

Exploration of Interrelationship between Music and Architecture

Dr. Sanjeevani Pendse (Assistant Professor)¹

Dr. Vasudha A. Gokhale (Professor)²

B.N. College of Architecture, SPPU Pune

¹Email: sanjeevani.pendse@bnca.ac.in

²Email: gokhale.va@gmail.com

Abstract

Architecture and music share many terms that represent aesthetical quality manifested in music in aural and in architecture in visual form. The Indian craftsman exhibited their constructional skills in connecting architecture with music, while concepts borrowed from Indian music in architectural design are a nascent area of concern. This research analyzes the intrinsic qualities of Indian Classical Music from an architectural perspective. The uses of concepts borrowed from music in creating architecture are discussed. The spatial quality of music and its relationship with architectural form is examined in light of the musical tradition of Gwalior and Jaipur Gharana and the architectural character of historic structures located in the city of Gwalior and Jaipur. The analysis revealed similarities in the aesthetic expression of music and architecture, indicating the potential of Indian classical music to help architects conceptualize an architectural creation.

Keywords: Gharana, firmitas, visual, spatial, shikhara

Introduction:

India is a country with a diverse mixture of tradition and culture. Temples, churches, mosques, and forts are part of Indian Classical architecture, and different art forms like sculpture, painting, literature (style), and music and dance form constitute this tradition and culture. Every medium has developed its rules and regulations sharing the same religious beliefs. The association of spiritual states and symbols and their process was detailed (Vatsyayan K., 1991). Indian classical music is referred to as "ShastriyaSangeet" the Sanskrit word for music is Sangeeta which represents song (Geeta), instrument (Vadya), and dance (Nritya) characterized by a rich, stylized structure containing many musical forms. Music had proved a source of inspiration for architectural development, and many buildings and structures were conceptualized based on musical parameters (Xenakis, 1971). The research shows connections between some musical styles and places, varying in scale from neighbourhoods and cities to the national and multinational or global. It suggests that music plays a very particular and sensual role in producing place partly through its peculiar embodiment of movement and collectivity (Cohen S., 1995). The inspiration for an architectural composition used is music and is termed a "leap vehicle" (Young, Bancroft, & Sanderson, 1993). Music, theatre, visual artwork, and architecture diverse cultures and historical eras possess distinct characteristics and common themes that are represented and

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

revealed with the help of contextual clues within the works of art that need to be interpreted. Architecture and music are two inherently different art forms that rely on an inherently different character. However, if identified, the similarities can provide evidence, and comparisons can be made based on that.

Application of concepts of Music in Architecture:**Historical perspective -**

The trace of interrelation between music and architecture is vividly visible in literary sources from ancient times. In the works and philosophy of Roman Imperial architect, Vitruvius the association between music and architecture is seen or understood. In 'De Architecture,' he has written on architecture and mechanics, music theories have much impact. He says that the ratios and proportions found in nature should be applied in the design of musical instruments and structures. Here he has explained an analogy. The volumetric proportions of temples and theatres were such that visual and auditory effects were elevated and augmented.

In the same way, a composer designs the temporal space to create a melody. His description and analysis of temple and theater design were consistently based on applied music theory. The distance between the columns in the temples can be based on the intervals between the tones in the music has also been illustrated. Vitruvius also says that there is a resemblance in musical scales and temple fronts, showing that each temple's analogy and intuitive and aesthetic quality is different (Tayyebi, 2013). The elements of a building are like the different musical units (Enharmonic, Chromatic, and Diatonic), which consists of the primary structural language of the scale as stated in Classical orders (Doric, Ionic, Corinthian) in the Greek period (Walden, 2014).

