Quality Parameters for Renovation

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FOREWORD

There is no easy way to define the quality of renovation. It is possible to set numerical threshold values for ensuring the safe load of roof construction under the snow, or there might be regulations for air-condition and energy-efficiency defined by exact numbers. However, the task becomes difficult when we judge the quality according to the standards of a human being living in or using that building. In that case, the quality is evaluated holistically based on one's own understanding and sensory experiences. Now the built environment takes shape as an integral whole, where its different aspects blend in, giving impressions of comfort and bringing well-being.

This is the standpoint of architecture, where the quality of building is defined in complex holistic terms. In renovation, the quality management is extremely challenging. This report, written mainly by architect Pekka Saatsi, points out that difficulty, yet emphasizing the necessity to manage the quality analytically. Pekka is a well versed renovation specialist, and he has developed a twelve-part criteria for evaluating and managing the quality of renovation.

The report has been written in EU Interreg Botnia-Atlantica funded project "Nordic Renovation Centre", carried out between 2015–2018. The project aimed at setting up a joint Nordic portal where the expert knowledge of renovation is available for professionals and lay builders as well. The project leader was Novia University of Applied Sciences, and the project partners were Tampere University of Technology, Seinäjoki University of Applied Sciences, Umeå University, County Council of Västerbotten, SP Technical Research Institute of Sweden, and The Arctic University of Narvik. The quality criteria forms a part of the results of this extensive project.

Ari Hynynen

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INTRODUCTION

Approximately one-half of the construction work carried out in Finland is renovation construction, and its share is growing. In residential construction, the amount of renovation work has already exceeded the volume of new construction. The total maintenance backlog of buildings and infrastructure is estimated to be as much as one-tenth of the value of the entire building stock, which is about 350 billion euros. (1) This maintenance backlog has emerged because of a shortage of preventive maintenance and only urgent repairs have been carried out. This means there has been less maintenance than wear.

Renovation has major impacts on employment and the economy, as well as the comfort and healthiness of the environments in which people work and live. Renovation differs from new construction in many ways: renovation projects are complex and require more and different types of special skills than new projects. Buildings may also remain in use during a renovation project. The amount of moisture and mould problems constitutes a particularly large challenge. In a study carried out by the Finnish Institute of Occupational Health at the request of the Audit Committee of Finland's Parliament, the cost of mould damage was estimated to be 450 million euros per year. (2) The estimate includes costs arising from symptoms, illnesses, their diagnosis, loss of ability to work and the reduction in work efficiency and productivity. According to the study, the one-off renovation costs of significant moisture and mould damage amount to 1.4 billion euros. This equates to approximately 0.4 percent of the value of the entire building stock and approximately six percent of the annual value of house construction. According to the study, the most common reasons for moisture damage include risky design solutions, shortcomings with moisture management at construction sites, errors in construction site implementations, maintenance violations and natural wear-and-tear or structural damage at the end of service life.

Quality parameters can and should be set for renovation construction. Only by setting parameters it is possible to reliably evaluate the success of a repair. Converting them to numbers does not make sense in this context even though it would make it easier to measure success. Some of the parameters are qualitative and some of them are complex even in terms of quantities. The purpose of the proposed parameters is to serve as a check list that can be utilised in planning and thereby contribute to the success of a renovation project.

One of the goals of the Nordic Renovation Center project is to determine what kinds of quality parameters can and should be established for renovation. The purpose of this report is to act as a speech in the discussions carried out on the issue. We shall present twelve quality parameters below, which we have created during the project. A list similar to the one we shall present has not previously existed. Some of the parameters are classic and generally accepted (Vitruvius), others are relevant to topical debate on construction

quality (incl. moisture safety and quality of indoor air), and some have been brought up during our discussions with the researchers at TUT's Department of Construction Engineering (fluent communication).

1. ROTI report, www.roti.fi

2. Bulletin of Parliament 18th October 2012. https://www.eduskunta.fi/FI/tiedotteet/Sivut/Homevaurioiden%20terveyshaittojen%20hinta%20on%20450%20miljoonaa%20euroa%20vuodessa.aspx


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Images at the side:

1. Black wool not only indicates air leaks and mould, but also previous unsuccessful repairs. Over time, the additional insulation of log houses has proven to be a non-sustainable repair method, and at the same time the architectonical character of the building has been destroyed.

2. The root cause of mould problems is often the lack of structural physics skills. As a result of incorrect repair methods, heat and moisture are not able to move in the structures in the way they should. Paint blistering due to an excessively dense paint type in Narvik, Norway. Moisture may have penetrated the wall from the inside with warm air, from outside with rain, or the timber was moist when it was painted.

12 Quality Parameters for Renovation

1. Architectonical quality
2. Ensuring of historical values
3. Functionality
4. Accessibility
5. Energy efficiency
6. Moisture & Mould safety
7. Good indoor air quality
8. Sustainability
9. Legislative quality
10. Cost-efficiency
11. Competence of participants
12. Fluent communication

Renovation is more challenging than new construction. There are many things to consider and you have to be prepared for changes during the work. A check list is needed to keep the entity clear.

The picture shows the repair site of Kuitia manor horse stable. All repairs are done under the weather protection.

1. ARCHITECTONICAL QUALITY

As in the case of quality in general, architectonic quality is difficult to quantify. Designed, and particularly implemented, architecture is always a product of its time. Different eras have led to extremely diverse interpretations of what good architecture is. It is clear that architectonic quality is not dependent on the time of construction; both good classism and high-quality post-modernism have been achieved. Architectonic quality can be ensured or enhanced in many ways when carrying out a renovation project – for example by preserving time-tested architectonic features or by changing the entire architectonic expression into something that is very different. Therefore, preserving architectonic quality is not the same thing as building preservation, which is covered in the next section. Many successful renovation projects are characterised by simultaneously succeeding in preserving the original architectonic expression and to some extent complementing it with contemporary design language. Both-and is usually a more productive premise than either-or. A modifying renovation is a good solution particularly in situations where the original appearance of a building is found to be alienating and problematic. There are many of these kinds of buildings located in the so-called concrete suburbs built in the 1950s and later. There are good examples of achieving a desired, high quality environment, in addition to energy savings and other goals, by modifying the architectonic expression in connection with a renovation project. However, it must be noted that there are more and more buildings within the modern building stock that have features worth preserving. It will be a major challenge in the near future to repair these kinds of buildings in a way that preserves the original architectonic values while simultaneously changing structures because, for instance, the original construction method has proven to be unsustainable and vulnerable to damage.

Images on the following page:

1. Architectonical high quality is combined with a healthy and sustainable construction method. Louhisaari Castle in Askainen, in 1655.

2. When architecture is of high quality, there is a desire to preserve the building from one century to another, even if the repairs occasionally fail. Helsinki Cathedral, architects Engel and Lohrmann, built in 1852. The latest repair has been carried out with high quality as designed by Professor Vilhelm Helander.

3. The sensitive values of modernism that concern dimensions and materials can be destroyed with unprofessional repairs. A recently repaired 1950s apartment building in Harstad, Norway.

4. Demolition is often an alternative for renovation, which will be the result in many cases in the future, because the construction method of the last few decades is often unrepairable, and the architectonic values are considered to be modest. Demolition site in Herttoniemi, Helsinki.


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ALEXANDER II
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2. ENSURING OF HISTORICAL VALUES

According to Section 118 of the Land Use and Building Act 132/1999, care shall be taken to ensure that buildings or townscape of historic or architectural value are not marred when construction work, repairs or alterations are carried out on buildings. By European standards, Finland's building stock is exceptionally young and there are fewer and fewer genuinely old buildings remaining. The main buildings considered valuable, such as churches, parsonages and manors are, to a large extent, protected. The threats to everyday buildings and yards include repair and modification work that undermine their historical value and technical sustainability, stricter building codes and changes in lifestyles and values. During renovation projects, building preservation is often considered to limit planning. There may also be the thought that museum authorities issue negative statements for projects without proper reasoning. Building preservation should, however, be considered as a resource and opportunity provider, not an inhibitor.

