CHALMERS
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Adaptive reuse of pre-1914 buildings as activity based workplaces

Master's Thesis in the Master's Programme Design and Construction Project Management

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Abstract

There is currently a trend where organisations move towards more flexible working where how, when, and where the job is performed vary. Consequently, organisations require offices that could be adapted to organisational demands. As a result, organisations have been attracted to new buildings where floor plans easily can be rearranged in order to suit the organisation. However, another way to enhance flexibility could be by redefining how the office is organised. Activity based workplaces is one way to meet the new organisational demands but this solution requires a high degree of planning. Many buildings in central Gothenburg were built pre-1914 as private residences, governmental institutional buildings and factories. These buildings were constructed in accordance with the then current methods. This however, affects the possibilities for design changes, making the pre-1914 buildings inflexible in comparison to modern office buildings. Exploring if flexible organisational demands can be compatible with the inflexibility of the pre-1914 buildings leads to the thesis research questions: is it possible for an ABW to function in a pre-1914 building? Which problems are connected to adaptive reuse of pre-1914 buildings? What differences are there between a pre-1914 building and a modern building? What benefits could be gained from ABW in pre-1914 buildings? What measures must be taken in order to create ABW in a pre-1914 building?

To answer the research questions a literature review and a qualitative interview study have been conducted in combination with a five buildings case study from Higab building stock. The possibilities of adaptive reuse of pre-1914 buildings are evaluated according to a checklist. The checklist considers aspects such as flexibility, health and safety and cultural heritage. Factors such as environmental, social and economic viability have been considered during the evaluation of the pre-1914 buildings as activity based workplaces. This thesis has found that the pre-1914 buildings could be used for activity based workplaces if the buildings are complemented and refurbished. Even if the buildings could function in their current condition, safety regulations block adaptive reuse unless the buildings are refurbished. When refurbishing pre-1914 buildings cultural heritage aspects must be considered and managed.

Keywords: Adaptive reuse, Activity based workplace, Pre-1914 buildings

Anpassning och renovering av byggnader byggda före 1914 till aktivitetsbaserade arbetsplatser

Examensarbete inom masterprogrammet Design and Construction Project Management

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SAMMANFATTNING

Organisationer rör sig mot mer flexibla arbetssätt. Var, när och hur arbete utförs idag skiljer sig från hur arbete traditionellt utförts. Organisationer har börjat ställa nya krav på de kontor som används idag som ett resultat av denna utveckling. Detta har resulterat i att organisationer attraheras av byggnader där planlösningar enkelt kan anpassas efter deras krav. Emellertid skulle flexibiliteten kunna utökas genom att omdefiniera hur kontoret är organiserat och hur arbetet utförs. Aktivitetsbaserade arbetsplatser är ett sätt att möta de nya organisatoriska krav, men även denna lösning kräver en hög flexibilitet. Många byggnader i centrala Göteborg är byggda före 1914 som privata bostäder, institutionsbyggnader och industrier. Byggnaderna är konstruerade med tidsenliga metoder vilka möjliggör få planlösningsändringar. Det leder till att byggnaderna inte är flexibla i jämförelse med ett modernt kontorshus. För att undersöka om ett flexibelt arbetssätt är kompatibelt med de icke flexibla byggnaderna byggda före 1914 behandlar denna studie flera frågeställningar: är det möjligt att ett aktivitetsbaserat arbetssätt fungerar i en byggnad byggd före 1914? Vilka problem finns med återanvändning av byggnader byggda före 1914? Vad skiljer en byggnad byggd före 1914 och en modern byggnad och hur påverkar det hur den fungerar som aktivitetsbaserad arbetsplats? Vilka åtgärder måste vidtas för att en aktivitetsbaserad arbetsplats ska fungera i en byggnad byggd före-1914?

För att besvara forskningsfrågorna har en litteraturstudie och en kvalitativ intervjustudie genomförts. Även en fallstudie har gjorts med fem byggnader från Higabs fastighetsbestånd. Möjligheterna för återanvändning av byggnader byggda före 1914 utvärderas enligt en utarbetad checklista. Aspekter som flexibilitet, hälsa och säkerhet och kulturarv har tagits hänsyn till i utvärderingen. Även faktorer som miljömässiga, sociala och ekonomiska hållbarhetsaspekter har beaktats. Denna undersökning har funnit att byggnader byggda före 1914 skulle kunna användas som aktivitetsbaserade arbetsplatser om de kompletteras och renoveras. Även om byggnaderna skulle kunna fungera i nuvarande tillstånd innebär svenska säkerhetsföreskrifter att de måste renoveras. Byggnadernas kulturhistoriska värde måste beaktas vid renovering och inför framtida aktiviteter.

Nyckelord: återanvändning, aktivitetsbaserade arbetsplatser, byggnader före 1914

Contents

Preface

This study has been carried out from December 2015 to June 2015. The first idea of the study was initiated in October 2014 at a project meeting at Higab. During the meeting, where I was a participant of a mentorship program with Svante Thun, the problem of flexibility in old buildings was discussed. This later developed into a master thesis. The thesis has been carried out at the Department of Technology Management and Economics, Division of Service Management at Chalmers University of Technology. I would like to thank my supervisor at Chalmers University of Technology Jan Bröchner for supervision and assistance.

I would also like to thank Higab and everybody who has contributed during the interviews, providing me with valuable information and assistance during the process. A special thanks to Kajsa Wide who has supported me during this project and contributed to the development and direction of the process.

Göteborg, June 2015

Carl Olsson

1 Introduction

1.1 Background

In today's knowledge-based economy companies are in need of well functioning workplaces that support their continuously changing demands (Steiner, 2006). The demand for offices in Gothenburg is increasing and at the moment there are no indications on trend changes. Vacancy levels were in the summer of 2014 at 6.1% with the lowest vacancies in the central areas of the city at levels at 3.5% (Lundkvist, 2014).

1.1.1 History

The city of Gothenburg was founded in 1621. The present form originated in the 17th century and was first constructed as a fortress with a surrounding moat. Many of the houses in today's city centre are however built in the late 19th century and in the early 20th century (Lönnroth et al., 1999). The houses were commonly designed as residential buildings for the upper middle-class. Gothenburg has been a city of development since it was founded from first a fortress in the 17th century to a harbour city with trade. In the 18th and 19th centuries the trading houses had a significant role and the industry was developing, primarily the city was a large provider of textiles (Ohlsson, 2003). In the 20th century manufacturing dominated with SKF, shipyards and Volvo. In present days, the heavy industries have less importance as a major employer and people are heading towards more knowledge based working.

The inhabitants of Gothenburg increased from 37 000 in 1860 up to 202 000 in 1920. This growth was connected to lower child mortality and the industrialization that was taking place in Gothenburg and other cities all over Europe (Fritz, 2004). The population growth enabled expansion of the city and during the years 1850-1920 many parts of the city that today are considered central in the city were developed such as Lorensberg, Vasastaden and Linnéstaden. Also areas further from the city centre were developed to support the city with services. The buildings during this period were still traditional with a neo-renaissance style. Masonry houses in combination with natural stone are common facade materials but the most common material is timber (Caldenby et al., 1979).

1.1.2 Construction

The buildings constructed in Swedish cities between 1880 and 1920 are basically designed in the same way. The most common components are nature stone, bricks and timber. The foundation was constructed with nature stone. The nature stone was usually from places nearby which resulted in granite in the buildings in Gothenburg. The outer walls are built with bricks that create a load bearing construction. There are also load bearing inner walls constructed in the same way that support the outer walls. The load bearing walls are usually thicker in the bottom levels and get thinner higher up in the building when the load that needs to be carried decreases. Inner walls that are not load bearing were originally constructed with timber with a finish of reed and plaster (Engdahl and Dranger Isfält, 1982). The load bearing

rafters were constructed of timber carrying the roof of timber and copper. Each level was carried by a system of joints of timber that was held up by a pocket in the load bearing walls. The floor on the upper levels was constructed of timber and between the joints there usually was sawdust to function as insulation. The ceilings were constructed in the same way as the floors but after the timber had been placed they were usually plastered (Engdahl and Dranger Isfält, 1982). The buildings were constructed in more or less in the same way until 1920. However when the first word war erupted, the war caused a lack of supplies which resulted in lower quality in materials. This resulted in lower qualities and development of new techniques resulting in a major change in the buildings in the following years (Caldenby et al., 1979).

1.1.3 Higab

Higab is a municipally owned real estate company owned by the city of Gothenburg and manages approximately 300 buildings. The company was founded in 1966 and provides real estate for smaller companies, cultural activities and sport. In their real estate stock there are several buildings that are characteristic for the city of Gothenburg such as the Stora Teatern theatre, the fish market Fiskekôrka and the Ullevi arena among others. Many of the buildings managed by Higab are built around 1900 and earlier. When managing an old building it is crucial to maintain the aesthetics of the building. A problem with this type of buildings is that it sometimes is hard to find a tenant appropriate for the building and sometimes the buildings cannot even be used due to safety issues. This thesis aims to provide guidelines for how pre-1914 buildings can function as Activity Based Workplaces (ABW).

1.2 Purpose

The purpose of this master thesis is to evaluate how pre-1914 buildings located in Gothenburg will function as activity based offices. In the evaluation, various characteristics of the facility will be considered such as structural system, floor plans, technical functions and also the cultural value. Moreover, this thesis aims to evaluate the suitability for ABW in five building cases from the Higab building stock. By answering the following research questions the purpose of this thesis will be met:

- Is it possible for an ABW to function in a pre-1914 building?
- Which problems are connected to adaptive reuse of pre-1914 buildings?
- What differences are there between a pre-1914 building and a modern building concerning adaptability to ABW?
- What benefits could be received from ABW in pre-1914 buildings?
- What measures must be managed in order to get ABW in a pre-1914 building?

By answering these research questions a general assessment will be provided of whether pre-1914 buildings are appropriate for activity based workplaces.

1.3 Limitations

This thesis will focus on refurbishment and technical service upgrading of pre-1914 buildings. All of the cases in this study were taken from the Higab building stock. This was a way to get the information needed and also a way to ensure similar presentation of the building characteristics. Other limitations made were time period limitations, geographical limitations, and refurbishment limitations. The refurbishment limitations will be presented in Chapter 4 with the case studies.

1.3.1 Time period limitations

The buildings that will be studied in this report are built between 1862 and 1905. The time period is characterized by high quality materials. The following time period was affected by the wars and had a lower quality level. The pre-1914 houses are also constructed in similar ways which allows that a general conclusion of how pre 1914 can be used as activity based workplaces can be provided.

1.3.2 Geographical limitations

The geographical limitation of the case study has been the central parts of the city of Gothenburg. This limitation is set to provide homogeneity among the buildings regarding prices and vacancies. This selection also mirrors the Higab real estate stock and therefore can be of importance for future refurbishment projects.

2 Method

To be able to answer the research questions of this thesis a qualitative approach will be used. The work process has been divided in four main stages: literature study, case study, interview study, and discussion/conclusion. Different activities of the thesis process have taken place in parallel to make the process proceed, but the main principle has been to work in the stated order, illustrated in Figure 1.1.

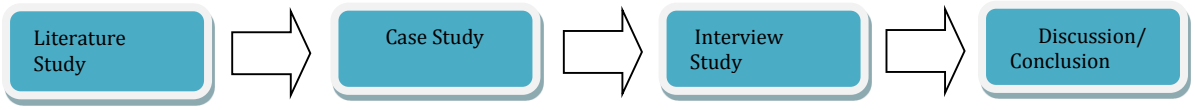

Figure 1.1 The four stages of the thesis process.

2.1 Introduction meeting

In December 2014 an initial meeting was held with Kajsa Wide from Higab and the supervisor/examiner, Jan Bröchner from Chalmers University of Technology. During the first meeting the possibilities for the project was discussed and major guidelines for the project were drawn up. However, the final subject and the research question were not yet defined during this meeting. The final orientation of the thesis was defined during a later meeting with Wide.

2.2 Literature study

The literature study was conducted to find existing information related to three main topics: activity based workplaces, theories for evaluating viability, and characteristics of pre-1914 buildings. To be able to understand how organizations use activity based workplaces, a study has been conducted. To find appropriate information, facts have been gathered after consultation with the supervisor and located in databases such as lib.chalmers and through Google Scholar. The Architecture Library at Chalmers University of Technology also provided information regarding adaptive reuse of pre-1914 buildings. The Architecture Library also provided material for how the houses were constructed as well as historic data concerning pre-1914 housing.

2.3 Case study

In the case study five buildings have been examined as to how they would function and serve an organisation that works with activity based work methods. The buildings have been chosen from Higab real estate stock and are intended to represent different parts and functions of the Gothenburg building history. The different building categories are: exclusive private residences, former industrial buildings, governmental institutional building, and multifamily

buildings. The different categories were chosen in order to provide a representative view of the concept of adaptive reuse of pre-1914 buildings as activity based workplaces.

