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Test Report 100793-64.1

Client: Nevoga GmbH
Order number: 1100793-64
Part: Reinforced protective cap «Nevosafe-Plus»
Test date: 21.11.2017
Rev.: 000

Punching shear tests on reinforced protective cap «Nevosafe-Plus»

Test series with reinforcement diameters $d=12\text{mm}$, $d=16\text{mm}$, $d=24\text{mm}$



| Rev. | Date | Comment |
|------|------------|-------------|
| 000 | 07.12.2017 | First issue |

The 'Punching shear tests on reinforced protective cap «Nevosafe Plus» / test report 1100793-64.1' is comprised of 10 pages; the test report documents, the testing regime, the test setup and the execution of the test.

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1 Introduction

The company Nevoga GmbH, represented by Mr Manuel Mösl, approached the Lucerne University of Technology & Architecture with a request to carry out fall sack tests on the reinforced protective caps «Nevosafe-Plus» in combination with reinforcement diameters of $d=12\text{mm}$, $d=16\text{mm}$ und $d=24\text{mm}$.

2 Results of test series 1 with reinforcement $d=12\text{mm}$

The total 3 test bodies «Nevosafe-Plus Ø6-20» behaved almost identically.

The achieved values of the test are summarised in a table as follows.

| Test body | Behaviour | Punching shear | Sharp break lines | Damage to the fall sack | Protective function |
|-----------|-----------|----------------|-------------------|-------------------------|---------------------|
| 1 | Buckling | No | No | No | satisfied |
| 2 | Buckling | No | No | No | satisfied |
| 3 | Buckling | No | No | No | satisfied |
| | | | | | |

Figure 1: Summary of the test results $d=12\text{mm}$

3 Results of test series 2 with reinforcement $d=16\text{mm}$

The total 2 test bodies «Nevosafe-Plus Ø6-20» behaved almost identically.

The achieved values of the test are summarised in a table as follows.

| Test body | Behaviour | Punching shear | Sharp break lines | Damage to the fall sack | Protective function |
|-----------|-----------|----------------|-------------------|-------------------------|---------------------|
| 4 | Stability | No | No | No | satisfied |
| 5 | Stability | No | No | No | satisfied |
| | | | | | |

Figure 2: Summary of the test results $d=16\text{mm}$

4 Results of test series 3 with reinforcement $d=24\text{mm}$

The total 3 test bodies «Nevosafe-Plus Ø20-36» behaved almost identically.

The achieved values of the test are summarised in a table as follows.

| Test body | Behaviour | Punching shear | Sharp break lines | Damage to the fall sack | Protective function |
|-----------|-----------|----------------|-------------------|-------------------------|---------------------|
| 6 | Stability | No | No | No | satisfied |
| 7 | Stability | No | No | No | satisfied |
| 8 | Stability | No | No | No | satisfied |
| | | | | | |

Figure 3: Summary of the test results $d=24\text{mm}$

5 Testing tasks

Verification of the protection function based on the SUVA classification fall test Class B.

Testing of the cover by the manufacturer (state of the art)

The manufacturer carries out load tests to ensure that the reinforced protective covers can withstand the specified maximum forces. The specified test values are state of the art. The test differentiates between 2 classes:

Class A -> fall from a level,

Class B -> Fall with a fall height up to 3.0 m.

The covers are approved from the diameters 10 to 22 mm. The manufacturer must state for which diameter the cover is suitable and has been tested.

Shear punching test: In both classes a shear punching test is conducted with a load that is continuously increased from 0 to 5 kN. This test is conducted with an iron rod.

The following information must be taken into account in the fall tests of Classes A and B:

- Three reinforcement iron rods in a row
- Reinforcement distance 300 mm
- Length of the reinforcement rods: 300 mm
- Length of the cover that need to be tested: approx. 1.0 m
- Fall body: Sand sack, diameter approx. 450 mm, total mass 100 kg (+/- 0.5 kg)
- Fall height Class A -> 1 m
- Fall height Class B -> 3 m



The most important information about crane transport of the connecting reinforcement bars

- Loads transported by crane must be secured and attached to ensure that they cannot fall
- It is strictly forbidden to lash bundles of reinforcement bars to bundling wire!
- Bundles of reinforcement bars must be wound twice round with dual tackles (wire ropes or chains) image 4
- Ensure that suppliers deliver bundles of reinforcement bars that are already wound with wire rope.

