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Energy Retrofits with TES Energy Façade as an Opportunity for Architectural Regeneration

Yrsa Cronhjort
Researcher
Aalto University School of Arts
Finland

Frank Lattke
Lattkearchitekten
Germany

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Energy Retrofits with TES Energy Façade as an Opportunity for Architectural Regeneration

Yrsa Cronhjort
Researcher
Aalto University School of Arts
Finland

Frank Lattke
Lattkearchitekten
Germany

Abstract

The European built environment is in the need of major renovations and urban renewal. The largest building stock derives from the Post World War II - era and now requires interventions. Building envelopes, floor plans and building services are at the end of their lifespan. Concurrently we should decrease greenhouse gas emissions and enhance resource efficiency. The energy efficiency of existing buildings must be increased but in a cost efficient way. TES Energy Facade, using prefabricated, timber based elements for improving the energy efficiency of the building envelope, is one response.

This paper presents and analyses the design of three refurbishment cases, two Finnish and one German realized between 2011 and 2013. All three buildings were originally built of concrete with a bookshelf frame and the modernization process included a facade retrofit, additional internal repair works and building service upgrades. In common was also a striving for added values for both the inhabitant and the building owner. But the architectural concept for the facade retrofit and the application of TES Energy Facade varied.

Based on presented projects, TES Energy Facade is a viable option for renewing and enhancing the quality of buildings and built environments. The method, based on a continuous digital workflow and prefabrication, forms a functional basis for a lean and industrialized facade retrofit process. It has potential for large scale applications and replication. Are we architects ready to tackle the challenges of refurbishment and urban regeneration; are we bold enough to redesign and rebuild, revise the ideals of the modern town?

Keywords: Energy efficiency, facade retrofit, TES Energy Facade, refurbishment, wood

Acknowledgments: The TES Energy Facade – method has been developed in two international Woodwisdom-Net projects: *TES Energy Facade* 2008-2010 and *smartTES* 2010-2013 coordinated by Dipl.Eng. Frank Lattke, Technische Universität München. TES demonstrations including cases Virkakatu, Oulu, Finland and Grüntenstraβe, Augsburg, Germany have been realized within the framework of the EU Fp7 funded project *E2Rebuild* 2011-2014, coordinated by Christina Claeson-Jonsson, NCC SE. Research leading to this publication has received support from the KIINKO Real Estate Education.

Introduction

Europe is currently facing a growing demand for refurbishment and increased energy efficiency of our existing buildings. In Finland alone the current renovation debt is between 30 and 50 milliard euros[1] with over one fifth of the residential apartments being located in concrete buildings from the late 1960´s and the early 1970´s. The buildings are typically situated in suburbs, consisting of a homogenous building mass and thus forming a monotonous townscape. The challenge and scale is pan-European. (Figure 1) Often these environments are perceived as unsafe and unpleasant, and many suburbs suffer from high unemployment rates and social unrest. The buildings themselves are in the need of comprehensive interventions with the building structures and building services at the end of their lifespan.[2]

Figure 1. *Thamesmead, London – a Regeneration Challenge. The Area is Vast and Consists of Mainly Social Housing Built from the Late 1960´s Onwards. The Houses were Built Fast and of Poor Quality.[3] Image: Yrsa Cronhjort*

Concurrently, the European Union is aiming for a sustainable growth and resource efficiency, including the 2020 -targets[4] for a climate friendly development. With regard to the building sector the expectations are high, as this sector alone stands for on average 40-50% of our total energy consumption

[1]Vehmaskoski T. et.al. 2013. Rakennetun omaisuuden tila 2013. p 6
[2]Cronhjort Y., le Roux S. 2013. Sustainability indicators for building modernization and urban regeneration. *SB13 Oulu Sustainable Procurement in Urban Regeneration and Renovation Conference proceedings.* VTT, RIL. ISBN 978-951-758-562-0, ISSN 0356-9403
[3]http://en.wikipedia.org/wiki/Thamesmead accessed 21.05.2014,
http://www.bwz.se/sp/b.aspx?vi=12&vid=813&ucrc=C25C6708 accessed 21.05.2014
[4]http://ec.europa.eu/europe2020/targets/eu-targets/ accessed 22.05.2014

and 36% of the European greenhouse gas emissions, with the current demand for heating energy being the biggest challenge. The strategy chosen for reducing this consumption is to build near to zero energy new buildings and aim at a cost and energy efficient upgrading of existing buildings.[1]

