brenstol

5th of November 2008

Test report about the behavior of solid flooring on sub-heated floors

of the Estonian manufacturer Brenstol OÜ

at the flooring testing institute of Tokyo Gas
3-13-1 Minami-Senju, Arakawa-ku, Tokyo 116-0003, Japan

1) General data about the test array

a) Nomination of test material

Espresso Ash, treatment at 215 °C

b) Test period

From 15th of July 2008 till 30th of September 2008

c) Lengths

Falling lengths 606, 909, 1.212, 1.818 mm
Width 130 mm
Thickness 15 mm

d) Equipment of sub-heated floor

Heating mat with beam layer type UFM-12D2D1-SKD 2.379 x 1.470 x 12 mm

e) Test field dimensions

1.800 x 2.700 mm

f) Installation on beams

1) Flooring and beams in a right angle (90 degrees)
2) Top side joints on the beams
3) Flooring is glued to the beams
4) Flooring is nailed to the beams by using 38-mm-nails

g) Sub-floor

12-mm plywood

2) Test conditions

a) Before test begin it must be assured that the gap between the boards at top side and wide side is less than 0,5 mm.

b) The heating mat must be permanently supplied with hot water of 80 °C.

c) The test lasts 1.100 hours.

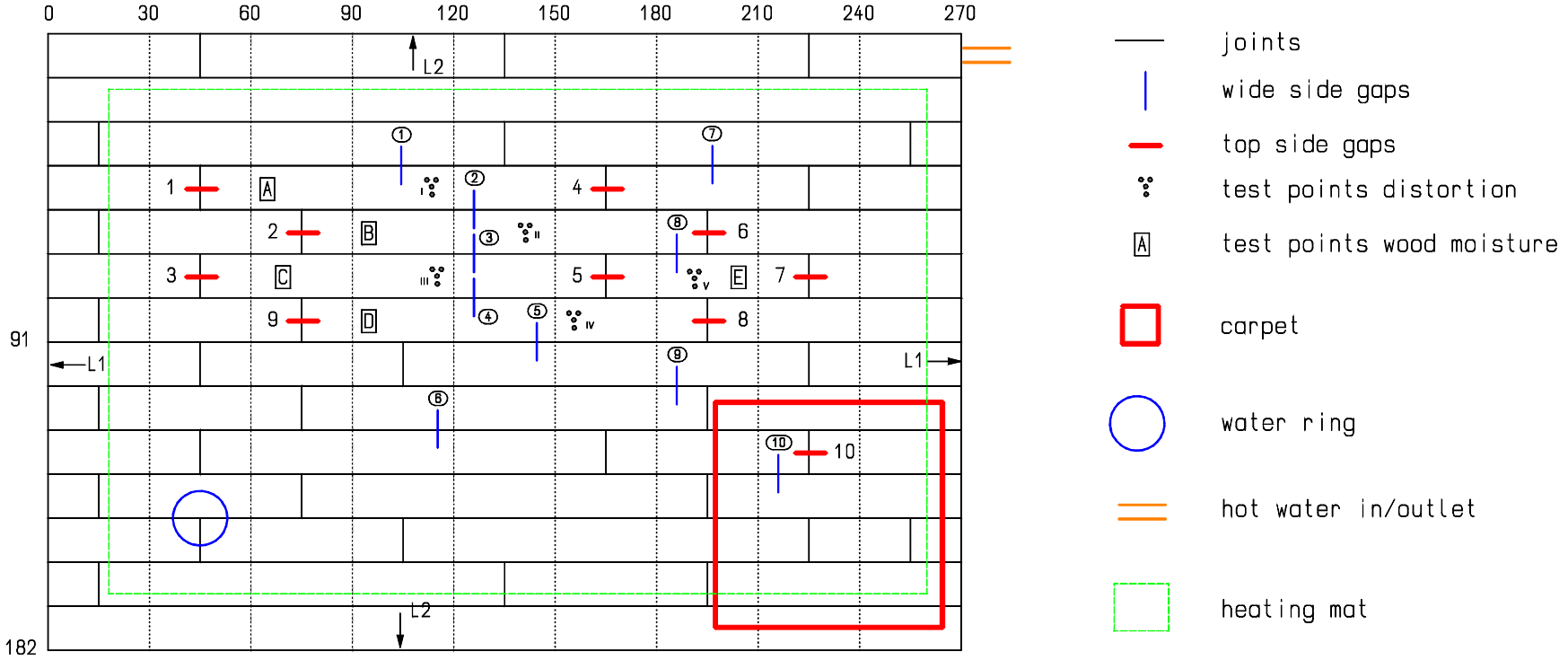
d) A carpet with the dimensions 7-10 x 600 x 600 mm covers a part of the test field and several top side and wide side joints.

