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Article

Acoustic characterization and modeling of padel courts in urban residential environments

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Abstract: Padel courts are now common in many residential and mixed-use projects, but the published measurement base for their outdoor noise impact is still small. Recent work has flagged siting conflicts and padel-related acoustic concerns, yet few studies place padel and tennis side by side under the same site conditions. This paper addresses that gap through field measurements and acoustic modeling at one mixed-use development in Abu Dhabi, United Arab Emirates. A padel court and a tennis court were each recorded for a single 15-minute period, and the resulting levels fed an outdoor propagation model. At 10 m, the padel court reached LAeq = 64.2 dB(A) and LAmax = 71.3 dB(A), against LAeq = 58.4 dB(A) and LAmax = 63.6 dB(A) for tennis. Padel showed stronger octave-band content at mid- and high frequencies, consistent with ball-wall impacts and reflections off its rigid glass and metal enclosure. These levels were then carried into a CadnaA model built on ISO 9613-2 to trace propagation toward the nearest residential facades. With 4 m barriers around the padel courts, predicted facade levels at the most shielded positions fell by 4 to 5 dB(A). A single site and one recording per sport bound these conclusions: they describe a case study rather than a general emission standard for padel. What the data do provide is a matched padel-versus-tennis comparison and a worked example of how a small field set can steer acoustic planning early in residential design.

Keywords: padel court noise; urban acoustic impact; recreational facility planning; noise mitigation strategies; CadnaA modeling

1. Introduction

Over the past decade, padel has spread quickly through residential, hospitality, and mixed-use developments [1,2]. That trend has made a fairly practical question hard to avoid: what happens when courts are placed close to bedrooms, guest rooms, terraces, or other noise-sensitive spaces? Padel differs from most racket sports in one obvious way. It is played inside a rigid enclosure made largely of glass and metal mesh. That enclosure changes the way sound behaves around the court by adding reflections and extra impact events.

The literature no longer supports blanket statements that padel acoustics have been ignored. Recent work has already described siting conflicts and has also reported measurement-based evidence of padel noise exposure [3,4]. What still seems limited is a direct comparison between padel and tennis under closely matched outdoor conditions, followed by a site-specific propagation analysis for nearby residences. That is the narrower space this paper tries to address.

This paper uses one development case in Abu Dhabi, United Arab Emirates, to combine field measurements with acoustic modeling [5, 6]. Measurements were taken at a reference distance of 10 m from a padel court and a tennis court during representative play periods. Those data were first compared directly and then used as inputs to a CadnaA model prepared for the project layout. The purpose was simple: to see how court placement and barriers might affect predicted residential exposure within this specific site.

The scope of the paper needs to stay narrow [7]. This is a single-site case study with a short measurement period for each sport. It does not establish a general emission database for padel courts, and it does not include independent post-construction validation. What it contributes instead is a bounded comparison that can inform early design, provided the limits of the evidence are stated plainly.

The study pursues two questions. First, did the padel and tennis courts differ in A-weighted level and octave-band behavior over the sampled period? Second, did changes in setback and the addition of barriers move the predicted sound levels at the nearby residential facades in the case-study layout? Stating the aims this way keeps the discussion close to the actual scope of the data.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature on urban noise and acoustic assessment methods. Section 3 outlines the theoretical background. Section 4 describes the measurement and modeling approach. Section 5 presents the results. Section 6 discusses their implications for planning and design. Section 7 closes the paper with the main conclusions and recommendations.

2. Literature review

Published work on sports-facility noise remains much smaller than the literature on transportation, industrial, and broader urban acoustic environments [1, 5, 8–12]. At the same time, the novelty claim in this paper needs to be qualified. Recent studies have already addressed padel from planning and acoustic perspectives, including work on residential siting conflicts and at least one peer-reviewed study that reports padel-related acoustic characterization [3, 4]. The present study therefore should not be presented as the first peer-reviewed work on padel noise. A more accurate claim is that a direct padel-versus-tennis comparison under matched site conditions, combined with case-specific propagation modeling for residential receptors, is still limited in the published literature.

The real gap is not the total absence of prior work. It is the limited amount of comparable field data that can be used in actual design decisions [3, 4, 13]. There is still not much published material that ties together measured padel levels, spectral content, comparison with tennis, and receptor-based modeling inside the same study. For planners and consultants, that combination is more useful than a broad novelty claim because it connects source-side observations to concrete siting decisions.

Barrier studies from transportation and industrial acoustics are a reasonable starting point, but they should not be transferred to padel without caution [14–18]. Padel noise is intermittent, impact-driven, and shaped by a reflective enclosure. Because of that, broadband insertion-loss values reported for roads or railways do not automatically describe what happens around a court. In this paper, then, the barrier discussion stays tied to the modeled case-study layout rather than being presented as a general design rule.

Against that background, the aim of the paper is fairly modest [3,4,6,13]. It reports one padel-versus-tennis comparison at 10 m and uses the measured levels as inputs to an ISO 9613-2 propagation model for one residential development layout. The value of the study is practical. It shows what a limited measurement set can still contribute to early planning, while also making clear what cannot be claimed from such a small sample.

Setback distance remains one of the simplest planning tools available when sports uses sit close to housing [3, 13]. No single distance fits every site, though. At the source level, the shape of the land, intervening buildings or other obstacles, the acoustic behavior of the ground, and the limit set at the receiver all shift the separation a site actually needs. Setback is therefore handled here as a project-specific design decision rather than a fixed universal distance.

On that basis, this study keeps its contribution deliberately bounded. It presents one measured comparison between a padel court and a tennis court and then applies those data to a residential noise model developed for the case-study site [3,4].

The goal is not to define a universal acoustic standard for padel courts, but to show how limited field data can still support early planning when the assumptions and limitations are stated openly.

3. Theoretical framework

The acoustic characterization of racket sports requires attention to sound generation, outdoor propagation, and the way people perceive intermittent events in open environments [19]. Racket sports share several common sources of noise, including ball-racket impact, contact with the playing surface, and interaction with perimeter elements. Even so, the magnitude and character of the sound can change substantially with court geometry, materials, and style of play.

