Investigation and Analysis of Transportation Planning and Design of Shanghai Maritime University

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Abstract: With the continuous expansion of the scale of China's colleges and universities and the increasing number of motor vehicles, campus traffic problems are becoming more and more serious. How to balance the four elements of human, vehicle, road and environment is an important content of campus traffic planning. Taking Shanghai Maritime University as an example, this paper analyzes the existing major traffic problems on campus by investigating the layout of campus roads, traffic flow at major intersections, the distribution of traffic signs and the distribution and quantity of parking spaces on campus, and puts forward the strategies for optimizing the campus traffic system.

1. Introduction
Since the 1920s, with the continuous development of the educational system and teaching methods of colleges and universities, higher requirements have been put forward for the campus construction work of colleges and universities, which has also brought challenges to the campus traffic planning and design work. At the same time, along with the rapid increase in the scale of motorized transportation and the expansion of campus opening, huge changes have taken place in campus transportation. The problems of road congestion, environmental pollution, traffic safety, and vehicle parking in colleges, restrict the efficient connection between various functional areas on campus and between various buildings, and affect the further development of Chinese colleges and universities.

As one of the five colleges and universities in the Pudong Lingang New Area, Shanghai Maritime University has a certain degree of representativeness in the Lingang New Area. This article takes Shanghai Maritime University as an example to study and analyze its transportation system, and find its shortcomings, hoping to provide some useful thinking on the construction of the new campus of the university.

2. Current Traffic Status and Existing Problems of Shanghai Maritime University

2.1. Basic situation
The new campus of Shanghai Maritime University is located in the southwest corner of Lingang New City. The planned construction area of the campus is 1.333 million square meters, which is about 2000 acres, and the total construction area is about 600,000 square meters. The entire campus will be divided into different areas: secondary college area, public teaching area, living area, sports center area, supporting function auxiliary area. According to the strategic development plan of Shanghai Maritime University, the final scale of development is that the number of students in the school reaches and stabilizes at about 20,000. However, with the massive expansion of the number of graduate students in the past two years, the current number has exceeded the original number. There are more than 26,900
students, including more than 16,000 undergraduates, more than 7,200 postgraduates of various types, and nearly 600 international students[1]. In addition, the distance between the teaching area and the student dormitory has caused the number of bicycles and electric vehicles in our school to increase significantly, resulting in the problems of random parking and difficulty in parking. This requires planning and building a reasonable road network and the number of them is appropriate. Parking area for non-motor vehicles. Due to the continuous expansion of our school, the land is relatively concentrated, showing a phenomenon of large dispersion and small concentration. If the school's response measures are insufficient, it will cause the problems of transportation to continue to expand. Therefore, we should follow the people-oriented and sustainable development concept and quickly make a reasonable campus transportation plan.

2.2. Road system analysis

The internal road network of Haida campus is in the shape of "ring + grid", which is convenient for the organization of motor vehicle traffic. However, the road section design is mainly based on vehicles, using urban road templates, and there is insufficient walking space [2]. The roads on the campus of Shanghai Maritime University are divided into four levels: main roads, secondary roads, branch roads, and footpaths. However, the classification is vague and the walking roads are not continuous, resulting in poor accessibility. Table 1 shows the road comparison between the Lingang campus of Shanghai Maritime University and the other three universities.

| School Name                | School size (ha) | Current road analysis                                                                 | Current road width (Arranged in rank order) | Current usage                                                                 |
|----------------------------|------------------|---------------------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------|
| Tsinghua University        | 335              | There are three levels in the near term: main roads, secondary roads, and branch roads; in the long term, there are four levels: urban roads, outer ring roads, secondary arterial roads, and bicycle lanes. | The area of roads above 8m accounted for 16.8% of the total roads | The road area of 6m~8m or more accounts for 37.1% of the total road; The road area of 3m~6m or more accounted for 46.1% of the total road |
| Shanghai University Baoshan Campus | 95              | Campus roads are divided into four levels: outer ring motor vehicle lanes, inner ring non-motor vehicle lanes, secondary non-motor vehicle lanes, and pedestrian paths | The outer ring road is 15 m wide and the red line is 20 m wide. The inner ring road is 12 m wide and the red line is 12 m wide | Radioactive non-motor vehicle lane width 7m; The walking path is 3~5m wide |
| Tongji University Headquarters | 69              | Road classification is blurred, and the difference between main roads and secondary roads is not obvious | The main road is 5m to 8m, except for the Aixiao Road, which is 9m wide | The width of the secondary trunk road is 4m; The branch road is about 3m wide |

At present, the road width in Tsinghua campus is relatively low. The main road in the north-south direction is 8m wide and the secondary road is 6m wide. The width of the road is relatively wide compared with the actual use, especially in the pedestrian area. The 12-meter-wide road is still ample even during the rush hour of school.
congested during the peak hours of school.

