Sustainable transformation

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SUSTAINABLE TRANSFORMATION

– Building heritage, transformation and sustainability in a holistic perspective

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SUMMARY

This paper is about sustainable transformation with a particular focus on listed buildings. It is based on the notion that sustainability is not just a question of energy conditions, but also about the building being robust. Robust architecture means that the building can be maintained and rebuilt, that it can be adapted to changing functional needs, and that it has an architectural and cultural value.

A specific proposal for a transformation that enhances the architectural qualities and building heritage values of an existing building forms the empirical material, which is discussed using different theoretical lenses.

It is proposed that three parameters concerning the 'transformability' of the building can contribute to a more nuanced understanding of sustainable transformation: technical aspects, programmatic requirements and narrative value. It is proposed that the concept of 'sustainable transformation' may describe the transformation of existing buildings in a holistic perspective seeking to pass on maximum value to present and future generations.

KEYWORDS

Architecture, Transformation, Building heritage, Sustainability, Research by design

INTRODUCTION

Currently, there is a major focus on transformation and energy renovation. It seems as if energy improvement and insulation of existing buildings is of particular interest and that energy consumption is considered the central sustainability parameter. There is a risk, however, that the unilateral focus on energy improvement may result in projects where existing architectural qualities and building heritage values become blurred.

Questions about resources, the use of buildings and architectural qualities as parameters in a comprehensive sustainability strategy seem to be underexposed. Similarly, the importance of building heritage values as a potential when working with transformation and energy renovation seems to have been studied insufficiently.

Sustainability is a complex concept that includes both material and non-material values. It concerns social, economic and environmental conditions. The Brundtland Report from 1987 defined sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In the broadest sense, the aim of sustainable development is to "promote harmony among human beings and between humanity and nature" (Our Common Future, 2014).

Vitruvius emphasizes in his Ten Books on Architecture that architecture "(...) should possess strength, utility, and beauty", in Latin *firmitas*, *utilitas* and *venustas* (Vitruvius, 1914). Although Vitruvius does not use the concept of sustainability, it can be argued that this is precisely what he describes: An architecture that possesses qualities that ensure that the building has technical durability, programmatic usability and aesthetic values that contribute to making the building last long and to the resources being used in the most optimal way.

Architecture that possesses these qualities could be called robust. Among others, the Swedish architect Johan Celsing uses the term to describe buildings built to last. He points out that architecture is a slow medium that "requires major resources for its creation" and that "the robust is important if architecture is to be taken seriously and contribute to the development of a sustainable community" (Celsing, J., 2008).

Following this, this paper is based on the notion that sustainability is not just a question of energy conditions, but also about the building being robust. Robust architecture is here defined to concern technical aspects: that the building can be maintained and rebuilt; programmatic conditions: that the building can be adapted to changing functional needs; and aesthetic conditions: that the building has architectural and cultural value, hereafter called narrative value.

This leads to the research question: In what way are sustainable parameters manifested in a design for a transformation project – and how can they be developed without weakening, but rather by strengthening existing architectural qualities and building heritage values? How can these parameters contribute to a more nuanced understanding of sustainable transformation in a holistic perspective?

This paper is a presentation of the preliminary findings in the research project "Sustainable transformation – transformation models, strategies and methods". The research project is based on the notion that existing architectural values must be a part of an aesthetic strategy for a future transformation. Development of existing architectural values is assumed to constitute the basis of a sustainable transformation architecture that combines a strong identity, a high level of spatial and material performance and low energy consumption in a new architectural synthesis able to redeem current programme requirements.

The first part of this paper is about a red brick functionalist building known as the constable building. It was designed by architect at the Danish Naval Building Service Jens Klok in 1937. The building originally housed the Danish Navy's enlisted students. After the Navy moved from the building at Holmen in Copenhagen in 1993, the building was used for a while by the Red Cross, but since 2002, it has been empty. The building is listed with high preservation value (Toft Jensen, H., ed., 1996), which means that the building can be transformed with permission from the local authorities.

