
| RESEARCH ARTICLE

Analysis and Research on Space Syntax in Urban Heritage Building: the Conservatório de Macau as an Example

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| ABSTRACT

Space syntax is one of the important methods for urban analysis and calculation. Based on the theory of space syntax, this study takes the Macau Conservatory of Music, an important Portuguese historical building, as an example, to first analyze the particularity of its development history in urban heritage, followed by the internal spatial structure, and import Depthmap for operation, combined with topology-related calculation methods. By analyzing the topological values such as the overall integration, local integration, global depth and selectivity of the space, we can quantitatively explore the structure of the space, understand the relationship between the overall space and the local space of the Macau Conservatory of Music, discover the deficiencies in the space structure, and propose corresponding optimization strategies are proposed to provide ideas and reference for the future renovation of the typical performing arts architectural space in the urban heritage of Macau.

| KEYWORDS

Space syntax, Urban heritage architecture, Performing arts architecture, Macau.

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1. Introduction

Although Macau is a small place, it has been a port for more than 400 years. Due to historical reasons, it is slightly behind in terms of music activities. However, despite this, there are still many enthusiastic people to promote music. Relevant departments have also noticed that a lot of funds have been allocated to promote cultural undertakings, and the music scene in Macau has begun to become lively.

The Macau Conservatory of Music, the Music School of the Macau Conservatory for Performing Arts, is a school with a long history in Macau. It is headed by Shen Yongbao, a famous musician from Hong Kong and Macau. He has visited Hong Kong several times to perform and participated in the performance of the Yellow River Music Festival for decades. Thousands of students have been trained successively, and some of them have been successful in their studies and engaged in music work. For example, Zheng Linuan, a musician from a family, specially took a boat from Hong Kong to Macau to teach and finally stayed at the Macau Conservatory of Music to teach. With the development of the times, the music school with Portuguese architectural style has become a typical performance building space in the urban heritage of Macau.

Up to now, the music school has become a formal music art school with the largest scale, the complete disciplines, the largest number of professional teachers and students, and the provision of vocational and technical education and general education in Macau. Currently, the Music School of the Macau Academy for Performing Arts currently has two teaching locations, namely, the Avenida de Horta e Costa 14 – 16, and the new teaching site in September 2008, the campus of Wangde Church, No. 35 Helong Street, Macau. This study analyses the Macau Academy of Performing Arts School of Music Costa Cam-pus (see Fig. 1).

