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Better, faster and cheaper energy facades for transformation of multi-storey blocks built between 1960 and 1976 – how to optimize renovation through an industrialized process?

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Abstract

The intention of presenting the project 'Better, Cheaper and Faster energy facades' is to spread information and knowledge about an ongoing process concerning industrial prefabricated energy facades for renovation projects and to spread information of how to develop the project through an innovative process. The aim is to inspire clients and consultants to think smart through optimizing the planning and design process as well as the building process. Through this way of thinking we can secure a better, cheaper and faster energy renovation of the existing building stock.

The project is under development and has only been finished half way through, but the intention behind the system delivery deserves to be spread. Through the programming phase the project has now gone through a phase of total enterprise. This first phase defines the overall quality and functionality for up to 2500 dwellings and is carried out as competition in February 2013. The judging committee has now given their report and decision, and a contract for the following phase is given to 3 contractors. Over the summer 2013 a new mini competition will take place. In this tender the solutions of context and client specific demands will be taken in consideration – and through this phase the final decisions of the individual renovation will be set, and tenants and department executives will be defining their wishes and demands to the specific renovation.

The innovation project and the process to explore the client demands in such large scale projects have been driven by the housing association AL2bolig, Tilst, Denmark. Author was part of the architectural discussion through planning process and the evaluation of the first frame competition.

The methods used are:

- participation through the development process
- comparable research analysis to other projects
- discussions on the level of industrialized building process
- reflections through comparable renovation initiatives from Austria
- literature studies

The result achieved will prove that because a well-defined tender an industrial upgrading of the process can be lifted to a very high level. New logistic ways of cooperating, very ambitious levels of system delivery and optimized time flow can bring quality into all phases from planning, design, executing the building process and handling the tenants wellbeing. Add to this a vibrant architecture and a high performed and energy efficient result.

Keywords:

industrialized renovation, integrated design, optimization, innovation, learning through all phases

Introduction

The main goal of the project 'Better, Cheaper and Faster energy façade renovations' of the social housing blocks from the montage period 1960 – 1976 is to create an industrial platform which can fulfill and create an advanced and highly industrialized architecture and process for energy renovation of facades and to secure future for at least a volume of 16.000 dwellings in Denmark [Poulsen 2012].

A large numbers of the housing blocks from the period have a bad reputation both seen from a social, technical and aesthetical point of view. Cause these aspects the blocks have already been renovated at least once [Vestergaard 2011] and to prevent a bad second renovation a great deal of efforts from the owners have been obtained into the innovation project. Owners are social housing associations, which base their decisions about renovations on tenant's democracy – which means that all changes related to design and rent have to be agreed by the tenants. This means that a building renovation always has to optimize aesthetics, functions and benefits to be affordable. Definition of intentions which are laying behind the papers headline, referring to the building program:

'Better' means to secure the coming renovation to last at least 30 years. All former bad experiences should be prevented and new knowledge should be taken into account. It is expected that a better and sustaining production should afford sustainable materials and technological solutions and secure decisions which have taken responsibility to climate. Related to the energy performance it is not economical possible for the owners to go further than the demands described in the Danish legislation BR10: the Danish Landsbyggefonden (Country Building Foundation) gives at the moment only loans for upgrading building technique to the level of Danish building law and not to higher energy performance. But on the other hand it is mentioned that total economy and LCA (life cycle analysis) should be taken in account to secure a minimum of maintaining.

'Cheaper' means to create more value for the client in all phases: programming, project, building and maintaining. The goal is to create knowledge- and competence based process which can lead to a 20% prize reduction – related to what we normally see in DK at the moment. This means that the owner can get 20% more quality for the same investment.

'Faster' means to reduce the time disturbing the tenants by the building process while facades are changed. It is the intention to organize the building period through an industrial mind set, understood as minimizing the failures, minimizing the manpower used and minimizing waste of materials and time [Poulsen 2012].



