

Material parameters

Product description:

The product **durfill** is a complete system for filling hybrid constructions made of welded sheet metal or cast iron with cast. This ready-mix dry powder, to which only water is added for mixing, results in a pumpable, self-compacting, and self-venting casting compound. In this way, machine components are stiffened, vibrations dampened, and thermal deformation is reduced. The basis of the technology is a special cement of the Dyckerhoff GmbH.

Material parameters:

Characteristics	[]	Value	Test specifications, notes
Density	ρ_c	2,275 kg/m ³	
Compressive strength 28 d, after 3 and 7 days	f_{cm}	90 Mpa 70 / 80 MPa	DIN EN 1015, on prism, storage in accordance with the standard
Flexible tensile strength 28 d, after 3 and 7 days	f_{ctm}	10 Mpa 10 / 10 Mpa	DIN EN 1015, three-point test, on prism 40 x 40 x 160 mm, standard storage
Static modulus of elasticity	E_c	32,000 Mpa	DIN 1048 with cylinder Ø 150 x 300 mm
Dyn. modulus of elasticity	E_c	40,000 Mpa	DAfStb-Rili, ultrasonic sound
Poisson's ratio	μ	0.20	In accordance with EC-2
Logarithmic decrement	Λ	0.035 [-] (D = 0.56 %)	Test specimen 400 x 100 x 100 mm
Thermal expansion	α_T	$12.4 \cdot 10^{-6} K^{-1}$	at 20°C
Thermal conductivity	λ	2.7 W/mK	at 20°C / 65 %
Specific thermal capacity	c_p	1.05 J/gK	at 20°C
Temperature resistance		until 90°C	for modification of the characteristics at higher temp. see EC-2-2 and EC-4-2
Formwork pressure on enclosing members/form		25 kN/m ³ x h h=height in m	Fluid pressure and pressure due to swelling of the material of < 1,5 %.
Transportable after		12 to 16 h	Depending on ambient temperature
Recommended setting time prior to further processing		> 2 weeks	Depending on temperature and the required quality of precision processing
Maximum particle size		4.5 mm round particle	Flow inlet in member > Ø 100 mm; material transport by silo trucks and blowing into stationary silos is possible
Fibers		fiber-free	
Coating, bonding		possible	For example, with epoxy or PU-materials
Casting performance, casting height		[-]	Depending on mixer and pump; no concrete-specific limitation
Processing time		ca. 60 min	Depending on ambient temperature
Yield 1 ton of dry concrete		440 liter	Ready-to-use flowing filler-concrete
Amount of mixing water for 1 ton of dry concrete (depends on the mixer)		110-115 l/ton 250–260l/m ³ 4.4 – 4.6 ltr. per 40kg bag	Flow Table Test without shocks > 600 mm acc. to DIN EN 12350-5. Flow Table Test without shocks > 240 mm acc. to EN 1015-3 Contact us for a mixing demonstration.
Storage		for 3 months	Dry, in original packaging
Hazard rating			See Safety Data Sheet

Processing

Structural prerequisites:

A swelling agent is part of the casting compound. A closed cross-section is needed in order to build up a three-dimensional state of stress. Meanwhile, the pouring of open boxes should be avoided. For the in-filling, openings with a minimum size of Ø 100 mm must be provided. The common distance between the filling openings is 2 m.

There is a swelling agent in the mixture. To build up a three-dimensional state of pressure, only closed cross-sections are to be filled. If open boxes are filled, cracks will occur on the top surface of concrete which is in contact with the ambient air.

During the filling process heavily strained areas like the linear guide rails should be positioned down below or on the side. The casting compound will be filled from the top. However, after turning the construction this will be the floor of the finished element. Due to the self-compacting properties the air rises upwards and needs to escape. Boreholes from Ø 8mm up to Ø 16mm are operating as vents at high points or horizontal surfaces. Moreover the filling might be controlled as well. In the case that these holes are provided with a thread, a screw may be inserted during filling in order to prevent the flow out of the material. Alternatively a riser may be used. Using a square timber, the construction may be arranged with a slope, so the ventilation openings are situated on the top areas. If threaded holes are provided for injection nipples, air bubbles at critical points can also be filled by grout injection easily.

Due to the dead weight of fresh concrete, beams need additional support in order to prevent a deflection of the element. The deformation is freezing and will cause higher processing costs during the machining. All openings with exposed concrete surfaces should be sealed, so that no water can penetrate to the concrete. This can be done with welded sheet metal, glued plastic lids or an epoxy or polyurethane coating.