The building stock causes various challenges but can also be seen as a resource for e.g. embodied energy and reusable building material - sources for urban mining. Additionally, the needs for refurbishment allow for adapting existing buildings to better meet current demands and future needs, including new townscape design and architectural regeneration.

TES Energy Facade

TES Energy Facade has been developed within several consecutive European research projects since 2008[2]. The original target was to develop an industrialized method for using prefabricated, large scale timber based elements for improving the energy efficiency of the building envelope. (Fig. 2)

Figure 2. *TES Energy Facade is Based on the Use of Large-scale, Prefabricated Timber Based Facade Elements Including a Self-load Bearing Timber Frame, Thermal Insulation and Possibly also an Airtight Layer and Soft Adaption Layer, Internal and External Cladding. Windows and Building Services like Ductwork may be Integrated during the Prefabrication Process. The Elements can be Designed for either Horizontal or Vertical Assembly.*

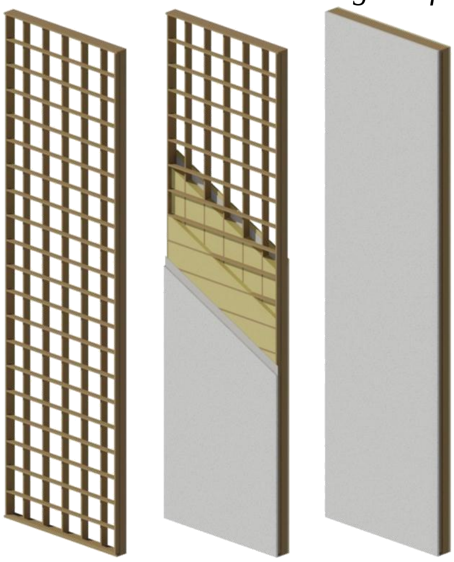


Image: Ville Riikonen, Aalto University

The self-load bearing frame allows for a complete replacement of the old facade but also new construction like extensions as part of a refurbishment. Horizontal and vertical extensions can be realized using TES elements as such,

[1] http://bpie.eu/renovating_eu_buildings.html#.U33tZXfyW70 accessed 22.05.2014
[2] *TES EnergyFacade* (2008-2010), *smartTES* (2010-2013), *E2ReBuild* (2011-2014)

prefabricated space modules or a combination of both. The advantage of using timber based structures is the comparably light weight: the demands on the load bearing capacity of the old building core are minimized. Many types of cladding material may be used with TES elements thus providing freedom of design. Additionally, the system allows for a scaffolding free building site. Paired with a continuous digital workflow the aim is for a leaner retrofit and modernization process as compared to current State-of-Art.

Figure 3. *A TES Retrofit Process Modelled. The process from the Left: 1) Original Building, 2) External Parts Demolished according to the Retrofit Design, 3) Assembly of a Soft Adaption Layer, 4) Assembly of an Airtight Layer, 5) Assembly of Prefabricated Facade Elements on Top of the Adaption Layer, 6) Finalization of the Facade Retrofit with New Roof and Detailing, 7) the Addition of New Balconies. 3D-Visualization: Ville Riikonen, Aalto University.*

A social target for the TES Energy Facade development has been the opportunity for inhabitants to stay in their apartments during the facade retrofit. Work on site is optimized by prioritizing prefabrication and assembly of the new facade directly onto the existing building, utilizing the old envelope and core. As an end result the comfort of living is improved and the costs for heating are decreased - all during a continued stay in the apartment. The TES System can also be used as part of a holistic building refurbishment with the target of a complete renewal including updated building services. The load bearing core allows for integrated windows, doors and building services.

