



Research on Optimization Design of University Campus Traffic System - Taking Qinghai University as an Example

Xiaochu Wen^(✉), Juanyi Li, and Qi Chen

College of Civil Engineering, Qinghai University, Xining 810000, China
1121597704@qq.com

Abstract. With the development of economy and society, the form and total amount of traffic on campus have changed greatly, and the influence of campus traffic environment on teaching life has been expanding. Therefore, this paper takes Qinghai University as an example to understand and analyze the problems existing in the current campus traffic, and plans and designs the campus traffic with the flow of people, traffic flow and static traffic as subsystems, and puts forward the optimization strategy of Qinghai University traffic.

Keywords: Traffic planning · Traffic system · University campus

1 Introduction

In recent years, due to the rapid growth of the level and scale of higher education in China, the surge in the number of students in school and the rapid increase in the level of social traffic motorization, the problems of parking difficulties, poor traffic order, and chaos in the right of way have become an important factor affecting the orderly development of colleges and universities. Therefore, this paper takes the campus of Qinghai University as an example, and explores the planning scheme of campus transportation system according to the concept of “people-oriented and moderate mixed traffic”.

2 Overview of the School

Qinghai University is located in Xining City, Qinghai Province, with a total planning area of nearly 200 hectares and a history of more than 60 years. Among them, the headquarters of Qinghai University is located in the north of Xining City, located at the foot of the mountain, the terrain is high in the northwest and low in the southeast, and there are school gates around the city. According to the architectural nature, the campus can be simplified into five areas: living area, teaching area, family courtyard, administrative office area and Qinghai Academy of Agriculture and Forestry Sciences. Due to the influence of climate, terrain and campus scale, the traffic on campus is mainly walking and driving, and there are few non-motor vehicles.

© The Author(s) 2023

R. Lotfi et al. (Eds.): UPRE 2023, AEBMR 253, pp. 268–276, 2023.

https://doi.org/10.2991/978-94-6463-218-7_30

3 Current Situation of Campus Traffic

3.1 Analysis of Pedestrian Flow Line

In the campus, Jinxiu Road and Tangli Road are used as public routes to connect the streamlines together. Only Jinxiu Road realizes the separation of people and vehicles through the isolation of electronic road piles.

The existing problems include the high coincidence of pedestrian and vehicle flow lines, and pedestrians walking directly on the lanes of some roads; the structure of walking system and road network is unreasonable. The specific performance is that the living area on the west side is inconvenient to contact with the teaching area, the convection conflict of the branch crowd during the course change is serious, and the connection between the pedestrian road and the campus landscape is poor.

3.2 Analysis of Car Flow Line

The current situation of the campus car flow line is organized according to the structure of the partition single line, and the streamline separation of the three campus functional areas of the living area, the teaching area and the administrative area is basically realized.

The existing problems are the lack of systematisms and poor operation of the road network. The specific performance is that the excessive pursuit of ‘partition’ leads to the connection of each partition through urban roads, the inability to open some small loops restricted by terrain, and the poor implementation of one-way roads.

3.3 Analysis of Static Traffic

According to the survey and statistics, there are 1050 parking spaces in the campus, including 20 large parking spaces and 1030 small parking spaces.

The area with a large contradiction between supply and demand of parking on campus is the administrative region on the east side, Changyue canteen, the teaching area composed of science and technology museum, finance college teaching building and computer department teaching building, and the teaching area composed of wisdom building and chemical engineering college teaching building. At present, the supply of parking space in the agricultural science academy area slightly exceeds the demand.

According to the “Technical Management Guidelines for Urban Planning in Qinghai Province” (2018 revised edition), the minimum control index of parking spaces in colleges and universities should reach 45% of the total number of faculty and staff. As of January 2023, Qinghai University has 2330 faculty and staff. The current parking demand of Qinghai University is 1049 vehicles.

According to public data, the average annual growth rate of faculty and staff in Qinghai University from 2016 to 2023 is about 3.3%. Considering the rapid development of social motorization, the parking demand of Qinghai University at the end of the planning period is predicted at a growth rate of 4%, and the total parking demand of campus motor vehicles will be 1385 by 2030.

