

Rebo

Strategies for Sustainable Renovation – Focus on the Period "Folkhemmet"

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Brief Report on Research | 2014: nr 1



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Background

The Need for Renovation

About 56% of all investment in today's housing construction involves remodeling, renovation, and maintenance (SB, 2011). Remodeling and renovation are also a great challenge in terms of the requirements of various directives and regulations, such as reducing energy consumption and increasing accessibility, and at the same time goals such as social sustainability and economic profitability must be achieved.

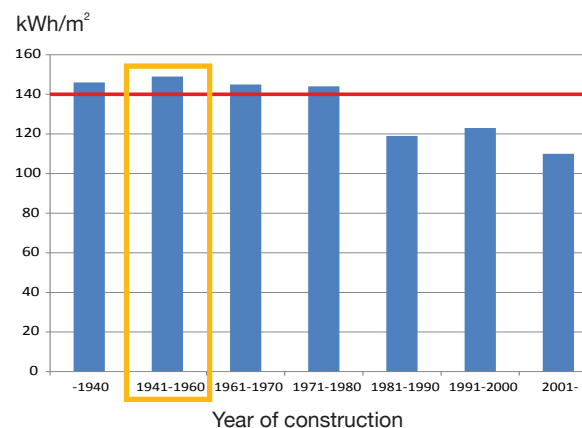
Much of Sweden's housing stock is apartments, and 26% of these (660,000) are in multi-family buildings built in the Folkhem era, 'People's Home' (1941-60). This period is often considered the golden era of twentieth-century Swedish architecture and an international model to emulate (Rudberg, 1987). The buildings were designed to form cohesive neighborhoods, with great care for the quality of the home and a high level of craftsmanship in the treatment of materials and attention to detail. These are enduring qualities that are still appreciated to this day. Buildings from the Folkhem period are considered valuable from a cultural historic, architectural, and social perspective.

Apartment buildings from that era are now due for comprehensive renovations to address wear and tear, high energy consumption, inadequate accessibility, poor indoor climate, etc. While the housing projects of the 1960s and 70s are being given a great deal of attention today, there is a shortage of expertise on the specific challenges of renovating apartment buildings from the Folkhem period in a sustainable way.

Goal

Rebo is a research project with the goal of developing strategies to support decision-making for sustainable renovation of apartment buildings from the Folkhem period. The point of departure is to weigh environmental performance, energy efficiency, and cost-effectiveness with cultural historical, architectural, and social values when making decisions about building renovations and alterations. The project was undertaken primarily in 2011 and 2012.

The goal of this report is to give a summary account of the Rebo project, and to share the results with the construction industry. Our target audience is stakeholders in the construction industry who in one way or another are involved in remodeling and renovation of apartment buildings from the Folkhem period.



Average energy use for heating and domestic hot water in apartment buildings year 2011 (Energimyndigheten, 2012).



Apartment buildings from the "Folkhem" period. Above: Klackerup in Halmstad. Middle: Kyrkbyn in Göteborg. Below: Staircase Klackerup.

Method and Execution

A Collaborative Arena

In order to address the many at times conflicting objectives and expectations in the renovation of existing housing, expertise from a broad spectrum of participants is needed, especially in the early stages of a project. Rebo has therefore been conducted as a collaboration between researchers at Chalmers University of Technology and partners from the construction industry (housing companies, an architect firm, technical consultants, a construction company, and representatives from the Swedish Union of Tenants, the Gothenburg City Museum, the City of Gothenburg Office of Planning, and the Västra Götaland Region).

We have made use of a so-called arena model—a collaborative arena based on interdisciplinary didactics with participants from a variety of backgrounds. A key concept was for the arena to bring together people who don't usually meet in the early stages of a renovation project.

The participating partners have played active roles, each contributing their own expertise and experience, and together with the researchers defining the problems and developing solutions. The researchers have been primarily responsible for the organization of the project, coordinating the activities, and the documentation.

