Evaluation of fungal infestation and decay in a simulated use class 3 situation (block test) after some years of exposure

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Introduction

- Field tests without ground contact
- Test methods in use class 3 conditions
 - Lap-joint test (CEN/TS 12037)
 - L-joint test (EN 330)
 - T-joint test
 - Double layer test









Use class 3 - testing

- Conformance to all use class
 3 conditions
 - Dry to wet conditions (UC 3.1/ 3.2)
 - Without ground contact
- Accelerated under natural conditions
- Evaluation of the test
 - Non destructive beside destructive evaluation
- Easy test setup and sample preparation
- Tests for preservative treated and modified wood as well as natural durability







Block test

- First blocks outside since 2002
- · 50 blocks in Göttingen
 - further blocks in Australia, Norway,...
- Research questions
 - Fungal infestation and decay within the blocks?
 - Variations between the different layers
 - Evaluation of the stakes
 - MOE dyn. and visual assessment











General test setup

- One block includes 40 samples (20x30x300 mm³)
 - 20 test samples
 - 10 reference samples (Scots pine sapwood or beech)
 - 10 feeder stakes (Spruce)
- Samples are arranged alternately in the block
- Blocks are surrounded by a rack covered with a water permeable textile grid







Sample evaluation - Pick test

Sample structure of blocks

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

feeder stakes (Spruce) untreated references treated wood





General test setup

- \cdot Evaluation of the sample
 - Determination of MOE dyn.
 - · GRINDOSONIC
 - Visual assessment following EN 252 (pick test)



- Class 0: Sound
- Class 1: Slight attack
- Class 2: Moderate attack
- Class 3:
- Class 4:
- Severe attack
- Failure







- Evaluation regarding fungal infestation and type of decay
 - Carried out in summer 2010
- Evaluation of ten different blocks
 - outside exposure of the blocks started between 2002 and 2006
- Three samples of each block were selected
 - Depending on:
 - · Exposure time
 - $\cdot\,$ Position within the block
 - Wood species
- Microscopic evaluation of decayed areas





Results - Decay

- 6 blocks were evaluated after 4 years outside exposure
 - Initial infestation started in middle and bottom layers
 - Highest rate of decay in the middle layers
 - Intensity of brown and white rot was higher than soft rot









Results - Decay

 4 blocks were evaluated after 7 and 8 years outside exposure

All layers were infested with a similar intensity of the different types of decay







Results - Decay

Block no.	Top layer	Middle layers	Bottom layer
1	S ²	B ³ , W ³ , S ³	W ¹
2	B ⁵ , W ⁵	B ⁴ , W ⁴	W ⁴
3	B ³ , S ³	B ³ , S ³	W ¹ , S ¹
4	W ¹ , S ¹	W ³ , S ³	W ³ , S ³
5	W ³	B ⁴ , W ⁴	B ³ , W ³ , S ³
6	B ¹ , S ¹	B ² , W ²	W ³ , S ³
7	B ¹ , W ¹	B ² , W ²	B ² , W ²
8	B ³ , W ³	B ⁵	B ⁵
9	W ³	W ⁵ , S ⁵	W ⁵
10	B ¹ , W ¹	B ²	W ¹ , S ¹
B – Brown rot W – White rot S – Soft rot		¹ Scots pine sapwood ² Scots pine heartwood ³ Spruce ⁴ Oak heartwood ⁵ Beech	





- Bottom layer close to ground:
 - Major type of decay: white rot as well as white rot in combination with soft rot
- · Middle layers and top layer
 - Infestation mainly by brown and white rot, but also soft rot
- At the majority of the selected samples more than one type of decay was detected





Sample evaluation - MOE dyn.

- Determination of loss in elastic properties is a good addition to the pick test
- Evaluation of MOE dyn. needs more sophisticated equipment and experienced staff
- Requirements for MOE dyn. measurements applied in field tests:
 - Use of either climatized or water stored specimens
 - \cdot water storage for a minimum of 24h
 - No vacuum-pressure impregnation to avoid the potential risk of destroying fungal hyphae within the wood tissue to be deteriorated during field tests



Further discussion: Results of MOE dyn. and difficulties of measurements





Block 3: untreated wood







Block 2: Melamine







Block 1: with organic preservative/ oil







Sample evaluation - Pick test

(after 60 months outside exposure) Block 1 (oil-organic WP)

2	1	2	1	1	1	2	1	1	1
1	3	1	1	1	3	1	2	1	1
2	1	2	1	1	1	1	1	1	1
1	3	2	3	2	2	2	3	2	2

Block 2 (Melamine)

2	2	3	3	4	4	4	3	4	3
2	2	2	3	2	4	4	4	4	4
3	2	3	2	3	3	3	4	4	4
2	3	2	3	2	4	3	4	4	3

Block 3 (untreated samples)

3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	4	3	3
4	3	3	3	4	3	4	3	4	3
3	4	3	4	3	4	4	4	3	4





Sample evaluation - Wood moisture content

- High enough wood moisture content within the blocks!
 - Wood moisture content between 38% and 126%
 - \cdot Depending on treatment/modification as well as position within the block
 - High moisture values in the bottom and middle layers (higher than 80%)
 - Moisture value in the upper layer also high enough for fungal infestation (above FSP)





Summary

- Within a few years after start (approx. 3-5 years), attack by white rot, brown rot and soft rot can be found in the stakes
- No significantly differences in type of decay between hard-and softwood
- In use class 3, if moisture is available for long enough, soft rot degradation occurs under the given test conditions





Summary

- Test setup
 - Suitable for untreated wood and treated wood without leaching
 - Chemicals with higher leaching during test duration can influence fungal infestation
 - Decelerated infestation of untreated references and feeder stakes
- \cdot Test conditions
 - No ground contact
 - But high moisture levels particularly in middle and bottom layers of the block
 - \cdot Fungal infestation starts in bottom and middle layers





Thanks for your attention





