

Durability of TMT

Durability and Durability Classes

Natural durability of wood is the term for its resistance against the attack by wood-decay organisms, such as fungi, insects or marine organisms.

Wood-decay fungi require local moisture in wood starting from about fibre saturation. Certain fungi, e.g., dry rot, already develop at lower wood moisture levels of above 20 %. Wood-decay fungi include basidiomycetes, causing brown rot and white rot, and soft rot that require higher wood moisture than basidiomycetes.

The European Standard EN 350 serves as a guideline for determining natural durability or for allocating natural wood species to durability classes (examples cf. Table 1).

Table 1: Durability classes of solid wood acc. to EN 350-2 and examples

Durability class	Explanation	Wood species (sapwood-free heartwood)
1	very durable	teak (1-3), makoré
2	durable	white oak, bangkirai, robinia (1-2)
3	moderately durable	pine, larch (3-4)
4	little durable	spruce, fir
5	not durable	sapwood in general, beech

Use Classes of Solid Wood

The installation situation for wood-based components and their consequential exposure to moisture and harmful organisms is expressed in use classes (UC). These are defined in DIN 68800-1:2011-10 „Wood Preservation. Part 1: General“ and largely correlate with the European use classes acc. to EN 335. However, use class 0, as it is determined in Germany, does not exist there. Table 2 describes those use classes where an infestation by wood-decay fungi is principally to be expected. Moreover, the required durability for damage-free use in the use classes is indicated in EN 460.

Table 2: Use classes that can be threatened by fungi (extract from DIN 68800-1:2011-10, Table 1)

UC	Wood moisture / exposure	General conditions of use
2	occasionally moist (> 20 %) mean relative humidity above 85 % or temporary moistened by condensation	wood or wood-based product under roof, not exposed to weathering; high ambient humidity may lead to occasional, but not permanent moistening
3	3.1 occasionally moist (> 20 %) an accumulation of water in the wood, not even in locally limited areas, is not to be expected	wood or wood-based product not under roof, being weather-exposed, but not permanently in soil or water contact; an accumulation of water in the wood, not even in locally limited areas is not to be expected due to rapid back drying
	3.2 frequently moist (> 20 %) accumulation of water in the wood, also locally, is to be expected	wood or wood-based product not under roof, being weather-exposed, but not permanently in soil or freshwater contact; accumulation of water in the wood, also locally, is to be expected
4	mainly to permanently moist (> 20 %)	wood or wood-based product in permanent soil or water contact
5	permanently moist (> 20 %)	wood or wood-based product permanently exposed to seawater

Durability Testing

Durability of wood is best tested in outdoor testing. It is evaluated by comparing the exposure time (duration up to destruction) of test and referential wood. Wood species of lower durability serve as referential wood; pine sapwood is used for testing coniferous wood and European beech is used for testing deciduous wood. Outdoor testing takes several years. More short-term laboratory testing (test duration approx. five months) allows preliminary grading in durability classes. Laboratory testing is performed in conditions favourable to fungal growth. Basidiomycete testing is performed by applying several test fungi deliberately injected into wood test samples. For soft rod testing, the test samples are placed into a soil substrate. Table 3 provides an overview of relevant test methods.

Institut fuer Holztechnologie
gemeinnuetzige GmbH

Zellescher Weg 24
01217 Dresden · Germany

+49 351 4662 0
+49 351 4662 211
info@ihd-dresden.de
www.ihd-dresden.com

Contact persons



Timber Modification
Dr. rer. silv.

Wolfram Scheiding

+49 351 4662 280
wolfram.scheiding@ihd-dresden.de



Biological Testing

Dipl.-Biol.

Katharina Plaschkies

+49 351 4662 334
katharina.plaschkies
@ihd-dresden.de



Wood Preservation

Prof.