Figure 1 shows the court enclosure that makes padel acoustically different from tennis [20]. The side and rear glass walls, together with the metal mesh extensions, create a semi-enclosed volume where reflections remain part of the local sound field. Because play is packed into a smaller footprint, the near-field sound can also feel more pronounced.

Outdoor sports noise is usually captured with a short set of standard indicators that summarize both average sound energy and high-intensity events [15]. LAeq and LAmax are two of the most useful. LAeq carries most of the comparison because it folds time-varying sound energy into one value that holds up across different sources and scenarios.

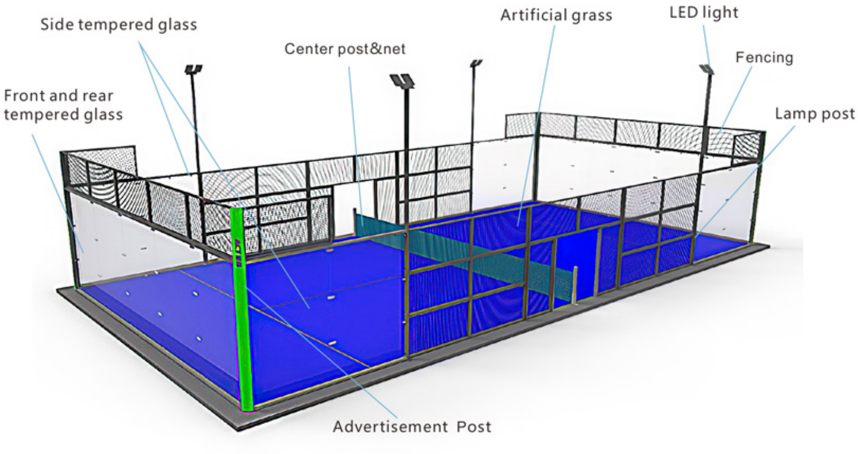


Figure 1. Typical padel court design.

The mathematical formulation of LAeq is expressed as:

$$L_{Aeq,T} = 10 \cdot \log_{10}\left[\frac{1}{T}\int_0^T \frac{p_A^2(t)}{p_0^2}dt\right], \tag{1}$$

where $L_{Aeq,T}$ represents the A-weighted equivalent continuous sound pressure level in dB(A), $p_A(t)$ is the instantaneous A-weighted sound pressure, p_0 is the reference sound pressure (20 uPa), and T is the total measurement time [21]. This logarithmic form follows standard acoustic practice and reflects the frequency sensitivity built into the A-weighting curve.

In this study, LAeq is the main comparison metric because it captures total sound energy over the sampled play period [22]. LAmax is kept alongside it because short, sharp events often shape the way racket-sport noise is experienced [23]. Work on impulsive-sound classification points in the same direction: one broadband descriptor rarely tells the whole story when short events dominate the listening experience [24].

Spectral analysis fills in part of what a single broadband value leaves out [25]. It helps show which frequency bands dominate the sound and which parts of the spectrum are more likely to remain important as the sound travels outdoors. That matters here because the padel enclosure can change the balance between low-, mid-, and high-frequency components.

The general calculation structure follows the form:

$$Lp = LW + DC - A, \tag{2}$$

where Lp represents the sound pressure level at the receptor, LW is the source sound power level, DC is the directivity correction, and A is the total attenuation term, including geometric divergence, atmospheric absorption, ground effects, barrier attenuation, and other secondary factors [6]. In this study, that framework was used as a practical outdoor calculation basis rather than as a claim of full physical completeness for event-based sports noise.

ISO 9613-2 was developed mainly for steady or quasi-steady outdoor sources, but it is still widely used in engineering practice for average-level assessment [6]. In this paper, it is used in that practical sense only: to compare scenarios within the same project, not to claim a full description of every transient feature of padel noise.

The translation from measured sound pressure levels at 10 m to equivalent source sound power levels suitable for model input requires accounting for measurement geometry and applying appropriate corrections. For a source radiating hemispherically over a reflective ground surface, the sound power level can be estimated from Equation (3):

$$LW = Lp, 10m + 20log10(r) + 8 + Aatm(r), \tag{3}$$

where Lp,10m is the measured level at 10 m, r is the source-to-microphone distance, the 8 dB constant reflects hemispherical spreading over a reflective plane, and Aatm(r) accounts for atmospheric absorption over r [6]. Strictly speaking, the 10 m measurement distance cannot be treated as far field for a source as large as a padel court. The court itself is 20 m by 10 m, and this matters even more at low frequencies, especially below 250 Hz, where the wavelengths are large relative to the source size. For that reason, the back-calculation used here should be understood as a practical engineering approximation rather than an exact far-field derivation. Even so, the same procedure was applied to both court types, so any systematic bias would affect them in the same direction. Under that assumption, the measured 5.8 dB difference between padel and tennis remains the relevant comparative result.

In this study, calibration was used only to verify that the adopted source representation reproduced the measured levels at the reference position with reasonable engineering agreement [5, 6]. This was useful as an internal consistency check for the case study, but it does not amount to independent validation of the model at the residential receptor locations.

Surface conditions also play an important role in propagation, since facades, paved areas, vegetation, and exposed ground do not absorb or reflect sound in the same way [18, 25]. In the present model, hard surfaces were treated as reflective, and vegetated areas as acoustically soft limiting cases. That simplification was useful for comparing scenarios, but it does not capture every frequency-dependent behavior of real surfaces.

Acoustic barriers are a common outdoor mitigation strategy because they interrupt the direct path between the source and the receiver [14, 16, 17]. Their performance depends on geometry, diffraction, receiver height, and the relationship between the blocked line of sight and the diffracted path over the top edge.

CadnaA estimates barrier attenuation within the ISO 9613-2 framework and was used here to compare alternative project layouts [6,14,16]. The 4 m barrier height was selected as a practical screening option rather than as a claimed optimum. The same is true for the front and rear placement used around the padel courts.

