BUILDING COMMON GROUND

MAX FRANK®

Expert Assessment Report

Stremaform®

1014/16 | 18.04.2016 | english

Stremaform® Elements in construction joints for constructions according to DIN EN 1992-1-1: Eurocode 2

Tested by: Prof. Dr.-Ing. Harald Sipple, Wenzenbach

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Note: This is a translation of the German original document not examined by Prof. Dr.-Ing. Harald Sipple, Wenzenbach

Professor Dr.-Ing. Harald Sipple

By the IHK Regensburg publicly appointed and sworn expert
for
Concrete engineering; damage of components and buildings made of concrete

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Expert Assessment Report

Stremaform Elements ("STREMAFORM 3000 – flat material")
in construction joints

for constructions according to DIN EN 1992-1-1: Eurocode 2

Your order of 6 March 2016

My Ref.: 1014/16
Date: 18 April 2016

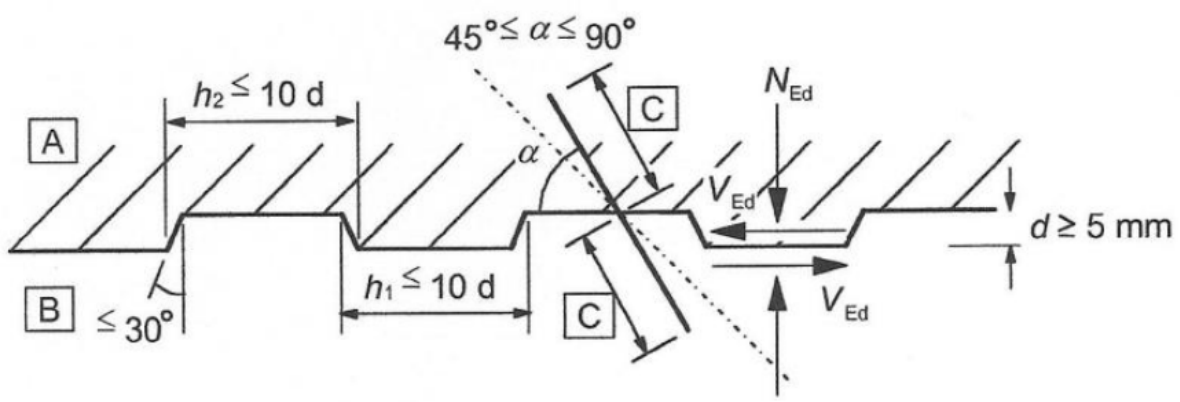
Number of documents handed out: 1 original, 2 copies and as pdf file

Report text: 6 pages

1. DEFINITION OF THE ASSESSMENT TASK

The undersigned was commissioned by Max Frank Pressig GmbH to assess in what way the results acc. to [1 - 3] of the previously performed tests for the product "Stremaform 3000 – flat material[1]" in construction joints can be assessed in terms of DIN EN 1992-1-1: Eurocode 2[2].

The main focus is on the question of classifying the construction joint surfaces covered with Stremaform 3000 according to DIN EN 1992-1-1: Eurocode 2, or according to Fig. 6.9 in the same section (included in this document as Figure 1):



A 1st pouring section B 2nd pouring section C anchoring of reinforcement

Fig. 1:
Fig. 6.9 - Toothed joint (from DIN EN 1992-1-1: Eurocode 2)

"Stremaform 3000" is a special construction-steel mat with factory welded on expanded mesh in the shape according to Fig. 2. The elements are resistant to bending and can be produced as flat or profile mats, depending on project requirements.

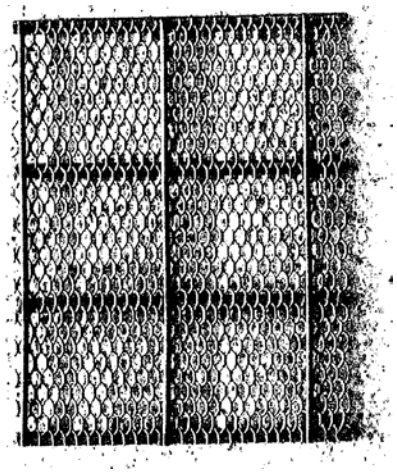


Fig. 2
"Stremaform 3000"
Product surface, factory photo.

