ISOHEMP
NATURAL BUILDING

Guidelines for Hempro system

All-in-one construction system

Contents

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1. Introduction

Guidelines for Hempro system

1.1 Introduction

Hempro is a modern, smart construction system consisting of a thermal and acoustic envelope made of hemp blocks and a reinforced concrete post-and-beam load-bearing structure enclosed within this envelope. This construction system is simple to apply, easy to plan and completely friendly to the environment.

The envelope is built using 36 cm thick blocks, glued together and stacked like traditional masonry. Drilled blocks and U-blocks are used within the walls to create the formwork for the columns and beams respectively.

Thanks to its lightness and large format, with only 8.3 blocks per m^2, this masonry allows blockwork contractors to significantly reduce construction times.

This construction system eliminates thermal bridges thanks to its drilled and U-blocks elements and ensures compliance with current thermal standards.
Thanks to the composition of hempcrete, this construction system is the most environmentally friendly way of building, while preserving the traditional role of the blockwork contractors.

The Hempro construction system allows the building to be easily modified at a later date, without the need for major, time-consuming work on the load-bearing structure.
With a constant concern for respect for the environment, it has been designed so that all materials can be deconstructed and recycled more than a century after the building's construction.

This modern construction system also guarantees that the building will still be standing even in the event of an earthquake.

1.2 General information

The Hempro system is a construction system that complies with all the technical requirements set out in the standards, with the added bonus of being friendly to the environment. The biogenic carbon content of the products is -17.9 kg/m^2 of masonry for the 36 cm block construction system (compliant with EN 15804:2012+A2:2019). The lifespan of the blocks is estimated at 60 years in the TOTEM reference (Belgium), although it is actually longer and could extend to 150 years. One of the big advantages of the hempro system is that it can be dismantled at the end of its life and fully recycled. Separating the materials that make up the building envelope is easy and does not require any special deconstruction operations. Because its load-bearing structure is confined within the thickness of the masonry, any alterations are straightforward and do not require any structural changes.

You can find all the technical data sheets on hemp blocks at **www.isohemp.com**

1.3 Loads and resistance

IsoHemp blocks have a compressive strength of > 0.22 Mpa, compliant with standard EN 772-1. Masonry cannot be considered load-bearing. The loads are carried by the post-and-beam structure enclosed within the thickness of the hemp block masonry.

1.4 Thermal

The λ value of the material is 0.071 w/mK according to EN 12664. The Hempro 36 wall alone has a thermal resistance of 5.07 m²K/w and complies with current Belgian's regulations. This can be increased by adding blocks from the IsoHemp range. The table below shows R and U values for other compositions.

	Block 30cm	Block 36cm	Block 36+9cm	Block 36+12cm	Block 36+15cm	Block 36+20cm	Block 36+25cm
Wall thickness	33 cm	39 cm	48 cm	51 cm	54 cm	59 cm	64 cm
R-values	4,427 m²K/W	5,272 m²K/W	6,539 m²K/W	6,962 m²K/W	7,384 m²K/W	8,089 m²K/W	8,793 m²K/W
U-values	0,226 W/m²K	0,19 W/m²K	0,153 W/m²K	0,144 W/m²K	0,135 W/m²K	0,124 W/m²K	0,114 W/m²K
	Low and very low energy				Passive		

With interior plaster coating 1 cm and exterior rendering of 2 cm

2. Materials used in the Hempro construction system

Guidelines for Hempro system

2.1 Hempro blocks

The system consists of Hempro blocks with mortise and tenon joints. These blocks are glued together using a 9 cm trowel to create two strips of adhesive mortar arranged on either side of the thickness of the block. The IsoHemp blocks are not load-bearing and will be supplemented by drilled blocks and U-blocks to create the columns and beams respectively.

2.2 Drilled blocks

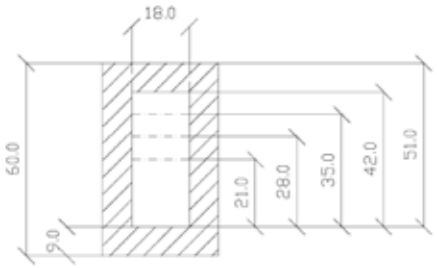
These blocks are inserted into the masonry to recreate a lost formwork for the columns. It is important to comply with the concrete composition and fluidity specified by the project structural engineer.

Possible section sizes for the concrete columns are:

- 18x18 cm (drilled block).
- 18x27 cm (drilled block recut).
- 18x42 cm (U-block horizontal).

2.3 U-blocks

These blocks can be cut down to the required dimensions to form the beams. It is important to comply with the concrete composition and fluidity specified by the project structural engineer. These elements must be propped up while the concrete is being poured into the formwork. It is important to handle these blocks with great care, given the small amount of material they contain.

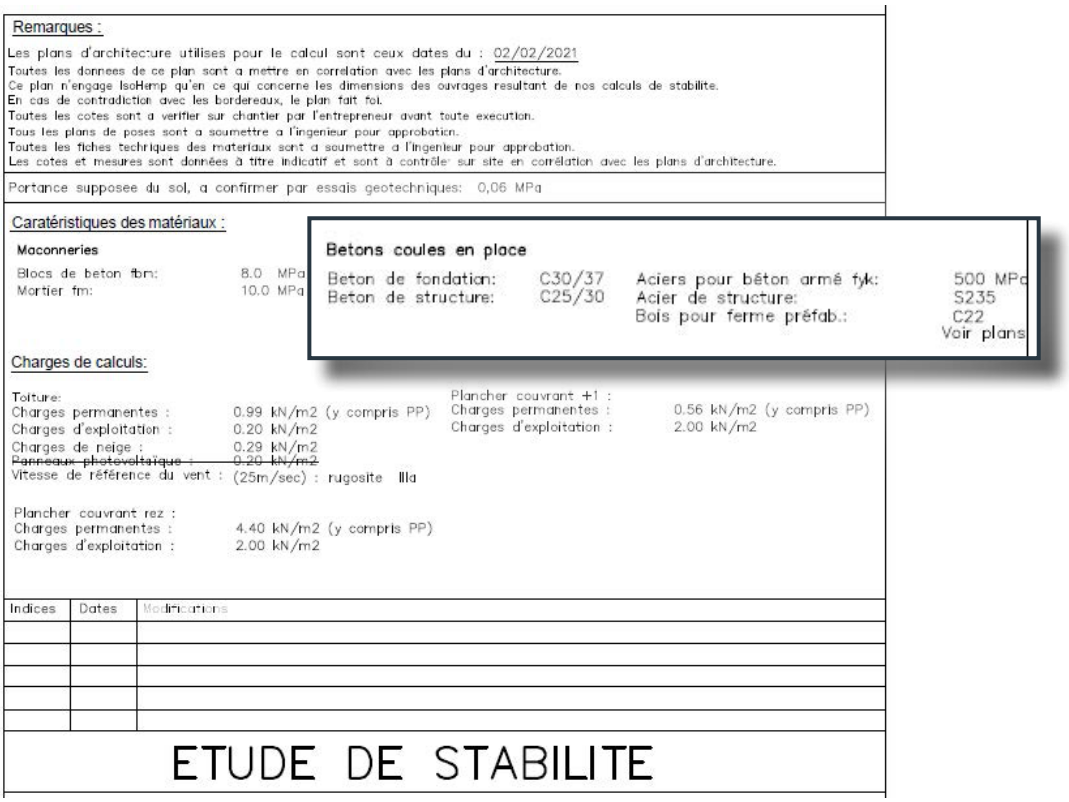


2.4 Adhesive mortar

The adhesive mortar should be mixed according to the recommendations on the bag. This adhesive is applied using an IsoHemp adhesive trowel suitable for hemp blocks.

