

Cooperation partner wanted in some European Countries, Russia, South Korea, Japan, China, India, Canada and in the United States of America.

FILIGRAN®-Punching Shear Reinforcement FDB Reinforcement for Efficient Flat Slabs

- developed approved and successfully applied -

January 2019

Flat Slabs

Reinforced slabs are built economically as two-way span constructions. This enables in general to build thinner slabs. Columns are being increasingly used as vertical structural elements in multi-storey buildings as wall replacements to save construction material and increase the available floor space. There are different constructions for the support of slabs on columns:

- a) beams on the columns
 - beam -supported slabs
- b) columns with column heads
 - mushroom slabs
- c) columns without column heads
 - flat slabs

Beam-supported slabs and mushroom slabs reduce the clear storey height and require more time and effort for formwork and reinforcement installation. Flat slabs are in these aspects advantageous. Nevertheless, punching the column through the slab – that means a cone-shaped concrete failure in the slab – must be avoided.

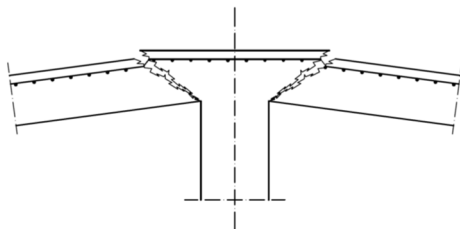


Fig 2 Punching shear failure

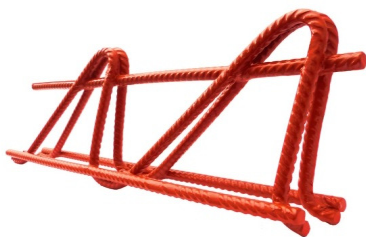
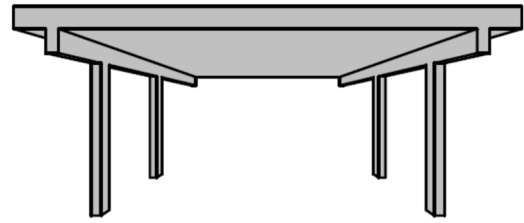
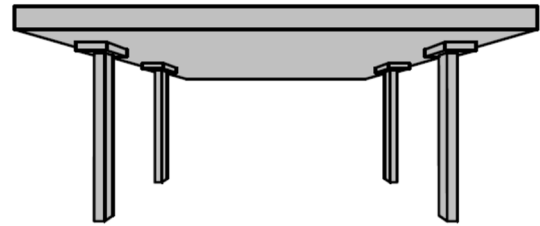


Fig 3 FILIGRAN-Punching Shear Reinforcement (German abbreviation: FDB)

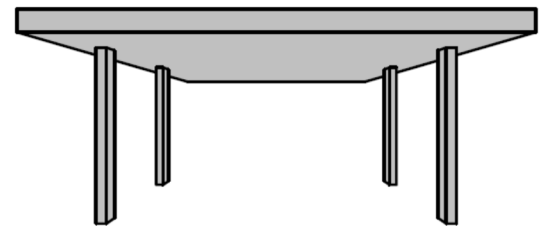
¹ WIPO / PCT WO 2014/026781 POINT-SUPPORTED ELEMENT OR FLAT CONCRETE CEILING



a) Beam-supported slabs



b) Mushroom slabs



c) Flat slabs

Fig 1 Slab systems

FILIGRAN-Punching Shear Reinforcement

Filigran Trägersysteme GmbH & Co. KG has developed a special punching shear reinforcement to avoid punching shear failure in flat slabs and to increase the load-bearing capacity of the slab. Typical for this patented¹ reinforcement is the anchorage of the inclined bars by a combination of loops and welding plus effective geometry. The load-bearing bars are inclined differently to the column to achieve the highest possible punching shear resistance. Reinforcement consists of several pre-fabricated linear elements.

Production

The inclined bars are produced by Filigran Trägersysteme GmbH & Co. KG as ribbed bars with a yield strength over 500 MPa and defined elongation properties. The FILIGRAN - Punching Shear Reinforcement FDB is produced on fully-automated bending and welding machines.

