SITE PLANNING AND BOUNDARY IN SCHOOL CAMPUS

—A study on the planning of elementary schools in Nan-Tou county
of Taiwan Rebuilt after Ji-Ji earthquake No. 1—

校舎の配置計画と敷地境界

—台湾南投県のジジ地震後に再建された小学校計画に関する研究 その1—

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This paper will focus mainly on campus reconstruction after the 1999 Ji-Ji earthquake¹⁾ in Taiwan, through document analysis and field research. 54 reconstructed elementary schools in Nan-Tou County (City) were selected for this research (New Campus²⁾). The reconstruction planning is analyzed from the planners' point of view. Literature analysis and field study methods were used to discuss the planning of the schoolyards, buildings and campus outdoor spaces. The research will be discussed in several articles. This particular article will directly focus on the classification of campus planning. This article is summarized in the following 3 points:

1) Some schools should have more building area³⁾ on each campus. Some of the schools are under the standard area⁴⁾ and tend to have a site area⁵⁾ too large in proportion to the size of school. There are also schools that do not meet the standard total floor area⁶⁾ per student, meaning that each student does not have enough space.

2) Campus arrangement of these schools can be categorized into 5 different types. Collinear and atrium types are traditional arrangements, while deploy, series, and centrocinal are newer arrangements. The majority of the schools are still traditionally arranged, but there are also a significant number of schools with the more innovative arrangements.

3) Some of these reconstructed schools are influenced by the concept of opening schools to the community. However, these schools tend to be located in country or mountain areas. Although some schools were constructed with low hedge walls or an opened gate, more schools, especially those in urban areas, still use an enclosure wall with closable gate for safety and protection reasons.

Keywords: Ji-Ji earthquakes, Campus Reconstruction, Space Planning, Open school and Elementary School

ジジ地震、校園再建、配置計画、開放空間や小学校

1. Introduction

1-1. Research background and purpose

The 1999 Ji-Ji earthquake was the largest earthquake in Taiwan in the last 100 years, destroying many housing, office, public and school buildings. In order to prevent heavy losses in the education system from the Ji-Ji earthquake, the Government of Taiwan gave first priority to the reconstruction of school buildings. The Ministry of Education in Taiwan held the "Ji-Ji Earthquake Junior High School and Elementary School Reconstruction Conference" in 1999, right after the earthquake. In this meeting new ideas for the reconstruction, such as open schools, were discussed and adopted. As a result, there are many differences in the planning between post and pre-earthquake schools. Previous research on this subject shows that these differences stem mainly from the open concept from Japan⁷⁾.

When the Government of Taiwan launched the large-scale school planning and construction program, it pioneered the movement away from traditional school planning in Taiwan. This study is an in-depth examination of these post-earthquake reconstructed schools, drawing points of comparison between them and traditional pre-earthquake schools. This is done in order to understand the differences in school planning and the adoption of the open concept from Japan. The purpose of this paper is to gain insight into the space planning of the school yard in order to establish a foundation on which the concepts of classroom space, in the following paper, can be compared to. To do this, three main points will be discussed: 1) The relationship between building area, site area, total floor area, and the size of school. 2) Site planning. 3) Site area boundary.

1-2. Research scope and subjects

According to the report "Elementary and Junior High School Reconstruction" published by the Ministry of Education after the Ji-Ji earthquake in July 2001, 293 schools needed to be rebuilt. About 75.0% (220/293 schools) of them were elementary schools. And among them, 50.0% (110/220 schools) of them were located in Nan-Tou County, shown in Table 1.

The damaged elementary schools in Nan-Tou county were divided into 4 levels according to the extent of damage. Which were: 1) all buildings to be rebuilt. 2) more than one building to be rebuilt. 3) part of the building to be rebuilt. 4) repair without rebuilding. 56 schools belong to the first level which account for

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51.0% (56/110 school). In this research, 54 of them were chosen as subjects of case studies, not including Fa-Xiang elementary school and Xien-hanshan elementary school, because the construction of these 2 schools were not completed yet when the earthquake occurred. Table 2 and Fig 1 show the details of the elementary schools which needed to be rebuilt in Nan-Tou county.