Workshops and Case Studies

In the arena we conducted seven workshops with various themes related to renovation, and went on a group field trip to Copenhagen, where we studied renovation projects from the same era as Sweden's Folkhem.



Photo: Paula Femenias
Partners in the collaborative arena on the way to a study visit in Halmstad. The conference bus offered opportunities for short presentations and exchange of experiences.

We have also worked in smaller groups with case studies of housing developments that are owned and managed by property owners in the project: Torpa and Långängen in Gothenburg and Hökarängen in Stockholm. The three areas are all being planned for renovation, each with a different set of conditions and needs. Work on these cases has been conducted under the direction of the owners in collaboration with the researchers. In the case of Torpa, most of the members of the collaborative arena participated, and it can therefore be considered our primary case study.

Rebo Model

Parallel with their work in the arena, the researchers have developed a conceptual framework, the Rebo model, with the objective of defining, describing, and evaluating important and often overlooked qualities in the housing stock of the Folkhem period. The Rebo model is an attempt to find methods for “measuring the immeasurable.” We give qualitative descriptions of several of the qualities found in apartments of the period in question that must be addressed if one is to achieve an enduring, sustainable renovation.

We developed the model because there was no other model available that could give a comprehensive description of the housing stock that included not only technical, environmental, and economic qualities, but also social, cultural historical, and architectural ones.



Study trip to Denmark



Case Studies

Torpa

Torpa was one of the first housing developments in Gothenburg built according to the ideals of the Folkhem period. The area was built by Bostadsbolaget, which still owns and manages the property. Torpa is classified as of national importance to the preservation of our cultural heritage because of its coherent design surrounding a central green area. The façades are uniformly designed with either yellow brick or pale stucco, and thoughtful detailing.

The development comprises about 600 apartments, most of which are one-bedroom units of about 50 m². The area is highly appreciated among its residents. Torpa is due for an immediate renovation, facing several problems that must be addressed, including: high energy consumption, leaking façades, moisture damage, poor indoor air quality, low standard in bathrooms and kitchens, inadequate electrical wiring capacity, and very limited accessibility.



That the tenants ask for a renovation illustrates an article in the newspaper Göteborgsposten 8 August 2011.



Torpa in Göteborg. Year of construction 1946-49. Architects: Nils Einar Eriksson & Erik Ragndal. Source: City Planning Department, Göteborg.

Area: Few changes have been made during the life of the building. Much of it is in the original condition.

Challenge: Renovating a desirable area where interventions to improve the technical performance of façades and to conserve energy must be weighed against the preservation of architectural and cultural historical qualities.

Question: Identifying long-term strategies: How should such areas be upgraded? In what order should the interventions be undertaken?

Participants: Almost all of the organizations that participated in the arena. Bostadsbolaget, which owns and manages the area, led the work with the case study, with support from the researchers.

Focus: The façades and the difficulty of balancing cultural historical and architectural qualities with energy efficiency, the desire to achieve good indoor air quality, and solutions that are practical in terms of property management.

Results: Strategy matrix (see page 9).

Långängen

Långängen typifies the architecture of the Folkhem period with its slender three-story buildings. The area comprises approximately 500 apartments, of which half are studios and the rest one- and two-bedroom units. It is now in dire need of renovation. Its central location, close to downtown and to new developments around Kvillebäcken, will eventually increase the attractiveness of living in Långängen. Familjebostäder owns and manages the property, and has a high level of expertise on technical issues, but is less confident regarding the social aspects of neighborhood renovation.

Area: Underwent renovation in the 1980s and 90s with little consideration for its architectural qualities.

Challenge: Earlier renovations have been undertaken sporadically; now a comprehensive approach is desired.

Question: What housing qualities does the area offer, how much might residents be willing to pay for them?

Participants: Familjebostäder, White Architects, the Swedish Union of Tenants, and researchers. White was responsible for the project management, with support from the researchers.

Focus: Dialogue with the neighborhood residents. Exploring the housing qualities and the residents' attitude toward the impending renovations.

Result: A deeper dialogue with residents (p 10).

