

Installation manual



Installation manual and handling recommendations Incomat®

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HUESKER Synthetic GmbH

Fabrikstraße 13-15, D-48712 Gescher
Tel.: + 49 (0) 25 42 / 701 - 0
Fax: + 49 (0) 25 42 / 701 - 499
E-Mail: info@HUESKER.de
Internet: www.HUESKER.com

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1 Types of Incomat

Hereinafter the individual types are presented for the different applications.

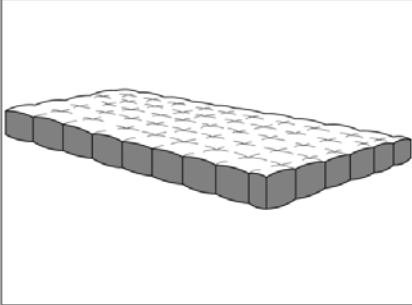

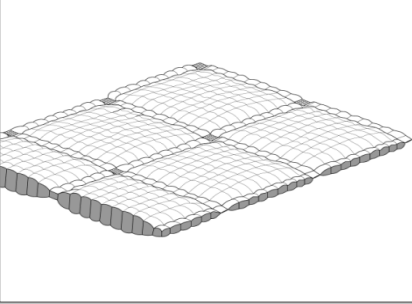

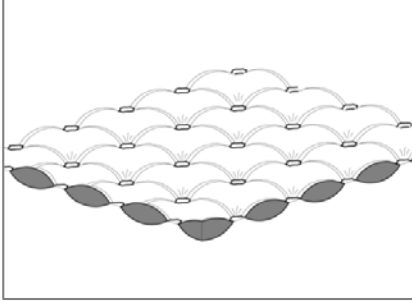

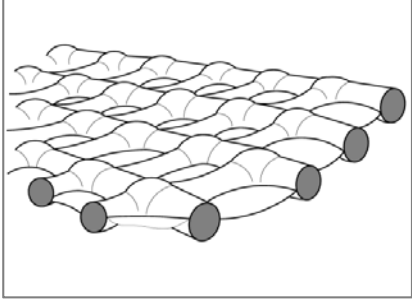

<p>Incomat Standard: as sealing and erosion protection with a continuous and nearly constant profile</p>		
<p>Incomat Flex: as erosion protection with pillow shapes areas, predetermined breaking points and filter points for the reduction of low hydrostatic pressures</p>		
<p>Incomat FP (Filterpoint): as erosion protection with regularly placed filter points for the use under hydraulic loads</p>		
<p>Incomat Crib: as erosion protection with possible greening after installation Consisting of tube-like grating profile with unfilled intermediate areas for the use as technically ecological erosion control</p>		

Table 1: Types of Incomat

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2 Form of delivery

2.1 As rolled material

The rolls are packed into black PE-sheets and identified according to ISO 10.320.

- Mill width Incomat = 5 m
- Roll: length = 100 m, external diameter ca. $\varnothing = 0.4$ m, weight of max. 230 kg incl. steel pipe
- Steel pipe: length = 5.60 m, external diameter $\varnothing = 114.3$ mm, internal diameter $\varnothing = 107.9$ mm

Damages of the Incomat-fabric during loading or storage on site have to be avoided! Also a dry storage is recommended. The wrapping should only be removed shortly before installation.

2.2 Prefabricated Incomat panels consisting of several sheets

For following reasons larger factory produced Incomat panels (several Incomat sheets are sewn together) have proved to be beneficial:

- Fast installation on huge areas up to 1000 m² (limited by weight of panels, max 200 gr/m²)
- The 5 m width sheets predict in general the concrete casting sections
- Possible prefabrication of elements to alleviate the installation and handling by: Inlets, loops, helm stitches and zippers for connection of panels
- The factory made layout drawing allow the installation within most complex geometries by taking intersections (e.g. pipes, openings) into account.