In the Western context Villa Savoye designed by Le Corbusier, built-in 1929 at Poissy near Paris, resembles a guitar, a musical instrument. The proportions of curved walls and parallel lines match with the instrument. (Figure 1). There is an application of abstract music as a symbol for concrete architecture where the parallel lines evoke a string of notes, and the curved walls are like the shape of a guitar (Imaah N., 2004). In the bays of Notre Dame Paris, a rhythm matches the musical polyphony. There are three levels in the bays, one above the other, and each level is paralleled with a choral voice. (Figure 2)



Figure 1 : Villa Savoye, Paris



Figure 2 : Notre Dame, Paris

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

The parallel lines of villa savoye match the string of notes of guitar (Imaah N. , 2004) and rhythm in the bays of Notre Dame, Paris shows resemblance with compositions of the composer Perotin in 1240, where the rhythmic phrases were placed one above the other, forming a melody (Jencks, 2013). Research indicated several minarets situated along al Mui'zz el-Din Street, Cairo, inspired by music. Here the optical measurements of the minarets correspond with “Maqam,” a set of notes used in Arab music (Riad, 2009), providing them an interesting visual character.

The Indian Precedents:

The spiritual significance of art and science from early ancient Egyptians to Vedas in ancient India was studied by Pythagoras, a mathematician who lived in 580 BCE. The rhythm of harmony and the mathematical law bridge to infinity (Rao R., 2011). In the Indian context, the manifestation of sound is seen in the Mandala of Virabhadra Temple, Keladi in the Shimoga district of Karnataka state. The mandala is a picture of a frozen wave pattern where the wave is depicted to be staying in one place. It is an effort in the medium of art to visualize the concretization of sound vibrations in a two-dimensional representation, depicting a region containing sound waves that are perfectly uniform in distribution (Rao R., 2011). The relationship between music and architecture in the Indian context is visible in many contexts. Musical pillars in Mahamandapam (great-stage) Vithala temple (1422 AD) at Hampi, the world heritage site, are made of granite stone which audible sound when struck with a finger similar to the sound produced by various musical instruments. (Figure 3)

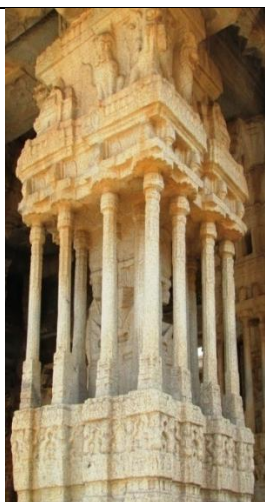


Figure 3 :Vithal temple Hampi

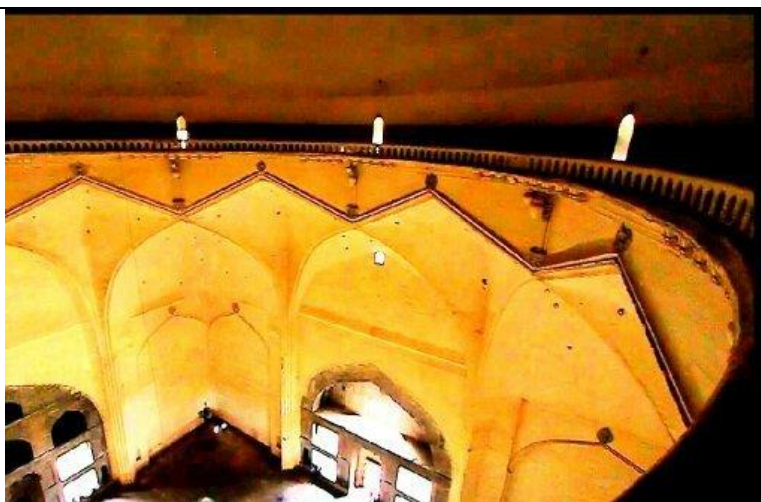


Figure4 : Whispering gallery Golgumbaz, Bijapur.

Suchindram temple Kanyakumari, Meenakshi Temple, Madurai, and Nellaiappar Temple Tamilnadu are other examples of musical pillars (Kumar et al., 2008). The building design for characteristic acoustic performance is exhibited at the mausoleum of Mohammed Adil Shah (1627-55) of the AdilShahi dynasty of Indian sultans named Gol Gumbaj at Bijapur (Figure 4). The structure consists of a colossal dome 43.3 meters in diameter resting on a

