

EUROPEAN ASSESSMENT DOCUMENT

EAD 130087-00-0204

December 2017

MODULAR CONSTRUCTION SYSTEM

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The modular construction system is a wood based kit to construct load-bearing walls for buildings.

The modular construction system is composed of complete ready-made, standardized and industrially manufactured wood modules made of spruce to be used in buildings (see Figure 1).

The kit is composed of a series of prefabricated elements – bricks – made by MFP pre-cut pieces glued and stapled together. This kit uses mechanical connections (angular steel plates, screws and staples) and adhesives within bricks and between bricks to be installed in situ. The basic element of the modular construction system is the wall module (see figure 2)

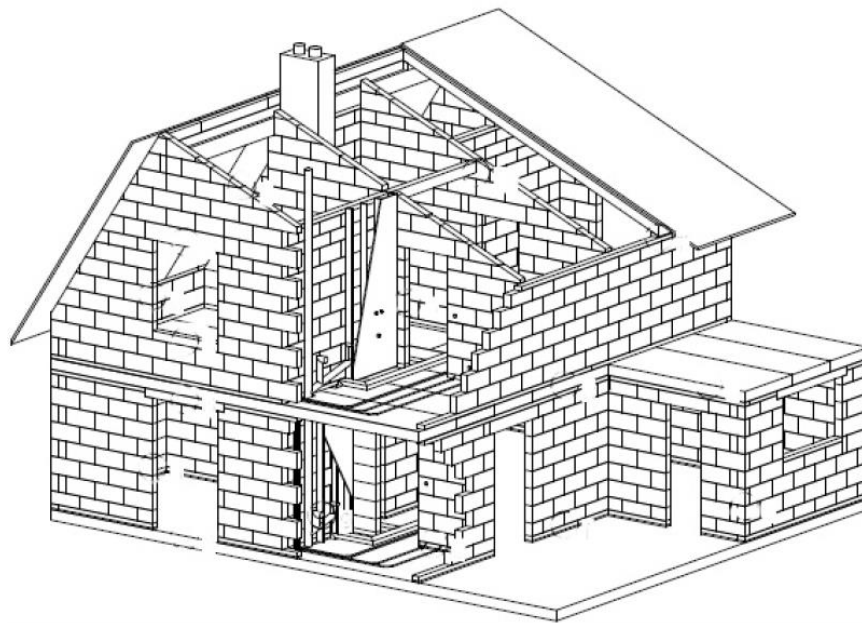
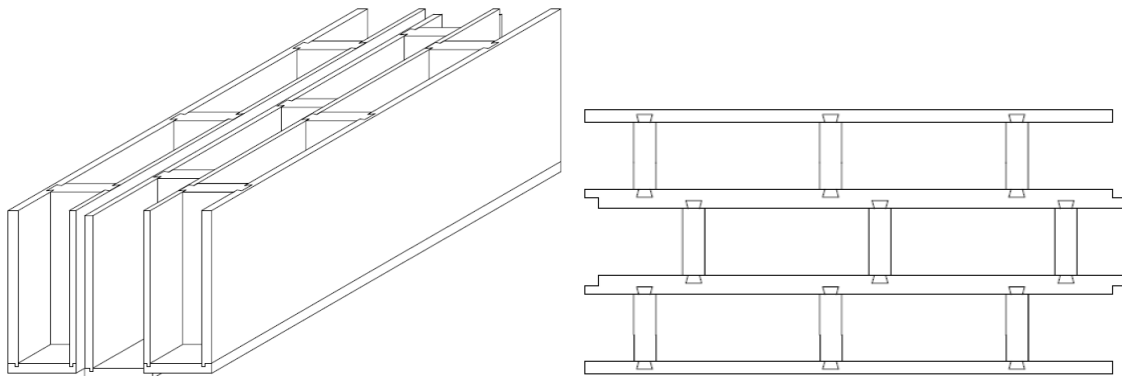


Figure 1: Modular construction system composed of wood modules



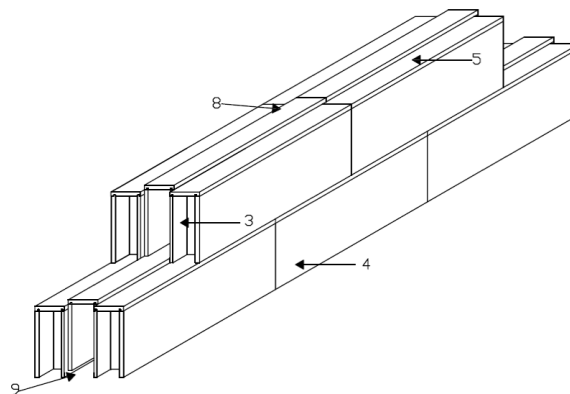


Figure 2: Basic module of modular construction system

The components of the modular construction system are:

- Modules of MFP Blocks (bricks) made from pre-cut MFP boards
- Special pieces (for wall corners, windows openings, ceiling links, ground floor connection) made from pre-cut MFP boards.
- Steel angles to connect floors and walls (as an inter-link provision across multiple floors). Steel angles to connect floors and walls according to EN 1090-1 with execution class (EXC) defined by the designer, minimum EXC2
- Adhesive for in situ connection between bricks. Adhesive used in situ and in factory, type I according to EN 15425
- Mechanical staples for in situ connection between bricks. Mechanical fasteners for timber structures (screws, bolts, staples...) according to EN 14592 or ETAs for structural use
- Other connection systems (to be elaborated according to tests results, e.g. using screws on the ground floor to resist base shear under lateral loads). Metal Anchors for Use in Concrete according to ETAs for structural use (ex ETAG 001).
- Mineral wool (insulation) according to EN 13162.

Annex 1 describes in detail the dimensions of the brick types included in the system.

The product is not covered by a harmonised European standard (hEN). The harmonized standard EN 13986 for the MFP boards does not cover the intended use in this EAD

The MFP-boards are CE marked in accordance with EN 13986 and supplied to the ETA holder. The MFP boards are cut by the ETA holder to manufacture the bricks, modules and special pieces.

The steel angles and staples are CE marked based on applicable harmonized standards or ETA's where relevant and supplied to the ETA holder based on his specifications.

The adhesives are specified as type I in accordance with EN 15425.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The system is intended to be used above ground in load-bearing and non-loadbearing interior and exterior walls for buildings with a maximum of 2-3 floors including the attic space (the actual maximum height will come out from test results and relevant calculations).

The modular construction system shall be subjected to static, quasi static and seismic actions.

The product is intended to be used in service classes 1 and 2 according to EN 1995-1-1.

Members which are directly exposed to the weather shall be provided with an effective protection for the modular construction system in service. The elements must always be well plastered, coated or protected by a ventilated façade on the outside and never left exposed

The maximum possible opening for windows or doors does not exceed 1.85 m on the loaded side.

The floors of the buildings provide a distributed load introduced along the surfacing wall, for example by XLAM or Glulam elements (horizontally laid down). The floors are not part of the ETA or the EAD.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the modular construction system for the intended use of 50 years when installed in the works (provided that the modular construction system is subject to appropriate installation. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation

1

affecting the basic requirements for works .

