



Journal of Applied Sciences

ISSN 1812-5654

science
alert

ANSI*net*
an open access publisher
<http://ansinet.com>

Design Exploration of the Club Building in Lingnan-Case Study on the Tennis-badminton Center Club in Guangzhou

¹ZhenYu Song, ²Chun Xie, ²XiaoShan Fang and ¹Lin Lin

¹Architecture Design and Research Institute, South China University of Technology, Guangzhou, China

²State Key Laboratory of Subtropical Building Science, SCUT School of Architecture, SCUT, Guangzhou, China

Abstract: In the architectural climate zoning, Lingnan belongs to the hot-humid regions. Lingnan region is also a hilly area and there are many buildings are located in the slopes. Combined with the case study on the design of the Tennis-badminton Center Club at Science City in Guangzhou which is a typical city in Lingnan, this study analyzed and summarized the climate-adapted design strategies in the hot-humid region and the design strategies for hilly terrain. The proposal and usage of these design strategies could protect the environment, save operating energy consumption while creating the wonderful space and the comfort environment in the building. The design exploration was tried to create the contemporary and regional "new Lingnan architecture" by combining the new building materials, the new construction technology and the space technique of the traditional Lingnan architecture. Furthermore, this paper concluded that the core design idea to build the "New Lingnan architecture" is to adapt to climate of Lingnan, to adapt to hilly terrain of Lingnan and to refine, heritage and rational use of symbol of Lingnan traditional architecture.

Key words: Tennis-badminton center club, lingnan, hilly terrain, hot-humid region

INTRODUCTION

Guangzhou Science City has three big world-class stadium hall which are the Guangzhou international tennis center, the Guangzhou international badminton training center and the Guangzhou international sports center for performing arts. The tennis center and badminton training center are close to the JianTa Mountain and the sports park. The area is the high quality sports leisure zone in Guangzhou.

The Tennis-badminton Center Club at Science City is located in the middle of tennis center site and badminton training center site which is in the east of Kaitai road and in the north of science road. The project aims to provide tennis and badminton player and other sports enthusiasts with high quality of leisure service, offer perfect facilities which including catering, entertainment, accommodation during the period of operation event, setting standard outdoor swimming pool and other Supporting facilities. This project will become a strong complement to the science city sports leisure zone and will make contribution to the sustainable management of tennis center and badminton training center.

The Tennis-badminton Center Club as athletes' inn and space for emotional communication, should be combined with natural, historical and cultural

characteristics of region. In the design of Tennis-badminton Center Club, we refined the characteristics of hot-humid climate and hilly terrain in Lingnan region. We try to combine the romantic natural environment with reasonable modern architecture. This design exploration would reflect the creation theme that the building would be original from climate and adjust to the mountain. Also it should be a place with leisure, health, distinct personality Fig. 1.

In this design project, the authors are facing three challenges (1) How to embody the characteristics of the sports clubs which would be unified with the original environment? (2) How to adapt to the characteristics of Lingnan climate? (3) How to adapt to the hilly terrain?

THEORETICAL STUDY

The design features of sport leisure club: Club is one of the recreational building types from the west which has a distinct subculture property and supply the place for leisure, entertainment, sport and recreation. Club can be divided into professional club and residential club. Professional club include: golf club, badminton club, tennis club, yacht club, etc. The Tennis-badminton Center Club at Science City belongs to professional club (Ming, 2003).



Fig. 1: The design picture of the Tennis-badminton center club at science city (Source: designed by writers)

There are many activities held in the club, so the club building needs its internal space and external space links frequently. Also the club members need a spatial form of openness and closeness to meet the dual needs of privacy and interaction. Therefore the flowing, turning, undertaking space is especially important in club building. Because of its uniqueness of function and space, the architectural image of club building is different from other types of recreation building. The club building has the fluent façade line and beautiful contour. The plan and shape of club building is concise and less interspersed, while the detail is paid more attention to. Due to the context of continuity and traditional inheritance, the club building is always designed with landscape and environment to reflect the local culture characteristic. Therefore, the club building is one of the type of architecture that could fully reflect the diversity and uniqueness of different nation, geographical and architectural culture (Du, 2002).

Design strategy of adapting to the hot -humid climate in Lingnan: In the architectural climate zoning, Lingnan belongs to the hot-humid regions. The Professor Xia Changshi from South China University of Technology

once summarized the way of architecture adapting to the humid climate in the Lingnan region. The basic strategy can be summed up in three words: Shading, insulation and ventilation. In practice, the way means that using the components of building to resist the adverse effects of excessive solar radiation on the building environment, while actively using the wind energy to improve the thermal environment of buildings. The way and practice is in line with building energy efficiency and building ecological design principles (Guohua, 2005).

