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PROPERTY DAMAGE ASSESSMENT METHODS AND MODELS DUE TO ARMED AGGRESSION

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ABSTRACT

The paper deals with the conceptualization of the gross development value to assess direct damages and the restoration needs of lost, destroyed and damaged real estate as a result of armed aggression. A critical review of the existing practice of assessing property damage has been carried out. The measurement units of direct damages and the restoration needs, the evidence base used, the valuation methods for the determination of property damage are analyzed. The methodological potential of compounded cash flow models and the criteria for assessing their reliability is substantiated. A system of valuation models for calculating direct damages and restoration needs is proposed, depending on the category of real estate and market conditions at the valuation date. These valuation models are relatively simple to implement and understandable to the intended users of property damage valuation reports.

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1. Introduction

The armed aggression of the Russian Federation against Ukraine has led to a large-scale humanitarian catastrophe, the social, economic and environmental consequences of which will be experienced for a long time not only by Ukraine, but also by many countries of the world.

Overcoming the consequences of armed aggression determines both the multiplicity and complexity of tasks for the revival of the affected areas. The Joint Declaration of the European Commission, the World Bank and the United Nations Sustainable Development Group on post-crisis assessments and recovery planning of September 25, 2008, is aimed at solving these problems, in which utmost importance is given to the assessment of property damage (Joint Declaration, 2008).

Of course, not all real estate will be the subject of assessment, but only that which has experienced a destructive impact and information about which was included in a special Register created to record the damage caused.

In general, we can talk about three main categories of real estate affected by armed aggression:

- lost real estate, covering subjects in respect of which the control of their owners has been lost and / or which cannot be restored to their original location;
- destroyed real estate, including subjects that, due to the destructive impact, became unsuitable for further use for their intended purpose and the restoration of which is physically impossible and / or economically not advisable;
- damaged real estate, which includes subjects that have undergone partial destruction, but which can be restored through repair or reconstruction.

With regard to these categories of real estate, two methodologies for assessing property damage can be used: a preliminary (rapid) assessment and a detailed (object-by-object) assessment.

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The preliminary assessment is due, on the one hand, to a large and ever-increasing number of damaged facilities, and on the other hand, the need to obtain operational information on the extent of damage and losses and to determine the financial resources necessary for the restoration of specific sectoral infrastructure and certain territories of the country. For Ukraine, such an assessment was implemented in the report "Rapid Assessment of Damage and Recovery Needs - August 2022", jointly prepared by the World Bank, the Government of Ukraine and the European Commission.

However, the preliminary valuation uses a simplified methodology, does not provide asset-level information, and is not intended for legal or compensation claims (World Bank, 2022, p. 45).

A detailed assessment, the methodology of which this article is devoted to, is important for providing objective information at the level of each real estate subject, which will have legal significance, and can be used for the following lawsuits (including in international courts and courts of other countries), compensation payments, etc.

All this allows us to formulate two main objects facing the valuers:

1. The assessment of the direct damages due to loss, destruction, and damage to real estate.
2. The assessment of the restoration needs of lost, destroyed, and damaged real estate.

These types of assessments should be consistent and transparent and based primarily on economic principles and reliable evidence. This is especially important given the high level of uncertainty and limiting conditions inherent in wartime and post-war times.

The latter actually outlined the purpose of this paper – to propose methods and models for assessing direct damages and restoration needs of real estate destroyed as a result of armed aggression that are adequate to generally recognized valuation standards in the world

2. Literature review

2.1. Subject area of property damage assessment

Recognition and compensation for property damage is one of the universally recognized norms of civil (private) law, legally enshrined in all European countries and in many countries of the world.

Issues related to recognizing the fact of property damage and determining the amount of compensation have not only a legal, but also an economic aspect. For several centuries they have been in the center of attention of valuers. It was the solving of these issues for the purposes of real estate insurance and its expropriation for public needs that largely contributed to the formation of valuation as a separate type of professional activity (Wyatt, 2007, p. 75).

The positive practice of determining the amount of property damage is reflected in professional literature as early as the beginning of the 20th century. Clarence Albert Webb, in a fundamental textbook on real property valuation, devoted two sections to valuation methodology for damages, "Compensation for compulsory purchase" and "Valuation of Fire Insurance Claims" (Webb, 1909).

Therefore, it is quite natural that today most of the provisions of the valuation practice for determining the amount of property damage have acquired an imperative status in national and globally recognized valuation standards and guidance notes issued by the International Valuation Standards Council, the European Group of Valuers' Associations, the Royal Institution of Chartered Surveyors, the Appraisal Foundation.