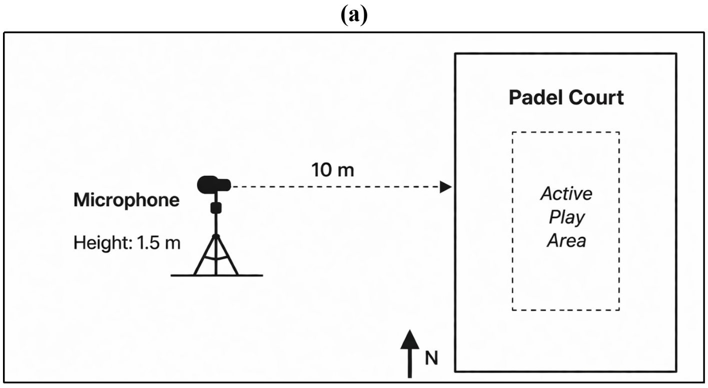
The integration of three-dimensional terrain and building geometry in the acoustic model enables realistic simulation of complex sound propagation paths, including reflections from building facades, diffraction around structures, and shielding effects. To keep the computation manageable while still resolving the dominant paths, only first-order reflections were retained, and higher-order ones were dropped. That omission costs little here: each additional reflection adds spreading loss and surface absorption, so multiply-reflected paths contribute marginally at the receptors except in tightly reverberant urban-canyon settings, which this open layout does not present.

4. Methodology

This study combines in-situ measurement, acoustic modeling, and direct comparison between two racket sports [4, 6, 7]. The purpose was to build a workable case-study assessment of padel noise near sensitive receptors, not to define a general emission protocol for all courts.

Figure 2 presents both a field photograph and a schematic plan view of the measurement configuration, clearly indicating the microphone position, measurement distance (10 m), and court geometry.

(a)



(b)

Figure 2. Measurement setup for acoustic data collection. **(a)** Field photograph of the measurement campaign; **(b)** Schematic plan view showing the relative position of the microphone at 10 m from the court perimeter and at a height of 1.5 m above ground level. The schematic illustrates the geometric configuration used for both padel and tennis measurements.

Measurements were taken between 19:00 and 21:00 in January 2026 with Class

1 instrumentation and routine field checks consistent with standard measurement practice [7]. The microphone was placed about 1.5 m above the ground and 10 m from the courts. Each sample lasted 15 min. That is one reason the results are now described as short-duration case-study observations, not as a full operating profile.

The measurement setup does not meet ideal free-field conditions because the padel court includes reflective glass and metal surfaces [7]. For that reason, the normalization step is treated here as an engineering approximation for comparative work, not as a strict conversion to ideal free-field conditions. A −3 dB correction was applied, following the ISO 1996-2:2017 Annex A guidance for measurements over a hard reflecting plane: there, the ground-reflected contribution lifts the reading by about 3 dB above the free-field value at the same distance. Subtracting 3 dB brings the data back to an equivalent free-field level, which is what the ISO 9613-2 propagation model in Section 4 expects as input. The figure is not interpolated or site-specific; it is the standard hard-ground approximation given in ISO 1996-2 [7].

Both courts were recorded under the same basic configuration, so the comparison holds practical value. Local reflections should bias both data sets in much the same way. Uncertainty remains, but the relative difference between the two courts stays interpretable.

Traffic, equipment, and unrelated human activity were kept under control as far as site conditions allowed. The records therefore represent the sports activity well enough, even though no separate background-noise series was collected.

Each court was played by two players per side in a typical recreational session. Weather held steady enough for a fair comparison, yet the short sampling window and the absence of repetition still limit how far these results generalize [7].

Results from acoustic measurements conducted during representative usage conditions reveal significant differences between the sound pressure levels generated by padel and tennis courts. As presented in **Table 1**, LAeq values measured during padel matches reached 64.2 dB(A), while tennis registered lower values on the order of 58.4 dB(A). Consistently, maximum levels (LAmax) associated with padel were higher, reaching 71.3 dB(A), compared to 63.6 dB(A) measured during tennis matches. These measured values serve as the fundamental basis for subsequent acoustic modeling and comparative analysis between both sports.

Table 1. Results of noise measurements for both scenarios.

Location	LAeq (dB)	LAmax (dB)	L90
Padel Field	64.2	71.3	51.4
Tennis Field	58.4	63.6	48.2

The measured LAeq of 64.2 dB(A) at 10 m for the padel court is broadly consistent with recently published padel measurements reported in the Piana et al. [4]. That agreement should still be interpreted cautiously because the number of available studies is small and site conditions differ.

For purposes of this research, results obtained from in-situ acoustic measurements were applied to an actual project planning scenario requiring a high level of acoustic comfort. The selected case study corresponds to a mixed-use development combining a luxury hotel and high-end residences associated with a recognized international perfumery and jewelry brand, currently in the design phase. The project is located in Abu Dhabi, United Arab Emirates, on a private island situated approximately 8.5 km from the urban center. The development contemplates a 5-star hotel, luxury residential villas, beach clubs, an event hall, and various recreational and leisure spaces. As part of the master plan, tennis and padel courts are planned in close proximity to residential areas, making these sports facilities relevant noise sources for evaluation within the framework of this analysis. **Figure 3** illustrates the spatial configuration of the master plan, showing the relative location of residential villas with respect to tennis and padel courts within the development.

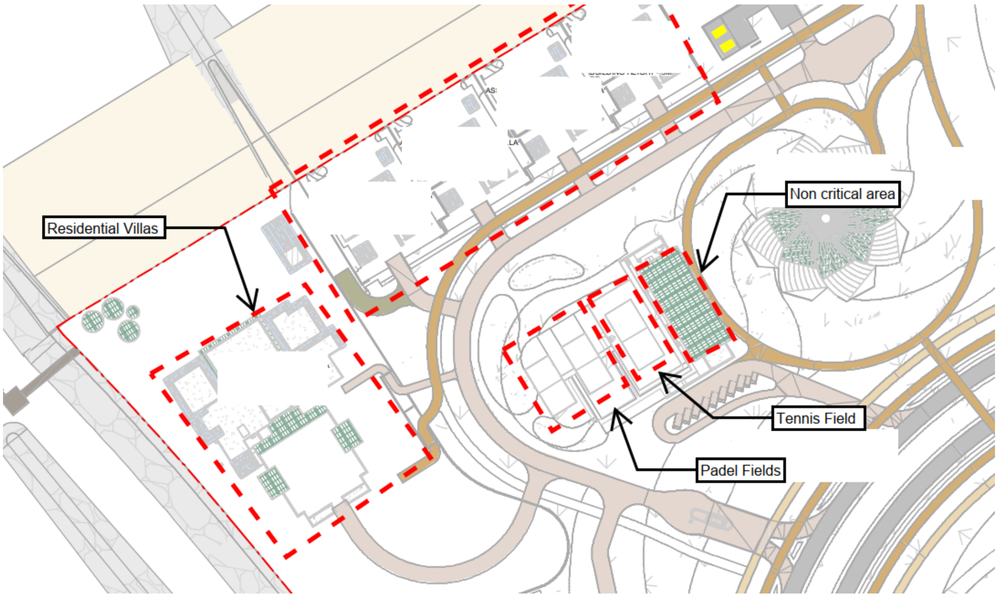


Figure 3. Location of the residential villas relative to the padel and tennis courts within the study project.

