Assessment of the Renovation Need, Material Authenticity, and the Cultural and Environmental Value of Historic Apartment Building Neighbourhoods

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Abstract

Preserving the built heritage, maintaining the original exteriors of historic apartment buildings, and achieving today's living standards and ambitious environmental objectives require a multidisciplinary approach encompassing cultural, economic, legal, social, environmental and historical factors. This study aims to assess the need for renovation and the cultural and environmental value of historic apartment buildings. Architects, conservators and civil engineers have been involved to evaluate the authenticity of materials and forms, their technical condition and suitability to the historic urban milieu across 19 building components. Our findings reveal significant replacement activities in various elements such as roof coverings, roof eaves, façades, stairwell windows, stairwells, exterior doors, and window and frame distribution, with a particular focus on materials rather than geometry. Notably, there is often a lack of original materials of the windows. When comparing materials and geometries, we observed a higher frequency of material replacement. While the immediate need for intervention may not be urgent, many historic apartment buildings are at risk of imminent material deterioration, necessitating timely renovation. The deep renovation approach, which extends the service life, enhances energy efficiency and indoor climate and restores the exterior aesthetics, offers a threefold benefit. However, aligning the current reconstruction requirements with the preservation of milieu values may remain ambiguous, leading homeowners to resist or overlook these obligations.

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Consequently, a culture of step-by-step (staged) renovation emerges, contributing to an eclectic appearance of the historically valuable area and promoting the use of inappropriate materials. In conclusion, this research emphasizes the importance of a holistic approach to building renovation, which yields architecturally superior and technically sustainable outcomes. The current study underscores the necessity for a shift in the authorized heritage discourse in Estonia. Rather than primarily imposing restrictive measures on construction and renovation projects, the focus should pivot towards effective communication of historical values. It is crucial to provide support and guidance (not restrictions) to building owners, designers and builders in this regard.
Keywords: renovation; historic apartment buildings; areas of cultural and environmental value; resilience; durability.

Introduction

Historic buildings constitute a vital element of architectural heritage. Depending on their heritage value, these buildings can be categorized broadly on three scales: as a historic monument, a building in an area of cultural and environmental value, and a building of officially undetermined value. Residential areas of milieu value, designated as culturally and environmentally significant by urban planning, are characterized by the preservation of their historical street layouts, green spaces, architectural styles, and other reasons of public interest (MKM, 2008), e.g. the use of a specific material or work method, decorative details, plot structure etc. The local government or the heritage authority can form heritage or milieu-valuable areas, which include well-established built-up areas dating back to a certain period of history.

Preserving the built heritage and old exterior appearance while meeting today's living conditions and ambitious environmental goals (EC COM 662, 2020) can be challenging and requires a multidisciplinary approach. Vicente et al. (2015) demonstrated that the state of degradation of old buildings in historical city centres impacts cultural, economic, social and historical values. Havinga et al. (2020) have developed a method to determine, analyse and represent the heritage significance of attributes to assess the heritage impact of refurbishment strategies. Buda et al. (2022) reviewed computer-based decisional tools for conservation-compatible energy retrofit and concluded that different aspects of energy performance and conservation need to be considered in the broader context of the sustainable management of buildings. They also investigated how the implementation of the EN 16883 (2017) (which provides a decision roadmap for how energy efficiency measures can be identified that both respect the heritage values of the building and improve the energy performance (Leijonhufvud et al., 2021)) can be enabled by adopting a selection of existing computer-based tools to support the identification, assessment, and selection of retrofit solutions in historic buildings. Belpoliti et al. (2018); Buda et al. (2022) analysed energy performance of a historical town using a parametric approach which was applied to the entire cluster to determine the town's baseline consumption and to test energy retrofit scenarios and developed energy policy to revitalize the whole town. Evaluating heritage buildings' sustainability, Seduikyte et al. (2018) found that although some historical features may change or even disappear during the renovation of historic buildings, this loss is less than if a heritage building is abandoned, which can lead to degradation and a complete loss of historical value.

In Estonia, numerous well-preserved residential areas hold significant historic milieu value. Most of these historical landscapes include a large number of wooden apartment buildings from different decades, styles and typologies mainly from the middle of 18th to the middle of 20th century. Preserving early wooden districts is essential because they represent an important stage in the history of the development of Tallinn as they were the very first urban residential areas of this scale constructed specifically for Estonians who came from rural areas to work in different plants and factories.

Nevertheless, over time the demands on residential buildings have evolved. Nowadays, people have higher expectations regarding safety, health, comfort and functionality of buildings. Today people take for granted that buildings have electricity and water (including domestic hot water), but these comforts were not common at all when these buildings were built. This causes the need to have the buildings upgraded. The same applies to the energy performance of buildings. Today, buildings are expected to use much less energy than when they were built. During their construction, there was no assessment of building emissions. Today our target is to achieve a zero-emission building stock (EPBD recast, 2018).

