FULL SCALE TESTING ACCORDING TO ANNEX J OF EN1168

Aad van Paassen
Research & Development
VBI Ontwikkeling BV

START DISCUSSION IN 1988

How to check the shear capacity.

Research by Walraven and Rise:

Tensile strength is not a good parameter for predicting shear capacity.

It is better to carry out full scale tests.

WHAT IS THE PURPOSE OF THE TESTS?

Quality control

Finished product inspection

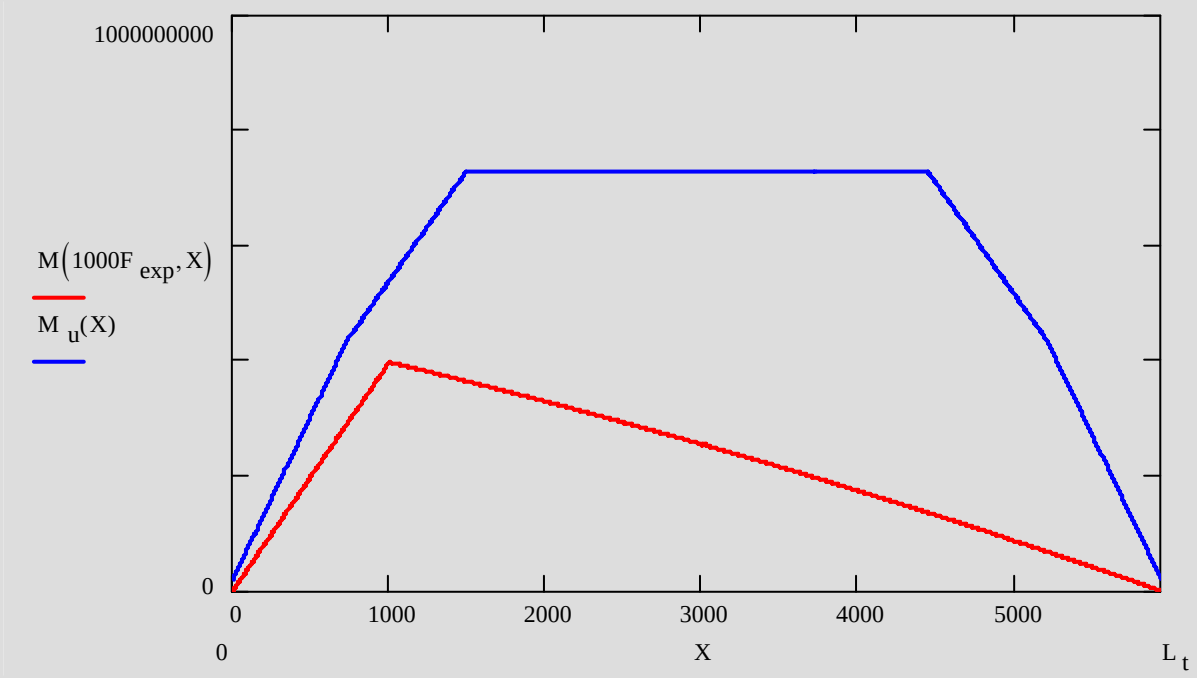
Shear resistance can be: shear tension, shear flexure, anchorage, cracking moment, etc.
Test should confirm the calculated failure.

Problem:
Failure modes are close to each other.