2.5 Concrete

During a stability study, the project structural engineer will describe the characteristics of the materials to be used on site. The specification for the concrete to be used in the frame can be found in the Structural engineering notes document and generally also annotated on the construction drawing for the project.



Remarques :

Les plans d'architecture utilises pour le calcul sont ceux dates du : 02/02/2021
Toutes les donnees de ce plan sont a mettre en correlation avec les plans d'architecture.
Ce plan n'engage IsoHemp qu'en ce qui concerne les dimensions des ouvrages resultant de nos calculs de stabilite.
En cas de contradiction avec les bordereaux, le plan fait foi.
Toutes les cotes sont a verifier sur chantier par l'entrepreneur avant toute execution.
Tous les plans de poses sont a soumettre a l'ingenieur pour approbation.
Toutes les fiches techniques des materiaux sont a soumettre a l'ingenieur pour approbation.
Les cotes et mesures sont données à titre indicatif et sont à contrôler sur site en corrélation avec les plans d'architecture.

Portance supposee du sol, a confirmer par essais geotechniques: 0,06 MPa

Caratéristiques des matériaux :

Maconneries
Blocs de beton fbm: 8.0 MPa
Mortier fm: 10.0 MPa

Betons coules en place
Beton de fondation: C30/37
Beton de structure: C25/30
Aciers pour béton armé fyk: 500 MPa
Acier de structure: S235
Bois pour ferme préfab.: C22
Voir plans

Charges de calculs:

Toiture:
Charges permanentes : 0.99 kN/m2 (y compris PP)
Charges d'exploitation : 0.20 kN/m2
Charges de neige : 0.29 kN/m2
Panneaux photovoltaique : 0.20 kN/m2
Vitesse de référence du vent : (25m/sec) : rugosite IIIa

Plancher couvrant +1 :
Charges permanentes : 0.56 kN/m2 (y compris PP)
Charges d'exploitation : 2.00 kN/m2

Plancher couvrant rez :
Charges permanentes : 4.40 kN/m2 (y compris PP)
Charges d'exploitation : 2.00 kN/m2

Indices	Dates	Modifications

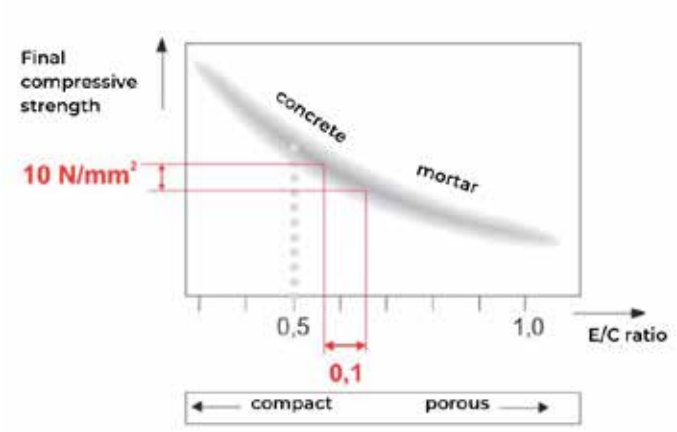
ETUDE DE STABILITE

The stability study generally specifies the strength class, the exposure class, the resistance class and the maximum size of the largest aggregate.

Resistance class

The most commonly used class is C25/30, which means a characteristic cube compressive strength of 30 N/mm² or a characteristic cylinder strength of 25 N/mm².
This class is recommended for concreting beams, columns, floors and other reinforced elements.
The manufacture of the concrete is not from a simple recipe made up of cement, aggregates and water.
All these components must be mixed carefully and according to specific rules, in order to guarantee the resistance class. **The easiest way to obtain the right concrete is to use ready-mixed concrete manufactured in a facility.**

Close attention must be paid to the W/C ratio, which represents the quantity of water (expressed in kg) to the quantity of cement (expressed in kg). As a reminder, a litre of water represents 1 dm^3 and has a mass of 1 kg. The W/C ratio may not exceed 0.5. A slight fluctuation in this ratio can lead to a significant loss of resistance. The diagram below shows that a difference of 0.1 in this ratio results in a loss of 10 N/mm^2 of strength for the class of concrete.



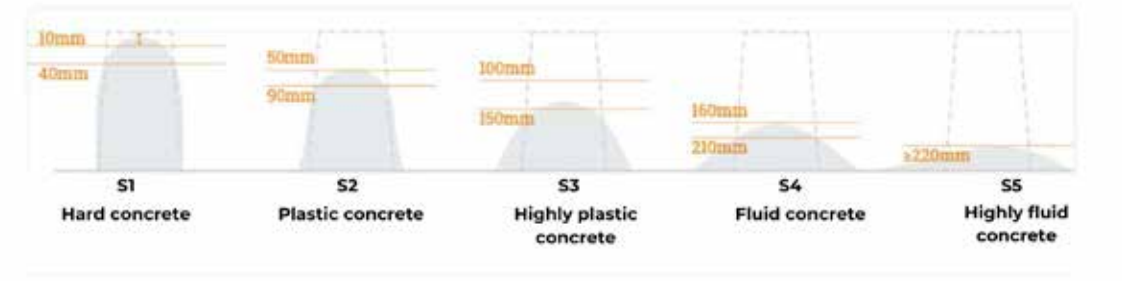
Class C25/30 concrete must have a minimum cement content of 320 kg/m^3. An excess of 0.1 on the ratio means that 32 litres of water have been used too much for 1 m^3 of mixture.

The exposure class

Defines the environment in which a concrete product will be produced and can influence its composition and strength. In this case, the concrete will be in a dry environment.

Consistency class

Consistency classes are measured using the Abrams cone test. They correspond to a characteristic of fresh concrete. These different classes make it possible to measure the fluidity of the concrete and adjust the dosage. In order to maintain the W/C ratio, it is recommended that a liquefier be added to the fresh concrete. This makes the concrete more liquid without adding water. It comes in liquid form and is added when the concrete is mixed (in the concrete mixer). Depending on the product, it can be added by simply pouring or after diluting the product in the mixing water (follow the product instructions).



The maximum size of the largest aggregate

We recommend a maximum gauge of 10 mm, as the reinforcement is embedded in Hempro 36 elements to a depth of 15 mm. With reinforced concrete, it is advisable to have a minimum coating of 1.5 x the largest aggregate. The aggregate should be no thicker than 7 or 10 mm.