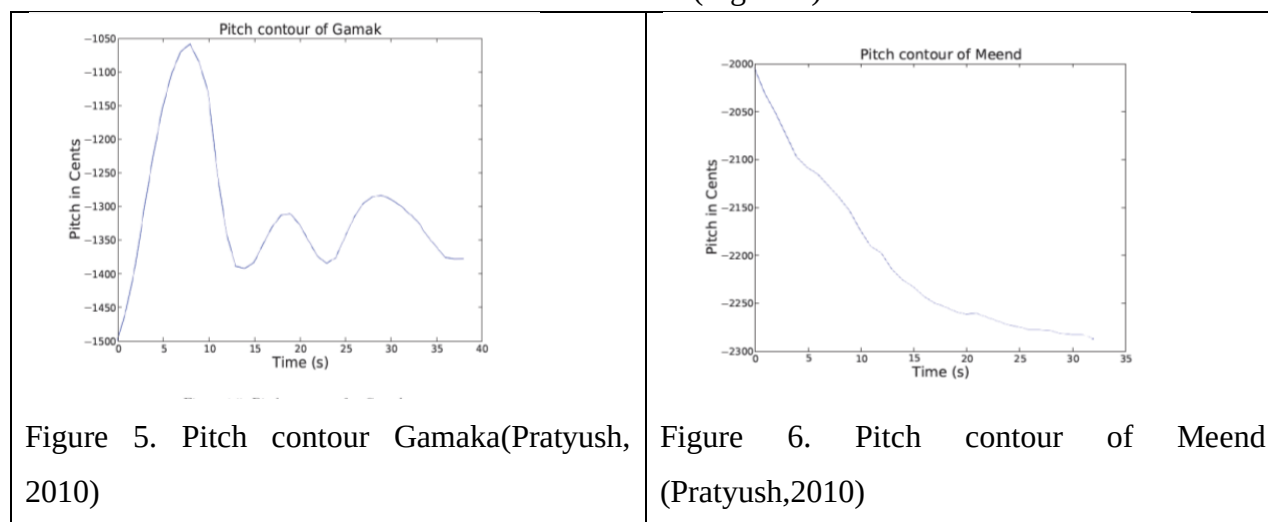
UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

massive square chamber, making it among one of the giant domes in the world. The construction is acoustically designed so that the slightest sound made at one side of the gallery indie can be clearly heard across the other side.

Aesthetical expression in Music and Architecture:

There are melodic modes in the presentation of Hindustani music where ornaments play a significant role, which helps differentiate the melodic modes with a similar melodic structure (Pratyush, 2010). These are small arrangements done in the presentation of notes to enhance the beauty of the musical piece. To name the ornaments, a glide between two notes, multiple oscillations of a single note, grace note, oscillation between notes, etc. (Pratyush, 2010).

In Indian classical music, the transition space between the notes plays a crucial role along with the sequence of the notes. The gap between the notes is filled by ornamentation, which imparts the aesthetic quality to the music (Ross & Rao, 2012-13). Gamakas alludes to ornamentation utilized as a part of the execution of Indian music. Indian music does not have a settled recurrence for a Swara (note) and can have diverse varieties (developments) around a note, not at all like Western music. The varieties are called Gamakas and can occur in different structures (Figure 5). For instance, it could be a short faltering around a note or a direct move beginning with one note then onto the following. For each raga, just a specific sort of Gamakas (varieties) is permitted 75 round a Swara providing an imperative insight for recognizable proof (Kulmethe & Patil, 2017). About fifteen types of ornamentation are described in the musicological treatises under the generic title of "*gamak*" (Rao S. R., 2014). These aspects act as ornaments adding to the aesthetical expression of the composition. A *Meend* is a smooth glide from one note to another touching all the relevant pitches. What pitches are included in a *Meend* depend on the raga. A *Meend* can be sung to a vowel sound, to a syllable of lyric, or to the solfa syllables of the main note(s). The point of a *Meend* is that it includes all the relevant notes in a smooth transition. (Figure 6).



Architectural ornamentation in Indian architecture and the adaptation of aesthetic principles in construction are essential. Hindu temples demonstrate profound use of ornamentation to the interiors and outer surfaces in carvings, sculptures, ornamental pillars, capitals, arches, etc. It

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

includes a wide range of stone reliefs to depict floral, animal, figural, foliated, and geometrical designs. In Mughal architecture, great emphasis is given to the decorations of monumental buildings with various forms of embellishment, including glazed tiling, stone mosaic, inlay works, fresco, mural paintings which render them aesthetically appealing (Gulzar, 2016).