[1] ... Hereinafter referred to as Stremaform 3000.
[2] ... There is a former Expert Assessement Report of the author on the same subject, in which the test results have been assessed according to the former DIN 1045-1, version 2001 (my no. 600/05 of 2.6.2005).

2. RESULTS OF THE TESTS PERFORMED IN [1 – 3]

The most significant test results in connection with the question to be assessed within the scope of this document are presented below.

2.1 Evaluation report [1]

> Falkner, H., Teutsch, M., Rohde, S.: Evaluation of the resistance to shear and of water tightness of construction joints using STREMAFORM formwork elements.
> Institut für Baustoffe, Massivbau und Brandschutz – IBMB *[Institute for construction materials, solid construction, and fire protection]*, authorised materials testing organisation for civil engineering. Issue 110, Brunswick 1994.

A total number of 6 units of test girders 15 cm x 15 cm x 300 cm were produced and tested. The girders were either produced as plate strips or girders (3 units each) and were equipped with a construction joint – covered with Stremaform 3000 formwork – in a distance of 60 cm, 80 cm, and 100 cm off the support point, respectively. Previous to the test, the trial girders were subjected to forced centric load in order to obtain a tearing crack at the construction joint. This type of "preliminary damage" is a frequent problem in buildings, due to which the construction joint opens by force. Another trial girder was produced as body of comparison without construction joint.

The plate strips were not equipped with stirrup reinforcement in the area of the construction joints in order to enforce shearing failure. With the girders, the stirrup reinforcement was dimensioned so that failure of the concrete strut was likely.

After concreting of the first section, the construction joint was cleaned from cement laitance by jetting it with water. Then, it was covered in cloth and film to keep it moist and after approx. 2 days a second layer of concrete was applied.

Results[2]:

I... Neither in terms of maximum loads nor in terms of deflection was it possible to find any differences between the monolithically produced components and those equipped with a construction joint – this, despite "preliminary damage" of the trial bodies by centric pre-loading.

II... The shear cracks run across the construction joints without offset or recess.

III... The main expansion values of the trial bodies with construction joints approximately correspond to the values of the trial bodies without construction joints.

[2] ... Cf. Evaluation report [1], P. 19, 27, 29, 34.

2.2 Evaluation report [2]

Falkner, H., Teutsch, M., Claußen, Th.: Evaluation of the resistance to shear of cast concrete between hole-type, block-type, and socket-type footing and column base with concrete surfaces with different profiles.
Institut für Baustoffe, Massivbau und Brandschutz – IBMB *[Institute for construction materials, solid construction, and fire protection]*, authorised materials testing organisation for civil engineering. Issue 110, Brunswick 1994.

A total number of 9 test bodies were produced which were intended to represent the column base in the hole-type footing (see Fig. 3). The formwork between the footing and the cast concrete and between the cast concrete and the column, was carried out in three variants:

a) With trapezoid strips (2.0 cm x 4.0 cm x 2.0 cm) on formwork planking,

b) With bubble wrap on “Pecafil” product

c) With “Stremaform 3000”

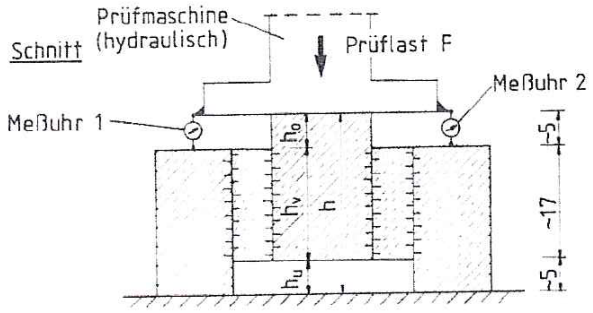
The column base was pushed downwards by the piston of the test machine, which caused the cast concrete (B35 according to DIN 1045(88)) to be sheared off at the transition areas a) to c).

Results[3]:

I... The table below, included from the evaluation report, reveals that the transition areas covered with Stremaform 3000 reached breaking shear load values that were approx. 37% higher than those for areas covered with conventional trapezoid wood strips.

