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Interactive Planning of Suburban Apartment Buildings

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***Abstract*—**Construction in Finland is focusing increasingly on renovation instead of conventional new construction, and this trend will continue to grow in the coming years and decades. Renovation of the large number of suburban residential apartment buildings built in the 1960s and 1970s poses a particular challenge. However, renovation projects are demanding for the residents of these buildings, since they usually are uninitiated in construction issues. On the other hand, renovation projects generally apply the operating models of new construction.

Nevertheless, the residents of an existing residential apartment building are some of the best experts on the site. Thus, in this research project we applied a relational model in developing and testing at case sites a planning process that employs interactive planning methods. Current residents, housing company managers, the city zoning manager, the contractor's and prefab element supplier's representatives, professional designers and researchers all took part in the planning. The entire interactive planning process progressed phase by phase as the participants' and designers' concerted discussion and ideation process, so that the end result was a renovation plan desired by the residents.

***Keywords*—**Apartment building renovation, interactive planning, project alliance, user-orientedness.

I. Need for Renovation of Suburban Apartment Buildings in Finland

CONSTRUCTION in Finland is focusing increasingly on renovation instead of conventional new construction, and this trend will continue to grow in the coming years and decades. The focus of construction in the near future will be on suburban renovation and infill construction, where the goal of improving energy efficiency will make the task more challenging. According to the EU's directive, the objective is to reach nearly zero-energy construction by 2020. The impact of new construction on improving the energy efficiency of the building stock is a slow process. Thus, improving the energy efficiency of existing buildings is very significant. Today suburbs are the least energy-efficient segment of Finland's building stock. Most problematic are the residential apartment buildings from the 1960s and 1970s: they are poorly insulated and most numerous [1], [2].

Finland's concrete-frame apartment buildings from the 1960s and 1970s—fast approaching the age when they must be repaired—contain altogether around 570 000 apartments, so their renovation is an undertaking that affects a large portion of our population. The suburban building stock has been repaired here and there, but this has mainly consisted of a facelift. For this reason the need for renovation is connected to building technology and facades, which need to be repaired because of the aging of the buildings and equipment. At the same time, curbing climate change and the aging of the population pose major new types of challenges to the development of the building stock. Renovation needs also arise from changes in the use of buildings and room layouts, such as making more efficient use of so-called above-ground cellars. What's more, the properties of the existing building stock—such as the quality of furnishings—do not meet the demands and wishes of current residents. Since residential apartment buildings should be renovated every 40–50 years, now is a good time to renovate the residential apartment building stock built in the 1960s and 1970s and at the same time improve their quality and energy efficiency. A sensible renovation project should always combine improvement of functionality, technical and aesthetic quality and energy efficiency. Indeed, repairs that seek to improve energy efficiency alone are not often done, and as such they rarely are economically feasible [3]-[5].

Fig. 1 Typical Finnish concrete apartment buildings from the early 1970´s. The buildings have a load bearing bookshelf frame, non-load bearing facades of concrete sandwich elements and self-load bearing balconies

Renovations require not only money, but also expertise. However, due to their technical solutions and the conditions set by their architecture and surroundings, the individual needs of suburban buildings vary so much that it is impossible to develop a universal renovation solution for suburban buildings. Indeed, the goal is to develop an industrial renovation concept where solutions can be tailored site-specifically and implemented on a business network basis. Well-chosen repair methods can also shorten the renovation time and minimise disturbances that the renovation inflicts on the residents.

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II. KLIKK Study Develops Suburban Renovation Methods

An extensive national research project, "KLIKK – User- and Business-oriented Suburb Renovation Concept, was started in Finland in 2012. Its participants are the University of Oulu, Aalto University, Tampere University of Technology, VTT Technical Research Centre of Finland and several cities and construction companies. The Ministry of the Environment is also a partner in the project. The project is concentrating on examining the possibilities of suburban infill construction and developing novel zoning practices, studying renovation solutions for suburban apartment buildings and especially ideating and examining construction of additional floors in suburban apartment buildings. At the same time the research project has studied the possibilities of developing operating models for renovation, concentrating on the possibilities of interactive planning and project implementation in collaboration with all the participants of the project by utilising an alliance model.