The Taiwan scholar Mr Lin Xiande has been committed to the study of green buildings in hot-humid climate. He summed up the architectural features to adapt hot-humid climate which are moderate openings, rich shadows and fully ventilation (Lin, 2003).

Through theoretical study and practical exploration, the authors believe that in the design of external environment, reasonable layout of outdoor environment can lower the outdoor ambient temperature and can create the outdoor space to be suitable for activities in Lingnan region. These measures include: (1) Increase green planting area: Not only increase the green plant of the ground but also the use of green roofs and green vertical wall climbers; (2) Reduce the hard surface while use permeation ground as far as possible; (3) Arrangement artificial water features such as pool, fountains, artificial waterfalls, etc. (4) Use trees and buildings to form shadows in order to reduce the impact of direct solar radiation. Through these measures, part of the heat could be blocked and absorbed and the environment temperature could be low down.

Design strategy of adapting to the hilly terrain in Lingnan: Lingnan region is a hilly area and there are many buildings are located in the slopes. The characteristics of mountain building tend to have three aspects: (1) Reduce to contact with the ground to avoid producing a large amount of earthworks; (2) Flexible basal plan to make reasonable use of the terrain; (3) Mountain and building integration (Han, 2010). The construction can choose different form of contact with ground to reduce the terrain changes and earthwork and to protect the original ecology of natural environment. In order to achieve balance with the mountains, the building should be reversed depending on the topography of different angles based on the terrain and used structural platform, split level, drop level, improve the plinth to deal with the terrain elevation. In landscape design, we should protect the shape of the mountain and the feature of the terrain. We

tried to create the landscape corridor between the buildings and nature.

DESIGN PRACTISES

The Tennis-badminton Center Club consists of catering, recreation, accommodation and other function, including outdoor swimming pool and tennis courts. The total land area was approximately 37000 m² and the construction area was about 35000 m² (Fig. 2).

MASTER PLANNING

Continue the greenway in the site: The project is located in Lingnan region and the most significant feature of the site is beautiful mountain and nice green land. The land is hillside topography, northwest higher while southeast on lower.

In the planning, the author conformed to the mountain trend and retained the eucalyptus forest as eco-green nuclear of the site. The building stretched basing the main structure of the planning which not only benefit to the lighting and ventilation of interior but also protect the landscape. The large green trees can filter the noise and exhaust from the road and improve the environment and landscape quality of the leisure club (Fig. 3).

Scatter the building into several parts: Based on the topography, the design scattered the building into several parts to combine into the natural environment in an appropriate scale. The mountain elevation of the site is not so high, while the vertical distance between the main building basement elevation and the top of the mountain is about 48 metres. In order to protect the beautiful skyline of the mountain, the building should be looked

smaller, scattered and transparent to defuse the huge volume of more than 30000 m² which would give great pressure to the environment (Fig. 4).

Through slope analysis of land topography, the site is divided into two main terraces, while the main building would be scattered into three parts. Every building part is connected by corridor, platform with roof above. Various parts of the terrain would change with environment, such could form their own spatial characteristics.

Comply with the height difference and adapt to climate:

In the planning, the authors controlled the depth of building such could do favor to the use of natural lighting and ventilation. The authors also controlled the width of building to form the wind corridor between the club building and the mountain. Different parts are connected by corridor, set platform and shading component which providing guests with a lot of shade and shelter gray space.

The underground garage was built depend on the terrain and divided into two platform of -4.500 m and -8.400 elevation. The two parts were connected through the lane. Underground garage have three entrances. The west entrance near to badminton center and the east entrance near to tennis center. Part of the basement wall was above land because of the terrain, so that the garage could be natural ventilation.

Courtyards layout in the trees: Learning from the Lingnan tradition architecture, the building is in concordance with the mountains to create a casual atmosphere. Several courtyards were layout in the trees to create the flowing and penetration of the internal and external space. Outdoor standard



Fig. 2: The master plan of the Tennis-badminton center club at science city (Source: designed by writers)

pool is surrounded by building and mountain and the swimmers would have nice feelings (Fig. 5).



