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## A Comparative Study of Design Strategies for Lobby of Outpatient Department of Hospital Buildings in Cold Climate Region in China

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### Abstract

This paper aims to clarify the relationship among lobby-design, energy consumption and daylight environment of outpatient department in hospital buildings, and further goal is to explore effective design strategies for outpatient lobby in hospitals for better healthcare environment while lower energy consumption.

Firstly, investigation that focused on thermal and daylighting environment on current hospitals was carried out in Tianjin. Based on the investigational data, it is concluded that space-design and façade-design are both the main factors that impact physical environment. Then simulation was conducted to study how these factors affect energy consumption and physical environment. In the first study that concerns the space-design of lobby, four basic comparative models with different positions of lobby were built up to compare energy consumption and daylighting environment; then for further analysis, space orientation and height were studied. The results of simulations in the first study indicates that: (1) Concerning the position, Form I case has the lowest energy consumption level and the most satisfactory interior daylight environment; (2) Concerning the orientation, w-orientated case has the highest energy consumption level while s-orientated case has the lowest level; (3) Concerning the height, it shows that increase of lobby's height brings great increase in energy consumption while no obvious help in improving daylighting environment. In the second study that concerns façade-design of lobby, both window-wall ratio and skylight ratio were analyzed. The results of simulations in the second study show that: (1) Concerning window-wall ratio, the raise of the ratio has insignificant impact on increasing energy consumption level but noticeable impact on developing the interior daylight environment; (2) Concerning skylight ratio, the raise of the ratio causes great increase in both energy consumption level and daylight availability, which might lead to excessive consumption and daylight availability under extreme condition.

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## 1. Introduction

Hospital buildings are considered to be one of the most energy demanding building types [1]. Data shows that annual energy consumption of hospital buildings in Tianjin, a typical city in cold climate region in China, is more than 245kWh/m<sup>2</sup> [2], ranking the second highest in all kinds of non-residential buildings. Lobby is the most primary and complete public space in outpatient department, which composes the most important functional part in hospital buildings. And because of the highest occupancy and design-diversity, the lobby of outpatient department is taken as the main research object in this paper. Literature shows that natural daylight makes great contribution to creating comfortable and healthy interior atmosphere in hospital buildings and helps speed up patients' recovery [3]; and the environmental comfort in lobby of outpatient department is a key issue in hospital design. On the other hand, in some cases, the lobby with inappropriate designs such as excessive mass, wrong orientation or unsuitable external-wall construction, may lead to the consequence with huge increase of energy consumption while no ideal natural daylight brought in [4]. To clarify the relationship of lobby-design, energy consumption and daylight environment of outpatient department, more investigation and detailed study are demanded.

In the cold climate regions of China, taking Tianjin as example, five cases with different lobby-designs in outpatient department were investigated at the beginning of the study (see Fig.1 and Fig.2). It is found that interior physical environment, especially daylight environment, is almost determined by the way in which lobby connects to exterior space. Space-design factors (including position, orientation and height of lobby) and façade-design factors (including window-wall ratio and skylight ratio) are remarkable points encountered during the specific investigation of lobby-designs. Three cases in the investigation have skylight design in the lobbies (see Fig.3). All of the skylight brings more natural light into lobby space and help create positive atmosphere in hospital buildings. Meanwhile, interior daylight environment and space view are diversified by the different ways of skylight design (especially skylight ratio). As a result, lobby's position, orientation, height, window-wall ratio and skylight ratio are chosen as the main factors in this research to achieve comprehensive design strategy of lobby in hospital buildings.

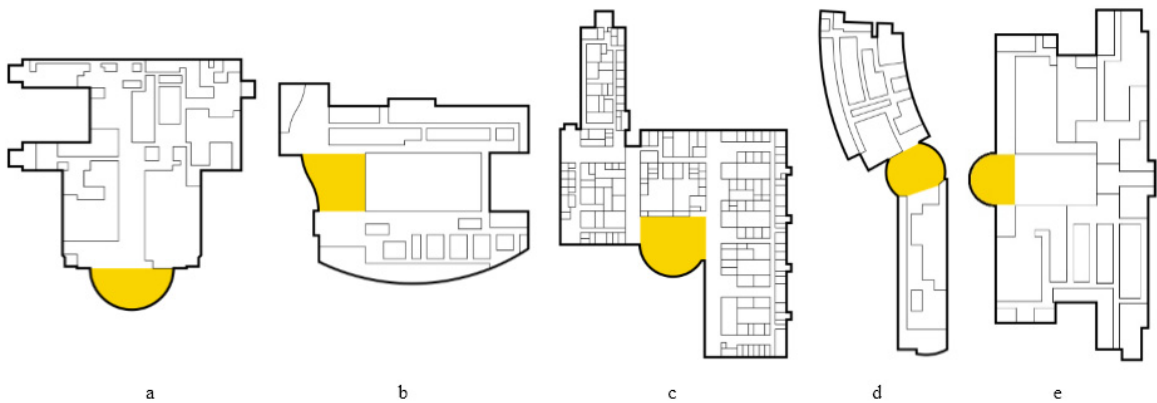


Fig. 1. (a) Plan form of lobby in Hospital R; (b) Plan form of lobby in Hospital E; (c) Plan form of lobby in Hospital Z; (d) Plan form of lobby in Hospital Y; (e) Plan form of lobby in Hospital N

By analyzing the relationship among lobby-design, energy consumption and daylight environment, the research aims at achieving the goal for better interior environment but lower energy consumption in the outpatient department of hospital buildings.

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