



Security and safety requirements of sandwich wall elements

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This thesis is part of a two-staged project conducted in collaboration with Hämeen University of applied science. This thesis is the first stage of this project and the target of this thesis is to determine the need for a second stage.

The research is based on burglary resistance standardization and how the standardization is implemented in to the products of the sandwich wall element manufacturers on a European level. Partly taking in to consideration the manufacturers on a national level in Finland. The research also clarified what organizations are responsible for the standardization testing and certificating of sandwich wall elements on a European level.

This research is a literature review on researches, standardizations and products in the field of, burglary resistance of sandwich wall elements. In this thesis I have clarified what standardization are used and how they're implemented in the field of sandwich wall elements on a European level.

Based on this research and the arguments for doing this two-stage research, there's not a need to conduct the second part of this project. The head organization on a European level is active and the European manufactures of sandwich wall elements have to some level implemented burglary resistance in to their products. As Sandwich wall elements become more common and more widely used to different facility purposes there most likely will be a need for a burglary resistance research of sandwich wall elements based on different arguments. This research gives a good starting point for further researches in this field.

Keywords: Sandwich wall elements, Construction material, Standardization, Burglary resistance & Security and safety implementation.

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1 Introduction

This thesis project is the first part of a joint project with Häme University of Applied Sciences. The project is divided into two stages and supervised by Häme University of Applied Sciences. The second stage of this project is dependent on the result of the first part. Laurea University of Applied Sciences is part of the first stage in which I conduct research on behalf of Laurea on standardisation and testing of burglary resistance of sandwich wall elements. Häme University of Applied Sciences conducts the second stage of the project and it's implemented as a research, developing and testing project. The first stage determines if there's a need for the second stage of this project.

The research that is done in this thesis is conducted on the basis of the background material provided by Häme University of Applied Sciences and the main goal for this research is to provide the information needed to determine if there is a need for a second stage of this project. Based on the background material for this joint project, my research can be divided into two main questions to answer; burglar resistance and standardization of sandwich wall elements and is there an association on a European level that conducts the field of sandwich wall elements. The background material states that there is no clear information regarding security and safety standardization on sandwich wall elements and that there's an urgent need for an update on testing methods regarding sandwich wall elements. There are a few burglary resistance standards on a European and Scandinavian level and through my research I will find out if any of those standards are used for testing burglary resistance of sandwich wall elements. Besides the burglary resistance and standardization of sandwich wall elements the background materials provided by Häme University of Applied Sciences state that there's no head organization in the sandwich wall element field of manufacturing and development.

In the background material for this project there is no information about other cooperation partners of this project and there is only a statement that there is a need to do something about the situation. Not knowing who the co-partners of Häme University of Applied Sciences for this project are gives me free approach on this project. The questions to answer in my research are provided by Häme University of Applied Sciences and the background material also restricts this research to a European level.

In the background material regarding this project Häme University of Applied Sciences state that, as sandwich wall elements become more common as a building material for buildings the significance of their burglar resistance will be emphasized. In Finland there have been burglaries where the burglars have targeted sandwich wall element buildings and penetrated through the sandwich wall elements. One case that made head news was the burglary on Lahden Launeen Prisma, a large market close to downtown Lahti. In the article they state

that the burglar penetrated in to the building through an element wall. The police stated that the burglar was done by professionals and that the burglar got away with 100 000€ worth of goods. (Appendix 2, Appendix 3)

The background material also states that there's not been done any research concerning burglary resistance of sandwich wall elements. It also states that researches on sandwich wall elements have not been effectively implemented in to companies' research, development and innovation. And for Finnish companies to be competitive on international level there is a need for research and experimental research in the field. (Appendix 1)

1.1 Häme University of Applied Sciences

As already mentioned in the introduction this is a joint project between Laurea University of Applied Sciences and Häme University of Applied Sciences. Häme University of Applied Sciences is governing this project. The Sheet Metal Center of Häme University of Applied Sciences is the division behind this project. My contact person at Häme University of Applied Sciences, sheet metal center is senior lecturer Timo Kärppä.

Häme University of Applied Sciences is a institution for higher education located in central populated area of southern Finland. Häme University of Applied Sciences provides education to 7200 students and employs 625 people. Häme University of Applied Sciences has 37 degree programs. (About häme university of applied sciences)

Häme University of Applied Sciences has close relation to business and industry and can there for offer students learning environments that are authentic and beneficial for both the student and the enterprises in collaboration. Häme University of Applied Sciences has four research units that conduct customer oriented research and development projects for businesses and industry within the region. (About häme university of applied sciences)

1.2 Background material for this research

For this project I was provided with background information in a form of a power point. The background material power point titled in Finnish, "Seinäelementtirakenteen murtosuojaus" which translate into Burglary resistance of wall construction elements. (Appendix 1)

The background material is the result of collaboration between Häme University of Applied Sciences and Finnish manufacturers. Based on conversation with Timo Kärppä there's some real concern regarding burglary resistance of sandwich wall elements and the manufacturers see a need to certificate and test their product for burglary resistance. And both Häme University of Applied Sciences and the manufacturers see this as a key point in future development of sandwich wall elements. There was never mentioned who the manufacturers where in this joint project. (Appendix 1)

There's a short presentation of the background for this project, with the main arguments provided by Häme University of Applied Sciences and the copartners:

- Wall elements research, development and innovation have created new products for the construction market.
- In this project wall elements mean sandwich wall elements.
- As sandwich wall elements get more common the signification of burglary resistance will be emphasized.
- Burglary resistance and efficient solutions for production and testing is the demand for staying competitive on and international market.

In the background material there's a brief presentation of the present moment:

- There's no clear view on safty standardization and conventions.
- Testing methods and their present practice are in need of an update.
- Research on burglary resistance is not actively done.
- Research information is not implemented in companies development and innovation.
- For Finnish wall elements solutions to stay competitive on there's research and testing to be done.

The last part in the background material concerning me was execution plan for the first part of this project. Burglary resistance research, standardization and testing methods of sandwich wall elements. There was three key points:

- Safety requirements. Are there safety requirements on a national and European level?
- Product demand of burglary resistance. Is there any requirements related to sandwich wall elements.
- Testing methods. What are the testing methods are there other standardization than SSF 1047 and who conduct the tests on a European level.

Based on the background material and conversation I had with Häme University of Applied Sciences I got a good over view on how to start this research.

1.3 Objective of this thesis

This is a development type of thesis based on guidelines provided by Häme University of Applied Sciences and this research has a clear target based on the background information provided. I have no information about how the background information for the first stage of this project was gathered, but the information in the background material provided to me will be the base for this research and that information is also the setting the borders for this research. The target for this research is to answer the questions provided by Häme University of Applied Sciences and my research determines the need for a second stage.

One concern regarding this research was regarding the topic, is there enough information available to conduct the research (Hirsjärvi, Remes & Sajavaara 2013, 79.). Before accepting this project I did a quick study on the topic and based on the searches in the field of sandwich wall elements I felt confident that the research would be possible to conduct in the given time frame. From a research point of view it's also critical that the topic is of interest to the researcher (Hirsjärvi, Remes & Sajavaara 2013, 77.)

As the topic was chosen for this project, the basic problems and questions to research was already recognized and introduced in the background material for this research. My interest in this topic and my open mind approach to this topic should still provide me with the space to reflect on the topic and to contribute to the whole project. The basic demand for an ordered research is that the researcher dose his research on the given topic and by doing this gives the decision makers tools to make a decision. (Hirsjärvi, Remes & Sajavaara 2013, 71-72.)

