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# Harmonization of building regulations in the Nordic countries for wooden houses

Harmonisering av de nordiska träbyggreglerna

*Main report*





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# Foreword

This report is a descriptive compilation of regulations of the Nordic countries for wooden houses. The project is a part of “The Nordic Countries as one well-functioning market and an integrated region”, a project of the Nordic Innovation. The report is financed by Nordic Innovation, the Forum for Building Costs in Sweden and industries in Sweden, Norway and Denmark. The project went on during 2007 and was finished during 2008. The work is based on a questionnaire survey and on the comparison of standards and regulations.

I would like to thank all the participants who contributed to this project, especially those who answered surveys and those who attended meetings and commented on the material.

Skellefteå, September 2008

Anders Gustafsson



# Executive summary

**The purpose of the project:**

The purpose of the project is to strengthen the Nordic industry through the establishment similar and transparent regulations, so that with a minimum of technical "trade obstacles", the market can increase with the intention to further develop the construction of wooden houses. The aim is to compile a package of measures to accomplish a reduction of the differences in the current Nordic regulations that the industries experience as obstacles. The most important objective in this project has been:

- to list the most common obstacles based on experience from the industries
- to prioritize the obstacles
- to compare and analyse the background of the obstacles
- to recommend measures to avoid or remove the obstacles
- to compare Nordic standards and Nordic regulations
- to recommend new standards based on function

Included are regulations and requirements that create problems and extra work or costs in getting houses accepted by an authority or future proprietor in any participating country. Difficulties can occur, for example, with regard to sizes and dimensions, design of rooms and houses, building products or design rules.

**The study has achieved this aim by:**

- clarifying some of the differences between the countries based on information from the industry
- clarifying and comparing the differences in the building codes
- showing how important good communication is for harmonization of building regulations

**Method:**

The project was divided into three parts—Analysis of obstacles, Communication and Innovative Standardization. All three parts are important to attaining good understanding of the differences between the countries and providing good possibilities for future changes of the regulations.

Gathering information from the industry is included in the first part. We will find out the most important obstacles and problems experienced by the industries within exporting wooden houses/products in the Nordic countries.

Part 2 of the project includes a survey and description of ongoing work with development of digital information and communication systems in Nordic countries.

In Part 3, the different standards for wooden products and performance that are relevant for building permits and products have been studied and compared with the requirements in the Nordic building regulations.

## **Main results**

### ***Analysis of obstacles***

About 60 questionnaires have been sent to the wood housing industries and construction companies in order to get information about their problems. Different areas have been pointed out as most interesting to analyse: stairs, size and dimensions of specific rooms, energy, structural design and moisture protection in bathrooms. There are different types of requirements, formal and informal, that a manufacturer of wooden houses has to have knowledge about with regard, for example, to cultural differences, building regulations, and building regulations.

Just to compare and find adequate information can therefore be very time-consuming for the companies involved.

The obstacles are mostly caused by:

- small differences in the building codes
- small differences in building standards
- culture
- tradition
- lack of good information

### ***Communication***

Storing and communicating all common information about a building and its parts in a standardized format, accessible to all stakeholders and at all stages, can improve the building process. It requires competition between companies on equal terms, and in the long term, the entire industry in the Nordic countries will be a winner on the commitment to open collaboration and communication. Environmentally sound buildings are increasingly considered a necessity. In order to know the total environmental impact, there must be declarations and use of open standards, and IFD could use the same standard in the Nordic countries.

### ***Innovative standardization***

Standards for wooden products and performance are relevant for building permits. Product requirements have been analysed and compared with the Nordic building regulations. The basis for the contents of performance standards has been analysed.

### **The following conclusions can be drawn from the results of the study**

- The interviews and questionnaires show there is a need for more cooperation between the countries to avoid and eliminate obstacles. Small differences can have great importance for manufactures.
- Most of the differences have no bearing on the quality of the house, and most likely, the end user have to pay more for the product.
- When it comes to information, most of the companies seem to have difficulties finding relevant information in an easy way.

### **Recommendation for continued work:**

- Establish a “Nordic Building Harmonization Task Group” whose purpose will be to investigate and make recommendations as follows:
  - Compare and make recommendations regarding new regulations and standards.
  - Coordinate and collate a common “lowest” standard for different sizes, values and other requirements that are presented from the Nordic countries.
  - Give third-party recommendations where opinions differ.
- Establish a common database for the building regulations in the Nordic countries. One of the biggest problems for industries that are interested for exporting is the lack of relevant information. Building regulations in all countries are complex, and at present, there is no efficient way to obtain good information. Sharing information is critical to gaining knowledge about other countries’ regulations.



# Summary in Swedish

Norden är en marknad ett invånarantal på drygt 21miljoner. För de nordiska länderna är den europeiska marknaden en viktig del för exporterande industri. Norden är kunnig inom området träbygg och har stora möjligheter att exportera både kunskap och produkter inom träbyggområdet.

Stora initialkostnader och fasta kostnader för (svenska) trähusproducenter kräver en stor och jämn avsättning, vilket är svårt att som helhet uppnå på den inhemska marknaden. Ett inslag av export bedöms av många aktörer som avgörande för att uppnå de önskade volymerna som tryggar en fortsatt utveckling av branschen i Norden. Detta försvåras av att bygg- och transportregler inte är harmoniserade mellan de europeiska länderna.

Trots detta utgör export av trähus en mindre del av ländernas exportindustri. Ett av de hinder för ökad export och större gemensamma marknader som kan urskiljas är att byggande i andra marknader än hemmamarknaden innebär ökad risk i form av ökad antal okända faktorer. Export av trähus är komplex, och byggande omgärdas av ett stort antal regler. Genom att samordna reglerna inom Norden kan bättre förutsättningar skapas för att gemensamt bearbeta hela Europa. Större marknader ger även möjlighet till större volymer för hustillverkare, som därmed kan rationalisera sin process, vilket ger i slutänden möjligheter för kunden att få lägre boendekostnader.

Syftet med denna rapport är att utreda en del av de hinder som finns för trähusbyggande inom Norden. Frågorna gäller byggbranschen i allmänhet, men inriktningen har varit mot, i första hand, trähusbyggande. Underlaget grundas på ett tjugotal enkätsvar från exporterande företag i Norden. De viktigaste målen för projektet har varit:

- lista och prioritera vilka hinder som upplevs som mest resurskrävande
- analys och jämförelse av hinder
- ge rekommendationer för att ta bort eller undvika framtida hinder
- jämförelse mellan ländernas krav och standarder

Projektet har delats in i tre delprojekt: Analys av hinder, Kommunikation och Innovativa standarder. Alla tre delar är viktiga för att få en god insikt i möjligheten att påverka och ta bort tekniska gränshinder inom byggandet.

Från frågeformulär som sänts till träkomponent- och trähustillverkare har ett antal tekniska hinder analyserats. De hinder som framkommit har baserats på skillnader i byggregler, olika ställda krav, kulturella skillnader och brist på information. Några av dessa hinder är

- fritt mått i dörröppningar
- korridorbredder
- mått i badrum
- sättstegens höjd i trappor
- vattentäta skikt i våtrum
- energiberäkningar

Kommunikation och tillgång till information viktiga delar för en väl fungerande byggprocess. Etablering på nya marknader kräver god kunskap kring de regler och förutsättningar som gäller för avsedd marknad. Byggandet omgärdas av en mängd regler och restriktioner. Även om ett stort antal tekniska hinder kan undanröjas kommer det alltid att finnas specifika regler för, till exempel, snölast, vindlast, etc.

Byggregler är till en stor del funktionsbaserade, med få detaljkrav på utförande. Kraven är vanligtvis redovisade som råd och anvisningar. Vägledningar till föreskrifter har olika omfattningar och status i de nordiska länderna. Standardisering är ett medel till att harmonisera byggnadsreglementet som har kommit relativt långt på materialnivå, men icke för sammansatta produkter.

## **Följande slutsatser har framkommit i projektet**

I intervjuer och frågeformulär visas på ett behov av mera samarbete över gränserna och att små skillnader har stor betydelse för trähustillverkarna. De flesta skillnaderna har ingen större påverkan på byggnadens kvalitet, och troligen innebär skillnaderna en merkostnad för slutkunden. Företagen har svårt att finna relevant information för nya marknader

De skillnader som framkommit i undersökningen kan delas in i två grupper, det som kan åtgärdas på kort tid och det som kräver längre tids samarbete och eventuellt fortsatt forsknings- eller utvecklingsarbete.

På relativ kort tid anses följande kunna göras:

- Utveckla standardiserade märkningssystem med inklusive ländernas krav.
- Fortsatt samverkan av test- och utvärderingsmetoder.
- Standardisering och godkännande av beräkningshjälpmedel (mjukvara).

För att undvika och avlägsna hinder föreslås följande åtgärder:

- Etablera en nordisk grupp som kan bearbeta befintliga hinder och godkänna/samordna framtida regelverk inklusive krav och vars arbetsområden bör vara:
  - jämförelse och rekommendationer för nya tillkommande krav/regler
  - ställa samman och utvärdera lägst möjliga krav
  - tredjepartutlåtande vid meningsskiljaktigheter
- Etablera en gemensam databas där tekniska skiljaktigheter kan noteras.

Mycket arbete har lagts ner under lång tid på harmoniseringar inom Europa (t ex i framtagandet av Eurocoderna), men många insatser återstår. En stor del av detta arbete har en lång horisont innan effekter nås. Att verkligen åstadkomma en harmonisering av Nordiska och övriga Europeiska länders byggregler är en långsiktig ansats som bör drivas politiskt. Statliga initiativ tycks vara det instrument som är bäst lämpade för detta.

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# 1 Introduction

## 1.1 *Nordic project*

This project was initiated by the timber industry because of the problems experienced in cross-border trade in the Nordic region. The project was limited to buildings based on wood components and was managed from an industrial perspective on the basis of relevant priority areas of the industries. The project was based on the Nordic construction industry in general and on the timber industry in particular.

The Nordic countries traditionally use a lot of wood for small residential houses, but in recent years, wood has also been used for larger apartment buildings. Wood has a great importance for employment and the economy in the Nordic region. Wood is a lightweight material, and the houses are thus suitable for being manufactured in factories and transported to building sites. Many European countries wish to increase the use of wood. National building regulations, however, complicate the trade in houses even in the Nordic region. With all the Nordic countries as one home market, the industry can be strengthened, which can create a basis for increased exports also to the rest of Europe.