Additionally is it possible to rent hot cutting knives and hand held industrial sewing machine from HUESKER Synthetic GmbH to adjust and sew Incomat sheets on site. The panels are delivered as a roll or folded.

3 Inlets

The filling of the Incomat is via an opening in the weaving. These may be formed by a cut, a factory-assembled inlet or via the Incomat- ring.

Cut- opening: In the area of the cut, the filling height cannot be achieved. For this reason, this type of filling opening can only be recommend at embankments where this area is supposed to stay unfilled.

Factory-assembled inlets: This inlets are the most common practice and are sewn in accordance with the project geometry to the prefabricated panels.

Inlet with Incomat- ring: This option allows the installation of the inlet flexible on the building site and can be used in flat and inclined surfaces. For further information please refer to the installation instructions of Incomat -rings.

The amount of required inlets by the use of a concrete with a consistency class F6 (see also chap. 5) can be assumed with a spread of concrete over a radius of about 2.5 m (see also. DIN EN 1536 and 1538). Therefore, one fill port covers in general a 5 m wide Incomat sheet. The number of inlets in longitudinal direction is subjected to many different constraints that have to be considered in accordance to project-specific requirements.

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4 Required level and slope preparation

- The surface of the slope (including berms, crest, toe) should be levelled;
- Protruding elements as stones, roots or other sharp elements, which might damage the Incomat have to be removed;
- The plain has to be plane, compacted and capable of bearing;
- Locations of leaking water have to be secured with gravel or appropriate drainage materials;
- Scours and major unevenness under water have to be filled with gravel or geotextile bags;
- A non-woven for filtration has to be installed below water-permeable mattresses
- A non-woven for protection has to be installed if the subsoil is coarser or if the Incomat mattress is exposed to waves or strong currents.

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5 Concrete / filling mortar

As a filling for Incomat self-compacting concrete (SCC) according to DIN 1045-2 (EN 206-1) is recommended for choosing the correct exposure classes.

The fresh concrete must have a flowable to very flowable consistency with at least a consistency range of F6 with a slump ≥ 63 cm, acc. to DIN EN 12350. This requires normally the addition of concrete admixtures (superplasticizers). The use of colloidal mortars has been proven to work.

Round-grained aggregates are preferable to broken material. In addition, the maximum grain size should not exceed 8 mm.

Annex D provides an overview of concrete mixtures that were used successfully in previous projects.



Illustration 1: Determining the slump acc. DIN EN 12350-5

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6 Installation of Incomat

6.1 Disposition of conveying- and filling equipment

The selection of the required equipment for filling depends on the circumstances of the project and the conditions on site. The following table provides a rough overview of the necessary equipment (see also Annex A).

Amount	Equipment	Comment
≥ 1	Concrete mixer	Depending on the distance between site and concrete mixing plant
≥ 1	Concrete pump	Pump capacity < 50 m³/h
≥ 1-2	Reducing piece	Reducing from conveying hose to filling hose respectively conveying hose
Related to pump distance	Conveying hoses	-
≥ 1-2	Filling hoses	DN 65 (or DN 55) or minimum Diameter $\varnothing_{outer} \leq 2/3 \times$ Incomat filling height, sharp edged hose endings have to be avoided.

Table 2: Disposition of conveying- and filling equipment

In flow to the concrete pump a close-meshed sieve (opening width 16 mm) should be installed to restrain a possible oversize and thus to avoid clogging the hoses.

If longer delivery times of the concrete can be expected, it is advisable to move regularly the concrete in the hose to avoid clogging. If necessary, a residual concrete pool or a residual concrete surface should be foreseen.

6.2 Preparation Incomat

When using non-prefabricated sheets shrinkage, required anchorage length, as well as seam allowance when cutting, has to be taken into account. The necessary equipment can be borrowed over the HUESKER Synthetic GmbH.

The prefabricated panels are designed according to the installation drawing (see 2.2), and connected by seams or industrial zippers. Sufficient elements as sandbags and / or steel rods are to be kept. Depending on the geometry, surface, and mat thickness, it is necessary to provide anchorages at a distance of up to 25-50cm (see Annex B).