The buildings floor plans were studied and complemented with an inspection on site. The floor plans were studied to find similarities within the buildings to provide a general description of characteristics of the pre-1914 construction. The inspection on site was conducted to give an impression of the area and of building status. The inspection was complemented with an interview with the technician responsible for the building.

2.4 Interview study

The interviews in this study were conducted to understand problems and opportunities connected to adaptive reuse of pre-1914 buildings as ABW. The interviews can be divided into two parts, where the interviews with the technicians of each building is one and the other interviews were conducted with experts in different fields to give a wider picture of adaptive reuse of pre-1914 buildings as ABW.

The interview study was conducted after the main part of the case study had been completed. By understanding the strengths and weaknesses of the pre-1914 buildings could ensure that the interviewees could contribute to the topic of the thesis as much as possible. A qualitative method was chosen to ensure a deeper understanding of the problems studied (Bryman, 2002). Questions were developed uniquely for each interview to ensure that the competences of the interviewee were recognized. However, some questions where similar for some interviewees due to the cross-functional nature of the question.

The interviews were conducted in a semi-structured form which was chosen because it enables the interviewer to switch the order that the questions are asked (Patel & Davidson, 2011). The possibility to ask follow-up questions was considered valuable since it provides possibility to more fully understand problems connected to ABW in pre-existing buildings. Also, the chosen form enables the interviewee at any time to speak of a theme of their own interest connected to the subject (Bryman, 2002). The interviewees where chosen to provide cross-functional experience relevant for adaptive reuse of pre-1914 buildings as ABW.

To complement the information about the characteristics of ABW that was gathered during the literature review, an interview was made with the architect Christian Kahlefeldt from Gestalt Arkitektur, an architectural firm with experience from adaptive reuse into ABW. To understand problems connected to technical services in pre-1914 buildings due to preservation demands, and how they can be solved, Tomas Sörquist and Pontus Frygner, both from Higab were interviewed. The Higab antiquarian Henrik Ogstedt was consulted to provide information on general preservation and especially for the pre-1914 buildings. Erik Grunnesjö, fire engineer at Räddningstjänsten Göteborg, was consulted to provide information on requirements and risks in adaptive reuse. Finally Caesar Kroge, facility manager at Higab, was interviewed concerning how new tenants are selected and how the financial issues related to pre-1914 building could be managed.

2.5 Processing the raw data

The processing of the qualitative material gathered during the interviews was conducted in accordance with Patel and Davidsson (2011). All of the interviews were recorded and later transcribed. This was performed in order to ensure what actually was said during the interviews was represented correctly. The information from the interview was later sent to the interviewee to ensure that the information was correct and that no misunderstandings had occurred. The transcribed material was later rewritten to running text. The aim when rewriting was to find aspects that were of importance for adaptive reuse of pre-1914 buildings as activity based workplaces. The processed text was later structured so the result was easily managed and presented and so that the different experts' competences and thoughts upon the subject could be compared and analysed.

2.6 Discussion and conclusions

The discussion and conclusions part of this thesis in Chapters 6 and 7 was written to meet the purpose and answer the research questions of this thesis. To evaluate the usability as activity based offices of the selected properties, an adaptive reuse checklist was developed. A checklist provided by Steiner (2006) was used to assess the suitability of existing buildings for workplace needs. The context of the thesis however required that the Steiner checklist was complemented in order to answer to the purpose and research questions of this thesis. The original Steiner checklist includes the following aspects:

- Integrated building – The ability for tenants, architects and engineers to impact the development of the buildings. The adaptability to personalize the building in order to meet organisational demands.

- Flexibility – The buildings flexibility considering the flexibility of the building. The physical flexibility regarding possible floor plan changes and what activities occurring in certain rooms. Ever-changing organisations demands offices that could be changed in order to meet changes in number of employees and other changes in the organisation

- Technological innovations –The ability for the building to install and integrate technical services, both the techniques used today but also the possibility for future technical innovations. Aspect considered is IT, electricity, lighting and other aspects necessary for future technological development.

- Safety, health and comfort – Health and safety become central in knowledge based organisations. The ability for accessibility and fire protection becomes of great importance. The ability to ensure ventilation services and temperature regulating services becomes crucial to ensure required comfort levels. The architecture and the physical context contribute to the overall satisfaction level.

- Energy efficiency – Possibilities to upgrade the building in regard of more energy efficient services. Occupancy sensors and efficient temperature regulating services

contribute to reduced energy consumption. Also aspect such as insulation levels and other physical aspects influencing the energy consumption.

- Cost-effectiveness – Considering higher initial costs enabling the building to better meet the pervious aspects. Higher initial cost can in the long run create savaging for real estate owners and strengthen the appearance of the company image.

- Sound construction and maintenance – development of a refurbishment plan in order to satisfy tenants. An ongoing refurbishment and maintenance process can reduce the total cost in the long run.

The Steiner checklist is perhaps more suitable to a context with modern office buildings. In order to use the Steiner checklist for evaluation of adaptability of pre-1914 buildings as activity based workplaces, the aspect of cultural heritage has been added in this thesis:

- Cultural heritage- The cultural value of the pre-1914 buildings is of high importance. Many pre-1914 buildings are listed which impact what parts of the building can be changed. It also concerns what refurbishment and maintenance methods are appropriate.

For each building a thorough evaluation was conducted in accordance whit the adaptive reuse checklist. A general evaluation in accordance with the adaptive reuse checklist was also carried out to provide a general assessment of adaptability of the pre-1914 buildings as ABW. Finally the results were discussed with support of prior literature to fulfil the purpose and answer the research questions.

3 Theory

The theory in this master thesis is developed to structure information to understand the characteristics of pre-1914 buildings and their components as well as what affects the work environment in an office. Aspects of flexibility and how it can vary in different ways in the concept of the workplace will be presented.

3.1 Building characteristics

A majority of the buildings in the central part of Gothenburg is constructed with thick walls of masonry bricks or stone carrying the weight of the buildings. Bricks are manufactured by burning clay aggregate at temperatures around 1000ºC where the clay goes through a plasticization process (Burström, 2006). The outer walls is usually somewhere between 45 and 90 cm thick and the thermal losses from the outer walls generally represent 35% in historical buildings in the geographical area (Zagorskas et al., 2013).

Buildings represent a large part of a city's identity both architectural but also representing religious, social and economic history (Zagorskas et al., 2013). Changes in technology, working methods as well as emerging cultures have made many office buildings out-of-date, not able to meet future demands. Re-engineering and refurbishment is a way to preserve existing houses to meet future organisational demands (Chilton and Baldry, 1997). Historical buildings, as well as old buildings in general, contribute to the characteristics of the city. With higher demands on viability it comes on the agenda whether to refurbish the old buildings or replace. To decide whether to refurbish or demolish certain property there are several aspect to consider such as cost, marketing value, historic value, energy consumption e.g. (Zagorskas et al., 2013).

When upgrading the energy efficiency in historical building tend to lose some of its uniqueness due to changes on the façade. A new building would perform much better in energy consumption, flexibility as well as at a lower cost but at the same time have considerably lower uniqueness and cultural heritage values. The cost of upgrading a historic building to the same level as a new would be higher. Also, it is not even sure that the old building can accomplish the same level of energy efficiency (Zagorskas et al., 2013). However, in a study conducted by Power (2008) examining whether to refurbish or demolish brick-built terraces, the social, economic and environmental impact would be much larger due to demolition which therefore should be considered undesirable. In a study conducted by Shipley et al. (2006), the possibilities of adaptive reuse of older building in Ontario Canada were examined. It was found that in some cases the cost for adaptive reuse was lower than the cost for new production.

The bricks have a heat capacity of 1000 J/(kg*C) which combined with a heavy construction provides the building with a buffering system that gives a very stable indoor temperature (Burström, 2006). The thermal conductivity of bricks is 0.7 W/(m*C) which provides a quite low insulation for the building even with the relatively thick outer walls. The heat capacity could be used for storing heat or to reduce temperatures during certain hot or cold periods. This could be especially beneficial in the pre-1914 buildings where the technical services cannot reach appropriate temperature and provide enough fresh air.

Upgrading the energy performance of the outer walls is not unproblematic, if the insulation layer is put on the outside; much of the historical architectural characteristics will be lost (Zagorskas et al., 2013). However, if the insulation layers are put on the inside of the building walls moisture problems might occur. Heat loss from the unisolated building otherwise helps to dry out moisture from the walls, coming from the bricks' capillary effects (Burström, 2006). Thus, upgrading the performance of the pre-1914 buildings becomes complicated both due to architectural values and building physics.

3.2 Cultural heritage

Several of the pre-1914 buildings are listed and refurbishment in parts of the structures is sometimes impossible to implement due to preservation requirements. When dealing with buildings with cultural heritage it becomes difficult how to measure the historic value. According to Pereira Roders and Hudson (2012) it is important for facility managers to ensure that their decisions do not inflict on benefits for future generations. When refurbishing buildings with cultural heritage it is important to reduce the impact on the buildings.
By taking caution and carefully plan the refurbishment and with a combination of appropriate techniques and materials the negative impacts can be reduced. Pereira Roders and Hudson (2012) further mention that impacts on buildings with cultural heritage are not only negative, positive impacts such as opening the building up for the public is one aspect that can be very beneficial.

Buildings that have significant cultural heritage are protected and listed by the Cultural Heritage Act (SFS 1988:950). For a building to become listed, it must either be a building with high cultural value or to be a part of an environment that has a high cultural heritage. In Sweden the responsible authority of the listed buildings varies depending upon if they are governmentally owned or not. It is the county administrative boards who are responsible for the non-governmentally owned listed buildings; it is also they who can make a building listed. The Swedish National Heritage Board supervises the county administrative boards in questions concerning cultural heritage. It is also the Swedish National Heritage Board that is responsible for the governmentally owned buildings. When a building is being listed, decision is taken upon what parts of the building that cannot be changed. The decision also can state how a certain building must be maintained and managed (Riksantikvarieämbetet, 2015).

3.3 Office development

The way knowledge based working is performed is ever-changing. The development of technical solutions has changed how and where people perform their work with possibilities to connect to your company server at anytime, anywhere (Fawcett and Rigby, 2009). The definition of the workplace has gradually changed from strictly the office, in which the employees spent their predetermined working hours, to basically anywhere (Green, 2014). In the traditional office, each staff member had their own workstation as well as fixed working hours. As a result of the more flexible way of working, the utilization of each working station has gone down resulting in half empty offices (Fawcett and Rigby, 2009). A combination of more project and knowledge -based working has increased the demand for places to have

spontaneous and informal meetings (Steiner, 2006). The way our workplaces are constructed today is developed upon how work was historically performed. In best cases offices are developed according to how work is performed today, but the future demands will for certain look different.

One large trend in recent years has been to work in activity based workplaces (ABW) where staff shares different types of workspaces. By sharing spaces the objective for organisations is to increase facility utilization, performance, user satisfaction, client image as well as personnel flexibility (van der Voordt, 2004). However, the activity based offices are not always used as intended and in four cases studied by Appel-Meulenbroek et al. (2014) negative effects could be documented such as loss in productivity, illness and dissatisfaction among employees. This indicates that facility managers and organisation managers cannot see ABW as an office type suitable for all companies and organisations.

When comparing the way that companies organise how their employees are seated to how students at school and universities are, it is evident that there is a major difference. In the academic world, students lack personal workplaces and instead pick an appropriate workplace that is currently untaken. Meanwhile in companies all members of the organisation occupy their own personal workplace. This is something that Karen Mosbech (2004) has realized and argues that organizations have a lot to gain especially in the field of communication and learning fields. Mosbech (2004) further states that by creating environments that are similar to educational institutions the organization can support learning activities. The positive effects are gained by increased informal communication and employees that know each other better which will increase knowledge sharing. This is effects that an ABW will create if it is planned properly. Given these earlier findings, the assumption that an environment such as an ABW would be beneficial for learning activities can be supported.

3.3.1 Activity Based Workplaces

The history of the concept of activity based workplaces begins in the 1980´s and the concept of CoCon-office (COmmunication and CONcentration). The idea was that the employees working in the CoCon-office could choose a workplace appropriate for the planned activity. In the 1990´s the occupancy of these offices was low which enabled employees to switch workplace several times a day and pick the workplace that was most appropriate at the moment. When the development of mobile technical solutions took off and when and where work was performed lost importance, the trend grew even stronger (Appel-Meulenbroek et al., 2011).

The trend converting cellular offices into open landscapes without a personal workplace has increased rapidly in the last years. Instead of an own workplace the employees are offered to choose an appropriate vacant workplace which is suitable for the planned activity. In order for the ABW office to be effective there are some functions that the common areas must provide such as: informal meeting places, quiet zones, workplaces, private meeting rooms, phone booths, room for personal storage and ordinary office desks (Samson, 2013).