Hökarängen

In Hökarängen we have a clear example of the Folkhem ideal of creating a neighborhood unit complete with plazas, services, and green space. The area was originally constructed for low-income residents and comprises approximately 3500 apartments, most of which have one bedroom. The area is well preserved, but stigmatized by a bad reputation that has been hard to shake. The bad reputation and small apartment size have led to a high level of transience and vacancy. The owner, Stockholmshem, is working to improve Hökarängen in a process that involves building on its original cultural, historical, and architectural qualities and working with social and environmental enhancements. Much of the conversation today is about how to renovate the façades.

Area: A large area, much of it in original condition, including details.

Focus: The area is highlighted as a good example. We took a field trip through the area.

Result: Inspiration from the working methods and the strategies undertaken.



Photo: Anna Sofia Wannerskog

Långängen in Göteborg. Year of construction 1950-53. Architect: Ragnar Dahlberg.



Foto: Liane Thuvander

Hökarängen in Stockholm was constructed 1949-51. Architect David Helldén. Renovation of windows goes on.

Results

The study results consist of a repertoire of examples worked through in our case studies that show working methods that can provide direct support for making decisions about renovation projects. The results also include experiences from working in a neutral collaborative arena—across organizational boundaries and among partners who seldom have an opportunity to sit down together and discuss concrete renovation issues. The hope was that each party could contribute expertise that would benefit other actors in the construction industry. Our work with case studies has been an important building block for illuminating a variety of the challenges involved in a renovation process.

Multiple Actors and Multiple Qualities

One of the most important results from the arena, and the one that was most appreciated by nearly all the project participants, was the broad mix of actors with expertise from various parts of the industry. The conversations held in the arena have generated a better understanding of various problems and aspects to look out for when renovating. It also became clear that the project gave companies timely access to expertise they were lacking.

"This has really been inter-disciplinary and a great learning experience."

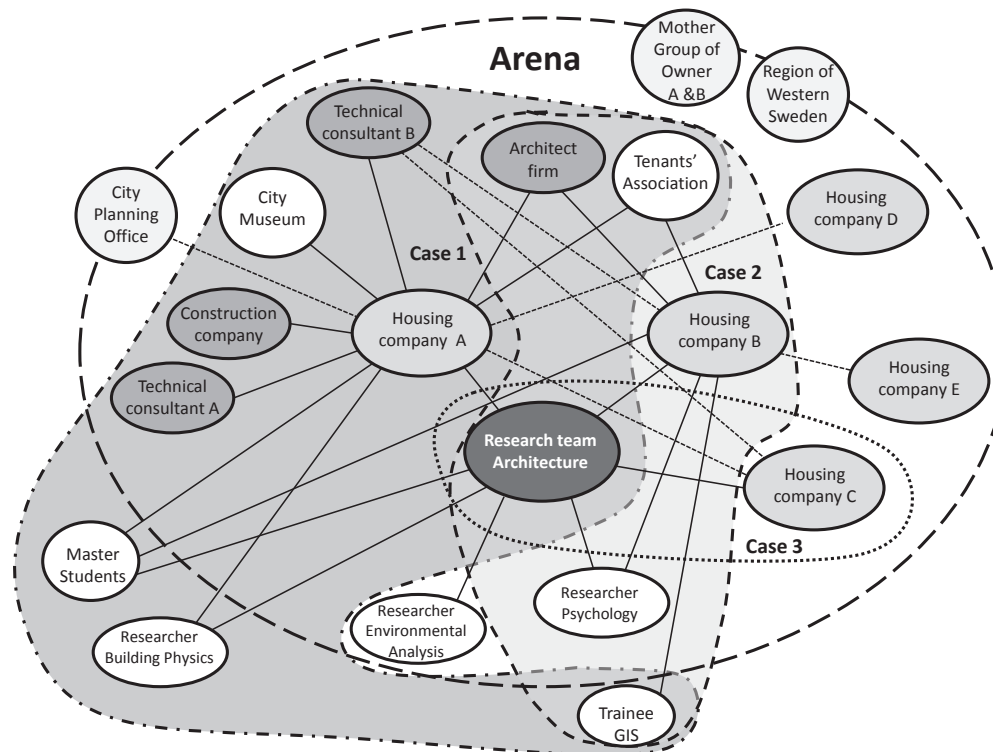
Further, the project has provided insight into the complex challenge of trying to satisfy everyone's interests, and taking a holistic approach, and understanding how shared issues require shared solutions.