At the same time, with the recognition of tort (non-contractual) liability arising from natural and man-made disasters, including armed aggression, the tasks of assessing property damage have expanded. In addition to preparing expert opinions for the consideration of court cases regarding the amount of compensation for lost, destroyed, or damaged real estate, the assessment has become essential for forecasting nationwide, sectoral, and territorial needs for the rebuilding of real estate that has experienced a devastating impact, and for developing policies to finance such needs (Bollin & Khanna, 2007).

Tort liability provides for full and not conditioned by contractual obligations compensation for property damage for the period from the moment of its infliction until the moment of final restoration of the lost, destroyed, and damaged property, taking into account the possible escalation of costs associated with changes in the main macroeconomic indicators in the country as a whole and affected areas in particular.

Such an increase in the liability limit, taking into account the two main types of impact of disasters on society and the economy – the destruction (total or partial) of tangible assets and the subsequent changes or modifications in economic flows in the affected area – was proposed by the United Nations Economic Commission for Latin America and the Caribbean in

1972 (Bello, 2014, p. 31) and is now universally recognized in the development of the recommendations of the World Bank and other international organizations to overcome the consequences of the devastating impact of disasters (Joint Declaration, 2008).

Over the past five decades, based on the accumulated experience, the subject area of property damage assessment has been refined, which includes:

1. Damages – total or partial destruction of tangible assets in the affected area. Their monetary expression are the prices that were valid before the event (Jovel & Mudahar, 2010b, p. 2).
2. Losses – a change in economic flows (cash flows) due to a disaster. These occur until the final economic recovery of the affected area is achieved (Jovel & Mudahar, 2010b, p. 2).
3. Financial needs for recovery – the costs of replacing destroyed assets with modern equivalents that meet the requirements of sustainable development (energy conservation, inclusiveness and civil protection). Reconstruction costs are expressed in prices at the property damage assessment caused to the property owner is limited to determining the amount of damage due to loss, destruction or damage to property and the restoration needs of such property (IVSC, 2021, p. 32, 111).

In other words, the task of assessing property damage from the point of view of the property owner is to determine the nature and extent of the disaster (what happened?) and provide information about the needs, determining the level and type of assistance needed for the affected population (what needs to be done?) (Planitz, 1999, pp. 2-3).

It is clear, that the amount of damage caused to real estate is critical to determining the needs for restoration (reinstatement) of such property, while the assessment of losses is an indicator of the needs for the recovery of the economy (Bello, 2014, p. 31). However, it is the change in macroeconomic indicators that will determine the realities of the post-war period, including the situation in the real estate market, which is of decisive importance in assessing the restoration needs (Martí & Jovel, 2003, p. 15).

At the same time, regardless of the valuation task – determining the amount of direct damages or the volume of restoration needs – the main unit for measuring property damage is the prices (costs) necessary to acquire or create a real estate subject or its components.

2.2. Measurement units of property damage

A review of the literature indicates a certain solidarity in measurement units of the direct damages. This is, as a rule, the market value and the depreciated replacement cost, sometimes the book (historical) value. In any case, only value indicators are used for the monetary expression of the direct damages.

With regard to measurement units, there is no such unambiguity in the restoration needs assessment. With the general point of view that this assessment should be based on prices (costs) for the repair (reconstruction, restoration) of damaged property, the restoration of destroyed property or the acquisition of a replacement for lost property, the following are proposed among the criteria for needs assessing:

1. book (historical) value of a building or structure (APEC, 2011, p. 18),
2. actual cash value – the costs necessary to return the property to the state in which this property was before the damage – neither better nor worse, taking into account its functional use; the size; age; physical deterioration; remaining term of physical life (Held, 2022, p. 1, p. 3),
3. replacement cost new; reinstatement cost – the cost of replacing damaged or destroyed property using materials of the same type and quality without any deductions for depreciation and without taking into account the cost of land (APEC, 2011, p. 18; Held, 2022, p. 2; RICS, 2018, p. 4; TEGOVA, 2020, pp. 125-127),
4. functional replacement cost – the cost of replacing damaged property using functionally equivalent materials without any deductions for depreciation and without taking into account the cost of land (Held, 2022, p. 2; RICS, 2018, p. 4),
5. replacement cost of a building (structure) – the cost of building a similar facility with equivalent utility, using modern materials and technologies (APEC, 2011, p. 18; IVSC, 2021, pp. 49-50; TEGOVA, 2020, pp. 126-129),
6. reproduction cost of a building (structure) – the cost of creating an exact copy of a subject using authentic materials and technologies (IVSC, 2021, p. 49),
7. market value of real property (Appraisal Institute, 2010, p. 2; Haberman & Perks, 2020; IVSC, 2021, p. 24; PFSRM, 2002, p. 4-8; TEGOVA, 2020, p. 124; The Appraisal Foundation, 2020, p.