Pos.	Profiled by.	Resistance to shear in breaking condition [kN/mm²]				Comp. value [%]
		Test body 1	Test body 2	Test body 3	Average value	
1	Trapezoid strips on formwork planking	4.984	4.997	4.917	4.966	100
2	Bubble wrap on Pecafil	5.115	5.027	4.406	4.849	97.65
3	STREMAFORM 3000 (expanded mesh)	6.739	6.997	6.647	6.794	136.82

Fig. 3
Tab. 1 from [2], P. 18



below: Testing equipment

[3] ... Cf. Evaluation report [2], P. 18.

2.3 Evaluation report [3]

> Timm, M.: Bonding effect of concrete in the area of Stremaform formwork elements.
> Institut für Baustoffe, Massivbau und Brandschutz – IBMB *[Institute for construction materials, solid construction, and fire protection]*, authorised materials testing organisation for civil engineering. Evaluation report 2000.

In case of suboptimal compaction of green concrete near the formwork element or during jetting of the cement laitance from the element or the connected joint tape or joint metal sheet after concreting, there is a risk of cavity formation in the concrete. Such faults in construction cannot be avoided completely. The advantage of Stremaform 3000 formwork elements is that they are readily visible. In such situations it is common practice to cut open the expanded mesh in the area of the fault and fill it with concrete of the second concreting section.

The purpose of the test sequence was to verify whether or not transmission of shear loads in the construction joint was reduced through this procedure.

To this end, two units of large test bodies with a dimension of 70 cm x 100 cm x 100 cm were produced. These were manufactured in two concreting stages with a formwork cover of Stremaform 3000 in the construction joint located at the third-point of the body. From these test bodies a total number of 18 test girders with a size of w x h x l = 30 cm x 15 cm x 70 cm were cut out from the sections with “good” and “moderate” bonding in the sense of DIN 1045(88) and tested after application of bottom-glued lamella reinforcement (steel straps, thickness = 5 mm). Shear reinforcement was not present. Moreover, 3 reference girders of the same dimensions but without construction joint were produced.

The critical fault points are created by irregular wash-out of the compacted concrete in the first concreting stage down to a depth of approx. 15 mm behind the formwork element.

Results[4]:

I... The shear capacity of the girder without shear reinforcement is not reduced by the Stremaform formwork element.

II.. Faults that may have occurred due to washing or jetting in areas near the element, may be filled completely by thorough compacting in the second concreting stage. The bonding effect is thus not reduced.

[4] ... Cf. Evaluation report [3], P. 16, 17.

3. ASSESSMENT

The results of the test sequences performed in 1994 and 2000 by the Authorised materials testing organisation of the Brunswick University of Technology are applicable independent of the relevant standards and regulations. The scope of the tests is sufficient for answering the questions as per section 1.

All test results confirm that reduction of the maximum loads – both in the bending test (s. section 2.1 or [1]) and in the shear test (s. section 2.2 or [2]) – in comparison with the monolithically produced bodies of comparison is not required. The shear test (s. section 2.2 or [2]) reveals significantly higher breaking shear load values than with conventionally produced toothing with trapezoid strips.

Fault points adjacent to the formwork element can be completely filled – i.e. without impairment of the bonding effect – by thorough compaction of the concrete (s. section 2.3 or [3]).

Consequently, it can be concluded that in the calculation approach for shear force transmission in joints covered by “Stremaform 3000 – flat material” formwork elements the classification of the surface structure and texture according to section 6.2.5 of DIN EN 1992-1-1: Eurocode 2 in accordance with Fig. 6.9 can be stated as **“toothed”**.

<<Stamp : PROF. DR.-ING. HARALD SIPPLE
By the IHK Regensburg publicly appointed and sworn expert for
concrete engineering; damage of components and buildings made of concrete>>
<<Signature, illegible>>
Prof. Dr.-Ing. Harald Sipple

EVALUATION REPORTS

[1] Falkner, H., Teutsch, M., Rohde, S.: Evaluation of the resistance to shear and of water tightness of construction joints using STREMAFORM formwork elements.
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