The use of wood in TES Energy Facade is an environmental choice: building with timber increases the amount of embodied carbon dioxide in our existing building stock. Additionally, the timber frame allows for a significant increase of the thermal insulation level making a decrease of the heating energy demand feasible - even up to 90% in the Finnish context[1]. This greatly reduces carbon dioxide emissions during the building use phase. As a building material, timber is a renewable and recyclable resource that, when sustainably managed, is an environmentally friendly choice in forest regions.

TES Energy Facade has been developed by engineers but also architects and it opens up a new field: the possibility to use energy efficiency retrofits and infill development as a means to turn existing buildings into new architecture.

Case Studies

By 2014 nine pilot buildings retrofitted with TES Energy Facade have been investigated by the authors. The demonstrations and research have been supported by European research and development projects[2]. Aims in common to the projects have been a remarkable reduction of energy consumption for the buildings in use, an improved quality of living and architectural renewal.

Most of the built projects are situated in south Germany. Two cases have been realized in Norway and two in Finland. The Nordic cases are structurally similar representing Post World War II concrete buildings with a load bearing bookshelf frame and facades of concrete sandwich elements, whereas the German cases show a bigger diversity in construction system. This paper presents an analysis of the two Finnish cases and, as a comparison, one structurally similar German case.

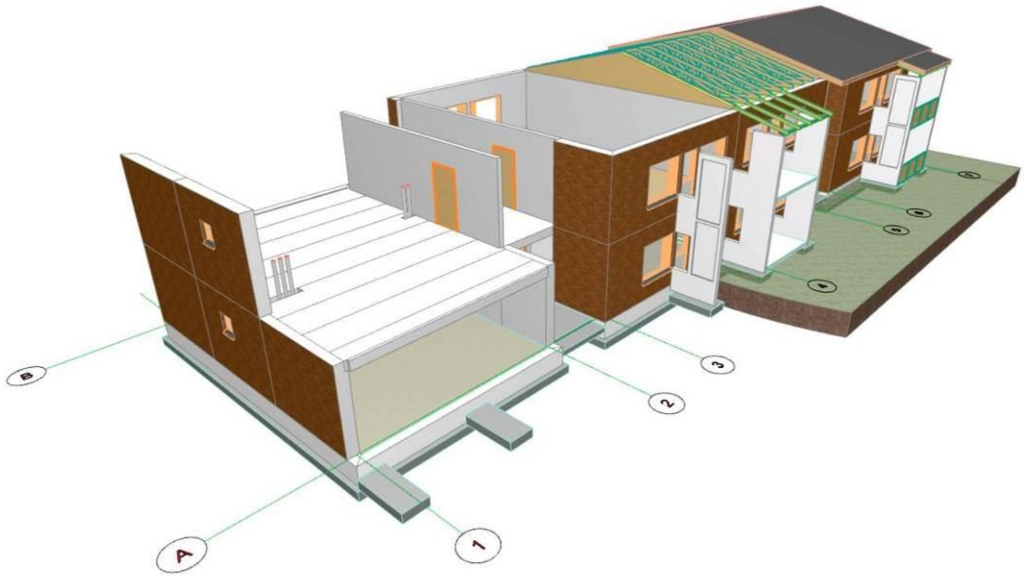
The two Finnish buildings represent applications of the BES-system (Concrete Element System, see Figure 4). The BES- system is a method for building new concrete buildings based on prefabricated building elements and predesigned details. It was created in the late 1960´s as a response to the need for efficient, industrialized scale of new building developments as to meet with the challenges of a continuous urbanization.

The extensive use of elements and striving for savings in time and costs often resulted in a monotonous architecture. Windows were usually placed in the middle of the element, of standard size and used throughout the building facade. The surface treatment was for mostly the same in all elements. The repetitive image of the buildings was underlined by constructing whole areas and suburbs at once, replicating the same design. Now we need to develop industrialized refurbishment methods that have the same replication potential.