"We were already clear on the technical part, but we realized afterward that that was the easy part of the challenge."

Not least, participation in the arena generated new contacts.

"It was very beneficial for me to be involved, met new people I will benefit from knowing in the future."

Actor network - how the different participants interact.



Strategy Matrix

"We now have a structure we can keep working from."

In the case of Torpa, we have developed a method for producing a basis for decisions that is comprehensive and provides a good overview of a renovation project from an early stage. The method is based on the conceptual Rebo model, and has been translated into an operative framework we call a "strategy matrix", with building technology components on one axis and influence factors/value areas on the other.

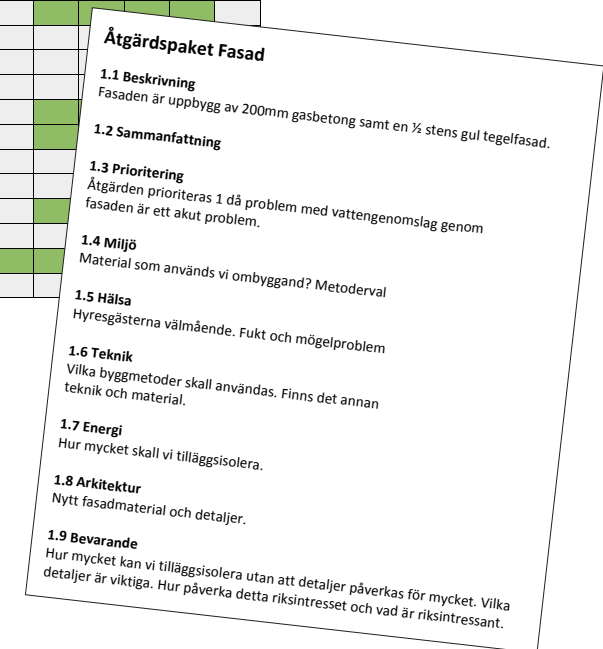
The goal of the matrix is to make it possible to quickly identify potential conflicts between different qualities, such as between cultural historical aspects and user comfort in relation to façade alterations, and to know when it's necessary to call in experts in certain fields.

The point of departure for Torpa was the aim of identifying possible technical solutions that would not conflict with conservation requirements, for example, and that were economically viable. Because fixing the leaky façades was a high priority, and because renovating them would impact almost everyone in the neighborhood, we chose the façades as the subject for further study in order to develop our methodology.

In the next phase of the project, we developed a document we called an "interventions package" that identifies various problems, solutions, and potential

Byggnadskomponent	Uppskattad livslängd	Beräknad livslängd	Teknisk prio	Miljö	Hälsa	Teknik	Energi	Arkitektur	Bevarande	Tillgänglighet	Arbetsmiljö	Framtida boende	Boendekostnad	Ekonomi	Hyresgästinflytande	Social konsekvens
Gestaltning område																
Utemiljö			3													
Husstomme			3													
Yttertak			3													
Fasad			1													
Ventilation			2													
El installation			2													
Värmesystem																
Tappvatten			3													
Avlopp			3													
Badrum			1													
Köksrenovering			2													
Stomkomplettering			3													
Ytskikt			3													
Radonåtgärder			1													
Brandåtgärder			3													
Allmänna utrymmen																
Hiss			-													

Strategy matrix with building technology components on one axis and value areas on the other.



Document template for the intervention package "façade".

conflicts. The interventions package describes each solution in relation to the others. The document is filled in by all of the participants and circulated among the group.

The strategy matrix works together with a description of the highest priority interventions from the interventions package to form a working method that provides on one hand a checklist of important aspects to remember and on the other a tool to help us see the big picture and understand relationships.