Types of concrete production

Although the best solution is **high volume batch-mixed concrete**, it is understandable that the quantities are sometimes small and that supply of a ready mix concrete would not be practical or be an expensive option.

A second solution is to buy bags of ready-mixed dry concrete. These must be mixed using the amount of water prescribed by the manufacturer, this value is generally written on the back of the bag. The contractor will mix the mixture in small quantities on site using a concrete mixer. A fluidifier is necessary to guarantee the liquid state of the concrete. Particular care must be taken to comply with the specifications of both the concrete manufacturer and the manufacturer of the fluidifier.

The third solution is to order dry concrete from the facility. It will be delivered in smaller quantities to the construction site. The facility operative will indicate on the delivery documents the quantity of water to be added to the volume supplied. The contractor will mix the mixture in small quantities on site using a concrete mixer, ensuring the correct volume of water is added. A fluidifier will also be needed to make the concrete more liquid**.**

Let's take an example:
A contractor has 1.5 m³ of dry concrete delivered by a batching facility, the delivery note specifies that 120 litres of water must be added.

1.5 m³ corresponds to 1500 dm³ or 1500 litres of concrete. A bricklayer's bucket holds 10 litres.

So we delivered the equivalent of 1500/10 = 150 buckets.

You need to add 120 litres of water, or 12 buckets.

If the contractor pours 20 buckets of mix into his concrete mixer, he will have to add: 20 (12/150) = 1.6 buckets of water: in other words, one 10-litre bucket and 6 litres of water.

We recommend the following formulation for concrete columns and beams:

Resistance: C30/37

Granulate maximum: 10 mm

Covering the steel reinforcing elements with 15 mm of concrete

Fluidity: S4 or S5

2.6 The Steel reinforcement

The reinforcement is defined in the steel schedules issued by the project structural engineer. It is important to comply with the grade described in the stability plan, generally fyk ≥ 500 Mpa. The HEMPRO 36 construction system requires the concrete to be 15 mm thick. The specifications, overlaps and positioning described in the stability plans must be scrupulously respected.

3. Geometric design

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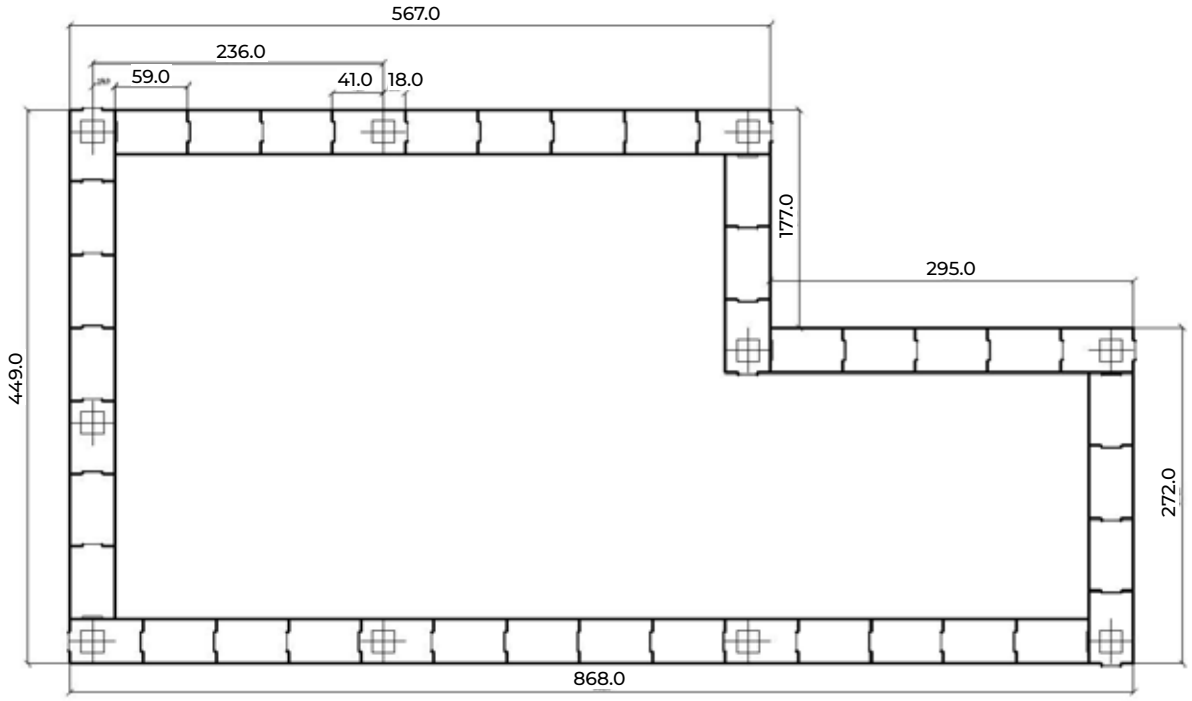
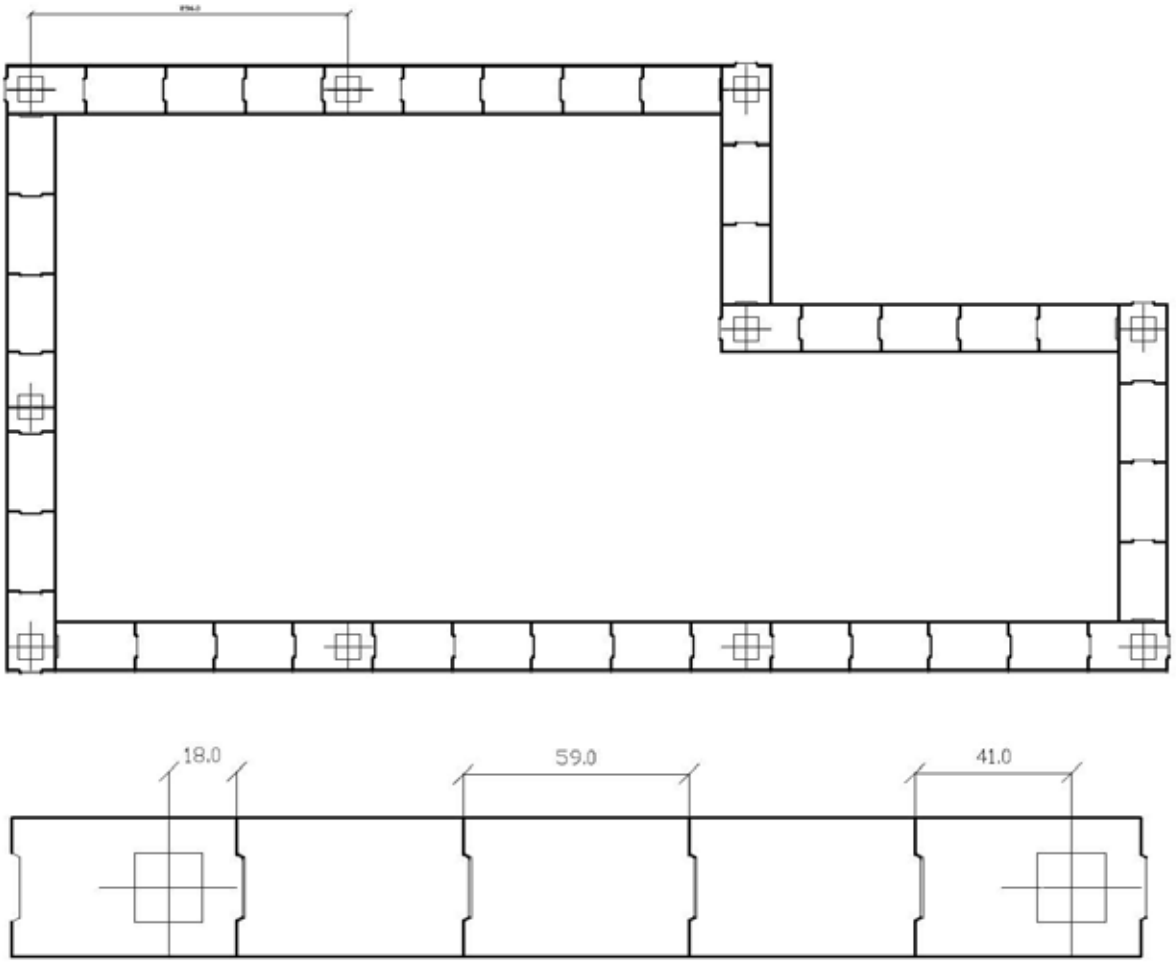
3.1 Layout of blocks in plan view