Another criterion for a qualitative research is that the topic's of the right branch of science for the researcher (Hirsjärvi, Remes & Sajavaara 2013, 77.). When I read through the background material it was clear that even as the research is on an unfamiliar field, the research are of this topic is familiar to me form other projects and I feel that my knowledge can contribute to the whole project. The whole research unites different fields of science but burglary resistance and standardisation related to that is part of my branch of science. I also feel that this research will give me new knowledge that will expand know-how.

1.4 Choice of topic

For my research the topic was already chosen when I decided to accept to do the research for the first stage this project. The diction to conduct this research was made by Hämeen University of applied science and their co partners. Laurea University of applied science, security management degree programme was chosen to conduct the research for the first stage. The basic demand for an ordered research is that the researcher dose his research on the given topic and by doing this gives the decision makers tools to make a decision. (Hirsjärvi, Remes & Sajavaara 2013, 71-72.)

The topic on the background material provided to me by Hämeen University of applied science was burglary resistance of panel wall structure. In the project information specification it was determined that in this case panel wall structure meant sandwich wall structure and that this research was restricted to sandwich wall elements; elements with an insulated core and metal sheets covers. And the first criterion for a good topic is that the topic is of interest to you (Hirsjärvi, Remes & Sajavaara 2013, 77.).

I would not have accepted this project if it would be of no interest to me or I felt that it would not be able to go through with it. This is an essential requirement for conducting a qualitative research (Hirsjärvi, Remes & Sajavaara 2013, 77.).

2 Background theory

2.1 Key concept

Sandwich wall elements are multilayer construction products that essentially consist of two profile surface layers and an insulating layer in the middle. Sandwich wall elements are not self-supportive and need to be attached to a wood or steel sub frame. The connection between two sandwich wall elements is called a joint and these vary depending on the design of the sandwich wall element product. (VDS, Sandwich elements as room closing wall and roof components.)

The term sandwich wall element to day is used for a variety of element products and as innovation on wall element building continues there will in the future be an even wider variety of products using the product name of sandwich wall elements. My research is focused on thin metal covered elements with an insulated core; the background material for this research restricted this part. There's also sandwich wall elements that uses mixed layers on the inner and out side and there's also sandwich wall elements made of concrete layers and an insulated core. Other materials use for outer layers on the elements is wood and brick. As all of these products are called sandwich wall elements, witch is confusing in many cases, but the basic idea of a sandwich wall element product is a inner and outer core that are attached to a insulated core creating a element that can be combined with other elements for a tight seal. Sandwich wall elements are also used as a roof building material. As my research is restricted to metal covered elements I will focus on them from this point forward, but many of the characters I describe also complies in many cases to sandwich wall elements with different outer layer materials.

Sandwich wall elements are construction products with excellent insulating characters because the insulation is integrated into the product. Sandwich wall elements consist of two thin metal covers, one outer sheet and one inner sheet. The sheets are combined whit an

insulated core, the insulated core normally consist of polyurethane foam, hard polystyrene foam or mineral wool. Sandwich wall elements with a core material of mineral wool have a higher fire resistance than polyurethane and polystyrene foam. Sandwich wall elements with mineral wool core are available up to EI 120 fire resistance class of standard EN 1365. The size of these elements varies and the space between supports can be up to 11m. (EPAQ, Sandwich panels)

Burglary resistance is a definition for an object to with stand physical violence intrusion and mechanical security devices prevent 42% of all attempted burglaries (IFT Rosenheim, Limit and opportunities in mechanical burglary resistance, 91.). It's measured and graded by standardization such as the European standardization series SFS-ENV 1627-1630 published in 2011 or the Swedish standard SSF 1047 commonly used in the northern parts of Europe, mainly Scandinavia. Burglary resistance is based physical measurements of the material strength.

Standardization is the basis to ensure safety, quality and reliability of products, processes and services in the given field (European Commission, Standards and Standardization Handbook, 6.). Standardization also plays a vital role supporting regulation and ensuring efficient production and cost reduction through competition (European Commission, Standards and Standardization Handbook, 6.). There are three types of standards, formal, informal and private standards (European Commission, Standards and Standardization Handbook, 7.). Formal standards are divided into a tree sub standard bodies, national, regional and international standards bodies. Informal standards are those published by standard development organizations. Private standards are standards developed by a company or trade association (European Commission, Standards and Standardization Handbook, 7.).

Standardization is based on voluntary and there's no is obligated to use theme and this is what differentiates them from regulation (European Commission, Standards and Standardization Handbook, 7.).

Standardization can perform on four different fields; compatibility, quality, optimization and information (European Commission, Standards and Standardization Handbook, 5-6.). Compatibility by standardization means that products from different manufacturers will adapt together, for example electrical plugs and outlets (European Commission, Standards and Standardization Handbook, 5). Quality by standardization means that the products suitability and safety is ensured by standard (European Commission, Standards and Standardization Handbook, 5.). Optimization by standard is to ensure uniform system for mass production and to reduce prices, for example shoe sizes (European Commission, Standards and Standardization Handbook, 6.). Information by standardization means that the standard ensures that the materials, functions and processes are tested and measured to full fill the demands of standard in questions (European Commission, Standards and Standardization Handbook, 6.).

3 Research methods

3.1 Literature review

The first step in doing a literature review is to research the earlier researches in the field and find out if the research I'm about to do already has been done. This is the first step for me to do now that the research topic has been chosen and the field of research is determined. (Adams, Khan & Raeside 2007, 49.)

After defining the researches done in the field of security and safety of sandwich wall elements the next step is to determine the experts in the field of sandwich wall element manufacturing and research. From an early stage it was clear that there would be a very small amount of literature in form of books available for my research because the term security and safety of sandwich wall elements was not used on a larger scale and there was no research done in that field prior to my finding. By following up references used in journals, informational publications and on web sites by manufacturers I was able to determine the head organization in the field of my research (Adams, Khan & Raeside 2007, 50.). By following the recurring references in the publications by the manufacturers of sandwich wall elements I was able to create a "road map" for my literature review (Adams, Khan & Raeside 2007, 50.)

From the background material provided by Häme University of Applied Sciences for this research the base theory and questions was provided. Based on the theory provided by Häme University of Applied Sciences I was able to determine the data required to answer the questions already set by Häme University of Applied Sciences (Adams, Khan & Raeside 2007, 50.). The two first steps of this literature review answers the two most important uncertainties; had there been earlier researches in the field of security and safety of sandwich wall elements and who are the experts in this field. These two first steps defined the already given questions and theory of this research. In the background material provided by Häme University of Applied Sciences I was also able to find the critique and alternative theories, also the strength and weakness of my theory is evident in the background material (Adams, Khan & Raeside 2007, 51.). In fact as the theoretical knowledge expands, the particular topic reveals shortcomings and enables the researcher to identify more important research questions (Adams, Khan & Raeside 2007 51.). As the questions for my research was provided in the background material, the critique and alternative theories could also be found. The main weakness found in the background material was the lack of basic knowhow in the field of sandwich wall element by the material provider. This on the other hand strengthens the questions provided and made my approach to this research more direct.

Earlier researches done in the field of sandwich wall elements are of a qualitative nature and the main researches done by EPAQ are to support the manufacturers on a European level. As I

wasn't able to find any researches regarding security and safety of sandwich wall elements I will ground my research based on the researches done in the field of sandwich wall element as construction material. The main researches in that field are content analysis and grounded theory. (Adams, Khan & Raeside 2007, 51.)

As sandwich wall element as a building material is quite new compared to traditional building material many of the researches done in this field are exploratory nature (Adams, Khan & Raeside 2007, 51.).