3.3.2 Flexibility

Gibson (2003) studied how flexible buildings affected organizations' ability to apply flexible working methods. However, it was found that the ability to change working position was the most important factor in organizational flexibility. Flexible working could be considered as a tool that could be used by facility managers to provide appropriate activity based workplaces (Khamkanya and Sloan, 2008). Organisations strive to have offices that can absorb changes in the utilization of the workplace, both due to higher utilization during certain hours of the day and also due to changes in the total number of employees (Gibson, 2003). Further they want their building to be unique and serve and assist the organization when employees change work activities. In order to serve the organization with appropriate workplaces the facility managers need to understand the processes and activities that occur in the office.

The question if flexible space is needed for flexible working was studied by Green (2003) who concluded that organisational flexibility could be divided into three categories: Contractual flexibility, Time flexibility and Location flexibility. In this study the contractual flexibility is not of interest since it illustrates how to manage the employees' activities and does not concern the building itself. Green further stated in the study that it is important for the facility managers to fully understand what the organisation does within the office in order to provide appropriate office solutions. Hence, by getting more information the workplaces can become much more efficient and better adapted to organisational demands.

3.3.3 Creating an ABW

According to Steiner (2006) real estate cost is the second largest expense after salaries for 95% of companies. With the trend of fewer hours spent in the office, a rational solution is to reduce the number of workplaces in the office which will lead to reduction in the total rented office space (Fawcett and Rigby, 2009). However, when refurbishing and adapting a pre-existing property to an activity based office, there is initial cost that needs to be considered such as renovation, refurbishment and technical upgrade to meet higher organisational demands (van der Voordt, 2004). When planning initial refurbishment property owners should consider higher investments to increase flexibility to ensure future savings (Steiner, 2006).

To maximize the utilization of each workplace, the number of workplaces needs to be lower than the number of employees. To be able to measure the relationship between workers and workstations the Sharing Ratio is used. The Sharing Ratio is given by dividing the number of workers by the number of workplaces (van der Voordt, 2004). However, negative effects can be observed and in relation, the costs of real estate are smaller than the cost for personnel (Fawkett and Rigby, 2009). Van der Voordt further mentions possible negative effects connected to activity based offices such as losses in productivity due to distractions, problems with working environments, noises, and time spent searching for free workspace, as well as lowering morale and employee resistance. Other losses could be reduced work satisfaction due to reduced privacy, identity and status.

In contrast to the cellular offices where you have positive effects such as higher concentration, open activity based workplaces increase the level of communication in the office. Increased office communication and collaboration is considered one of the bigger benefits of ABW. In corridors of offices, spontaneous communication is hindered by the physical distance and

privacy of the individual office. Consequently, the shared spaces of ABW could increase communication and office collaboration but they also increase the possibility to get interrupted and disturbed (Heerwagen et al. 2007).

Heerwagen et al. (2007) express a problem with organizational leaders that have overestimated the positive effects of a high level of communication. A high level of communication and collaboration could be problematic and be a hinder for people to perform their job undisturbed. The ABW does not fit all organizations and in some cases organizations have been forced to abandon the ABW due to that they could not perform their work.

Chilton and Baldry (1997) conducted a study aiming to evaluate how changes in existing workplaces affected the organizations. What was concluded in the study was that there were several aspects that needed to be considered and the study also provided actions to help solving the problems. Aspects that needed to be considered was for instance cost awareness among senior managers, using technical innovations, changes in communication, the connection between the wellbeing among employees and the office design and also that organizations must deal with conflicts occurring due to increased communication and noise levels. From these aspects Chilton and Baldry (1997) concluded that there were four key questions that needed to be considered:

- Is there an optimum density of occupation for identifiable work functions?
- How can companies determine the parameters of the conflict between increased occupancy levels and increased office noises and other distractions?
- What methods are suitable to reduce noise levels within open planned offices?
- How can organizations identify the particular integrated workplace strategy which is suitable for which environment and how can organizations identify the most appropriate solutions to functional needs?

These results highlight the complexity of moving from cubical offices toward more open landscapes and ABW solutions.

3.4 Economic benefits

Various results have been presented when measuring the cost reduction ABW has created. Van der Voordt et al. (2004) have acknowledged different variables that affect the cost savings connected to ABW. Firstly there is the aspect of reducing the amount of office space needed which affects the rent level if the total space is reduced. Secondly, van der Voordt mentions the quality level of furniture as one reason for the total cost to vary. By compensating the personnel with higher quality furniture that supports their work, the satisfaction level of the staff may stay high but higher quality furniture usually comes at a higher price which affects the cost savings of the ABW.

However the initial cost of furniture can be written off quickly, which would make the initial investment higher and therefore seem as a higher cost. Thirdly the cost for implementation of ABW structure on the workplace differs. The concept of ABW is not usually liked by all employees and therefore a development process needs to be performed to get personnel to have an opinion which could be seen as a cost for the organisation. Other costs that van der Voordt describes are the cost for internal changes in the organization where the flexibility enables changes and also changed cost for technical services due to changed demands in the

ABW office. This would indicate that it would not be wise for a facility manager to implement ABW with the only reason to save money.

The office boundaries have changed due to the technical development and certain tasks that previously only could be solved on sight now can be managed from anywhere. In a study by De Paoli et al. (2013) real estate functions at the Norwegian telecom company Telenor was studied. The study concluded that the way that Telenor worked, the workplace was not just defined as the physical building due to technical development and changes in how, when and where people perform their work. Instead they proposed that real estate should be regarded as a tool that organizations use to perform their work, supporting work both in the physical office but also from other places. Further they suggested that the real estate management should be more integrated in the business strategy of the company supporting the strategic decisions of the company. De Paoli et al. (2013) further addressed the importance of the integration of real estate management with other departments of the company such as human resources and IT management department.

Different workplaces affect the employee's satisfaction and health status differently. In a study from 2008 Bodin Danielsson and Bodin tested the hypothesis if office types influenced the health and satisfaction of the employees. The study showed that different type of offices affected the health level differently. The best health levels were found in employees working in cubical offices and in flexible working offices. Aspects such as size and number of people sharing rooms were also taken into account. The result showed indications on what could affect health levels. From this study it could be concluded that an ABW solution is not better for health and satisfaction than cubical offices, but it is not worse either.

3.5 Flexibility

The importance of building flexibility in flexible working could be argued. Finch (2012) argues that due to the ever changing organizations of today, inflexible building is a problem and creates dysfunctional organizations. The flexibility in the building influences the possibility to meet future organizational demands. However in an ABW the flexibility is not mainly in the building but rather in the organization. Further Finch (2012) concludes that facilities management must focus on the future and stop making decisions based only on past experience. The ability to meet future demands must be viewed with new eyes.

At the same time as trends in organizations develop, the buildings occupied by the organizations develop. Hierarchical organizations where static individual work is performed at predetermined place and time is replaced by flat organizations, where teamwork is carried out at varying time and place. In the same time, buildings develop to meet the new organisational demands (Mosbech, 2004). This is illustrated in figure 3.1 and 3.2.

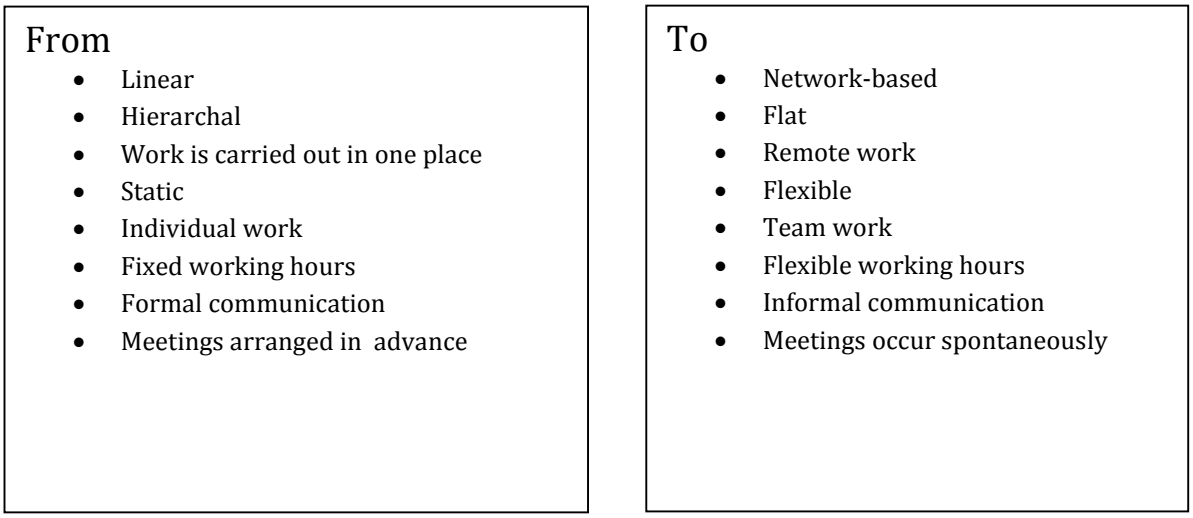

Figure 3.1 The evolution of organisations (Mosbech, 2004).

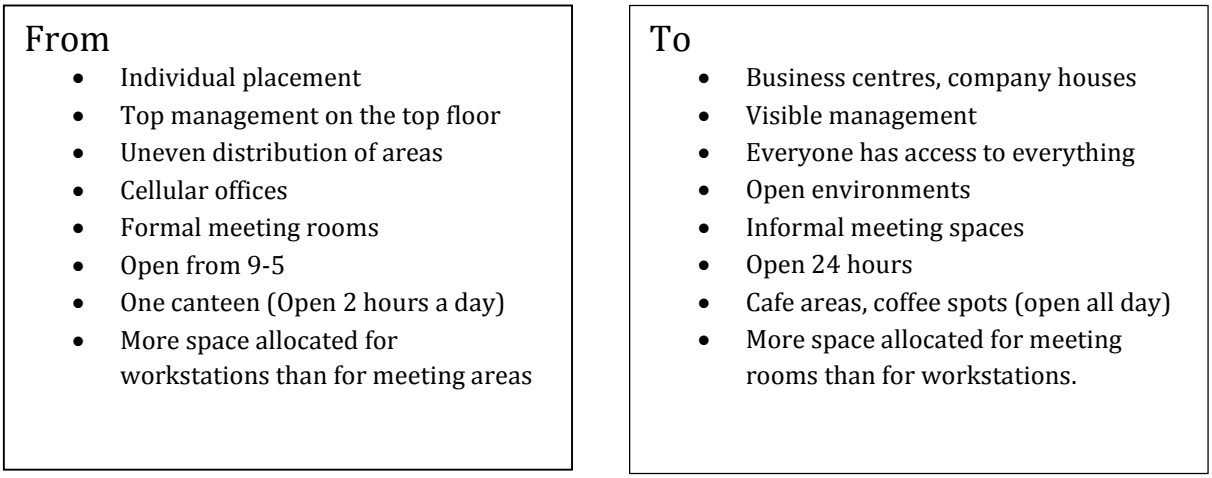

Figure 3.2 How the workplaces have evolved in order to meet the changed demands from the organisations (Mosbech, 2004).

A common view is that the only way to ensure investors to make reasonable return on their investment is to demolish existing structures and replace them with new buildings more adapted to future demands. However, the debate between the property owners' demands and the historical and aesthetic values in buildings will continue and both sides must be heard (Shipley et al., 2006). To be able to preserve old beautiful, historical buildings, investors with incentives to maintain and keep them in good condition are important (Shipley et al., 2006).

4 Interviews

As explained in the method, an interview study was conducted to get cross-functional experiences on the subject of adaptive reuse of pre-1914 buildings as ABW. Six qualitative interviews, each approximately 45 minutes, were carried out with different experts to get their opinion about the studied area. The interviews was recorded and transcribed. The text was also sent to the interviewee to ensure no misunderstanding had occurred during the process. The text was processed and organised in order to enlighten the different aspects of the subject.

To understand problems connected to refurbishment of pre-1914 buildings an antiquarian from Higab, Henrik Ogstedt was interviewed. To get a deeper understanding of the concept of ABW and especially ABW in older buildings, Christian Kahlefeldt from Gestalt Architectur was consulted. Thomas Sörquist from Higab was consulted upon the area of electrical services. Pontus Frygner, also he from Higab was interviewed regarding other technical services such as ventilation, heating and cooling. To receive safety and fire protection information Erik Grunnesjö from Gothenburg fire department was consulted. Finally to get an idea of how the economic situation would look like for pre-1914 buildings facility manager Caesar Kroge from Higab was interviewed.