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274),

8. gross development value – the price that can be received in the market from the sale of a completed property, and which allows one to cover all the costs associated with this development, including the cost of financing and the profit of the developer (IVSC, 2021, pp. 117-118; RICS, 2019, p. 25).

Behind the variety of units for measuring needs, there are two points of view regarding the composition of restoration costs and their evidence base (Drapikovskyi & Ivanova, 2022).

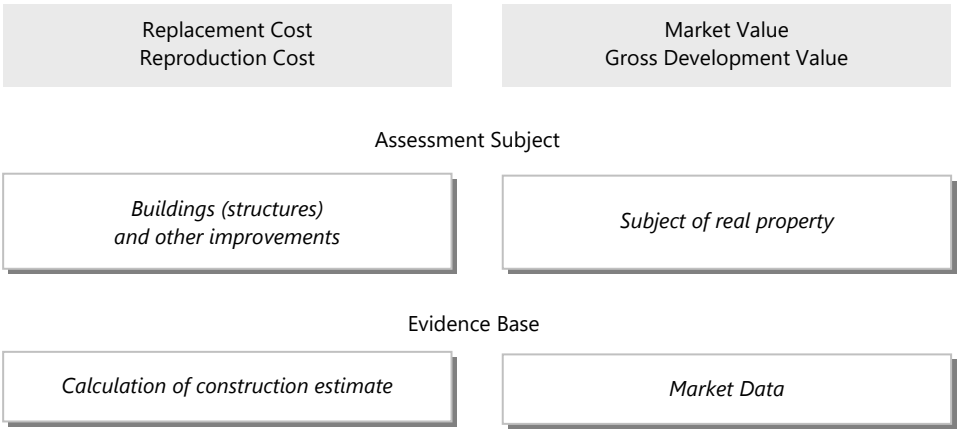


Fig. 1. Assessment subject and evidence base of measurements units for the restoration needs. *Source*: own study.

Supporters of the first point of view focus on the restoration of buildings and structures, limiting themselves only to the cost of replacing or recreating them. As a result, a number of costs (in particular, consultants' fees, financial costs, remuneration for entrepreneurial initiative, etc.) fall out of the composition of the costs necessary for the implementation of the restoration process of the construction subject.

In addition, in this case the evidence basis of the assessment is the construction estimate, which from the point of view of International Valuation Standards and the recommendations of the World Bank is considered to have the substantial subjectivity and requires checks on the expectations of market participants (IVSC, 2021, p. 120, 122; Jovel & Mudahar, 2010b, p. 13).

In this regard, the specialists of the US Appraisal Foundation are even more radical and emphasize that construction estimates cannot be considered an appraisal at all (The Appraisal Foundation, 2020, p. 343).

Supporters of the second point of view consider the restoration of a destroyed building and structure as a special case in the restoration of real estate in general. This point of view does not result in the loss of any necessary recovery costs. At the same time, regarding the sum of these costs, the evidence base is market data, which should be relevant to the valuation date.

2.3. Valuation methods

Taking into account the measurement units, the methods used in assessing property damage will refer to the market and cost approaches or to a combination of these approaches (Held, 2022, pp. 3-4; IVSC, 2021, p. 49, 113; Ripinsky & Williams, 2015, p. 219).

According to the Appraisal Institute, market comparison is the simplest and most transparent method, which is especially important for assessing the consequences of disasters, which more than one intended user will rely on (Appraisal Institute, 2010, p. 2). The same opinion is shared by specialists of the global consulting firm J.S. Held, which has a wide practice of cases in compensation for property damage (Held, 2022, p. 3).

The market approach makes it possible to directly obtain the market value of the real estate (the sales comparison method) and, if necessary, to determine the contribution of the improvements to this value (the extraction method) – (Held, 2022, p. 5).

Cost approach methods give an idea of the amount of costs required to replace or recreate either construction subjects (the replacement cost method and the reproduction cost method) or real estate subjects (the depreciated replacement cost method). At the same time, the depreciated replacement cost

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method, depending on the evidence market nature of costs and depreciation, can indicate the direct value of the market value of real estate (Haberman & Perks, 2020, p. 177; IVSC, 2021, p. 24).