| Shanghai Maritime University Lingang Campus | 133.3 | Divided into four levels: main road, secondary road, branch road, pedestrian road | The main road width is concentrated in 8-13m | The width of the secondary trunk road is 4m | The width of the branch road is about 3m, and the width of the walking path is 2 to 3m | The overall road width is relatively low. Several roads with heavy traffic such as Minsheng Road 4m and several small roads on Haiyan Mountain are about 2 meters as shown in Figure 1. The small roads in Area A and D of the third teaching building (below Haiyan Mountain), Basically cannot meet the current required width |

As can be seen from the above table, the Lingang campus of Shanghai Maritime University, like other campuses, has narrow roads on campus. This phenomenon is particularly obvious during the peak hours of classes. In addition, the road itself has a fuzzy classification, and the phenomenon of mixed traffic between people and vehicles is serious. Vehicles often pass through the teaching area and student living area, causing serious interference to the study and life of teachers and students. In addition, the school did not consider the development speed of motor vehicles and the scale of enrollment during the construction period. The motor vehicle parking space in the student apartment area is seriously insufficient, especially motor vehicles have nowhere to park. The school had to build on-street parking in the later stage, as shown in Figure 2. Two lanes were occupied by motor vehicles on Wuhua Road and Shuren Road. In addition, during the peak period of school, because bicycles occupy the road too much, the sidewalk is too narrow, and the tall trees occupy most of the space, the usage rate of the pedestrian path is reduced, and the pedestrians and vehicles are mixed, which greatly interferes with each other. Reduce the traffic rate of the road [3]

Figure 1 Haiyan Mountain

Figure 2 Wuhua Road
2.3. Analysis of traffic facilities

The traffic facilities are mainly traffic signs, traffic markings, isolation piers and speed bumps. Many facilities in our school are not very reasonable.

The signs and markings in schools should not only learn from urban traffic signs and markings, but also consider the characteristics of the traffic in the school. However, our school’s guidance signs lack continuity. Only important intersections have signs, and their functions are single, with only directivity, no other auxiliary guidance signs, and unclear directions. Especially for freshmen who have just entered school, it is difficult to find dormitories and canteens without clear signs. Various places. Simple signs can let the driver know the basic road conditions ahead at a glance when vehicles are passing quickly on urban roads. However, the traffic on campus is dominated by pedestrians and non-motor vehicles, and the speed of motor vehicles is not fast. In addition to prompts and warnings, the main function of traffic signs is to indicate and guide [8]. The traffic signs on the campus should be able to instruct motor vehicles to safely and smoothly find the planned destination or nearby parking areas; while pedestrians and non-motor vehicles should fully understand the location, buildings and roads in the surrounding area, and reflect campus culture. The role of traffic markings on campus is the same as that of urban roads, but in view of the characteristics of the roads on campus and the lag of management methods, the effect of traffic markings is usually not as good as that of urban roads. Take the current Shanghai Maritime University Shuren Road as an example: roadside The corresponding parking spaces have been planned with solid white lines on one side, but there are still some people stopping at the turn of the intersection, which seriously affects the passage of students and other vehicles.

Nowadays, the most commonly used speed bumps in school transportation facilities, as shown in Figure 3, are set to be too long, and the distance from the roadside is about 30cm. Such a roadside gap length setting is too wide for motor vehicles, but very narrow for bicycles. Therefore, it can neither prevent the motor vehicle from passing the speed bump unilaterally, but also prevent the bicycle from smoothly circumventing the speed bump. According to statistics, about 77% of cyclists pass through the gap between speed bumps and sidewalks.

![Figure 3 Speed bumps in school](image)

2.4. Parking analysis

Bicycles have already become the main means of transportation in campus life, and practical issues such as parking planning and parking safety have attracted the attention of school students. At the beginning of semester, through field investigations on the current situation of bicycle parking in front of the teaching building and dormitory building on the campus of Shanghai Maritime University, it was found that the bicycle parking was disorderly, occupying too much space and "zombie cars" in the underground parking lot of the student apartment were prevalent [8]. Therefore, it is particularly important to solve the problem of bicycle parking on campus. Through field research, it is found that the largest number of bicycles parked on campus is the living area and teaching office area.

The living area mainly includes the student apartment area and the canteen area. In the student apartment area No. 23, the main parking point for non-motor vehicles is the underground parking garage. Due to the early construction time, the dilapidated interior, the dim indoor light, and the large...
number of used bicycles in it, it is inconvenient for students to pick up the car. It did not attract students to park, but parked the car at the door of the apartment or on the sidewalk, which caused great inconvenience to the students. In the Haiqin canteen area, there are several parking sheds next to the Haiqin canteen. However, due to the large number of non-motorized vehicles, some electric vehicles and bicycles are parked in the open air. This shows that the number of parking facilities in the living area is obviously insufficient.