4.1 Implementation

Before decision to implement an ABW solution the facility, managers need to observe the organisation and how it operates in order to understand how the office should be utilized. When installing an ABW in an organisation, the number of employees needs to be at least 20-25 people within the company with intensions to expand according to Kahlefeldt. If the number of employees is fewer, the needed rotation between workplaces in the office will not occur and the idea of ABW loses its function. If 90% of the employees work at their individual workstations at all time, the benefits of implementing an ABW is non existing.. If the utilization of each workstation is 50%, the question whether each employee should have a personal workstation is more relevant.

Historically, the desk has been the workplaces used for most activities and therefore the importance of the desk was significant. The desk influence on offices today are still of major importance even if the way work is performed has changed. When studying the actual functions that the office should support, it was found that the desk is not the best workplace for activities according to Kahlefeldt. In the future, the customers might be different, their demands might have changed and the way the organisation performs its actions might be different. When planning the organisation's office it is important to have the future and the demands of tomorrow in mind.

One important aspect that needs to be considered before adapting an ABW is why the change to ABW is implemented. If the incentives are to reduce space and economic savings ABW might not be popular among the employees. ABW solutions could be a way to give the employee’s freedom to despondent their own time. Kahlefeldt expresses that at the same time the responsibility for each employee grows but in knowledge based organisations, responsibility could be the key to create personal engagement. The concept of ABW can

however become problematic due to the constant access that follows. These problems must be managed by the organisation and also personal boundaries among the employees.

4.1.1 Impacts on the organisation

Ergonomically the appropriate noise level and the choice whether how to sit or to stand up provides possibilities. The implementation from personal workstations to ABW is not always a smooth process. Sometimes people oppose shared workstations due to the higher noise levels and problems with concentration. Also the idea of personal workspace that can personalize with photos and other personal items is one aspect that frightens people. To illustrate the problems when changing to ABW, Kahlefeldt brought up one example with a employee that demanded his own office when changing to ABW that he had experienced The managers allowed him to keep his office but after a few months he realised that he missed out on a lot of the spontaneous communication that occurs in the office. After six months the employee moved out to the others in the ABW and the office that he occupied earlier started to be used as a room for more closed communication. This shows the importance of spontaneous communication and that employees are willing to change and adapt to new methods.

When an organisation implements ABW there are several things in the organisation that needs to be changed such as noise levels and occupation of space. Kahlefeldt expresses that all these aspects are important but what it all comes down to is, total consideration and respect among peers. One change that impact organisations when they change to an ABW is how documentation is handled. When an employee no longer has a personal workstation, all paper documents need to be stored in a locker. The companies to have a new system for paper copies and it becomes more complicated save material. Instead all paper documentation needs to be scanned and saved electronically. When the documents are stored digitally and accessed from a cloud, the needed space for each employee in the office is reduced. When the physical boundaries change and employees work from other locations, the office as we see it today could change according to Kahlefeldt. One vision expressed by Kahlefeldt is that workplaces of the future consist of people working from totally different organisations. It might even be so that 20 friends share an office.

When adapting a building into an ABW, the main focus should not be on how to build the walls or how to furnish it. The key aspect for how suited the organisation is for the building is the organisation itself. According to Kahlefeldt, the organisation must adapt to the ABW and the new working methods that comes with it. If the organisation adapts to the new working methods buildings can be used with far less physical adaptation in form of changed floor plans. One of the strengths Kahlefeldt mentions is that by application of ABW in an office, the possibilities for organisational growth by hiring more employees becomes more easily managed. Basically it is just to give the new employees the keys to their personal locker and the office should be able to be occupied by more employees. The same benefits can be applied on cross-organisational projects, where an ABW office enables different experts from other companies to work together easily in the flexible office.

4.2 Technical services

The demands on network connections and technical solutions in an ABW do not vary that much from an open landscape office. According to Kahlefeldt, generally the network connection needs to be higher to supply the mobile workforce. Usually organizations provide their employees with laptops but in some organisations stationary computers are installed where the employees just log on to the company network with their own account. In both cases however, the technical services will not affect the building substantially.

To increase the environmental viability via technical services becomes complicated due to preservation demands on pre-1914 buildings. To install electrical services in an ABW would be easier than in an ordinary office due to the relatively low energy consumption of the activities in the office. In the pre-1914 buildings it can be problematic to get the power distributed to the different work stations. In a modern building with box-offices, technical services would be distributed through the ceiling, trunking and by external cable channels. Though you're not allowed to install these kinds of technical solutions according to Sörquist, electrical services could be distributed through the already existing system. This indicates that the electrical services needed for ABW could be supported by any building.

The development of wireless networks has developed the flexibility of the offices and made installations easily adapted. However, the employees still need electric power for computers and other electrical devices. With increasing battery capacity that could be solved by charging stations in the personal lockers were computers could be charged during the night. According to Sörquist the initial cost to install the technical services would be approximately the same or even lower for an ABW than for open landscape solution. This also supports the reduced technical service complexity of adaptive reuse of a building as ABW.

The total energy consumption could be considered going up or down depending upon what ratio used according to Frygner. If energy per square meter is studied, the energy consumption would increase due to higher utilization in the office. However, if the ratio studied instead is energy per employee the energy consumption would be reduced, also due to higher utilization. When studying the concept of energy consumption in ABW with focus on the employees instead of the building itself, the energy consumption would be lower due to higher utilization.

When changing the function of a building via adaptive reuse to an office building there is commonly a need for lowering the temperature during the year. Sörquist expresses that the process to reduce the temperature is the most energy demanding process in the pre-1914 buildings. Further, to install the temperature reducing services is probably the technical installation that would inflict most problems in these old buildings due to the size of the chilled beams. Therefore, the cooling process can be seen as the hardest challenge when implementing ABW in pre-1914 buildings. The indoor climate acceptance level in older buildings is considered higher which could reduce the tenant’s demands.

Comparing pre-1914 buildings with modern buildings, the technical demands are higher on pre-1914 buildings in order to meet the same performance level. Frygner states that by re-using heat from the ventilation as much as 90% of the energy could be sent back into the building. Further, Frygner mentions that there are technical services that allow the building to reduce the energy in the parts of the building that is currently not in use. With the

transmission losses through the facade the houses will still demand climate changing actions to reach appropriate climate levels. In some of the listed building it is not possible to install climate changing equipment, for example the chiller is usually placed on the roof and would affect the aesthetics. One way to solve it could be by installing district cooling which also would reduce noise levels. District cooling reduces the energy consumption but the higher initial cost is higher and also, the problem with large baffles still remains.

4.3 Organisational demands on buildings

ABW could be adapted and function in a building where there already is a functioning office activity. However, to better adapt the building towards the specific functions there are some actions that could be applied to more efficiently support the demands of the organisation. When planning functions, such as toilets and kitchens, the capacity should be based on how many people that is there and not for how many people working in the organisation according to Kahlefeldt. However, when planning such facilities, the level needed based on an appropriate utilization should be complemented to meet future demands of an expansion according to. This would inevitably lead to higher initial investment cost but that investment would pay off quickly if and when the organisation grows.

When it comes to the actual adaptive reuse of pre-1914 buildings to offices in general it all ends up in how the rooms fit together with the intended furniture. If the rooms can fit the needed type of furniture the adaptability is considered well-functioning. If the furniture cannot fit the rooms, the entire building is considered a bad building just because the measurements do not work for the intended purpose. The pre-1914 buildings are according to Kahlefeldt multi-adaptable with their relatively large room sizes. Though the buildings are not flexible, this indicates certain flexibility within each room of the building.

The actual space needed for each employee in an ABW can differ from 8 square metres per employee in some call-centres and up to 20 square metres in other offices. The optimal square metre per employee is according to Kahlefeldt approximately around 15-16. If the area per employee is smaller, the office can tend to feel crowded and problem with mobility occurs. Further Kahlefeldt emphasises that the efficiency and satisfaction among the employees tend to decrease when decreasing the number of square metres per employee which should be taken into consideration when designing the office. Wages are usually the greatest cost for a company, which is why rehiring costs for should be considered before using ABW as a tool to reduce office space. The total area needed for ABW is around 400 square metres for the office to function properly. The most significant attribute determining the suitability for a building to be used as an ABW is probably the same as the most important attribute for private houses, the location. If the location is right, other shortcomings regarding the building can be overseen due to a fantastic location.

Furniture which is not a part of the building itself becomes of high importance with new working methods and higher utilization. Many organisations still use old and outdated furniture. For instance, furniture from the 1990’s was developed for other functions than what is needed today, with big computers and a high level of paper documentation. Kahlefeldt argues that just by replacing that type of furniture to more modern equipment the number of employees could be increased by one third and the office would still be perceived as less crowded. Today, some of the large office-furniture companies provide leasing contracts for

their furniture which could change the cost for furniture from a onetime expense to a running cost. If furniture was considered more as a car, coffee machine or a copier as something that support the organisation it becomes more viable.

4.3.1 Building characteristics

The thick brick walls in the buildings create a temperature buffering system where heat could be stored during time periods and could be used to balance the temperature during the day. This technique could especially be beneficial during the summer months were the need for cooling is the highest. By reducing the temperature in the building during the night, the energy needed would be reduced due to lower outdoor temperatures. According to Frygner, this process demands active maintenance and steering and would therefore be connected to a cost. This could definitely be a way to reach a higher indoor climate level in the pre-1914 buildings.

The environmental impact from refurbishing over 100 year old building versus building new one has both its benefits and its shortcomings. When building a new building the energy efficiency could become much higher at a lower price. Also, the demands on new buildings are governed more closely, especially if the building aspires for an environmental certification. Many companies today build their houses environmentally certified and according to Frygner, Higab certify all their new building by Miljöbyggnad which is a Swedish certification system. When applying Miljöbyggnad and similar certifications like LEED and BREEAM, all the materials that is put in to the building must be accepted and registered, by doing so the environmental impact is documented and more environmentally friendly methods and materials will be applied. When refurbishing an old building however, the same cautiousness and registration could be applied but there are many materials that could be dangerous both for the environment and for people trapped inside the building. Many of these materials are not hazardous when they are in the buildings, only when they get torn down. Another aspect that could be argued is that when renovating a building, the concrete and other environmentally damaging materials is already there which makes it more environmentally neutral compared to new production.

To adapt a pre-1914 house into an ABW there are aspects that must be considered. Some places in the building might not be appropriate for workstations due to heat leakage from the facade or defects in the building that causes comfort problems. One large problem in this type of building is downdraughts which can easily be fixed by installing modern windows. According to Ogstedt however, this is not an option in some of the buildings due to the high level of preservation. The tenant who decides to rent a office in a pre-1914 needs to be informed of the flaws and defects and if you want to move into a building like this there are probably other aspects that are more valuable such as location and aesthetics.

4.4 Safety, health and comfort

When changing the use of a building from a private residence or an industry into an office in Sweden there is a need for a new building permit. When a building permit is required the demands on the building increases to meet levels of new produced buildings. This can create problems related to fire protection, accessibility and technical services.

4.4.1 Fire protection

Safety becomes central in adaptive reuse of pre-1914 buildings. The building regulation is not retroactive so buildings that were built in this period do not need to meet the demands of today if the function of the building is not changed. When changing the function of a building such as changing from an industrial area to an office, a new building permit is required. When the new permit is required the demands on fire protection and accessibility increases to today's standard When changing the function only on certain parts of the building it is only the affected parts that need to meet the higher demands according to Grunnesjö. For example in a four-storied building where the two top levels are planned to have a changed using area, it is those levels and the entrances and stairway to them that needs to meet the high demands.

Fire protection differs between new buildings and older buildings such as the ones built pre-1914. The way that it is used in new buildings is that the building is divided in different fire cells for fire protection. This is not always possible in the pre-1914 buildings due to different reasons such as preservation and constructional aspects. Grunnesjö mentions that when performing adaptive reuse of pre-1914 properties, different actions to meet the fire protection standards could be taken. The most common action that could be taken is according to Grunnesjö to install sprinklers in the ceiling. Other actions that could be taken are to install shutters that close in case of fire or smoke hatches that open in case of fire to get rid of the smoke. One other action that could be taken is to have the fire alarm directly connected to the fire department to compensate for low fire protection. Though it is complicated to meet the higher demands put on buildings in connection to adaptive reuse, it is possible to manage in cooperation with the fire department.

Another aspect that becomes problematic in the pre-1914 buildings is that according to Swedish practice each building needs to have two separate fire escapes. In offices, where people work daily, windows could according to Grunnesjö be used as one of these fire escapes. If the window is used as a fire escape the window needs to have a width of 0.5 m and a height of 0.6 and the width and the height combined need to be at least 1.5 m. Further, Grunnesjö emphasizes that if the levelt of the window that will be used is higher than 11 metres, the firemen will not reach it with their ladders. Instead they must be able to get access with the fire truck. In each fire cell there is not allowed for more than 15 persons at a time, if a window is going to be used as a fire escape. This would restrict how certain areas of the building can be used.