The motivation of the study is to determine the general need for renovation of residential buildings located in milieu valuable areas, to evaluate the justification of renovation requirements, and assess the effectiveness of implemented renovation solutions. The aim is to identify the volume and typology of authentic materials, to identify arguments for updating current requirements and recommendations for deep renovation. Through appropriate requirements and recommendations, it is possible to increase the renovation volume, speed up the design process, make renovation more cost-effective for the owner, and raise awareness of sustainable renovation.

Methods

Field investigations

The survey is based on a questionnaire put together by experts to evaluate the buildings in three main categories: authenticity (originality of material and geometry), correspondence to milieu value criteria, and technical condition/renovation need. By the change of geometry, we mean both large surfaces (the shape of the roof) but above all the geometry of junctions of building envelopes and details. This is what particularly stands out in the exterior of the building – if a large building is proportionally lengthened by insulation so that it affects the urban milieu as much as a change in the solution of junctions.

During the survey, the buildings were evaluated according to their components (altogether 19 building components, including the roof, façade, window, door, basement). We compared the onsite and web-based (Google Street view) survey and considered the onsite survey to be more accurate and used this as the main tool for evaluation. In the questionnaire survey, we evaluated the buildings according to six (authenticity and technical condition) and seven (environmental value) levels, however, in the analysis, we reduced the evaluation criteria for the current sample buildings.

Since the subjectivity of on-site or virtual visual inspection largely depends on the knowledge and experience of the professional expert (Prieto et al., 2023), in the current study, different professionals, including three architects (37 % of buildings), two conservators (41 % of buildings), and two civil engineers (22 % of buildings), participated in the assessment of apartment buildings in the milieu valuable area. Initially, all experts conducted on-site evaluations collectively for selected buildings, allowing for the observation and discussion of different perspectives. Subsequently, individual test evaluations were performed, and the results were deliberated upon. Opinions were then aligned among specialists from different disciplines to establish a shared understanding of the authenticity, appropriateness within the environment, and the technical condition of the buildings. After the alignment, the buildings for the survey were selected and distributed among experts, for which each expert conducted the evaluation individually.

The concept of original or authentic refers to the building material and geometry present when the building was originally constructed (typically in the early 20th century). For instance, if wooden boarding is replaced with the same wooden boarding, it is categorized as a replica. However, if it is replaced with a different material, it is considered a new material. Partial or full replacement entails the replacement of a building component, either partially or entirely, based on the specific area in question

The milieu value assessment was based on the building component (see Fig. 1) and by considering the nearby buildings and area. Such an approach provided an overview of how the modification of the original substance has affected the aesthetical and technical situation in the milieu area. It also gives an understanding of how a single element could affect the impression of the whole and how many original/authentic materials exist today at all.

Fig. 1

Examples of the milieu value assessment of window materials

M1 No negative effect on milieu value

M4 Neutral effect on milieu value

M6 Spoils milieu value

Fig. 2

Examples of the technical condition assessment of the wooden façade boarding

T1 Dangerous, severe damage; Immediate renovation

T2 Bad, moderate damage Renovation within 3 years

T3 Satisfactory, some damage; Renovation within 3 years

T4 Good, minor damage; Renovation within 5 years

T5 Very good, slight damage; Renovation within 10 years

T6 Excellent, no damage, new; Planned maintenance

Statistical analysis

A total of 19 building components were analysed, categorized as follows: roof covering, dormer, roof eaves, façade, windows, plinth and slats (each for the main building and stairwell), façade junction, door, and fence. We asked opinions regarding the originality/authenticity, milieu value, and technical condition of each component with a total of 31 questions.

Responses were collected digitally using Google Forms and subsequently analysed by Grasshopper and MS Excel tools. **Fig. 3** shows the evaluation topics, criteria, and the primary and secondary dependency. To find a causal connection, we performed a cross-analysis on three different dependency scenarios. Firstly, we divided the buildings according to the milieu value and studied how the authenticity of materials or form was evaluated (primary dependency) and then based on the remaining subdivisions how the technical conditions were evaluated (secondary dependency). Secondly, we divided the buildings according to their technical conditions and studied how the authenticity of materials or form was evaluated (primary dependency) and then based on the remaining subdivisions how the milieu value was evaluated (secondary dependency). Thirdly, we divided the buildings according to the authenticity of materials or form and studied how the milieu value was evaluated (primary dependency) and then based on the remaining subdivisions how technical conditions were evaluated (secondary dependency).