Traditionally, the development process in Finland as in most of countries consists of requesting bids at every phase of the work and linking the different phases together. The developer requests bids from planners, who compile plans which are used in requesting bids from contractors. Building contracting and the operating methods involved have consisted of operational decentralisation, where the operators are chosen on the basis of the lowest bid without regard to life cycle costs or other indirect expenses. For this reason, projects employing conventional bidding procedures are very expensive for the orderer and also do not motivate suppliers and interest groups to act according to the objectives of the orderer. Poor management and consideration of interest groups have often also led to disputes and at least partial failures of projects [6]-[9].

In sub-studies related to the KLIKK project, the research team of the University of Oulu's Department of Industrial Engineering and Management observed that the conventional operating methods of infill construction and renovation were generally seen as factors that restricted project implementation. For current operating models to function, plans should be fully complete before bids are requested. For a project to be implemented as planned, the planning documentation must errorless—which is very challenging in renovation cases. If the planning or contracting documents are unclear, the bids received are also vague. Not only the plans, but also the contracting documents must be complete so that contractors cannot point to incomplete documents and demand additional fees. Extra work and changes are usually expensive and time-consuming, raising project costs higher than expected [10], [11].

Although housing companies generally recognise the need for renovation, the problem lies in getting decisions to renovate through the housing companies' decision-making bodies. Renovation construction, planning and the practices and problems of the work itself are often unfamiliar and daunting to the residents of suburban apartment buildings, who are uninitiated in construction issues. Therefore the threshold to start a renovation project is high for housing companies. Postponement of renovation decisions is part of the reason why, in Finland, housing company apartment buildings jointly owned by the residents are in clearly poorer condition than systematically maintained single-owner rental apartment buildings in the same suburb. That's why the KLIKK research project is concentrating on studying and developing novel practices of implementing renovation projects for housing companies. From the standpoint of managers and housing companies, user-orientedness means the project's implementation planning, cost estimates and implementation are available reliably from one operator and are based on a project description compiled and mutually agreed on in advance.

The motivation and participation of the owners (in apartment buildings broadly the users) are key factors. Early participation by interest groups and the feeling of really having an influence is the best starting point for getting renovation decisions through in the housing companies' decision-making bodies. Factors of choice and motivation related to buildings and renovation have been studied in cases of both private and professional owners. In professional operation, management of economic processes and long-term owner policy are important—primarily technical and economic rationality. Private individuals are mainly motivated by issues related to their own well-being, such as experienced comfort. Because suburban apartment require fundamental technical repairs both inside and out, the motivation and needs of the apartment owners are essential in carrying out renovation and in developing a novel renovation concept. Based on research results, it is known that choices are limited by the capacity to bear a financial burden, but improving one's own comfort is important [5], [12].

III. Interactive Planning

The KLIKK research project has developed and tested interactive planning in connection with apartment building renovation and enlargement planning. Interactive planning, where area or building planning is done as a collaborative effort by future users or residents and professional designers, usually leads to a good end result. Users or residents are aware of their own and their organisation's actions and development goals, or regarding living, their particular living habits or wishes. The architect and other designers for their part are able—based on their professional skill—to present functional, conceptual, or spatial solutions that the future users of the building may not think of. Interactive planning is process-like; initially the users or residents of the area or building explain or describe their needs and wishes as well as their limitations to the designers, after which the designer analyses this initial data. Based on the analysis the designer or designers produce several alternative idea-level drafts of solutions in which the initial criteria are emphasised differently or alternative functional concepts or architectural modelling principles are presented. The purpose of the drafts is to test the initial data and the analyses based on them [13].

In interactive planning, alternative drafts are subjected to open discourse by the future users of the area or building and the designers, where the drafts are assessed and the initial data and their order of importance are reconsidered and adjusted, if necessary. Usually, as an outcome of the mutual assessment some of the alternatives are eliminated, some are considered good and others worthy of development, perhaps combined with some other alternative draft. This phase results in more precise initial data and planning goals and also reduces the number of alternatives. Nevertheless, interaction has already provided a better starting point for planning than would have been possible otherwise, and the designers are able to begin more detailed planning having become well familiarised with the task at hand [13].