Methods based on a combination of market and cost approaches include the development method and the residual method. The difference between these methods can be seen as (1) "bottom-up" valuation, where the value of the completed real estate, also called the gross development value, is determined based on the cost of acquiring resources associated with this development, and as (2) "top-down" valuation, when the costs of real estate development are determined based on the market value of the completed real estate (IVSC, 2021, p. 118; RICS, 2019, p. 25; TEGOVA, 2020, pp. 170, 186-187).

In fact, both methods are based on the same valuation model, which reflects the relationship between the price that can be obtained on the market from the sale of a completed real estate, and the cost of resources and time required for this development.

Due to the peculiarities of this model, the approach to property damage is changing. In terms of economic consequences, it can be considered the opposite of an investment project (Marty & Hovel, 2003, p. 8).

All this, according to the authors of this paper, makes gross development value a key concept in solving problems associated with determining the direct damages because of the loss, damage and destruction of real estate subjects and the financial needs for rebuilding such subjects.

3. Gross development value model

3.1. Concept of gross development value

The issues of assessing the direct damage caused by the destruction of real estate and assessing the restoration needs of lost, damaged and destroyed real estate lie in the development stage of such property of through the building of vacant land or the reconstruction of improved real estate.

It is at the development stage that real estate from a state unsuitable for use, through construction, reconstruction or restoration, passes into a state of demanded use and thereby acquires value as an integral subject.

This allows, when determining the gross development value, to simultaneously apply the market and cost approaches arising from the alternatives that market participants have:

1. acquiring a completed real estate, or
2. buying a land plot and improving it in the same way.

In fact, the gross development value as the sale price of a completed real estate can be structured according to the costs of creating such a subject, including the costs of acquiring a land plot and construction costs, also adding finance costs as well as the developer profit

$$V_O = V_L + V_C + V_F + V_D, \quad (1)$$

where:

V_O - gross development value (value of the completed real estate),

V_L - value of land (value of the development property),

V_C - construction costs,

V_F - finance costs,

V_D - developer profit.

In other words, conceptually, the gross development value, structured by its components, links the real estate market and the development resources market. At the same time, from an economic point of view, regardless of whether the development was carried out with the involvement of third-party or own resources, all costs associated with the real estate development should be considered either at the price paid for them in the market, or at the opportunity cost – income that could be obtained for own resources in the market (IVSC, 2021, pp. 123-124).

It is important that the gross development cost as a function of the particular land use involves not only the costs necessary to achieve such use, but also the duration of the development stage – the time period from the acquisition of the land plot to the introduction of the completed real estate into operation. Therefore, when assessing the gross development value, it is necessary to take into account the distribution of cash flows over time (IVSC, 2021, p. 123).

This becomes possible if the finance costs and the developer profit are reflected not in an absolute monetary amount, but in an appropriate interest rate that satisfies the investor's interest (loan rate) and the developer's interest, and which will serve as a measure of the time value of money.

Obviously, as the duration of real estate development increases, so will the risks associated with such development. There are several ways to calculate them:

1) adjustment of cash flows by including the

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relevant positions in the costs of contractual work: administrative and engineering services, to cover the risk of all construction participants; to cover additional costs associated with inflationary processes; to pay consultants' fees; to commission payments,

2) adjustment of the interest rate, at which finance costs and the risk that the developer takes on are estimated, depending on the complexity and duration of real estate development.

Under these conditions, the annual interest rate will correspond to

$$i_A = (1+i_F)\cdot(1+i_D)-1, \quad (2)$$

where:

i_A - annual interest rate;

i_F - investor's interest (loan rate), which in the context of real estate development serves as a risk-free (conditionally risk-free) rate;

i_D - developer's interest, which, in the context of real estate development, serves as a risk premium for the developer.

Thus, risk accounting allows one to finally decide on an exhaustive list of input data for calculating the gross development value, in particular, the land value, the construction costs and the annual interest rate, and select a relevant valuation model that would reproduce the expectations and assumptions of market participants.

