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Sustainable Architectural Conservation

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Introduction

Besides the economic crisis, the threat from climate change and the democratization have been widely discussed globally. These topics affect also the building and planning sector to a large extent. So far the discussions have mainly concerned new developments but in the near future demands on both energy efficiency and sustainability will be applied on conservation and restoration projects as well. Both research and education must include these topics in their curriculum to prepare future conservation experts for these new demands.

The EU countries have established an environmental goal¹ for the coming decades in order to reach the agreed limits of global warming. To have a chance of reaching this goal there must be visible CO² emission reductions before 2020. This is why the EU has recommended a reduction in emissions of 25 - 40 % by 2020 and of 80 - 95 % by 2050, compared to the 1990 level for the European countries. The adopted goals that affect the building sector by 2020 are:

- CO² emissions reduction of 20 %
- the amount of renewable energy produced shall reach 20 %
- energy efficiency to be increased by 20 % which will require that all EU countries change their building codes, meaning that all restoration projects have to follow the new building regulations in respect of energy efficiency.

Sweden has produced its own environmental program. In harmony with the EU recommendations, they have decided to

- reduce CO² emissions by 40 % by 2020
- half of the energy consumption shall be based on renewable energy sources
- fossil fuels shall not be used for heating after 2020
- no greenhouse gases will be produced after 2050
- increase energy efficiency by 20 % (the same as the EU)

To be able to reach these goals Swedish building codes are changing step by step, allowing only a certain amount of energy consumption per square meter per year, depending on the geographical location and energy source. These building codes are up to now related to new

¹ www.swedisol.se/klimat-och-energimal

constructions, but will in the future affect the existing building stock since new buildings consume a very small part of total energy consumption.

There are several ways of economizing on energy consumption. One is to make the production of different building materials more efficient, reduce transport costs, etc. Another is to reduce energy use in the maintenance phase. A third is to promote a less energy-consuming lifestyle through the project. Several factors contribute to social issues and social sustainability in building projects if wellbeing is achieved; an inclusive and democratic process and qualitative planning.

Besides the building codes related to energy consumption there is another change in Swedish building legislation for environmental reasons that affects conservation praxis and this concerns the materials allowed and banned from being used and the requirement to calculate the comparative lifecycle assessment of each material. Such assessments will give the true environmental cost of a project. To mention just one of the most common materials used in conservation, linen seed oil paint is no longer permitted to be used over larger areas and we have many historic interiors painted with linen seed oil paint. These are now being replaced with matt acrylic paint.

Environmental legislation will continuously increase and we can be sure that conservation projects will be more and more affected by them. To reduce energy consumption measures must be taken on the existing building stock. Yet there is no comprehensive national program or strategy to reach the set goals and there is criticism of the authorities in the following areas:

- 1) What measures should be taken to reach the target for 2020 to avoid it becoming an obstacle for achieving the 2050 target, since the building solutions that will be implemented to reach the 2020 goals are not enough for the 2050 goal and we cannot expect people to re-build what has been newly erected.
- 2) There is too little focus on the carbon dioxide footprint. Regulations and discussions are mostly related to energy consumption.
- 3) There is no reliable national program of how to reach these goals. Today 50 % of electricity consumption comes from nuclear energy with the rest coming from water energy. There is no plan of how to replace nuclear power in a sustainable way.

This means that we are still at the beginning of planning strategies for achieving the environmental goals and there is yet no discussion on how they affect the cultural historic environment. This should be actively discussed, what does sustainable architectural conservation really mean and to what extent should or can our cultural historic buildings meet these demands. What kind of knowledge do we lack and what kinds of research do we need in order to achieve a truly sustainable architectural conservation?

Current situation in Sweden

One third of the existing building stock in Sweden was constructed before 1945. Current legislation requires that cultural historic values must be respected in restoration work on any building. This means that if or when we want to re-build or improve the energy performance of an existing building, we are obliged to analyze the effects it has on the cultural historic values. However, there are no test cases so far to guide us in how to evaluate one value criteria against another based on environmental aspects, and we do not yet have established tools for these types of projects.