Calculated capacity A400 X14

F_{exp} = 458,5 kN

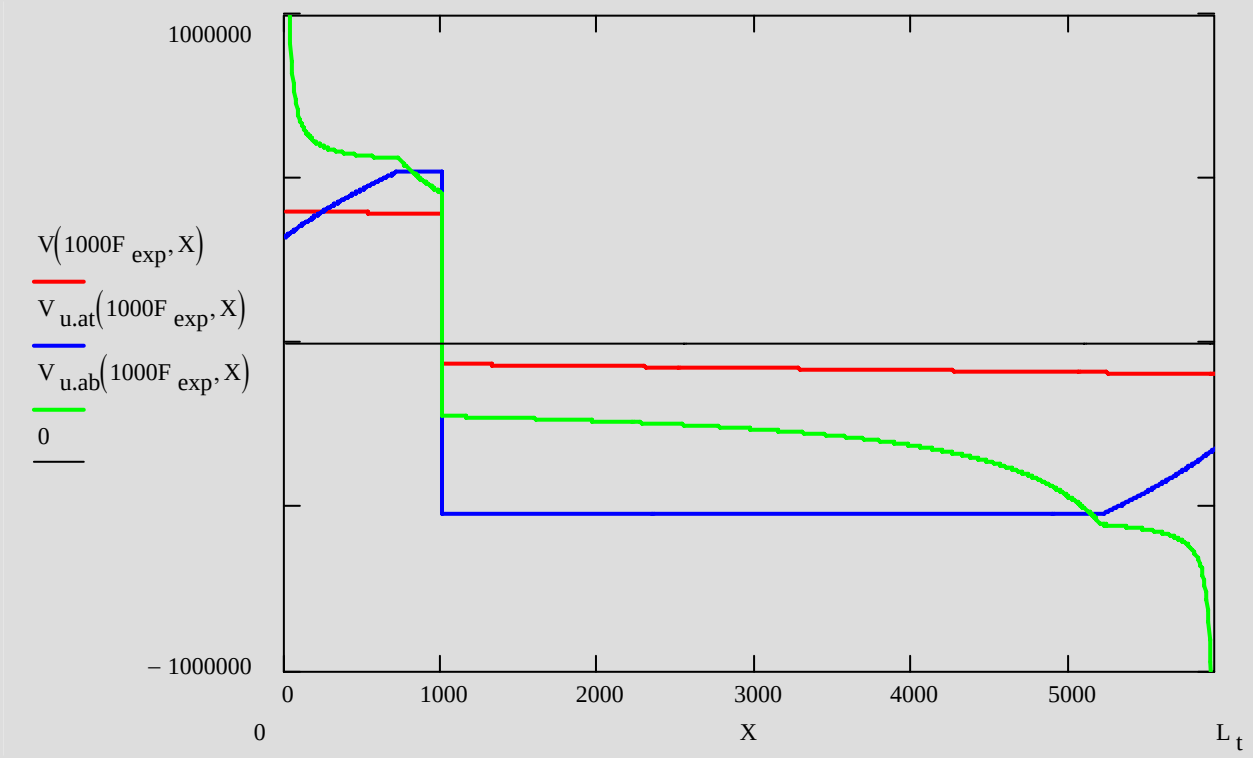
Bending moment



Calculated capacity A400 X14

F_{exp} = 458,5 kN

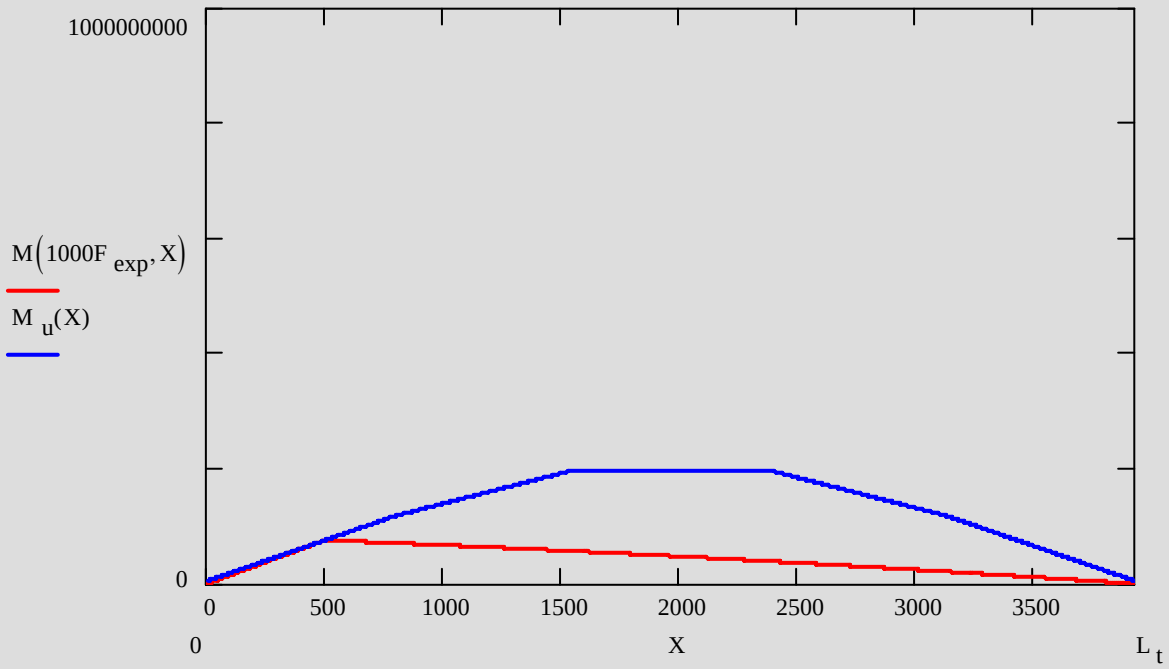
Shearforce



Calculated capacity A200 X8

F_{exp} = 166,9 kN

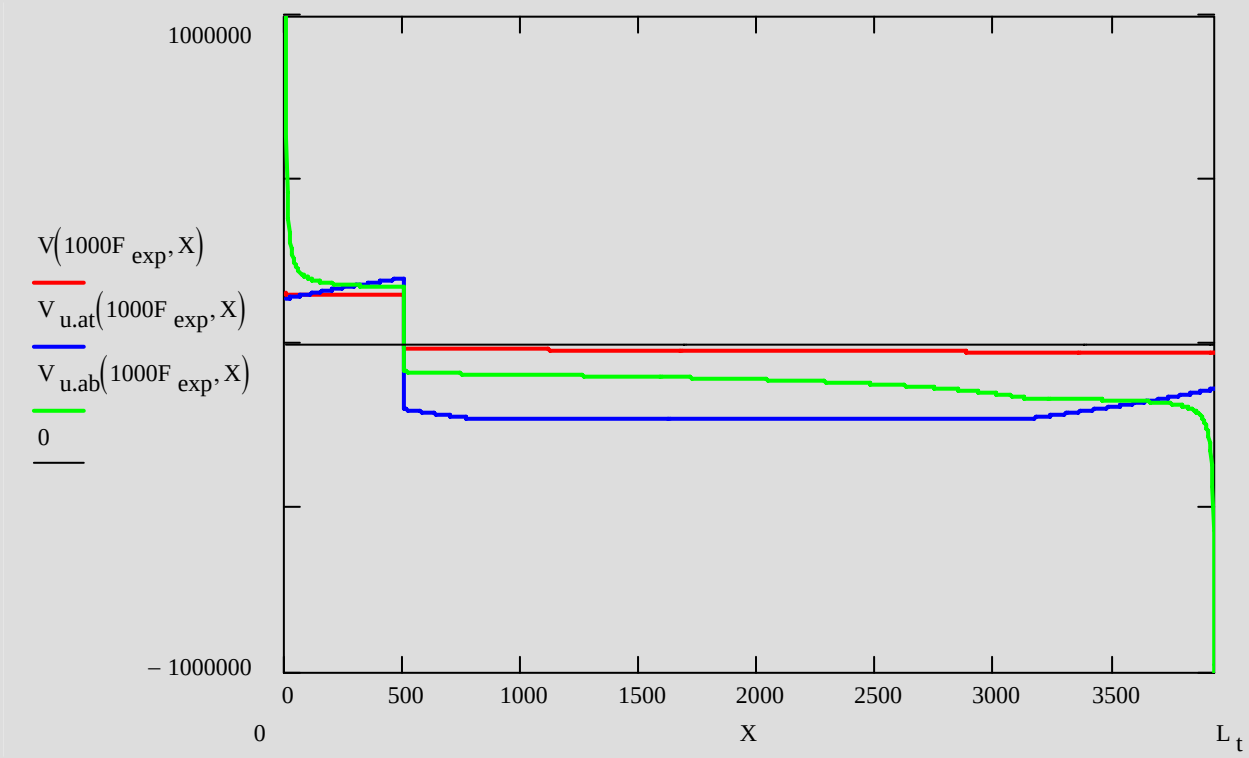
Bending moment



Calculated capacity A200 X8

F_{exp} = 166,9 kN

Shearforce



Also a discussion is going on about the shear tension formula in relation with the cross section and the location in the cross-section.

Need to do more tests for:
- quality control for safety
- calibrating calculation formulas

These are two different approaches!!

Goal:

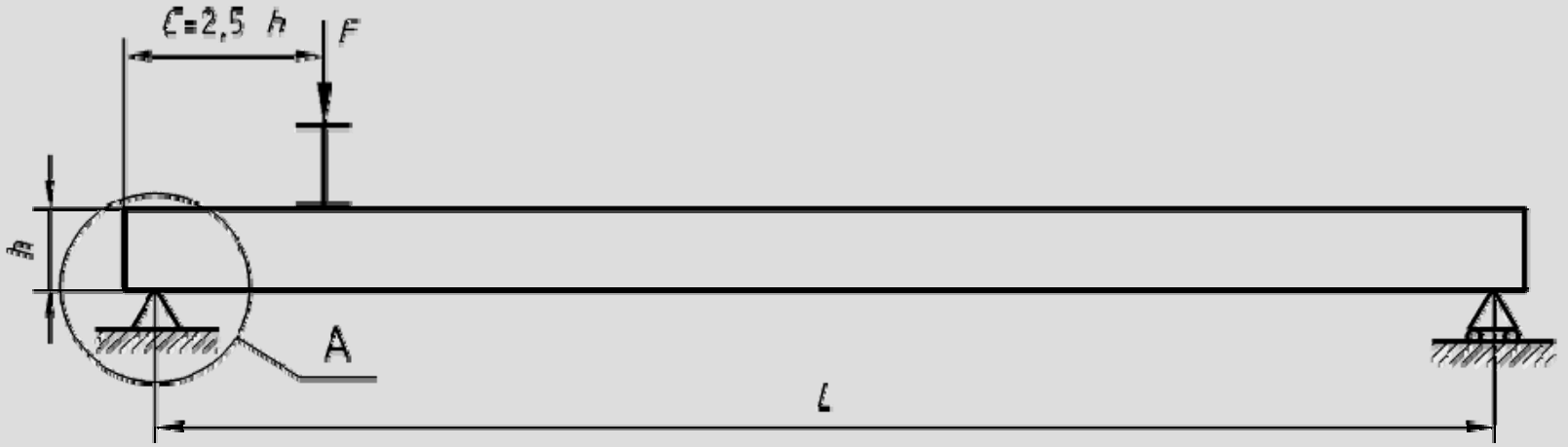
Test method according to annex J must be done the same way everywhere.