The main problem for me in this research was the amount of data available and in the earlier stages of this research I was mainly focusing on references to provide me with path to information that was trust worthy. The research can be divided into two different stages; the stage before finding EPAQ and the stage after finding EPAQ with the information and trust worthy interconnection provided by that association. As mentioned earlier there is a lack of information regarding sandwich wall elements as a building material because of that being a fairly new building technique compared to the traditional building techniques. The information found through my research regarding security and safety of sandwich wall element did on one hand suffer from quantity but it was of high quality. (Adams, Khan & Raeside 2007, 52.)

Through this literature research there was no big controversy and the quality material provided by EPAQ and the standardization organizations in this research answered the questions provided by the background material. The distinct nature of the questions in this research made the research path continually and by answering one question the research material provided me with a path to answer the next question. As the research is done for mostly using qualitative methods it's very difficult to provide testable presumptions. (Adams, Khan & Raeside 2007, 52.).

The main concern for my research topic was the lack of researches done in the field of Security and safety of sandwich wall elements. As this research is based on background material provided by Häme University of Applied Sciences I can directly dismiss the assumption that there is no interest in the information this research will provide. But the lack of researches in the field of security and safety of sandwich wall elements do support the assumptions made in the background material that there's a need for a larger research in this field. Also the manufacturers are behaving, as there's clearly a need for a wider research on how to test security and safety of these wall elements. The use of standardization designed for door and glass penetration isn't best combined with these wall elements.

3.2 Questions to answer

Hämen University of Applied Sciences had provided me with the background material for this research. The main question to answer with this research; is there a need for a second part in this project. The three main questions that determined the need for a second stage was; is there security and safety requirements for sandwich wall elements on a European level, requirements for burglary resistance of sandwich wall elements, who are testing burglary resistance of sandwich wall elements and what certification methods are they using.

The base for all questions is there a head organization on a European level supervising the field of sandwich wall elements, supporting manufacturers on the European market. As this answer the main argument of an unorganized field with no clear guidelines on a European level.

Hämen University of Applied Sciences already determined the borderlines for this research in the background materials. Also the questions to answer in this research where for most part determined by the background material. The questions to answer in this research are supportive and continuous. By researching the manufacturers and their products on a national and European level it will open the path to research material for answering the following questions. Are the manufacturers implementing burglary resistance in their products and research? Is there a head organization on a European level?

I will begin this project by researching Finnish and European sandwich wall element manufacturers to determine what kind of burglary resistance products they have and how the burglary resistance is determined. What standardization is used and is burglary resistance a common part of the manufacturers production line, a special product in the production line or totally absent.

By researching the sandwich wall element manufacturers production line I will also determine what standardization the CE mark is based on for Sandwich wall element, which is an essential part of the products specification for the European market. Researching the manufacturers products will also give me a research path to what organizations conduct the standardization tests and what standardization they are using, not only burglary resistance but also if there is a specific standard for Sandwich wall elements.

I also hope that my research on manufacturers will give me an path to the question; is there a head organization on the European level that oversee the sandwich wall element industry in Europe.

I will start my research on the Finnish national market by identifying the market leaders on the Finnish market and by doing this open up new paths to continue this research.

3.3 Restrictions

The base restrictions of this research were laid out in the background material and the assignment already heavily restricted, further more my research and the topic in itself places terms for the rest of my restrictions (Hirsjärvi, Remes & Sajavaara 2013, 83.). Further restrictions have to be made in line with earlier restrictions. Also the restrictions may evolve as the research advances and changes to the restrictions will be made as the research progresses. (Hirsjärvi, Remes & Sajavaara 2013, 83.).

On an early stage when approaching this research I noticed that the term “sandwich wall element” is widely used today and the manufactory material varies some. In the background material for this project there was a statement that in this research by wall elements they mean elements constructed in layers, thermal core with sheet metal surface (Appendix 1). Based on the information from the background material provided to me by Häme University of Applied Sciences I will restrict this research to sandwich wall element constructed with two sheet metal faces and a thermal internal core. The background material provided by Häme University of Applied Sciences also restricts my research to a European level and for this reason the research will only take into account companies that manufacture and test their products in Europe for the European market.

The restriction of topic can be practised and it's possible to use different techniques to restrict the research if restrictions do not come naturally (Hirsjärvi, Remes & Sajavaara 2013, 86.). At the beginning of this research of burglary resistance of sandwich wall elements it became clear that I would have to restrict this part of the research in some way as my research was growing out of proportion and I realised that what I was researching had to do with burglary resistance of sandwich wall elements and not burglary resistance as a whole. And for that reason I will restrict this research to only focus on burglary resistance of the product sandwich wall element and not on how the burglary resistance of these products affects burglary resistance as a whole.

As the research progresses to a wide field of manufacturers on the European market and my research findings of EPAQ, I will further more restrict this research to EPAQ members only and work through the EPAQ member's database to gather research material for this research. In this way I can reassure that the material for this research is from companies bound to the same demands of EPAQ.

Sandwich wall elements that are sold in Europe are governed under the European construction industry regulation, CPR or Construction Product Regulation. Products under the CPR are all already regulated for fire safety so I decided to exclude fire safety of sandwich wall elements from this research at an early stage.

4 Research

4.1 Sandwich wall elements

Sandwich wall element is a term used for a variety of products. The term is used as light-weight façade materials but also for heavier concrete façade panels. The term can also be used for, inner wall material and door materials; there are also occasions where this term is used for airplane construction materials. The term sandwich wall element is more of a term for panels that are bound together to create the final façade. Sandwich wall element is a product that combines materials for outer façade, for insulation and for interior into one piece that's possible to combine to another piece with a tight seal. The main reason for using sandwich wall elements as the construction solution for façade material is cost and time (Sandwich elements 2015).

As the sandwich wall element term may in some cases cause confusion in some cases. Still the general meaning of this term is a metal covered single insulation core that is internal and external covered by a metal core (Sandwich Panel Core: Metal Sandwich Panels 2015).

Sandwich wall elements are today often used as the construction solution for facade material on buildings and the wall elements are used as the main facade material in a large variety of buildings. The sandwich wall material also varies from concrete elements to lightweight aluminium covered elements. Sandwich elements are also widely used as lifting door material.

4.2 Head organization on an European level

EPAQ is a European association for the manufactures of metal profiled sheets, sandwich elements and ancillary products. They represent the manufacturers in all political, regulators, technical committees and in motions that are relevant for sustainable free market in Europe. EPAQ aims to provide expert guidance and information to decision makers in their field of expertise. The quality operation of EPAQ is based on European standardization that permits to certify a product with CE marking. Members of EPAQ are part of the association's own quality assurance system that supervise the products regularly. The association test product samples twice a year to guarantee that they full fill the association's quality regulation and the European standards. EPAQ generates rules for testing of products to ensure an equal quality level all over Europe. (European Association for Panels and Profiles 2015)

Revealing the European head association for the field I'm researching answers the first question in my research and this organisation provide information base for further research.

The EPAQ has 94 ordinary members located around Europe. The number of the ordinary member companies is somewhat misleading, as there are companies like the Kingspan Group from

Ireland that has 27 subcompanies around Europe with every Kingspan national represented separately as an ordinary member in the EPAQ list. Also Arcelomittal Construction have 20 subcompanies on a national level around Europe, these companies are also listed separately in the EPAQ list. Ruukki Construction Group and Ruukki Construction Company are listed separately on the EPAQ ordinary members list with the mention that Ruukki Construction Company in EPAQ represents Ruukki Construction Group. (Ordinary members)

EPAQ has two Finnish ordinary members, Paroc Oy and Ruukki construction Oy (Ordinary members 2015). Finland is also well represented in the associations committees; Kimmo Rantala from Paroc Oy is a member of the managing committee, Antti Helenius from Sweco Oy and Paavo Hassinen from Pontek Oy are members of the Quality Committee for Panels and Lars Heselius from LHH Consulting Oy is a member of the Working Group Standardization (Managing Committee 2015). The to main manufacturers of sandwich wall elements in Finland are active members in this organization and both Paroc and Ruukki employees are active in the committees.

