By Tineke van der Schoor (Hanze University of Applied Sciences, Groningen)

Strategies for energy efficient restorations

Tineke van der Schoor working at the Hanze University of Applied Sciences. Her areas of interest include green building, historical buildings, and energy sustainable communities. Currently she is working on her PhD thesis at the Maastricht University.

Abstract

Our society values historical buildings and strives to conserve these important works of art from former periods. Moreover, historical buildings are very important in the creation and maintenance of place identity.

Our starting point is Actor-Network Theory (ANT), which views technological arte-facts as networks of heterogeneous actors. In our built environment these networks consist of human actors, such as owners and users of historical buildings, restoration architects, energy advisors, heritage protection agencies and voluntary heritage organisations; as well as non-human actors, referring to legislation, traditions, materials and blueprints of the buildings. The obduracy of buildings is the result of the dynamics in these networks of actors. Recently, users are voicing new demands regarding functions, energy use and comfort. Energy efficient restoration for the building seems to be in order, however, according to heritage agencies, this can compromise historical values. We investigate conflicts of interest between heritage protection and energy efficiency. We use a case study approach and investigate five historical objects. Human actors, such as owners of historical buildings, use negotiation strategies in order to attain their vision of a restored, functional as well as energy efficient building. We find that a variety of strategies influences these negotiations in favour of energy efficient plans, such as involving the heritage board in a very early stage, bringing in energy experts before the restoration plan is finalized and offering extra conservation measures in exchange for energy measures. Furthermore, we find that involving the public is crucial in the protection of heritage, especially when inner cities are affected. A lack of expert advice on energy matters can result in disappointing results in energy performance. Lastly, the correct implementation of energy measures, while protecting historical values requires good organization and coordination of the building activities.

Introduction

The conservation of our heritage buildings is a European wide policy objective. Historical buildings are not only works of art, but embody an important source of local identity and form a connection to our past. Protection agencies aim to preserve historical qualities for future generations. Their work is guided by restoration theory, a philosophy developed and codified in the course of the 19th and 20th century. European covenants, such as the Venice Charter, express shared views on the conservation and restoration of built heritage. Today, many users expect a building with modern comfort as well as a historical appearance. Moreover, new functionality is needed for building types that have outlived their original function. For example, how to reuse buildings such as old prisons, military barracks, factories, or railway stations? These new functions and new demands pose a challenge to restoration design and practices.

Another, perhaps conflicting EU policy objective is the reduction of energy use in the built environment, in order to reach climate policy goals. Roughly 40% of the consumption of energy takes place in buildings, either in the production or consumption phase. However, energy efficiency is especially difficult to achieve in the case of historical buildings, because of strict regulations aimed at protecting historical values. Recently, there has been growing interest in energy efficient restoration practices in the Netherlands, as is shown by the 'energy-neutral' restoration of Villa Diederichs in Utrecht, the 'Boostencomplex' in Maastricht and De Tempel in The Hague.

Although restoration of listed buildings is obviously focused on the preservation of historical values, with the pressing demands from EU climate policy the energy efficiency of historical building is fast gaining importance. Furthermore, users have rising demands regarding comfort, energy use and energy costs of buildings. Therefore, we need to find more effective ways of designing and organizing energy efficient restorations, simultaneously taking care of historical values, user functionality and energy performance.

In a two-year research project, called Energieke Restauratie, which took place between 2011 and 2013, we carried out a series of case studies of energy efficient restorations in the Netherlands. Mixed method research of 15 historical buildings in the Netherlands that have recently undergone an energy efficient restoration forms the database for this study. In our research we study both technical issues and social practices. We apply actor-network theory, especially script analysis, to analyse these restoration projects.

