DEVELOPMENT OF KNOWLEDGE BASED SELECTION PROCESS FOR FINISHING MATERIALS AT BUILDING DESIGN PHASE

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ABSTRACT: Selection of finishing materials in the design stage is an important management factor in terms of use safety and satisfaction, and work cost and process. However, selection of materials in the design stage is usually conducted without related guidelines or a set process, but depends on the experience of the architect or advice of materials company employees. Therefore, the aim of this study was to develop a finishing materials selection process that can be used by a architect. Materials selection related rules collected through interview with experts and five office building cases were used as knowledge. In addition, another aim of the study was to propose a prototype system interface for use in the field.

Key words: Finishing materials, knowledge-based, material selection, rule-based, case based

1. INTRODUCTION

In order to select the appropriate finishing materials, there is a need to effectively reflect changing requirements of owner and the intentions of the architect, and to review related standards and laws. However, the architect usually ends up depending on materials related consulting companies or their employees when selecting finishing materials, and thus, it becomes impossible to counteract effectively to changed design-related factors. From the perspective of the materials company, repetitive materials selection related tasks lead to inefficiency. Therefore, in order to select appropriate finishing materials, there is a need for a process that appropriately applies related rules and cases. The aim of this study is to develop a finishing materials selection process using knowledge on rules and cases needed for materials selection based on analysis of the current situation of finishing materials selection tasks. Furthermore, the study aims to propose a prototype system for use in the field based on this information.

2. ANALYSIS OF CONSTRUCTION FINISHING MATERIALS SELECTION KNOWLEDGE

2.1 Current situation of finishing materials selection

As a result of analyzing materials selection processes of twenty-four people in the field, including architects, builders and materials company employees, it was found that the selection process is as follows. Physical performance such as specifications, physical characteristics and construction method are reviewed, and then materials cost is reviewed to complete construction within the limited budget. This study divided performance review for materials selection into different factors that influence the decision based on interviews with those working in the field to owner/architect requirements, laws/guidelines. Construction knowledge, and divided cost related factors into factors that influence materials selection, and collected materials selection knowledge. In addition, factors that must be applied such as laws or guidelines were divided as strong conditions, and those that can change according to the situation such as owner/architect requirement were divided as weak conditions.

2.2 Rules-based materials selection knowledge

Rules-based materials selection knowledge was collected through interview with experts, observation of materials selection process and reference research. The collected knowledge can be expressed in the form of 'IF condition THEN action' form, as shown in Table 1.

2.3 Case-based materials selection knowledge

The case was analyzed based on a typical floor and finishing materials selection according to each room and element in reference to planning books, and on cost according to unit area. The case analyzed was an office building constructed from 2007 to 2009. The analysis range was internal finishing work.

Results of finishing materials selection analysis showed that the same finishing material was used for the stairways and vestibule, and entrance space that require special performance such as EPS and bathrooms use materials selection that are not influenced by materials selection results of other rooms. In addition, comparatively small spaces such as storage and cleaning facilities rooms used materials that were similar to other rooms. Background material in the floor area of the working area was finished with O.A. floor carpet tiles.

Areas not many people pass through such as air-conditioning room and EPSs cost a small amount, and areas many people pass through such as the elevators, halls, bathrooms and corridors cost a higher amount. The cost per surface area unit was analyzed as being high for cleaning facilities rooms or storage rooms because they have a small surface area.

Table 1. Examples of Materials Selection Knowledge Expression according to Office building and Working spaces

Area	IF condition	THEN action	Factors of influence	Strong/Weak Condition
Floor	When the owner requirements good walking space	Application of floor materials that are 5 ㎜ in width or above	Owner/Architect requirements	Weak
	When the owner wants highest quality finishing	Application of stone finishing	Owner/Architect requirements	Weak
	Narrow walking space	Application of PVC tiles with a layered structure	Construction knowledge	Weak
Inside wall	When the building is over 12 stories or 50 m in height	Application of a product that is fireproof for 2 hours or more	Laws/rules	Strong
	When the building is higher than 4 stories but lower than 12 stories, or higher than 20 m but lower than 50 m	Application of a product that is fireproof for 1 hour and 30 minutes	Laws/rules	Strong
Ceiling	When the space is a large working space that is 300 ㎡ or larger	T-Bar method ceiling material	Construction knowledge	Strong
	When the space is a construction space that is 10 m2 or smaller or one side that is 3 m or under	M-Bar method ceiling material	Construction knowledge	Strong

3. KNOWLEDGE-BASED FINISHING MATERIALS SELECTION PROTOTYPE SYSTEM

3.1 Materials selection process

Just like the materials selection process of the architect, the materials selection process requires design plan information as general information. Next, the requirements of the owner/architect are entered according to the organized process of the knowledge-based process in order to review materials performance. Based on the entered information, solutions are found for each material from the materials information database.

This stage where performance is reviewed can be defined as stage 1 of the materials selection process.

The next stage of the materials selection process requires review of cost. Review of cost presents cost information of existing cases to the process, and the cost requirements of the user are entered while considering this information. The cost per surface area unit is calculated from cost requirements, and the most appropriate materials combination is selected. This stage of conducting cost review can be defined as materials selection stage 2. The finishing materials selection process can be shown as a diagram, as in Figure 1.

