HVAC PARKING NOISE RADIATION AND MITIGATION

Synthesized Case Study Based on PV1-PV8 Simulation Outputs

Source project: Al Marasem Square Mall parking ventilation zones

Prepared for SAMI SAMIR	**Prepared by** AHMED ELETHY	**Date** 21 April 2026
Source basis Uploaded ENOSH HVAC acoustics report	**Scope** PV1-PV8; parking zones only	**Standards referenced** ANSI/ASA S12.2-2019; AHRI 885-2008

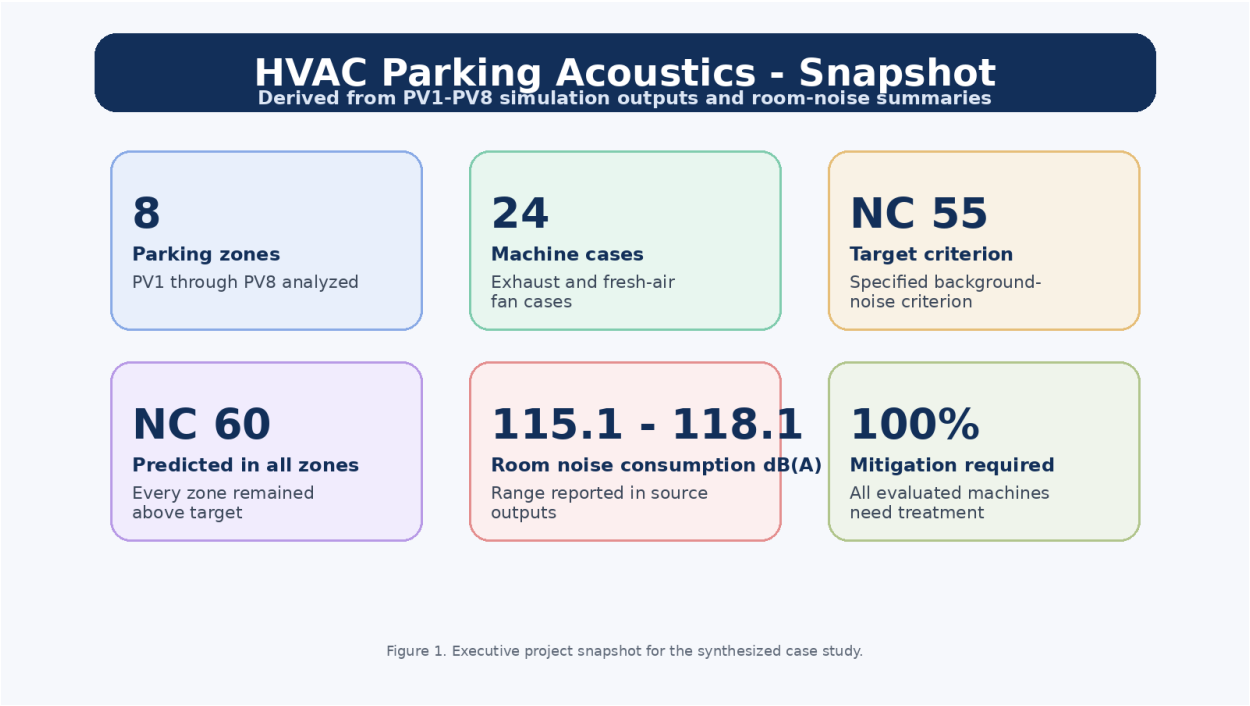


Figure 1. Executive snapshot derived from the uploaded PV1-PV8 source report.

Abstract

This case study synthesizes the uploaded ENOSH acoustics report evaluating HVAC noise radiation in parking ventilation zones PV1-PV8 of Al Marasem Square Mall. The original study applied ANSI/ASA S12.2-2019 room-noise criteria, used Enosh POESSL Analyzer for in-duct sound propagation and room-noise prediction, and assessed 24 machine cases across eight parking zones. Across all evaluated zones, the predicted condition remained at NC-60 against a project target of NC-55, indicating consistent acoustic noncompliance and the need for mitigation. Reported room-noise-consumption outputs ranged from 115.1 to 118.1 dB(A). The dominant control strategy in the source report is duct attenuation through lined rectangular ducts, supported by room-side measures such as suspended gypsum-board layers with a plenum where radiated noise remains significant. The synthesized assessment confirms that the issue is systematic rather than local, and that mitigation should prioritize source-path control, duct acoustic treatment, and routing discipline near sensitive adjacencies.

