



**IGF research project CORNET 272 EBR**

**EURODECK**

**Quality and Assessment Program for Wooden Decking**

**Performed by:**

**Institute of Wood Technology Dresden (IHD)**

**Project management: Dr. Wolfram Scheiding**

**Holzforschung Austria – Österreichische Gesellschaft für  
Holzforschung (HFA)**

**Project management: DI Claudia Koch**

**Duration: 01.05.2020 until 30.04.2022**

The project was initiated and carried out as a joint project of German and Austrian partners in the EU program CORNET (Collective Research Networking). The work was carried out jointly by the Institut für Holztechnologie gemeinnützige GmbH (IHD) and Holzforschung Austria - Österreichische Gesellschaft für Holzforschung (HFA) in the period from May 2020 to April 2022. The sub-project in Germany was funded in the Program for the Promotion of Industrial Cooperative Research (IGF) via the German Federation of Industrial Research Associations (AiF) with funds from the Federal Ministry for Economic Affairs and Energy based on a resolution of the German Bundestag. The sub-project in Austria was funded by the Austrian Research Promotion Agency (FFG). Co-financing was provided by a number of German and Austrian associations and companies. The project was applied for and formally supervised by the supporting association Institut für Holztechnologie Dresden e.V. (TIHD).

## 1 Initial situation

Wood decking for terraces, balconies, platforms, bridges, etc. is one of the most important uses of solid wood in outdoor applications; at the same time, there are major challenges here because the decking is subject to heavy exposure. Despite increasing sales of outdoor decking, the share of solid wood is declining. As a result, the demand for materials such as wood-polymer materials (WPC/NFC) or bamboo products (*bamboo scrimber*) is increasing, even though these have their own characteristics and are also subject to changes due to weathering.

The project was based on various research papers and publications as well as regulations on exterior wood coverings, the most important of which are:

- Fachregeln des Zimmererhandwerks 02 "Balkone und Terrassen" (BDZ 2015),
- Terrassen- und Balkonbeläge. Produktstandards und Anwendungsempfehlungen. Gesamtverband Deutscher Holzhandel e.V., 5. Auflage,
- FLL Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.: Holz und Holzprodukte im GaLaBau. Ausgabe 2019,
- Holzforschung Austria [Hrsg.]: Terrassenbeläge aus Holz. Technische Broschüre. Wien, 2016,
- Terrassen: Planen, verlegen, pflegen. VEH Holzterrassen. VEH Edition N° 8, 1. Aufl. 2013,
- Terrassenbeläge aus Holz. Lignatec-Broschüre Nr. 27 (Lignum, Schweiz).

Despite this good state of knowledge, the need for generally applicable rules or a normative regulation for exterior wooden decking has been repeatedly expressed in practice. In contrast, there is EN 14342 for wood flooring and parquet and EN 15534-4 for WPC/NFC decking as well as the European assessment document EAD-190005-00-0402. In addition, there are numerous criteria to be considered for wood decking and suitable testing and assessment methods are not always available.

## 2 Tasks, objectives, benefit

The work included the following tasks:

- Compilation of quality criteria, use-related requirements and available testing and assessment methods.
- Comparison with existing technical regulations,
- If necessary, filling gaps (test and evaluation methods, requirements, ...)
- Development of a guideline or catalogue of requirements for users in the DACH region,
- Development of basic principles for standardization work in CEN/TC 175 "Round and sawn timber".

The intended benefits for the timber industry were as follows:

- Support for manufacturers, planners, specialized trade, executors as well as builders/users,
- Increase in product quality and safety and consumer confidence
- Increasing demand and sales and strengthening the market position of companies
- Reduction of the complaint rate and costs,
- Basis for a European product standard "Wood coverings for outdoor use"

### 3 Work program

The work program comprised the following focal points:

- Compilation and evaluation of available testing and assessment methods, plus literature research taking into account available standards on the status quo,
- Development of methods for individual topics or properties "filling gaps",
- -Formulation of (minimum) requirements where these are missing and as far as possible,
- Compiling a comprehensive catalogue of all quality criteria, including requirements, test methods, classifications and other useful information.

## 4 Experimental work

### 4.1 Concept and material

The experimental work focused on properties that are particularly relevant in practice, but where no or insufficient information and data were available:

- Fire behavior
- Strength profile (for load-bearing application)
- Slope/drainage
- Cracking
- Microbial discoloration

Table 3 lists the wood species used in the studies, representing the main wood species used for exterior decking. The test material was provided by companies represented in the user committee.

