ANALYSIS

A variety of different analytical methods were applied to the project in order to examine the condition of the various indicators. As mentioned in the previous chapter, these analyses were intended both to support and guide the design process and to inform the scoring of the indicators and subsequent comparison of proposals.

Many indicators were not able to be analysed using established methods, e.g. the ability of the residents to shape their own space is currently best described in a qualitative scale. Conversely, some indicators could be analysed in several ways using different methods; e.g. daylight, which can be described using various common quantitative metrics. Only the analyses that were able to directly and quantitatively inform an indicator were used for this purpose. Most of the analyses with such a potential relate to the indoor environment, such as analyses of indoor air quality, acoustics, etc., whereas focus in this project was on a larger scale. Hence, daylight was ultimately the only indicator with a quantitative method of analysis used directly to score an indicator. The other indicators were informed through various forms of analysis.

Urban structure analysis

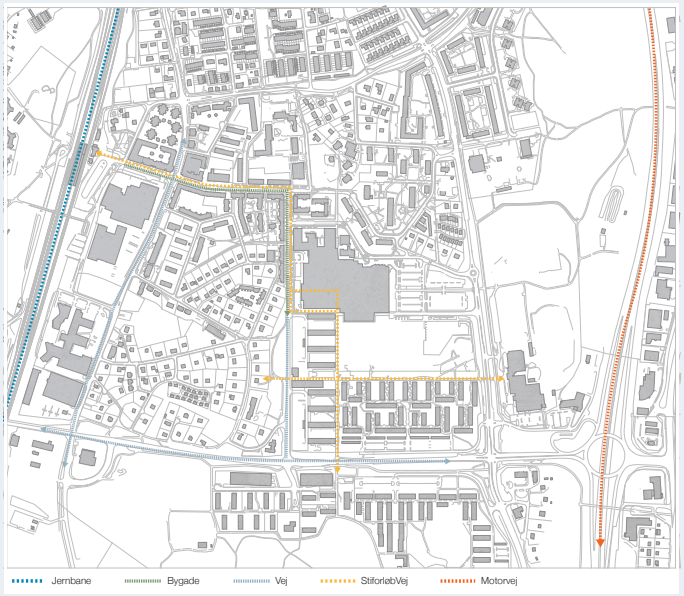
Based on a three day course at KADK from 5–7 April 2016 in the use of the Danish Planning Agency's Survey of Architectural Values in the Environment (SAVE; Stenak 2011), the methodologies behind the survey along with methods developed by Lynch (1960) were used to investigate the environment around Fyrklövern in terms of dominant features of the landscape and urban structure, building patterns and building elements as well as major and minor *paths*, *edges*, *nodes*, *districts* and *landmarks*[1]. These analyses resulted in a better understanding of the areas historical context, its connection to the rest of the city, its dynamics, people flows and identity drivers. Figure **F 6.8** shows three such analyses, which were considered central to the understanding and improvement of several main indicators. Other relevant analyses (including a mental map) are included in Appendix E.

Daylight analysis

Analyses of daylight access were performed in several stages and levels of detail. Initial shadow analyses were intended to investigate the outdoor environment upon return from the study trip, and later analyses of annual insolation confirmed the suspected issues of shade in the courtyards. The distribution of the vegetation was so that the green areas received far less direct sunlight over the course of a year than the asphalt-covered vehicle access areas

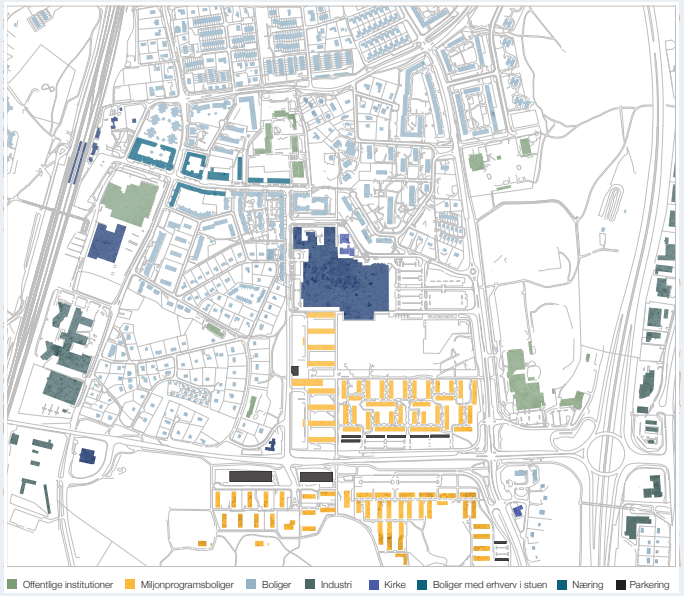
1 The five elements used by Lynch (1960) to make mental maps.

Infrastructure



The town of Upplands Väsby is located between the railroad in the west and the motorway in the east. The main street runs from the railway station in the north-west through the old city centre and turns south towards Fyrklövern, where pedestrians are led off the road and through the Väsby centre.

Typologies



Million Programme projects are located in the south-eastern part of Upplands Väsby, separated from the railway station by an area of smaller single-family houses. The only buildings with commercial ground floors are located close to the railway station in the old city centre.

Green areas

Fyrklövern is closed off on three sides by major roads, and although they are relatively close, the large green areas to the east and south have not been made an integrated part of the area.

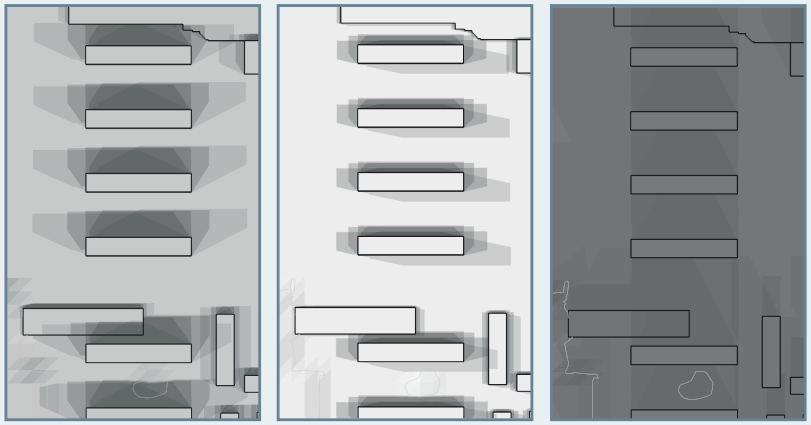
Relevant indicators

Connection / Accessibility	Urban connection	Connection to city Entrances Meeting places Foot traffic to and through area Area used by non-residents
Pride and sense of place	Residents image of area	Local landmarks

F 6.8 Analyses of the urban structure inspired by the SAVE analysis framework. Illustrations by Amanda Dahl and Märta Helander, used by permission

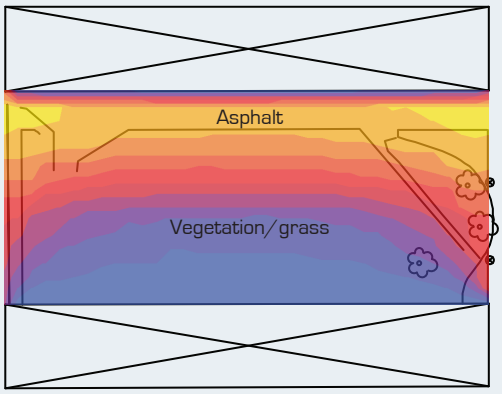
Shadow analysis, 2 hour intervals

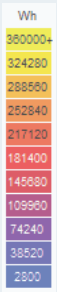
21 March | 21 June | 21 December



Upon visiting the site, concerns about the impact of the buildings on solar access in the green spaces were discussed. Especially the courtyards seemed to have been planned in an unfavourable way, leaving the green spaces in shadow much of the year. Subsequent shadow analyses performed by the architecture students investigated this issue.