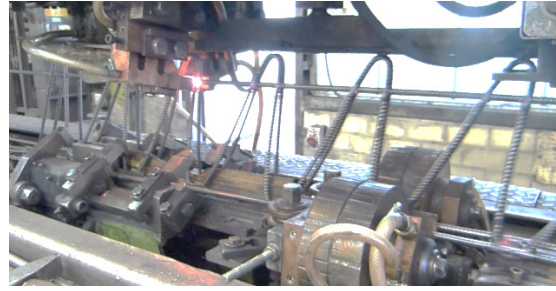


Fig 4 Production with fully-automated bending and welding machines

Testing and Approval

The FILIGRAN-Punching Shear Reinforcement (FDB) was tested in full scale tests at the University (RWTH) Aachen, Germany. The tested reinforced concrete slabs were between 180 mm and 360 mm thick. By the use of the FILIGRAN - Punching Shear Reinforcement the punching shear resistance is more than doubled. On the basis of a European Common Understanding of Assessment Document (EAD) the German Institute for Building Technology (DIBt) issued a European Technical Assessment (ETA)² and approved an increased load factor of 2.1, a factor higher than any other European-wide approved punching shear reinforcement system. The FILIGRAN - Punching Shear Reinforcement can be used in precast composite constructions as well as in in-situ slabs.

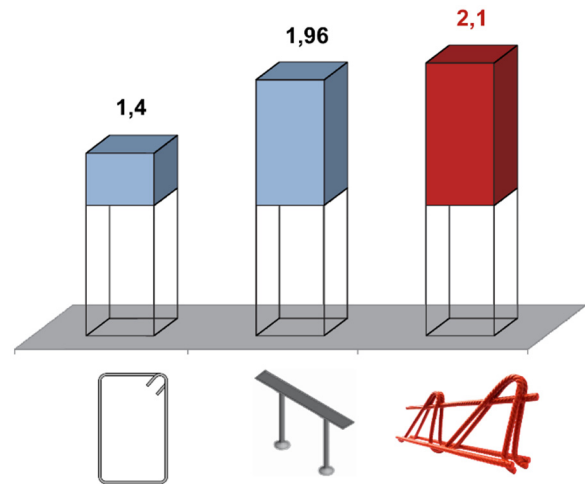


Fig 5 Increased load factors for different punching shear reinforcement systems in comparison

² Deutsches Institut für Bautechnik (DIBt): European Technical Assessment ETA-13/0521 Filigran punching reinforcement FDB, 14th June 2018.



Fig 6 FILIGRAN – Punching Shear Reinforcement with bending reinforcement in place

Application

FILIGRAN – Punching Shear Reinforcement FDB is a further development of a former lattice reinforcement, which has been used in Germany since 2001 based on a national technical approval. This system was initially developed for composite slabs made of precast slabs with lattice girders and in situ topping. The reinforcement elements are installed parallel to each other and parallel to existing lattice girders to allow easy installation. In in-situ concrete slabs an orthogonal arrangement of the reinforcement elements is also possible. The upper bending reinforcement is arranged on the upper chord between the loops.

The application of FILIGRAN-Punching Shear Reinforcement makes it possible to avoid beams and column heads.

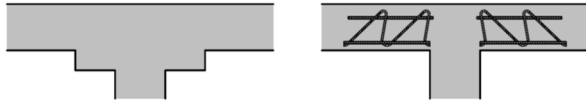


Fig 7 Avoid column head by using FILIGRAN - Punching Shear Reinforcement

FILIGRAN – Punching Shear Reinforcement FDB is mainly used in composite floor slabs in Germany and Europe. However, it is used in insitu concrete slabs too. The advantages of easy stockpiling and fast installation are used in precast plants. The benefits of the easy arrangement of the upper bending reinforcement on the upper chord as well as the highest punching shear resistance are leading to increased application of this system.



Germany - Hamburg 2007



Germany - Berlin 2015

Fig 8 Executed building projects with FILIGRAN - Punching Shear Reinforcement

Sales and Cooperation

The company Filigran Trägersysteme GmbH & Co. KG holds different patents for the FILIGRAN – Punching Shear Reinforcement. Currently, the product is made and distributed by the FILIGRAN Company.

Currently, FILIGRAN Trägersysteme GmbH & Co. KG is searching for cooperation partners in some European countries, China, South Korea, Japan, Russia, India, Canada and the United States of America.

FILIGRAN Trägersysteme

The Company Filigran Trägersysteme GmbH & Co. KG is an owner-managed family business going back to its foundation by Stefan Keller in the year 1949. The branded FILIGRAN construction method using lattice girders was developed by the company in Germany. In Germany and other European countries, the FILIGRAN construction method has become the most commonly used slab system. More than 70% of slabs are produced with precast slabs with lattice girders in Germany.

Filigran Trägersysteme GmbH & Co. KG is currently producing in two places in Germany and has an affiliated company based in Poland.

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