Energy Efficiency in Heritage Buildings

Conservation Approaches and Their Impact on Energy Efficiency Measures

Tomas Örn

Architecture
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Cover image: from the series "Den ryske punkarens val i Norrbotten. Hus i Nattavaara by". Artist: Jan Anders Jatte Eriksson, Mixed techniques..

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Licentiate thesis 2018

ISSN: ISSN 1402-1757


Luleå University of Technology

Department of Civil, Environmental and Natural Resources Engineering Architecture Research Group

www.ltu.se

Language proof reading: Sees-editing Ltd, United Kingdom

Printed by Luleå University of Technology, Graphic Production 2018
ABSTRACT

The impeding climate change challenge urges for a reduction of energy use in the built environment. Buildings account for nearly 40% of the total energy use and about 35% of the greenhouse gas emissions in Europe. EU member states are required to improve the energy efficiency of the existing building stock, for example by sharpening building regulations and developing enforcement schemes. Since energy efficiency retrofits can affect irreplaceable values in heritage buildings, heritage buildings are often excluded from mandatory demands aiming at reducing the energy use in buildings. However, saving energy have gradually become embraced by the conservation community and heritage buildings with are seen as part of the solution.

This licentiate thesis discusses the methods to identify heritage significance in a building and how the underlying theory determines different scenarios in a energy retrofitting process. The choice of conservation theory and conservation approach will affect the success the energy retrofitting process and determine how much the energy use that can be reduced. This thesis therefore suggests a framework to understand the different interpretation of the impacts that one could exert either by having an Objectivistic or Relative conservation value approach. Based on this framework, a decision-support tool is developed to further detail the impacts of such approaches for different energy measures.

Other results show that a majority of reviewed research publications focused on the operational energy in a building and only a few were concerned with energy use over the entire life-cycle of a building. These analyses are used to evaluate where most energy savings can be made, and often pinpoint weak spots in the building's envelope or technical system. If it was mentioned at all, the influence of cultural and historical factors on energy efficiency measures as applied to heritage buildings tended to be assessed only briefly. Indeed, the majority does not describe conservation principles or even mention the methodology used – if any – for assessing or defining heritage values. Instead, researchers often show an explicit (sometimes an implicit) understanding of conservation as essentially something that is not destructive of original construction material and hence the authenticity of a building.

This licentiate thesis is a compilation thesis, consisting of one separate sub-study, one literature review and an extended cover essay. The study is oriented towards a Swedish and European context, especially when it comes to climate conditions and discussions on building regulations and the theory and practice of architectural conservation. It addresses the growing research field of energy efficiency in heritage buildings and the thesis aims to contribute to an increased understanding on how the process of assessment and evaluation of heritage significance in buildings affects the making of heritage buildings more energy efficient. The main research question is: How do different approaches for assessing and evaluating heritage significance in buildings affect possible technical energy saving measures in heritage buildings?
Sammanfattning

Klimatförändringarna driver utvecklingen mot att energianvändningen i den byggda miljön behöver minska. Byggnader står för nästan 40% av den totala energianvändningen och cirka 35% av utsläppen av växthusgaser i Europa. EUs medlemsländer är bundna att förbättra energieffektiviteten hos befintliga byggnader, till exempel genom att skärpa byggreglerna och utveckla handlingsplaner. Eftersom energieffektiviseringar kan påverka värden i kulturhushistoriska byggnader, är dessa ofta undantagna från krav som syftar till att minska energianvändningen i byggnader.

Energibesparing och resurshushållning har gradvis blivit omfamnad av kulturmiljösektorn och kulturhistoriska byggnader betraktas allt mer som en del av lösningen på klimatförändringarna.


Andra resultat visar att en majoritet av de granskade forskningspublikationerna fokuserade på den operativa energin i en byggnad och bara ett fåtal gällde energianvändning under hela livscykeln i en byggnad. Dessa analyser används för att utvärdera var de flesta energibesparingar kan göras och ofta identifiera svaga punkter i byggnadens klimatskal eller tekniska system. Om det nämndes alls tenderade inflytandet av kulturella och historiska faktorer på energieffektivitetsåtgärder som tillämpas på arvsbyggnader endast att bedömas kortfattat. Faktum är att majoriteten av de genomgångna publikationerna inte beskriver bevarandeprinciper och inte nämner den metod som används för att bedöma eller definiera kulturhistoriska värden. Istället används ofta en explicit (ibland en implicit) förståelse för bevarande som i huvudsak något som inte förstör ursprungligt material och därmed autenticitet i en byggnad.

Denna licentiatavhandling består av en separat undersökning, en litteraturöversikt och en utökad kappa. Studien är inriktad på ett svenskt och europeiskt sammanhang, särskilt när det gäller klimatförhållanden och diskussioner om byggregler och teori och praktik för kulturhistoriskt bevarande av byggnader. Den är en del av det växande forskningsområdet energieffektivisering i kulturhistoriska byggnader och avhandlingen syftar till att bidra till en ökad förståelse för hur utvärderingen av kulturhistoriska värden i byggnader påverkar arbetet med att göra dem mer energieffektiva.

Huvudforskningsfrågan är: Hur påverkar olika metoder för bedömning och utvärdering av kulturhistoriska värden energibesparande åtgärder i kulturhistoriska byggnader?
Acknowledgements

This Licentiate thesis is based on part of my PhD studies in Architecture at Luleå University of Technology. It is a compilation thesis, consisting of a separate sub-study, a literature review and an extended cover essay. It concerns the theory and practice of architectural conservation generally, and specifically in European and Swedish contexts in terms of both climatic conditions and building regulations.

I am grateful to all the organizations that made this Licentiate thesis possible. The reported work is part of the Smart energy efficiency of historic buildings in cold climates project based at Luleå Technical University. The project is financed by the Swedish Energy Agency through the Save and Preserve (Spara och Bevara) research program, which started in 2007 and is currently running until December 2018, and the Hjalmar Lundbohm Research Center (HLRC).

Special and very warm thanks are due to my supervisor, Sofia Lidelöw, who helped me close my knowledge gaps whenever they turned up and without whom this thesis would not have been possible. Huge thanks are also due to Agatino Rizzo, Andrea Luciani, Kristina I. Nilsson and Tor Broström, who have also contributed to my supervision and provided valuable guidance.

Halldo Lundgren, Piteå municipality and LKAB Fastigheter have been very helpful in providing access to the case study buildings and practical help on site.

Thank you also Jan Anders Jatte Eriksson for letting me use your inspiring piece of art picturing a Russian punk rocker in front of an old building in Nattavaara by, Norrbotten, Northern Sweden.
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This thesis is partly based on work described in detail in the following papers.

Paper 1

Paper 2

These papers are referred to in the following text by the corresponding Roman numerals.

1. Introduction

Research focused on ways to make buildings with recognized cultural and architectural value more energy efficient has been increasing over the last decade. The European Union (EU) and its member states are leading much of this research, partly because new EU building regulations and environmental objectives are increasing needs to save energy without compromising buildings’ valued features (Martínez-Molina et al. 2016). Reducing the energy used in buildings is an important element of national and international efforts to reduce carbon dioxide (CO₂) emissions and has become an objective in energy strategies and sustainable programs in Europe (European Commission 2013, Proposition 2008/09:163). This objective of the EU also covers buildings with cultural value, which are therefore included in the legislative framework (Directive 2010/31/EU; Directive 2012/27/EU).

However, buildings considered to have qualities and values that require preservation are often excluded from demands intended to reduce energy use in buildings. For example, the EU Directive on the energy performance of buildings states that “buildings and monuments officially protected as part of a designated environment or because of their special architectural or historic merit, where compliance with the requirements would unacceptably alter their character or appearance” may be excluded from the energy requirements (EU 2002/91/EC, EPBD). Consequently, national legislation such as the Swedish Planning and Building Act (Plan- och bygglagen) (SFS 2010:900) also includes the possibility to exempt buildings from the new energy demands if they have particular historical, cultural or artistic value that cannot be compromised (SFS 2010:900, section 8:17).

Therefore both European and national legislation offers several alternatives regarding the energy performance of heritage buildings. These include regulations stipulating how the energy performance of a building can or should be increased, and the targets when altering a building, as well as the possibility of total exemption from energy-saving
regulations if features of cultural value would be distorted or damaged. For example, the Swedish building regulations (Boverkets byggregler) (BFS 2011:6) state that energy targets should be pursued and maximal U-values (thermal transmittance or insulation effectiveness values) must be met (BFS 2011:6 Chapter 9 section 91). But they also state that cultural, architectural and aesthetical values must be safeguarded when applying energy saving measures (BFS 2011:6 section 9:91). For example, when improving the U-values of a building envelope and windows it is recommended that windows with a “highly significant cultural value” should not be replaced and that other measures to increase the thermal resistance should be applied (BFS 2011:6, section 9:92).

Although the examples from the Swedish legislative framework show that heritage buildings can be exempt from the demands, traditional buildings are “under significant pressure to reduce carbon emissions” Godwin (2011: 13). This is because buildings with heritage significance comprise a substantial proportion of the total building stock, and high potential energy savings can be made in them, or at least high enough to be scrutinized in an energy efficiency perspective.

There are no definitive data on numbers of buildings that have architectural or historical value, and numbers of buildings with heritage significance differ between countries and between continents. Numbers in countries of the Baltic Sea region range between 2 and 13% of the total building stock according to estimates generated in Cool Bricks, an EU-funded project. The highest proportion was in Denmark, where it was estimated that 13% of the building stock, about 350,000 buildings, are considered worthy of conservation (Cool Bricks 2012:38). In England, Historic England has registered 377,388 listed buildings (Historic England 2017:12). There are no reliable data on the number of buildings that are considered to have heritage significance in Sweden, but it is estimated that 67,000 or 2% of 3.1 million buildings have legal protection in a local development plan (detaljplan) due to their heritage significance (Miljömålsrådet 2017). In the county of Norrbotten the estimated number of protected buildings is 2748 (Länsstyrelsen Norrbotten, 2013:8) or 2.3% of the county’s total building stock (Miljömålsrådet 2017). In addition, in February 2018 there were 10,103 listed buildings and 4,044 protected churches in the Swedish national Database of Built Heritage (Bebyggelseregistret 2018). The cited legislation has overlapping lists, so a given building may be protected by multiple regulations.

Although energy efficiency retrofits can affect irreplaceable values of heritage buildings, saving energy has gradually become embraced by the conservation community. Energy efficiency and reducing carbon dioxide (CO₂) emissions are now more widely considered important aspects of sustainable development, together with the preservation of heritage buildings (UNESCO 2013). At the same time, architectural and cultural heritage qualities in existing buildings are said to contribute to sustainable development and thus also need to be addressed (Pereira Roders & Van Oers 2011). Accordingly, since the mid-1970s the focus of efforts to conserve architectural heritage has broadened, from the preservation of single monuments of artistic and historic significance to include contributions to social, ecological and economic aspects of sustainable development.
In Sweden the shift in focus of conservation coincided with, and was partly triggered by, widespread demolition of old and historic buildings in almost every city between the 1950s and 1980s. The main aims of the demolitions were to improve housing standards, modernize the cities and make way for more rational streets that were more suitable for modern shops and business. The state-run sanitation (or slum clearance) committee (Saneringsutredningen) also wrote a report on the management of heritage buildings, which highlighted social reasons for preserving historic buildings as well as cultural and historical reasons (Saneringsutredningen 1973:23). They argued that older buildings contributed to variation in the housing market and that people tend to like their living environment even if “it does not seem to show any appealing characteristics at all” (Saneringsutredningen 1973:23). This understanding of how people related to their living environment was strengthened by the Council of Europe declaring 1975 the European Architectural Year.

The shift of focus was further emphasized in the 1972 World Heritage Convention (UNESCO 1972), European declarations such as The Amsterdam Declaration of 1975 (ICOMOS 1975a) and the European Charter of the Architectural Heritage (ICOMOS 1975b).

As Englebrektsson and Rosvall (2003:11) argue, the deliberate and politically sanctioned destruction of buildings and material history in the European cities drove a widening of conservation concepts and broadening of academic research regarding architectural heritage.

“The concept of ‘historical value’ as an instrument for valorising cultural heritage and selecting objects was subsequently scrutinized and re-defined in broader ways. Gradually, when scholars representing ethnology, social history and human geography took part in those investigations, social, technical and ecological dimensions of the built environment were added, usually with a process-oriented approach.” (Engelbrektsson & Rosvall 2003:4).

A little later, conservation was defined as “the action taken to prevent decay and manage change dynamically (Feilden 1982:3)” thus putting the focus on management and including change and development as an inherent element of conservation (Fielden 1986). Since then, there has been a general presumption that conservation of architectural heritage contributes to sustainable development in three (ecological, economic and social) dimensions.

More recently, the idea that cultural heritage and conservation are beneficial for development has also been incorporated in the policy of the EU, and hence its member states. Moreover, the Cultural Heritage Counts for Europe project has provided qualitative and quantitative evidence showing “that cultural heritage makes a key contribution to the Europe 2020: A European Strategy for Smart, Sustainable and Inclusive Growth” (Cultural heritage counts for Europe 2015:9).

In the project’s full report (Cultural Heritage counts for Europe 2015) cultural heritage is analyzed in terms of four dimensions of sustainability – cultural, social, economic and environmental. In its key findings section, it argues that cultural heritage contributes to
sustainable development in numerous ways. It contributes to the attractiveness of European regions and cities, provides countries with unique identities, sources of creativity and innovation, and good returns on investments; creates jobs; enhances people's quality of life; stimulates education and lifelong learning and “combines many of the above-mentioned positive impacts to build social capital and helps deliver social cohesion in communities across Europe, providing a framework for participation and engagement as well as fostering integration” (Cultural heritage counts for Europe 2015:29). Although the report mainly focuses on social, cultural and economic factors it also argues that cultural heritage is “part of the solution to Europe's climate change challenges, for example through the protection and revitalisation of the huge embedded energy in the historic building stock.” (Cultural Heritage Counts for Europe 2015:28).