It could according to Grunnesjö however be possible with another solution called a TR2 stairway. In the TR2 stairway you first access a first separate fire cell before you entering the stairwell that is a fire cell by itself. The first fire cell needs to have enough space so that it is possible to shut one of the doors before the next one is opened. Fire protection is an essential issue in adaptive reuse of pre-1914 buildings as ABW and to properly manage this issue,

close collaboration with the fire department is necessary to avoid future safety problems and further investments.

4.5 Historical preservation

In Sweden listed buildings are more heavily protected. However, what the law tells about listed building could be regarded as unclear according to Ogstedt. Further, Ogstedt explains that the Culture Heritage Act, which concerns listed buildings in Sweden, probably is the most transparent and easiest to understand. When a decision whether to list a building has been taken, a description of what parts of the building as well as what parts of the environment that are listed is made. The Culture Heritage Act is a stop law and it differs from the Planning and Building Act, which primarily refers to new construction, while the Culture Heritage Act obviously concerns existing structures. In the detail plan of an urban area there can be objects marked as culturally valuable. However, generally in Swedish cities the detail plans are more than 30 years old, and consequently they do not necessarily say anything about the cultural, historical value. Instead every case has to be examined to find out what level of cautiousness must be applied when refurbishing these buildings.

When the building is listed it becomes less complicated. If anything is to be changed it has to be performed with cautiousness. In buildings that are not listed the general consensus is that every action that is to be taken should be handled with cautiousness in accordance with the planning- and building-act. How to apply cautiousness and what it means is a matter of discussion and almost always create debate both internally and externally of the building. According to the Planning- and building- act, everything that is to be fixed in a building it should be done by cautiousness, even if the building was built yesterday. Though each building is unique and each new case has to be tested separately there are aspects that could be considered general. Even though the low U values for the houses, none of them is appropriate for additional facade insulation due to the historic values.

The floor plan design changes that are possible must be examined in every special building and in relation to the demands of the customer. In some cases there are few possibilities and changes must be approached in a very cautiousness matter in these buildings. Technical services must be installed in ways that is appropriate to the building. In listed buildings installations must be adapted to the current systems and really examine how it could be possible to upgrade it. Meanwhile in the buildings with lower preservation demands technical services could be installed more roughly with shafts and channelling.

Concerning preservation of historical values an ABW could be beneficial and increase the possibility to refurbish as little as possible, this is something that also Ogstedt expresses. As long as the design of the office is planned in accordance with the buildings current conditions which could be applied through adapting ABW. In the pre-1914 buildings it is possible different rooms used for different activities preserving as much possible. Ogstedt expresses that rooms could be used based on characteristics such as size, climate level and location in the building. However the office design and what activities that should be installed were are hard to decide before an actual customer is appointed.

4.6 Economic aspects

Higab has been appointed by the city of Gothenburg to provide municipal companies and organisations with appropriate facilities. In Higabs mission it is also stated that they should make areas and buildings more accessible for the people of Gothenburg.

In some areas in their real estate stock Higab tends to have tenants that fit a certain profile and the new tenants need to fit to a certain profile that correlates with the same profile in the certain area. For instance you can find that many tenants at Kviberg have a sports profile. Another part of the mission appointed to Higab is that the city wants to increase a certain type of activity a specific area. An example of this could be Postgatan where the city wants to get more activity on that street and the area located further in on Postgatan. As a result, the new tenants will be shops to attract people to Postgatan according to Kroge.

4.6.1 Tenants

When Higab is looking for a new tenant for a building the procedure varies between different geographical areas of their real estate stock. The rent level of a building becomes affected due to the profile demands that Higab puts on the tenant to fit the appropriate profile. It is not possible just to choose the tenant who is willing to pay the highest price. Instead it could be said that Higab practises a market value rent level, based on the certain activity of the area. When matching the appropriate tenant to a certain building, the longest allowed vacancy time varies depending on the profile of the area. If it is an ordinary office building the vacancy time allowed is short and the tenant is determined on financial strength. When it comes to the special areas where a certain profile is desired the allowed vacancy time is much higher to find the appropriate tenant.

The inflexibility of the buildings and outdated technical installations make the pre-1914 buildings less attractive among tenants. The inflexibility becomes a problem due to that certain rooms get unusable for anything but offices. They can be too big for one person but are not big enough for several persons in the same time as they are used as passages to other rooms. According to Kroge, the pre-1914 buildings rent level is generally lower than the average market price. The building flexibility is desired in order to manage organisational changes over time. Kroge expresses that this is a trend that has been shown in the last years and at Higab they can see that this is something that clients demand. Outdated technical services have become more problematic in recent years due to higher demands on working environment, both by employees and organisations.

However, for some tenants the pre-1914 buildings are attractive due to their organisational profile. These companies are according to Kroge however relatively few which keep the rent levels at a lower level than modern office buildings. Kroge further mentions that the more expensive maintenance cost of the pre-1914 buildings affect the profitability. The increased costs derive from both due to that they are listed but also due to the certain techniques required. High maintenance cost in combination with lower rents levels makes the income from the pre-1914 low, especially if there is a certain profile of the area. The increased cost for maintenance is something that also Frygner mentions, the problem with time and cost is constantly an issue regarding technical services. Much of the work today is in optimizing the current systems. A total replacement of the systems to less energy demanding and more easily

managed of the systems are often not economically defendable and is usually planned into the future. One large problem connected to investments in energy efficiency is that the economic savings do not benefit the real estate company who has to do the investment. The economic benefit from reduced energy consumption is instead received by the customer that rents the building.

4.6.2 Initial costs

One trend in energy savings is to work with total projects was several actions taken at the same time to improve the energy efficiency. Frygner expresses that by packing less costly actions with short payback periods with more expensive and with a longer payback periods, the total payback period gets more acceptable. For instance could optimizing chillers have a payback period in one year and a window change in a building has a payback period in 25 years, combined the total payback period might end up at 10 years. If every single action would be studied individually, energy savings might not be executed but when packaging them more actions can be executed and the environmental impact could be further reduced.

In an ABW in one of these houses the processes to reduce temperature would be the most energy consuming. The activities connected to office works is not that energy demanding but there will still be a need to reduce the temperature in conference rooms and workspaces according to Frygner. This process will affect the initial cost of the project.

By installing smart ventilation systems that move the air in the office to where it is needed energy consumption could be reduced. Lightning can on the other side be more problematic due to the importance to perception of the office. If the lighting is programmed so it only is lit up when there is somebody in the room it could affect the perception of the office according to Kahlefeldt. This is contradictory with the environmental objectives with the demands of the modern organisation, but if the lighting reacts on activity the office can be perceived as dark and dead which will lead to that the office becomes non-vivid.

5 Cases

Figure 5.1 Map illustrating the location of the building cases in this study.

In this study five cases has been examined to provide a general view on possibilities for activity based working in pre-1914 buildings. The five cases have been selected to represent varying parts of the Gothenburg building history. The different categories are: exclusive private residences, former industrial buildings, governmental institutional building, and multifamily buildings. The buildings have been chosen from the Higab building stock and the chosen building for each category is.

1- Postgatan 16 was built as a multifamily building
2- Briggen was built as a fire station
3- Dicksonska was built as an exclusive private residence
4- Slakthusområdet was built as a slaughterhouse
5- Kviberg is a former military regiment

Kviberg and Dicksonska are listed and are declared as historical buildings. The other cases are not equally regulated regarding preservation but there are still preservation demands concerning aspects of the buildings such as facades and construction.

5.1 Postgatan 16

5.1.1 History

The building is protected by preservation demands, but not the highest form of cultural heritage. Postgatan 16 was built in 1902 for the Ahrenberg family by F O Peterson & Söner. It is located at the corner of Postgatan and Torggatan as a part of the Borgaren block. The building is built in 3 stories and each level is approximately 300 square metres. During the nineties a large refurbishment occurred where the building became an office and the attic was furbished. The building was originally built as a combination of stores in the bottom level and private residences in the upper levels. East of the building there was earlier a parking lot that now has been used to build student flats (Lönnroth, 2003).

Figure 5.2 Facade of Postgatan 16.

5.1.2 Current activity

The building is today occupied by Göteborgs Fastighetskontor and Konsument Göteborg. The future vision of the building at Postgatan 16 is to install stores in the ground floor to attract more people to the street. The stores in the ground floor is part of a plan to attract more people to Kronhusbodarna and together with Postgatan 16, new stores should be placed at Postgatan in the buildings across the street. The location of Postgatan 16 is central in the old parts of Gothenburg. The building is located only two minutes' walk from Brunnsparken and five minutes' walk from the central station.

5.1.3 Building characteristics

At first sight the building appears to be well maintained with new brick joints and new windows which give an impression of a well renovated building. Over time, the interior had been refurbished and renovated continuously. The structure of the building is as for many other buildings from this period with load bearing brick walls with a system of joists carrying each floor level. In the entrance level and on first and second floors, possible changes in the floor plan would be restricted by the inner brick walls that run parallel with the outer walls.

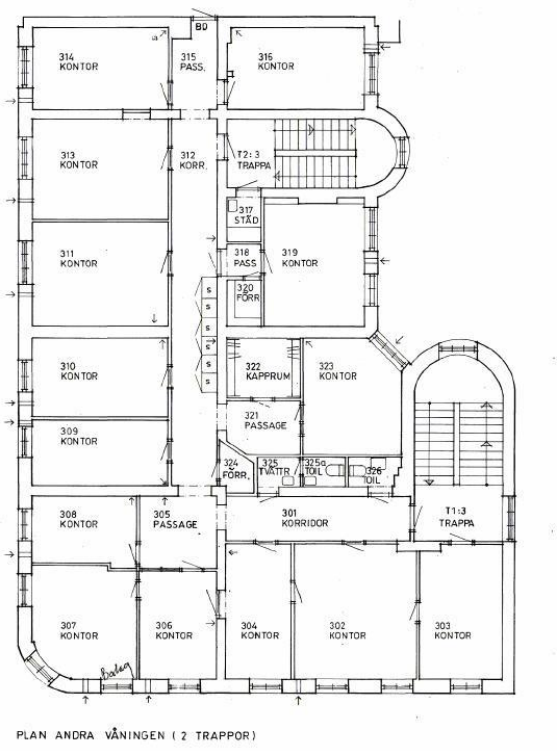

Figure 5.3 Floor plan of Postgatan 16.

The building has been complemented with inner glass and gypsum walls to create private offices for the current tenant. The refurbished attic lacks the bearing brick walls that the lower levels have; instead there are brick columns that carry the weight of the roof. This enables a much more flexible office environment according to Hansson. The building's technical services are in good condition and were upgraded when the building was refurbished in the nineties.

5.1.4 Usability as ABW

The parts of the building that could be appropriate for activity based workplaces is the first and the second floor and the attic. The plans to build a store in the street level would make the ground floor inappropriate according to Hansson. There is no plan to transform the entrance level into stores since the current tenant has not made any indications that they want to move out. The same is to be said for the upper floors that are also currently occupied. This does not affect the possibility to transform the upper floors to ABW in the future and in this thesis it is examined if it is possible in the future. In table 5.1, there is an evaluation in accordance with the adaptive reuse checklist.

5.1.5 The adaptive reuse checklist

Integrated building	The floor plans of the building is quite fixed due to the structure, there is however higher possibility for adaptation on the attic. Due to relatively recent refurbishments the adaptability becomes further reduced.
Flexibility	The flexibility at Postgatan could be considered relatively high on the attic and at the other levels the gypsum walls could easily be removed and replaced in a way to meet organizational demands. There is however still brick walls that could not be replaced.
Technological innovations	The current activity in the building will enable for an ABW and the technical installations needed. The low preservation demands on the inside could enable further fix technical installations meeting the organizational demands.
Safety, health and comfort	With the entire building today used as an office, the adaptation to a ABW can be managed easily. Ventilation systems other technical installations are adapted to meet organization demands.
Energy efficiency	There is no complementary insulation on the outer walls but the windows have been replaced. The building is heated with district heating improving the energy efficiency of the building. However the total efficiency is quite low as in the other buildings.
Cost-effectiveness	The status of the building provides good opportunities to keep the initial cost low when adapting to ABW. If a certain type of floor plan is desired initial refurbishments will be needed increasing the initial cost.
Sound construction and maintenance	The current condition of the building is one of the highest in this study. With recent refurbishments and a floor plan designed for office work, Postgatan 16 could almost function as an ABW just by renewing the furniture.
Cultural heritage	The preservation demands are not that high but actions such as extra insulation layer on the facade is not possible. Interior the building has no major restriction except for the load carrying walls

Table 5.1 The adaptive reuse checklist for Postgatan 16.

5.1.6 Summary

The building located at Postgatan 16 could function as an ABW. The interior glass walls of the upper floors might need to be changed and other adaptations might be necessary to meet organisational demands. The initial cost for a refurbishment to an ABW will be small in Postgatan 16 compared to less upgraded pre-1914 buildings.