Building regulations in the Nordic countries are mostly performance based, with few detailed requirements. Detailed instructions are mostly included as advice that can be followed to achieve the performance required. Complaints from the wood industry about the building regulations include measurement requirements, the design of housing, construction methods, products for buildings and computation and design rules. Many of the differences lead to increased production costs and thus increased housing costs.

This final report has been compiled by the project manager in cooperation with other participants in the project. Dissemination of results has also been done by industry associations and participating companies and through seminars and articles.

## 1.2 *Background*

The transformation of the wood manufacturing industries from local suppliers of finished products to creators of concepts establishes conditions for new companies and company groups. However, the ability of companies to adjust to new markets can take time and generate high costs. It is therefore important to make it easier for the industries to address larger markets. By removing obstacles such as differences in the building regulations and by making it easier for the industry to reach a larger market, productivity can be increased and provide opportunities for the development of new, innovative and nonstandard products. Considered over a longer period, the simplifications will also reduce the costs for houses.

The Nordic wood industry can take the initiative and influence building with wood in Europe. The Nordic countries have a common tradition, and therefore have good potential to promote wooden building in Europe. This can create a larger market for wooden houses, but differences in the building regulations complicate the sale of complete houses and building components even in the Nordic region. This project was initiated by the industry because of the problems experienced in cross-border trade within the Nordic region. Large fixed costs for timber companies entail a need for large and steady sales. Exports may benefit from increased production, which will safeguard the development of the Nordic timber industry. Larger markets give higher volume and efficiency, resulting in greater profitability and increased opportunities to affect neighbouring markets. In addition to the market in the EU, coordination of the Nordic timber industry will create opportunities to influence and increase the use of wood in construction in Russia as well.

There are differences in the building regulations on many levels (process, functional, and material requirements). Differences may be due to climatic differences (rain and wind), tradition, culture (construction methods), educational level, management of construction law, state and local political management and lobbying from businesses and organizations. A difference in the ways the Nordic countries administer the law is also one of the challenges the industry must deal with if it is to operate in the Nordic countries. This may include enterprise authentication, authorization of the measures and products with inspections and checks. The development of the

building industry must also comply with the requirements of digital solutions and opportunities for effective communication between different actors in the construction process.

Planning and building laws that form the basis for building regulations and standards in the Nordic countries are associated with the EU Construction Products Directive. Guides and recommendations to the regulations have varying importance in the Nordic countries. Standardization is a means of harmonizing construction. In the wood industry, and for construction products, the standardizations have come a long way at the material level, but for complex products, there are no common solutions.

Industrialized wood construction systems have been discussed in various contexts as a possibility to increase efficiency in the building sector. Within the wood sector, a few companies have managed to become complete suppliers of both services and products. There are good prospects that new knowledge will increase the current use of the Nordic applications in wooden structures on the European market. This could be of great benefit to the impact of the forthcoming European design standard (Eurocode) and ensure the competitiveness of Nordic wood and timber technology.

This project has many themes common to other projects under the sponsorship of the Nordic Council of Ministers, with the same goal: a "borderless region" in the Nordic and Baltic region, *i.e.*, the development of a stronger "Baltic Sea Region" within the EU. The Nordic cooperation project on building industries also has projects dealing with building legislation in both the Nordic countries and in the Baltic countries and Poland. The projects are about rules and frameworks for the construction industry. This applies to rules for building permits and control, as well as to taxes, labour, insurance, warranties, *etc.* But they have a somewhat different perspective; they have an overall perspective on the legislation, initiated by the authorities, and have a regulatory perspective. This present project takes the opposite perspective. It is based on specific and detailed requirements and possible obstacles to achieve an overall objective. It is initiated by the industry and has a trade-policy perspective, closely related to the timber industry.

Nordic Innnovation has also financed a project about the European harmonization of fire testing of construction products. Variations in the timing of changes and various choices of specific regulations also entail a reduced movement of goods and services for the market. An improved Nordic consensus is therefore essential and also increases opportunities for the Nordic countries to affect the further development of the European rules. The objectives of the project are to harmonize the choice of classes and the strategy of fire safety of building products in the Nordic countries in collaboration with industry and the authorities. It will also identify areas with particular relevance for the Nordic countries in the development of EU-harmonized fire rules.

Another Nordic project concerning fire is "Fire Safe wooden houses" that was started in the mid 1990s in order to exploit the new possibilities for higher wooden houses in practical construction, which, among other things, in 1999 led to the first version of the Nordic manual "Fire Safe wooden houses" /1/. The handbook provides practical advice on how to design and produce fire-safe timber houses and is used by architects and designers throughout the Nordic region. Many new methods of fire-testing and classification have been added during the 2000s. These are introduced gradually in the legislation. The project to make a new version of the manual is still going on.

Other projects in Europe have dealt with building regulations or the conditions for the development of the wood industry. In the Netherlands, projects have been implemented that compared building regulations in eight countries in Europe, as presented in two reports in 2002 /2/ and 2003 /3/. Building permits and controls, as well as technical requirements for buildings, were investigated. Some deviations from other countries were found in the Dutch regulatory structure and technical requirements, such as for fire, burglary, availability and the housing areas. At the EU level a 'Study to evaluate the Internal Market and competitiveness effects of Council directive 89/106/EEC' was started (2006-2007) with the goal to evaluate the Building Products Directive's significance for trade in the EU and for competition in the EU building sector (producers and builders), especially smaller businesses, as well as to establish the strengths and weaknesses of the directive and suggest improvements. "Roadmap 2010 for the European wood working industries" was an activity with visions that wood would be a leading material in the production of buildings and interiors, construction and interiors by 2010. It was found that in reality, it is mostly the material independent rules that restrict the use of wood.

A harmonization of the various rules and practices can greatly simplify matters for the construction industry and increase incentives for prefabrication. By "standardization" of the safety factors, deformation requirements, design principles, *etc.*, access to a wider market can be improved. Such a harmonization offers not only great efficiencies in production, but would also lead to a reduction in the amount of errors and a reduction of the costs for design, preparation and construction permits, while promoting higher quality. A reduction of the total costs for buildings will also provide for lower housing costs, although lower production costs do not necessarily directly lead to lower housing costs. Increased use of wood for buildings can also contribute to a sustainable community development and towards increased economization of resources and reduced environmental impact in the Nordic region.

In 2005, TCN (WoodCenter North) financed a feasibility study of the problems that one timber company experienced in the export of houses to the other Nordic countries. The result was that the building rules, recommendations and guidance on technical requirements for buildings and products contain differences. That

performance-based requirements and prescriptive requirements are mixed. The conclusion was that the harmonization of the building regulations must be made jointly at a Nordic level. That was the background and start for this project.

### *1.3 Scope and objectives*

The objective of the project is to strengthen the Nordic wood industry through similar and transparent regulations, so that with a minimum of technical "trade obstacles", the market can increase with the intention of further developing the building of wooden houses. The aim is to compile a package of measures bring about a reduction of the differences in the current Nordic regulations, which the industries experience as obstacles.

The project aims to simplify for the Nordic wood industries through similar, transparent regulations and a bigger market for wooden houses. This would be done by contributing to the harmonization of building regulations in the Nordic countries, so that the timber houses can be exported or moved to other Nordic countries without modifications, which will affect housing costs positively. This applies primarily to residential design, wooden structures and building products. The primary objective of the project is to compile an action plan for removing the obstacles that the industry experience with the Nordic design rules. The project will analyze the design requirements that apply to wooden buildings in the Nordic countries, and the goal is to improve the arguments for harmonization. This will be a basis for further efforts to push for a harmonization in the Nordic region.

The project will also support the process of integrating the Eurocode in the different countries. The harmonization of building regulations in the Nordic countries can continuously contribute to the harmonization of rules across Europe. The project deals primarily with the Nordic region, but it is obviously based on the ongoing evolution of a common Europe. The project can strengthen the Nordic consensus within the construction field in terms of building regulations and standards. This may strengthen the Nordic positions for the work in the EU and in international forums.

The project addresses the Nordic authorities, timber manufacturers, material producers and planners and the participating companies.

### *1.4 Organization and methods*

The project is divided into three subprojects: analysis of obstacles, communication solutions and innovative standardization.

#### **1.4.1 Analysis of obstacles**

Gathering input from the industry is included in the first part, where the project has analyzed obstacles and problems experienced by the industry related to the export of wooden houses and products. The information was compiled and analyzed in order to produce a proposal for a package of measures. Included in the project are regulations and requirements that create problems and extra work or costs to get houses accepted by an authority or future proprietor in any of the participating countries. This can, for example, relate to sizes and dimensions, design of rooms and houses, building products or design rules. This part was managed from Sweden.

#### **1.4.2 Communication solutions**

This part of the project included a survey and description of the ongoing work of developing digital information and communication systems in the Nordic countries (and partly EU). The aim was to clarify the principles of the systems, the implemented communication standards and their compatibility and how well they describe the properties and functions of building products. The intention was to analyze whether the development of these systems contributes to conserving, removing or creating new trade obstacles, and the importance for various users was evaluated. This part was managed from Norway.

#### **1.4.3 Innovative standardization**

In this part, the product standards and performance standards for wood products that are relevant for building permits were studied and compared to the requirements in the Nordic building regulations. The basis for the contents of performance standards was analyzed. Proposals for a Nordic organization of the standardization work will complement the survey in part 1. This part was managed from Denmark.



## 2 Building regulations in the Nordic countries

### 2.1 *Compilation of building regulations*

Planning and building laws that form the basis for building standards in the Nordic countries have their basis in Sweden, Norway, Finland and Denmark from the EC's Construction Products Directive. The legislation is updated continuously, and revisions of building regulations are made frequently in order to take advantage of new knowledge, products and designs, changing economic and social conditions, or new construction products or methods that engender new requirements. The laws are mostly performance based and have few detailed requirements.