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1

The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the assumed working life.

2. ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the modular construction system is assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
	Mechanical resistance of boards	2.2.1	Level
	Dimensions	2.2.2	Level
	Mechanical properties of wall element	2.2.3	Level
	Racking strength and stiffness of wall element	2.2.4	Level
	Interaction: moment – normal force	2.2.5	Level
	Creep and duration of load	2.2.6	Level
	Dimensional stability		Level
	Durability of timber without preservative treatment	2.2.17	Description
	Resistance to delamination	2.2.18	Level
	Resistance to corrosion of metal parts	2.2.19	Description
Basic Works Requirement 2: Safety in case of fire			
	Reaction to fire	2.2.7	Class
	Resistance to fire	2.2.8	Class
Basic Works Requirement 3: Hygiene, health and the environment			
	Content, emission and/or release of dangerous substances	2.2.9	Description

No	Essential characteristic	Assessment method	Type of expression of product performance
	Air permeability	2.2.10	Level
Basic Works Requirement 4: Safety and accessibility in use			
	Impact resistance	2.2.11	Class
Basic Works Requirement 5: Protection against noise			
	Airborne sound insulation	2.2.12	Level
	Impact sound insulation	2.2.13	Level
	Sound absorption	2.2.14	Level
Basic Works Requirement 6: Energy economy and heat retention			
	Thermal resistance	2.2.15	Level
	Thermal inertia	2.2.16	Level

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

Characterization of products to be assessed shall be done in accordance with available specifications, notably material properties and dimensions.

2.2.1 Mechanical properties of the boards

The MFP-boards are CE marked in accordance with EN 13986 with suitable strength class according to EN 312.

2.2.2 Dimensions

The dimensions and the shape of the modular construction system is determined according to EN 15498.

The nominal values of length, L, width, l, and height, h, shall be given in the ETA. The values are given with the following tolerances: length L ± 3 mm; width l ± 3 mm; height h ± 1 mm.

2.2.3 Racking strength and stiffness of wall elements

Racking strength and stiffness of wall elements is determined by tests made with walls build-up of minimum 5 rows of basic elements. The test shall follow the principles given in EN 594 with regard to test setup. Load cycles shall follow the principles given in EN 12512.

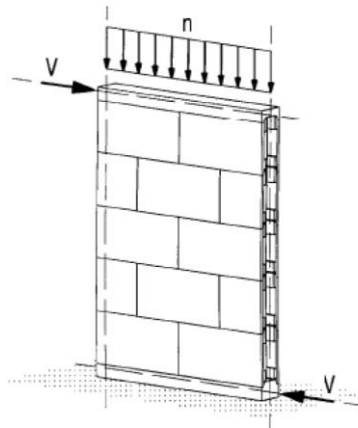


Figure 3: Test assembly for verification of racking strength and stiffness of wall elements

At least ten walls shall be tested - different module sizes are allowed. In that case, principles of calculation assisted by testing shall be applied according to Eurocode 1990, section 5.

The loads and corresponding deformations as well the measurement of the diagonal of the panel are recorded according to the test principles in EN 594. Apparent characteristic racking strength and stiffness of wall elements is calculated according to EN 594. Ultimate and yielding displacements, ductility, and viscous damping ratios are calculated according to EN 12512.

Apparent characteristic racking strength and stiffness of wall elements as well as use considerations, including seismic behavior factor q according to EN 1998-1 (Eurocode 8) are given in the ETA. The conditions for the q -factor are given in the ETA as well.

2.2.4 Interaction: moment - normal force

Moment – normal force interaction of wall elements is determined by tests made with walls build-up of minimum 8 rows of basic elements in height. A vertical load is applied onto the wall element. Afterwards a horizontal load is applied in the third-points until failure, see Figure 4.

At least ten walls are tested.

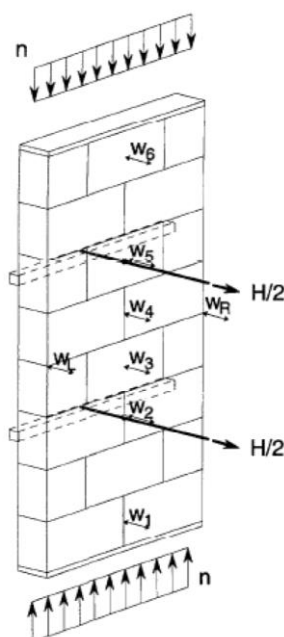


Figure 4: Test assembly for moment – normal force interaction

The loads and corresponding deformations are recorded during the test. Calculation assisted by testing is applied for evaluation of moment – normal force interaction.

Characteristic values for modulus of elasticity and moment separated for gaping of the joint as well as failure are stated in the ETA. Considerations for combined loading, moment and normal force, are given in the ETA.

2.2.5 Creep and duration of load

EN 1995-1-1 describes procedures for duration of load and creep using the modification factors k_{mod} and k_{def} respectively. As these values are given in EN 1995-1-1 for MFP Boards, calculation for duration of load and creep is undertaken in accordance with EN 1995-1-1 by using these factors.

The numeric value for k_{mod} and k_{def} are given in the ETA for the relevant service class and duration of load as defined in EN 1995-1-1.

2.2.6 Dimensional stability

Tolerances and dimensions

The manufacturing tolerances of the modular construction system are provided by the manufacturer and stated in the ETA.

Stability of dimensions

The moisture content at the time of shipping is provided by the manufacturer and stated in the ETA.

2.2.7 Reaction to fire

The modular construction system is classified using EC Delegated Regulation 2016/364/EU and EN 13501-1. The class is given in the ETA

The system is tested, using the test method(s) relevant for the corresponding reaction to fire class.

The specimen for the test according to EN 13823 shall have at least 5 rows of wall modules including heading and footer filled with cellulose insulation material. On the trolley the specimen shall be installed without any backing.

A vertical gap between the boards of at least 3 mm shall be provided in the corner. Vapour barriers or building papers shall be considered if existent.