Fig. 1 Developing group – working at industrial intentions

In order to secure this above mentioned intentions an innovative working process was formed and driven by the association of social housing AL2bolig, Tilst, Denmark. An interdisciplinary project developing group was formed to design the objectives, which have to be taken into account to fulfill the goal of an industrialized renovation – a goal which should contain the highest optimized level through all phases of the building case. The group had members such as building associate members, researchers, layers, architects, engineers, entrepreneurs, process consultants etc.. Parallel to that a network of potential clients was formed – people who were in charge to use the results from the innovation in their own organizations, when new renovation projects were coming up.

As a result of the developing work the project 'Better, faster and cheaper...' is published as a final tool for the frame tender and as a tool for everybody to use [Poulsen 2012]. As a continuation of this a specific frame tender was announced related to one building case of 35 blocks in Tilst. The competition was invited as a submission of tenders to total entrepreneurs and the first round was carried out February 2013. The second round of the competition will take place in September 2013 to find the most affordable entrepreneur and project which propose the best tender in relation to quality of architecture, construction, innovation and price.

Focus of paper will be to describe part of the process, which is judging the first round of finding the right total entrepreneurs to manage design, construction and process at building site.

Methods

Through the development of the program an interdisciplinary group has been working with the complexity of the beneath defined objectives, this gives a multidisciplinary approach to the competition program. Author was part of this group as a steering member.

Comparable research analysis to other projects:

Because persons in the developing group was chosen from their experiences from actual optimized renovations they brought their experiences into the building program. E.g. a building owner who had a renovation case Heimdalsvej in which the results intended to reach passive house level. The project had come out with a very low rise of the rent, because a very visionary building technique which gave simplified expression of the façade [Vestergaard 2012]. Many other experiences of different kind were brought into the program.

Discussions on the level of industrialized building process:

Through the whole planning process all needed experiences from Norden and Austria were brought into the program and discussions on how to qualify the industrialization process and the level of energy performance and how to demand the highest level of system delivery as possible.

Literature studies:

Through recent years several publications are published about a very high level of “new industrialization” and “mass customization” in Denmark, and several research projects are dealing with this: Three Ways of Assembling a House [Beim 2010], Architecture and Mass Customization [Jørgensen 2007], Sustainable System Deliveries in New Building and Building Renovation [Kauschen 2013], Architectural freedom and industrialized Architecture [Vestergaard 2012].

Reflections through comparable initiatives from Austria:

The above mentioned studies were combined and discussed towards results experienced at the passive house segment illustrated by Swanenstadt School in Austria [Plöderl 2008].

Objectives

The owner had expectations of an overall industrial solution, which can be talked about in the following headlines: the developed solutions is intended to be used for the specific building typology, offer for 16.000 social dwelling to use the results, important to measure the effect of the renovations, lifting the competences of industrial solutions in relation to digital use and pushing a further development of quality and productivity [Poulsen 2012].

What were the focused demands from building program in order to push the contractors?

Design and construction: Architecture, construction, energy/insolation, environmental sustainability, quality, functionality and flexibility. – Important to related to the existing architecture, high quality, sustainable materials, securing the future, included energy solutions and designing with energy demands to reach new architectural qualities.

Optimization: product, process and project optimization, building physical production, economical sustainability, product optimization and creating value, estimated future effects. Important to focus at new thinking related to building physical production and process, the ability to optimize the solutions related to private and society economy and secure new industrial platforms which also uses BIM and optimizes value, product and process.

Innovation: learning and knowledge sharing, organization and communication and dissimulation.

This means that all 3 main aspects had to be fulfilled with a good score to be selected as a contractor for the mini tender at the building sites. The 3 above listed demands represent 50%, 30% and 20% of the quality and functional judgment.

Results

The competition have shown that clients and building owners can push the contractors through their tender: the entrepreneurs had formed multidisciplinary teams containing architects, engineers, subcontractors as production firms delivered their material and were judged. The judgment of the competition showed different levels in the delivered material, but all teams had worked hard in integrated delivery groups, they had forced their thinking and results to a very high standard, both architectural expression, the way the energy demand were fulfilled, the industrial production and the logistic level both at production place and at montage at site, which were very promising for an optimized and innovative change of the traditional way of retrofitting the segment [Gade 2013].

The most important results of organizing the industrialized project are mentioned here.

