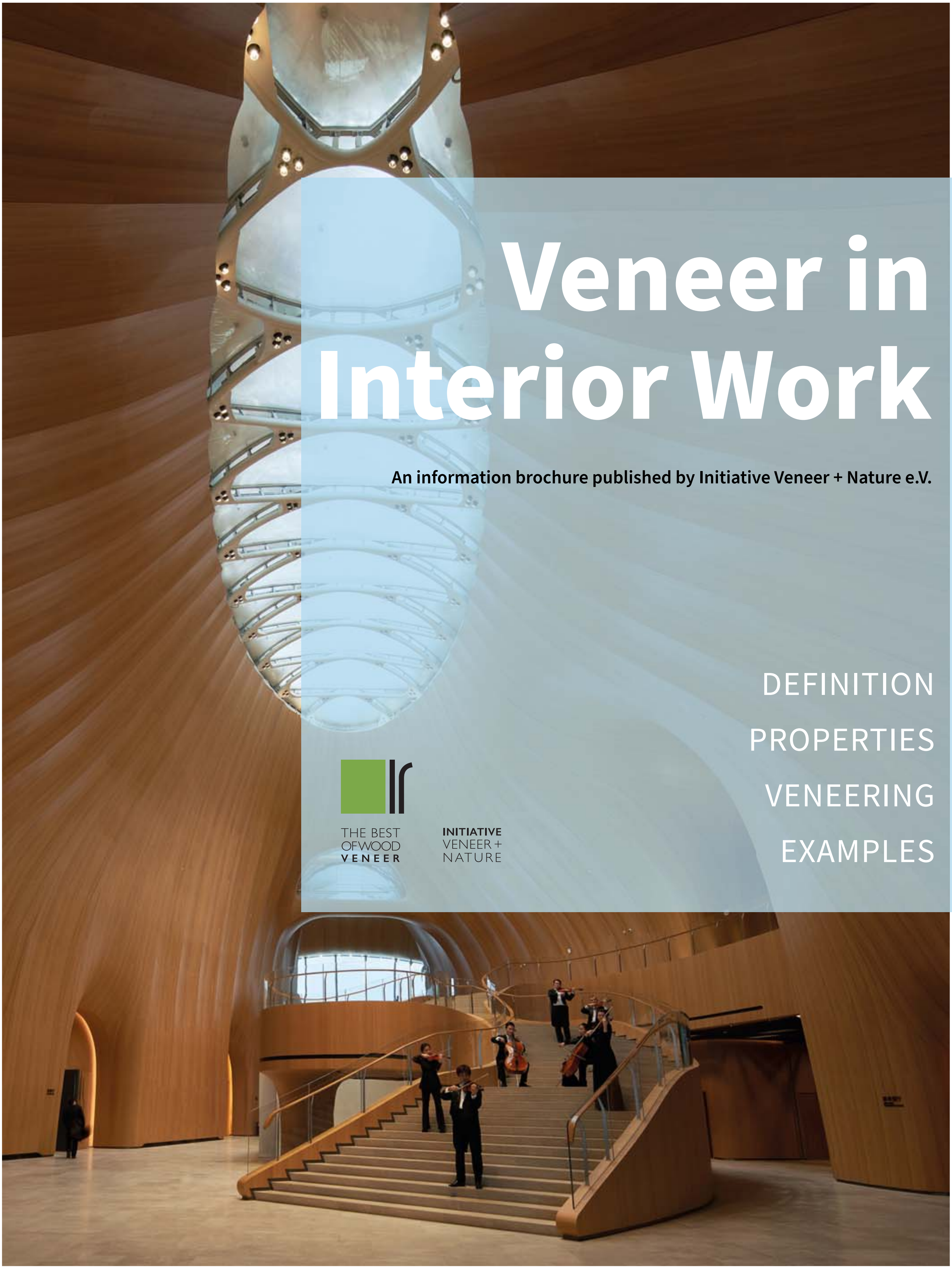

Veneer in Interior Work

An information brochure published by Initiative Veneer + Nature e.V.

DEFINITION

PROPERTIES

VENEERING

EXAMPLES

THE BEST OF WOOD VENEER

INITIATIVE VENEER + NATURE

OAK**NUT**

PINECHERRY**APPLE**

WALNUT**BIRCH**BEECH

ELSBERRYROBINIA**BOGOAK**

CEDAR**SPRUCE**FIR**DOUGLAS**

ASHOLIVE**CHESTNUT**ACACIA

EUCALYPTUS**CHIRBELPINE**

LIMEMAPLE

POPLAR

YEW

PEAR

LARCH

furnier.de

Editorial

Functionality and sensuality

It sounds obvious, but let me remind you: Wood is crisis-proof. Sure, harvests and prices vary, but wood is almost like renewable gold. Wood is the oldest material known to mankind. Its range of applications has always been vast and is becoming ever more versatile today thanks to imaginative developments and the desire for climate-neutrality. Wood scores with its functionality and sensuality at the same time. The same applies to its veneer. The thinnest solid wood in the world currently presents itself in an unprecedented variety. In addition to the traditional range of untreated veneer sheets from over 140 wood species worldwide, there are innovations such as smoked, printed, charred, combined with other natural materials or perforated veneers.

