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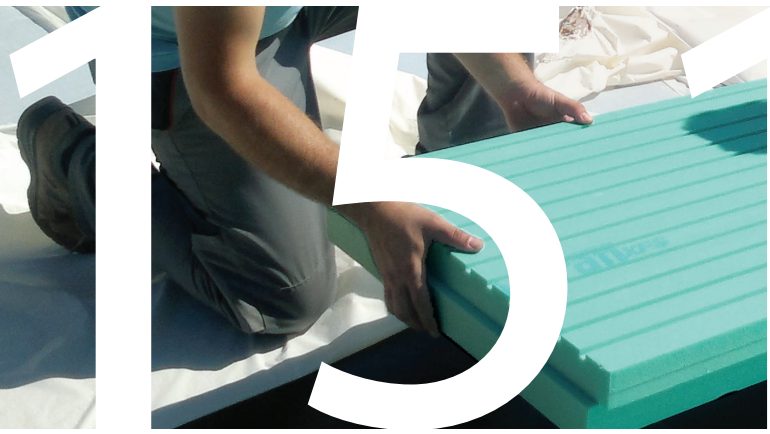


SEISMIC FOUNDATION PILLOW

Foundations of low-energy buildings
on earthquake-prone areas

SEISMIC foundation pillow substitutes the principle of building passive house foundations on top of a thermally insulated foundation slab in earthquake-prone areas with a design ground acceleration of a_g[1] ≥0,1g.

The advantages of the SEISMIC foundation pillow:

- controlled behaviour of the base of the building in the event of seismic activity
- load capacity is adapted to each individual building and its behaviour during seismic activities
- ensured permanent energy efficiency of the foundation structural element
- safely implemented insulation against moisture and water
- ensured safety for the installations
- equal cost for a significantly better effect
- simple implementation

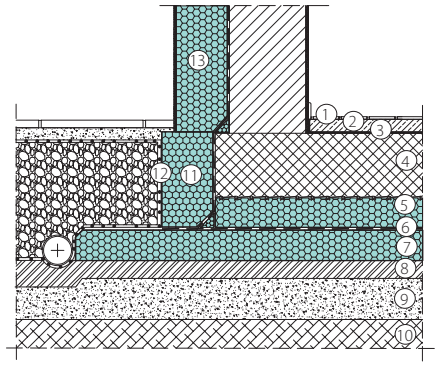
Tailor-made solutions of the foundation pillow

The foundation pillow is constructed according to the requirements of each individual building based on the dimensions of the building, its mass, structural design and materials, the presence of groundwater, soil type and of course the design ground acceleration and the required energy efficiency of the whole building. The solution is determined by a building designer with knowledge of earthquake engineering.

On account of dynamic seismic forces affecting the increased edge loads of the foundation slab onto the thermal insulating base, thermal insulation with a nominal compressive strength of no less than 400 kPa should be used; this corresponds to light prefabricated buildings and traditionally built low-rise buildings of ordinary dimensions. For higher and heavier buildings or buildings of less favourable dimensions, insulation with correspondingly better load bearing capacity should be used with, for example, a declared compressive strength of 500 or 700 kPa.
When choosing thermal insulation under the foundation slab, the data regarding the load-bearing capacity should be taken into consideration based on long-term load testing and maximum compressibility of 2%, for which it is necessary to obtain consent for use after extensive testing. FIBRAN has been issued a permit no. Z-23.24-1807 by the German institute DIBt for the use of FIBRAN*xps* insulation under the foundation slab.

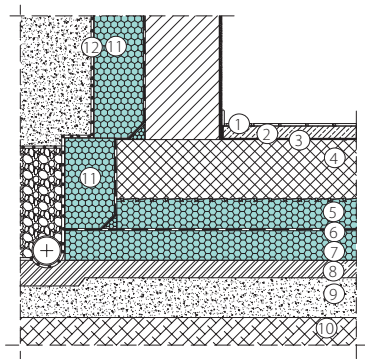
The most optimal solutions of the SEISMIC foundation pillow

I.