In interactive planning the entire planning process progresses phase to phase as the users' and designers' concerted discussion and ideation process where both bring their own expertise and ideas to each phase. Usually, as a result of this type of fruitful discourse the designers are better able to design the building to serve its users than would have been possible solely on the basis of the initial data provided. The process is also beneficial from the designers' perspective, as all of their work is focused on the final design outcome without unnecessarily heading along the wrong track. What's more, the discussions with the building's future users or residents are a source of new ideas for the designers [14], [15].

Nevertheless, interactive planning is very rarely used in planning residential areas or apartment buildings. The reason is that the future residents are rarely known when planning is started, so it is not possible to set up a planning team. However, the situation is completely different with an existing residential area or apartment building: the area and its buildings already have residents and they are the best experts on exactly that site. The residents of a suburban apartment building know the best and most preservable features of their own building and its surroundings, but they also know what things in particular are in need of repair or improvement. Indeed, it is not justifiable or even sensible to plan the renovation of a suburban apartment building without utilising interactive planning. However, to ensure the implementability of the plans and to keep costs under control it is recommendable for the future contractors and prefab element suppliers to participate in the planning as soon as the initial data have been tested.

IV. Use of a Relational Project Delivery Arrangements in Building Renovation Projects

The productivity and quality of construction and especially renovation are excessively poor in Finland. Studies show that at the worst about one-third of the productive work done at construction sites consists of chargeable ineffective time; change orders, corrections and unnecessary waiting. The greatest cause of this distortion is said to be the delivery and procurement models dominating the construction sector in Finland, where the bidding process splits up construction projects into several subcontracts with small profit margins, resulting in long chains of one-one-one contracts. Strictly defined contracts with small profit margins create a construction culture where collaboration between parties to the project becomes difficult and there is no motivation and incentive to collaborate. This finally leads to projects being implemented without a decent understanding of the end user's ultimate needs. The core competence of the various operators is not utilised in all phases of the project, which nevertheless would be crucial for achieving an overall optimal end result. This delivery model does not lead to an optimal final outcome, since each party to the project attempts to optimise only his own segment of the project without helping others. In addition, the practice includes a tendency to hurry to specify details without fully understanding the principles of the overall solution [6], [8], [10], [12].

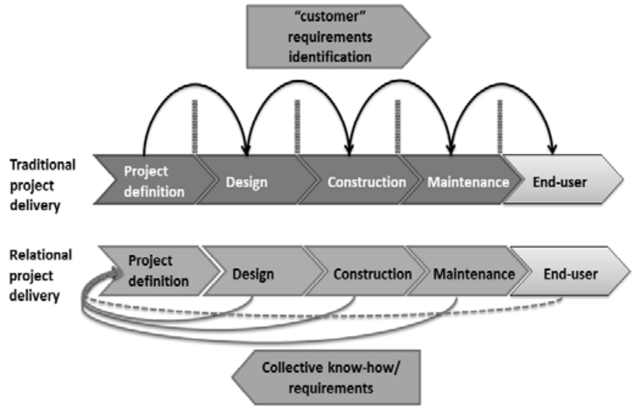

Fig. 2 Differences in principle between traditional and relational project deliveries

Relational project delivery arrangements that integrate the involved parties are widely proposed as a solution which creates added value for customers and also other parties to a project. It has also been noted that creating integrated project teams has had positive impacts on project outcomes. Relational contracts between several parties challenge traditional practice (e.g., design-bid-build) by comparing the customer's goals and demands with how the customer wants to achieve them, while taking certain constraints into consideration (Fig. 2). Various limiting constraints include, e.g., money, time and various regulations. The relational delivery method also helps the customer better understand how his/her wishes affect the project as a whole. The best known relational project delivery arrangements are project alliancing and integrated project delivery (IPD), where risks and profits are shared and the success of an individual party is directly proportional to the whole project's success [8], [16], [17].