The public teaching building is the place where students gather the most on campus, so the bicycle parking in the public teaching building is the most serious place, so it is necessary to study the bicycle parking in the public teaching building. As shown in Figure 4, a large number of bicycles have no place to park. As for the original sidewalks and the entrance of the teaching building, they have been used to park bicycles, not to mention the bicycles exposed to sunlight and rain washing; many people interviewed by students reflect that such a bicycle parking environment not only hinders traffic, but also makes the bicycle extremely inconvenient to use after school is hot or drenched.

3. Traffic system optimization strategy

3.1. Road system optimization
To establish a continuous and efficient transportation system, it is necessary to determine a road system that is safe, orderly, convenient, fast, and suitable for human and vehicle traffic branches based on topographical conditions and land use layout.

① Deal with the connection and effective separation of the internal roads of the campus and the outer city roads, especially the connection between gate 5 and gate 3. In addition, it is necessary to organize the connection between multiple entrances and urban roads. According to the city planning road network and the nature of the land Handle the junctions between campus roads and urban roads to make the connection between campus traffic and urban traffic more convenient.

② Set up a branch system for people and vehicles. For the rush hours of get out of class, the flow of non-motorized vehicles and the flow of people are usually mixed, and some collision accidents often occur. For this reason, it is necessary to separate the flow of people and vehicles. The travel route saves riding time and improves travel safety [10].

③ Through the overall planning of the pedestrian system, increase the sidewalk space and improve the walking comfort, gradually establish a walkable campus, and provide a safe, convenient, comfortable and beautiful travel environment for teachers and students [4].

④ Widen the internal roads of the school, regulate the management of vehicle parking, clear the fire passages, and improve the environmental quality of the living quarters of teachers and workers.

3.2. Optimization of transportation facilities
At each entry point of the Haida campus, add signs that can indicate adjacent arterial roads and special places in the campus (exit, graphics, university student activity center, etc.). At crossroads, T-junctions, and turns, detailed signs or signs should be set up. The electronic map makes the road traffic network of the entire campus more clearly displayed in front of pedestrians. Add a campus speed limit sign at
the campus entrance. The outside of the campus is Lingang Avenue, and the speed of cars is generally fast. After entering the campus, eye-catching traffic signs are required to remind the driver to reduce the speed to ensure the safety of teachers and students. Install wide-angle lenses at intersections with narrower campus roads, smaller corners, and more distractors or steep downhill intersections to expand the driver’s field of vision, reduce visual blind spots, and reduce vehicle-to-vehicle, vehicle-to-person collisions. Improve the marking system of each road in the campus, distinguish the color of the motor vehicle lane and the non-motor vehicle lane in the school, and improve the road markings such as parking lines and zebra crossings at each intersection.

In addition, a sign prohibiting vehicles should be set up on the road in front of the student apartment, so that the traffic safety of students in the vicinity of the student apartment area can be effectively guaranteed. Unlike the student apartment area, there is a lot of motor vehicle traffic near the teaching area, and it is not advisable to prohibit vehicle traffic for a long time. The method of separating people and vehicles can be implemented by time periods. Vehicles are temporarily prohibited from entering the teaching building area during peak periods. At the same time, a time-sharing walking system should be constructed on local roads with heavy traffic, and on the main roads and branches of Haida University. At intersections, fixed-time one-way road signs and corresponding detour road signs are set up to meet the need for one-way restriction during peak times.

3.3. Optimization of parking area

When solving the bicycle and car parking lot, it should be convenient for teachers and students to store and not damage the campus environment.

1. Increase bicycle parking areas, combined with external landscape greening, increase bicycle parking areas inside teaching areas and apartment areas, and guide students to place bicycles in an orderly manner to avoid the phenomenon of random parking and occupation of traffic lanes.
2. Improve the existing underground parking garage. Use transparent glass or partitions to increase indoor light, and regularly remove old and unused vehicles to allow students to enter and park.
3. Increase parking facilities. Generally, the parking of vehicles is divided into two types: underground and above ground. Combining the characteristics of bicycles and the principle of proximity to students, it is generally more convenient to choose ground parking.

4. Conclusion

The above is based on the research on the current situation of Shanghai Maritime University campus traffic and the optimization strategy. With the large-scale construction of new university campuses in my country, the campus traffic space also needs to be continuously optimized and improved. At the same time, in order to improve the current university campus traffic space environment, it is necessary to strengthen the research on the university campus traffic space and build a good campus environment suitable for student life and study.

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