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Building modules. Guideline for SINTEF Technical Approval

1. Scope

This guideline concerns application for SINTEF Technical Approval (TG) for prefabricated building modules. The guideline is mainly aimed at module designs based on timber and steel structures.

2. Application form

A written application for SINTEF Technical Approval shall be sent to SINTEF Building and infrastructure by e-mail; certification@sintef.no (or a known contact person at SINTEF), or by letter to SINTEF Building and infrastructure, att: SINTEF Certification, Box 124 Blindern, NO-0314 Oslo.

The application form is downloaded from

<http://www.sintefcertification.no/News.aspx?sectionId=0&newsId=1324>

3. Approval project

An approval project with a project manager and contact person is established when SINTEF Building and infrastructure, in the following called SINTEF, has received and registered the application.

SINTEF will then send a confirmation and a project contract to the applicant. The applicant should normally be the same body as the future holder of the approval. SINTEF's project manager will be a person in one of SINTEF's technical departments in Oslo or Trondheim.

It is recommended to hold a meeting at SINTEF Certification before sending an application, mainly in order to clarify the scope of a SINTEF Technical Approval and what products and structures should be covered by the approval.

In some cases it may be useful to carry out a limited pilot project before starting an approval project. The purpose of a pilot project is to assist the applicant to clarify the scope of an approval, and how the necessary basis for an approval concerning module performance etc. may be determined.

The approval project includes a revision of the construction details for the building system, specifications of all materials and components in the modules, documentation of the relevant module characteristics and performances, initial factory production control, and drafting an approval document plus a factory production control description.

4. Basis for an approval

4.1 Product description – Construction details

The construction of standard module design shall be described in detail by the manufacturer's own drawings, including standard connection details between the various parts of the building system. A list of construction details which is normally required is shown in **Appendix 1**. The list includes module systems to be used for multifamily buildings with sound insulation and fire resistance requirements between housing units.

All drawings must have a drawing number and a date for the last valid version. Easier communication and possible cost reduction for the approval project may be obtained if the applicant uses Appendix 1 as part of the application, and lists the relevant drawings as shown in the appendix.

4.2 Product description – Specification of materials and components

All materials and components which are part of the approved module design shall be specified in detail. Such specifications may be reference to a particular product from a given manufacturer, or to specific products from more than one manufacturer if this is relevant. It is also possible to specify products according to European product standards with relevant product type, class or performance, but such specifications must also require special assessments for use in Norway (in particular properties related to impact on the environment).

Examples of materials and components which are typical parts of wood based module constructions are shown in **Appendix 2**. An approval will normally cover the basic module design. Surface materials like floor covering, wall tiles, paints etc. are in most cases selected individually for each building project, and are normally not part of the approval. This may also be the case for supplementary components like doors and windows. What should be considered as standard design and what does the applicant want to be covered by the approval must be settled at the start of the approval project (see cl. 3).

All materials and components covered by a harmonized European product standard must be CE-marked according to the Construction Products Regulation (CPR).

Materials and components with SINTEF Technical Approval have the advantage of being assessed by SINTEF beforehand, and are then already found fit for use.

4.3 Intended use

The approval shall describe the intended use of the modules, for example building type (residential housing, low rise buildings or multistorey buildings). In particular requirements related to fire classification, sound insulation and structural safety class depend on the intended use.

SINTEF Technical Approval for building modules are divided in two separate product groups; modules for permanent buildings and modules for temporary buildings. Modules for permanent buildings fulfil all requirements of the Norwegian Regulations on technical requirements for building works (TEK). Modules for temporary buildings are designed to be removable, may for example have less thermal insulation compared to permanent building designs, and may have some technical details reducing the expected working life of the module.

4.4 Properties and performance

Properties and performances of the standard module designs shall be given in the approval. The applicant must provide the necessary documentation to verify the relevant properties and performances. This documentation may be test reports or calculations. Test reports must be issued by an independent and competent test body which is accepted by SINTEF.

Product performances may to a large extent be verified by references to SINTEF Building Research Design Guides (Byggforskserien). References may also be made to CE-marking and Declaration of Performance for materials and components used in the modules.

SINTEF Building and infrastructure may on request assist the applicant to provide the necessary performance documentation for building modules. This is normally done by assignments for separate test or calculation projects.

The module designs shall in general meet the performance requirements given in the Norwegian Regulations on technical requirements for building works (TEK), taking into account the relevant intended use. Minimum preaccepted performances are given in the guidance to the regulations. In addition the module design must also meet SINTEF's recommended minimum performance levels, given in SINTEF Building Research Design Guides and in relevant SINTEF guidelines for product approvals.