The report thereby focuses on the embodied energy in existing buildings, but also touches on the energy consumed during their use. It is argued that existing buildings should be adapted to meet new energy saving requirements and that Life Cycle Analysis (LCA) and Life Cycle Costs (LCC) calculations should be used when analyzing the older building stock (Cultural Heritage Counts for Europe 2015:145-148). Examples of how such policy can be implemented are found in national regulations regarding buildings and heritage like the guidance of Historic England (2011; formerly English Heritage) on Energy Efficiency and Historic Buildings, which states that “[t]here is no inherent conflict between the retention of older buildings and the principles of sustainability” (English Heritage 2011:8).

As far as policy goes, cultural heritage buildings are not exempted from contributing to the goal of reducing energy use in buildings but rather considered part of the solution to climate change. But it also stresses the importance of safeguarding a heritage that is perceived as a non-renewable resource. The challenge of conservation therefore seems to be that of saving energy without destroying the values and heritage significance of the heritage buildings (Godwin 2011:13; Historic England 2011:7). As a consequence the way values and significance of buildings are identified analysed and assessed becomes a key factor of success.

2. Aim, research questions & relevance

Aim

The overall aim of the study this thesis is based upon is to increase understanding of the implications of assessing and evaluating buildings’ heritage significance for efforts to make heritage buildings more energy efficient. In this thesis energy efficiency is understood as reducing the energy used in a building by implementing a measure that improves the energy performance of a building. This definition follows the definition of energy saving in the standard for Energy efficiency of Historic Buildings (EN 16883:2017).
**Research questions**

RQ 1: How could different approaches for assessing and evaluating heritage significance in buildings affect possible technical energy saving measures in heritage buildings?

RQ 2: What theories and tools are used to evaluate, assess and preserve cultural heritage significance in buildings?

RQ 1 is addressed in the extended cover essay. RQ 2 is addressed in Paper 1 by describing common methodology for identifying cultural building values and Paper 2 by reviewing relevant scientific literature. RQ 2 is also addressed in the extended cover essay by discussing methods that integrate assessments of heritage significance and energy efficiency measures.

**Relevance**

Identifying how different conservation approaches limit or enable energy-saving measures in a building can improve decision-support tools and methods for energy retrofits in heritage buildings by providing robust theoretical foundations. This will more explicitly highlight implications of retrofitting according to specified conservation approaches. It will also increase the transparency of heritage assessment approaches in (for instance) standardized processes such as EN 16883:2016, the predictability of possible energy savings, and efficiency of decision processes. It is the first rational step in the exploration of key factors to consider when developing methods to make informed decisions about heritage significance assessments. It will also contribute to the development of more rigorous practical conservation assessment and evaluation methods. Moreover, it could facilitate multi-disciplinary efforts (fundamental or practical) concerning both the conservation and energy efficiency of buildings.

**Research position and role of the researcher**

Before starting my doctoral studies I worked as a professional conservation officer and expert for several municipalities and a government authority in Sweden. Thus, I have practical and professional knowledge of assessing heritage significance in buildings and retrofit measures’ effects on the recognized values of heritage buildings. Some of that knowledge is the characteristically tacit knowledge of a practitioner, which I have tried to analyze and categorize in theoretical and methodological contexts. I have not evaluated or assessed the heritage significance of the buildings considered in the case studies (described in later sections). The assessments and evaluations of the impact of any energy efficient measures presented here are based on values of the buildings that had already been defined.

One of the reasons for me to examine different conservation approaches more closely is that through my experience and education I have come to realize that there is a tension between them, in both theory and practice. My work has shown effects of different approaches and their relations to cultural heritage and energy efficiency policies. It has also highlighted the impossibility of formulating clear recommendations regarding approaches to apply in practical conservation without clear specification of the primary objectives.
As part of the Smart energy efficiency of historic buildings in cold climates project I have collected data on energy use and temperatures in the case study buildings. These data are not presented here (or the appended papers), but they have provided important background knowledge that has increased my understanding of the buildings. The project focused on five buildings: two in Piteå, one in Luleå and two in Kiruna. Apart from being in a subarctic climate or within the Dfc zone (subarctic climate with cool summers) according to the Köppen-Geiger global climate classification scheme (Kottek et al 2006), the selection criteria were that: the buildings should have a timber construction, e.g. stud frame or log timber; recognized and identified heritage significance; few installed heating systems; the same use before and after reconstruction or renovation; and a management and investment phase enabling measures to be applied and evaluated within the project’s timeframe. No energy efficiency measures have been implemented in any of the buildings within this timeframe. This cover essay includes case studies of three of the five buildings: one in Piteå and two in Kiruna.

3. Research design
The primary interest in this thesis, and the underlying research, is in understanding aspects and knowledge that should be considered in the process of choosing energy efficient measures to apply in a heritage building.

Following Creswell (2003:182), this has involved qualitative and interpretative study. Making heritage buildings more energy efficient is an interdisciplinary research field that requires use of mixed methods, both qualitative and quantitative. However, as this thesis focuses on the assessment and evaluation of heritage significance in buildings, multiple qualitative methods have been used to collect and analyze data, and to address the underlying theory used for impact assessment and evaluation of the heritage significance.

By applying a qualitative approach, the intention has been to produce knowledge from a constructivist perspective (Creswell 2003:18), understanding the meaning of a phenomenon as something that is socially constructed, and I have sought to uncover the meaning of different conservation approaches by interpreting them. The approach has also been inductive; reasoning and making knowledge claims from empirical experiences (Creswell 2003:182-183). Data found in archives, theoretical texts and observations on site from which I draw conclusions, are not only analyzed through the theoretical framework of this thesis, but also filtered through my pre-understanding, education and experience of using different conservation approaches in practice. As in most qualitative research (Creswell 2003:183), data from various sources have been collected and analyzed iteratively, with reformulation of the problem and research questions. Moreover, data obtained from archival searches, ocular observations and phenomenological experiences of the buildings on site have been iteratively cross-checked and mutually validated.

Phenomenological investigation of a building involves moving around in it and experiencing it with all one's senses. This provides information that cannot be obtained from other sources, such as what it is like to walk along corridors, the way doors open
and timber elements have been cut and prepared, all of which is unique to every building. Almevik (2012:27) therefore argues that the experience of a building is a blend of common knowledge (e.g. the opening of a door) and unknown nuances (e.g. how the door opens). In phenomenology the experience of the world is central, and the consciousness that structures experience is always directed towards an object, the meaning of which we humans use to understand the world (Wallenstein 2004:35). Our consciousness is not a blank slate that passively receives without knowing, but part of a complex interaction between different elements that both passively and actively communicate meaning, for example in relation between a person and a physical object (Wallenstein 2004:35). Craib (1992:99) argues that this 'intentionality' or 'intentionality of consciousness' means that human experience is experienced in a context and in one way or another are provided with meaning that enables the understanding of the world. It also means that every experience also includes a pre-understanding of a phenomena that is not directly experienced, for example, previous experience is part of this new experience. Jan Bengtson (1987:6) exemplifies this with the understanding of a building: "[...] What is immediately presented in my perception [of buildings] is the houses' facades, a perspective of the cars whizzing past, the ice on the water puddle over there, the sound of the tram which is now approaching, and somewhere up on Karl Johan's church ending my direct experience of the world. Yet I perceive not only the buildings' facades, I also perceive full houses with floors, rooms, roof, courtyards, etc.; I also see that the ice on the pond water is cold even though I have not felt it [...] (Bengtson 1987:8).

Thus, as Creswell (2003:182) argues, my analyses and conclusions are inevitably influenced by my personal interpretation and colored by the historical and sociopolitical context. However, it should be noted that despite phenomenologists wanting to broaden the analysis of reality and reveal things as they are, they cannot not fully escape the Descartian dichotomy (Mo 2003:77). In my observations, assessments and understanding of different conservation approaches I have used previous experience, for instance of different building materials, their texture and materiality and the characteristics of historical architectural designs, to interpret the case study buildings as well as the possible impacts of considered energy efficiency measures on their heritage significance. The interpretation and analysis of the buildings and the impacts of the hypothetical measures discussed in this thesis may therefore be interpreted in other ways by someone with different experiences and in different contexts.

In Paper 1, the most commonly used methods to assess the value of a building are discussed. A defining feature is the differentiation between primary sources—the building itself (Almevik 2012:24-28) and historical records providing first-hand accounts—and literature sources. Therefore, the methodology includes description of the building and its architectural features.

Case study buildings
The three buildings considered in the case studies presented in this thesis (the former courthouse in Piteå and two Bläckhorn buildings in Kiruna) are described from both a technical perspective and in terms of their architectural and esthetical values.
Investigations in the Smart energy efficiency of historic buildings in cold climates project included air leakage tests and infra-red photography, as described in the report Luftläckagemätningar i tre historiska byggnader Piteå Museum, Biblioteket, Öjebyn, Bergströmska gården, Luleå (Linden & Lindström 2015). I collected quantitative data on outdoor and indoor temperatures using sensors with factory-calibrated ranges of -40°C to +80°C (accuracy ±0.1°C) between January 2014 and September 2015 in the former courthouse building in Pitéå and between December 2014 and September 2016 in the two buildings in Kiruna. In all three buildings the supplied power and energy were measured using a SABER energy meter (from KYAB Sweden). Image 1 shows the SABER energy meter installed in the Bläckhorn building B53 in Kiruna, Sweden.
The report on air leakages by Linden & Lindström (2015) and the data on energy use and temperature I collected are used to describe the characteristics and serve as background knowledge of the case study buildings, but are not further analyzed in this thesis. In Paper 1, the two Bläckhorn (ink-bottle) buildings in Kiruna are used as illustrative examples in analysis and discussion of the most common methodologies for identifying heritage significance in Sweden. In addition, implications of conservation approaches described in this thesis on the energy efficiency measures that could or should be applied in a building are hypothetically tested. This is done by considering effects of various possible energy efficiency measures on the heritage significance of the three buildings, and the dependence of the possible measures and their effects on the theoretical framework.

Stadsvapnet 6, Piteå, Sweden

The former courthouse in Piteå is today used as a public museum for the City of Piteå. It was built between 1829 and 1837 as a courthouse, but now houses exhibition halls, offices for employees, a small shop and reception and the museum collections. It is situated in the main square in the City of Piteå.

It has recognized heritage significance and since 1994 has been a listed building (Länstyrelsens Norrbotten 1994) in accordance with the Heritage Conservation Act (SFS 1988:950). The building is also part of an area of national cultural importance (Riksinteresse för kulturmiljövärden) (Riksantikvarieämbetet 2013) in accordance with the Environmental Code (SFS 1998:808). Its main heritage significance lies in the building’s architecture, design and function as a character building in the adjacent square and overall cityscape.

A characteristic feature of old timber buildings is that their envelopes tend to have numerous gaps that occurred in construction and leak air. An air leakage test (Blower door, standard EN 13829:2000) in the building recorded an air leakage rate of 1.6 l/s m2 at 50 Pa. In comparison, the air leakage rate of a passive house is around 0.3 l/s m2. IR-thermography at the same time showed that the leakage points are construction joints between doors and walls, floors and walls, but gaps between log rows also contribute (Linden & Lindström 2015).

In a Master’s project, Ronald Cruz (2014:55-57) considered possible physical measures to improve the energy performance of the former courthouse, suggested a number of possible energy improvements and asked three conservation experts to assess effects of the improvements on the building’s heritage significance. The three experts all had different opinions about what could be done, clearly indicating that practical considerations of energy efficiency measures in heritage buildings depend on personal choices or interpretations of conservation approaches.
Bläckhorn B52 & B53, Kiruna, Sweden

The two Bläckhorn buildings B52 and B53 are some of the first Bläckhorn buildings that the mining company Luossavaara-Kirunavaara AB (LKAB) built in Kiruna for the workers. They are located in what is called the Company Area (Bolagsområdet), which is owned by LKAB. Before the recent movement of buildings (necessitated by the likelihood of subsidence caused by expansion of mining operations) housing, hotel and offices were located in the area. Bläckhorn buildings B52 and B53 contained apartments, were designed by architect Gustaf Wickman, built in the early 20th century and look like ink-bottles (hence the colloquial name). The two buildings were amongst the first to be moved in 2017 due to the expansion of the mine and will continue to be used as residential buildings.

B52 and B53 are part of an area of national cultural importance (Riksintresse för kulturmiljövården) (Riksantikvarieämbetet 2013) in accordance with the Environmental Code (SFS 1998:808), and their cultural values have been described in an Environmental Impact Assessment (EIA). ‘Before the decision to move them, they were protected in a local development plan due to their heritage significance, which includes their architectural design, technical quality and very good condition. However, the primary significance emanates from the “general historical context, with the link to Kiruna’s oldest epoch, its genesis and development as a regional and national economic center, thriving through coherent symbiosis of industry and society.” (Joseph 2010 – translated from Swedish). The two buildings has been moved during 2017 to a new location in Kiruna. The basement of building B52 was demolished and a new foundation was constructed.

Research methods and types of empirical data

Archive search and historical sources

The methods used in these case studies included text analysis of records found in archives of public institutions and the mining company LKAB, analysis of historical photographs, observation and analysis of the two buildings themselves and literature review.

The collection of data from historical documents helps production of knowledge of the social and historical meaning of focal buildings as well as their historical and contemporary use and symbolic significance. In the archives, historical records were found that provided information about the buildings that have been used in the case studies presented here. The archived material includes both primary sources such as contracts and specifications for the construction of buildings and secondary sources such as inventories and analyses of the buildings’ heritage values. Literature on conservation theory, history of conservation, and histories of both Piteå and Kiruna has been used for analysis and contextualization of the historical records.