Building regulations are often considered a barrier to performance, innovation and trade. Performance-based building regulations mean that the basis of building activities should be the performance of the building in use rather than a prescription of how the building should be constructed. Many countries in Europe have implemented performance regulations. Many countries mix performance-based regulations with some prescriptive ones. In countries that have shifted their regulations to performance, there is also often still a significant dependence on traditional solutions. This is probably related to the convenience of working with current methods, and sometimes to lack of technology in some areas. For that reason, international cooperation and information sharing across borders is important in determining areas in need of research, both for policy and technical problems. There may be a need to merge performance requirements with prescriptive ones, as performance requirements often require greater efforts by the building professionals to demonstrate compliance. A lot of work is involved in verifying that new materials or methods comply with the performance-based regulations. In order to verify compliance, there must be a way to measure performance. Energy conservation and thermal comfort are often performance based, but fire protection usually has many prescriptive regulations.

Some areas in the Nordic countries have chosen performance-based regulations, and some have chosen more prescriptive ones. This complicates a comparison of the regulations. Often it is also difficult to disregard an advice or guidance, especially in terms of requirements for dimensions and layout.

In the case of building control, inspections and responsibility for the building procedure, there is also a difference between the countries, but that has not been specifically studied in this project. For more information about laws and building permits in each country, see also /5/ and /6/.

Building regulations in the Nordic countries consist of laws, regulations and recommendations. In Sweden, for example, there are laws adopted by parliament after a bill decision by the government, regulations adopted by the government without parliamentary participation, and regulations and recommendations decided by an authority, for example Boverket. Boverket is a national authority in Sweden on community planning, urban development, construction and housing that notifies on rules for the implementation of laws and regulations, such as BBR and BKR.

#### **Sweden**

- PBL, Planning and Building Act (1987:10),
- PBF, Planning and Building Ordinance (1987:383),
- BVL, Act (1994:847) on Technical Requirements for Construction Works, etc.
- BVF, Ordinance (1994:1215) on Technical Requirements for Construction Works, etc.
- (BFS 2006:12)
- BBR, Building Regulations, Boverket, (Regelsamling för byggande), 2008
- BKR, Structural Design Rules of the National Board of Housing, Building and Planning, (Regelsamling för konstruktion), (t.o.m. BFS 2003:6)

**Finland**

- Markanvändnings- och bygglagen 2000 (132/1999)
- Markanvändnings- och byggförordningen (895/1999)
- Finlands byggbestämmelsesamling A-G, funktionskrav, föreskrifter och anvisningar

**Norway**

- Plan- og bygningsloven
- Forskrift om krav til byggverk og produkter til byggverk (TEK), 97-07-01, 2007
- REN TEKNISK 1997, Veiledning til teknisk forskrift til plan- og bygningsloven 4. 2007
- Husbanken
- The Norwegian "Byggforskserien" (Byggdetaljblad, Planløsninger og Byggforvaltning) gives instructions, solutions and recommendations for design, construction and management of buildings and other construction work.

**Denmark**

- Lov om planlægning, LBK nr 883 af 18/08/2004
- Lov om byggelov, LBK nr 452 af 24/06/1998
- Bygningsreglement 2008

### 3 Analysis of obstacles

The objective of the project is to compile an action plan for a number of issues that could lead to the reduction of barriers and simplify rules in the Nordic region. The result of the project will describe improvements in the short term or long term. All problems cannot be investigated and answered in this project; the goal was to find some obstacles as a priority to work for removing the barriers.

#### 3.1 Compilation of experienced trade obstacles

The approach to the first subproject, “Analysis of Obstacles”, was to capture problems in the industries and based on the difficulties that arise in the daily activities and businesses. A questionnaire was sent out to companies in which they were consulted about their problems. They were also asked to estimate the influence of the obstacles. The questionnaire was designed to capture all possible issues that might be relevant to the project. It was sent to companies in the project and to others deemed engaged and interested responding. Information on the project was also spread through organizations and through an Internet site.

The companies completed the questionnaire so that their problems could be included in the project. They were urged to refer to rules or requirements that cause problems and extra work and costs to get the houses approved and accepted by authorities or clients in another Nordic country. The questionnaire contained the following questions that were to be answered for each of the problems experienced:

- Obstacles/disparities/problems between the countries?
- Which countries are concerned, and what is the difference?
- Extra work?
- What costs are affected, how much?
- Other comments?

Table 1. Results from the questionnaire

| Type of obstacle                                                       | Number of companies (%) | Estimated cost*        |
|------------------------------------------------------------------------|-------------------------|------------------------|
| Fire                                                                   | 15                      | Medium                 |
| Damp, wet areas, walls                                                 | 55                      | Small                  |
| Accessibility, rooms, bathrooms, disabled                              | 45                      | Small                  |
| Railing heights, risers in stairs                                      | 30                      | Small                  |
| Eurocode 5, design, static calculations                                | 45                      | Large                  |
| Snow zones for design calculations                                     | 30                      | Medium                 |
| Design calculations, roof trusses, roof joints, roof sheathing         | 55                      | Medium or small        |
| Thermal insulation, energy calculations, calculating the heating needs | 55                      | Large, medium or small |
| Sealing windows/plates, air barriers                                   | 30                      | Medium                 |
| Roof security, facade ladder                                           | 15                      | Small                  |
| Dimensions, calculations of areas (BOA), etc.                          | 30                      | Small                  |
| Transports, vehicle lengths                                            | 30                      | Medium                 |
| Product type approvals                                                 | 15                      | -                      |
| Material properties                                                    | 15                      | -                      |
| Building permits, construction process, the architect's role           | 30                      | Small                  |
| Occupational safety                                                    | 15                      | -                      |

\* Small ≤ 2000 SEK (200 €), Medium = 2000–10000 SEK (200–1000 €), Large ≥ 10000 SEK (1000 €)

The results from the questionnaire are compiled in Table 1. Rules and regulations that affect the wooden house companies apply in particular to plan dimensions in the design of housing, computation and design rules, as well as products for buildings. The work concentrated on issues regarding moisture, accessibility, design, roofs and energy.

### 3.2 Design and accessibility

Due to varying dimension requirements for houses and rooms, the housing companies have different layouts for otherwise similar houses in Sweden, Norway, Denmark and Finland. Dimension requirements affect the layout and the positions of walls or doors and are limitations in terms of architecture as well. The wood industry considers that a Nordic house that meets all the requirements of the Nordic countries would not be a good solution. It will result in a poor layout as well as increased costs.

The dimensions of housing studied:

- Dimensions at the entrances/halls
- Door width
- Corridor width
- Dimensions of bathrooms/toilet rooms

#### 3.2.1 Dimensions at entrances/halls

Accessibility at entrances may include access roads to the entrance, spaces outside the entrance, the entrance opening dimensions and spaces inside the entrance. The rules may also have different requirements for entrances for different floors of a building and different requirements for accessibility to rooms for different floors in a dwelling.

In Denmark, buildings shall generally ensure access for all, with an entrance directly from the outside or through a common passage from the outside. People in wheelchairs should be able to get around to all units and lifts in a building. All passages must be of sufficient width for the intended use. The clear width must be at least 1.3 m. For residential single-family houses, the municipal building board can ignore the requirements if the house is built by the owner for his own use, or when there are specific terrain conditions.

In Finland, the dimensions of residential houses are described in part G1 of the building regulations, but they also refer to part F2 for common buildings in terms of ramps, stairs and railings, *etc.* Access roads and paths to houses should be suitable for the disabled. For single-family houses, the connection from the border of the plot to the dwelling entrance, including the entrance, should be built to be suitable for the disabled if the terrain and elevation make this possible.

In Norway, access to the main entrance, or one of several entrances, should be easy to find, easy to use, without obstacles and with an overall guidance for disabled persons for residential buildings with a common entrance for more than 4 apartments. If it is necessary for the assumed use of the building, the municipality can require accessibility for disabled persons. For residential buildings where this is not required, it must still be shown how such access can be carried out later. "Husbanken" has the following requirements: Beyond minimum standards for house dimensions, there should be free passage and turning space for wheelchairs. At the entrance it is accepted that a cabinet is replaced with a hallway rack to provide space at the side of the door, and turning space can be up to 30 cm under the rack.

In Sweden, at least one entrance to a building should be accessible to disabled persons. For homes with direct entrance from ground level, the requirement is met if a ramp can be arranged afterwards by simple measures. Entrances and communication areas to be used by disabled persons must have enough room for a wheelchair so that people in wheelchairs can move around without help. An advice refers to a Swedish standard of general measurements for residential design "SS 91 42 21 Building Design - Housing - Interior Dimensions". Inside the entrance, there should be space to reverse the wheelchair partly under the hallway shelf. The dimensions are 1100 mm + 600 mm (shelf). The wheelchair turning circle is 1300 mm. The basis of the rules is the dimensions of wheelchairs and how people move. In the Swedish standard, there are two levels of wheelchairs, normal level and improved level (see Figure 1). Normal level indicates dimensions needed for accessibility and usability in housing when a manual or small electric wheelchair is used, and they contribute to minimum requirements of the building rules. Improved level may not be required by authorities. This level involves improvement of access for people with disabilities that use an electric wheelchair for limited outdoor use or need the help of other people.

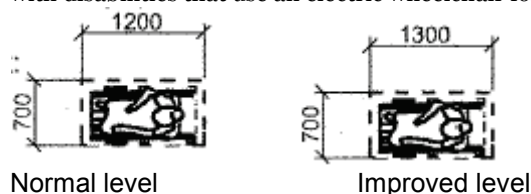


Figure 1. Dimensions of wheelchairs according to Swedish standard.

### 3.2.2 Door width

Building regulations for accessibility at doors cover free measurements for different types of doors and opening conditions. Height measurements of door thresholds are sometimes also specified. Finland has the highest requirements for door width, 800 mm, which was introduced in 2005. In Sweden, a publication, "Construction catch up with Disabilities", includes recommendations on the door widths and recommendations on wider doors than in the rules. For house manufacturers, wider doors mean that house plans must be modified, that the available space decreases with larger doors (doors require opening space) and that additional costs are entailed. For manufacturers with automated production, the entire fabrication process is influenced by changes of length of wall studs, wallboards, etc.

In Denmark, doors of a common access must have a clear opening of at least 0.77 m according to Danish standard "DS 1028 Inner enfløjede doors". When opening the door in the direction of the person, there must be at least 0.5 m at side of the door opposite the hinged side. Doors of access to dwellings must have a minimum width of 0.77 m.

In Finland, doors and passages from the entrance door to rooms in the apartment and other spaces that are necessary to serve the housing must have a clear width of at least 800 mm.

