European Technical Agreement  ETA-13/0339

(English version)

Nom commercial :  
Trade name:

MARC

Titulaire :  
Holder of approval:

IDF SOLAIRE

Type générique et utilisation prévue du produit de construction :  
Generic type and use of construction product:

Kit/système de coffrage intégré non porteur à base de panneaux constitués de matériaux isolants EPS. 
Non load bearing permanent shuttering kits based on panels made of EPS

Validity du :  
au : 
Validity from / to:

30/06/2013
30/06/2018

Usines de fabrication :  
Manufacturing plants:

MARC, Sos.Alexandriei 292, Bragadiru, Jud Ilfov, ROMANIA

Le présent Agrément technique européen contient :  
This European Technical Approval contains:

38 pages incluant 20 pages d’annexes faisant parties intégrantes du document.

38 pages including 20 pages annex which form an integral part of the document.
I \hspace{1em} \textbf{LEGAL BASES AND GENERAL CONDITIONS}

1. This European Technical Approval is issued by the Centre Scientifique et Technique du Bâtiment in accordance with:


   - Guideline for European Technical Approval of Non-loadbearing permanent shuttering kits/systems based on hollow blocks or panels of insulating materials and sometimes concrete ETAG 009, edition June 2002;

2. The « Centre Scientifique et Technique du Bâtiment » (CSTB) is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3. This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4. This European Technical Approval may be withdrawn by the « Centre Scientifique et Technique du Bâtiment » (CSTB), in particular after information by the Commission on the basis of Article 5(1) of Council Directive 89/106/EEC.

5. Reproduction of this European Technical Approval, including transmission by electronic means, shall be in full. However, partial reproduction can be made with the written consent of the « Centre Scientifique et Technique du Bâtiment » (CSTB). In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6. The European Technical Approval is issued by the approval body in its official language. This version should correspond to the version circulated within EOTA. Translations into other languages have to be designated as such.

\(^{(1)}\) Official Journal of the European Communities No L40, 11.2.1989, p12
\(^{(2)}\) Official Journal of the European Communities No L220, 30.8.1993, p1
\(^{(3)}\) Journal officiel de la République française du 14 juillet 1992
\(^{(4)}\) Official Journal of the European Communities No L17, 20.1.1994, p34
II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the system

The non-load bearing permanent shuttering kit Marc consists of elements made of expanded polystyrene with graphite (Neopor), applied as the formwork for plain or reinforced concrete walls cast in-situ.

The Marc shuttering elements consist of two panels of polystyrene (Neopor) held by polypropylene (HDPP) spacers, incorporated during production, that connect the shuttering panels and resist the pressure of the concrete during filling.

The kit consists of standard shuttering elements for a concrete core of 152,4mm/203,2mm/254mm, with the overall dimensions of 279,4mm/330,2mm/380mm and passive shuttering elements for a concrete core of 203,2mm, with the overall dimension of 446,7mm, in straight and corner types of blocks.

The height of the shuttering element is 406,4 mm and the length is 1219,2 mm. The upper and the lower surfaces of the shuttering panels are tongue and groove to lock elements together.

Renderings, coatings and plasters are not part of this ETA.
Structural analysis on concrete infill is not part of this ETA.

1.2 Intended use

The system is for use in forming loadbearing and nonloadbearing internal or external walls, for buildings. Once filled on site with concrete, the EPS formwork remains as a permanent part of the wall and so contributes to the overall thermal resistance of the completed wall construction.

When using this type of construction below ground a waterproofing membrane, according to applicable national rules and compatible with the EPS, should be provided on the external surface. The membrane should be applied in accordance with the manufacturer’s installation instructions and be protected from damage using an impact-resistant protective layer or sand blinding.

For the intended use it is essential to protect the formwork against effects of the weather.

1.3 Intended life

The provisions made for the shuttering kit Marc in this ETA are based on an assumed working life for the system of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the manufacturer or approved body, but are to be used as a means for selecting the appropriate product in relation to the expected economically reasonable working life of the works.
2 Characteristics of product and methods of verification

2.1 Characteristics of product

2.1.1 Shuttering panels (Neopor elements)

The shuttering elements, composed of Neopor shuttering panels correspond to the information and drawings given in Annex 1.