Insolation analysis, total annual direct radiation





Ecotect

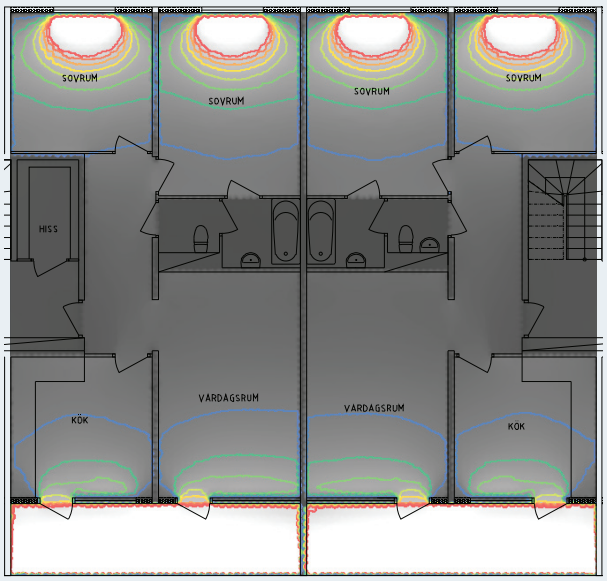
Wather data Stockholm

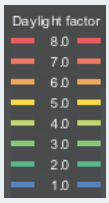
Including all context

Default material settings

A more detailed insolation analysis of total annual direct solar radiation in the courtyards confirmed that the southern parts of the courtyards where the green areas and vegetation was located received significantly less sun over the course of a year than the northern parts, which was largely covered with asphalt for vehicle access.

Daylight factor analysis





Velux Daylight Visualizer

Including building context

Second floor at 800mm

CIE overcast sky

Ground reflectance
0.21

Interior and exterior surface reflectance
0.84

Glass transmittance
0.78

Daylight factor analyses of standard three room apartments on the second floor showed a similar trend to the courtyards. The benefit of large windows in the southern façades was offset by the shading caused by the large balcony and the extra set of glazing. The result was that while the balcony enjoys a high daylight factor throughout, it is at the expense of the daylight levels in the living rooms and kitchens behind it, which generally suffer from a very low daylight factor, below 1% in the back half of the rooms.

Relevant indicators

Equity / Quality of Life	Comfort	Daylight
	Safety	Visibility

F 6.9 Various analyses of daylight access. Shadow diagrams by Amanda Dahl and Märta Helander, used by permission.

in front of the entrances, where there were very few opportunities to sit or linger. The effect of this was unknowingly seen during the site visit in March, where people were observed standing in the entrances in the late afternoon enjoying the sun, while no one was using the benches or green areas, which were in shade (see Figure **F 6.6**).

Analyses of the daylight factor in the apartments also yielded expected poor results in the south-facing living rooms and kitchens, which were withdrawn behind the large balconies (Figure **F 6.9**).

Daylight factor
The ratio, often given in percent, of the illuminance due to daylight at a point on a given plane indoors to the simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky.

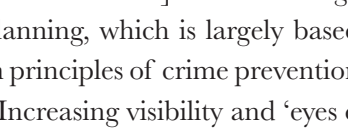
(Iversen et al. 2013)

CPTED

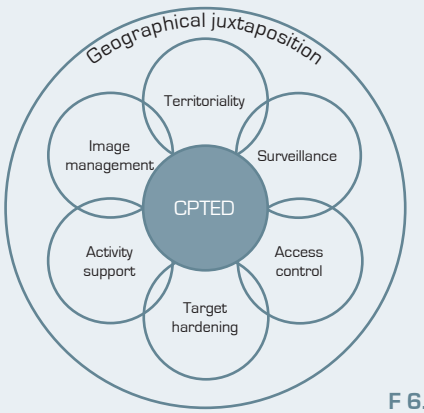
Many indicators relate directly or indirectly to the concept of crime prevention through environmental design (CPTED). The concept has been adopted in many forms, and is often used to reduce crime on public transport (Cozens & van der Linde 2015). Bjørn & Holek (2014) discuss several issues that are highly related to the concept, and the Danish Council for Crime Prevention [Det Kriminalpræventive Råd] have issued a guide for crime prevention measures in urban planning, which is largely based on CPTED (Skou & Madsen 2014). The main principles of crime prevention contained within CPTED are:

Surveillance: Increasing visibility and 'eyes on the street'.
Territoriality: Creating a sense of ownership among residents/users.
Access control: Defining and enforcing private and public space.
Target hardening: Increasing the effort required to commit a crime by using, locks, stronger doors, alarms, etc.
Image management: Maintenance and care makes an area appear more orderly and supervised.
Activity support: Attracting safe and legitimate users and activities.
Geographical juxtaposition: The influence of nearby land uses and activities.
(Cozens & van der Linde 2015)

Working with principles of CPTED and similar frameworks has constituted the analytical approach for a large part of the chosen indicators.



F 6.10 The necessities for crime. CPTED deals mainly with the issue of situation/place. After Skou & Madsen 2014)



Relevant indicators

Equity / Quality of Life	Comfort	Human scale
	Safety / Security	Feeling of security Natural surveillance Visibility
Connection / Accessibility	Urban connection	Entrances Meeting places Foot traffic to and through area Area used by non-residents Common facilities
Pride and sense of place	Public image	Differentiation of private and public
	Residents image of area	Maintenance and care
Social cohesion	Social networks	Local societies/communities

F 6.11 Principles of CPTED. After Cozens & van der Linde (2015).

DESIGN PROPOSAL AND SCORING

Drawing material
1:400 drawings of design proposal available in Appendix F, page 150

The project design proposal was gradually developed by the architects along with the investigation and analysis of issues relating to the different indicators. In order for the proposal to increase the social sustainability of the area, the intention was to increase the score of each indicator, thus substantiating an overall improvement. The architectural concept is illustrated diagrammatically and visually in Figure F 6.13 and F 6.14. Moving from large scale neighbourhood considerations to smaller scale changes to the façades, the proposal follows a logic that addresses all chosen indicators:

1. A new structural hierarchy increases the integration of the neighbourhood with the surrounding city. By raising the ground up to the first floor in two of the courtyards, a level connection is made with the green area to the west, and the road no longer acts as a barrier. At the same time the middle courtyards is accentuated as a different and more public space, which allows people flows in and out of the area.
2. One staircase in each building is opened up completely to allow a passage through the building. This breaks up the rigid, one-directional path system and allows for more casual, diverse people flows between the buildings. It also sets each building apart from the others in a visually characteristic way.
3. New student housing positioned in the western end of the courtyards replaces the removed building mass from the staircases and partially closes off the two elevated courtyards, further accentuating them as semi-public spaces.
4. Entrances are connected through to both sides of the buildings, and the staircases are expanded to include functional common spaces on each floor. New apartments, including two floor studios, are accommodated in the ground and first floors, connecting directly to the elevated courtyards. This creates a private zone around the edge of the elevated green courtyards, and together with the updated facade design, the buildings are oriented more towards each other, creating a semi-private space.

