

Psychology behind Music and Architecture

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Abstract—This research acts as an initiative in finding similarities and connections present in the elements of architecture and music by studying their logic to exhibit their psychological qualities. Further, this study shows the similarities between the pattern of arrangement of notes in a musical scale and the volumetric spatial arrangement in a built environment. Musical scale (raga) is referred as the soul of music. It is the medium to depict the aesthetic qualities such as emotion. It is a collection of notes with varying intervals to attain a discernible melodic form. Musical scales take different names (Raga in Indian music) in different styles. In this research few selective Indian classical scales are considered. The selected ragas are listened keenly to experience its emotions. The structural pattern of the selected ragas and its spatial intervals are analyzed along with architectural spaces with similar emotional experience, the experience of their volumes are studied. The ratios of volumes of a space vs spatial intervals in a musical scale are analyzed

Index Terms— Architecture, Emotions, Experience, Music, Raga.

I. INTRODUCTION

Architecture is a relationship between human mind and materialistic space. It is the psychological impact that the mind undergoes with the static and dynamic elements of a space which may be visually motionless but poses a kinesthetic movement psychologically while experiencing it. It is the science of associating the elements of space in the universe with its behavioral impact on human mind.

A. Ideology

Architecture is a form of art. Art-forms are a different means to express perception/Experience/Feelings/or any other subject. Instances prevail where an art form is emphasized and improvised through a means of a relationship with another form of art. Such as ‘Music and poetry where music is an art to express through the means of Sound. Poetry is experienced through music. Together when combined we get a song which has both the audible experience of music and intellectual expressions through words’.

B. Relationship between Music and Architecture

“ Architecture is frozen music “

Johann wolfgang von Goethe

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Architecture is an art to exhibit through designing a space. It is one of the earliest art forms, which pertains to survival of mankind rather than a source of entertainment. It is an inevitable visual art that we are most exposed to on a daily basis. An architect impacts the psychological state of a user through designing the space. Likewise, music has been used as a means of expressing ones emotions through sound to impact ones psychological state. A composer can express his emotions to a listener and change the listener’s state of mind.

The psychological impact of music and architecture is involuntary unlike other art forms. It is difficult to realize the reason behind the change in psychological state, likewise the state of mind attained would slightly vary among different individuals showing the subjective nature of the art.

II. MUSICAL SCALE (RAGA) – ITS STRUCTURE AND PSYCHOLOGY

Musical scales are referred in different names in different cultural styles [1]. This research insists on using the ‘Raga’ a prime component in Indian music. Raga – Means ‘the one which colors the mind’, also referred to as the soul of music. [2] Raga is a medium to depict aesthetic qualities such as an emotion. It is a scale or collection of notes with varying intervals to attain a melodic form. It is the soul which causes the change in state of mind through emotional balance.

A. Structure of a raga (musical scale)

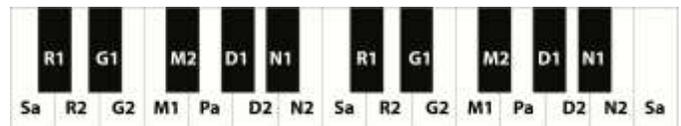


Fig 1 (Structure of a raga)

Basic notes of a raga are Sa, R1, R2, G1, G2, M1, M2, Pa, D1, D2, N1, And N2, (Fig 1). Raga has two reference notes (Sa and Pa). The reference notes form the base from which position of the rest of the tones are notated. All the tones which are positioned in odd intervals from the nearest reference note are given a suffix 1(R1, G1, M1, D1, N1). Similarly notes positioned in even intervals from the nearest reference notes are given a suffix 2(R2, G2, M2, D2, N2,).

B. Rasa – Emotional content in ragas

Taking Indian music into account, several thousands of years of research is present for ragas [3]. Each and every raga was discovered and given categorized structure and to convey an emotional experience which causes a psychological change in the state of mind when listened to [10].