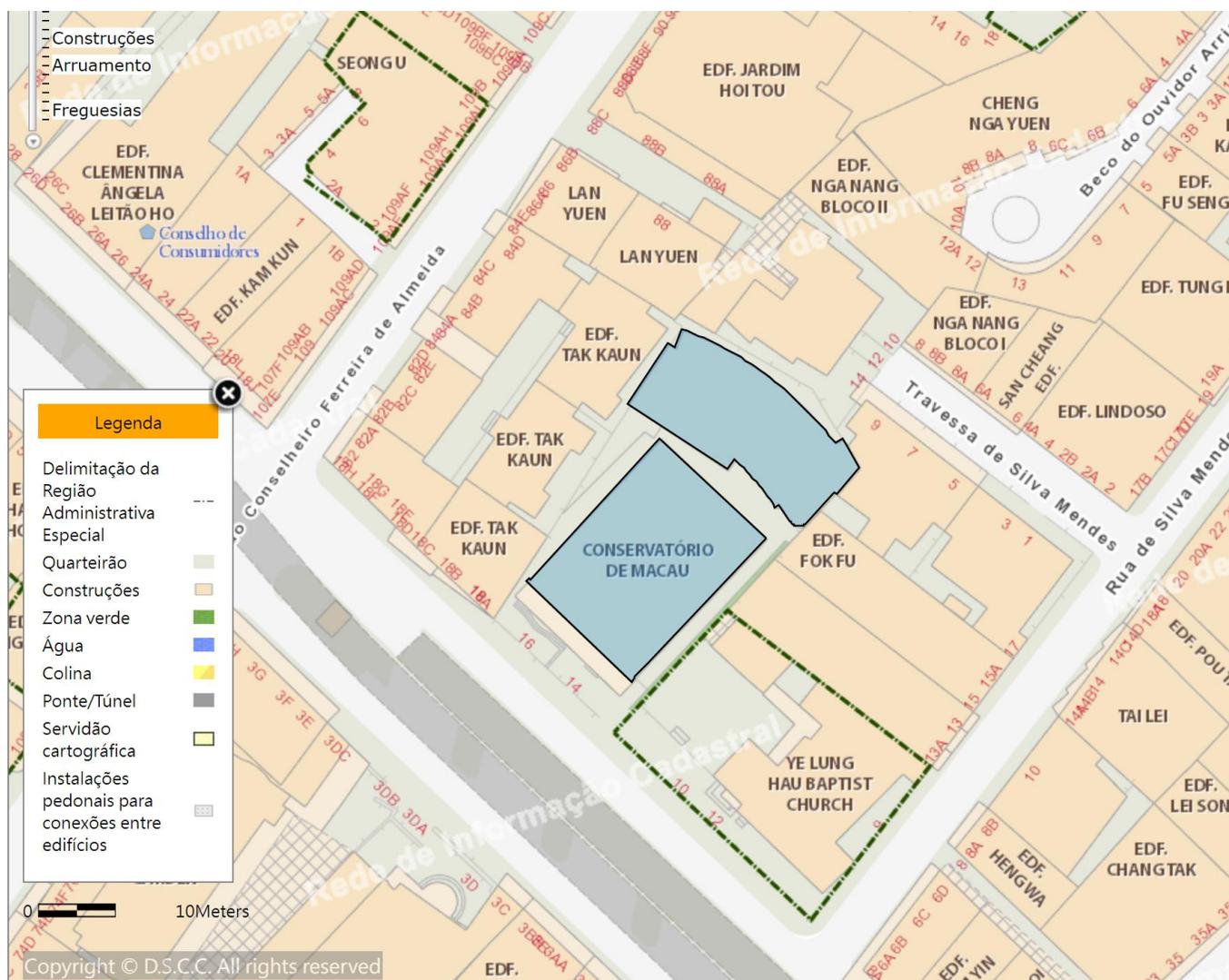


Fig. 1. CONSERVATÓRIO DE MACAU, Avenida de Horta e Costa 14 – 16 (Image source: The author is intercepted from the Macau Cadastral Bureau)

2. Distribution of space functions in the building

The Macau Academy of Performing Arts School of Music Costa campus is divided into a building and a teaching building in the back. There are more than 30 piano rooms, 1 office, 2 rehearsal rooms, 1 solfeggio classroom and an auditorium that can accommodate more than 80 spectators. Its spaces and devices have the following settings:

- (1) Rehearsal room: a complete set of musical instruments, equipped with air-conditioning equipment, available for the performance team to rehearse.
- (2) Solfeggio classroom: complete teaching equipment for teaching use.
- (3) Piano Room: Equipped with pianos, straight mirrors, tables and chairs, music stands and other equipment required for teaching. At the same time, each piano room has a professional sound insulation design to ensure the sound requirements during teaching. Each piano room is an independent teaching and practice space for teachers and students.
- (4) Auditorium: Equipped with a stage, professional lighting and sound, micro-phone, air conditioning and other equipment, it is a performance venue for small-scale performances in dance schools, music schools and drama schools, which can accommodate about 80 spectators.



Fig. 2. Appearance of the Music School of the Macau Academy for Performing Arts (Image source: Google Panorama Map)

3. Research Methods: Space Syntax

The concept of space syntax was born in the 1970s and was first proposed by Prof Bill Hillier in the United Kingdom, who believed that space could affect human behavior to a certain extent. Space syntax is a spatial analysis method based on topological theory and quantitative research on space. Based on people's perception of space and the connection between people and space, different space segmentation methods are adopted for analysis according to different types of space. As a computational method, space syntax clarifies the complex relationship and activity attribution between individual elements and social elements, as well as the overall space. The study of economic phenomena analyzes the spatial relationship and relationship between buildings and neighborhoods, neighborhoods and cities, and buildings and cities—interest impact. The "space" in space syntax not only refers to the spatial area in the geometric sense but also includes the distance between individuals, the actual accurate algorithm, the spatial topological relationship and the associated influence of the entire area. The role of the local space is also the division of space. And scale processing plays a role in the identification of measurement and rules.

Now that we have entered the era of big data and smart city technology, space syntax has become complete spatial analysis research and data calculation law, and has been applied to the theory of architectural design, social activities and urban divisions, and has been widely used in various countries internationally—design and engineering practice of commercial buildings. There are 3 mathematical models in space syntax: convex space, axis model and line segment model. In this paper, Depthmap software is used to analyze the global integration, local integration, global depth, understandability, selectivity and other values inside the commercial building and visualize the calculation result data. The overall integration, selection and global depth describe the structural features of the overall space, while the local integration and intelligibility describe the structural features of the local space. Through the analysis of space syntax theory and the functional structure analysis of typical performing arts buildings in Macau's urban heritage, it provides reasonable reference ideas for the subsequent maintenance or renovation of performing arts buildings.

4. Analysis results and Discussion

4.1 Viewshed Integration Analysis

As can be seen from Figure 3, the place with a high degree of integration of the visual field is concentrated in the orchestra rehearsal room. This space has the largest area and belongs to the core of the Macau Conservatory of Music. Using the convex space analysis method of space syntax, the software dyes it, and the color shows a state of red and yellow, and the overall space is warmer.

It shows that the visual field integration value of this space is high, and the agglomeration effect of people flow is strong, which can attract more people to gather. The second is the corridor on the south side of the bar space, which is yellow in color, indicating

that the integration of the visual field here is relatively high, and it can also attract a certain number of people to gather. Then there is the bar space, the corridor to the right of the orchestra rehearsal room leading to the exterior space, half of the soundproof practice room, part of the general room, and the corridor of the exterior space. The yellow-green state means that a small number of people will be attracted to gather here, but the gathering effect is not strong.