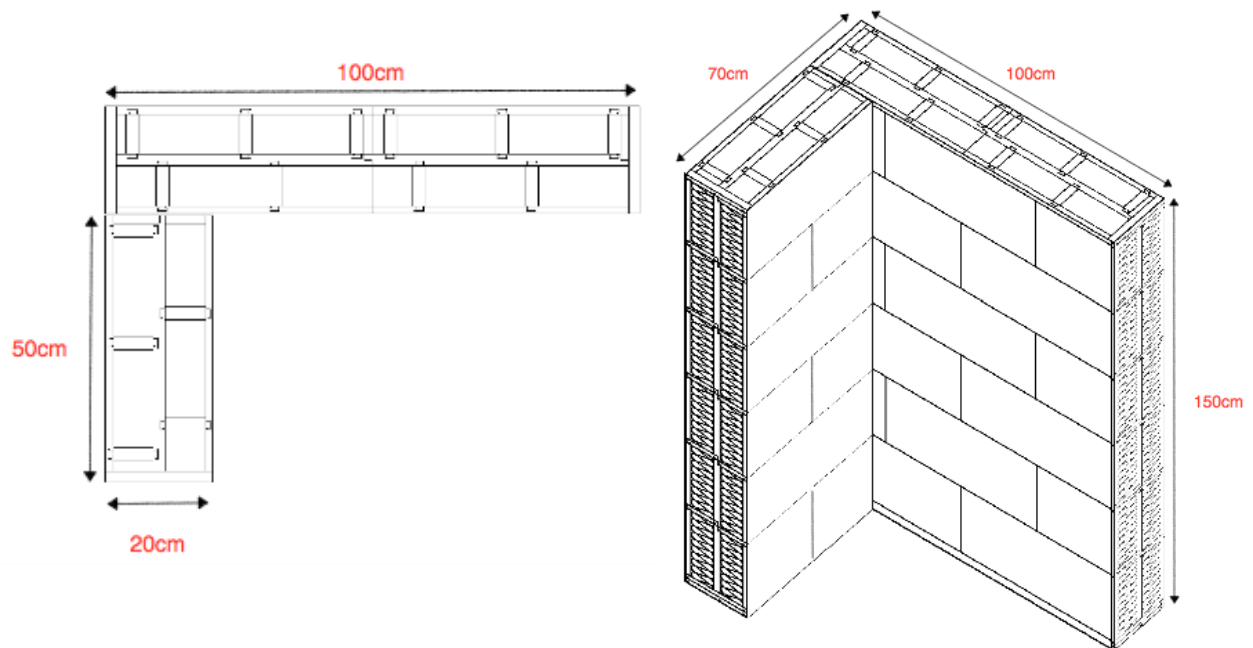


Figure 5: Test assembly for SBI test

The product classification in accordance with EN 13501-1 shall be given in the ETA.

2.2.8 Resistance to fire

The charring rate of the modular construction system is assessed in accordance with EN 1995-1-2.

Alternatively, the modular construction system is tested using the test methods in order to be classified according to EN 13501-2.

The charring rate in accordance with EN 1995-1-2 or the classification in accordance with EN 13501-2 is given in the ETA.

2.2.9 Content and/or release of dangerous substances (where relevant acc. to manufacturer's request)

The performance of the modular construction system related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer² after identifying the release scenarios (in accordance with EOTA TR 034) taking into account the intended use of the product and the Member States where the manufacturer intends his product to be made available on the market.

²

The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is **not** obliged:

- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS.

Any information provided by the manufacturer regarding the chemical composition of the products may not be distributed to EOTA or to TABs.

The identified intended release scenarios for this product and intended use with respect to dangerous substances for this product are:

IA1: Product with direct contact to indoor air.

IA2: Product with indirect contact to indoor air (e.g. covered products) but possible impact on indoor air.

S/W 2: Product with indirect contact to soil, ground- and surface water.

SVOC and VOC

For the intended use covered by the release scenarios IA1 and IA2 semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC) are to be determined in accordance with EN 16516. The loading factor to be used for emission testing is $1,0 \text{ m}^2/\text{m}^3$.

The preparation of the test specimen is performed by using all possible components of the kit (for the definition of the kit see clause 1.1) installed in accordance with the manufacturer's product installation instructions or (in absence of such instructions) the usual practice of installation.

Once the test specimen has been produced, it should immediately be placed in the emission test chamber. This time is considered the starting time of the emission test.

The test results have to be reported for the relevant parameters (e.g. chamber size, temperature and relative humidity, air exchange rate, loading factor, size of test specimen, conditioning, production date, arrival date, test period, test result) after 3 and 28 days testing.

The relevant test results shall be expressed in $[\text{mg}/\text{m}^3]$ and stated in the ETA.

2.2.10 Air permeability

The test is performed in accordance with EN 12114

The result is expressed as a value and given in the ETA

2.2.11 Impact resistance.

When quantified performance is needed, the test methods for soft body impact given in EOTA TR 001 is applied. The wall to be tested shall contain typical features for the construction in intended kit use, e.g. dowels, sealing strips and cross corners.

When the assessment is based on tests according to EOTA TR 001, the classification in ETAG 003 is used.

2.2.12 Airborne sound insulation

The test is performed as described in ISO 10140-2.

The result is expressed as a single number rating in accordance with EN ISO 717-1 and given in the ETA

2.2.13 Impact sound insulation

The test is performed as described in ISO 10140-3.

The result is expressed as a single number rating in accordance with EN ISO 717-2 and given in the ETA

2.2.14 Sound absorption

Sound absorption is only relevant when the modular construction system is used as an internal finish.

The test is performed as described in EN ISO 354.

The result is expressed as a single number rating in accordance with EN ISO 11654 and given in the ETA

2.2.15 Thermal resistance

Values of material properties may be taken from EN ISO 10456.

For the purpose of thermal resistance determination, the following information shall be given in the ETA.

- dimensions of the modular construction system parts
- density
- thermal conductivity

2.2.16 Thermal inertia

Values of material properties may be taken from EN ISO 10456.

For the purpose of thermal inertia calculations, the following information shall be given in the ETA.

- dimensions of the modular construction system parts
- density
- heat capacity
- thermal conductivity

2.2.17 Durability of timber without preservative treatment

Natural durability shall be taken as given in EN 13986. The timber shall have adequate natural durability and the service classes as defined in EN 1995-1-1 is given in the ETA.

2.2.18 Resistance to delamination

Adhesives used for the modular construction system (in factory and situ) are in accordance with EN 301 Type I or EN 15425 for PU adhesives.

The adhesives are tested in accordance with the test methods for determination of resistance to delamination given in EN 14080.

Delamination is described in accordance with the specifications of EN 14080 and given in the ETA.

2.2.19 Resistance to corrosion of metal parts

The product specification (including associated ancillary components) is examined and an assessment or appropriate test and evaluation shall be carried out to determine the thickness of corrosion protection or the material specification.

If a zinc coating is used its thickness shall be determined by:

- hot-dip galvanized coating to EN ISO 1461, using the methods described in the standard, preferably using the non-destructive magnetic method of EN ISO 2178, or using the gravimetric method of EN ISO 1460 as a reference method in case of dispute,
- hot-dip zinc-coated sheet to EN 10346:2009 using the non-destructive magnetic method of EN ISO 2178, or using the methods described in Annex A of the standard in the case of dispute,
- electroplated zinc coating to EN ISO 2081, using the methods described in the standard, or using EN ISO 2177 as a reference method in case of dispute.

If stainless steel is used, it is designated in accordance with EN 10088-1.

If aluminium is used, it is designated in accordance with an appropriate standard.

The materials' specification or minimum corrosion protection for different service classes shall be in accordance with EN 1995-1-1. Alternative materials may be used provided that they have sufficient corrosion protection for the proposed intended use shown by assessment or testing.

The edges of hot-dip zinc coated-steel sheet to EN 10346:2009, with a minimum coating mass of Z275, are galvanically protected by the zinc present on the faces of the sheet, and are known to have satisfactory long-term service in service class 2 provided the steel thickness is less than or equal to 3,0 mm.