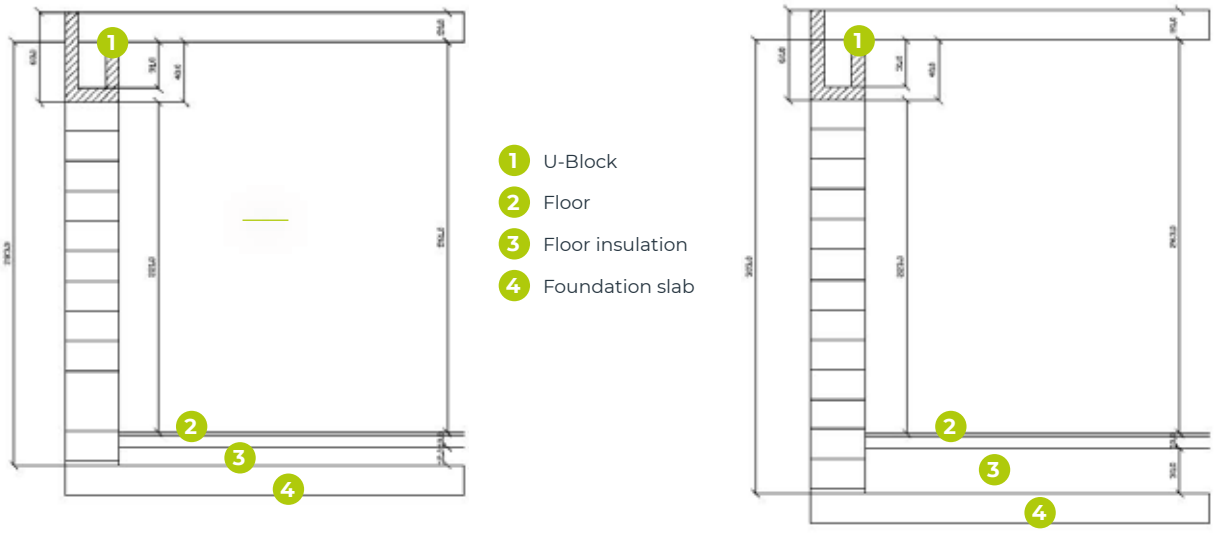
ROW R



ROW R+1



3.2 Layout of blocks in elevation view



4. Types of foundations using Hempro

