On the discharge side, circular tunnel silencers were pre-fabricated for low pressure drop and underground application. The silencers were designed with culvert pipe to handle the structural loading, and included embedded silencer baffles for noise reduction. These silencers completed the attenuation required to meet the noise criterion.

The system solution helped the design and construction teams to not only meet all system requirements, but also avoid lawsuits by disgruntled local residents.



Above
System solution for underground ventilation system

Left
Completed section of culvert pipe CD silencer

The circular tunnel silencers were pre-fabricated 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.