Styles in music and Architecture:

Geographical conditions profoundly influence man's cultural development, and most of the art reflects the influence of the physical environment very patently. However, it is more evident in architecture than other art forms because of its dependency upon the natural surroundings. Location and spatial relationship with the built environment are the significant force in man's cultural progress and, hence, his art that affects the generation of artistic styles and ideas. (Robinson, 1949). The research established that various contextual factors shape artists and their artwork that include their teachers, the preceding styles, demands, and ambitions of their patrons, and their socio-cultural and political environment (Pendse, 2019).

There are two main streams in Indian classical music: north Indian and south Indian based music and styles (Sharma, Panwar, &Chakrabarti, 2014). Both styles have different geographical, historical, and cultural influences, which is very obvious under which these styles have developed. Hindustani and Carnatic music can be distinguished by instruments, i.e., timbre feature and melodic contour. Listeners can distinguish the two styles from the vocal music extracted from the alap section of a performance. (Vidwans, Ganguli, &Rao, 2012)The form of melodic contours of the alap section can be graphically depicted on the basis of which the two styles can be identified as shown in melodic feature extraction of raga MiyaniTodi (Figure 7) and raga Subhapantuvareli (Figure 8).

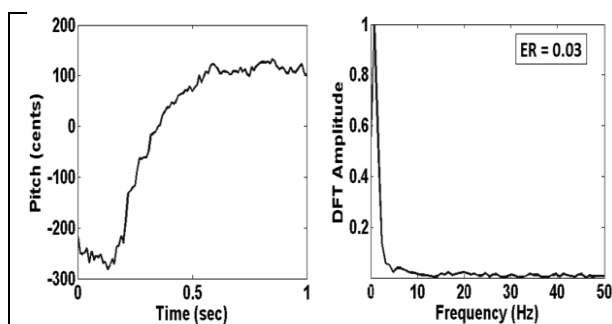


Figure 7.Raga – MiyankiTodi(Vidwans, Ganguli, &Rao, 2012).

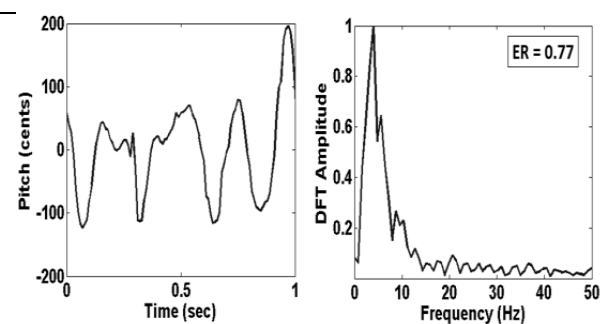


Figure 8. Raga – Subhapantuvareli. (Vidwans, Ganguli, &Rao, 2012).

Shreds of evidence from the old Sanskrit texts on music suggest that the two schools, the Northern or Hindustani and the Southern or Carnatic, preserve several essential ancient elements as well as essential parts.

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

Ancient Indian temples are classified into two broad types. This classification is based on different architectural styles employed in constructing the temples. Three main styles of temple architecture are the Nagara or the Northern style, the Dravida or the Southern style. It is noticed that the features of Hindustani and the Southern or Carnatic musical systems show close correspondence with the architectural form and structural concepts and apparent aspects of the ancient sacred and historical buildings located in the northern and southern part of India. There is a conspicuous similarity between the music systems and Indian architectural styles. In the North Indian music style, the ornamentation in the form of “Minda” has a curvilinear profile, solid stances, and patterns at a particular speed; however, in south Indian or Carnatic music style, the movement of melodies is very structured, geometric and have definite stages. The curvilinear profile of north Indian shikhara depicts the same concept (Figure 10).



Figure 9 :Shikhara of South Indian style temple.



Figure 10: Nagara style Shikhara

On the other hand, the highly structured profile of south Indian temples, which have progression like a stepped pyramid, exhibit a striking similarity with the aesthetical expression of Carnatic music style (Dhaki, Vatsyayan K., 1991) as shown in (Figure 9).

