

**ARCHITECTURE, CULTURE AND ACOUSTIC COMFORT: PROPOSAL FOR
A MUSIC SCHOOL AS AN INSTRUMENT OF URBAN AND IDENTITY
REVITALIZATION IN VIÇOSA DO CEARÁ**

*ARQUITETURA, CULTURA E CONFORTO ACÚSTICO: PROPOSTA DE UMA
ESCOLA DE MÚSICA COMO INSTRUMENTO DE REVITALIZAÇÃO URBANA E
IDENTITÁRIA EM VIÇOSA DO CEARÁ*

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*ARCHITECTURE, CULTURE ET CONFORT ACOUSTIQUE : PROPOSITION D'UNE
ECOLE DE MUSIQUE COMME INSTRUMENT DE REVITALISATION URBAINE
ET IDENTITAIRE A VIÇOSA DO CEARA*

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Abstract: This article presents the scientific, theoretical and methodological development of a preliminary architectural design for a Music School in the municipality of Viçosa do Ceará. The central problem investigates how architecture, integrated with environmental and acoustic comfort, can mitigate the loss of cultural identity in a city that hosts one of the state's largest music festivals but lacks permanent teaching infrastructure. The methodological path was anchored in Project-Based Learning (PBL) applied to studio design, encompassing climate diagnoses of the Ibiapaba Region, analysis of building acoustic constraints based on NBR 10152, and qualitative field research. The results demonstrate the detailing of an architectural typology that acts simultaneously as an urban sound-insulation barrier and as a public space for social gathering, redefining the role of cultural infrastructure in safeguarding intangible heritage and promoting passive energy efficiency.

Keywords: Acoustic Comfort; Bioclimatic Architecture; Music School; Viçosa do Ceará; Cultural Facility.

Resumo: Este artigo apresenta o desenvolvimento científico, teórico e metodológico para a elaboração de um anteprojeto arquitetônico de uma Escola de Música no município de Viçosa do Ceará. A problemática central investiga de que forma a arquitetura, integrada ao conforto ambiental e acústico, pode mitigar a perda de identidade cultural em uma cidade que sedia um dos maiores festivais de música do estado, mas carece de infraestrutura permanente de ensino. O percurso metodológico ancorou-se na Aprendizagem Baseada em Projetos (ABP) aplicada ao design de ateliê, englobando diagnósticos climáticos da Região da Ibiapaba, análise das condicionantes acústicas prediais com base na NBR 10152 e pesquisas qualitativas de campo. Os resultados demonstram o detalhamento de uma tipologia arquitetônica que atua simultaneamente como barreira de isolamento sonoro urbano e como espaço público de convivência, redefinindo o papel das infraestruturas culturais na salvaguarda do patrimônio imaterial e na promoção da eficiência energética passiva.

Palavras-chave: Conforto Acústico; Arquitetura Bioclimática; Escola de Música; Viçosa do Ceará; Equipamento Cultural.

Resumen: Este artículo presenta el desarrollo científico, teórico y metodológico para la elaboración de un anteproyecto arquitectónico de una Escuela de Música en el municipio de Viçosa do Ceará. La problemática central investiga de qué manera la arquitectura, integrada al confort ambiental y acústico, puede mitigar la pérdida de identidad cultural en una ciudad que alberga uno de los mayores festivales de música del estado, pero carece de infraestructura permanente de enseñanza. El recorrido metodológico se basó en el Aprendizaje Basado en Proyectos (ABP) aplicado al diseño de taller, abarcando diagnósticos climáticos de la Región de la Ibiapaba, análisis de los condicionantes acústicos de los edificios con base en la NBR 10152 e investigaciones cualitativas de campo. Los resultados demuestran el detalle de una tipología arquitectónica que actúa simultáneamente como barrera de aislamiento sonoro urbano y como espacio público de convivencia, redefiniendo el papel de las infraestructuras culturales en la salvaguarda del patrimonio inmaterial y en la promoción de la eficiencia energética pasiva.

Palabras clave: Confort acústico; Arquitectura bioclimática; Escuela de música; Viçosa do Ceará; Equipamiento cultural.

Résumé: Cet article présente le développement scientifique, théorique et méthodologique en vue de l'élaboration d'un avant-projet architectural d'une École de Musique dans la commune de Viçosa do Ceará. La problématique centrale étudie de quelle manière l'architecture, intégrée au confort environnemental et acoustique, peut atténuer la perte d'identité culturelle dans une ville qui accueille l'un des plus grands festivals de musique de l'État, mais qui manque d'une infrastructure d'enseignement permanente. Le parcours méthodologique s'est appuyé sur l'Apprentissage par Projets (APP) appliqué à la conception en atelier, comprenant des diagnostics climatiques de la région d'Ibiapaba, l'analyse des contraintes acoustiques des bâtiments selon la norme NBR 10152 et des enquêtes qualitatives de terrain. Les résultats démontrent le détail d'une typologie architecturale qui agit simultanément comme barrière d'isolation sonore urbaine et comme espace public de convivialité, redéfinissant le rôle des infrastructures culturelles dans la sauvegarde du patrimoine immatériel et dans la promotion de l'efficacité énergétique passive.