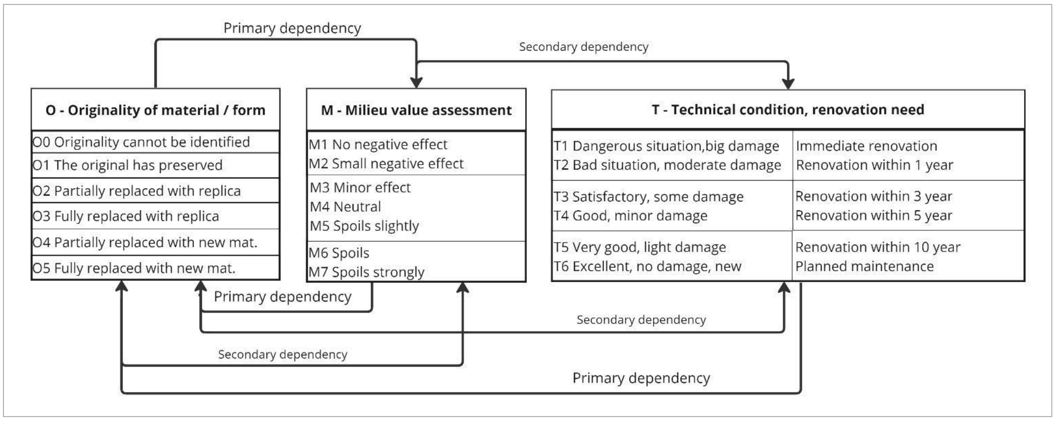

Fig. 3

The evaluation topics, criteria, and primary and secondary dependency analysed

This way we found different dependence relationships and branching distributions on how the building components are distributed based on these assessments. Consequently, we obtained quantitative output, representing the percentage of buildings falling into each dependency scenario. In our statistical analysis, we identified the extremes and the most common situation dependencies from the perspective of each specialty, thereby associating specific components with the buildings to which they belong.

The influence of material and geometry on the milieu value were studied on three scales: large surfaces (façade, roof, pinch, window, door), building envelope connections and smaller details (external wall connection with roof, stairwell, window, plinth, roof cornice), decorations (slat, cornice).

The studied areas of milieu value

The area of milieu value of Uus Maailm (New World) in Tallinn was selected for this study due to its wide variety of building types. Uus Maailm used to be a meadow until the middle of 19th century and most of the wooden apartment buildings were built between 1890 and 1939 and brick apartment buildings in 1950–60s. The residential area in the proximity of Luther Plywood and Furniture Factory (founded in 1883) began to develop due to the need for accommodation for the workers. The first houses were two-story wooden apartment buildings called the Lender House after the civil engineer Voldemar Lender who developed them and who later became the first mayor of Tallinn of Estonian nationality. The construction of new buildings in Uus Maailm was resumed after the end of the First World War (WWI) in 1923 when they continued to build wooden apartment buildings including Lender Houses but also others, two- to three-story houses with brick stairwells called the Tallinn House as they are characteristic only to Tallinn and their development was due to local fire safety regulations (RT 59, 1932). In areas where buildings were destroyed in the Second World War (WWII) bombings in 1944, new ones were built later. Those are massive brick apartment buildings from the Stalinist-era in 1950s that are positioned as an ensemble. In the 1960s and 1970s, some industrially designed brick and/or panel apartment buildings were constructed. Thus, the development of this area that is now considered of milieu value consists of a variety of building types of different size and construction materials allowing to follow and retell the historical events that have formed Tallinn.

Results and Discussion

General description of the studied buildings

Altogether 43 apartment buildings were investigated. 53% of the buildings were constructed before WWII, 21% of the buildings were constructed before 1960s (Stalinist period) and 26% after 1960s. 53% of the buildings were wooden (mainly log), 47% of buildings were non-wood (mainly brick).

The dominant roof material (Fig. 4, left) was steel sheet, with seamed steel (40 %) being the original, followed by profiled sheet (26 %) that is not allowed to be used in buildings built before 1940 (Tallinn, 2009). Other roof materials for pitched roof were stone and cement asbestos fibre board. Painted wooden boarding (41 %) and plaster (37 %) were the dominant façade materials. Plaster was the main (> 2/3) material also for plinth. Modern one-frame plastic was the main (51 %) material for window frame (Fig. 5, left), although it is forbidden to use plastic windows in buildings built before 1940 (Tallinn, 2009).