The project for a transformation aims at designing an extension and making an energy renovation of the existing building without compromising the existing conservation values, but rather enhancing them. In addition to the constable building, the research project is expected to include historicist apartment buildings, social housing from the 40s and 50s and family homes from the 60s and 70s. The buildings are selected with the intention of representing a programmatic and a temporal sample of Danish building culture.

METHODS

The investigation consists of two parts: a design proposal and an analysis.

Designing architecture is a complex process that does not follow predetermined theories and categories. As early as in the 1st century BC, Vitruvius described how architecture is a multidisciplinary discipline "arising out of many other sciences" and how practice as a "contemplation of the mode of executing any given work" and theory as "the result of that reasoning" in the architectural design process are closely interwoven (Vitruvius, 1914). The architectural design process is a non-linear process always dealing with a unique subject, taking place in a wide field of scientific and artistic disciplines. The architect must, according to Vitruvius, master many different disciplines, from being able to draw and write to being "not ignorant (...) of the heavenly bodies" (Vitruvius, 1914). Similarly, architectural research can be said to relate to many different scientific paradigms.

As the exclusively practicing architect is not able, according to Vitruvius, to "assign sufficient reasons for the forms he adopts," and because the purely theoretical working architect can only grasp "the shadow instead of the substance," he must "commit to writing his observations and experience, in order to assist his memory" (Vitruvius, 1914).

This description of the architect's working process can, in many ways, be said to be comparable to Donald A. Schön's description of a 'reflective practice' (Schön, D., 1986, 2001). According to Schön, the architectural design process may be understood as the continuous analysis and action performed in working with a complex and/or unique problem. It concerns the architect's experience, the understanding of the specific situation and a reflection on the presumed outcome. Central to Schön's definition is 'knowing-in-action', the general, practical knowledge we exhibit in our intelligent, physical performance; 'reflection-in-action', in which experience, knowledge and intuition work in interchange

with the action, and 'reflection on reflection-in-action', which is the retrospective analysis, which again indirectly can influence a future action (Schön, D., 1986, 2001).

The first part of this investigation is a 'reflective practice', which, in a 'reflective dialogue with the situation' in a larger 'network of choice', investigates the different so-called 'Normative / Descriptive Design Domains' (Schön, D., 2001), in this case relating to technical matters, programmatic requirements and narrative value that, as stated above, are expected to be of importance for a sustainable building culture. The 'reflective practice' as a method is supposed to be able to handle the complexity and unique character of the architectural project and at the same time deal with sustainability questions in a holistic perspective.

First, a registration, an analysis and a valuation of the existing building have been made. Then, a proposal for a transformation that adds a new insulating layer outside the existing building in extension of the identified heritage values has been designed. The project material consists of a set of drawings that include plan, sections and elevations in scales 1:500, 1:50 and 1:5, and an interior and an exterior visualization. The project has been designed in AutoCad, then modelled, rendered and finally completed in Photoshop.

The aim of the architectural project has been to create a new architectural entity, which relates to the existing building and its heritage values, and at the same time is able to express itself in its own, distinctive gestalt. The intention of the transformation is, in other words, to synthesize technical, programmatic and aesthetic qualities into a new architectural whole.

Although the transformation project is not built – and therefore does not contain the level of complexity of a completed work – the project is assumed to reflect, as mentioned above, an authentic architectural knowledge.

The second part of the investigation is an analysis and reflection on the architectural project, or a 'reflection on reflection-in-action', also called 'reflective research' (Schön, D., 1986, 2001). The first part of the investigation – which in itself, as mentioned above, can be understood as a production of architectural knowledge – is considered empirical material, which is subjected to an architectural analysis and discussed through various theoretical lenses. The analysis investigates – as the fabrication of the architectural project itself – the parameters that have to do with technical aspects, programmatic conditions and narrative value.