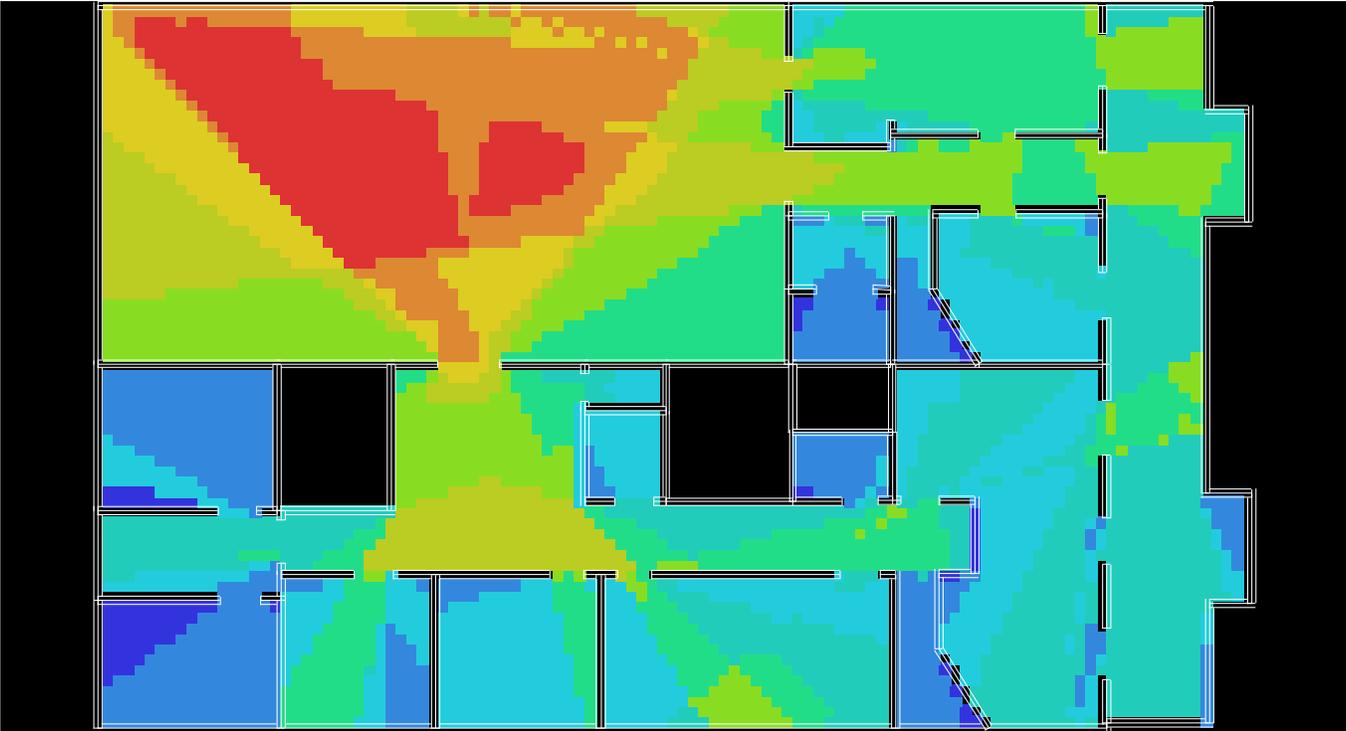


Fig. 3. Analysis of the integration degree of vision of the Macau Conservatory of Music (Image source: drawn by the author)