Earliest works of Bharatamuni [4] in his Sanskrit Hindu text on *Natyashastra* [5] showing the “world of emotions” consisted of inherent emotions or sentiments, which were established in the fourth century CE .The original ten are-

- 1 – Srungaram - Arousal, Longing, Desire, Romance, Love
- 2 -Hasyam- - Satire, Imitation, Tickle, Wit, Comedy, laughter
- 3 -Karunam - Pathos, Poverty, Hardships, Repentance,
- 4 - Raudram - Anger, Arrogance, Frenzy, Demolition
- 5 - Viram -Pride, Bravery, Fury, Perseverance, Awestruck
- 6 -Bhayanakam - Startle, Tremor, Stiffen, Paleness, Dreadful
- 7- Adbhutam - Surprise, Wonder, Inexplicable, Overwhelming
- 8 -Santam - Steady, Rest, Peace
- 9 -Bhakti - Devotion, Eternal, Ritual, Preach-in
- 10- Santosham - Joy, Pleasure, Contentment

Each raga is classified based on its rasa has its own unique characteristics which pertains to the raga and similarity exists in these characteristics for ragas having related structure. The psychological emotion which a raga expresses depends upon its structure. The emotional experience delivered by some ragas are also known to exhibit medical qualities [12]-[13].

III. METHODOLOGY AND DERIVATION OF CHARTS

This research focuses on relating music and architecture with respect to the emotional experience delivered. This emotional experience is manipulated through certain parameters. When considering musical composition the base for the emotional experience is the scale (Raga) with respect to which it is played [10]. Further enhancement of the experience corresponds to certain factors such as , mode of expression (with respect to the instrument it is being played), the prayoga which is the style/technique of expression (technique differ with respect to different musical styles like Indian classical, Hindustani, Rock, jazz, Folk etc.) [7], octave which the composition is played (eg , Sadness is more expressive when played in lower octaves compared to happiness), tempo of the composition etc. Likewise the sequence of volumetric space (planning) forms the base for the experience of the design by a user. Further enhancement of the experience is through factors such as lighting, colour, texture (Virtual and Tactile) , interaction etc. Volumetric enclosure [8] and lighting [9] combined, play a major role in delivering the psychological experience of a space . This is because the lighting inside a space determines how the space is going to be perceived visually hence determining the reality of the space[11]. Likewise sequence of spatial intervals in a raga and the typology of notes (R1, R2,G1, G2) play a major role in determining the experience of the musical composition. [6]-[10].

For this study five emotions expressing Balance/content, Majesty/astonishment, Excitement, Sad/Pathos, Confusion/ Chaotic are considered. Eight ragas for each emotion are chosen. The graphs exhibiting the spatial intervals between the notes are studied and compared for ragas delivering similar emotional experience. Pilot study is made on similarities in certain elements in architectural spaces to deliver similar emotions.

The psychological experience of one raga from Balance/content, Majestic/Astonishment, Excitement, Sad

/Pathos is studied on human subjects and analyzed. Similarly three built up spaces are considered (Jewish museum, Fransforth house by Mies Van Der Rohe, Hayder Aliyev center by Zaha Hadid, Dhaka state assembly By Louis Khan). The psychological experience of the built up spaces are studied on human subjects and analyzed.

Volumetric ratios are derived for each consecutive space in a design. The ratios are compared with respect to similarities in the Rasa (Emotion) experienced.

IV. DERIVATION OF GRAPHS FOR RAGAS AND COMPARATIVE ANALYSIS

A piece of music pertaining to a musical scale (Raga) can be played by fixing any key as the sama Sa (Reference note), provided the intervals between the keys while playing are maintained. **This shows us that the psychological experience of the raga is not due the positioning of its notes in its scale but in context of the relationship with its consecutive and preceding note.** Hence graphs are derived respective to the spatial intervals between the consecutive notes (**Error! Reference source not found.**) when the structure is divided into 12 equal spatial intervals.(Fig 2). The sequence of notes are with reference to the arohanam and avarohanam.

Arohanam or ascending notes is a basic sequential arrangement of notes to be maintained while ascending in a musical composition. Similarly avarohanam or descending notes is a sequential arrangement of notes to be maintained while descending in a musical composition pertaining to the raga. Hence arohanam and avarohanam form basic structure of a raga.