The site currently corresponds to an undeveloped island and presents no major existing noise sources beyond wind and occasional human activity. The nearest public road is about 1 km away, so traffic was not expected to dominate the baseline soundscape. A separate traffic study for the projected access connection suggested low circulation volumes, with values compared against common building acoustic guidance [25,26]. Under those conditions, the planned sports uses were treated as the main controllable outdoor noise sources in the development.

During the initial project planning stage, locating padel and tennis courts at an approximate distance of 20 m from residential areas was considered. That position carried clear acoustic and safety risks, however, since the courts sat close to sensitive receptors and stray balls could reach the dwellings. Weighing acoustic comfort and safety together, the team recommended pulling the courts back to at least 50 m from the residential areas. The change cut the potential sound impact, improved safety, and fixed the master plan layout shown in **Figure 3**. This planning-stage intervention represents a proactive mitigation approach, demonstrating how acoustic considerations integrated early in the design can substantially influence facility siting decisions.

To evaluate noise propagation from the padel and tennis courts toward sensitive receptors, the project team used DataKustik's CadnaA software together with a site model based on the planned buildings, terrain, and court layout [6,20]. The software was used here because it allows consistent comparison of alternative design scenarios within one project.

Background sound entered the model only in a simplified project-planning form. Because the site is largely undeveloped and far from major traffic corridors, sports activity was treated as the main evening source in the scenario examined here. That assumption is useful for comparing layouts, but it is not a substitute for a full background-noise survey.

Acoustic propagation was evaluated with ISO 9613-2 as implemented in CadnaA [6]. The method is commonly used in outdoor environmental acoustics and was applied here as a practical framework for comparing design scenarios within the same site. Because ISO 9613-2 was developed primarily for steady or quasi-steady outdoor sources, its use in this study should be understood as an approximation for average-level assessment rather than as a complete description of the event-based character of racket-sport noise. **Figure 4** shows the modeled two-dimensional sound distribution before mitigation measures were added.

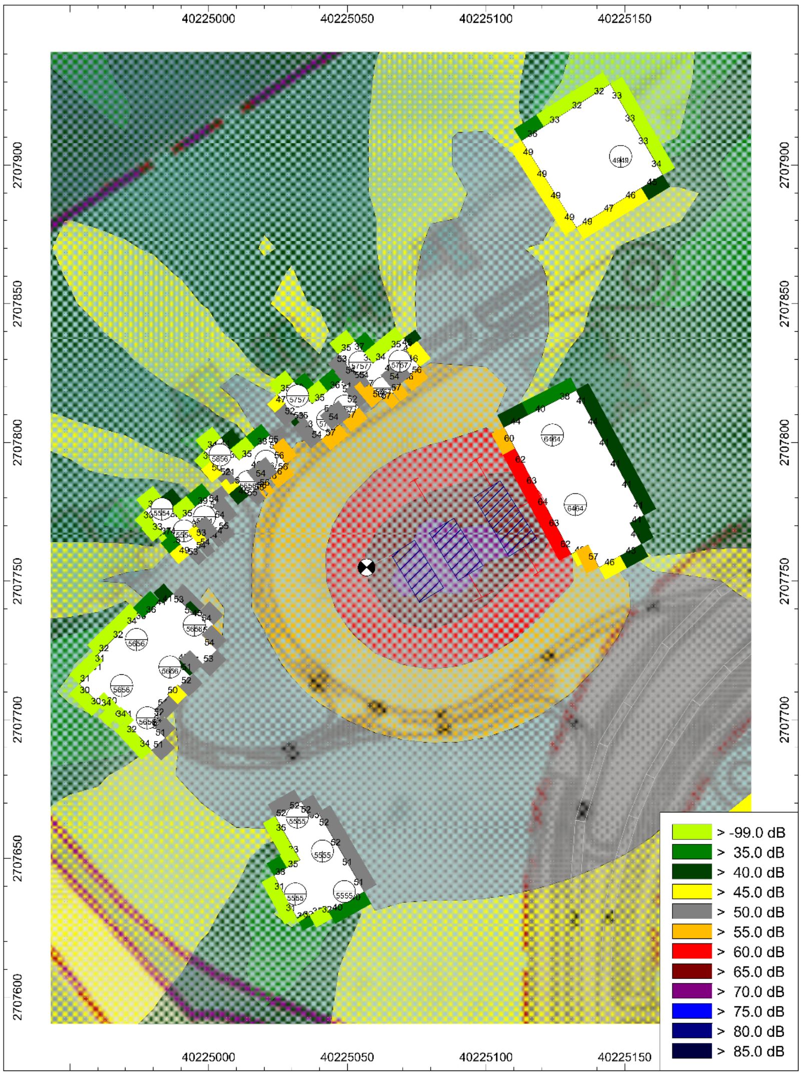


Figure 4. Representation of the 2D noise map without mitigation measures (LAeq).

The unmitigated results suggest that residential exposure still matters even after the courts are moved away from the nearest buildings. The issue in this layout is not an extreme facade level. It is that the predicted levels remain close enough to common residential guideline values to justify further design attention, especially for terraces and balconies.

4 m barriers were added around the padel courts as a practical mitigation scenario [14, 16, 17]. The purpose was not to claim a universally optimal barrier design, but to test whether a targeted intervention could reduce predicted residential exposure within the project geometry. **Figure 5** shows the resulting 2D modeled sound distribution after the barriers were added, and **Figure 6** presents the same scenario in three dimensions.