It is noted that standards for galvanized and electroplated coatings express mass/unit area of coatings with respect to the surface area, and standards for hot-dip coated sheet express mass/unit area with respect to the area of the sheet (ie the area of a sheet represents half the area of its surface).

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 97/176/EC

The system is: 1

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.

Table 3 Control plan for the manufacturer; cornerstones

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method (refer to 2.2 or 3.4)	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	The factory production control is performed in accordance with the provisions in EN 14080				
2	Delamination test of glue lines	EN 14080	As defined in the control plan	EN 14080	EN 14080
3	Design specifications <ul style="list-style-type: none"> • Dimensions • Materials • Geometry 	EN 15498	As defined in the control plan	EN 15498	every change of working shift
4	Visual inspection of modular construction system	Visual	As defined in the control plan	100%	
5	Checks on incoming materials <ul style="list-style-type: none"> • MFP boards • Adhesives (EN 15425) • Steel angles (EN 1090) • Metal fasteners (EN 14592) • Metal anchors (ETAG001) • Other connection systems 	Suppliers documentation	As defined in the control plan	Every delivery	Every delivery

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for modular construction systems are laid down in Table 4.

Table 4 Control plan for the notified body; cornerstones

Subject/type of control (<i>product, raw/constituent material, component - indicating characteristic concerned</i>)	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control				
Initial inspection of the manufacturing plant and of factory production control carried out by the manufacturer	As defined in the control plan	As defined in the control plan	As defined in the control plan	As defined in the control plan
Continuous surveillance, assessment and evaluation of factory production control				
Continuous surveillance, assessment and evaluation of the factory production control carried out by the manufacturer	As defined in the control plan	As defined in the control plan	As defined in the control plan	As defined in the control plan

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

ETAG 003 (1998-12), Internal partition kits for use as non-loadbearing walls

EOTA TR 001 (2003-02), Determination of impact resistance of panels and panel assemblies

EN 301, Adhesives, phenolic and aminoplastic, for load-bearing timber structures – Classification and performance requirements

EN 338, Structural timber — Strength classes

EN 13986, Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking

EN 14080, Timber structures - Glued laminated timber and glued solid timber - Requirements

EN 594, Timber structures — Test methods — Racking strength and stiffness of timber frame wall panels

EN 717-1, Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method

EN 1995-1-1, Eurocode 5 - Design of timber structures - Part 1-1: General - Common rules and rules for buildings

EN 1995-1-1/A1, 2008-06, Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings

EN 1995-1-2, Eurocode 5 - Design of timber structures - Part 1-2: General - Structural fire design

EN 13501-1+A1, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 13501-2+A1, Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

EN 13823, Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item

EN 15228, Structural timber — Structural timber preservative treated against biological attack

EN 15425, Adhesives - One component polyurethane for load bearing timber structures - Classification and performance requirements

EN 15498, Precast concrete products — Wood-chip concrete shuttering blocks — Product properties and performance

EN ISO 354, Acoustics – Measurement of sound absorption in a reverberation room

EN ISO 717-1+A1, Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation

EN ISO 717-2+A1, Acoustics – Rating of sound insulation in buildings and of building elements – Part 2: Impact sound insulation

EN ISO 10140-2, Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation

EN ISO 10140-3, Acoustics — Laboratory measurement of sound insulation of building elements — Part 3: Measurement of impact sound insulation

EN ISO 10456, Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007)

EN ISO 11654, 1997-04, Acoustics - Sound absorbers for use in buildings - Rating of sound absorption

EN 1090-1, Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components

EN 14592, 2012, Timber structures - Dowel-type fasteners - Requirements

ETAG 001, Metal anchors for use in concrete

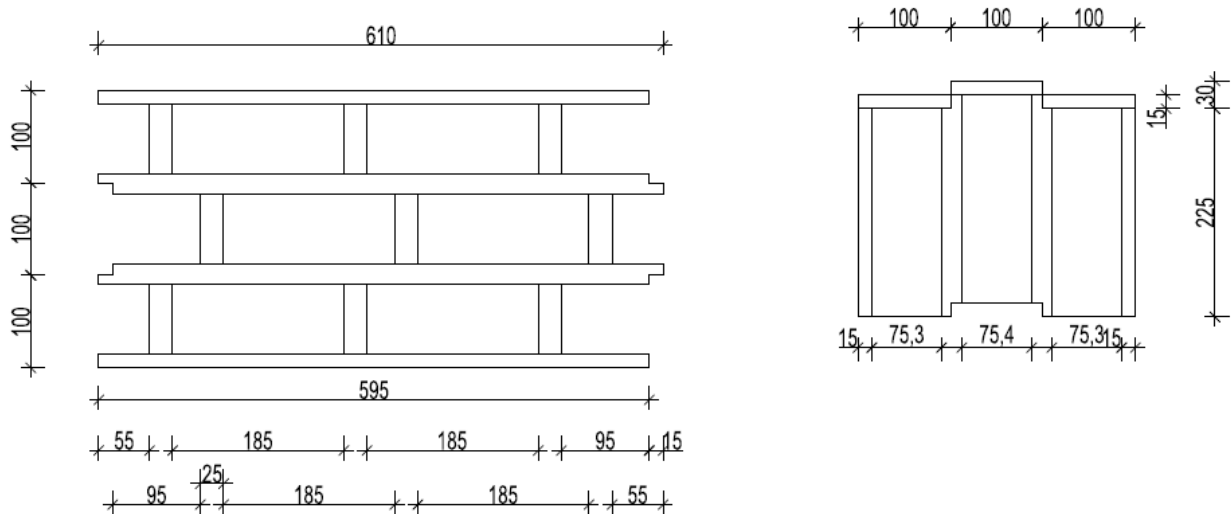
EN 13162, Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification

EN 1990, Eurocode - Basis of structural design

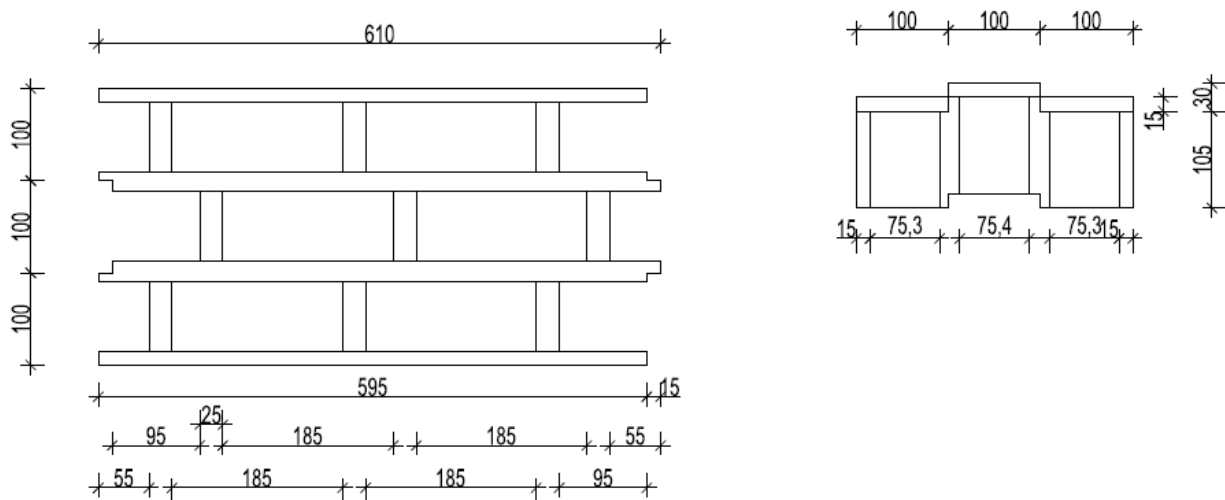
ANNEX A - DIMENSIONS OF THE PRIMARY BRICK TYPES

In addition to the examples given below, the kit consist of variations of bricks and various accessories, which will be specified in the ETA.