In Norway, doors in the areas of housing that are designed for disabled persons must have a width such that regular wheelchairs can pass with good and secure clearance to the frame and door leaf. Other doors to rooms for permanent residence shall have a width such that normal transport in relation to the function of the room can pass comfortably, with sufficient clearance to the frame and door leaf. In advisements, there are some measurements. Door widths are given as modules, where  $M = 0.10$  m, and refer to the outer frame dimensions. The following doors should have at least 10 M and be usable by the disabled: doors at the entrance to the building, doors for communication paths, corridors, etc., and entrances into apartments. Doors should be at least 9 M to all rooms that a wheelchair user may need access to. Door placement that prevents sufficient opening conditions is not appropriate. The housing should have at least one door to the living room, kitchen, bedroom, and bathroom/toilet that is at least 9 M. "Husbanken" has detailed accessibility requirements as prerequisites for providing loans for housing. Wheelchair users must be able to open/close and pass all doors. Doors should have a free opening of at least 80 cm.

In Sweden, the doors shall be designed to allow the passage of a wheelchair and so that there is enough space to open and close the door from a wheelchair.

### 3.2.3 Corridor width

Corridor width is based on making it possible to turn a wheelchair. It is influenced by openings and doors along the corridor and by whether the corridor bends. For the same total living space, wider corridors can give smaller rooms in the same layout, and this also affects the whole house production.

In Denmark, halls, corridors and similar entrance spaces shall be designed in such a way that their full width can be crossed unhindered. The regulations are met with a clear width of at least 1.0 m in the corridor. If there is a door or cupboard doors in the sides of the corridor, the width should be increased by at least 0.3 m to 1.3 m. A larger clear width increases comfort and ease of use.

In Finland, doors and passages from the apartment door to the rooms and other spaces should have a clear width of at least 800 mm. The same also applies to doors and passageways of the building and courtyard areas that are necessary and serve housing, such as closet, bathroom and sauna in the dwelling and multi-storey houses and storage areas for furniture, baby carriages and recreational gear.

In Norway, there are no measurement requirements for corridor width, but 1400 mm applies if one wants additional loans from Husbanken.

The general recommendation refers to the standard of measurements for residential design "SS 91 42 21 Building Design - Housing - Interior Dimensions (normal level)". For the normal level, according to the standard, a straight passage between the walls should be 1100 mm wide and with a door should be 1,200 mm in width with a passage that will bend 90 degrees. Generally, for all buildings, the communications facilities should have a clear width of at least 1.30 meters, but at limited obstacles, such as pillars, have a clear width of at least 0.80 meters.

### 3.2.4 Dimensions of bathrooms/toilet rooms

The rules for accessibility of bathroom/toilet room require sufficient space for a wheelchair or other technical means and space for a helper. The idea is to be able to roll in a wheelchair next to the toilet and lift the occupant from the chair. Different designs and sizes of bathrooms give rise to similar problems as for various door and corridor dimensions, which leads to more expensive production when the number of variations increases.

In Denmark, the dwellings on the entrance floor shall have at least one toilet room with free entry level and with an appropriate structure and size. There should be a washstand in the toilet room.

In Finland, for people who are using a wheelchair or wheeled gear, there must be a sufficient number of toilets and washrooms with appropriate size and equipment both for self-use and for use together with an assistant. To such spaces there must be direct access from the entrance hall, corridor or similar space. If the intention is that the person in a wheelchair should be able to move to the toilet from any side, there must be at either side of the toilet at least 800 mm clear width for a wheelchair or wheeled gear. The inner dimension of the wall with washstand should be at least 2500 mm, and the wall with the toilet should be at least 2200 mm. The toilet seat back should be 300 mm free from the wall.

In Norway, buildings with permanent activities should have enough toilets. Housing should be planned and designed so that it is easy to fit a toilet that can be used by the disabled. For apartment buildings, the municipality can decide how many flats that this requirement should apply to. In every apartment building, it is enough that 1/10 can be used for disabled persons. This does not apply in cases where it is understood that several or all apartments are useful for disabled persons.

In Sweden, the general recommendation refers to the standard of measurement for housing design, "SS 91 42 21 Building Design - Housing - Interior Dimensions". The minimum dimensions of a bathroom in the standard are mostly used in student housing. Normally there should be an opportunity for people in wheelchairs to visit the toilet, and after a conversion, also space for a helper. The Work Environment Authority typically recommends a clearance of at least 0.8 m on the side of a toilet.

### 3.2.5 Summary

On a European level, the "European concept for accessibility" includes some guidelines for dimensions of rooms and doors, but on a quite moderate level. The Nordic countries all have generally higher standards of accessibility to buildings. Housing requirements are often somewhat lower than for public buildings such as schools, workplaces, *etc.* In some cases, the requirement is only that it should be simple to change a home in order to use a wheelchair indoors. Building laws and standards are written as performance-based requirements and do not include many descriptive requirements and recommendations, so it is often difficult to know the requirements. For the independent movement of the disabled, there is a need for sufficient passage widths and turning surfaces and no level differences.

The dimension of the door width is based on the necessity for wheelchairs to be able to get through the door in a safe manner. Door width depends on the spaces behind, above and next to the door. In Sweden, free clearances are 760 mm at 90-degree opening of the door, 770 mm clearance in Denmark and 800 mm clearance in Finland. The dimensions of the corridor width are based on wheelchairs being able to get through in a safe and efficient manner. The requirement for corridor width is 1.3 m in Denmark. It assumes that a wheelchair can be turned, and it is assumed to be a reasonable demand compared with other European countries. In Sweden, the requirement is 1200 mm in a dwelling, and the assumption that it will be possible for a wheelchair to swing 90 degrees in order to get through a doorway along the corridor.

Requirements of the regulations are mainly performance based. Some measurements are given, but mostly as recommendations. Reference is made to national standards and building descriptions with detailed dimensions. Differences in rules may be due to different assumptions about types of wheelchairs or the separation of public buildings and private residences to different degrees in various countries. The disabled may also have different major influence, and authorities may have different policy regarding the construction of smaller, cheaper apartments on the basis of economic and environmental goals. The recommended dimensions are often compromises between the demands of the disabled for large spaces for mobility with wheelchairs and economic demands for the minimization of the residential area.

There is no real reason why there should be different dimension requirements or practices, assuming the same types of wheelchairs. Since wheelchairs are manufactured to international standards, there should be comparable dimensions. Therefore, the same space should be required to use a wheelchair in all countries. It is a political issue, where the balancing of different requirements for a good home should be done. What may affect this balance is the funding, which for example in Norway has some higher requirements when it comes to getting loans from Husbanken.

The proposal is the creation of a group from the Nordic countries to review regulations and recommendations with a view to making them equal and to continuously discuss changes in the national building regulations and consult with the other countries. The authorities need resources in order to prioritize this. The result would be the elimination of unmotivated differences so that the same layout can be used in all Nordic countries.

### 3.3 Stairs

Due to different requirements for the risers of stairs, there have to be different numbers of steps in a staircase, and therefore the stairs also need different areas in the plane. This affects the layout of houses, and the house companies must have several stairs in the stockroom, which increases the management cost of ordering and inventory.

In Denmark, the requirements for stairs are essentially performance-based requirements, but measurement requirements are stated in step dimensions for common evacuation passages. In other places, the stairs should be designed for the intended use and fitted with rails so that they are safe, especially for children. The measurement requirements for stairs are that riser and tread width for a staircase in a common passage may be up to 180 mm and 280 mm, respectively. Handrails must be placed at the height of about 0.8 m on both sides of the stairs in evacuation areas.

In Finland, the regulations specify recommendations on the type of stairs and gaps in the stairs. Moreover, regulations indicate step dimensions and where they should be measured in the staircase and the dimensions of railings. The following values are defined for use in stairs. For normal step rhythm, appropriate design according to the formula  $2h + d = 630$  mm, and the outer stairs up to 660 mm. There is a table for riser and tread width with recommendations for various types of stairs. Between rooms, riser  $\leq 190$  mm and tread width  $\leq 250$  mm. Indoor stair riser  $\leq 180$  mm and tread width  $\leq 270$  mm, outdoor stair riser under roof  $\leq 160$  mm and tread width  $\leq 300$  mm, outdoor stair riser without a roof  $\leq 130$  mm and tread width  $\leq 300$  mm.

In Norway, recommendations contain the following dimensions that should be used for the stairs. Stair width should be 0.8 m of housing, 1.0 m of the main staircase and 0.9 m for the other. Riser down to an external stairwell, 120–160 mm. Tread width should be at least 0.25 m, can be 0.15 m in internal line of a curved staircase, but in an evacuation route at least 0.2 m. Stair slope down to pitch angle of 30–36 degrees for an interior staircase and 17–30 degrees for an exterior staircase. The stair formula 2 risers + 1 width of tread = 620 mm  $\pm$  20 mm is used to give the appropriate steps in the staircase.

In Sweden, free height of stairs shall be at least 2.0 m. The general recommendations indicate that the design of stairs should consider the staircase inclination and length and the dimension relationship between the riser and the tread width. Staircase slope should not be changed within the same staircase. The following values are defined for the stairs. Tread width of stairs should be at least 0.25 m.

#### 3.3.1 Summary

On a European level, the “European concept for accessibility” includes some guidelines for stairs. There is also a European harmonized standard ETAG 008 – Prefabricated stair kits. Requirements for stairs are based on safety aspects for the users. One should be able to walk without tripping, one should not fall from the stairs and children should not be able to find themselves trapped.

For stairways in housing, the requirements are mainly performance based and conform well between the countries, with the objective that the stairs should be safe to use. Some differences occur, however. Finland has requirements for the openings in a stairway. For other countries, there are recommendations or instructions for such measures. All countries except Denmark require a banister or railing for stairways higher than 0.5 m. Finland also has requirements on the handrail height and when a guard should be used and how high it should be. For other countries, there are recommendations for such measures.

Recommendations and instructions for stairs vary between countries. Different measurements are given, probably depending on what was regarded most important. Many factors affect the safety of a staircase; for example, riser and design of the stairs, storey height, free height and width, location and design of railings and banisters, coatings and lighting at the stairs. In Sweden, there are several dimensions specified for openings in rails so that no child is harmed. In Finland, some of these are so important that they are included as requirements. For step dimensions, there is not much advice in Sweden, while in Finland, there are detailed recommendations. Finland and Norway refer to the staircase formula to obtain a good staircase.