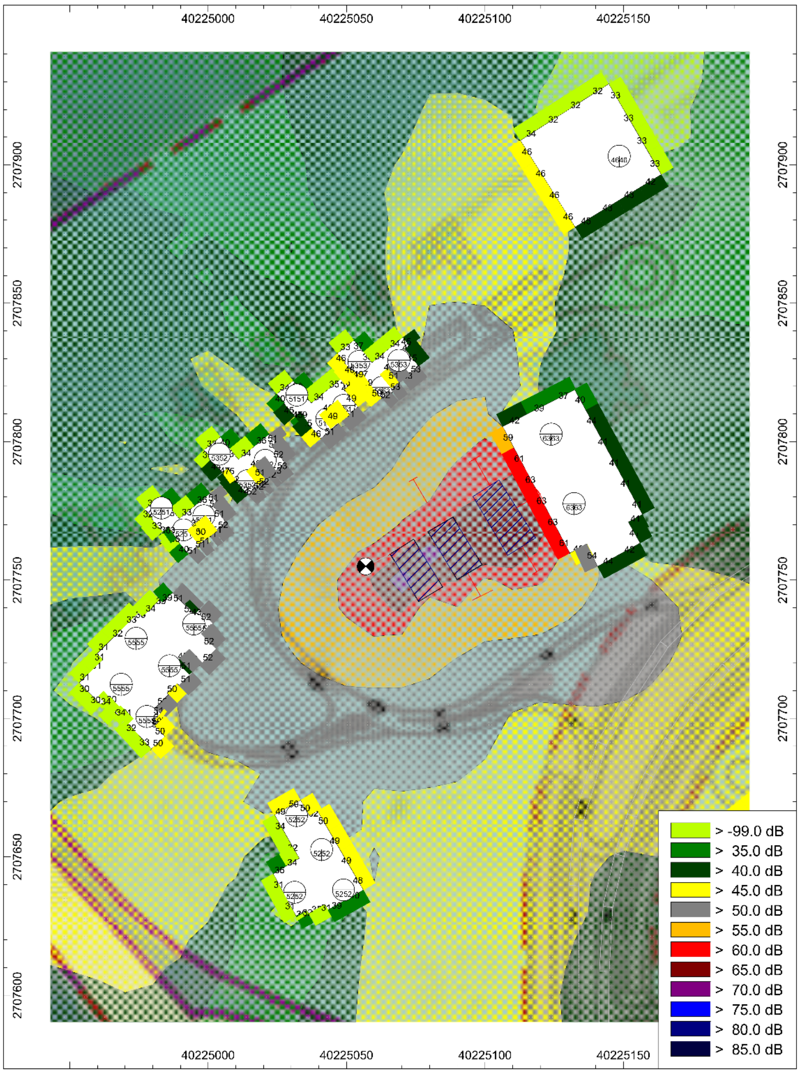


Figure 5. Representation of the 2D noise map with acoustic barriers (LAeq).

The mitigation scenario produced lower predicted levels at the most exposed residential receivers. In this case study, the reductions were sufficient to improve compliance margins against the project criteria for outdoor residential areas. The result should be interpreted as a modeled screening outcome for this geometry, not as proof that the same barrier configuration would deliver identical performance at other sites. The lower facade levels would also reduce facade insulation demand relative to the unmitigated scenario, although a project-specific facade calculation would still be required before selecting glazing or envelope assemblies [25].

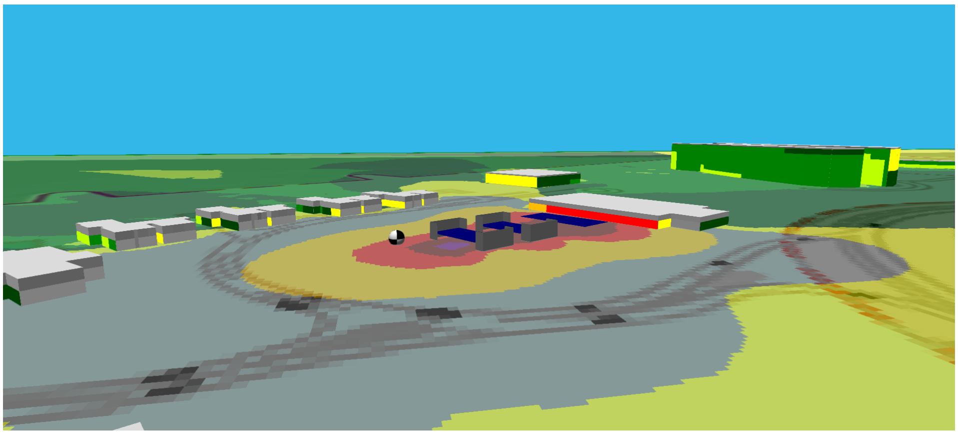


Figure 6. Representation of the 3D noise map with acoustic barriers (LAeq).

Acoustic modeling parameters and source definition

Padel and tennis courts were represented in CadnaA as distributed area sources rather than as point sources, since player movement, ball-racket impacts, and, in the case of padel, ball-wall contacts do not generated at a single fixed location but occur across the full playing area. Equivalent source sound power levels (LW) came from the 10 m sound-pressure measurements through a back-calculation consistent with ISO 9613-2. The back-calculation served only to fix an equivalent source strength; in the model itself, that acoustic power was spread evenly across the court surface. Player activity and ball impacts emit from a range of heights, which an effective source height of 1.5 m above ground level represents.

Propagation was computed with the ISO 9613-2 method in CadnaA (DataKustik), accounting for geometric divergence, atmospheric absorption, ground effects, and barrier attenuation. The calculation ran in octave bands from 63 Hz to 8 kHz, then A-weighted to broadband LAeq. Working band by band matters here because ground attenuation and atmospheric absorption both change with frequency, so padel and tennis noise propagate differently across the receptor distances studied.

Ground absorption used the simplified ISO 9613-2 ground-factor scheme: G = 0 for acoustically hard surfaces such as courts, pavements, and building footprints, and G = 1 for landscaped areas. This binary split is a simplification that misses intermediate and frequency-dependent ground behavior, but it matches the standard modeling workflow and the level of site detail on hand. Building facades and court surfaces were modeled as fully reflective elements (absorption coefficient alpha = 0). First-order reflections were included, whereas higher-order reflections were excluded in order to balance computational efficiency with the level of accuracy expected for this open-site configuration.