Comments to the most important module performances:

Mechanical resistance and stability

The approval document may state that the structural performance of the module design is calculated and documented for each separate building project and delivery. In order to reduce the necessary documentation in each building project it is also possible, in particular for standard module designs intended for low rise housing, to declare structural design capacities in the approval document. The load bearing performance may for example be given as maximum imposed loads on floors, maximum snow loads on roof and horizontal wind load capacity. Reference to the SINTEF Technical Approval may then be used as documentation in each individual building project.

The mechanical resistance and stability shall be calculated according to the structural design standards EN 1991-1 for loads, EN 1995-1-1 for timber structures and EN 1993-1-1 for steel structures, all with national annexes NA for Norway.

Structural capacities shown in SINTEF Building Research Design Guides may also be used as reference, and replace the need for other calculations where possible.

Safety in case of fire

Fire resistance for the relevant building parts (wall, floor and roof) shall be classified according to EN 13501-2 on the basis of tests, or calculation according to the relevant European design standard (EN 1995-1-2 for timber structures). Load bearing capacity during the declared time for fire resistance shall be verified. Reference to preaccepted fire resistance shown in SINTEF Building Research Design Guides is possible when the structure is covered by a relevant guide.

Reaction to fire for each material and component (see Appendix 2) shall normally be classified according to EN 13501-1. Classification is given in the product standard or the CE-marking for the most common products.

Properties related to impact on the environment

For each material and component (see Appendix 2) shall as a minimum the following documentation be available:

- Content of substances hazardous to health and environment
- Effect on indoor environment
- Effect on soil, surface water and ground water
- Waste treatment/recycling

A more detailed information on properties related to impact on the environment is provided by SINTEF.

Resistance against rain and air penetration

The tightness of the module constructions against rain and air leakage is normally assessed by SINTEF on the basis of construction detail descriptions and material and component specifications mentioned in cl. 4.1 and 4.2. Testing may be required for special designs in cases where SINTEF does not have the necessary long term experience of similar technical solutions used in Norway.

Sound insulation

The expected air and impact sound insulation performance between separate dwellings in finished buildings shall be given in the approval. Reference to SINTEF Building Research Design Guides may be used to a certain extent, but in particular for multistorey buildings will test results from building projects or a pilot building normally be required. Measurements and classification is done according to EN ISO 140, EN ISO 717 and Norwegian Standard NS 8175.

Thermal insulation

The U-value for each building part shall be calculated according to EN ISO 6946. U-values given in SINTEF Building Research Design Guides can normally be applied. Thermal bridge transmittance values shall be calculated if the modules have f.ex. steel or concrete components that make special thermal bridges.

Durability

Durability is normally assessed by SINTEF on the basis of construction detail descriptions and material and component specifications mentioned in cl. 4.1 and 4.2. Special investigations may be required if new materials with unknown performance are used in the module design.

Wet rooms

Wet rooms in the modules shall be part of the module approval. What is made in the factory and what is made as supplementary work on the building site must be clarified. When materials and components with SINTEF Certificate or SINTEF Technical Approval are applied, no additional documentation for is required, providing that the module is designed according to the conditions for use of these products. Wet room designs must follow the principles given in SINTEF Building Research Design Guides, and f.ex. is a detailed control description for installation of watertight membranes, connections to floor drain and installation of pipes and sanitary equipment required.

4.4 Special conditions for use

SINTEF use primarily construction detail descriptions and material and component specifications mentioned in cl. 4.1 as a reference to installation requirements and conditions for use stated in the approval document. SINTEF shall have a copy of the manufacturer's special guides for installation, transport, storage and maintenance where applicable.

5. Production control

The manufacturer shall have a documented factory production control plan for the modules. The plan shall describe what controls are made during the production, control frequency, who is responsible, how are faults handled, and how are the results from the controls filed.

All prefabricated module systems with SINTEF Technical Approval must in addition have a scheme for supervisory factory production control. This control shall be performed by SINTEF or another notified inspection body according to the Construction Products Regulation. A national body from the same country as the manufacturer, and which is notified for certification of this type of construction products, may be used for foreign manufacturers. The supervisory factory production control is performed by factory visits at least once every year.

An initial factory inspection shall be done by SINTEF before an approval is issued for the first time (all factories if more than one manufacturing plant is to be covered by the approval). The initial factory visit shall normally be done by SINTEF together with the future supervisory inspection body in cases where SINTEF will not perform the factory inspections itself.

6. Costs

The cost for SINTEF Technical Approval is charged according to work time and expenses. The total cost depends very much on the efficiency of the communication between the applicant and SINTEF, and how efficient the applicant provides the necessary background documentation for the approval. The cost depends also on how much guidance and advice the applicant needs, both in order to provide verification of product performance and in some cases to adapt the module construction to Norwegian requirements and market. Experience shows that the expected total cost may be in the order of NOK 400.000 ex. VAT.

The use of SINTEF Building Research Design Guides and the use of materials and components with SINTEF Technical Approval as verification of properties and performance may considerably reduce

work time and costs for an approval. Non-traditional and special construction methods require more work and higher costs.

