Determination of influencing factors on the axis grid for optimizing the economic efficiency of industrial halls

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ABSTRACT: The increasing costs of construction have led to a growing importance of economically optimized building practices in industrial and commercial construction, to maintain competitiveness. A qualitative research method was employed to investigate the influencing factors on the axis grid in the construction of industrial halls and to determine how economic efficiency can be achieved in these structures. The results demonstrate that potential savings and additional value for the client can be achieved through adjustments to the grid layout, which can be of significant importance in today's highly competitive environment.

KEYWORDS: axis grid, industrial hall, expert interview, project management, construction management

1 INTRODUCTION

The axis grid in industrial construction is an important component for economic efficiency, but it is often not adequately optimized. There is a lack of comparable literature on the influencing factors and economic viability of the axis grid in the construction of industrial halls. Given the rising construction costs and the current economic and political situation, there is an increased interest in economically optimized building practices, which has led to a request from a company to explore the influencing factors of the axis grid and how to better utilize them in the design phase of a project. [1]

Based on this research interest, the following research question emerges:

> *What are the influencing factors impacting the axis grid in the construction of industrial halls to economically optimize it?*

The literature review revealed that there is insufficient theoretical foundation to answer the research question, which prompted further literature research to identify the appropriate research methodology.

2 RESEARCH METHODS

Based on the posed research question and the lack of comparable literature, a second literature search had to be conducted. Building upon this, an appropriate research methodology was chosen to generate the sought-after content and answer the research question. It was determined that guided expert interviews would serve as a suitable data collection method for this research. The data was subsequently analyzed using qualitative content analysis according to Mayring, wherein the category system and codes were derived inductively based on the qualitative approach. Due to the absence of a foundational theory, no deductive quantitative research was conducted. A crucial criterion for this research was the structured and rule-guided approach to ensure the traceability and reproducibility of the study. As experts, individuals with extensive experience in the fields of planning/architecture, structural engineering, and project development/calculation were interviewed. This approach fulfils the criterion of triangulation in qualitative research, as the results were obtained from different perspectives. Following the interviews, the data was transcribed for further analysis. [2-4]

3 EVALUATION AND RESULTS

The data analysis is based on an inductively derived code system presented in *Tab. 3-1*.

Code	Definition
code 1: influencing factors	All passages which mention a factor influencing the axis grid in industrial hall construction directly or indirectly.
code 2: consideration of the axis grid at the initial stage	All passages which demonstrate how an axis grid is considered in the initial stages of industrial hall construction.
code 3: development of the axis grid	All passages which enumerate points that illustrate the development of the axis grid.
code 4: consideration of the economic efficiency of the axis grid	All passages which list the correlation between the economic efficiency of the axis grid and the economic optimization of industrial halls based on the axis grid.
code 5: questioning the axis grid during the design phase	All passages which describe the questioning or scrutiny of the axis grid.

Tab. 3-1: code system

This coding system serves the purpose of traceability and evaluation of the transcribed interviews. Building upon this coding system, the analysis was divided into two approaches - first, the examination of the influencing factors themselves, and second, the economic optimization of industrial halls through these influencing factors. In addition to listing the influencing factors that were considered trivial and insufficient to answer the research question, the analysis revealed insights into the interrelationships between the influencing factors. Based on these findings, the economic optimization of industrial halls can also be demonstrated. Therefore, the influencing factors are categorized into two groups: non-controllable and controllable factors. Using this classification, the relationships and interconnections of each influencing factor are presented.

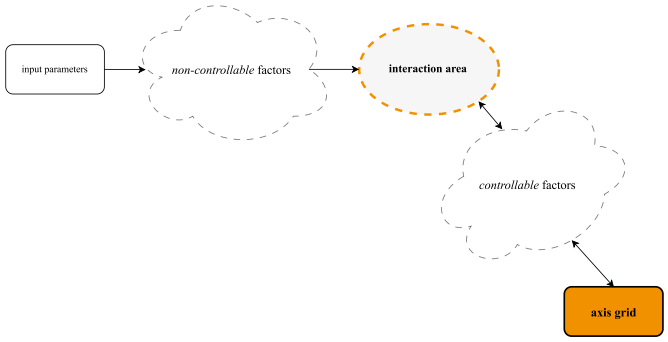

Fig. 3-1: an overview of the relationship between the factors

Fig. 3-1 illustrates the relationship between the non-controllable and controllable influencing factors.