Bonding course:

The bond between steel and casting material is crucial for damping. Due to thermal and material-caused deformations during hardening of the concrete, delamination cannot be excluded, even if the steel surface was cleaned and sandblasted. For critical applications and substrates we strongly recommend:

- (1) Mechanical interlock: welded perforated plates as stiffeners, welded shear studs Ø 16mm, welded or screwed M16 bolts, length 70mm, welded reinforcing bars Ø16mm, l = 100mm, etc. as a mechanical connection between steel sheet and concrete. A typical grid pattern is 20cm x 20cm. Using this solution, descaling or grit blasting of the steel surface is not required, due to the mechanical bond. The rougher the surface, the better is the bond. There should be no oil or grease at the surface, which prevents the adhesion between steel and concrete.
- (2) Bonding: A 2-component epoxy resin is applied to the clean steel surface and the moist compound is sprinkled with aggregate (inert granular material). The casting material can be applied as soon as the resin is tack dry or has set.
- (3) Injecting: Alternatively, the planned gap between concrete and steel may be filled by injection grouting with a resin.

Mixing and casting:

Two semi-skilled workers are required for carrying out the work. Mix the **durfill** ready-mix casting compound with the amount of water specified. The mixing time depends on the mixing technique used. The resulting compound must be viscous, cohesive, pourable, self-leveling, and self-venting, without bleeding of water. The compound can be cast, poured, shoveled, or pumped – or can be cast via inclined chutes. Vibration leads to separation; light poking or knocking is permitted. All equipment used can be cleaned with water and a brush, or alternatively with a steam-jet cleaner.

Curing:

The material is not suitable for use on fair-faced concrete surfaces. Cracks on open areas cannot be avoided, even with careful curing. The machine component can be transported on the next day and, for example, placed in the storage yard. Standard equipment can be further processed 3 or 4 days afterwards, when the compound has almost completely hardened and the concrete has cooled. High-precision equipment requires a waiting time of two weeks so that deformations and restraints that accompany the hardening process of the cement are largely completed.

Embedded parts:

Conduits inside the machine must be watertight. We recommend HT or KG pipes (sleeves with rubber seals) from a specialist construction-materials dealer. Waterproof electrical connection boxes for embedding in concrete (e.g., Spelsberg, Kaiser) are available in the electrical trade. Please note for all other embedded parts that the casting compound reaches a temperature of up to approx. 60 °C during hardening.

Retrofitting

Durfill is not suitable for filling existing machines, as the accuracy of the guideways will be lost.

Structural calculations

Use as structural casting material (thick-plate construction):

The steel structure is regarded as a self-supporting structural component and structural calculations are performed, for example, with consideration of stiffening ribs and design e.g. to resist fatigue. The concrete cross-section is not taken into consideration. The concrete is used solely to add weight, for adjustments with respect to the eigen frequency, for damping vibrations and as well as reducing sound emissions.

Use as effective supporting composite (thin-plate construction):

The steel structure is designed as a composite material with a thickness of 5 to 8 mm, e.g., in accordance with Eurocode 4 (DIN EN 1994-1-1). For additional strengthening and improving the stiffness, reinforcing steel BSt 500 or a steel structure can be welded on. This design method results in fine cracking of the concrete; its stiffness can be calculated in accordance with Eurocode 4.

Waste disposal

Dispose hardened product according to your local regulations for concrete.

Testing Equipment for consistency check

<ul style="list-style-type: none"> Mortar Set: Setting bowl acc. to EN 1015-3 Art.Nr. B2904 and Plexiglass-Table 325mm/320mm Art.Nr. B29041 	Available from: Form+Test Seidner, Riedlingen, Germany Web: www.formtest.de
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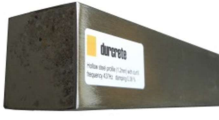