Simulations were performed under favorable propagation conditions consistent with ISO 9613-2, using an air temperature of 30 °C and a relative humidity of 70%, which are representative of typical evening conditions in Abu Dhabi during the study period. Receivers sat 1 m from the residential facades and at representative outdoor locations tied to residential use, all evaluated at 1.5 m above local ground. Noise maps came from a calculation grid resolved finely enough to track the sound-level gradients across the study area.

The main background source inside the development, the access road, was entered into the model as an independent steady-state source and was energetically summed with the sports sources at each receptor. Given the low ambient noise conditions of the island site, these background contributions were found to be acoustically secondary at the residential receptor locations considered, with padel and tennis remaining the dominant contributors during the analyzed operating period.

The model was internally calibrated by adjusting source sound power levels until the predicted sound pressure levels at the 10 m reference positions matched the corresponding field measurements within a tolerance of plus or minus 1–2 dB. This procedure should be understood as model calibration rather than independent validation, since no separate post-construction or external validation dataset was available. The predicted facade and outdoor receptor levels should therefore be interpreted as calibrated planning estimates within the uncertainty normally associated with ISO 9613-2-based environmental noise modeling.

5. Results and discussion

Table 1 collects the measured sound pressure levels. Padel reached an LAeq of 64.2 dB(A) and an LAmax of 71.3 dB(A); tennis stayed lower at 58.4 dB(A) LAeq and 63.6 dB(A) LAmax. That puts padel 5.8 dB above tennis at an equivalent level and 7.7 dB above at the maximum level. Padel also opened a wider LAeq-to-LAmax gap, 7.1 dB against 5.2 dB for tennis, which points to a stronger run of peak events during play, though that gap alone should not be read as a measure of impulsiveness.

Figure 7 brings out clear frequency-dependent differences between the two sports. Across the mid-frequency range, padel ran higher in A-weighted octave-band level, while tennis edged ahead only at 63 Hz and 8 kHz. The gap widened most between 125 Hz and 1 kHz, where padel led by roughly 5–7 dB. Both peaked near 1 kHz, padel at 61 dB and tennis at 54 dB, and from 500 Hz to 4 kHz, padel held the lead, spanning 54 to 61 dB against 50 to 54 dB for tennis. So, the padel packs more of its acoustic energy into the band that matters most for human hearing.

The higher mid-frequency content observed for padel is plausibly linked to the acoustic behavior of enclosed courts. Impacts against rigid glass walls and metallic structural elements can generate broadband sound and increase the contribution of reflected energy compared with open tennis courts. In addition, the limited acoustic absorption of these surfaces promotes multiple reflections, which can reinforce sound levels within the enclosure and prolong the presence of mid- and high-frequency components.

This difference matters in psychoacoustic terms, since the 1–4 kHz range overlaps the band where human hearing is most sensitive. Energy in that band drives perceived loudness, so it can raise the annoyance potential. High-frequency sound fades faster outdoors than low-frequency sound, yet the measured spectrum still places padel above tennis through the critical mid-frequency bands, which suggests a larger environmental noise impact at the nearby receptors.

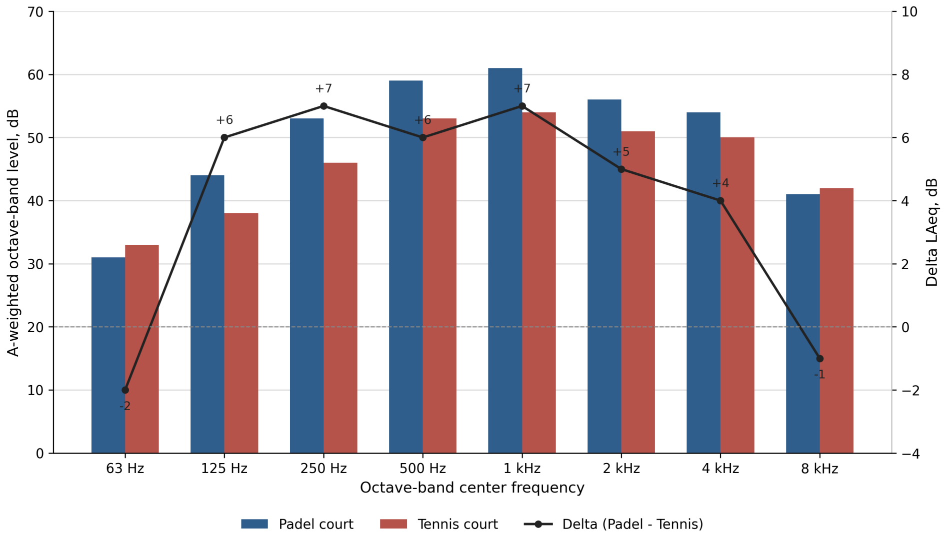


Figure 7. Comparison of A-weighted octave-band LAeq levels measured at 10 m from the padel and tennis courts. Padel noise was higher across most bands, especially between 125 Hz and 4 kHz.

To test whether A-weighting alone drove the gap, the octave-band spectra were re-examined in unweighted sound pressure levels (dBZ). **Figure 8** shows padel generating more acoustic energy than tennis across most of the audible range. From 125 Hz to 4 kHz, the gap ran 4–7 dB, peaking in the 250 Hz and 1 kHz octave bands. At 63 Hz and 8 kHz, the two sports came out comparable, with only minor differences.