Requirements for the measurements of the stairs can be based on evacuation opportunities in the event of fire, space to carry out a stretcher, the possibilities for carrying furniture in the stairs, space for normal use of stairs and avoidance of accidents, mainly for children. Actually, there are no conflicting requirements for stairs; the performance requires a secure and usable staircase. But in practice, instructions and “practices” are difficult to avoid. Recommendations for stairs in the building standards and views should be coordinated. There is no reason, for example, that Swedes and Finns should take different strides in a staircase. Coordination ought to take place between the countries by a working group processing the existing differences and constructing solutions.

### 3.4 Moisture

In bathrooms, a high relative humidity can be expected. This causes a high vapour pressure in the bathroom and, consequently, diffusion of moisture through walls. For constructions that are part of the building envelope, it is necessary to take safety measures to avoid moisture inside the structure, which is normally accomplished by the use of a vapour barrier. The combination of a vapour barrier with a watertight membrane in the bathroom wall can cause problems. The wall construction in bathrooms must also be able to resist ordinary mechanical loads from persons and furniture without deformations that damage the watertightness. For the wood house industry, the differences involved in the choice of whether or not to keep the outer vapour barrier give rise to difficulties with different wall designs. In addition, different requirements for product approval for bathrooms necessitate changes and variations in design.

In Denmark, traditionally, bathrooms have been made from heavy inorganic materials such as masonry and concrete clad with ceramic tiles. The use of light-weight bathrooms has been allowed during the last thirty years. In order to use light-weight bathroom constructions, documentation must be available, for example, from testing and subsequent approval. For light-weight constructions, the requirements are expressed as stricter rules regarding strength and stability in order to ensure they are strong and stiff enough to prevent damage to the watertight membrane. Today, watertightness of a light-weight construction can be achieved in several ways, and the most common is a watertight membrane (in fluid form) on the underlay normally protected by a wearing surface, most often tiles. Some years ago, prefabricated membranes were preferred in Denmark because there were many problems with fluid-applied membranes. This led to a requirement of a minimum 1-mm thickness of the fluid applied membranes. A prefabricated membrane has a well-defined thickness, but may cause problems with the joints, especially in the corners, while a fluid-applied membrane has no problems with joints, but may cause problems if the thickness is too low. MK approvals are approvals by “By- og Boligministeriet” of materials and structures and are issued for materials, waterproofing systems or specific floors or walls. They follow the text of building codes that certain products for bathrooms will be approved. The approvals are made on the basis of functional tests and subsequent assessments.

In Finland, the building regulations declare that water-resistant materials should be used for structures subjected to water. Information on approvals of building materials and products is also included in the Finnish regulations. If the design has two layers of materials with poor moisture permeability, no materials that require the possibility of drying should be left between them if there are no special arrangements for the moisture to escape. The building should be designed so that risk of water penetration between layers of dense materials is small. Water-vapour permeability and air leakage in the outside walls and its various layers and structures must be such that the moisture content of the wall will not be harmful. Water entering the wall from the surface or the inside must be able to dissipate without causing injury or health risk. An indication of acceptable solutions is that the water vapour and air leakage should be secured by installation of material layers that act as barriers against water vapour, air and wind. Water-vapour resistance of the material layer located on the warm side of the thermal insulation must be at least five times as high as the water-vapour resistance of the layer located on the cold side. Otherwise, a separate water-vapour resistant material layer on the warm side of the thermal insulation should be added. Exceptions can be made if experience or testing have been able to demonstrate that the design is moisture safe.

In Norway, the building regulations state that floors, walls and ceilings exposed to water in wet areas should be constructed using moisture-resistant surfaces. The underlying design should be protected with a waterproof layer. Materials should be chosen so that the risk of mould and fungus is minimal. The walls and ceilings must therefore have an air- and moisture-resistant layer, normally a separate vapour-resistant layer, on the warm side of the insulation. On the outside of the insulation, there must be a wind-barrier layer, which should be moisture permeable. The building will then have a self-drying ability. For wet areas, moisture-sensitive material should not be used, and the material's moisture resistance should be documented. “Byggebransjens våtromsnorm” (BVN) is used for design of wet areas to ensure waterproof, durable bathrooms in accordance with advice, guidelines, instructions and regulations as well as details in “Byggforskserien”. BVN is based on the construction industry's own knowledge and experience. BVN is voluntary, but is used to ensure that wet areas are built in accordance with the requirements of building regulations or even better. BVN is updated regularly.

In Sweden, the purpose of the rules is to limit the amount of moisture in the structures and facilities of buildings so that they will not be damaged by moisture. In BBR from 2006, two new property requirements were introduced: water vapour resistance and durability towards alkalinity. The rules of BBR require a maximum moisture condition for materials used in buildings. It is based on a critical moisture state of the materials and methods of use and is determined to reduce the risk of growth of mould and bacteria on and in the material. If there are no other data, then a relative humidity (RH) of 75% is the critical value. This is a new requirement. If moisture-sensitive materials are placed between two dense materials, such as between a water-vapour-proof layer and a waterproof layer, it is recommended to verify that the maximum moisture condition of the material is not exceeded. Water-vapour resistance (Z) of the waterproof layer should be greater than  $10^6$  s/m unless a moisture-protection design calculation shows that lower Z can be used. In addition to the rules of BBR, the industry has developed many industry standards for materials and workmanship. The rules deal with water resistance and waterproof finishes. The organizations have developed approved systems. Examples of the trade organizations are “Byggherkerådet” (BKR) and “Golvbranschens våtrumskontroll” (GVK). “Branschregler för Våtrum” (BBV) from BKR states in the latest rules that cardboard-coated plasterboard should no longer be used in bathroom walls.

### 3.4.1 Summary

Tiles are the most common surface material in bathrooms. The number of moisture-related problems has increased in recent years. This may be due to new materials and material combinations with new qualities and to changes in behaviour such as taking more showers. Problems with watertightness are mainly due to lack of a watertight membrane or to poor detailing. Builders often choose themselves how the design will be solved, but almost all work is carried out in accordance with industry rules from national organizations.

In Norway and Sweden, there have been problems with mould and fungus growth on cardboard-coated plasterboard. In Sweden, there are no specific construction rules as to how the walls should be constructed at wet areas. Problems with stud walls protected against moisture with a vapour barrier, in combination with the watertight layer in bathrooms, have been investigated during recent years. The risk is that moisture or humidity that penetrates through the membrane is trapped between the two impermeable layers without possibility to dissipate. This can lead to accumulation of moisture and ensuing severe damage. Sometimes the ordinary vapour barrier is therefore left out and replaced by the watertight membrane, but the recommendations differ between the countries.

Due to earlier problems with gypsum boards, now special “wet-room boards” with a higher density and silicone-impregnated gypsum are used, or gypsum boards as fibre reinforced boards without carton. Also moisture-proof materials, such as cement panels, which are not so easily attacked by mould, are used. Documentation of bathroom materials must be available, for example, from testing and subsequent approval. National test procedures are now being replaced by European harmonized standards by EOTA, but the requirements will still be national.

The climate in the Nordic countries is relatively equal, and the wall structures should therefore behave in the same way in all these countries. Material qualities and behaviour (such as the number of showers) should also be similar, so that the same requirements for products and designs could be used. Building regulations and advice in all the Nordic countries require waterproof layers and have requirements for the underlying structure. The instructions are recommended values for, for example, water-vapour permeability. These technical requirements should be discussed jointly to maintain the same level. Detailed instructions for designs usually meet the requirements issued mainly by professional organizations in each country. The recommendations of organizations also need to be coordinated.

A European standard is in the pipeline that will form the basis for CE marking of wet-room products according to a European Technical Approval (ETAG 022). It will replace some of the national standards, but not all, and the requirements will still remain national. ETAG 022, Watertight covering kits for wet room floors and or walls will include three parts: Part 1—Liquid Applied Coverings with or without wearing surface, 20 July 2007; Part 2—Flexible sheets; and Part 3— Kits of inherently watertight boards including jointing bands.

## 3.5 Energy

The timber industry has raised issues concerning the U values, insulation and energy and heating calculations. Requirements for U values vary. Sweden places greater demands on the U value than does Norway. Energy calculation is increasingly recognized as the total energy calculation for the whole house. Finland does not include hot water in the calculations. Using an air-to-air heat pump that recycles heat in the air to radiator water and hot water this will result in different calculations. In Sweden, loose-fill loft insulation is approved, but it is not approved in Finland. It takes longer on the site to install blanket insulation, which raises construction cost. Heating-estimate calculations and calculation of U value for the floors to crawl space give rise to problems.

Energy use is a major environmental issue for society, because all energy production entails environmental emissions. In particular, the emission of greenhouse gases such as carbon dioxide should be avoided. Society requires reduced energy use in buildings and a switch to renewable energy sources. An EU directive of 2002 on buildings was introduced to reduce energy use in new construction. New energy regulations are in place in all the Nordic countries. Different approaches and methods and differences as to what should be included give a complex overall picture. The energy requirements for houses affect the construction surfaces, wall, ceiling and floor thicknesses, the use of materials, window and door design and number and installations of heating and ventilation.

For the wood house industry, energy calculations with respect to different types of energy and input parameters can yield different thicknesses of wall insulation. This causes increased work for the industry to handle. Increased wall insulation also provides less living space for the same total building area, or alternatively greater building area for the same living space. The size of window surfaces may also be affected. The uncertainty of how to count becomes too great; calculation programs are not standardized, and no normal input data are available. There are many different computer programs on the market today to deal with energy calculations. Many are general and calculate power and energy, but some programs are specialized in different aspects of an energy calculation. The input of data often requires skilled users to take into account various factors, such as solar radiation, different zones, installation, technical components and control functions, which provide relatively complex programs. The difficulties with obtaining reliable energy calculations are many, as many parameters interact. Moreover, results are affected by the residents' habits, such as current temperature, hot-water usage and washing frequency.

Within the energy sector, big changes are afoot. The EU Directive aims to lower energy use in buildings, and the same goal applies on the national level as well. The Nordic countries are at various stages in the transition to requirements with regard to total energy usage in the house, instead of requirements on individual construction elements. Calculation of total energy usage requires calculation programs and input data, and coordination between the Nordic countries in this area seems not to be a priority. This can lead to new problems and obstacles for the industry. Secondly, it can lead to the need for custom-made calculation programs for each country and to different requirements for insulation thickness in walls and floors and different requirements for windows.

