

## Relationship between Architectural Outer Shape and Function of Buildings: Behaviour Study on Building Constructed in China

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**Abstract:** The present study attempted to investigate the behaviour of some projects designed and constructed in China during the last decades from an architectural view point and their compatibility with respect to the relationship between the outer shape and function of the building. The study includes different groups of architectural works including; Culture architecture, Education architecture, Office architecture and Hotel architecture surveying about 60 projects divided into four groups. Four types of relationship were adopted depending on score given to each building. The statistical tools also used to classify and specify accurately the relationship between the buildings and the groups. The study concluded that most of the buildings give good relationship and express the function of the building in addition to aesthetics considerations but the educational architecture give the best representation.

**Key words:** China architecture, architecture design, elevation

### INTRODUCTION

It is well known that, as a way of guiding the transition from architectural idea to built reality, an architecture designs and draws for each building a set of details that show how it will be put together and how these details will achieve the desired results? The architectures may also wonder; will the buildings that they represent go together easily and economically? Will it shed water? Will it be easy to heat and cool? Will the building grow old gracefully and will it last for the requisite period of time<sup>[1]</sup>? Other important questions are; will the building be compatible with the environment surrounded? Will the building be satisfying the aesthetics requirements? Will the out shape if the building express the function of the building in accordance with all the above?

However, the elevation and the outer shape of the building give an exceptional impression, which should collect aesthetics, economy and compatibility. Therefore, studying the relationship between buildings shape and the function of the building are required. These were tried to be investigated the shape of the building from the out side and their correlation with respect to main building function. The projects lastly design and constructed in China are of the main interest to be investigated. A total of 60 projects were

investigated including; Cultural architecture, Education architecture, Office architecture, Hotel architecture forms design and constructed in China<sup>[2]</sup>. Thus, the projects forms divided into 4 types to express compatibility of the outer shape and building function.

### MATERIALS AND METHODS

In order to investigate the behaviour of each building, four groups were adopted to express the relationship between the building's out shape and the building's function, as shown in Table 1. The elevation and outer size of the building can express the interior design by noting the interior parts of the building such as (management part, cultural part, service part, entertainments part, etc.), whereas, some building have an element in the elevation make it easy to recognize

Table 1: Group types description

Group	Description
Type A	The outer shape fully express the internal functions from 80-100%
Type B	The outer shape almost express the internal functions from 60-79%
Type C	The outer shape medially express the internal functions from 40-59%
Type D	The outer shape weakly express the internal functions from 0-39%

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Fig. 1: Elevation of (management-traditional) building<sup>[5]</sup>



Fig. 2: Church in Tokyo, cross sign outer shape



Fig. 3: Museum, art sign outer shape



Fig. 4: Office and trade building, Academic elevation

the type of building as shown in Table 2. Figure 1 shows the parts expressed in elevation. Depending on each type of structure, the relationship between the outer shape of the building and the function of the building can be judged. The sign refers to the function of the architectural work can be recognized from the outside, such as large window, corridor and balcony of the residential building, the cross of churches, as shown in Fig. 2, an art shape refers to museum, as shown in Fig. 3, may refer to special meaning related to the cultural architecture depending on social function<sup>[3]</sup> and academic elevation refers to office and trade building, as shown in Fig. 4.

Table 2: Element in elevation reflect the type of building

Element	Type of building
Minaret	Mosque
Chimney	Factory
Balcony	Residential
Big openings	Traditional-Entertainment
Small opening longitudinal and transverse	Service

The differences between each architectural work can be appeared due to the aesthetics consideration required depending on the basic idea of the designer<sup>[4]</sup>. The parameters of windows, doors, corridors, final outer shape, special elevation shape, special curvature