5.2 Briggen

Figure 5.3 The facade of Briggen showing the market hall at ground floor.

5.2.1 History

In the district of Linnéstaden in central Gothenburg, the market hall Briggen is located. The building was originally built as a fire station in 1891. The building has 2 and 3 levels and was designed by the architect Georg Krüger (Lundberg, 1996). The bottom level was the area for the firemen and where the fire trucks were kept. The upper levels in Briggen were the private residence of the chief fire officers and the assistant fire officers lived with their families. The fire officers lived in the fire station until the 1970's (Grunnesjö, 2015). The building was used as a fire station until 1988 when the fire defence moved to its new facilities in Gårda (Lundberg, 1996).

5.2.2 Current activity

Since the fire station moved out, the ground floor of the building has been refurbished and now is occupied by a market hall with delicatessens and other specialized food shops as well as restaurants. The upper levels where the fire officers had their residences are today occupied by a district library. The district of Linné is an attractive area with a high number of cafés and restaurants. Briggen is located close to Järntorget which is one of Gothenburg's larger transportation hubs with a variety of buses and trams passing by.

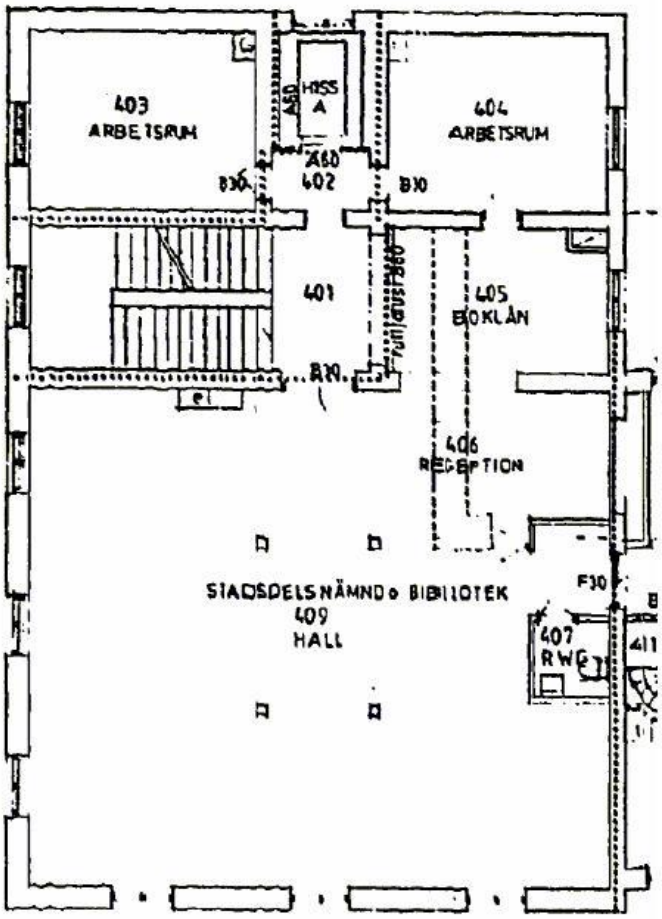

Figure 5.4 Floor plan at Briggen.

5.2.3 Building characteristics

The building is constructed with bearing brick walls and systems of joints that carries the floor plans. Before the library moved into the building in the part of the old private residences, brick walls were replaced by steel columns to create rooms more suited for the future activity. The floor plan is illustrated in figure 5.4. This has created a large room on the different floors. When the brick walls were removed all the way from the first floor up to the top, the structure did not need to carry as much weight and thereby enabled the open floor plan which otherwise usually is problematic in brick houses.

The floor plan of the second floor is presented in figure 5.4 and all of the three top floors have basically the same design. The top floor changes in the fact that the walls are not bearing and the weight of the roof is carried by brick pillars instead. The building has been renovated during the years due to water leakage from the roof which forced major renovation of the facade according to Johansson. The ventilation was upgraded when the major refurbishment was carried out in the early nineties. Briggen is connected to the district heating system of Gothenburg. However, Briggen is not connected to the district cooling but there is a cooling generator installed in the building to keep temperatures low for the market hall.

5.2.4 Usability as ABW

When analysing Briggen the part which is of interest is where the library currently is. This area is quite different from the other case study buildings due to that a large part of the carrying inner walls has been replaced with bearing steel beams. This has created a large space that could be used if a more open landscape type of office is desired. Also the two smaller rooms that can be observed at the top of figure 5.4 could be good from an ABW point of view. For example they could be used as quiet rooms for higher concentration or for project rooms that could be bookable. Also the large room in the lower part of figure 5.4 could be complemented with walls to meet organisational demands from a future tenant.

To further explore the usability of the library part of Briggen an evaluation was carried out in accordance with the adaptive reuse checklist. The result can be seen in table 5.2 in the following section.

5.2.5 The adaptive reuse checklist

Integrated building	When converting the old fire station into a library thick brick walls was replaced by steel beams carrying the weight of the construction. This has enabled for future tenants to have impact on the design plan of the building.
Flexibility	The ability to use Briggen as an ABW becomes quite high due to the large rooms in combination with a stairway and elevator that increases the accessibility in the building.
Technological innovations	The upgrading that was made for the library could easily provide an ABW with the technological installations needed. Also there are possibilities for further installments in the quite modern interior of the building.
Safety, health and comfort	Fire escapes are accessed either down the stairway or towards the other parts of the building. The elevator provides accessibility in the entire building and makes it easy to move between the different floors.
Energy efficiency	When Briggen was refurbished in the early 1990ies windows and ventilations systems were upgraded. Also district heating was installed and due to these factors Briggen has one of the best energy efficiency of the buildings in this study.
Cost-effectiveness	The open floor plan enables Briggen to function quite well as an ABW with also the elevator installed. The cost for bathroom and kitchen can be considered moderate in relation to other cost that's not necessary in this building.
Sound construction and maintenance	The status of the buildings condition Is currently high and there is no need for renovation of the building based on low condition.
Cultural Heritage	The former fire station has a high historic value representing civil history. Briggen is not however listed as the highest form of cultural heritage which can enable interior modification.

Table 5.2 The adaptive reuse checklist for Briggen.

5.2.6 Case summary

The floors in the old fire station located on top of the market hall provide a range of opportunities. The open spaces where the book halls of the library are currently located provide an open landscape and a physical flexibility unusual for a pre-1914 building.

5.3 Dicksonska

Figure 5.5 The facade of Dicksonska.

5.3.1 History

The Dicksonska villa was built in 1862 as a private residence for the politician Oscar Dickson. The house is built in a neo-renaissance style and it became a listed building in 1973. During the 20th century the villa served as a domestic science school and restaurant and later was bought by the city of Gothenburg for representative purposes. When the villa was built it was located in the city's outskirts surrounded by a park and a field (Johansson, 2013). Today the building is centrally located at Parkgatan 2 in the corner of Södra vägen and Nya allén. Entering through the main entrance the villa gives a majestic impression, an impression that continues in the preserved rooms.

5.3.2 Current activity

Today the ground floor and the first floor of the Dicksonska villa are used sporadically for representation and for civil marriages. The basement is rented by different companies such as restaurants and plumbers as storage room. The second floor and the attic are currently vacant.

The attic is unfurnished and has a great potential. The location at Heden is strategically strong in the heart of Gothenburg. The location with two larger roads on each side of the house can however be disturbing. Many of the rooms in the building are very well preserved and must be kept in the current standard. However, there are some rooms in the building's first and second floors in the eastern part of the house that are not in original condition, where there has been a kitchen that could be subject for refurbishment according to Bonnier.

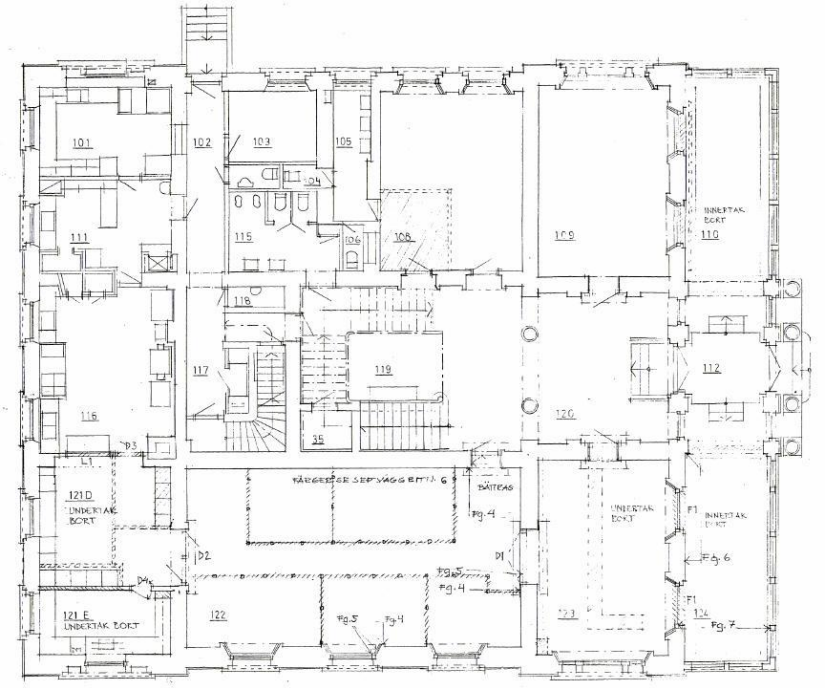

Figure 5.6 *The floor plan at Dicksonska. The exclusive stairway can be observed in the middle of the building.*

5.3.3 Building characteristics

The building is constructed in a classic way with walls of bricks and plastering and the floors are carried by a system of joints. The vision for the building is to be able to increase the utilization of it and to have people making the house more alive. However the old rooms on ground floor and the first floor cannot work as offices but there are other parts of the building that could be used. To be able to use the attic, there must be an extra fire escape but due to the listing of the building there is no possibility to put a fire escape of galvanized steel on the outside of the building. Also there are different levels in the attic which makes accessibility problematic. These are regarded as the greatest barriers for the ability to use the building.

5.3.4 Usability as ABW

The parts that could be used for ABW are the top two floors but the level of preservation is possibly little lower than on the entrance level. To be able to use the attic the problems with accessibility and the fire escapes must be managed. The accessibility can be solved by using ramps and a special designed lift that can open at different height at the attic.

When it comes to managing the fire escapes it can according to Grunnesjö be done in two ways, either by using a TR2 stairway where an extra fire cell is placed just outside the fire cell of the stairwell and the lift or by using the windows as fire escape. If a window is to be used there will however be necessary with other measures such as only 15 people per fire cell. This would require that the attic becomes divided into several smaller fire cells.

The attic also needs complementary insulation, when the roof currently lacks any sort of insulation. This process is possible but it will require a large initial investment. Also ventilation, heating, and other services will require large initial investments but it all depends on whether the building should be used or not. An ABW solution is probably one of the less expensive when it comes to initial cost due to less costly fire protection policies.

5.3.5 The adaptive reuse checklist

Integrated building	The ability for the client to affect the design is almost nonexistent except that maybe a new door could be installed. Dicksonska is the building in this study with the lowest impact possibility on the design plans.
Flexibility	The physical flexibility at Dicksonska is minimal due to the high preservation level. However does the relatively large rooms provide possibilities for organizational flexibility, were different room could be used for different activities.
Technological innovations	The high preservation level at Dicksonska makes it problematic for fixed installations. However, electric and ventilation installations are pre-existing and in combination with development of portable techniques the required needs can be met.
Safety, health and comfort	The ventilation, fire escapes, elevators and accessibility must be upgraded to be able to use the attic and the third floor as office area. The customer that wants to rent Dicksonska probably has to accept a lower comfort level than In a new building.
Energy efficiency	The energy efficiency in Dicksonska is low due to the construction and lack of technical upgrading. The building with its cultural historical value will after refurbishment still have low energy efficiency but because of the listening there is not much to be done.
Cost-effectiveness	To be able to use the two top floors there has to be major investments initially to ensure safety and comfort. These investments will probably not make the building more suitable for flexibility; it just has to be done to make it usable.
Sound construction and maintenance	The building lack of modern installations that affect the climate on the building has enabled the building to function as it was originally planned. If future refurbishments will be executed, they should be performed in accordance with original techniques.
Cultural heritage	The preservation demands are very high due to the listing. Many areas of the building is not able to change. If the building however is to be used and refurbished, all parts need s to be managed with high cautiousness and consideration.

Table 5.3 The adaptive reuse checklist for Dicksonska.

5.3.6 Case summary

Dicksonska is perhaps the hardest building to adapt to an ABW. However, the strategic position of the building and the historical value can be regarded as very beneficial for many organisations that fit the profile of the building. To summarise, Dicksonska can be adapted into an ABW but the initial cost will be very high and the process will be complicated.