As in most statutory and official heritage significance evaluations, the underlying theory and methods are not described in the official documents (Eriksson et al. 2014:138).
Literature on conservation theory has therefore been applied in analysis of the documents in efforts to understand the paradigms and approaches used in historical appraisals of the buildings in Piteå and Kiruna. In addition to the decisions to list or protect the former courthouse in Piteå and two Bläckhorn buildings in Kiruna, the analysis has also focused on discussions preceding the official listing and protection.

The studied buildings in Kiruna and Piteå are all officially recognized as having heritage significance, parts of areas of national cultural importance (Riksintresse) and all have legal protection to safeguard their heritage significance.

The formal decision to list and protect the former courthouse in Piteå, Stadsvapnet 6, the formal development plan that protects the buildings in Kiruna, and the regional program for Norrbotten’s Cultural Heritage (Länsstyrelsen Norrbotten 2010) have been analyzed by comparing the criteria for evaluation and selection that are described in the documents with the actual buildings on site.

Specifications for parts of the buildings that are protected (skyddsbestämmelser) have also been compared with the actual buildings on site. The records have been found at offices of the County Administrative Board of Norrbotten (CAB), the government authority responsible for formal decisions for listing and predicting heritage buildings in the county that meet relevant criteria in the Swedish Heritage Conservation Act (SFS 1988:950) and archives of authorities responsible for the development plans in the city of Kiruna. The descriptions and value definitions of the Areas of national importance were gathered from the Swedish National Heritage Board.

Information has also been acquired from archives of Norrbottens museum. Discussions on the heritage significance of the former courthouse in Piteå were found in correspondence between representatives of Norrbottens museum, the Swedish National Heritage Board, the City of Piteå and Norrbotten’s CAB. Discussions and definitions of the building’s specific heritage significance have also been found in inventories and planning documents of the city of Piteå. Furthermore, Norrbottens museum’s archives also hold conservation plans for the so-called Company Area in Kiruna where most of the Bläckhorn buildings are located. The conservation plans do not include the specific Bläckhorn buildings considered in case studies in this thesis, but they include descriptions and recommendations for preservation and restoration actions regarding a number of heritage buildings, including a few Bläckhorn buildings.

Current building permits from the City of Kiruna regarding the move of the two Bläckhorn buildings have also been analyzed by using conservation theory literature in efforts to elucidate the conservation paradigm that was applied.

Other formal decisions have been found in Bebyggelseregistret, a national Swedish information system with information about the built cultural heritage hosted by the Swedish National Heritage Board. The register holds all the documents regarding listing of buildings in accordance with the Swedish Heritage Conservation Act (SFS 1988:950).
Historical records such as architectural drawings, plans, building permit applications, contracts, receipts, invoices and specifications of the building contracts are kept in the archive of the mining company LKAB and have been used to examine the original design and construction of the Bläckhorn buildings. LKAB owns the two Bläckhorn buildings considered here and has documents showing the original architecture as well as descriptions of construction details.

Historical photographs have been used to gather information about the original design and construction of the buildings in both Piteå and Kiruna. Photographs have also been compared with the buildings on site to identify changes that have been made to the buildings. Sources of these images include the Swedish National Heritage Board's photographic database, Kulturmiljöbilder, and Kiruna bådsamling, a database of historical photographs owned by the City of Kiruna.

Observations
Ocular observation (and other phenomenological experience) of buildings and tacit knowledge of the researchers have been used when collecting data and analyzing results. The buildings have been compared with formal and officially described heritage significance and historical records. Ocular observation has also been used to collect information about the material properties of each building, window constructions, design of the exterior façade, shape of the roof, materials used in the basement, functions of the buildings, floor plans and the buildings’ relations to their surrounding contexts.

In any conservation efforts, the focal buildings are considered primary sources of information. They are mute and cannot speak or tell their story, but their history can be decoded using various methods, including use of researchers’ bodily experience for collecting data and producing knowledge (Almevik 2012:24-27). Such a phenomenological approach has been used when observing and collecting knowledge about the buildings on site. Historic aspects, such as construction methods, conditions for the workers, and clues about people who lived in the house, can be traced from characteristics of construction materials in the basement, roof, walls and associated meanings. Phenomenological experience can also provide valuable information that cannot be readily acquired in other ways, about phenomena such as how well new modern windows complement the older architecture in terms of light in the rooms, and overall appearance of the building.

Literature review
An extensive qualitative review of peer-reviewed journal articles concerning energy efficiency in heritage buildings has been executed and published in Paper 2. The publications were considered in terms of two main perspectives: energy analysis in heritage buildings and analysis of cultural heritage values of buildings. Part of the analysis focused on how the reviewed publications addressed the assessment and evaluation of buildings’ heritage significance. The analysis of how heritage significance
in buildings was understood in the reviewed publications has been further used to
develop the theoretical framework described and applied in the extended cover essay.

In addition, other literature such as reports from research institutes on energy efficiency
in heritage buildings, publications on conservation theory, theses on heritage values in
renovation and development processes and reports of projects on heritage and
sustainability have been used to analyze empirical data and develop the theoretical
framework described and used in this thesis.

4. Theoretical framework

Conservation theory

Architectural, artistic and historical analysis

Modern conservation theory stems from several academic disciplines in which different
methods are used to collect data and analyze empirical material. In the beginning of the
1900's the art historian Alois Riegl (1994) laid the ground for what can be understood as
modern conservation theory when he drew distinctions between the commemorative
and artistic value of a monument (Riegl 1994:72-78). He discussed a set of values (Age
value, Historical value and Deliberate Commemorative Value) (Riegl 1994:72-78). Riegl's
theory on evaluation of monuments reflected his history of art background,
emphasizing the visual and aesthetic appearances of an object. He introduced the notion
of subjectivity to the understanding and assessment of a monument's significance,
arguing that “[a]ccording to the older definition, a work of art was considered to possess artistic value
if it corresponded to the requirements of an allegedly objective, but to date never clearly formulated,
aesthetic. The more recent point of view assesses the artistic value of a monument according to the extent
to which it meets the requirements of contemporary Kunstwollen (artistic volition), requirements that are
even less clearly formulated and, strictly speaking, also never will be because they change from subject to
subject” (Riegl 1994:71).

The subjectivity in assessment and evaluation heritage significance has been
subsequently acknowledged in conservation theory and methods. Sweden the
subjectivity in the assessment and selection of a representative stock of heritage
buildings, and problems associated with evaluating buildings' cultural values, were
discussed in one of the reports by the previously mentioned Sanitation (slum clearance)
Committee (Saneringsutredningen 1973:23-25). The Committee rejects the possibility of
objective evaluation based on the compilation of catalogues of buildings and selection
of typical examples representing (for instance) particular fashions or periods
(Saneringsutredningen 1973:27). Instead they argue that although the knowledge used to
evaluate the cultural values of a building is based on inventories and facts, the evaluation
is by its nature subjective (Saneringsutredningen 1973:24). Thus, one person assessing a
building might emphasize its aesthetic value while another may emphasize its social
history (Saneringsutredningen 1973:24).
The concepts of value that Riegl defined can be traced in key conservation concepts such as patina and authenticity developed by 19th century theorists like Boito, Ruskin and Morris (Araoz 2011:59, Krus 2006:26-27, Wells 2010:465). They criticized the prevailing conservation doctrine, strongly advocated by Viollet-le-Duc, that buildings should be restored to their ‘ideal shape’ based on their architectural style, even if they may never have looked like that (Sjöholm 2017:115). In Sweden this conservation paradigm is called stilrestaurering, and is often associated with the architect and conservator Helgo Zettervall, whose restorations of churches have been extensively discussed by Åman (2015). As Krister Olsson (2003) argues, this practice of conservation was much a process of design and a creation of image of the past (2003:54). The critique focused on the creative re-design of buildings which was called both vandalism (Olsson 2003:54) and forgery of history (Krus 2006:26). Parallel to the development of history generally and history of art specifically as academic subjects, the critics highlighted the historical testimony that buildings provide, the need for awareness of the authenticity of historical development, and hence respect for the many historical and aesthetical layers that may be present in a building (Krus 2006:26). Around the beginning of the 20th century conservation began to focus on the authenticity of materials. This approach was modernized in the Venice Charter (ICOMOS 1964) and is still a cornerstone of conservation practice. A broader perspective of the concept of authenticity was introduced in the Nara document on Authenticity (ICOMOS, 1994), which declares that the cultural context and different sources such as form, tradition and feelings can be used when considering the authenticity of an object. However, the concept of authenticity is rooted in an objectivistic idea of values and the notion that objects have intrinsic values that should not be falsified (Krus 2006:27).

In his Contemporary Theories of Conservation, Muñoz-Viñas (2005:81) criticizes this conservation doctrine, which he argues is based on two main principles: that the integrity of objects should be maintained, and an object consists of its physical properties and parts. Similarly, other critics such as Araoz (2011:59) argue that conservation principles are oriented towards protecting and preserving material, not values.

The consensus regarding the norms defined in the Venice Charter has been challenged and is being “replaced by an atmosphere of openly contentious and fractious cultural politics” (Avrami et al. 2000:6). Among other things, the very idea of objects being ‘truthful’ and hence ‘authentic’ is questioned. For instance, David Lowenthal (2000:21) argues that the idea of maintaining the integrity of an object is “futile” because “[t]he object itself, endowed with quasi-human, if not divine, sanctity. And it flies in the face both of physical mortality and of alternative norms”. Lowenthal argues that not only is replacement of material part of conservation, but destruction is part of human nature and a creative part of life.

Ethnological and sociological analysis
The other main element of conservation knowledge production is related to a more ethnological and anthropological understanding of the cultural context in which objects were once situated. From the debates on restoration and conservation theory in the 19th century, searching for the true essence of architecture and the cultures it represents has
been a main task. In his famous book *The Stones of Venice* [1851] (1903), John Ruskin characterizes gothic architecture by connecting the design and form to ideas and beliefs regarding cultures and people’s psychological conditions. This way of transferring human emotions and mind to objects is still central to the analysis and understanding of the objects studied in conservation of historical buildings (Almevik 2012:52).

Jeremy Wells, another critic of the objectivistic approach, argues that the “dominant concept of historical significance rests in a century-old empiricist positivist paradigm that emphasizes objectivity, ‘facts’ and ‘truth’ while deprecating subjective cultural, social and experiential meaning (Wells 2010:464). He further argues that in such a paradigm, heritage significance only exists if human senses can directly perceive it, and that social and cultural meanings that depend on interpretation cannot therefore be considered (Wells 2010:467). He advocates a more holistic conservation paradigm and states that “at some point the material fetish of the Venice Charter must give way to the pluralism of truth rooted in cultural rather than material contexts” (Wells 2007:12), that is, a conservation paradigm that includes the social meaning of space, as expressed in the term ‘sense of place’ (Wells 2010:468-469).

This approach is also advocated in a dissertation by Olsson (2003:51), discussing how heritage should not mainly be a way of keeping the status quo in a building rather than a way to produce values.

Olsson (2003:51) distinguishes between values created when a goal set by society is met and values that are considered universal. For example, the preservation of historic buildings is a goal set by societal institutions. Conservation and research aiming at preserving historic buildings therefore has an instrumental value.

As discussed in Paper 1, in order to understand the language of an object such as a building, aesthetical analysis alone is not sufficient. The researcher must also have knowledge and empirical data that can provide material for an analysis of the building’s personality. Thus, a phenomenological understanding of the world, and specific places that are to be explained, has been incorporated into conservation theory and practice. Phenomenology of place is based on the idea that every individual place has an intrinsic meaning, an identity that can be unveiled and identified. The identity of place makes the place meaningful and it is a necessity for human identity (Norberg-Schulz 1999: 111). In conservation this identity is referred to as the ‘sense of place’, ‘identity of place’, ‘integrity of space’ or ‘genius loci’ and is often applied in the identification of buildings with cultural value (Wells 2010:468-469). The identity or sense of a place is often used by government authorities and researchers as an argument for preservation (ICOMOS 2008, Legnér 2010:58, Riksantikvarieämbetet 2008:2, Wells 2010:477).

Such phenomenological understanding is an important element of the understanding of a particular building and its heritage significance. It is also the starting point when adding or altering a heritage building, but it has not been codified in a transparent methodology. Instead it is part of the professionalism in conservation practice when producing knowledge about a building, where the body is used as a tool for data collection. The
Conservation professional uses phenomenological principles when collecting data and evaluating the knowledge that is of historical significance and should be preserved (Almevik 2012:27). The phenomenologist perspective is that analyses and descriptions of a space or building should start from ‘the ontology of space’ (Bengtsson 1994:27), i.e. the existing qualitative properties of space (Norberg-Schulz 1999:99).

The inherent subjectivity in the evaluation of heritage significance is also recognized when considering social aspects of the built heritage. The Sanitation Committee that acknowledged the subjectivity of evaluations (see above) proposed a definition of the value concept of cultural heritage that they noted should be sufficiently wide to avoid excluding any other reasonable version because of its inherently subjective tenor (Saneringsutredningen 1973:27). The definition emphasizes the importance of perspectives of members of the society and that the cultural value of buildings should include the social and cultural contexts they are part of: “[cultural historical values are such values, perceptible to members of society, which can be attributed to a building beyond its utility value” (Saneringsutredningen 1973:27 – translated from Swedish).