Table1 : The number of schools which needed to be rebuilt at Ji-Ji earthquake in each county

unit: school

County	Elementary school					Junior high school					high school					kindergarten					Total
	A	B	C	D	Total	A	B	C	D	Total	A	B	C	D	Total	A	B	C	D	Total	
Taipei	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tao-Yuan	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Miao-Li	2	0	3	10	15	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	16
Tai-Zhong	7	0	18	16	41	2	0	7	6	15	2	0	0	1	3	1	0	1	0	2	61
Nan-Tou	14	0	45	51	110	6	0	14	7	27	5	0	0	1	6	0	0	0	0	0	143
Zhang-Hua	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Yun-Lin	0	2	6	1	9	0	4	1	0	5	0	0	0	0	0	0	0	0	0	0	14
Jia-Yi	0	6	11	21	38	0	5	2	4	11	0	1	0	0	1	0	0	0	0	0	50
Tainan	0	2	0	1	3	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	5
Total	23	10	83	104	220	8	11	24	18	61	7	1	0	2	10	1	0	1	0	2	293

Remarks : The schools were classified into 4 group according to the organization charged of the school rebuilding (A) Construction and Agency, Ministry of Interior (B) Ya-Xing engineering adviser company. (C) Local government and the founder of school (D) Private-sector industry. Source of data : the ministry of education Data results of the study

Table2 : The elementary schools which needed to be rebuilt in Nan-Tou Country

unit: school(%)

Condition		Area		Nan-Tou County	
all buildings needed to be rebuilt	study case		54(49.1)	56 (51.0)	
	Delete case		2(1.9)		
more than one building needed to be rebuilt				38 (34.5)	
circumjacent facilities needed to be rebuilt				16 (14.5)	
Repair without rebuilding				--	
Total				110 (100)	

Source of data : Nan-Tou County

Data results of the study

2. Method

In this research, the school planning was analyzed by reviewing related documents and the field surveys conducted on the site. The process was as follows:

1) Understanding the background and motivations of school planning: Information was gathered through literature analysis the background information on the effect of the Ji-Ji earthquake on school buildings and the Government of Taiwan's plans for reconstruction of these schools. This information was then used to narrow down and decide the objective, research scope, and the research subjects of this study.

2) Collection of the initial data and case analysis from the documents and the field surveys: After deciding on the 54 schools as the research subjects, more specific information was gathered about each of these schools, such as the location, topography and area of the schoolyard; as well as the population and any special characteristics of the school.

3) Execution of the field survey: A visit was made to each of the 54 schools, where maps of the school were obtained. Photographs were taken of both the interior and exterior of the schools. Finally, interviews were conducted with some of the members of the school staff concerning their thoughts and opinions on the space arrangement of their school.

4) Case classification and analysis: The analysis and discussion of the data gathered in this study will be done in two parts. The first part is to obtain a general understanding of the current arrangements of each school. The second part is specifically on classrooms. This paper deals mainly with the first part, in which there are 3 main focuses: (1) Classifying the type of space utilization in school campus and layout of buildings. (2) Site planning. (3) Schoolyard's boundary.

5) Conclusions of the school planning: From the analyzed data, a conclusion is drawn about the differences in the planning of the campus between traditional schools and the reconstructed schools.

3. Site area utilization

From the data gathered in this investigation, it was discovered that the ratio of building area to site area for most schools is different from the standard level stipulated by the Ministry of Education. This variation questions whether students have sufficient space. The answer can be found through the analysis of the building area and site area. Furthermore, the analysis of this data will lead to a deeper understanding of the current circumstances in community population, school size, and the building and site areas of these schools.

3-1. The ratio of building area to site area

In communities with smaller populations the schools tend to be built on a small scale. On the other hand, communities with larger populations tend to have large-scale schools. This shows that the scale of a school is directly proportional to the size of the communities in which it is located. Table 3 shows that all 54 schools were located in communities with a population over 10,000. The majority of these schools, 59.3% (32/54 schools), were located in communities with a population between 10,000 and 50,000. Furthermore, minimum scaled schools (6 classes) also stood the in majority, 53.7% (29/54 schools).

Table 4 shows the site area in terms of school size. The majority, 25.5% (17/54 schools), of the schools had a site area of 20,000 m² ~30,000 m². Out of the 29 minimum scaled schools, the majority, 44.8% (13/29 schools) had a site area between 3,000 m² to 10,000 m².