In discussion with the architects, the design proposal was given a rating from 4-10 for each indicator, based on its performance on the developed measurement scales. The individual ratings are shown in Table T 6.4 and the scales can be seen in Appendix C. Using the MCDM Excel tool that had been developed, the results have been visualised in Figure F 6.12.

T 6.4 Scores for existing and proposed design for indicators and criteria.

Themes	Criteria	Ex.	Prop.	Indicators	Ex.	Prop.
Equity / Quality of Life	Freedom of choice	4,00	8,00	Ability to shape own space	4	8
	Comfort	4,56	7,11	Daylight	4	6
				Human scale	5	8
	Safety / Security	6,16	7,88	Feeling of security	7	7
				Natural surveillance	4	9
				Visibility	7	8
Connection / Accessibility	Urban connection	4,73	9,08	Connection to city	4	9
				Entrances	5	10
				Meeting places	4	8
				Foot traffic to and through area	7	9
				Area used by non-residents	5	8
				Common facilities	4	10
Pride and sense of place	Public image	5,00	10,00	Differentiation of private and public	5	10
	Residents image of area	5,50	9,00	Maintenance and care	5	8
				Local landmarks	6	10
Social cohesion	Social networks	4,00	9,00	Local societies/communities	4	9

F 6.12 Scoring graph of design proposal (green) versus existing conditions (red). Produced by aggregating scores in the Excel MCDM tool.

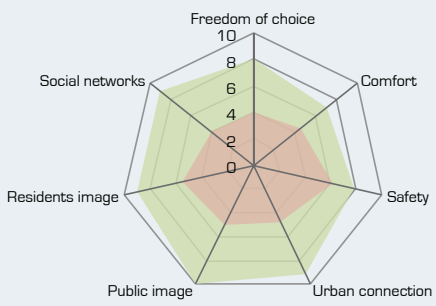
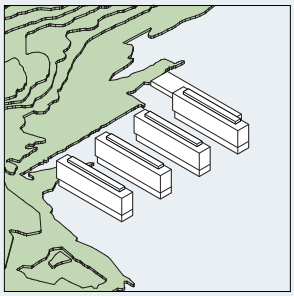
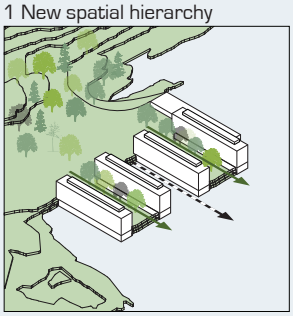


Diagram of architectural concept



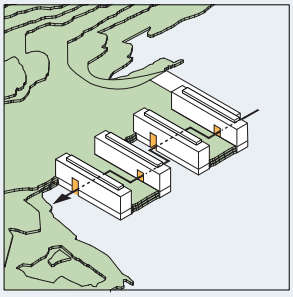
Existing conditions.

1 New spatial hierarchy



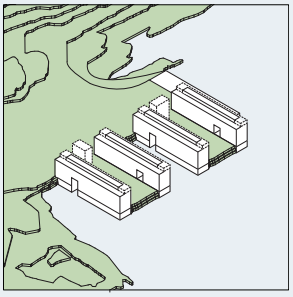
Landscape dragged into the courtyards and public connection is made in the middle courtyard.

2 New connections



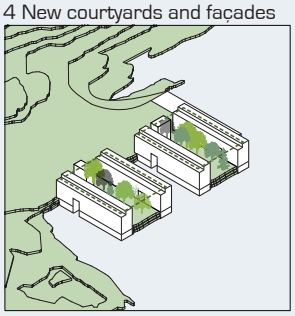
By removing building mass the building blocks are opened up and a north-south people flow is facilitated.

3 New volumes



New volumes are places in the two semi-private courtyards.

4 New courtyards and façades



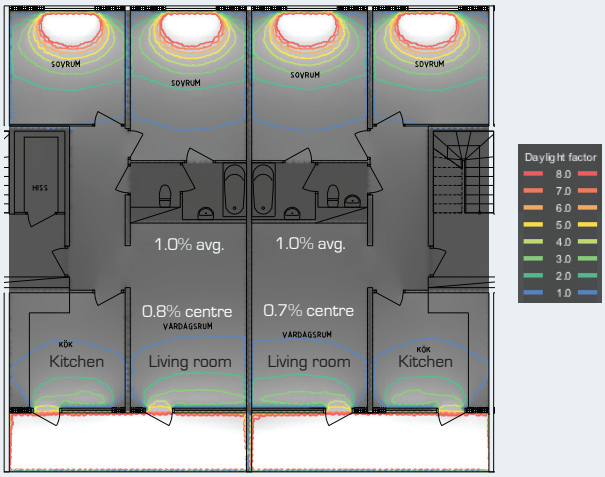
New green courtyards are created with new entrances and façades causing buildings to face towards each other.