**Conservation and energy efficiency: the need for an integrated approach**

Fouseki and Cassar (2014:96-97) argue that heritage values should be integrated in the decision-making process when considering interventions in historical buildings and propose that principles of the Burra Charter (Australia ICOMOS 2013) should be applied before interventions are carried out. They further argue that no clear methodology for integrating heritage values in decision-making processes in energy efficiency projects has been developed yet, partly because of the “lack of collaboration of the professionals involved in such projects who hold theoretical and practical expertise in heritage-management methods and tools for understanding heritage values”. Other authors, like Roders and van Oers (2011:10), argue that the World Heritage Convention (UNESCO 1972) has become “the single-most important instrument” in the field of heritage management and sustainable development because it has been widely used for formulating goals, standards and evaluation systems internationally. Moreover, some attempts to integrate heritage values into decision-support tools have already been made, in both research and practical projects. Notably, the UNESCO Case Studies Guidebook Energy Efficiency and Energy Management in Cultural Heritage (UNESCO 2013:I-VI) proposes management and governance systems to meet energy efficiency challenges in heritage sites. The guidebook also presents illustrative studies of several cases in European countries where management has addressed the challenge of retaining heritage values while making heritage sites more sustainable.

In addition to conventions and charters that may facilitate decision-making, a standard for Energy Efficiency of Historic Buildings has been implemented in Europe (EN 16883:2017). This presents a standardized decision-making process for making historic buildings more energy efficient, and describes the putatively ideal order for acquiring knowledge about energy use and heritage values then taking decisions.
Decision-support tools and management instruments have also been developed in practical and research projects. For example, Grytli et al. (2014:92) developed a flowchart showing steps of a decision-making process for evaluating energy saving strategies in terms of effects (including impact on heritage values) in lifecycle perspectives based on Life Cycle Assessments (LCAs), energy calculations and cultural heritage assessments.

Funch (2011) presents a workflow and process for energy refurbishment of an historical building in Denmark (2011:61), which was subsequently used as an example in the Cool Bricks project (Cool Bricks 2012:17). The workflow starts with compilation of a general list of all potential energy saving initiatives that could be considered in any building. Those that could be applied in a specific case are then considered in a first interdisciplinary evaluation by a work group consisting of architects, HVAC (heating, ventilation and air conditioning) and structural engineers, heritage experts/agencies and the developer/landlord. The workflow process includes a total of four workgroup assessments. Between the workgroups, heat losses and energy use are estimated from recordings of the building’s current use of water, heating and electricity. Potential energy efficiency measures are simulated to determine how specific proposals could be carried out in more detail, and their effects on CO₂ savings, energy savings and indoor climate (Funch 2011:61-64). Heritage values and energy efficiency measures are integrated by the working group, which should include persons with expertise in both fields. Use of the workflow as a decision-making tool is based on qualitative assessments of the heritage significance of the building and the impact of energy efficiency measures.

Şahin et al. (2015:32) describe a methodology for energy efficient retrofits in a historic building that integrates heritage values and energy efficiency retrofits by risk-benefit assessment. It starts with characterization of the building, focusing on building components that are energy-related, especially components of the building envelope. The characterization describes materials, architectural features and relations of each building component to the rest of the building and its contribution to the specific architectural style (Şahin et al. 2015:133). It includes both a description of the building and definition of the heritage values that must be respected (Şahin et al. 2015:134). Before a risk and benefit assessment of proposed energy efficiency measures is carried out, targets for the retrofit are defined. These may include energy saving targets, such as a certain percentage reduction of total primary energy consumption, maximal U-values for specific building parts and building conservation targets such as minimal changes to the material in the construction as possible (Şahin et al. 2015:132). The study focused primarily on building conservation, which was therefore prioritized over energy saving and U-value targets (Şahin et al. 2015:132). A list of possible retrofits is then assessed according to the risk or benefit of achieving the defined target to identify, and discard, inappropriate options. A retrofit measure such as additional insulation of the attic floor was assessed as neutral since it does not damage the construction material or change the visual appearance of the building. Changing the windows or adding exterior insulation on the walls is assessed as high risk since it negatively affects the architectural appearance and heritage values of the building (Şahin et al. 2015:135). The remaining short list of appropriate retrofits is divided into packages such as weather stripping (air tightening of
the building envelope) and interior insulation of the walls (Şahin et al. 2015:134). If the packages meet multiple targets they can be implemented, otherwise the packages should be adjusted and the assessment repeated (Şahin et al. 2015:132).

A methodology for integrating assessments of, and balancing, impacts of retrofit measures on heritage significance and energy savings has been developed by Eriksson et al. (2014:134-146). The methodology has been used in the development of a decision support system in the EFFESUS project (EFFESUS 2015). This is a software tool for use by those making decisions about retrofitting historic districts, on either practical or strategic levels, and it turns qualitative evaluations of heritage significance into quantitative outputs (Eriksson et al. 2014:134). The software provides two sets of data. One set consists of spatial data for the building stock, the energy used, the heritage significance, local climatic conditions and climate-change predictions. The other dataset consists of repositories of retrofit measures, which are generic while the spatial dataset is specific for a given location (Eriksson et al. 2014:135). The outputs from processing these two datasets are packages of suitable energy efficiency measures for the focal district. The software assesses operational energy, indoor environments, fabric compatibility, heritage significance, embodied energy and financial parameters (Eriksson et al. 2014:135-136). The heritage impact assessment consists of three parts, Heritage significance evaluation, Heritage impact definitions and Heritage balancing process. Data from statutory and official designations of heritage buildings together with conservation plans form the basis of the Heritage evaluation, which is grouped into urban districts, building exterior and building interior (Eriksson et al. 2014:138-139). This identifies the heritage significance (visual, spatial or physical) from the urban district level down to both exterior and interior building components (Eriksson et al. 2014:139-104). The Heritage significance levels are categorized using a five-point scale from 0 (neutral or no heritage significance) to 4 (‘exceptionally outstanding significance’) (Eriksson et al. 2014:140). Similarly, Heritage impact is categorized using a five-point scale from 0 (no negative impact) to 4 (the most severe impact) (Eriksson et al. 2014:141-142). In a final balancing step, Heritage significance levels are compared to Heritage impact levels (Eriksson et al. 2014:143). A combination of very high Heritage significance of 4 and low Heritage impact of 1 is likely to be acceptable, whereas a combination of moderate Heritage significance of 2 and high Heritage impact of 4 will not be acceptable (Eriksson et al. 2014:143).

The methods described above provide various ways to integrate heritage values with energy efficiency measures in decision-support tools. They all provide assessments of the impact of possible measures on buildings’ heritage significance in the process of choosing an energy efficiency strategy. However, none of the decision-making tools described or mentioned above specifies the theory underpinning the methodology to identify or assess impacts on heritage significance. This is also discussed in the literature review presented in Paper 2, which shows that most of the considered studies that included analysis of cultural heritage values either did not discuss or only described an implicit understanding of the theory and methods used to assess heritage significance. Clearly, this raises questions about how the impact assessments should be executed.
flow charts developed by Funch (2011) and Grytli et al. (2014) do not specify which conservation theory to use for the assessments. This introduces uncertainty and inevitable variation in the outcome of using decision-making tools, depending on the conservation theory that heritage experts (or other users) choose.

The support system developed by Eriksson et al. (2014) identifies heritage significance in physical terms, indicating that it is based on conservation theory that considers heritage significance as something that is embodied and intrinsic in the authentic material (Eriksson et al. 2014:139-104). This also applies to the method developed by Şahin et al. (2015), as one of their defined targets was to avoid causing damage to original material (Şahin et al. 2015:132). The use of a conservation approach that is more open to change and replacement of authentic material would affect the outcome and the energy efficiency measures that would be deemed appropriate or acceptable.

The lack of discussion regarding the theoretical underpinning is also relevant to the use of international charters, as advocated by Roders & van Oers (2011) and Fouseki and Cassar (2014). Like many of these charters, the Burra Charter (Australia ICOMOS 2013) mentioned above treats heritage significance as something embodied in the building material itself, as stated in article 1.2: “cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.” (Australia ICOMOS 2013:2). Although it clearly states how assessments should be executed, the conservation approach described in the Burra Charter is contested. Gibson and Pendlebury (2001) argue that the concepts of values as constructed rather than intrinsic has become the dominant theoretical approach in social and human sciences. They further argue that “such an orientation has consequences both for the assessment of significance and the heritage management of a building, object or environment” (Gibson & Pendlebury 2001:1). Clearly, there is more than one conservation theory, and I argue in following sections that the choice of conservation theory needs to be discussed and justified when integrating heritage values with energy efficiency measures.

A novel framework to start integrating conservation theory into decision support systems

According to Olsson (2003:55) the dilemma in conservation theory discussed above (the needs for artistic and creative input to preserve the architecture of buildings, while avoiding falsification of authentic history) was debated throughout the 20th century. In close examination of how cultural values were addressed in an urban redevelopment and planning process in the city of Umeå, Sweden, Olsson (2003:346) found that in the process (which sought to add and create both social and economic values), cultural values were not included in the overall aims. Since cultural values were understood as intrinsic they were not defined in relation to any other social or economic values and were not therefore added to the values that were being developed or added. Olsson argues that the conservation of buildings requires a new function and that the process of conservation involves compromises when actions to renew and upgrade a building...
are taken. Therefore, conservation should be treated as both a creative process and a tool for preserving authentic history (Olsson 2003:55).

Similar arguments are made by Krus (2006) in an analysis of how cultural values are affected and addressed on the scale of a building in a restoration process, as further discussed in Paper 1. In a case study of a refurbishment process of a listed building in Stockholm, Östra stallet, Krus (2006) shows how objectivistic values not only became problematic when they were handled together with relative (e.g. economic) values, they also tended to be downgraded or neglected. Values that were considered authentic and having intrinsic values, were difficult to include in a process intended to add value and this resulted in a loss of cultural values. Krus (2006:100) also argues that a relative approach to cultural values could have led to their preservation in other ways, using aesthetic or architectural methods.

Extrapolating from this corpus of literature, I suggest that conservation approaches can be categorized as Objectivistic value and Relative value approaches. Both of them consider changes in the material, appearance and design of a heritage building, but they also have fundamental differences, as discussed below.

The Objectivistic value approach is based on the ontological view of values being intrinsically embodied within the material of the focal object (Avrami et al. 2000, Holtorf 2013, Krus 2006, Muñoz-Viñas 2005, Olsson 2003, Wells 2010). The authenticity of archeological and historical objects is described by Holtorf (2013:430) as a quality within the material of an object because it is the material that was constructed and created in the past and that [i]his explains why the inherent material substance of an object carries so much weight here: it is this material substance, after all, that was constructed or made in the past.

Based on the Objectivistic value approach, the Venice Charter (ICOMOS 1964) and Burra Charter (Australia ICOMOS 2013) offer guidance for assessing and managing change and additions in heritage buildings. They state that new additions should not detract from interesting parts of the original building, its setting, balance in composition and relation to the surroundings. New additions should also be clearly distinguished from the historical object and be of contemporary design. To avoid falsifying historic or artistic evidence, replacement of material and form must harmonize with overall design but still be clearly distinguished from the original.

A Relative value conservation approach is based on the ontological view of values being created when objects become socially or culturally meaningful, that values are assigned and associated with objects (Avrami et al. 2000, Krus 2006, Olsson 2003, Wells 2010). As argued by Gibson and Pendlebury (2001:1), the constructivist position understands the fabric and object as “bearer of an externally imposed culturally and historically specific meaning”. However, an object’s meaning can be interpreted in various ways. Michael Landzelius (2001), for instance, discusses semiotics as a way of identifying and understanding objects and their meaning where ‘spatial sign-vehicles’ (Landzelius 2001:2) are carriers of meaning and hence heritage significance. Although Relative value approaches focus on the
socially and culturally constructed meaning of an object, this does not mean that its material properties are insignificant, as the attributed meanings are constructed in relation to the object's physical properties.

A Relative value approach to conservation suggests a broader view of values associated with the focal object and greater willingness to accept alterations of original architecture and form as well as acceptance of replacement of original material. The heritage significance of a building is not regarded as being embedded in its material, but in the perceived meaningfulness of the material, form, and design of the building. Examples include cases where the visual appearance of a building or building techniques are related to specific architectural styles and historical periods that are considered meaningful for people to know about and thus warrant conservation. The materiality of a building can also be an important bearer of meaning in its texture, shape and color. As discussed in Paper 2, some publications that include explicit discussion of value assessments also discuss how adding or changing the design of a building may enhance its meaning. For instance, Yarrow (2016) discusses how contested perceptions of the authenticity of buildings are negotiated by their owners, professional conservators and architects. While the professional conservators' approach is to preserve the original fabric of the building, the owners regard energy efficiency measures as contributing to the character of the building since change is the "essence of what a building is" (Yarrow 2016:346). In this perspective, adding or removing materials and changing the visual appearance can potentially enhance the perceived meaning of the building, and hence its heritage significance. As argued by Yarrow (2016:346):

*As distinct from this understanding in which change is a form of continuity, improvements in energy performance are sometimes positively connected to the enhancement of character through the logic of restoration. If the character of a building is understood as an embodiment of a specific period of time, then authenticity can be reconstructed through the re-incorporation of materials and components understood to be more truthful to this 'original' period.* (Yarrow 2016:346)

Since the two conservation approaches have fundamentally different understandings of values and how the values can be preserved they cannot be combined or merged. Thus, a conservation approach must clearly be chosen before any evaluation of heritage significance or impact assessment is attempted.