Literature

Conservation of historical values is often studied from a heritage viewpoint. Recently energy use, energy efficiency and the consequences of restoration for the physical state of the building have been taken up as a research topic. Several studies investigate problems with building physics, such as ventilation, moisture and material deterioration (Bidner et al. 2003:1133-1141; Cantin et al. 2010:473-484; Hanna 2002:1-10; Schellen 2002). Bidner found that the increased heating and improved isolation of a medieval castle, combined with a considerable growth in the number of visitors, resulted in severe moisture problems. Cantin et.al. studied ten cases in France, suggesting that older buildings can perform surprisingly good on energy-efficiency.

A second line of research concentrates on energy retrofit, which delivers important technical details on restoration projects (Ascione et al. 2011:1925-1936; Bin and Parker; Schellen 2010) .

A third approach is focusing on the role of historical buildings in the city (Akkar Ercan; Bullen and Love 2010:215-224; Del Saz Salazar and Montagud Marques 2005:69-77; Doughty and Hammond 2004:1223-1233; Larkham 1996:329; Townshend and Pendlebury 1999:313). For example Townshend & Pendlebury analyse the evaluation by the public of two historic neighborhoods in Newcastle. Ferrante, Mihalakakou and Odolini also take up embeddedness of historical buildings in a wider city area. They report a combination of area development and energy performance in their study about the rehabilitation of an industrial urban area in Legnano, Italy. (Ferrante et al. 1997:577). However, these primarily technical studies do not include social processes in their description. The present paper places precisely these processes centre stage.

Regarding strategies, we refer to the work of Hommels in Unbuilding Cities (Hommels 2001:221), where she describes the 'unbuilding' of three large, complicated city planning projects. Hommels mentions three strategies to strengthen the obduracy of buildings: continuity with the past; stressing the age of a particular urban design and reference to investment. We took this as a starting point for our analysis. In our discussion section we focus on ten strategies that were used to create and maintain the obduracy of historical buildings.

Theoretical approach

Science and Technology studies (STS) describe technological development as the result of an ongoing process of negotiation and framing by social groups. A certain technical artefact, such as a heat pump, is in this view not a neutral piece of machinery, but instead is produced and reproduced by the actions of a multitude of interested parties. In the same way, a historical building and its preservation is the result of the activities of such a network of actors. In actor-network theory the heterogeneous network consists of human and non-human actors, which means that materials, documents and other things also are supposed to have agency, i.e. influence actions of others. The actors in the network have economic, social, political, or aesthetical attachments to the objects and to each other. The quality and quantity of these attachments determines the strength of the network, and thereby – in our cases – the survival of the historical building.

Human actors enter the scene with a frame in their mind, a picture of the result they want the project to reach. Subsequently they then try to arrange other actors and actants in order to realize this goal. These actors use diverse negotiation strategies to get their restoration design approved by the heritage board. However, overflows can occur; other actors with opposing views enter the scene. For example, the municipality does not grant the license for the restoration.

An important concept in our study is obduracy, or resistance to change, which is also present in historical buildings. In this case we need to protect obduracy, to preserve historical values of the buildings. Creating new attachments and strengthening existing attachments can strengthen obduracy of such buildings. This paper investigates negotiation strategies used in restoration processes. It provides an analysis of the cooperation of heritage protectors, architects, energy-advisors and users in the design of restoration plans. It ends with recommendations to improve the energy efficiency and thermal comfort of historical buildings. Findings pertain to communication with the heritage board, cooperation with energy experts, organisation of the restoration process, and involvement of the public.

The remainder of this paper is organized as follows. After presenting the methods in the next section we present short portraits of five cases that form the basis of my argument. Then we present an analysis of the results. We conclude with a discussion of theoretical and practical implications of my research.

Materials and methods

We evaluated five restorations of historical buildings, where the initiators had a relatively high ambition regarding energy efficiency. Cases were chosen according to two criteria: a high-energy ambition and accessibility. In two cases the project was brought to our attention by the provincial heritage board (Nieuweschans, Kolham), one case was a national prize winning project (Driebergen), in one case an architect suggested the project (Franeker) and in one case it was brought forward by Natuurmonumenten (Dutch organisation for natural heritage). Our research brought us to very different buildings, ranging from a former train station, a hospital, a prison, military barracks, (church activities) building, a farm, and a residential block to a water tower.