The shuttering panels are made of expanded polystyrene with graphite (Neopor) according to EN 13163. The parameters and characteristics of the Neopor elements are indicated in Table 1.

<table>
<thead>
<tr>
<th>NEOPOR PANELS</th>
<th>Designation Code of Neopor according EN 13163</th>
<th>Mean Value of Density ρ (kg/m³)</th>
<th>Nominal Value of Thermal Conductivity λ (W/mxK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Panel</td>
<td>EPS-EN13163-T2-L1-W1-S2-P4-DS(7,-1)-BS250-SC(10)-120-DS(N)-2-TR100-WL(T)-0,7-WD(V)-3</td>
<td>24</td>
<td>0,030</td>
</tr>
<tr>
<td>Passive Panel</td>
<td>EPS-EN13163-T2-L1-W1-S2-P4-DS(7,-1)-BS250-SC(10)-120-DS(N)-2-TR100-WL(T)-2-WD(V)-3</td>
<td>24</td>
<td>0,030</td>
</tr>
</tbody>
</table>

2.1.2 Spacers

The spacers are moulded of high density polypropylene (HDPP spacers).

The tensile strength of the HDPP spacers shall be at least 28 N/mm² for standard shutter element and 31 N/mm² for passive shutter element.

Spacers are fabricated by S.C. MAT PLAST INDUSRTY S.R.L. located in Piteşti (Romania). Trade name is Spacer15, Spacer20, Spacer25 and Spacers passiv depending on the MARC kit.

The material characteristics, dimensions and tolerances of the shuttering elements not indicated in Annex 2.

2.2 Methods of verification

2.2.1 General considerations

The assessment of the fitness of the shuttering system for the intended use has been made in compliance with ETAG 009 Guideline for European Technical Approval of non load-bearing permanent shuttering kits/systems based on shuttering elements or blocks of insulating materials and sometimes concrete edition June 2002. The ETA is issued for the MARC System shuttering kit on the basis of agreed information, deposited with the « Centre Scientifique et Technique du Bâtiment » (CSTB), which identifies the shuttering kit that has been assessed and evaluated. Changes to the production
process of the kit or the components which could result in this deposited information being incorrect, shall be notified to the CSTB before the changes are introduced. The CSTB will decide whether or not such changes affect the ETA and consequently the validity of the CE Marking on the basis of the ETA and, if so, whether further assessment and/or alterations to the ETA shall be necessary.

2.2.2  Mechanical resistance and stability (ER1)

2.2.2.1  Resulting structural pattern

In end use conditions walls made with MARC System shuttering elements are walls of continuous type according to ETAG 009, paragraph 2.2.

2.2.2.2  Efficiency of filling

The requirements according to ETAG 009, section 6.1.2 are met through observation of the filling of a test panel with concrete and observation of filling technique. The use of vibThe efficient filling without bursting of the shuttering and without voids or any uncovered reinforcement in the concrete core is possible.

2.2.2.3  Possibility of steel reinforcement

The instructions in the MARC Working Procedures are appropriate to install steel reinforcement for walls according to EN 1992-1-1 : 2004 or corresponding national rules. The requirements according to ETAG 009, section 6.1.3 are met satisfactorily.

2.2.3  Safety in case of fire (ER2)

2.2.3.1  Reaction to fire

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>TRADE NAME</th>
<th>RAW MATERIAL</th>
<th>REACTION TO FIRE according EN 13501-1:2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARC</td>
<td>MARC kit</td>
<td>BASF NEOPOR</td>
<td>Euroclass E</td>
</tr>
</tbody>
</table>

It is pointed out in addition that the inner panels of the walls are intended to be covered by gypsum boards or other coatings under technical agreement. The reaction to fire classification shall be therefore verified according to the field application.

2.2.3.2  Resistance to fire

The shuttering system MARC can be assimilated to a continuous type structural wall and meet the resistance to fire requirements given in the first column of Table 1 in Annex C of ETAG 009.