New open staircase

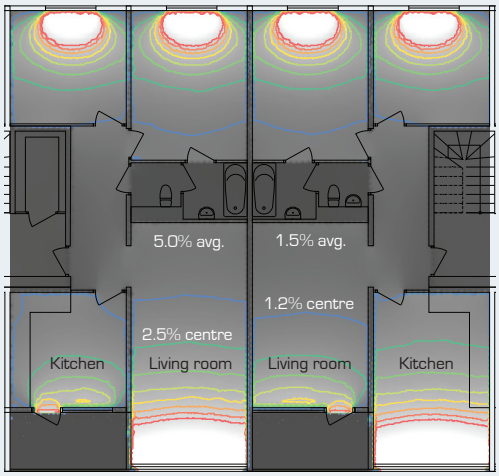
New courtyard and facades

Daylight factor analysis

Existing facade

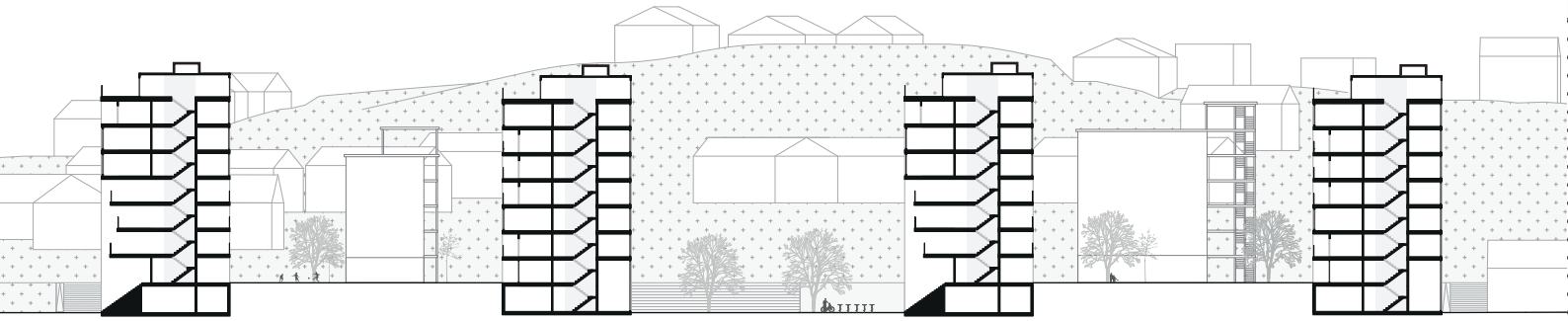


Proposed facade

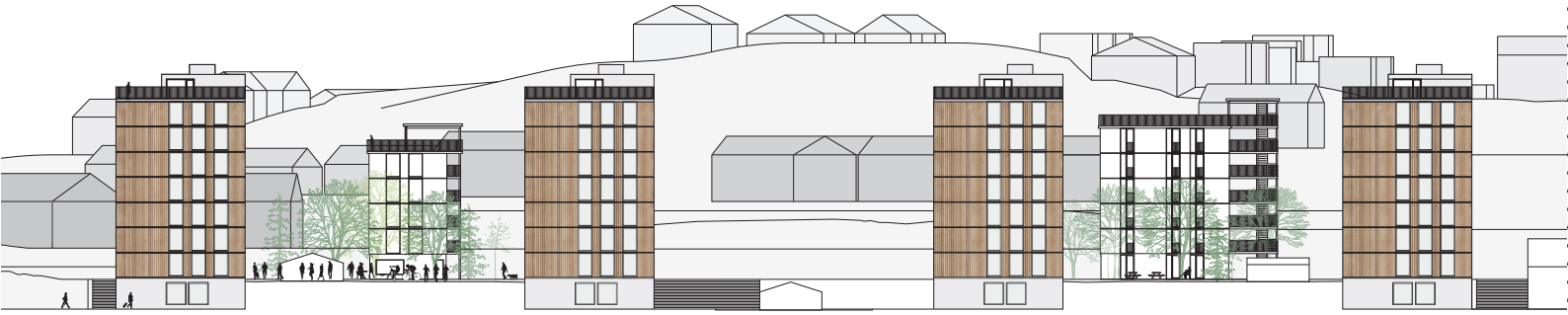


In the proposed façades either the living room or kitchen of each apartment is extended outwards, reducing the area of the balconies by half. At the same time the balconies are opened and the glazed area is increased to allow more daylight to enter. The daylight factor in the centre of the living room is increased from 0.7–0.8% to 1.2–2.5%.

F 6.13 Proposal for transformation of the blue houses in Fyrklövern. Daylight factor simulations use the same setup as the precious. All material (except daylight factor analyses) by Amanda Dahl and Märta Helander, used by permission.



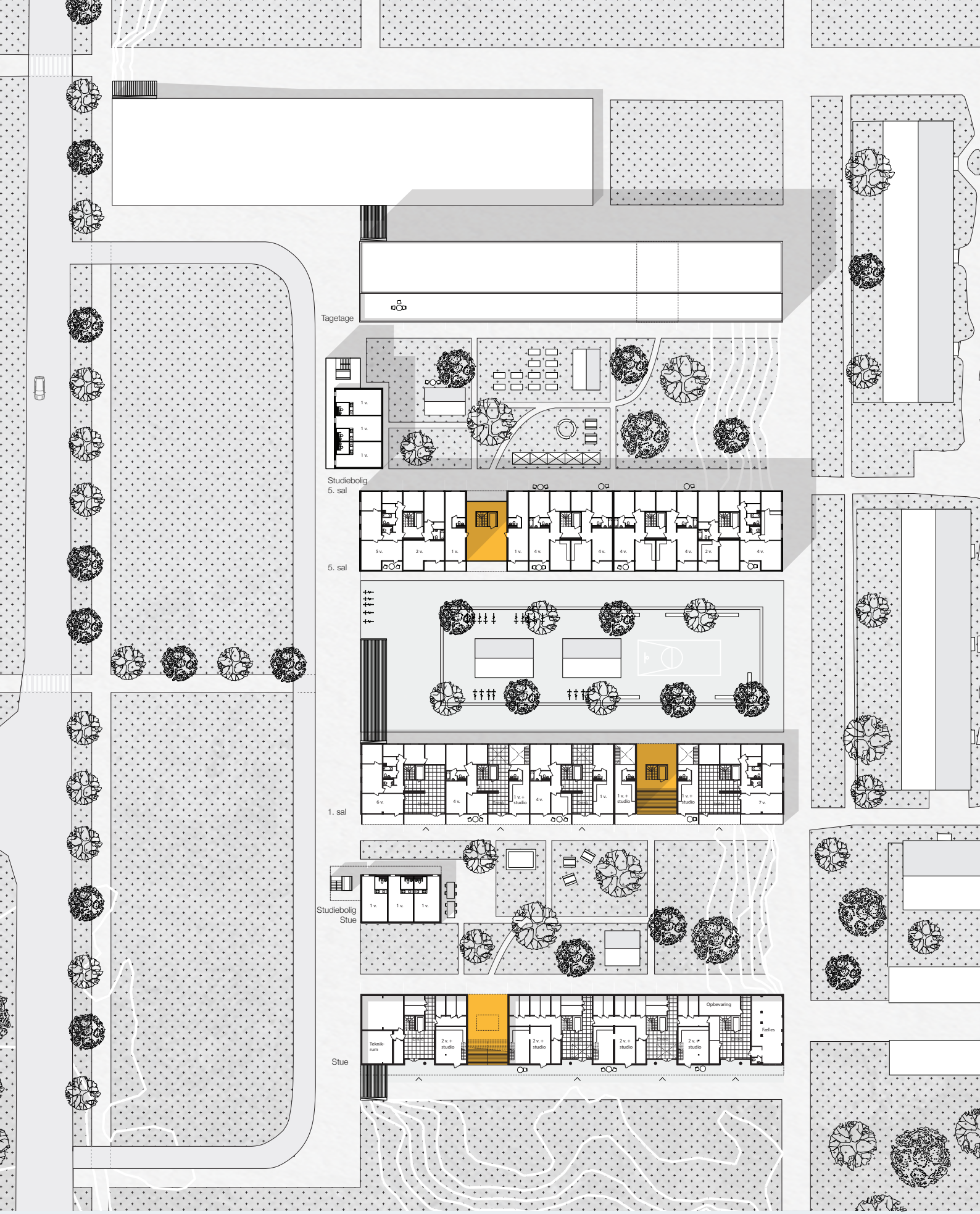
East sections, 1:800



East elevations, 1:800

North elevation, 1:800

South elevation, 1:800



Site plan with ground floor, first and 5th floor, 1:800

F 6.14 Project proposal. Opposite page: Section and elevations. This page: Site plan with floor plans. All material by Amanda Dahl and Märta Helander, used by permission.

DISCUSSION

The scoring of the indicators was performed by the architects and the author based on the developed measurement scales. This process, like the development of the measurement scales themselves, is sometimes inevitably *subjective*. Although an accurate objective description can be preferable, subjective input from users or designers should not always be bypassed in favour of increased objectivity (Benoît & Mazijn 2009). Especially when the model is used to support architects in their early design considerations, subjective input can be sufficient to decide between design proposals, however considering the need to qualify social sustainability in terms of economic benefits, increased objectivity and measurability should still be on the agenda.

Looking at the graph in Figure F 6.12, the score of the design proposal far exceeds that of the existing conditions for most of the indicators. Given that the indicators were chosen for their poor performance, this comes as no surprise. The usefulness of this type of graph — showing only the final proposal and initial conditions alongside each other — is also questionable, however it demonstrates how the scoring and visualisation of performance could work. Due to restraints which will be explained below, it was not feasible to undergo this process of scoring for every design concept that was conceived, but this is eventually what is pursued.