The EPAQ label on sandwich panel products ensures the customer that the product will full fill the requirements of the European standard SFS-EN 14509 and that the product will be of a high quality (Quality 2015). Members of EPAQ are allowed to use the quality label EPAQ for their products after clearing a process of auditing, testing and evaluation by independent third parties (The quality label of the European Association for Panels and Profiles is called EPAQ 2015). Paroc Panel Systems Oy Ab is the only Finnish Company that owns the right to use the quality label EPAQ (Finland 2015).

After researching Paroc and that research leading to EPAQ and quality label owners, I started researching the quality label owners. There are 12 companies from 7 European countries that have the EPAQ quality label. From these 12 companies Paroc is the only company of the 12 companies on that list that's clearly putting resources on burglary resistance of their products. (The quality label of the European Association for Panels and Profiles is called EPAQ 2015)

Aalto University and LHH consulting Oy AB Ltd from Finland has been part of EASIE project that was a European collaborative project. Mainz University of Applied Sciences and the Commission of the European Communities governed this project. (EASIE Final report 2011)

European Quality Assurance Association for Panels and Profiles was also a member of this project, the EASIE project begun in 2008 and ended in 2011 (Congresses and workshops 2015). EASIE is shortening for Ensuring Advancement of Sandwich Construction Through Innovation and Exploitation. This is a project that aimed for small and medium sized enterprises to make use of high-technology construction products focusing on sandwich technology and innovation. (EASIE Final report 2011)

In Germany there is also a University Institute; Mainz University of applied science that conduct research on sandwich elements. Institute of Innovative Structures is part of the Technik Hochschule Mainz and the Institutes carries out basic research and applied research in the area of sandwich technology. (Institutes of the School of Technology 2015) This institute was also a member of the EASIE project (EASIE Final report 2011).

Karlsruhe Institute of Technology combines the both the traditions of a University and a research institute (Mission Statement 2015). Karlsruhe Institute of Technology was part of the EASIE project and they do research in sandwich element technology (EASIE Final report 2011).

Information and reports about the EASIE project can be found at EPAQ home page.

European Quality Assurance Association for Panels and Profiles has since 2008 held an annual congress. In 2009 the congress was held in Helsinki, Finland (Congresses and workshops 2015).

4.3 EPAQ ordinary members

There are 94 ordinary members of EPAQ witch many are part of large global group's or divided into sub-companies by country (Ordinary members). There are large international corporations like ArcelorMittal, Tata Steel and Kingspan. Together these 3 corporations represent 69% of the ordinary members in EPAQ (Ordinary members).

There are two EPAQ ordinary members that offer burglary resistance products as part of the product specification and that represent a little over 2% of the ordinary members counting by the 94 members. This is counting ArcelorMittal, Tata Steel and Kingspan sub companies as single companies. The true present is higher as there are ordinary members that have products that are certified for burglary resistance but they don't advertise this as a future if the product in the specification. I came across some products that were tested for burglary resistance when I was researching certifications for burglary resistance construction products conducted by IFT Rosenheim and VTT Expert service. This could be because this has been a requirement for some project the product is used for.

In EPAQ research material burglary resistance is never brought forward as a necessary requirement for sandwich wall elements and this follows up through the ordinary members products and product information. For example, I now from researching Finnish burglary resistance sandwich products that Paroc Panel System have two products that are certified for burglary resistance. Paroc Panel System products AST-S & E are certified by the Burglary resistance standard SSF 1047, but they don't mention this as a future (Finanssialan keskusliitto, Rakenteellisen murto-suojauksen tuotteet 2017). Both certified products also have technical specification that is identical to other products in their product line up that don't have certi-

fication for burglary resistance (Paroc, AST-laatu sandwichelementeissä). This indicates that these products never were designed with burglary resistance as a crucial future. The Paroc burglary resistance sandwich wall elements were certified according to protection grade 2 and 3 in both Finland and Sweden (Finanssialan keskusliitto, Rakenteellisen murto-suojauksen tuotteet 2017). Paroc Panel System states that the company's products are manufactured according to EPAQ quality specifications (Paroc Panel System - Tietoja meistä, 15).

The Slovenian Company Trimo have 3 sandwich wall element products that are certified by the SSF 1047 standard. All 3 burglary resistance products have a class 2 certified. The Trimoterm Power S and Perform C products that has been tested for burglary resistance aren't designed differently than the other Trimoterm products Power T, Perform R and Sound R. (Trimoterm technical specification)

The burglary resistance standard certification is for one sandwich wall element product regardless with thickness the elements are. For example Trimos Trimoterm Power S sandwich wall element can be had 1 nine different thicknesses varying from 60mm to 240mm (Trimoterm technical specification). With the same product the thickness offers different fire resistance varying from EI60 to EI240 (Trimoterm technical specification). As mass effect fire resistance of these products it also affect burglary resistance of theme, 180mm different between the slimmest and the thickest product have an effect on the tool to use for breaking through the element.

Ruukki Oy has a large variety of sandwich wall element products, a total of 30 sandwich wall element products. Some of these products are multipurpose a can be used for façade wall, inner wall and ceiling (Ruukki Oy - Other panels for walls, roofs and ceilings). Sandwich wall elements for outer roof use are not multipurpose. Ruukki Oy has 3 burglary resistance sandwich wall element products. The Ruukki SPA E LIFE and SPA S are certified by the Swedish standard SSF 1047 and are approved by class 2 (Ruukki Oy - Sandwich panel SPA E LIFE / Ruukki Oy - Sandwich panel SPA S). Ruukki SPA F is also certified by SSF 1047 but approved for classes 2 and 3 (Ruukki Oy - Sandwich panel SPA F). All 3 products are available in thickness from 100mm to 230mm. All 3 products have an external metal sheet of 0,60mm thick and an inner sheet of 0,50mm thick. These 3 products that are certified for burglary resistance have the same basic design as the rest of Ruukki sandwich wall element products and for example the Ruukki product SP2D WE have the same specification as the 3 certified products but its not certified for burglary resistance (Ruukki Oy - Sandwich panel SP2D WE).

Ruukki has a wide sandwich wall element buildings reference list and their sandwich wall element products have been used for a wide variety of businesses. The list is impressive and Parocs Panel System, Trimo and Ruukki Oy sandwich wall elements products meet the requirements of the European standard SFS-EN 14509. Witch is the European standard for self-

supporting double skin metal faced insulating panels. (Paroc, AST-laatu sandwichelementeissä 2016) (Ruukki, sandwich paneelit 2016)

Because of product standardization, CE mark products don't differ much from company to company. The basic specification for these products doesn't depart that much between competitors from a specification point of view. The basic information is sub 1mm thick aluminium sheets with a thermo core and certification based on CE mark and CPR requirements.

One thing I noticed researching product specifications of different manufacturers was that many has public available documents on how to install their products. Part of the installation information available is how to cut out a hole for windows and doors in their products. EPAQ member Metecno, an Italian sandwich wall elements manufacturer have per sandwich element product an installation guide. In that guide they state, "difficult cutting in the middle of the panel may be done with a Trumpf panel cutter" and on "on site cutting can be done with jigsaw or portable circular saw. (Metecno - General installation instructions)

4.4 Sandwich wall element products made for protection

Researching certified construction products of EPAQ members I found sandwich wall element products that were specifically designed with burglary resistance in mind. Based on IFT Rosenheim certification there was some company's that stood out.