The understanding of a building's 'shearing layers of change' (Brand, S., 1994) is used to discuss the importance of building technology, including aspects of maintenance and suitability for rebuilding and the importance of programmatic flexibility. The question of the 'narrative value' (Michalski, S., 1994; Muñoz Viñas, S., 2005) is discussed in relation to the importance of the heritage value of the building. It is pointed out that the concept of 'sustainable conservation', understood as ensuring maximum value for present and future generations (Staniforth, S., 2000; Muñoz Viñas, S., 2005), can be included in a holistic sustainability strategy.

Finally, the architectural project and the subsequent reflection define a basis for outlining strategies for an architectural practice for a future sustainable building culture, or in the words of Schön, the reflection will "(...) concentrate on the development of themes which the practitioner in such situations can construct their own theories and methods from" (Schön, D., 2004).

RESULTS

The construction principle of the transformed building expresses a structural hierarchy in which the concrete structure is the most permanent; the facade of the building has the second-longest life, and the complementary elements are the least permanent parts of the building. The transformation project respects the hierarchy by not changing the primary concrete structure, by proposing an addition to the facade and by replacing all the complementary elements (Figures 1, 2, 3). The hierarchy allows for the building to be continually adapted to new functional needs.

The structural hierarchy manifests itself in a clear, tectonic articulation where every building part – facade, entrance, eaves, etc. – is clearly expressed. The design of the transformation project continues this tectonic articulation by expressing each layer independently. For example, the new brick facade is articulated as an independent new layer in itself; the entrance manifests itself as an independent volume, and the eaves are designed as autonomous distinctive elements (Figures 4, 5).

The materials – concrete, brick, wood – are of high quality, both in terms of being durable and in relation to their aesthetic expression. The details are designed in a way so that the materials can last

long and weather beautifully. For example, the distinctive eaves protect the facade from rain. The relief in the masonry is likely to emphasize the textural expression of the material and contribute positively to the future weathering (Figure 9).

The new layer of brick is built directly onto the exterior of the existing one. Window holes are enlarged and new volumes are added. Broken masonry can be easily repaired, and bricks that are destroyed can be replaced. Building parts can be repaired and/or dismantled and reused. The materials and the design of the parts ensure that it is possible to continue to maintain, rebuild and expand the building (Figures 6, 7) and that the building can be adapted to new needs.

The new brick facade is made of recycled bricks. It is proposed that it be erected in lime mortar so that the bricks can easily be cleaned and used again in a different context. Because of the clear tectonic articulation, the building parts – brick facade, windows, eaves and entrance – can be disassembled and reused in a different context (Figures 6, 7).

The principal structure made of concrete frames allows the building to be used for many different programmatic needs. In the transformation project, most of the interior spaces are constructed from movable furniture. New partition walls are made ready to be disassembled and removed. Installations – such as plumbing and electricity – are made visible so that they can be easily repaired and/or replaced. The spatial organization is general, in order to facilitate future programme flexibility (Figure 8).

It could be discussed whether there is a risk that the addition to the existing building reduces the flexibility and any future change in programme, especially with regard to the daylight condition on the first floor in the existing building. This could point to the need for an overall spatial quality as a sustainable parameter.

The design of the transformation project recognizes and continues the architectural motifs that are characteristic of the existing building. The functionalist expression, the facade rhythm, the heavy brick volume character with crisp detailing, and the building as an identity marker in the area are preserved and enhanced in a comprehensive, architectural design. The materials and the detailing are of high quality. The exterior as well as the interior have a distinctive atmosphere that reinforces the architectural and experiential value. New motifs, such as the pattern of the facade, enhance the narrative value of the building (Figures 8, 9).

The above investigation points at a number of sustainable parameters present in the transformation project:

– Technical matters dealing with the building structure and hierarchy, the tectonic articulation, the quality of the materials and their weathering, the extent to which the building can be repaired, disassembled and/or rebuilt, and the extent to which building parts can be replaced and recycled are parameters that can contribute to the general adaptability and resilience of the building.

– Programmatic requirements related to changing programmes and new ways of using the building are supported by the general adaptability in the building's structure and materials, the general spatial organization and the flexibility of the interior.

– Narrative values dealing with architectural qualities and heritage values enhance the importance of the building as an identity marker in the area. The distinctive atmosphere of the interior and exterior of the building, designed in continuation of the existing architectural qualities and heritage values, increases the narrative value of the building.

