

A Study on the Classification of Envelope System Type for Building Remodeling in the Public Sector

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ABSTRACT

In response to the deterioration of the building envelope, there is a need for optimizing the energy efficiency of buildings through remodeling of the right time. Building envelope system plays significant role in energy saving by reduction of heat transfer between indoor and outdoor environment. This study aims to classification of envelope system type for public building remodeling. The results of this study are classified according to building age, size and purpose of public buildings. The results of envelope system type for public buildings can significantly contribute to the improvement in energy efficiency maximization of public buildings.

KEYWORDS

Public building, Remodeling, Envelope type

INTRODUCTION

The building sector has very high potential of energy saving so that it is defined as the field with high potential to realize the governmental intention to reduce carbon emission, and in order to reduce carbon emission, the energy improvement or remodeling of the existing buildings that are more than newly constructed buildings should be realized.

Since the full-scale action plans for the preservation of global environments have been prepared throughout the world, there is a growing interest in green remodeling rather than the new building construction and the relevant remodeling items are being added to various eco-friendly certification systems or the systems related to performance improvement and energy efficiency are being introduced.

Especially, the demands for reduction of greenhouse gas emission and improvement of energy efficiency from existing public buildings will be accelerated gradually and it is necessary to prepare the energy-efficient remodeling plan to meet such demands. Accordingly, the remodeling business is being revitalized in the building sector as the measure to improve the environments and reduce the greenhouse gas emission, and

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especially the governmental support for remodeling of public buildings is being expanded.

The deterioration level of public buildings retained by each agency varies depending on the completion year, but the energy efficiency of most buildings that have passed 20 years or longer has been declined due to deterioration and their energy performance is poor due to insufficient insulation standards at the time of their completion so that the energy consumption in these building are increasing continuously. The remodeling demands for public buildings increase continuously but the remodeling technology which is irrelevant to the number of age, size and purpose of various public buildings is applied so that the energy-efficient remodeling is not carried out.

Remodeling which improves the energy performance of a deteriorated building can be classified into the architectural section, facility section and new and renewable energy section, and the outer wall among remodeling elements in the architectural section is the part which has the highest heat gain and loss in the building and the cooling and heating energy consumption and the greenhouse gas emission can be minimized through the improvement of insulation performance of outer wall.

Therefore, the purpose of this study is to classify and analyze the envelope type of public buildings per number of age, size and purpose using the existing materials and support efficient remodeling of public buildings.

Date classification

In order classify the envelope type of public buildings per number of agr, size and purpose, the comprehensive analysis was carried out using the reference, research reports and existing materials on remodeling cases.

The investigation on the envelope status of public buildings was carried out using the 'Construction expense analysis data per type of public building' provided by the Public Procurement Service, 'Master plan for improvement of environments of deteriorated facilities contributing industrial technologies' carried out by National Research Council of Science & Technology, '2014 white paper on green remodeling pilot project of public buildings' published by Ministry of Land, Infrastructure and Transport and Korea Infrastructure Safety and Technology Corporation and other references. The data classification is as shown in Table 1.

Table 1. Classification of data for analysis of public building envelope

| <i>Classification</i> | | <i>Number of buildings</i> |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------|
| Construction expense analysis data per type of public building | Public Procurement Service | 454 |
| Master plan for improvement of environments of deteriorated facilities contributing industrial technologies | National Research Council of Science & Technology | 20 |
| 2014 white paper on green remodeling pilot project of public buildings | Ministry of Land, Infrastructure and Transport, Korea Infrastructure Safety and Technology Corporation | 11 |
| Public building remodeling execution cases | Korea Institute of Civil Engineering and Building Technology | 4 |

Public building envelope data was collected and classified according to the building purpose, total floor area and exterior materials as shown in Table 2. The building purpose was classified into 4 types including business facility, education & research facility, lodging facility and other facilities, and the total floor area was classified into 5 types including below "500 m²", "500 m² ~ 1,000 m²", "1,000 m² ~ 3,000 m²", "3,000 m² ~ 10,000 m²" and "over 10,000 m²". The building age was classified into 4 types over 25 years, 15~25 years, 5~15 years and 0~5 years, and the exterior materials were classified into 9 types including tile, brick, stone, panel, panel+brick, painting, external insulation system and other exterior material (curtain wall).