The first step towards smart preservation is to identify the values that are hoped to be preserved. A good tool for this is a building history survey (BHS). During a building history survey, the building's history, planning and alteration phases as well as the current condition are studied. It is a compilation of the building's story in an easy-to-read, illustrative and inspiring manner. The statement consists of the key information of the building and its immediate vicinity, on the basis of archive and field work. A good BHS provides an overall image of the building's stages. In addition, a building history survey describes a building as objectively as possible in its current state. Conclusions, such as appraisals, are clearly separated in their own section. A building history survey helps to understand a building in an in-depth manner, and understand its history and different phases. It joins the subject to phenomena that have occurred in culture. A building history survey is a tool for repair and alteration planning, town planning and the definition of preservation objectives, and thus the preservation of the building's identified values. A carefully prepared BHS serves designers by helping in the reading of a building. In addition to the owner and designers, it also serves as a data source for the implementers of repair work, and more comprehensively for those interested in building heritage. During a project, it is often useful that a BHS has been completed as early as possible, before starting any alteration and repair planning. Sometimes the survey is completed for the purpose of documenting and appraising a building before its demolition. A building history survey helps authorities and the owner of the property in the definition of preservation objectives. When the building's values have been identified, its preservation is easier in terms of decision-making, repair planning and implementation. A building history survey helps perceive and keep in mind the overall entity. The most significant use purpose of the survey is to convene all the values that have been identified in it to all decision-making concerning the building. The decision to preserve va-

In order to be able to cherish values in a renovation project, they must first be identified. Building history survey is a good tool for this.

Oittaa manor house, Espoo.

lues, and in some cases waiving them, can justifiably be done only once such values have been identified. If it is a case of a building which has undergone a lot of repair work and a wide-scale general renovation is due again, a building history survey is a good place to collect all the previous plan phases as initial data; this will be beneficial in the planning and implementation of a future project. The author should aim to be an objective observer. Appraisals do however unavoidably come up as limitations of archive material and a selected view, as well as choices of the wording used in the work. At best, work carried out on the values is completed in a multidisciplinary group towards the end of the work. Values are always bound to time and the surrounding reality. A good building history survey helps the owner make a decision on repair options.

The authority guidance website on renovation construction (www.korvo.fi) raises the fact that the requirements of museum authorities and the goals of builders often clash. Developers generally aim to implement the premises they require, cost-effectively and with as little regulatory control as possible. The duties of a museum authority involve caring for general interest and securing historical values for buildings. This task is implemented, for example, by means of negotiations and statements. If the developer has not taken into account the time and resources spent on these, disputes may arise. The statement period of a museum authority can easily be three months. A competent designer is able to consider the museum authority's view in a timely manner, arrange necessary negotiations and apply for pre-statements, in which case matters will flow with a lot more ease during the building permit phase. One challenge is the fact that the museum authority may not always hold a qualification in the construction industry. In addition to architects, statements are written by, for example, qualified art historians and conservationists. At a practical level, projects often involve that the building technical or building physical preservation of the protected building requires tampering with the protected material. For example, in the course of work related to reinforcing foundations, old archaeological layers may be destroyed. It may also be a case in which it would be preferable, from a preservationist perspective, to preserve a building's old clay tile roof, but the poor condition of the structure would require a lighter roof, such as sheet metal or felt. Flexibility and visionary thinking is often required from all parties in order to reach an overall favourable result.

One dimension of building historical values is authenticity. The preservation of a built environment involves a sufficient number of familiar elements in the environment, which allow people to identify the entity. Without them, people feel themselves detached. (1) The presence of chronological depth in the environment helps us place ourselves on the historical timeline. Recovering the forms of the past, therefore, involve the risk of losing trust - what is authentic, what is staged? Architect Kaarin Taipale has stated that the purpose of fictional history is not to help remember the past, but instead to forget the present time. (2)

1. Lilius 1990, s. 20

2. Taipale 1990, s. 17

Images at the side:

1. The layers of a building's past can be indicated with the help of drawings and colours. An extract from the stratification diagram related to the building history survey of Kuitia Manor House's main building.

2. A colour statement can also be attached to a building history survey. In this way, valuable information can be provided for the support of renovation design. Surface layers from the colour statement attached to the building history survey of Kuitia Manor House's main building.

3. FUNCTIONALITY

According to Vitruvius, practicality is among architecture's three main objectives: venustas, firmitas, utilitas, the latter being also understandable as functionality and usability. A building's suitability for intended use is an important objective in renovation design, and the impetus of the entire project is often the need to make the building better meet changed needs. There are, however, situations where, for example, technical factors limit structural options to some extent. Frame depth, module dimensions or layer height can be difficult to change. Building preservation may also cause additional challenges. Obtaining sufficient natural light or arranging emergency exit routes often require creativity and expertise in renovation and alteration projects. However, these additional challenges make renovations particularly interesting and demanding compared to new construction.

Below we shall review the perspectives of functionality and usability through concrete examples. The development of Suomenlinna (historically known as Viapori) during the last decades shall be used as an example. Suomenlinna is an interesting example since in Finnish conditions it has an exceptionally diverse, rich and layered building heritage, in a geographically compact area. In Suomenlinna's management plan proposal that was prepared during the years 1973-74 (1) such buildings are proposed to be demolished that are "insignificant from an antiquarian perspective" and which have been left "under construction plans of higher use value". The idea of use values and functionality to be a main reason for preservation - and renovation - of buildings is actualised in Suomenlinna. Appreciations also change over time, sometimes very quickly. It is, for example, stated in Suomenlinna's management plan (page 42) that "boat sheds C27 are from the antiquarian point of view invaluable, and their condition is such that wider scale renovation cannot be justified. New boat sheds can be built in their replacement." At the moment, the situation is completely different: the use values of the boat sheds, and the antiquarian value are undeniable and their condition is good. The resources defined for the renovation of the buildings, and thus their condition, are direct consequences for what type of values – whether they are antiquarian or use values – they are deemed to have.

Functionality can also be used as a stepping stone for justifying other objectives. This was the case at Suomenlinna's Iso Mustasaari in 1976, when the raising of the crownwork Ehrensvärd's wing buildings was justified: "The wing buildings lost all of their architectonical values and the majority of their use value as a result of the lowering. Thus, it is understandable that the idea to raise the wing buildings has already achieved common approval." (2) The working group was appointed by Senior Manager C. J. Gardberg in 1976. It was a negotiating body operating in the framework of the Finnish National Board of Antiquities, which "in its meetings handles received Suomenlinna-related proposals, as well as documents relating to the same issue that have been created by the board"; Gardberg


Form follows function.
Insect beds and a ”butterfly bar” made by children.

operated as the chairman of the working group, and Olof af Hällström as the secretary, both are art historians. Considering the wider framework, the actual stimulus of a raising project seems to have been the statement-writers' personal preferences and restoration-philosophical understandings, instead of the use values.

One practical example of the clash between building historical values and functionality is the debate concerning Suomenlinna's Länsi-Mustasaari's so-called post-implementation plans on the implementation of such new builds, which would take their architectonical examples from incomplete Swedish era service centre plans. Barracks buildings that were built in the 1750s have many solid wall surfaces and a small number of windows. Pre-assessments on the planning of new construction opportunities of Suomenlinna's Länsi-Mustasaari that were prepared by Arkkitehdit Ky Gullichsen, Kairamo & Co since 1976 highlight the difficulty of consolidating the current provisions of that time and the old architecture. With the frame depth and fenestration in accordance with the old plans, the well lighted habitable area is reduced to 53 percent. By reducing the frame depth, the well lighted area can be increased to 70 percent. To make the apartment suitable for normal use would require both the reduction of the frame depth and the increase of fenestration. Having frame depth and fenestration in accordance with the old plans would result in centre-corridor solutions, which would mainly consist of small studios equipped with kitchenettes.