<table>
<thead>
<tr>
<th>Concrete core thickness (mm)</th>
<th>Resistance to fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>REI 120</td>
</tr>
<tr>
<td>200</td>
<td>REI 120</td>
</tr>
<tr>
<td>250</td>
<td>REI 120</td>
</tr>
</tbody>
</table>

This classification is only valid with the following conditions:

- The design of the building has to take into consideration the secondary effects of fire. Especially constraints, introduced by thermal strain, should be sufficiently low and appropriate building joints should be foreseen. The rules, valid in place
of use, govern. Structural requirements on work in normal conditions, valid in the place of use, may require larger dimensions. Concrete cover for the reinforcement has to be observed according to the rules valid in the place of use.

- The strength of concrete shall be between C20/25 and C50/60 according to EN 206.
- Indoor and outdoor finishes on walls must not contain organic chemicals.
- Walls have to be exposed on one side.

This classification is only valid with the following conditions:

- The degree of utilisation in fire situation \( \mu_{fi} = \frac{N_{Ed,fi}}{N_{Rd}} \) shall be limited to 0.7 according to Annex C of EATG 009;
- The risk of spalling shall be consider according to §4.5 of EN 1992-1-2:
  - Explosive spalling shall be avoided: control of the moisture content of the concrete according to §4.5.1 (2) of EN 1992-1-2;
  - Falling off of concrete in the latter stage of fire exposure shall be avoided: surface reinforcement should be provided according to §4.5.2 (2) of EN 1992-1-2;

The classification of the walls constructed with the shuttering system regarding to fire resistance are valid for walls without openings (for windows or doors for example).

2.2.4 Hygiene, health and the environment (ER3)

2.2.4.1 Content and/or release of dangerous substances

Based on the declaration of the manufacturer, the products of the shuttering kit MARC do not contain harmful or dangerous substances as defined in Regulation (EC) No. 1272/2008, with exception of flame retardant.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Product Regulation, these requirements need also to be complied with, when and where they apply.

The use of “T+” or “T” substances according to Regulation EC 1272/2008 must be avoided. When such use can’t be avoided for technical reasons, a specific evaluation must be done.

The intended use for this kit is IA2 and S/W3.

The manufacturer states that MARC system contains Hexabromocyclododecane (HBCD) as a flame retardant. The content of HBCD is less than 0,1% w/w.

The release of organic chemicals VOC, VVOC and SVOC is not verified with this ETA.

2.2.4.2 Water vapour permeability

The tabulated design value of water vapour diffusion resistance coefficient of expanded polystyrene, in accordance with the European standard EN ISO 10456 “building materials and products, hygrothermal properties- tabulated design is been worth” is 60.
The values for the water vapour diffusion resistance of concrete in dependence of density and type and of the different inserts of insulating material are tabulated in EN ISO 10456.

Impact of moisture accumulation inside a wall using MARC shuttering kit has not been examined.

2.2.5 Safety in use (ER4)

2.2.5.1 Bond strength between the shuttering leaves and the concrete core
The bond strength is at least equal to the resisting concrete pressure of the shuttering elements according to clause 2.2.4.2. The requirements of ETAG 009, section 6.4.1.3 are met satisfactorily.

2.2.5.2 Resistance to filling pressure
During the pouring and casting of the concrete infill, the formwork resists the pressure of wet concrete through the inherent strength and tying action of spacers.

The resistance to filling pressure has been determined by observation of lower sections of the shuttering leaves and is satisfactory for filling up to heights of approximately 3.0 m. At each time, filling height shall not exceed 80 cm. Time between two fillings shall be at least 25 minutes.

The resistance tests carried out on elements subjected to a pressure effect simulating the push of the fresh concrete for panels with 60 mm thickness show the risks of bursting of the panels appear limited.

Requirements according to ETAG 009, section 6.4.2 are met satisfactorily.

2.2.5.3 Safety against personal injury by contact
As delivered on site the shuttering elements do not have sharp or cutting edges. Because of the soft surface of the shuttering leaves there is no risk of abrasion or of cutting to people.

The requirements contained in ETAG 009 chapter 6.4.3 are regarded as satisfied.

2.2.6 Protection against noise (ER5)

2.2.6.1 Airborne sound insulation
The « no performance determined » option in ETAG 009 is used.

2.2.6.2 Sound absorption
The « no performance determined » option in ETAG 009 is used.

2.2.7 Energy economy and heat retention (ER6)

2.2.7.1 Thermal resistances
For thermal resistance, the nominal value of the thermal resistance R of the wall using MARC System elements, once filled with concrete, can be determined in accordance with EN ISO 6946:2007, EN 13163:2008 and EN 12524:2000. Once moulded and
cured, the EPS has a nominal density of 24 kg/m³ with a nominal thermal conductivity of 0.030 W/(m x K).