We focused on negotiations and interactions in the restoration process and investigated the technical results of the restoration concerning energy use, comfort and building conservation. In each case we interviewed important actors in the restoration process, such as the architect, energy-advisor, heritage board member, owner and/or user of the building. In total 12 interviews took place. The interviews were transcribed and coded with the aid of NVivo.

Technical information was gathered by site visits, preferably in the presence of the architect and/ or the user of the building. Furthermore, we performed technical evaluations, concentrating on energy use and possible damage to historical values. Blueprints, thermal images and the actual use of energy in KWh's formed the basis for these evaluations.

Relevant archival records were studied, to get an impression of the development of the building through time. What imprint did former users leave on the building? The formal licensing documents shed light on formal side of the juridical procedures.

In this article I draw on the findings in the following cases:

- Library, Franeker
- Stable and Coach House, Eerde
- Villa Diederichs, Driebergen
- Trainstation, Kolham
- Military Police Barracks, Nieuweschans

Five cases

In this section vignettes of five cases are presented, evaluating the restoration regarding process, historical values, user functionality and energy performance. Every case is briefly introduced, then new functions and energy measures are described, the vignettes conclude with actor evaluations of energy efficiency and preservation of heritage values. Furthermore, cases are compared by categorizing the strategies that are applied in the restoration process. In the discussion section we suggest several 'obduracy strengthening strategies', which are used in the restoration process.

1. Military Police Barracks, Nieuweschans

Restoration of the former military barracks in Nieuweschans, a small town in the North of the Netherlands, was in full swing in 2012. The barracks was built in 1918 in 'Interbellum' style, containing two dwellings, an office and three storerooms. In the 1970s the walls on the ground floor were removed to create an open plan gallery. The present owners initiated an energy efficient restoration. They want to use the building as their dwelling, but also make room for a gallery, a bed & breakfast and a painters' workshop. The restoration plan proposed a new use of the old garage and restored the compartmentalized structure of the building in order to decrease energy use. The former garage now houses a spacious kitchen.

Case 1
Military Police Barraks, Nieuweschans

Restoring the former black roof tiles brought back some of the earlier visual impact of the building. This also created a negotiation space for licensing the mentioned thermal solar collectors. Energy measures were comparatively moderate, comprising of a thermal solar collector and the fitting of floor heating and thermal insulation in the radically redesigned annex.

Heritage professionals positively evaluate the preservation and repair of historical values. Although the functional changes seem promising the present user has yet not fully realized his energy ambitions. We suggest that the absence of expert energy advice is responsible for this gap. Negotiations with the heritage board went fluently; repair of historical values was met with approval of new energy technologies.

2. Public Library, Franeker

An important Jugendstil building in Franeker, dating from 1909, was formerly used for activities organized by Roman Catholic youth. After the restoration in 2003 the building houses a public library, offices, a shop and a welfare cafe. The restoration plan was from the beginning geared at the new uses, including improving day lighting, creating offices and public spaces.

The energy measures were rather modest, but carefully integrated in the building. A host of stakeholders were involved in the project, such as the shop owners in the neighbourhood, the church opposite the building (also the former owner). The municipality was very active in involving all of these stakeholders in a sounding board and secured funding for the project.

Heritage professionals consider the result of the restoration as excellent; the public chose the library as the most beautiful library in the Province of Fryslân. However, the present users have some critical remarks, both on the functionality and the energy performance of the building. The high amount of electricity used is presumably due to the inferior heat pump installation. Noise, drafts, lack of functionality of the former hallway, difficulties with access due to multiple steps and the lack of storage space are other user criticisms.