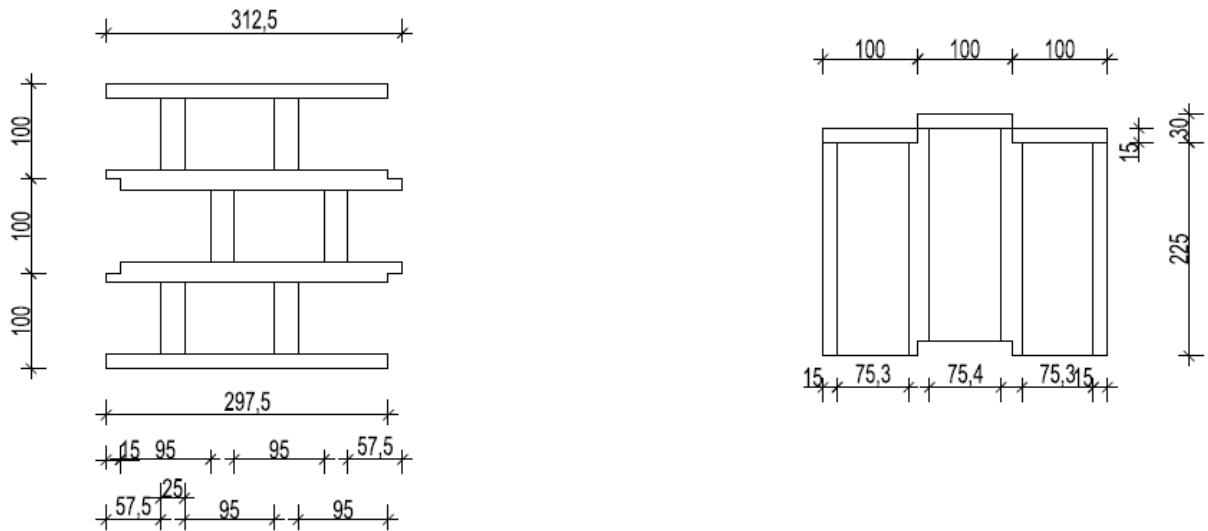
STANDARD BRICK 600x240x300



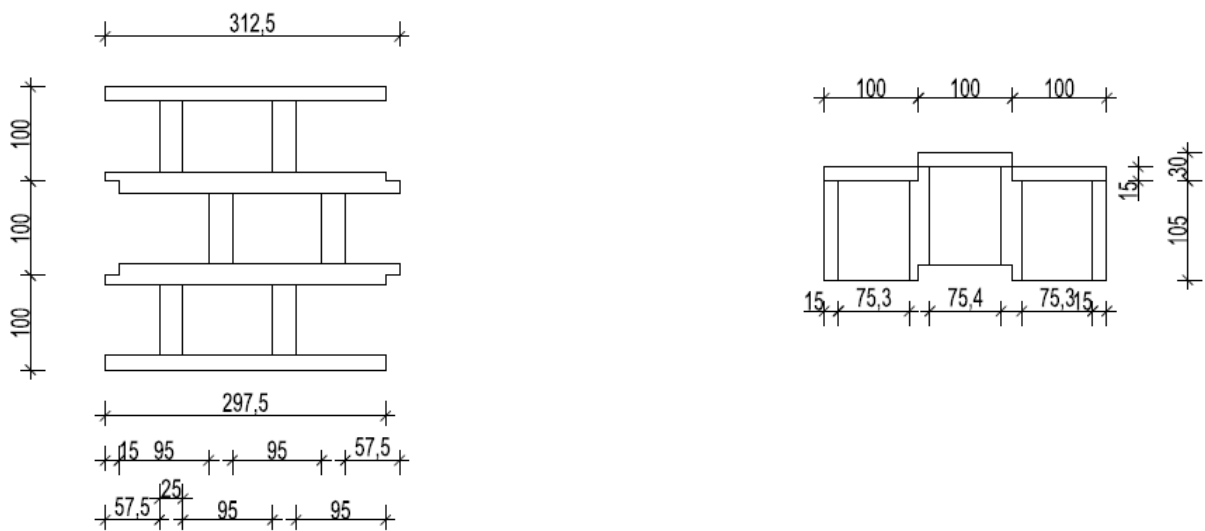
LOW BRICK 600x120x300



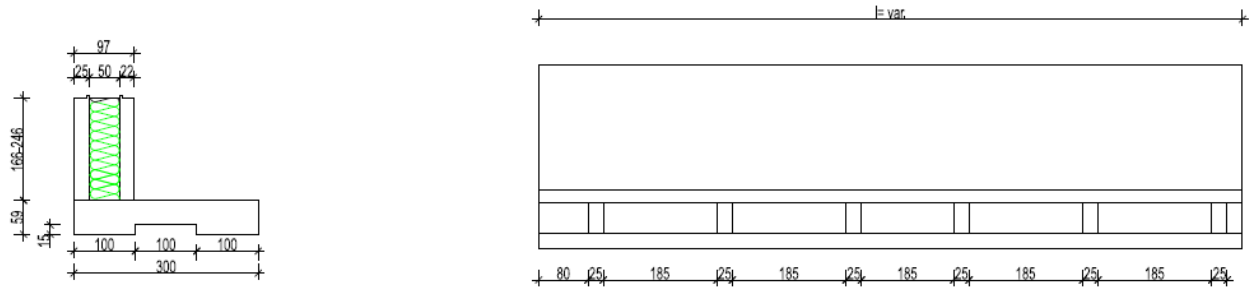
HALF BRICK 300x240x300



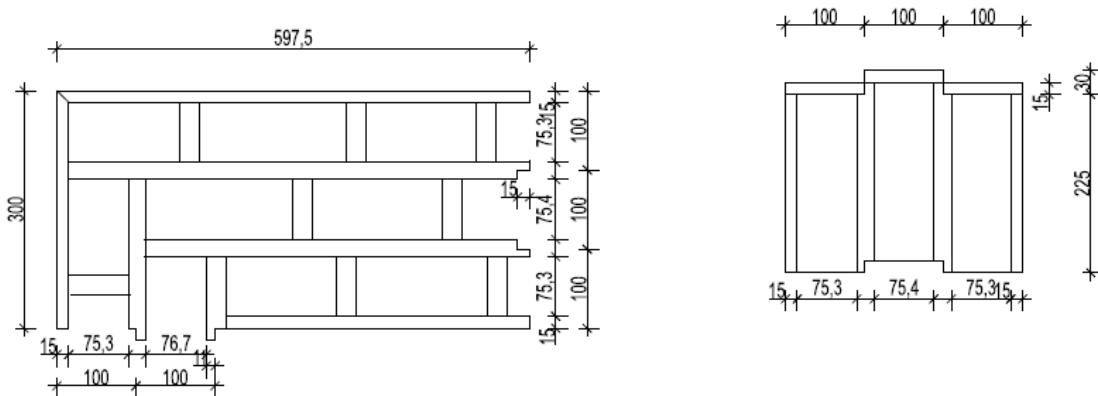
HALF LOW BRICK 300x120x300



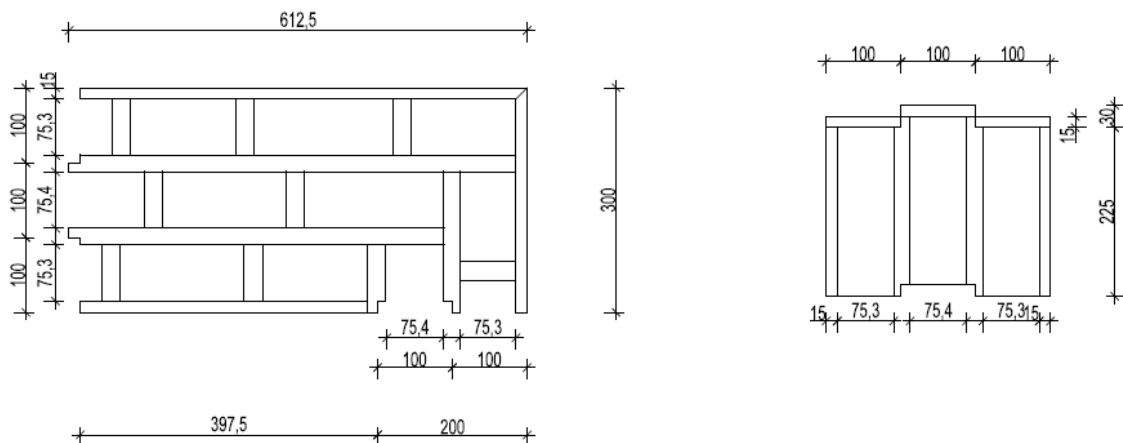