The problems of static traffic in Qinghai University include: insufficient supply of parking spaces and insufficient consideration of peak parking periods such as freshmen opening, undertaking social examinations, sports meetings, and weekly study days.

4 Traffic Planning

4.1 Planning of Pedestrian Flow Line

For teachers and students in the school, in addition to walking as the most commonly used mode of transportation, it also undertakes the role of social interaction and showing the campus style [1]. Due to the current situation of construction and use, the characteristics of campus functional zoning and the influence of climatic conditions, it is difficult for the campus of Qinghai University to realize the ideal pedestrian-vehicle diversion mode of the outer ring and the inner ring, and it does not have the conditions to promote the use of non-motor vehicles. Therefore, in the design of campus traffic system, we should make clear the principle of people-oriented [2], ensure that the pedestrian trunk road is not affected by traffic flow, and consider creating a beautiful campus environment to realize the smooth, safe and beautiful pedestrian system.

According to the above requirements, the pedestrian flow line planning starts from the use demand and combines the main landscape square nodes of the campus to form a primary and secondary walking system. The main road is connected to each functional partition of the campus, and the secondary road undertakes the travel demand in each partition. The main pedestrian road is basically separated from the main vehicle road. Pedestrian streamline planning is shown in Fig. 1.

In the walking system, combined with the sports center under construction, the west side walking main road is added to connect the living area and the teaching area. The new north side walking main road solves the problem of inconvenient connection between living area and snack street; according to the tradition of the school’s ‘Sunshine Green Circle’, a slow walkway for teachers and students is planned.



Fig. 1. Planning diagram of pedestrian streamline (Image source: Self drawn)



Fig. 2. Planning diagram of car flow line (Image source: Self drawn)

4.2 Planning of Car Flow Line

Due to the objective existence of commuting, logistics and emergency care needs, the emergence of motor vehicles on university campus is inevitable. Therefore, the core of car flow planning is to balance the relationship between car flow and people flow under the premise of ensuring traffic efficiency [3]. In order to solve the problem of pedestrian streamline interference caused by different types of moving lines and the problem of plane intersection of people and vehicles during peak hours, according to the characteristics of clear campus functional zoning, the author proposes a 'big open, small closed' car flow line organization method based on the urban road circulation network [4]. Specifically, the large ring line is used as the skeleton to connect the campus partitions, and each functional area forms a small ring line microcirculation to realize the separation of the pedestrian flow line and the large ring line.

According to the above concept, the campus road system is divided into three levels: trunk road, branch road and auxiliary road. Among them, the main road can be two-way driving, that is, the school ring road; the branch is mainly one-way driving, with moderate traffic flow, forming a small ring line; the auxiliary road is only one-way driving, which is used to connect the trunk road, branch road and parking facilities. The car flow line planning diagram is shown in Fig. 2.

4.3 Planning of Static Traffic

The parking problem of motor vehicles is one of the core contents of campus traffic planning. Most of the existing research focuses on the choice of parking methods and the design of specific parking lots [5]. However, the system composed of static traffic and traffic flow lines can better solve the imbalance between gate supply and demand of parking and disorderly parking.

According to the supply and demand situation of each functional partition of the campus, the campus parking is re-planned, and the total amount is controlled by the partition. According to the land use conditions and parking demand distribution, the area with insufficient supply during the current situation investigation is focused on.

After planning, there are 1296 parking spaces on campus, including 20 large parking spaces, 1276 small parking spaces, and 246 new ones. There are 156 parking spaces in the living area, and 120 new ones are added. It can serve the administrative office needs of the student activity center, the sports center and the logistics needs of the canteen. There are 248 parking spaces in the family area, mainly off-street parking, which serves the commercial needs of Changyue Business Center, the teaching and office needs of Tibetan Medical College and the parking needs of the residents in the family building. There are 261 parking spaces in the administrative office area, with 75 new ones, which mainly meet the parking needs of administrative offices; there are 601 teaching areas, including 20 large parking spaces, 581 small parking spaces, and 21 new ones. Parking spaces are planned beside each teaching building. The campus static traffic planning is shown in Fig. 3.