The German company Weiss-Chemie is one of the larger manufacturers of sandwich wall elements that aren't a member of EPAQ (Ordinary members). Weiss-Chemie has sandwich wall element products that are tested by the European standard EN 356 and their products are classified for all three burglary resistance levels. They have 3 products in the Cosmos Protect product range that have been certified for burglary protection. Cosmos Protect P6B and P8B products have 1,5mm thick aluminium cover sheets with special aluminium inlay (Weiss-Chemie - Cosmos Protect P6B / Weiss-Chemie - Cosmos Protect P8B). The third burglary resistance product from Weiss-Chemie is the Cosmos Protect P7B. Cosmos P7B has PVC cover panels with a thickness of 2mm and a middle layer of aluminium (Weiss-Chemie - Cosmos Protect P7B).

All Weiss-Chemie protect products have been tested by the European standard En 356 for burglary resistance and the test certification test was done by the German test facility IFT Rosenheim. (Burglary protection/impact resistant composite panels 2015)

In their words, impact resistance sandwich elements must be rated higher than impact resistance glass constructions. Sandwich panels that are of a higher protection grade do need to

be mounted on frames or constructions that offer the same or higher resistance to attacks as the panels do. (Burglary protection/impact resistant composite panels 2015)

Based on The Finance Finland report about certified burglary resistance wall building products from late 2017 there's one company, Gunnebo Nordic Ab that have sandwich wall elements products that are certified by the en 1627 (Finanssialan keskusliitto, Rakenteellisen murto-suojauksen tuotteet). The Swedish company Gunnebo offers a modular wall solution for extreme protection. The Gunnebo product City Wall is certified for resistance level RC4 by the European standard ENV 1627. The product is used for creating high security rooms and for example this product is used in ATMs installation spaces. The product is also certified by the European standard EN 1522 for ballistic resistance. The CityWall is made from electrogalvanized steel plates and insulated with mineral wool. (City Wall. 2015)

In the product information Gunnebo states that the when the wall is fitted with a door, the door must carry the corresponding accreditation in order to maintain the security level. (City Wall. 2015).

Like Weiss-Chemie, Gunnebo is neither a Member of the EPAQ and these modular walls are extreme compared to the facility wall material manufactured by EPAQ members (Ordinary members).

The German company Stadur, a manufacturer of sandwich wall elements for an international market. Stadur have a product named Sandwichelement Protec Intruder Protection. This product is much like the Weiss-Chemie Cosmos Protect products. There is three Stadur Sandwichelement Protec Intruder Protection products; FB-4 aluminium, FB-2 Laminated and FB-1 PVC. Stadurs Sandwichelement Protec Intruder Protection, products are tested by the German standard DIN 52290 for brake through resistance and this is the German standard for burglary resistance glass. The rating and test methods are the same as EN 356 and Stadurs Sandwichelement Protec Intruder Protection are certified to P6B level. (Stadur, Sandwichelement Protec Intruder Protection)

4.5 Standardization and regulation

On a European level there are three standardization organisations that are recognized by EU for defining and developing standards on a European level. The European Standards Organizations is the following organizations:

- European Committee for Standardization (CEN)
- European Committee for Electro technical Standardization (CENELEC)
- European Telecommunications Standards Institute (ETSI)

The EN marked standards are products of these three organizations. (Standards and Assessment Documents 2015)

The confirmed standards for Finland have the SFS marking in front of the EN marking and every European country has a personal marking (SFS, EN ja ISO 2015). There are European standards that have ENV mark instead of just EN; these are European pre-standards (Glossary 2015). The international standards bear the marking ISO and they are products of the International Organization for Standardization (About ISO 2015).

The main standard for factory made sandwich panels is EN 14509; a European standard for self-supporting double skin metal faced insulating panels that are to be used for roof, wall and external walls. This is a European standard, which is confirmed in Finland as SFS-EN 14509. It's a technical basis for factory made sandwich panels. (Quality Regulations for Sandwich Panels 2011)

The Finnish company VTT Expert Services Oy, a formally government owned institute conducts certification for building products such as sandwich elements (Certifications, VTT Oy. 2015). From their certification database we can see that they have done certification on the European standard SFS-EN 14509 for both Ruukki and Paroc (Find certificates 2015).

The SFS-EN 14509 is also the standard on which the European product quality label CE is granted to sandwich wall element products for the European market (Paroc elementeillä on CE merkintä 2016).

The European standard SFS-EN 1365; fire resistance test for loadbearing elements. Part one of this standard is for walls. There are sandwich elements that are loadbearing but not all are. One important factor of sandwich elements is the frame they are attached to, it plays a vital role in the resistance of the sandwich wall.

The Finance Finland report about certified burglary resistance products from late 2017 they clearly state that there are two standards for testing burglary resistance on façade wall. The two standards used for testing burglary resistance are the European standard ENV 1627 and the Scandinavia standard SSF 1047. (Finanssialan keskusliitto, Rakenteellisen murto-suojauksen tuotteet)

The European pre-standard SFS-ENV 1627 is one standard of a series; the other standards of that series are SFS-ENV 1628, SFS-ENV 1629 and SFS-ENV 1630 (SFS-EN 1627, 3). The SFS-ENV 1627-1630, Pedestrian door sets, windows, curtain walling, grilles and shutters. Burglar resistance:

- SFS-ENV 1627 - requirements and classification

- SFS-ENV 1628 - test method for the determination of resistance under static loading
- SFS-ENV 1629 - Test method for the determination of resistance under dynamic loading
- SFS-ENV 1630 - Test method for the determination of resistance to manual burglary attempts

SFS-ENV 1627-1630 should be considered as a package.

The Federation of Finnish Financial has guides or they could be called informal standards. The guides are basically combined information from different security and safety standards such as ENV 1627, SSF 1047, EN 356. The guides are created in collaboration between Finnish banks, insurance companies, financial funding companies, stockbrokers and asset management companies. (Perustietoa Finanssialan Keskusliitosta 2015)

The Federation of Finnish Financial structural burglary protection guide is divided in to three parts, Rakenteellinen murtosuojeluohje I, II, III. This guide is more of a technical guide for burglary alarm systems and physical protection of premises such as access control, locking mechanics and structural demands of doors, windows and facade. The information in the guides are based on European standards and applied to the Federation of Finnish Financial demands to create an equal level of protection from different standards. Their guides are public, free and can be found online on their site. (Rakenteellinen murtosuojeluohje 1 2011)

The main guideline for outer walls on premises is that the wall should be having such strength and building manners that it's not possible to penetrate without tools. The outer wall elements should not be removable from the outside without breaking it. These are basically the requirements for a burglary protection wall of class 1. (Rakenteellinen murtosuojeluohje 1 2011)

The Swedish standard SSF 1047, Inbrottsskyddande väggar krav och provning, which translates into burglary, protected walls, requirements and testing. This standard is often used by northern European certification facilities (Vår kunskap ger trygghet 2015). SSF stands for Svenska Stöldskyddsföreningen, which is a Swedish association that is specialized in security and safety (Vår kunskap ger trygghet 2015). The Standard ENV 1627 is also confirmed in Sweden and can be found as SS-EN 1627, the standard is a product of Swedish standard institute (SIS) (Standarder 2015). The Swedish standard SSF 1047 is close to the European standard ENV 1627-1630. Both Ruukki and Parocs sandwich wall elements that are tested for burglary resistance are tested by the Swedish standard SSF 1047 and the tests were conducted by VTT (Finanssialan keskusliitto, Rakenteellisen murtosuojauskeskuksen tuotteet 2017).