Further information about the topic

Suva learning unit 88802: Selection of lashing equipment (www.suva.ch/waswo/88802)

Suva, construction division, Tel. 041 419 50 49,
Bereich.bau@Suva.ch

Relevant regulations and standards

| | |
|---------|------------------------|
| BauAV | Art. 8.2f |
| KranVO | Art. 6 -> Lifting work |
| SIA 262 | Sec. 5.2.6.10 |

Figure 4: SUVA Factsheet 33055

6 Test setup

The reinforcement rods are clamped tightly into two facing U-profile steel frames. The rods protrude freely by 500mm. The load is applied using a fall sack with a tested weight of 100kg that is lifted with the hall crane to a height of 3.00 m above the clamped rod, and is then released via a panic button to fall freely.



Figure 5: Mobile clamping frame made of construction steel



Figure 6: Clamped single rod $d=12\text{mm}$ with centred fall sack



Figure 7: Lifting the fall sack and checking the fall height 3m for a rod diameter $d=12\text{mm}$



Figure 8: Situation after impact with a rod diameter $d=12\text{mm}$, buckling



Figure 9: Test body 2 with buckling but without shear punching

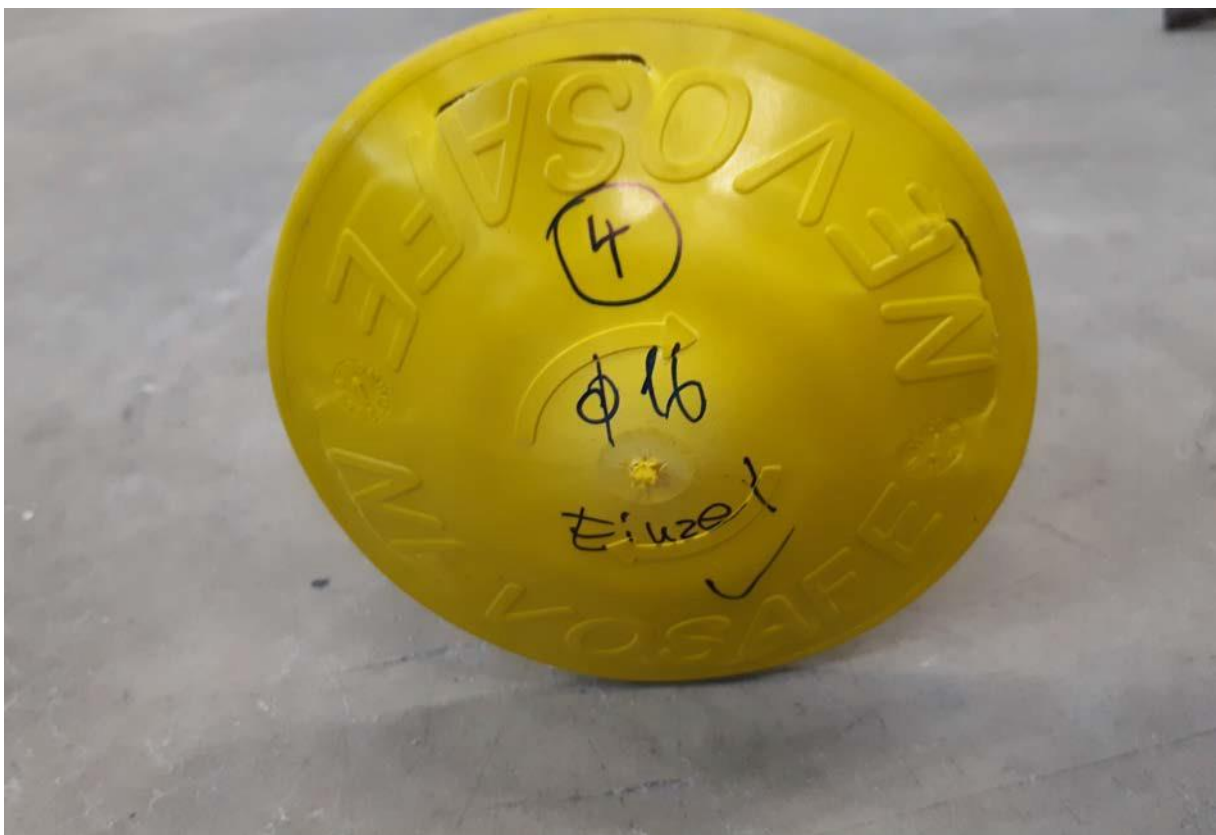


Figure 10: Test body 4 with visible deformation but without shear punching



Figure 11: Test body 8 with deformation and slight twisting but without shear punching