Figure 1: Plan, existing and new conditions

Figure 2: Section, existing and new conditions

Figure 3: Elevation, existing and new conditions

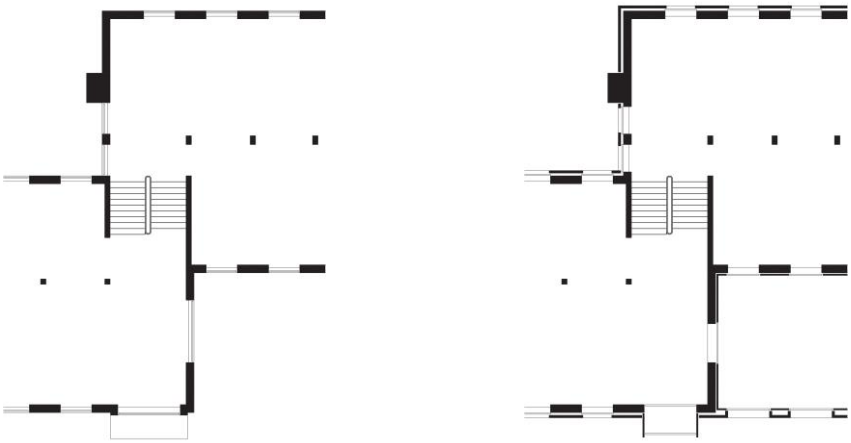

Figure 4: Plan, existing and new conditions

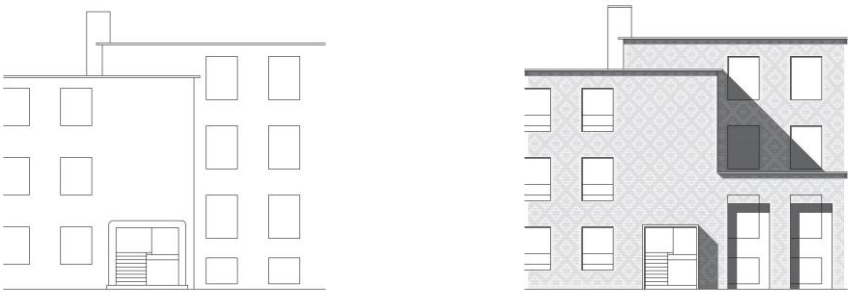

Figure 5: Elevation, existing and new conditions

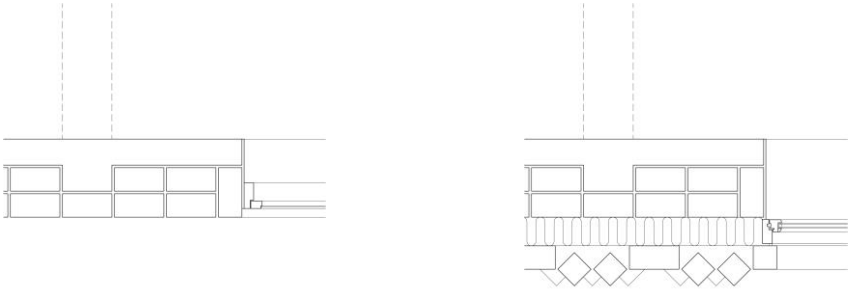

Figure 6: Detail plan, existing and new conditions

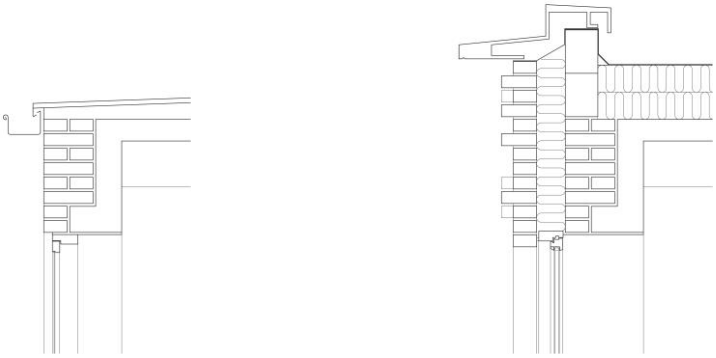

Figure 7: Detail section, existing and new conditions

Figure 8: Interior visualization

Figure 9: Exterior visualization, existing and new conditions

DISCUSSION

Sustainability can, as described in the introduction, be assumed to include resource-saving strategies relating to technical durability, programmatic usability and narrative value. In a sense, the transformed building has already proved, by having reached a certain age and by being attributed a high heritage value, that it possesses qualities that have sustainability perspectives.

Shearing layers of change

The life of the building after it is built – the temporal perspective – is in this sense a crucial parameter. Steward Brand describes in How Buildings Learn, inspired by the principles of Francis Duffy, how a building should be understood as consisting of a number of systems, each with its independent time. The so-called 'shearing layers of change' consist of: the site, which has the longest life since the context can be traced through generations; the main structure, which has a time perspective of between 30 and 300 years; the exterior surfaces (skin), which change approximately every 20 years; installations (services), which must be replaced every 7-15 years; the space plan, which will be changed about every 3-30 years; and the furniture (stuff), which has the shortest time perspective, as it is moved all the time (Brand, S., 1994).

In the transformation project, the choices concerning location and structural design have already been made. The existing building has a structural hierarchy with a clear separation between the different building parts, allowing each part to have its own time and thus a "slippage between the differently-paced systems of the Site, Structure, Skin, Services, Space plan and Stuff" to prevent that "the slow systems block the flow of the quick ones, and the quick ones tear up the old ones with their constant changes" (Brand, S., 1994).

The different times – the structural hierarchy – are recognized in the design of the transformation project, and the different layers – concrete structure, brick facade and complementary elements – are independently expressed through a clear tectonic articulation, which prevents the different temporal layers of the building form working against each other.