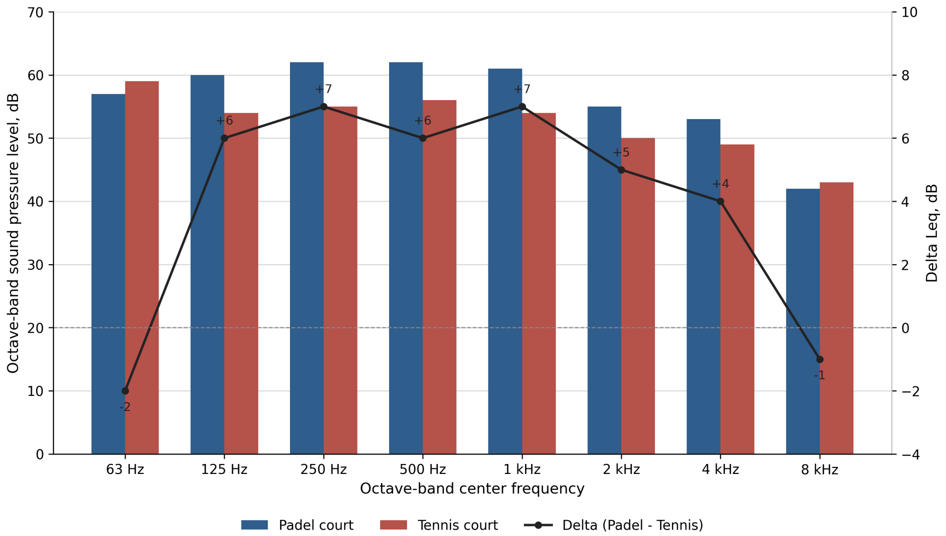


Figure 8. Comparison of octave-band Leq levels measured at 10 m from the padel and tennis courts. Padel noise was higher across most bands, especially between 125 Hz and 4 kHz.

So padel's higher measured levels are not an artifact of the frequency weighting; they reflect genuinely greater acoustic energy from the sport itself. Raised levels across a wide frequency span fit how enclosed courts behave, where repeated ball-wall impacts and reflections off rigid glass and metal surfaces lift both the magnitude and the persistence of the emissions. Overall, the comparison between **Figures 7** and **8** shows that the greater acoustic impact of padel is primarily related to higher source strength and not only to spectral characteristics that favor A-weighted assessment metrics.

Figure 4 shows the two-dimensional noise distribution without mitigation. Predicted levels exceeded 65 dB(A) LAeq within approximately 15–20 m of the padel courts, compared with 10–15 m for the tennis courts. At the residential façades roughly 50 m north of the courts, predicted levels fell between 50 and 55 dB(A) where exposure was greatest and between 47 and 52 dB(A) at partially shielded spots. The peak predicted façade level reached 54.8 dB(A), with a 51.3 dB(A) mean across all residential receptors. These figures sit nominally within the local 55 dB(A) daytime limit, but they hug the threshold where annoyance can start to matter in outdoor residential spaces, especially over the evening period studied here.

Figures 5 and **6** show the predicted noise distribution after the introduction of 4 m barriers around the padel courts. Façade levels previously in the range of 52–55 dB(A) decreased to 47–50 dB(A), with reductions of 4–5 dB at directly shielded locations and 2–3 dB at oblique positions. The maximum predicted level decreased from 54.8 to 49.6 dB(A), while the mean level across residential receptors decreased from 51.3 to 47.8 dB(A). Reductions at individual receptors spanned 2.1 to 5.2 dB, set by the source-receiver geometry. The 60 dB(A) contour shrank from about 3,500 m^2 to 1,200 m^2, and the area above 55 dB(A) dropped from 8,200 m^2 to 2,800 m^2. Once the barriers were in place, every residential receptor stayed below 50 dB(A) LAeq.

As modest as they look in absolute terms, these reductions carry acoustic weight: they pull the most exposed façades off the top of the predicted range and open a clearer compliance margin. The variation in attenuation across receptor points is consistent with barrier diffraction effects, with the largest reductions occurring where the barrier more effectively interrupts the direct propagation path between the courts and the façades.

The results, read together, confirm a greater acoustic impact from padel than from tennis under comparable conditions. The measured 5.8 dB gap in LAeq and 7.7 dB gap in LAmax show padel is louder on average and marked by stronger peak events. That pattern again fits the enclosed court, where rigid glass and metal surfaces raise reflection and stretch out the sound after each impact. For planning, it means setback distances and mitigation that pass for tennis cannot move across to padel without adjustment.

The modeled scenarios also show padel can sit comfortably within residential developments when acoustic criteria enter the design early. Here, a greater separation distance plus targeted barriers cut predicted façade exposure to far more manageable levels than the unmitigated layout. That carries practical weight, since such measures cost far less to build in during planning than to retrofit after construction.

These findings still need to be read against the study's limitations. The field campaign rested on one 15-minute measurement per sport, so it cannot capture the full spread tied to playing intensity, skill level, or shifts in activity over time. ISO 9613-2 also targets continuous sources, and this model was calibrated rather than independently validated against separate receptor measurements. Even so, the overall pattern is consistent: padel remained acoustically more intrusive than tennis across the evaluated scenarios, and barrier placement proved effective in reducing façade exposure at the studied site.

Figure 9 further supports this interpretation by showing that the predicted attenuation profiles for padel and tennis remain broadly parallel with distance, with padel consistently higher across the modeled range. This suggests that the main difference between the two sports is related to source strength rather than to fundamentally different propagation behavior. Matching residential exposure across the two would therefore call for either more separation or extra mitigation on the padel side.

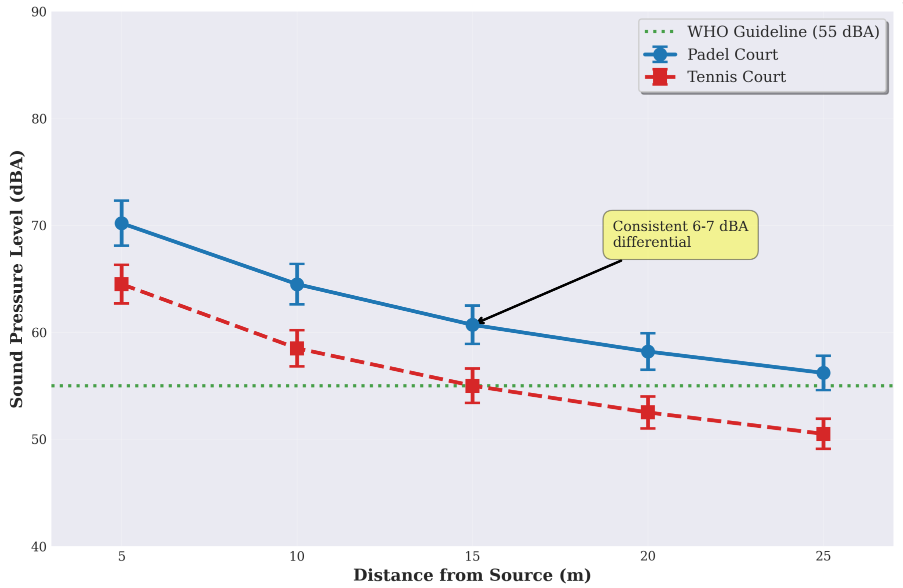


Figure 9. Comparative attenuation profiles: Padel vs. Tennis court.