Mots-clés: Confort acoustique ; Architecture bioclimatique ; École de musique ; Viçosa do Ceará ; Équipement culturel.

1 Introduction

Contemporary urban space is the material reflection of social interactions, economic forces and, fundamentally, the cultural expressions that give a people its identity. When a city's physical infrastructure fails to house and support its traditional practices, a process of identity emptying and weakening of community relations can be observed. In the state of Ceará, the municipality of Viçosa do Ceará stands out historically for its close connection with art and the music scene, establishing itself as a regional reference for culture and ecotourism in the Serra da Ibiapaba.

This artistic vocation reaches its peak every year with the Ibiapaba Music Festival (Festival MI), an event promoted by the Ceará State Department of Culture (SECULT) that attracts hundreds of students, instrumentalists, arrangers and tourists from various regions of the country. During the event, melodies and arrangements echo through the town's squares, streets and historic houses, showing the potential of music as a catalyst for local tourism and socioeconomic dynamics. However, this cultural effervescence runs into a structural contradiction: the ephemeral and seasonal nature of the programming and the severe shortage of permanent infrastructure dedicated to musical teaching and practice throughout the year.

Currently, the workshops and temporary courses offered by the festival are adapted and set up in an improvised manner in conventional classrooms of the municipality's public schools. This dynamic creates two chronic urban and environmental problems. First, the improvised accommodation of hundreds of students in these basic education institutions causes severe habitability problems and spatial discomfort. Second, the total absence of acoustic insulation treatments and systems in ordinary classrooms results in the uncontrolled propagation of high-intensity noise and sound waves into the

surroundings, generating noise pollution and zones of environmental conflict with residents and nearby businesses.

Given this panorama, the following research problem is outlined: *How can Architecture and Urbanism, through the scientific specification of environmental and acoustic comfort, intervene in the urban setting of Viçosa do Ceará to resolve the noise conflict, value the local musician and permanently and sustainably establish the city's musical identity?*

The general objective of this work is to carry out the theoretical, normative and design research necessary to substantiate and develop a preliminary architectural design for a Music School for the municipality. The facility aims to fill the cultural infrastructure gap, offering a technical space of excellence aimed both at laypeople and learners and at music specialists and professionals, operating under the premises of passive thermal, lighting and acoustic comfort.

2 Theoretical framework

2.1 Music as a Factor of Human Development and Educational Legislation

The introduction of music into the educational environment goes beyond the mere training of technical skills for handling instruments; it acts as a structuring vector for individuals' cognitive, motor and psychosocial development. In the Brazilian legal system, the relevance of this practice was formalized with the approval of Federal Law No. 11,769, which amended the National Education Guidelines and Framework Law (LDB), making music teaching compulsory in basic education throughout the country.

This legal provision is based on the understanding that cultural and aesthetic education is a decisive factor in the formation of citizens. Snyders (1992) asserts that, historically, the regular school risks being perceived by children and young people as a rigid environment, whose rewards and promises of happiness lie only in an indeterminate adult future. The inclusion of musical language works as a humanizing element of pedagogy, introducing a dimension of joy, expression and engagement that is experienced in the present, stimulating students and making the school environment conducive to intellectual flourishing.

Complementing this view, Gainza (1988) categorizes the benefits of systematic musical activities along three fundamental prophylactic and therapeutic axes:

- Physical: Acts directly to relieve muscle tension and systemic fatigue resulting from emotional instability or everyday stress.
- Psychic: Channels and organizes the processes of internal communication, individual expression and release of emotional tension through controlled sound stimulation.
- Mental: Provides an abstract apparatus that stimulates a sense of order, harmony, mathematical proportion, discipline and spatial organization.

Therefore, the design of an architectural space intended to house these activities must reflect this humanizing and organizing character, offering environments that stimulate concentration and promote psychological well-being.

2.2 Building Acoustics and the Standardization of Sound Comfort

The design of a Music School requires the architect to have strict command of the laws of sound propagation and architectural acoustics. Unlike standard classrooms or office buildings, music rehearsal rooms require the simultaneous treatment of two

distinct phenomena of building physics: Acoustic Insulation (blocking the transmission of sound between different spaces) and Internal Acoustic Conditioning (controlling the reflections of sound waves within the space itself to ensure listening quality).