According to the previous forecast, there are still nearly 90 gaps in parking spaces after planning by 2030. Considering that Qinghai University is still in a period of rapid development and the landing of construction projects is uncertain, a centralized parking lot that can accommodate 100 parking spaces can be reserved between the south side of the training base of the medical college and the north side of the south outer ring according to the index of 27 m²/unit. In addition, the way of building underground garage can be considered. Although its construction cost is high, underground parking is



Fig. 3. Planning diagram of static traffic (Image source: Self drawn)

still a more reasonable solution from the perspective of lagging construction of civil air defense engineering, campus style protection and long-term development requirements.

4.4 Planning of Peak Period Traffic

The traffic planning during the peak period mainly includes the period of sports meeting, the period of undertaking social examination, the period of undertaking general meetings or activities and the period of opening school. Traffic planning in peak hours should meet parking needs and reduce interference with normal teaching and office activities on campus. Based on this, a solution of adding temporary roadside parking spaces and isolating vehicles through roadblocks is proposed.

The Car Flow Line During the Sports Meeting

The sports meeting is jointly held by the school headquarters and the affiliated Kunlun College of Qinghai University, hospitals and primary and secondary schools. When



Fig. 4-1. The car flow line during the sports meeting

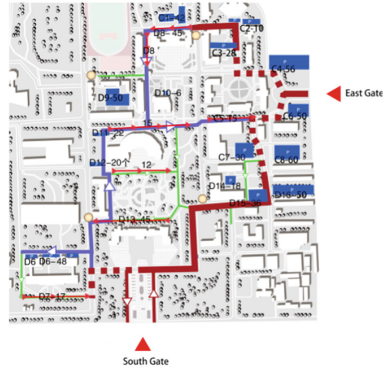


Fig. 4-2. The car flow line during the outside school personnel examination



Fig. 4-3. The car flow line during the conference or activity period

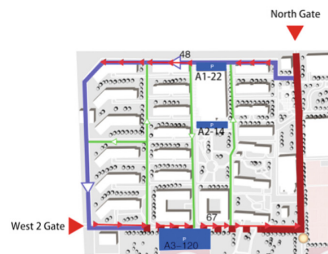


Fig. 4-4. The car flow line of students at the peak of school opening

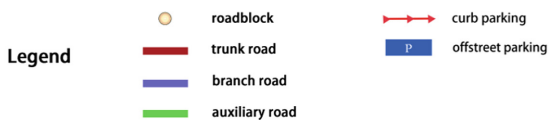


Fig. 4. Planning diagram of peak period traffic (Image source: Self drawn)

planning the sports meeting, the vehicles mainly enter from the south gate and the west gate, and open the west gate temporarily. The streamline covers 318 parking spaces near the target building and is shown in Fig. 4-1.

According to the data of the order book of previous school sports meetings, the total number of team members during the sports meeting period is 1300 to 1500, of which students account for about 45%; the number of people who need to drive to the school includes the representative teams of six departments or directly affiliated institutions, such as Kunlun College, Affiliated Hospital and College of Continuing Education, accounting for about 10% of the total number. Parking demand is predicted by 150; considering the driving needs of other off-campus guests and other teaching staff, the more than 300 parking spaces covered by the streamline can meet the parking needs of relevant personnel.

The Car Flow Line During the Outside School Personnel Examination

It refers to the streamline when the school undertakes the social examination. Since the social examination is generally held during the holidays, it is necessary to focus on avoiding the impact of vehicles on the daily lives of teachers and students. The vehicle is mainly entered by the east gate and the south gate, and can be parked nearby around the corresponding teaching building. The streamline covers 675 parking spaces near the target building and is shown in Fig. 4-2.