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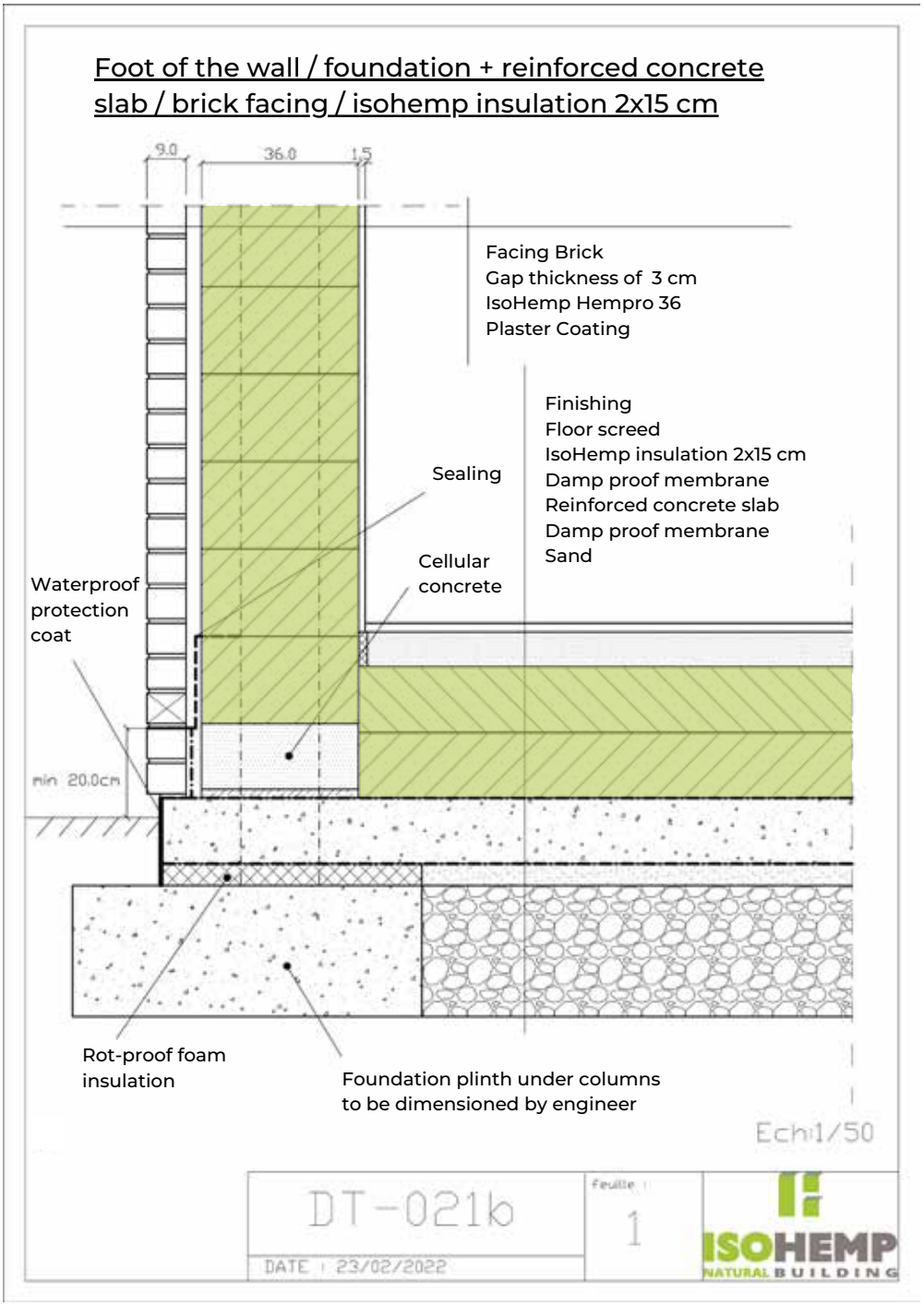
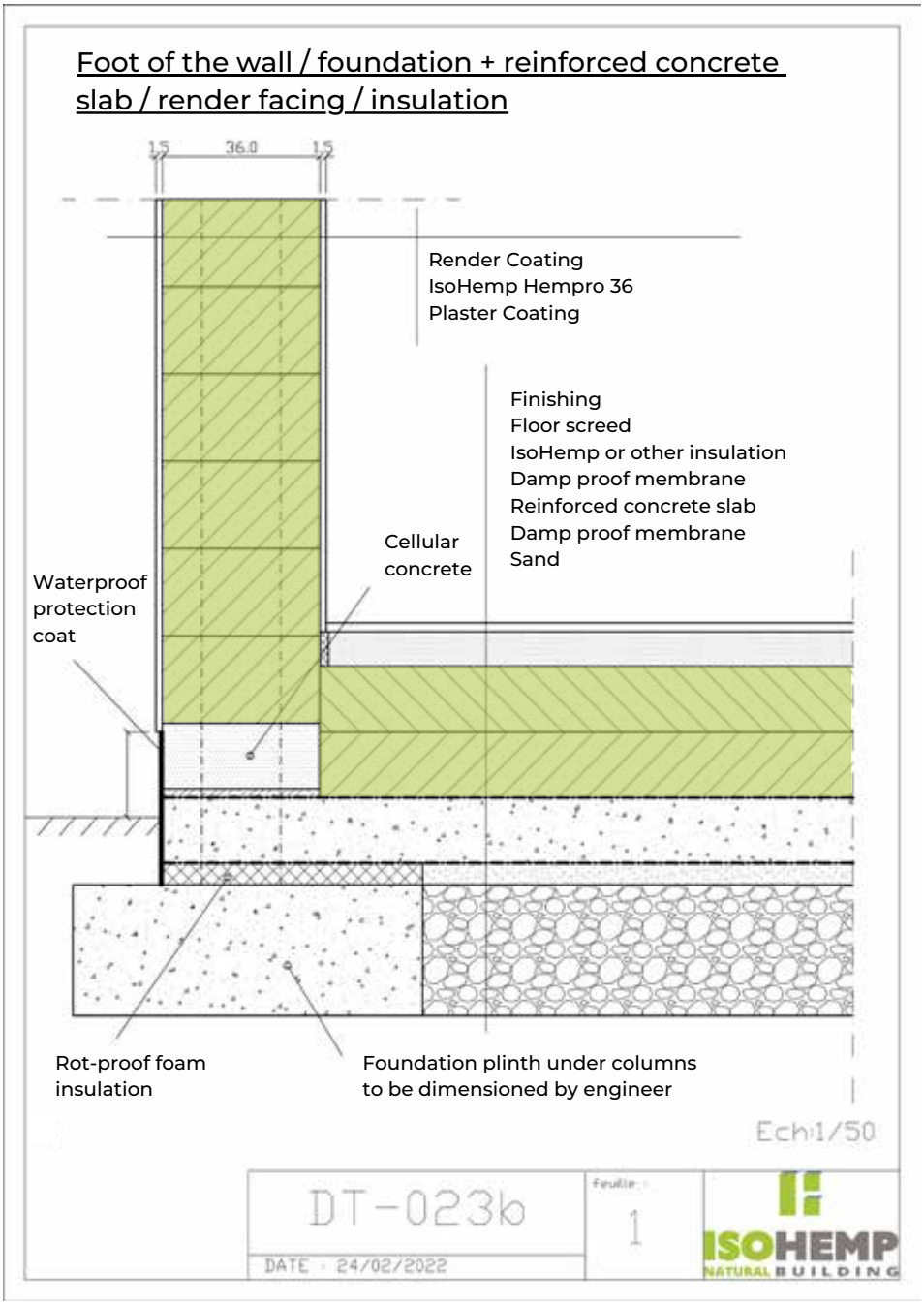
4.1 Foundation pads under Hempro columns