Wood veneer is able to combine the desire and reality of climate protection, which is incredibly advantageous nowadays: one cubic meter of wood yields an average of 400 m^2 of veneer. This can be used to produce furniture surfaces for around 12 bedrooms. Whether oak, walnut or softwood, veneer is enormously resource-efficient. The buyers of veneer increasingly accept the growth characteristics of a tree, such as branching or medullary rays, as natural, which gives every strip of veneer highly valued individuality. In addition, because of their high quality, furniture frames, boards and panels of wood and its veneer can be reused in a multiple sequential use (cascade use), which expands their lifespan greatly.

According to the guiding principle “Reduce, Repair and Re-Use”, a sustainable approach can thus be implemented against the overproduction of waste that is harmful to the climate.

This information leaflet, “Veneer in Interior Construction, Definition, Properties, Processing and Applications”, provides basic knowledge about veneer. The handbook is primarily aimed at trainees in the carpentry and joinery trades, apprentices in the furniture industry and students of interior design, architecture and civil engineering. It is also aimed at professionals in the aforementioned occupational groups and decision-makers in interior design and construction projects. The expertise is provided by the Chair of Wood and Fiber Materials Technology at the Technical University of Dresden and the Institute for Wood Technology, Dresden. The only registered veneer association in Europe, the Initiative Furnier + Natur (IFN), is responsible for the preparation and publication of this handbook. The objective of this leaflet is to work together to ensure that veneer becomes a substitute for other, unecological materials.

Ursula Geismann

Managing Director of the Initiative Veneer + Nature

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1.

INTRODUCTION

1.1 What is veneer?

Veneer is wood in its most attractive form. Experts call veneers the finest thing that can be produced from wood. Veneers are the most economical way of using wood and therefore form the greatest added value of this natural material.

Wood is a naturally grown raw material. Each wood species has characteristic features and decorative particularities. In the same way as no tree is like any other, no two sheets of veneer are the same. The colour, figure (pattern) and structure of each sheet of veneer are unique. Each sheet of veneer has its own individual character. Veneer is a design element, which retains its natural beauty and dynamism, even after working.

1.2 Definition

Veneer is a thin sheet of wood, which is separated from a log by peeling, slicing or sawing. This is how DIN 4079 defines veneer. From what thickness a veneer is to be named as such, is not defined. DIN 4079 defines nominal thicknesses for veneers made from different species of wood. They are generally between 0.5 mm and 0.6 mm. Veneers of this thickness are also called standard veneer. Other veneer thicknesses are also produced, depending on their intended use, which are called micro or thick veneers according to their thickness. Micro-veneers are very thin, translucent veneers between 0.1 mm and 0.3 mm thick. Their extreme thinness makes them susceptible to cracking, which requires particular care when they are used. Thick veneer is the name given to veneers that are between 0.9 mm and 2.5 mm thick. There is no fluent transition between individual veneer thicknesses. Veneers are always produced with defined thicknesses, e.g. as 0.55 mm, 1.5 mm and 2.5 mm thick veneers. However, these thicknesses vary from wood species to wood species.

DIN 68330 classifies veneers according to the type of production and their intended use (Table 1).

Table 1 | Types of veneer acc. to DIN 68330

Classification by use

- **Face veneer**
  Outer veneer | Inner (back) veneer
- **Secondary cross-band veneer**
- **Cross-band Veneer**

Classification by production

- **Sliced veneer**
  Flat-cut slicing | True quarter, False quarter
  Crown quarter
- **Peeled veneer**
  Rotary peeling | Stay-log | Rift peeling
  „From the heart“ peeling
- **Sawn veneer**

Fig. 1 | Veneer edges in all wood species
Photo: istock

1.3 History

Face veneers are veneers that form the visible surface. Face veneers are divided into outer and inner (back) veneers. The outer veneers form the outer surfaces of the finished products, which determines the appearance of the product, while the inner veneers on the inner surfaces of the product contribute less to the appearance.

High-quality sliced or peeled veneers are used as face veneers. The production of sliced and peeled veneers and the resulting matched veneers (veneer matches) are described in detail in chapter 2.2.3.

Secondary cross-band and cross-band veneers are located under the face veneer and are mainly used to improve dimensional stability.