Relational delivery methods are project implementation methods that are based on close, interactive, goal-oriented and rewarding collaboration between the parties to the project (Fig. 3). Relational project deliveries integrate people, systems, business structures and operating methods into a process where collaboration helps harness the talents and views of all the participants of the project in order to optimise

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the project's outcome, add value for the owner, reduce waste and maximise productivity throughout all planning, manufacturing and construction phases [18].

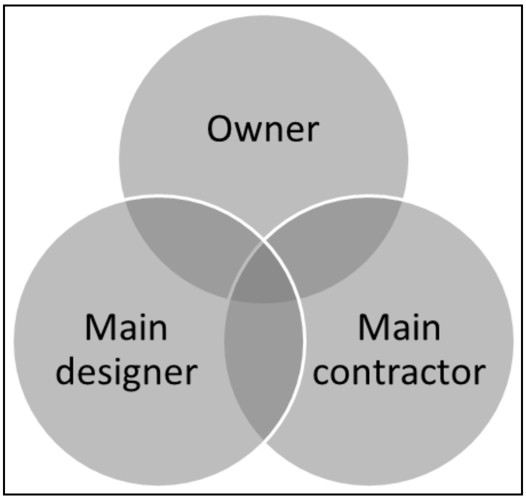

Fig. 3 Commitment of main parties involved in the new project delivery methods

Benefit	Purpose
Early involvement of parties	Exploiting the expertise of all parties Maximizing the value creation of the whole project Team as 'a knowledge pool'
Communication and interaction	Building trust between team members
Cultural change	Continuous and unrestrained coordination of the projects Information sharing 'Best for the project' decisions Services orientation Commitment to mutual objectives
Making relation project delivery well known	Contractual terms (risk and reward sharing) Incentives Collective responsibility for the project Transparency and willingness to provide assistance when needed

Fig. 4 The main benefits of integrated deliveries and project teams [21]

Typical of integrated project deliveries are unanimous decisions made in collaboration, early involvement of all parties to the project and shared risks and rewards. In integrated project deliveries the project contract is often made between several parties. These parties include at least the owner, the main designers and the main contractor, but the contract may also include other designers, subcontractors, etc. In addition, the success of the parties depends on the success of the project. If the project achieves its cost objectives, each party receives a profit margin agreed on beforehand. If the project's costs are below the objective, the savings are divided among the parties to the contract as bonuses which are added to the profit margin. If the project exceeds the cost objective, the overrun is divided and subtracted from the profit margin. The sanction may only be as large as the profit margin, so the orderer is the only one that can realise a loss [8], [18]-[20].

The benefits of relational project deliveries and integrated project teams (Fig. 4.) compared with traditional project delivery methods are early involvement of parties to the project, creation of simple and clear-cut practices, adoption of service-oriented work methods, more effective processes, improved information flow and emphasis on the project's initial preparatory phases (project planning, implementation planning).

V. Testing the Operating Models in Case Studies

A. Block 41

Block 41 is situated in the 4th district in the city centre of Joensuu. The block currently has five apartment buildings, each with its own housing company. As elsewhere in the city of Joensuu, the construction density of block 41 is relatively low; the block density coefficient is e = 0.65. The purpose of Joensuu's new partial disposition plan is to raise the density level of the entire city centre by increasing the number of floors in the building stock by one or two. This will allow the city to meet the demand for apartments in the city centre and ensure that services will remain in the centre. At the same time the goal is to improve the city image and residential milieu of the city centre.

A relational steering team, comprised of residents and managers of the block's housing companies, Joensuu's city zoning manager, the contractor's representative and representatives from the KLIKK project, was set up to plan the block's infill construction and additional storeys. In each planning phase different alternatives were examined in meetings of the monitoring team from the standpoint of each participant, and guidelines and ideas for further development were given to architect Toni Pallari, the designer of the site within the KLIKK project.

In the planning phase models of infill construction were analysed which would increase block density without compromising living comfort. The goal was to compile a plan that would enable resident-oriented infill construction on the block, but which solution would also be applicable in other similar Finnish apartment building blocks a few decades old. Three different alternatives were created as a basis for decision-making and further planning.