The thermal resistance data of the shuttering elements are given in Annex 17 (CSTB’s report on thermal resistance). Thermal conductivity of reinforced concrete is 2.0 W/(m x K).

2.2.7.2 Thermal inertia
The tabulated values for heat capacity and diffusivity of concrete and expanded polystyrene are given in EN ISO 10456.

The impacts of moisture accumulation have not been examined in this ETA.

2.2.8 Aspects of durability and serviceability

2.2.8.1 Resistance to deterioration
2.2.8.1.1 Physical agents
The requirements contained in guide 009 chapter 6.7.1.1 are regarded as satisfied.

2.2.8.1.2 Chemical agents
The requirements contained in guide 009 chapter 6.7.1.2 are regarded as satisfied.

2.2.8.1.3 Biological agents
The requirements contained in guide 009 chapter 6.7.1.3 are regarded as satisfied.

2.2.8.2 Resistance to normal use damage
2.2.8.2.1 Incorporation of ducts
The instructions given in the installation guide of the manufacturer are suitable for the realization of perforations through the walls to make pass ducts. Generally, ducts should be incorporated in twin shuttering elements prior to concreting.

2.2.8.2.2 Anchorage of suspended objects
The anchorage of suspended objects is not allowed into the shuttering leaves. It must be anchored into the concrete core.
<table>
<thead>
<tr>
<th>EE</th>
<th>Paragraphe ETAG sur la performance du produit à évaluer</th>
<th>Classe Catégorie d'utilisation Valeur numérique</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>§ 6.1.1 Resulting structural pattern</td>
<td>Continuous type</td>
</tr>
<tr>
<td></td>
<td>§ 6.1.2 Efficiency of filling</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>§ 6.1.3 Possibility of steel reinforcement</td>
<td>Acceptable</td>
</tr>
<tr>
<td>2</td>
<td>§ 6.2.1 Reaction to fire</td>
<td>Euroclass E</td>
</tr>
<tr>
<td></td>
<td>§ 6.2.2 Resistance to fire</td>
<td>Tabulated values</td>
</tr>
<tr>
<td>3</td>
<td>§ 6.3.1 Dangerous substances</td>
<td>No harmful substances declared</td>
</tr>
<tr>
<td></td>
<td>§ 6.3.2 Water vapour permeability</td>
<td>Tabulated values</td>
</tr>
<tr>
<td></td>
<td>§ 6.3.3 Water absorption</td>
<td>Acceptable</td>
</tr>
<tr>
<td>4</td>
<td>§ 6.4.1 Bond strength</td>
<td>No performance determined</td>
</tr>
<tr>
<td></td>
<td>§ 6.4.2 Resistance to filling pressure</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>§ 6.4.3 Safety against personal injury by contact</td>
<td>No performance determined</td>
</tr>
<tr>
<td>5</td>
<td>§ 6.5.1 Airborne sound insulation</td>
<td>No performance determined</td>
</tr>
<tr>
<td></td>
<td>§ 6.5.2 Sound Absorption</td>
<td>No performance determined</td>
</tr>
<tr>
<td>6</td>
<td>§ 6.6.1 Thermal resistance</td>
<td>Thermal resistance values</td>
</tr>
<tr>
<td></td>
<td>§ 6.6.2 Thermal inertia</td>
<td>Tabulated values</td>
</tr>
</tbody>
</table>
|    | § 6.7.1 Protection against damages caused by:  
|    | – physical agents  
|    | – chemical agents  
|    | – biological agents | Acceptable  
|    | § 6.7.2 Resistance to normal-use damage:  
|    | – shocks in normal use  
|    | – incorporating ducts  
|    | – fixing objects | Acceptable  
|    | | Acceptable  
|    | | Acceptable  
|    | | Acceptable |
3 Evaluation of Conformity and CE Marking

3.1 Attestation of conformity

The system of certificate of conformity applicable to these products, described in mandate 98/279/CE of December 5, 1997 (Official Journal L 127, 24.04.1998) of the European Commission, is of type 2+ (Appendix III, clause 2(ii) second possibility of the directive 89/106/EEC) for the kits which there is not clearly identifiable stage of the manufacturing process allowing an improvement of the classification of fire performance.

a) tasks for the manufacturer
   1) initial type testing of the product;
   2) factory production control;
   3) testing of samples taken at the factory in accordance with a prescribed test plan.

b) tasks for the approved body: certification of factory production control on the basis of:
   1) initial inspection of factory of the factory production control;
   2) continuous surveillance, assessment and approval of factory production control.