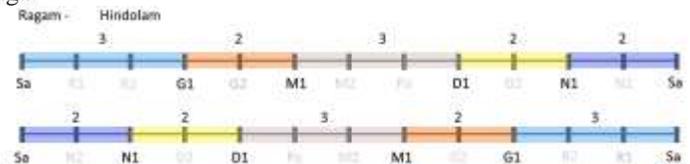


Fig 2 (Arohanam And Avarohanam of Raga Hindolam)



Fig 3 (Spatial interval graph of raga Hindolam)

A. Balance/Peace/Content happiness (Santham)

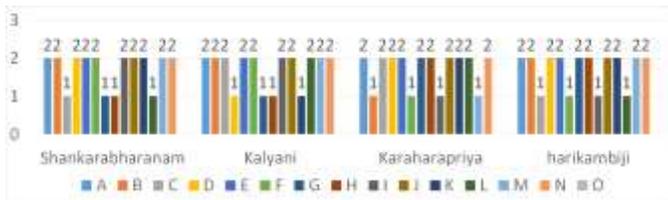


Fig 4 Graphs for ragas expressing balance [1]

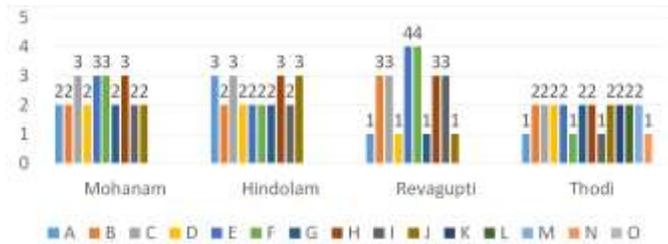


Fig 5 Graphs for ragas expressing balance [2]

All the chosen ragas expressing balance have symmetry in their structure i.e the arohana and the avarohana contain the same notes.

The Emotion ‘balance’ is achieved when the user experiences simplicity and finds logic in predicting the space. The spaces have precise visual clarity and symmetry in their planning. Lighting is homogeneous with clarity in perceiving the space. Eg Salk University- (Fig 6)



Fig 6 Salk university by Louis Khan, (a) View and (b) Plan

The Typology of spatial interval is limited to largely 2 spaces as seen in shankarabharanam, Kalyani, Kharaharapriya, Mohanam, shudhasaveri, sama, and hindolam,)(Fig 4 and Fig 5) and a maximum of 3 in revagupthi (Fig 4).

Maximum difference between two spatial intervals is 1 in most of the ragas except for Revagupthi (Fig 5) which has a maximum interval of 3.

Hence a Balance exists in the pattern of the consecutive spatial intervals seen in the graph when compared to other emotions. The spatial intervals are arranged in a rhythmic orderly fashion.

This emotional character can be seen in architecture designs expressing balance where the user experiences consecutive spatial volumes having similar proportion, with minimum variation in height, such as, instances of balance in the volumetric proportions of spaces seen in Fransforth House and Sabharmathi ashram.(Fig 7)



Fig 7 (a) View of Fransforth house and (b) Sabharmathi Ashram

B. Excitement

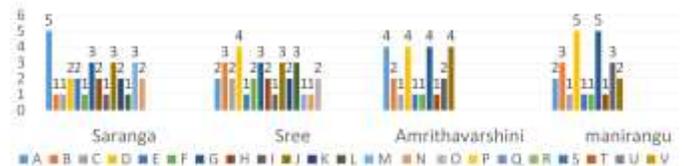


Fig 8 Graphs for ragas expressing excitement [1]

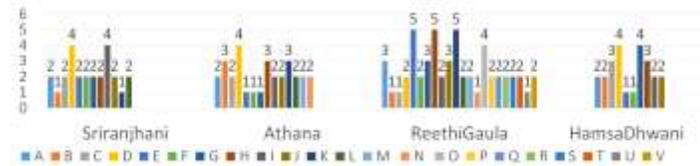


Fig 9 Graphs for ragas expressing excitement [2]