For further reading about the strategy matrix, refer to "Case Torpa" report, White Architects' final report (both in Swedish), and CESB conference article.

Deepening the Dialogue with Residents

The project in Långängen focused on social values. We worked with a method called “deepening the dialogue with residents” to more clearly integrate the user’s perspective into the renovation process and to get more stakeholders involved.

The dialogue process comprises four different steps: designing the consultation process and choosing the tools, gathering information from current users, compiling material, feedback, and following up. In order to gather information about the area today and about current users, we have employed a series of different methods:

A status quo description uses a variety of statistical data and results from prior studies conducted in the area to form a description of the neighborhood today. The status quo description of Långängen revealed, among other things, that the population of the area was lower than expected, with nearly half of the residents in the 25-44 year age group.

Intercept interviews, i.e. short interviews conducted on the streets of the neighborhood, indicated that two qualities are particularly important from the residents’ perspective: proximity to green areas and the charming character of the older buildings.

A questionnaire about housing qualities revealed, among other things, that the most important factors in determining residents’ overall satisfaction with their

apartments were how satisfied they were with the kitchen, the quality of daylight inside, and the sound insulation. The questionnaire showed that in preparing for renovations, it is important to provide residents with information about and influence over the project, especially the increase in rent. Choosing the right standard for the renovation was considered important by respondents, as was giving residents influence over aesthetic aspects (color, material, appearance).

During a *walking tour*, a number of impacted stakeholders (users, area administrators from the property management company, etc.) walked through the area together and discussed seven different places, the problems and challenges of each, and also their opportunities and positive aspects.

We presented the results of the questionnaire and the walking tour at a meeting of residents. Based on their feedback, we then conducted focus group interviews—several different residents interviewed together to get a deeper understanding of certain issues that had come up in the previous studies.

For further reading about the dialogue, refer to the series of reports “Deeper Dialogue with Residents in Långängen” and White final report (all in Swedish).



Stop 3. Close to the football ground.



Stop 6. Kitchen.

Pictures from the walking-tour in Långängen, examples of two places (stops). Problems and challenges as well opportunities and positive aspects were discussed.

The Rebo model

The Rebo model is designed as a checklist for making well-founded and integrated decisions early in a renovation process. At present the model is conceptual, complex, and most useful for research. The idea is to eventually make the Rebo model useful as a point of departure for describing the current conditions in a neighborhood that is facing renovation or further development. Property owners are thus seen as the primary users of the model, but it could be of interest to others as well. Property owners may perceive that some of the qualities of an area can be hard to quantify, or discover qualities they've never considered before.

Structurally, the Rebo model is built around eight quality areas: general description, technical description, environmental performance, architectural qualities, social qualities, cultural qualities, economic performance, and renovation process qualities.

Each of these areas is further divided into four levels of detail. The Rebo model refers to the eight overall quality areas as parameter level 1. In the second and third levels of detail, important areas of focus are grouped within each overall quality area. One objective has been for the fourth level of detail to consist primarily of measurable parameters.

For further reading, refer to "Integrated Sustainable Renovation Process: Focus on the Swedish Housing stock 'People's Home'," and in the report "Case Torpa" (in Swedish).

Value areas

PL1

General description

Architectural description

Cultural historical description

Social description

Technical description

Environmental description

Economic description

PL2

Maps and cadastral data
Management finances
Use and functions
Size and dimensions

Spatial organisation of the building
Perceived qualities of the building
Layout of the urban space

Building technological value
Historical value
Cultural and architectural historical value
Joy and experience value

Equity
Connection/Accessibility
Pride and sense of place
Cohesion
Living quality and health
Safety and security
Democracy, comprehension, action

Load bearing structural systems
Non load bearing envelope components
Interior
Supporting systems