New campus include : Nan-Tou have 9 Counties (Zhong-Liao, Shui-Li, Xin-Yi, Cao-Tun, Guo-Xing, Lu-Gu, Ren-Ai, Yun-Chi, Ming-Jian) 3 village (Ji-Ji, Zhus-Han, Pu-Li) and Nan-Tou city

Fig1: New Campus Seat

Table 5 shows that 88.9% (48/54 schools) of the schools did not meet the standard building area to site area ratio of 30%, as stipulated by the Ministry of Education. Of these schools, 42.6% (23/54 schools) had a building area to site area ratio of only 10%. This leads to the question of whether these statistics show only a technical problem of variation between building and site area, or a lack of sufficient individual space for each student. Hence it was necessary to further analyze the site and building areas separately in relation to the size and population of the schools.

Table3: Community population and Classes condition of New campus

Population Class	Less than 10,000	10,000 to 50,000	50,000 to 100,000	More than 100,000	Total
6	—	13(24.1)	4(7.4)	1(1.9)	29(53.7)
7~12	—	5(9.3)	3(5.6)	1(1.9)	9(16.7)
13~24	—	4(7.4)	3(5.6)	—	8(14.8)
25~36	—	—	3(5.6)	—	3(5.6)
37~48	—	—	2(3.7)	—	2(3.7)
48 over	—	—	2(3.7)	1(1.9)	3(5.6)
Total	—	32(59.3)	17(31.5)	4(7.4)	54(100.0)

Table4: Site area and Class number of New campus

Site area (m ²) Class	3,000~10,000	10,000~near 20,000	20,000~near 30,000	Over 30,000	Total
6	13(44.8)	10(34.5)	6(20.7)	—	29 (100.0)
7~12	2(22.2)	3(33.3)	4(44.5)	—	9 (100.0)
13~24	—	3(37.5)	4(50.0)	1(12.5)	8 (100.0)
25~36	—	—	3(100.0)	—	3 (100.0)
37~48	—	1(50.0)	—	1(50.0)	2 (100.0)
48 over	—	—	1(25.0)	2(75.0)	3 (100.0)
Total	15(27.8)	17(31.5)	18(33.3)	4(7.4)	54(100.0)

Table5: The ratio of school building area to site area

Schoolyard scale (m ²) The ratio of school building	3,000~10,000	10,000~near 20,000	20,000~near 30,000	over 30,000	Total
Under 10%	1(6.7)	2(11.8)	4(22.2)	1(25.0)	8(14.8)
10%	3(20.0)	8(47.1)	11(61.1)	1(25.0)	23(42.6)
20%	7(46.6)	5(29.4)	3(16.7)	2(50.0)	17(25.5)
30% (standard)	1(6.7)	1(5.9)	—	—	2(3.7)
Over 30%	3(20.0)	1(5.9)	—	—	4(7.4)
Total	15(100.0)	17(100.0)	18(100.0)	4(100.0)	54(100.0)

3-2. The relationship between site area and the size of school

The majority, 63% (34/54 school), of the schools had a student population between 36 and 210. Table 6 shows that among these 34 schools, most of them, 32.5% (11/34 schools) has 88.03 m² to 146.70 m² of site area per student. According to the school planning standard regulated by Nan-Tou county, the minimum site area per student should be 10.67~14.67 m². Thus, all of the 54 schools met this standard, meaning that there are no problems with insufficient space for each student in terms of site area. However, aside from the two schools that are right on the standard, the rest of the schools were able to give their students more than the required amount of site area. Among them, schools with a site area of 29.34 ~44.01 m² and 88.03~ 146.07 m² were prominent, each representing 22.2% (12/54 schools) of all the schools. The two schools that are right on standard level were both large-scale schools. Furthermore, they were both schools that did not meet the standard building area to site area standard level of 30%. Therefore, it can be inferred that the reason these two schools did not meet the standard is a lack in the school building area.