Fig. 3: The design picture of the entrance area at the site of Tennis-badminton Center Club (Source: designed by writers)



Fig. 4: The bird view picture of the Tennis-badminton Center Club at Science City (Source: designed by writers)

ARCHITECTURAL DESIGN

Functional layout suitable for climate: The building plan is neat and column grid size is 8400X8400, while vertical transportation parts are arranged at the corners of the building.

The gray space between indoor and outdoor space is adapt to subtropical climate and necessary for sport club flowing space which could let the user rest and contact in the nature.

Traffic line organization adapt to terrain: Taking into account the use request during the competition of the Tennis-badminton Center Club, the entrance of the site is set in the middle of Yingri road. Roadway is 5 meters width and around the building and eco-green nuclear. Underground garage entrances are set at south side and north side. Because there is 6 to 10 meters height difference between Yingri road and building entrance, the design set a ramp to link the city road with the building entrance, and the ramp slope was controlled in less than 8%.

Club style reflect the Lingnan characteristic: In the design, the authors controlled the proportion of the glass surface to avoid too much heat getting inside. Architectural style is modern and elegant, while integrated into refined Lingnan architectural element. Pitched roof, façade vertical bump and sun visor, those not only bring shadow for building but also improve the indoor physical environment. Building materials is green tile and white wall with big glass, wood grill, bamboo curtains and hard rock to enhance the cultural and



Fig. 5: The design picture of the swimming pool at the Tennis-badminton Center Club at Science City (Source: designed by writers)

geographical. The pitched roofs echo the shape of the mountain and reflect the Lingnan characteristic.

Landscape design: The project is adjacent to Science City's sports leisure park. The nice greenery and mountain landscape is the biggest feature in the site.

The trees, vegetation and terrain of the base are completely retained in site design which would optimize the original landscape system. Trees retained in site are higher than the club building, so that construction would be hidden in the environment which reflect the privacy and landscape of the club.

In order to ensure the continuity of the landscape visual corridor, the building function blocks scattered arrangement. The southeast slopes are through the overhead layer of the building extend to the Jianta mountain. The authors used more slope and reduced using retaining wall to create soft landscape. The rocks dug out at the site during the construction are ideal material to be the landscape wall by reorganized which also could save a lot of investment through using local resources.

In the interface of urban landscape, the authors suggested to plant trees along Yingri road which not only reduce the noise but also make the landscape of urban road beautiful.

CONCLUSION

To create the club with Lingnan characteristics and meet the modern usage habits and psychological needs it need to learn from Lingnan traditional architecture of the design experience that adapt to climate and use modern climate and physical environment theory. The authors believed that the core design soul of creating new Lingnan architecture is to adapt to Lingnan climate, to adapt to terrain, to heritage and develop the symbol of Lingnan traditional architecture.

During the process of Tennis-badminton Center Club design and construction, the authors understood that architect should fully respect the natural environment and should rational use the natural

resource. Face the natural environment, architect should take a more humble and cautious attitude.

ACKNOWLEDGMENT

This article was financially supported by National Natural Science Foundation (No: 50908087), supported by independent research project (No: 2011ZC17) from State Key Lab of Subtropical Building Science, South China University Of Technology and supported by the Fundamental Research Funds for the Central Universities (No: 2011ZM0075). Special thanks to all the participation of this design project.

REFERENCES

- Du, H., 2002. Study on design art of club architecture. *Huazhong Architecture*, 20: 40-44.
- Fang, X.S. and Z.Y. Song, 2012. The climate-adapted design for the hot-humid region-case study on the university library in the lingnan region. *Adv. Mater. Res.*, 433-440: 1840-1844.
- Guohua, T., 2005. Xia Changshi's sunshade and lingnan architecture heatproofness. *New Archit.*, 2005: 17-20.
- Han, X., 2010. On the mountain building. *Shanxi Constr.*, 36: 29-30.
- Lin, X., 2003. *Green Building in Hot-humid Climate*. 1st Edn., Jane's Book, Taipei, Taiwan, Pages: 148.
- Ming, L., 2003. Settlements architectural design research, introduction. Master. Thesis, Xi'an University of Architecture and Technology dissertation.
- Song, Z. and X. Fang, 2011. Harmony with site and assimilated into nature. *Proceedings of the ICMT International Conference on Multimedia Technology*, July 26-28, 2011, Hangzhou, China, pp: 3979-3982.
- Xiaoshan, F. and T. Liming, 2011. The Climate-adapted landscape design for the hot-humid region-case study on the design of tianluhu forest park entrance area. *Proceedings of the International Conference on Electric Technology and Civil Engineering*, April 22-24, 2011, Lushan, China, pp: 3618-3622.