Case 2
Public Library, Franeker

Case 3
Villa, Driebergen

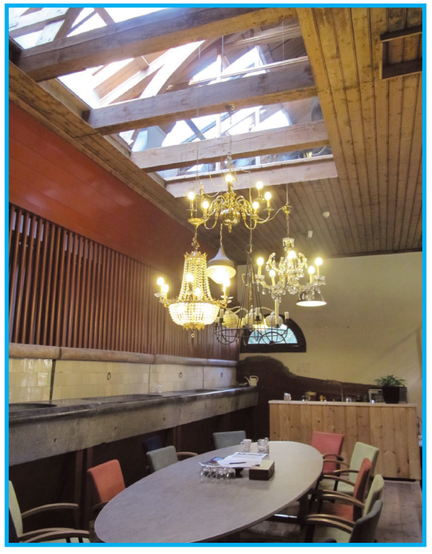
3. Villa, Driebergen

In Driebergen the first 'energy-neutral restoration' in the Netherlands was carried out. The villa from the 1920s was originally built as a dwelling for the general secretary of the municipality. When the widow of the secretary died, the municipality wanted to sell the villa. The sale was set up as a restoration design competition, aiming at an energy neutral building. A host of external energy advisors was brought in to design the energy plan. The energy measures involved substantial investments. Luckily, the municipality was able to secure extra funding for the project.

The architectural quality of innovative solutions used led to the nomination for a national architecture prize in the Netherlands.

The energy-neutral restoration is met with mixed feelings by conservationists, because they feel some important characteristics have been lost. The ambition to reach energy neutrality put a lot of pressure on the process; the heritage board is quite outspoken that this is surely not the best way to tackle energy efficient restorations. The functionality of the new building however is very good, the new annex housing a kitchen and expanded sitting room make the old villa a comfortable and roomy dwelling. The same annex also incorporates a cellar, in which the substantial installations find a place. However, energy results up till now do not completely confirm the energy-neutral ambitions.

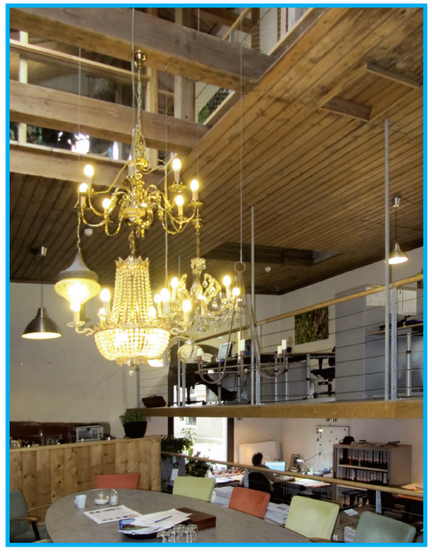
Case 4
Coach House, Eerde



4. Coach House, Eerde

A coach house and stables in Eerde, built in the first half of the 19th century, have been restored and given a new use for the regional office of Natuurmonumenten. Energy measures include a heat pump, lighting measures and insulation. Clever architectural solutions comprise bringing in light from a large breakthrough in the backside roof; and create well-lighted working places on a raised floor.

Heritage professionals consider the result of the restoration excellent, and the present users are very satisfied with the beautiful and functional building. Very clever architectural solutions have been used 'to bring people to the daylight, instead of the other way around'. However, some improvements would be welcome, as the users report a high electricity bill, presumably due to the over dimensioned heat pump. Also the coach house has a serious moisture problem, which results in the plaster falling of the walls repeatedly. Negotiations with the heritage board were encouraged by involvement and communication from the beginning of the project.



5. Station Building, Kolham

Along the former Woldjer-railway eight stations were built in 1929, designed in the style of 'zakelijk expressionisme'. Six of these stations are vanished, but the building in Kolham was remarkably well preserved. The restoration was initiated and carried out by the present owner and user, an architect with a high energy and sustainability ambition. Because of his profession and expert knowledge he was able to maintain a good relationship with the heritage board that was rather critical to the first restoration plans.
The proposed energy measures were far reaching and involved considerable changes to the building. In order to get a license to carry out the restoration, some alternative measures had to be proposed by the initiator.