Music and Architecture : Jaipur

The Jaipur gharana is known for its unique layakari or rhythmic aesthetics. The rich repertoire of ragas. The integrated movement and progression of swara and laya is noticeable where the complex note patterns are rendered with precision and spontaneity. The tanas are basically “vakra” instead of the flat taan, gamak (taan sung with double notes with a delicate force behind each of the component double-notes of the taan) makes the taan spiral into seemingly never-ending cycles. The ornamental approach using meend in aalap and gamak in

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

taan are the characteristic feature of this style of recitation (Gayaki). The historic architecture at Jaipur is known for stone carving, brackets, The intricate detailing of stone jalis, multi-foliated arches, decorative parapet bands, jharokhas, chajjas, all full of ornamentation. Figure 11 presents the Jali pattern at Albert hall museum, Jaipur which is very ornate, decorative and intricate. The entrance façade of Amer fort in Jaipur has ornamental bands, inlay work, which render it highly decorative (Figure 12).

Rambag Palace in Jaipur, built in Indo-Saracenic style. The Square base and round chattris, cusped and multi foliated arched openings, niches, lime jaalis inspired from the Rajput-Mughal vocabulary of architectural aesthetics. It is a beautiful infusion of the Mughal, European and Rajput styles of architecture .



Figure 11 :Jali pattern Albert hall museum, Jaipur



Figure 12: Entrance Amer fort, Jaipur

Use of complex detailing in design and detailing in Jaipur architecture is comparable to the stylistic qualities of gayaki of Jaipur gharana. The use of elaborate ornaments and complex taans, gamak, tans with balpench or curved shape, mukhbandi tans, alapchari in more than one avartan in single breath, bolbanav of laya provide a distinct aesthetical quality that is intricate, and melodious.

Musical tradition of Jaipur gharana characterized by use of jod ragas (compound ragas) and sankeerna ragas (mixed ragas) that is a blend of multiple Raags and preference of new bandishes and rendering of non prevalent ragas. Similarly in Jaipur architecture the use of architectural elements from different architectural styles to create a new aesthetic expression is evident.

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals**Music and Architecture : Gwalior**

The image of Gwalior architecture represents planar proportions and scale, subtle coloration and surface effects, interesting superimpositions of form, the play of surface and depth. The imposing structures are bold and massive, with lesser emphasis on decorative elements (Fig . Similarly in the Gwalior gharana the singing with loud full-throated and open voice is preferred. The tan pattern is straight, clear, and varied.

The entrance of Gwalior fort that is bold and imposing (Figure 13) while the jali pattern of Mohamed Ghaus tomb is simple and subtle (Figure 14).



Figure 13: Entrance Gwalior fort



Figure 14: Jali pattern Mohmed Ghaus tomb, Gwalior

The architectural expression indicate use of simple and known forms wheareas Gwalior gharana's incination towards "Parichit" simple as apposed to compound raga is noteworthy.

Methodology:

Classical music follows a typical pattern in different ragas and compositions in terms of spatial characters for pause, creating a different effect. To further elaborate this aspect, the spatial character of raga Jaunpuri is analyzed considering the different notation patterns followed in the two different north Indian music schools or gharanas, namely Gwalior and Jaipur. The graphical derivation of ragas is widely used in research particulary for semantic or cross-modal abstraction betwenn two art forms (Duthie,2013, Pendse, 2020).

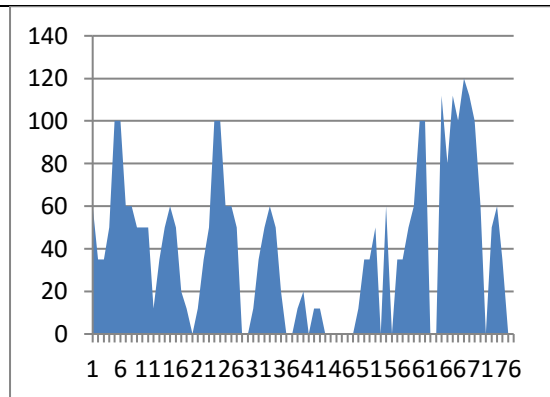
The Asthayi of a chota khyal is taken from Gwalior and Jaipur Gharana the notation and the frequency of the notes (shruti) is identified (Oak,2010) as shown in the table 1 .

