

University High-End Equipment Dynamics and Control Team Laboratory Space Remodeling Design

Tingyu Yang and Qian Ji

School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan, Hubei, China

ABSTRACT

Objective With the country's increasing emphasis on new laboratories, in order to improve the efficiency of efficient laboratory space resource utilization, more and more laboratory construction and renovation are on the agenda. This paper focuses on the space renovation design research of the DDC laboratory of the School of Mechanical Engineering, Huazhong University of Science and Technology. The method applies the principle of co-participation, and carries out the laboratory space optimization and renovation design according to the needs of the laboratory entrusting party. The principle of participatory design is an important guiding principle for carrying out the actual design project proposal. The designer seeks out stakeholders, and identifies the differences between the thinking of the designer and the user. The result is to guide the thinking of the user based on the actual site design conditions, in order to achieve a better communication process and the best design solution. **Before the concrete implementation**, through field visits to excavate the pain points of laboratory personnel, and considering ergonomics, environmental psychology, aesthetic psychology and other factors, in-depth excavation and consideration of user needs. **Conclusion** To solve the pain points of scientific research, to create a safe, comfortable and beautiful scientific research space for laboratory staff. In the reconstruction of the site, the construction of an overall style of laboratory, rational use of laboratory space and resources, to ensure and realize the operation and development of the laboratory.

Keywords: Co-participatory design, Laboratory space transformation, Mechanical laboratory

INTRODUCTION

At present, the laboratories of most universities in China still continue the architectural style and interior decoration style of the Soviet Union in the last century. The development of laboratories is limited to the replacement of experimental instruments, and there is no space improvement according to the needs of experimental personnel. The contradiction gradually became apparent. With the purchase of more and more precision instruments and the increase in the number of experimental personnel, issues such as how to build new laboratories, rationally allocate resources, and improve work efficiency have been included in the important research scope of university laboratory reform. And designers began to pay attention to laboratory construction and put forward their own design solutions and design thinking. There is no lack

of multi-disciplinary and psychological aesthetics in the laboratory design research, and the design research is more humanized. As a result, laboratory construction has gradually formed a multi-field, interdisciplinary, and development-oriented design trend in China.

DESIGN METHOD

The principle of co-participation originates from multi-party participation (He Suli, 2018). It originated from the political concept of the ancient Greek city-state, that is, “qualified adult males participate in the management of the city-state together regardless of occupation” (Shen Liangye, 2019), and later it has been applied to the concept of management. With the gradual diversification and multi-discipline of design, design science gradually absorbs the relevant management knowledge of management disciplines and forms the theory of co-participatory design. Based on the joint participatory design (Sun Ming, 2018), this paper formulates the design flow chart, and carries out the project process design and implementation combining theory with practice.

The main research on the principles of participatory design can be interpreted in many ways. (Jirachai, 2006) The main research content can be divided into part research on design thinking (worldview) and part research on project management implementation (methodology).

Design thinking part of the study. In the “International Handbook of Participatory Design” compiled by Jesper et al., participatory design is defined as follows: It is a design process in which multiple participants jointly “think-act” and learn from each other. Participants include both users and designers. In the process of participatory design, designers strive to understand user situations (Liu Jun, 2013), while users strive to express their desired goals and learn appropriate technical means to achieve those goals. The core idea of participatory design has always been to respect the subjectivity of design users and to respect the value of tacit knowledge that cannot be covered by today’s so-called disciplines and expertise (H.M. Leung, 1998). The inspiration brought by participatory design is not only a design strategy and method, but also involves a deeper level of the subjectivity of design users, the role and limitations of designers, respect for traditional knowledge, inheritance and transcendence, etc. problem thinking. The design process is mainly to understand, evaluate, provide choices, decide, reflect, and improve.

The research is carried out from the project management implementation part. In-depth understanding is the methodology of the combination of project communication management and design in the concept of management (Zhang Ke, 2013).

For the designer, to give full play to the overall planning and leadership role of the product manager, the designer must have basic professional quality and strong communication skills, and use design thinking flexibly in engineering design.

In the actual project process, in order to ensure the project progress, the designer uses the three-level project plan progress management system to clearly list the responsible content of the stakeholders.

The principle of co-participatory design is a design method that integrates and adopts the design requirements and suggestions of multi-stakeholders in order to achieve and construct common goals, which can be reflected in many major projects and product design schemes. design effect. This method will be used in the design process of the laboratory space renovation, which is embodied in multiple visits, observations, and detailed investigations, looking for explicit and implicit stakeholders, summarizing the demand points of multiple parties and taking them as important design points in the plan. be embodied. The co-participatory design method runs through the design process of laboratory space renovation. From the initial requirements of the entrusting party and the construction party to the mid-term design requirements to the later construction details process, all parties need to work together to achieve an optimal design.