Table6: Schoolyard area per student

Site area (m ² / student) No. of students	10.67under	10.67~14.67m ² (standard)	14.68~29.33	29.34~44.01	44.02~58.68	58.69~73.35	73.36~88.02	88.03~146.7	146.8~234.7 2	234.73~308.07	308.08 over	Total
under 35	—	—	—	—	—	—	—	—	—	—	—	—
36~210	—	—	1(2.9)	3(8.8)	3(8.8)	1(2.9)	5(14.8)	11(32.5)	6(17.6)	1(2.9)	3(8.8)	34(100.0)
211~420	—	—	—	1(16.7)	1(16.7)	2(33.2)	1(16.7)	1(16.7)	—	—	—	6(100.0)
421~525	—	—	—	1(100.0)	—	—	—	—	—	—	—	1(100.0)
526~840	—	—	—	6(85.7)	—	1(14.3)	—	—	—	—	—	7(100.0)
841~1050	—	—	1(100.0)	—	—	—	—	—	—	—	—	1(100.0)
1051~1260	—	—	—	—	—	—	—	—	—	—	—	—
1261~1470	—	—	—	1(100.0)	—	—	—	—	—	—	—	1(100.0)
1471~1680	—	—	—	—	—	—	—	—	—	—	—	—
1681over	—	2(50.0)	2(50.0)	—	—	—	—	—	—	—	—	4(100.0)
Total	—	2(3.7)	4(7.4)	12(22.2)	4(7.4)	4(7.4)	6(11.1)	12(22.2)	6(11.1)	1(1.9)	3(5.6)	54(100.0)

3-3. The relationship between total floor area and size of school

According to "The planning Guideline of Reconstruction of Elementary Schools" published by the Ministry of Education, total floor area per student cannot be less than 10 m². Table 7 shows that 90.7% (49/54) of the schools had reached this level, the majority with 10 to 19 m² per student, which accounted for 31.5% (17/54 schools). On the other hand, 9.3% (5/54) of the schools did not reach this level, most of which were schools with more than 1681 students. This shows that some large-scaled schools did not have enough total floor area per student. Therefore, these schools should consider increasing their total floor area through expansion of the school building.

Table7: The total floor area per student and size of school

area (m ² /student) No. of students	Under 10 m ² (under standard)	10 ~19 m ²	20 ~29 m ²	30 ~39 m ²	40 ~49 m ²	50 m ²	Total
35under	—	—	—	—	—	—	—
36~210	—	5(14.7)	11(32.4)	10(29.4)	4(11.8)	4(11.8)	34(100.0)
211~420	1(16.7)	2(33.3)	3(8.8)	—	—	—	6(100.0)
421~525	—	1(100.0)	—	—	—	—	1(100.0)
526~840	—	7(100.0)	—	—	—	—	7(100.0)
841~1050	—	1(100.0)	—	—	—	—	1(100.0)
1051~1260	—	—	—	—	—	—	—
1261~1470	—	1(100.0)	—	—	—	—	1(100.0)
1471~1680	—	—	—	—	—	—	—
1681over	4(100.0)	—	—	—	—	—	4(100.0)
Total	5(9.3)	17(31.5)	14(25.9)	10(18.5)	4(7.4)	4(7.4)	54(100.0)

Data results of the study

4. Site planning

Upon investigation of the site planning of these 54 reconstructed elementary schools, the campus arrangement of two schools were discovered to be drastically different from traditional school campus arrangement in Taiwan. Thus, the site planning of these two schools will be further analyzed and discussed in this paper.

In addition to the two schools mentioned above, three schools (Zhi-Cheng, Nan-Gang, and Guang-Ying) were also discovered to have no running track. This characteristic is also unique as most school campuses consist of the school building(s) and a running track. These three schools were all small-scale schools with six classes located in a mountain area.

4-1. The campus arrangement of two schools

Elementary School	Site planning characteristic	Principle
Tan-Nan	This school is located in a mountain area. From 1994 to 1999, it has had an average student population of 86 people. Although the schoolyard area is limited 3270.57m ² , it still meets the standard ratio per student for both building and site areas. The two-story school building is surrounded by a running track, something that did not exist in past school site planning, where the running track was always in a separate area, away from the school buildings. Fig2	Fig2
Min-He	Also located in a mountain area, this school had an average student population of 80 people between 1994 and 1999. Each of the grades 1 to 6 classrooms in this one-story school are separate, stand-alone structures with no interior corridor to link between them. In order to access between the classrooms, students have to go outside. This idea is also nonexistent in previous school site planning, where all classrooms are linked with an interior corridor. The running track of this school is also unlike that of many schools. Instead of being an oval shape, because of the limited site area, the running track is straight. Fig3	Fig3

Data results of the study

4-2. Planning space of school buildings

The site planning for Taiwanese schools before the 1950s have all included a rectangular two-story building with long narrow interior corridors that link all the classrooms together. Because of the rise in student population, it became necessary to expand the school building area. Instead of building more floors, expansion was achieved by adding onto the ends of the original school building to create Π-shaped or □-shaped schools. These styles of schools remained even after the 1950s. However, analyzing the site planning of these 54 reconstructed schools revealed that schools exist in other shapes different from the traditional Π-shape and □-shape. Including these two traditional ones, the arrangement of all 54 schools could be classified into 5 different types.