The result of the restoration is expected to be adequate by heritage professionals. However, the architect-owner is still looking for ways to incorporate more energy-producing units on new adjacent buildings, because his high-energy ambitions are not yet realized.

Case 5
Station Building, Kolham

Obduracy strengthening strategies

The three strategies to strengthen the obduracy of buildings suggested by Hommels (Hommels 2001:221) served as starting point for the identification of further strategies in our cases. The first strategy, *continuity with the past*, is primarily helping with negotiation: constructing convincing arguments to strengthen the case for preservation of a building. The second strategy, *stressing the age of a particular urban design*, concerns on the one hand a juridical procedure to apply for a listed building status, while on the other hand communication with the public is involved. The third strategy, *reference to investment*, again provides arguments to strengthen the case, this time tying in financial and social capital.
These strategies have a function in stabilizing the heterogeneous network by creating more attachments and by 'freezing' a situation in a formal building license. On the basis of my research we suggest further strategies, **see table 1**. The added strategies are discussed in the next subsections.

Embedding in wider urban framework

We propose to add the notion of 'embeddedness' of the building in the wider urban framework to this strategy **(table 1, 2c)**. Especially in Franeker the historical urban structure was improved in the architectural restoration plan, which added a substantial annex to two sides of the building and created a new alleyway to the nearby shopping street. This design served to get the municipal actors and the local commercial parties more firmly on board.

Financial arrangements

Financial instruments, such as subsidies, obviously have a stimulating role, as can be seen in the cases Franeker and Driebergen **(table 1, 3c)**. In both cases subsidies had been obtained for the project. Apart from the direct benefit of subsidizing energy efficiency measures, this also had the effect of posing deadlines for completion of the project. This caused a lot of stress, but a deadline can also keep necessary pressure on a project.

Table 1, Obduracy strengthening strategies

1.	Continuity with the past	• Stressing the original ideas, embedded in the design • Positioning the structure as 'historical exemplar' • Insisting on lasting value of structure.
2.	Stressing the age of a particular urban design	• Registration as a monument • Calling it monumental in public communications • Stressing embeddedness of building in wider urban structure
3.	Financial aspects and (earlier) investments	• In a financial sense; such as vested interests • In social terms, as when cutting through a neighbourhood. • Subsidies and sponsors
4.	Attract new users	• Propose new functionalities
5.	Strengthen network	• Involve new stakeholders • Early involvement of heritage board • Active role of municipality
6.	Facilitate changes in the building	• Functional changes • Improvement of energy efficiency
7.	Organisation & coordination	• Building team • Expert advice on energy

Securing investment in a financial sense was a necessary condition in Eerde, Franeker, and Driebergen. The functionality, regulation and money needed in Franeker served to side-track the original owner, next the possibility of subsidies attracted new actors with a more positive attitude towards heritage conservation. Several subsidies significantly sped up the process by imposing deadlines. In Eerde a clever positioning of different budget categories was necessary to secure money for the project. This included framing the project as 'necessary maintenance', instead of restoration. The money, that would normally have been set apart for maintenance, could now be used for the restoration. In Driebergen actors such as the Province of Utrecht secured the project by subsidizing the restoration.

Involvement of stakeholders

Involvement of the public, both the general public as well as interested parties, proves to be a very important strategy in potential contentious projects, such as Franeker **(table 1, 5a)**. In this case the stakeholders, such as the neighbours and the shopkeepers in the nearby shopping area were involved in two ways. Firstly, a 'sounding board' was set up, that had to come to terms on the best way to restore the building. Secondly, when the plans were ready to apply for a building license, the architect personally approached all the neighbours. In this way he convinced the neighbours of the qualities of his design, consequently no one objected to the building plans, which saved a lot of time in the procedure. This was necessary to secure an important extra subsidy, as is argued in the next paragraph.