1. Study basis and scope

The uploaded report presents a multi-zone parking acoustics assessment centered on HVAC exhaust and fresh-air fan systems, with room-noise predictions generated for PV1 through PV8.

The document repeatedly frames compliance against a target criterion of NC-55 for parking areas, while the individual machine-case outputs and zone summaries indicate a predicted NC of 60 in every analyzed zone.

This restructured case study does not replace the original calculation sheets; it reorganizes their evidence into a publishable narrative format with concise engineering interpretation, summary tables, and visual synthesis.

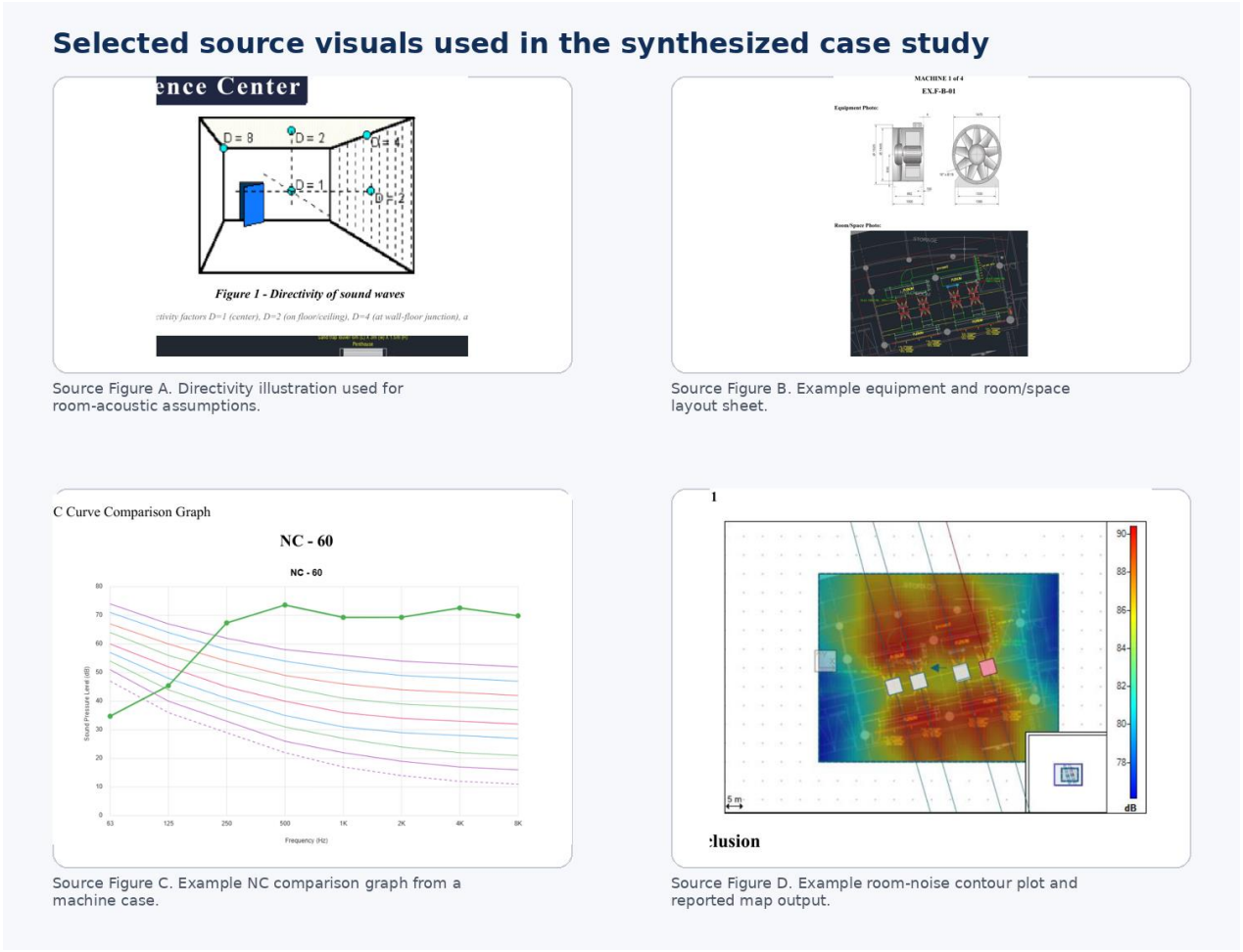
2. Methodology

- Source data extraction: project-level summaries, machine counts, NC comparison graphs, room-noise maps, and the source report abstract/conclusion sections were used as the primary evidence base.
- Standards frame: the source report explicitly references ANSI/ASA S12.2-2019 for room-noise evaluation and AHRI Standard 885-2008 in the software credits section.
- Modeling framework: Enosh POESSL Analyzer (HVAC Acoustics Analyzer / Flow modules) was used in the source report for duct attenuation and room-noise prediction.
- Acoustic assumptions: where direct acoustic data for dampers and air outlets were unavailable, the source report states that best-practice estimates were used.
- Prediction equations: the source report uses a room sound-pressure estimate based on source sound power, directivity, distance, and room constant, together with a room-constant expression based on surface absorption and lumped absorbers.