For easier handling of the filling hoses (with sheet lengths ≥ 7 m), it is possible to use in advance introduced ropes / cables.

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When underwater installation is required the positional stability of the unfilled Incomat- panels anchor rods or pegs on the embankment toe should be used at the flow exposed edge. If the site is in the range of significant flows, the dimensions of the laid Incomat should be small enough to accomplish the filling within 2-3 days. Laying and filling can be carried out usually at flow rates of up to 1.0 m / s without using additional safety devices. Under specific circumstances it can be beneficial to install the filling hose into the Incomat before placing.

7 Filling of Incomat

Consider with regard to the filling process:

- in the beginning, the tip of the filling pipe should be about or less than 1.0 m above the lower end of the Incomat;
- during the filling process, the pipes have to be pulled backwards in order to avoid local high pressure;
- during filling the tip of the filling pipe should be kept permanently immersed into the fresh concrete in order to avoid segregation of the concrete aggregates;
- the filling process has to be observed permanently; submerged installation demands the operation of divers;
- if the filling inlets are located close to each other the filling hose doesn't have to be pushed into the Incomat;
- the filling has to be made in sections acc. to Illustration. 2, depending on consistency and pumping capacity:
 - o dry installation: about 1.0 m hydrostatic pressure (to avoid high pressure at the bulkheads)
 - o submerged installation: about 1.5 m hydrostatic pressure
- The filling can be continued by taken the solidification behavior (usually 30-60 minutes) into account. In the meantime, the adjacent elements can be filled. For more precise evaluation of the solidification behavior the application "knead bag test" according to DIN 18 128; 2010-01 is recommended.

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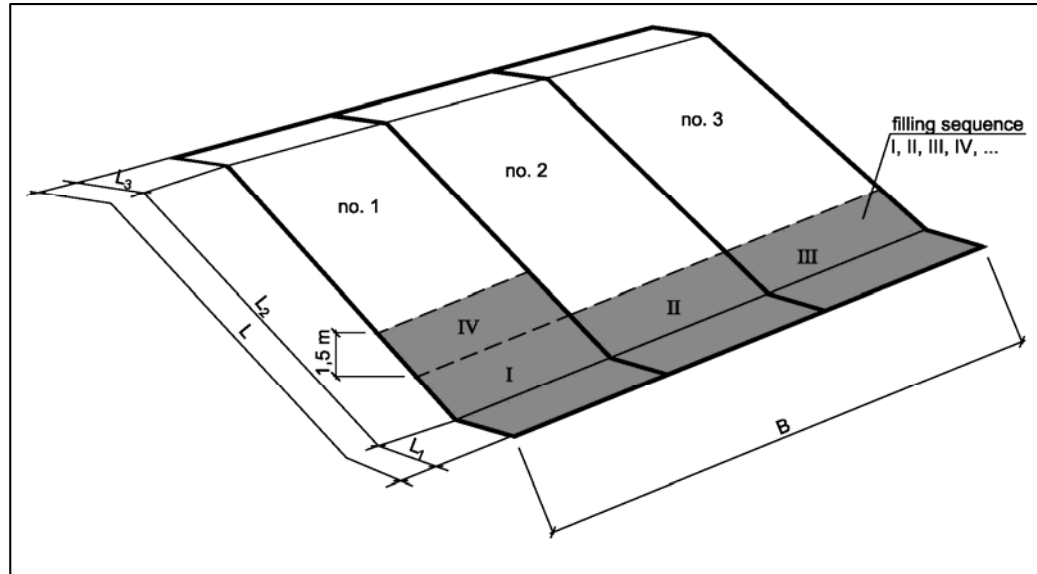


Illustration 2: "Stepwise" filling process of Incomat

During filling, the stress in the textile must be regulated by loosening the anchor, particularly in the area of the embankment crown.