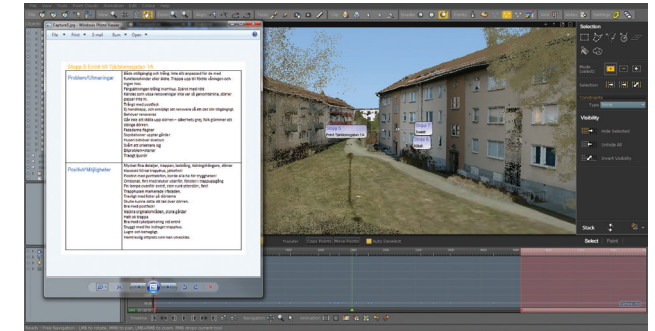
Metabolism of energy
Metabolism of material
Metabolism of water
Comfort and health
Green spaces/outdoor green structure
Transport

Social economy
Property economy

The figure illustrates the Rebo-models value areas for two levels of detail (PL1 och PL2).

Digital Visualization

In connection with the case studies, the strategy matrix, and the deeper dialogue with residents, a lot of different kinds of information are accumulated, which is important to the use of a holistic approach. An effective documentation and presentation of the material is needed to make it useful in support of decision-making.



Point cloud model from laser-scan together with results from the walking tour (software Bentley Pointools). The laser-scans were carried out by the company Terratec.

Throughout the project we collected information in a variety of ways, including reports, maps, tables, and images. We also conducted a laser-scan survey of Torpa and Långängen to test the communications potential of such tools.

For further reading, refer to the case study report for Torpa (in Swedish).

Reflections & Conclusions

The Rebo project brought together a number of construction industry stakeholders representing a variety of different areas of expertise that are all important to consider in a renovation project. These individuals are seldom able to sit down together around one table for a discussion.

Our work with case studies has been central to the project, and has made the issues explored in the study more concrete. All of the participants were engaged in the effort, but to different degrees depending on the case study. Since the case studies were not planned right from the start, the intense work with them did not begin until some way into the second year of the project. Nevertheless, we were able to develop methods that have been immediately useful for the participating organizations—the strategy matrix and the deeper dialogue with residents.

The strategy matrix helps provide structure for dealing with multiple qualities in a renovation process, and has great potential for supporting complex decision-making in preliminary studies at the start of a renovation project. Bostadsbolaget, the housing company that managed the Torpa case, considers the strategy matrix and the materials produced to be useful in their future work renovating buildings from this era.

The deeper dialogue with residents can illuminate social issues, enable various stakeholders to express their opinions, and identify potential problem areas. Experiences from the dialogue will provide the basis for future work with the renovation of Långängen.

Working with an interdisciplinary team takes time. It takes time to build the team, and time to administer to all the participants and satisfy their needs and expectations. As in other large projects, the conditions are constantly changing. Different representatives from a single company have participated at different times in order to contribute the most relevant expertise. In general, the participants appreciated the unusual mix of stakeholders that contributed expertise from a variety of different fields.

Working in an interdisciplinary team also demands clear communication about the role and responsibility of each team member, and a clear understanding of the project goals among all the participants, including those that join the project later in the process. Each individual participant needs to understand the whole picture to be able to contribute to the effort. At the same time, certain issues ripen over time, and it can take a while to build consensus around them.

Working with several cases simultaneously has meant that not every partner could participate in every case. Torpa may be seen as our primary case, since most of them took part in that one. At the same time, the Torpa case provides a clear illustration of the conflicts among cultural historical and architectural qualities, energy efficiency, technology and health, which is one of the issues on which the project was initially based. The case also demonstrates that different actors with different expertise must be engaged in the project from the earliest stages. Torpa showed how various interests

and stakeholders have varying degrees of support in legislation and regulations, and therefore varying abilities to influence the outcome of a particular decision about renovation.

In summary, we conclude that the Rebo project has:

1. increased knowledge of the renovation process and its need for expertise, with particular focus on the Folkhem period
 - increased understanding of the complexity of a renovation process in which decisions must be made based on the existing conditions
2. expanded the base of knowledge for making decisions about renovation through case studies
 - developed methods that are more general and can be applied in other projects: the strategy matrix and deepening the dialogue with residents
 - illuminated examples from which to learn: Hökarängen and Danish projects
3. contributed practical experiences of how one can organize a more effective collaboration in a renovation process
 - based on an interdisciplinary didactic
 - showed that a collaborative arena is an effective working method
 - established new contacts.