Foot of the wall / foundation + reinforced concrete slab / render facing / insulation
1.5
36.0
1.5
Render Coating
IsoHemp Hempro 36
Plaster Coating
Finishing
Floor screed
IsoHemp or other insulation
Damp proof membrane
Reinforced concrete slab
Damp proof membrane
Sand
Cellular concrete
Waterproof protection coat
Rot-proof foam insulation
Foundation plinth under columns to be dimensioned by engineer
Ech:1/50
DT-023b
feuille :
1
DATE : 24/02/2022
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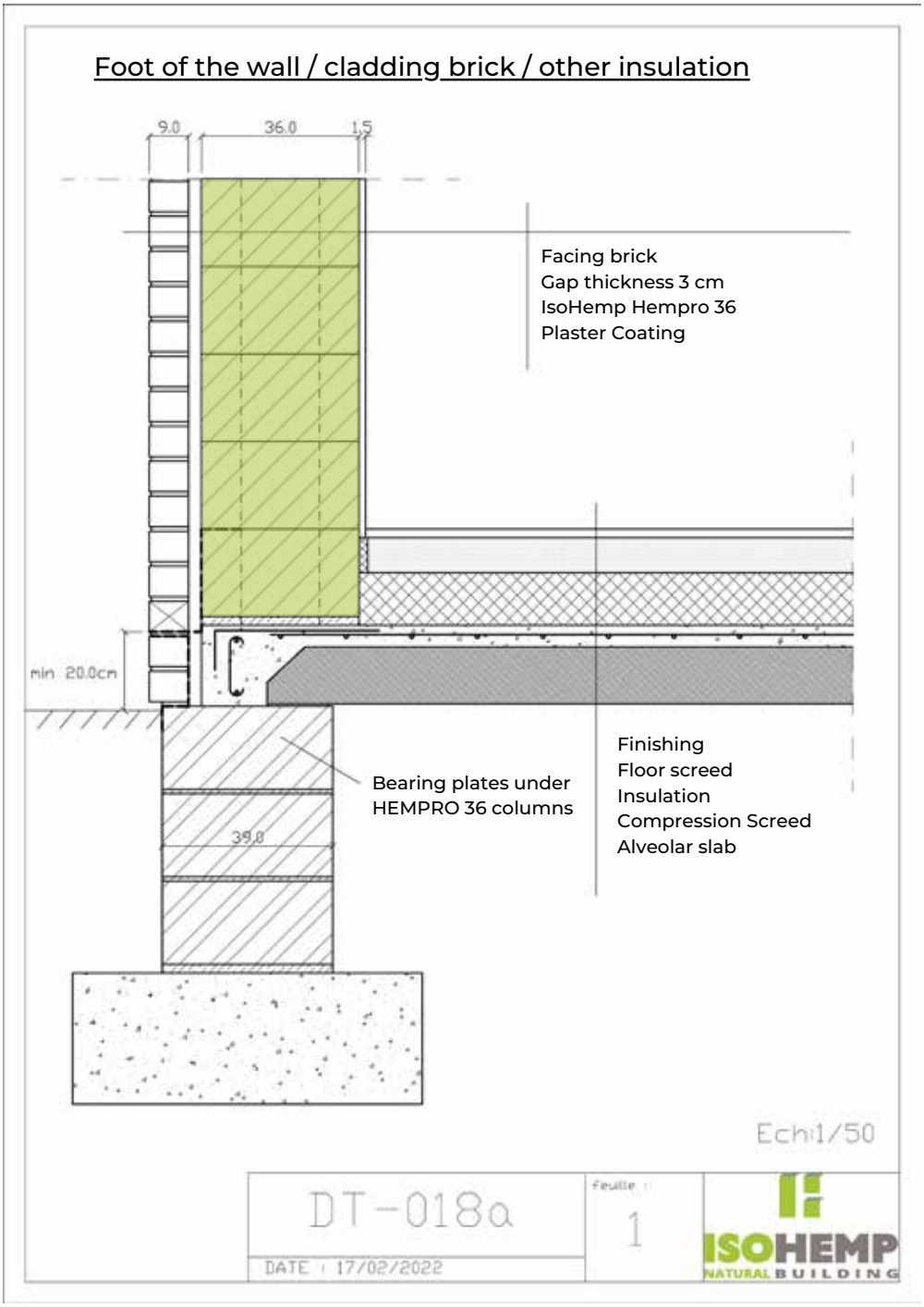
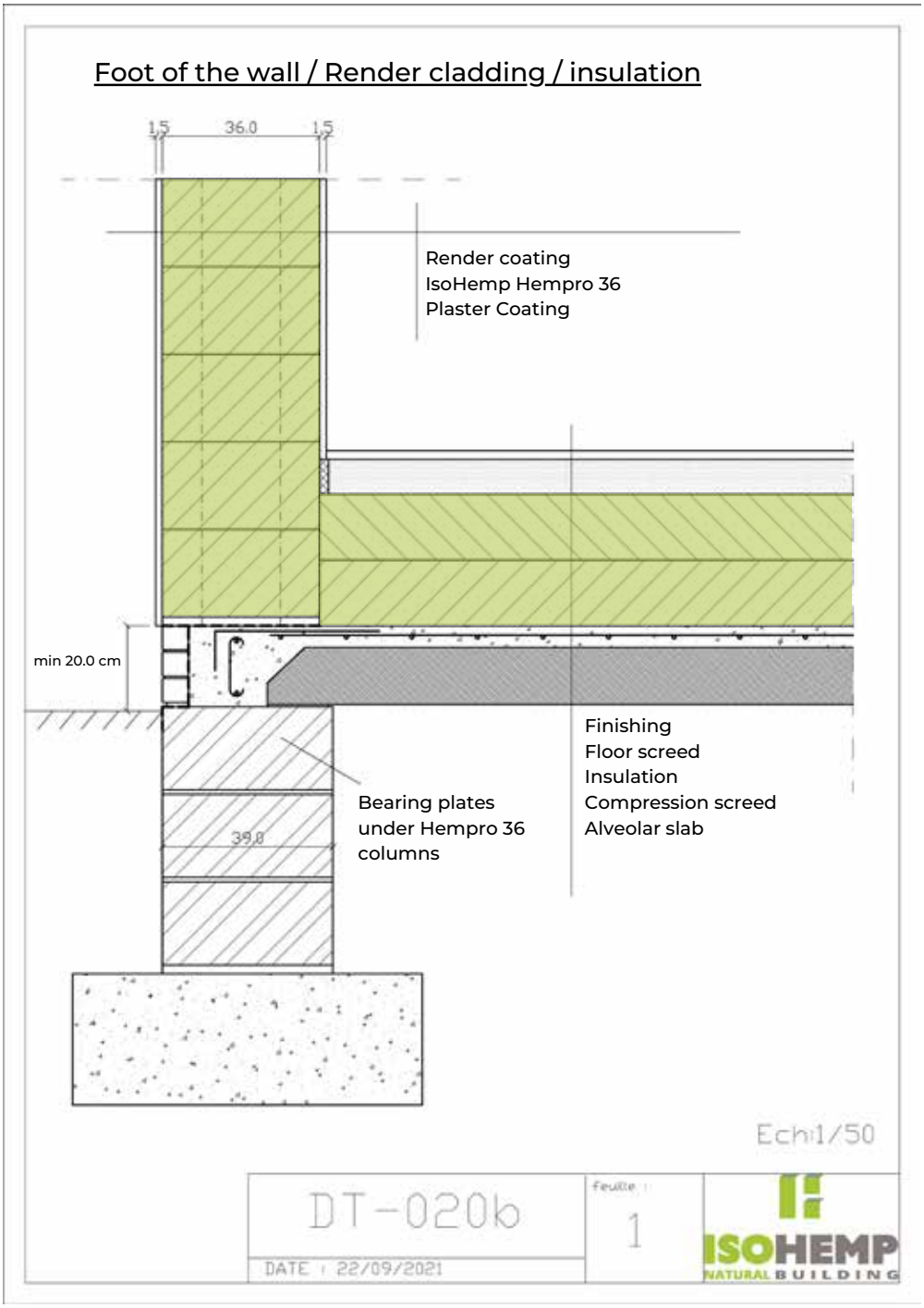
4.2 Strip foundation




