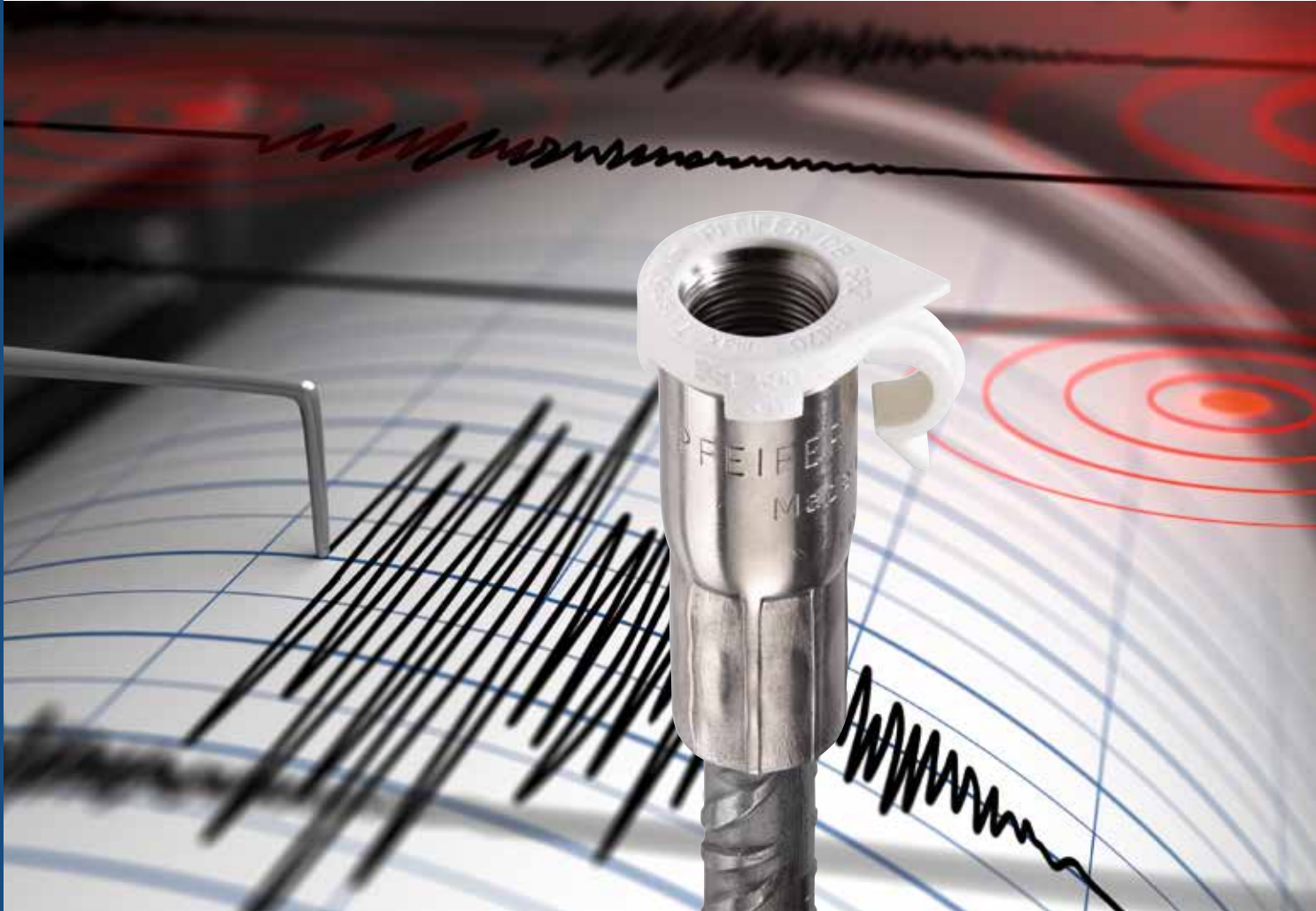


# PFEIFER

**For keeping your heartbeat  
calm during an earthquake!**



01/2018

**PFEIFER-Seismic Solutions  
DB Foot-mounted Anchor**

**PFEIFER  
SEIL- UND HEBETECHNIK  
GMBH**

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## What is an earthquake?