1. Suomenlinna's management plan proposal. https://frantic.s3.amazonaws.com/suomenlinna/2014/06/Kayttosuunnitelma_1974.pdf

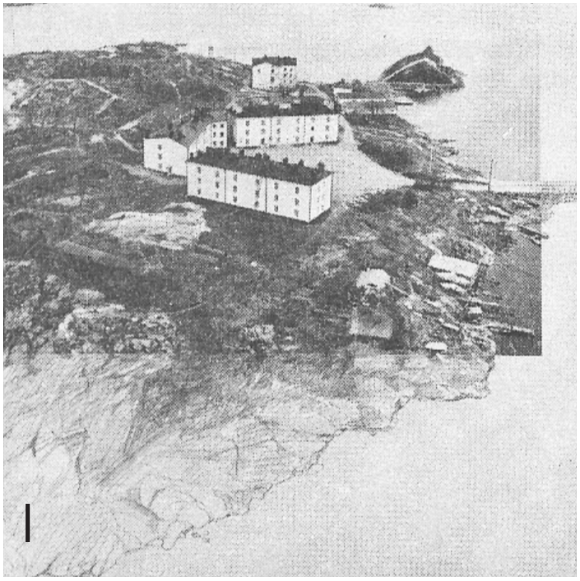
2. Finnish National Board of Antiquities' Suomenlinna working group's meeting memorandum 28/10/1976

Images on the following page:

1. Perspective image montage of the Länsi-Mustasaari situation when preparing the management plan. Source: Suomenlinna's use plan proposal 1974.

2. Proposal for the new construction of Länsi-Mustasaari. Source: Suomenlinna's management plan proposal 1974.

3. Proposal for the new construction of Länsi-Mustasaari. Floor plan. Extract from the management plan's illustration map. Source: Suomenlinna's management plan proposal 1974.



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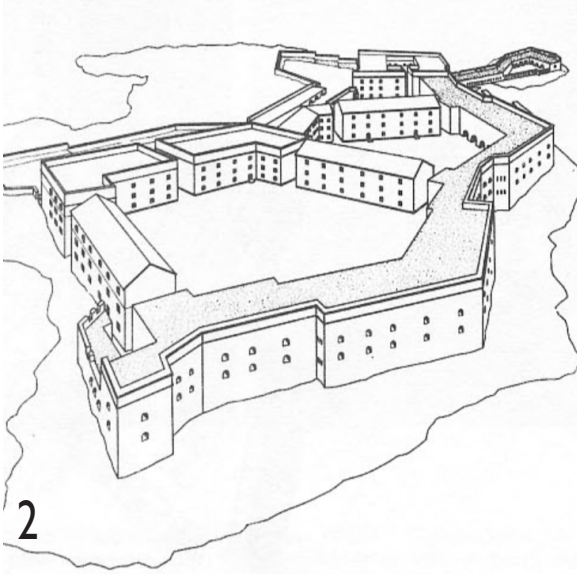

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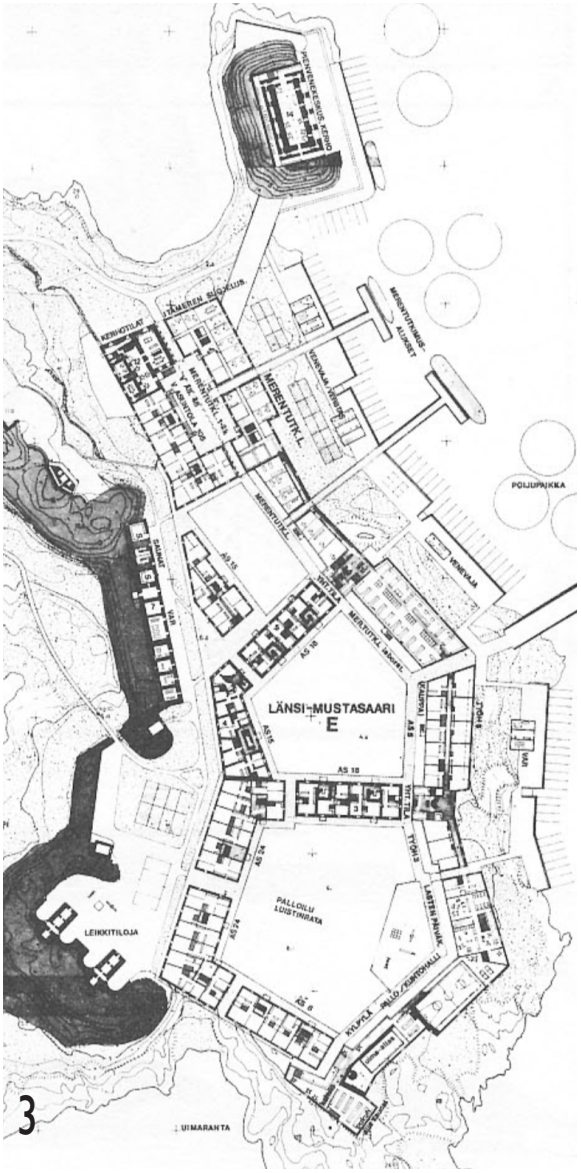
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E
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LOISTOMATA
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4. ACCESSIBILITY

An accessible building is such that everyone has equal access to, and it is also suitable for the use by people whose ability to move or otherwise operate is limited. In renovation construction, the implementation of accessibility in cases of e.g. floor and level changes can be at odds with the aims of building preservation. Accessibility issues are referred to in Section 53 of the Land Use and Building Decree 895/1999. In addition, more specific provisions have been set out in the Finnish Collection of Building Codes. The implementation of accessibility is often understood merely from the perspective of wheelchair users. There are many life situations in which building users have special needs: accessibility with a pushchair, special needs concerning sight and hearing disabilities and aging, with its multitude of challenges, are examples of issues to be considered. Accessibility also considers, for example, issues concerning sight, hearing, communication and electronic messaging. An accessible environment is functional, safe and pleasant for all users, and it is also easy for all users to access all rooms and floors of a building. Rooms and the functions within them should be as easy-to-use and logical as possible. More information on an accessible built environment is available from e.g. Kynnys or the accessibility centre's website, www.invalidiliitto.fi.

When it is a case of a historically valuable building, the implementation of accessibility requires very special expertise and sensitivity in design work. It is difficult to provide generally-applicable guidelines; each situation must be solved individually with consideration to the specific building and its context. The Finnish National Board of Antiquities has published a manual on the issue called "From the Same Door" (Samasta ovesta). It presents accessibility solutions that have been implemented, for instance, in Ainola and the Turku Castle, in which some parts of the building were made accessible by constructing ramps that blend into the building as a whole, and by levelling the yard. Sometimes compromises are necessary: only some rooms can be made accessible or an accessible entrance is from a side door.

In the prologue of the book, Kynnys Ry's operational manager, Kalle Könkkölä, writes: "Accessibility is not just a perspective or a question of comfort - we are talking about a basic human right. A change in perspective has taken place during the past few years. The change is emphasised with the UN-approved disabled people's rights agreement, which raises accessibility as one human right." (1)

1. *Flink, Selja ja Kilpelä, Niina (eds.) 2012. Samasta ovesta. ('From the Same Door') Achievable culture-historical sites.*

The accessibility renovation of historic buildings requires special sensitivity and competence.

Korppoo's new unobstructed entrance to the Medieval Church. The slope has been made sandy.

5. ENERGY EFFICIENCY

According to legislation, energy efficiency must be improved in connection with repair or alteration work on a building that is subject to a building permit or action permit if it is possible from a technical, functional and financial perspective. This obligation does not apply to buildings whose intended use would be unreasonably hampered if energy efficiency needed to be improved. In other words, the aim is to improve energy efficiency in renovation construction, but in many cases other values such as building preservation take precedence.