[1]Cronhjort Y. 2012. Renovate, densify, change – by timber based element systems! in *Forum Holzbau Nordic Växjö 12, 1. International Holzbau-Forum Nordic, Växjö 12 (IHN 2012) Nordic Wood Construction Conference.*

[2]http://www.tesenergyfacade.com/ , http://www.e2rebuild.eu/ accessed 21.05.2014

Figure 4. *Structural Analysis of the BES-System Used in Case Virkakatu, Oulu. The Building was Constructed Using Prefabricated Wall Elements, Hollow Slab Elements and Concrete Sandwich Facade Elements.*
3D-Model: Simon le Roux, Aalto University.



Case Saturnuksenkatu, Riihimäki, Finland

The case building in Riihimäki, Finland is situated in the residential area of Peltosaari, a homogenous neighborhood with 103 000 m^2 of living quarters in apartment housing blocks built between the early 1970´s and 1990´s. It is a typical example of the mass produced Finnish suburban housing areas.[1]

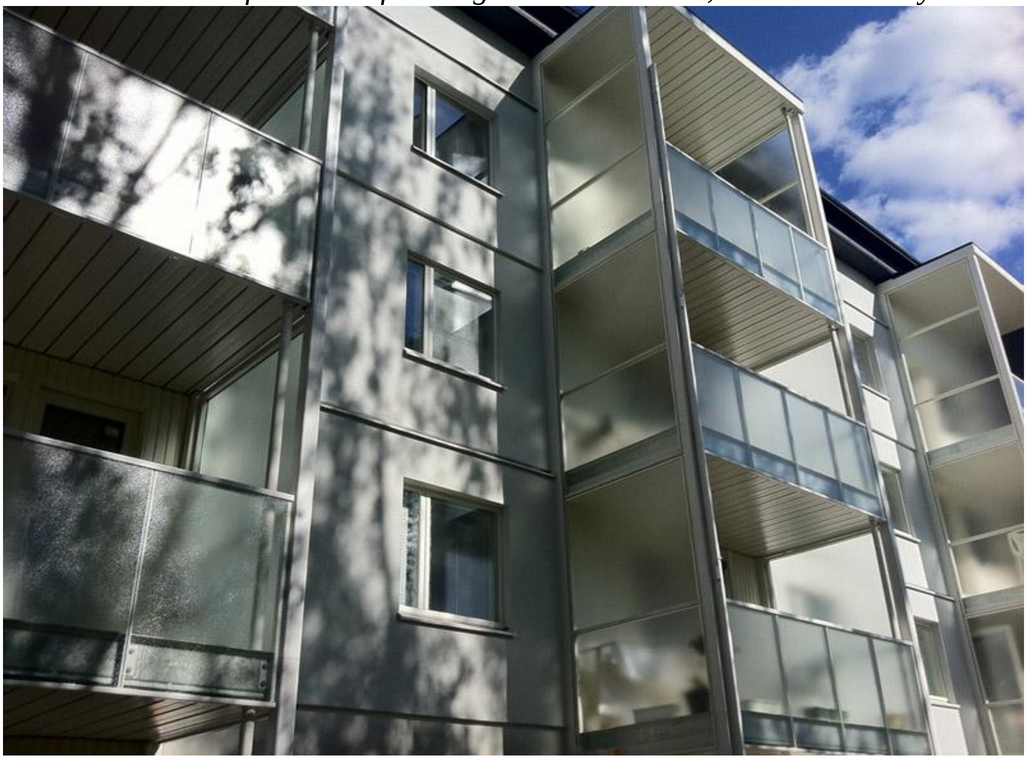
Figure 5. *The Area of Peltosaari in Riihimäki. The Buildings in the Photograph Originate from the Early 1970´s. Image: Ville Riikonen, Aalto University*

The area is currently being developed aiming at both social and structural renewal and some single buildings have already been refurbished. Typically