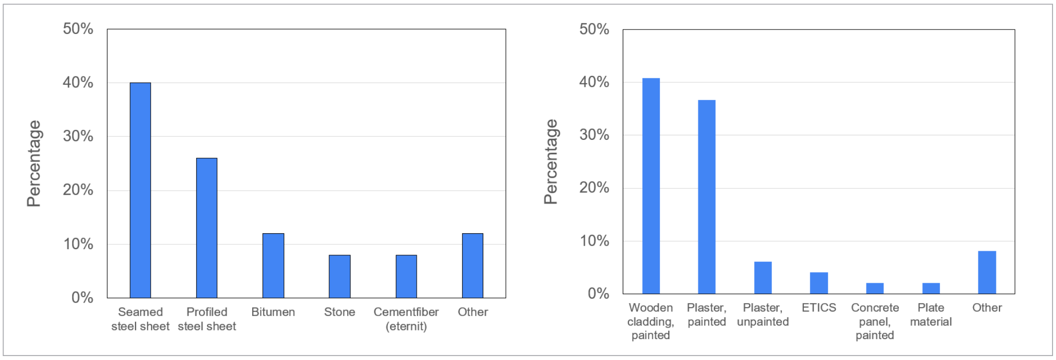

Fig. 4

Material of the roof (left) and the main façade (right)

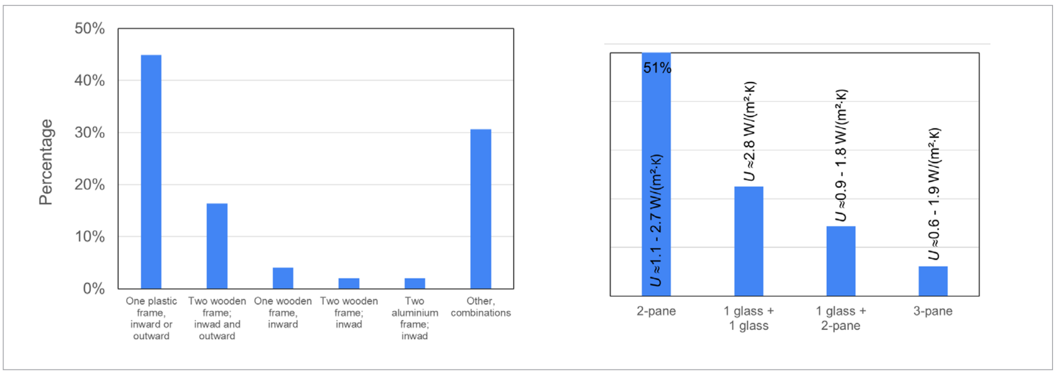

Fig. 5

Window frame material (left) and glazing (right, 2-pane means double glazing, 3-pane means triple glazing, 1 glass means single glass in a separate frame)

Originality and authenticity

By material authenticity we describe materials that can be literally the original elements or new elements but of the same material as the original. Material authenticity of large areas (roof, façade, window) was preserved only in 30 % of cases and was mainly changed to new material in 44 % of cases (total area 31 % or partly 13 %). Material replica was used in 13 % of cases and it was not possible to determine material authenticity in 14 % of large areas. Considering also smaller façade areas (plinth, dormer, door), the balance between original and new materials was equal. In most cases, the plinth (60 %) and façade (40 %) materials were preserved and less often window (21 %) and roof (14 %) materials. The window material had the least original substance. Windows were replaced by new material in 74 % of cases – from wooden to plastic frame. Better material authenticity preservation was noted in small slats and decorations, averaging 49 %. Conducting the element-based analysis, it turned out that in approximately half of the cases, the window mouldings and cornices are left original. As a comparison, it can be stated that the original windows are kept only in about quarter of the cases. Overall, there is less area of original material than new material. When comparing material and geometry, then geometry is renewed less often. Roof geometry was preserved in 86 % of cases while window/door geometry was preserved only in 40 % of cases. Geometry of building envelope connections (wall-roof, wall-plinth, wall-stairwell) has been preserved on average in 70 % of cases.

Milieu value

General

Altogether 69 % of large areas had no or just a minor negative effect on the milieu value ("does not damage", i.e. supports the preservation of the milieu value of the neighbourhood). Only 8% of large-area solutions have been evaluated as detrimental to the surrounding environment, earning the label "ruining the milieu area". In terms of geometry, the negative effect is even smaller: 81 % have no or just a minor negative effect and a ruining effect in only 4 % of cases. Thus, the material selection influences milieu value more than geometry. This result suggests that the energy renovation of neighbourhoods of milieu value may be less critical if building material can be replaced with the original and the geometry of building envelope connection proportions can be retained. For some building elements (e.g., skylights or the presence of a stairwell or window trim) there could be several historically accurate solutions, thus it was assessed that they do not affect the milieu negatively while the specific original appearance of the building was largely not identifiable. The stairwell window trim material and geometry and roof geometry have no or just a minor negative effect on the milieu value regardless of the original, replica or new solution used.