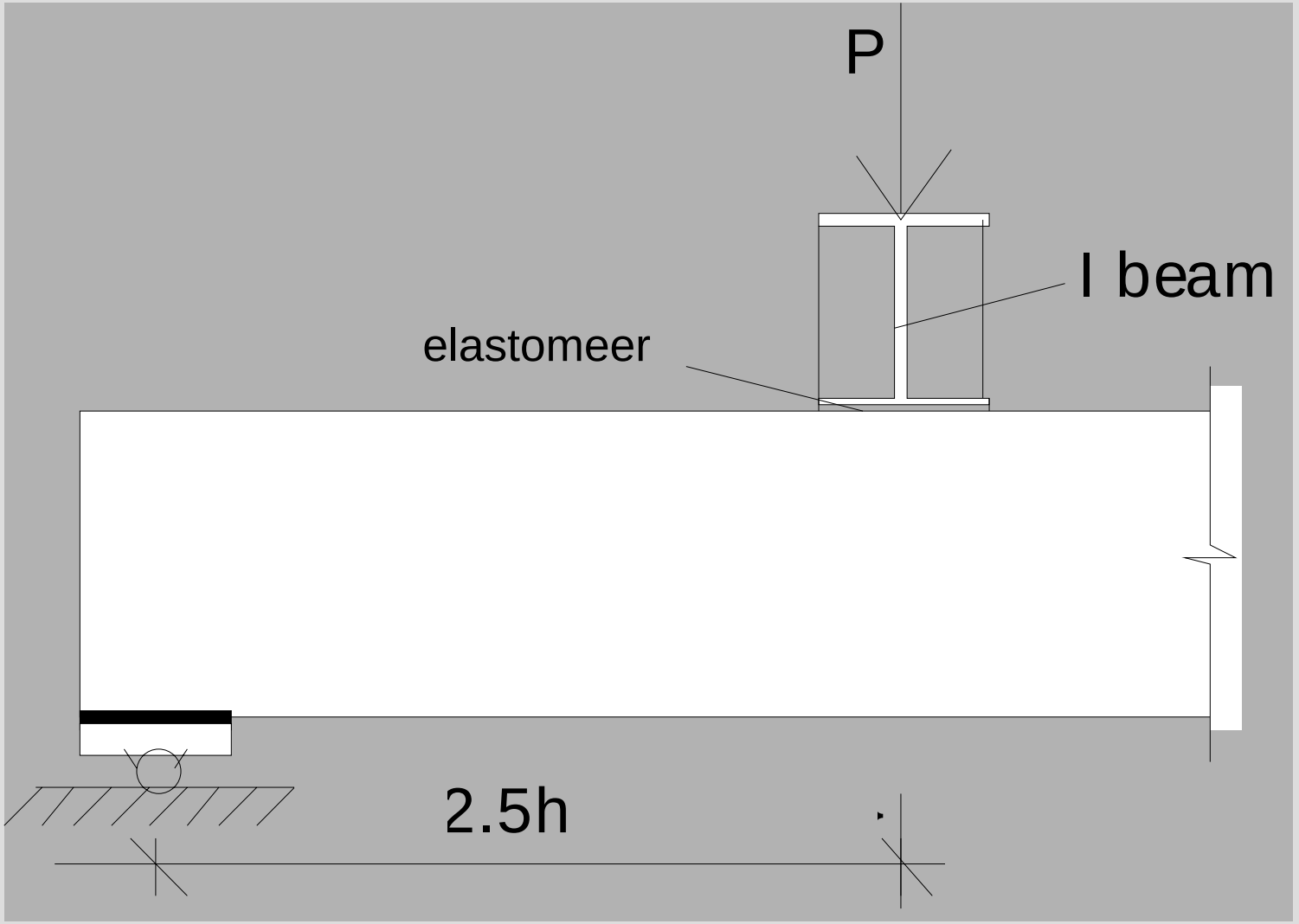
Tests must be performed according to one generally accepted protocol.

All information can be filed into one database.