UGC-CARE enlisted & Indexed in the EBSCO International Database of JournalsTable.1 : Notation of Chota Khayal of Raga Jaunpuri

RAGA JAUNPURI- Gwalior Gharana																						
TEENTAAL - MADHYALAYA																						
CHOTA KHAYAL																						
1	2	3	4		5	6	7	8		9	10	11	12		13	14	15	16	BEATS			
DHA	DHIN	DHIN	DHA		DHA	DHINDHIN	DHA		DHA	TIN	TIN	TA		TA	DHIN	DHIN	DHA		BOL			
ASTHAYI																						
							DHA_	MA		PA	DHA_	NI_	SA'	NI_	DH_	.	PA	DHA_	SHRUTI			
							60	35		50	60	80	100	80	100	80	60	60	50	60	FREQUENCY	
MA	PA	DHA_	MA	PA		GA_	.	RE	.		MA	GA_	RE	SA		RE	MA	PA	PA	SHRUTI		
35	50	60	35	50		20	20	12	12		35	20	12	0		12	35	50	50	FREQUENCY		
DHA_	SA'	SA'	SA'	RE'		.	NI_															
60	100	100	100	112		100	80															
RAGA JAUNPURI																						
TAAL - MADHYALAYA TEENTAAL																						
CHOTA KHAYAL																						
ASTHAYI																						
															DHA_	MA	MA	PA	SA'	SA'	SHRUTI	
															60	35	35	50	100	100	FREQUENCY	
ni_																						
DHA_	.	PA	.		.	RE	MA	.	PA	HA_	PA	GA_	.	RE	SA	.	RE	MA	PA	SA'	SA'	SHRUTI
60	60	50	50		50	12	35	50	60	50		20	20	12	0	12		35	50	100	100	FREQUENCY
ni																		re				
DHA_	.	PA	.		.	RE	MA	.	PA	HA_	PA	GA_	.	.	RE		GA_	SA	RE	RE	SHRUTI	
60	60	50	.		.	12	35	50	60	50		20	.	.	12		20	0	12	12	FREQUENCY	
SA	.	.	.		.	SA	RE	MA	MA		PA	.	DHA_	.		MA	MA	PA	DHA_	SA'	SHRUTI	
0	.	.	.		.	0	12	35	35		50	.	60	.		35	35	50	60	100	FREQUENCY	
SA'	.	.	RE'		NI_	RE'	SA	GA'	RE'	SA'	DHA_	.	PA	DHA_	MA						SHRUTI	
100	.	.	112		80	12	10	120	12	100	60	.	50	60	35						FREQUENCY	

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

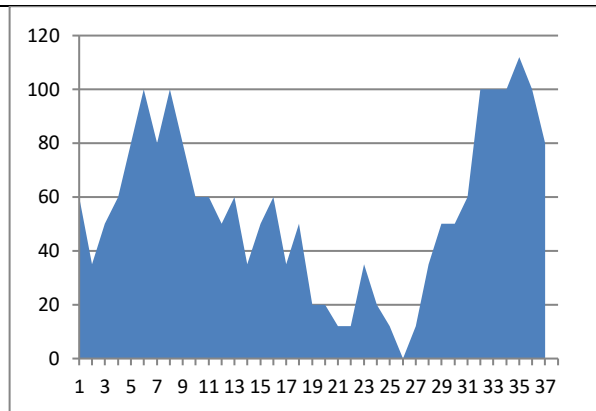
It is translated in graphical mode depicting the pitch contour where the frequency is taken in Y-axis and tempo of the “Tala” in X-axis (Pratyush,2010). Figure 15 shows the graphical form of Raga Jaunpuri in Jaipur Gharana while figure16 shows in Gwalior Gharana.