The typology of the spatial intervals is not less than three 3 in all the ragas and reaches a maximum of five in Reethigaula (Fig 9). Hence dynamism exists in the pattern of consecutive spatial intervals seen in the graphs. , likewise it is hard to predict the sequential arrangement in the same when compared to ragas expressing balance. . The structure of the ragas are not symmetrical I.e the arohana and the avarohana contain different variety of notes and hence a different variety of spatial intervals. The maximum difference between spatial intervals reaches four in case of Saranga and Manirangu, (Fig 8Error! Reference source not found.) three in rest of the ragas

This is seen in spaces such as Malls, convention centers and many modern deconstructive designs, where the user experience a variety of volumetric enclosures with varying proportions in its dimensions. Instances of dynamic arrangement of volumes in Maxxi museum and Hayder Aliyev Center-.(Fig 10, Fig 11 and Fig 12

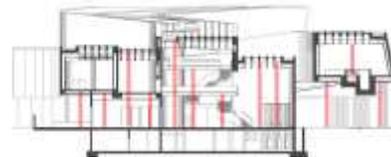


Fig 10 ; Section of Maxxi Museum by Zaha Hadid

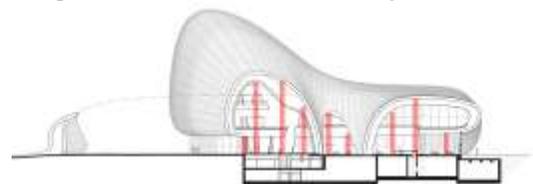


Fig 11 ; Section of Hader Aliyev Center by Zaha Hadid

The lighting inside the spaces are diverse with numerous bright light sources enhancing the character of the space (Fig 12)



Fig 12 ;(a) Interior View Of Hayder Aliyev center and (b)Maxxi Museum)

Excitement is also achieved in spaces through extreme visual clarity and the contrast of light and shadow. This creates a series of patterns using bright spots and shade. The source of light may or may not be visible but the path of light is direct making bright impressions inside the volume. This increases the complexity and gives the human mind lots to perceive making it highly enthusiastic.



Fig 13 World design capital pavilion, Dublin

Exiting Volumes are more enhanced by diversity in colour and contrast

C. Astonishment/Majestic (Adhbutam)

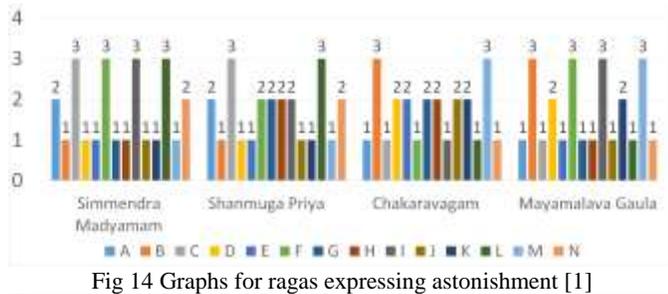


Fig 14 Graphs for ragas expressing astonishment [1]

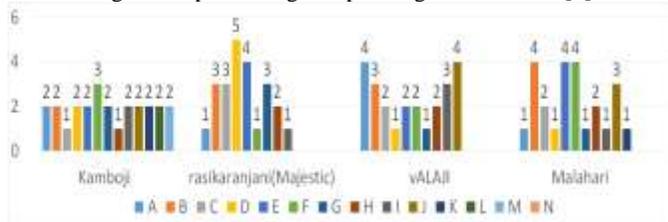


Fig 15 Graphs for ragas expressing astonishment [2]

The typology of the spatial intervals exceeds 3 in most of the ragas .Sudden expansion in the spacial intervals can be seen in the graph of Simmendra madhyamam, Chakkaravagam, Mayamalavagoula, Shanmugapriya And Kamboji (Fig 14, Fig 15). It is this character of arrangement in spatial intervals deliver the emotion. In case of Valaji and Rasikaranjan (Fig 15) where a gradual increase to the peak is observed. Logic in the arrangement can be observed in case of Simmendra madhyamam, Chakkaravagam, Mayamalavagoula, Shanmugapriya, Kamboji and Valaji. (Fig 14, Fig 15)

This character is seen especially in religious spaces such as temples, cathedrals and where the might and of power of the deity is expressed and also in top priority government buildings

such as senate, national assembly etc. exhibiting the power and capability of a nation to the rest of the world.