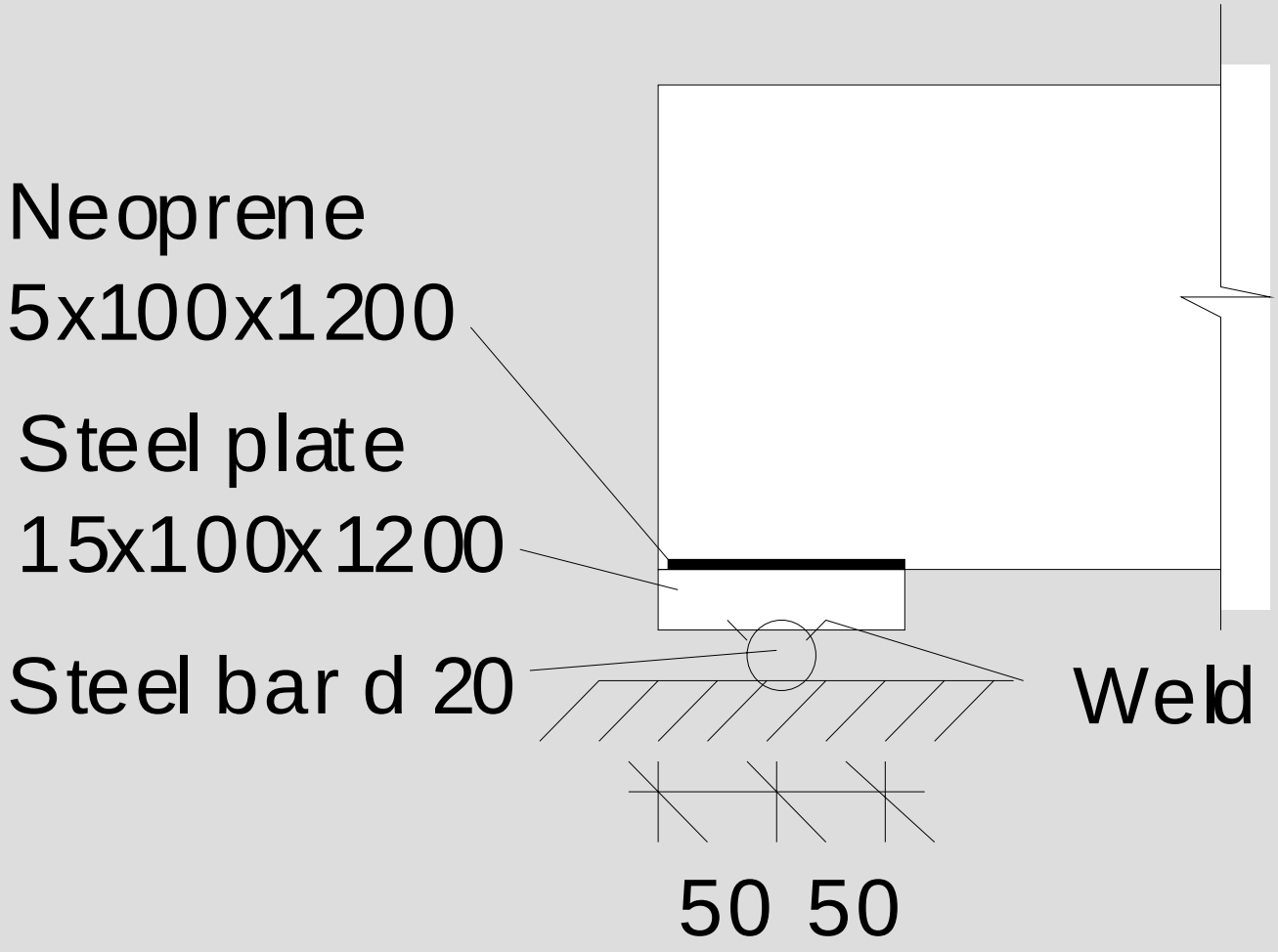
Interpretations of the tests results

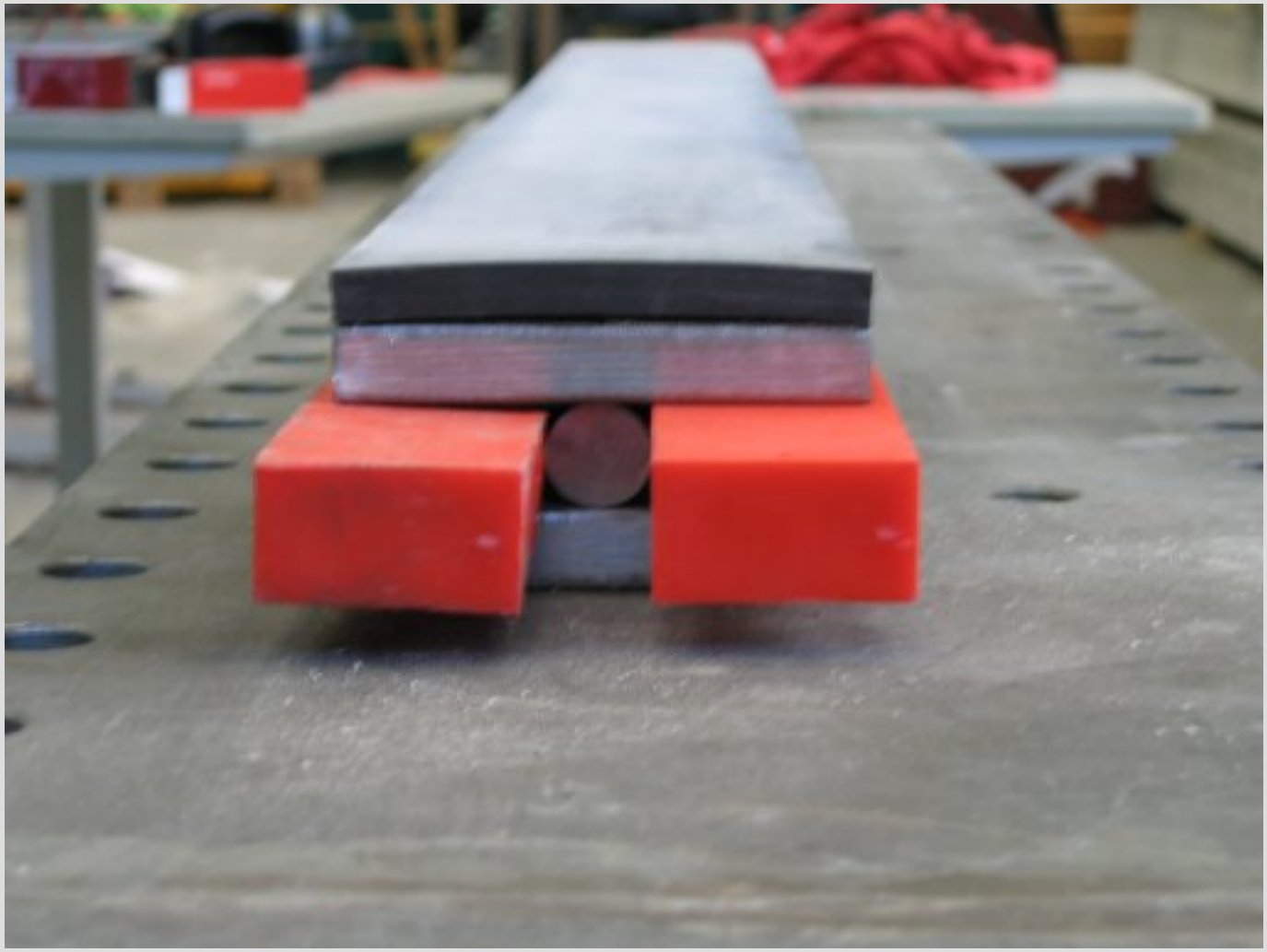
- Calibrating shear capacity formulas