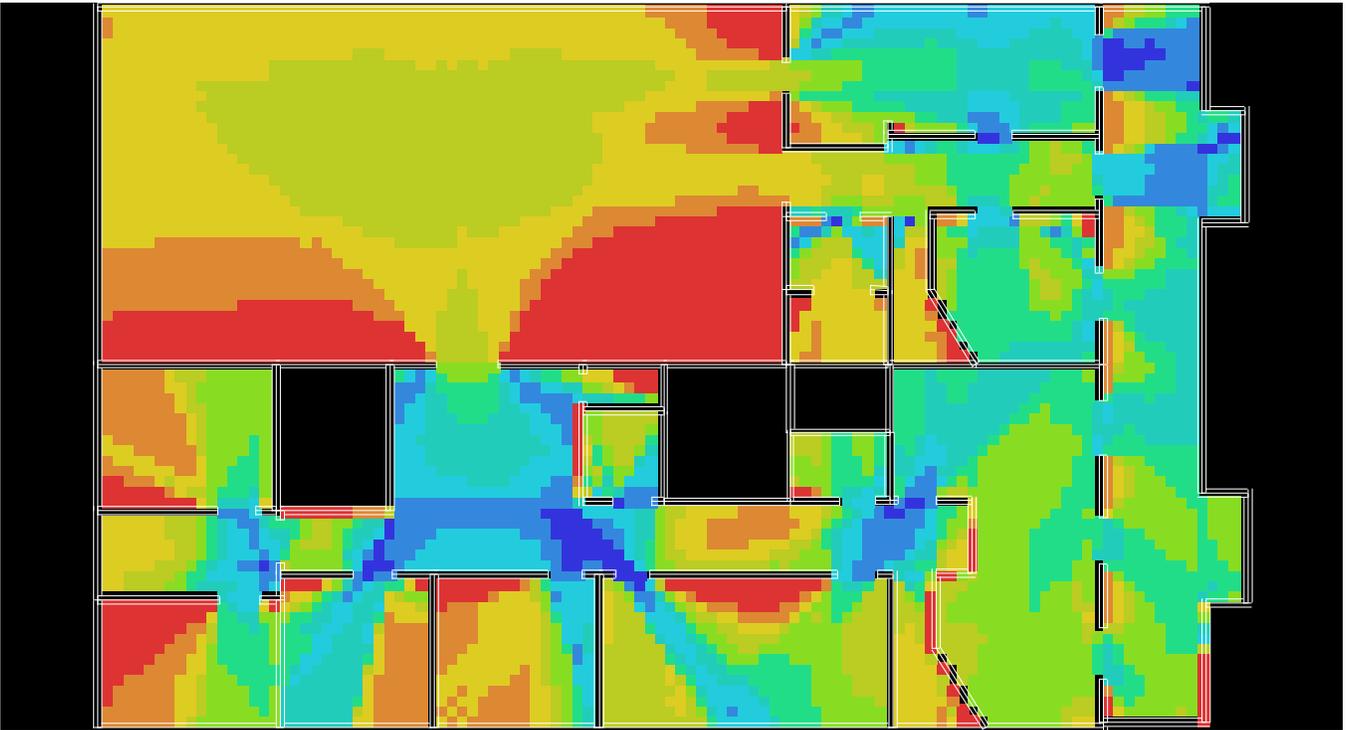


Fig. 4. The agglomeration coefficient of the visual field of the Macau Conservatory of Music (Image source: drawn by the author)

4.2 Viewshed Clustering Coefficient Analysis

It can be seen from the figure that the places with high visual field clustering co-efficient are the orchestra rehearsal room, four soundproof practice rooms, the north wall of the general room, the stairs on both sides and the wall of the external space. The colors of these areas are warmer, and the crowding effect is the strongest on the entire floor plan (Figure 4). The rehearsal room can not only provide a rehearsal place for the personnel of different local units, including staff, students, retired staff and cadres, etc. It can also provide a practice base for local bands and artists to perform in the future. Therefore, the rehearsal room needs to have professional and complete equipment. During the rehearsal process, there are professional teachers from the Conservatory of Music who will conduct in-depth discussions and exchanges with the rehearsal students on how to present the program in front of the leaders and the public according to the type of performances to ensure the quality of the rehearsal staff's performance and the effect of the rehearsal. The professional rehearsal room is designed by the designer according to the principles of architectural acoustics and is built together with a large number of sound insulation equipment and radio-related equipment. Before entering the rehearsal room for rehearsal or after the rehearsal in the rehearsal room, some staff need to go to the soundproof practice room to practice and improve themselves on the relevant content.

Compared with the rehearsal rooms and practise rooms with a high concentration, the spaces with a low concentration are the corridors on the south side of the bar, the dressing room, the maintenance room for instruments, the corridor outside the club studio and part of the viewing platform on the east side of the plane. . The main function of the Conservatory of Music is related to music and is basically closed to the public. The main purpose of rehearsal personnel entering the Conservatory of Music is to rehearse the repertoire for the performance of a certain period of time later, so the bar is for most unit rehearsal personnel. Not particularly important. Just for the rehearsal members who don't come out of the band to drink before or after the rehearsal. Therefore, the agglomeration effect of the bar is not particularly strong, and the color also shows a cool state. The instrument maintenance room is a place for the staff of the Conservatory to enter and exit occasionally. During the regular inspection of the instruments, some rusted instruments are pushed to the maintenance room for maintenance, but the number of times is not very large, so it also presents a cool color. state. The outer side of the club studio and some areas on the east side of the corridor plane are also less crowded. In the aggregation process, the aggregation time is also relatively short. In the analysis of syntax, the average value of the entire plane is analyzed, so the analysis results also have a certain reference value and reference value.

4.3 Viewshed Connection Value and Viewshed Control Value Analysis

The changing trend of the viewshed connection value and the viewshed control value is basically the same. Viewshed Control values are also higher, whereas the Viewshed Link value is higher. Taking the entire public space of the Conservatory of Music as the research object and taking the closed space of each building area as the boundary, the degree of spatial connection within a certain area is the measure, and the obtained index can reflect the entire internal space of the Macau Conservatory of Music accessibility. Viewshed control values help highlight areas where rehearsers can see a large view of the spatial layout. As can be seen from the figure, the place with the highest visual field connection value is the orchestra rehearsal room. Through the convex space analysis method of space syntax, the color is bright red, followed by the three doorways connected to the rehearsal room. As the distance from the doorway increases, the viewport connection value gradually decreases, and the color gradually changes from red to yellow-green. The areas with higher viewshed connection values are in the bar and in the corridor outside the bar, and the color increases with distance from the bar. The places with the lowest visual connection value are in the remaining spaces, namely conductor and score archives, men's and women's changing rooms, instrument and maintenance rooms, restrooms, orchestra rehearsal rooms, studios and societies, general rooms, clothes storage rooms, etc. Unnamed small space. As the area shrinks, the viewshed control value gradually decreases, and the color reaches blue. It shows that with the reduction of the area of public space, the tightness of the connection is poor.