3.2 Responsibilities

3.2.1 Tasks for the manufacturer, Factory production control

The manufacturer continues to operate a factory production control system and sustains a permanent internal audit of production. Quality control are carried out at various stages of the production to ensure quality and aptitude for the intended use of all components. All elements, requirements and provisions adopted by the manufacturer are documented. This ensures the product conforms with this ETA.

The production quality control system ensures that the product is in conformity with ETA-XX/XXXX. The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the prescribed test plan. The prescribed test plan is deposited with the « Centre Scientifique et Technique du Bâtiment » (CSTB) and is made available to the approved bodies involved in the conformity attestation process.

The raw materials shall be subject to agreed controls and tests by the manufacturer before acceptance. Checks on incoming materials, such as Neopor raw material and polypropylene spacers, shall include control of the certificates of conformity presented by suppliers (comparison with nominal values) and by verifying dimensions and determining material properties, e.g. chemical composition and physical properties.

The manufactured components are checked for dimensional compliance and visually for surface and other defects.
The frequency of controls and tests conducted during production and on the finished panel is laid down in the prescribed test plan, taking account of the manufacturing process.

The results of factory production control are recorded and evaluated. The records include at least:

- designation of the product
- type of control or testing
- date of manufacture of the product and dates of testing of the product or basic material and components
- result of control and testing and, if appropriate, comparison with requirements
- signature of person responsible for factory production control.

The records shall be presented to the inspection body involved in the continuous surveillance.

Details of the extent, nature and frequency of testing and controls to be performed within the factory production control shall correspond to the prescribed test plan included in the technical documentation of this ETA.

### 3.2.2 Tasks for approved bodies

#### 3.2.2.1 Initial type-testing of the product

For initial type-testing the results of tests, assessments and calculations performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary type-testing has to be agreed between the « Centre Scientifique et Technique du Bâtiment » (CSTB) and the approved body involved.

#### 3.2.2.2 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the system components with the specifications given in part II, section 2 and the accompanying Annexes to this ETA.

#### 3.2.2.3 Continuous surveillance

The approved body shall visit the factory at least once a year for routine inspections. It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the prescribed test plan.

The results of continuous surveillance shall be made available on demand from the approved body to the « Centre Scientifique et Technique du Bâtiment » (CSTB). Where the provisions of the European Technical Approval and the prescribed test plan are no longer fulfilled, the certificate of conformity shall be withdrawn by the certification body.
3.3 CE marking

The CE Marking shall be affixed to the packaging and on commercial documents. The CE symbol shall be accompanied by the following information:

- identification number of the notification body
- identification of the product MARC
- name or identification mark of manufacturer
- the last two digits of the year in which the CE Marking was affixed
- number of the European Technical Approval XX/XXXX
- number of the EC certificate of conformity
- Reaction to fire Euroclass E according to EN 13501-1

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The ETA is issued on the basis of agreed data/information, deposited with CSTB, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to CSTB before the changes are introduced. CSTB will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA and if so whether further assessment or alterations to the ETA shall be necessary.

4.2 Installation

4.2.1 Detailed marking of the walls

The detailed marking is done according to the project, depending on the level points and items placed in the field when marking the construction layout, in order to determine the contour and the major axes of the walls. Such planimetric and altimetric markings shall materialize so that to become reference points throughout the entire duration of the construction process, serving for sending the horizontal and vertical data to all levels.