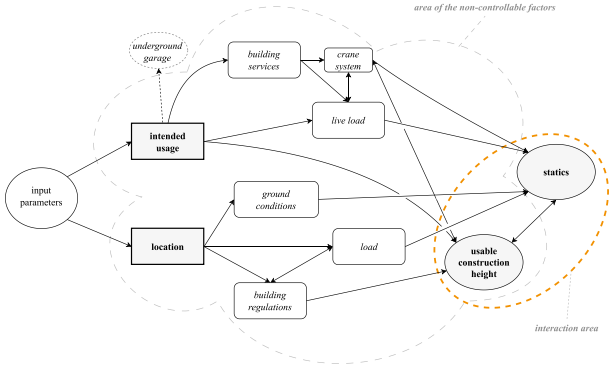

Fig. 3-2: non-controllable factors

Furthermore, *Fig. 3-2*, depicts which influencing factors are resulting based on the input parameters and subsequently form the interaction area. Within this area, the controllable influencing factors are formed, which ultimately serve as the levers for economic optimization. These controllable influencing factors are presented in *Fig. 3-3*.

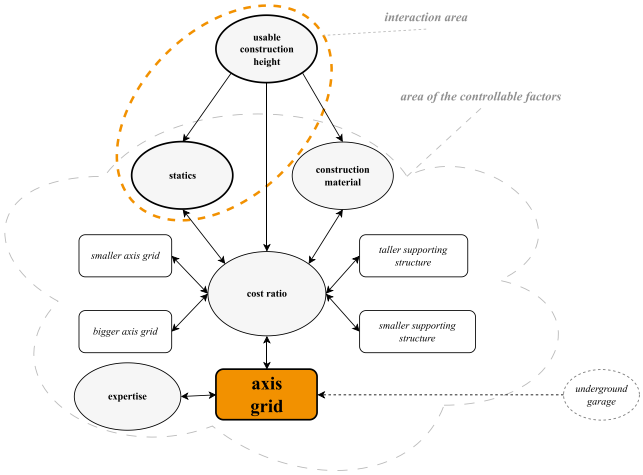

Fig. 3-3: controllable factors

To illustrate the controllable influencing factors, a calculation of different variants was subsequently performed.

4 VARIANT STUDY

During the variant study, the influencing factors of material choice, usable construction height, and the resulting cost ratio were illustrated using a real project as a basis. Positions such as the load-bearing structure, roof structure and facade were examined, and costs of different axis grid widths and construction heights were compared. The result of this comparison of variants showed that considering these influencing factors and especially the current market situation of building materials, an industrial hall can be economically optimized using the axis grid. Based on the studied market situation, it was found that in this case, a larger axis grid is more cost-effective. Moreover, this optimization does not compromise the quality for the customer; on the contrary, they benefit from a larger effective usable area. In the competition with other companies, this price advantage combined with improved quality can be crucial for the end customer. It is important to note that this result represents a snapshot of the market situation at that time, particularly when steel and wood prices were relatively high. It also highlights that this process needs to be individually tailored for each project.

5 CONCLUSION

The concluding chapter presents this study's research results and insights, aiming to identify the influencing factors on the axis grid in industrial hall construction and demonstrate their economic optimization. The qualitative research method of expert interviews was employed to obtain relevant information. The data analysis led to the identification of twelve influencing factors that affect the axis grid. The correlation between these factors and their categorization into controllable and non-controllable factors are essential insights for the economic optimization of the axis grid. The variant study demonstrates that considering these influencing factors leads to economic optimization. In conclusion, the research question has been successfully answered and the economic optimization of the axis grid can provide added value for customers and competitive advantages.

6 REFERENCES

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