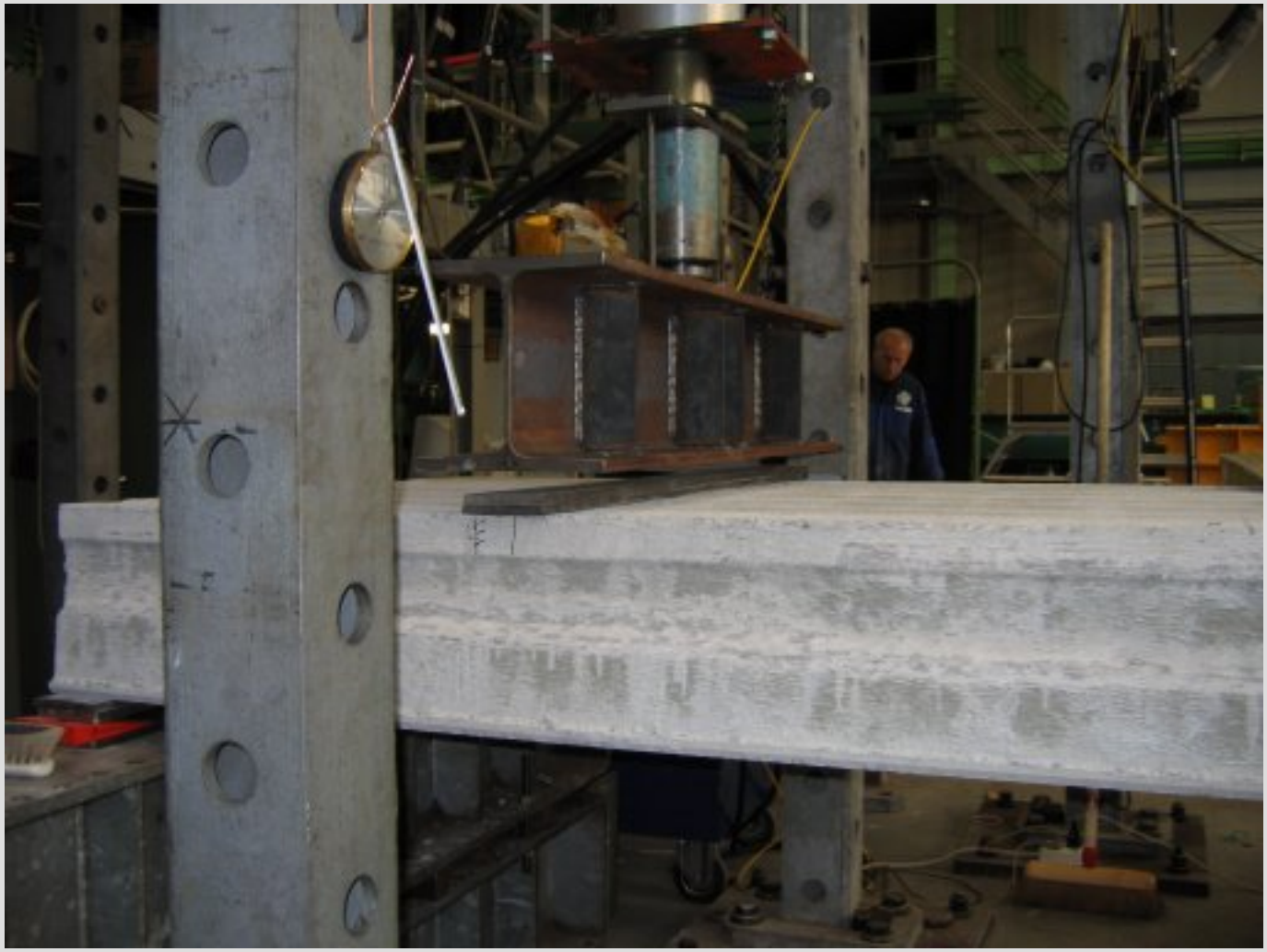



P
I beam
elastomeer
2.5h

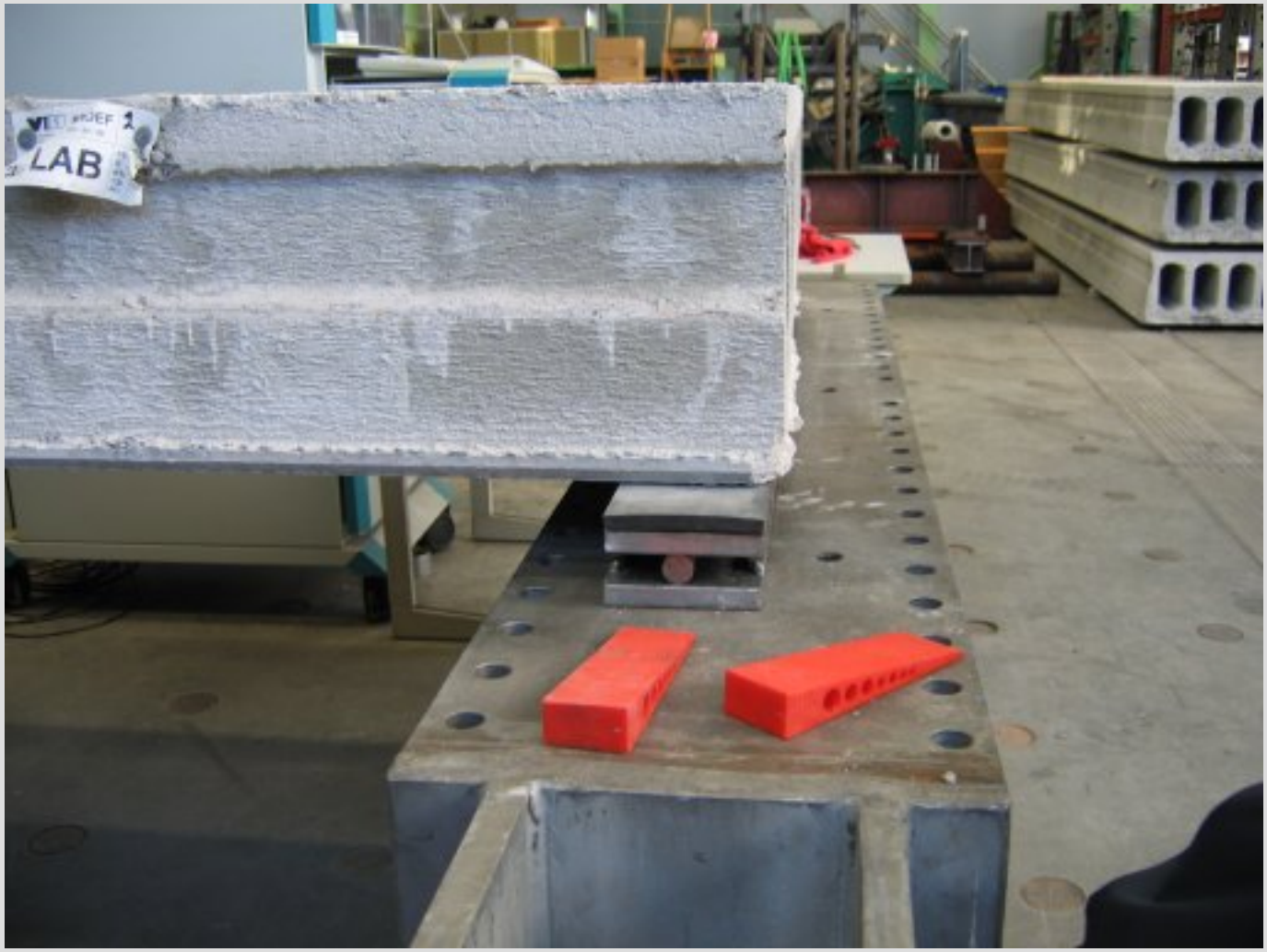
Active end