[1]Lahti P., Nieminen J., Nikkanen A., Nummelin J., Lylykangas K., Vaattovaara M., Kortteinen M., Ratvio R., Yousfi S. 2010. *Riihimäen Peltosaari Lähiön ekotehokas uudistaminen*. VTT Research Notes 526. VTT. p21 ISBN 978-951-38-7565-7 , ISSN 1455-0865

the outer surface of the sandwich elements and the old thermal insulation have been removed and replaced with new thermal insulation and plaster. In case Saturnuksenkatu the same method was applied but using timber based elements: the outer layers were removed and replaced with prefabricated, vertical facade elements that were rendered. The bottom layer was added on to the elements during the prefabrication process prior to transport and assembly. The final layer was added on site as to cover the joints between elements and reach an even final finishing. The energy efficiency aim of the refurbishment was for passive house level local standard as suggested by VTT. The target for heating energy demand after retrofit was ≤25 kWh/m^{2}a, equal to 75% savings in heating energy demand.[1]

Figure 6. *Case Saturnuksenkatu in Riihimäki was the First Retrofit in Finland to Implement TES Energy Facade. The Four Storeys High Building Hosts 33 Rental Apartments and a Daycare Facility. The Facade was Retrofitted Using Vertical, 12 Meter High Panels. The Horizontal Pattern Adds Architectural Interest and Identifies Separate Apartments.[2] Year of Building: 1975. Retrofit: 2011-2012. Design by Kimmo Lylykangas Architects. The Photograph was Taken at the End of the Retrofit. Image: Simon le Roux, Aalto University*



[1]Lylykangas K. *Passiivikorjaus esivalmistetuilla julkisivuelementeillä - Saturnuksenkatu 2, Riihimäki.*

[2] Lylykangas K. *Passiivikorjaus esivalmistetuilla julkisivuelementeillä - Saturnuksenkatu 2, Riihimäki.*

Case Virkakatu, Oulu, Finland

The second Finnish case building is located in Oulu and was originally built in 1983. It has two storeys and a structural core of concrete. The facade was built of non-load bearing concrete sandwich elements with an outer surface of thin facade bricks. Its 8 apartments are divided into two staircases with 4 apartments each, 2 of which are on the ground floor and 2 on the first floor. The building functions as rentable student housing owned by PSOAS, Pohjois-Suomen opiskelija-asuntosäätiö.

Figure 7. *Panorama Showing Case Virkakatu Before, During and After Retrofit. Year of Building: 1983. Size: 2-Storeys, 8 Rental Apartments. Retrofit: 2012-2013. Design by M3 Architects. Image: Simon le Roux, Aalto University*

Building works on site were realized during 6 months from September 2012 through February 2013. Targets for the project included updated student family homes, an upgraded energy efficiency aiming for close to passive house level according to the local suggestion by VTT, a renewed architectural image of the building and the piloting of TES Energy Facade. The final project extended to a holistic renewal including the replacement of ground floor slabs, external layers of the facades with TES elements and outer roof, new floor plans with new bathrooms, kitchens and saunas and new building services including apartment specific air ventilation units. Only the core was left intact.[1]

Case Grüntenstraβe, Augsburg, Germany

Case Grüntenstraβe is situated in Augsburg, south Germany. It is a 3- and 6-storey high building complex from 1966 with 60 apartments owned by the public housing company WGB Augsburg. The facade retrofit and building works on site were completed in 2012.

Tenants were at the heart of the modernization. Since building works on site were conducted in an inhabited state, the interests of the inhabitants were a central concern throughout the process. A high degree of prefabrication of

[1] http://www.e2rebuild.eu/ accessed 22.05.2014

structural elements and the building envelope reduced construction times and overall stress of concerned parties.[1]

Figures 8 and 9. *Project Grüntenstraße Before and aAfter Retrofit. The TES Energy Facade Elements were Assembled Directly Onto the Old Facade. Year of Building: 1966. Size: Six Storeys, 60 Apartments. Retrofitted 2011-2012. The Retrofit was Designed by Lattkearchitekten. Images Frank Lattke*

[1]Lattke, F. 2013. TES Energy Façade – proven practice in *Implementing Sustainability, Barriers and Chances. Book of Abstracts.* Fraunhofer IRB Verlag (2013). ISBN 978-3-8167-8965-9, ISBN 978-3-8167-8966-6.