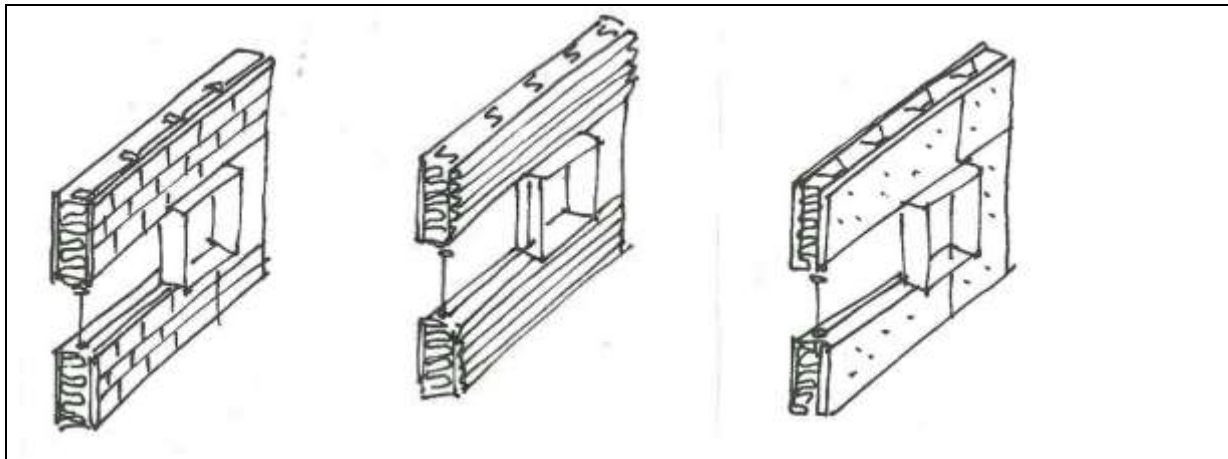


Fig. 2 Construction of wall element based on 3 materials: wood, steel, concrete – a variety of sustainable façade materials – all included at the system delivery platform

One entrepreneur presented an industrial platform from which client and consultants can choose light weight elements basically made from wood or steel and final façade interface in both lightweight materials as wood and plate, but also heavy materials as high strengthened concrete and glass. The choices represent an industrial platform from which the client and the architect can choose and compose because all joints represent a corresponding system.

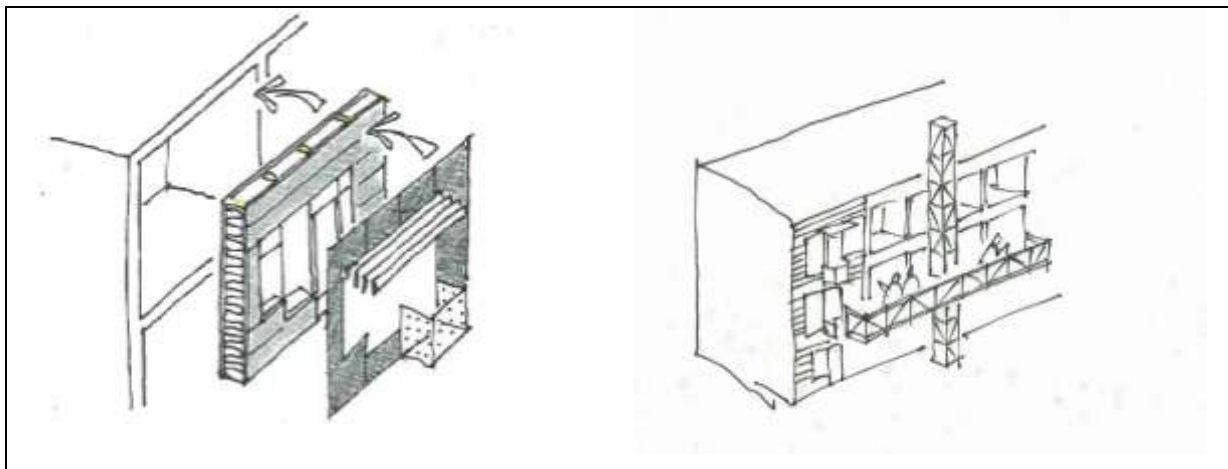


Fig. 3+4 Two tempi montage, high performing energy façade – and optimized montage