e) Daily ca. 30 cm^3 water are applied to a top side joint. To avoid the water from draining away, a ring 150 mm in diameter is laid.

f) Test points

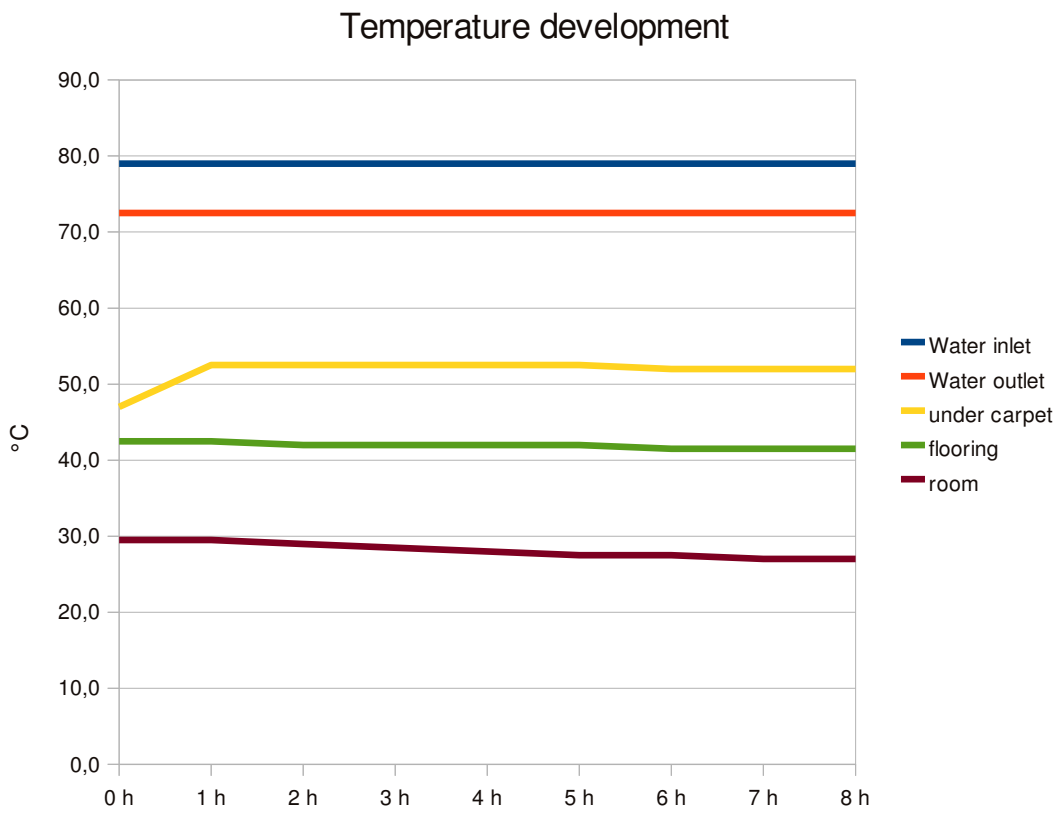
– Hot water inlet and outlet (2 test points)

- Temperature on flooring (1 test point)
- Temperature on flooring under the carpet (1 test point)
- Room temperature (1 test point)
- Wide side and top side gaps (20 test points)
- Distortion side-wise (5 test points)
- General impression
- Moisture level (5 test points)



g) Temperature development

The temperature of the test field and of the room is kept constant during the test:



3) Test results

a) Gaps

The maximum gap horizontally at the wide side between 2 boards was measured at 0,25 mm:

Gaps horizontally on wide sides								
Original state	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
0,10 mm	0,05 mm	-0,05 mm	0,05 mm	-0,05 mm	0,15 mm	0,05 mm	0,35 mm	0,25 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,10 mm	0,05 mm
0,10 mm	0,05 mm	-0,05 mm	0,00 mm	-0,10 mm	0,00 mm	-0,10 mm	0,00 mm	-0,10 mm
0,10 mm	0,05 mm	-0,05 mm	0,05 mm	-0,05 mm	0,15 mm	0,05 mm	0,30 mm	0,20 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,15 mm	0,15 mm	0,00 mm	0,10 mm	-0,05 mm	0,15 mm	0,00 mm	0,25 mm	0,10 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,05 mm	0,05 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,15 mm	0,15 mm	0,25 mm	0,25 mm
0,20 mm	0,25 mm	0,05 mm	0,25 mm	0,05 mm	0,35 mm	0,15 mm	0,40 mm	0,20 mm

The maximum gap horizontally at the top side between 2 boards was measured at 0,05 mm:

Gaps horizontally on top sides

Original	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
state	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,10 mm	0,05 mm	0,10 mm	0,05 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm
0,10 mm	0,10 mm	0,00 mm	0,10 mm	0,00 mm	0,10 mm	0,00 mm	0,10 mm	0,00 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,00 mm	-0,05 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm
0,00 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm
0,05 mm	0,10 mm	0,05 mm	0,10 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,00 mm

The maximum gap vertically at the wide side between 2 boards was measured at 0,15 mm:

Gaps vertically on wide sides

Original	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
state	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,00 mm	0,00 mm	0,00 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm	0,05 mm
0,20 mm	0,25 mm	0,05 mm	0,25 mm	0,05 mm	0,25 mm	0,05 mm	0,30 mm	0,10 mm
0,25 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,30 mm	0,05 mm
0,25 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,40 mm	0,15 mm	0,40 mm	0,15 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,05 mm	0,10 mm	0,05 mm	0,20 mm	0,15 mm	0,20 mm	0,15 mm	0,20 mm	0,15 mm
0,05 mm	0,05 mm	0,00 mm	0,10 mm	0,05 mm	0,20 mm	0,15 mm	0,10 mm	0,05 mm
0,05 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,05 mm	0,00 mm	0,20 mm	0,15 mm
0,00 mm	0,05 mm	0,05 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm

The maximum gap vertically at the top side between 2 boards was measured at 0,15 mm:

Gaps vertically on top sides								
Original	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
state	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
0,15 mm	0,10 mm	-0,05 mm	0,20 mm	0,05 mm	0,30 mm	0,15 mm	0,20 mm	0,05 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,25 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,30 mm	0,05 mm	0,30 mm	0,05 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,25 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,25 mm	0,00 mm	0,35 mm	0,10 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,15 mm	0,20 mm	0,05 mm	0,20 mm	0,05 mm	0,25 mm	0,10 mm	0,25 mm	0,10 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm	0,00 mm
0,10 mm	0,15 mm	0,05 mm	0,15 mm	0,05 mm	0,15 mm	0,05 mm	0,15 mm	0,05 mm

b) Distortion side-wise

The maximum side-wise distortion was measured at 0,21 mm:

Distortion side-wise								
Original	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
state	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
0,04 mm	0,11 mm	0,07 mm	0,14 mm	0,10 mm	0,02 mm	-0,02 mm	0,21 mm	0,17 mm
-0,01 mm	0,02 mm	0,03 mm	0,03 mm	0,04 mm	-0,08 mm	-0,07 mm	0,10 mm	0,11 mm
0,03 mm	0,09 mm	0,06 mm	0,12 mm	0,09 mm	-0,01 mm	-0,04 mm	0,15 mm	0,12 mm
-0,03 mm	0,07 mm	0,10 mm	0,11 mm	0,14 mm	0,00 mm	0,03 mm	0,18 mm	0,21 mm
-0,01 mm	0,02 mm	0,03 mm	0,01 mm	0,02 mm	0,05 mm	0,06 mm	0,11 mm	0,12 mm

c) Moisture level

The wood moisture level remained constant at 4%:

Wood moisture level

Original state	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
4,00%	4,00%	0	4,00%	0	4,00%	0	4,00%	0
4,00%	4,00%	0	4,00%	0	4,00%	0	4,00%	0
4,00%	4,00%	0	4,00%	0	4,00%	0	4,00%	0
4,00%	4,00%	0	4,00%	0	4,00%	0	4,00%	0
4,00%	4,00%	0	4,00%	0	4,00%	0	4,00%	0

d) Dimensional stability of test field

In longitudinal direction the dimensional change of the total area was measured at 0,00 mm. Cross ways the dimensional change was measured at 1,00 mm, i.e. The filed was shrinking from 1.820 mm to 1.819 mm.

Dimensional stability of test field

Original state	After 100 hours		After 300 hours		After 600 hours		After 1.100 hours	
	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation	Measurement	Deviation
2724,0 mm	2724,0 mm	0,00 mm	2724,0 mm	0,00 mm	2724,0 mm	0,00 mm	2724,0 mm	0,00 mm
1820,0 mm	1819,0 mm	-1,00 mm	1819,0 mm	-1,00 mm	1819,0 mm	-1,00 mm	1819,0 mm	-1,00 mm

e) General impression

All three different test areas, the watered area, the carpet covered area, as well as the normal area didn't show any particular problems concerning cupping, cracking, distortion or similar.

	General impression			
	After 100 hours	**After 300 hours**	**After 600 hours**	**After 1.100 hours**
Watered area	no noticeable problems	no noticeable problems	no noticeable problems	no noticeable problems
Carpet area	no noticeable problems	no noticeable problems	no noticeable problems	no noticeable problems
Normal area	no noticeable problems	no noticeable problems	no noticeable problems	no noticeable problems