(i) collinear-type: the main space of school building was built in collinear way and mostly in — type or L-type. Classrooms are lined up in a row with a long narrow veranda-like corridor to link between them (Fig4)	Fig4 Yu-Feng Elementary School	37.1% (20/54 schools) Majority of the schools.	(ii) atrium-type: the most obvious feature is it is in Π or □ shape creating an atrium in the center. Classrooms are also lined up in a row with a long narrow veranda-like corridor to link between them. (Fig 5)	Fig5 Zhi-Cheng Elementary School	24.0% (13/54 schools)
(iii) deploy-type: classrooms are allotted to different buildings and these buildings are dispersed respectively according to subject and specialization. Most buildings are connected by exterior pavement and walkways. (Fig 6).	Fig6 Pu-Li Elementary School	3.0% (7/54 schools)	(iv) series-type: similar to the deploy-type, but buildings are connected together by roof-protected corridors, porches, or passageway. (Fig7).	Fig7 Tu-Cheng Elementary School	14.0% (13/54 schools)

<p>(v) centrocinal-type: Also similar to the deploy-type, except the classrooms are all individual structures constructed centripetally facing a main building, either for special courses or administration. (Fig8).</p>	<p>Fig8 Min-He Elementary School</p>	<p>1.9% (1/54 schools)</p>	<p>Out of these 5 different types, the collinear and atrium types can be considered traditional school structures dating back to the 1950s. Contrastingly, the deploy, series, and centrocinal types can be considered to be new, innovative school structures. Table 8 shows that the collinear and atrium types make up 61.1% (33/54 schools) of the schools, indicating that most schools are still structured in a traditional fashion. However, the other significant 38.9% (21/54 schools) consisting of the three more innovative types indicates that there is definitely change in school site planning. Comparison between the traditional and more innovative styled schools show that classrooms and buildings of the innovative schools are grouped more specifically according to function or subject, which allows for clearer and better understanding of the different areas of the school. Further examination of the classrooms will reveal that in the more innovative styled schools, classrooms and buildings are arranged to create more equal walking distance in between them. On the other hand, in consideration of Taiwan's humid and wet climate, the deploy and centrocinal types are less efficient than the other three types because they do not have roof-protected walkways between classrooms and buildings.</p>
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Table 8:Space planning of school buildings

unit: schools(%)

Classes	6	7~12	13~24	25~36	37~48	48over	Total	
Type								
Continuous linear-type	17(31.6)	3(5.5)	--	--	--	--	20(37.1)	33(61.1)
Atrium-type	8(14.8)	2(3.7)	3(5.5)	--	--	--	13(24.0)	
Dispersed-type	2(3.7)	--	1(1.9)	2(3.7)	1(1.9)	1(1.9)	7(13.0)	21(38.9)
Series - type	1(1.9)	4(7.4)	4(7.4)	1(1.9)	1(1.9)	2(3.7)	13(14.0)	
Centripetal -type	1(1.9)	--	--	--	--	--	1(1.9)	
Total	29(53.7)	9(16.7)	8(14.8)	3(5.6)	2(3.7)	3(5.6)	54(100.0)	

Data results of the study

5. Site area boundary

The elementary schools of the past in Taiwan were built with a solid concrete wall 1.5m or higher. However, some of the campuses reconstructed after the earthquake are different in that they may not have a wall, a gate, or neither wall nor gate. Some of the schools also have very low walls, such as hedge walls. This is the result of influence from the open concept from Japan because it favors a more open and direct connection between school and community. The analysis of the wall and gate will first be done separately and then put together in order to make a conclusion.

5-1 School boundary

Although "The Planning Guideline of Reconstruction of Elementary Schools" published by the Ministry of Education 1999 strongly recommended the use of a hedge wall as the school boundary, it is not common. According to the survey, the types of school boundaries could be divided into 3 types according to their height:

- 1) The enclosure wall, 1.5m or higher.
- 2) The banisters (a low wall), between 1~1.2m.
- 3) The hedge wall, 1m or lower.