The building was measured using a tachymetric total station. A laptop connection enabled the development of a 3D model already on site. Production design of the timber frame for the new building envelope was later done on the basis of the model and every piece of timber was defined with parametric information to be processed by a digital cutting machine[1]. TES elements were prefabricated including the timber frame, the inner and outer paneling, thermal insulation, windows, winter garden glazing and the cladding. Windows serve multiple purposes: the ventilation was solved through moisture controlled exhaustion with ventilation units placed on the roof, and valves for fresh air supply integrated in the window frames of sleeping and living rooms.[2] The energy efficiency target was for the standard German KfW Effizienshaus 70 which was achieved with a TES Energy Facade building envelope with Uw = 0.11 W/m²K and integrated windows with Uf = 0.98 W/m²K.

Retrofits as a Means to Enhance Living Quality and Architecture

A strong architectural vision is in common to the presented projects. Case Grüntenstraβe was transformed to contemporary architecture and the overall design supports the visibility of the building in the urban context. A similar aim can be recognized in case Virkakatu, where the target was to create new architecture and a fresh new image for the building and in the future the whole area. Hence the cladding material and the vibrant green color scheme are in contrast with the original building and remaining closest built surroundings. In case Saturnuksenkatu, the architectural aim was to renew the appearance of the building without losing the sense of the original facade, hence the rendered surface in various shades of grey. The facade design integrates the building visually with its immediate surrounding buildings. In all cases, a modernized architecture was one outspoken target for the building refurbishment and facade retrofit, adding both value and quality to the built environment. The presented cases show two different approaches to a facade retrofit: in the Nordic cases the old facade was partially demolished before being replaced by new, timber based elements and in Germany the new facade was assembled directly onto the original building envelope.

The facade material was exchanged in all three cases. In Augsburg the facade was cladded with rough sawn, white painted spruce boards. In Riihimäki the facade was rendered and in Oulu cladded with cement fiber board. Maintenance requirements and durability were important selection criteria for the facade materials and surface treatments[3]. The aim was for reduced maintenance costs but positively perceived materials of high quality.

Exterior design in presented cases reached further than the facade: to reduce the risk for summertime overheating, shading was a concern that was solved by architectural design. The outside changes improved both living

[1]Hundegger K2

[2]Lattke, F. 2013. TES Energy Façade – proven practice in *Implementing Sustainability, Barriers and Chances. Book of Abstracts.* Fraunhofer IRB Verlag (2013). ISBN 978-3-8167-8965-9, ISBN 978-3-8167-8966-6.

[3]Paint used in Augsburg: silicate paint for wood

comfort and architectural appearance of the buildings. In Riihimäki the window areas are relatively small and the larger openings are to the balconies. The balconies were renewed as part of the building works and are deeper than the original ones adding shading also inside. In Oulu the apartments open to the south and hence the balconies were extended to cover most of the facade and the depth of both balconies and eaves was increased up to and over 2 meters. (Figure 12) In Augsburg existing balconies were converted into living room extensions thus creating additional interior living space and new balconies were added in between the old ones. In all three cases the design solutions increased building integrated outdoor spaces. In Oulu the balconies on the top floor and larger shaded outside area on the ground floor concurrently increased the quality of the spaces. In Augsburg the new winter gardens add to the quality of living with a mediating space in between indoors and outdoors. (Figure 10)

Figure 10. *Project Grüntenstraße, Augsburg. The Existing Balconies were Converted into Winter Gardens thus Generating More Living Space and Increasing Sound iIsulation Towards the Nearby Street. Image Frank Lattke*