Figure 10 maps the LAmax spectrum across octave bands from 125 Hz to 8 kHz. Padel ran above tennis through most of the mid-frequency range, parting most widely between 500 Hz and 4 kHz. This is particularly relevant because human hearing is most sensitive in this region, so increases in these bands are likely to contribute disproportionately to perceived loudness and annoyance. The spectra therefore suggest that mitigation for padel facilities should not focus only on overall level reduction, but also on controlling sound energy in the mid-frequency range where both acoustic energy and auditory sensitivity are greatest.

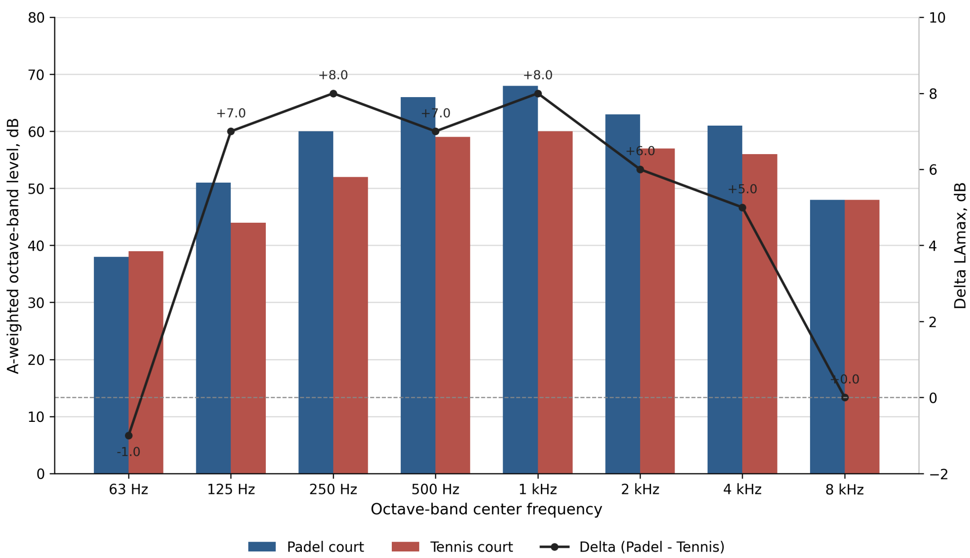


Figure 10. Comparison of A-weighted octave-band LAmax levels measured at 10 m from the padel and tennis courts. Padel noise was higher across most bands, especially between 125 Hz and 4 kHz.

6. Conclusion

This study presents a comparative acoustic assessment of padel and tennis courts based on field measurements and outdoor sound propagation modeling using ISO 9613-2. The results help clarify how padel noise behaves in residential settings and provide case-specific evidence for planning and mitigation in noise-sensitive developments.

Under the sampled conditions, padel courts produced higher noise levels than tennis courts, with measured differences of 5.8 dB in LAeq and 7.7 dB in LAmax at 10 m. Spectral analysis put padel above tennis through most of the mid-frequency range, sharpest between 500 Hz and 4 kHz, where the ear is most sensitive. The wider LAeq-to-LAmax gap for padel again points to stronger peak events during play, though on its own it should not be read as a measure of impulsiveness.

These differences trace back to how enclosed padel courts behave acoustically. Rigid glass and metal surfaces add reflections and stretch out the sound after impact, pushing overall levels above those of open tennis courts under comparable conditions. In practical terms, padel facilities need acoustic attention of their own in site planning and design, not assessment by analogy with tennis.

The modeling shows that, left unmitigated, padel courts can drive façade levels toward the top of common daytime residential criteria even at a 50 m setback. Adding 4 m barriers brought down predicted exposure at the worst-hit façades by amounts that tracked the source-barrier-receiver geometry. At this site, they cut the maximum predicted façade level from 54.8 dB(A) to 49.6 dB(A) and dropped the mean across residential receptors by 3.5 dB. Barrier performance, then, hangs on configuration and belongs in a project-specific evaluation rather than a generic insertion-loss figure.

The case study also shows that padel courts can fit acoustically into residential developments when noise control enters the design early. Here, more setback distance combined with targeted barriers gave a far better acoustic outcome than the original layout. That matters in practice, since these measures are much cheaper to fold into planning than to add after construction.

The findings still come with several limitations. Each sport was sampled once for 15 min, so the results miss the full variability of playing intensity, skill level, and activity changing over time. The model was also calibrated to the field data but not independently validated at separate receptors, and ISO 9613-2 is built for continuous sources rather than intermittent sports noise. For that reason, the numbers stand as case-study estimates, not universal emission or propagation values.

Even so, the pattern is clear: padel carried a greater acoustic impact than tennis across both the measured and the modeled scenarios, and barriers cut façade exposure at this site. On balance, the work makes the case for padel-specific acoustic assessment in residential settings and offers practical evidence to guide planning, mitigation, and design in future developments.

7. Future research directions

This study adds another case to the thin body of evidence on padel court acoustics, while making plain how much is still open. Building a firmer base will take repeated measurements across several sites, paired with fuller records of playing conditions, enclosure details, and background sound.

Later campaigns ought to cover facilities with varied court layouts, wall materials, and operating conditions. A wider sample would let researchers report confidence intervals, compare player groups, and pin down defensible working ranges for padel emissions.

It is also worth checking whether the spectral and temporal traits measured for padel really translate into more annoyance in lived-in residential settings. The present data cannot settle that on their own; listening tests, field surveys, or other user-centered methods would help.

Model validation matters most of all. Follow-up measurements at the receptor positions would quantify model error and lend more weight to future design recommendations.

Other mitigation routes deserve a look too: transparent acoustic barriers, surface treatments, vegetation-assisted screening, and source-oriented measures. For now, these belong on the list of design paths to explore, not among the results this case study has established.

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