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THE WEAR IN RELATION TO THE QUALITY REQUIREMENTS OF HOUSING CONSTRUCTION

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Abstract: *The wear generally, and the construction wear in particular, through its forms of expression, has the gift of impairing the construction quality, especially towards the end of its normal life. The knowledge of this phenomenon, of its way of being quantified through appropriate mathematical formalization, has the gift of extending the life of the building in compliance with the quality requirements regulated by law.*

Key words: *lifecycle, construction, depreciation*

1. Wear – The Cause of Weakened Housing Construction

The fixed assets, in this case housing, are being "consumed" with time, losing its technical and economic characteristics, in other words it wear. In economic language, ***„wear" means the consumption of components during in the process of use and disuse.***

In the European Standard of Evaluation 11.06 EVS, ***the wear, called depreciation is defined "as a impairment of an asset resulting from its use, through the passing of time or from inadequate due to technological or market changes."***

The same Standard of Evaluation 11.06 EVS identifies four types of wear (depreciation), namely:

1. ***Economic wear (depreciation)*** – represents the age, the condition (or physical wear size), the degeneration or atrophy resulting from the passage of time and the last use, the likely size of the cost of future use, the maintenance obligations, compared to a modern building.

2. ***Functional wear (depreciation)*** - suitability for everyday use and for the prospect of continuing its use or for other purposes. For example, a building constructed or adapted for specialized including particular industrial processes may have a useful life apparent lasting longer than provided for operations currently carried out;

3. ***Strategic wear (depreciation)***- a strategic decision taken in business can make certain activities and the building become obsolete. This can affect partially or fully an integrated process, even if buildings could have value for another company or even for the current owner, if the decision had not been taken.

4. ***Wear (depreciation) related regulations related to environmental compartments*** - the use as well as the existing technology currently used, it

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must be made in the context of current and anticipated regulations at the local, national decrees, directives and / or control of pollution and waste management policies[1].

2. Wear, Durability and Reliability in Housing Construction

The measurement of fixed assets depreciation is done in different ways depending on its nature, the parameter that expresses being the degree or rate of wear. In general, the degree and rate of wear ***(G_u),*** is dependent on the size of the main factors that constitute the causes of obsolescence, as follows [2]:

$$G_u = f\left(D, M, C_m, C_{e\hat{i}}, P_t\right) \qquad (1)$$

where:

D - is the life of the asset, materialized between the time of its commissioning and when assessing the degree or rate of attrition/wear

M - the nature of main material the asset is realized from, its physico-chemical properties, its pace of "aging" etc .;

C_m –the environmental conditions in which they are exploited the fixed assets, including the variability of climatic agents action, the variation in temperature from summer to winter, gelivity, wind, earthquake, floods etc

$C_{e\hat{i}}$ - the operating conditions and maintenance, resulting in the manner and pace of repairs current capital repairs of capital goods regulated by law, strictly observing the destination for which the asset was designed and executed, in this case the housing construction;

P_t - the technical and technological progress which enables higher renewing of fixed assets in terms of technical performance, the response to increasingly dynamic user requirements.

The total wear expressed as size, through the degree and rate of wear ***G_u***, involves three distinct components, namely:

- normal wear expressed by normal wear ***G_{un};***
- accidental wear, wear expressed by accidental, ***G_{ua}***;
- obsolescence expressed by the degree of obsolescence ***G_{um};***

The total wear, **G_u**, is not necessarily the sum of the three components noted the following:

- A housing construction, as well as any asset can consume its normal service duration with or without being subject to obsolescence. Such a situation is very rare in construction or may be thought more theoretical. In this case:

$$G_u = G_{un} \qquad (2)$$

- A building, though it "consumed" only part of the normal "life" can be impaired significantly by several exceptional cases earthquakes, floods, strong winds, etc. In these circumstances, the normal wear increases the accidental stresses, considering that:

$$G_{ua} \subset G_{un} \qquad (3)$$

- A housing construction, which is consumed at a rate greater or lesser period of "normal life" is always subject to obsolescence mainly by dynamic change of user requirements related to living conditions. In these circumstances, the obsolescence will be added to normal wear or accidental wear:

$$G_u = G_{un} + G_{um} \qquad (4)$$

or

$$G_u = G_{ua} + G_{um} \quad (5)$$

It is known that in general according to some authors, the **durability of construction**, as part of the concept of quality, *represents their ability to preserve their performance during the "life", representing the quantitative expression of user requirements related to the necessary characteristics (stability, operational safety, fire safety, economy, sealing, atmospheric ambience, acoustic, visual comfort, etc.)[3]*.