**Step 1:** Verify the project stage PT+DE and determine the walls layout and dimensions.

**Step 2:** Using a chalk cord or a string, mark the wall placement on foundation or the elevation plate (mark either the external contour or the internal contour of the wall – usually, it is most convenient to mark the external contour). The marking line of walls layout is to be doubled by another line a few centimeters away, in order not to loose the positioning reference point while assembling the formworks.
An alternative to chalk cord marking is the use of an L or U-shaped section made of thin walled metallic section. The section must be attached to the foundation or the elevation plate by means of nail gun concrete anchors or adhesive foam.

Step 3: Check the corners to be right-angled (90°) using an angle bevel, surveying devices and by measuring the edges and diagonals and verify them by applying Pitagora’s theorem.

Step 4: Measure and mark on the foundation or on the place the position of gaps and mark down the balustrade height inclusively.

4.2.2 Formwork and formwork supports

Step 1: Place the formworks straight starting from the corners towards the center of the wall or the gap frame. If the foundation or plate reinforcement (continuity bar) touches the spacer, the latter deviates to some extent.

Step 2: After placing the second row of formwork assembly the support system, which concomitantly provides the walls verticality. This is to be done on one side of the interior walls in their field areas, with the systems pillars spaced at maximum 1.50 m, respectively on both sides (or on one side with external lining) after preliminary cutting the spacers from the end areas, where woven cases made of bar are used, the systems pillars spaced at maximum 60 cm.

Step 3: The other rows of formwork are to be placed as described in step 3, each unit being fastened with slight blows.

Step 4: It is mandatory to lay additional lining on the following areas: all walls crossings, formworks where a spacer had been cut, formworks joints on an area resulting after cutting one of the formworks, compensated joints between the formwork units and the gaps edges.

Step 5: Glue the base of the first row of foundation or plate formwork using a gun for adhesive foam with controlled bloating inserted in cracks at 5-30 cm. Leave the adhesive to cure for 10-60 minutes.

4.2.3 Reinforcing

Reinforcement will be done accordingly to the local rules and regulations and to the structural engineers’ plans.
REQUIREMENTS:

**Requirement 1: Shaping the reinforcement according to the project**

Criteria: 1.1 Type and class of products for reinforcements;
1.2 Dimensions: nominal diameter, lengths and joining lengths within
the admissible deviations, on a case by case basis;
1.3 Shape within the admissible deviations.

**Requirement 2: Mounting the reinforcement according to the project**

Criteria: 2.1 Compliance with the project by the shaped reinforcement
(individual or case-assembled), verified when mounted;
2.2 Compliance with the relative position between bars and to the
formwork (concrete casting);
2.3 Compliance with the positions of bars joining and of the
overlapping lengths for this type of joining.

**Requirement 3: Providing shape stability and the reinforcement position
throughout the works, after mounting the reinforcement**

Criteria: 3.1 Type, layout and fastening of spacers providing concrete
coverage;
3.2 Type, layout and fastening of spacers (other than cross-ties and
fasteners) ensuring the distance between the reinforcements rows.

**Requirement 4: Providing preliminary conditions for reinforcement shaping and
mounting**

Criteria: 4.1 Existence of the work project, and the necessary data;
4.2 Providing conditions for reinforcement shaping by order sent to
the processing entity, if case;
4.3 Existence, on a case by case basis, of the data and conditions for
making the joining using other methods than overlapping;
4.4 Existence of reception documents for formworks and support
works;
4.5 Providing the conditions specific for this category of works:
technical endowment, facilities, skilled personnel, adequate
materials.

**Requirement 5: Reception of assembled reinforcements**

Criteria: 5.1 Verifying the assembled reinforcements;
5.2 Solving non-conformities, if case;
5.3 Preparing the reception documents.

4.2.4 Concrete placing and consolidation

The concrete order to suppliers or to its own concrete stations is launched according to
the provisions of concrete specification attached to the project, prepared according to
the provisions of the technical plans.
Tab. 2 Characteristics recommended for the concrete specification

<table>
<thead>
<tr>
<th>Concrete Characteristic</th>
<th>Formwork type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150 mm</td>
</tr>
<tr>
<td>Minimum class of concrete</td>
<td>C 20/25</td>
</tr>
<tr>
<td>Consolidation [mm]</td>
<td>150</td>
</tr>
<tr>
<td>Water/cement ratio A/C</td>
<td>0.55</td>
</tr>
<tr>
<td>Maximum dimension of the aggregate [mm]</td>
<td>8</td>
</tr>
</tbody>
</table>

4.2.5 Pouring fresh concrete by pump

The fresh concrete is placed in compliance with the provisions of the local rules and regulations.