Energy requirements for buildings are largely determined by political decisions. Energy consumption, the amount of electrical energy available and access to alternative sources of energy vary between countries and between localities, which could affect the requirements. This is probably difficult to harmonize. The introduction of new calculation rules can be harmonized. The results of the introduction of the energy directive in the European countries should be continuously monitored. It would be reasonable that the Nordic countries jointly go through them every five years and coordinate their requirements and standards for the calculations and values. Some standardization of the computer programs would also be desirable.

### 3.6 Design calculations

The industries have raised questions especially about snow loads and roof design and execution. Snow loads are described in the building regulations and standards for different snow zones of the country. Based on weather statistics, relatively accurate snow-zone maps have been developed.

Differences in geographical or climatic conditions (*e.g.*, wind or snow) have been taken into account by providing choices in the Eurocodes for identified values to be determined at the national level (called Nationally Determined Parameters), thus allowing the States to choose the level of safety, including aspects of durability and economy, applicable to works in their territory. At the borders between zones, the values can differ. The snow maps have been updated and harmonized previous to the implementation of the Eurocodes. Locally, some differences occur particularly between Sweden and Norway in the high mountains. There can be large local variations in the actual amount of snow, but also the sizes of zones influence what values that have been chosen for the maps. Some differences will always exist, but they have been reduced by the new snow zones. The problem is difficult to remove if the snow maps are not highly detailed.

Another problem is how to calculate prefabricated roof trusses. There are many software programs for this. Some are national, and some are tailored to specific nail plates. Earlier, there have been tested and approved programs. Since the introduction of harmonized standards and CE marking, there are no longer approvals of prefabricated roof truss programs. However, in Sweden, previously, the P-marked prefabricated roof trusses met certain requirements beyond the CE mark. With regard to design, there are national differences in how to assess bending moment and E-modulus to be used. Calculation accuracy can also vary between calculations so that there will be somewhat different results. Some programs use a simplified calculation model. There are also differences in the calculation of loads. According to Eurocodes, it is possible to impose some national values. The national annexes with optional values are not entirely finished and published yet. A coordination of national values of snow loads and load combinations as well as values for material strength would be desirable in the Nordic region.

2008–2010 is a conversion period for design calculations between the use of "old" national regulations or standards and the use of the new Eurocodes and related national appendices (EC+NA). Member countries of the EU and EFTA have adopted the Eurocodes to be a reference material for compliance with the requirements of the Construction Products Directive. It will also support design calculations and design of constructions and support the harmonization of technical specifications for building products. Each country has a right to complement the Eurocodes with a National Annex, NA, which should only contain information about the national choices, such as values on partial safety factors where alternatives are possible in Eurocode, national methods where alternative methods are possible in Eurocode, country-specific data (geographical, climate, *etc.*), adoption of informative parts specified in Eurocode and use of nonconflicting references.

For the design of a wooden structure, there are a number of parameters that affect the outcome. Some factors can be chosen by each country and are presented in the National Annexes. These factors are:

- Partial factors to take into account the loads and self weights,  $g_d, g_c$
- Loads and load combination factors,  $\psi_0, \psi_1, \psi_2$
- Material factors,  $\gamma_M$

The Eurocode also allow each country to choose the security level for a design. The Nordic countries have chosen different methods to achieve the desired level of security.

Table 2. Examples of security/reliability levels/classes\*

|                  | Denmark $\gamma_d$ | Finland KFI | Norway $k_L$ | Sweden $\gamma_d$ |
|------------------|--------------------|-------------|--------------|-------------------|
| Security level 1 | 0.83               | 1.1         | 0.8–0.9      | 0.83              |
| Security level 2 | 0.91               | 1.0         | 0.9–1.0      | 0.91              |
| Security level 3 | 1.0                | 0.9         |              | 1.0               |

\* Listed tables are only small excerpts from each country's standards and not always the latest version and should not be considered complete.

In determining the design value of a material property from the characteristic value, the design value is defined as:

$$X_d = \frac{k_{\text{mod}} X_K}{\gamma_M}$$

where

$\gamma_M$  is partial factor for material property

$k_{\text{mod}}$  is conversion factor to take into account the load duration and design moisture content.

$\gamma_M$  and  $k_{\text{mod}}$  can both be chosen on a national basis.

Table 3. Examples of recommended partial factors for material  $\gamma_M$ 

| Materials/load comb. | Eurocode 5 | Denmark*        | Finland  | Norway | Sweden** |
|----------------------|------------|-----------------|----------|--------|----------|
| Wood                 | 1.3        | 1.35 $\gamma_3$ | 1.4      | 1.3    | 1.3      |
| Glulam               | 1.25       | 1.30 $\gamma_3$ | 1.2      | 1.25   | 1.3      |
| Joints               | 1.3        | 1.35 $\gamma_3$ | 1.2, 1.4 | 1.3    | 1.1      |

\*  $\gamma_3$  takes into account the product's production control. At site construction with normal control,  $\gamma_3=1.0$ . For elements manufactured in a factory deemed to apply control,  $\gamma_3=0.95$ .

\*\* If less distribution in material properties can be identified,  $\gamma_M$  for wood and wood-based materials can be equal to 1.2

### 3.7 Future development

The building regulations are documents that are changed and improved and adapted to new materials and designs continuously. A large part of recent changes are due to EU directives on, for example, building products and energy. The Nordic countries are obliged to implement these directives in their rules. Product standards and calculation standards (Eurocodes) must be introduced in the building regulations.

Collaboration is lacking, however, so that these directives are not introduced in the same way. The timing of changes in the national rules is not coordinated either. This causes problems for the industry when in the transition to new rules it must adjust its methods or houses only for one country for the time being, and later for another country. Much of the standardization work will probably continue to be carried out within the EU, and it is important to alter the national rules so that they become adapted to the Nordic conditions, but also that the Nordic countries can cooperate with the introduction of rules in their national building regulations.



## 4 Communication solutions

IFC is an acronym for "Industry Foundation Classes". It can best be explained as an object-oriented file format with a data model developed by IAI (International Alliance for Interoperability). The purpose is better interaction and communication in the building industry. IFC describes objects with geometric representations and properties with unique identities. It facilitates the control that technical solutions fulfil the functional requirements. The format is typically used to define and exchange Building Information Models ("BIM"). The key point is that the model specification for IFC is open, neutral and freely available. It is also important that the file format is designed such that it can be read and understood by humans. This makes it easier to implement and ensure quality than if the format had been binary. There are many software programs that support the IFC. Examples are MagiCAD, Tekla Structures, Vector Works (via a "plug-in"), Archicad, Bentley Architecture, DDS-CAD, and Autodesk Revit and AutoCAD.

IFD stands for "International Framework for Dictionaries", and is a supplement to IFC. The purpose of the IFD library is to provide semantic understanding. By using the IFD, for example, it is possible to look up a building component in a building information model and translate the properties that component has from Swedish to English, Finnish, Danish and Icelandic. Another example is that the use of IFD can add definitions of environmental properties in the product databases, so that contractors that handle the products have opportunities to compare features of products from multiple vendors in different countries. A Norwegian does not need to know what a property is called in Swedish, Finnish, Danish and Icelandic to investigate whether product providers in those countries have products that meet that property. He can simply use Norwegian to tell the computer to search, and using the IFD library can keep the databases in other Nordic countries responding.

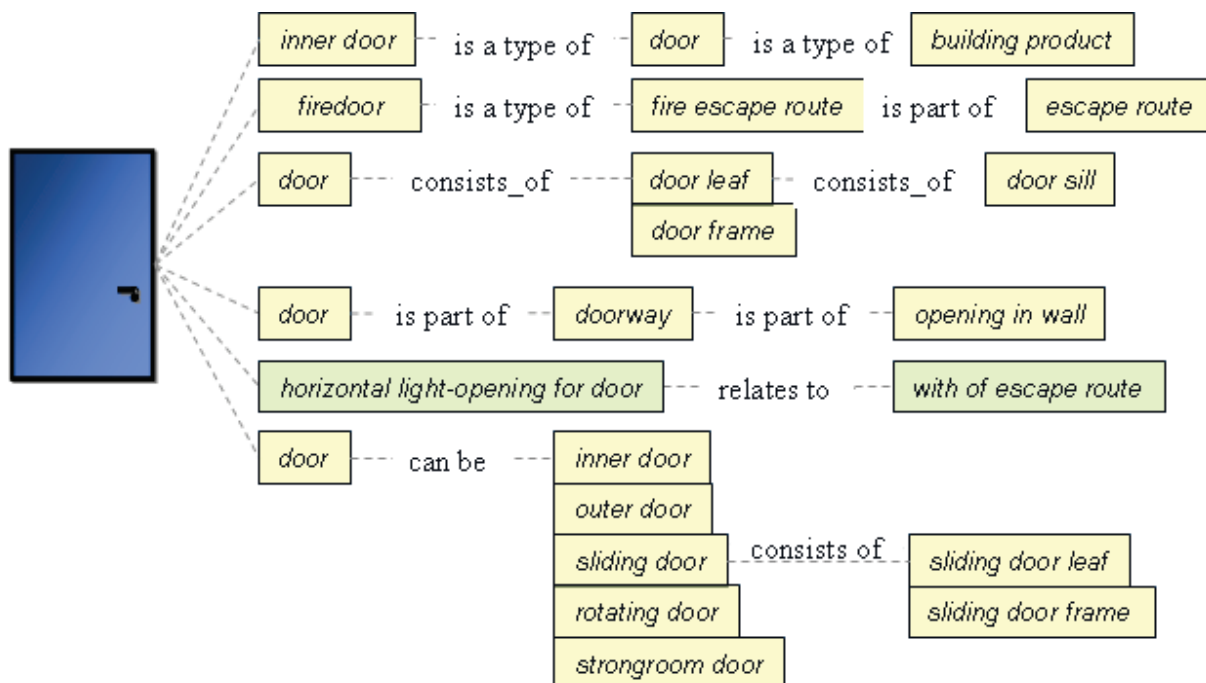


Figure 2. IFD defines a concept not only by its name and description, but it also relates to other concepts that are defined in the IFD. The figure was made by Lars Bjørkhaug and Eric Bell and is taken from the wiki page "IFD in a nutshell."

IDM stands for "Information Delivery Manual". The purpose of IDM is to capture and enable integration of the business process, as it explains in detail what information an actor must exchange with another actor in the

building process. IDM consists of a process map, the exchange requirements and the functional parts. In addition to this, IDM is also essential to determining what information should be in BIMs at different times.