Building Physics Professor Juha Vinha has brought up in several occasions that progress in energy efficiency requirements has occurred too fast. If thermal insulation is added, know-how is required to avoid causing moisture and mould problems. If, for example, the thickness of roof insulation is increased from 400mm to 600mm, new moisture risks may outweigh the added insulative value. This increase of risk is due to so-called wasted heat no longer being able to keep the insulation layer dry. Thermal insulation does not increase in the same relation as thickening the insulation layer, because convection begins to take place in the soft, thick insulation layer, which cools down the insulation layer.

In terms of the sustainable use of natural resources, it would be more important to focus on proven, long-term, simple and functional solutions rather than the measurement of momentary performance. One such solution is the so-called solid structure. A solid structure is a structure where one uniform structural layer takes care of all the key functions of the structure. Solid structures include, for example, horizontal log structures and full-masonry brick walls. The physical function of the solid structure in building construction is clear and certain. Due to its thermal storage properties, the solid structure is energy efficient. U value calculations do not correctly take in to account the solid structure's thermal storage properties. Thus, calculations make the solid structure seem weaker from an energy efficiency perspective than it really is. In light of completed energy consumption statistics, solid brick houses that were built at the end of the 1800s and the beginning of the 1900s are so energy efficient that even buildings built in the 2000s cannot reach their standards. The actual energy consumption of new houses is often greater than in calculations. This is due to the fact that e.g. electricity consumption is greater than assumed, blown roof insulation insulates better in theory than in practice, and the cooling needs of efficient thermal-insulated buildings are high. In addition, users' effects on energy consumption are greater than it is often thought to be. (1)

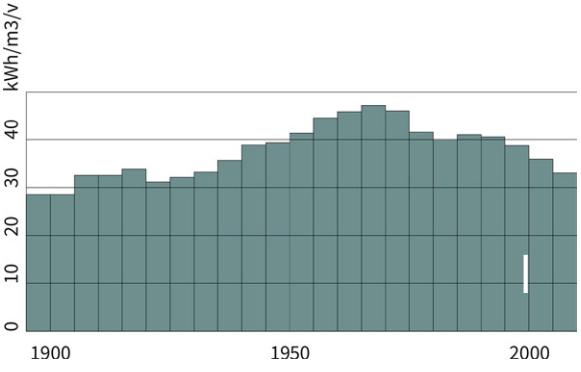
1. Tampere University of Technology's Building Physics Professor Juha Vinha's presentation at the #renovatingmodern seminar 26/5/2016

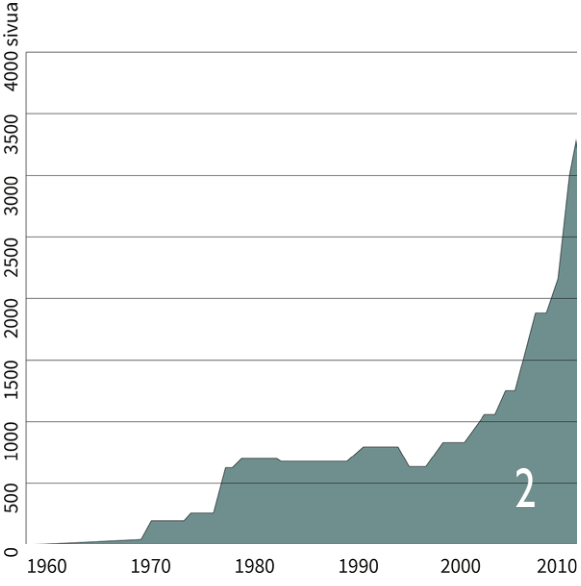
2. Architect Juulia Mikkola's article. Arkkitehti 3/2017.

Diagrams:

1. Pages 1960-2013 from the current publications of the Ministry of the Environment and the Finnish Civil Engineers' Association RIL concerning building physics, including guidelines and instructions. Source: Professor Juha Vinha.

2. Apartment blocks' actual energy consumptions according to the construction time of the building, including the consumption of district heating and property electricity. (2)





6. MOISTURE & MOULD SAFETY

According to information obtained from the Building Physics Department of the Tampere University of Technology's HKPro project, only 50 % of repair projects have a moisture control plan. This kind of plan is usually required in new construction. The problem may be that the plan is too general (not specified for projects) or it is not followed. Awareness of the importance of moisture control is on the rise, but it should be implemented to the last step. The "dry chain" of a building project should be carried out from start to finish, including planning, construction and use. No moisture that could harm indoor air during use is left in structures nor should they form there during use.

No risks of any kind should be taken during planning with regard to indoor air; solutions must be functional and safe in terms of moisture dynamics. The structures of a building must function properly as a whole, taking into account the conditions, structures and building systems. To minimise the amount of water that accumulates on structures during construction, structures should be designed so that exterior walls and roofing are made waterproof as soon as possible and harmful accumulation of water on structures is prevented. When drawing up an implementation schedule, the time required for drying structures should be taken into account. Additional covering structures should not be implemented until the building envelope is watertight and structures have reached the critical degree-of-dryness value indicated for them. According to Juha Vinha the biggest shortage concerns information about how adding thermal insulation affects the moisture dynamics of a structure.

According to the Occupational Health and Environmental Medicine Professor of the University of Turku, Tuula Putus, natural moulds are weak allergens, and in indoor environments they only rarely cause health risks (e.g. Cladosporium). Microbiologist, Mirja Salkinoja-Salonen, from the University of Helsinki has also often discussed how natural mould does not pose any risks. She considers "healthy forest moulds" to be beneficial. According to Salkinoja-Salonen, there should be a lot of these natural moulds in buildings, just as there are outdoors. (1) On the other hand, Putus points out that many moisture damage indicators bring serious health risks (e.g. Stachybotrys, Chaetomium, Aspergillus versicolor). These harmful microbes find their ecological chamber in modern environments, where moisture damage and insufficient ventilation and cooling systems come together. (2)

1. Mirja Salkinoja-Salonen's presentation Do we insulate the life out of our buildings seminar 2016.

2. Tuula Putus's presentation at the Modern architecture repair course arranged by Alvar Aalto Academy 2016.

When working under weather protection, the result is better, not to mention the safety of work and the pleasure of work.

The picture shows the repair site of the Kuitia manor horse stable. All repairs are done under the weather protection.

7. GOOD INDOOR AIR QUALITY

The goal of a renovation project should be the health and safety of the living environment both during and after the construction period. A healthy house has good indoor air that is odour-free, dust-free, draft-free, has a pleasant temperature and is noise-free. In addition to quality plans, achieving objectives requires several individual procedures at the construction site. Enough time and space should be reserved for work and the construction site kept clean. Workers should be equipped with proper safety equipment and should report any deficiencies to supervisors. Solutions during construction work have a direct effect on the quality of a finished building. Quality applies to construction materials, craftsmanship and supervision. Construction should be done carefully, precisely in accordance with the architectural and specialised plans.

The implementation of good indoor air quality requires correct choices and decisions at several stages: planning (noise, pollution), design (sufficient time, realistic schedule), building (moisture management, dry chain), deployment (functionality check and adjustment of systems) and during maintenance and repairs (maintenance book, continuous monitoring). (1)

Despite what is often thought, indoor air problems are not always caused by moisture damage. Modern building materials often use chemical compounds to add and improve technical features. Dangerous compounds within materials that are properly manufactured, processed and used do not usually cause health problems. For individuals who are more sensitive, organic compounds, aldehydes, or ammonia released from materials may cause sensitisation symptoms. For example, plaster board which is generally used in construction creates particles that are similar to those of asbestos, the boron used in cellulose wadding promotes the growth of toxic microbes at the cost of natural moulds, because toxic microbes generally tolerate boron. Even normal cleaning can cause indoor air problems. For example, the use of biocidal cleaning chemicals may lead to the growth of toxic microbes. Biocides are chemical substances, products or micro-organisms, which are used to destroy, prevent or make harmful organisms safe, prevent their effect or limit their presence. The use of so-called air cleaners is not problem-free either; for example, ozone is classified as a biocide. There are thousands of potential pollutants and there is currently not enough information about which of them are the most harmful to health. Therefore, it is safest to only use materials and substances which can be trusted on the basis of long experience, such as solid wood and burnt or unburnt clay.