**Table 3:** Wood species used for experimental studies and with wood species sheets

Group of wood species	Wood species
Naturally durable coniferous woods	European larch Siberian larch
Naturally durable deciduous woods	European oak Bangkirai
Modified timber	Thermally modified ash Accoya (acetylated Radiata pine)
preservative treated (PT) timber	preservative treated pine

Some of the experimental investigations and their results are presented in more detail below.

## 4.2 Reaction to fire tests (Holzforschung Austria)

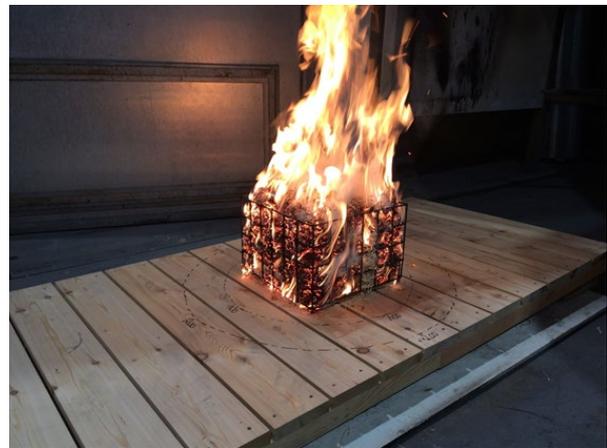
### *Task and methods*

A test method for determining the fire behavior of exterior wood coverings did not exist until now and was therefore to be developed on the basis of standardized test methods. The aim was to evaluate fire classes and to enable verifiable classifications with special consideration of roof terraces. First of all, an analysis of the building law and fire protection requirements for the types of use garden terraces, balconies/loggias and roof terraces in Germany and Austria was carried out. It was found that there are no general legal requirements for common outdoor coverings, but there are for use in roof terraces.

The radiant panel test according to EN ISO 9239-1 developed for indoor floor coverings (classification according to EN 13501-1) was used for the fire test of outdoor coverings and the external fire exposure test according to CEN/TS 1187 or DIN 4102-7 with classification according to EN 13501-5 for roof terraces (Fig. 1 and 2). Numerous fire tests were carried out on the wood species European larch, Siberian larch, oak and Bangkirai with different plank dimensions, wood moisture contents and construction variants, whereby the worst-case scenario was assumed.



**Fig. 1:** Radiant panel test



**Fig. 2:** External fire exposure test

### *Results*

The fire behavior and thus the classification into fire classes depend very much on the structure (joint width, distance to the substrate) as well as on the type of substrate, whereas the wood species plays a minor role.

As a result, the wood species European larch, Siberian larch, oak and Bangkirai were classified in reaction to fire class D<sub>fl</sub>; the prerequisite for this is a certain structure, which is described in detail in the EURODECK user guide in the leaflet "Fire behavior".

The B<sub>ROOF (t1)</sub> classification required for the use of wood decking in roof terraces can in principle be achieved with a lath grid on 5 cm gravel, although this is a rather unfavorable variant. For roof terraces without a gravel substrate, a construction variant with the wood species larch was classified, which is also described in the aforementioned leaflet of the user guide.

## 4.3 Strength profile (Holzforschung Austria)

### *Task and methods*

The use of exterior decking in load-bearing areas requires assured mechanical characteristic values. The characteristic values specified in EN 338 for various wood species and grading classes are based on edgewise tests and cannot be applied across the board to components subjected to flat-edge loading. The

values given in EN 338 for boards and planks assume that they are graded as squared timber, which is not usually the case for decking boards. Also, grading by appearance alone is not sufficient. The aim was therefore to determine a performance profile (bending strength, bending modulus of elasticity, bulk density) on the basis of a separate grading specification and normative mechanical tests.

The tests carried out at Holzforschung Austria were based on European larch from three growing regions in Austria, Germany and the Czech Republic and corresponded to the VEH-A/B grade. Commercially available smooth-edged decking boards with common cross-sections (three widths up to 150 mm, two thicknesses from 19 mm) were examined.

### Results

Based on the visual grading for decking boards according to the VEH Quality Guideline (7th edition 2016) and in combination with grading criteria for load-bearing capacity according to EN 14081-1 and DIN 4074-1, a grading rule was derived for the grading classes EURODECK 1t and EURODECK 2t, which combines visual and strength-related criteria, with the classes largely corresponding to the mixed grading VEH Top or VEH AB. As is usual with wood grading, class 1 is better than class 2. The grading specification can be found in the EURODECK user guide, leaflet "Exterior decking for load-bearing purposes", where the procedure for deriving a characteristic performance profile is also described in detail.