In the analysis of the viewshed control value, the area with a higher numerical value is still the same as the area of the viewshed connection value, indicating that the rehearsal here sees a larger area of the large view of the spatial layout. In the future design of the interior space of the rehearsal room, the concept of "defending self-esteem, making progress together, and contributing to the development of the motherland in the new era" should be adhered to into a material with a complete sound insulation effect, while enhancing the echo effect of the interior space. On the LOGO design of the interior walls, colors and shapes with more Macau characteristics can be designed, and photos and introductions of musicians from Hong Kong, Macau and Mainland China can be posted so that people who come to rehearsal can be proud of these musicians and inspire themselves in the future. In the process of performing, you can devote yourself more whole-heartedly and give yourself and the masses a satisfactory explanation. On the walls of the south corridor of the bar with high visual field control value and the outer corridor of the soundproof room, the corridor wall of the bar can adopt a retro style, and the music symbols can be made into different shapes and equipped with different colors. The choice of colors is not only Cool and warm colors can be matched, and color gradient design can be carried out. The design style is more in line with the characteristics of the Conservatory of Music, that is, grand, atmospheric, high-end, and high-grade. To attract more people's attention, the feelings of the unit personnel who came to rehearsal and the feelings of different band members on the small cards each time they came to rehearsal can be posted on the wall. The staff of the

Conservatory of Music collected their cards and made them into different shapes for those who came to visit the day before. Visitors from other places can watch so that tourists can feel the good atmosphere of the Conservatory of Music. At the same time, at the viewing platform on the right, set up corresponding exhibition boards, including those attached to the wall and those placed on the drawing board brackets. The content of the exhibition boards can include the photos of the performance, the characters of the performance, the introduction of the performance time: and bits and pieces of performers' training. Let more people come to the rehearsal to understand the experience of the former performers here, so as to achieve a good publicity effect.

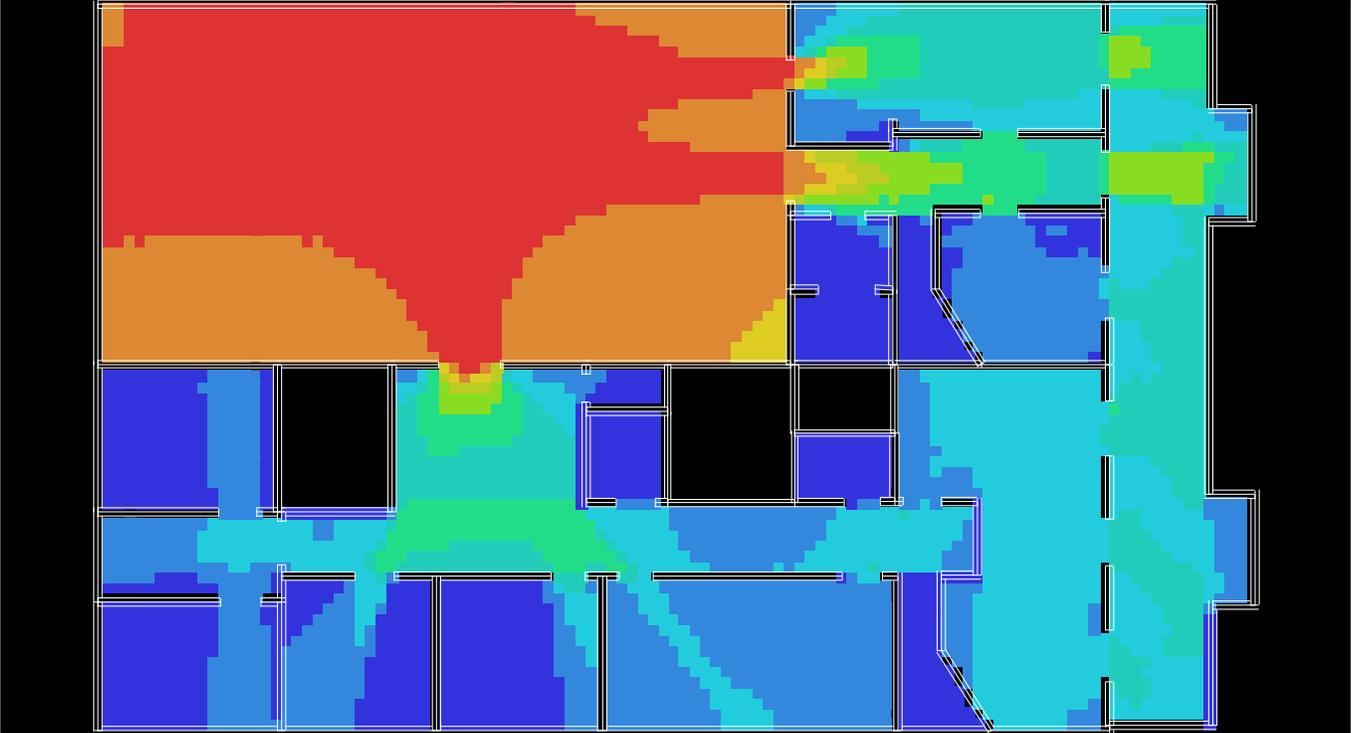


Fig. 5. Viewshed Connection Value Analysis (Image source: drawn by the author)

