Exploring Architectural Space Optimization Aimed at Enhancing the Resilience of Campus Food Security in Higher Education Institutions

——Case Study of Nan'an Campus, Chongqing Jiaotong University

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Abstract: *Compared to typical urban communities, university campuses have unique characteristics such as a dense transient population and a lack of self-sufficiency. In emergency situations, such as lockdowns, the food supply for students on campus can be significantly impacted. Addressing this practical issue, the research team focused on the operational status of university campuses during the COVID-19 pandemic. Through a survey of nearly 100 students and an inspection of over 5,000 square meters of campus space, the study proposes a dining space solution based on a pre-packaged meal product system that includes "ready-to-distribute," "ready-to-cook," "ready-to-eat," and "ready-to-heat" categories. Following design principles of non-congregation, timeliness, flexibility, and standardization, and targeting dormitory living areas or other underutilized campus spaces, the project employs BIM modular design techniques and prefabricated construction concepts. The aim is to create an automated and shared dining space that can operate 24 hours a day, even during lockdowns, thereby enhancing the resilience of campus food security.*

Keywords: *Food Security Resilience, Architectural Space, Optimization Design, Chongqing Jiaotong University*

1. Introduction

Due to differences in historical backgrounds, cultural ideologies, and educational models, significant disparities exist in the spatial layouts and management styles between universities in the East and the West. Generally, Chinese universities tend to be introverted and enclosed, characterized by high walls that isolate them from the outside world, limiting student activities within campus boundaries and housing most students in dormitories. In contrast, Western universities are more integrated with urban areas, without clear boundaries between communities and educational institutions, leading to a more social lifestyle for students who often live in residential homes, depicting a relatively open environment. Additionally, influenced by China's unique political system, the management model in Chinese universities is more bureaucratic and centralized in power. Thus, when emergencies occur, such as lockdowns, the food supply for students within the campus is significantly impacted. During the severe periods of the pandemic, Chinese universities typically implemented strict management, leading to

reduced shopping options for teachers and students, increased dining numbers, non-centralized dining times, and dissatisfaction with cafeteria food. To prevent virus transmission later on, universities confined students to their dormitories with meals delivered by the school, which led to delays in food delivery, lack of variety in meals, and deterioration of food during transit [1].

The mandatory control measures, such as lockdown and isolation, which restrict personal freedom, naturally provoke negative emotions like complaints, depression, and anxiety among students, and could even trigger serious psychological crises [2]. Inadequate food supply during lockdown periods undoubtedly exacerbates the occurrence of psychological disorders and causes panic among the population. University canteens, being a focal point of student concern, have always faced issues like mismatched tastes, limited dish variety, and food safety concerns. Now, although the COVID-19 pandemic has ended, the world has not entirely escaped the influence of the pandemic, with the potential for small-scale outbreaks remaining. Therefore, addressing the vulnerabilities in university food security exposed during public health emergencies is especially crucial [3].

2. Analysis of the Problem

2.1. Observations During Lockdown

As a firsthand experiencer of the pandemic, I deeply felt the negative emotional impacts caused by the inadequacy of food supplies during the lockdown period. In the early stages of lockdown, the university encouraged students not to gather unnecessarily and advised them to take meals back to their dormitories while banning external food deliveries, leading to a significant amount of white trash and labor costs. As the pandemic intensified during the mid-lockdown, the school encouraged students not to leave their dormitories, and meals were delivered in mass by dorm leaders. The quality of cafeteria meals improved noticeably, with nutritious dishes provided timely for breakfast, lunch, and dinner to boost students' resistance during the lockdown, which kept my emotional state relatively stable [4].

However, in the later stages of the lockdown, as the situation became more severe, the university enforced strict dormitory isolation, and some students were even isolated off-campus. I began to experience negative emotions such as anxiety, panic, and stress. Concurrently, issues like delayed food deliveries leading to cold and spoiled meals emerged, causing a significant decline in meal quality. In response, the university later distributed convenience foods like instant noodles and self-heating meals, but the monotonous taste and limited variety of these foods only provided temporary comfort. Eventually, the university adopted a balanced approach of alternating between convenience foods and boxed meals, which helped to endure the challenging lockdown period [5].