System partner and sources of supply

Material	Source of supply
Ready-mix 'durfill', including binder, aggregate and additives, ready-to-use, requiring only the addition of water. <ul style="list-style-type: none"> Bulk goods – 25 tons per silo truck Bagged goods - 40 kg per bag, Minimum quantity: 1 palette with 35 bags ea. = 1.40 tons; loaded on truck or packed for export in overseas container Only full palettes, no single bags 	Available with worldwide delivery from: durcrete GmbH Dr.-Ing. Bernhard Sagmeister Am Renngraben 7, 65549 Limburg, Germany Tel.: +49 6431 58 40 376 Fax: +49 6431 58 40 377 Mail: info@durcrete.de Web: www.durcrete.de
Bags with 5 kg or 25 kg, available as single bags for testing and prototypes	Webshop: www.moertelshop.de Backstein Engineering GmbH Langgasse 21 D - 65510 Idstein Germany E-mail: Sven.Backstein@moertelshop.com
Sale and rental of silos for dry premix concrete	Upon request
Equipement for liquid or self levelling floor screed: Mixer and feeding pump in one aggregate for silos e.g. m-tec QLMP-FE up to 100l/min Mixer and feeding pump in two aggregates for silos e.g. Knauf PFT HM5 und ZP 3 XXL up to 90 l/min e.g. mixer and WM Variojet FU up to 30 l/min Mixer and feeding pump in one aggregate for bags e.g. UMP1 Standard plus up to 24 l/min e.g. m-tec duo mix 2000 Continous mixer for silo and/or bags without a pump e.g. Knauf PFT HM 2002 up to 30 l/min e.g. WETMIX, diverse models and sizes	 www.m-tec.com m-tec, D-Neuenburg www.pft.de Knauf PFT, D-Iphofen www.werner-mader.de Mader, D-Erbach www.deutsche-foerdertechnik.de D-Bautzen www.m-tec.com m-tec, D-Neuenburg www.pft.de Knauf PFT, D-Iphofen www.wamgroup.com WAM, D-Altlußheim
Bonding course made of steel, sprinkled with crushed stone e.g., epoxy resin primer EG, Art.No. 32434 e.g., quartz sand QS, Art. No. 09660 alternative dry crushed split Ø 2 mm to 5 mm	quick-mix Gruppe GmbH & Co KG Web: www.quick-mix.de Orders from local construction material suppliers
Repair of voids by grouting Direct sale of reaction resins, packers, pump, mixing technology, test equipment, etc.	Desoi GmbH Web: www.desoi.de With Web shop/catalog

durfill is designed for the use in machinery construction. Regarding the special characteristics, it doesn't fit the the regulations of EN 206 / DIN 1045 or the German Code 'DAfStb-Richtlinie zu Vergussbeton und Vergussmörtel'. So it may not be used for construction purposes within Germany.

Effectiveness

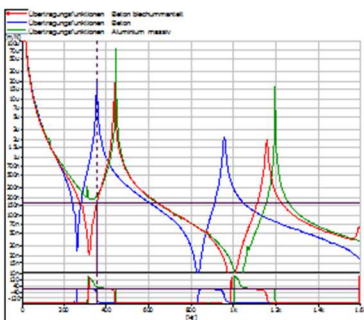
Dynamic tests performed by Prof. Nebeling, University for applied science Reutlingen

Material		
Nanodur-Concrete 40 x 40 x 700mm		
1. Eigenfrequency	354 Hz	
Damping D in [%]	0,56 %	
Logarithm. Decrement Λ	0,035	
Sandwich with durfill 40 x 40 x 700mm		
1. Eigenfrequency	437 Hz	
Damping D in [%]	0,38 %	
Logarithm. Decrement Λ	0,024	
Aluminium 40 x 40 x 700mm		
1. Eigenfrequency	445 Hz	
Damping D in [%]	0,1 %	
Logarithm. Decrement Λ	0,006	

Übertragungsfunktionen der drei untersuchten Proben



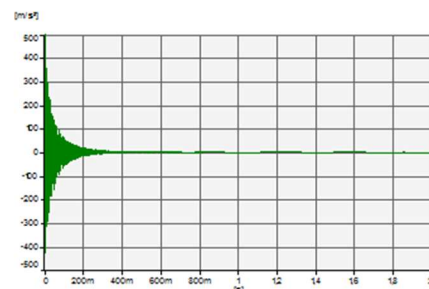
Abklingkurve Beton



Erste Resonanzfrequenz der drei untersuchten Materialproben

Materialproben	Eigenfreq.	Dämpfung
Beton	354 Hz	0,56 %
Beton Blechmantel	437 Hz	0,38 %
Aluminium	445 Hz	0,1%