- Mitigation logic: duct lining, absorbent media, and lightweight suspended layers were the principal control measures proposed in the source document.

Key equations reported in the source study

$$L_p = L_w + 10 \log_{10}\left(\frac{D}{4\pi d^2} + \frac{4}{R}\right)$$

$$R = \frac{\Sigma S\alpha + \Sigma A}{1 - \bar{\alpha}}$$



Source Figure A. Directivity illustration used for room-acoustic assumptions.

Source Figure B. Example equipment and room/space layout sheet.

Source Figure C. Example NC comparison graph from a machine case.

Source Figure D. Example room-noise contour plot and reported map output.

Figure 2. Selected source visuals: directivity concept, machine sheet, NC graph, and room-noise map.

3. Results

The report demonstrates a uniform pattern of noncompliance. In every parking zone, the predicted result remained NC-60, which is 5 NC points above the stated project target. At the portfolio level, 24 machine cases were assessed across eight ventilation zones, with the zone-by-zone machine count summarized below.

Zone	Machine cases	Predicted NC	Target NC	Status
PV1	4	60	55	Mitigation required
PV2	2	60	55	Mitigation required
PV3	2	60	55	Mitigation required
PV4	2	60	55	Mitigation required
PV5	4	60	55	Mitigation required
PV6	4	60	55	Mitigation required
PV7	4	60	55	Mitigation required
PV8	2	60	55	Mitigation required

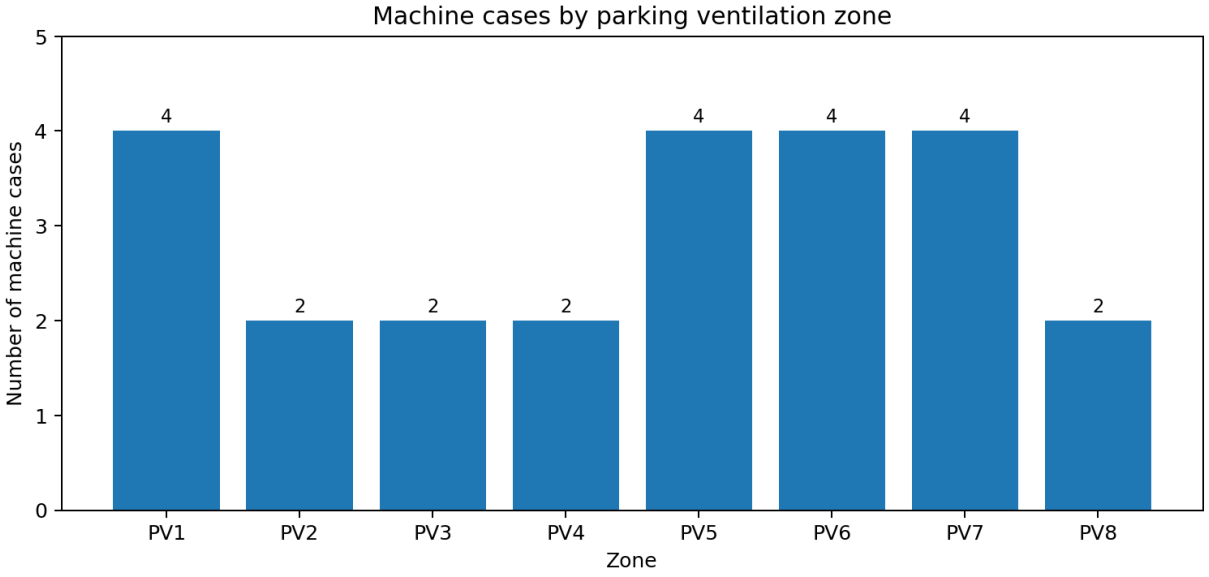


Figure 3. Machine-case distribution across PV1-PV8 (total = 24 cases).