Model development and integration

The model of social sustainability was continually developed during the course of the case study. As a result, not all elements of the methodology were fully utilised at the correct times in the process. Instead, the process and the model have mutually informed each other to build a methodology, which could then be used only on the later stages of the process. This was unavoidable due to the parallel time scopes of both projects and it limits the usability of the case study in the earliest phases where the model could have helped introduce some clarity and focus. The architects held the same view, noting that "many of the things on the list were discussed on the way, but having the indicators formulated in a list would have made some of the process a lot more straightforward." The architects also showed interest in the idea of including reference projects and examples of how to work with the individual indicators. Although a reference for each indicator to various sources of literature has been made, it seems crucial in this context to provide more succinct specifications. Having a more detailed specification for each indicator would reduce the time needed for a specialist, who might then focus on user engagement instead. These indicator specifications, however, would likely have to be the result of a broader engagement of experts from various fields, and not the work of engineers or architects alone.

Indicator analysis and objectivity

For the architects, the list of social sustainability indicators was seen first and foremost as a useful list to "remind you which main issues needed to be worked on" as they noted, yet they were also conscious of the need for analysis. But unlike the environmental sustainability indicator of Global Warming Potential (climate change), which depends very much upon the single factor of greenhouse gas emissions, the social sustainability indicators require a more varied approach to analysis. As of yet there exists no database containing physical interventions and their social consequences for each indicator, so a method similar to LCA can not be efficiently used. Instead, the indicators must be analysed using available methods, some of which were used in the case study. Following the completion of the project, architect on the project Amanda Dahl noted:

> I think it is a good idea to have a list of indicators of social sustainability as a tool to analyse architecture. The list will however need to be very general if it is to be used as a general tool, and therefore it is difficult to get in depth with the concrete case. And so the list cannot stand alone but must be supported by other analytical tools.

This report has started down the path of identifying and/or creating useful tools that are able to inform social sustainability indicators, but more research needs to be done in this area before a full range of analytical tools can be available. Specifically, the possible use of GIS has been discussed in this context.

Use of analytical tools would certainly help make indicators increasingly quantifiable, however as mentioned using more specific indicators could also help in this regard without necessitating tools; as Dahl commented on the scoring process:

T 6.5 Taking the next step towards a specification of the indicators: Method/units of analysis for indicators and indication of whether they can be qualitatively or quantitatively determined.

	Themes	Criteria	Indicators	Method / Unit of analysis	Qual.	Quant.
Social Sustainability	Equity / Quality of Life	Freedom of choice	Ability to shape own space	Variety of available options	X	
		Comfort	Daylight	Daylight factor		X
			Human scale	Range of scales that relate to human body	X	
		Safety / Security	Feeling of security	Percentage area properly lit	X	
			Natural surveillance	Percentage area with natural surveillance / no. enclosed spaces	X	
			Visibility	Percentage area with good visibility	X	
	Connection / Accessibility	Urban connection	Connection to city	Number and types of connections (path, roads) into area	X	X
			Entrances	Distinctiveness, openness, brightness, facing direction, privacy	X	
			Meeting places	Number (per building), variation	X	X
			Foot traffic to and through area	Volume (no. people), attraction, facilitation	X	X
			Area used by non-residents	Volume (no. people), attraction, facilitation	X	X
			Common facilities	Number (per building), ease of access, variation of use	X	X
	Pride and sense of place	Public image	Differentiation of private and public	Level of graduation, use of semi-private spaces	X	
		Residents image of area	Maintenance and care	Expected quality/ease	X	
			Local landmarks	Number, variation	X	X
	Social cohesion	Social networks	Local societies/communities	Capacity/facilities to support groups/activities	X	

> It was very difficult to be objective when we were scoring our renovation of the Million Programme in Upplands Väsby. For example regarding the number of meeting places in the area, because how do you define a meeting place? The indicators should be more defined; this would make it easier to be objective.

This demand for specificity/objectivity contrasts the demand for generality in the previous quote. This relates to the issue of model flexibility discussed in the end of the previous chapter. Arguably, using more objective indicators could increase the validity of the model results, yet a too specific model also loses its general appeal. The three levels (themes, criteria and indicators) were intended to address this, but the model might need yet another level of detail. To accommodate the need for objectivity and to take the next step towards developing analytical tools, a specification of method (and unit) of analysis is proposed based on the case study (see Table **T 6.5**).

Limitations to user involvement

Because of the nature of the project and limited resources, it was not possible to conduct any user involvement processes apart from the direct interaction performed on-site in Upplands Väsby. This is a major drawback, as an inclusive design process has repeatedly been highlighted as a prerequisite for social sustainability. However, this did not affect the ability of the case study to examine the practical use and outcomes of the proposed model and methodology. Regarding the outcome of the project, the architects felt that closer contact with the residents would definitely have had an impact on their proposal in terms of understanding the users, yet the solutions to the issues would not necessarily have come from them. Hence, looking at the model both as a tool to support the design process and as a tool to facilitate user integration, the former has been investigated here, while the latter has yet to be examined.

Educational project setting

The fact that the project was carried out in an educational setting and not in a professional context had several implications. In the words of the architects:

> In a school project you have more time to go in depth, more time to discuss and investigate different solutions. In a competition you have to make decisions faster, but often you also have a bigger knowledge foundation do base the decision on, since you are a bigger team with more experience. In a school project you can, like in our case, choose a focus to work with and draw from, such as social sustainability. This you can do based on your own interests. But in the real world you need to take clients and the wording in the competition programme into account. If the client has emphasised environmental sustainability it is hard to get the time to work thoroughly with both aspects.

So the ability to work thoroughly with social sustainability was largely enabled by the freedom of the school project, however the results can only be regarded as preliminary, as the conditions may not be representative of the conditions in a real design competition.

IN CONCLUSION

This chapter presents a case study in the use of the proposed model of social sustainability, describing how it was used in a design process at KADK to produce a proposal for the transformation of part of the social housing area Fyrklövern in Upplands Väsby north of Stockholm. Initial research and visits to the site led to the selection of a focus on the space between the buildings, façades and ground floors, which was further underpinned by discussing, selecting, weighting and analysing indicators from the proposed social sustainability model.

The design proposal deals with the identified issues and analysis results on all relevant scales by changing the internal structure of the area, improving integration with the surrounding city, redesigning and reorienting the ground floors and façades, breaking down scales and using level differences and a graduation of private, semi-private and public to introduce a more logical hierarchy of the outdoor spaces.

The design process was successfully supported by the proposed model of social sustainability, however as part of the model was developed in parallel, it could not be fully implemented in early phases of the process. Although the model was considered to be useful by the architects, they also called for increased indicators specificity and analytical tools in order to validate and justify their design outside of the design process.

Finally, the educational setting of the case study did not take many factors into account that would affect professional projects, such as more limited time, the client and larger design team, nor did it allow for any significant involvement of users. However, the freedom of focus and increased attention to detail made the setting well-suited for an initial test and development of the social sustainability model.

LESSONS AND REVISION

7

This short chapter is a continuation and widening of the discussion in the last chapter. It picks up on the learnings from the case study and combines them with input from professionals and researchers to revise and refine the proposed tentative model of social sustainability and the framework around it.

The first sections take a step back and look at what did and did not work and more importantly what should be changed as a result. The final section presents a revised and expanded version of the model of social sustainability, which is intended as a worksheet for the design process and as a platform for further development.

LESSONS FROM CASE STUDY

Lessons and revisions to the social sustainability model resulting from the case study are presented here.