1.5m and higher

Fig9-1 : enclosure wall

Pic1 : Zhong-Zhou elementary school

Pic2 : Ji-Ji elementary school.

Pic3: Bei-Gang elementary school

1.5m and higher

Fig 9-2 : enclosure wall

Pic4: Dong-Guang elementary school

Pic5 : Guan-Gfu elementary school

Pic6 : Yu-Chi elementary school

1.0m-1.2m

Fig 10: banisters (a low wall)

Pic7 : Rui-Tian elementary school

Pic8 : Gun-Keng elementary school

Pic9 : Gan-Feng elementary school

Fig 11: hedge wall

Pic10 : Shui-Wei elementary school

Pic11 : Ren-He elementary school

Pic12 : Nan-Gang elementary school

While conducting this study, it was discovered that there were 2 main types of enclosure walls: iron bars set into a concrete frame (Fig9-1), or a criss-cross network of iron wire set into a steel frame (Fig9-2). On the other hand, the majority of banister type boundaries were made with wooden materials (Fig9-3) and most hedge walls are brick walls with plants grown on top of it (Fig9-4). Through this survey, it was discovered that not all the schools used only one kind of wall; rather, a significant number of schools used a combination of two different types. According to Table9, 66.7% (36/54 schools) of schools used only one kind of outer wall. Among them, enclosure wall was mostly used: 44.4% (24/54 schools). 33.3% (18/54 schools) of the schools used more than one kind of outer wall. Among these, enclosure and banisters (a low wall) were mostly used. About 13.0% (7/54 schools) of schools used a combination of enclosure and hedge walls. Results show that small-scale schools (6 classes) tend to have more variation in type of school boundary. However, enclosure and hedge walls were most widely used; each represented 24.1% (7/29schools). Out of all the different types of walls, enclosure is to be the most common as it appears in schools of all sizes.

Table9 : The area of schoolyard that each student of new campus

Classes	Just one kind of the way of schoolyard's boundary			More than one kind of The way of schoolyard's boundary			unit school(%)
	enclosure	banisters(a low wall)	hedge	enclosure + banisters	enclosure +hedge	banisters +hedge	
6	7(24.1)	3(10.3)	7(24.1)	4(13.8)	5(17.2)	3(10.3)	29(100.0)
7~12	4(44.4)	--	1(11.1)	--	2(22.2)	2(22.2)	9(100.0)
13~24	6(75.0)	1(12.5)	--	1(12.5)	--	--	8(100.0)
25~36	3(100.0)	--	--	--	--	--	3(100.0)
37~48	2(100.0)	--	--	--	--	--	2(100.0)
48over	2(75.0)	--	--	1(25.0)	--	--	3(100.0)
Total	24(44.4)	4(7.4)	8(14.8)	6(11.1)	7(13.0)	5(9.3)	54(100.0)
	36(66.7)			18(33.3)			

Data results of the study

5-2 Gate planning

The way of gate planning can be divided into two:

Fig12: Closable gate

Pic13 : Shui-Li elementary school

Pic14 : She-Liao elementary school

Pic15 : Ji-Ji elementary school

Yu-Le elementary school

Nan-Gang elementary school

Gua-Ngying elementary school

Pic17: Opened gate.(gate without traditional door)

According to Table 10, an enclosure wall, which accounted for 44.4% (24/54schools), are strongly related to the presence of a closable gate. Similarly, presence of a hedge wall is directly proportional to the presence of an open gate. Therefore, the higher, and more closed the wall is, the more closed the gate is likely to be. On the other hand, the lower and more open the wall is the more open the gate is likely to be. Among 38 schools with a closable gate, 21 (55.3%) of them used an enclosure wall as schoolyard boundary, and 8 of 21 schools had a reception office beside the school gate. These 10 schools with a closable gate, an enclosure wall and a reception office might be the strictest in school safety and protection. However, this also means that the school is completely segregated from the surrounding community, which prevents people from being able to see the school grounds and facilities without special permission. Among the 15 schools with an open gate, 33.3% (5/15 schools) had a hedge wall, and 20.0% (3/15 schools) had a combination of banister and hedge walls. Schools with a low hedge or banister and hedge combination wall and an opened gate allows more direct contact and interaction, physical or visual, between the school and the public, but results in a decrease in school safety and protection. According to the survey, even some schools with hedge walls had a closable gate. Taking the construction materials of the boundary into account, however, it can be seen that even many schools with a tall enclosure wall, through the use of iron bars or wire fences, still allow people to look into the school campus. Therefore, compared to traditional schools surrounded by tall and solid concrete walls closing it off to the eyes of the public, these schools still exhibit features influenced by the open concept.