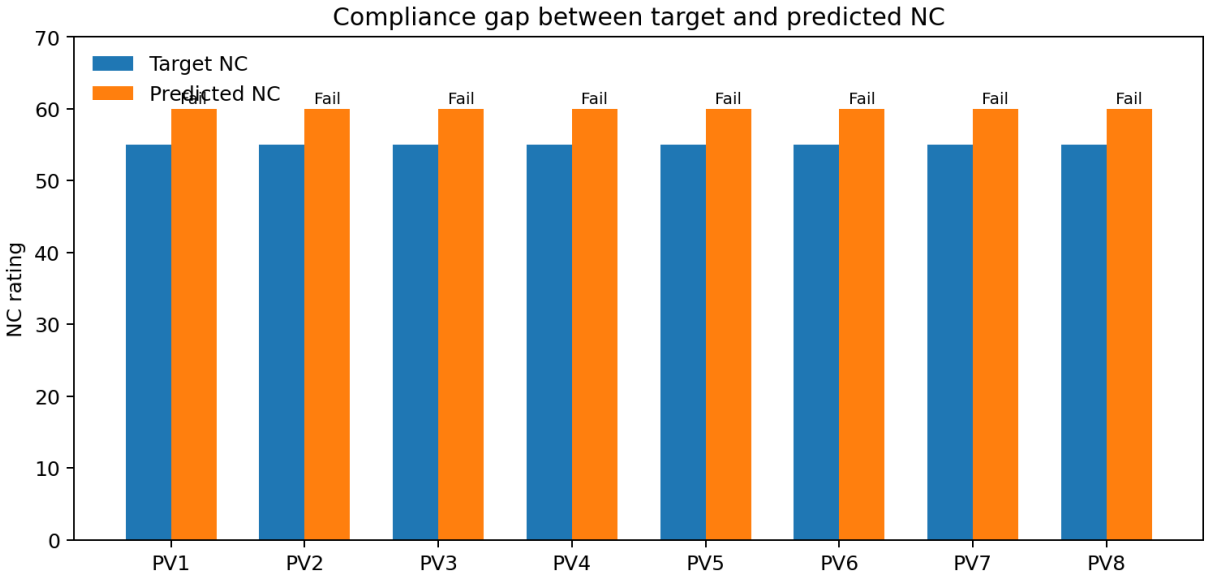


Figure 4. The uploaded report indicates a consistent NC-60 result against a target NC-55.

Representative acoustic outputs extracted from the source

Zone	Room identifier	Reported room-noise consumption dB(A)	Comment
PV1	Room 1	118.1	Visible in source summary / room-noise map
PV2	Room 2	115.1	Visible in source summary / room-noise map
PV3	Room 3	115.1	Visible in source summary / room-noise map
PV5	Room 5	118.1	Visible in source summary / room-noise map
PV7	Room 7	118.1	Visible in source summary / room-noise map
PV8	Room 8	115.1	Visible in source summary / room-noise map

The directly visible room-noise outputs support the range reported in the source abstract, namely 115.1-118.1 dB(A). This means the exceedance problem is not restricted to a single room geometry or a single fan family.