The first quantity of concrete (the sediment initially coming out through the hose) is pumped out of the formworks.

If the pump is not fitted with a reduction of maximum 8 cm, the pump hose shall be positioned horizontally at 1-1.5 m parallel to the MARC formworks in order to mitigate the concrete dropping force.

The concrete placing starts from one point and goes along the wall perimeter clockwise or anti-clockwise. The concrete placing stops at approximately 0.6-0.9 m away from the next corner. The concrete must not be placed in the same place again until at least one hour later.

The concrete must always be placed at constant pace (the recommended pace for pouring the concrete of MARC system walls is between 600 and 900 mm/h, maximum 1200 mm/h) and on heights of maximum 0.90-1.20 m in one pouring stage.

The corners require a special attention during concrete placing given their shape. Compared against straight formwork, the corner formworks are always subject to a higher lateral pressure because of concrete positioning. The solution is to equalize as much as possible the concrete pressure on both sides of the corner formworks, as follows:

- start by pouring the concrete from approximately 0.6-0.9 m distance from the centre of the corner;
- the concrete is poured at constant pace on both sides of the corner formwork by moving the pump hose or the discharge point back and forth;

The door and window frames must be filled in on both sides in a pouring stage.

At a lintel, the walls are filled continuously, along its entire length of approximately 0.6 - 0.9 m on both sides of the void.

If another floor is built on top of the current one, stop filling the upper row of formworks at least 5 cm below the formwork top edge. The upper side is left rough, uneven, so that the second concrete placing has a rugged surface.

The surface of the last row of formwork where the concrete is poured shall be evened with the trowel.
4.2.6 Concrete condensation

Each layer of concrete shall be vibrated, using standard vibrators, chosen according to the concrete workability, the dimensions of the element and the reinforcement density. No new layer of concrete shall be poured until completely vibrating the concrete from the previous layer. The previous layer of concrete shall be covered with the new layer before bonding, so that the bottom layer is able to be re-vibrated with the new layer placed.

The vibrating device is inserted in concrete given its weight down to 5–15 cm deep into the previous compacted layer, and the same device should be pulled out as slowly as possible, approximately 8 cm/s in order not to create voids on the layer’s surface.

The optimum vibration duration is 5–15 seconds depending on the concrete workability and type of vibrating device. The vibration points shall be chosen so that the influence areas overlay horizontally.

The vibration stops when the concrete surface becomes horizontal and slightly shiny, no more air bubbles are coming out from the concrete, the concrete no longer settles and water or cement milk gathers on the concrete surface.

Avoid contact between the vibrators and formworks, reinforcement bars, embedded parts etc.

Tab. 3 Characteristics of the immersion vibrators

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>15 cm thick walls</th>
<th>20 and 25 cm thick walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum diameter of the head [mm]</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>Frequency [rot/min]</td>
<td>10000</td>
<td>9000</td>
</tr>
<tr>
<td>Maximum range of action [mm]</td>
<td>100</td>
<td>152</td>
</tr>
<tr>
<td>Immersion depth [mm]</td>
<td>152</td>
<td>228</td>
</tr>
<tr>
<td>Centrifugal force [daN]</td>
<td>100</td>
<td>225</td>
</tr>
<tr>
<td>Productivity [m³/h]</td>
<td>1.5-3.0</td>
<td>1.5-3.8</td>
</tr>
</tbody>
</table>

5 Recommendations

5.1 Recommendation on packaging, transport and storage

5.1.1 Packaging

Packaging of the components has to be such that they are protected against moisture during transport and storage, unless other measures are foreseen by the manufacturer for this purpose.

The components are to be protected against damage.
5.1.2 Transport

The company IDF ensures transport to the construction work. However transport can be arranged by another supplier.

5.1.3 Storage

Packs should be stored flat.

5.2 Recommendations relating to the use, maintenance and repair

For a good efficiency of filling, the casting of the concrete must be done in several steps from the top of walls under roofing, and in two steps at least for current storey heights.