A process map describes the overall process in the light of a specific role (for example, cost calculation, energy analysis or structural calculations). It must be emphasized that it is not intended to model the full process in detail, but rather to create a process model referenced or adjusted in relation to national, internal company or internal project needs. An important part of a process map is "switches". These explain what decisions need to be taken depending on the information received at specified times.

An exchange requirement describes the information needed in the business process, in addition to which information is provided as a result. Each exchange requirement is referred to in one or more process map.

The purpose of a functional part is to describe a specific part of information within an exchange requirement. To share a building model, one must first model walls, windows, doors, roofs, *etc.* in a functional part. In this case, it is possible to reuse a functional part in multiple exchange requirements. While an exchange requirement describes the information in a nontechnical way, a functional part describes the use of each entity, each property/feature set that is involved. A functional part may consist of other functional parts.

Can the increased use of the new open standards lead to increased trade within the Nordic countries? Increased use of open standards can make the world (and the Nordic countries) both smaller and larger at the same time. The importance of the geographical distances, differences in language and different rules will be less.

New opportunities for manufacturers, suppliers and buyers of building materials can be the result. The trend is that IFC and, eventually, IFD will be used more both for buying and for production. The requirements and properties to be satisfied by construction materials can be described in a standardized way with IFD. Product providers that support IFD can add the unique information about their products on the Internet. Thus, the search for items that meet certain criteria can be more efficient than it is today. There is reason to believe that this will lead to greater competition wherein comparisons are made quality, cost and possible delivery security. Differences in language are less important since the definitions that are created with the IFD are unique.

Can the actors in the Nordic countries grow large together? Each of the Nordic countries is small in the European context. But in sum, they are a large region. There are major differences between the Nordic countries, but there is also much that is in common: geographical proximity, similar climate challenges, partly shared history and companies operating in several Nordic countries. By using the technology described in this chapter, the companies can have the advantage of facing a larger market.

Consultants, researchers, computer programmers and advisers can use IFC, IFD and IDM, and this may increase the actual work market for these workers. One possible example would be that someone who is skilled in the analysis of static design can more easily sell services in other countries when the open standards and common databases are available (based on IFD).

Differences in standards of practice can be just as limiting to trade between the Nordic countries as formal restrictions do. By using open standards and common databases, however, the implication this has for restrictions in trade is reduced. The rules and standards can still be different, but the implications of these differences can be narrowed if easy access to information about exactly what these differences consist of is available.

If builders, suppliers and buyers largely use software databases based on IFD, products in each of the countries for which there is insufficient demand can still be offered because there will be sufficient demand in the overall Nordic market. The point is that the simpler search could lead to more "niche products" being offered. This is an interesting example of how increased standardization can lead to increased variety.

#### 4.1 *Future development*

There are ongoing initiatives from the state builders in the Nordic countries who have taken initiatives to increase the use of standardized building information models.

- In Norway, important initiatives have been taken. The state of Norway decided in 2007 to use BIM in five ongoing projects. During 2010, BIM should be used as a general rule in State buildings and building processes.
- In Finland, the state requires of the builder Senati that all projects exchange information in the IFC format and requires the use of software that is certified IFC2x3.
- In Denmark, there is a requirement that in projects costing over 40 million €, where the state is the client or pays the cost of the operation, the IFC is used.
- In January 2008, a "BIM statement" was signed by representatives of "State Builders" in the United States, Denmark, Finland and Norway which says that they will require BIM and open standards and work together to increase the prevalence of building SMART in the construction industry.

It is likely that the requirements of many of the major government builders in the Nordic countries will directly and indirectly lead to accelerated use of open standards in the building industry.

Storing and communicating all common information about a building and its parts in a standardized format, accessible to all stakeholders and at all stages, can improve the building process. New technology provides new opportunities. It requires competition between companies on equal terms, and in the long term, the entire industry in the Nordic countries will be a winner on the commitment to open collaboration and communication. Environmentally sound buildings are increasingly considered a necessity. In order to know the total environmental impact, there must be declarations and use of open standards, and IFD could use the same standard in the Nordic countries.



## 5 Innovative standardization

The various Nordic countries approve products, companies, building control, *etc.*, differently. Taken to excess, the process of approval of these building licences, treated differently in each country, can be a barrier.

The regulations are mostly performance (function) based, with few detailed requirements for the contractors. The regulations are primarily advice and instructions. Guidelines for instructions have varying extent and authority in the Nordic countries. Standardization is a mean for harmonization of building regulations, which has gone far at the material level, but not for compound products.

It should be mentioned that in principle, the major part of TC 112 (Wood-based panels) and TC 124 (Timber structures) standards from CEN (European Committee for Standardization) can be applied as performance standards by the option given in the standards to declare “own” properties instead of applying minimum technical classes by fulfilling the six essential requirements stipulated in the Construction Products Directive.

### 5.1 *Compilation of standards*

Of the missing standards in EU, the production of solid wood elements and so-called volume elements (finished housing boxes) should be mentioned. As regards solid wood elements, a product standard in EU CEN format has been prepared in a former Nordic Nordtest project. The standard has been published, but we recommend that this standard, which is in English, should be implemented in the Nordic countries, and concurrently, CEN/TC 124 WG 3 (Working Group 3: Glued laminated timber) is offered, which has structural glulam as its field of activity.

For volume elements, prEN 14732 (Timber structures - Prefabricated wall, floor and roof elements) can partly be used, and ETAG 011 (Light Composite Wood-based Beams and Columns) can partly be used, at least for the future development of performance-based box or volume elements, either structural or nonstructural. A standard should be prepared either to fit in with the ETAG or the EN 14732.

### 5.2 *Future development*

Proposals for content and construction of 2<sup>nd</sup> generation standards, performance standards, were given in interim report 3 as reference to already-existing performance standards on the area and identification of area, in which performance standards are still lacking.

### 5.3 *Obstacles*

In the ‘new’ system based on European Eurocodes, missing reference standards in relation to the Danish Building Regulations BR08 cannot immediately be identified on the timber area.

The status of implementation of Eurocodes and harmonized standards in the other Nordic countries is not clear.

It should, however, be stated that the extent of reference standards on the timber area is at the normative reference level in Eurocode DS/EN 1995-1-1, which means that all references are to European standards from CEN that all EU and EFTA countries are obliged to implement.

## 5.4 *Need for harmonization*

Interim report 3 analyzes on basis of the Nordic building regulations references to national, Nordic, European and international standards. Links between national building regulations and coming Eurocodes and European harmonized standards appear from the analysis.

On the basis of the project cooperation, it has become quite clear that if the declaration of intent of the Nordic countries acting as an inner market for the active partners, which effectively in cooperation should characterize both the Nordic and the European harmonization, the organizational cooperation between active partners and Nordic standardization should be given full consideration. A first step should be to examine the possibility of merging the Nordic countries NAs (National Appendices) with the structural Eurocodes.

The lack of a reference basis for a common Nordic standard for visual strength grading of structural timber (INSTA 142- Nordic visual strength grading rules for timber) has been identified, and a proposal for a joint Nordic cooperation on the standardization area with INSTA 142 as an example has been given. Recently, the Nordic countries have started to develop a revised version in English of INSTA 142. It is in English in order to take into account other East European businesses and to have a straight reference to EU and the harmonized standards for structural timber and glulam.

## 6 Required changes in building regulations

### 6.1 Driving forces for change

If a manufacturer wishes to export or import houses/components to or from another country, the expectation should be to encounter as little trouble and paperwork as possible. All countries are interested in ensuring that the houses are safe, environmentally friendly and have a good standard.

A change to more harmonized requirements in the Nordic countries increases our possibilities to influence future European harmonization of building regulations. It also increases the possibilities for house manufacturers to export more to the European market, and it encourages the use of wooden components and products. A larger market share and higher production units will also provide for a more industrial-scale manufacturing process, which often is a foundation for cost-effective production. In the end, this may decrease living costs for the house owner.

Example: Different risers

Manufacturers of houses that deliver houses to different markets may have to use different types of stairs because of differing requirements for the size of the riser (distance between the treads). That will cause the manufacturer extra costs for the purchase, storage, design and risk (see Figure 3).

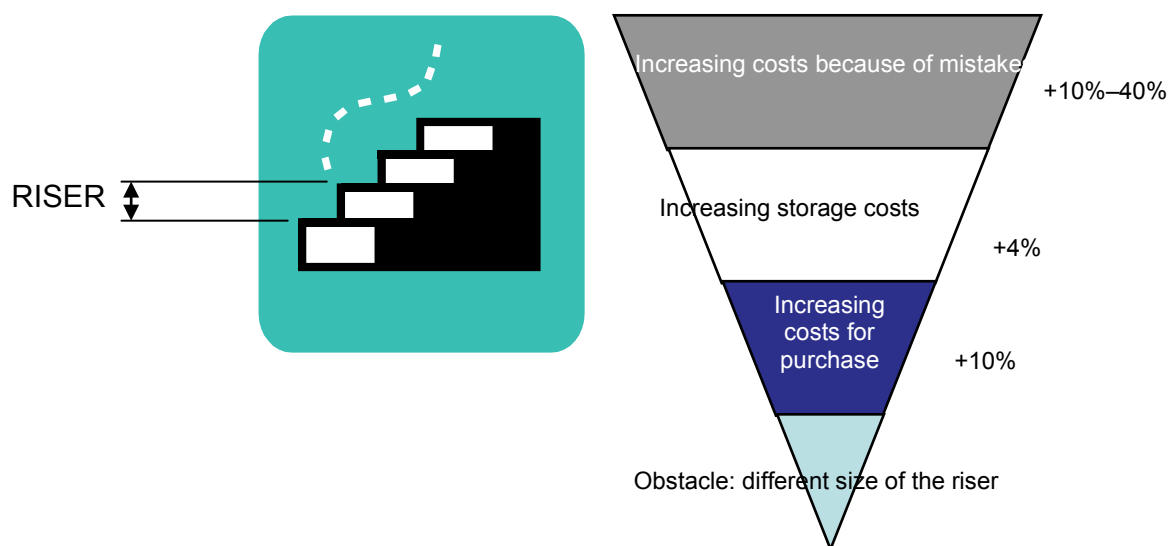


Figure 3. Increasing costs of stairs because of differences in requirements.