Another entrepreneur proposed a fully high industrialized and detailed building system with a very vibrant architecture. Many levels of energy solutions related to 2015, 2020 and extreme passive house standard were argued related to total economy. A third entrepreneur was especially qualified cause of top tuned industrial and logistic handling the building process. All 3 proposals had a new and innovative way of threatening the architectural expression with respect to the original concrete element façade. Results concerning systems for ventilation had all possibilities from separate to central solutions and pipes built in the façade elements to minimize trouble of tenants. Finally it was shown that the actual disturbing the tenants under the building process can be brought down to 1-2 days, which means that people can be staying in their flats under the retrofitting period. This saves trouble and time and money for all involved in the building case.

The optimization of the building process – from producing elements, transport, montage and the final last layer of cladding has been optimized and innovated through the tender, and a demand of organizing and maximizing learning in all parts of the production chain were also delivered. It is important to learn from project to project and bring new knowledge further to the whole building sector.

The project and the tender have shown that the renovation process can be optimized, can be more effective and made cheaper. The optimized results seen as better architecture and better indoor climate in terms of better thought designs, tighter climate screens and separate ventilation solutions. Well prepared planning of architecture, climate screen, indoor climate and building process can be achieved through industrialization, dry building and a better flow at the building site. This gives a higher level of quality, tighter buildings, shorter building period and possibility for tenants to stay in their dwellings under renovation process – all these points with advantage for a better result of the whole process.



Fig. 5+6 Entrance façade and garden façade, design Enemaerke team [Competition 2013].



Fig. 7+8 Entrance façade and garden façade, design Friis Poulsen team [Competition 2013].



Fig. 9+10 Entrance façade and garden façade, design MT Højgaard team [Competition 2013].

Through an integrated project development the project has created value, optimization and innovation and the success has given quality and inspiring proposals for tenant's democracy, building case and organization of the building site and delivery of the complete building.

Discussion

How is it possible to bring the construction relevant parts together?

How can we create conditions and atmospheres which give ownership to the renovation?

It is needed to develop the Danish industrializing, to develop smart joints and details, to use new digital tools to measure the existing buildings and to develop better communication structures in the whole value chain.

Such a development creates innovation and can give "green" innovation potentials for the building industry.

Because only through learning in all value chains we can create experience at a high industrialized level concerning ownership, architecture and processes.

These experiences can then be brought into new and coming projects.

Such a development demands, that all interests are pushed towards better quality, bigger overview and flow, and better managing the building site and the tenants demands.

Recommendation

- that further development of customized and industrialized processes concerning renovation of climate screen and installations are carried out – in order to take important consideration to architectural expression, to architectural and cultural heritage and to a better indoor climate.

- it is also obvious that not all renovations can be carried out in this way, but the building process can be far more efficient and highly industrialized, which is affordable for the economy.

- to insist on results worked out in a coordinated effort of cooperation between knowledge- and research institutions, clients and the building industry and consultants is needed, it is important that all parts are focused on new and optimized thinking through integrated processes.

- to insist on public authorities such as Governments in the Nordic Region pay attention to the obvious potentials which lay in industrial energy renovations, potentials which gives huge possibilities to green innovation and better employment.

Which is also positive for climate.

Acknowledgement

Author want to thank senior consultant Claus Poulsen, AI2bolig for letting my research relate to a concrete content through participating in the process and in the competition committee. Without these involvement ideas of innovative and optimized production would only have been theoretical – in this case the research gives also aesthetics and new perspectives to reaching the practical development of energy renovation of our architectural heritage from the montage period.

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MT Højgaard team: MT Højgaard A/S, RUBOW Arkitekter A/S, Pluskontoret A/S, Møller og Grønborg, Niras A/S, Scandibyg A/S, Niels Haldor Bertelsen
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Illustrations

- Figure 1 – 4 Illustrator Lars Henriksen, Associate Professor Emeritus, Architect maa
- Figure 5 -10 Visualizations from DOMMERBETÆNKNING [Gade 2013]