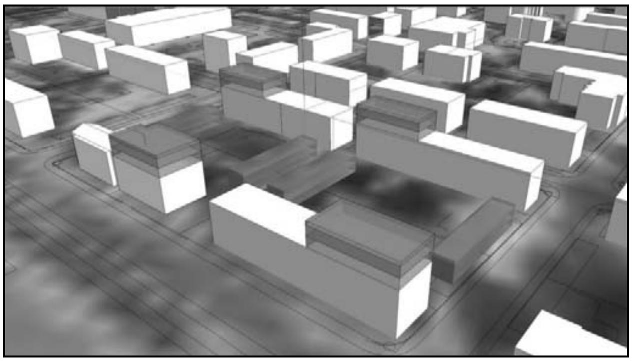

Fig. 5 Additional stories and in-fill construction KLIKK-case study in Joensuu. New building volume is indicated by dark grey color. Alternative 1, block density e = 1,36

In alternative 1, infill construction—altogether 5900 floor m²—focuses on the roofs of the apartment buildings, where two additional floors would be constructed. The courtyard functions would remain unchanged. The need for 59 parking places created by the additional floors would be met by converting Sepänkatu into a parking street for residents. The proposal's additional floor area would make it possible to finance the housing company's inevitable future repairs. However, the proposal would not improve the structure of the block nor could one speak of a block entity.

The purpose of the proposal was to present the lightest infill construction methods on the block.

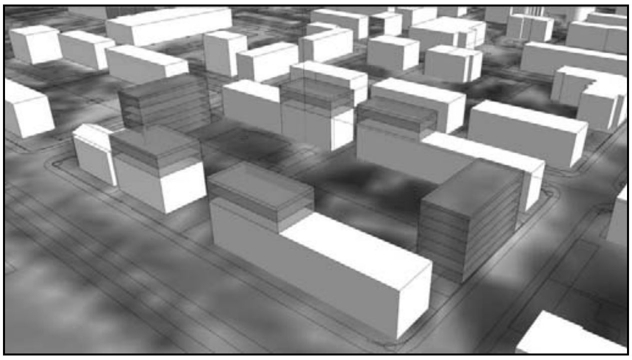

Fig. 6 Alternative 2, block density e = 1.49

In proposal 2, infill and new construction—altogether 7602 floor m²—focus on the roofs of the apartment buildings and the ends of the block. Two additional floors would be built on the roofs of the two smaller buildings on the block and one and a half floors on the roofs of the three larger buildings. New six-storey buildings would be situated at the ends of the block. In this proposal the functions of the courtyards would be rearranged to allow for more parking places. The rest of the additional parking places needed would be situated on Sepänkatu as in the previous proposal. Parking, waste containers, an air-raid shelter and bicycle storage would be situated in the middle of the block. The courtyard would include two separate recreational areas for mutual use by all the housing companies on the block.

The purpose of the proposal was to present a maximum amount of above-ground parking places while preserving the pleasantness of the recreational areas.

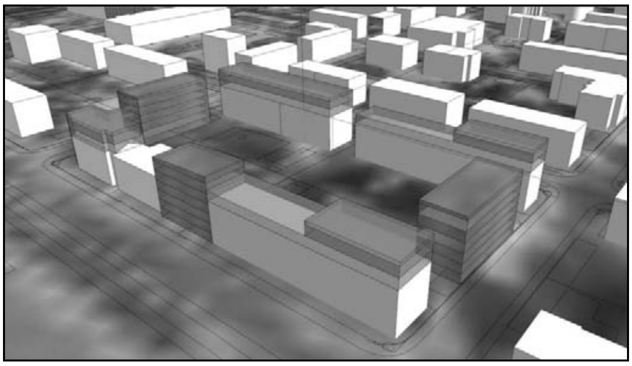

Fig. 7 Alternative 3, block density e = 1.93

In this proposal, infill and new construction—altogether 13080 floor m²—focus on the roofs of the apartment buildings, the ends of the block and the courtyard. Two additional floors would be built on the roofs of all the buildings and new six-storey apartment buildings would be situated at the ends of the block. In addition, two-storey duplexes would be situated in the courtyard. This solution would be very close to the maximum density proposed by the city, e = 2.0.