The cost does also depend on the manufacturer's location, and is f. ex. influenced by travel costs for the initial factory inspection. Costs are also higher if English versions of the approval documents are needed.

The cost for the annual supervisory factory production control is charged by SINTEF according to work time and expenses. A cost estimate can only be done when the manufacturer's location is known. When SINTEF is not the supervisory inspection body will SINTEF only invoice a minor annual cost for revising a copy of the inspection report made by another inspection body.

An annual fee for the administration of the approval scheme and for publication on www.sintefcertification.no is charged in addition to the cost for the supervisory factory production control. For year 2016 the fee is NOK 16.000.

7. Examples of approval documents

Examples of approval documents for issued and valid SINTEF Technical Approval may be downloaded in PDF format from www.sintefcertification.no.

8. More information

Contact information and a general description of the approval scheme and is found on www.sintefcertification.no.

Appendix 1

Examples of standard construction details required for SINTEF Technical Approval for prefabricated building modules

The construction details are the manufacturer's own drawings. For a complete module system the drawings should normally cover the construction details listed below. Recommended drawing size is A4. The drawings should be electronically available in PDF format (or tif), and each drawing must be identified with a drawing number and a date. If necessary may more than one drawing illustrate one construction detail.

Construction detail		Drawing no.	Drawing date
External walls			
1	Vertical and horizontal section of principal standard wall design		
2	Elevation of standard structural system		
3	Principal design of structural supplements around door and windows openings (beams and sidestuds)		
4	Installation of windows and doors – Section of joints between wall and bottom, side and top frame members		
5	Horizontal section of standard corner joints		
Internal walls			
1	Vertical and horizontal section of principal standard wall design		
2	Elevation of standard structural system		
3	Principal design of structural supplements around door openings (beams and sidestuds)		
4	Horizontal section of standard corner joints		
5	Vertical and horizontal section of principal standard separating wall design between housing units		
6	Elevation of standard structural system for principal standard separating wall design between housing units		
Floors			
1	Vertical section of standard floor design over foundations		
2	Vertical section of standard floor design over other modules		
3	Plan of standard structural floor system		
4	Structural design for floor openings		
Roof			
1	Vertical section of standard module roof design		
2	Plan of standard structural module roof design		
3	Vertical section of standard module roof design with integrated external roofing		
4	Vertical section of standard roof design with external roof installed on site		
Connections between module parts			
1	Vertical section of joints between module floor and external wall		
2	Vertical section of joints between module floor and internal walls		
3	Vertical section of joints between module walls and roof		

(continued on next page)

(Appendix 1 cont.)

Construction detail		Drawing no.	Drawing date
Wet rooms			
1	Vertical and horizontal section of principal standard wall design		
2	Elevation of standard structural wall design		
3	Vertical section of standard floor design, including slope towards floor gutter		
4	Horizontal section of wall corner joints		
5	Vertical section of joints between floor and walls		
6	Vertical section of floor at door opening		
7	Vertical section of connection between wall and roof/ceiling		
8	Section of floor gutter installation and pipe penetrations (if not covered by Technical Approvals for the applied membrane system)		
9	Principle design of pipe installations		
Shafts for technical services			
Drawings of shaft walls and sealing system around pipes and ducts in shafts for technical service installations shall normally be included for approvals of prefabricated house module systems.			
Connections between modules – Standard module installation details			
1	Section of principle standard connection between module and foundation		
2	Section of standard connection between modules at external walls		
3	Section of standard connection between modules at internal walls		
4	Section of standard connection between modules at floors		
5	Section of standard connection between modules at dwelling separation walls		
6	Section of standard connection between modules at dwelling separation walls and dwelling separating floors		
7	Section of standard connection between modules at external roof		

Appendix 2

Examples of materials and components normally to be specified in SINTEF Technical Approval for prefabricated building modules based on timber structures

What materials and components to be specified in an approval depends on the construction design, and what by agreement with the approval holder shall be covered by the approval.

Examples of material and component specifications may be seen in published approval documents for building modules on www.sintefcertification.no.

Material / component	Specification (Non specified material dimensions shall be specified in "Standard construction details" or specific for each individual building project)
Structural components	
Wall studs	
Floor joists	
Roof structure components	
Load bearing panel materials	
Subfloor	
Roof sheathing	
Wind bracing wall sheathing	
Thermal insulation	
Insulation in walls, floors and roof	
Cladding and lining	
External cladding	
Internal wall lining and ceiling	
Membranes	
Water vapour control layer	
Wind barrier	
Roofing	
Joint materials	
Sealants	
Gaskets	
Tape	
Fire sealing compounds	
Fasteners and metal components	
Screws and nails	
Glue	
Anchor products	
Wet room products	
Watertight membranes	
Panel products	
Water pipes	
Drainage pipes	
Floor gully	
Joint sealant	