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Report no. Hamburg TR 1.0
Appendices 3
Initials TB, TBA

Test Report – ITT testing according to ETAG 008:2002 Prefabricated stair kits.

Type of stair: **HAMBURG – modular staircase**
See Appendix 1

Sampling: The test material was sampled specifically for prototype testing.

Method: Testing is carried out according to company instruction manuals:
D1-General Info, D2-Analysis and reporting, D3-Modular staircase testing, E1- Technical setup- and load specifications
The test arrangement used is shown in appendix 2.

Evaluation according to:
ETAG 008: 2002 – *"Prefabricated stair kits"*
EN 1991-1-1:2002 – *"Actions on structures – Part 1.1; General actions – Densities, self-weight, imposed loads for buildings"*.

Period: November, 2010

Result: Tested as stairs (load category A-Stairs, EN 1991-1-1 table 6.1) The test results are given in :
Appendix 3: Horizontal line load on hand rail,
Point load at step,
Uniformly distributed load.

Load bearing capacity at ultimate limit state[1)] – Characteristic values of resistance R_k:

Part of stairs	Type of loading	Characteristic values of resistance			γ_m [2)]
Flight	Vertical variable uniformly distributed load q	$q_{R,k}$	[kN/m^2]	4,22	1,1
Step	Vertical variable single load Q	$Q_{R,k}$	[kN]	4,2	1,1
Hand-rail	Horizontal line load q_h	$q_{h,R,k}$	[kN/m]	1,04	1,1

[1)] Note. Proof of ultimate limit state is only given if the design value of the actions does not exceed the design value of the resistance $F_d \leq R_d$ with $F_d = F_k \times \gamma_F$ and $R_d = R_k / \gamma_m$
F_k = characteristic values of actions (imposed loads acc. EN 1991-1-1)
γ_F = 1,5 (recommended partial safety factor, in absence of other national regulations R_k and γ_m
[2)] From ETAG 008-5.1.1.1- steel - recommended in absence of other national regulations.

Load bearing capacity at serviceability limit state[1)] – Deflections under load:

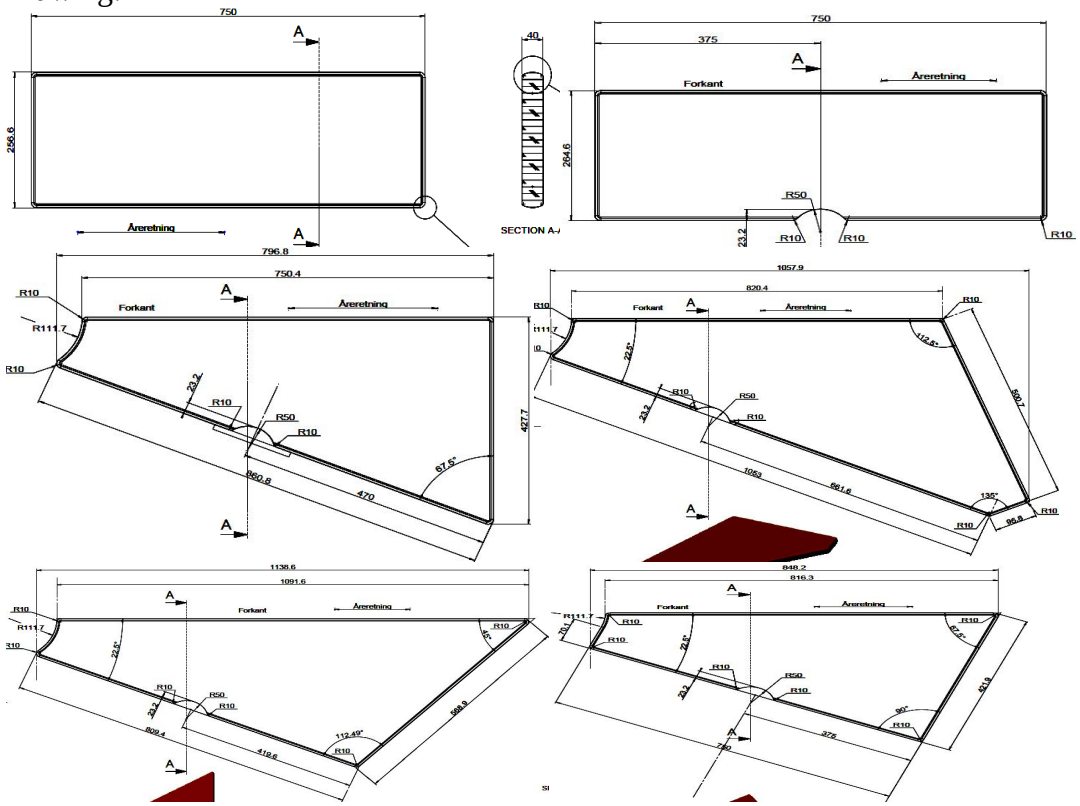
Deflection of the flight under service load (uniformly distributed load)			
Load	p	2,8	[kN/m^2]
Length of the median line of the flight	L	4900	[mm]
Deflection under service load related to the median line of the flight	w	L/200	[-]
Deflection of the step under service load (point load)			
Load	P	3	[kN]
Span of the step	L	4900	[mm]
Deflection under service load related to the median line of the flight	w	L/200	[-]