The amount of new floor area in this proposal is so great that there would be no room above ground for the 130 parking places required, so they would have to be placed underground. Due to the groundwater level and the clayey soil, the cost of underground parking in Joensuu is high. This should be taken into consideration when assessing the economic benefits of infill and new construction.

The purpose of the proposal was to present the maximum amount of infill and new construction while preserving the liveability of the existing apartments.

Fig. 8 A view of the suggested additional constructing on the top of an existing building

As planning progressed the proposals were reviewed by the steering team, and proposal 2 was chosen as the most optimal alternative. Proposal 1 was viewed as a necessary solution, but was given up because the residents on the steering team wanted to improve the functionality of the courtyard. Some of the residents felt the minimal amount of construction would have been a reason to choose this alternative. The massive infill and new construction plans of proposal 3 were rejected immediately. The major economic benefit achieved by the additional floors would have shrunk to a minimum because of the high price of the underground parking space.

B. Kirkkokatu 18

The target of planning is situated in the very centre of the city of Joensuu: alongside the market square and pedestrian street, block 38. The target of planning, KiinteistöosakeyhtiöKirkkokatu 18, is situated in the northern corner of the block at the intersection of Koskikatu and Kirkkokatu. The lot has two four-storey concrete-framed apartment buildings built in 1971, which are connected by a single-storey wing containing commercial space. The apartments along Koskikatu contain mainly office space, while those along Kirkkokatu are in residential use.

Fig. 9 Kirkkokatu 18, present situation

The courtyard is almost completely comprised of parking space. The courtyard view is dominated by a parking building in the middle of the block; its concrete wall forms the boundary of the courtyard of Kirkkokatu 18. There is a six-storey commercial and residential building at the corner of the block at the intersection of Koskikatu and Kauppakatu.

A steering team was set up to support additional construction. The team was comprised of members of the board and the manager of KOY Kirkkokatu 18, the zoning manager of the city of Joensuu, the contractor, the prefab element supplier and representatives from the KLIKK project.

The targeted scope of the additional construction is 2500 floor square meters, which the housing company tentatively assessed as sufficient to cover the cost of repairing the old sections. Infill construction on the lot should not significantly impair the views and lighting of the existing apartments nor darken the apartments in neighbouring buildings. The obvious direction of construction on the narrow lot bordered by the neighbouring buildings is upward. The new partial disposition plan for the centre of Joensuu, which became effective in 2013, increases the number of floors permitted on the block to six, meaning two storeys could be built on top of the existing four-storey apartment buildings. In addition, the building along Koskikatu could be enlarged on top of the single-storey commercial wing located between the Koskikatu and Kirkkokatu wings. However, filling in the space between the buildings would almost completely block the view of the street from the apartments on the courtyard side of the Koskikatu wing. At the same time the airiness and lighting of the courtyard would suffer.

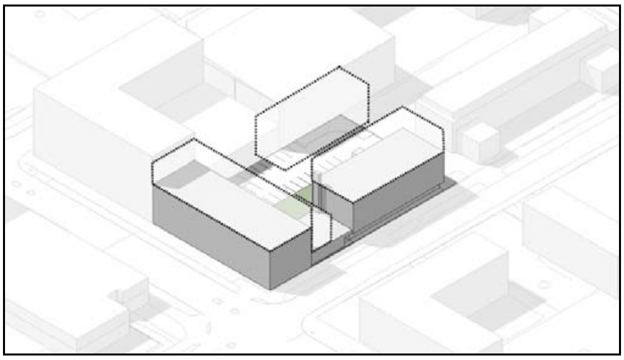

Fig. 10 Possible places for infill and supplementary construction

Because the existing buildings are situated at the edges of the lot along the streets, there is room in the courtyard for new construction in the southern corner. A new building can be constructed in the courtyard against the wall of the parking building, leaving room for outdoor functions in the courtyard of Kirkkokatu 18 and sufficient distance to the residential apartment building of the Kirkkokatu wing. According to the partial disposition plan the courtyard building can also be six storeys high.