Revised indicator selection strategy

A main drawback from the case study was the missed opportunity to test the social sustainability model as a guidance and support in the earliest design process phases. As architects noted, it might have introduced some much needed clarity. Still, they elaborated on the way indicators should be selected and weighted and proposed an alternative approach, in which all indicators in the model were discussed and weighted in the beginning of the process:

1. All indicators are reviewed in the beginning of the project.
2. Based on its relevance in the specific case, each indicator is given a weighting from 1-10.
3. All indicators with a weight below 4 are disregarded.
4. The rest of the indicators denote the primary issues and thus the focus of the project.

By following this process, a more thorough examination of the relevance of each indicator is ensured, and the number of chosen indicators will also reflect the extent of the social sustainability concerns within the project. This would make it possible to use the model in the beginning of all projects to test whether social sustainability is an issue. For example, a project with few social sustainability issues might only identify one or two relevant indicators and focus can be directed elsewhere, whereas another project might discover pertinent social sustainability issues that had not been addressed before.

Time scale

Chapter 5 described the importance of addressing the immediate needs of the residents before commencing with large scale changes. This consideration was not possible to make in the case study due to insufficient user interaction. It is interesting to note, however, that the design concept proposed major changes to the landscape and buildings as a first step in the transformation. As these are long-term changes, residents would be unlikely to see any short-term benefits, and the smaller scale changes to the facade and courtyards were only likely to happen after the big changes were completed. These issues might have been avoided through an earlier consideration of the *time scale* of the different interventions and their order of implementation.

Tools

A need for more measurable indicators was clearly expressed by the architects, and thus the model was expanded to specify the method and unit of analysis.

Indicators

Revisions have been made to some of the indicators used in the case study. The revisions are made due to overlaps in what is covered by some indicators, specifically the ones relating to connection to the city, foot traffic in the area and meeting places. The intention was to avoid overlaps and too general indicators by making each indicator more specific. Also, heritage value has been added as an indicator of public image to better include cultural/historical parameters in a context that is relevant to social sustainability.

FEEDBACK FROM PROFESSIONALS

Robin Andersson, sustainability specialist at White architects' Stockholm office, reviewed the social sustainability model. His comments were mostly related to themes of identity and meeting places:

> Somewhere I would like to add 'identity', which I find very important when I interview people. Every part of every city has some kind of identity (can be both good and bad), and this tends to be very important for people to either get rid of or maintain/enhance … Also I would recommend a theme called 'meeting places/public places' — both commercial and non commercial, programmed and non-programmed. People find it important to be able to just 'hang around', both young and old. Especially young girls need places to 'hide' from the public and programmed environment.

In terms of *identity*, the intention behind the model was that these issues would be addressed under the theme *pride and sense of place*, which deals with indicators affecting the image of the area, both internally among residents and externally in media and the general public (as these two are not necessarily the same, especially in stigmatised areas). As a result of Anderssons comment, the theme is renamed to *identity of plac*e, which more appropriately describes that it deals with the identity which residents and the public attach to the place in question. Also, the indicator *common facilities* has been removed in favour of *private meeting places*, which deals more generally with the spaces available for the residents to meet casually and formally, as opposed to public meeting places, which are not only available to residents. These indicators might benefit from a more detailed investigation into the specific types of meeting places, as was also mentioned by Amanda Dahl in the case study.

Åsa Bjerndell corroborated Anderssons focus on meeting places and shared spaces as central drivers for socially sustainable behaviour. She referred to Granovetter (1973), describing the importance of having many *weak ties* to other people and argued that the physical environment can stimulate the generation of these ties by inducing and facilitating social interaction; in this respect, public shared spaces are key.

LEARNINGS FROM STED NETWORK CONFERENCE

Present at discussion, among others:

Elise Grosse
White architects

Paula Femenias
Chalmers

Peter Andreas Sattrup
Danish Assoc. of Arch. Firms

Lotte Bjerregaard Jensen
DTU

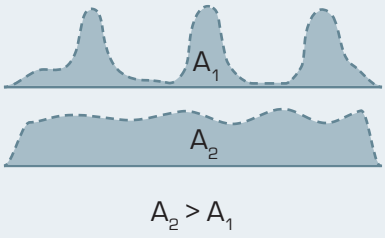
On 9 June 2016, the Nordic Built Sustainable Transformation & Environmental Design (STED) Network Conference was held at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. The first part of the conference consisted of short, individual poster sessions with presentations by students, professors and representatives from architectural studios. The second part of the conference consisted of more in-depth discussion sessions, where participants had the chance to discuss and elaborate on the issues presented during the poster sessions in smaller, subject-specific groups. One of these sessions were on the topic of social sustainability, and the discussion participants were able to provide interesting perspectives on social sustainability in the design process and on the proposed model[1].

Include solutions

The first perspective that was offered relates to the usability of the model in the design process. It was proposed that the model be expanded to include a compilation of *attractors* or *solutions* for improvement juxtaposed to the individual indicators. This might work as inspiration for the design, and by collecting empirical evidence in and after the design process, over time it might become a knowledge bank, with a database of example projects and possible strategies for improvement of social sustainability. In that sense, the case study in the previous chapter can be regarded as a first collection of data, although it is not possible to collect real evidence of the effects of the transformation.

User engagement strategy

Part of the discussion was on strategies to include residents in a more efficient way. Specifically, it was discussed how the use of mobile applications might facilitate contact



F 7.1 Proposing a more 'flat' user engagement curve, increasing the overall level in the entire design process.

1 A scaled-down version of the poster presented at the STED Network Conference as well as an example of the feedback hand-out that was distributed to participants during the discussion session are included in Appendix G.

between residents and the design process. By maintaining a more constant contact throughout the design process, users might feel more involved with less effort, and their input could inform the design process in a more continuous way, resulting in a more 'flat' user engagement curve. Additionally, the overall user involvement level would most likely be higher.

A specific tool for this was suggested in the form of *Maptionnaire*, a subscription-based software tool to create map-based questionnaires and civic participation platforms (Maptionnaire 2016). Such a tool could also help provide deeper information about an area.

Quantification — urban analysis tool

In terms of quantification, the Swedish company *Spacescape* was mentioned as a possible source of inspiration regarding analyses of urban structures. The Swedish company works with urban planning and applies several methodologies and analysis tools for quantitative analysis of urban environments, including proximity analyses, access analyses, grid analyses, area analyses and urban life analyses (Spacescape 2016). These sorts of analyses also have a potential to quantify social sustainability in terms of economic effects, such as the effects of amenities on property value. Still, such analyses require development of complex axial maps as well as access to methodologies and software, which the company might not be expected to share freely.

On the other hand, there exists a variety of tools that are freely available online, and which might be able to perform some of these analyses to a satisfactory degree. Specifically, it is interesting to look at tools that could function inside an integrated dynamic model, such as plug-ins for Grasshopper and Rhino, examples being the SpiderWeb tool or the Urban Modelling Interface (UMI 2016; SpiderWeb 2016).

Perspectives

A final perspective of interest addresses the list-form of the proposed model, which essentially works by explicating the contents of social sustainability. As Peter Andreas Sattrup noted, most of the indicators in the model of social sustainability are already a *tacit* part of an architect's working process: "Architects always address social sustainability — and they quantify it every time they draw a line."

This understanding of the problem focuses on the drawing as the end product and thus as the materialisation of the social sustainability strategy. It emphasises the architect's role as the one who produces the drawings, and the proposed model of social sustainability then works as a method towards structuring the architect's argument, e.g. by making concrete economic connections. At the current stage, however, more research and empirical data is needed in order to operationalize this aspect of the model.