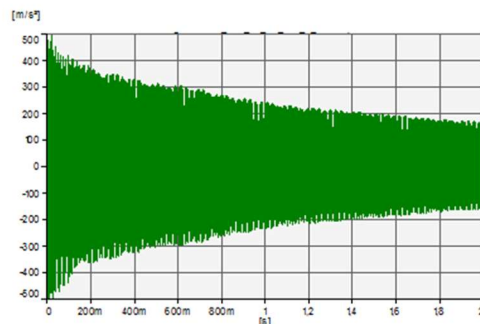
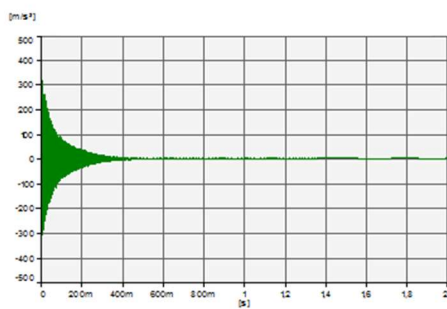
Als Proben wurden jeweils massive Materialproben mit einem Querschnitt von 700x40x40 mm untersucht. Der Blechmantel hatte eine Wandstärke von 1,5 mm.



Abklingkurve Beton blechummantel



Abklingkurve Aluminium

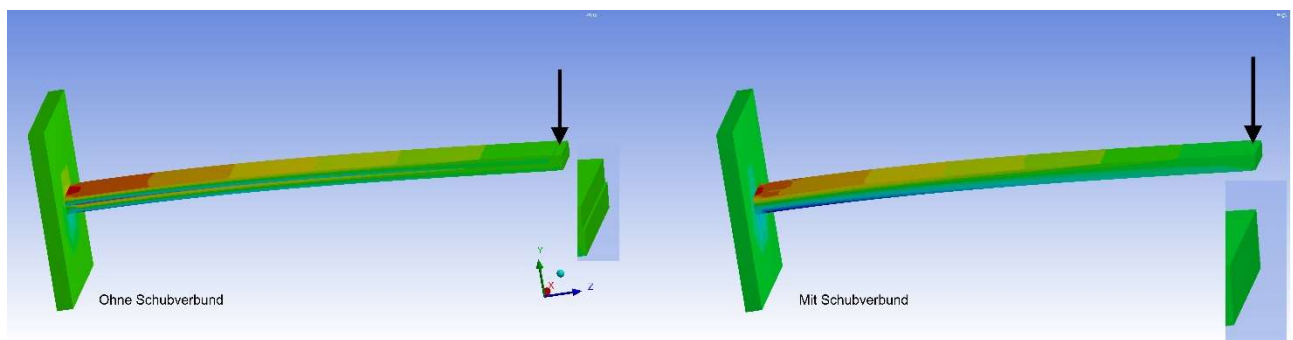


Test of Fraunhofer IWU in Chemnitz, dated 31th of Mai 2016 proofs, that the damping characteristiv of durfill is better than other products available. Download of the Test-Report (German only) at <http://durcrete.de/downloads/>

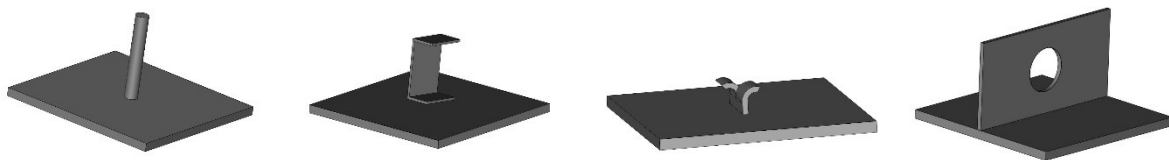
Shear Connection

For a good bond, the fresh filling compound must be pressed against the steel, so that it does not detach when the concrete shrinks during hardening. This is achieved by a swelling agent in the mixture. When the element is subjected to load, the joint between the steel and the filling compound is subjected to shear. Concrete and steel surfaces try to slide against each other. In order to ensure an optimal uniform supporting action, a perfect shear bond is necessary. Therefore, the following design measures must be taken in account for bending as well as tension and compression elements.

The action of shear can be illustrated on a cantilever, which consists either of two superimposed boards (left picture) or a well connected cross section (right picture).



For flat steel sheets, every 200 x 200mm a shear connector is required



This is not possible using rectangular or circular hollow profiles. Therefore every 100 mm horizontal and vertical holes are drilled, through which threaded bolts \varnothing 16mm or reinforcement bars \varnothing 16mm are placed and fixed by welding. It is sufficient to do this at the beginning and at the end of the profiles, since in the middle third the shear forces are usually low. In stainless steel tubes, the same method can be applied using screws instead of welding.