Table 2. An example of a table

| | Classification | Number of buildings | Ratio (%) |
|--------------------|----------------------------------------------|---------------------|-----------|
| Building purpose | Business facility | 181 | 36.6 |
| | Education & research facility | 193 | 39.1 |
| | Lodging facility | 43 | 8.7 |
| | Other facilities | 77 | 15.6 |
| Total floor area | Below 500 m ² | 19 | 3.9 |
| | 500 m ² ~ 1,000 m ² | 8 | 1.6 |
| | 1,000 m ² ~ 3,000 m ² | 43 | 8.7 |
| | 3,000 m ² ~ 10,000 m ² | 246 | 49.9 |
| | Over 10,000 m ² | 177 | 35.9 |
| Building age | Over 25 years | 24 | 4.9 |
| | 15~25 years | 15 | 3.0 |
| | 5~15 years | 156 | 31.6 |
| | 0~5 years | 299 | 60.5 |
| Exterior materials | Tile | 7 | 1.4 |
| | Brick | 49 | 10 |
| | Stone | 77 | 15.7 |
| | Panel | 115 | 23.4 |
| | Painting | 16 | 3.3 |
| | External insulation system | 8 | 1.6 |
| | Other exterior material | 55 | 11.2 |
| | Panel+Brick | 22 | 4.5 |
| | Panel+Stone | 143 | 29.1 |

RESULTS

The analysis result of exterior materials according to the building purpose is as shown in Figure 1. "Panel+Stone" (37%) for business facility, "Panel+Stone" (24%) for education & research facility, "Panel" (37%) for lodging facility and "Panel" (30%) for other facilities showed the highest ratio respectively. Especially, stone, panel and stone+panel account for 78% of total exterior materials in case of business facilities.

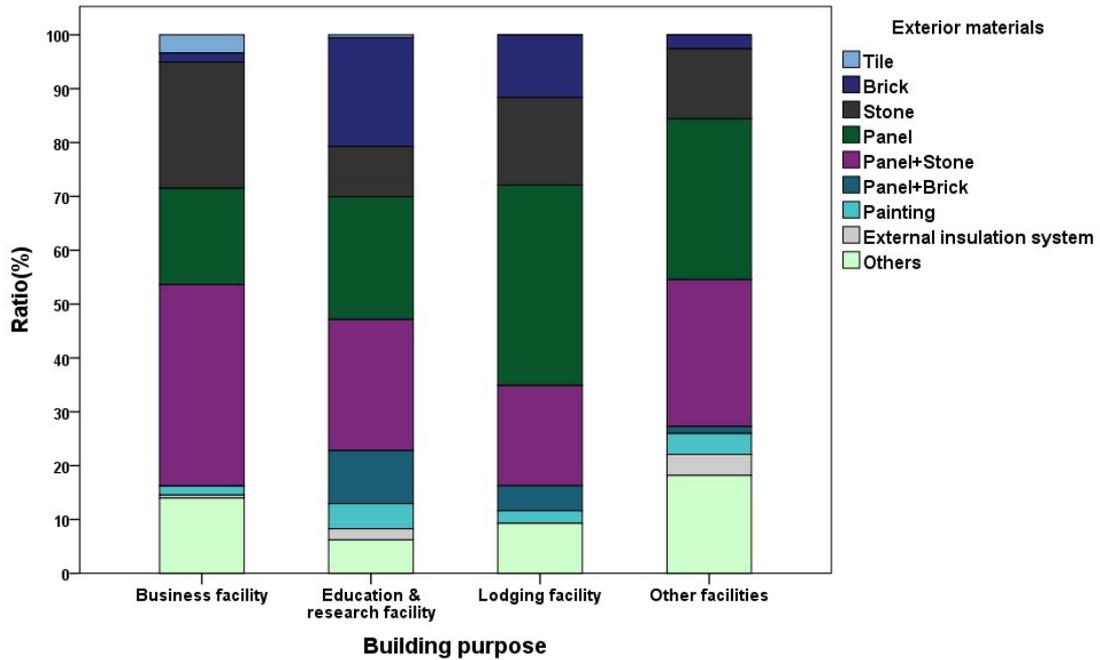


Figure 1. Classification of exterior materials according to the building purpose

The classification result of exterior materials according to the total floor area is as shown in Figure 2. Stone (42%) for buildings with total floor area below 500 m², brick (50%) for buildings with total floor area between 500 m² and 1,000 m², Panel+Brick (29%) for buildings with total floor area between 1,000 m² and 3,000 m², Panel+Brick (27%) for buildings with total floor area between 3,000 m² and 10,000 m² and Panel+Brick (33%) for buildings with total floor area over 10,000 m² showed the highest ratio respectively. It shows that as the total floor area is larger, the application ratio of panel and other exterior materials (curtain wall) becomes higher.