Windows

The material and shape of windows and doors and the frame distribution have the highest negative effect on the milieu value – this is understandable as in these aspects we have the highest number of original features replaced by new ones. In the case of substituting the original material with a new one, windows are the element that affects the historical value of the urban environment most negatively (17%). These buildings were mainly smaller two- to three-storey wooden apartment buildings with plaster or wooden cladding façade. So, it seems that plastic windows on large-scale brick or pre-fab panel buildings are more tolerable than on smaller wooden buildings. Surprisingly, the element with the most answers of new material not affecting the milieu negatively is the material of stairwell windows (in case of new material 27% of assessments for this element were "does not affect the milieu") and plinth windows (24%), because one might expect plastic windows to spoil the historical context of areas of milieu value. The result for apartment windows was 21%. When looking at specific buildings, we could see that half of them were large-scale multi-storey brick or pre-fab panel apartment buildings that have very many windows. Although not all of them are the same in regards of openness and frame width, it nevertheless follows that the overall unified appearance of windows made of new material is very important. Nevertheless, in case of window openness there were 23 % of buildings with new window material that had solutions suitable to the milieu. It must be considered that in the case of plastic window frame, their openness affects the width of the frame and thus has a visual impact. It may be concluded that when substituting old wooden windows with plastic ones, preserving the same openness on all will help to minimize the negative effect of the new material on the surrounding historical milieu. Also Wise et al (2022) showed that complete replacement of windows with plastic ones was the most unacceptable to the heritage value. Minor window improvement with a lower impact on heritage values like secondary glazing and thermal curtains lead only to 2–3 % of average savings compared to the original windows (Iyer-Raniga et al., 2012).

On the other hand, changing the windows pragmatically can be somewhat understandable, because the residents' perception of the role of windows in the home can be very different: to serve practical functions, for example, cool air, task lighting and daily rhythm, to support additional experiences of comfort, for example, brightness, indoor appeal, improved mood, spaciousness and visual privacy, to mediate information about outdoor conditions and the interaction between residents and people outside—allowing observation, verbal communication and the use of intentional or unintentional visual cues (Gerhardsson et al., 2021). The weighted average thermal transmittance of existing windows with two glass panes is quite high (U≈2.2 W/(m^2·K)) containing high potential for decreasing thermal transmittance while it is more than three times lower for modern triple glazing (U≈0.6 W/(m^2·K)). Thus, by changing the current windows, both the urban environment and the energy efficiency of the buildings could be improved.

There is a need to develop a new window solution for areas of milieu value that looks similar to the original window on the outside and have triple glazing pane on the inner frame. Front doors made of metal got the most negative assessments even when used on a large-scale brick apartment building – 9% of all answers for this element and all solutions with new material that were considered as spoiling the milieu were metallic doors.

Façade

New material did not have a negative effect on the milieu value when it is also historically accurate to the building's specific original material, e.g. when the cladding of a wooden building is substituted with plaster. This is the case even when the substitution is made partially or is in a poor technical condition. This kind of substitution is not less tolerable than a case of original cladding which is substituted by a simpler one, e.g. with no profile or of narrower width. When dealing with plaster the texture is important.

Questionnaire and evaluation

In case of most of the observed buildings, all specialists agreed that even if a specific element does not meet the requirements of the milieu area, it does not necessarily affect the appropriateness of the entire building in the milieu area. The questionnaire about the whole of the building allows us to identify the element that affects the overall impression of the building the most. This gives an indication of which existing requirements are most rarely followed during the reconstruction and which of the requirements need to be explained to the homeowners the most in the future.

Although different professions were represented on the highest professional level and personal assessments were calibrated, the assessment of milieu value could still be personal. The assessment of milieu value may be difficult also from the administrative perspective, as regulations (Tallinn, 2009) do not provide specific values either and only present limitations and requirements. This does not allow the designer to approach the values in terms of their content but only carry them out mainly within the framework of prohibitions and orders. It can kill creativity and divert focus from the original goal. Also Kallast (2021) has showed that the Estonian authorised heritage discourse has focused on setting restrictive measures for construction and renovation works instead of properly communicating the historical values.

Technical condition and renovation need

In general, there were only a few buildings (4 %) in a hazardous or poor situation with considerable and moderate damage that required immediate renovation (T1 + T2), Fig. 6. The worst performing building component in this category was foundation plinth (7 %). Klõšeiko et al. (2011) studied 133 wooden apartment buildings in Estonia (a different sample compared to the current study) and showed that nearly a quarter of the investigated buildings needed immediate renovation and substantial investments to extend the service life and minimize the degradation. So, in more than 10 years, a lot has been done and the acute renovation need has been decreased. On average, 2/3 of studied apartment buildings were in very good or better condition with slight or little damage and will require renovation not earlier than in 10 years. Single building components with the best technical condition (T5 + T6) were the roof (82 %), window (72 %) and external door (74 %). This can be justified by the fact that roof influences building durability and service life the most by protecting it from precipitation. Windows can be changed by the apartment owner and it requires no financial negotiation with the apartment association.