The majesticity is predominantly expressed through the sudden increase in scale of the space. (Atrium of guggenheim museum Fig 16 (b)) and pantheon (Fig 16 (a)).The experience of a space with majestic scale is enhanced when the path is through a confined space(View of Taj Mahal from Buland Darwaza) (Fig 16 (b)),



Fig 16 (a) Section of Guggenheim museum , (b) View of Taj Mahal , (c) Section of Pantheon)

The scale of the emphasized volumes have high visual clarity, where the source of light is very bright, well defined and out of reach for a human observer (Fig 17). The light source is either peripheral or direct along the longest axis along the longest dimension emphasizing the scale of the spatial volume in a space especially when the longest axis is the height. (Fig 17)



Fig 17 (a) Pantheon and (b) St peter's Basilica

D. Confusion/Chaotic.

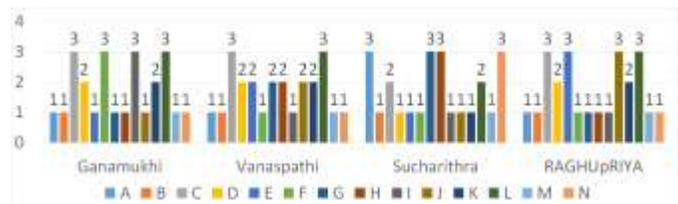


Fig 18; Graphs for ragas expressing Confusion /chaotic [1]



Fig 19; Graphs for ragas expressing confusion/chaotic [2]

These are Ragas containing very next consecutive notes of similar notation but with variety in its spacing. Eg the notation of avarohanam in Rathnangi (Fig 19)is Sa R1 G1 Ma PA D1 N1 Sa which is similar to Thodi, but G1 is not the actual tonal interval of Ga it is R2 notated as G1, hence the actual structure of Rathnangi is Sa R1 R2 M1 Pa D1 N1 Sa. Due to this unique characteristics of these ragas, they defy the conception of tonal scale depiction. Likewise the presence of both R1 and R2 in the same scale makes it difficult for the listener to understand as the tonal intervals between R1 and R2 is very minute and hard to

grasp, hence confusing the listener. Not many compositions are made using these ragas due its unpleasant nature.

V. DERIVATION OF GRAPHS AND COMPARITATIVE ANALYSIS BETWEEN ARCHITECTURAL SPACES AND RAGAS

The structure of the raga is only a base for the sequence of how the musical composition in the raga is going to be. It is the order or sequence of notes from the least to the maximum distance from the Reference note Sa (Fig 2). Hence the raga shows only one standard possibility of how the proportion of spatial interval is going to be in this basic sequence. Likewise, diversity in the order of spatial intervals will be present when a musical composition is derived using the notations of the raga. A musical composition is a mixture of sequential orders, yet maintaining its basic character similar to the arohana and avarohana of its raga. The path or sequence which the composer is going to take cannot be defined, hence the listener is subjected to infinite no. of possibilities with respect to the sequence of notes experienced. Similarly the sequential order of spaces with respect to accessibility from the entry can be maintained by the designer, where he tries to define a standard path of experience similar to that of the basic structure of raga (Arohana and Avarohana). But the actual sequence pertains is determined by the infinite number of possible paths undertaken by the user that cannot be predicted.

In case of music the standard structure is present the raga(Arohana and Avarohana), from which musical compositions are made. Whereas in architecture the spatial experience is a composition from which the standard structure has to be derived. Hence in this research the space is divided with respect to a hypothetical path of experience for comparison.