ASTHAYI

Figure 15 : Raga Jaunpuri- Jaipur gharana

Source:Author



ASTHAYI

Figure 16 : Raga Jaunpuri – Gwalior gharana

Source:Author

Both exhibit different structure, which is based on the way it is composed and improvised by the singer following the set tradition. The graphical form of the raga Jaunpuri in Jaipur Gharana shows a delicate and sleek pattern; however, the graphical form in Gwalior Gharana is massive and bold, corresponding to the defined characteristics of both the Gharanas. The architectural expression in Jaipur architecture represents intricacy of detailing with delicacy having jewel like features that are often exotic. It is similar to the musical composition of Jaipur Gharana, known for its complex and melodic form, which arises out of the involuted and undulating phrases that comprise it. On the other hand, the architecture at Gwalior is bold massive with less detailing in terms of ornamentation. It is in line with the musical tradition of Gwalior Gharana having lucidity and simplicity.

Discussion:

Literature established that the two subjects, music and architecture had a complementary association in the built form, spatial organization, and details. This research found that both art forms share many concepts from a theoretical perspective. Analysis indicated stark similarity in the structure and process in their creation and expression. Both follow principles of aesthetics where the ultimate aim is to provide a feeling of pleasure to the people. Music and architecture were established in the literature as complex phenomena with creative, perceptual, and experiential qualities. It has been stated that there are several vocal schools refereed as gharanas representing different lineages of ideology in music. Each Gharana possesses its character, which is different mainly in musical content and cultural context. Each Gharana follows a specific ideological history and culture where their musical individuality depends on voice production, which is imparted to the followers by the masters

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

through rigorous training. A distinguishing feature of Gwalior Gharana is its simplicity, presentation of well-known ragas, rejecting obscure ones, straight or sapaat tans. A parallel is found in the architectural creations with simple and bold forms at Gwalior. Jaipur Gharana has a vast repertoire of ragas, including compound (Jod) and mixed (sankeerna) ragas. In this style the use of gamaktaan with a succession of notes with a delicate application of force and oblique formation of notes create complex and melodic form. The delicate and complex nature of aesthetic expression in Jaipur architecture apparently follow the set aesthetical concepts used in music.

Conclusion:

Indian classical music and architecture are closely related art forms in the context of their aesthetic sensitivity, form and structure, and expression. The great masters of architecture continue to use musical concepts in their architectural compositions. Architects and musicians both work under ideologies to create conducive environments that result in the course of creativity in a particular society. The similarity between two art forms developed in a geographic location is evident as artists' impressions from the environment where they live stimulate their art. However, art is not imitation; it is a way of expressing inter-subjective experiences through the externalization of creativity; the impressions that man derives from his environment is an impetus for his art creation. The art is dynamic; hence the cultural and environmental influences availability of material and technology and mainly highly gifted people affect creations of all art forms similarly. Architecture is intimately intertwined with music; the reciprocity between these art forms can result in inter-influences and mutual collaboration to enrich individual lives and society as a whole. For creating composing a musical piece, musicians use their creative skills within the defined boundaries that are unique but still follow a defined character. It has resulted in the everlasting character because Indian Classical Music has flourished with its long-lived traditions and welcoming new principles. Indian Classical Music has made an irrefutable impact on the life of people and society through the development of their unique melodious compositions. Each raga and composition follows a structure that results in a particular expression. Such principles could be used for architectural planning and design.

References:

1. Cohen, S. (1995). Sounding out the City: Music and the Sensuous Production of Place. *Transactions of the Institute of British Geographers*, 434-446.
2. [Duthie, A. C. \(2013\). Do music and art influence one another. Measuring cross-modal similarities in music and art. Iowa: Graduate Theses and Dissertations.](#)
3. Gulzar, S. (2016). Glazed Tile Ornamentation in Mughal Monumental Architecture. *Journal of Research in Chemical, Metallurgical and Civil Engg*, 114 - 117.