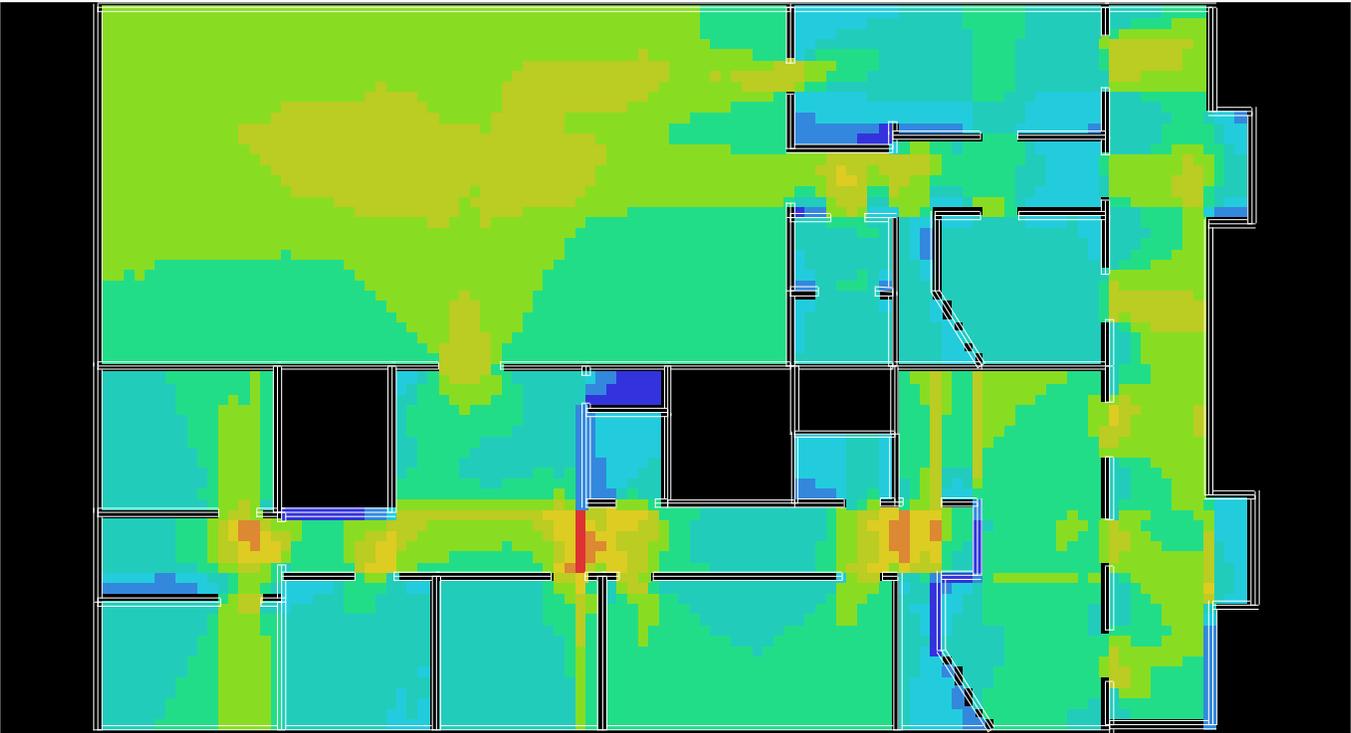


Fig. 6. Viewshed Control Value Analysis (Image source: drawn by the author)

4.4 Visual Depth Analysis

The concept of depth is one of the most important features in space syntax, where "deep" refers to a number of interwoven spaces to reach a certain space; "shallow" refers to a destination that can be reached through fewer spaces. The lower the visual depth value is, the line of sight in this space can see other elements in the space system after a few turns. The more types and numbers of elements seen, the more people can be attracted to this direction. On the contrary, it is not easy to attract people's attention. As can be seen from figure 7, the area with the lowest visual depth value is the orchestra rehearsal room, which is the largest in the entire conservatory. Here people observe more things, more types of elements, and a wider range. Standing anywhere in the rehearsal room is basically a "wideangle" perspective. Excluding the rehearsal instruments, chairs, pianos, tables, etc. The entire space between the ceiling and the rehearsal room floor can be observed. People rehearsing here are more comfortable physically and mentally, and the effect of the rehearsal is very satisfactory. This is followed by the bar connected to the orchestra rehearsal room and the corridor area on the right. Since the corridor after the door on the right side of the rehearsal room is directly connected to the viewing platform, people can see all the elements in the corridor from the right area of the rehearsal room. Although there are certain restrictions, it does not hinder people's viewing angle and breadth. The place where the visual depth is told is the two soundproof practice rooms on the left side of the plane and the two stairs on the right side. The colors of the two sound-proof rooms and the stairs are in a warm color state, indicating that the visual depth value is high, which means that the line of sight in these four spaces can see other elements in the space system after many turns. The fewer types and numbers, the harder it is to attract people's attention. Therefore, when the rehearsal staff came out of the orchestra rehearsal room, they would occasionally get lost, and they could not find the stairs leading to the second floor and the soundproof practice room. Therefore, relevant signs should be set up on the outer wall of the rehearsal room to guide people to move in the direction of the stairs and the soundproof practice room.