1. final layer
2. breeze concrete
3. PE foil
4. foundation slab
5. FIBRANxps SEISMIC[2]
6. FIBRANhydro SEISMIC T-1,8sk/sk[3]
6a. FIBRANhydro T-3sk[3]
7. FIBRANxps[2]
8. leveling concrete
9. stone fill
10. soil
11. FIBRANxps 300-L
12. drainage veil
13. FIBRANxps ETICS GF (plinth)

I.a



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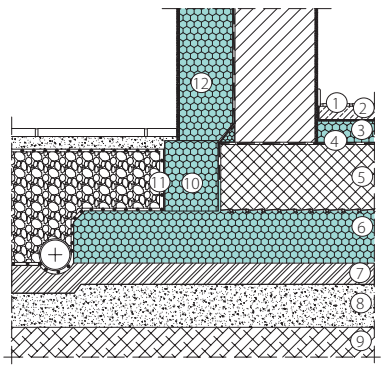
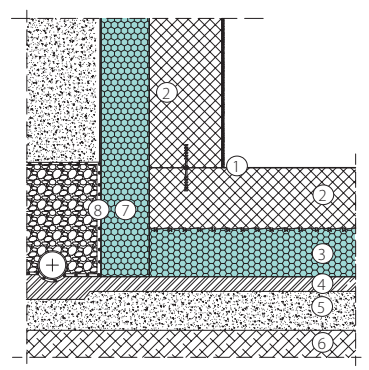
II.



1. final layer
2. breeze concrete
3. FIBRANxps 300-L
4. waterproofing
5. foundation slab
6. FIBRANxps SEISMIC[2]
7. leveling concrete
8. stone fill
9. soil
10. FIBRANxps 300-L
11. drainage veil
12. FIBRANxps ETICS GF (plinth)

II.a



1. final layer
2. foundation slab – watertight concrete
3. FIBRANxps SEISMIC[2]
4. leveling concrete
5. stone fill
6. soil
7. FIBRANxps 300-L
8. 8. drainage veil

[1] *a_g is peak ground acceleration on a rocky surface (type A ground according to EN 1998-1) and with an earthquake with a return period of 475 years. With worse soil, the a_g value is factored with the ground coefficient (S parameter according to EN 1998-1)*
[2] *400-L, 500-L or 700-L*
[3] *Waterproofing - you can find the details on the last page (layer C)*

For permanent efficient thermal insulation properties below grade in the moisture and water, it is necessary to use thermal insulation material with the lowest values of water absorption by diffusion, e.g. WD (V) 1 and the lowest long-term water absorption by total immersion WL (T) 0.7; FIBRAN*xps* insulation conforms to these requirements.

An example of installing the SEISMIC foundation pillow with a double layer of thermal insulation (details in I. and I.a)



Prior to placing the first layer of thermal insulation, special attention should be paid to the pipe installations. For installations, we recommend a lateral conduit into the building in line with the earthquake safety regulations. As is shown in the example in the picture, whenever the pipes are placed underneath the building, they must be placed inside protective flexible tubing or double tubing up to the level of the slip plane. By doing so, we are protecting the pipework from the effects of the shear force in the event of excessive horizontal seismic forces.

The FIBRAN*xps* thermal insulation of suitable compressive strength[2)] should be placed on top of a well stabilized gravel surface, which has been levelled with a layer of breeze concrete (concrete base). When constructing the building on the same surface as the surrounding terrain, the bottom layer of thermal insulation should be extended beyond the ground plan in order to prevent the soil beneath the building from freezing to the level of the frost zone.

Adhere the waterproofing membrane on top of the accurately placed first layer of FIBRAN*xps*[2)] thermal insulation of adequate thickness. You will find the details about waterproofing the SEISMIC foundation pillow on the last page, layer C.



Place the formwork[4)] of the foundation slab on top of an adhered layer of a double-sided self-adhesive FIBRAN*hydro* **SEISMIC** waterproofing membrane. The protective foil of the waterproofing membrane should be removed gradually, just before placing each individual SEISMIC thermal insulation board on top, so that no dust comes between the two layers which could potentially reduce its adhesive properties. FIBRAN*xps* **SEISMIC** should be placed onto the adhesive membrane surface carefully and precisely because the surface is very sticky and any correction is practically impossible. The boards should be installed with a staggered offset for maximum effect.