Looking Ahead

The housing stock from the Folkhem period, on which the Rebo project focused, is an important asset that must be included in the debate over renovation practice.

"A housing epoch that has almost been forgotten with all the focus on the 60s and 70s."

Sustainable renovation demands a holistic perspective from which to look for shared answers, and where various actors' differing viewpoints can be integrated early in the process. Sustainable renovation also demands a holistic perspective from which the built environment's various qualities may be viewed and respected to ensure that important qualities are not lost along the way. In this context we wish to highlight the value of the round table discussion as a method that ought to be incorporated early in every renovation project so that conflicts among various qualities and stakeholders can be worked out.

The Rebo project has carved out a number of interesting areas that can be further developed in the future.

The Rebo model in its current condition is extremely complex and therefore of most use to researchers. To become more useful in general practice, it needs to be further developed and simplified, and the links among the different quality areas need to be studied further.

The strategy matrix needs to be tested on more renovation projects. It also needs to be simplified, for example, to include checklists that can be used easily by actors not involved in the Rebo project.

Since we have only worked with a single interventions package, we have not had time for a full discussion of the more strategic question of in what order interventions should be undertaken.

One interesting path is to work further with various kinds of visualization to illustrate, for example, relationships, synergies, and conflicts among various quality areas that must be balanced when making decisions about renovation work.

In both cases, the strategy matrix and a deeper dialogue with residents are both needed to secure feedback to determine how applicable they are in other renovation projects.

Finally, we hope the Rebo project contributes knowledge that can be valuable when major renovation interventions are undertaken with other apartment buildings from the Folkhem period.

Liane Thuvanders and **Paula Femenías** research focuses on sustainable development of the built environment.



Liane Thuvander

Lianes research focuses on the implementation and communication of sustainable building knowledge in practice.

Among others she is interested in how visualization can support the decision-making process of alteration and transformation of the built environment.

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Paula Femenías

Paula forskar på new construction and remodeling from a development- and innovation perspective.

Her goal is to increase the knowledge about how the construction sector works and acts on goals such as low energy buildings and sustainable development.

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References

SB (2011). Fakta om Byggandet. Sveriges Byggindustrier: Stockholm.

Energimyndigheten (2012). Energistatistik för flerbostadshus 2011. ES 2012:05.

Rudberg, Eva (1987). Folkhemets bostäder - en svensk modell. Folkhemets bostäder 1940-1960. C. Engfors. Stockholm, Arkitekturmuseet: sid. 9-23.

Publications from the Rebo project

Homepage: <http://www.vgregion.se/rebo>

A slideshow from the study trip to Copenhagen can be found on: http://www.vgregion.se/sv/Ovriga-sidor/ReBo/ReBo/gen_akt/Studieresa-Kopenhamn/.

Torpa

Danielsson, A; Wannerskog, A S, Thuvander, L & Femenías, P (2013). Case Torpa. Arbetsrapport, Chalmers, Göteborg.

Femenias, P; Thuvander, L; Danielsson, A (2013). Integrated Strategies for Sustainable Renovation of Early Post-War Housing: The Case of Torpa, a Housing Area and National Heritage Asset in Sweden. Proceedings of the European Workshop, EWCHP, 16-18 September, Bolzano, Italy

Thuvander, L; Femenías, P; Danielsson, A & Wannerskog, A S (2013). Testing a multi-value

approach to support decision making in renovation in the pre-design phase: A housing area in Sweden from the 1940s. Proceedings of the Central Europe towards Sustainable Building conference, CESB13, 26th -28th June, Prague.

Långängen

Ottosson, C & Thuvander, L (2013). Fördjupat boendedialog i Långängen, Göteborg. Chalmers, Göteborg.

Wannerskog, A S (2013). Nulägesbeskrivning. Delrapport 1 i serien "Fördjupat boendedialog Långängen, Göteborg".