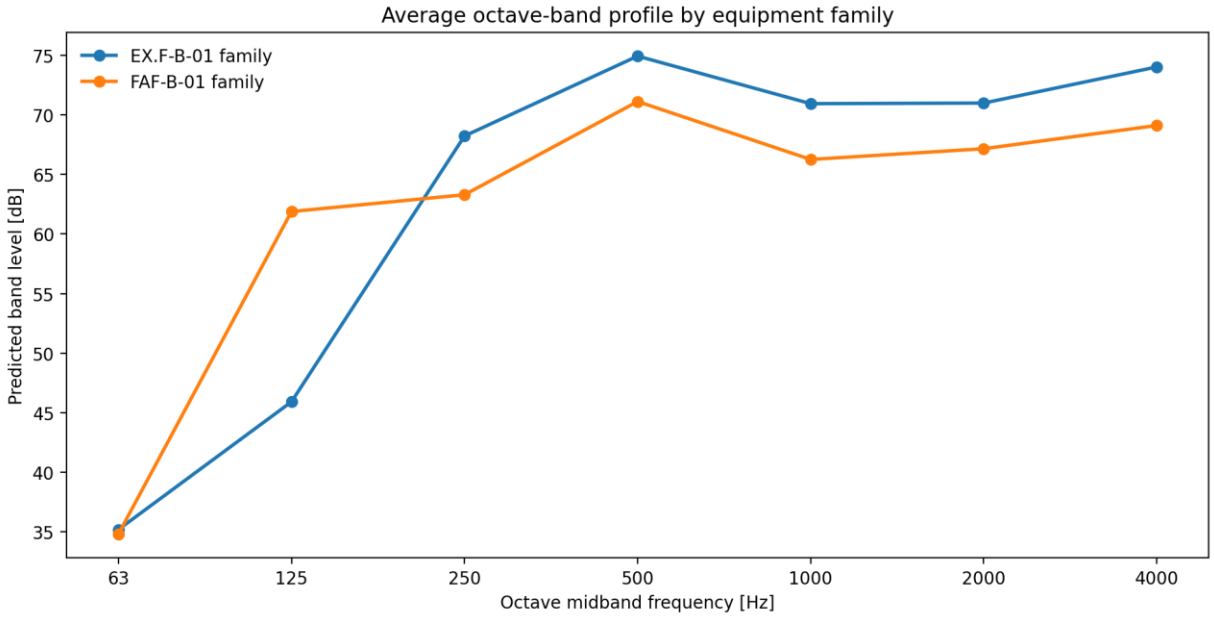


Figure 5. Average octave-band profile synthesized from the EX.F-B-01 and FAF-B-01 families.

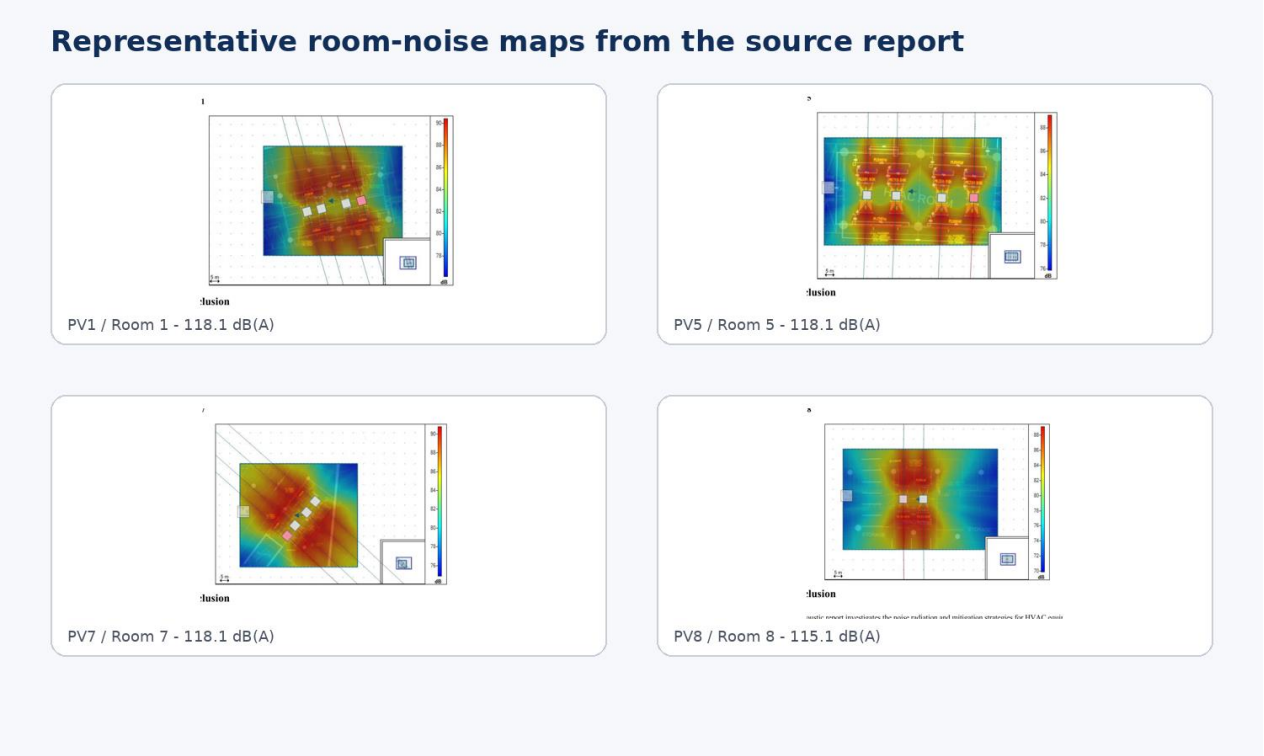


Figure 6. Representative room-noise maps compiled from the uploaded source report.