SBSC (Svensk Brand- och Säkerhetscertifiering AB) is a Swedish certification Institute that is specialized in fire and security certification (SBSC 2015). They have conducted certification for Paroc burglary resistance sandwich elements and as with VTT the test was based on the Swedish standard SSF 1047 and approved by Federation of Finnish Financial (Finanssialan Keskusliitto). (Appendix 4: Paroc Certificat)

Finnish Ministry of Finance, in Finnish Valtiovarainministeriö, has created a vahti guide that is public and can be found on the Internet. This guide is always evolving and there is a department that is continuously working on improving the Vahti environment and tools (Vahti-toiminta). In the 2013 business premises information security guide, in Finnish Toimitilojen tietoturvaohje, the fourth section of this document is dedicated to structural security requirements. In this section they state that external surface of a building cannot be removable from the outside. In the same section they state that an external surface should not be penetrated in less time than what is defined as the response time in the premise security documents. (Rakenteelliset turvallisuusvaatimukset 2013). Security requirements for facades materials and endurance are combined to what the building is used for. Vahti is of course based on standards and the standards used for wall structures are SSF 1047 (class 1-3) and SFS-ENV 1627 (class 2-4) (Määritelmät ja lyhenteet 2013).

The EN 356 is the European Standard for burglary resistance glass and it could be considered a collateral standard to the ENV 1627. The burglary prof qualifications are P6B, P7B and P8B. P5B and sub qualifications are for mischiefs. (SFS-EN 356)

The SFS-EN 1063 is a standard for bulletproof glass. The SFS-EN 1063 is not connected to any testing of sandwich wall elements of my finding and the only case where ballistic testing had occurred by my findings was with Gunnebos modular wall solution for extreme protection that I have mentioned in the earlier chapter Different solutions comparable to sandwich wall elements.

Laurea students (security management) Andreas Schneider and Jaakko Pesonen did their thesis about benchmark times of delay of for structural objects for TUREAN-analysis tool. In their research they tested different wall materials by the Swedish standard SSF 1047 or the European standard SFS-ENV 1627 (Schneider, A & Pesonen, J, 8). They used tools that are in line with the standards requirements (Schneider, A & Pesonen, J, 30). For SSF 1047 the burglar has five different tools available hammer, axe, crowbar, chisel and demolition tools (Schneider, A & Pesonen, J, 30). The interesting fact of their test is that a wooden wall was the only material to rise to different class but all tree wall materials was fairly close in penetration time. But the test only used tools that are applied by the standard and there are far better and more efficient tools for penetrating a wooden wall. But this is the case of all those materials and one very important point they make is that the test's generated a lot of noise. They

also wrote that a reinforced concrete that's over 200mm thick basically unharmed after 5min of work with tools applied from the standard (Schneider, A & Pesonen, J, 32). Based on Schnider & Pesonens research the EN 1627 and the SSF 1047 is possible to use these standards for testing burglary resistance of wall's built with different construction materials. The re-search conducted by Schneider and Pesonen also show a weakness of these standardization tests, restriction of tools used and the same tools are used regardless of the building material.

In Europe a construction product must also be CE approved and for sandwich wall elements that CE mark is obtained by certifying the product to the European standard EN 14509. Regulation for a CE mark determine that construction product is a product that is left as a permanent part on the construction object and that product has to be CE marked. Products that are used under the construction work but removed before the construction object is finalised is not considered a construction product. A CE marked construction product indicates that the product fulfils all the requirements for free movement on the European economic area. The products performance declared in CE market ensures that the product performance is defined by the same methods through out the European Union. It also ensures that the requirements for the manufacturers quality control and third-party supervision are the same through out the European Union. CE mark makes it easy to compare different products by different manufacturers to ensure you get the best product for your need. Tukes is the market surveillance authority for construction products in Finland. (Tukes, Construction products subject to CE marking)

The CPR is Shorten for Construction Products Regulation. It's a European regulation for marketing construction products on a European market. The regulation is for the consumer and provides technical information about construction products in a common language so the consumer is able to compare products from different manufacturers from different European countries. The regulation also ensures that technical information is available for the public, professional and authorities. (Construction Products Regulation)

Under the CPR there are 15 different acts and for most parts these acts are delegated regulation implementing different European standardizations to the CPR. And the most important delegated regulation for my research is the commission-delegated regulation 2016/364; on the classification of reaction to fire performance of construction products pursuant to regulation (Eu) No 305/2011 of the European Parliament and Council. The regulation is based on different ISO and EN standards regarding fire safety. (Commission Delegated regulation 2016/354)

Sandwich wall elements are there for regulated under CPR and CE mark for fire safety on the European market. The CPR and the CE mark have no demands on burglary resistance of construction material and the subject is in no way introduced in the regulations.

The Finnish company Inspecta Sertifiointi Oy conducts CE marking tests for building products based on the European Construction Products Regulation 305/2011 (Tuotesertifiointi 2015).

The Finnish law 954/2012, paragraph 3 determines that the capability of a construction product can be determined by either a technical approval, certification or in-process inspection. In paragraph 5 the Finnish law states that a technical approval is notified by a testing facility that conducts tests on technical abilities of the product, but in special cases the Ministry of the Environment Regulation can notify technical approval of a construction product. In paragraph 7 the Finnish law states that any company that produces construction product can apply for a technical approval of their product. For the application the company have to include a description of the product and description of the production of their product. The application should also include test reports, calculations, blueprints and other reports that prove the capability of the product. Paragraph 7 also states that to the description of the product the company should include instructions on how to install their product, how to use their product, how to maintain their product and also how to store their product. In the application there should be a notification of who conducts the test for the technical approval of their product. (Laki eräiden rakennustuotteiden tuotehyväksynnästä 2012)

As is stated in paragraph 7, companies are obligated to include instruction for their products and for sandwich wall elements there's one very important point here and that is installation of sandwich wall elements. As sandwich wall elements are not self supportive and need a sub frame for installation. And there for burglary resistance of sandwich wall elements is just a resistance measurement for one sheet as the burglary resistance for the whole wall is dependent also on the sub frame supporting the sandwich wall element wall.

The Finnish law contains a regulation by the Ministry of the Environment Regulation for product approvals for certain construction products. Paragraph 12 in the Finnish law 555/2013 contains demands for certain building and construction product control; self-supporting sandwich elements are combined with this decree. (Ympäristöministeriön asetus eräiden rakennustuotteiden tuotehyväksynnästä. 2013)

Jens Pickelmann from Itf Rosenheim stated in a conference speak about burglary resistance that even on a political level there's interest in making burglary resistance mandatory for components in Germany. In the same conference speak he also includes that installation of burglary resistance components in high efficient Sandwich walls is problematic but that manufacturers are working to find viable solution and obtaining suitable test evidence. (FT Rosenheim, Limit and opportunities in mechanical burglary resistance, 91)

5 Conclusion

From a building material point of view the sandwich wall element building technique is efficient and cost worthy. There are also a healthy amount of quality sandwich wall elements manufacturers on a European level. The competition in the sandwich wall element field, keeps the development, quality and innovation evolving. The large number of manufacturers also keeps the variety of products high for the customer.

From a burglary resistance point of view there's some main concerns regarding this building technique. As the building material and technique is made easier and consumer friendly. Giving the customer easy access to building guides and material information you also give this information to burglars. Companies have panel-wall assembly handbooks, guides public available. In these handbooks the company guide consumers on how to cut a hole in their sandwich wall panel products and what tools are needed for the job. (Metecno - General installation instructions)

One of the main goals for this research was to answer the question is there a further need for a second stage of this project based on the information from the background material. One of the main questions to answer in this research was at what stage the field is in on a European level. I focused on European field and is it governed by a head organization, the question was; is there a head organization in the field of sandwich wall element manufacturing and based on my research there's a head organization for manufacturers of sandwich wall elements on a European level. Based on my research in to the field on an European level I was able to conclude that the field is governed by EPAQ which is the European association for the manufactures of metal profiled sheets, sandwich elements and ancillary products and almost all the main big manufacturers in this field in Europe are part of this organization. Through my research I was able to conclude that the organization is active and has an annual conference every year in Europe. I was also able to show that the main Finnish manufacturers are members of this organization. The Finnish manufacturers Ruukki and Paroc also represent Finland in this association and both are also active members of this association and their employees are also members of different EPAQ committees.