5.4 Slakthusområdet

Figure 5.7 The entrance buildings of Slakthusområdet provide a grand impression but hves lost some of its original finish due to heavy use during time.

5.4.1 History

In the 1880's several major cities in Sweden saw public slaughterhouses as a way to make meat handling more sanitary. After a decision from the Swedish parliament in 1897 the Gothenburg city council was given a mandate to realize such plans. In 1899 they set apart an area in Marieholm in Gamlestaden for a public slaughterhouse. The Slaughterhouse was ready to use in 1905 and has been a place for meat industry ever since (Andersson, 1973).

5.4.2 Current activity

Today, Slakthusområdet is mostly occupied by large meat producers such as Jacobsdal, Dalsjöfors and Styckmästaren but also other tenants such as architects, construction firms and cleaning firms. The buildings in the area have been renovated and received complementary buildings through time but the area gives a worn out impression and is in need of renovation. Slakthusområdet is located at Marieholm, Gamlestaden in Gothenburg. The location of the area is valuable due to god communications, close to city centre and in an area that currently goes through a redevelopment process. There are six tram lines that stop only two minutes' walk from the area as well several buses and a commuter train station. The close access to the railway is not only beneficial. Slakthusområdet becomes limited due to the location of the area. The area is located alongside the Göta Älv River and has road 45 on one side and the railways to Trollhättan and Strömstad. It might be a need for safety measures on the parts of the area that are 50-70 metres away from the road or the railroad. The area itself is however 300 meter wide so there will still be area left for development, according to Grunnesjö.

5.4.3 Building characteristics

The buildings have a total are between 20,000 and 25,000 square metres depending on how calculated but the area will be reduced when removing complementary buildings such as storage rooms and levelers according to Eriksson. The buildings are brick buildings constructed in the same way as all the other buildings in this case study, with bearing brick walls and systems of joints that carry the floor plans. The area has been used for meat producing activities for 110 years which has affected the appearance of the area.

Many of the complementary buildings that have been built have changed the appearance of the area. The characteristic tower as well as the three entrance buildings, which are probably the most recognized landmark at Slakthusområdet, will in a future refurbishment be in more of their original appearance. Other buildings might be torn down and others complemented. At the moment there is no listing of any of the buildings at Slakthusområdet but there is ongoing work on a new detail plan of the area which would ensure that some of the buildings become listed.

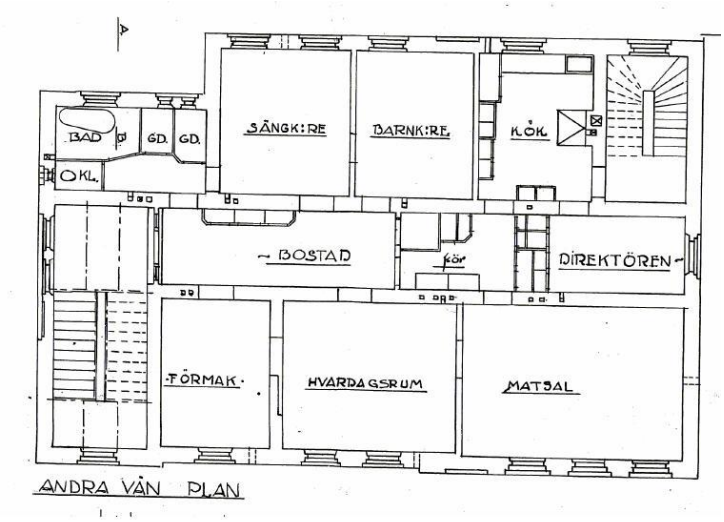

Figure 5.8 The floorplan of one of the buildings at Slakthusområdet

5.4.4 Usability as ABW

Slakthusområdet is facing a major refurbishment and all of the buildings will change more or less. The entrance buildings are the ones that are most alike the other pre-1914 buildings in the case studies, with the same floor plan with a hallway in the middle and rooms on both sides of the hallway. It is not possible to change floor plans in the entrance buildings due to the construction method of the buildings. The other buildings have much larger rooms and it is more likely that they become changed during the upcoming refurbishment. In the larger buildings the possibilities are huge and there will be no problems what so ever to fit an ABW. One problem with the area is that it becomes flooded occasionally when water from Göta älv rises. In the following section (table 5.4) Slakthusområdet has been evaluated in accordance with the adaptive reuse checklist to assess its suitability as ABW.

5.4.5 The adaptive reuse checklist

Integrated building	The ability for a future tenant to integrate the building to meet organizational demands is very high at slathusområdet. When the future development of the area will be carried out the entire area will be changed enabling a high level of adaptation.
Flexibility	The flexibility in some of the building is very high, especially for those builing used as large storage rooms. The flexibility in the buildings located at the entrance of the area has a lower flexibility in line with the flexibility of the other buildings in this study.
Technological innovations	The possibility to meet the organizational demands concerning technical innovations is very high. When refurbishing the entire area major changes could be carried out due to the low level of preservation on interior parts of the buildings.
Safety, health and comfort	There are problems connected to the location of the area. Both the fact that slakthusområdet is located between a large road and the railway but also due fact that the area occasionally gets flooded.
Energy efficiency	When refurbishing the area the energy efficiency could be optimized to meet high environmental demands. The facades can however not be complementary insulated du to preservation demands.
Cost-effectiveness	To adapt a building at Slakthusområdet to a ABW will require an major investment due to the current condition of the area. However, the initial cost to use the buildings for any other activity would also require major investments.
Sound construction and maintenance	When refurbishing the area the future maintenance must be taken into account to ensure a sustainable development of the area. This should be regarded as a possibility for the entire area.
Cultural heritage	The preservation demands on the area is currently not that high. However whit a new detail plan over the area when the renovation starts several parts of the area will become protected. The environment and the buildings have ah great historic value.

Table 5.4 The adaptive reuse checklist for Slakthusområdet

5.4.6 Case summary

To summarise, Slakthusområdet has great potential, both as ABW and for whatever activities that will occur there in the future. The initial investment will be large but the entire city of Gothenburg will benefit from a development of the old slaughterhouse area.

5.5 Kviberg

Figure 5.10 The entrance building Aspero at the regiment of Kviberg.

5.5.1 History

In 1890 the Swedish king and the parliament took the decision to acquire Kvibergs landeri from its former owner to build new barracks for the Royal Göta artillery regiment. In October 1895 the new regiment buildings were inaugurated. During the 20th century the regiment was used by the Swedish armed forces first as artillery regiment and later in 1962 as an anti-aircraft regiment (Johansson, 2013). The buildings at Kviberg were used by the Swedish armed forces until 1994 when anti-aircraft regiment LV6 moved to Halmstad. This was the end of the military era at Kviberg.

5.5.2 Current activity

Today Aspero, which is the entrance building at Kviberg, is occupied by a sports secondary school, but the vision is to use the facility as offices. The building is between 700 and 800 square metres and consists of 4 levels. Kviberg is the area located least centrally of the five cases but the area has undergone major change where new residential buildings have been built and at the moment a large indoor sport centre is being constructed. Though Kviberg is the least central of the cases, it only takes 10 minutes with public transport from the central station of Gothenburg.

5.5.3 Building characteristics

Today the old barrack buildings are used for different purposes but there is a major focus on sports in form of municipal units, schools and sport clubs. The buildings are constructed with a foundation of granite stone and the walls are constructed with bricks according to Bengtsén. The building where the old main entrance is located, Aspero, has many original details preserved such as decorated ceilings and original wooden decorations on the inner walls.

The room sizes vary from relatively large to smaller rooms such as the rooms in the towers of the building. The big rooms enable organisations to use them as more open landscape solutions which could be appropriate in an ABW. Aspero became a listed building in 1971 (Johansson, 2013). The towers and the stairwells are listed with their special details but otherwise the building has been upgraded to meet modern demands (Ogstedt, 2015)

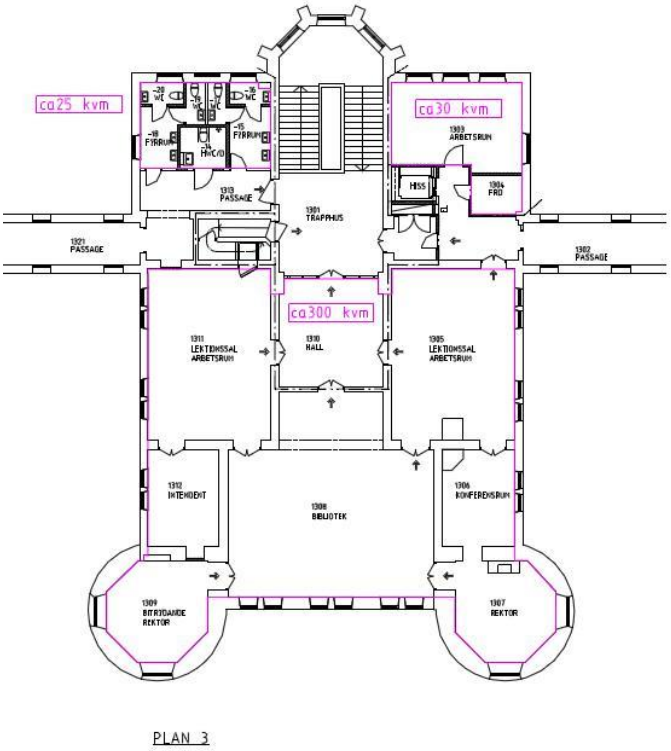

Figure 5.11 The floor plan at Aspero illustrating the large room sizes and the characteristic towers.

5.5.4 Usability as ABW

When studying the Kviberg case the focus has been on the entrance building, Aspero. The variety of sizes of the rooms that can be seen in figure 5.11 could enable different kinds of activities. The building consists of some larger rooms where adaptation through furniture could be managed to meet organisational demands. At the first floor of the building the school cafeteria is located and to fully use this part a refurbishment will be needed. This could however increase the level of adaptability of the building. To evaluate how appropriate the old entrance building could be as an ABW an evaluation has been performed in accordance to the method of this paper where the adaptive reuse have been used (see table 5.5).

5.5.5 The adaptive reuse checklist

Integrated building	The ability for the client to affect the design becomes limited due to the preservation demands on the building. However, with careful planning of the building the organization could enhance the flexible benefits due to the size of the rooms.
Flexibility	The flexibility at Aspero becomes high due to the large rooms. The ability to quickly move between different levels is however not optimal which reduces the flexibility of the building. Also in some parts of the building walls can be moved.
Technological innovations	With the current use of the building as a school much of the needed techniques already exist. The fact that most of the building is not listed makes it more adaptable for new installations.
Safety, health and comfort	The performance level of the ventilation system is high at the moment due to the current activities in the building. The large rooms in combination with the smaller rooms could provide a working environment appropriate for ABW.
Energy efficiency	The insulation of the building is not optimal and due to preservation requirement on the facade there is not much room for upgrading. The ventilation system is replaced in the end of the 90ties and could be upgraded for higher performance.
Cost-effectiveness	The ability for major investments becomes reduced due to the high level of preservation. The large room sizes could easily be complemented with appropriate furniture to meet organizational demands.
Sound construction and maintenance	There has been no major renovation on the building since the 90ies but new refurbishments will take place to meet the new customer. The building is currently in good condition and has not had any moist related problems.
Cultural heritage	The preservation demands are n high due to the listing. Many areas of the building is not able to change. There is however room for interior changes due to that the current school activity has modernized the facilities.

Table 5.5 The adaptive reuse checklist for Kviberg.

5.5.6 Case summary

To summarise, Aspero could function quite well as an ABW if the appropriate organisation could be found. However, the distance to the city centre could frighten some companies. Also there has to be refurbishments that could create higher initial costs.

6 Discussion

During the interview study and the literature review information has been gathered to find out whether brick buildings built around 1900 could be used for ABW. Initially, the discussion will be conducted in relation to the developed adaptive reuse checklist which was used as a guideline to evaluate adaptability for the buildings to function as ABW. Subjects such as environmental, social and economic viability will be analysed during the discussion where the different opinions brought up by respondents will be analysed.

As mentioned in the method chapter, a checklist developed in this thesis which has been based on the Steiner checklist (2006) has been used. In this chapter the results from the checklists provided in each case study will be compared. The information gathered from the background, theoretical framework and the interviews will be discussed in separate sections in the following text, evaluating the suitability for pre-1914 buildings as ABW.

6.1 Integrated building

The possibility to integrate the buildings for future clients becomes quite restricted in some cases due to cultural heritage. One of the cases is more difficult than the other buildings, and here most of the floor plans must be preserved in their current condition. There is also one more case that is highly protected by demands on preservation but the current activity and the status on the technical services make it easier to adapt the building to an ABW. For the other cases, the possibility to implement the integration will be restricted but it would be easier than in the listed cases. However, the possibility to influence which activities occupy a certain room is still flexible.