Andersson, K (2013). Genskjutsintervjuer. Delrapport 2 i serien "Fördjupat boendedialog Långängen, Göteborg".

Andersson, K (2013). Enkätundersökning. Delrapport 3 i serien "Fördjupat boendedialog Långängen, Göteborg".

Ottosson C & Walldin, V (2013). Gå-tur. Delrapport 4 i serien "Fördjupat boendedialog Långängen, Göteborg".

Andersson, K (2013). Fokusgruppsintervju. Delrapport 5 i serien "Fördjupat boendedialog Långängen, Göteborg".

Rebo

Femenías, P & Thuvander, L. (forthcoming). Strategies for integrated and sustainable renovation: A stronger voice for architectural knowledge.

Manuscript accepted for publication in Architecture and Sustainability: Critical Perspectives, (eds) Khan, Ahmed Z., Allacker, Karen, Verbeeck, Griet.

Thuvander, L; Femenías, P; Mjörnell, K & Meiling, P (2012). Unveiling the process of sustainable renovation. Sustainability. Vol 4, Iss 6, pp 1188-1213.

Thuvander, L; Femenías, P & Meiling, P (2011). Strategies for an Integrated Sustainable Renovation Process: Focus on the Swedish Housing stock 'People's Home'. Proceedings of the 2011 World Sustainable Building Conference October 18th-21st, Helsinki.

White (2013). Strategier för integrerad hållbar renovering av bostadsbestånd: Fokus på perioden folkhemmet. Slutrapport, ARQ 7:2011.

Related degree projects

Qian Wang: New in old. Sustainable transformation of Västra Torpa, within the Master Program "Design for Sustainable Development" at the Department of Architecture, Chalmers University of Technology, 2012.

Wenyue Gao & Peng Zhang: Sustainable renovation projects of residential buildings. 5 examples in Austria, within the Master Program "Design for Sustainable Development" at the Department of Architecture, Chalmers University of Technology, 2011

Wenxuan Zhang & Jingjing Song: Beyond Green within the Master Program "Design for Sustainable Development" at the Department of Architecture, Chalmers University of Technology, 2011

Thanks!

The project has been financed by the Swedish Research Council Formas and the Swedish Centre for Innovation in the Built Environment (Formas BIC), the Centre of Management of the Built Environment (CMB), Bebo, and the companies and organisations listed below. Especially we like to thank all the participants in the collaboration arena who contributed with valuable knowledge and experiences:

Bengt Dahlgren AB

Jakob Pontusson
Maria Skarrie

Göteborgs stads bostadsaktiebolag

Leif Andersson
Marcus Götberg

Chalmers Arkitektur

Anna Sofia Wannernskog
Annika Danielsson
Kristin Andersson
Liane Thuvander
Paula Femenías
Pär Meiling

Chalmers Energi och Miljö, miljösystemanalys

Birgit Brunklaus

Familjebostäder i Göteborg AB

Sara Hamon
Liselotte Heintz

Halmstad Fastigheter AB

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Ingrid Horner
Anneli Permer

White Arkitekter AB

Anna Reuter Metelius
Camilla Ottosson
Johanna Engberg
Ulla Antonsson
Ulrika Nilsson
Viktoria Walldin

European Context

The Rebo project is also a part of an European research project within the Eracobuild framework: ReCoRe - Energy efficient, resource conserving and differentiated renovation of historic European building stocks. It is composed of 3 national programmes with partners from ETH Zürich in Switzerland, TU Vienna in Austria and Chalmers in Sweden.

More information: www.recore.info



Centre for Management of the Built Environment

CMB is Sweden's principle forum for management issues relating to the built environment. CMB was established in 1998 as a long-term collaboration between Chalmers University of Technology and the built environment sector in Sweden. Our overall objective, in a rapidly changing environment, is to promote a modern approach to management that contributes to a sustainable built environment.

For more information: [**www.cmb-chalmers.se**](http://www.cmb-chalmers.se)