Involve heritage board & municipality

Informing the heritage board in an early stage was an important success factor in the cases of Eerde and Franeker **(table 1, 5b)**. As the agreement of the heritage board is necessary to obtain a building license, the board has to be convinced of the appropriateness of the proposed restoration and energy measures. This runs counter to the often-expressed view that it is best to present the restoration plan only when fully developed.

Examples of ways to inform and involve the heritage board include the organisation of a meeting with heritage officials in the early stages of the process. In a dilapidated building a careful presentation of the proposed result of the restoration plan carries great effect. It shows the building as it can become, contrasted to the sorry state it is in at present. Another strategy is early communication between different government bodies. For example, in Franeker the municipal officer informed the heritage board very early. He considered this a very important factor in securing their cooperation. The role of the municipality is often under-estimated, however their cooperation can be crucial in solving legal and financial matters.
When communication is neglected, this can cause difficulties. For example in Driebergen the heritage board was approached after the competition for energy neutral restoration plans had taken place. This meant that the heritage board did not have the change to influence the criteria for the competition beforehand. They did try to prevent damages to the historical values as much as possible, but would have preferred to be involved in an earlier stage.
A last sub strategy in this category is to negotiate 'energy favours' in exchange for extra heritage protection measures. For example, in Kolham the owner/ architect entered the licensing procedure as a negotiation, positioning his arguments strategically, keeping in mind a 'fall back'-position. Another example of applying a strategic approach is Nieuweschans, where the gesture of re-installing black roof tiles was used as a means to get permission for the thermal solar collector and roof windows.

Using a 'building team' approach

When the initiator has a high-energy ambition the building team approach can be efficient in drawing together all the necessary knowledge in an early stage (table 1, 7a). Close cooperation between architect, initiator, energy expert and heritage board proved crucial in the case of Driebergen, a complicated project that took a long preparation time. In this case the heritage board advised the winners of the competition to seek out as much expertise as possible. No less than six parties were involved in designing and coordinating the project: OPAi, energy advisor; ZECC, architect; Bouwvrouw, building coordinator; Hagen, energy advisor; a building physics advisor, and an engineering bureau. The result was that on all aspects the best advice was obtained, coordinated by the Bouwvrouw.

In Nieuweschans there was unfortunately no agreement between the owners and architect about the organization of the project. The architect would have preferred a project team, which can bring together expertise in an early stage, thereby preventing costly mistakes.

Energy expertise

In all our cases we found that designing an energy efficient restoration requires specific energy expertise **(table 1, 7b)**. In the case of Franeker, the architect (and his co-workers) possessed considerable expertise, which led to a design that could be followed up by the engineer. However, the chosen engineer lacked experience with larger projects and had no prior experience with the specific energy installations used. This circumstance led to a lot of difficulties in the actual building phase.

Another case that underscores the need for incorporating energy expertise in an early stage is the Military Police Barracks in Nieuweschans. Here the architect advised the initiator to seek out energy specialists, however the owner decided to act on the information he could find himself on the Internet. On top of that, the hired building contractor lacked expertise and experience both on restoration and energy efficiency. The end result is a building that does not fulfil the high-energy ambitions of the owner. A monitoring project is now set up, to find out how improvements may be made in a later stage.
Our cases suggest that it is very important to bring in both the energy experts and the heritage board very early in the planning process.

Conclusion

Strategies to maintain obduracy of buildings used in restoration projects appear to be primarily concerned with appreciation of historical values by concerned parties including owners and public, early communication between stakeholders of the project and cooperation between experts. Negotiation processes, focused on energy use, user demands and historical values, are important to attain satisfactory restoration plans. The organisation of the building process would profit from a building team approach, where cooperation between experts and hands-on experience is fostered. Recurring problems concerning specific energy technologies, such as heat pumps, can be due to poor cooperation between experts in the design stage, and/or lack of aftercare by the engineering companies. Lack of knowledge by the commissioner, the user, as well as engineering companies prove a weak point in the implementation of heat pumps.