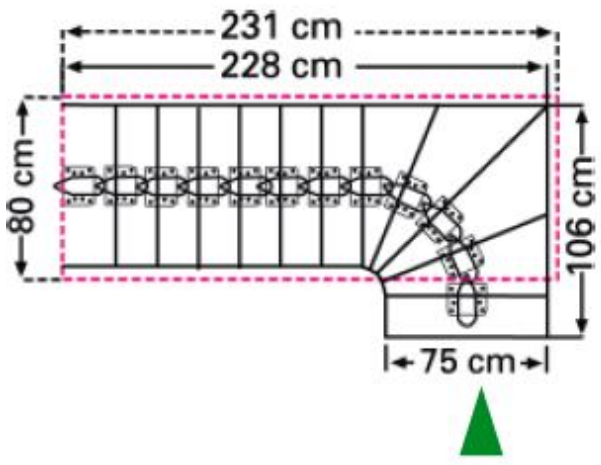
Tested materials

Type of stair : Modular staircase, type Hamburg

Material : Length: 4900 mm
Step: 15
Thickness: 40mm
Width: 750mm
Depth: 264,6mm
Rise between steps: 215 mm
Consol: Steel
Barrier:
Handrail: Wood (Ø40mm)
Balluster: Steel (Ø25mm)
Wire: Stainless steel cable (Ø6mm)

Drawing:





Principle of the Hamburg (1/4 turn) staircase and final setup 15 step

Test arrangements - Horizontal line load on hand rail

The principles of the horizontal line load on handrail are depicted below.

The handrail with a length of 1300 mm is mounted to a 6 step Hamburg staircase. The staircase is mounted to a wood test wall developed for the test purpose. The two line holders are firmly mounted to the floor and the line is firmly attached two places on the handrail with a weight carrier attached in the rear end. Each weight carrier is loaded with 10 kg weights, which means that 20 kg are added each time. The weights are added until the handrail is broken, or the deflection/deformation is perceived to be too much for adequate use.

Test arrangements - Point load at step

The principles of the point load at step test are depicted below.

The construction of this test is done by mounting the Hamburg tread and consol to be tested to both a top consol which is mounted to the wall test wall developed for the purpose, and on weights adjusted to the height from floor to consol, which should stabilize the tested tread. The length of the tested tread is 750 mm. A hole is drilled in the middle farthest away from the centre of the step. A hook is attached and the weight carrier is attached in the bottom of the hook. Then, the potentiometer is placed as close as possible to the point on the tread where the weight carrier is attached allowing the potentiometer to increase in length as the tread is pushed down when the weights are loaded.

The tread is initially loaded with 40 % of the maximum failure load. The weights are placed on both sides of the weight carrier, starting with 20 kg loaded on each tread. When 20 kg have been placed on the weight carrier, the computer snapshot is taken and additionally 20 kg are added to each tread. This cycle continues until break, heavy deformation or until the weight carrier, with a capacity of 512 kg, is full.

Test arrangements - Uniformly distributed load

The Hamburg staircase is setup in a ¼ turn with 15 steps, a length of 4900 mm and a rise between each tread of 215 mm mounted to the floor and the test wall developed for the purpose. Each potentiometer is mounted to a bar, attached to the floor, placed on top of the wide part of each of the 15 treads farthest away from the centre of the tread. The installation of the potentiometers should allow them to increase in length as the treads are pushed down when the weights are loaded.

The staircase is initially loaded with 40 % of the maximum failure load. The weights are placed on each tread, starting with 20 kg. When 20 kg have been placed on each tread, the computer snapshot is taken and additionally 20 kg are added to each tread. This cycle continues until 100 kg have been added to each tread, to a total of 1500 kg or until the staircase is perceived to be close to break.