Facade retrofits target the outside of the building, but interiors are affected as well. When upgrading energy efficiency, thermal comfort is concurrently improved. In the Oulu and Riihimäki cases the original facade consisted of concrete sandwich elements that were partially replaced with new timber based elements. The U-values of the original facades were close to 0.50 W/m^{2}K and 0.28 W/m^{2}K respectively. Air tightness was poor and the measured n50 value in Oulu was 3.3 l/h prior to renovation[1]. In both cases, the outer concrete layer and old thermal insulation were removed, whereas the inner concrete layer was left intact. In Riihimäki this made living inside the apartment feasible even during renovation[2]. In Oulu the air tightness of the building envelope was improved prior to the assembly of the new facade, whereas air tightness in Riihimäki was solved by adding an airtight layer onto a first soft layer of thermal insulation. In both cases the thickness of thermal insulation increased with the addition of new facade elements from less than 100 mm:s to in total 300 mm and more than 450 mm:s respectively. In Oulu the airtightness measured 0.8 l/h[3] directly after retrofit. In Augsburg the new thermal insulation layer measures 220 mm. An improved thermal insulation and air tightness increase thermal comfort and decreases draft for the inhabitant.

Figure 11. *A New Window in the Renewed Facade. The Deeper Facade Creates a Usable Window Sill on the Inside. The Air Inlet for Incoming, Preheated Air can be Seen Above the Window. Ventilation Ducts were Integrated in the Vertical Facade Elements and Encapsulated Air Distribution Ducts were Placed Inside the Apartments, in the Upper Part of the Exterior Walls. Case Saturnuksenkatu, Riihimäki. Image: Tomi Tulamo, Aalto University*

The increased thickness of external walls affected interior aspects like balcony doors, window sills and lighting conditions. In the Finnish cases old

[1]Puotiniemi J. 2012. *Ilmatiiveysmittausraportti Psoas Virkakatu 8 90570 Oulu 15.07.2012*. CRAMO. Oulu, Finland. p 4.
[2]in Oulu the apartments were emptied for the refurbishment
[3]Puotiniemi J. 2013. *Tiiviysmittausraportti Psoas Virkakatu 8 90570 Oulu*. CRAMO. Oulu, Finland.p 1.

windows were replaced with new passive house windows. In Riihimäki the new windows were placed at optimal depth with regard to thermal insulation close to the facade surface, whereas the windows in Oulu were fastened to the old inner concrete, leaving them slightly deeper inside the building facade. The solution caused demanding detailing of the window fittings as all different layers of the facade element had to be protected against water and moisture. The Riihimäki solution allows for usable and deeper window sills on the inside, and less detailing (Figure 11). However, the different fastenings had implications on window sizes and hence also the lightning conditions of the apartments: the windows in Oulu could be close to the original size whereas the windows in Riihimäki were designed slightly smaller than the original ones, as to ensure the fit of new facade elements to the measures of the old facade. In Augsburg the windows were integrated into the TES element. The existing windows were demolished prior to the assembly of the new facade thus creating a closed envelope throughout the building.

Indoor air quality was improved in all three cases. The aim for passive house level of energy efficiency in Finland requires the addition of mechanical air ventilation systems as to ensure sufficient heat recovery during the winter time period. In Riihimäki this was solved by adding a centralized air ventilation unit on the roof of the building. New ducts for incoming air were integrated in the new facade elements and air distribution ducts were installed inside the apartments. Old, existing ducts were utilized for exhaust air. In Oulu each apartment was equipped with its own air ventilation unit that was placed in the bathroom. In both cases the effect on the interiors or floor plans of the apartments was minimal, but the effect on living comfort through improved indoor air quality was significant. In both cases the heat recovery is an integral part of the design for energy efficiency. In Augsburg the addition of exhaust air units was sufficient with air inlets integrated in window frames.

Discussion

In Europe, we are facing the challenges of urban renewal on large scale, concerning mainly residential areas from the 1950´s to the 1980´s, often in need of both environmental and building specific improvements due to technical, architectural and social deficiencies. The use of prefabrication allows for replicable and industrialized building renovations. Moreover refurbished buildings should also meet sustainability requirements of the future: durable, economic and ecological solutions are necessary to transform our existing buildings and meet standards regarding energy consumption and carbon dioxide emissions. The TES - method offers a timber based solution for eco-efficient building retrofits.