REVISION OF MODEL

The revision proposals have been incorporated into a new revised version of the social sustainability model, which includes an expanded set of parameters and condenses all the aspects into Table T 7.1. The table is intended as a control panel for the social sustainability based design support by requiring the user to reflect on its content and write down methods and tools for analysis and strategies for possible solutions as well as their physical scale and time scale. The left side of the table has space to record weightings of the individual criteria and indicators as well as the indicator scores. The table should be used in combination with the developed MCDM Excel tool, or could be made available in a digital version that connects results to a visualisation.

The revised model has also been included in an A4 leaflet, which is intended to briefly present the model and methodology as well as the research behind it. The leaflet is included in Appendix H.

T 7.1 Revised and expanded model of social sustainability including added parameters and a condensation of the case study results.

	Themes	Criteria	Weight	Indicators	Weight	Score
Social Sustainability	Equity / Quality of Life	Affordability		Rent level Heating cost Individual metering Possibilities for food production Good quality apartments		
		Freedom of choice		Variation in apartment sizes Variation in tenure Apartments for residents with special needs Access to balcony Access to green/recreational areas Access to storage Ability to shape own space Ability to cultivate/grow		
		Comfort		Daylight Heating Indoor climate Noise Wind Human scale		
		Health		Ability to exercise Access to health facilities Awareness of own health		
		Education		Access to elementary schools Access to secondary education schools		
		Safety / Security		Vandalism removal Road safety Lighting Natural surveillance Visibility		
	Connection / Accessibility	Transportation		Public transport Carpool Balance of modes of movement		
		Urban connection		Garbage collection Entrances Parking facilities Car access to area Pedestrian access Bike access Area used by non-residents Public meeting places Private meeting places		
		Disabled access		Possibility to stay in your own home Accessibility indoors/outdoors		
		Services/jobs		Presence of local amenities Range of service Local job opportunities Support system for entrepreneurs		
	Identity of place	Public image		Name of streets Public stigma (media reports) Public landmarks Heritage value Differentiation of private and public Definition of uses (programming)		
		Residents image of area		Maintenance and care Resident's opinions Local landmarks		
	Social cohesion	Social diversity		Social mix Social inclusiveness		
		Social networks		Volunteers Local societies/communities Residents' association		
	Democracy	Participation		Residents included in decision processes		
		Communication		Access to information/internet		

Method / Unit of analysis	Qualitative	Quantitative	Tools	Attractors/Solutions	Scale			Time scale
					Apart.	Build.	Neigh.	
Variety of available options	X			Flexible design, private outdoor spaces, user influence	X	X	X	Short to long
Daylight factor		X	Velux Daylight Visualizer	Increased glazing area, new facade	X	X		Medium
Range of scales that relate to human body	X		CPTED/SAVE	New, smaller buildings, varied facade		X	X	Medium to long
Percentage area properly lit	X		CPTED	New/improved lighting	X	X	X	Short
Percentage area with natural surveillance / no. enclosed spaces	X		CPTED	Active ground floor	X	X	X	Medium
Percentage area with good visibility	X		CPTED/SAVE	Reduce corners	X	X	X	Medium to long
Distinctiveness, openness, brightness, facing direction, privacy	X		CPTED/SAVE	Increase glazing, create semi-private zone		X		Medium
Volume (no. people), attraction, facilitation	X	X	SAVE	Increase number of amenities			X	Long
Number (per building), variation	X	X	Mental map	Playgrounds, benches, shops, cafés, playing fields			X	Medium
Number (per building), ease of access, variation of use	X	X	Mental map	Common rooms, laundry rooms, roomy staircases		X	X	Medium to long
Level of graduation, use of semi-private spaces	X		CPTED	Semi-private areas, level differences		X	X	Medium to long
Expected quality/ease	X		CPTED	Easily cleaned/replaceable materials		X	X	Medium
Number, variation	X	X	Mental map	Artwork, architecture, a special tree, a special shop			X	Short to long
Capacity/facilities to support groups/activities	X			Common facilities, playing fields, green areas		X	X	Medium to long

IN CONCLUSION

Based on the learnings from the case study and opinions from professionals and researchers, this chapter presents a revised and expanded version of the model of social sustainability. Among the revisions are changes to the indicators, which have been done mostly in order to avoid overlaps, and a revised strategy for selection of indicators, which requires all indicators to be weighted in the beginning of the design process. Among the expansions are specifications of the method and unit of analysis, tools and possible attractors/solutions, which can also serve as a reference for future projects, along with considerations of both space and time scale. Finally, considerations of new user involvement strategies and more advanced, quantitative analysis tools point towards these areas as the natural next steps in the development of the model.

DISCUSSION AND CONCLUSION

8

The discussion was initiated in the case study chapter and subsequently expanded in scope in Chapter 7. This final chapter rounds off the discussion, maintaining a wide perspective, and tries to address the more fundamental questions regarding social sustainability in a design process.

After a brief conclusion, this chapter also takes a final view at some of the possibilities for further research that have been identified in this research.

DISCUSSION

Should all projects be socially sustainable?

The short answer is yes. Although it is important to build environmentally sustainable and profitable buildings, it is worth considering that the end goal of the sustainability agenda is essentially social. Is it then enough to focus on environmental sustainability with the long term goal of preventing the social effects of future climate change? Or should there also be a more immediate focus on creating societies that are equitable, diverse, connected and democratic and provide a good quality of life? The answer seems obvious: Social sustainability is always a parameter, and it is important to address it on both the short and long term, on the large and small scale.

Having said that, different projects require different levels of focus on social sustainability depending on their preconditions. This is especially true for renovation projects. The model of social sustainability within this report offers one approach to creating a focus within a given context. Although it has been developed bearing Nordic social housing in mind, the proposed indicators are aimed at a much wider application, and the list can be easily customised to a different setting.

Indicator specification

As of now, many of the indicators are only vaguely specified in terms of how they should be quantified or evaluated. In consequence, the specification happens on project level, which project participants in the case study felt was too subjective. Although a specification of the method and unit of analysis adds a new layer to the model, it is necessary to conduct more research into each indicator in order to properly substantiate their individual methods of quantification. Such research would also clarify potentials regarding the use of tools.

The link to economic sustainability

Parallel to an increased specification of each indicator, it is of central interest to relate their social sustainability benefits to an economic perspective. Although it has not been the subject matter of this research, this is an issue that has continually surfaced throughout the report in literature, interviews and meetings, and economy constitutes much of the foundation for the need to quantify social sustainability in the first place (see arguments on page 45). With this in mind, it is not straight-forward how the issue should be approached.

There seems to be two sides to the argument: A need to determine *how much* is benefited from social sustainability in economic terms, and a need to determine *who* benefits.

Starting with the latter, it was mentioned in the introduction chapter that problems of split incentive could pose a barrier to social sustainability. This was also emphasised by Elise Grosse at the STED Network Conference: "The return of investment in social sustainability does not come to 'us' but the return is 'over there'." In the subsequent discussion, proposals to up the incentive for social sustainability included a calculation of the economic benefits of social sustainability (e.g. of improved health) on a national level possibly followed by subsidies for socially sustainable projects, a change in the way leases are written to ensure the building owner benefits from the improvements, or even an investigation into the branding value for the clients investing in social sustainability.