How to deal with buildings and housing developments from the 1970s which are often poorly insulated and of materials that age badly is a challenge that is more and more discussed in Sweden today. How should architecture from the 1970s be valued and what scale of changes should be allowed? Park Lane in Sheffield has been presented as a successful project, rescued through the changes it has undergone². Do the values from the original project still exist? The social context is lost through the gentrification of the development. Large-scale building projects from the 1970s are in many cases inhabited by immigrants or lower income groups. How can these areas be improved and their historic character safeguarded through sustainable conservation projects where both democratic and environmental processes are incorporated. Can democratic inclusiveness help to prevent gentrification? Can it be a tool towards improved wellbeing and social sustainability?

An important issue in a sustainable society includes a lifestyle that does not burden the carbon dioxide footprint and where the inhabitants feel happy. Happiness has almost become a term in the planning process; happy grounds, happy Stockholm, etc. In Swedish we have a term *trivsel* which means 'to feel good' and which has become an important term in planning. Recent research² has also noted the importance of this and how feeling good contributes to sustainability by maintaining places in a better way, with fewer changes of inhabitants and less need for social welfare³. How can this be combined with rescued values in areas that are not widely appreciated at present? We know that value judgments change over time and one cannot be sure of future evaluations.

Another way of including people in the planning is by telling them the story of the buildings or places as a method for choosing buildings and areas to be listed and maintained. The focus on the story has emerged since historians have started participating in the field of architectural conservation. It is interesting to notice the presence of a growing diversity of experts now

² [http://en.wikipedia.org/wiki/Park_Hill,_Sheffield/References and External links](http://en.wikipedia.org/wiki/Park_Hill,_Sheffield/References_and_External_links)

³ <http://livingbusiness.fi/uusimaa/hankkeet/8-kaynnissa-olevat-hankkeet/25-aatu-asukas-ja-asiakaslahtoiset-kaupunkiymparistojen-turvallisuusratkaisut> and <http://www.tekes.fi/ohjelmat/Turvallisuus/Projektit?id=10198652>

participating in the care and management of the cultural heritage and the changes it brings. A new group of experts who will begin to participate in the process will be various environmental experts and this will again bring future changes and new demands.

Environmental demands range from large-scale to small-scale solutions. In Sweden we have the widely used method of heat distribution by district heating which is efficient and can quickly adjust to the mass use of new energy sources such as waste, surplus energy, etc. In Amsterdam, for instance, they have to introduce this kind of large-scale system when they are changing to ground water heating for the entire city.

Electricity is another energy source that is more efficiently distributed through large-scale systems. What is not yet solved in Sweden is how local solar cell systems should be combined with the national electricity network from an economic perspective. Renewable energy is promoted but the costs must be fair to everyone. How this will be solved will affect future attitudes to the use of solar cells, as well as solar panels.

Expected Environmental Demands and Some Possible Solutions

Many buildings in Sweden had supplementary insulation installed in response to the energy crisis of the 1970s. In many cases energy performance and efficiency were in focus, not the cultural-historic value of the building, and as a consequence we have many bad examples of re-building from this period.

We must learn from this and aim at a long-term sustainability which includes *economic, ecological and social factors and estimate which risks our aim might cause.*

A decrease of energy loss may risk a loss of cultural historic values and an introduction of more efficient heating supply may cause humidity problems and changes of functions or standard may give high extra costs.

So what are the future possibilities which could enable us to reach the required environmental goals without loss of cultural historic values? I will list a few examples of recent research results, as well as suggested future research topics that could be interesting for the Cultural Heritage sector.

The Swedish company, Svenska Aerogel AB⁴, states that according to a EU case study, adding thermal insulation to existing buildings in the EU could potentially reduce CO² emissions from heating and cooling by 42 %. This insulation material is based on silica (silicon oxide), where the silica particles have been treated to a nano level to prevent air movement, resulting in a material three times more efficient than mineral wool. This type of insulation is already being produced in the US, and a factory is planned in Slovenia. In

⁴ <http://www.aerogel.se/>

Sweden planned production will start next year. The Swedish process differs from the American one by using much less energy in the production process.

At University of Dalarna we are planning to incorporate aerogel insulation in a full scale project in the region. Aerogel is a hydrophobic material and has to be integrated into the construction in such a way that condensation is prevented. While super-efficient insulation materials already exist, they are based on a vacuum which will leach eventually and they are not based on as environmentally friendly a material as silica.