The same concept of sustainability is defined by others as acquiring construction to maintain the actual length of service an appearance satisfactory, fulfilling at the same time functions that have been designed in normal environmental conditions and without requiring maintenance expenses exaggerated.

Putting together the definitions wear, see section 1, or sustainability, both concepts related to constructions, it can easily be seen that the wear is inversely proportional to sustainability. In other words the higher the sustainability of the building is the lower the wear is.

Considering that we express the durability of a building through a unique parameter, labeled „G_{dur}”, one could write that:

$$G_{un} = \frac{1}{G_{dur}} \text{ or } G_{dur} = \frac{1}{G_{un}} \quad (6)$$

Although rarely used in the literature, we consider that the product of the construction activity accounted for object construction can be analyzed in terms of reliability. The reliability, in general, is the probability that the product, in our case the construction, barred the mission of fulfilling at least a given time t_0 in the conditions of "specified" use, thus:

$$R(t_0) = \Pr ob(T \geq t_0) \quad (7)$$

Noting that the reliability of a building could be directly proportional to sustainability, we ruled that sustainability is inversely proportional to its normal wear, namely:

$$G_{un} = \frac{1}{R(t)} \; or \; R(t_0) = \frac{1}{G_{un}} \quad (8)$$

3. Methods for Calculating the Normal Wear

The quantification of wear and tear, especially economically, should start from the definition of fixed assets which specifies the transfer of value between the assets to products resulting from the manufacturing process. Theoretically, the ratio expressed as a percentage of the amount transferred (accumulated depreciation), denoted by $\boldsymbol{A_a}$ and the initial value of fixed asset (both discounted to the valuation date), denoted $\boldsymbol{V_{ci}}$, would be (and is really written in the amortization linear regimes), the degree of normal wear and tear of the asset, namely:

$$G_{un} = \frac{A_a}{V_{ci}} \cdot 100 \quad (9)$$

where:

$\boldsymbol{G_{un}}$ - the normal wear and tear of an asset;

$\boldsymbol{A_a}$ - the transferred value (accumulated depreciation), the withheld value from operating the asset, till the date of amortization;

$\boldsymbol{V_{ci}}$ - the initial highlighted book value of the asset, representing the purchase value or the value of the construction;

This method of calculation of the degree of wear does not express in any way the actual wear of all the factors that generate the wear of the asset. Given such considerations, the wear estimated to be as close to reality, should not be viewed through the prism of accumulated depreciation (value recovered in time by selling products which implementation has contributed to the asset for which the calculated degree of wear.)

This is because without any connection with the recovery of the investment costs (depreciation) of the asset being used, on its duration of use act on many factors of impairment and rehabilitation with staple and nonlinear influences in time, with unexpected appearances and disappearances, which cannot be predicted and described in real time so that the linearization of these effects or even its description as linear functions defined on time intervals, cannot predict a real wear level and cannot provide a measure of this wear at any time of the existence of a fixed asset.

In other words, the various damping systems proposed, implicitly the regulations by laws, can give a picture of the degree of wear of a fixed asset, construction, but this will never be the real one, regardless of a time.

This is because real factors that determine the level of impairment for an asset-building, traditionally expressed by the wear, from the point of view of the operation and not as the investment recovery [4].

Accepting as decisive parameter in estimating the degree of wear and tear, the duration generally expressed as the period of time consumed, we can write that:

$$G_{un} = f\left(D_c\right) \tag{10}$$

or

$$G_{un} = \alpha \cdot D_c \tag{11}$$

where:

D_c- the consumed duration of use expressed by months or years, representing the period between the commissioning of the asset and the time when the calculation of wear coefficient is made;

The domain of the function expressing the linear dependence - approximate dependence but sufficient for a globally expressed war for a construction representing a complex system is a closed interval as:

1. **[o, D_n],** where **D_c-** uration of use, expressed as:
   - **D_{sn}-** standardized service duration according to Law No. 62/1968.(D_n=D_{sn})
   - **D_{un}-** normal useful life according to Law No.15/1994 and HGR No. 266/1994. (D_n=D_{un})
2. **[o, D_c+D_R]** - where **D_R-** the duration of remaining service in months or years, established specialists in technical expertise. In this case we have:

$$D_c + D_r > D_n \tag{12}$$

In these circumstances the relationship 3.1 takes the following form:

$$G_{un} = \frac{D_c}{D_u} \cdot 100\% \tag{13}$$

such:

$$G_{un} = \frac{D_c}{D_c + D_r} \cdot 100\% \tag{14}$$

Through graphic representation of the 10 function by plotting the definition set intervals one can quickly determine the degree of wear and tear, expressed global for the fixed asset, fig. 1- housing masonry for which Law No 15/1994 states Dun = 60 years. In the above conditions:

$\alpha = \frac{100}{D_{un}}$ the function becomes:

$$G_{un} = \alpha \cdot D_c = 1.66 D_c \quad (15)$$

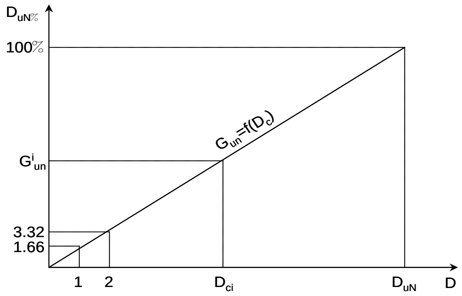

Fig. 1. *The linear dependence consumed duration - degree of wear and tear globally expressed*

Based on Figure 1 one can easily determine the overall attrition knowing the consumed duration. Basically, taking into account other factors that influence the wear of a building-material, the environmental conditions, the operating conditions, etc., the a nomogram is amended as seen in Figure 2 below.

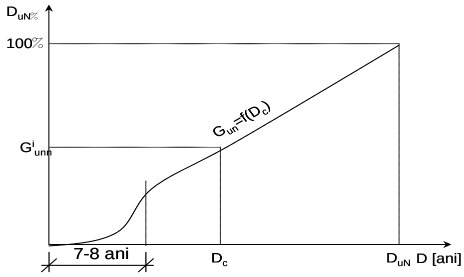

Fig. 2. *The dependence between the consumed duration and the normal wear and tear, including the action of other factors*

It is known that any complex construction is a system that involves several elements that interact, and ensure the purpose of a construction – housing.

The practice of designing and building constructions revealed the following components - important elements – of the **system for housing construction and their shares, Table 1.**

The share p_i of structural elements of a building system for housing (according to P135/1999) Table 1

No.	The element/component of the system	The share of the element in the system p_i
1	The resistance structure (Foundations, structural frame, framing)	$P_1 = 40$ %
2	The tire (closures, divisions, seizures, carpentry, covering with its annexes)	$P_2 = 17$ %
3	The finishes (wet or dry plastering, painting, flooring, painting)	$P_3 = 25$ %
4	The functional service facilities (heating, electrical, plumbing, low current, gas)	$P_4 = 18$ %
	TOTAL	100 %

The medium global wear for housing construction, taking into account the normal wear for each element of the system - building for housing - will be:

$$G_{un} = \sum p_i \cdot D^e{}_{un} \quad (16)$$

where:

p_i –the share of the element in the building housing system, expressed in %, table 1;

D_{un}^{e} - the wear of each element of the system, taken either from the normative basis depending on the consumed length of service, established on the basis of technical expertise, developed by a specialist in evaluating construction, expertise which finds the spot, methods and procedures specific technical condition of the item, thus its degree of wear.

4. Estimating the Construction Obsolescence

Less considered in construction, for various reasons, such as: **the high value of the asset, the more than normal duration, the mentality of people** etc., the obsolescence is the permanent depreciation, technical observed of the asset as a result of the emergence and use of means with superior technical characteristics to the existing ones.

In construction, the obsolescence is necessarily **linked to the performance** demands which means used materials, used technologies etc., as well as the users' requirements for functional, comfort etc.

Tied for first appearance, **the performance requirements**, we consider that a building can be considered obsolete if another building that meets the same requirements, for example housing, is made of material more robust in a much shorter duration, with much smaller financial effort.

The second issue raised in the case of obsolescence, the user requirements, is crucial as it keeps from the functionality of the building, the dimensions in plan of divisions, the functional link between them, the vertical movement, the interior and exterior finishes and comfort, interior deterioration of the spaces of a building, providing heating, lighting, climate etc. In the overall assessment of the wear of a building one can consider a coefficient of obsolescence **(G_{nm})** appreciated by experts.

5. Conclusions

Generally, the constructions, including those for housing, must meet the user requirements, which in turn subscribes to the quality requirements regulated by Law No. 10/1995. Given that much of constructions housing life service is approaching the regulated lifecycle, the concern in quantifying the causes that could accelerate their depreciation should increase. In this direction we have presented a faster interpretation and assessment of the wear of residential constructions.

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