According to the survey, there are 158 permanent social examination rooms in Qinghai University, including 5 spare examination rooms. Each examination room is predicted by 30 candidates (the examination staff is generally held by teachers and students in the school, and the vehicle can be parked in other areas); according to the data released by the Qinghai Provincial People's Government, the share rate of bus motorized travel in Xining City will reach 65.2% in 2023; considering the influence of walking, ride-hailing, taxi and other travel modes, the parking space covered by the streamline can meet more than 65% of the maximum parking demand, and the remaining unmet demand can be diverted to the National University Science Park of Qinghai University, which is close to the west gate of the school.

The Car Flow Line During the Conference or Activity Period

The period of hosting meetings and activities should reduce the impact on the normal teaching work on campus. The vehicles are mainly entered by the south gate, and can be parked near the target buildings such as the Science and Technology Museum, the Smart Building, and the Salt Lake Chemical Building. The streamline covers 497 parking spaces near the target building and is shown in Fig. 4-3.

According to the survey, the academic lecture hall in the Intelligent Building and Salt Lake Chemical Building can accommodate 150 to 200 people. The parking space near the building can meet the parking needs of small and medium-sized academic reports, competitions and conferences. The science and technology museum auditorium can accommodate up to thousands of people, but considering that the participants in the

school science and technology museum are mostly teachers and students of the school, there are fewer off-campus guests, so it can meet the basic parking needs.

The Car Flow Line of Students at the Peak of School Opening

The vehicle is mainly entered by the north 1 door, and can serve all the student apartment buildings through the microcirculation streamline. The streamline covers 271 parking spaces near the target building and is shown in Fig. 4-4. On the basis of 156 parking spaces planned in the living area, 115 temporary parking spaces can be provided, which can alleviate the current situation of poor vehicle order in the living area at the beginning of school. In addition, the roadblock on the north side of the campus can be removed during the time when the freshmen arrive at the school, and the vehicles can be evacuated to the northeast side of the family area, which can provide 248 parking spaces, but the streamline should be isolated again during the time when the residents in the family area travel and return.

5 Conclusions

Due to the popularity of motor vehicles and the rapid development of colleges and universities, the problem of traffic chaos and conflict between people and vehicles in the campus is becoming more and more serious. Taking Qinghai University as an example, this paper puts forward the concept of “people-oriented, moderate mixed traffic” through the investigation and combing of the current situation of campus traffic. Combined with the characteristics of campus functional zoning and the needs of practical use, this paper explores the planning method of campus traffic system with the three subsystems of people flow, traffic flow and static traffic as the core, and makes some exploration in optimizing campus traffic and realizing safe, orderly and beautiful campus environment.

Acknowledgment. This work has been funded by the exploration and practice of the second phase of the campus road network planning of Qinghai University’s 2022 education and teaching research project (JY202220).

References

1. H. Zhang, H. Ding, K. Guan, Y. Sun, W. Zhang, The Evolution Strategy of University Campus Traffic Space from the Perspective of New Generation College Students: A Case Study of Zhejiang University’s Zijingang Campus, *Architecture and Culture*, no. 6, 2019, pp. 183–185.
2. J. Shan, Y. Zhang, G. Xiong, Cold University Campus Traffic System Planning and Design Optimization, The 10th International Green Building and Building Energy Efficiency Conference and New Technology and Products Expo, 2014, pp. 68–74.
3. N. Liu, Research on the optimal design of university campus traffic based on the theory of pedestrian and vehicle separation: A case study of the screen campus of Guilin University of Technology, *Urban Architecture*, vol. 19, 2022, no.15, pp. 85–87+103. DOI: <https://doi.org/10.19892/j.cnki.csjz.2022.15.19>.

4. K. Zheng, Research on Traffic Organization Optimization of Urban Road Microcirculation Network, Chongqing Jiaotong University, 2016, pp. 20–21. DOI: CNKI:CDMD:2.1016.158736
5. R. Zhang, S. Ren, W. Pang, Research on the Planning and Design of Vehicle Static Traffic System on University Campus - Taking Huazhong University of Science and Technology as an Example, 2020 China Urban Planning Conference, 2021, pp. 611–627. DOI: <https://doi.org/10.26914/c.cnkihy.2021.036844>.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