The examined alternative locations of the additional construction potentially include much more total floor area than the 2500 floor m^2 that the housing company hoped for. The partial disposition plan recommends recessing the additional storeys, and it is not reasonable to raise the edges of the narrow lot to six storeys together with the six-storey courtyard building. Several alternative architectural models could be created within these limitations and the goal of 2500 floor m^2. They were reviewed by the steering team, which gave guidelines and more specific goals for further development to architect Petri Pettersson, the designer of the site within the KLIKK project. As the planning process progressed, three basic alternatives for infill and new construction were formed from the various alternatives:

Alternative A Area, 2500 floor m^2

Basic alternative based on tentative architectural modelling. There are two additional storeys along Koskikatu and one additional storey on top of the Kirkkokatu wing. The courtyard building would be as high as the Kirkkokatu building—five storeys high.

Alternative B Area, 2500 floor m^2

Two additional storeys are along Koskikatu, but none along Kirkkokatu. The courtyard building would correspondingly be one storey higher than in version A. The version was included in case the residents of the apartments in the Kirkkokatu wing did not approve of additional storeys on their roof.

Alternative C Area, 2800 floor m^2

A more extensive alternative than version A. Additional floors as in version A, but the courtyard building is as high as the partial disposition plan allows—six storeys. The top floor provides views over Kirkkokatu.

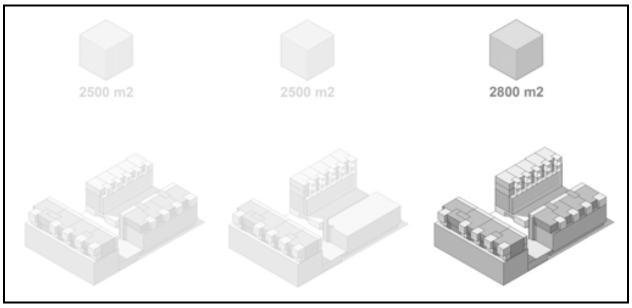

Fig. 11 Alternatives A, B and C. Alternative C on the right with area of 2800 floor m^2 was chosen

The three alternatives for additional construction were presented to the shareholders' general meeting of KOY Kirkkokatu 18 in May 2013. At the meeting the shareholders were especially concerned about the cost of the coming renovation. For this reason the general opinion favoured alternative C, where the sale price of the additional floor area would be sufficient to cover the cost of renovating the buildings. Continuing planning on the basis of alternative C was proposed at the meeting, and after a vote the decision gained the support of the shareholders' general meeting.

Fig. 12 Additional stories on top of existing buildings, Kirkkokatu 18

VI. Summary

The KLIKK research project has developed and tested a relational project model and interactive planning in connection with apartment building renovation and enlargement planning. Case sites were block 41 and KiinteistöosakeyhtiöKirkkokatu 18 in Joensuu. Both sites were comprised of four-storey residential apartment buildings built in the 1970s.

In interactive planning the entire planning process progressed phase to phase as the buildings' current residents' and designers' concerted discussion and ideation process where both brought their own expertise and ideas to each phase. As a result of this type of fruitful discourse the designers were better able to design the building to serve its users than would have been possible solely on the basis of the initial data provided.

Relational project delivery arrangements that integrate the involved parties are widely proposed as a solution which creates added value for customers and also other parties to a project. It has also been noted that creating integrated project teams has had positive effects on project outcomes. This happened in connection with the case sites in this study. The implementability and cost-efficiency of the plans were also under continuous scrutiny during the planning process, as the steering teams also included—in addition to residents and managers—representatives of the contractors and prefab element suppliers.

The benefits of integrated project deliveries and project teams compared with conventional operating models are early participation of parties to the project, creation of simple, clear-cut operating methods, adoption of service-oriented work methods, speedier processes, improved information flow and emphasis on the project's initial preparatory phases.

Interactive planning, where area or building renovation or enlargement planning was done as a collaborative effort by the residents, professional designers and future builders, led to a good end result. The residents are some of the best experts on the site. The residents' or apartment owners' participation in the planning is a key factor of success and guarantees their motivation. In both case sites the process led to planning solutions that the residents considered desirable, which is a prerequisite for implementation of the plans

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