Foot of the wall / Render cladding / insulation
1,5
36.0
1,5
Render coating
IsoHemp Hempro 36
Plaster Coating
min 20.0 cm
39,8
Bearing plates
under Hempro 36
columns
Finishing
Floor screed
Insulation
Compression screed
Alveolar slab
Echl1/50
DT-020b
Feuille :
1
DATE : 22/09/2021
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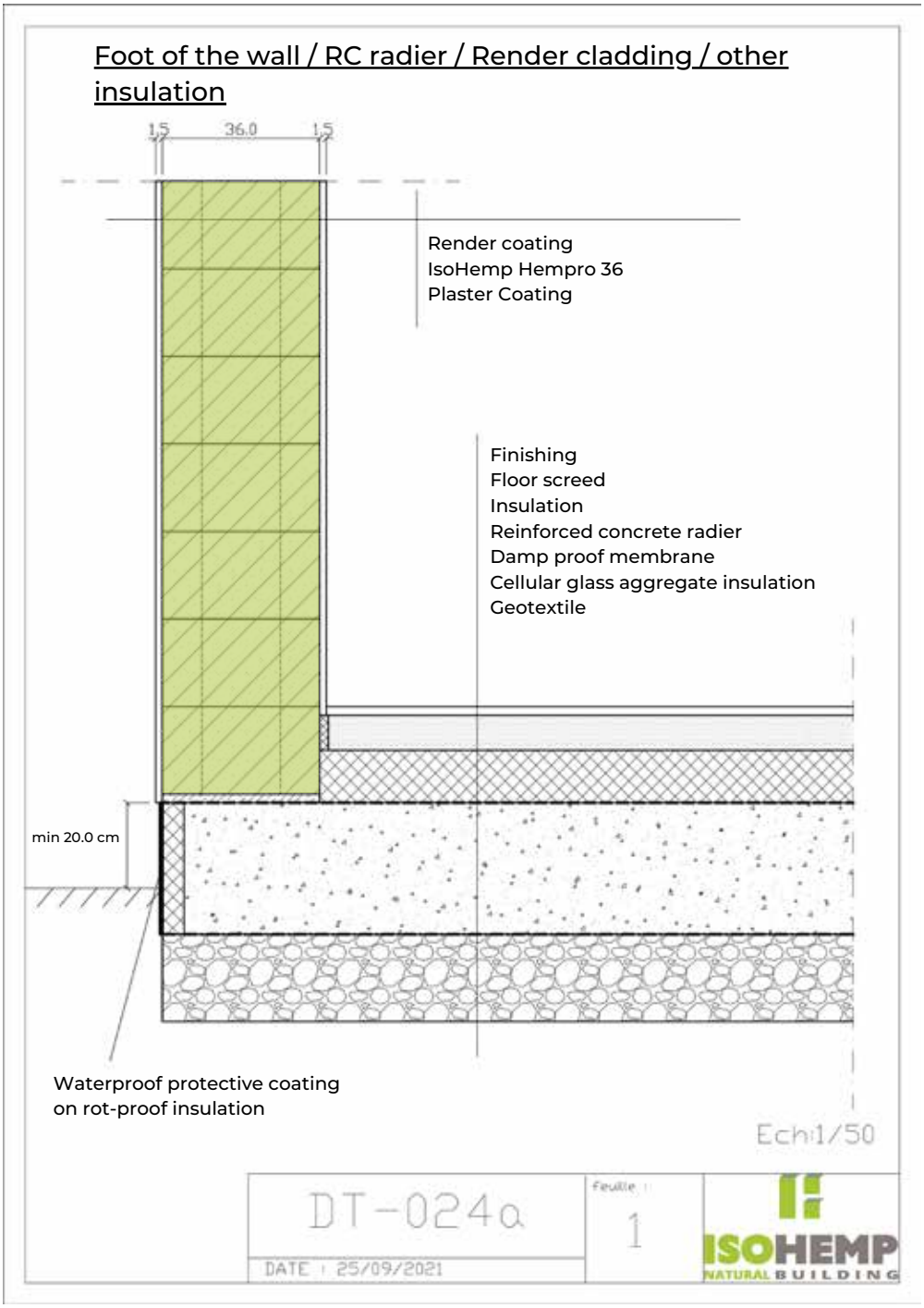
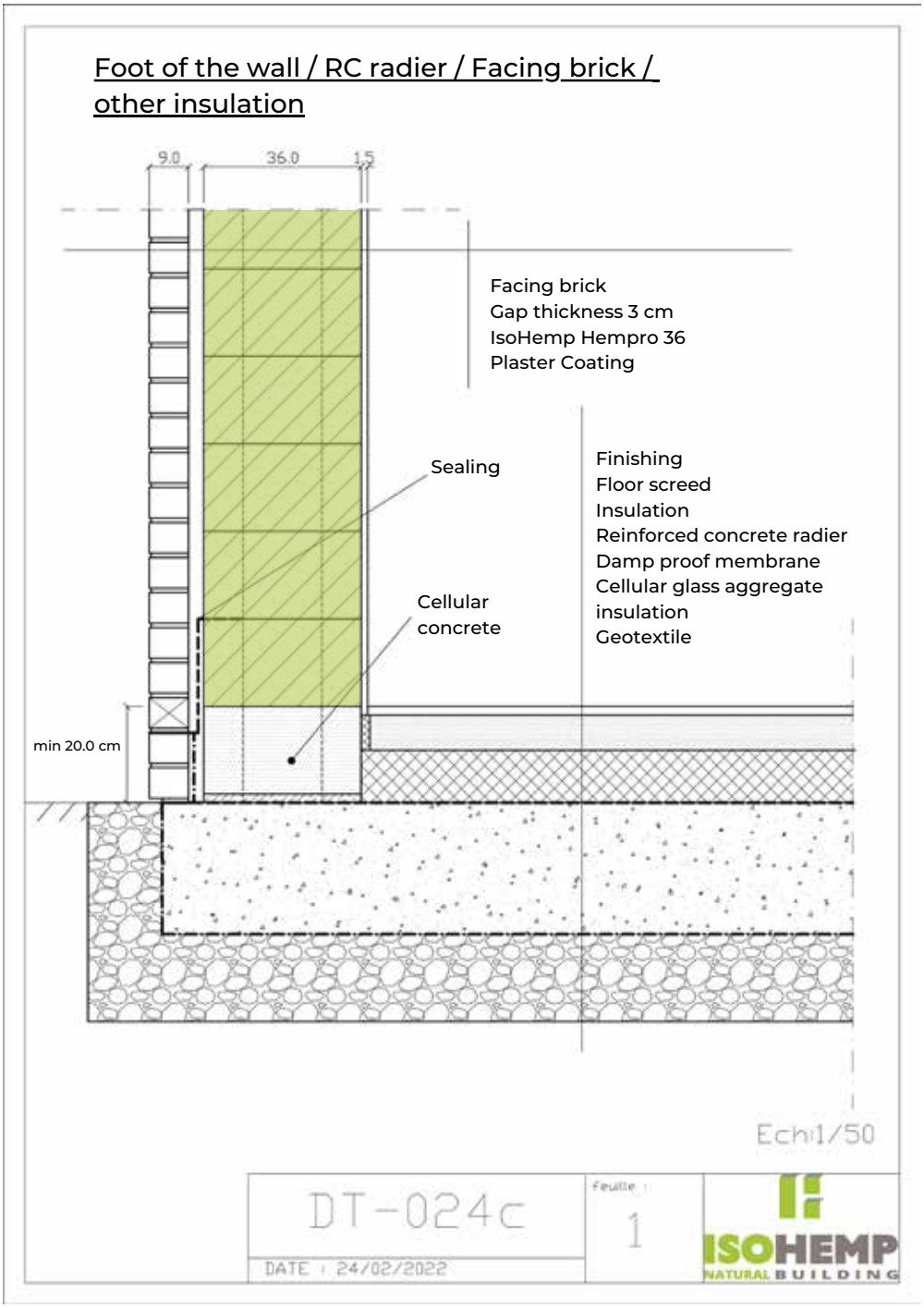
4.3 Structural reinforced concrete slab