I realized that food not only provides the basic necessities for the human body but also shifts the negative emotions of those in lockdown, offering emotional value that helps stabilize students' conditions. Therefore, I believe it is especially important for schools to provide stable food supplies during sudden public events. This experience prompted me to think about utilizing the spare spaces in student dormitories to create a supply point that could address food provision during emergencies, meet diverse student needs, and reduce labor and material costs.

After the pandemic, I surveyed over 5,000 square meters of campus space and identified two main types of usable campus spaces: idle public spaces and existing spaces that could be transformed. The transformable spaces, widely distributed with high shareability and located in areas of high foot traffic,

could serve as central hubs for a district but are costly to remodel and not suitable as emergency supply points due to their distance from student dormitories. On the other hand, idle public spaces, mainly consisting of communal platforms in dormitories and abandoned shower rooms on various floors, though limited in range and size, could serve as excellent emergency storage spaces due to their accessibility to residents of each floor.

2.2. Post-Lockdown Survey Analysis

Along with my team members, we conducted a survey at the Nan'an Campus of Chongqing Jiaotong University, analyzing students' perceptions of campus food supply during the later stages of lockdown. The campus houses over 14,000 students and has five student canteens, with three main ones located in the Jingyuan area, providing about 5,000 dining seats. We distributed 110 questionnaires and received 100 back, achieving a 90.9% response rate. The survey results indicated that the main dissatisfaction during the mid-lockdown was related to the taste, quality, quantity, and unstable delivery speed of the food, showing overall low satisfaction; while in the later stages of lockdown, complaints were mainly about long waiting times and lack of flavor uniqueness, showing moderate overall satisfaction. This provided reference data for the creation of the shared dining space project.

3. Analysis of Shared Dining Spaces in Universities

3.1. Background of Shared Dining Spaces

The concept of "shared dining spaces" refers to areas where both dining and cooking are communal. These spaces provide students with facilities to prepare and process food, which they can then take back to their dormitories. By enhancing the efficiency of resource use, these shared spaces not only cater to the diverse tastes and dietary habits of students but also address unhealthy behaviors such as the frequent consumption of takeout food due to mismatched schedules with cafeteria hours. Furthermore, the emergence of shared dining spaces offers platforms for work-study programs and adds a new dimension to the labor education curriculum [6].

3.2. Survey Analysis of Shared Dining Spaces at Our University

A survey was conducted at Chongqing Jiaotong University involving students and faculty as the sample population. We distributed 97 questionnaires and received 87 back, achieving a response rate of 88.78%. The survey examined various aspects, such as dining preferences, cooking habits, and attitudes towards the construction of shared dining spaces. The results indicated that taste and quality of food were key factors influencing students' dining choices, followed by convenience, price, and the dining environment. Consequently, many students preferred eating off-campus, followed by using the cafeteria or ordering takeout. Regarding cooking, only a few students had proficient cooking skills, and most were not inclined to cook independently but were willing to try with some assistance. As for the attitudes toward shared dining spaces, over 70% of students supported this initiative, expressing a desire for these spaces to be flexible and convenient, providing a variety of tasty, authentic food options. However, a minority of students expressed concerns about electrical safety during the cooking process. These insights offer a direction for the future optimization of shared dining spaces.

3.3. Main Challenges Affecting the Resilience of Food Security in University Campuses

Accessibility of Food Supply. University canteens are significantly affected by cost, leading to issues with the sustainability and diversity of food supply sources. Thus, during major public emergencies, the stability and accessibility of food supply play a critical role in deciding the effectiveness of the response.

Control of Food Quality and Price. Issues such as improper food storage, unclean cooking environments, and lack of hygiene awareness among staffs may lead to food contamination or cross-contamination. Moreover, to cut costs, some university canteens may use low-quality ingredients, resulting in poor nutritional value and taste.

Variability in Food Taste and Variety. The limited variety and uniform taste of food offered in university canteens restrict students' dietary choices. The lack of regional specialties and the uniformity of flavors fail to meet the diverse taste preferences of students, lacking innovation and personalization.

Flexibility of Dining Environment and Timing. Some universities have fixed dining schedules that are not flexible, compelling students to eat within specific time period regardless of their personal schedules. This leads to overcrowded dining halls and long waiting times, which negatively impact students' dining efficiency and comfort.