This paper will use the collaborative design theory in service design as the main theoretical guidance for project practice, and assist environmental psychology, ergonomics, space design aesthetic theory and laboratory design standards as the basic design standards, and strive to complete the project design with theory combined with practice.

FIELD RESEARCH

Field research includes project problem analysis and stakeholder analysis. Requirement conclusions are drawn through stakeholder and problem analysis. Project problem analysis is through visiting the project construction site and listing the on-site use problems. Stakeholder analysis is a list of real stakeholders based on actual projects, and then based on on-site visits to actual user needs, analysis and establishment of user models, and drawing of virtual activity journey maps of characters to dig deep into user psychology, understand user needs, and propose improvement plans. The results of on-site investigation are analyzed and summarized in combination with the feedback from the construction party.

After communicating with the entrusting party and the contractor in the early stage of the design, it is necessary to organize the materials in the laboratory, make full and reasonable use of the available resources, and use the old materials as much as possible. Through material sorting, it is found that many of the existing materials have been in disrepair for a long time, which is inconsistent with modern facilities, and the utilization rate is low. In the later reconstruction and design process, try to save materials and use as many original materials as possible on the premise of ensuring the decoration effect.

USER NEEDS ANALYSIS

Under the guidance of the principle of participatory design, the relationship between stakeholders is listed and analyzed. The main stakeholders of this project are: designer, contractor, supervisor, public manager and owner. After determining the main stakeholders of the project, the task assignment process of the project task plan is carried out, and the functions of each unit are clarified.

The designer plays the role of coordinating, coordinating and promoting communication in this project, urging all parties to complete the tasks in time and accept the achievements.

For users, the needs mainly include experimental needs, storage needs, cooperative discussion needs, data processing needs and leisure needs. Experimental demand is the most important demand, and experimental space occupies the largest proportion in the overall space. Second, storage space. Due to the large number of laboratory instruments, storage problems need to be solved. Finally, data processing, collaborative meeting and leisure requirements, which are the auxiliary requirements of the laboratory, will take a secondary consideration in the later design.

Digging into the user's psychology can extract the user's high-frequency vocabulary. After the integration and stratification of high-frequency words, it can be concluded that the psychological needs of users mainly include: actual needs, indicating that the laboratory needs to be popularized to every user, and users need enough space for scientific research tasks; Two is the need for space division, that is, space division must be reasonable, and the laboratory has a large number of sophisticated hardware facilities, so space division needs to be compatible with storage function, experimental function and office function, maximize the use of space. Efficiency; Second, interior decoration and emotional needs, through the design, so that the laboratory has an overall style, more humanized.

SPACE PROGRAM DESIGN AND IMPROVEMENT

According to the principle of joint participation in the design adopted by the actual needs, since the client is not a professional design participant, the design guidance that can be provided is limited, and there is no basic concept for the required design style and visual presentation. If there is no effective communication in the early stage, during the design process Unpredictable situations may occur during the project implementation process, delaying the design progress and affecting the visual presentation.

Therefore, it is necessary to clarify the similarities and differences between the designer's thinking and the user's thinking, seek common ground while reserving differences, and communicate with users in a method acceptable to users.

The mode of joint participation and user interaction is the reason for the iteration of the plan that will inevitably occur in the process of the project. The designer designs the scheme through the user's demand point of view, and the user generates new design thinking and needs through the designer's scheme design and interpretation, and then the two sides make a final design scheme after fusion, compromise and adoption. In order to convey design information more intuitively and clarify user needs, the designer collected space style pictures on the basis of the client's existing image words, showing the intuitive comparison effect of different styles of space, which is convenient for the client to understand and choose.

DESIGN SKETCH

Combined with the preliminary work, hand-painted design sketches and design plans. It mainly includes floor plans, exhibition wall renderings, and laboratory space plans, which are intended to inspire design inspiration.

In the process of sketching, brainstorming and thinking divergence are carried out at the same time to ensure that the green design is integrated into the laboratory renovation design while meeting the needs of the entrusting party.

For example, the laboratory space renovation design plan, as well as the later construction and actual use process, need to first consider the practicability and safety of the laboratory, and then carry out the space beautification and detail design on this basis. Green design is an important design thinking in modern architectural design. The use of diversified green plants and green system design is integrated into the architectural design of space design. Taking into account the green cycle of the laboratory, it is integrated into the basis of the existing safety cycle system. Diversified garbage disposal methods, planting green plants in many places and in many ways, purifying the air and keeping the interior of the space as clean as possible. Various green plants and hydroponics utilize indoor space at multiple levels to improve space utilization. In addition, a leisure area is set up outside the common office space, taking into account the multi-faceted needs of users. The home design is a half-width design, which ensures that the interior design sketch meets the basic functional requirements of the laboratory and adds multiple functions, which is innovative in the existing laboratory design.

PROGRAM ITERATION

After three iterations of the plan, the third plan expanded the original display space, set up a corner, and used the corner as the laboratory teacher's work station, and removed the original glass window of the compartment, the space was changed to semi-open, and the glass window was Display cabinets are placed and used in conjunction with the corridor exhibition walls as a display area for laboratory results.