In terms of how much is benefited, it is difficult to point to any common economic denominator for all the indicators of the model. Rather, economic benefits seem to be scattered all over: Will high levels of comfort and access to high quality outdoor spaces keep residents healthy for longer, reducing hospital bills? Will a better public image and thriving local services and amenities create jobs and increase revenues? Åsa Bjerndell suggested that a higher level of safety and security and increased sense of ownership could reduce vandalism and secure better maintenance.

As a result, approaches to determine the economic benefits of social sustainability are highly diverse, and such investigations should not be carried out without considering first whether the return on investment helps create incentive towards social sustainability.

Tacit knowledge and subjectivity

The current tendency towards IDP means that engineers are increasingly included as active participants in the early phases of the design process. However, according to the IDP frameworks, engineers still work as specialists, whereas it is the architect who assumes the holistic perspective.

In the social sustainability model, however, engineers must also participate in the weighting and selection of indicators in the beginning of the process, in order to broaden the professional basis of the weighting process. This includes making qualitative assessments of what is most important to a project, based on preliminary analyses and professional opinion. Naturally, this also means that all projects are not assessed against the same criteria. The rationale behind the selection process is that a more focused optimisation of the most important parameters will results in a better project than a broad optimisation of all available parameters.

But how to decide what indicators are most important? Architects are trained in making qualitative assessments of their designs. Many of these assessments hinge partly on tacit knowledge and professional experience, and are a natural part of the architects working process. Engineers on the other hand will likely feel hesitant at the notion of having to decide early on, which design parameters are the most important, since the subsequent optimisation seems then to be based on a subjective foundation. But this view fails to recognise the importance of the informed professional opinion. As it was mentioned in the case study discussion, subjectivity should not always be bypassed in favour of increased objectivity, especially if the objective parameters fail to capture the full picture. In the early design process phases, when all the cards are still on the table, any number of specific quantitative enquiries is unlikely to provide an adequate basis for decision. This is due both to the multitude of parameters, and to the fact that many parameters (such as those relating to architectural value) are inherently qualitative. Instead, a synthesis of the combined tacit (and explicit) insight of all project participants — including engineers — seems more likely to yield fruitful results in the form of a judicious choice of project focus.

Limitations to quantification

The need to retain a subjective perspective is not limited to the initial weighting and selection process. Paradoxically, while the architect is moving towards increased quantifiability, the engineer must increasingly acknowledge the value of the inherently qualitative parameters that govern architecture.

It is important to keep in mind that the role of the model is design support in order for it not to become a mere lookup list for standardised solutions to individual problems. Instead, it should constitute a vehicle for breaking down and analysing design issues and synthesising design solutions across the different indicators. The danger lies in a mechanistic translation between indicator unit of analysis and design solution. If issues with entrances, interior daylight levels and human scale are identified (such as in the case study) these should not be addressed separately; rather it should be considered whether a new facade design could potentially improve all three. The architectural concept then improves the indicators, but is not dictated by them. Working with different scales might help identify these potentials.

CONCLUSION

This research has looked at how to improve the tangibility and practicability of social sustainability in the design process by way of theoretical as well as practical investigations. Specifically, it has investigated how a design process can be supported to secure more socially sustainable solutions in the transformation of Nordic post-war social housing projects. It is based on three perspectives: The fundamental theory of social sustainability, current conceptualisations and the design process integration.

1. What is social sustainability, what characterises socially sustainable solutions and how can the concept be made more tangible?

It was found that social sustainability is still a contested concept, and while many attempts have been made to define it, no commonly accepted definition exists. Instead, in the absence of a comprehensive definition, a number of defining themes and characteristics were more well-suited for practical applications. The main findings of this chapter thus relate to the identification and specification of these characteristics, which include, i.a., equity, social mixing, cohesion, empowerment, participation, well-being, and quality of life. Furthermore, literature on environmental psychology, evidence based design in health care as well as evidence collected from international cases of transformation of social housing projects, strongly suggest that a link exists between architecture and social sustainability.

2. How can social sustainability be evaluated and/or quantified and how can this inform a design process?

Finding that S-LCA, the framework most similar to E-LCA and LCC, had major limitations to its use in a design process, four other conceptualisations of sustainability were investigated to determine an approach that was suited for the purpose of design support. A convergence was found, both in some of the indicators used by the four frameworks and in the way they were represented: Recurring themes of social cohesion, health and safety, social mix, participation, accessibility, identity and comfort were broken down into more tangible indicators. It was also found that the most central issues in terms of design process integration were related to how indicators were analysed, their scale, weighting, visualisation and comparison of results as well as inclusion of residents in design processes, yet none of the considered frameworks offered a comprehensive model that could be used to effectively integrate social sustainability into a design process.

3. How can a design process be organised in order to include the social dimension?

The integrated design process (IDP) was found to be promising as a way to integrate an operationalization of social sustainability, especially the con-

cept of interdisciplinary integration and a focus on an iterative process were found to be essential. For the integration of social sustainability parameters on equal terms with more traditional areas of focus, multi-criteria decision-making (MCDM) provides a solid framework. Community involvement was also seen as essential to the design process, especially since an alignment of investor and community interests could lead to an increased sense of ownership among residents.

How can a design process be supported to secure more socially sustainable solutions in the transformation of Nordic post-war social housing projects?

Utilising the knowledge that had been gained from the three research perspectives above, this report has proposed a compilation of themes to cover the key topics of social sustainability, each with a set of associated criteria and a list of indicators, constituting a model of social sustainability for use in the transformation of Nordic post-war social housing. Based on the conditions of the individual project, the indicators can be weighted to direct focus towards the most relevant issues. Then, based on an analysis of the indicators and a conversion of qualitative and quantitative results to a common scale, the social sustainability performance of design proposals can be visualised to support the design process.

Despite a lack of community involvement, a case study in the application of this model to a KADK project, dealing with a design for the transformation of a social housing project near Stockholm, yielded mostly positive results, as the design process was successful supported and resulted in a design proposal in which significant improvements to social sustainability could be substantiated and visualised. Still, it was also found that more specific indicators and analytical tools were needed in order to validate and justify the design outside of the design process.

Addressing the research question, a design process can be supported to secure more socially sustainable solutions in the transformation of Nordic post-war social housing projects by applying the revised and expanded version of the model of social sustainability that resulted from the case study and from input from professionals and researchers. However, in terms of measurability, this report has only taken the first step by providing a framework of what is to be measured. A discussion of what can and should be measured and further research into the specifics of each indicator are necessary next steps.

Hence, although this research has not succeeded in conveying a *complete* (or even comprehensive) model for the integration of social sustainability in a design process, it has developed an analytical approach that can prove useful for further systematic enquiry into socially sustainable transformation of the built environment.

FUTURE RESEARCH PERSPECTIVES

The following list contains perspectives for further research that would continue and support the work of this project:

Further *investigation into indicators* (such as meeting places, to more carefully specify the kinds of meeting places that are needed) and looking at how each indicator can be quantified.

Getting *experts from various fields* together to discuss the content of social sustainability in the built environment and to specify indicators and methods of measurement.

Determining the *economic benefits* of improving each indicator, as well as *who benefits*.

Examining the possibility to *integrate* the model of social sustainability with *LCA and LCC methodologies*, investigating cross-benefits.

Looking at the importance of *community involvement processes* for social sustainability.

Looking at the *potential of GIS* (or other tools) in the quantification of social sustainability.

Testing the method in a *real design competition*.

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APPENDICES