Before starting the filling of a section, make sure that the following panel is already connected to this. An attachment to already casted sections is usually not or only with great effort possible.

The pump ability of the concrete within the mat can be increased by watering the mat before casting.

7.1 Following up concrete casting

- Openings in the textile, which were used for introducing the filling hose should be closed. Inlets can be laced with a wire, cable ties or similar. Cuts should similar with the aid of non-woven fabric be sewn again.
- The surface of Incomat should be flushed and cleaned with water; when installing Incomat types with filter points in the dry this is essential;
- After installing the Incomat it must not be entered as long as the concrete has reached a sufficient hardness.
- When concreting in winter possibly a cover / heating during the hydration process of the concrete is required.

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8 General remarks

Slopes steeper than 1: 3.5 (1: 5, if at the underside a geomembrane is placed), the sliding safety must be demonstrated. To hold the driving forces, the anchoring in the crown area, the formation of a foot support and possibly other stabilizing measures must be sufficiently strong.

Connections to buildings, sheet piles or penetrations etc. can be executed in various ways and will be chosen according to project requirements.

9 Conclusion

The success and the long-term stability of an Incomat revetment depends on the determination of an adequate Incomat type, the prudence of installation and decisively on the concrete quality/flow capability.

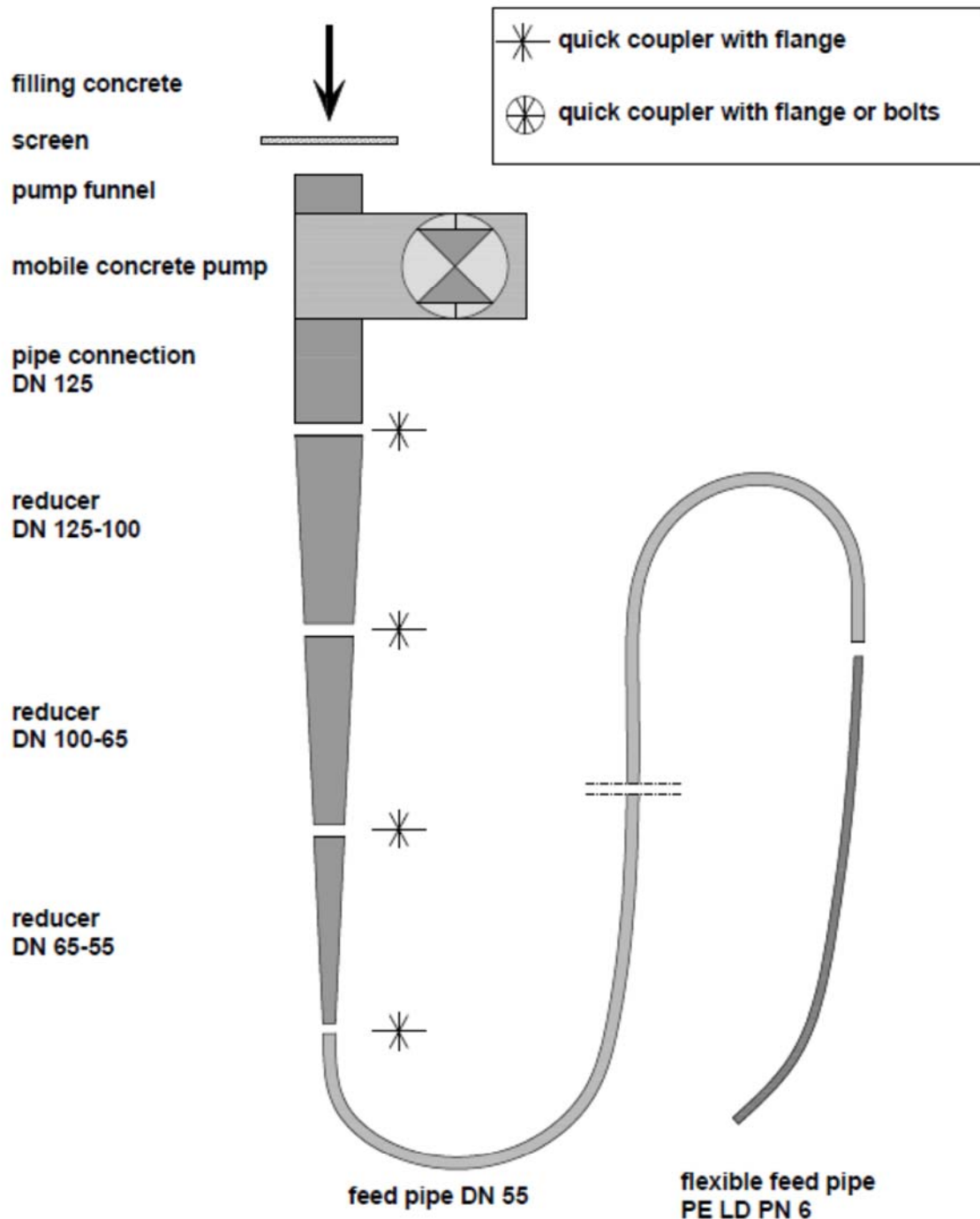
For situations and details that are not treated in this installation manual (e.g. design of penetrations, culverts, connections/junctions to constructions, etc.) please contact the designer or HUESKER Synthetic GmbH.