It requires a certain adaptability to achieve a high age. "Age plus adaptivity," says Brand, "is what makes a building come to be loved" (Brand, S., 1994). In addition to respecting the already flexible structural hierarchy, the transformation project is, as shown above, adaptable because of the tectonic articulation, the possibility of repairing, disassembling and/or modifying, as well as replacing and recycling building parts. It could be argued that the transformation project learns from the building – which, according to Brand, has already learned from its residents, as the project ensures, on many levels, a continued physical adaptability.

To avoid a static structure, Brand calls for a more fluid type of programming, or what is called 'scenario planning'. Instead of a space plan that is based on a prediction that can never be fulfilled, one must work with a strategy that is designed to take account of future programmatic changes, or as Brand puts it: "A good strategy ensures that, no matter what happens, you always have manoeuvring room" (Brand, S., 1994).

The general spatial organization of the transformation project can be regarded as an attempt to approach 'scenario planning' rather than traditional planning. When transforming a building from a very general use to a very specific programme, this is challenging. New internal partition walls do not

directly allow for a flexible plan, but by working with general usable space plans and movable furniture, and by making partition walls and installations respect the hierarchy of the building and ensure that they can be dismantled and remodelled, the chances of future programmatic flexibility are increased.

Narrative value

One may ask why buildings have been preserved in the first place and, by extension, assume that preserving a building – to take care of it – in itself is a sustainable action that can help reduce resource consumption. Similarly, it can be argued that the same conditions prevail when it comes to ensuring the future longevity of a building. In other words, the reason that a building has been preserved and the strategy to ensure it a long future life are similar.

In extension of Brand, it can be argued that architecture understood as a static, self-contained object has been replaced by an understanding of the building as an adaptive structure where "the building learns from its occupants, and they learn from it" (Brand, S., 1994). The building is, in this way, a narrative of human habitation since "age plus adaptivity is what makes a building come to be loved" (Brand, S., 1994). The residents love the building and ensure its preservation, and the building is, through its adaptability, a narrative of human habitation.