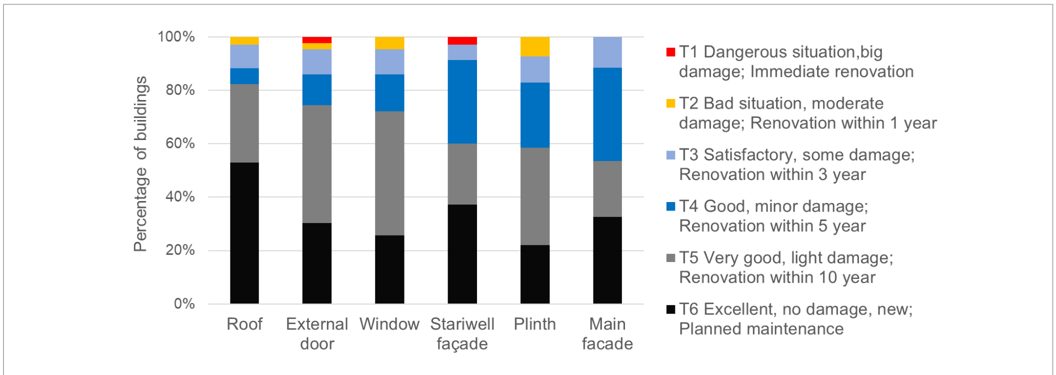

Fig. 6

Technical condition of the main building envelope exterior surfaces

Excellent or very good condition means that there is limited need for renovation from the technical point of view in the near future. It also means that possibilities to improve energy performance of the buildings are locked for some time as it is financially and emotionally difficult to motivate people to renovate structures that have been renovated only some years ago, although without substantial improvement of the building's energy performance. Based on the building survey, close to half of the façades and plinths were in a technical condition that required renovation within 5 years (technical condition T4 or worse). As additional thermal insulation of historic wooden buildings (Arumägi et al., 2014; Maia et al., 2023) and brick buildings (Kuusk et al., 2014) is cost-efficient (especially when other more cost-effective options have already been used (Niemelä et al., 2017)), it is strongly recommended that with the renovation of the façade, the building should be additionally insulated to avoid the formation of renovation lock-in effect and the continuation of CO_2 emissions. When insulating wooden buildings from the outside, the characteristic projection of plinths, firewalls, stone stairwells, eaves cornices and other architectural details must be preserved (Tallinn, 2009). This allows to achieve good energy performance and minimal influence on the milieu value (Arumägi et al., 2015). The earlier the renovation is started, the lower the cumulative CO_2 emissions will be (Fawcett, 2014; Maia et al., 2023).

Three-criteria analysis

In the following, the interrelations between the three investigated criteria (originality/authenticity, milieu value and technical condition/renovation need) are analysed.

Originality / authenticity and milieu value

We investigated the relationship between originality/authenticity (material or geometry) and milieu value, looking for confirmation to four hypotheses (see Table 1). The hypotheses were created on the assumption that by maximizing the original, also the milieu value is maximized. To get a clearer difference in milieu assessment, we considered M1 & 2 and M5 & 6, while the neutral area was not considered. The hypothesis was not true for roof and plinth materials presumably because the visibility of the roof from the street level is minimal and a damaged plinth can also damage the milieu value.

As to the roof, windows and door geometry, authenticity guaranteed better preservation of the milieu value. It is quite easy to ensure the same window shape, opening and frame distribution as in the original. Responsible window and door sellers who do not offer unsuitable products to areas of cultural and environmental value can also play a role here. If the simplification of the window details is due to the cost, then here the authority laying down the milieu rules (local municipality) could support the preservation of the urban milieu value, for example, by covering part of the difference in the cost of the product.

The hypothesis that partial replacement/change of a building component is more suitable for the milieu value than complete replacement while the complete replacement is more damaging than partial replacement was less confirmed. It is quite easy to ensure the same window shape, opening and distribution as the original. It was somewhat surprising that the hypothesis of replacing a damaged original (material and/or geometry) with a replica fits the milieu better and a new one less, while replacing it with a new one spoils the milieu value more than replacing it with a replica was not confirmed. So, we cannot say that a copy of the original is necessarily good and the new one is necessarily bad.