The information contained herein is up to the latest experiences and knowledge. We reserve to conduct changes due to the technical development. Warranty claims cannot be asserted based on this installation manual.

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Annex 1: Configuration of the filling equipment (example)

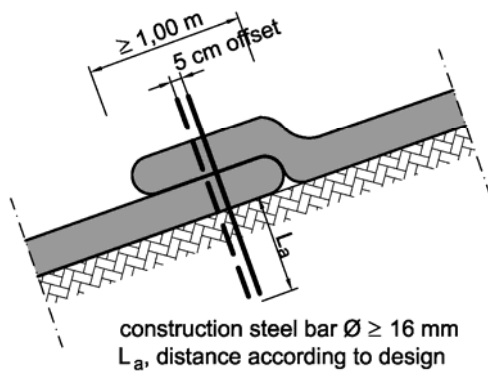
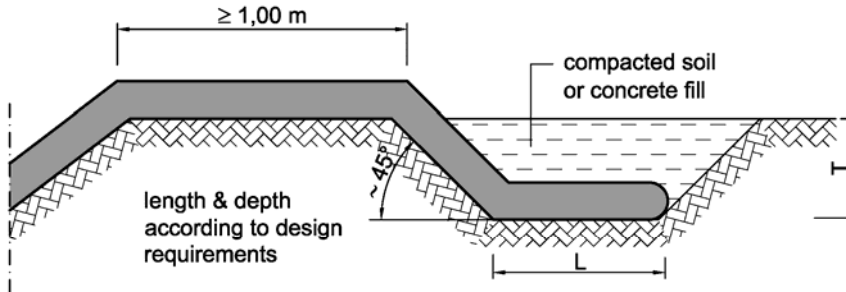
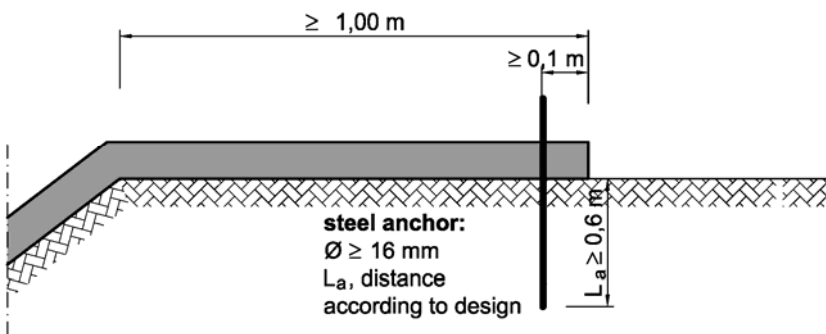
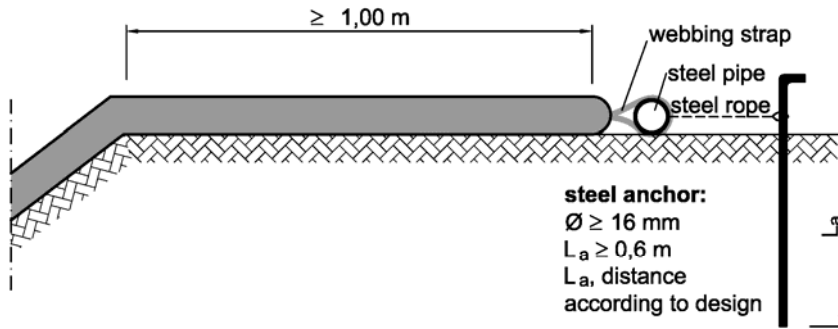