Aerogel insulation has great potential for improved thermal insulation in conservation projects since the most efficient placement for the additional insulation is on the outer side of the structure. This is especially important when the structure is made of wood, which is the case in 90 % of Swedish small-scale housing. A 7-8 cm addition would be as efficient as 20 -25 cm of mineral wool, which is not far from a passive house standard (30-34 cm). This could be applied in many buildings without affecting the eaves of the roofs. The facade material would, however, have to be renewed completely if plastered, and to a large extent if made of wood, but such changes could be considered part of a normal maintenance. This would achieve a major decrease energy consumption for heating; the remaining heating demands could easily be obtained from renewable energy sources.

Wood is, besides being the dominant traditional building material in the Nordic countries, one of the most environmentally friendly building materials that exists at is Sweden's main export product.

Besides its traditional usage as a structural material in different ways, as a façade material, and in interiors there are a wide range of wood used in different types of new board products and wood fiber used for casting. With new technology, forest and wood-pulp products have additional potentials that should be exploited. Research is at the moment being initiated on several products that could be developed further for building and conservation purposes. I will list some of them⁵.

- Light conductive paper that could be used for ceilings in the traditional way where electric lamps are not suitable for cultural historic reasons.
- A fiber roof or wall panels without seams of nano pulp technology which can combine different properties since it is produced in three layers with different properties such as a waterproof surface and light conductive and heat reflective layers.
- Bitumen paper for roofs is a renewable material based on forest crude oil that could replace asphalt paper. This paper could be produced with white colour for improved cooling effects.
- Wood fiber wool could be used in interiors where the wear is high.
- A nutritious lawn with a fabric of bio-waste could be applied on courtyards/roofs and contribute to better air and noise reduction.

⁵ <http://www.ekoportal2035.se/>

- Wood impregnated with TreeTiles, an extractive component from wood, could be used in bathrooms or places with high humidity. Pine oil and furfuryl alcohol gives a stability and resistance against humidity and mold.
- Glue, double component water-resistant, based on lignin.

The Swedish National Property Board, together with a research center at Uppsala University, has begun research⁶ on how to reduce heat loss through windows by testing different types of glass applied to the inner side of existing windows, different types of mountings, and the consequences of glass colour, reduction of heat loss, etc. The results will be used as guidelines for future conservation works.

Conclusion

The National Property Board has, as have all state institutions in Sweden, established an environmental policy and requires the same from the consultants they hire. In Sweden working with listed buildings means almost always that a practitioner is engaged by a state department.

Conservation praxis is constantly expanding due to new considerations that must be incorporated in projects, as well as the requirement for better documentation throughout the projects, and the team involved in a project is growing accordingly.

Not long ago accessibility was a new requirement, and we already have stricter demands on security and fire protection. Up-coming discussions in the field will concern the climate question and environmental demands, as well as social sustainability and inclusion. The stock of listed buildings is constantly growing which is economically difficult to manage. Maintenance costs demand better solutions for how to take care of the cultural heritage. In Sweden there has been a selective process of buildings which will be presented and preserved and the criteria used in this selection process have been based on the stories the buildings represent and their relevance to the public. Values supposedly lost in this process are being discussed, but yet there are no evaluations giving proofs or suggestions. The assumption is that values related to the material, and the authenticity will not be as well safeguarded as earlier.

But all heritage buildings are not listed buildings. There are a large number of buildings of local value. Even if fewer and fewer new buildings are listed each year, some of these might achieve this status in the future, especially if participatory planning processes increase. From this inclusive perspective, what is loved by local inhabitants must be respected and considered. This is of course true, but we should at the same time not forget the impact of artistic quality and the conflicts of interest that can occur between different groups: experts *vs* laymen, architects *vs* antiquarians, historians *vs* engineers, etc. With an increasing number of

⁶ www.sfv.se/elisabet.jermsten. The report is in progress.

participants in the conservation process there will be an increasing number of opinions of what is considered important.

Future conservation experts face a situation of more and more objects, historic areas and ensembles to deal with and an increasing number of experts as well as laymen participating in projects, at the same time as environmental demands are tightening along with an economy that cannot pay for everything. The conservation courses must provide knowledge about new demands and prepare the conservation experts to meet discussions about changes in values, new technical solutions etc.

How shall the selection of buildings be done?

How can we devise a participatory process that includes users?

Sustainable goals are being tested and outcomes are important to share. How can we learn from each other and create a global dialogue?