SUPPORT ELEMENT FOR FLOOR X-LAM H160-180-200-240mm



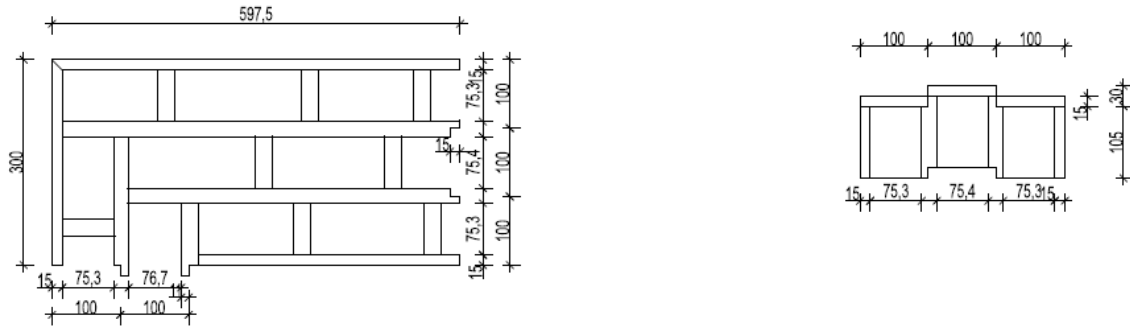
CORNER BRICK WITH TONGUE 600x240x300



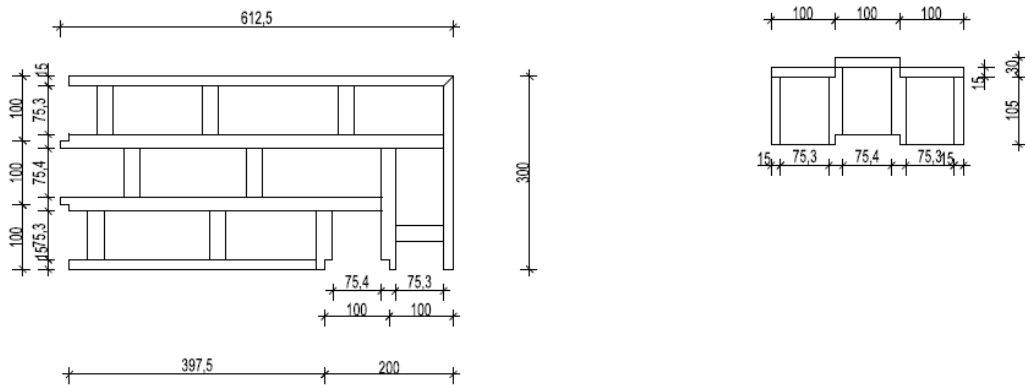
CORNER BRICK WITH GROOVE 600x240x300



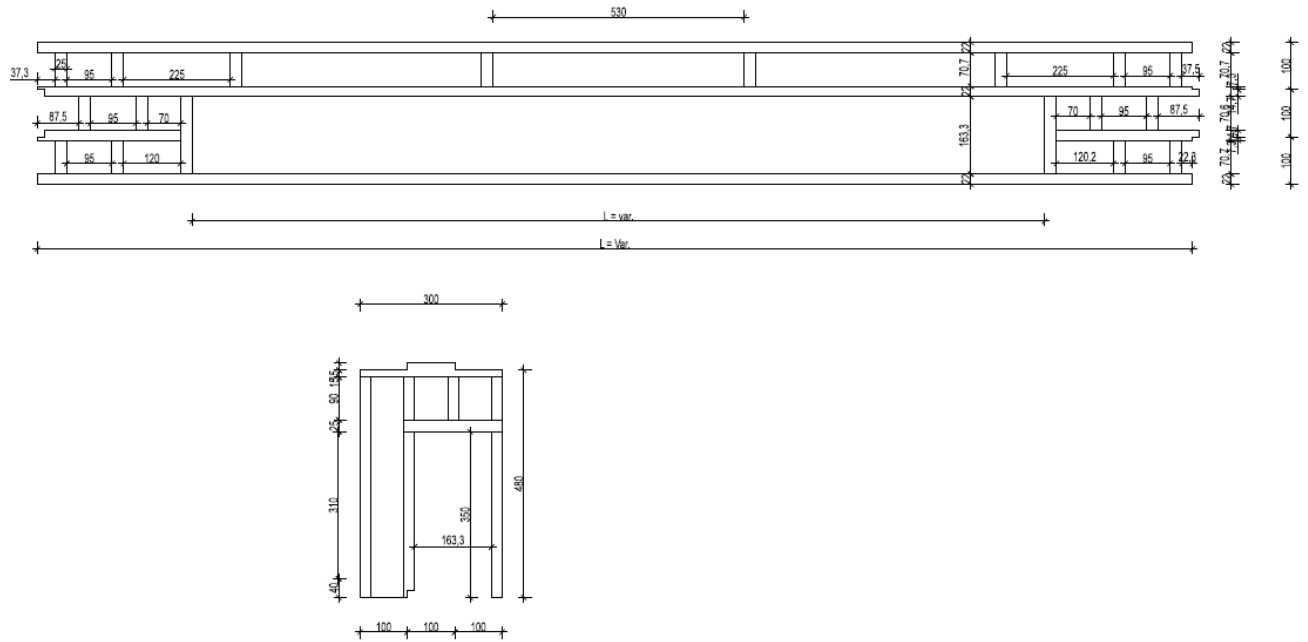
LOW CORNER BRICK WITH TONGUE 600x120x300