What characterizes objects that have been preserved is that they "communicate something" (Muñoz Viñas, S., 2005). Objects can, according to Muñoz Viñas, become conservation objects, "not because they are cultural, artistic, historic or old," but because they possess a symbolic meaning (Muñoz Viñas, S., 2005). Referring to Michalski's 'three-dimensional space' (Michalski, S., 1994), the probability of an object being preserved grows the greater the personal, social and scientific narrative value the object represents (Muñoz Viñas, S., 2005).

Although Muñoz Viñas as a conservation theorist argues that a conservation object must be conserved – and not transformed – it can, in a sustainability perspective, be argued that the same can apply to the transformation of buildings, to the extent that the existing narrative value is not reduced, but enhanced.

The reason that an object will be conserved is thus not a predetermined truth, but rather the result of the narrative value possessed by the object. It can, in extension of Muñoz Viñas, be pointed out that it is the preservation and enhancement of the private, the social and the scientific narrative value that must characterize not only objects, but also buildings that are likely to be conserved in the future – and thus to reduce resource consumption. This can, as pointed out in the above investigation, be done through a valuation of the heritage values, and through the transformation of the existing building, it is possible to further develop the narrative values that will enhance the identity of the building and give it a continuous long life.

Sustainable conservation

When a building is worth preserving because of its narrative value, the contribution to a sustainable, resource-saving strategy can be to extend the physical life of the building by enhancing the elements that create meaning, making it worthy of conservation – even if the building is not restored, but transformed based on the identified values.

Conservation can, in this way, add to a resource-saving strategy that can contribute to sustainable development. In the Brundtland Report, sustainable development is defined, as mentioned above, as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Our Common Future, 2014). This definition is, with reference to Staniforth (2000), a direct reflection of the whole purpose of conservation of cultural heritage, which is to "pass on maximum significance to future generations" (Muñoz Viñas, S., 2005).

This understanding of conservation suggests that conservation work is a negotiation between different interests including not only contemporary, but also future users and therefore experts. Conservation does not represent a final truth, but rather it is rooted in "the uses, values and meanings that an object has for people" (Muñoz Viñas, S., 2005).

Following Muñoz Viñas, it can be argued that sustainable transformation of an existing building is not an end in itself but a means, "a way of maintaining and reinforcing the meanings in an object" (Muñoz Viñas, S., 2005) that contributes to a resource-saving strategy and sustainable development by ensuring maximum meaning for present and future generations.

CONCLUSIONS

Following the result and discussion presented above, the supposed sustainable parameters concerning technical aspects, programmatic requirements and narrative value are manifested in a variety of ways in the transformation project. It is thus proposed that the following parameters, which are related to the 'transformability' of a building, can contribute to a more nuanced understanding of sustainable transformation:

Technical aspects
– The structural hierarchy of the building
– The tectonic articulation
– The quality of the materials
– The weathering of the materials
– The extent to which the building can be repaired, disassembled and/or repaired
– The extent to which the building parts can be replaced and recycled

Programmatic requirements
– The physical adaptability of the building
– The general space plan
– The flexibility of the interior

Narrative value
– The existing heritage values
– The distinctive atmosphere of the interior and exterior of the building
– The personal, social and scientific narrative value

It is shown above how to design a transformation of an existing building without weakening, but rather by strengthening existing architectural qualities and heritage values. It is pointed out that a thorough analysis and valuation of the existing building can be the basis for resource-saving strategies that do not weaken but strengthen existing architectural qualities and heritage values in a holistic architectural perspective.

A robust, sustainable architecture is characterized by qualities that ensure the technical durability, programmatic usability and narrative values of the building, ensuring maximum meaning for present and future generations. The parameters described above can help in the development of strategies for an architectural practice for a future sustainable building culture, or in the words of Schön, they can contribute to "(...) the development of themes from which the practitioner in such situations could construct their own theories and methods" (Schön, D., 2001).

It is proposed that the concept of 'sustainable transformation' can describe the transformation of listed buildings in a holistic perspective that seeks to ensure maximum value for the benefit of present and future generations. It is also proposed that 'sustainable transformation' can be used in transformation of not only listed, but also non-listed buildings.

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