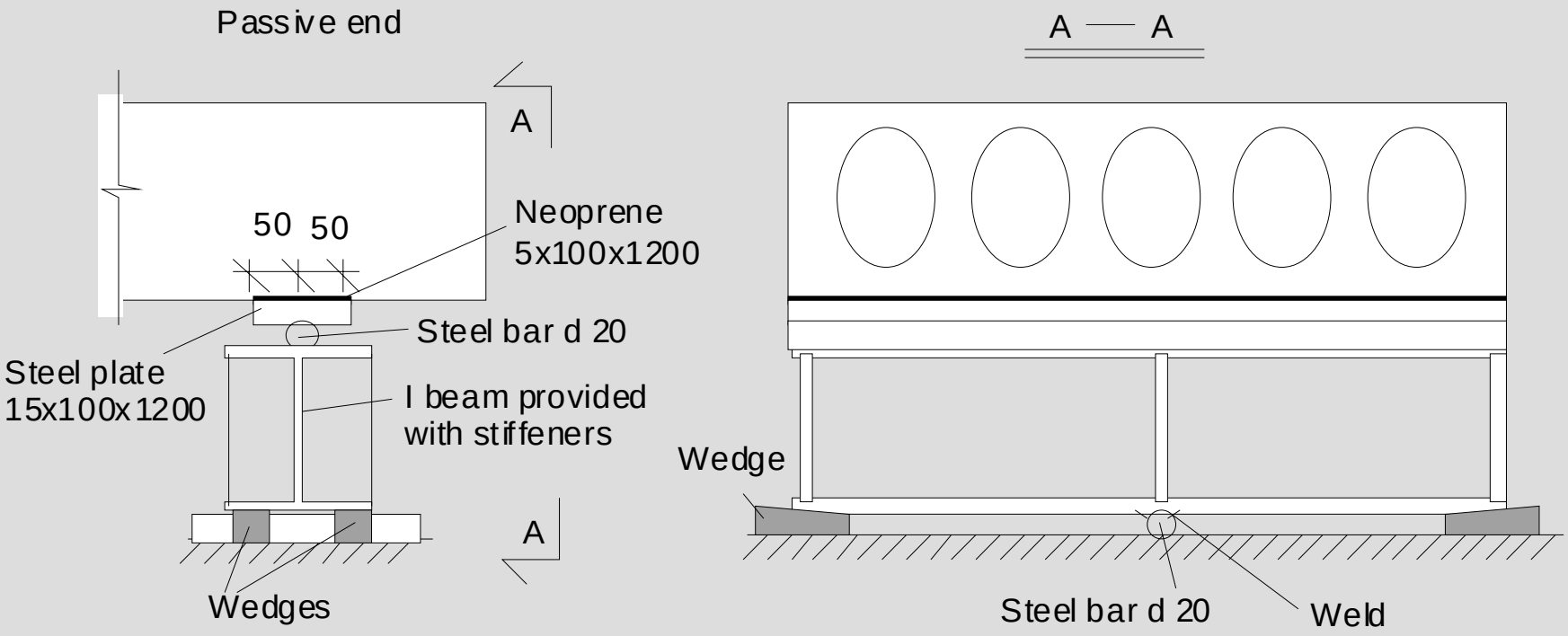

Neoprene
5x100x1200
Steel plate
15x100x1200
Steel bar d 20
Weld
50 50

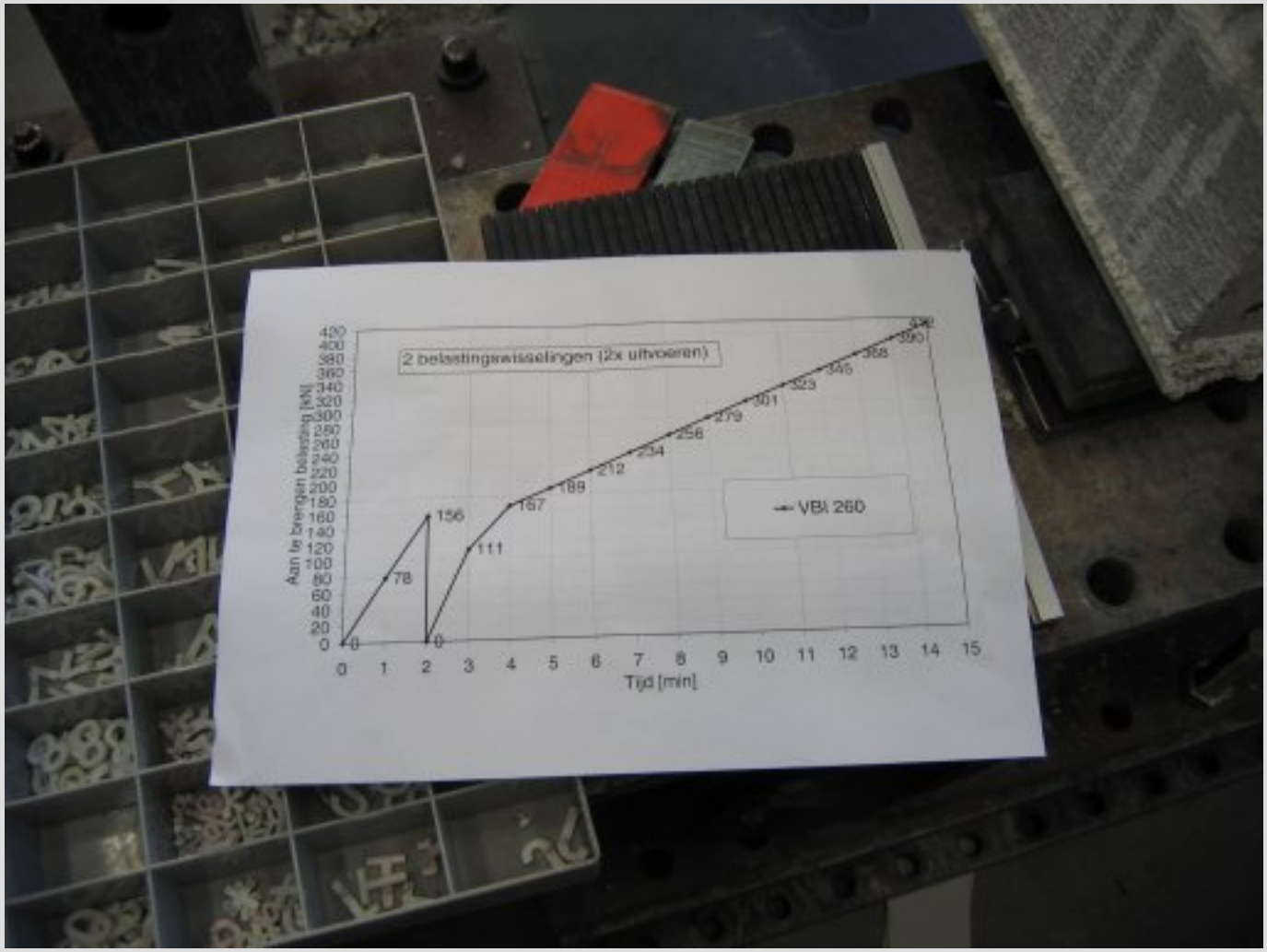


