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Instruments for risk analysis as an alternative decision-making method in the forensic sciences

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Abstract. The paper introduces an alternative method for damage pricing on buildings in consequence of defects, failures and collapses. The method operates with time-independent price of the structure and following damage on the construction. Using risk analysis methods, the price is reduced – depending on technical condition – to proper damage and evaluation of the object, building or structure.

Introduction

The method can be used by sworn experts in preparation of their opinion [4], [3]. In those areas it is required to determine the costs of damage caused to a known structure or building by external influences. The expert, this being, in particular, the case of a sworn expert, is often required to express such damage in financial figures. Insurance business or construction assessment experts often use the term “a time-related price" - this means the price after amortization. Wear and condition of the construction at the moment of assessment are often considered there.

Fig 1 : Building damaged by arson

Unlike the assessment of the building, this quantity (the damage expressed in financial figures) has nothing to do with the time-related price (this means, with the price relating to the age/existence of the construction or building). The time-related price is based on the service life of the building/construction and duration of its existence (the age) [3].

This means it is not advisable to use the time-related price when defining the damage to a building or structure. The proposed method is used for a house damaged by fire. The objective is to express the damage in financial figures [4], [3].

Methods and conceptual approach

Let us take the risk gravity scale as the basis [3]. The risk gravity scale can be modified by extending the *Sv* values – for instance, $Sv_{max} = 8$. It is possible to make the risk gravity scale narrower or wider, as necessary.

The simplest solution is a non-linear function that will be able, depending on the values in the risk gravity scale, to reproduce C_i in terms of the financial figures.

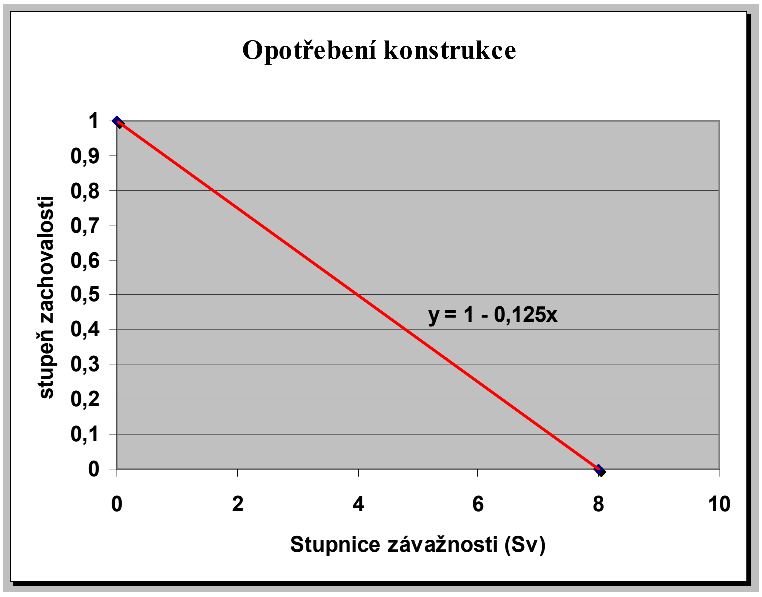

Fig. -2: Determining the coefficient for damage reduction

The resulting equation for a line, when $Sv_{max} = 8$ and for 100 % C_i if $Sv = 0$, will be:

$$y = \frac{8-x}{8} = 1 - 0{,}125 \cdot x \qquad (1)$$

The resulting variable can reduce the final value of a part of the building/structure depending on results of the risk analysis.

For instance, let $Sv = 6$, the financial costs are reduced as follows (1):

$$y = \frac{8-x}{8} = 1 - 0{,}125 \cdot x = 1 - \frac{1}{8} \cdot 6 = 0{,}25$$

In case of the structures that were damaged completely but the price of the structure was zero or negligible, if compared with purchase/construction costs, it is very easy to use any risk analysis method. The method can be used for any structure and any building. It can be applied in any sphere of the life. In this case, let us use UMRA [4]. The application will cover preparation of a sworn expert opinion.

This method, however, requires a rather deep depth of knowledge of and detailed information about the matter under investigation.

Segments of the project	Source of danger							
	1	2	3	4	5	6	7	8 ……n
1	5	6	<null>	<null>	<null>	<null>	<null>	<null>
2	7	8	7	6	<null>	<null>	<null>	6
3	3	4	<null>	<null>	<null>	<null>	<null>	<null>
4	4	4	<null>	<null>	<null>	<null>	<null>	<null>
5	6	<null>	<null>	<null>	<null>	<null>	<null>	<null>
6	3	3	<null>	<null>	<null>	<null>	<null>	<null>
7	4	4	<null>	<null>	<null>	<null>	<null>	<null>
8	<null>	<null>	5	<null>	<null>	6	3	6
	7	7	6	<null>	<null>	6	<null>	<null>
	<null>	<null>	4	6	3	<null>	<null>	<null>

Fig. -3: Matrix

When assessing partial segments of the unit using the same or constant weights of the factors (UMRA) or same constructions, it is possible not to use the Risk Analysis Matrix (2)

$$M_{Sv} \equiv \left(c_{i,k}\right) = \begin{pmatrix} c_{1,1} & c_{1,2} & c_{1,3} & c_{1,n} \\ c_{2,1} & c_{2,2} & c_{2,3} & c_{2,n} \\ c_{3,1} & c_{3,2} & c_{3,3} & c_{3,n} \\ c_{m,1} & c_{m,2} & c_{m,3} & c_{m,n} \end{pmatrix} \tag{2}$$

but to create a row or column matrix (3).

$$Sg_1 \equiv \left(c_1 \quad c_2 \quad c_3 \quad c_n\right) \tag{3}$$

A segment can be a finite unit (a comprehensive system) of structures with the identical gravity of failures (this is a part of the construction underassessment) and with sources of hazard for individual parts of the construction.

It is possible then to compile more easily the matrix for one construction under assessment. In this case, the number of segments corresponds to the number of parts of the building/construction. The sources of hazard are given by individual parts or components of the construction.

The assessment is carried out for the entire matrix of the individual experts. Then, a team coefficient is determined for perception of the risk.

$$Pc_t = \frac{\sum\limits_{ijk} Sv_{ijk}^{E}}{Sv_{\max} \cdot N_{act}^{E}} \tag{4}$$

The risk perception ranges between 0 and 100 %. Two extreme cases are a completely safe structure and a completely hazardous structure. Of course, the following condition must apply:

$$Pc_t \in \langle 0;1 \rangle \quad (5)$$

Once the damage ratio is determined (for instance, the finances are reduced by 25 per cent for *Sv* = 6), the remaining value is regarded as betterment and improvement of the construction.

A sufficient number of experts/assessors are needed in order to eliminate subjective factors as much as possible.

Solution results

So far, good experience has been gained for this method. The method needs to be made more general so that it could be used simply and quickly in practice by those who are less aware of risk analysis, without introducing any errors into the assessment.

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