As prescribed by NBR 10152 (Acoustics – Sound pressure levels in indoor environments), there are strict limits on acceptable background noise levels to ensure acoustic comfort and human health in classrooms and music studios, measured in A-weighted decibels, dB(A). For music practice rooms and recording studios, the acceptable background noise level must fall within the strict range of 30 dB(A) to 35 dB(A). Values above this threshold mask the harmonics of the instruments and cause early auditory fatigue in musicians.

To achieve these levels in an urban area, the architecture must rely on the mass law principle and the Mass-Spring-Mass system (MASCARÓ, 2015). Simple walls of hollow ceramic blocks have low density and high porosity, allowing vibrations to pass through. Insulation requires the specification of heavy double walls, the use of air cavities filled with highly absorbent porous materials (such as rock wool or glass wool) and the complete elimination of acoustic bridges at seals, doors and windows.

As regards internal acoustic conditioning, the guiding parameter is the Reverberation Time (RT_{60}), which defines the time required for the sound intensity to decay by 60 dB after the sound source stops. The calculation is governed by the classic Sabine Formula:

$$RT_{60} = \frac{0,161 \cdot V}{A}$$

Where V represents the total volume of the room in cubic meters (m^3) and A represents the total absorption of the room in square meters of sabine (m^2 sabine), calculated by summing the surface areas multiplied by their respective sound absorption coefficients (α) of the constituent materials:

$$A = \sum (S_i \cdot \alpha_i)$$

According to the studies of Barron (2009), music rooms with excessively high reverberation time produce a “permanent echo” effect or sound muddling, destroying the clarity of the music. Conversely, excessively absorbent rooms (dead rooms) make performance arduous and lacking in natural brilliance. The ideal balance is achieved through the precise, calculated proportioning of reflective surfaces (thick plasterboard, dense wood), diffusing surfaces (panels with irregular geometries to scatter sound) and absorbent surfaces (perforated acoustic panels, open-cell foams).

2.3 Bioclimatic Architecture in the Ibiapaba Region

In addition to the severe acoustic restrictions, the architectural design must respond precisely to the climatic conditions of Viçosa do Ceará. Located in the Serra da Ibiapaba Environmental Protection Area (APA), at an average altitude of 740 m above sea level, the city has a microclimate classified as Humid Tropical (Subhumid). Unlike the coastal capitals and the flat semi-arid hinterland, the highlands record milder temperatures throughout the year, with averages ranging between 18°C on winter early mornings and 30°C on summer afternoons, associated with a regime of strong winds and constant fog in the wet months.

According to the guidelines established by Lamberts, Dutra and Pereira (2014) for the bioclimatic zoning of the region (Bioclimatic Zone 7), the design should adopt passive solar heating strategies and high thermal inertia for the night period, combined with selective natural ventilation for the daytime.

The great challenge of the architecture of a music school in a subhumid climate lies in the technical antagonism between ventilation and acoustic insulation: open windows allow the refreshing wind to enter but destroy the building's sound insulation. Resolving this paradox requires the design of indirect ventilation systems and acoustic silencers in ducts (baffles or acoustic louvers), which allow airflow to pass by natural thermal convection but force the sound wave to collide with internal absorbent materials, dissipating the noise before it reaches the outside.

3 Methodological Path of the Research

This research is configured as a descriptive and propositional study of a qualitative and applied nature, structured in the fundamental stages for developing a preliminary Architecture and Urbanism design. The methodological path was organized into four complementary investigative axes:

1. Qualitative Field Research (Interviews): Semi-structured in-person interviews were conducted with residents near the festival's rehearsal venues and with local musicians. The qualitative sampling aimed to diagnose social perception of the disturbances caused by urban noise from the temporary workshops and to map the population's aspirations regarding the program of needs for a new permanent cultural center.
2. Physical and Urban Survey of the Site: An analysis of urban insertion in Viçosa do Ceará was carried out, considering the guidelines of the Municipal Master Plan, road circulation axes, universal accessibility, the rugged topography characteristic of the highlands, and proximity to the historic heritage listed by the National Institute of Historic and Artistic Heritage (IPHAN).
3. Sizing and Case Study Analysis: National and international scientific articles, related undergraduate theses and international reference projects of music schools (case studies) were analyzed. This survey supported the determination of the ideal dimensions of individual rehearsal rooms, group rehearsal rooms, auditoriums and studios.
4. Normative Parameterization: Strict application of **NBR 10152** was adopted to establish acoustic control targets and the approximate calculation of panel insulation, serving as the basis for the zoning of the architectural scheme (separation of noisy zones and quiet zones).

4 Design Development and Guidelines of the Proposal

The synthesis of the data collected in the methodological phase guided the development of the architectural scheme of the preliminary design for the Music School in Viçosa do Ceará. The design response was based on the harmonious integration of aesthetic modernity, appreciation of the historic urban fabric and environmental technical rigor.