5. Development of a decision support system with integrated assessment of different conservation approaches

A decision support system for making heritage buildings energy efficient must aim to combine energy efficiency goals with preservation of the buildings' heritage significance. Such a system requires knowledge of the buildings' physical characteristics and heritage significance, as well as a system to assess and evaluate the impact of both the energy efficiency and the heritage significance.
As previously discussed, current decision support systems for energy efficiency in heritage buildings have criteria for assessing the impact of possible measures on buildings’ heritage significance. However, they do not explicitly state which conservation approach is used or preferred. Drawing on the framework of different conservation approaches described above, my proposed decision support system focuses on assessments of the effects of energy efficiency measures on buildings’ heritage significance and describes the impacts according to two contrasting conservation approaches: an Objectivistic value approach and a Relative value approach. In this suggested support system, the two conservation approaches are used to assess the same energy efficiency measures. Knowledge of the heritage significance of buildings is collected from archives, formal designations and in situ observations, then used as inputs. By including the comparison of conservation approaches the decision support system should help users to make informed choices of approach when assessing energy efficiency measures in heritage buildings. Although both conservation approaches can be used in parallel in the same retrofit project, a consistent use of one of the approaches will help to avoid conflicts in assessments of potential measures’ effects on buildings’ heritage significance.

Like any other alteration, energy efficiency alterations mean additions, removals or changes to the building they are implemented in. The energy efficiency measures that could be implemented are determined by the building’s physical characteristics. Knowledge of the energy balance of the building, i.e. energy flows to and from the building, provides foundations for identifying where energy improvements could be made. Calculations of the energy balance of a building are used to identify measures that could be implemented to reduce the operational energy within a building (Ståhl et al. 2011:81). Overall, the supplied energy ($Q_{\text{supply}}$) equals the loss of energy ($Q_{\text{loss}}$).

$E_{\text{quation 1}}$

$Q_{\text{supply}} = Q_{\text{loss}}$

$Q_H + Q_E + Q_S + Q_P + Q_{HW} = Q_T + Q_V + Q_{SG} + Q_L + Q_{DC}$

Included in the supply ($Q_{\text{supply}}$) are the energy from heating ($Q_H$), heat from electricity ($Q_E$), heat from the sun ($Q_S$), the heat from people ($Q_P$) and heat from hot water ($Q_{HW}$). Heat loss by transmission through the building envelope ($Q_T$) and ventilation system ($Q_V$) are two major factors contributing to the loss of energy. Other factors are for example heat loss through the sewage system ($Q_{SG}$) and heat losses caused by leakages in joints ($Q_L$), heat loss through distribution and control systems inside the building ($Q_{DC}$) and energy used for cooling due to heat gains from the sun ($Q_S$) (Abel & Elmroth 2006 and Nordström 2014:9-19).

As described by Ståhl et al. (2011), energy balances enable identification of parts of buildings that would be affected by retrofit measures. In their pre-study Hållbar och varsam renovering och energieffektivisering av kulturhistoriskt värdefulla byggnader - en förstudie the
cited authors describe types of measures that can be taken to reduce the energy use in a heritage building. The heat balance described by Ståhl et al. (2011:81) is used to connect knowledge about the energy flows of a building with energy efficiency measures and the building's heritage significance. The measures proposed by Ståhl et al. (2011:23-77) are used as a list of possible energy efficiency measures that will be assessed and potentially implemented:

- Change old windows to new ones with better U-values
- Upgrade existing windows
- Add more insulation internally on the outer wall
- Add more insulation externally on the outer wall
- Add more insulation in the basement
- Add more insulation in the attic
- Add more insulation of the roof
- Improve air tightness
- Change and upgrade the heating system
- Change or adapt the ventilation system
- Change or adjust the control and regulation system
- Install sunscreens to reduce energy used for cooling

Criteria for the Impact of energy efficiency measure on a building's heritage significance are drawn from studies such as the cited studies by Şahin et al. (2015) and Erikson et al. (2014), together with conservation principles expressed in charters such as the Venice Charter (ICOMOS 1964) and Burra Charter (Australia ICOMOS 2013). The criteria are selected to enable assessment by both conservation approaches.

Criteria used are Material impact, Visual impact and Design impact. A measure will have Material impact if it causes damage or destruction of material or imposes replacement or addition of material, Visual impact if it results in visible changes, and Design impact if it affects the building's design and architecture. Possible measures are assessed in terms of these criteria using both the Objectivistic value and Relative value approaches. Some energy efficiency measures may have similar impact according to both conservation approaches, as shown in Tables 1-3, while the impact of other measures...
(highlighted in yellow in the tables) may strongly depend on the selected approach. The suggested decision-making system shows the differences in assessments in a generic and systematic manner. In Chapter 6 the decision support system is applied to the case study buildings, considering their specific identified heritage significance.

Table 1

The proposed system for supporting energy efficiency decisions for buildings with recognized heritage significance

<table>
<thead>
<tr>
<th>Heat balance</th>
<th>Possible energy efficiency measures</th>
<th>Impact of energy efficiency measures</th>
<th>Objectivistic value approach</th>
<th>Relative value approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine buildings’ heat loss or heat gain, (Q_x) (Ståhl et al. 2011:81).</td>
<td>List energy efficiency measures proposed by Ståhl et al. (2011:23-77).</td>
<td>Assess impact using material, visual and design impact criteria.</td>
<td>Assessment of impact of the energy efficiency measure on the heritage significance using an Objectivistic value approach.</td>
<td>Assessment of impact of the energy efficiency measure on the heritage significance using a Relative value approach.</td>
</tr>
<tr>
<td>Determine buildings’ heat loss or heat gain, (Q_x) (Ståhl et al. 2011:81).</td>
<td>List energy efficiency measures proposed by Ståhl et al. (2011:23-77).</td>
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<td>Assessment of impact of the energy efficiency measure on the heritage significance using an Objectivistic value approach.</td>
<td>Assessment of impact of the energy efficiency measure on the heritage significance using a Relative value approach.</td>
</tr>
</tbody>
</table>

6. Analysis: application of the decision support system to case study buildings

Stadsvapnet 6, Piteå

The building is a former courthouse but today it functions as a City museum. Built between 1829 and 1837, it has a timber construction. It is located on the main square of Piteå, which has a characteristic design in that the corners are closed off by the surrounding buildings. To the north there is an extension built in 1922 that functioned as a police station and now houses offices of the museum. During the 2nd world war the basement was built as a bomb shelter (Norrbottens museum 1994)
Heritage significance

The heritage significance of the former courthouse is defined in relation to its status as a listed building (Länsstyrelsen Norrbotten 1994) in accordance with the Heritage Conservation Act (SFS 1988:950). The listing protects the building from any change of its exterior architectural design. The floorplan and timber construction are also of value and protected. In one room there are also valuable wall-paintings painted directly onto the timber frame (Länsstyrelsen Norrbotten 1994).

The building is also part of an area of national cultural importance (Riksintresse för kulturmiljövården) (Riksantikvarieämbetet 2013) in accordance with the Environmental Code (SFS 1998:808). The main reason for designating Piteå an area of national interest lies in its main square and overall city plan, a renaissance grid network of streets laid out in the 17th century, but contributions of characteristic wooden buildings such as the former courthouse are also recognized (Riksantikvarieämbetet 2013:19). In fact, in response to questions whether the former courthouse should be listed or not, the National Heritage Board of Sweden argued that the building itself had limited value and did not meet the requirements, but supported the listing because it contributes to the value of the square (Norrbottens museum 1994).
According to RAÄ [The National Heritage Board] the square in Piteå as a whole has such cultural historical value that it may be regarded as being an exceptionally remarkable built environment. The separate buildings certainly have limited cultural historical value, but contribute to the uniform and closed shape of the square (Norrbottens museum 1994, translated from Swedish).

Thus, the heritage significance of the former courthouse is intimately associated with the square and the architecture of the building is mainly preserved to support the value of the square and cityscape.

Application of conservation approaches and their impact on energy efficiency measures

Table 2 shows results of applying the suggested decision support system to the case study building in Piteå. The first two columns from the left show the heat balance and energy efficiency measures described by Ståhl et al. (2011), the third column describes the criteria used for assessing the measures' impact on heritage significance. The fourth and fifth columns summarize my assessment of the impact of energy efficiency measures on the building's heritage significance using an objectivistic and relative value approach, respectively. Then assessments are made in relation to the heritage significance described above.

Table 2

<table>
<thead>
<tr>
<th>Energy balance</th>
<th>Plausible energy efficiency measure</th>
<th>Impact of energy efficiency measure</th>
<th>Objectivistic value approach</th>
<th>Relative value approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change windows to ones with better U-value</td>
<td>Visual, material, design</td>
<td>Existing windows are historical layers that must be respected. New windows should have contemporary design.</td>
<td></td>
<td>New windows with reconstructed design of original windows could enhance the heritage significance of the building and adjacent square, as well as the energy performance of the building.</td>
</tr>
<tr>
<td>Transmission losses through the building envelope</td>
<td>Upgrade existing windows</td>
<td>Material, visual, design</td>
<td>An extra inner glass or replacement of the inner glass sheet, with better U-value is the preferable solution; maintaining integrity of the architectural design and preserving material of existing windows.</td>
<td>Upgrading of existing windows would not have a major impact on the architectural design and visual appearance of the building.</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Add more insulation of basement</td>
<td>Material</td>
<td>Internal insulation of the basement would affect the material of the building and have a minor visual impact from the inside.</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td></td>
<td>Add more insulation of walls - internally</td>
<td>Material, visual, design</td>
<td>Would change the material and log timber construction, especially in the room with wall paintings.</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td></td>
<td>Add more insulation of walls - externally</td>
<td>Material, visual, design</td>
<td>Would affect original architecture and overall appearance of the building and the surrounding environment. Would destroy original material.</td>
<td>Would enable reconstruction of the façade. Material and production method important bearers of significance which can be enhanced in a reconstruction process.</td>
</tr>
<tr>
<td></td>
<td>Add more insulation of attic</td>
<td>Material, visual</td>
<td>Heritage significance not affected</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td>Question</td>
<td>Heat Loss Description</td>
<td>Material, Visual, Design</td>
<td>Heritage Significance</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
<td>--------------------------</td>
<td>----------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Q1</td>
<td>Heat loss through leakages in construction joints</td>
<td>Weather stripping, sealing of construction joints</td>
<td>Material</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td>Q2</td>
<td>Energy loss through the ventilation system</td>
<td>Change or adjust ventilation system, heat exchanger</td>
<td>Material, visual, design</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td>Q5b</td>
<td>Energy loss through sewage</td>
<td>Heat exchanger</td>
<td>Material</td>
<td>Heritage significance not affected</td>
</tr>
<tr>
<td>Q6c</td>
<td>Energy loss through distribution and control systems in the building</td>
<td>Adjust or change heating system</td>
<td>Material, visual, design</td>
<td>Heritage significance not affected</td>
</tr>
</tbody>
</table>

Add more internal insulation of roof: The visual and material impact would affect original architectural design and overall composition of the building such as the relation between the roof and façade.
Assessment of the impact on heritage significance using the Objectivistic value approach.

Windows - Although the windows are not original, the existing windows represent an historical layer that should be respected. Upgrading the windows with an extra inner glass with better U-value is therefore the preferable solution because it would have acceptable impact on the material, visual appearance and architectural design. If existing windows are replaced, the new windows should not be a reconstruction of the original or previous ones but have a contemporary design that does not draw attention from the original architectural design.

Insulation - Internal insulation of the basement would affect the material of the building and have a small visual impact from the inside. However, the basement is not original and although it should be respected as a historical layer, internal insulation can be accepted because it does not directly destroy or alter the material. Adding external insulation of the outer wall would destroy the original paneling or alter it in a way that would change the original architectural design. Since added function and material should have a modern and contemporary design, clearly distinguishable from the original, a new façade would change the architectural appearance of the building and character of the adjacent square. Internal insulation would have a negative impact in that it would also change the material properties of the log-timber wall, especially the wall paintings in one of the upper floor rooms. Its visual impact would be lower, but it would also have a negative impact on the architectural design, by deepening window recesses. This in turn would impact the way light flows through the windows, an architectural feature. The attic has already been insulated, and the insulation does not conflict with the heritage significance. The insulation and the construction to hold it in place have a small negative impact on the material of the building, but little or no impact on the visual and architectural design of the building. Insulation of the roof would affect the material and construction of the roof. It would alter the proportions and relations between the roof and the rest of the building volume, especially by increasing dimensions of the eaves of the roof, which would unacceptably change the architectural style.
Ventilation – Although the heritage significance would not be directly affected, changing the ventilation system could have a negative impact in that original material would be destroyed or altered by installation of new ventilation ducts. New systems should have a contemporary design and be distinguishable from the original appearance of the building. A heat exchanger has already been installed and has no impact on the heritage significance.

Solar energy – sun shading affects architectural design and has a clear visual impact. Since the impact on material is lower, sun shades could be considered if they have a contemporary design rather than mimicking a historic design.

Assessment of the impact on heritage significance using the Relative value approach:

Windows – Replacement of existing windows with new ones that have better U-values is the preferable option using the Relative value approach. The existing windows are only partially adapted to the architecture. New windows with a reconstructed design would improve and enhance not only the energy performance but also the heritage significance of the building itself and the square. Upgrading of existing windows would not have a large impact on the heritage significance.

Insulation – External insulation of the outer wall can be accepted if the paneling and architectural design are reconstructed. The paneling must be re-used or reconstructed to retain the design of the façade and adapt the visual and architectural impact to the heritage significance. Since the material is an important bearer of values, appropriate material and construction methods must be chosen to maintain the heritage significance. The architectural design is also a bearer of values and must be considered in the reconstruction. Since the heritage significance is so closely related to supporting the character and value of the adjacent square, the Relative value approach allows changes in the original and existing façade. The same arguments are relevant when assessing additional insulation of the roof. Roofing material, the construction methods and design of the building must be reconstructed to retain the heritage significance. Internal insulation of the basement and attic would not conflict with the heritage significance of the building according to the Relative value approach. Internal insulation of outer walls is also acceptable, except for the walls with the wall paintings.