Specifically: the rectangular laboratory modified the originally closed display space into a semi-open display space, and the electronic display screen was used for multimedia display and placed on the wall. The closed partition wall becomes an open wall, one wall is multi-purpose, the overall air in the room is smooth, bright and energy-saving. Replace the original bulky furniture with simpler and more flexible combined furniture to meet the various experimental needs of users. Teachers' workstations are set up in the window, and the lighting is good. In addition, considering the storage needs of large equipment, an area is added for equipment placement.

The L-shaped laboratory is converted into a leisure area. Considering the limited space of the laboratory, the unimportant space can be used as tables and chairs to increase the space utilization efficiency. The L-shaped laboratory space is special. In order to increase the space utilization rate and ensure that the flow of people is clear and clear, the designer divides the function of the experimental area and the office area, and divides the experimental table

and the desk to ensure that the flow of people is clear and clear. At the same time, the quantity meets the demand of the client's capacity.

After communicating with the entrusting party, the entrusting party agreed with this plan. The designer has entered the implementation stage of the elevation rendering scheme design project.

Combined with the actual needs of the entrusting party, the main display functions of the laboratory are placed in the L-shaped laboratory. The main purpose of the rectangular laboratory is for experimental office and storage of large equipment. Both laboratories have both experimental and office functions. For the L-shaped laboratory, the office area is placed on the right to maintain good lighting, and the experimental table is placed on the left to combine with the display space to ensure ample space. The storage cabinet is placed against the wall in the office area to maximize the use of low-utilization space, and the display space is on the wall and in the corridor. For the rectangular laboratory, increase the storage space of large-scale experimental equipment, place the storage cabinet in the area against the wall, and arrange the office experimental space with three rows of desks in the middle, and four experimental desks on the two sides to ensure a clear flow line of people, the space compatibility is high, the secondary display area is placed on the wall, and there is no additional form division.

The main colors of the scheme are white and blue, and the tones are fresh and natural to avoid excessive color jumps and violate the laboratory decoration policy.

The main exhibition wall of the L-shaped laboratory adopts a combination of straight lines and arcs. The lines are simple, which means square and circle, reflecting the progress and professionalism of both technology and art. The overall effect of the laboratory is stable, bright and tidy. In the choice of display form, the smaller exhibition wall combines electronic display screens with traditional display panels to maximize the effect of displaying information. The electronic display screen mainly displays the dynamic history of the laboratory and patent awards, which can be updated in real time. Electronic display A light strip is set above the screen to increase the light effect. A protruding timeline is designed under the electronic display screen to record important time node information of the laboratory, and a movable display stand is placed under the timeline to place small certificates such as patents or physical photos. The left and right sides of the exhibition wall are used as display racks to display awards and patent photos. The display method of the side exhibition wall is the same as that of the small exhibition wall, which is also the combination of the exhibition board and the electronic display screen. The display board adopts the form of display board with replaceable information content, which is convenient for the replacement and real-time update of the display board content. The acrylic display board has good light transmittance and reflectivity, adding a sense of refinement to the display area in the details. In addition, a storage cabinet is set under the exhibition wall to increase the storage space by using the vertical space, and the top of the storage cabinet can also be used as the display of experimental equipment. Combining the exhibition board and the electronic display screen is a very

intuitive display method. The rectangular laboratory effect is unified with the L-shaped laboratory effect.

After the integration of the third plan, it was discussed with the entrusting party and the construction party. The construction party said that the plan had no unreasonable spatial design and could be implemented. The entrusting party believes that this plan can be continued, and the corresponding detailed design of the laboratory will be carried out next.

The main colors of the scheme are white and blue, the tones are fresh, stable and elegant, and the overall interior space is simple and elegant. The functional layout of the laboratory is reasonable, the flow of people is clear and smooth, and the safety is excellent. Increase the display space and storage space to meet the various needs of users, with strong practicability.

CONCLUSION

In a variety of projects in different industries, the trend of joint participation is becoming more and more obvious, and the importance of joint participation is becoming more and more prominent. The whole process of design practice is carried out under the guidance of multi-party participation in the design. The stakeholders are listed, the multi-party design logic is sorted out, and the multi-party coordination is carried out according to the actual needs of the relevant stakeholders, and finally the design is completed and the project is implemented.

For the designer, the final plan effect is based on the actual site of the laboratory and the actual needs of the owner. During the process, it has undergone many revisions, of which large and small revisions have been made many times, and the details have been figured out many times. Some of the contents are too trivial so they are not fully displayed in the article.

The project progress management mode in joint participation is a very efficient design management mode, not only for design under the narrow theory, but also under the development trend of multidisciplinary education, I believe that in the future, the principle of joint participation in design will become more mature in design, to make new contributions to the theoretical development and practical application of modern design.

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