The costs can increase 15%–30% simply because of a small difference (10 mm), and the house owner will not gain any benefit for the extra money he has to pay.

## 6.2 *Today's changes in building regulations in Nordic countries*

Since the late 1980s there has been an ongoing effort to harmonize the technical building regulations on the European level in order to reduce barriers to trade for the benefit of the consumer. The harmonization effort regarding technical regulations is based on an EC Construction Products Directive (89/106/EEC). This means that Member States shall presume that the approved products or building kits are fit for their intended use, *i.e.*, they enable works in which they are employed to satisfy the essential requirements during an economically reasonable working life. All the Nordic countries have agreed to follow this agreement.

The agreement enables its signatories to adopt uniform technical requirements for the approval of parts and equipment. Since the start, more than one hundred European Technical Approvals, ETAs, have been adopted on the basis of this agreement. Most of them were adopted by a large majority of member states and integrated into their national legislation.

The regulations cover most of those parts and pieces of equipment that are relevant for type approval in all member states. The regulations are continuously updated to reflect the current state of the art, and they are then transposed into national legislation by the signatories. The ETA deals only with the product and state classes or product characteristics to be used by the designer of the works. The declared regulation performance of the product must be compared with the relevant requirements in the building regulations from country to country, taking into account the intended use in relation to type of building, site, *etc.*

The harmonisation of building regulations up to today has been restricted to product specification and methods of measurement. Comparative analysis of these regulations demonstrates several impediments to more fundamental harmonisation.

## 6.3 *Ongoing European harmonization*

The prospect for further harmonization of building regulations in Europe has two faces. On the one hand, it could be argued that the differences in systems and formulations are too severe to expect further harmonization. On the other hand, there is the development of energy labeling of buildings according to the European directive for energy performance that may give a new impulse to more uniformity of systems of regulation in the EU.

### 6.3.1 **CE marking**

CE marking is generally considered to be useful for increasing harmonization between countries. However, CE marking is still not well known by the manufactures of houses, and there is some misunderstanding and lack of understanding about CE marking. Additionally, small companies will have problems because they lack technical understanding, financing and capacity. The construction of houses is still in many cases a local business engaged in by small companies. Different requirements in different countries are today not normally included in the CE marking, and if it were to be included, there will be even more paperwork, so a common harmonized requirement is probably the best way to go forward.

## 7 Recommendations

The Nordic countries see their regulations as “performance based”, and the intentions of the regulations are often similar. Nevertheless, there are many quite fundamental differences in detail. Practical implementation of requirements often relies on guidance that is not written in regulations. Guidance varies between countries for many different topics and with regard to information from regulations through to independent guidance. Further harmonization of building regulations in the Nordic countries can be looked at in two different countenances. One is in the short term, regulations that are easy to change, and one is in the long term, with many different questions and a need for research and development.

The Construction Products Directive (CPD) is an important foundation of the European building sector. Against this background, utmost prudence has to be exercised when making changes to the legislative instrument on the basis of which the Nordic construction and house manufacturing industry has been working for a long time. The companies need a permanently reliable framework for their activities. It is our belief that neither the majority of the companies nor their trade associations are interested in radical changes to the current system of regulation. For instance, the quality of the product standards ought to be improved, to facilitate their applicability in all the Nordic countries.

The interaction between harmonized regulations, construction products and national provisions governing the safety of structures, sizes and dimensions, cannot be simplified at random, because structures often have to satisfy very complex requirements.

There are different barriers between countries that can influence what is possible to change or agree about:

- Culture. The demands of different customs based on tradition, economic factors, *etc.*, are difficult to change, or perhaps ought not to be changed. It must be up to every buyer to decide what sort of house he or she wants to buy.
- Different testing methods. There are different testing methods and ways of analyzing test results; for example, testing of watertightness in bathrooms, needs some consolidation.

### 7.1 Action plan, initial priorities

This project has examined some of the obstacles for manufacturers to work in all the Nordic countries. Many of the obstacles can be removed by better information and cooperation, and some obstacles will require more time for research to gain adequate information so the obstacle can be removed.

#### 7.1.1 Marking the product

Putting a CE mark on the product can be a way to clarify that the product is controlled and can be used in a proper way. However, CE-marking has to include all the different requirements and would therefore not differ from the situation as it is today. All the harmonizing should be in place before a CE mark can be placed on a house for all the Nordic countries, including the requirements that must be fulfilled for it to be considered a “Nordic house”.

#### 7.1.2 No possible change

Even if the Nordic countries are quite similar, there are some differences in climate, but probably there are greater differences within some of the Nordic countries. Snow, temperature and wind are some of the characteristics that differ depending on where the house is located. Weather and other climate factors are difficult to change, so a possible way to make it easier for manufacturers is to provide better information.

#### *Standardized testing methods*

There are still some different methods in use for, for example, measuring watertightness. Considerable work has already been done in this area, but there are still some methods that are not harmonized.

### *Standardized design software*

For all structural design today, most engineers use software. Designing a truss can be quite time consuming without any software. Today, the software for trusses and other types of design is not “quality” marked, so it is up to the designer to take the full responsibility and to deal with local governments. To avoid discussion about structural design methods for basic structures such as trusses, standardized design software that is approved in all countries would make life easier for the manufacturers.

*Table 4. Action plan*

| Method               | CE-marking,<br>including<br>requirements. | No possible<br>change;<br>More information | Standardized<br>method | Standardized<br>design software |
|----------------------|-------------------------------------------|--------------------------------------------|------------------------|---------------------------------|
| <b>Obstacle</b>      |                                           |                                            |                        |                                 |
| Stairs, riser        | X                                         |                                            |                        |                                 |
| Doors, free openings | X                                         |                                            |                        |                                 |
| Corridors, width     | X                                         |                                            |                        |                                 |
| Moisture             | X                                         |                                            | X                      |                                 |
| Energy               | X                                         |                                            | X                      | X                               |
| Snow load            |                                           | X                                          |                        |                                 |
| Design roof          |                                           |                                            | X                      | X                               |

## *7.2 Action plan, long-term priorities*

The European standards and codes that are being constructed for regulating the building market are based on the assumption of great benefits in an open market with no barriers. They are pro-market in nature, and most are prudential types of regulations with the purpose of ensuring the basic safety and soundness of constructions. The core principle underlying these regulations is the freedom of mobility for products/houses.

### **7.2.1 Resources for R&D and harmonization in the Nordic countries**

One of the primary aims of harmonization of the Nordic countries' building regulations and codes is to encourage the governments in all the Nordic countries to put in place appropriate supervisory groups to remove barriers between the countries for further integration.

Resources must be put in place so people in specified groups can work for harmonization and work with adequate R&D to remove barriers. This is a direct investment in value creation and is necessary for a harmonized market.

It can be a start of a Nordic Building Harmonization Task Group whose purpose should be to investigate and make recommendations as follows:

- Compare and make recommendations regarding requirements and standards.
- Coordinate and collate a common “lowest” standard for different sizes, values and other requirements that are presented from the Nordic countries.
- Give third-party recommendations where opinions differ.

### **7.2.2 Information**

One of the biggest problems for industries that are interested in exporting is a lack of good information. Building regulations in all countries are complex, and to get good information in an easy way is difficult. Modern information technology offers great opportunities to provide manufacturers of wooden houses the means to obtain correct information about building regulations in each country in an efficient manner. That will result in better quality at a lower cost for the customer.

A key part of this broad effort is the development of a Nordic building regulation information network in order to provide users with access to an always-up-to-date database, regardless of when or where the user needs the information. Such a system would help house manufacturers and contractors to manage their own information needs by giving them access to a common building regulation information database. The initiative of BuildingSMART, an alliance of organizations with the aim of defining the use and sharing of information, is a good start.

### **7.2.3 Third-party certifications**

Putting a CE mark on products is one way to remove some of the obstacles, but not all. CE-marking that includes all the applicable regulations from different countries is more or less impossible unless the regulations are harmonized. If a manufacturer decides to build and CE-mark a house that is suited for all the markets with regulations as they are today, it will probably not be cost effective.

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# Appendix 1

Delrapport 1: Trähusindustrins problem och byggreglernas krav

Appendix 1 is available as a separate publication:

# Appendix 2

Delrapport 2: Kommunikasjon, åpne standarder og handelshindringar i Norden

Appendix 2 is available as a separate publication.

# Appendix 3

Delrapport 3: Innovativ standardisering

Appendix 3 is available as a separate publication.

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## TABLE OF ABSTRACT

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| <i>Organisation(s):</i><br>SP Wood Technology; Danish Technological Institute, Timber; SINTEF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Title (full title of the report):</i><br><b>Harmonization of building regulations in the Nordic countries for wooden houses</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Abstract</b></p> <p>The purpose of the project is to strengthen the Nordic industry through the establishment of similar, transparent regulations, thus minimizing technical "trade obstacles", allowing the market to increase with the intention to further develop the construction of wooden houses.</p> <p>The study has achieved this aim by using a questionnaire to clarify some of the differences in regulations and by comparing the building codes. This showed how important good communication is for harmonization of building regulations</p> <p>The interviews and questionnaires demonstrate the need for more cooperation between the countries to avoid and eliminate obstacles. Small differences can have great importance for manufactures. Most of the differences have no bearing on building quality, but most likely, increase costs for the end user. The companies seem to have difficulties finding relevant information.</p> <p>Recommendations for continued work:</p> <ul style="list-style-type: none"> <li>• Establish a "Nordic Building Harmonization Task Group" whose purpose should be to investigate and make recommendations as follows: <ul style="list-style-type: none"> <li>- Compare and make recommendations regarding regulations and standards.</li> <li>- Coordinate and collate a common "lowest" standard for different sizes, values and other regulations that are presented from the Nordic countries.</li> <li>- Give third-party recommendations where opinions differ.</li> </ul> </li> <li>• Establish a common database for building standards in the Nordic countries. One of the biggest problems for industries interested in export is the lack of good information. Building regulations in all countries are complex, and there is presently no efficient way to get good information. Sharing information is critical to acquiring knowledge about other countries' regulations.</li> </ul> |                     |                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <i>Name of project:</i><br>Harmonization of building regulations in the Nordic countries for wooden houses // Harmonisering av de nordiska träbyggreglerna                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     | <i>Project acronym (if relevant):</i>                                                                                                                                                                                                                                                                                                                                                           |
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