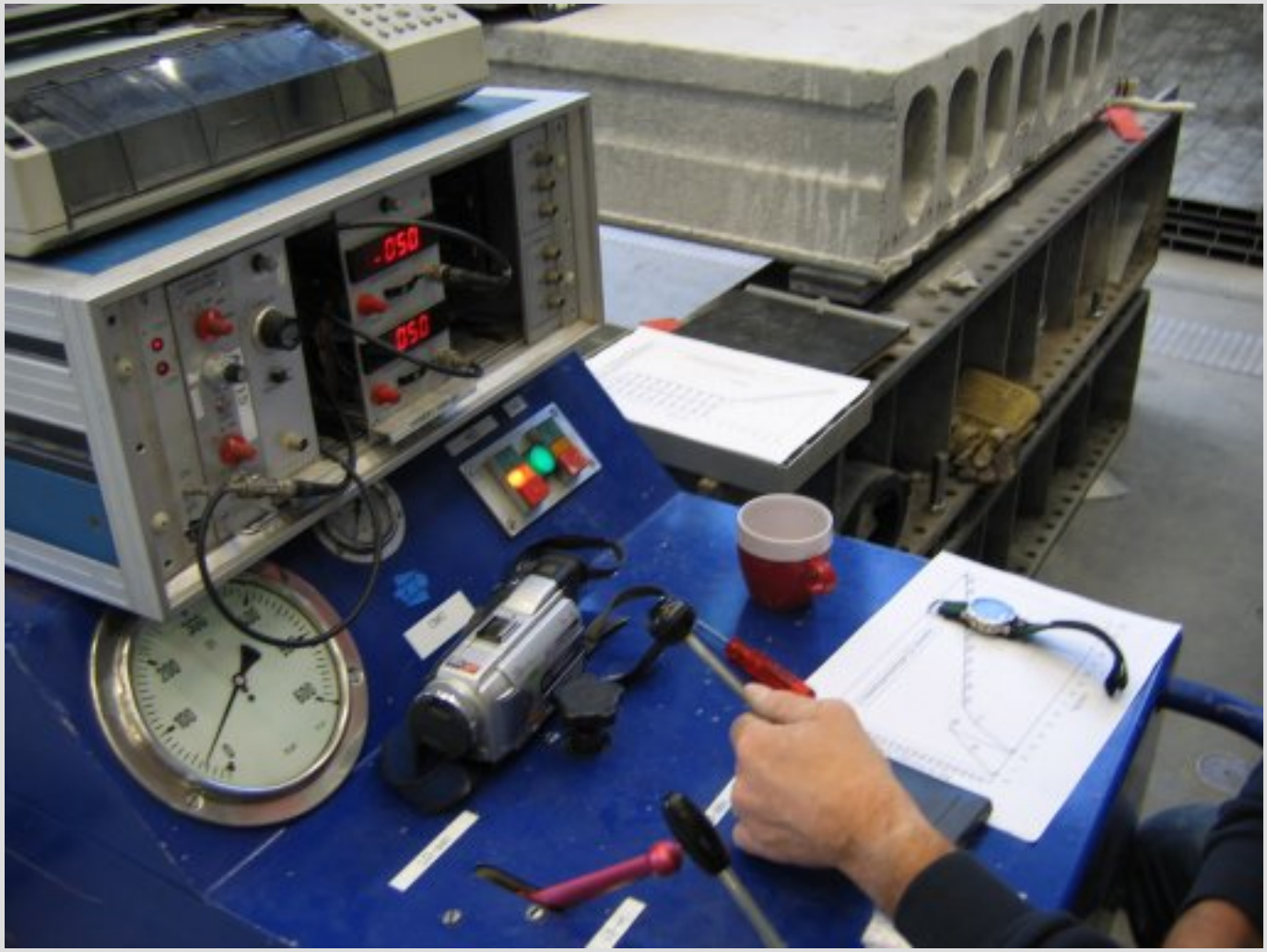


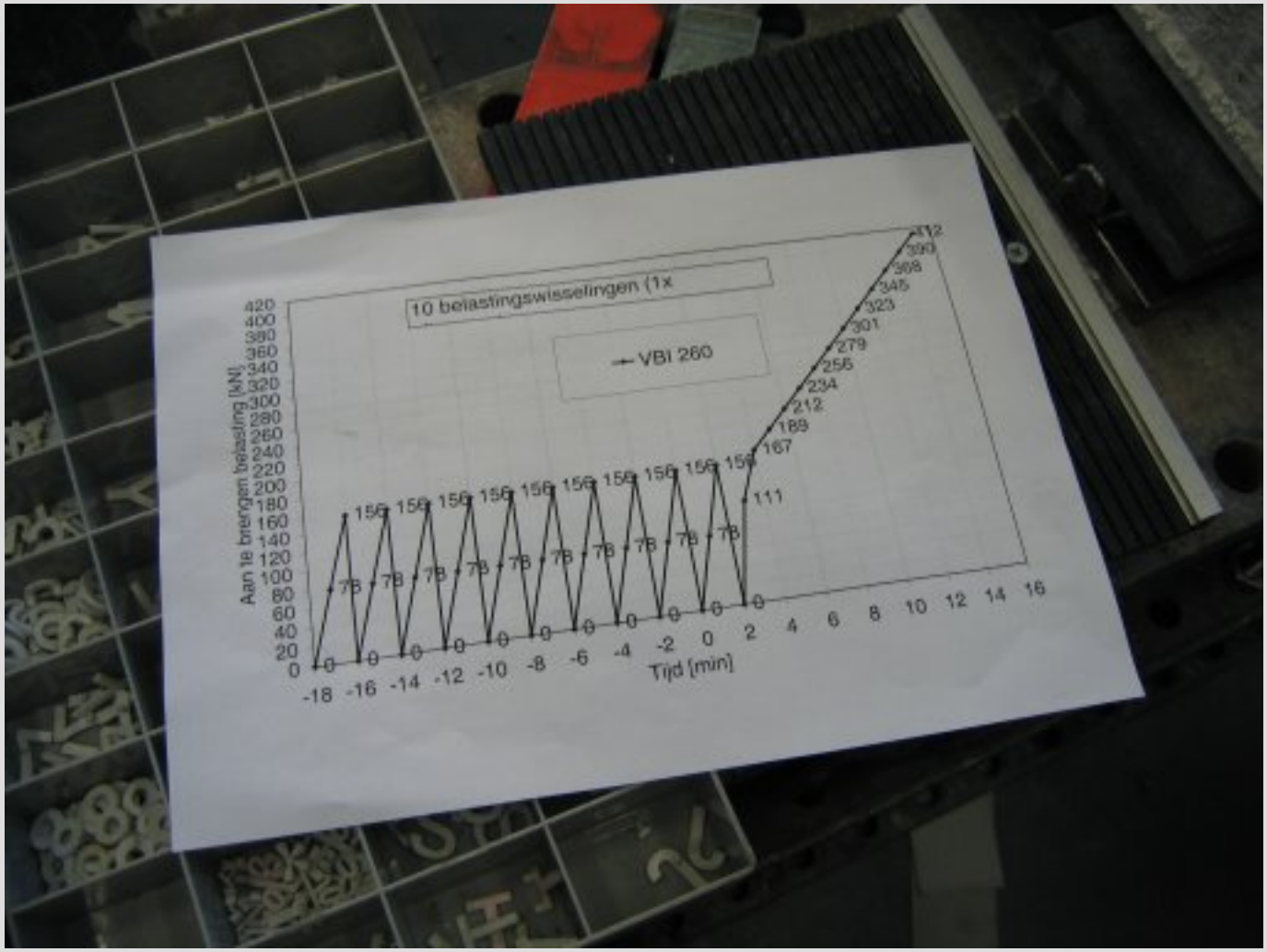
NO1 28-10-05
VB1
260 /4100/4000
FMAX= 302KN