A total of 364 flat edge bending tests according to EN 408 were carried out on EURODECK 2t sorted plank sections made of European larch. A characteristic performance profile was determined from the 5 % quantiles of bending strength and gross density as well as the mean values of the bending modulus of elasticity, resulting in an equivalent classification into strength class C 24 according to EN 338. These results are also applicable to Siberian larch.

## 4.4 Slope/drainage (IHD Dresden)

### Task and methods

There are very different opinions among experts on the necessity and the effect of a certain pavement slope. Therefore, the influence of slope and profiling on water drainage and moisture retention should be determined and existing specifications on minimum slope should be evaluated. The orienting investigations were carried out on two decking grids of approx. 1 m<sup>2</sup> exposed in the open, each consisting of two smooth and two grooved planks of European larch; the slope was 0 % and 2 % (Figs. 3 and 4). Wetting and runoff/drying behavior were observed on these grates during and after rain events, respectively. On all 8 planks of the decking grates, the wood moisture content was continuously recorded from July 2021 to March 2022 (electrical resistance method, Scantronik Mugrauer system).



**Abb. 3:** Decking grates with 2 % (left) and 0 % (right) slope



**Abb. 4:** Water film at 2 % slope after rainfall

In addition, smooth and grooved plank sections with 0 %, 2 % and 4 % slopes were "sprinkled" with water for 20 s in the laboratory and the drainage behavior was evaluated. The slope effect was evaluated according to where the water ran off, how long water dripped off or how long a water film was visible and how much water remained on the floorboard.

### *Results*

For the pavement grates exposed in the field, no clear differences in wetting behavior during and after rain were found between the variants (smooth/rugged; 0/2 % slope). The 2 % slope had only a short-term effect, as the water film receded faster, especially in depressions or at the base of the corrugation. However, the long-term average wood moisture content was very close in all variants and was mostly below 20 % throughout.

The targeted sprinkling tests showed that for both smooth and corrugated boards without slope, residual water remained in depressions (due to minor deformations) or in the corrugation base for a long time after dripping; in these areas, the dripping time was significantly shorter than the water film duration. In the case of planks with slopes, dripping occurred almost exclusively over the lower end; here, the dripping duration was about equal to the water film duration, both being shorter the greater the slope. With the slope; smooth and corrugated planks behaved about the same here.

Even though these were only orientational tests, the following conclusions can be drawn with regard to the slope:

- The effect of a slope of up to 4% on moisture buildup or long-term wood moisture content and thus the risk of fungal attack (rot) is very low and is overestimated.
- A slope of 2%, which is often required, is therefore not absolutely necessary, but it is also not disadvantageous.
- If a load-bearing covering is involved, for which the Fachregeln des Zimmererhandwerks 02 must be observed as a recognized rule of technology, a slope of at least 2 % must be maintained.
- Other measures are more effective than a slope in limiting moisture penetration of decking boards over a prolonged period of time resulting in a risk of rot; these include good air circulation, minimization of contact areas, avoidance of capillary joints, and regular cleaning to prevent accumulation of dirt on, between, and under decking boards.

## 4.5 Crack formation (IHD Dresden)

### *Task and methods*

In weathered wooden components, cracks form some time after installation. Their number and characteristics (length, width, depth) vary depending on the type of wood, incision as well as weathering, etc. As a rule, this does not affect the serviceability. However, the cracks can be perceived as disturbing. The aim of the investigations on the seven wood species was to observe the specific course of crack formation and to work out differences as well as influencing factors.

Using plank sections of 10 wood species, from a common medium grade with smooth and uncoiled surface, decking grates of approx. 1 m<sup>2</sup> area were manufactured (screwed to wood UK; 6 planks each with 8 mm longitudinal joint). The grates were laid on a bed of gravel with a distance of approx. 15 cm between the covering and the subfloor. Already existing cracks were marked. After 1, 2 and 7 months, the surface cracks on the visible side were evaluated in each case in the dried state with respect to length and width as well as number. The crack quantity was classified according to the scheme from EN ISO 4628-4.

### *Results*

During the evaluation, it was found that crack width and crack quantity are decisive for the aesthetic impression. The largest and most cracks were formed in areas with horizontal annual rings (flap boards especially in the softwood variants); in half-rift and rift boards, the cracks were smaller and more evenly distributed. As expected, the higher the wood moisture content and the less uniform the drying quality, the more pronounced the shrinkage or drying cracks were. The softwood variants were found to be more susceptible to cracking than the hardwoods, with cracking preferentially occurring in the area of larger knots with local fiber deviations), which also confirmed expectations. In the hardwoods Cumaru, Bangkirai, on the other hand, cracks always occurred in alternate rotation growth zones, mostly oblique and relatively short; however, these cracks are hardly avoidable. The observations confirmed that a limitation of the plank width of max. 120 mm is useful to minimize cracking.