On the basis of this preliminary study we conclude with five practical recommendations:

First recommendation is the setting up of a building team, where architect, energy experts and heritage advisors take part. In Driebergen experience showed this to be a fruitful way to approach historical buildings.

Second recommendation is to inform and involve the general public, direct neighbours and other stakeholders in an early stage.

Third, there is a clear need for new and adequate financial instruments. These could stimulate more cases of energy efficient restorations.

Fourth, user functionality is very good taken care of by the architects that were involved in the cases we studied.

Lastly, probably the most important recommendation is to involve qualified energy experts in an early stage of the project. Energy advice is often sought late or not at all, and in other cases the engineering does not live up to its promises. This needs to be improved urgently.

References

Akkar Ercan, Müge, *Challenges and Conflicts in Achieving Sustainable Communities in Historic Neighbourhoods of Istanbul*. Habitat International In Press, Corrected Proof.

Ascione, Fabrizio, Filippo de Rossi, and Giuseppe Peter Vanoli 2011 Energy Retrofit of Historical Buildings: Theoretical and Experimental Investigations for the Modelling of Reliable Performance Scenarios. *Energy and Buildings* 43(8):1925-1936.

Bidner, Thomas, Barbara Lanz, Sonja Mitterer, Arno Recheis, Walter Hauser, C. Franzen, and Peter W. Mirwald, 2003 Material Properties, Room-Climate Measurements and Building History—an Interdisciplinary Project to Set the Conditions of Restoration and Re-use for the Fortress of Kufstein, Tyrol, Austria. *Building and Environment* 38(9-10):1133-1141.

Bin, Guoshu, and Paul Parker, Measuring Buildings for Sustainability: Comparing the Initial and Retrofit Ecological Footprint of a Century Home – the REEP House. Applied Energy In Press, Corrected Proof.

Bullen, Peter A., and Peter E. D. Love, 2010 The Rhetoric of Adaptive Reuse Or Reality of Demolition: Views from the Field. *Cities* 27(4):215-224.

Cantin, R., J. Burgholzer, G. Guarracino, B. Moujalled, S. Tamelikecht, and B. G. Royet, 2010 Field Assessment of Thermal Behaviour of Historical Dwellings in France. *Building and Environment* 45(2):473-484.

Del Saz Salazar, S., and J. Montagud Marques, 2005 Valuing Cultural Heritage: The Social Benefits of Restoring and Old Arab Tower. *Journal of Cultural Heritage* 6(1):69-77.

Doughty, Mark R. C., and Geoffrey P. Hammond, 2004 Sustainability and the Built Environment at and Beyond the City Scale. *Building and Environment* 39(10):1223-1233.

Ferrante, A., C. Odolini, and G. Mihalakakou, 1997 The Rehabilitation Investigation of a Historical Urban Area. *Renewable Energy: An International Journal* 10(4):577.

Hanna, R., 2002 Environmental Appraisal of Historic Buildings in Scotland: The Case Study of the Glasgow School of Art. *Building and Environment* 37(1):1-10.

Hommels, Anique Marie, 2001 Unbuilding Cities: Obduracy in Urban Sociotechnical Change. S.l.: .

Larkham, Peter J., 1996 Conservation and the City. London etc.: Routledge.

Schellen, H. L., *2010 Klimaat En Behaaglijkheid in Monumentale Gebouwen*. reader BK 6010.

Schellen, H. L., *2002 Heating Monumental Churches
Indoor Climate and Preservation of Cultural Heritage.* Ph.D. dissertation, Technische Universiteit Eindhoven.

Townshend, Tim, and John Pendlebury, 1999 Public Participation in the Conservation of Historic Areas: Case-Studies from North-East. *Journal of Urban Design* 4(3):313.