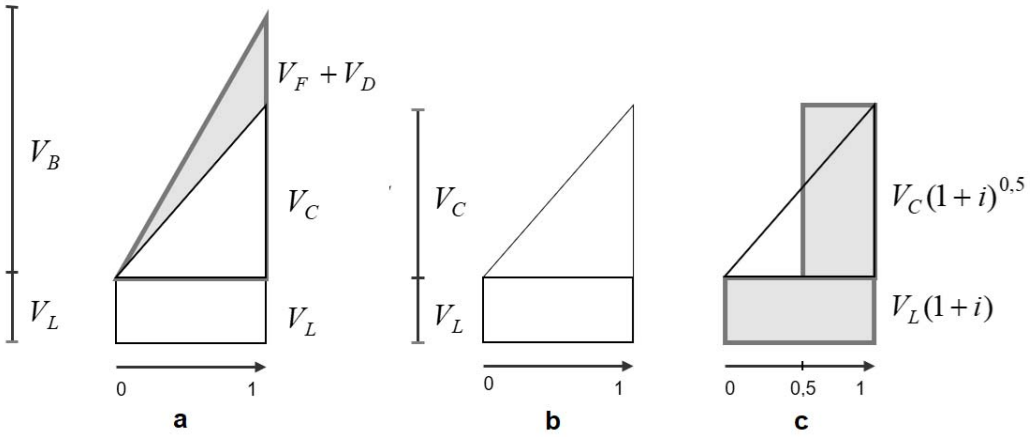
3.2. Choice of valuation model for determining the gross development value

An acceptable market procedure for determining the gross development value is a cash flow compounding model based on the unrecovered investment principle. Within this model, the gross development value is determined by the sum of the future value of a land plot and the future value of construction costs, which are calculated using a compounding rate, the value of which is determined by the duration of the development of the real estate and ensures the interest of both the investor and the developer.

To date, in valuation practice, numerous models for compounding deterministic and stochastic, discrete and continuous cash flows are used, which differ in the complexity of analytical tools and the level of detail of input data.

Taking into account the transparency of the procedure for calculating the gross development value and the simplification of the perception of this procedure by persons who will rely on the results of the assessment, according to the authors of this article, preference should be given to models with minimal complexity of analytical procedures and detailing of input data.

These requirements are fully met by the valuation procedure proposed by William Britton together with colleagues (Britton & et. al, 1989). This procedure is based on the assumption that land acquisition costs are a one-time, initial investment, and payments for construction work are paid gradually over the development life, so land acquisition costs should be compounded over the entire development life, whereas construction costs – only for half of this period (Fig. 2).



a) the land value and the improvements value,
b) the costs for the acquisition of land and the construction costs,
c) the costs for the acquisition of land and the construction costs taking into account their financing and the developer profit.

Fig. 2. Visualization of William Britton's compounding cash flows model. *Source*: Drapikovskyi & Ivanova (2013).

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The formalization of this assumption is the following model

$$V_O = V_L \cdot (1+i) + V_C \cdot (1+i)^{0,5}, \quad (3)$$

where:

V_O - gross development value (value of the completed real estate),

V_L - value of land (value of the development property),

V_C - construction costs,

i - compounding rate, the value of which is determined by the duration of the real estate development period and is calculated based on the annual interest rate according to the formula:

$$i = (1+i_A)^{h/12} - 1, \quad (4)$$

h - duration of real estate development (in months).

The reliability of the constructed model can be assessed by comparing the gross development value calculated using the cash flow compounding model with the result obtained on the market comparison basis. At the same time, the main subject of testing for compliance with the market is the value of the compounding rate (specifically, the developer's interest).

3.3. Features of gross development value application value for property damage assessment

William Britton's gross development value model, which is characterized by sufficient transparency and flexibility, creates the possibility of its wide application in assessing direct damages caused by the loss, destruction or damage to real estate, and in assessing the restoration needs of lost, destroyed and / or damaged real estate.

Obviously, depending on the task – determining direct damages or restoration needs – the valuation date as the basis for the analysis and formation of the valuer's conclusions will be different, since market conditions will also be different.

To estimate the direct damages, the input data must reflect the state of the market on the date before the armed aggression, which will allow you to get an idea of what was lost. At the same time, the determination of the restoration needs will be based on prices current at the date of the decision on the necessary amount of the post-war reconstruction costs.

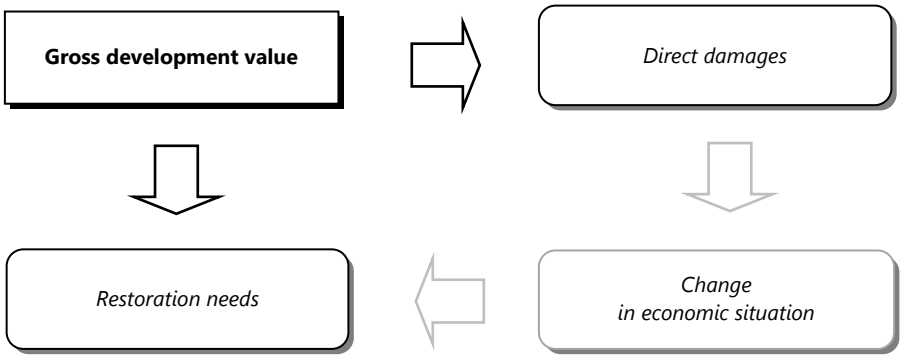


Fig. 3. Application of the gross development value to assessment property damage. *Source*: own study.