Table 1

Relationship between originality / authenticity and milieu value of large building envelope surfaces (roof, façade, stairwell, plinth, window, door) and their connections

Hypothesis	Background	Building surfaces		Connections, details	
		True of hypothesis		True of hypothesis	
		Material	Geometry	Material	Geometry
Comparing the original and the full replacement, the original is less in very good and excellent condition (T5 & 6) and at the same time the original is more damaged (T3 & 4) than the full replacement	Original represents value	75 %	86 %	100 %	86 %
Comparing the original and the new, the original is less in very good and excellent condition (T5 & 6) and at the same time the original is more damaged (T3 & 4) than the new	Less replacement / change, less influence on milieu value	38 %	43 %	14 %	29 %
Comparing the original and the copy/replica, the original is less than copy/replica in very good and excellent condition (T5 & 6) and at the same time the original is more damaged (T3 & 4) than copy/replica	Copy / replica is more similar to the original and should spoil the milieu value less	0 %	29 %	0 %	0 %
In terms of area, the original is more suitable than the replacement	In the field of milieu value, the rules should ensure the preservation of existing materials	25 %	86 %	86 %	86 %

Milieu value and technical condition / renovation need

Given that dangerous and poor technical conditions (T1 & T2) were rare, our comparison primarily focused on T3 & T4 and T5 & T6 technical conditions concerning the originality and authenticity of material and geometry. Specifically, regarding façade material, our hypothesis was confirmed: solutions that align with the milieu value (preserving originality) tend to be in poorer condition (due to age), while solutions that are neutral or detrimental to the milieu (newer) are more damaged (as illustrated in Fig. 7, left). Conversely, as to the roof material, which was mostly replaced (maintaining very good conditions) and has a limited impact on the milieu (not being visible from the street), our hypothesis was not substantiated (as depicted in Fig. 7, right).

Originality / authenticity and technical condition / renovation need

The results of the comparison of originality / authenticity and technical condition / renovation need indicated that the original is less in very good and excellent condition than replacement (based on area) or copy/replica or new material. It is argued that the original and the old can be more durable because they are usually built with good attention to detail (such as weather resistance) and with

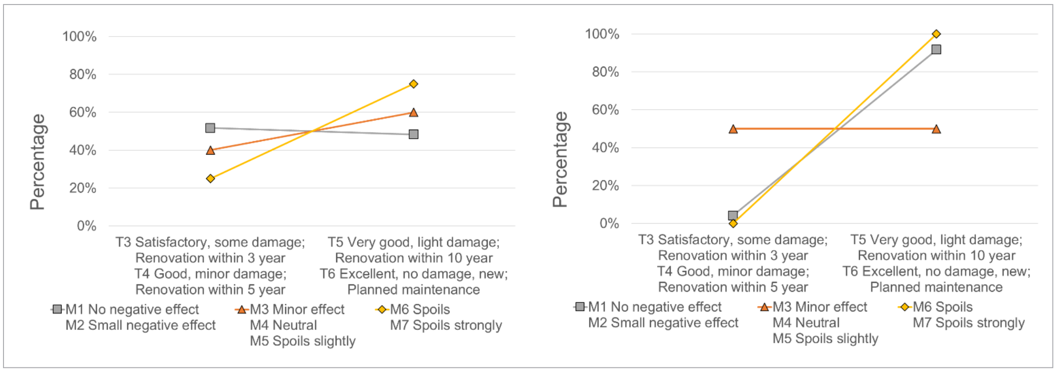

Fig. 7

The influence of material authenticity to the technical condition / renovation need of façade material (left) and roof (right)

high-quality materials (such as old-growth timber) (Sims et al., 2006). The reason for our result that the original is not in the best condition may be that the examined components in the study have been renovated too recently and the damage has not been revealed yet. In future studies, the age of the building and parts should also be considered in the analysis. Although according to the Heritage Protection Act (RT I, 19.03.2019, 2009), the preservation of authenticity must be ensured for a monument if it is possible to use original materials and traditional work methods and technologies, the requirement in the milieu value area is not so strict, and before renovation, it must be determined whether the reason for the degradation was originally too little durability and climate resilience of the original solution to the given climate load.

Table 2

Relationship between originality / authenticity and technical condition / renovation need of large building envelope surfaces (roof, façade, stairwell, plinth, window, door) and their connections

Hypothesis	Background	Building surfaces		Connections, details	
		True of hypothesis		True of hypothesis	
		Material	Geometry	Material	Geometry
In very good and excellent condition (T5 & 6) there is less original then fully replaced and at the same time the original is more damaged (T3 & 4) than the full replacement	Original is older than full replacement and therefore could be more damaged	78 %	67 %	50 %	57 %
In very good and excellent condition (T5 & 6) there is less original then new and at the same time the original is more damaged (T3 & 4) than the new	Original is older than the new and therefore could be more damaged	78 %	57 %	25 %	86 %
In very good and excellent condition (T5 & 6) there is less original then copy/replica and at the same time the original is more damaged (T3 & 4) than copy/replica	Original is older than the new and therefore could be more damaged	56 %	43 %	25 %	57 %
Replacement with the new is more likely to be in very good and excellent condition (T5 & 6) and less damaged (T3 & 4) than replacement with copy/ replica.	When material had to be replaced/ renovated, i.e. the original material was not suitable for this place and for this climate load.	89 %	57 %	75 %	71 %
In the case of new, there is a greater difference between very good and excellent condition (T5 & 6) and less damaged (T3 & 4) than copy/replica	When material had to be replaced/ renovated, i.e. the original material was not suitable for this place and for this climate load.	67	43 %	50 %	43 %