A. Dhaka national assembly by Louis Khan (Astonishing/Majestic)

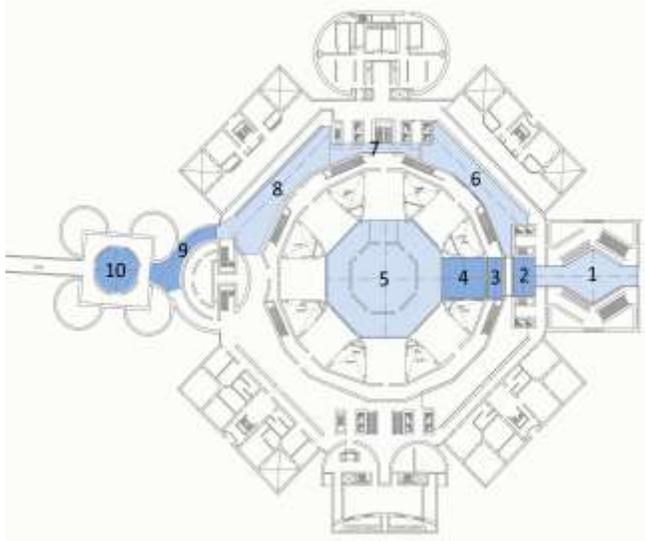


Fig 20 Dhaka National assembly plan

Consider the hypothetical path of experience to be 1, 2, 3, 4, 5, 4, 3, 6, 7, 8, 9 And 10 .(Fig 20)

X is the shortest dimension crossing the center a space, Y is the longest dimension crossing the center of a space and Z is the height from the center of the space. . ,

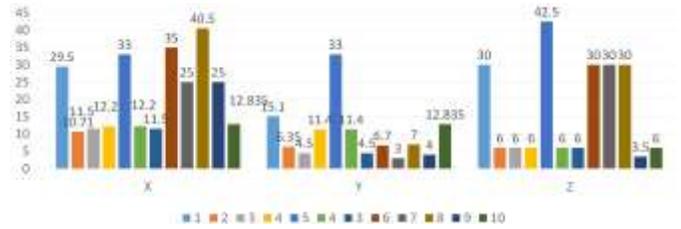


Fig 21 Values of X, Y and Z for consecutive spaces in a hypothetical path of experience for Dhaka state assembly

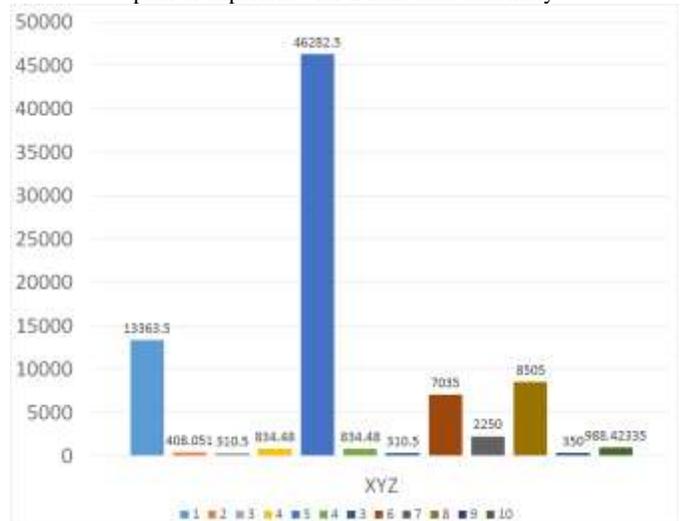


Fig 22 Value of XxYxZ For consecutive spaces in a hypothetical path of experience for Dhaka state assembly