The real estate subjects that should be selected for comparison with the valuation subject will also be different. The assessment of direct damages refers to the real estate subject that it was at the time of damage, and consists in comparing the utility of the property "before" and "after" the destructive impact, that is, the main task of this assessment is determining the lost value. When assessing restoration needs, the damaged real estate subject is replaced with a modern equivalent (as it should be – "Build Back Better" concept), taking into account regulatory requirements for energy efficiency, inclusiveness, civil protection and sustainable in general (TEGOVA, 2020, pp. 194-221).

However, regardless of these differences, the assessment of property damage is preceded by fixing (documenting the evidence) the fact of damage; establishing a causal relationship between illegal actions and damage; determination of the amount of damage caused in physical terms as prerequisites for the emergence of a tort liability. Only after

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establishing the physical extent of the damage is it possible to proceed to the calculation of the direct damages and the restoration needs of real estate in monetary terms.

4. Property damage assessment models

4.1. Assessment of the direct damages

In physical terms, direct damages are measured by the loss of the full or partial suitability of a real estate subject or its separate part for further use. This involves displaying the actual state of real estate at the moment preceding the armed aggression, and the change in this state caused by the armed aggression.

In view of the limited available information, it is suggested to use the initial technical inventory materials, space survey data, geospatial and cartographic data to conduct a retrospective analysis of the condition of the affected subjects and technical survey materials, including photographs, video materials, materials of aerial photography by manned and unmanned aircraft, to determine the losses direct damages, as well as their consequences to the further use of the real estate.

The monetary value of the direct damages is the decrease in the market and/or depreciated replacement cost (gross development value, taking into account depreciation) of the real estate due to the destructive impact. Therefore, a key role in assessing direct damages involves the determination of the costs of the construction of similar equivalents to the valuation subject V_C^S and the distribution of these costs by structural elements, as well as assumptions regarding the depreciation degree of the valuation subject.

The calculation of the depreciation of land improvements is based on two specific assumptions.

1. The first assumption is due to the fact that the valuer, most likely, did not have the opportunity to personally inspect the subject real estate before damage was caused and is forced to form a judgment about the actual state of the subject on a special assumption about the proper level of maintenance and exploitation of buildings (structures) and related equipment and devices (Appraisal Institute, 2010, p. 5).

   From this assumption it follows that all structural elements, the useful life of which is less than the physical life of the building (structure) as a whole, were repaired and replaced in a timely manner, that is, they have no signs of either physical or functional obsolescence. The economic (external) obsolescence, even if it took place, is already taken into account in the prices prevailing in the market in which the assessment subject is presented (TEGOVA, 2016, p. 127).

   In other words, the only reason behind depreciation is the irreparable obsolescence of structural elements, the useful life of which coincides with the term of the physical life of the building (structure).
2. The second assumption (IVSC, 2021, p. 52) concerns the trend of depreciation and assumes that depreciation due to irreparable physical deterioration is straight-line and is calculated as the ratio of the effective age of the building (structure) to its physical life

$$d = w_{inc} \cdot \frac{EA}{NL}, \tag{5}$$

where:

d - degree of the depreciation of the building (structure) – structural elements, the physical obsolescence of which cannot be eliminated (incurable physical deterioration);

w_{inc} - specific weight (share) of structural elements with incurable physical deterioration;

EA - effective age of the building (structure) at the time of damage;

NL - physical life of a building or structure.

Obviously, in order to make a final judgment on the degree of land improvements depreciation before damage occurs, the real estate value calculated using the gross development value model must be tested for compliance with market data, where the main subject of testing for market compliance is the value of the degree of land improvements depreciation.