To find the right tenant for each building is complicated especially if the tenant has to match a certain profile as mentioned by Kroge (2015). However in some of the studied cases there is much space that can be used, which can provide another way for organisations to integrate within the buildings. In this way the real estate stock of pre-1914 buildings as a whole can provide ways for building integration. The ability to change each room's function by changing furniture and organisational restrictions such as noise level, maximum number of people and only allowing certain activities, is possible in all studied cases. As a result of this, organisations could adapt themselves to fit the building and not the other way around.

6.2 Flexibility

The physical flexibility in the cases must be considered as nearly non-existent in all cases except one where the entire area will be changed. However the organisational flexibility, concerning both numbers of employees as well as how the company is organised, becomes almost total due to the principles of ABW. The aspect of flexible working as presented by Gibson (2003) can take the flexibility discussion to another level where the organisation itself can provide a sufficient amount of flexibility. When the employees can perform their work with both time and locational flexibility the flexibility demands put on the building itself will be reduced.

The ABW concept also provides a possibility of contractual flexibility described by Gibson (2003) due to the simplicity of just installing another employee in the same area. This is also supported by Kahlefeldt who especially mentioned the possibilities for a growing organisation where it basically just is for a new member of the organisation to arrive and start working.

Also, within each building, the decisions upon what rooms should be used for what purpose still remains flexible. However, due to the high level of preservation restrictions, the specialisation of each room is limited. The adaptation and specialisation of the different rooms in the ABW must be completed with the possibilities provided by the furniture which would enable further flexibility. The flexibility of the building however is not the most important factor, as presented by Gibson (2003), which also was supported by Kahlefeldt during the interviews; it is the organisational flexibility that is significant for how well a building will suit a certain organisation.

The inflexibility in the pre-1914 buildings can, from an environmental point of view, be seen as something positive. In a modern office house the inner walls are often consisting of gypsum and studs and are easily replaced. The possibility to easily change the appearance of the office provides facility managers with a relatively easy way to remodel the entire office. This is not environmentally viable and could be regarded as an easy fix. In the pre-1914 buildings however, there is little possibility to move any walls. Instead, facility managers have to cooperate with organisational managers and manage the organisation after the given conditions.

6.3 Technological innovations

The technical development that enables alternative working methods has reduced the need for fixed technical services. The electrical services already existing in the buildings would, as mentioned by Sörquist (2015), be enough to provide capacity for the low energy demanding activities. The future technical demands are hard to predict but the trend does not move towards more fixed services, rather in the opposite direction with more portable solutions in accordance with Fawcett and Rigby (2009).

If there still is a need for more fixed technical services it might become problematic due to the high preservation demands in the more restricted areas. Demands such as floor boxes for power and raised floor systems might not be appropriate due to effects on the old wooden floors.

The pre-1914 buildings are perhaps not the best buildings for high tech companies that need big server halls and considerable energy and heat reduction. However as mentioned by Kroge, the pre-1914 buildings tend to attract a certain type of customers that appreciate the aesthetics and for them these buildings are the most appropriate of all. After all, the pre-1914 buildings can provide the technical services needed for an ABW, and by showing that such a concept is applicable in the pre-1914 buildings could make the buildings attractive to more customers.

6.4 Safety, health and comfort

The satisfaction level and well-being among employees is of highest importance for organisations and therefore heavy space reductions are not preferable. The satisfaction level and health among employees in ABW is as expressed by Bodin Danielsson (2008) among the highest for the different office types. This result does not necessarily ensure that just by implementing an ABW, employees will be satisfied. Instead before an organisation implements an ABW, an analysis should be performed examining the demands of the organisation. All organisations are not suited for ABW, as expressed by Kahlefeldt.

The large percent of a company's expenses that connected to costs for employees makes it counterproductive as argued by Steiner (2006) to implement to large space reductions as a way to save money. The inflexibility of the floor plans would require more space for each employee due to that not all space is appropriate for office activities. In a new building the measurements can be adapted to reduce space loss that can occur in the pre-1914 buildings. With approximately 15 square metres per employee the level of satisfaction would be kept at a high level.

In one of the cases there is currently a problem with fire escapes which can cause difficulties. This is a problem that has occurred at other similar buildings according to Grunnesjö and it is fair to conclude that this is a common problem in pre-1914 buildings. If a window was to be used as a fire escape, restrictions would be put on how many people could work in the same fire cell. This could however be managed by not installing more workplaces than what is allowed, but it will further reduce the flexibility. To be able to use the two top levels a new fire-escapes must be installed and to ensure accessibility a lift must be installed. Another of the cases has problems with heavy traffic and railroads passing by closely. This problem is perhaps not specific for the pre-1914 buildings but something that needs to be taken into consideration when refurbishing in an urban environment.

When it comes to managing the indoor climate the pre-1914 buildings become limited. Ogstedt expressed that the preservation demands makes it complicated to install for instance ventilation due to aesthetical demands. This was one of the reasons why the rent-income was lower on the pre-1914 buildings than on modern buildings located in similar areas according to Kroge. The preservation demands also impacts the indoor climate negatively in other ways such as downdraughts in connection to the old windows and other less insulated parts of the façade, and other problems connected to the temperature during certain seasons.

6.5 Energy efficiency

The pre-1914 buildings are as presented in this report poorly insulated and as much as 35% of the energy is lost through the façade. To improve the energy efficiency the most obvious action would be as presented by Zagorskas et al. (2013) to improve the outer wall insulation. This action could not be possible due to preservation demands as expressed by Ogstedt. Instead energy has to be reduced by other measures. One such action could be improving ventilation and optimising and actively managing the technical systems that regulate the indoor climate. In some cases the heat leaving the building could be used again by having a heat exchanger. Another way to reduce the energy consumption could be by using district

heating and cooling. This would enable a more controlled heat and cooling supply in a more energy efficient way with higher utilization compared to self distribution.

If a building of those studied in this report would be refurbished and adapted to function as an ABW, the most energy demanding process would probably be cooling the office. However, there are several energy saving actions that could be applied. One measure that could reduce the internal temperature and reduce the time that the cooling system would have to operate is by reducing the temperature during night time to receive a lower temperature in the beginning of the day. This process would be especially beneficial due to the solid brick walls and the heat capacity of the bricks. In this way the brick walls could be used to buffer extreme temperatures during the day. For instance during summer the indoor temperature at night time could be reduced to a low temperature. By reducing the temperature during the night instead of daytime, the cost to reduce the temperature would be lower due to the lower outdoor temperature.

Another way to reduce the energy consumption could be to have activity sensors that turn of the light if there is no activity in the specific room. The same could be used for ventilation where the ventilation must be started manually when using the room. This was ideas that both Sörquist and Frygner found especially beneficial in an ABW solution where all rooms are not used at all times. This is something that Kahlefeldt however opposes; he expresses the importance of that all rooms feel alive and welcoming. If part of the office is dark and an employee must actively turn on the ventilation this will affect the perception of the office. This becomes especially important in the pre-1914 building that has generally a smaller window area than a modern office building and therefore is darker. This is something that could become problematic especially when the environmental demands on viability increase. This is something that the tenants however will have to make decision upon based on their policies and profile. For the facility manager the question whether the office should be welcoming and bright or more energy sustainable becomes a part of how the organisation wants to profile itself.

During the interviews there were indications that real estate owners had fewer incentives to install more energy efficient installations. This is due to that the economic savings in energy consumption only benefitted the company renting the office. A natural action would be to create incentives for the real estate owner to install energy saving equipment in their building. This can be solved by allowing the real estate company to also save money by upgrading the systems. How this should be executed is hard to say but by ensuring the real estate company to benefit financially from all the energy savings, their incentives to upgrade the energy system would increase.

6.6 Cost-effectiveness

The cultural heritage of the building cases in this study makes it hard to ensure economic viability. The listing of the buildings puts demands on special techniques and materials that increase the costs for maintenance. The demands put on the buildings from the county administrative boards and the National Heritage Board also frighten some tenants, resulting in lower rents according to Kroge. In some cases the best solution from a financial viewpoint might be to demolish the building and replace it but that is impossible due to preservation demands.

The refurbishment of the pre-1914 buildings might not always be the most beneficial investment but if the buildings already are part of a company's real estate stock the question whether to invest in refurbishment or not changes focus. Instead a new investment analysis needs to be made where the cost of refurbishment and possible future rent revenue is compared with the option where the building just stands there, unusable. Higab also has the task of making some buildings with cultural heritage more accessible for the people of Gothenburg. This is another aspect that needs to be considered when planning a possible refurbishment.

The cost of furniture becomes an important issue for ABW in pre-1914 buildings. When the physical flexibility of the building is limited, higher demands is put on the furniture and the flexibility it can provide. This is one of the most important aspects for making ABW function in a pre-1914 building according to Kahlefeldt. This will lead to a higher initial cost due to higher quality furniture. The furniture should however be considered as a valuable tool supporting the organisational objectives. This view aligns with what van der Voordt (2004) expresses, that a higher initial investment will provide economic savings in the long run. The possibility for organisational expansion and changes without further office investments is also increased. At last, the probably most important aspect deciding whether the buildings could be used as ABW is probably the location. If the location is right, all other parameters become of less importance and the tenants are probably more willing to accept flaws.

6.7 Sound construction and maintenance

The decision to demolish the buildings is ruled out due to cultural heritage aspects in all cases except perhaps one were complementary buildings will be replaced. In some cases this is beneficial but as Power (2008) argues the decision to replace old buildings increases the environmental impact. By maintaining the buildings a large part of the city's historical value becomes preserved. When refurbishing pre-1914 buildings the choice of method and material is in some cases regulated by the listing.

However this cautiousness has not always been present, and materials that are dangerous for both people and the environment have been used in these buildings. Frygner includes the possibility to find environmentally hazardous substances in the buildings. By doing the renovations in accordance with Miljöbyggnad, the documentation of the building becomes extensive and the potential for future refurbishment will be clearer, and also the environmental impact will be reduced.

6.8 Cultural heritage

The preservation demands are high especially in two of the cases were the buildings has been listed as historical buildings. In the other cases there are nevertheless preservation demands on the facades and load bearing inner walls. In one of the cases there might be a listing ahead when a new detail (urban) plan is developed. In that detail plan specific buildings could be listed but also certain parts of the surroundings. When adapting pre-1914 buildings for a new activity, an office of ABW character provides possibilities for the facility manager. The listing of the building and the cultural value reduces the opportunities due to the inflexibility of the

building. The concept of ABW however enhances a level of flexibility enabling an organisation to occupy the building in the current status. This could decrease necessary refurbishment, resulting in better preservation of features of pre-1914 buildings.

The historical value of the pre-1914 buildings could be regarded as an asset. As argued by Kroge, there are certain tenants who really appreciate this type of buildings. By refurbishing and finding tenants for the buildings that can open up the buildings to the inhabitants of Gothenburg the cultural heritage value of the buildings will increase. This is argued by Pereira Roders and Hudson (2012), and it is line with the vision of Higab to make buildings of cultural value accessible for the people of Gothenburg. Some tenants even require the environment that the pre-1914 buildings provide. By adapting the buildings to ABW, the buildings can be shown to support a new type of client demand. This would increase the number of possible tenants resulting in an increased rent level.

7 Conclusions

Regarding the suitability for activity based workplaces (ABW) in pre-1914 buildings, it is perhaps not as high as it is in a modern office building. However this thesis aimed to evaluate how pre-1914 buildings can function for ABW and the outcome has proven to differ between the five buildings studied here. The organisational flexibility provided by ABW is well suited for the pre-1914 building. ABW could be a way to increase the interest for the pre-1914 buildings and at the same time being able to increase the rent levels.

Adapting the different pre-1914 buildings into offices are perhaps the easiest form of adaptive reuse due to the relatively low regulatory requirements on offices in Sweden compared to other building types. The important aspect of whether a building in general is suited for ABW is the organisation that is planned to occupy it and how they can adapt to the building. The pre-1914 buildings also however need to be planned carefully and adapted to fit the appropriate organisation. The room size and design of the floor plans enables natural places for different activities with varying levels of communication and noise.

In this study, no conceptual floor plans have been developed to visualize how a pre-1914 building would function practically as an ABW. This is a field for further development. Also, I recommend further research in development of office hotels for start-up companies using ABW solutions and preferably in pre-1914 buildings. This could be a way to revolutionise the way people perform their work in buildings with heritage qualities.

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Interviews

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Hansson, G. (Facility technician at Postgatan) interviewed by the author 11 February 2015

Bonnier, J. (Facility technician at Dicksonska) interviewed by the author 11 February 2015

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Ogstedt, H. (Antiquarian at Higab) interviewed by the author 6 March 2015

Frygner, P. (Energy engineer at Higab) interviewed by the author 6 March 2015

Sörquist, T. (Electrical services manager at Higab) interviewed by the author 5 March 2015

Kroge, C. (Facility manager at Higab) interviewed by the author 9 May 2015

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