## **4.6 Microbial discoloration (IHD Dresden)**

### *Task and methods*

A laboratory test method was to be developed to determine the susceptibility of a decking material to fouling or attack by wood-discoloring microorganisms. These include molds, blue stain fungi and (unicellular) green algae. Laboratory tests were carried out according to EN ISO 846 and EN 152 on the seven woods mentioned above. As test organisms, 6 mold or blue stain fungus species were used, which frequently occur in practice. Additionally, samples were exposed on the outdoor test field of the IHD. The evaluation of all samples was carried out according to EN 16492.

### *Results*

Laboratory test methods for the detection of the susceptibility of biocide-free wood coverings to wood-discoloring fungi were derived. The type of pre-stressing (natural vs. artificial weathering) is to be examined in the validation still required.

Of the woods tested, larch and also oak were found to be more sensitive to wood-discoloring fungi than Bangkirai, Accoya and thermo-ash. It should be noted that discoloration is much more noticeable on the light Accoya wood than on thermo-ash.

## **5 User's guide**

The most important result of the project is the "User's Guide to Outdoor Wood Decking". This was originally conceived as a compact compilation of all relevant properties and parameters of decking with corresponding information. Holzforschung Austria – based on extensive experience on the subject – developed an extended, user-centered approach.

For this purpose, seven types of use were defined, which represent the majority of practical cases, as well as six general criteria, which are important for the planning and selection of decking materials. Types of use and criteria are linked to a basic table in which the respective requirement classes are specified. In further tables, relevant properties with corresponding requirements are assigned to the criteria, and the requirements classes are also broken down in terms of content. The tables are supplemented by various information sheets and additional information on relevant topics. Furthermore, the user guide contains wood species sheets for the seven wood species mentioned above, which were also used in the experimental work.

The user guide is preceded by a so-called basic document; this contains general information and definitions of terms, explanations of the concept, structure and use of the guide, the basic table and an overview of the documents. It is followed by an extensive list of standards, regulations and publications relevant to exterior wood coverings, as well as an index with references to documents. Figure 5 provides an overview of the partial documents contained in the user guide.

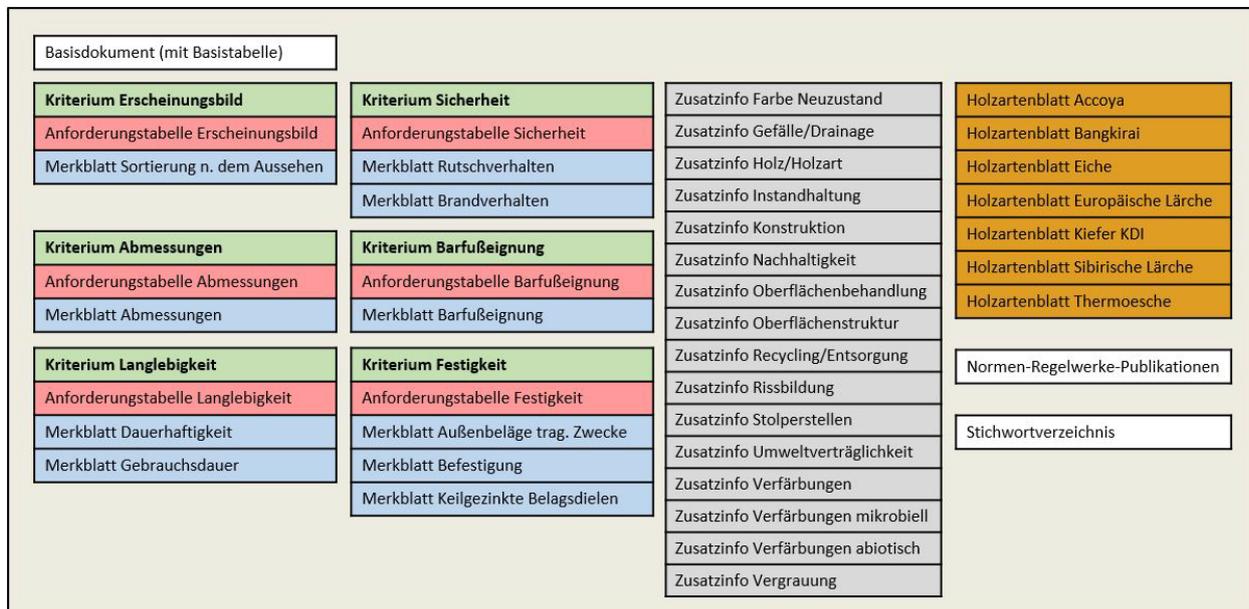


Fig. 5: Partial documents of the EURODECK user's guide

The user guide is the first comprehensive quality and evaluation program for exterior wood coverings. Several essential functions are available to the user:

1. possibility of creating a requirements profile for a specific project, based on the desired or planned wood species and the type of use given by the object,
2. obtaining comprehensive information on more than 25 relevant topics as well as selected decking wood species.
3. use of the grading tables for factory grading
4. planning and design of load-bearing decking based on the grading specification for larch species
5. planning and design of decking for fire protection requirements or for roof terraces.