One of the main concerns in the background material was that that there's not been done any research concerning burglary resistance of sandwich wall elements and it also state that researches on sandwich wall elements have not been effectively implemented in to company's research, development and innovation. For Finnish companies to be competitive on international level there's a need for research and experimental research in this field. The background material is partially right about there not been done any research on sandwich wall elements regarding burglary resistance. The fact is that I was not able to find any research on

sandwich wall elements where burglary resistance was the main focus. But manufacturers have adapted burglary resistance standardization to their products. The main problem is that traditionally a building's weakest point is the door or window, but with buildings built with sandwich wall elements this is not a certainty. The fact is that there is a possibility that the weakest point of a sandwich wall element building is actually the wall itself. From a standardization point of view this is not a problem as the weakest point determines how strong the burglary resistance of that building is. Sandwich wall elements aren't a traditional wall building technic, sandwich wall elements aren't self-supportive and need a sub frame to create a wall and therefore burglary resistance of a sandwich wall element wall can't be based on the resistance of a single element in that wall. And as Gunnebo states in the information about their product Gunnebo city, when the wall is fitted with a door, the door must carry the corresponding accreditation in order to maintain the security level. Or the other way around, a wall must carry the corresponding accreditation in order to maintain the security level. It's clear that the wall's weakest point measures the strength of the whole wall. In the product information Gunnebo states that when the wall is fitted with a door, the door must carry the corresponding accreditation in order to maintain the security level. As traditionally burglaries are carried out through a window, door or another abnormality in the façade. Burglary resistance is built on those assumptions and as this is the case, this is also the main approach when building and planning surveillance for a site. The main target of that surveillance system is to notice a burglary attempt as early as possible. The difference here is that when windows and doors on a traditional building may account for 20% - 30% of the façade, buildings built with sandwich wall elements that percentage is 100. So for buildings built with sandwich wall elements the approach on burglary resistance has to be done on an entirely different level than when done with a traditional building if that burglary resistance is a necessity.

The background material stated that there's a need for this kind of research for Finnish companies to be competitive on an international level. The statement is true and for Finnish companies to be competitive on an international level research and development is a must. Research and development should always be the main focus for companies. As EPAQ and EPAQ members aren't focusing on researching burglary resistance and prioritising product development on other parts it's fully understandable that burglary resistance isn't that high on the list of evolution of sandwich wall elements products. Finnish companies are on the frontline on development and research in their field on an international level and part of many EPAQ projects and researches. There's also clearly interest in adding burglary resistance in sandwich wall elements from some European companies and companies like Weiss-Chemie and Stadur have products that have been innovated with burglary resistance as main focus, these products differ from other products on the market. Also Pickelmann from IFT Rosenheim stating that there's interest in making burglary resistance mandatory for components in Germany.

As I through this research concluded fire safety of sandwich wall elements is part of the CPR and for burglary resistance to become a general part of sandwich wall product specification throughout the European manufacturers it need's to be done in this way.

From my research into the field of burglary resistance of sandwich wall elements it's clear that manufacturers are testing sandwich wall element products for burglary resistance and the tests are based on European burglary resistance standardization. There are manufacturers that have innovated new products with burglary resistance as a main specification and these products stand out, but these manufacturers are not part of EPAQ. EPAQ as an leading organization in the field of sandwich wall elements is also not actively supporting burglary resistance testing of products in their field and this can clearly be seen thru their ordinary members, as only 2% of their ordinary members that have products tested for burglary resistance.

I have through my research disclosed the question about a European head organization for the sandwich wall element field and showed that the main Finnish manufacturers in this field are active members of that organization. Standardization of burglary resistance regarding sandwich wall elements there is partially some truth in the background material. The problem with sandwich wall elements is what building material or technique to compare it to. Should it be compared to brick wall or a glass façade? From my research on standardization used by testing facilities for testing burglary resistance of sandwich wall elements, the tree main standardizations used for testing burglary resistance are ENV 1627, EN 356 and SSF 1047. Are the ENV 1627, SSF 1047 and EN 356 testing methods suitable for products like sandwich wall elements? Schneider and Pesonen didn't include the EN 356 in their research for wall strength. Standardization test facilities, testing sandwich wall elements included the En 356 into testing burglary resistance of sandwich wall elements indicating that manufacturers are implying sandwich wall elements to be more compared to light weight façade building materials such glass facades instead of comparing theme to a brick, wood or concrete wall. Glass façade are also comparable to sandwich wall elements, as they also need a sub frame for installation. And as with sandwich wall elements the glass wall façade burglary resistance is based on one glass element and not the wall as a whole.

When researching the EPAQ ordinary members I was able to confirm that the procreant for burglary resistance products are very low. Thought this is something that I noticed throughout researching EPAQ. Burglary resistance in the head organization on a European level is not on high demand and this can be seen throughout the ordinary members and their products. Earlier in the Standardization and regulation I quoted Jens Pickelmann from Itf Rosenheim, who in a conference speak about burglary resistance that there's interest on a political level in making burglary resistance mandatory for components in Germany. Companies like Gunnebo and Weiss-Chemie who are not members of the EPAQ have invested a lot in burglary resistance

and they clearly see a market place for that and these companies also promote burglary resistance as they introduce their sandwich wall element products. I restricted this research to EPAQ members only to obtain a consistent information basis and companies like Gunnebo and Weiss where an anomaly in this large field of manufacturers on the European market. But these companies show us that the development and products already exist. But EPAQ represents the major manufacturers on a European level and manufacturers that produce products for a global market and at the moment these major players in this field don't see a need for implementing burglary resistance to their products. The fact is that companies like Arce-lorMittal, Tata Steel and Kingspan represent 69% of EPAQ ordinary members and they have no product that they advertise as certified for burglary resistance.

Based on this research there are appeared many new questions that would need to be researched. One of the main concerns regarding burglary resistance standardization testing on sandwich wall elements is that the tools use are not up to date with these new products and what kind of tools that's available today for the public. The main problem I was faced with through my research is that the standardization used burglary resistance is mainly for evaluating the resistance of the facility's windows and doors. The EN 356 standard, higher resistance level; P6B, P7B and P8B are tested with sledgehammer and axe and the requirements vary from 31 to 71 blows. And manufacturers say the best tools for penetrating sandwich wall elements is by sawing. (SFS-EN 356)

Products like Ruukki SPA F which is certified by SSF 1047 for classes 2 and 3, have the same specification as the Ruukki SP2D WE, which is not certified for burglary resistance. This adds to the question is there a need for burglary resistance of these products as it's just down to testing and not about innovating new burglary resistance products like Weiss-Chemie or Stadur. Should burglary resistance be part of the CE mark, a step further from Jens Pickelmanns speak about making burglary resistance mandatory for components in German?

The question for further researches in this field should be, is there a suitable standard for testing burglary resistance of sandwich wall elements? This also supports the argument, that there's a need to update research methods regarding burglary resistance of sandwich wall elements.

From the background materials there was stated that there is no clear information about security and safety standardization on sandwich wall elements and that there's an urgent need to update the research methods regarding security and safety of sandwich wall elements. This argument is partly true. Products for the European market are certified with the CE mark and part of the CE mark is the CPR, which include fire safety of the products. This is a major safety certification that's part of the CE mark. Burglary resistance is clearly not a top priority for

EPAQ members as only 2% of the ordinary members have added burglary resistance certification to some of their products.