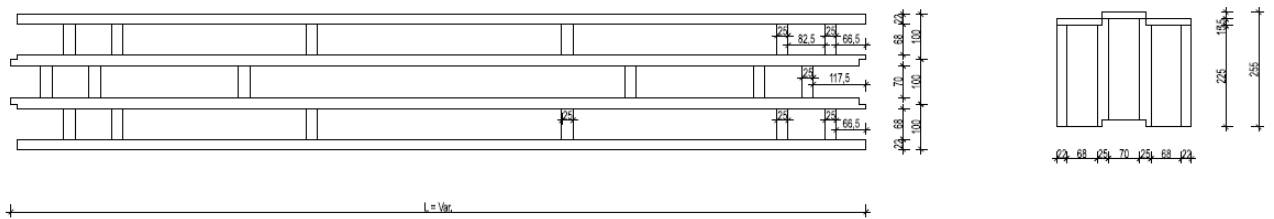
LOW CORNER BRICK WITH GROOVE 600x120x300



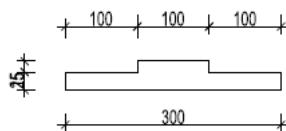
BOX FOR ROLLER SHUTTER (L= Var.)



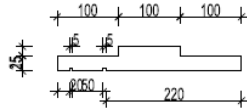
LINTEL L=Var. x 255x300



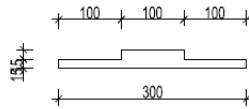
START ELEMENT WITH TONGUE H40mm L=var.



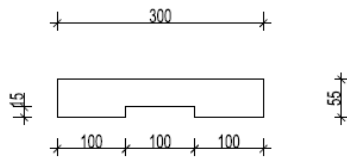
START ELEMENT WITH TONGUE (FLOOR) H40mm L=var.



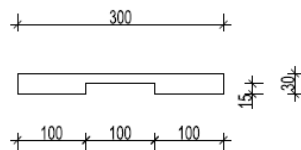
WALL CLOSING WITH TONGUE H30mm L=var.



WALL CLOSING WITH GROOVE H55mm L=var.

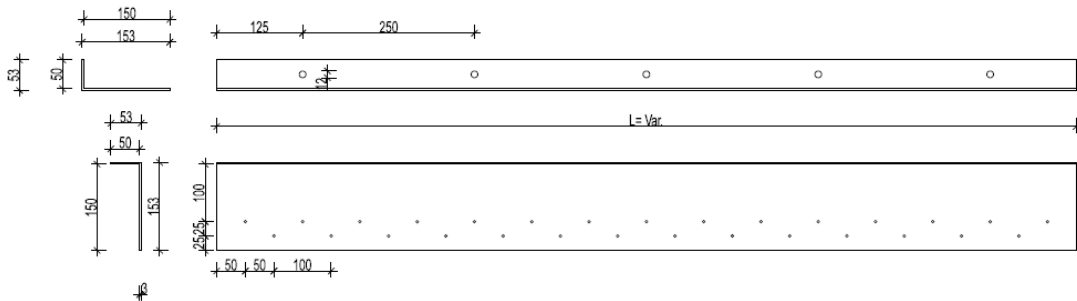


WALL CLOSING WITH GROOVE H30mm L=var.



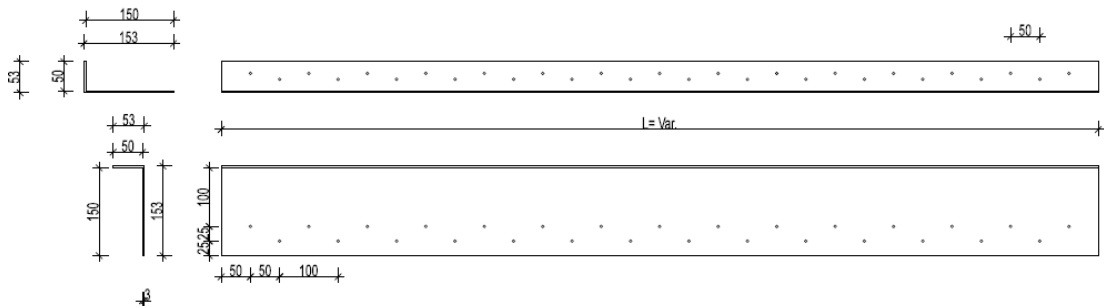
BASEMENT STEEL ANGLE BRACKET

50x150x 3mm thickness L= var.

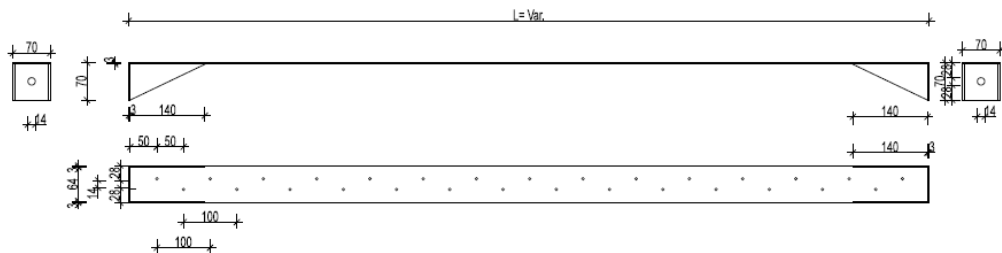


STEEL ANGLE BRACKET

50x150x 3mm thickness L= var.