Foot of the wall / RC radier / Facing brick / other insulation
9.0
36.0
1.5
Facing brick
Gap thickness 3 cm
IsoHemp Hempro 36
Plaster Coating
Sealing
Cellular concrete
Finishing
Floor screed
Insulation
Reinforced concrete radier
Damp proof membrane
Cellular glass aggregate insulation
Geotextile
min 20.0 cm
Echl1/50
DT-024c
Feuille :
1
DATE : 24/02/2022
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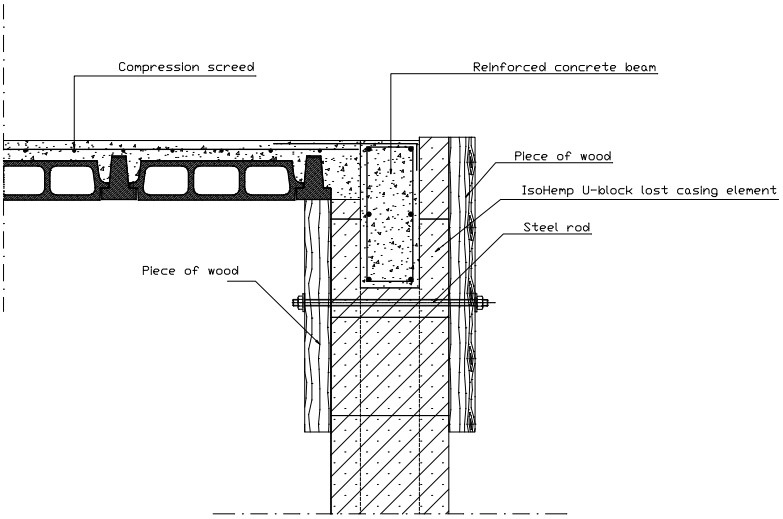
5. Hempro beam cross-sections

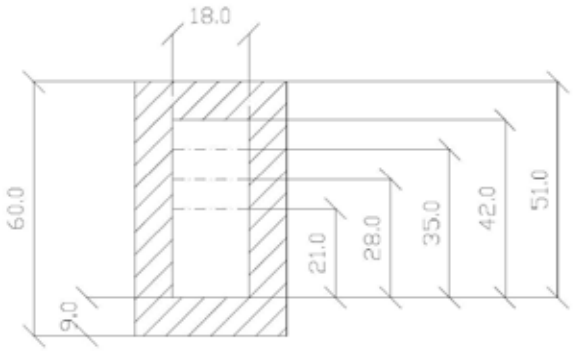
Guidelines for Hempro system

5.1 General information

The U-block has been specially designed to enable the IsoHemp formwork to be adapted to the dimensions of the concrete beam required by the structural engineer.
It is essential to reinforce the vertical walls of the U element during concreting operations. See diagram below.



5.2 Possible sections



Possible reinforced concrete beam cross-sections:

- 18x21 cm
- 18x28 cm
- 18x35 cm
- 18x42 cm
- 18x51 cm

5.3 Span tables

Floor: Plank BA 13+5 cm			Floor: Plank BA 16+5 cm			Floor: Timber beam plank 12+4 cm		
Max. span (m):	**4,80**		**Max. span (m):**	**5,60**		**Max. span (m):**	**4,30**	
Permitted floor load			Permitted floor load			Permitted floor load		
G:	5,25	kN/m²	G:	5,65	kN/m²	G:	3,35	kN/m²
Q:	2,00	kN/m²	Q:	2,00	kN/m²	Q:	2,00	kN/m²
C:	1,20	kN/m²	C:	1,20	kN/m²	C:	1,20	kN/m²
Permitted loads on HEMPRO beam at ELS			Permitted loads on HEMPRO beam at ELS			Permitted loads on HEMPRO beam at ELS		
G:	15,48	kN/m	G:	19,18	kN/m	G:	9,79	kN/m
Q:	4,80	kN/m	Q:	5,60	kN/m	Q:	4,30	kN/m

Span between columns (m)			Span between columns (m)			Span between columns (m)		
	Two supports	Multiple supports		Two supports	Multiple supports		Two supports	Multiple supports
240	21	21	240	28	28	240	21	21
260	28	21	260	28	28	260	28	21
280	28	28	280	28	28	280	28	28
300	28	28	300	35	28	300	28	28
320	35	28	320	35	28	320	35	28
340	35	28	340	35	28	340	35	28
360	35	35	360	35	35	360	35	35
380	35	35	380	35	35	380	35	35
400	42	35	400	42	35	400	42	35
420	42	35	420	42	35	420	42	35
440	42	35	440	42	35	440	42	35
460	42	42	460	42	42	460	42	42
480	42	42	480	51	42	480	42	42
500	51	42	500	51	42	500	51	42
520	51	42	520	51	42	520	51	42
540	51	42	540	51	51	540	51	42
560	51	42	560	51	51	560	51	42
580	51	42	580		51	580	51	42
600	51	51	600		51	600	51	51

Floor: Timber beam plank 16+4 cm			Floor: Reinforced concrete slab 20 cm thick			Floor: Timber girder C24 8x23 cm every 40 cm		
Max. span (m):	**5,50**		**Max. span (m):**	**4,50**		**Max. span (m):**	**4,70**	
Permitted floor load			Permitted floor load			Permitted floor load		
G:	3,85	kN/m²	G:	7,88	kN/m²	G:	0,80	kN/m²
Q:	2,00	kN/m²	Q:	2,00	kN/m²	Q:	2,00	kN/m²
C:	1,20	kN/m²	C:	1,20	kN/m²	C:	1,20	kN/m²
Permitted loads on HEMPRO beam at ELS			Permitted loads on HEMPRO beam at ELS			Permitted loads on HEMPRO beam at ELS		
G:	13,90	kN/m	G:	17,73	kN/m	G:	4,70	kN/m
Q:	5,50	kN/m	Q:	4,50	kN/m	Q:	4,70	kN/m

Span between columns (m)			Span between columns (m)			Span between columns (m)		
	Two supports	Multiple supports		Two supports	Multiple supports		Two supports	Multiple supports
240	28	28	240	21	21	240	21	21
260	28	28	260	28	28	260	21	21
280	28	28	280	28	28	280	21	21
300	35	28	300	35	28	300	21	21
320	35	28	320	35	28	320	21	21
340	35	28	340	35	28	340	21	21
360	35	35	360	35	35	360	28	28
380	35	35	380	35	35	380	28	28
400	42	35	400	42	35	400	28	28
420	42	35	420	42	35	420	28	28
440	42	35	440	42	35	440	28	28
460	42	42	460	42	42	460	35	35
480	51	42	480	51	42	480	35	35
500	51	42	500	51	42	500	35	35
520	51	42	520	51	42	520	42	35
540	51	51	540	51	51	540	42	42
560	51	51	560	51	51	560	42	42
580	51	51	580		51	580	42	42
600		51	600		51	600	42	42

The tables listed here serve only for overview purposes and are intended for orientation. Please refer to the specific details of your project in your static calculations and consult accordingly with your engineering office.