Earthquake is the name given to measurable vibrations in the earth. They arise mainly from sudden movements in the earth's crust. They cause various kinds of seismic waves that spread out from the seismic centre. This conveys unimaginably large amounts of energy, causing enormous damage to infrastructure, buildings and machines. This also threatens human lives, in particular through collapsing structures. In coastal areas this can also result in tidal waves (tsunamis).



### Examples of classification of earthquake intensities:

Richter magnitudes	Earthquake magnitude class	Earthquake consequences	Worldwide event frequency
< 2,0	Micro	Micro-earthquake, not felt	≈ 8,000 times per day (> Magnitude 1.0)
2,0 ... < 3,0	extremely light	Usually not felt, but measured	≈ 1.000 times per day
3,0 ... < 4,0	very light	Often felt, but damage is rare	≈ 49,000 times per year (estimated)
4,0 ... < 5,0	light	"Noticeable shaking of objects in rooms, rattling noises; usually no damage"	≈ 6.200 times per year (estimated)
5,0 ... < 6,0	moderate	Significant damage to poorly constructed buildings, slight or no damage to strong buildings	≈ 800 times per year
6,0 ... < 7,0	strong	Destruction up to 70 km away	≈ 120 times per year
7,0 ... < 8,0	large	Destruction over wide areas	≈ 18 times per year
8,0 ... < 9,0	very large	Destruction up to hundreds of kilometres away	≈ once per year
9,0 ... < 10,0	extremely large	Destruction up to a thousand kilometres away	≈ every 1 to 20 years
≥ 10,0	global disaster	Never yet recorded	unknown



## What special qualification of fastenings is needed?

Fastening points in building and particularly connections in precast construction have a big effect on the stability of the building or the general safety of people and furnishings and equipment. Therefore these points must be particularly suitable in earthquake regions, with performance categories divided into C1 and C2. Which one is required depends of the earthquake intensity measured as a multiple of the acceleration of gravity and the classification (significance) of the building concerned.

Seismic intensity	Significance category of the building			
	I	II	III	IV
$a_g \cdot S^*$				
very low < 0,05 g	No earthquake stress			
low 0,05 g – 0,10 g	C1	C1 (non load-bearing components) C2 (load-bearing components)		C2
> low > 0,10 g	C1	C2		

\* Reference – peak value of ground acceleration · ground parameter




In contrast to other dynamic load types, anchorages with an earthquake qualification must be safely able to take both tensile and compressive forces from a seismic loading.