1. DI, building health expert Tuula Syrjänen's presentation at the Rakennusperintö-SAFA seminar in Lapinlahti 2016.

2. Microbiologist Mirja Salkinoja-Salonen's interview 11/11/2017.

Pictures on this page:

1. The prevailing method of construction is, in many aspects, based on chemicals and additives about which we do not have long-term experience. Their individual and combined effects may cause symptoms for many.

2-3. According to Mirja Salkinoja-Salonen, natural outdoor microbes are healthy and strengthen our immunity system. Spending time outdoors is generally considered to be healthy. Nowadays, we spend far too much time indoors.

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8. SUSTAINABILITY

According to legislation, a building must be sustainable in terms of its ecological features in accordance with its purpose of use. Special attention should be paid to the reparability and replaceability of building elements and technical systems. Demolishing or heavily renovating buildings every few decades runs counter to sustainable development principles. A huge amount of waste and pollution is caused by the production and disposal of modern technical building materials. Also, chemicalisation, technical uncertainties and overly-complex structures bring health risks to people living or working in the buildings.

Circular economies have rightfully been discussed a lot during the past few years. Circular economy maximises the preservation of materials and their value for as long as possible in such a way that the amount of emissions created is as low as possible. In circular economy, resources are retained even when the product has reached the end of its service life. The aim is to design and manufacture products from the start in such a way that they will remain in use and recycled for as long as possible. Circular economy is a multidisciplinary and wide-scale change in operating methods. The aim of the Finnish government is to raise Finland to be a top circular economy country by 2025. The achievement of this objective is promoted with high-profile projects concerning bioeconomy and clean solutions. (1)

On the basis of centuries of experience, houses should be built from solid wood or brick and be equipped with gravitational ventilation. Such buildings can be guaranteed a future of several centuries, if they are designed and built well. Sustainable buildings do not have a life cycle where they would inevitably become run down and be in need of renovation. Life cycle thinking (or in Panu Kaila's words, life cycle illusion) is related to the method of regeneration felling in forest management. Sustainable construction is closer to the principle of continuous education, where the forest is continuously kept covered with the help of improvement cutting and small-scale clearcutting. In construction, as in forest management, diversity should be cherished and different solutions should be enabled, instead of dogmatically following one truth. Current building regulations are very uniform and extremely detailed, and this has often to led to authorities not wanting to grant exceptions, e.g. issues concerning ventilation levels or energy efficiency, for fear of making mistakes.

1. Kierrolla kärkeen. Finland's road map to circular economy 2016-2015. http://media.sitra.fi/2017/02/27175308/Selvityksia117-3.pdf

Massive structures are healthy, durable and ecological.

The frame of the Karjapiha s Hiipipaja building in Kuitia Manor is made of a massive brick bars.

9. LEGISLATIVE QUALITY

The parties of a construction project must be aware of laws, regulations and official guidelines for issues concerning responsibility. One challenge is simply the large number of binding regulations, not to mention recommendations and guidelines, which makes it extremely difficult and even impossible to learn them completely. According to Professor Juha Vinha, there are already over 4,000 pages of regulations on building physics as of 2013. In 1960 there were no such documents at all. Another challenge is that regulations may be difficult to interpret and even the authorities may interpret regulations differently. That is why the website www.korvo.fi exists; it is commissioned by the Ministry of the Environment and keeps track of developments in regulations pertaining to renovation construction.

There are numerous regulations and guidelines concerning renovation. These include the Land Use and Building Act 132/1999, as well as the Land Use and Building Decree 895/1999. The Ministry of the Environment maintains the National Building Code of Finland, which is a collection of building regulations and codes, as well as instructions of the Ministry, compiled by virtue of the aforementioned law.

The regulations of the National Building Code have traditionally concerned the construction of new buildings. In cases of renovation or alterations, the regulations have been applied only when required by the type and extent of the measure or by any change in the intended use of the building or part thereof (unless specifically regulated otherwise). There is flexibility in the application of the building regulations, to the extent possible considering the characteristics and special features of the building.

The Land Use and Building Act deals with structural strength and stability, fire safety, health, safety in use, accessibility, noise abatement and acoustics, and energy efficiency. In repair and alteration work, the attributes and special features of the building and its suitability for the intended use must be taken into account. Alterations may not endanger the safety of the building's users or compromise their health. In addition, construction must in any case comply with good building practice. There are varying ideas of what this means in practice.

Many mold buildings have also been built according to laws. Provisions must be condemned, even though responsibilities are frightening.

Mäntsälä's Ehnroos school demolition site.

10. COST EFFICIENCY

A high-quality renovation project is not always expensive, and an expensive renovation project is not always of high quality. A project often becomes expensive because the entity engaged in the construction has not reserved enough resources for analysis and design work before starting construction work. It is also easy for hunger to kick in, and a small repair can expand to a full renovation. Quality repair projects aim to always find a reasonably priced solution where safety is not compromised, in which case the money saved can be used, for example, for better quality surface materials or fixtures. In the framework of the Renovation Centre project, we visited Norway to study the recent renovation of Narvik's town hall, which was completed under budget. (1) New fixtures were acquired for the entire building, although it was first thought that they could not be afforded.

A professional cost plan helps avoid surprises throughout the entire project. Reserves for unexpected changes and the general increase of cost levels during the project, which are considered in cost planning sometimes lead to over-budgeting, which can occasionally prevent the project from being started. Costs can also be managed by ensuring procurement expertise. One-off developers in particular, and sometimes procurement units of the public sector, would require more targeted training.

1. UiT researcher Eigil Roaldset's interview 4/9/2017

11. COMPETENCE OF PARTICIPANTS

Competence of participants means that the parties of a renovation project have the appropriate skills, training and qualification to perform their duties. Parties include the developer, designers, authorities and builders. From a legal point-of-view the issue is simple: in the end, the developer is responsible for everything. Construction is, however, a case of cooperation, and possibly the developer's most important task is to hire a suitable team for the work.

According to legislation, construction design shall involve a principal designer who is responsible for design in its entirety and of its quality. This role is usually filled by the architect. "For the term of the construction project, the lead designer must ensure that the construction plan and special plans form a whole in such a way that the regulations and provisions concerning construction, as well as the requirements of good construction practice are met." The lead designer must also ensure that anyone participating in the construction project is informed of any significant planning aspects concerning his/her duty of care. In addition to a lead designer and an architect, renovation projects usually also need at least HVAC and structural designing. Depending on the project, it may be necessary to utilise the skills of e.g. a landscape architect or geo-designer.

According to legislation, construction work that requires a building permit shall have a senior manager,

who shall manage the construction work. The site manager is responsible for the entirety and quality of the construction work and shall make sure that the construction work is carried out in accordance with the granted permit, building rules and regulations, and good building practice.

A good way to increase the quality of design is to select designers as a team, not as individual operators. If the designers are selected one-by-one on a from-here-and-there basis, whoever works in the relevant subarea at the most affordable price, the occurrence of problems is unavoidable. When the team consists of professionals who have experience in working together and there is mutual trust, the situation is ideal for the implementation of high quality.

Picture on this page:

Solutions are often made in repair projects where healthy, high-quality and beautiful building parts and materials are replaced with new ones that are not appropriate. This results in wasted natural resources and an unnecessary increase in expenses. Old, wooden windows have been replaced with new, aluminium ones in an 18th century house in Loviisa.