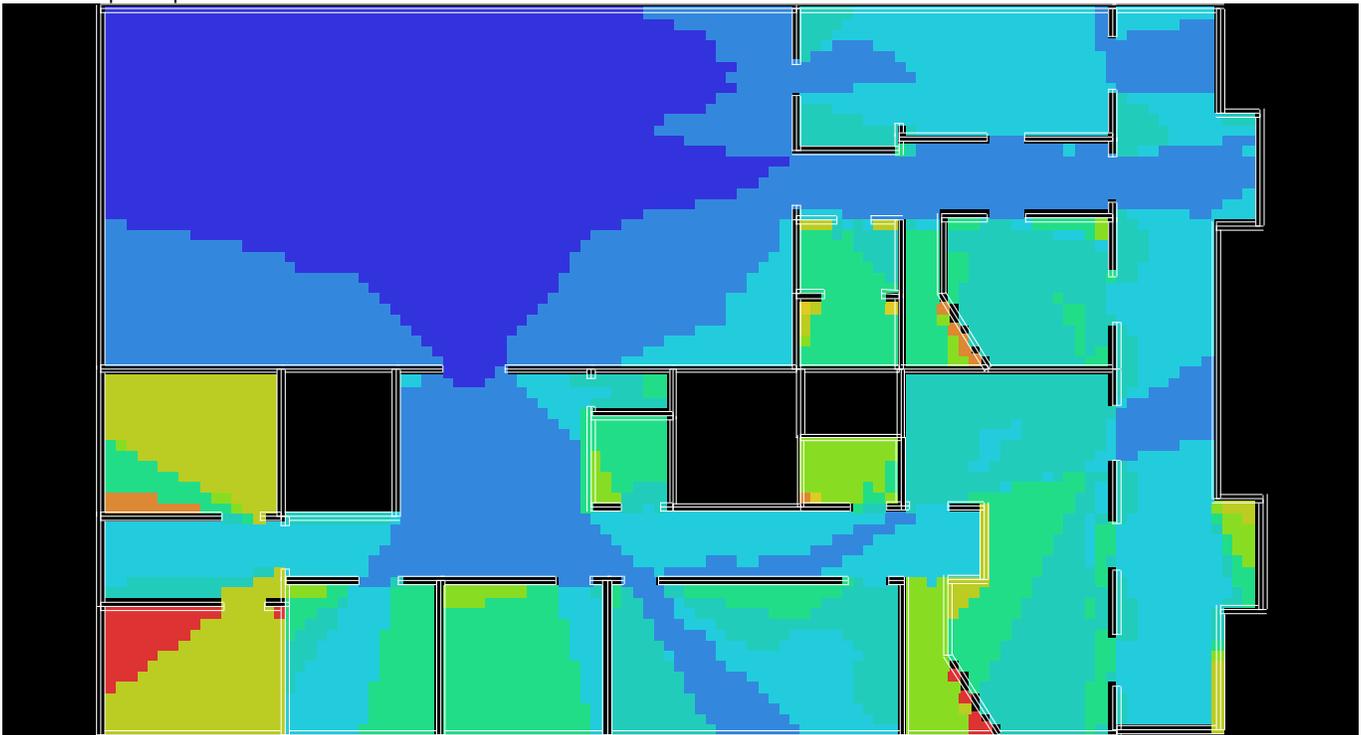


Fig. 7. Visual Depth Analysis (Image source: drawn by the author)

4.5 Agent Robot Analysis

An analysis of the agent robot on the plane of the Macau Conservatory of Music shows that red represents the most traversed paths, and blue represents the least. It can be seen from Figures 8 and 9 that the red area is concentrated in the orchestra's rehearsal room, where the agent robot passes through. The number of times is the most, and the number of "back" fonts is the most. The permeability of the space is better, and the vitality is stronger. The perception of the flow of people is relatively good. Changing rooms, instrument and maintenance rooms, restrooms, studios, patios, general rooms, locker rooms and clothing storage, soundproofed practice rooms, and bars are colored blue, indicating that the robot takes relatively few paths through these areas. On the whole, in each room and the viewing platform on the right, the robot passed the second and third soundproof practice rooms and the general room on the south side the least, and the number of "back" characters generated was also less. These two spaces are less permeable, the perception of the flow of people is weak, and the vitality is poor, and it is easy to form a space "crime".