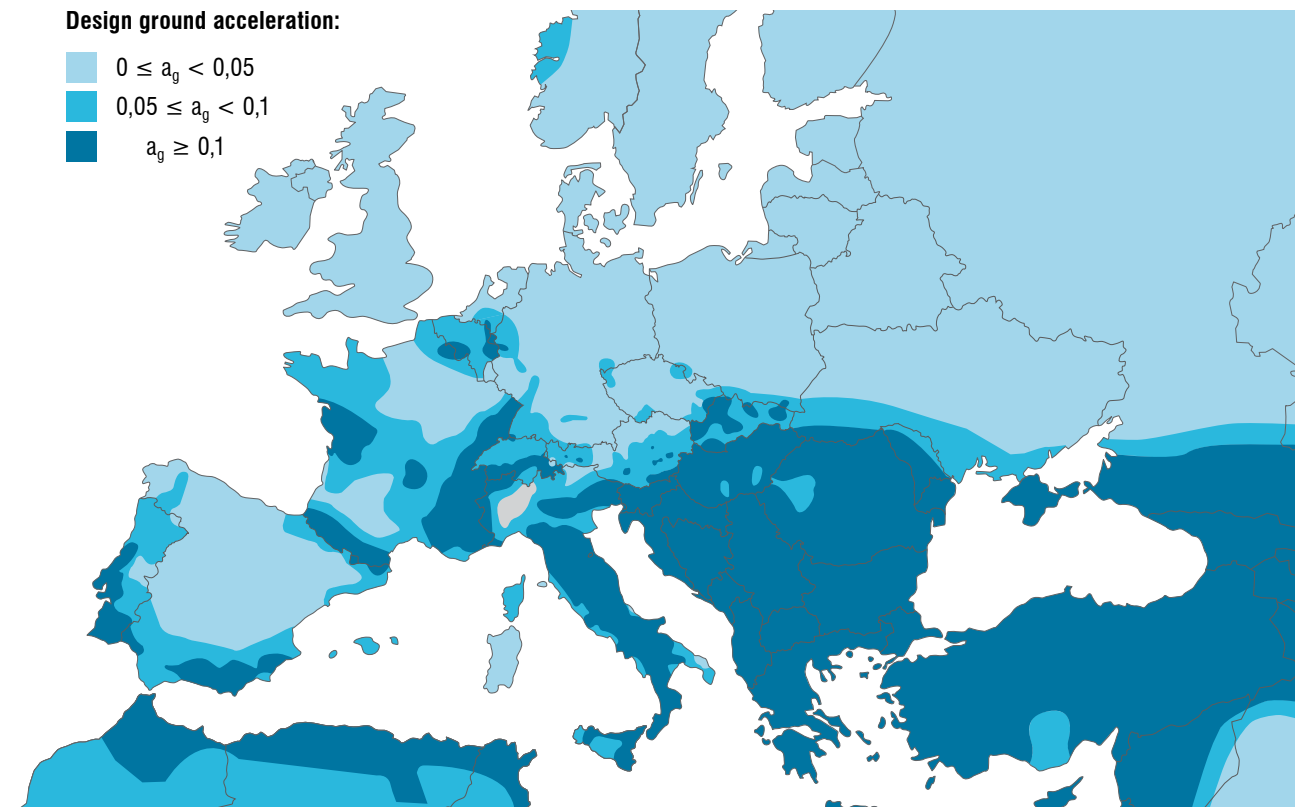


## What performance do fastenings require?

Technical test evidence is required for anchorage systems rated and approved for performance categories C1 and C2. The qualification for requirements for anchors for performance category C2 are significantly stricter than those for C1. While the resistance for performance category C1 applies only to the data about loadings, deformations are also important for category C2. This is also reflected in the comprehensive test series described in the European Assessment Document EAD no. 330012-01-0601.

### Design ground acceleration:

-   $0 \leq a_g < 0,05$
-   $0,05 \leq a_g < 0,1$
-   $a_g \geq 0,1$



## How was the testing done?

### Qualification for performance category C1

The qualification for this performance category is carried out by means of repeated tensile tests with a defined number of load cycles with a seismic characteristic. Specific load levels are thereby approached, depending on the size.

The evaluation of all trials showed that the resistances originally declared for static and quasi-static tensile loads may also be taken as the basis for proofs within the context of the performance categories C1.