Fig 23 (a), (b) Interior Views From Dhaka National Assembly

B. Fransforth house by Mies Van Der Rohe (Balance)

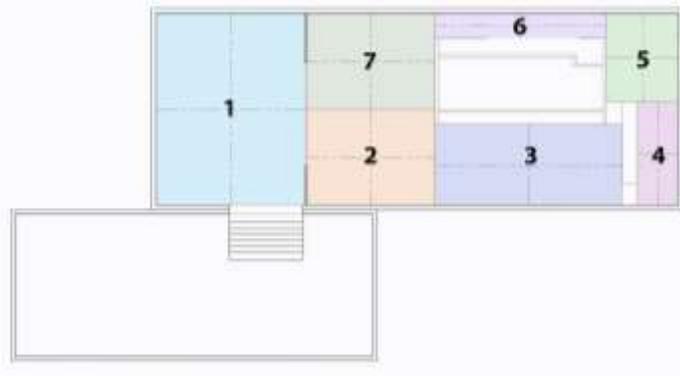


Fig 24 Fransforth House plan

Consider the hypothetical path of experience to be 1, 2, 3, 4, 5, 6, and 1. (Fig 24)

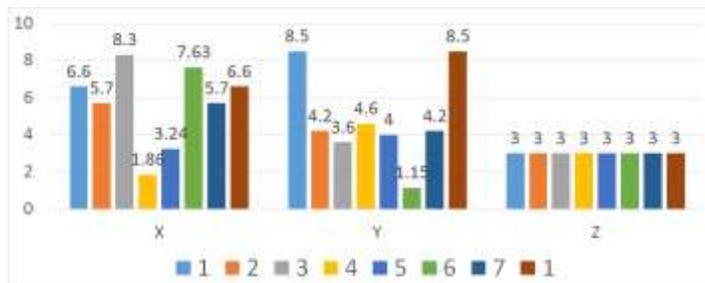


Fig 25 Values of X, Y and Z for consecutive spaces in a hypothetical path of experience for Fransforth house

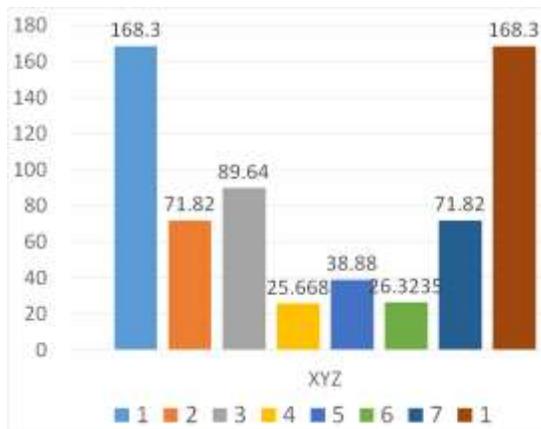


Fig 26 Values of XxYxZ for consecutive spaces in a hypothetical path of experience for Fransforth house