Table 3: Architectural works included in the study

	Group A	Group B	Group C	Group D
No.	Culture architecture	Education architecture	Office architecture	Hotel architecture
1	Wenzhou Grand theater	Concert hall of Shanghai Inst. of Music	Sun Time International Museum	Shennong hotel
2	Nanhui Cultural Arts Center	Tongji Plaza	Jiaxing News papering Center	Ruijin hotel
3	Jingde Zhen Ceramics Museum	Revolution of the 1.29 Auditorium of Tongji Univ.	Zhonghai Tower	Pudong Shangri-la Hotel, Shanghai
4	Pu'an Christian Church in Shanghai	Teaching and Laboratory of China Science and Technology Univ.	Unilever China R and D Center	Daoxing state guest hotel of Anhui Province
5	Jingganshan Revolutionary Museum	Tongji Univ. Medical College	Shanghai Tobacco Group R and D Center	Sinopec Urumqi Co. Building
6	Dongying Grand Theatre	Jiading College Phase 1 of Tongji Univ.	Jincheng Tower Nanjing	Peninsula Hotel, Shanghai
7	Hefei Grand Theatre	Teaching Complex for Nanjing Political College-Shanghai	Sunon Tower	Jingmen hotel (Quanzhou)
8	Dongguan TV and Radio Broadcast center	Xinghai Institute of Music	Qinghuangdao newspapering	Holiday Inn of Ancient well
9	Jiangxi Provincial Archives Building	Yifu Library of Anhui Univ.	Zhonghe Building	New Merry Tower
10	Cultural Center of Fangsong Community	Shanghai Univ., Engineering Technology	Lihu Technology Building	Radison Sas Lansheng Hotel, Shanghai
11	San Fernando National Modernm Performing Art's Center	Suzhou Univ. New Campus	Nanchang Customs Tower	Wujiang Hotel
12	Huizhou Museum	Teaching Complex of Beijing Central Music College	China National Petroleum Corporation	Club of Gaoxin district, Nanjing
13	Anhui Provincial Museum of Ancient Animal Fossil	Jiading Telecom College of Tongji Univ.	International Financial Tower	Sanfod Hotel Rizhao
14	Baoshan Media Center	New Campus Teaching Building of Anhui Univ.	West Mansion	Taixing International Hotel
15	Huaqiao Expo Center	Auditorium of Shanghai Univ.	Dongguan new customs tower	Sichuan Chuantou Tennis Center

shape, special art shape and special signs are all considered in decide the relationship between the building's outer shape and their function<sup>[5]</sup>.

### INVESTIGATION DATA

The architecture data used in the study are those selected from the designed and constructed projects in China. The survey includes different groups of architectural works including; Culture architecture, Education architecture, Office architecture and Hotel architecture. The architectural works included in the investigation are 60 projects divided into four groups each group contains 15 works, as shown in Table 3 and Fig. 5.

### DATA ANALYSIS

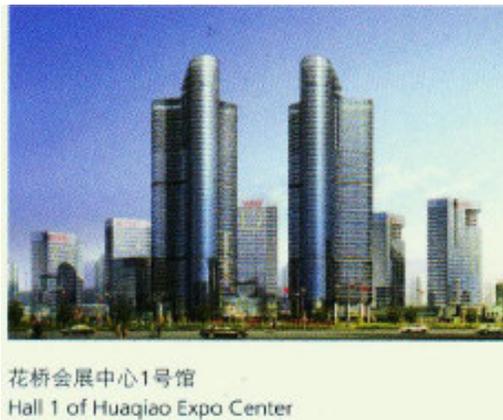
The architectural works included in the present study where analyzed considering the description cases

and grade marks specified in Table 1 for each group of building given in Table 3.

Accordingly, a score for each architectural works are given depending on the relationship between the outer shape and function of the work considering the special marks given in Table 2. The results are shown in Fig. 6. The marks given for the works are statistically analyzed using variance.

$$\sigma^2 = \frac{\sum_{i=1}^N (x_i - u)^2}{N}$$

Where, ( $\sigma^2$ ) is the Variance, which is calculated for each group separately,  $x_i$  is the grade mark for  $i^{th}$  work,  $u$  is mean value for each group,  $N$  is the number of works for each group = 15. The standard deviation of each group ( $\sigma$ ) were also calculated which is the square root of variance<sup>[6]</sup>.



(a) Group A Huaqiao Expo Center



(c) Group C West Mansion



(b) Group B Tongji University Medical College



(d) Group D Ruijin Hotel

Fig. 5: Selected works from those included in the study

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - u)^2}{N}}$$

The results are shown in Table 4.

### DISCUSSION

Using the marks to define the relationship between the building shape and function facilitate the possibility to understand the nature of each group of building in the studied society, in the present study are the building constructed in China. The results show that; depending on the means calculation of each group the Group A is laid in the range of Type B, Group B lied in the range of Type A, Group C lied in the range of Type B and finally Group D lied in the range of Type B.