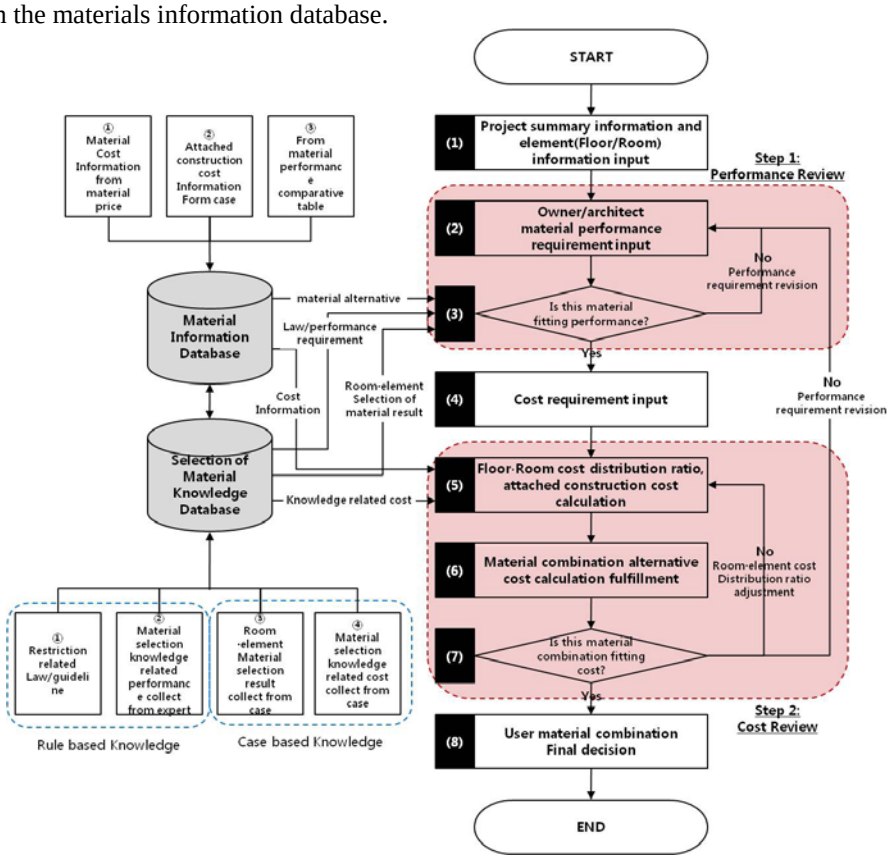

Figure 1. Knowledge-based construction finishing materials selection process

3.2 System interface

The rule-based performance review interface is shown in Figure 2. This stage shows the results of applying the

requirements entered by the user to the system. Laws and some construction knowledge have strong conditions that must be reviewed without any information from the user, so it is applied regardless of whether or not the user inputs anything.

The case-based cost review interface is shown in Figure 3. The typical floor finishing work cost is presented as the cost that can be used for a typical floor excluding space finishing work cost that is not handled by the system, and the work cost per ㎡ is presented. The system goes through rule-based performance review and case-based cost review and presents appropriate materials combination solutions for each area with order of priority. The user can select one of the final solutions.

Figure 2. Rule-based performance review

Figure 3. Case-based cost review

3.3 System verification

Utility of the prototype system was verified through 10 materials selection experts. The categories of verification are shown in Table 2. When asked about the utility of the system and process proposed in this study the result was 4.1 on a 5 score scale, showing that it is comparatively effective. Those working in the field highly evaluated reduction of time consumed and cost review in terms of system utility, and lowly evaluated the limited application range. In terms of process, the evaluation was that the attempt to apply materials selection knowledge to the system and reviewing laws/guidelines and construction knowledge were effective. There were opinions that the system could be improved in the future by adding visual information such as color and construction photographs to make it a more effective system.

Table 2. System verification categories

No.	Category
1	How effective is this system for supporting materials selection tasks and what is the reason for the evaluation?
2	How effective is the materials selection process presented in this study for supporting materials selection tasks and what is the reason for the evaluation?
3	How rational do you evaluate the materials selection knowledge presented in this study to be and why?
4	This study was conducted on the typical floor of an office building. If it is used to support the materials selection process of the entire building in the future, which facility, floor or room should be the first priority of research?
5	What are possible points of improvement of this system?

4. CONCLUSIONS

Through this study, a materials selection process that can effectively be applied from the design stage to the finishing materials selection stage of office buildings was developed, and a prototype system that applied the process was presented. Appropriate materials selection by the architect by comprehensively using related rules and a case related to building finishing materials selection was made possible.

The knowledge-based construction finishing materials selection process presented in this study is significant in that it was developed based on the knowledge of practitioners in the field who conduct materials selection tasks and analysis tasks. It is expected that architects will be able to reduce time and efforts consumed for materials selection task through the system and materials company employees will be able to reduce inefficient tasks and raise productivity levels.

ACKNOWLEDGEMENT

This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MEST) (No. 2010-0024159).

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