Fig 27 (a), (b) Interior view Fransforth house

C. Sabharmathi by Charles Correa (Balance)

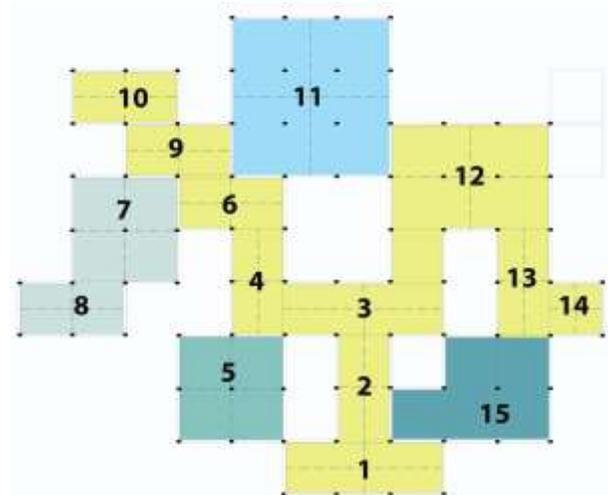


Fig 28 Sabharmathi Ashram Plan

Consider the path of experience to be 1,2,3,4,5,4,6,7,8,9,10,11,12,13, and 15

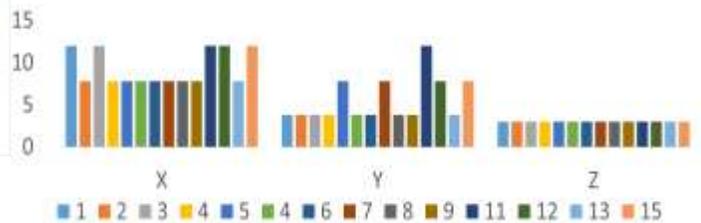
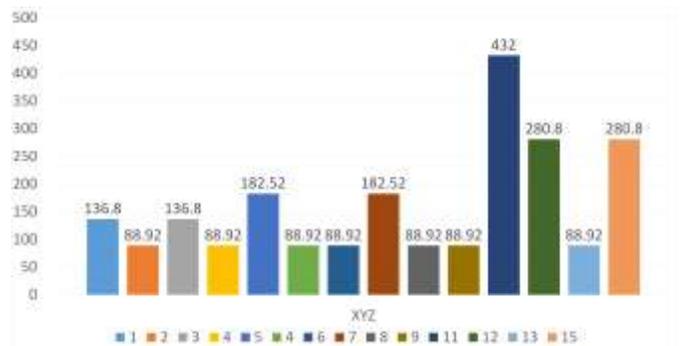


Fig 29 Values of X, Y and Z for consecutive spaces in a hypothetical path of experience for Sabharmathi Ashram



Graph 1 Values of XxYxZ for consecutive spaces in a hypothetical path of experience for Sabharmathi Ashram



Fig 30 (a), (b) Sabharmathi Ashram interior view

D. Comparative analysis

Sudden expansion in volumes can be seen in spatial volumes 1,5,6 and8 of Dhaka national assembly (Fig 20) with largest difference in volume present in path between the spaces four

and five (approximately 45, 000 m³), with space-5 having approx 55 times the volume of space-4)(Fig 22). These sudden expansions can be compared with the wide spatial intervals seen in the graphs of astonishing ragas (Fig 14, Fig 15). More precise similarities can be seen while comparing the graphs corresponding to the ratios of heights, with a maximum difference of 32.5 between spaces-4 and 5 (Fig 21).

In case of Fransforth house (Fig 24) varying ratios of x, y and volume can be seen in their corresponding graphs (Fig 25, Fig 26) but the height (Z) remains constant (Fig 25) unlike that of the Dhaka state assembly. Moreover the maximum difference in volume between consecutive spaces is not more than 97m³ (Fig 26). Volume of space-1 is 2.2 times that of space-2. The same can be said for Gandhi museum where Values of X and Y in **Error! Reference source not found.** maintain minimum diversity in values with constant values for Z (Fig 25). This is similar to the graphs derived for ragas exhibiting balance (Fig 4, Fig 5) where constant spatial intervals is maintained between most the notes with not more than two typologies of spatial intervals in most ragas.

This shows that height of a space is the key element defining the psychological experience of a space. An observer can visually experience height without any obstruction (in most cases unlike the axis defining the floor plane) but cannot physically accomplished it in a space.

VI. CONCLUSION

Many emotions such as balance, focus, excitement, sadness, desperation expressed in music can also be expressed in architecture. Only the elements of the art-forms differ. Similarities are present in the usage and proportion of these elements to be implied for deriving a similar emotional experience.

The graphs derived from ragas expressing similar emotional qualities exhibit similar characteristics in the arrangement of spatial intervals between consecutive notes. The comparison of graphs derived from volumetric proportion architectural spaces Vs the spatial interval between the intermediate notes of ragas show similar characteristics for the emotions balance and Astonishment/Majestic. Hence a logical relationship is established between architectural spaces and structure of ragas when considering similar emotional qualities from both sides. The emotional quality of a raga can be expressed in architecture by studying and incorporating its proportion of spatial intervals into designing of spatial volumes. Experiments on ragas for curing cardiovascular disorders and stress reduction are present, similarly by incorporating the characteristics of ragas proved with medical values in architectural designs, designing of medically curing spaces can be made possible.

This research focuses only on comparing the space in built forms and spatial intervals in ragas. Further study can be done by comparing other elements of Light, color texture etc. The similarities in emotional qualities between selective spaces and ragas can be proved by exhibiting them to human subjects.

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