Regular checks should be carried out on render finishes to ensure that any damage is detected and repaired as soon as possible.

The recommendations on use, maintenance and repair in ETAG 009 section 7.5 shall be considered.

Le Directeur Technique

Charles BALOCHE
standard insulated concrete form
LEFT CORNER BLOCK 90°-15 cm

SECTION Y-Y'

SECTION X-X'

PLAN STANDARD ICF RIGHT CORNER 90°

VIEW 2-3

VIEW 1-2

VIEW 3-4

standard insulated concrete form
LEFT CORNER BLOCK 90°

s15 ICF-LCB 90°
standard insulated concrete form
LEFT CORNER BLOCK 45°-15 cm

SECTION Y-Y'

SECTION X-X'

PLAN STANDARD ICF - LEFT CORNER 45°

VIEW 1-2

VIEW 2-3

VIEW 3-4

VIEW 4-1
standard insulated concrete form
STRAIGHT BLOCK -20 cm

Section Y-Y'

Section X-X'

PLAN STANDARD ICF STRAIGHT BLOCK

View 1-2

View 3-4

View 2-3

View 4-1
standard insulated concrete form
LEFT CORNER BLOCK 45°-20 cm

SECTION Y-Y

SECTION X-X

PLAN STANDARD ICF - LEFT CORNER 45°

VIEW 2-3

VIEW 1-2

VIEW 4-1

VIEW 3-4
standard insulated concrete form
STRAIGHT BLOCK -25 cm

SECTION Y-Y

SECTION X-X

PLAN STANDARD ICF BLOCK

VIEW 1-2

VIEW 3-4

VIEW 2-3

VIEW 4-1
passive insulated concrete form
RIGHT CORNER BLOCK 90°-20 cm

SECTION Y-Y'

SECTION X-X'

PLAN PASSIVE ICF RIGHT CORNER 90°

VIEW 2-3

VIEW 4-1

VIEW 1-2

VIEW 3-4

ecological insulated concrete forms for passive buildings
m arc

do i c f - r c b 9 0 °
passive insulated concrete form
LEFT CORNER BLOCK 90° - 20 cm

SECTION Y-Y'

SECTION X-X'

PLAN PASSIVE ICF LEFT CORNER 90°

VIEW 1-2

VIEW 2-3

VIEW 3-4

VIEW 4-1
Annex 2: Spacers details

Standard ICF -15 CM
Standard ICF -20 CM

Dimensions:
- Width: 120.5 cm
- Height: 295.4 cm
- Depth: 308.4 cm
Standard ICF 25 CM
Annex 3 : thermal resistance values calculated by CSTB (référence 12-088)

<table>
<thead>
<tr>
<th>MARC block</th>
<th>Elements thickness: outside EPS / Concrete / inside EPS</th>
<th>EPS thermal conductivity $W/(m.K)$</th>
<th>$U_p$ $W/(m^2.K)$</th>
<th>Thermal resistance $R_p$ $(m^2.K)/W$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passiv kit 44.6cm</td>
<td>18 / 20.3 / 6.3 (cm / cm / cm)</td>
<td>0.028</td>
<td>0.13</td>
<td>7.93</td>
</tr>
<tr>
<td>Passiv kit 44.6cm</td>
<td>0.032</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard kit 38cm</td>
<td>6.3 / 25.3 / 6.3 (cm / cm / cm)</td>
<td>0.030</td>
<td>0.25</td>
<td>4.03</td>
</tr>
<tr>
<td>Standard kit 38cm</td>
<td>0.035</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard kit 33cm</td>
<td>6.3 / 20.3 / 6.3 (cm / cm / cm)</td>
<td>0.030</td>
<td>0.25</td>
<td>4.00</td>
</tr>
<tr>
<td>Standard kit 33cm</td>
<td>0.035</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard kit 28cm</td>
<td>6.3 / 15.3 / 6.3 (cm / cm / cm)</td>
<td>0.030</td>
<td>0.25</td>
<td>3.98</td>
</tr>
<tr>
<td>Standard kit 28cm</td>
<td>0.035</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The EPS thermal conductivity shall be proved by thermal certificate, attestation of conformity (CE marking) or using French Th-Bât rules tabulated values.

Spacers impact on thermal resistance has been taken into account.