Bjoern Weiss

+49 351 4662 270
bjoern.weiss@ihd-dresden.de

Table 3: Test methods for determining the biological (natural) durability of wood

UC	Threatened by	Laboratory testing	Outdoor testing
3	basidiomycete fungi	CEN/TS 15083-1	CEN/TS 12037 (lap-joint test) IRG/WP 04-2019 (double-layer test)
4	basidiomycete fungi	CEN/TS 15083-1	EN 252 (dig-in test)
	soft rot fungi	CEN/TS 15083-2	
5	marine organisms	-	EN 275

Use classes and durability classes are correlated in both EN 460 and DIN 68800-1:2011. This is where the required durability for damage-free use in the use classes is indicated. Table 4 quotes the respective table from DIN 68800 (modified).

Table 4: Minimum requirements of durability of sapwood-free dark-coloured heartwood towards fungal infestation for application in use classes 2 to 4

GK	Durability class acc. to DIN EN 350-2			
	1	2	3	4
2	+	+	+	-
3.1	+	+	+	-
3.2	+	+	-	-
4	+	-	-	-

+ natural durability sufficient
- natural durability insufficient

Durability of TMT towards wood-decay fungi

Thermally modified timber (TMT) distinguishes itself by considerably increased durability towards wood-decay fungi. This is mainly due to the degradation of wood components, preferably of hemicelluloses (wood sugar), and to lower equilibrium moisture, reduced by 50 % on average. Capillary water intake is possible despite the reduced hygroscopic equilibrium moisture. Hence, TMT can be attacked by wood-decay fungi under unfavourable conditions with long-term or permanent moistening.

EN 350-2 includes details regarding the natural durability of wood species of special importance to Europe; modified or otherwise treated wood species are not listed there. However, the requirements of durability, as per EN 460 or DIN 68800, for example, can also be applied in that sense to modified timber.

Up to now, durability specifications regarding TMT are mainly based on laboratory testing. TMT durabilities identified there could partly be verified by outdoor testing (inter alia Plaschkies et. al, 2010).

Depending on the wood species, procedures and intensity of treatment, different durability classes are achieved in TMT. With the same intensity of treatment, higher durability is obtained in deciduous species of wood than in coniferous species. TMT made of hardwood is mostly graded in classes 1 and 2; TMT of softwood is usually found to be graded in Classes 2 and 3.

Durability of TMT against wood-colouring fungi

Compared to native wood, the risk of TMT being infested by wood-colouring mould and blue-stain fungi is lower, with less intensive growth, respectively. Infestation can, however, not be precluded in unfavourable conditions, since TMT represents an organic substrate without any biocidal substances contained in them and having a certain, albeit low moisture content.

Durability of TMT against wood-decaying insects

As several investigations have shown, TMT has a higher resistance towards wood-decaying insects, such as the long-horned beetle or anobia, which use the wood as a breeding and feeding substrate. However, no increased resistance towards termites could be determined so far.

Bibliography

- EN 335:2006-10: Durability of wood and wood-based products – Definition of use classes
- DIN EN 350-1:1994-10: Durability of wood and wood-based products – Natural durability of solid wood – Part 1: Guide to the principles of testing and classification of the natural durability of wood
- DIN EN 350-2:1994-10: Durability of wood and wood-based products – Natural durability of solid wood – Part 2: Guide to the natural durability and treatability of selected wood species of importance in Europe.
- EN 460:1994-10: Durability of wood and wood-based products – Natural durability of solid wood. Guide to the durability requirements for wood to be used in hazard classes
- DIN 68800-1:2001-11: Wood Preservation – Part 1: General
- Plaschkies, K.; Scheiding, W.; Weiß, B.; Jacobs, K.; Dauerhaftigkeit verwendungsbezogen ermitteln. Biologische Dauerhaftigkeit von thermisch modifizierten Hölzern – Ergebnisse aus Labor- und Freilandprüfungen. Holz-Zentralblatt 136(2010)21, pp. 524-525
- Plaschkies, K.; Scheiding, W.; Jacobs, K.; Weiß, B.: Durability of thermally modified timber assortments against fungi – results from a 6-year field test in comparison with results from lab tests. 5th European Conference on Wood Modification. Riga September 20th-22nd 2010, edited by Hill, CAS.; Militz, H.; Westin, M. [eds.]