Good examples of renovation

Analysing all the building parts together, three buildings were drawn out with their suitability for the milieu and the excellent technical situation (see Fig. 8). The comparison of the relationship between the milieu values and authenticity reveals that the relationship between the geometry and material of building parts generally follows the same trend, for example, when looking at the graphs of the stairwell door awning and plinth sills. This can lead to the conclusion that building parts have been renovated or altered at a similar pace and it is possible to keep the geometry as it was when the building was originally built. In most cases, the original solution has always been better from the perspective of milieu value. It is only in case of window materials and finishes that there are more replica solutions than original ones that do not disrupt the milieu value.

Fig. 8

Good renovation and construction examples from the studied Uus Maailm milieu value area

Timber building: Luha 35 a | Brick building: Luha 30 | New building: Kristiina 12

Conclusions

In the present study, we examined the need for renovation, the preservation of original materials, and the milieu value, with a focus on the apartment building neighbourhood Uus Maailm as an illustrative example. The evaluation method developed by us demonstrated its suitability and can be applied in future studies that require the evaluation of renovated buildings and their various aspects.

Among the materials utilized in the analysed buildings, some were found to be in violation of regulations (e.g., plastic windows, profiled metal sheeting roof). This indicates that the current approach to managing the milieu value, which relies on commandments and prohibitions, is ineffective. Instead, there is a need for quantification of values to enable a more objective assessment as well as for an advisory and financing system that supports homeowners in deep renovation of valuable buildings.

Only 30% of the investigated buildings' large areas (i.e., roof, façade, windows) retained their original materials, while 44% were primarily replaced with new materials. More specifically, 74% of the windows were replaced with a new material – transitioning from wooden frames to plastic frames. With the use of windows with appropriate thermal transmittance, there is a potential to enhance both the milieu value of the neighbourhood and the energy performance of the buildings by adopting alternative solutions that resemble the original windows externally while incorporating triple glazing panes within the internal frame. According to the building survey, almost half of the façades and plinths were in a condition requiring renovation in the near future. The worst performing building component in this category was the foundation plinth. Single building components with the best technical condition were the roof, window, and external door. Therefore, there is a need to renovate the façades. It is essential that renovation recommendations and requirements facilitate deep renovations without resulting in a renovation lock-in effect, similar to the issue with windows, whereby inefficient changes are made that fail to yield significant benefits and are deemed emotionally and financially unacceptable for further modification.

In the majority of cases, the original material or geometry offered the lowest risk of compromising the milieu value. However, such original elements were often in poorer technical condition and necessitated more expeditious renovation. Prior to renovation, it is crucial to ascertain whether the degradation was initially caused by insufficient durability and climate resilience of the original solution under the prevailing environmental conditions.

For the owners of buildings located in an area of milieu value, certain rules have been established for reconstruction which should ensure the preservation of the historical environment. The analysis shows that if the building is treated as a whole, it is possible to ensure the architectural appearance and engineering performance after reconstruction, even if other techniques and materials are used besides the traditional options. In areas of historical value, there are buildings that have been preserved or reconstructed true to their era, but there are also those cases where various stages of construction have significantly distorted their original appearance. The current study underscores the necessity for a shift in Estonia's authorized heritage discourse. Rather than primarily imposing restrictive measures on construction and renovation projects, the focus should pivot towards effective communication of historical values. It is crucial to provide respective support and guidance (not restrictions) to building owners, designers and builders.

Based on our analysis, the suitability of buildings in the area of milieu value is enhanced when all structural components are contemporaneously and thoughtfully renovated. The analysis showed that the staged renovation of buildings creates an architecturally eclectic exterior that does not improve or correspond with the historic area and may result in non-functional technical solutions across various structures. Conversely, a comprehensive renovation can yield a suitable and structurally functional outcome for a milieu-valuable area, even if specific non-deterministic details may not fully comply with current conservation requirements. For instance, when external insulation is applied to the façade, other elements like eaves, staircases, plinths, and windows should also be addressed to maintain proportions and eliminate thermal bridges. The discourse on heritage preservation should advocate for and endorse deep renovations, ensuring that the quality of the historic urban environment is conserved during the renovation process.

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