4.1 Acoustic Zoning and Organization of the Program of Needs

The main strategy for ensuring acoustic comfort without inflating the costs of heavy absorbent materials was the Spatial Acoustic Zoning of the scheme. The program of needs was distributed into three concentric noise zones, isolated by landscaped inner courtyards that work as natural acoustic barriers through geometric distance:

- Noisy Zone (High Sound Emission): Houses the rehearsal rooms for percussion, brass, drums, orchestra/band rehearsal rooms and the recording studio. This wing was positioned in the underground or semi-buried sectors of the site's topography, taking advantage of the very high inertia and natural insulation provided by the surrounding soil.
- Intermediate Zone (Medium Sound Emission): Composed of theory classrooms, string rooms (violin, cello), piano rooms, pedagogical coordination, administrative office and music library.
- Quiet Zone / Urban Transition: Entrance hall, foyers, general administration, cafeteria and external gathering plaza open to the public.

4.2 Detailing of Environmental Comfort, Bioclimatic Design and Façade

To respond to the highland climate of Viçosa do Ceará, the volumetry adopted a horizontal and organic design, integrated with the natural profile of the terrain to avoid negative visual impacts on the city's listed historic landscape.

The façades with the greatest sun exposure received a double-skin treatment. The outer layer is composed of textured concrete cobogó panels, traditional perforated elements of Northeastern Brazilian architecture. These cobogós were designed with specific angles to provide total shading of the inner glazed surfaces against direct solar radiation.

Behind the cobogó barrier, a window with acoustic laminated double glazing (6 mm + argon cushion + 8 mm) was positioned. Natural ventilation is ensured by acoustic louvers installed at the base and top of the rooms, promoting the stack effect (cool air enters from below, absorbs the internal heat and escapes through the upper openings), fitted with internal noise dampers that prevent the instruments' sound from escaping into the urban public space.

The roofs were designed using the green roof system (vegetated cover) over a massive, thick reinforced concrete slab. This solution provides a dual technical-scientific advantage: the large mass of concrete and soil ensures superior airborne sound insulation against external noise and intense tropical rain, while the vegetation layer provides excellent thermal insulation through evapotranspiration, keeping the classrooms at stable and pleasant temperatures throughout the year and eliminating the need for continuous use of mechanical air-conditioning systems.

5 Results and Discussion

The modeling and development of the preliminary design guidelines produced significant results that demonstrate the feasibility and impact of the intervention proposed for the highland municipality.

5.1 Mitigation of Urban Noise Pollution

With the strict application of the insulation guidelines calculated on the basis of NBR 10152, the environments of the Noisy Zone reached an estimated sound insulation index of 55 dB. This means that the internal performance of a wind orchestra registering peaks

of 95 dB inside the rehearsal room will be perceived in the external public space at a residual residential level below 45 dB.

This result definitively resolves the noise pollution problem identified in the diagnostic phase, allowing the school to operate at full capacity in daytime and nighttime shifts without disturbing the tranquility of neighboring residents, easing the relationship between cultural activity and the right to urban quiet.

5.2 Social Gathering Space and Urban Regeneration

The siting of the building was not limited to the design of a closed educational institution; it generated a public and accessible cultural esplanade. The transition plaza designed at the entrance of the complex connects directly to the historic road network of Viçosa do Ceará, offering areas shaded by native trees, an open-air amphitheater for small free performances, reflecting pools for microclimate and ergonomic street furniture, as shown in Figure 1.

Figure 1 – Synthesis of the design proposal



Source: Research data.

This public space turns the Music School into a meeting and gathering point for the local population and for visitors and tourists outside the festival period. The architecture acts as an element of urban construction, transforming an idle plot of land into a hub that generates urbanity, leisure, accessibility and preservation of artistic memory.

6 Final considerations

The development of this preliminary design for a Music School for the municipality of Viçosa do Ceará demonstrates that the tools of Architecture and Urbanism are fundamental for resolving urban socio-environmental conflicts and recovering the intangible heritage of a region. The loss of cultural identity caused by the absence of permanent public infrastructure can be reversed when the architectural project is anchored in scientific rigor and social contextualization.

The integrated building comfort solutions showed that it is perfectly feasible to reconcile the high demands of acoustic insulation for musical practice with the premises of sustainability and passive bioclimatic energy efficiency required by the highland climate of the Ibiapaba. The coordinated use of heavy walls partially sunk into the ground, green roofs, protective cobogós and ventilation systems with acoustic louvers resulted in a building of high technical performance and expressive sculptural and aesthetic value.

It is concluded that the future executive implementation of this cultural facility represents a strategic investment for Ceará. By providing an environment of excellence for the continuous training of new talents and the dignified reception of music professionals, the project establishes Viçosa do Ceará not only as the temporary host of an annual festival but as a true “City of Music”, where art, education and citizenship find lasting shelter in the built space.

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