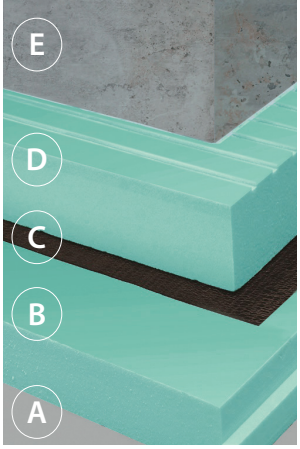
4) The formwork of the foundation slab can also be installed using FIBRAN*xps* FORM *elements.*



The layer of thermal insulation should be promptly protected from strong sunshine. Prior to installing reinforcement rods, seal off any potential gaps at the board joints or alongside the formwork with polyurethane foam or suitable adhesive tape in order to prevent any cement from leaking in while laying concrete. No sealing foil can be used when using SEISMIC boards. Next is the installation of reinforcement rods with spacers on top of the SEISMIC thermal insulation and concreting.

The foundation slab of the **SEISMIC foundation pillow** is thus ready for further masonry, concreting or installation work.

All the possible solutions of the SEISMIC foundation pillow can be found at www.fibran.com



SEISMIC foundation pillow is a composite material consisting of a reinforced concrete foundation slab and SEISMIC insulation. When there are two layers of thermal insulation, they are joined together with layers of water-proofing material, so that the whole foundation pillow acts compositely and there is no sliding between individual layers. In the event of excessive seismic forces, the properly fitted pipe installation should follow the movements of the building.

The components of the SEISMIC foundation pillow:

A.) Levelling concrete

In countries with a design ground acceleration of ≥0.1g, the foundation pillow is constructed on top of a stabilized aggregate base covered with a concrete base in order to achieve the highest possible coefficient of static friction when in contact with the FIBRAN*xps* thermal insulation.
In areas which are not prone to earthquakes (peak ground acceleration < 0.1g), it is sufficient to level the aggregate base by using fine sand and laying drainage veil on top.

B.) The bottom layer of thermal insulation

When there are two layers of thermal insulation, the bottom layer of FIBRAN*xps* thermal insulation of suitable compressive strength (400, 500 or 700 kPa)[2)] is installed in the appropriate thickness which will depend on the maximum allowed heat transfer (the U-values are listed on our website). If you want a good low-energy, passive or nearly a zero-energy building, it is necessary to lay at least 24 cm (2x12 cm) of insulation under the foundation slab, which should have a thermal conductivity of no more than 0.036 W/mK (U< 0,14 W/m^{2}K).
When insulating a building that does not have a basement and where the foundations do not reach below the frost zone, the bottom layer of the XPS thermal insulation should be extended by at least the depth of the estimated frost line at the building location. For the purpose of insulating the frost line, it is sufficient to use insulation with less load-bearing capacity such as FIBRAN*xps* **300-L**.

C.) Waterproofing

When applying two layers of thermal insulation, the most important additional layer is a double-sided self-adhesive waterproofing membrane FIBRAN*hydro* SEISMIC T-1,8sk/sk. If the terrain is dry or completely drainable, the waterproofing membrane is laid on top of FIBRAN*xps* (400-L, 500-L ali 700-L) in one layer. If there is groundwater, waterproofing is installed at least in two layers; either as a double-layer FIBRAN*hydro* SEISMIC T-1,8sk/sk or a combination of the one-sided self-adhesive waterproofing membrane FIBRAN*hydro* T-3sk and FIBRAN*hydro* SEISMIC T-1,8sk/sk. After installing the one-sided self-adhesive waterproofing membrane, the top protective PE film should be melted because otherwise there might be slippage where the two waterproofing layers are joined. All the joints are additionally sealed. The FIBRAN*xps* **SEISMIC** boards of suitable compressive strength[2)] are then installed, so that the waterproofing membrane is protected from the sun and any potential mechanical damage as soon as possible.

D.) SEISMIC thermal insulation boards

FIBRAN*xps* **SEISMIC** is a thermal insulation system of suitable compressive strength with a top surface structure which ensures a flawless joint with the reinforced-concrete foundation slab, even in the event of considerable horizontal seismic forces. The standard thicknesses of the SEISMIC thermal insulation are 12 cm and 20 cm.

E.) Reinforced concrete foundation slab

It is necessary to follow the instructions of the structural engineer when building a reinforced concrete foundation slab. In the case of using watertight concrete, special sealant tape is installed into the concrete slab in order to make a watertight joint between the foundation slab and the concrete wall, which is built later.

FIBRAN d.o.o. | Print: Kočevski tisk d.d., Kočevje | 06/2018

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