Ventilation – The Relative value approach includes high acceptance of measures to enable modern use of a building. When the heritage significance is attached to the architecture, new systems are preferably hidden and concealed even if that means destruction of original material and construction. However, original systems such as natural ventilation systems may contribute to the significance as they may be connected to traditions and craftsmanship as well as the contemporary use of the building. New ventilation systems would therefore have a negative impact on the heritage significance of the building according to a Relative value approach.
Solar heat gain – Sun shades are acceptable additions. Their design may mimic historical ones or be contemporary.

Bläckhorn B52 & B53, Kiruna
The two Bläckhorn buildings B52 and B53 are located in the Company Area (Bolagsområdet) in Kiruna and are amongst the earliest residential units that LKAB built for its workers. Like many of the LKAB buildings in the area, the Bläckhorn buildings were designed by architect Gustaf Wickman (Sjöholm 2013:18).

In 2017 the buildings were moved to a new location. The basement of B52 was demolished and replaced by a new one. Since they were moved there are has been no new description or evaluation of the heritage significance. Therefore the assessments in this thesis are based on the design and context the buildings had before they were moved.

Heritage significance

Bläckhorn buildings B52 and B53, as well as the whole Company Area, are part of an area of national cultural importance (Riksintresse för kulturmiljövården) (Riksantikvarieämbetet 2013:12) in accordance with the Environmental Code (SFS 1998:808). The buildings were also included in the conservation plan for Kiruna, which covered many of the areas and buildings with heritage significance (Sjöholm 2013:21).

In the Conservation Plan from 1984 the heritage significance is described as follows:

“[The Company Area] is the oldest preserved residential area in Kiruna. It’s here where LKAB built its first working farms and engaged the architect Gustaf Wickman, one of the country’s top architects. There are, among other things, Kiruna’s first two storey buildings, the first "bläckhorn" and the largest residential type buildings built in the beginning of the 20th century; 16-room worker housing. The buildings are still in their original design and unchanged environment.

The Company Area as a whole is historically valuable culturally as it represents the turn of the century's housing environment and contains several different types of LKAB's first workers’ housing.” (Kiruna kommun 1984, translated from Swedish).

The heritage significance of Bläckhorn buildings B52 and B53 has been further described in an Environmental Impact Assessment (EIA):

“[They] are characteristic buildings for Kiruna, and the oldest of their kind with many followers. The buildings are of high architectural and building-technical quality and in relatively good conditions, which contributes to very high cultural values.” [...] "The cultural values of the buildings are primarily in the general historical context, with the link to Kiruna’s oldest epoch, its genesis and development to becoming a regional and national economic center, thriving through coherent symbiosis of industry and society.” (Joseph 2010 – translated from Swedish).

Application of conservation approaches and their impact on energy efficiency measures

Table 3 shows results of applying the suggested decision support system to the case study buildings in Kiruna. The first two columns from the left show the heat balance and energy efficiency measures described by Ståhl et al. (2011), the third column describes the criteria used for assessing the measures’ impact on heritage significance. The fourth and fifth columns summarize my assessments of the impact of the energy efficiency measures on the buildings’ heritage significance using an objectivistic and
relative value approach, respectively. Then assessments are made in relation to the heritage significance described above.

Table 3

Application of the proposed decision support system to the case study buildings in Kiruna

<table>
<thead>
<tr>
<th>Energy balance</th>
<th>Plausible energy efficiency measure</th>
<th>Impact of energy efficiency measure</th>
<th>Objectivistic value approach</th>
<th>Relative value approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change windows to ones with better U-value</td>
<td>Visual, material, design</td>
<td>Existing windows are historical layers that must be respected. New windows should have contemporary design.</td>
<td>New windows with reconstructed design of original windows could enhance the heritage significance of the building and the adjacent square as well as the energy performance of the building.</td>
<td></td>
</tr>
<tr>
<td>Upgrade existing windows</td>
<td>material, visual, design</td>
<td>An extra inner glass or replacement of the inner glass sheet, with better U-value is the preferable solution; maintaining the integrity of the architectural design and preserving material of existing windows.</td>
<td>Upgrading of existing windows would not have a large impact on the architectural design and visual appearance of the building.</td>
<td></td>
</tr>
<tr>
<td>Add more external insulation of basement</td>
<td>material</td>
<td>Heritage significance not affected</td>
<td>Heritage significance not affected</td>
<td></td>
</tr>
<tr>
<td>Q.</td>
<td>Transmission losses through the building envelope</td>
<td>Material, visual, design</td>
<td>Would change the material and construction of the wall.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Add more insulation of walls - internally</strong></td>
<td></td>
<td></td>
<td>Heritage significance not affected. But it offers possibility to enable reconstruction of inner wall surfaces. Material and production method are important bearers of significance which can be enhanced in a reconstruction process.</td>
<td></td>
</tr>
<tr>
<td><strong>Add more insulation of walls - externally</strong></td>
<td>Material, visual, design</td>
<td>Would affect original architecture and overall appearance of the building and the adjacent square. Would destroy original material.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Add more insulation of attic</strong></td>
<td>Material</td>
<td>Heritage significance not affected</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Add more insulation of roof</strong></td>
<td>Material, visual, design</td>
<td>The visual and material impact would affect original roof design and overall composition of the building such as the relation between the roof and façade.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heat loss through leakages in construction joints</strong></td>
<td>Weather stripping, sealing of construction joints</td>
<td>Material</td>
<td>Heritage significance not affected</td>
<td></td>
</tr>
</tbody>
</table>

Would enable reconstruction of façade and paneling. Material and production method important bearers of significance which can be enhanced in a reconstruction process. |

Would enable reconstruction of roof material. Material and production method important bearers of significance which can be enhanced in a reconstruction process. |

Heritage significance not affected.
| Q. | Energy loss through the ventilation system | Change or adjust ventilation system, heat exchanger | Material, visual, design | Heritage significance not affected, but new ventilation ducts could destroy original material. New systems should have a contemporary design and be clearly distinguishable from the original design and function. Heat exchanger already installed in the attic with little material and visual impact on the architecture | Heritage significance not affected |
| Q5. | Energy loss through sewage | Heat exchanger | Material | Heritage significance not affected | Heritage significance not affected |
| Q6. | Energy loss through distribution and control systems in the building | Adjust or change heating system | Material, visual, design | Heritage significance not affected | Heritage significance not affected |
| Q7. | Energy gain from the sun | Install sun shading of windows to reduce energy for cooling | Visual, design | Negative impact on the original design and alteration of balance of the original architecture. Historicized sunshades would ‘falsify’ the architectural context and surrounding environment. Historicizing sunshades would enable enhancement of perspective of pastness in the façade and the environment that is no longer unchanged. Modern design acceptable. Solar panels and photovoltaics have symbolic potential. |  |
Assessment of the impact on heritage significance using the Absolute value approach.

Windows – The impact assessment of the windows using the Objectivistic value approach is the same for the Bläckhorn buildings as it for the former courthouse in Piteå. The windows are not original and were installed in the mid-20th century. They represent an historical layer that should be respected. An extra inner glass with better U-value would have acceptable impact on the material, visual appearance and architectural design. New windows should have a contemporary design that blends in with the overall appearance but is clearly distinguishable from the original architectural design. A reconstruction of original windows would falsify the historical and artistic testament of the original buildings.

Insulation - External insulation of the basement would have a small effect on the material of the building. Adding to the external insulation of the outer wall would destroy the original paneling or alter it in a way that would change the original architectural design. Since added function and material should have a modern and contemporary design, clearly distinguishable from the original, a new façade would change the architectural appearance of the building and the character of the adjacent square. Internal insulation would have a negative impact as it would also change the material properties and construction of the wall. Its visual impact would be lower, but it would also have a negative impact on the architectural design by deepening window recesses. This would in turn impact the way light flows through the windows, an architectural feature. Insulation of the attic would not conflict with the heritage significance since it would have neither visual nor architectural impact. The insulation and the construction to hold it in place would have a small negative impact on the material of the building. Insulation of the roof would affect the material and construction of the roof. It would alter the proportions and relations between the roof and the rest of the building volume, especially by increasing dimensions of the eaves of the roof, which would change the characteristic architectural design of the roof.

Ventilation – As the heritage significance of the buildings lies in their architectural design, and its relation to Kiruna’s oldest epoch, a new or upgraded ventilation system would not greatly affect their heritage significance. However, new ventilation ducts and ventilation funnels on the roof would destroy material and change the roof design. New ventilation systems and funnels would have their own architectural expression, contrasting with the characteristic and original roof design. A heat exchanger would have no impact on the heritage significance.

Solar energy – sun shading would affect the architectural design and have clear visual impact. Since the impact on material would be lower, sun shades could be considered if they have a contemporary design rather than mimicking a historic design.
Assessment of the impact on heritage significance using the Relative value approach:

Windows – Replacement of existing windows with new ones with better U-values is the preferable option according to the Relative value approach. The existing windows are only partially adapted to the architecture. New windows with a reconstructed design would improve and enhance not only the energy performance but also the heritage significance of the buildings. Upgrading of existing windows would not have a large impact on the heritage significance.

Insulation – External insulation of the outer wall can be accepted if the paneling and architectural design are reconstructed. The paneling must be re-used or reconstructed to retain the design of the façade and adapt the visual and architectural impact to the heritage significance. Since the material is an important bearer of values, appropriate material and construction methods must be chosen to maintain the heritage significance. The architectural design is also a bearer of values and must be considered in reconstruction. Since the material is an important bearer of values, the choice of material and the construction methods, is crucial to maintain the heritage significance. Also the architectural design is a bearer of values and a reconstruction must also consider this. The original design of the façade and window settings are described in the archive material from LKAB and archival photographs from Kiruna bildsamling (Image 10-14). A reconstruction of the façade and its window setting would not only enhance the thermal performance of the building but also enhance the heritage significance. The architectural design that is emphasized as a core value of the buildings heritage significance could be restored. The same arguments are relevant when assessing additional insulation of the roof. Roofing material, the construction methods as well as the design of the building must be reconstructed to keep the significance. Internal insulation of the basement and attic is not in conflict with the heritage significance of the building using the Relative value approach.

Ventilation – The Relative value approach includes high acceptance of measures installed to enable modern use of a building. When the heritage significance is attached to the architecture, new systems are preferably hidden and concealed even if that means destruction of original material and construction. However, original systems such as natural ventilation systems may contribute to the significance as they are connected to traditions and craftsmanship as well as the contemporary use of the building. New ventilation systems would therefore have a negative impact on the heritage significance of the building according to a Relative value approach.

Solar energy – Sun shades are acceptable additions. Their design may mimic historical ones or be contemporary.
7. Summaries of Papers 1 and 2

Paper 1: Identifying Cultural Building Values – Methodology review for energy efficiency alterations.

Paper 1 presents and discusses results from the first part of the research process: an overview of the most commonly used methods to assess and evaluate heritage significance. One of the findings was that most methods have a theoretical underpinning that rests on an objectivist view of value, regarding authenticity and values as intrinsically embodied in the building material. A corresponding concept of conservation is present in international charters and promoted by government and local authorities. Paper 1 also discusses how conservation strategies have been adapted to the concept of sustainability, including social change and climate considerations. It is discussed how a broadened concept of conservation as a tool for mitigating climate change also requires a broadened view of values that focus less on authentic fabric of a building and more on the socially constructed values that can be associated with a building.


Paper 2 presents and discusses results of the review of peer-reviewed journal articles published up to 2016. It addressed the reviewed publications’ treatment of both energy analysis and cultural heritage values. Consideration of their energy analysis focused on the phases of buildings’ life cycles that were included in analysis of the buildings’ energy use. Most publications were found to focus on operational energy use (largely seeking to identify points where most energy savings can be made in a building), but a few applied a life cycle perspective. Consideration of the publications’ treatment of buildings’ cultural heritage values focused on the methods and theory used for assessing and analyzing these values. Three main ways of including cultural heritage values in the analysis of buildings were identified. Some publications paid no detectable attention to value assessment, except (in many cases) through reference to official protection or an unspecified cultural heritage value of focal buildings. Another set implicitly referred to value assessment, often by citing international conventions or conservation principles such as “reversibility” or “authenticity”. A third set included discussion of values with explicit underpinning from conservation theory. If mentioned at all, the influence of cultural and historical factors on the applicability of energy efficiency measures to heritage buildings tended to be only briefly addressed. Indeed, most of the articles do not describe conservation principles or even mention the methodology used – if any – for assessing or defining heritage values. Instead, they indicate an explicit (sometimes implicit) understanding of conservation as essentially something that does not destroy original construction material and hence the authenticity of a building.
8. Discussion and conclusions

The ultimate objective of this thesis and the underlying research is to assist efforts to reduce energy use in the existing building stock without distorting or damaging cultural historical values. The practical aim to meet this objective is to increase understanding of the implications of assessing and evaluating buildings’ heritage significance for efforts to make heritage buildings more energy efficient.

After providing background information, this thesis presents first steps towards integrating conservation theory in decision support tools for energy retrofitting by describing and discussing a theoretical framework (Chapter 5) and applying it to three case study buildings (Chapter 6). Previous research has shown that it is possible to implement energy efficiency measures in heritage buildings while preserving their heritage significance. This framework complements this by showing that it is possible to save energy in heritage buildings either an Objectivistic value or Relative value approach. The framework highlight differences in impact arising from use of different conservation approaches when considering whether specific energy efficiency measures should be implemented in heritage buildings.