The production of veneer and veneering itself were practised in Egypt as far back as ca. 2900 BC. Fine, high-grade woods were valuable. Therefore, the Egyptians invented economic ways of using and working these woods and sawed the logs into the thinnest possible boards and planks. In Europe, veneers were increasingly used in furniture-making from the 14th century.

However, at the beginning of the modern age, the production of small quantities of veneer was so labour-intensive and time-consuming that the pieces of furniture made from them were exclusively reserved for prosperous sections of society. Until the 19th century, veneers were solely made by sawing. During this period, industrial production began, which enabled larger quantities of veneers to be produced and worked. The first veneer peeling machine was patented in 1818. The first veneer slicing machine was started up in 1870. With it, the cornerstone of the modern veneer industry was laid. Due to the increasing use of wood-based materials, in the middle of the 20th century, veneer was the predominant surface material used for furniture, doors and in interior work. Today veneer competes against a range of decorative coating materials, however, it is an important design element in the furniture industry, door production and in interior work (e.g. in floorings, ceiling and wall panelling, in interiors in boat, aircraft and car manufacture).

Fig. 2 | Stacked veneer sheets after slicing
Photo: IFN

Fig. 3 | Veneer sheets with typical woodworm bite
Photo: IFN

2.

MATERIAL

2.1 Raw wood

The structure of the wood is produced as a result of the growth of a tree. Due to the different functions necessary for the growth of a living tree, wood is made up of different types of tissues and cells. They are arranged in rings around the trunk (stem) axis (medulla, pith). Cells are also created to supply the trunk in a radial direction; these are called wood rays (xylem rays). These evolve as radial, often shiny lines.

Depending on the climatic conditions, a tree forms annual rings or growth zones as a result of its annual growth. These are a clear sign of wood material, because by cutting the annual rings in different directions, different wood patterns are formed, also called the figure or grain of the wood. Fig. 4 shows the three cutting planes in wood with their typical figure.

The cut perpendicular to the longitudinal (trunk or log) axis is called an end-grain (cross-grain) cut or cross-section (transverse section). In the end-grain cut the annual rings appear approximately round.

The radial or rift-cut (also known as the edgegrained or quarter-cut) is a cut parallel with the longitudinal axis of the trunk or log.

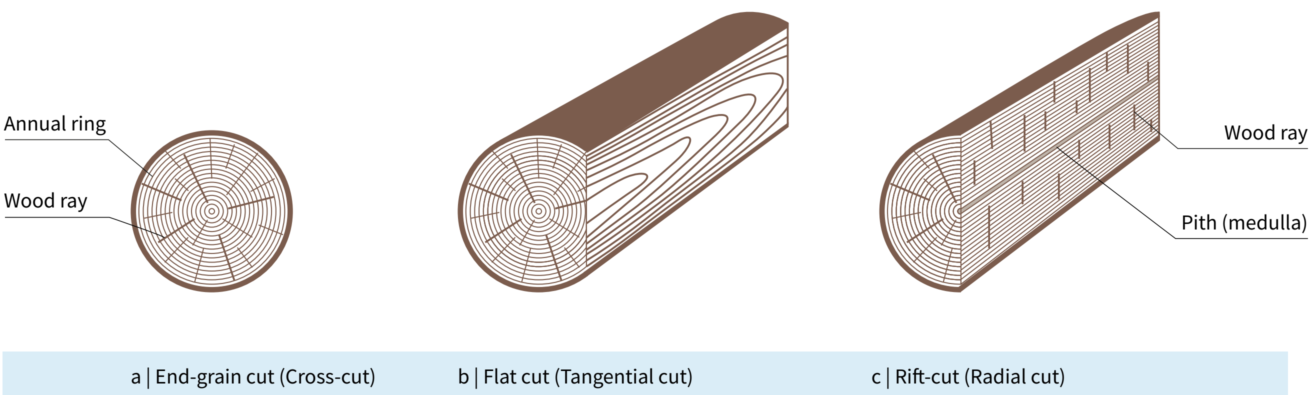
It runs in the direction of the radius of the annual rings, approximately parallel to the wood rays. The annual rings form parallel stripes in the radial cut.

The cut along the tangent of an annual ring circle is called a tangential, crown or flat-sawn cut (in Australia back-sawn timber), (more rarely plainsawn or through-and-through sawn). It also runs parallel to the log axis, however, it cuts through the annual rings, which taper conically towards the top of the tree. They therefore appear as parabolic curves and produce a figure known as crown figure (also described as tapered, oval, arch, heart, looped, conical) or figured.

In practice, the longitudinal sections are often combined, so that a semi-radial or semi-tangential cut is produced. Selected figures are described in chapter 2.3.4.