Depending on the category of real estate destroyed due to armed aggression, three models for assessing direct damages can be proposed, which take into account or do not take into account the land value V_L and the overall degree of suitability of individual structural elements for further use s:

lost real estate

$$V_{DAM} = V_L \cdot (1+i) + V_C^S \cdot (1+i)^{0,5} \cdot (1-d) \tag{6}$$

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destroyed real estate $$V_{DAM} = V_L \cdot ((1+i)-1) + V_C^S \cdot (1+i)^{0,5} \cdot (1-d) \quad (7)$$

damaged real estate $$V_{DAM} = V_L \cdot ((1+i)-1) + V_C^S \cdot (1+i)^{0,5} \cdot (1-d) \cdot (1-s) \quad (8)$$

The overall degree of suitability of the structural elements of the building (structure) is assessed as sum of the degree of suitability elements (*i*) of building (structure) for the further use, weighted according to their share in the construction costs for the replacement of the subject real estate with the similar equivalent:

$$s = \sum_{i=1}^{n} s_i \cdot w_i \,, \quad (9)$$

where:
s - overall degree of suitability of the structures (elements) of building for the further use,
s_i - degree of suitability of element *i* of the building (structure) for the further use,
w_i - share of element *i* in the construction costs.

An alternative and equivalent way to assess the direct damage from the destruction of a building (structure) can be to calculate the reduction in their value based on a preliminary determination of the cost of replacing damaged structural elements with similar equivalents:

$$\Delta V_C^S = V_C^S \cdot (1-s) = V_C^S - V_C^S \cdot s \,, \quad (10)$$

where:
ΔV_C^S - costs of the replacement of damaged elements of the building (structure),
V_C^S - construction costs on replacement (recreation) of building (structure) with similar equivalent without damages,
$V_C^S \cdot s$ - construction costs on replacement (recreation) of the building (structure) with a similar equivalent, taking into account suitability for further use,
with subsequent and obligatory accounting for the degree of depreciation of the building (structure) according to the formula:

$$V_{DAM} = V_L \cdot ((1+i)-1) + \Delta V_C^S \cdot (1+i)^{0,5} \cdot (1-d) \,. \quad (11)$$

Loss, destruction and damage to real estate subjects is a source of not only direct damages, but also indirect losses arising from loss of income from the rental of real estate and / or involuntary costs associated with the need to relocate and temporarily use someone else's real estate.

The assessment of indirect losses is based on the compounding model of cash flows generated by lost income and/or involuntary expenses during the time from the moment of property damage to the completion of the restoration of the lost, destroyed or damaged real estate. In this case, the compounding rate will be the rate of return on the capital invested in real estate:

$$V_{IND} = \sum_{t=1}^{n} PGI_{O_t}^P \cdot (1+Y^P)^{n-t} \,, \quad (12)$$

where:
V_{IND} - indirect losses due to loss, destruction and damage to real estate;
$PGI_{O_t}^P$ - potential gross income and/or forced costs for the t-th month;
Y^P - monthly rate of return;
$V_C^S \cdot s$ - month for which no income was received and/or forced expenses were incurred ($t = 1 \div n$).

And although indirect losses are not the subject of this paper, their compensation is a mandatory component of tort liability.

4.2. Assessment of the restoration needs

The assessment of the restoration needs of lost, destroyed and damaged real estate is aimed at determining the amount of costs required to replace such property with a modern equivalent, and involves calculating the gross development value – the price expected at the date of the assessment that can be received if the completed real estate is sold on the market.

This valuation task includes three important questions.

Firstly, the complex nature of the problem determines the needs for market analysis, and hence the correlation of real estate development costs with the market value of completed real estate as a basis of value formed under the influence of current economic circumstances, social trends, regulatory rules and environmental conditions. The comparison of real estate development costs with the market value of the completed real estate will also determine the needs for subsidies, if such a need arises.

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Secondly, a modern equivalent is real estate that has a functional purpose similar to the lost, destroyed or damaged subject, but differs from such a subject in a modern design solution and the use of safe materials and progressive construction technologies.

Thirdly, the development property, within the framework of the model for determining the gross development value, as already noted, can be both vacant and improved land plots, which is important, since, according to the results of damage assessment, the restoration needs of lost, destroyed and damaged real estate deals with three main situations: the restoration of real estate in a new location and the restoration of real estate within an existing site, the land improvements of which may be partially usable or not at all suitable for further use.

The assessment of the real estate restoration needs in a new location should be based on the principle of integrated development, which, in accordance with the spatial planning project, involves preliminary engineering preparation, construction of external engineering and transport networks, as well as landscaping.

If the cost of above mentioned integrated development work was the subject of a separate valuation, then the restoration needs of a particular property could be calculated using the gross development value model, in which the primary investment (development property) will be the vacant land value:

$$V_{NEE} = V_L \cdot (1+i) + V_C^M \cdot (1+i)^{0,5}, \quad (13)$$

where:

V_{NEE} -amount of costs for the restoration of lost and / or destroyed or damaged real estate, in another place (on another land plot),

V_L - market value of vacant land plot,

V_C^M - construction cost of replacing the building (structure) with a modern equivalent,

i - compounding rate, the value of which is determined by the duration of construction and meets the interests of the investor and developer.