This paper presented three TES Energy Facade projects: case Virkakatu in Oulu and case Saturnuksenkatu in Riihimäki, Finland, case Grüntenstraβe in Augsburg, Germany. All projects demonstrate a complete makeover of the building envelope including foundations, facades, windows and doors, balconies and roof. In all three the refurbishment also included building service retrofits and internal works. The renovation processes aimed at post-refurbishment energy efficiency level close to passive house local standard[1].

The architectural targets of the projects varied: in Riihimäki the aim was to blend in but with a modern touch, whereas in Oulu the outspoken target was to make a statement and separate the building from its nearby environment. In Augsburg the aim was to highlight the positioning of the building at the gate of the city. In all cases the set target was reached. The renewed Oulu building represents 21st century architecture. The choice was bold and untypical in Finland. The Augsburg project represents a central European approach to building retrofits taking a fresh new attempt at the building.

Figure 12. *Case Virkakatu, Oulu, Finland as Finished. It Makes a Bold Statement in the Oulu Townscape. Image Jaakko Kallio-Koski, M3 Architects*

A comprehensive refurbishment requires investment and is hence often motivated by added values. In presented cases the main added value was based on a decreased heating demand and a longer lifespan for the building with the investment cost being weighed against achieved life cycle costs and life time. However, the owner in all cases was institutional and the objects represented social rental housing. None the less, the projects also aimed at social benefits and increased quality of life for the residents, such as improved living comfort and indoor air quality, new outdoor spaces and renewed apartments better suited for their clientele hence reflecting an aim for a socially sustainable outcome. An additional and welcomed improvement in Augsburg was the transformation of the access to barrier free by adding elevators connected to every floor level.

[1]Local Finnish suggestion by VTT. http://passivehouse.vtt.fi/files/passiivitalon%20maaritelma.pdf accessed 21.05.2014

Conclusions

In Europe today the refurbishment of buildings and growing need for urban regeneration is a topical task but could the challenge also be seen as an opportunity for sustainable architectural regeneration of our post war suburbs?

Based on presented cases, TES Energy Facade is a functional method for renewing the building envelope as the system allows for an independent, self-load bearing building facade. The opportunity to combine elements and space modules adds the option of changing the building volume with infill development. The facade material can be selected based on architectural vision rather than structural limitations. Based on these parameters the method is a viable option for renewing the external appearance of a building and the urban structure of the built environment.

TES Energy Facade aims at improving the energy efficiency of our existing building stock for mostly by making a sufficient increase of thermal insulation in the building envelope feasible. Living quality is enhanced by increased thermal comfort. However, the method itself does not solve any functional shortcomings inside the building. The rebuilding of floor plans and building services can be part of a holistic refurbishment in addition to a facade retrofit.

TES Energy Facade is a forerunner retrofit method based on the use of timber construction and hence an opportunity for increasing the amount of embodied carbon dioxide in existing buildings. Built on the idea of a continuous digital workflow and prefabrication, the TES -method additionally forms a functional basis for a lean and industrialized facade retrofit and building extension process. From this viewpoint the method is well suited for large scale renewal of numerous buildings, representing several different typologies like housing, office and public buildings. The application and replication potential exists.

From an architectural viewpoint, TES Energy Facade gives the opportunity to a complete regeneration of the building appearance along with a significant upgrading of the building´s energy efficiency and envelope. In the Finnish context, the TES method offers a new alternative for renewing buildings with facades that have reached the end of their lifespan. Typical examples represent the mass-produced housing stock of the early 1970´s.

Architecture creates added value and enhances the quality of built environments. It is a means to improve the acceptance of building renewal and urban regeneration processes. In the end, the responsibility for the perceived quality of our built environment lies with the designers. Are we architects ready to tackle the challenges of refurbishment and urban regeneration; are we bold enough to redesign and rebuild, revise the ideals of the modern town?

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