Two conservation approaches, an Objectivistic and a Relative value approach, were shaped by using literature on conservation theory and other reviewed and discussed literature. The result from the application of the developed framework and the decision support system has shown that there are significant differences between using an Objectivistic value approach and a Relative value approach when assessing the impact of energy efficiency measures on heritage buildings. Either of the two conservation approaches can be used to assess the impact of energy efficiency measures that could be implemented in a heritage building without impairing the heritage significance. Usually very little destruction or alteration of the authentic material and design of a building is permitted when an Objectivistic value approach is applied, and alterations and additions are given a contemporary and clearly distinguishable design. In contrast, the Relative value approach permits alterations of material and design if they are intended to enrich or clarify the heritage significance of the building. A broader concept of heritage significance is also applied in the Relative value approach when considering adaptations of design and architecture required to implement energy efficiency (or other) measures. Thus, it enables installation of more energy efficiency measures in buildings’ envelopes, including insulation and new windows.

The decision support system developed to understand the implications of the two conservation approaches gives an opportunity to make a transparent and informed decision on which conservation approach to use and how that choice affects the possibilities to implement different energy efficiency measures. At the same time this method has the risk of over simplifying complex understandings of the building. As previously discussed, the assessment of heritage significance is affected by personal judgement with either of the two conservation approaches. Therefore, the assessments I have made in this thesis could look different if made by others even by using the same decision support system. However, the subjective nature of the qualitative methods and
interpretations for assessing the impacts on heritage is ingrained in all the decision support systems reviewed in this thesis while it is also consistent with the phenomenological stance of my study.

One of the results that benefits from a deeper discussion are that the material and fabric itself has shown to be important factors to consider when using both conservation approaches. Using the Relative value approach, the assessment of new or reconstructed windows and facades was based on the function of the fabric to construct meaning and hence the heritage significance of the building. The phenomenological approach to understanding the meaning of a place and an object goes beyond what is directly perceived or observed, but also includes an understanding of the whole phenomena to include the qualities and properties of a material; the texture, the sound of it, how it reflects light, the work and human thought that go into the construction of it. A reconstructed façade or a reconstructed window can therefore be a strong bearer of the socially embedded meanings that are associated to the material and building and very much contributes to the character of a building. A reconstruction with other materials will therefore not have the same impact. Since the reconstruction typically implies adding insulation or improving the energy performance of windows, the value of improving the energy performance of the building is added to the already meaningful object. The historical as well as contemporary function of the building envelope and the windows are mainly to keep the heat inside the building. Any upgrade of this function can be seen as part of the building tradition and meaning of the building.

An Objectivistic value approach values material differently. Here the authentic material is important. Since the historical context in which the production and manufacturing of the materials cannot be recreated, the original material is therefore not replaceable with new material even if it has similar or identical properties. The object is seen as inseparable from both its history and setting (ICOMOS 1964).

Paraphrasing the Venice charter, in the Objectivistic value approach, the “unity of style is not the aim of a restoration” (ICOMOS 1964). Meaning that all important historical layers shall be respected and that it would be a falsification of the true history if one was to copy, reconstruct or move the object or its parts (Wells 2010:464). The use of contemporary design, which clearly distinguishes itself from the authentic design and material, is therefore an important part of the Objectivistic value approach.

The issue of the design and material of new additions to existing heritage building also presents a complexity that also would benefit from deeper discussions. The aim of new additions is to blend them in so that they do not disrupt the composition of the building which could lead to the use of an historic design. Similarly, using the Relative approach, the use of a contemporary design and material could enhance the heritage significance in that it creates a contrasts that highlights architectural features that make the heritage significance. This again displays the complex issue of subjectivity in my decision-making system and by extension to systems that need input from people with knowledge to interpret heritage significance and impact assessment.
The results from the studies in Paper 1 and Paper 2 show that what I have termed the Objectivistic value approach is the most commonly used approach to assess heritage significance. However, this study has shown that from the 20th century onwards the Objectivistic value approach has been contested by those supporting what I have termed the Relative value approach. This discussion has continued to at least the last decade. A rather surprisingly result of this study is therefore that so few of the research publications I have examined have an explicit discussion on conservation approaches while most of these studies are biased towards an Objectivistic value approach. Keeping in mind that the Relative value approach is said to replace the Objectivistic value approach (Avrami et al. 2000:6). On the other hand international charters and conventions such as the World heritage convention (UNESCO 1972) are based on the Objectivistic value approach. It is therefore reasonable that research on buildings within a world heritage site will adopt the same conservation approach.

To conclude, this thesis has suggested a framework to understand the different interpretation of the impacts that one could exert either by having an Objectivistic or Relative conservation value approach. Based on this framework, a decision-support tool was developed to further detail the impacts of such approaches for different energy measures. Two different storylines, that of the Objectivistic and Relative value approaches, have thus been unfolded by applying the tool to two case studies in Northern Sweden. While my tool helps clarify the complex interactions between heritage value approach and the impact of energy efficiency measures, more research is needed to further clarify the implications of such a dualistic framework for a much needed decision support system for energy efficiency in heritage buildings.
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UNESCO (1972) Convention Concerning the Protection of the World Cultural and Natural Heritage.


Paper 1
ABSTRACT
This paper intends to discuss methodology of identifying historical, aesthetical and other cultural values in buildings.

The existing methodology aims to identify the building as a source of knowledge and the building as a function as an architectural and aesthetic object.

The methodology most commonly used, promoted by official bodies and international charters, rests on an objectivistic view on value. The notion of authenticity and values as something intrinsic and embodied in the material present both principle and practical problems in conservation practice.

Over the last decades discussions about conservation practices and the underlying theoretical foundation, have been given more attention in research and the cultural heritage community. At the heart of the discussion is the role of heritage and conservation practice in society and communities.

Alterations of a building are almost always likely to have an impact on the defined values of that building. Each specific alteration has its own logic and can be of necessity for keeping the values (conservation), for adaptation to another use or to improve or keep the technical status, such as energy improvement-

Depending on the building's construction, architectural and cultural historical value, the alteration may have a greater or smaller impact. In order to know the effect, the values must be defined and assessed with regard to the alterations. But the impact also depend on which value system is used to identify the values in a building. A methodology based on an objectivistic value system may be difficult to handle in a refurbishment process.

Keywords
Cultural heritage, methodology, conservation, architecture, historical buildings, phenomenology.

1. Introduction
This paper is part of a project at Luleå University of Technology, that studies how buildings with historical and architectural values can be made more energy efficient. All buildings that are studied within the project are officially recognized as part of the built heritage in Sweden. Some buildings from Kiruna and Malmberget are mentioned as examples. The project also includes studying how conservation methodology and practice can be developed in order to facilitate reduction in energy usage.

2. Common methodology for identifying cultural values in buildings
There are many methods used to describe and analyse space and the historical and aesthetical importance of buildings. In her candidate thesis, Anna Rodin (2009) makes an overview of the most commonly used methods and perceptions of knowledge and perspective on aesthetical and historical values. Rodin shows that the different methods range from a scientific approach (as expressed in article 2 in the Venice charter 1964), via art historian and visual to a structuralist tradition (Rodin 2009:6-15). John R. Mansfield also discusses the interdisciplinary nature of conservation and points to the "diffuse boundaries" and the fact that it draws in method and theory from the humanities as well as sciences (Mansfield 2008:272). This is of course a fact that always needs to be taken into consideration when discussing methods and the underlying theoretical base.

Regardless of what part or factor of space (visual or scientific), scale (building or landscape), or empirical material (historical records or inventories) used, the different methods are applied in much the same way and can be described in chronological steps. The way of using the methods correlates to doctrines such as international charters and conservation principles (Whitbourn 2008:123-130). In fact they are products of the same process, which also includes development of legislation focused on protection of built heritage such as the Swedish planning and building act (SFS 2010:900).

2.1 Data Collection and Inventory
First, data in the form of historical records and inventories of buildings and objects are collected. Most commonly this is based on a description of architectural features or descriptions of the historical records of the building. Historical methods such as differentiation between primary sources and literature are an essential part, or put in other

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words: "Sound conservation depends on accurate s historical data" (Cherry 2007: 10). To most significant part is t e at t e building and objects t e themselves are considered a primary source.

Gunnar Almén (2012) describes t eroughly by described and pointed out t e principles and methods used to investigate t e building as a primary source. Almén (2012: 28) summarizes t e investigation and study of a building as a primary source that can be divided into t e steps: documentation, identification, age determination, analysis and interpretation.

2.2 Interpretation and Evaluation

Second, interpretation of the collected data must be conducted. And t hirdly evaluation of t e interpretation is carried out.

To illustrate t e steps, t e methods or perhaps model, presented by Unnerback (2002) at t e time employed at t e Swedish National Heritage Board, can be used as an illustration. It is t e approach t e most widely used methods of identifying cultural values in t e built environment in Sweden. T e method proposed by Unnerback is based on identification of t e "main motif", which is divided in "document value" consisting of t e s t e historical properties and features of t e building; and "experienced value" which consists of t e aesthetical and socially engaging properties of t e building (Unnerback 2002:21).

T e two value categories, in turn, consist of different values such as "social value", "architectural value" and "historical value" (Unnerback 2002:24). T e important features of a building and "periods of significance" that t e US authority National Park Services (cited in Legner 2010:54) refers to, are examples of such main motifs.

T e categorization and specification is t e equivalent to t e two value categories (aesthetical and s t e historical) t a are to be found in t e Venice Charter (Arzo 2011:56).

T e main motif is t e s t e supported by so-called "strengthening motifs", which include factors such as, "authenticity", "quality" and "representativity" (Unnerback 2002:24).

T e nature and importance of authenticity and the debate of its significance has t o greater interest and deserves a move in depth discussion than can be presented in t e text in this paper. However, some main criticisms of the interpretations and t eoretical foundation of its use in defining cultural values will be touched upon in t e discussion in section 5.

2.3 The Example of Kiruna and Malmberget

T e heritage description by Unnerback (2002) is used by t e heritage conservation professionals for identifying t e cultural values in Malmberget and Kiruna, Sweden.

An inventory (data collection) over Malmberget was made with t e s t e inventory was t e committee "House and Rooms" concerned material used and t e on (Eskero, Svensson & Vestlund 2009).

In an attachment to t e Environmental Impact Assessment (EIA), t e buildings cultural and s t e historical value in Kiruna is defined (evaluation and interpretation) on two levels (Johansson 2010). A general evaluation includes a specific evaluation for each building.

Figure 1 "Ink bottle" buildings. Workers housing built by the mining company, in Kiruna, Sweden Photo: Jennie Sjöholm.

2.3.1 General Evaluation for the Whole Area

Architectural and s t e economic and s t e historical context of t e founding of Kiruna are identified as main motifs.

"Bots" as well as corporate and railway buildings erected through t e style and tasteful, distinctive designs, with some expressions recur in slight variations. T e applies not to the "ink-bottle"-buildings and their "patented" design language and the panel arc architecture visible on several buildings [...] T e cultural values of t e buildings are primarily in t e general s t e historical context, with t e link to Kiruna's oldest epoch, its genesis and build-up to become a regional and national economy, thriving to be a co-evalent symbiosis between industry and society." (Josef 2010: ?) (translation made by t e author).

2.3.2 Individual Evaluation and Assessment

Each building is individually evaluated and assessed. Strengthening motifs such as representation and degree of authenticity are identified.

"T e three ink-bottle buildings are co-architectural buildings for Kiruna, and t e oldest of t e kind with many followers. T e buildings are o f t e architectural and technical quality, and built relatively well, which contributes to t eir very sip cultural value " (Josef 2010:25) (translation made by t e author).

2.4 "Sense of Place" - Conservation and the Phenomenology of Space

T e use of t e term "sense of place", "identity of place", "integrity of space" or t e antique version "genius loci" is often a part of t e methods of identifying buildings with cultural value (Wells 2010:468-469). Usually, t e sense of place is not put in a transparent methodology but rather something that is related to the professionalism in heritage conservation practice. T e term "sense of place" is frequently used as an argument for heritage conservation by both governmental bodies and research, as an important understanding of values (ICOMOS 2008, Legner 2010:58, Riksantikvarieombetet 2008:2, Wells 2010:477).

The idea of sense of place and experience of space can be traced to the phenomenology. The phenomenological eory was introduced by Husserl (Bengtsson 1987a) and further developed by Heidegger and

The phenomenology of space as often been used as a
criticism against modernism architecture. The argument
from phenomenologists like Perez-Gomez and Norberg-
Shultz as in analyses only on t-e geometry, abstractions and
images of space cannot explain nor produce t-e qualitative
and lived experience of space (Dovey 1999:39, Norberg-

T-e analyses and description sowould therefore instead have t-e existing qualitative properties of space - "t-e ontology of
space" (Bengtsson 1994:27) - as its starting point (Norberg-
Sculuzi 1999:99). W.e can adding or creating new space
the particular identity at any given space - its generic loci
(Norberg-Sculuzi 1999:106-114) - in what should determine
what sowould be built and t-e existing space should be altered. Only then does t-e built environment and space
can contribute to the existential identity of people (Norberg-

This means at alterations and additions and occasionally
even interventions, in existing buildings and space sowould
if not totally, become an integrated part of existing space, at
least consciously related to existing qualities.

The possibility of connecting emotions and bodily
experiences to a terminology, historical events and space, the
ps phenomenological approach, is often used to get erf
with identity politics as an argument for social and cultural

It is also used by building sistorians and the sitage community as well as architects, as a tool
for analysis. Gunnar Almevik (2012:27) describes how a
building sistorian physically moves through t-e empirical
and primary sources in t-re dimensions. Ps phenomenology is
about t-e ability to use t-e bodily experience as an instrument
for bot e gearing data and analysing space.

3. The Impact of Integrated Conservation

Over the last decades discussions about conservation practices and t-e underlying t-eoretical foundation, has been given more attention in research and with in the cultural sitage in community. At t-e sart of t-e discussion is t-e role of sitage and conservation practice in society and communities.