12. FLUENT COMMUNICATION

A huge amount of information is required, and created, during a renovation project. Fluent communication and information management are nowadays increasingly important, and their demand level will continue to increase. In addition, parties should also be deeply aware of thousands of pages of material; there should be room for creativity and innovation in both design and implementation. There is a wide range of project banks and cloud services in use for managing and sharing plans and material. Many of these function rather well, although there is a lot to develop in usability. Each party is responsible for ensuring that their own materials are constantly up-to-date, otherwise the project archives do not provide any benefits.

Design tools and software have developed significantly. For example, 3D scanning and point cloud technology are already a natural part of renovation work, particularly in larger projects. However, the purposefulness of technology should not go ahead of matters in renovation projects. Sometimes the manual measurement of a small site continues to be the most efficient and highest quality method of becoming familiar with the site's features, and observing and interpreting structures and damage. When a designer personally familiarises themselves with the building at the documentation stage, the actual design work is easier and better compared to a situation where the designer is provided with complete initial data.

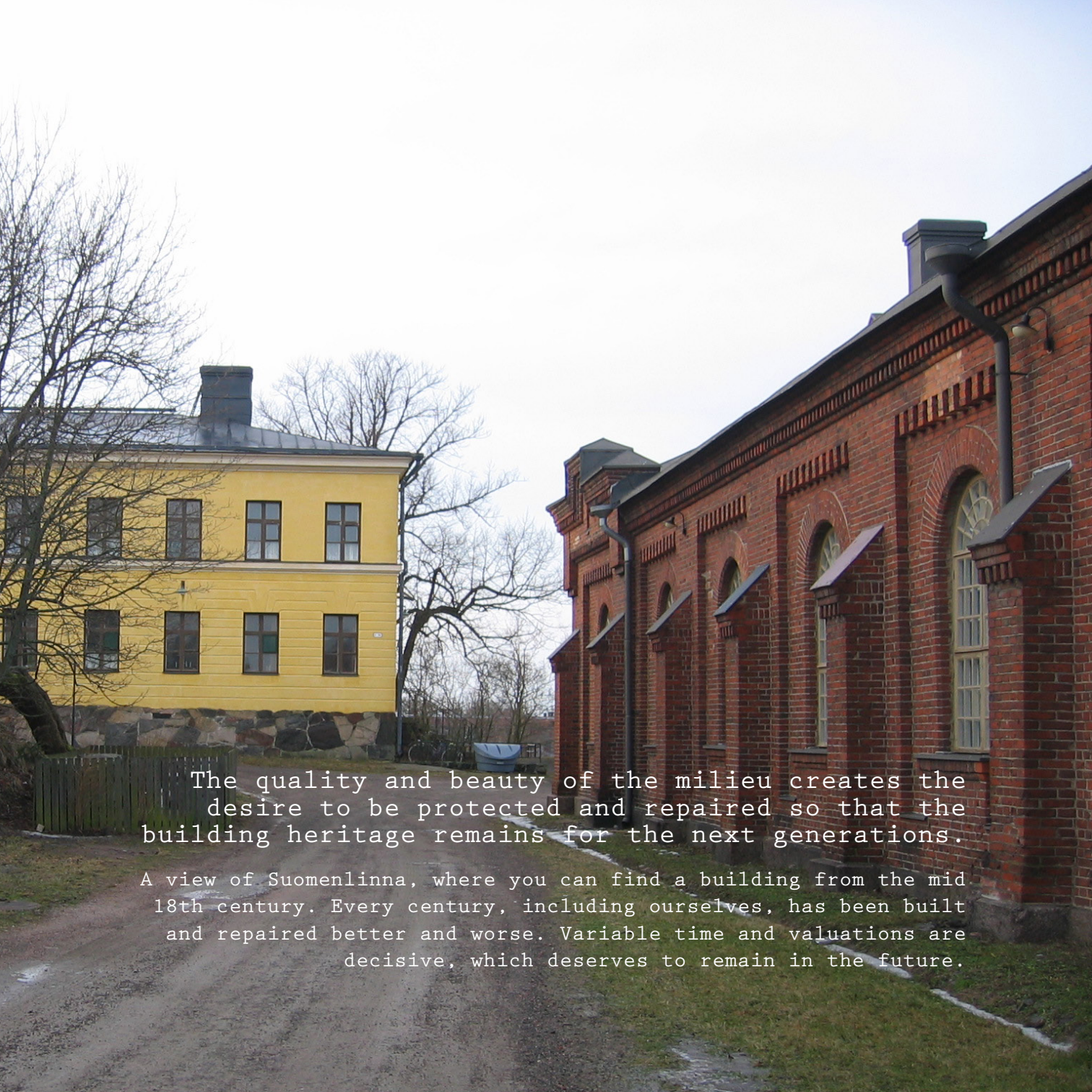
In connection with the HKPro research project, the Cross Check tool has been developed at the Building Physics Department of the Tampere University of Technology. This tool aims to improve the prerequisites for a successful renovation project. Cross checking is necessary because even an experienced building inspector may be blind to his or her own mistakes. Without a comprehensive and detailed condition survey, the designer does not have the full prerequisites to succeed in his/her work, which can easily lead to the failure of a renovation project.

The success of a repair job is beneficial if the designer does the measurement and documentation of the object itself and thus familiarizes the building thoroughly before starting the design.

Measurement work is ongoing at Aulangon Onnentemppeli.

SUMMARY

Quality parameters can and should be set for renovation construction. Only by setting parameters it is possible to reliably evaluate success. The purpose of the parameters proposed above is to serve as a check list that can be utilised in planning and thereby contribute to the success of renovation projects. Architectural quality and safeguarding historical values of a building help protect aesthetic aspects and preservation of architectural heritage. Functionality and accessibility are equally important in repair as well as new construction but require a special effort to be fully realised in renovation projects. A key goal is enhancing energy efficiency, but it cannot lead to increased risk of moisture and harm to historical values. Enhancing moisture safety requires additional regulation from authorities as well, even though the general tendency is to reduce regulation in the spirit of eliminating norms. Renovation construction is naturally a part of sustainable development. Its realisation also requires solutions from new construction that can be repaired in the future. Legislative quality forms a juridical basis for renovation construction. Management of costs is vital to all construction even though there are often more financial risks in repair than in new construction. There is plenty of knowledge in the industry regarding the ensuring of competence and the tools for it mainly exist. There is still a need to sharpen the skills to use them. Good communication is an area of quality that has received too little attention and which should receive much more investment and effort.



The quality and beauty of the milieu creates the desire to be protected and repaired so that the building heritage remains for the next generations.

A view of Suomenlinna, where you can find a building from the mid 18th century. Every century, including ourselves, has been built and repaired better and worse. Variable time and valuations are decisive, which deserves to remain in the future.

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NORWEGIAN POINT OF VIEW

Professor Bjørn R Sørensen, UiT The Arctic University of Norway, Department of Building, Energy and Material Technology

INTRODUCTION

Renovation of buildings stands for an increasing share of the total activity in the building sector also in Norway. Renovation projects are being carried out all over the country at a fast rate, from large high rise buildings to single family homes. The building stock in Norway consists of about 4,2 million buildings, where of 37% are residential buildings. Most buildings in Norway were built after the second world war with a peak construction rate in the 1970s. This means that a quite large share of existing buildings are 40+ years old, and furthermore that a significant share is in need of renovation. Renovation projects now stand for more than 30% of the total turnover in the building sector, and this share is steadily increasing.

The Norwegian building sector employs about 10% of the total work force, and represents about 20% of the gross national economy. This implies that the architects and engineers of the building sector have an increasingly important role in the development of society.