The assessment of the restoration needs of destroyed or damaged real estate within the existing site also involves the application of the gross development value model, in which the initial investment will be the value of the improved land, not the vacant plot, taking into account the overall degree of suitability of improvements for further use and, if necessary, additional costs for cleaning up a piece of land from the effects of destruction, if these costs were not the subject of a separate valuation:

a) for destroyed real estate

$$V_{NEE} = V_L \cdot ((1+i)-1) + V_C^M \cdot (1+i)^{0,5}; \quad (14)$$

b) for damaged real estate:

$$V_{NEE} = V_L \cdot ((1+i)-1) + V_C^M \cdot (1+i)^{0,5} \cdot (1-s). \quad (15)$$

The overall degree of suitability of structural elements of a damaged building (structure) is determined as the sum of the degree of suitability of i-th structural elements for further use, weighted by their share in the construction costs to replace the building or structure with a modern equivalent.

An alternative and equivalent way to assess the restoration needs of a damaged building (structure) within the boundaries of an existing land plot can be to calculate the amount of costs for replacing damaged structural elements with their modern equivalent:

$$V_{NEE} = V_L \cdot ((1+i)-1) + \Delta V_C^M \cdot (1+i)^{0,5}, \quad (16)$$

where:

ΔV_C^M -costs of replacing damaged elements of a building (structure) with a modern equivalent $(\Delta V_C^M = V_C^M \cdot (1-s) = V_C^M - V_C^M \cdot s)$.

The costs of replacing the damaged structures of a building (structure) with their modern equivalent and the duration of restoration work should take into account, if necessary, the complexity of performing such work within the boundaries of an existing land plot with an appropriate justification for the degree of complexity (establishment of easements, use of additional devices, special technologies for performing works, etc.).

In general, the economic feasibility of restoration needs is assessed by comparing the necessary costs with the benefits that can be obtained from the restored subject. As a rule, such a comparison involves the calculation of the net present costs of the life cycle of possible improvements that satisfy the same requirements regarding the performance, reliability and safety of the facility, but differ both in the costs of restoring buildings and structures, and in further costs for their maintenance (ISO 15686-5, 2017; TEGOVA, 2020, p. 206).

5. Conclusions

The main tasks of real estate assessment for the

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purposes of recognizing and compensating for property damage caused by armed aggression is to determine the amount of direct damages due to loss, destruction, or damage of real estate subjects and to determine the restoration needs of such subjects.

The solution of these tasks will allow objective information to be obtained, on the basis of which it is possible to make balanced decisions on compensation for losses and determine the financial resources necessary for the reconstruction of the affected settlements and territories. Thus, the property damage assessment must be evidence-based, both in relation to documenting evidence of the facts and the degree of destruction, as well as in relation to market and other inputs on which the valuer will rely.

As a rule, property damage in monetary terms is measured by the cost for replacing (recreating) the lost, damaged and destroyed real estate. Therefore, it is natural that methods of the cost approach are considered as the primary methods in property damage assessment. However, verification of such costs requires market evidence, which leads to the need to reconcile the results of valuation procedures for determining the replacement (reproduction) cost and / or the depreciated replacement cost of the real estate with their market value.

The concept of the gross development value combines elements of the market and cost approaches. On the one hand, the gross development value corresponds to the price that can be received by selling the completed real estate on the market, on the other hand, the amount of money sufficient to cover all the costs of acquiring the land and improving it, including the finance costs and developer profit.

Conceptually, the gross development value model makes it possible to structure the market value of the completed real estate in the context of the costs of its creation, justified from the point of view of market participants.

This model can be used to resolve two problems – assessing the direct damages and the restoration needs – which differ from each other both in the valuation subject and in the markets in which this subject is presented.

The direct damages assessment looks at the property as it was at the time of the damage and compares the utility of the property "before" and "after" the destruction, i.e. the main objective of this assessment is to determine the value that has been lost.

The restoration needs assessment refers to a real estate that needs to be created in a new market situation. Such an assessment is connected to real estate development, which involves a certain amount of money and time, and will require taking into account the conditions for restoration in terms of the complexity of development and the effectiveness of institutional instruments aimed at eliminating a possible mismatch between supply and demand.

According to the authors of this article, the use of the gross development value model as a basis for assessing the direct damages due to the loss, damage, and destruction of real estate and in assessing the needs for the costs of restoring such real estate makes such assessments transparent and understandable to those who will rely on their results.

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