The argument for an integrated conservation practice is based on t-e idea that sitage values no longer sowould be "defined as static and objective entities representing intrinsic values, applicable for well-defined kinds of cultural objects" but instead used as an instrument in "planning situations" and ofs transformation processes (Engelbrektsson & Rosvall 2003:3).

Because of this, cultural sitage as become an outspoken political discourse. Cultural sitage as has been promoted by the heritage community as well in national political agendas and by minority groups as an important part of t-e identity politics with its spatialisation individual and collective identities (Carlberg & Möller Christensen 2003, Jensen 2008:54, Landzelius 2001:3, Proposition 2004/05:23 p.8, Ross 2007:225, Weissglass, Paja, Westin & Danell 2002:10-11).

Based on t-e understanding of sitage as an existential
ingredient of t-e lives of individuals and societies, t-e built
sitage is also more frequently used by t-e tourist industry
and has become an integral part of city branding (Pendlebury

In urban theory t-e role of cultural heritage therefore ranges
from empowerment of local inhabitants (Engelbrektsson & Rosvall 2003:9-10) and the function of old buildings for use
of small niches and (e.g. shops) or cultural activities (Jacobs
2010). To t-e role of advertising a city on t-e global market
an industrial city to a knowledge based economy is only
one example of t-e reuse and reinterpretation of built
sitage in included in urban political processes (Mak
2005:120-131). The regeneration of old industrial sites in Baltimore, USA, and Nortkoping, Sweden, are
typical examples of how t-e notion of t-e built entity is closely
associated with t-e built cultural sitage and architectural features (Legner 2009).

3.1 Sustainability Greenwash?

At least since t-e introduction of t-e sustainability concept, cultural sitage as has been seen as a part of t-e environment (Mansfield 2008:277). The report "Our Common Future" (1987) from t-e World Commission on Environment and Development established this on the global level, and national legislations such as t-e Swedish Environmental Act (SFS 1998:808) formalised it on national and local levels.

Increasingly, cultural sitage has been promoted as part of the sustainability concept even concerning t-e ecological sustainability.

In t-e wider scope, t-e connection between environmental impact and the built environment is stated in reports on t-e national and international level. Nicolás Stern (2007:416) points to t-e need for both, private and public investments in buildings to take the climate change into consideration, and increasing demands on lowering t-e climate gas emissions are occupying political bodies such as the European Commission and national law making bodies (Europe 2020 2010:9, Proposition 2008:04:162 p.11-12).

At a first glance, the increasing demands for CO₂ reductions and making the existing building stock more energy efficient seems to fit well with the concept of conservation as part of sustainable development. More and more voices are heard arguing that conservation of the built environment is also a contribution to sustainable ecological development. Rodwell 2007 (cited in Legner 2010:51) argues that "[r] e-use is much more energy efficient than any other type of intervention in t-e built environment, and conserving t-e built environment is therefore an important contribution to sustainable development". Supporting this is t-e argument that climate gas emissions are embodied in an existing structure. Compared to a new-built building an upgraded and
retrofitted existing building is more climate neutral, since it requires less new material and construction efforts. The argument is promoted by Stephan Fickler (2013) and shown in a comparative study carried out by Ervind Selvig (2011) on an assignment from The Directorate of Cultural Heritage in Norway.

However, as Menzies (2011) points out, the embodied or “sunk” energy, does not make the building stock more energy efficient. In order to reduce energy usage and climate gas emissions, the reuse of buildings needs to be complimented with retrofitting and energy efficient measurements (Menzies 2011; Selvig 2011).

Reuse as a way of lowering climate gas emissions postulates a transformation and upgrade of the building. As an argument for conservation of cultural values, it therefore challenges some of the basic principles of conservation theory and practice.

4. Outlining of a Problem
It is evident that cultural heritage increasingly is used as a tool in many different transformation processes not only in the social and cultural contexts, but also in the economic and ecological contexts. The transformation processes include both changes of the historical fabric as well as reinterpretation of the symbolic and historical content of the heritage objects. This is sometimes described by the heritage conservation community as a threat (Araoz 2011:56), but it is also clear that this change of role of heritage conservation is promoted by the people and organisations professionally involved with heritage conservation (Ashworth & Phelps 2002:3).

In response to what he calls a paradigm shift, Gustavo F. Araoz (2011:56) argues that the integration of heritage conservation in development processes has made the former "toolkit" and old "doctrinal foundation" for conservation insufficient. Araoz argues that "[...] the theory and praxis of conservation evolved for almost centuries as an increasingly sophisticated effort to prevent form and space from undergoing changes" (Araoz 2011:56). The intention of the conservation practice that Araoz refers to is to lift the object out of the process it is currently in; to stop, or at least slow down the deterioration process, and to fixate the symbolic and aesthetical content.

Araoz exemplifies these shortcomings in the common conservation theory by discussing the Venice charter from 1964 and that it only recognizes two types of values: historic and aesthetic (Araoz 2011:56), and that the heritage conservation practice now needs to consider many more values, most of them intangible and impossible or at least difficult, to refer to any material or aesthetic. Some values such as the biological heritage and tradition, is even defined by the cycle of life and death (Araoz 2011:57), a transformation process which to anyone would seem impossible to stop or reverse.

4.1 A new Paradigm or just Patching up the Theoretical Framework?
Araoz’s argument (2011:57) is valid as an analysis of the shifting challenges that heritage conservation is facing. However, the action taken for a new paradigm or a new agenda runs the risk of becoming a lacun, which at a distance keeps the deteriorating artwork still looking as the artist intended. A closer reading and analysis of the conservation theory and practice is therefore needed.

Returning to the argument that the re-use of buildings contributes to making the building stock more energy efficient, and that conservation of existing buildings is a way of contributing to lowering climate gas emissions caused by building and living in houses.

The very notion of re-use and upgrading of buildings and building parts as a conservation, action implies an acceptance of transformation, alterations and interventions in the material and historical fabric as well as re-reading and re-understanding of the buildings characteristics. It is a truism that such an approach is not compatible with a set of doctrines and methods that aims to prevent form and space from changing.

In principle the idea of preventing form and space from undergoing change opposes the idea of transformation as a conservation method. In practice, the tool kit used in heritage conservation needs to fit with other types of values such as energy targets, economic investments new usages and functions and the process in which they are assessed and evaluated.

5. Discussion
Returning to arguments for a new paradigm (Araoz 2011) and that re-use of buildings is not only energy efficient and lowering climate gas emissions, but also a preferable conservation action in itself (Legner 2010; Selvig 2011). The described theory and methods above do not give sufficient guidance in principle or a practical way to handle the transformation and refurbishment process that is needed for these goals to be achieved.

5.1 Principle
The conservation methodology and practice described above has been discussed and debated from different perspectives. It is a debate that goes back to the 20th century debates on conservation principles and on the nature of a truthful restoration and authenticity between significant names such as Ruskin and Viellet-le-Duc (Araoz 2011:59; Mansfield 2008:276; Wells 2010:465). Even today in seemingly local contexts the same discussions on truthfulness and authenticity appear on a smaller scale as in single reconstruction projects such as the one at Villa Gannebo, Sweden (Ernstsson & Johansson 2002: 110).

At the core of the debate around authenticity and properties referred to a building, lies the notion and perception of value (ICOMOS 1964, ICOMOS 1994). The main issue is whether the values are intrinsic and something that is embodied in the material, or if values and meaning are something that is created in a relation between a subject and the object, i.e. attributed to the object.

The difference is not only a question of semantics or only relevant for researchers and policymakers, but also relevant in a practical sense. Depending on which value system that is used as a reference frame for identifying or defining
(attributing) values, it will affect how they are perceived and handled in a transformation and refurbishment process.

In the described method above and in the case of the evaluation of the buildings in Kiona there is little, if any, that point in the direction of how the identified values should be handled or assessed in a situation of re-use or refurbishment process. It is hard to find traces of the argument that the re-use of buildings is not only energy efficient and lowers climate gas emissions, but is also a preferable conservation action in itself (Legner 2010, Selvig 2011).

The problem could therefore be described as twofold, on a principle level and on a practical level, and that they are both dependent on each other. Neither the criticism nor the proposed alternatives are newly introductions to the debate. The context of energy efficiency targets and conservation as a way of reducing CO2 emissions makes the debate once again significant.

5.1 Objectivism and truthfulness
As seen in the described method above and as Jeremy C. Wells points out “[t]he dominant concept of historical significance rests in a century old empiricist-positivist paradigm that emphasizes objectivity, 'facts and 'truth' whilst deprecating subjective cultural, social and experiential meanings” (Wells 2010:464). Also Muñoz Vifias (2005:81) argues that conservation is orientated to preserving material and goes further in arguing that this perspective is based on two main principles, to keep the integrity of the object and that the object consists of its physical properties and parts. The conservation action is therefore, according to Muñoz Vifias (2005:81), a way of constituting and framing truth.

The connection between this theoretical objection and conservation practice is shown by Araoz when he points out that even though conservation theory and practice is said to identify and protect values, "the heritage professionals have never protected or preserved values; the task has always been protecting and preserving the materials, that in lyrical language of the Venice charter (ICOMOS, 1964) are "imbued with a message from the past [...]" (Araoz 2011:59). This practice can only fulfill its purpose if the historical and aesthetical values in fact are embodied in the historical (authentic) material and if the goal is to preserve the truthful or "accurate" history (Cherry 2007:10).

5.2 Objectivism and practical dilemmas
Anna Knas (2006) has analysed the value system of heritage conservation and shows that behind the idea of intrinsic values embodied in the material lies a relativistic value system (Knas 2006:23-30). See also (Muñoz Vifias 2005:81, Wells 2010:464).

In a case study Anna Knas (2006) shows how the objectivistic values not only become problematic when they are handled together with relativistic values such as economic; they also tend to be reduced or lost.

Knas (2006) studied the transformation process of Ostra stallet, a listed building in Stockholm, Sweden, which was going to be turned from an old military stable to office space and a library for The Swedish National Heritage Board.

By studying the refurbishment process and how different values are handled and assessed, Krus could show that in an refurbishment process, surplus and added values that in themselves increase the total value of the building (more economic, functional, meaningful etc.) are more likely to increase (Krus 2006:97). Values that are tied to authenticity and seen as intrinsic, are more difficult to tie to surplus values and include in the total value of a building after a refurbishment process.

One of the factors that was identified is the idea that aesthetical and historical values are embodied in the material (Krus 2006:99). Krus shows that the loss of an identified value in showing the old function of the stables was greater than it needed to be and that this was due to the material and authenticity oriented methodology in conservation practice (Krus 2006:99). A relativistic approach on showing the value of the buildings old function, could have been preserved or created in other ways, by photographs or aesthetical or architectural solutions (Krus 2006:100).

The case of Ostra stallet in Stockholm also shows that the argument for re-use (Legner 2010:51), is not totally compatible with an idea of values embodied in the material.

5.2.1 Identifying Sign - Vehicles
Another crucial aspect that Krus identified is that in a refurbishment process it is necessary to identify not simply the historical context of a building and its position in an architectural historical or economic historical context. In order to handle different values in a refurbishment process the values must be tied to the actual properties in the building that represent the values (Krus 2006:97).

The need for identifying the "vessels that carry value" as Araoz (2011:59) calls it, is something that is stressed in conservation practice regardless of if it is from an objectivistic or a relativistic perspective. For instance by Legner (2010:54) discussing re-use and transformation of old industrial sites.

From a relativistic perspective on the (re)production of values, Landzelsius uses semiotics as a way of identifying "spatial sign-vehicles" (2001:2), i.e. objects and form that people perceive and experience as meaningful. Landzelsius argues that because of the fact that semiotics does not recognize "[...] essential differences between, on the one hand, new spatial objects, and, on the other, left overs from the past" (Landzelsius 2001:2). The focus will therefore always be on the meaning (value) that the object or building represents rather than the material itself.

5.3 Truthfulness and "sense of place"
In phenomenology of space, the perspective of the lived and bodily experience and the existing qualities of space promotes truth as opposed to falsification. It is the lived experience that should be considered.

As discussed above, the conservation methodology is based on objectivism, authenticity and truthfulness in interventions of buildings. Put together with the phenomenological theory of place and space as something experienced, by subjects is in principle an impossible combination. However, the
phenomenological experience of space is experienced as understood as 'truth' and 'authentic'.

The social anthropologists Ulf Hannnerz (1998) has studied globalization processes and why local cultures are considered more genuine and more important in a more a globalized and international world and connects to the feeling of 'truth' that is described both in the notion of authenticity as well as the phenomenological understanding of place. Hannnerz argues that the reason that people call situations they themselves experience for "real" (or in the phenomenological terminology "lived") and what they have seen on television or read about, "not real", is that people use all of their senses in a face-to-face and bodily interaction. The feeling of "immediacy and immersion" that this creates is at least partly what "real is about" (Hannnerz 1998:27).

Moreover, the connection between identities, space and culture (experience) has also been studied by Manuel Castells (1998). Castells argue that there is no support for the idea that local environment leads to (determine) specific identities or behavior (1998:73); which is not to say that peoples’ identities are not in "significant ways related to spatial semiosis" (Landzelius 2001:2).

The use of the phenomenological notion of "sense of place" in architectural and heritage conservation practice has become understood as synonymous with the notion of authenticity and truth and a objectivistic perspective on value. In fact the phenomenological approach to the meaning of space and objects is based on the meaning a subject experiences in relation to space and objects within it and therefore should acknowledge values as something culturally constructed. The phenomenological perspective is therefore compatible with ethnological method, as for example illustrated by Wells (2010:467-469).

6. Acknowledgements

Our thanks to the HLRC and the Swedish Energy Agency for funding this project.

7. References

The people’s architectural heritage is of international funding. Therefore, it is important to read the ICOMOS paper on the Co-existence of cultures and the Social Wellbeing. The quality of life of great American cities.

Paper 2