The user guide (in German) has both a print version and an electronic version (pdf format). The structure is modular, i.e. the individual documents (cf. Fig. 5) are – besides a pdf-collection folder – also available as individual files and can be used separately, e.g. for customer information or for planning, tendering or quotation preparation. The EURODECK user guide is expected to be available for a nominal fee from May 2022 via the IHD or Holzforschung Austria; information will soon be available on the institute websites [www.ihd-dresden.de](http://www.ihd-dresden.de) and [www.holzforschung.at](http://www.holzforschung.at) as well as on the project website [www.eurodeck.eu](http://www.eurodeck.eu).

It is planned to create a web-based version as part of a follow-up project by Holzforschung Austria; this will be similar in design to the flat roof planner at [www.dataholz.eu](http://www.dataholz.eu).

## Acknowledgements

The CORNET/IGF project 272 EBR of the research association Trägerverein Institut für Holztechnologie Dresden e.V. (TIHD) was funded by the Federal Ministry for Economic Affairs and Climate Actions via the AiF within the framework of the program for the promotion of joint industrial research (IGF) based on a resolution of the German Bundestag.

Supported by:



on the basis of a decision  
by the German Bundestag

The project was also supported by the Austrian Timber Industry Association (Fachverband der Holzindustrie Österreichs), the Federal Committee of the Building Materials, Iron, Hardware and Timber Trade (Austrian Federal Economic Chamber), Deutsche Bauchemie e. V., the Association of the European Planing Industry (VEH) and the companies ATECTA GmbH & Co. KG, Enno Roggemann GmbH & Co. KG, FIXINGGROUP GmbH, häussermann GmbH & Co. KG, HOKA GMBH GERMANY, Holz-Henkel GmbH & Co. KG, HolzTec Dethloff GmbH, Holz Waidelich GmbH & Co. KG, Marianne Frey-Amon Holz und Holzprodukte, M. Hechenblaickner Holzhandels-gesellschaft m. b. H., Mühlbauer Holz GmbH, J. u. A. Frischeis Gesellschaft m.b.H., Osmo Holz und Color GmbH & Co. KG and SWERO KG.

The complete project report (will be available in German and English) can be ordered from:

Trägerverein Institut für Holztechnologie Dresden e.V.

Zellescher Weg 24

01217 Dresden

GERMANY

## References

DIN 4074-1:2012, Sortierung von Holz nach der Tragfähigkeit - Teil 1: Nadelschnittholz

EAD 190005-00-0402, Terrace decking kit. EOTA, 2017

EN 152: Wood preservatives - Determination of the protective effectiveness of a preservative treatment against blue stain in wood in service - Laboratory method

EN 338:2016-07, Structural timber - Strength classes

EN 408:2012, Timber structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties

EN ISO 846: Plastics - Evaluation of the action of microorganisms (ISO 846:2019)

EN ISO 4628-4:2016, Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 4: Assessment of degree of cracking (ISO 4628-4:2016)

EN 14081-1:2019, Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements

EN 14342:2013, Wood flooring - Characteristics, evaluation of conformity and marking

EN 15534-4:2014, Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) - Part 4: Specifications for decking profiles and tiles

EN 16492:2014: Paints and varnishes - Evaluation of the surface disfigurement caused by fungi and algae on coatings

Fachregeln des Zimmererhandwerks 02 "Balkone und Terrassen". Bund Deutscher Zimmermeister, Berlin 2015

FLL Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.: Holz und Holzprodukte im GaLaBau. Ausgabe 2019

Holzforschung Austria [Hrsg.]: Terrassenbeläge aus Holz. Technische Broschüre. Wien, 2016

Terrassen- und Balkonbeläge. Produktstandards und Anwendungsempfehlungen. Gesamtverband Deutscher Holzhandel e.V. 5. Auflage

Terrassen: Planen, verlegen, pflegen. VEH Holzterrassen. VEH Edition N° 8, 1. Aufl. 2013

Terassenbeläge aus Holz. Lignatec-Broschüre Nr. 27 (Lignum, Schweiz) 2013