4. Discussion

The strongest finding is consistency. The source report does not show a marginal or mixed result; instead, every parking zone remained above the target criterion. In practice, this shifts the project response from case-by-case troubleshooting to a programmatic mitigation package.

The octave-band behavior indicates that the problem is not purely low-frequency. The EX family rises sharply into the mid bands and remains elevated through 4 kHz, while the FAF family shows a flatter but still persistently high mid-band response. That pattern helps explain why the NC curves remain elevated despite some duct attenuation.

Because the source report uses best-practice estimates for dampers and air outlets where direct vendor acoustic data were unavailable, the present interpretation should be treated as conservative preliminary engineering rather than final commissioning evidence. Nevertheless, the repeated NC-60 outcome across all zones suggests that modest modeling uncertainty would be unlikely to reverse the compliance conclusion.

The mitigation hierarchy proposed in the source report is technically reasonable: first attenuate within the duct path through lining and absorbent media, then add lightweight suspended construction where radiated noise remains problematic, and finally keep noisy routes and equipment away from sensitive adjacencies wherever planning flexibility exists.

Recommended mitigation package synthesized from the source report

Control path	Measure	Engineering intent	Priority
Source-path	Add internal acoustic lining to selected rectangular ducts (1 in / 25 mm class in	Increase insertion loss before sound reaches the occupied parking	High

	the source sheets).	volume.	
Duct absorbent treatment	Use fiber-glass or equivalent flexible absorbent media with permeable facing, density 24-48 kg/m3 and thickness 25 mm.	Improve mid/high-frequency attenuation while maintaining airflow function.	High
Room-side radiated control	Install at least one 12.5 mm gypsum-board suspended layer with plenum >200 mm where radiated noise remains excessive.	Reduce breakout/radiated transmission into adjacent areas.	Medium
Layout / coordination	Keep noisy equipment and duct routes away from adjacent sensitive zones and avoid direct cross-talk pathways.	Reduce flanking and adjacency-driven transmission.	High
Data refinement	Obtain manufacturer acoustic data for dampers, outlets, and final installed equipment.	Move from preliminary simulation to final verified design.	Medium

5. Conclusion

Based on the uploaded PV1-PV8 report, the parking HVAC systems exhibit a repeatable acoustical compliance gap: all zones were reported at NC-60 against a target of NC-55. The evidence indicates that the project needs a coordinated mitigation strategy rather than isolated corrective actions. The most defensible immediate measures are duct lining, absorbent media, and room-side suspended construction in critical areas, followed by refined vendor-specific acoustic data and post-installation verification.

6. Future work

Future project phases should include (1) acquisition of vendor-certified sound power data for all terminal components, dampers, and outlets; (2) recalibration of the simulation using final installed geometry and airflow conditions; (3) octave-band field measurements after installation; (4) validation of room-noise contours against measured SPL/NC values; and (5) optimization of duct routing and plenum construction near sensitive adjacencies.

7. Acknowledgment

This synthesized case study was prepared from the uploaded ENOSH source report and reorganized into a publication-ready engineering format. Appreciation is extended to Prof. Dr. Ibrahim El Noshokaty and the ENOSH Science Center context reflected in the original report materials.

8. Conflict of interest

The present document is a synthesized technical restatement of an uploaded project report. No commercial conflict of interest is declared by the drafting assistant. Product references such as K-Flex are retained because they appear in the source material as engineering examples rather than endorsements.

9. References

1. ANSI/ASA S12.2-2019. Criteria for Evaluating Room Noise. Acoustical Society of America / American National Standards Institute.
2. AHRI Standard 885-2008. Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

3. ASHRAE. HVAC Applications Handbook. Sound and vibration control guidance for air-distribution systems.
4. Uploaded project source report: Evaluating HVAC Noise Radiation and Control Measures in Parking Facilities: An ANSI/ASA S12.2-2019 Compliant Approach. ENOSH Science Center, Al Marasem Square Mall, PV1-PV8 outputs.
5. Enosh POESSL Analyzer software credits page as included in the uploaded source report (report timestamp 15 January 2026).

Appendix A. Quick evidence summary

- Total analyzed zones: 8 (PV1-PV8).
- Total machine cases: 24.
- Repeated predicted criterion outcome: NC-60 in all zones.
- Target criterion stated in the source sheets: NC-55.
- Reported room-noise-consumption range: 115.1-118.1 dB(A).