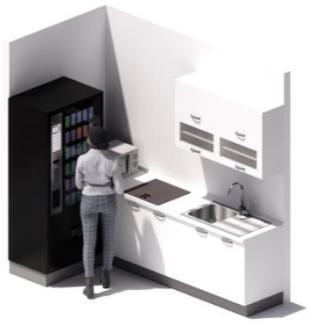
4. Conclusion and Recommendations

4.1. Introduction of Pre-prepared Meals

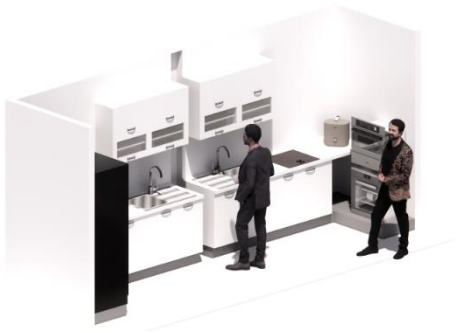
Pre-prepared meal products offer several benefits including low reprocessing difficulty, short preparation time, high fault tolerance, and consistent output, making them more inclusive and efficient compared to experience-based shared kitchens. These meals not only provide a cooking experience for students but also ensure the quality of the food's taste.

4.2. Utilization of Modular and Prefabricated Building Concepts for Campus Space Renovation

To maximize cost savings and to quickly and effectively respond to public health emergencies post-pandemic, this project proposes the creation of prefabricated modular shared dining spaces. Using the Jingyuan dormitories at Chongqing Jiaotong University as a case study, the project involves on-site surveys, data measurement, site selection, and simulation modeling [7]. By applying ergonomic principles, ordinary shared dining spaces are divided into multiple "standard modular units," aiming to establish prefabricated shared dining areas within student dormitories or unused campus spaces. This not only saves public resources of the school but also time for student dining, addressing issues such as the monotony of cafeteria menus, post-class crowding, long waiting times, and awkward shared table settings. Also provides a solution during public health crises [8].



Basic unit module



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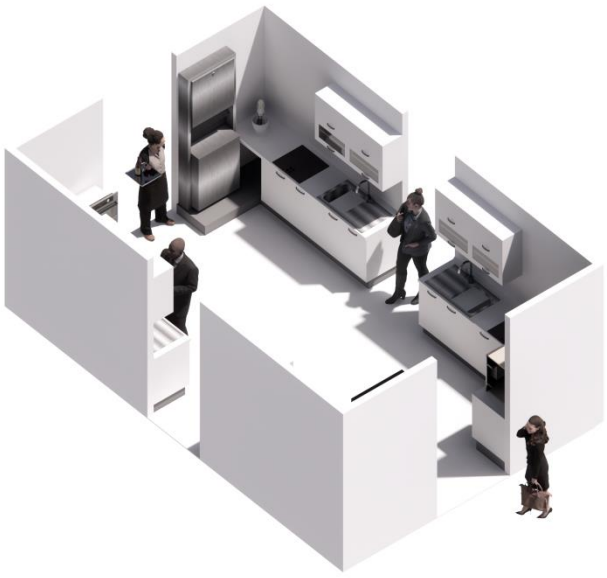

Multiple modular space composition

4.3. Additional Recommendations

4.3.1. Development of an Online Mini Program

Implement an online ordering system that allows for online menu selection and reservation of cooking stations. This easy-to-use system, based on the "Internet + Pre-prepared Meals" model, links machines with smartphones, offering students the enjoyment and novelty of cooking meals themselves. It would promote the automation and intelligence of machines. Designing a WeChat mini-program would provide students with a more convenient, faster, and personalized ordering platform [9].

4.3.2 Breaking Traditional Time Constraints, 24/7 Operation

Current university canteens operate at fixed times, causing many busy students to miss meal times. Shared dining spaces would break these traditional constraints, allowing dining at any time, greatly alleviating the pressure on school canteens and providing 24/7 dining options for busy students [10].

5. Conclusion

Food is an indispensable part of student life on campus and has always received extensive attention.

Under the unique management model of Chinese universities, enhancing the resilience of food security undoubtedly adds a reinforcing lock to campus food supply. In emergency situations, addressing the issue of campus food supply becomes an urgent matter. Through personal experience and survey research, this paper proposes the introduction of quick, tasty pre-prepared meals and the use of modular design concepts to create 24-hour shared dining spaces, providing a referable direction for enhancing campus food security resilience.

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