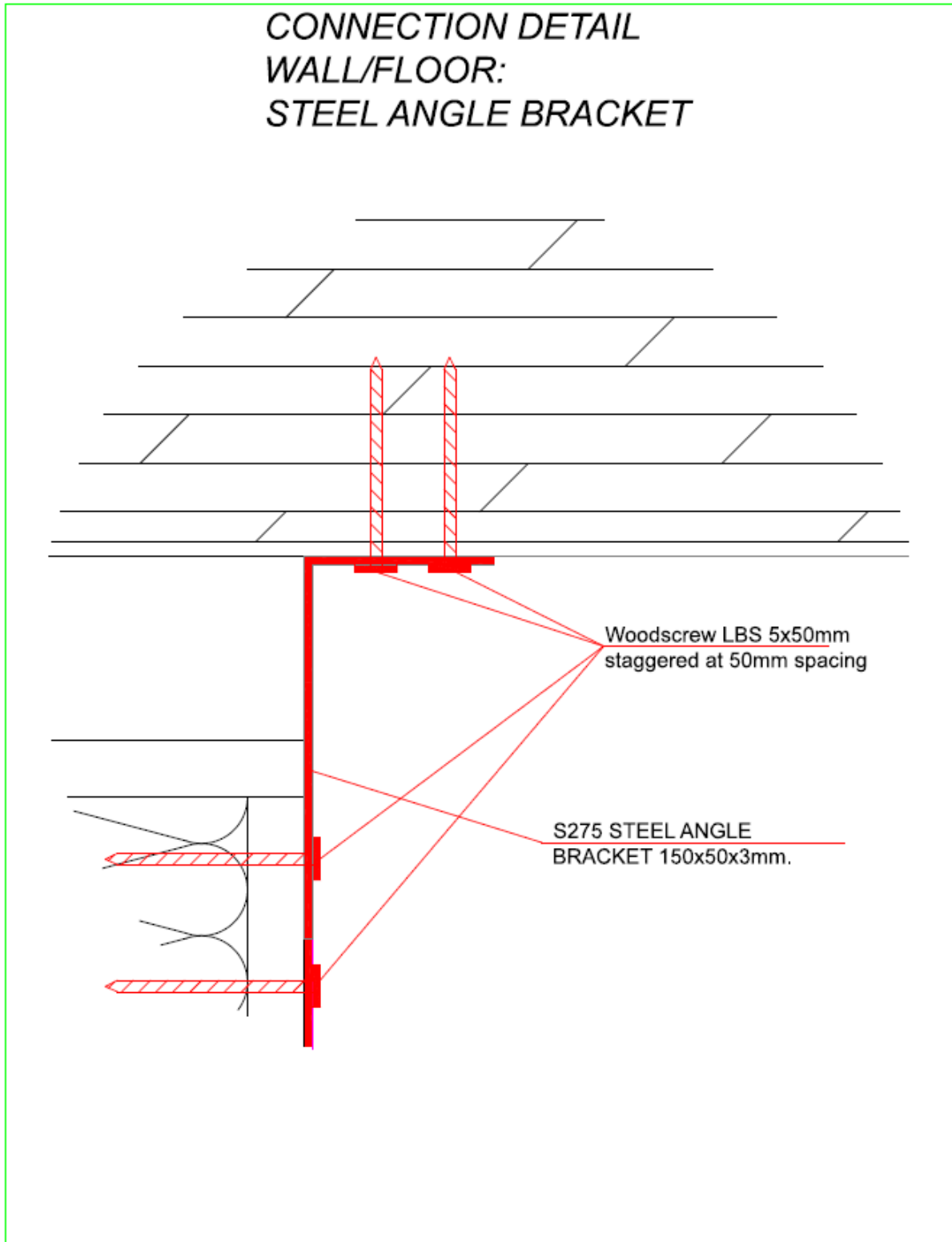
"Hold-down" 70x3mm thickness L= var.



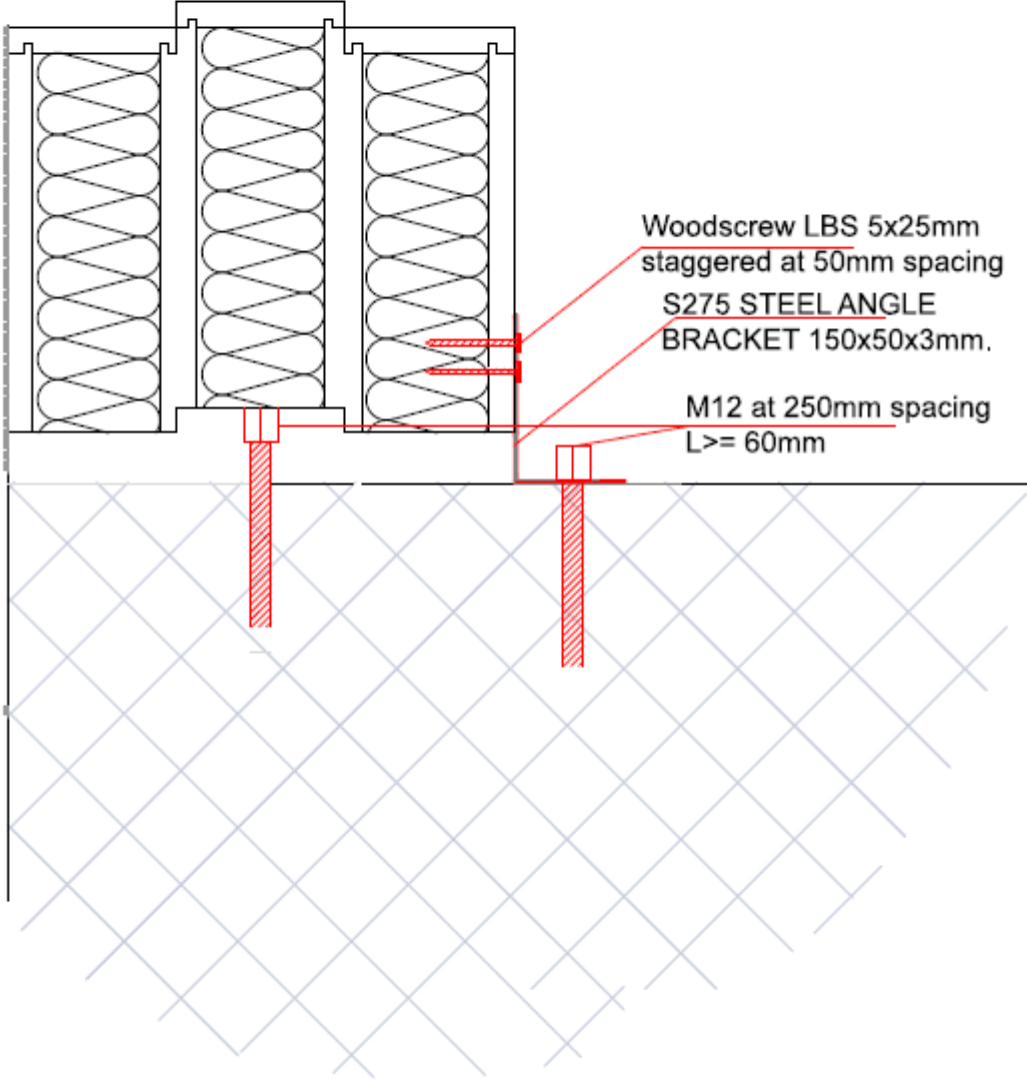
 reinforcement steel plate 10mm thickness

 reinforcement steel plate 10mm thickness

Annex B – EXAMPLES OF DETAILS OF STRUCTURES



CONNECTION DETAIL CONCRETE/WALL 1: STEEL ANGLE BRACKET



CONNECTION DETAIL CONCRETE/WALL 2: "HOLD DOWN" and perforated steel bracket