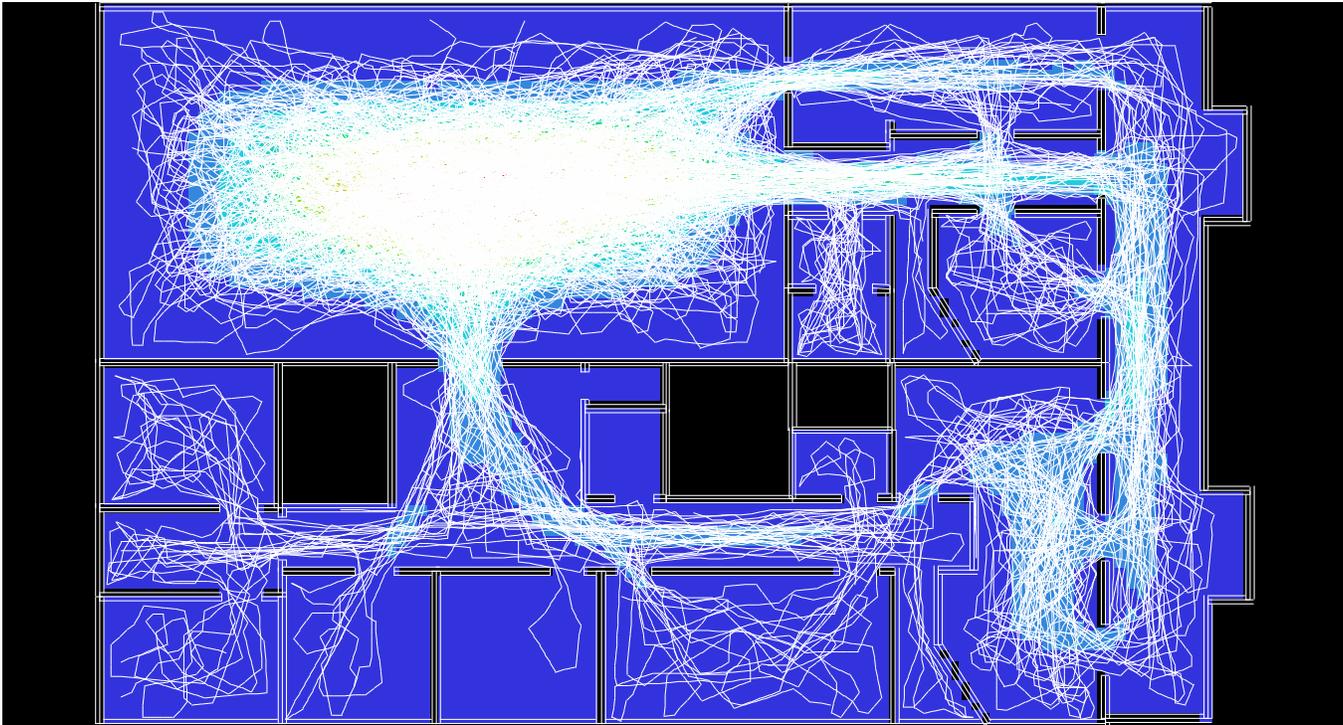


Fig. 8. Agent Robot Analysis (1) (Image source: drawn by the author)

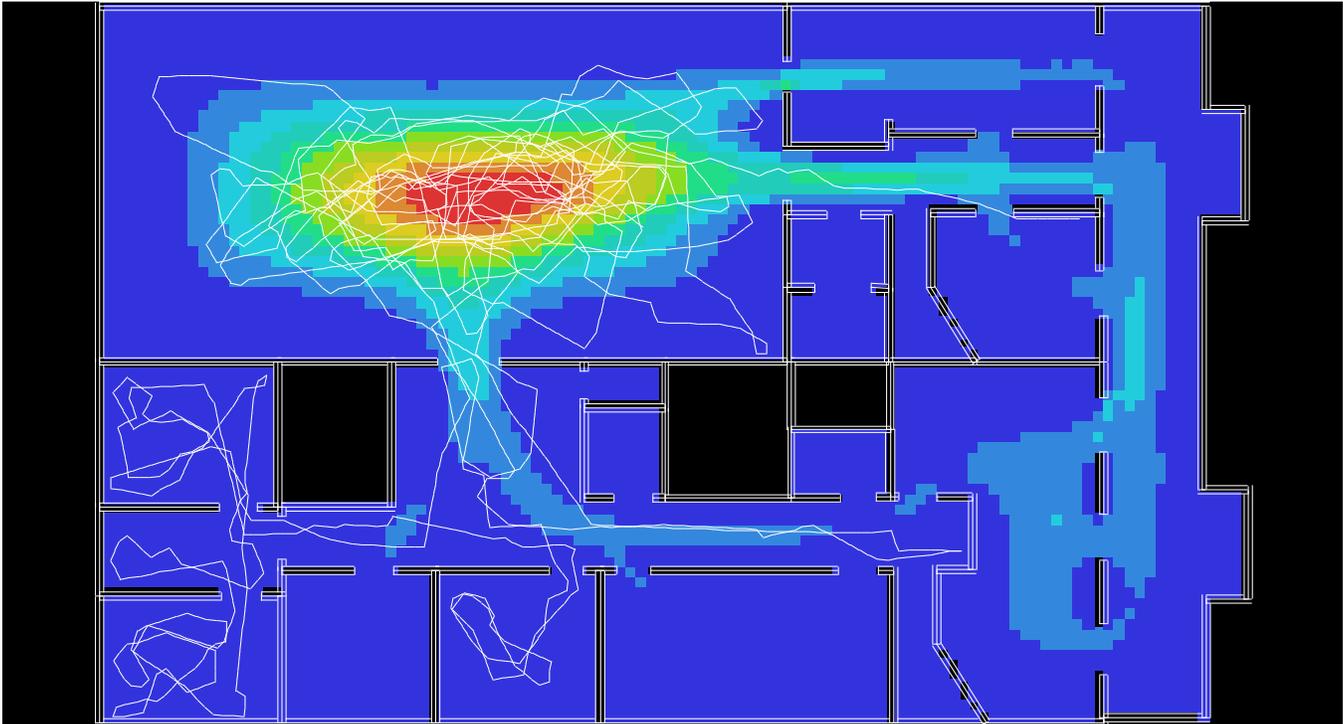


Fig. 9. Agent Robot Analysis (2) (Image source: drawn by the author)

5. Conclusion

Since the Music School of Macau Academy for Performing Arts was built before Macau returned to the motherland, it has been in use for a long time since 1930 and has a certain Portuguese architectural artistic value. Through the calculation of its spatial structure and spatial agglomeration by the Depthmap software, and by observing the spatial characteristics of the current stage, the problems existing in the current use can be found as soon as possible, which can provide reference ideas for the subsequent effective spatial optimization design, and also provide a spatial calculation for the protection of Macau's urban heritage's reference.

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