A question that often arises in connection to evaluating an older building is whether it would be better to demolish it, rather than renovating it. This is an interesting and difficult question which cannot be answered consistently. There are certainly challenges related to building new, but renovation implies in many cases very different and perhaps costly challenges. For instance, building new gives almost unlimited possibilities to implement functionality, safety and fire issues, etc. Renovation of older buildings is restricted by the building's existing layout, structural support system, floor area and heights and so on. In addition to costs, there are often other considerations involved when trying to decide whether to demolish or build new. Historical value, architectural expressions, urban preservations could be important.

MAJOR RENOVATION VS DEEP RENOVATION

There may often be discussion about whether the renovation is considered major or minor. In Norway, if the renovation is categorized as "major", a number of requirements are triggered by the building regulations. There is however no strict boundary that separates major renovations for non-major renovations, which means this must be assessed in every special case. However, the classification as "major" renovation implies that the work on the building is so comprehensive that the renovated building appear essentially as new. It implies changes or repairs that require formal approval and that must be planned and conducted by professionals and certified companies. For a building to undergo a major renovation, the whole building must satisfy the prevailing building regulations. If the building undergo limited upgrades or stepwise renovation that don't in essence change the building's appearan-

ce, major structures or overall functionality, less strict actions is required.

Deep renovation is sometimes mentioned in connection with major renovation. Deep renovation of a building certainly falls inside the scope of a major renovation, but the concept of deep renovation (or deep retrofit) is linked to the building's energy performance or environmental footprint. It involves improving energy efficiency substantially. In Europe, this is commonly defined by obtaining 60-90% energy savings.

WHY RENOVATION?

There can be many reasons why we should renovate our buildings. In the greater context, for policy makers, renovation is seen as an important instrument for encouraging to large scale urban upgrade, decreasing the dependency on energy imports and on fossil fuels, and for reducing impact on the environment. On a smaller scale, renovation is assessed as required for instance if the building has historical value (and needs to be taken care of), if the cost of renovation is less than demolishing/building new, if the building has structural damages (or other safety issues), if the building has indoor environmental issues (air quality, moisture, mold growth etc.), if the building is too costly to manage/operate, if the building needs new functionality or simply if the building (or parts of it) is outdated or looks bad. It could also be a combination of several of these issues. So which issues or parameters can be defined as success parameters for renovation? That depends on the specific building, its condition, its value, etc.

1. ARCHITECTONICAL QUALITY

The quality of the client- and direct-communication between the architect and the client/user of the building is a crucial factor in quality management. If architectural practices want to secure high quality architecture, they might have to consider limiting the commissions they undertake.

2. ENSURING OF HISTORICAL VALUES

The Directorate for Cultural Heritage is responsible for the management of all archaeological and architectural monuments and sites and cultural environments in accordance with relevant legislation.

We are responsible for ensuring that a representative selection of monuments and sites from all periods is preserved for present and future generations. The selection of monuments and sites must provide an overview of historical developments, the way of life and the range of works of art and craftsmanship of each period.

We ensure that cultural heritage considerations are taken into account in all planning processes, and that the interests of cultural heritage are safeguarded at all levels in the same way as the interests of society as a whole.

The Directorate for Cultural Heritage comes under the

environmental management umbrella, and answers to the Ministry of Climate and Environment. The Directorate collaborates with other directorates in the environmental sector wherever appropriate.

3. FUNCTIONALITY

Architects and engineers face challenges when it comes to planning for new functionality in existing buildings. Older buildings were constructed on the basis of needed functionality and expected use at the time when they were erected, and the suitability for changed conditions may not be obvious. In fact, the renovation project itself can be a result of a building not meeting new demands with regards to its functionality, and this often restrict the designer's and planner's possibilities. Moving internal walls, heightening ceilings, relocating stairways and so on all require careful investigations of the building's structural abilities.

Whether the building in question is suitable for intended future use hence is one of the most crucial factors with regards to the "demolition/building new" aspect, as this question will be raised if a building cannot meet functionality requirements. There may however be other aspects that justify the building's further life, e.g. historical value.

4. ACCESSIBILITY

In Norway there is similar strict rules concerning accessibility. All commercial buildings must comply to national regulations concerning accessibility to buildings, as required by the Planning and Building Act (PBL) of Norway. The same requirements does not apply for privately owned residential buildings. However, accessibility to buildings have during later decades become more and more in focus, and is today accepted standards also for residential buildings.

5. ENERGY EFFICIENCY

Energy efficiency has a strong focus in Norway during recent twenty years. As a part of the EEA agreement, Norway is obliged to implement the EU directives in different areas. In the fulfillment of these obligations, Norway has implemented even stricter regulations concerning energy efficiency of buildings (TEK17). A new version of the regulations of the buildings act of Norway was published in 2017, and it will be in full force by beginning of 2018. It is anticipated by 2020 that regulations in Norway will demand passive house level in all new buildings. In parallel, existing buildings, when going through major renovations, are put under a similarly rigid regime of requirements. Norway expect to see significant changes in energy use for the housing sector in the coming years. Enova, which is representing a national fund for energy improvements, is providing financial incentives for investing into energy efficient solutions both in industry and residential areas. Enova annually reports of huge progress of improvements of energy efficiency in the building sector, and from the beginning of year 2000 until now, energy use for new residential houses area has diminished a factor of two.

Regarding energy renovation, which requirements coming into force depends on which degree of renovation the building is going to have. If it is just a minor renovation, which is not including ichanges or repairs that require approval that must be planned and conducted by professional and certified companies, no documentation is required. However, for major renovations prevailing regulations will have effect.

6. MOISTURE & MOLD SAFETY

If there is a major renovation, Norwegian regulations will impact the renovation as if it was a new building. Moisture and safety is in Norway very important as the country has strong exposure to driving rain and heavy weather conditions, especially in the western coastal areas. Climate change also have raised the awareness of moisture impact on building constructions.

7. GOOD INDOOR AIR QUALITY

For some occasions, the sole reason for renovating a building can be poor indoor environmental (IEQ) conditions. No matter how good the building's structure, safety, functionality, design etc. are, if it is not fit to work or live in, it cannot be used. IEQ refers to health and perceived well-being, and in that sense, IEQ can be said to be the most crucial parameter when it comes to judging the success of a renovation project. IEQ includes by definition many physiological sensory areas, for instance thermal conditions, air quality, lighting, noise and vibrations. Building regulations include requirements to ensure satisfactory IEQ for the inhabitants. Satisfactory IEQ means that the vast majority of inhabitants perceive IEQ as acceptable. Thermal comfort criteria must be met, air quality must be good and so on.

As mentioned, air quality is one of the most important measures of IEQ. It includes all the pollutants emitted to the air, which occupants will be exposed to. This is typically particles or gases with different chemical and biological compositions that affect our perceptive senses in a negative way. In our daily life, this can for instance be as CO2 exposure or odors from buildings materials and furniture, as well as volatile organic compounds. Ventilation system and strategy are the means to achieve good indoor air quality. Buildings must be supplied with sufficient amount of fresh air, and the ventilation system must be able to transport pollutants out of the building. The ventilation system of a building may need very different configurations and control strategies, all which must be considered in each case and situation.

In Norway, the building act and its regulations provide the minimum allowed ventilation rates for buildings.

9. LEGISLATIVE QUALITY

In Norway the parliament approves the Planning and Building Act (PBL). Regulations of the PBL in Norway follow up EU's directives, which Norway, as an EEA country, is obliged to implement. Technical regulations (TEK) provide the minimum requirements for buildings, in order for a building to be erected legal-

ly in Norway. TEK also applies to renovation projects, i.e. projects which comprise comprehensive building works such as alteration or upgrade of bearing structures, new bathrooms, change of facades, etc. Furthermore, TEK refers to specific standards to be used during the construction work. Energy requirements can be mentioned as an example, where TEK provides the minimum performance (allowed energy consumption, maximum U-values etc.), and where the Norwegian standard NS3031 gives the method for energy calculations. In addition to the technical issues, building matters regulations take effect for major renovation or upgrades in buildings (SAK). Both TEK and SAK are managed by the Directorate for building quality (dibk) which is a governmental agency.