Table10: The school of gate and As for the way of schoolyard's boundary of new campus

unit: school(%) [include reception office]

Form	The way enclosure	Banisters(a low wall)	hedge	enclosure + banisters	enclosure +hedge	banisters +hedge	Total
Closable gate	21 [8] (55.3)	4 [1] (10.5)	3(7.9)	5 [1] (13.2)	4 [1] (10.5)	2(5.3)	38(100.0)
Opened gate	3(20.0)	--	5(33.3)	1(6.7)	3(20.0)	3(20.0)	15(100.0)
Total	24(44.4)	4(7.4)	8(14.8)	6(11.1)	7(13.0)	5(9.3)	54(100.0)

Data results of the study

6 Discussion

The reconstructed schools after the Taiwan earthquake were completed under the influence of the idea of open education. No matter from which angle these schools are studied, site planning or site boundary, these schools show some areas of differences from the traditional schools built before the earthquake. The investigation and analysis done in this paper reveal that the change in educational instruction influences the planning of the space arrangement of school campuses. This data will form a basis for future research. On the other hand, the effect of the differences in space arrangement in classrooms on the quality of educational instruction remains a topic unanswered, requiring further research and investigation. The outcome of this article could be concluded to the three main points as follows:

1) About the type of space utilization in school campus and layout of buildings, we found that 88.9% of new schools in Nan-Tou country did not reach the standard level. Of these schools, two can be considered lacking in school building area while the others have more than the required amount of schoolyard area per student. We found that 9.3% of schools were under standard level for the total floor area per student, and most of them tend to be larger schools with more than 1681 students. The easiest and most economical solution to this problem is to decrease the number of students admitted into the school each year, thereby decreasing the student population, giving each student more individual space. If economically and legally possible, these schools can also consider increasing the total floor area through the expansion of the school building(s), either horizontally by adding new wings to the school building or vertically by adding more stories.

2) The site planning and building arrangement of school campuses can be classified into 5 general types: collinear, atrium, deploy, series and centrocinal types. Out of these 5 different types, the collinear and atrium types are considered to be traditional arrangements while the deploy, series and centrocinal types are newer arrangements. From the statistics gathered in this investigation, it can be seen that while the majority of schools are still constructed and arranged in a traditional fashion, there is also a significant number of schools that use new arrangements. These new arrangements have many good features such as emphasizing the grouping of classrooms and buildings according to function and subject, making it easier for students and teachers to understand the layout of the school. Also, these schools are arranged to create approximately equal walking distances, allowing better and more efficient access to classrooms and buildings. However, the deploy and centrocinal arrangements are inefficient in terms of Taiwan's climate because they do not have roof-protected walkways. Taking this into consideration, factors like climate should be considered more carefully in future school planning.

3) About schoolyard boundary design, it was getting popular to have open boundary with open gate in new schools, according to the concept of opening the school to the community. But these schools tend to be located in country or mountain areas. More schools still use enclosure wall with a closable gate for security reasons, especially schools in urban areas. Despite the continuing usage of a tall enclosure wall, instead of using solid concrete, many schools use iron bar set in concrete or criss-cross fences, which allow the public to see into the school campus. These new walls are excellent combinations of two important ideas: I) the open concept idea which encourages more interaction between school and community & II) the high level of security provided by the presence of a tall wall. Contrastingly, although schools with low walls also allow the public to see into the school campus, more consideration should be put into safety and protection. These ideas should be all be considered carefully in future school planning.

One purpose of this paper is to reach a deeper understanding of the campus arrangement of the reconstructed schools completed after the Ji-Ji earthquake and how they differ from the traditional arrangement of schools constructed before the earthquake. To achieve this purpose, the ratio between school building area and schoolyard area in section 3 and the differences in site planning in section 4 are discussed. Furthermore, through the discussion in section 5, it can already be seen that some of these differences are created or influenced by the idea of open education from Japan. However, more information and deeper discussion of this relationship between open education and the differences between pre and post earthquake schools will be done in a future paper about the arrangement of classrooms of these kinds of schools.