One future research on sandwich wall elements should be if there's a need for burglary resistance of sandwich wall elements. Manufacturers as Weiss-Chemie and Stadur seem to believe in the need for burglary resistance products and they have been innovative with products that differ from EPAQ member's burglary resistance products.

In the background material for this project there was a statement that there's not been done any research regarding burglary resistance of sandwich wall elements. Throughout my research I was not able to find research on burglary resistance of sandwich wall elements. Safty research include fire safty and sandwich wall elements have based on CPR been tested widly for fire safty and all manufacturers have fire resistance of their products in the product specification. But this is a requirement for the product to have the CE mark applied.

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Appendix 1: Background material, burglary resistance of sandwich wall elements.

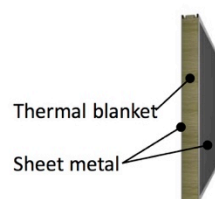
Seinäelementtirakenteen murtosuojaus

Laurea Ammattikorkeakoulu Oy
Hämeen Ammattikorkeakoulu Oy, Ohutlevykeskus

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Taustaa lyhyesti



Taustaa:

- Seinäelementtien T&K&I toiminta on tuottanut uusia tuoteinnovaatioita ja uusia tuotteita rakennusteollisuuden käyttöön.
- Seinäelementeillä tässä selvitystyössä tarkoitetaan ns. sandwich rakennetta
- Elementtien yleistyessä niiden murtosuojauksen merkitys korostunut.
- Murtosuojaus-ominaisuuden kehittäminen, uusien kustannustehokkaiden ratkaisujen tuotteistaminen ja testaaminen ovat kilpailukyvyn edellytyksiä myös kansainvälisillä markkinoilla.

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Nykytilanne:

- Seinäelementtirakenteiden turvallisuusstandardeista ja käytänteistä ei ole selvää kuvaa.
- Testausmenetelmät ja niiden nykyisiin tuotteisiin soveltuvat käytänteet vaativat päivityksen.
- Murtosuojaukseen liittyvää tutkimusta ei ole aktiivisesti tehty.
- Tutkimustyön tuloksia ei ole hyödynnetty suoraan yritysten T&K&I toimintaan.
- Suomalaisten seinäelementti ratkaisujen kilpailukyvyn vahvistamiseksi tarvitaan alan tutkimusta ja kokeellista testaamista.

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Seinäelementtirakenteen murtosuojaus selvitystyö

Kaksivaiheinen kehityshanke:

TOTEUTUS 1: LAUREA:

Tutkimus murtosuojauksen standardeista ja testausmenetelmistä

1) Turvallisuusvaatimukset

- Millaisia turvallisuusvaatimuksia seinäelementeille on olemassa?
- Selvitetään turvallisuusvaatimukset Euroopan tasolla.

2) Tuotevaatimukset liittyen murtosuojaukseen

- Mitä erityisiä vaatimuksia seinäelementtien rakenteelle ja toiminnalle on olemassa?

3) Testausmenetelmät

- Millaisia testausmenetelmiä on käytössä?
- Onko muita testausstandardeja kuin SSF 1047 standardi?
- Missä seinäelementtejä testataan ja kuka sertifioidi?

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Seinäelementtirakenteen murtosuojaus-kehityshanke

Alustavat:

- Aikataulu
 - Toteutus 1: 10/2015-12/2015
 - Toteutus 2 2/2016-8/2016

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Seinäelementtirakenteen murtosuojaus-kehityshanke

Toteutus 2: HAMK:

2) Tutkimushanke

Seinä-elementtirakenteiden kehittämisprojektit ja tuotekohtaiset uudet sovellukset.

- Tämä kohdistuu pääasiassa kansainvälisillä markkinoilla toimiville/sinne pyrkiville yrityksille
- Kehitysprojektit: Yritysten seinäelementtituotteille haetaan uusia ratkaisuja murtosuojaukseen liittyen mm. valmistuksellisuus ja kustannustehokkuus.
- Hyödynnetään mm. simulointia. Esimerkiksi teräsrakenteet ja levyn muovattavuus-simuloinnit.
- Soveltuvien osien, koostetaan ”Seinäelementtirakenteiden murtosuojaus”-materiaali.
- Testataan uudet rakenteet.

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Appendix 2: Ilta-Sanomat news article, outrageous thieves broke straight through the wall.
10.1.2015.

ILTA-SANOMAT

Harvinaisen röyhkeät varkaat iskivät: Tunkeutuivat suoraan seinän läpi



Yöllisen murron jäljet olivat aamulla näkyvissä Prisman parkkihallissa. Murtautajat pääsivät sisään kännykkämyymälään elementtiseinään tehdyn reiän kautta. (KUVA:)

Julkaistu: 10.1.2015 16:34

Lahden Launeen Prisman DNA-myymälästä varastettiin viime yönä arviolta 100 000 euron edestä kännyköitä, tabletteja ja muuta elektroniikkaa.

Asialla oli poliisin mukaan kolme henkilöä.

He tunkeutuivat DNA-myymälään röyhkeästi suoraan seinän läpi. Vorot tekivät Prisman parkkihallin elementtiseinään reiän ja pääsivät siten suoraan myymälään. Elementtiseinä on metallirakenteinen.

Rikoskomisario **Ville Hahl** <<http://www.iltasanomat.fi/haku/?search-term=Ville%20Hahl>> Hämeen poliisista kertoo, että vorot lastasivat tavarat isoihin kasseihin. Kassit olivat Hahlin mukaan niin sanottua lentokenttämallia, joiden toisessa päässä on pyörät ja joita vedetään toisesta päästä.

Kolmikko veti arvolastia kadun vartta pitkin kohti Lahden keskustaa. Hahl toivoo, että mahdolliset silminnäkijät ottaisivat yhteyttä Hämeen poliisiin Lahteen.

Appendix 3: Ilta-Sanomat news article, who broke through the wall at Hollola Expert. 23.11.2015.

ILTA-SANOMAT

Kuka murtautui Hollolan Expertiin seinän läpi? – ”Vaikuttaa ammattilaisten täsmäiskulta”



Varas on murtautunut viikonloppuna Hollolan Expert-myymälään seinän läpi. (KUVA: Lukijan kuva)

Julkaistu: 23.11.2015 11:07, Päivitetty: 23.11.2015 13:11

RIKOS Hollolassa sijaitsevaan Expertin myymälään murtauduttiin lauantain ja sunnuntain välisenä yönä. Poliisi pyytää havaintoja tapaukseen liittyen.

Tutkinnanjohtaja **Jari Kiiskinen** <<http://www.iltasanomat.fi/haku/?search-term=Jari%20Kiiskinen>> Hämeen poliisilaitokselta kertoo, että Hollolan Expert-kodinkoneliikkeessä on tapahtunut törkeä varkaus lauantain ja sunnuntain välisenä yönä.

Liikkeestä anastettiin poliisin mukaan myyntipakkauksissa olleita viihde-elektroniikkaa kymmenien tuhansien eurojen edestä.

Kiiskisellä ei ollut vielä maanantaiaamuna tietoa siitä, minkälaisella ajoneuvolla varas tai varkaat ovat olleet liikenteessä.

– Poliisi toivoo havaintoja tapauksesta, tutkinnanjohtaja toivoo.

Myymäläpäällikkö **Pekka Halme** <<http://www.iltasanomat.fi/haku/?search-term=Pekka%20Halme>> sanoo, että murto vaikuttaa olleen hyvin ammattimainen ja tarkkaan suunniteltu.