LAB


Passive end
A
50 50
Neoprene
5x100x1200
Steel bar d 20
Steel plate
15x100x1200
I beam provided
with stiffeners
A
Wedges
A — A
Wedge
Steel bar d 20
Weld


2 belastingswisselingen (2x uitvoeren)
Aan te brengen belasting [kN]
Tijd [min]
VBI 260
0
78
156
0
111
167
189
212
234
256
279
301
323
345
368
390
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420


.050
050


10 belastingswisselingen (1x
VBI 260
Aan te brengen belasting [kN]
Tijd [min]

NO1
VBI

For interpretation of the tests actual values are needed such as:

- Actual concrete compressive or tensile strength
- Actual width of web (actual dimensions or the cross-section)
- Release strength

Actual tensile strength

In order to get reference values of the concrete strength (direct structural strength – see EN 13369: 2004 item 4.2.2.2.3), cylindrical cores shall be drilled out of the element. To obtain these cores, a slab segment of 200 mm
$\pm$ 5 mm length shall be sawn out from the casting bed, directly adjacent to the test specimens. This segment shall be conserved under the same condition as the test specimens. Shortly before testing, three cores shall be drilled out of the slab segment (see also Table A.3) and their strength shall be measured within $\pm$ 3 days from the date of the test. The mean of the three measured values gives the actual compressive strength f_c.

Or actual compressive strength

Instead of drilled cores, in order to get reference values of the concrete strength, 3 specimens (cubes or cylinders) may be made during the fabrication of the test piece and submitted to the same heat treatment in order to obtain the indirect structural strength (see EN 13369:2004 item 4.2.2.2.4). The specimens shall be conserved under the same conditions as the test piece. The compressive strength of the specimens shall be measured within $\pm$ 3 days from the date of the test. The mean of the three measured values gives the actual compressive strength f_c.

The design model reliability is confirmed if the following requirements are met.

For each test

$F_{test} / F_{exp} \geq 0.95$

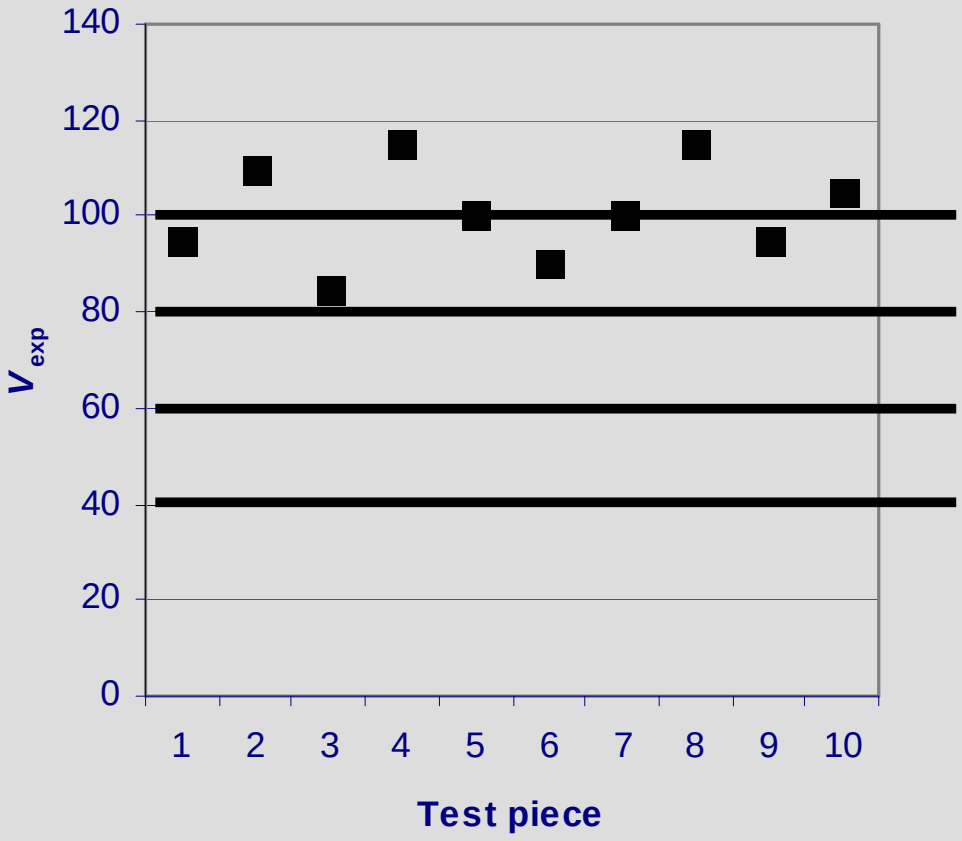
For the mean of the three tests

Average ($F_{test} / F_{exp} \geq 1.00$)

Interpretation of results

The results of the test shall be checked against the expected ultimate load F_{exp}, calculated using the design model for failure, with the actual strength parameters of steel, with the actual strength parameters of concrete derived from its compressive strength such as measured in J.3, taking
$\alpha_{cc} = \alpha_{ct} = 1.0$ and $\gamma_C = \gamma_S = 1.00$,
with the actual dimensions and with regard to the most unfavourable failure mode. Instead of derived from compressive strength, tensile strength of concrete may be measured by tests (see J.3).

Explanation on safety level



V_{Rm} (average value)

V_{Rc} (characteristic value)

V_{Rd} (design value = V_{Rc} / γ_M)

V_R (serviceability value = V_{Rd} / γ_Q)

Goal for IPHA members:

- A manual will be made of the test procedures
- Data sheets will be prepared to fill in
- Information databank of tests

Background information for:

- Shear capacity formulas in EC2
- Quality control in the factory