### Qualification for performance category C2

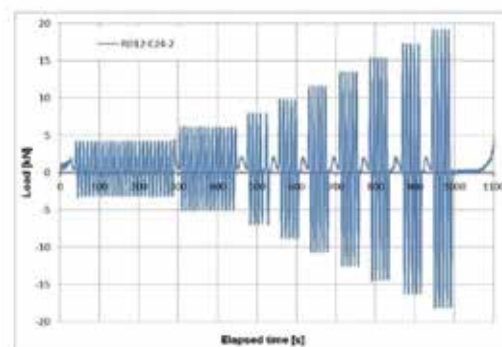
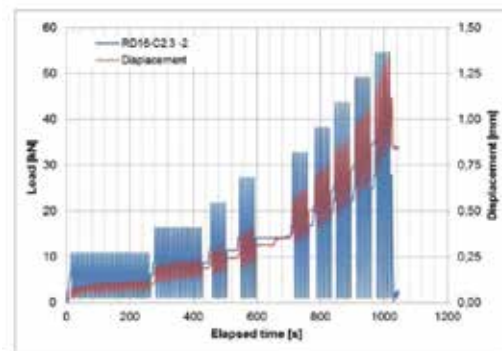
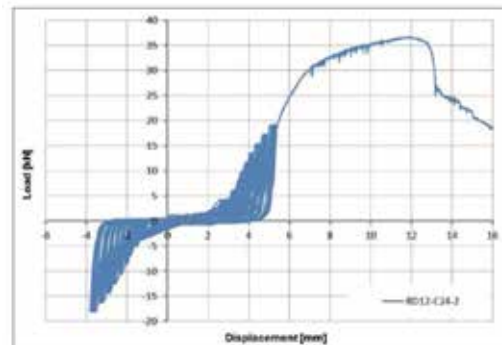
For this performance category also, comprehensive test series are necessary. These must be carried out in addition to those for performance category C1. The effort for this is several times as high, since all testing must be done on large-size concrete items. The focus is mainly on the load-bearing and deformation behaviour of the anchor within a crack. For exact analysis, reference and functional test is done with pulsating tensile load. For assessment of transversal shear force behaviour, alternating (reversing) test series were done, intended to simulate effects characteristic of an earthquake.

For performance category C2 this achieved the same resistance values as for static and quasi-static load cases with corresponding ductility.



## Our solution!

On the basis of a new European Assessment Document ETA no. 330012-01-0601, the existing European Technical Approval has been extended by the seismic application. As the first anchor system for cast-in concrete anchors, the PFEIFER DB foot-mounted anchor has an approval for seismic applications. All relevant resistance values and displacements are included for the performance categories C1 and C2.



## Our solutions in other areas

Also in the areas "reinforcement continuity" there are comprehensive tests for qualification for seismic applications. We are expecting soon a corresponding official confirmation for the PFEIFER PH system.

**PFEIFER  
PH system**



## PFEIFER innovations – unique in quality



For over 25 years PFEIFER has been developing, producing and selling, in addition to lifting anchors for lifting concrete components, also products for permanent fixings of and to concrete components. Based on the quality standards in the Lifting Anchor Systems segment, the products with building authority approval in this product segment have been developed in co-operation with research institutes to precisely meet the customer's needs. Both research and testing institutions at universities and the German Institute of Building Technology (DIBt) are involved at an early stage in the development of application-appropriate properties. In the company's own test site various qualification tests up to fatigue testing are carried out. Recognised experts from the world of seismics give specialist assessments of the application properties. A whole group of specialised civil engineers within PFEIFER then optimises the products for the later application.

Right from the development, great attention is paid to ensuring that only ideally suited raw materials are used. The material quality is also ensured in series production through exact specifications for the steel manufacturers, combined with our own factory checks. Precision steel tubing made to our own specification is used for the production of the sockets for the DB Anchor, because only this tubing meets all the requirements for the subsequent product quality. All of these factory monitoring measures in production are documented and archived accordingly. These documented factory production controls are regularly monitored by an external testing body.



Lifting Anchor Systems  
Thread System



Lifting Anchor Systems  
BS Anchor System



Lifting Anchor Systems  
WK Anchor System



Fixing Systems  
DB Anchor 682  
for Permanent Fixing



Fixing Systems  
Socket Dowels  
Polyamide Sockets



Fixing Systems  
HK Assembly Anchor System



Connection Systems  
Column Shoe System  
Wall Shoe System



Connection Systems  
Stell Bearing  
Staircase Bearing VarioSonic



Connection Systems  
Sandwich Anchor System  
Delta Anchor System



Connection Systems  
Concrete Earthing System BEB



Reinforcement Systems  
VS®-Wire Rope Loop System



Reinforcement Systems  
PH Reinforcement Continuity System



Cable Tension Members  
Tension Rod System



Attachment Materials  
(Wire Ropes, Chains, Textiles)



Lashing Systems



Grabs for Reinforcing Steel  
Balancing Spreader Beams

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