NOTES

- 1) Ji-Ji earthquake: The Taiwan Ji-Ji earthquake occurred at 1:47am on Sep. 9th, 1999. It is the largest earthquake in the past 100 years.
- 2) New Campus: The reconstruction of 54 elementary schools after Ji-Ji earthquake in Nan-Tou of Taiwan.
- 3) Building area: "Building foot print" in other word. The sum of all the areas of vertical projection from furthest points, in all directions, of the school building(s).
- 4) Standard area: According to the standard device datum in the national middle and primary schools of Ministry of Education of 1994 in Taiwan, the school building area should be 3/10 (30%) of the site area
- 5) Site area: The total area of the campus, including the building area.
- 6) Total floor area: The sum of the areas of all the floors of the school buildings.
- 7) Open concept from Japan: It is clear that new ideas in school planning come from Japan. For example, low (under 1M) walls as the school's boundary, the absence of a fixed closable gate, and the presence of various different areas in the classroom designed for furthest points in all directions of the school building special activities or learning.

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和文要約

本研究は台湾南投県のジジ地震後に再建された小学校計画に関するものである。1999年の9月21日に台湾で大地震が発生し、倒壊した学校校舎を短期間で再建することが国の課題となったが、この計画を行う際に開放式教育理念の導入やキャンパス空間計画の新しい設計手法が採用され、単なる建替ではない新たな学校計画の契機となったという点で非常に注目された。今回調査した多くの小学校は台湾において短期間で同時に行われる大規模なキャンパス計画によって生みだされたものである。本研究はこれらの新しい学校計画を分析・考察することによってその問題点や課題を浮かび上がらせるとともに、今後の台湾の学校建築の計画指針を得ることを目的としている。再建された学校は総計293校であり、その中の220校は小学校、更にその中の110校は南投県に位置している。またその中で56の小学校は校舎が全壊しており、その内の建替対象となった54の小学校が本研究の調査対象である。本報はその1として校舎の配置計画と敷地境界の構成に注目して分析・考察を行ったものである。研究の考察は以下の3点にまとめた。

1) 校舎と敷地利用に関して、調査校の88.9%が敷地面積に対する校舎面積の割合が基準に達していないことが分かった。また児童一人当たりの校舎面積は、調査校の9.3%が基準に達していないことがわかった。このケースは1681人以上の児童数を持つ大規模学校に見られる。この問題に対処するには学校で児童数を少なくし児童一人当たりのスペースを増やすのが簡単な方法であるが、できれば法的・経済的に可能な範囲で学校の校舎面積を増やし、児童の一人

当たりの面積やパーソナルスペースを増やすべきであろう。

2) 地震後再建された54ヶ所の学校における校舎配置タイプを明らかにした。一般教室や特別教室などの配置に注目して、調査対象の学校施設を全部で5つの校舎配置タイプ、1)線型連続式 2)中庭式 3)分散式 4)繋ぎ式 5)集中式に分類した。台湾において、50年代以前の学校計画でよく採用された形式は、片側廊下の細長い校舎を複層に積み上げるタイプであった。その後増築などで空間配置はコの字型・口の字型に拡張していった。調査校では、往来からある一般的なタイプに加えて、新しい配置形態が登場していることが明らかになった。学校再建と新しい教育理念とが結びつき、多様で豊かな空間形態が生み出されたと言える。特に新しいタイプである繋ぎ式や集中式の校舎では、全ての教室から等しい距離で学校内のさまざまな場所にアクセスすることができる。

3) 新しい学校の敷地境界のデザインは、近年の学校を地域に開いていくコンセプトに沿って、開放的なものが採用されるようになってきた。ただこれらは山間部に位置するものが多く、市街地は安全のためにまだ閉鎖的な塀や門を採用する傾向が見られる。しかしその場合でも高い塀でもコンクリート製ではなく、金網など学校の敷地内部を見渡せるものも増え、地域と学校との（視覚的な）つながりは増している。今後の学校計画では、安全を確保しながらも、学校開放のコンセプトに沿って学校と地域の視覚的な関係を築いていくことが重要である。

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