Attention: the herein given diameters are empirical values and correspond to a concrete mattress with a binder length of 10 cm; for thicker mattress consistent diameters have to be chosen



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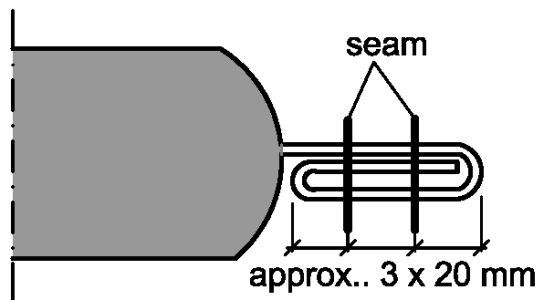
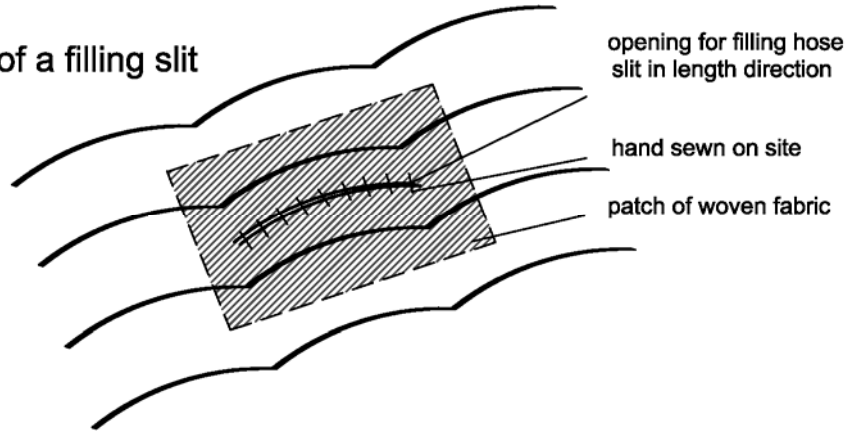
Annex 2: Ways of anchoring (temporarily and permanent)



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Annex 3: Closing of openings / Execution of edge seam

Closure of a filling slit



Einbauanleitung

Annex 4: Overview of used concrete recipes

This abstract is an implement to support the detection of an adequate concrete mixture.
The finally used concrete mixture is suggested to be controlled by a test-filling for each application.