The final setup can be seen from the following picture:

Test Results - Horizontal line load on hand rail

The test results can be seen from the following tables:

Hamburg line load test results kN/1,3m			
Test 1	1,372	kN/1,3m	Permanent deformation
Test 2	1,372	kN/1,3m	Permanent deformation
Test 3	1,274	kN/1,3m	Permanent deformation
Test 4	1,372	kN/1,3m	Permanent deformation

Hamburg line load test results kN/m		
Test 1	1,13	kN/m
Test 2	1,21	kN/m
Test 3	1,21	kN/m
Mean	1,18	kN/m
Std dev	0,04	

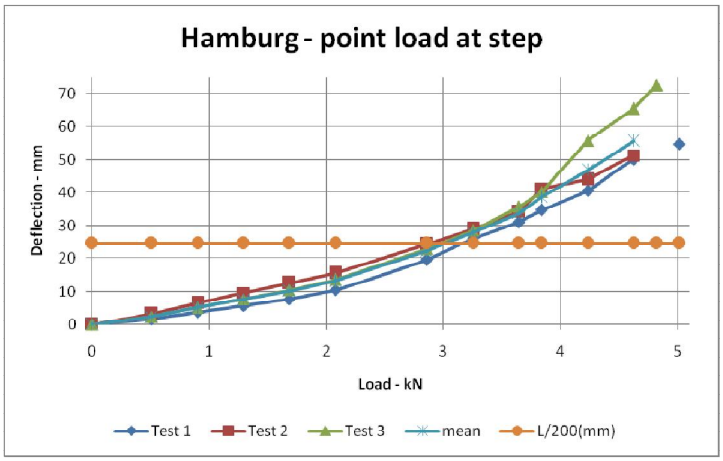
Characteristic value is calculated according to ETAG 008 Annex C

$$x_k = x_{mean} - k_n \cdot x_{stdafv} = 1{,}18 - 3{,}15 \cdot 0{,}04 = \underline{\underline{1{,}04 kN/m}}$$

Picture of the final test result (test 2):

Test results - Point load at step – Load bearing capacity at "ultimate limit state"

Load/deflection curve:



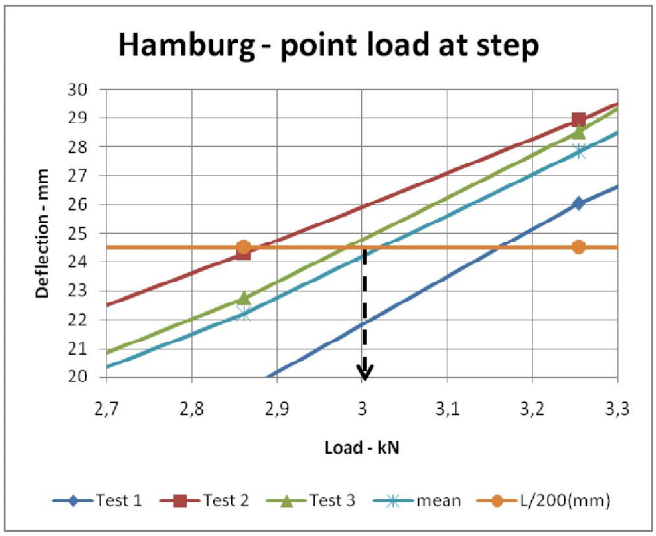
Hamburg Break/deformation Loads			
Test 1	5,02	kN	Consol deformation
Test 2	4,63	kN	Consol deformation
Test 3	4,82	kN	Consol deformation
Mean	4,823333	kN	
Std dev	0,195021		

Characteristic value is calculated according to ETAG 008 Annex C

$$x_k = x_{mean} - k_n \cdot x_{stdev} = 4{,}82 - 3{,}15 \cdot 0{,}19 = \underline{\underline{4{,}2kN}}$$

Test results - Point load at step – Load bearing capacity at serviceability limit state

On the load/deflection curve below the load bearing capacity at serviceability limit state are shown:



P = 3 kN at W = L/200

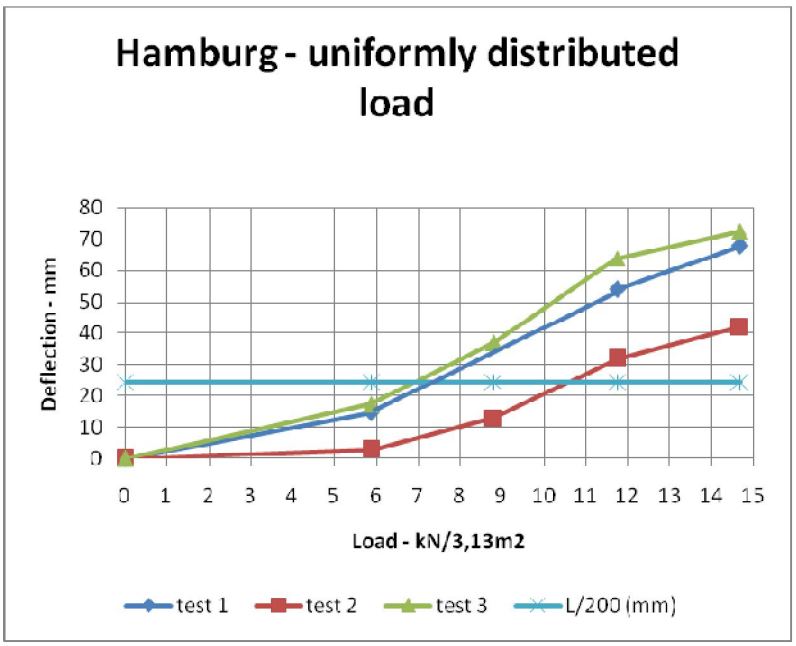
kg	kN	Test 1	Test 2	Test 3	mean	L/200(mm)
0	0	0	0	0	0	24,5
52	0,51	1,67	3,24	2,43	2,44	24,5
92	0,90	3,81	6,46	5,10	5,12	24,5
132	1,29	5,66	9,59	7,65	7,63	24,5
172	1,69	7,63	12,65	10,44	10,24	24,5
212	2,08	10,41	15,64	13,65	13,23	24,5
292	2,86	19,56	24,31	22,75	22,20	24,5
332	3,25	26,05	28,92	28,52	27,83	24,5
372	3,65	31,03	34,18	35,67	33,63	24,5
392	3,84	34,64	41,20	40,27	38,70	24,5
432	4,23	40,60	44,03	55,83	46,82	24,5
472	4,63	50,05	51,31	65,49	55,62	24,5
492	4,82			72,62		24,5
512	5,02	54,77				24,5

Deflection measured in mm.

Picture of the final test result (test nr 1):

Test Results - Uniformly distributed load – Load bearing capacity at "ultimate limit state"

Load/deflection curve:

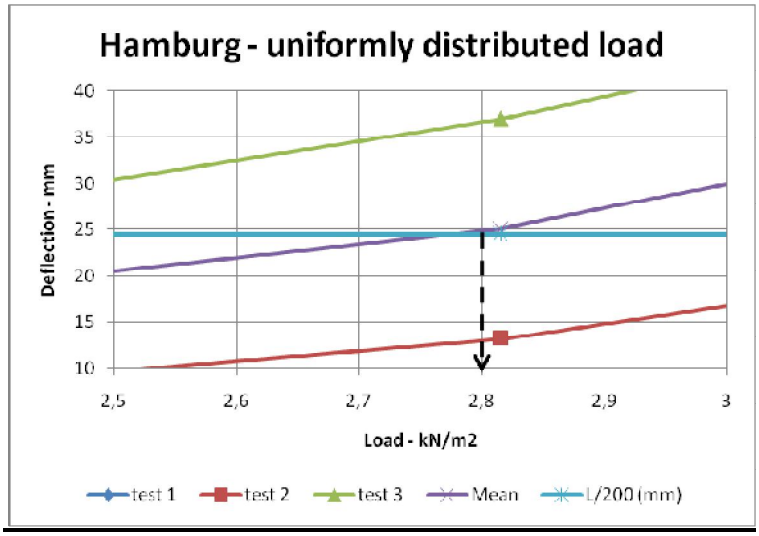


Due to no break, the Mean value = max load of all test=13,72 kN/3,13 m² = 4,69/m²

Due to no break the characteristic value is calculated according to 90% of the total weight loaded onto the staircase:

$x_k = 0{,}90 * 4{,}69 = \underline{\underline{4{,}22 kN / m^2}}$

On the load/deflection curve below the load bearing capacity at serviceability limit state are shown:



P = 2,8 kN/m^2 at W = L/200

Load result kN/3,13m²:

	0 kg/3,13 m²	600 kg/3,13 m²	900 kg/3,13 m²	1200 kg/3,13 m²	1500 kg/3,13 m²
	0 kN/3,13 m²	5,88 kN/3,13 m²	8,82 kN/3,13 m²	11,76 kN/3,13 m²	14,7 kN/3,13 m²
Test 1	0	14,76		54,14	68,04
Test 2	0	2,82	13,12	31,83	41,99
Test 3	0	17,43	37,04	63,86	72,51
L/200 (mm)	24,5	24,5	24,5	24,5	24,5

Load result kN/m²

	0 kg/m²	191,55 kg/m²	287,33 kg/m²	383,10 kg/m²	478,88 kg/m²
	0 kN/m²	1,88 kN/m²	2,82 kN/m²	3,75 kN/m²	4,69 kN/m²
Test 1	0	14,76		54,14	68,04
Test 2	0	2,82	13,12	31,83	41,99
Test 3	0	17,43	37,04	63,86	72,51
Mean	0	11,67	25,08	49,94	60,85
L/200 (mm)	24,5	24,5	24,5	24,5	24,5

Deflection measured in mm.

Picture of the final test result (test nr. 2):