Table 4: Statistical results

Group	Average	Variance	Standard deviation
A	77.1	116.5	10.79
B	80.0	107.0	10.34
C	75.87	157.3	12.54
D	69.5	151.5	12.30

These results may be due to the fact that the educational building contains less variability required in shape to express the internal function comparing with the topics required for the other types of buildings such as cultural, office and hotel. Although, the results can be used to judge the type of group, but the group itself contains differences between works. The results of statistical analysis show that group B give the largest variation between the works followed by group A. Lesser variation are found in group D.

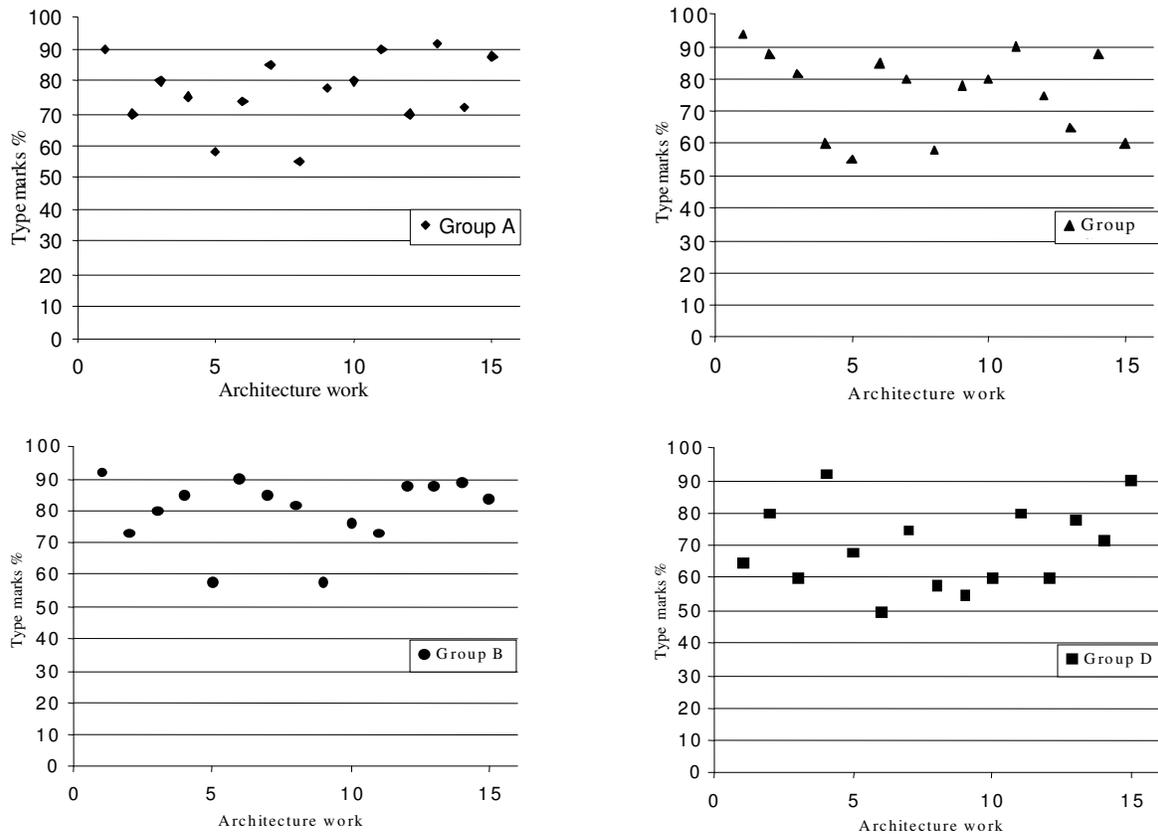


Fig. 6: Grade marks of the architecture data groups

**CONCLUSION**

Depending on the above results, several conclusions can be stated as:

- The first group represents the cultural architecture, the third group represents the office architecture and the fourth group represent the hotel architecture are almost express the internal function of the building.
- The second group represent the education architecture is fully expressed the internal function of the building.
- No one of the groups studied show medially or weakly expression related to the internal function.
- The group B gives the largest variation between the works while Lesser variation is found in group D.

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