Concrete					Cement + minor component			Aggregate			Additive			Water	Installation	Country	Proj.nr.
Strength class	Exposition class	Consistency	Flow diameter	Strength development	Type/Strength class	Mass	w/z _(eq)	Type	D _{max}	Particle size group/mass		Type	Mass (related on mass of cement)	Mass			
		DIN 1048 – Teil 1, EN 12350-5															
C20/25					CEM II/A-S 42,5 N	485 kg/m ³	0,54	sand, fine	4 mm	1600 kg/m ³	Super plastiklis Muraplast ¹	FK 63,30	2,2 l/m ³	260 kg/m ³	U.W. ²	LAT	
C25/30					CEM I/42,5	560 kg/m ³	0,3	sand	4 mm	0/4 1470 kg/m ³	Plastifikator Stasimen 2000 ¹		4,0 l/m ³	170 kg/m ³	U.W. ²	LTU	
C25/30	XC4, XF3, XA1	F6	63 - 70 cm		CEM III/A 32,5	350 kg/m ³	0,48	sand	2 mm	0/2 699 kg/m ³	Viscocrete 1020 X ¹		2,8 kg/m ³	190 kg/m ³	dry	FRA/GER	
							gravel	8 mm	2/8 855 kg/m ³								
C25/30					CEM II/A-M 42,5	550 kg/m ³	0,34	sand	4 mm	0/4 1700 kg/m ³			0,85 % (4,675 kg/m ³)	190 kg/m ³	U.W. ²	AUT	
C25/30					CEM II/A-M 42,5	415 kg/m ³	0,34	sand	2 mm	0/2 700 kg/m ³				190 kg/m ³	-		
					Flugasche	135 kg/m ³		gravel	8 mm	2/8 700 kg/m ³							
C30/37	XC4, XF1, XA1, XD1 /WA	F6	63 - 70 cm	M	CEM II/B-M 42,5 N	420 kg/m ³	0,41	sand, fine	2 mm	0/2 903 kg/m ³		FM-PCE	1,1% (4,5 l/m ³)	180 kg/m ³	dry	GER	09-233-1W
							sand	4 mm	2/4 739 kg/m ³								
C35/45	XC3				CEM II/A-S 42,5 N	400 kg/m ³	≤ 0,41	sand, fine	4 mm	0/4 890 kg/m ³	Muraplast ¹	FK 63,30 (0,75%)	2,0 l/m ³	164 kg/m ³	U.W. ²	LAT	
							gravel	16 mm	4/16 925 kg/m ³								
C40/50	XC3				CEM II/A-S 42,5 N	410 kg/m ³	≤ 0,45	sand, fine	4 mm	0/4 760 kg/m ³	Muraplast ¹	FK 63,30 (0,75%)	3,0 l/m ³	182 kg/m ³	U.W. ²	LAT	
							gravel	16 mm	4/16 1060 kg/m ³								

¹ individual names of products according to the producer

² submerged (U.W.: under water)

Einbauanleitung

Annex 5: Thickness and shrinkage

(Version 6.11.2015)

The following values are based on experiences with Incomat® mattresses.

Values may differ due to the individual installation conditions.

Incomat®-Type	length of spacing binders [cm]	average thickness* [cm]	shrinkage/expansion** [%]					
			bottom of slope		only slope		crest of slope	
			width	length	width	length	width	length
Standard 20.108	8	11	1 to 2	2 to 12	2 to 3	2 to 4	2 to 3	-3 to 1
Standard 20.115	15	17,5	1 to 2	6 to 10	2 to 3	2 to 3	2 to 3	-5 to -2
Standard 20.120	20	22						
Crib 10.100		5	9 to 10	3 to 13	9 to 10	0 to 4	4 to 5	-2 to 2
Crib 10.200	-	11	9 to 10	8 to 17	10 to 12	4 to 6	6 to 7	-6 to -3
Flex 20.106	6	7						
Flex 20.108	8	9						
Flex 20.112	12	13						
Flex 20.115	15	15,5	6 to 9	6 to 7	7 to 9	5 to 7	5 to 6	-3 to -2
Flex 20.116	16	18						
Flex 20.118	18	20						
Flex 20.130	30	22						
FP C60.148	***	10			13	14		
FP C60.148/20	****	17						

* The stated values are only benchmarks. The real thickness strongly depends on the degree of filling

** positive values = shrinkage [%]; negative values = expansion [%]

*** Grid of filterpoints approx. 20 cm x 20 cm

**** Grid of filterpoints approx. 35 cm x 32 cm