

## Application Research on Selection of Curtain Wall Type Based on Analytic Hierarchy Process

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**Abstract.** On the basis of a curtain wall type selection model using AHP, this paper further optimizes the influence factors of curtain wall type selection and gets 13 factors and they are concluded into function index, cost index, schedule index and quality index. Final, case analysis shows that the model has fair practicability and reliability.

### Introduction

To solve the plight of curtain wall type selection, a kind of curtain wall type selection decision-making model was put forward, namely the curtain wall type selection decision-making model based on analytic hierarchy process (AHP). And the model still exists the space to be optimized further. This paper optimizes the model through discriminating impact factors further, and gives a case analysis.

### The Optimization of Curtain Wall Type Selection Factors

The curtain wall type selection model using AHP extracts 15 factors through studying the main process of design, construction and management of curtain wall construction with Delphi technique. With the reference to literatures and the advice of experts, this paper distinguishes the 15 factors mentioned above according to the factor selection principle of scientific, systematic, applicability and comprehensiveness. The results show in Table 1. And we acquire 13 factors including airborne sound insulation performance, water tightness performance, air tightness performance, resistance to wind load performance, plane deformation performance, thermal performance, optical performance, safety performance, aesthetic appearance, quality assurance, design cost, construction cost, maintaining cost, project period. To eliminate the correlation and repeatability between each factor, according to the experts' recommendations, we summarize the factors into performance index, construction period index, cost index and quality index. The evaluation of performance index includes airborne sound insulation performance, water tightness performance, air tightness performance, resistance to wind load performance, plane deformation performance, thermal performance, optical performance and safety performance. The evaluation of construction period index is based on the construction period. The evaluation of cost index includes design cost, construction cost and maintenance cost. The evaluation of quality index is based on quality assurance.

Table 1 Curtain wall type selection factors

Before adjustment	After adjustment	Way of adjustment	Reason of adjustment
Airborne sound insulation performance	Airborne sound insulation performance	keep	
Water tightness performance	Water tightness performance	keep	
Air tightness performance	Air tightness performance	keep	
Resistance to wind load performance	Resistance to wind load performance	keep	
Plane deformation performance	Plane deformation performance	keep	
Thermal performance	Thermal performance	keep	
Optical performance	Optical performance	keep	
Safety performance	Safety performance	keep	
Applicability performance	availability	Split then delete	The factor before adjustment is too rough; availability is precondition index.
	Aesthetic appearance	Split then keep	The factor before adjustment is too rough
Quality assurance	Quality assurance	keep	
Design cost	Design cost	keep	
Construction cost	Construction cost	keep	
Maintaining performance	Maintaining cost	change	The factor before adjustment is not accurate enough
Construction period	Project period	change	The factor before adjustment doesn't include the cost in design stage.

### Case Study

The case comes from a curtain wall project the author used to participate in. the project is about the curtain wall type selection of a building from the second floor to the top. Candidates are unitized-system hidden frame supported glass curtain wall and stick-system hidden frame supported glass curtain wall. This case's hierarchical progressive model is shown in Fig. 1.

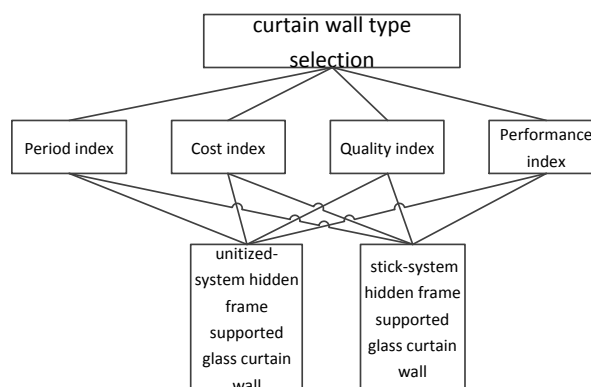


Figure 1. Hierarchical progressive mode

We invited 6 experts (2 project leaders, 2 senior engineers and 2 professors in the relevant field)

to evaluate criterion layer and plan layer. The results show from Table 2 to Table 5.

Table 2 Evaluation of comparison matrix of criterion layer

	Period index	Cost index	Quality index	Performance index
Period index	1	2	1/2	2
Cost index	1/2	1	1/2	2
Quality index	2	2	1	3
Performance index	1/2	1/2	1/3	1

Table 3 Comparison matrix of plan layer relative to period index

period index	stick-system	unitized-system
stick-system	1	1/2
unitized-system	2	1

Table 4 Comparison matrix of plan layer relative to cost index

cost index	stick-system	unitized-system
stick-system	1	2
unitized-system	1/2	1

Table 5 Comparison matrix of plan layer relative to quality index

quality index	stick-system	unitized-system
stick-system	1	1/2
unitized-system	2	1

Table 6 Comparison matrix of plan layer relative to relative to performance index

performance index	stick-system	unitized-system
stick-system	1	1/2
unitized-system	2	1

According to comparison matrix, we calculate the weight vector of criterion layer with root method:

$$W_{cr} = (0.269, 0.190, 0.420, 0.121)^T \quad (1)$$

Relative to construction period index, the weight vector of unitized-system curtain wall and stick-system curtain wall is:

$$W_p = (0.667, 0.333)^T \quad (2)$$

Relative to cost index, the weight vector of unitized-system curtain wall and stick-system curtain wall is:

$$W_c = (0.333, 0.667)^T \quad (3)$$

Relative to quality index, the weight vector of unitized-system curtain wall and stick-system curtain wall is:

$$W_q = (0.667, 0.333)^T \quad (4)$$

Relative to performance index, the weight vector of unitized-system curtain wall and stick-system curtain wall is:

$$W_p = (0.667, 0.333)^T \quad (5)$$

In plan layer, the weight vector of unitized-system curtain wall and stick-system curtain wall is:

$$W_{pl} = \begin{pmatrix} 0.667 & 0.333 & 0.667 & 0.667 \\ 0.333 & 0.667 & 0.333 & 0.333 \end{pmatrix} \quad (6)$$

Total layer sorts:

$$W_t = W_{pl} \bullet W_{cr} = (0.604 \quad 0.396)^T \quad (7)$$

All the consistency checks meet the requirements.

As the results of calculative process show, in the given condition of construction, the superiority vector of unitized-system curtain wall is 0.604. While the superiority vector of stick-system curtain wall is 0.396. So, in this condition, we had better choose unitized-system curtain wall, which is true of accrual choice.

## Conclusion

The decision method of curtain wall type selection based on Analytic Hierarchy Process is practical and reliable. If there is any weakness, it should be the avoidless subjectivity because of the comparison matrix evaluated by experts.

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