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

4. Horri, F. (2018). Finding the Relevance of Music and Architecture in Shaping Physical Space and Structural Form of Prince Garden, Mahan Kerman. *Urban Studies and Public Administration*, 184-198.
5. Imaah, N. (2004). Music: A source of Inspiration and Harmony in Architecture: An African View. *International Review of the Aesthetics and Sociology of Music*, 169-182.
6. Jencks, C. (2013). Architecture becomes music. *Architectural Review*, 91-108.
7. Kulmethe, M., & Patil, M. (2017). Techniques of Characteristics, Components of a Raga Identification System. *Imperial Journal of Interdisciplinary Research*, Vol-3, Issue-9.
8. Kumar, A., Jayakumar, T., Rao, C., Sharma, G., Rajkumar, K., Raj, B., et al. (2008). Non destructive characterization of musical pillars of Mahamandapam of Vitthala temple at hampi, India. *Journal of Acoust society*.
9. Morris-Kay, G. (2010). The evolution of human artistic creativity. *The journal of anatomy*, 158-176.
10. Mahajan. (2001). *Ragas in Hindustani Music ; conceptual aspects*. New Delhi: Gian publication.
11. Neuman, D. (1985). Music as a Cultural System. *Asian Music*, 98-113.
12. Neuman, D. M. (2012). PressIndian Music as a Cultural System. *University of Texas Press*, 98-113.
13. [Oak, D. \(2010\). 22 Shruti. Mumbai: Samskar prakashan](#)
14. Ola, C., & Adegboye, A. (2015). Cultural Heriatge collections preserevation and access; case of university of Ibadan. *Journal of african Educational research*.
15. Pendse, S. (2019). "Exploration of the Interrelationship of Architecture and Indian Classical Music ", Unpublished Ph.D. dissertation, S.P. University of Pune.
16. [Pendse, S. \(2020\). "Cross-modal Abstraction between Indian Classical Music and Architecture" Connections: Exploring Heritage, Architecture, Cities, Art Media, International conference , University of Kent.](#)
17. Pratyush. (2010). *Analysis and Classification of Ornaments in North Indian (Hindustani) Classical Music*. Barcelona: Universitat Pompeu Fabra.
18. Rao, R. (2011). *Science and Golden Ratios in Mandala Architecture* (First ed.). Delhi: D.K Printwold [P] Ltd.

UGC-CARE enlisted & Indexed in the EBSCO International Database of Journals

19. Rao, S. R. (2014). An Overview Of Hindustani Music In The Context Of Computational Musicology. *New Music Research*.
 20. Riad, M. (2009). *Archirecture: Music, City and Culture*. Maryland: University of Maryland.
 21. Robinson, H. (1949). The Influence of Geographical Factors Upon The Fine Arts. *Geography, M Arch*, 1949, Vol.34, No.1, 18-29.
 22. Ross, J., & Rao, P. (2012-13). Detection of raga- cahraacteristic phrases from Hindustani classical music audio. *Proc of the 2nd comp music workshop*. Istanbul, turkey.
 23. Tayyebi, F. (2013). *A Quest on the Relationships between Music and Architecture*. North Cyprus: Eastern Mediterranean University.
 24. Trupti, K. (2013). Multiple Techniques for Raga Identification in Indian Classical Music. *National Conference on recent Trends in Computer Science and Technology*. Hyderabad: International Journal of Electronics Communication and Computer Engineering.
 25. Vatsyayan, K. (1991). *Concept of space: Ancient and Modern*. New Delhi: Indira Gandhi National Centre for the Arts: Abhinav publications, New Delhi.
 26. Walden, D. (2014). Frozen Music; Music and Architecture in Vitruvius' De Architectura. *Greek and Roman Musical Studies*, 124-145.
 27. Xenakis, I. (1971). *Musique Architecture*. Tournai: Casterman.
 28. Sharma, A., Panwar, A., & Chakrabarti, P. (2014). Analytical Approach on Indian Classical Raga Measures by Feature extraction with EM and Naive Bayes. *International Journal of Computer Applications (0975-8887)*, Volume 107- No 6.
 29. Vidwans, A., Ganguli, K., & Rao, P. (2012). Detecting Indian Classical Vocal Styles from Melodic Contours. *2nd Compmusic Workshop*. Istambul: Department of electrical Engineering, Indian Institute of Technology, Bombay.
 30. Young, G., Bancroft, J., & Sanderson, M. (1993). Musi-Tecture: Seeking Useful Correlations between Music and Architecture. *Leonardo Music Journal*, Vol.3, 39-43.
-