To initiate a renovation project which includes measures where application is mandatory (such as a major renovation project), the developer (or his/her representative – i.e. the responsible applicant) has to apply for permission to the municipal building department. This further implies liabilities for the applicant, and professional companies will be contracted as responsible designer, responsible contractor etc. for the different disciplines of the project. The building project ends when a certificate of completion is issued.

SWEDISH POINT OF VIEW

Anders Gustafsson, RISE Research Institutes of Sweden, SP Wood Technology

1. ARCHITECTONICAL QUALITY

Every renovation has its challenge. Often, a better function should be built into an old structure and many older houses are well constructed even if there are errors. Smaller technical upgrading can many times be sufficient. A large part of the renovation need exists in areas where the payment capacity is low. This is a big challenge and merging apartments to larger units can be a way to move forward. This means that the renovation is governed by the economic reality. The importance of combining improved technical function and architectural design to socially sustainable renovation is important and increasing.

2. ENSURING OF HICTORICAL VALUES

In Sweden The Planning and Building Act states among other things that one should take into account the urban and natural landscape, and the site's natural and cultural values. If a building is marked (often can be seen as a sign on the wall) and have a historical or cultural value, it is legally protected. Often this legal protection give a protection to a building not be demolished or altered in such a way that the cultural value decreases. The protection of parks may mean that trees and other vegetation may not be removed and that the vegetation must be handled in a certain way.

Often, it is only in connection with a building or environment's cultural values are threatened as it becomes clear that they must be protected. The sign means then that the cultural value may remain and give the community a greater value. There are different signs that give the building protection;

Historical building. A heritage building is a historically important building protected by the government or the provincial government. The owner can get support from the government to maintain and manage the building.

Church heritage. Church buildings that are erected before 1940 cannot in any significant way be changed without the permission of the provincial government.

Q-sign. Q-sign provides protection to the building or buildings in an area that are detail planned. Security rules for culturally valuable buildings and environments at the municipal level are regulated.

There are also other requirements to consider as protect the building's character, regulations against distortion and maintenance requirement.

3. FUNCTIONALITY

The need for renovation of a building is often based on the desire for improved function. This may include additional insulation of facades or new kitchen units. In the first case, also economic aspects play into whether and how the renovation will be done. When replacing the kitchen for example, better working height can be

the improved function. Common to most of the renovations and the function are that they have to fulfill the requirements according to the current regulations and functions stated by the regulations, such as energy savings and fire safety. Overall the CPR, Construction Products Regulation, Regulation (EU) No 305/2011,and the part of the regulations concerning Hygiene, health and the environment and Environmental Noise Directive, 2002/49/EC can be are identified as main important regulations for building functionality.

4. ACCESSIBILITY

The purpose of the accessibility regulations is to enable as many people as possible to participate in society on equal terms. The built environment should be able to be used by persons with full mobility as well as persons using for wheelchair, stick or reduced vision or hearing. It is the owner of the building who is responsible for compliance with the regulations. In Sweden you have to follow this regulations regarding accessibility: the UN Convention, the Planning and Building Act (PBL), the Building Regulations (BBR) and standards.

The regulations contain both design requirements and technical characteristics. The difference is that the design requirements will be controlled in handling of the building permits while the technical properties requirements are handled in the start meetings and the control plan. The local building board may require a certified expert to check that the requirements for availability are met when the builder's own inspection is insufficient.

5. ENERGY EFFICIENCY

In 2016 was a report (1) published in which the question was how the regulations affect the extent of the renovation. It also included the question when is the optimal time of renovation and which renovation level should be selected. Should all accessibility requirements be met, the costs can be too high and no renovation will be done. The authors of the report made proposals to free the bonds between accessibility and renovation requirements. Quote "The regulation shall simply say that a certain proportion of the apartments for a building stock to be renovated within a certain time interval. For example, 10% within 5 years, 40% within 20 years."

6. MOISTURE & MOLD SAFETY

The Swedish Building regulation recommend that a moisture safety is taken into account in all phases of the design processes. Important part of the design should be documented and saved for future moisture control. In the regulation a critical moisture level is defined as the moisture level when a material's intended properties and function are no longer met. It means that the level of moisture is critical when microbial growth occurs. Factors as temperature and duration are of importance for biological growth and their interaction can be included in the determination of the critical moisture level. If the critical moisture level for a material is not identified, a level of relative humidity (RH) of 75% shall be used as the critical moisture level.

Important part and details should also be documented during the construction time. Moisture documentation may include protection of sensitive parts during construction, action plan for possible errors and checklists.

8. SUSTAINABILITY

Design of a construction should take into account sustainability aspects; social, economic and ecological.

Social aspects

In the social aspects is included among other things, that buildings should be accessible and useful for people with reduced mobility and orientation. It also means that people are not exposed to harmful air pollutants, chemical substances, noise, or other unacceptable health or safety hazards

Economic aspects

Economic aspects, among other things is to create the conditions for housing to be built at reasonable costs and still maintain the resources of land, water, energy and commodities and striving for a cycle-based economy, a circular economy.

Ecological aspects

Another part of take into account ecological aspects is to use a life-cycle perspective in assessing the environmental impact of the building. Use of energy, land and other natural resources should be considered in an efficient, resource-saving and environmentally-friendly way. Good waste management is another part of the ecological aspects. Using environmental indicators is a way to follow the environmental and environmental impact.

9. LEGISLATIVE QUALITY

Renovations as all construction involve a lot of people and organizations and it is important to understand different regulations and who do what. In Sweden the parliament approves the Planning and Building Act, PBA. The Government approves the Planning and Building Ordinance, PBO and Boverket publishes mandatory provisions and general recommendations for construction.

The municipal Building Committee shall assess whether the design requirements are fulfilled. In conjunction with the technical consultation and start-up statement, the Building Committee shall deal with the technical property requirements regarding housing design and other technical property requirements. The municipal Building Committee also has supervisory responsibility for construction and in the end the owner of the building is responsible for compliance with the regulations.

Since 1995 the building permit covers only the locational aspects and does not look at the technical requirements. Responsible for the technical requirements is the owner. There are three different methods of control; control by self-certification, control by third part

and control by local authorities building departments.

10. COST-EFFICIENCY

Renovations are often based on some sort of economic calculations that are needed in order to make investment decisions.

To determine whether a renovation has a reasonable effect, the savings should be compared to the costs that are required to achieve them. This can be done for work that includes energy savings and is presented in the form of investment calculation. Well known economic models can be used to compare the costs and savings in energy use. It is much more difficult to assess the added value of improved comfort, better environment, accessibility, etc.

11. COMPETENCE OF PARTICIPANTS

A building permission is not required to alter the layout of or make other internal changes to a building such as laying a new floor or removing a dropped ceiling. According to BBR the developer of the building should at an early stage consider the need for the relevant competency for the respective tasks which together with the conditions for the design and construction are presented to form the basis of the inspection plan.

When altering a building and if the status and designs are not known, it is especially important to have access to the appropriate skilled labour when following up the execution.

12. FLUENT COMMUNICATION

During the building process communication is an important part in the goal of construct a “good” building. After a building notice is received in Sweden the building committee will convene a meeting with the consultancies. During this meeting an examination is made regarding planning of the construction work, need for inspections, supervision and other necessary controls. Documentation as drawings, specifications and protocols must be in good order.

The building owner has the responsibility to set an inspection plan to confirm that the technical requirements have been complied.

To bring order to all this work a quality assurance supervisor is used. The building owner shall appoint a person that can be quality assurance supervisor and shall assist the building owner at meetings, inspections and also other issues. The building owner can appoint a number of supervisors based on different part of the construction.

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