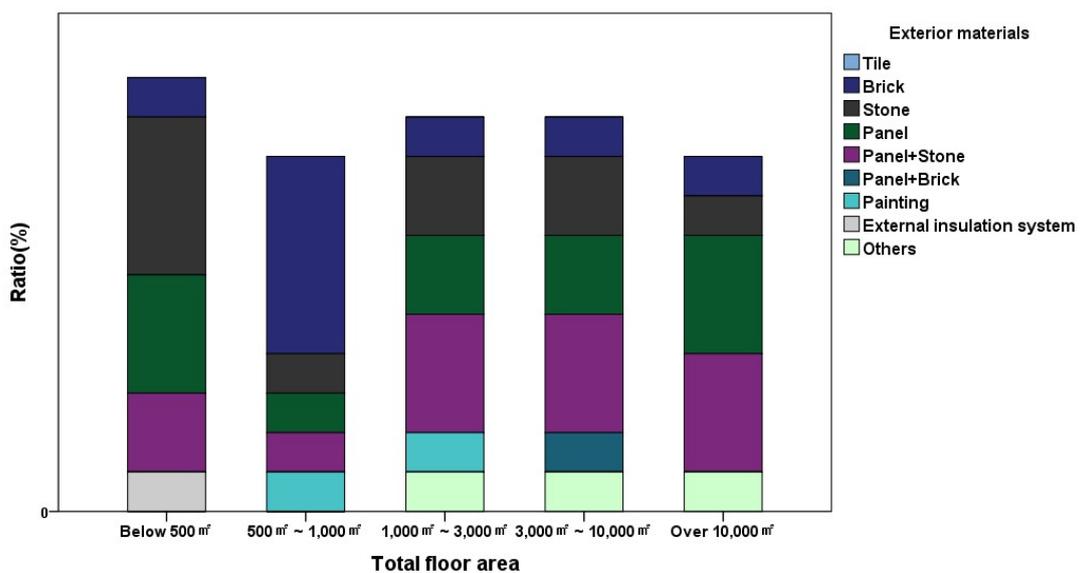


Figure 2. Classification of exterior materials according to the total floor area

The classification result of exterior materials according to the building age is as shown in Figure 3. The brick (38%) and painting (25%) for buildings that passed over 25 years, the brick (31%) and painting (23%) for buildings that passed 15~25 years, other exterior materials (25%) and panel+stone (22%) for buildings that passed 5~15 years and panel+stone (36%) and panel (31%) for buildings that passed 0~5 years showed the highest ratio respectively. In other words, the outer wall of public buildings that have passed over 15 years consists of brick and painting mainly, as the number of elapsed years is lesser, the application frequency of panel and stone becomes higher.

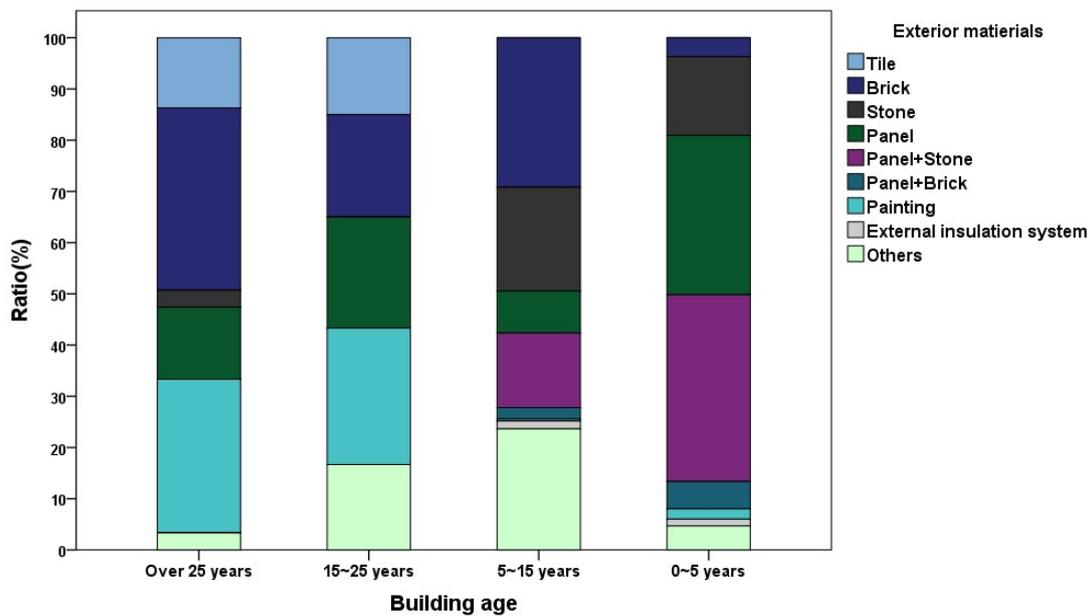


Figure 3. Classification of exterior materials according to the building age

CONCLUSION AND IMPLICATIONS

The envelope type of public buildings age, size and purpose was drawn through this study, and this will enable the support of efficient remodeling of public buildings and contribution to the development of technologies for envelope remodeling of public buildings. The development of optimization technology for maximizing the energy efficiency according to typical envelope type of public building will be carried out in future studies.

ACKNOWLEDGEMENTS

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) and the Ministry of Trade, Industry & Energy(MOTIE) of the Republic of Korea (No. 2015210103180).

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