The inner part of a cross-section through a log, which in the living tree is only used to store material and as strengthening, is called heartwood. It is mostly different in colour to sapwood and is significantly darker than the sapwood. The sapwood is the outer, in most cases lighter coloured part of a trunk cross-section.

Fig. 4 | Cutting planes in the wood
Source: GWT-TUD GmbH



Apart from its natural beauty, as a material, wood has many special properties, which have to be taken into account when processed and worked.

Wood is a hygroscopic material, which can absorb and dissipate water from and to the air. During this change in moisture content, dimensional changes occur; the swelling or shrinkage of wood.

Due to the annual ring structure and the different tissue and cell types, wood in an inhomogeneous material.

Most of the cells or fibres of a tree are aligned parallel with the tree trunk axis (also called stem axis). Wood therefore has different physical properties in different directions. The longitudinal direction of the fibres is the direction parallel to the trunk axis. It is in this direction that wood has its highest strength, its highest stiffness and the lowest swelling and shrinkage values. Perpendicular to the fibre direction, a further differentiation is made between radial and tangential directions, which are analogous to the cutting planes. The strength and stiffness values perpendicular to the fibre direction are significantly lower than in the longitudinal direction of the fibres. The swelling and shrinkage values on the other hand are highest in the tangential direction; those in the radial direction are somewhat lower.

All these properties require a certain understanding for the use, processing and working of wood. Each wood species has specific properties, which must be noted and taken into account when a combination of different wood species is used.

High-quality, defect-free logs only are used to produce veneers. This reduces the growthinduced disadvantages and highlights the natural beauty and aesthetic quality of wood.

2.2 Veneer production

Each veneer sheet (leaf) is unique. A large number of different veneer matches can be produced during veneer production. To limit the choice of veneer, veneer producers provide the option of joint sampling. To this end, manufacturers, veneerers and designers/clients, examine different veneers, in order to agree the veneer selection or veneer match in detail at an early stage. The designer/client should make use of the opportunity of sampling, i.e. examining veneer examples, and therefore the ability to discern the expertise of the veneer producer or dealer, in order to avoid misunderstandings in the veneer selection.

Despite modern technology, veneer production requires much experience and craft skills. Each wood species is individually processed. Veneer is produced in the technological steps described in the following.

Fig. 5 | Veneer sheets are sewn together by hand or by machine.
Photo: IFN

2.

2.2.1 Bark stripping, cutting to length, flitching

In the first step, the cut tree trunk (log) must be prepared for veneer production. Apart from optimum utilisation of the wood and quality grading, the main aim is, as far as possible, to create a defects-free, regular veneer surface with uniform colour and structure.

With the stripping of the bark (debarking) from the log, foreign materials such as stones, metal parts, sand or soil are also removed. The subsequent cutting to length takes into account growth features, colour, structure, shape, dimension and length specifications. Flitching is the name used to describe the longitudinal cutting and cutting to size of the veneer log into sections (flitches) ready for conversion into veneers. The log is halved, quartered or cut into three equal parts; this produces the veneer blocks (logs, bolts, billets) or flitches, which are clamped into the slicing or peeling machine. The flitching also decides the slicing technique and therefore the veneer match. This clearly shows how important this step of the work is: it is here that it is decided whether or not the most attractive veneer match can be achieved and at the same time the valuable raw material wood can be used optimally (Fig. 6).

2.2.2 Steaming and cooking

In order to achieve high-quality cutting, the veneer blocks have to be plasticised, i.e. „softened“. For this reason, they are placed in large vats filled with water, and are steamed or cooked (Fig. 7). Apart from the plasticising effect, the cooking also changes the colour of the wood. The length of the cooking process decides the achievable colour. For example, originally white beechwood acquires its salmon-coloured to reddish shade through the steaming or cooking. Light-coloured timbers, whose shade is to remain light, are made into veneer without steaming or cooking. This includes white beechwood and maplewood. These timbers are plasticised using cold water.

The steaming or cooking period (heating schedule) can last from a few hours to several days, depending on the wood species and the required colour. During this period, the individual wood species are subjected to different temperature variations, which must be precisely adhered to. The parameters required for fault-free steaming and cooking are empirical values of each firm and are strictly kept secrets.

Fig. 6 | Trimming of a log
Photo: IFN/Schlautmann

Fig. 7 | Steaming the veneer blocks
Photo: Schorn & Groh GmbH

Fig. 8 | Walnut veneer as a sought-after material for lampshades
Photo: IFN/GoFurnit

2.

2.2.3 Production techniques

SLICING

During slicing a sheet of veneer is cut from the veneer block by moving the block horizontally or vertically. The slicer blades can cut parallel or perpendicular to the fibre direction, which is why a differentiation is made between longitudinal and transverse slicing (Fig. 9).

With longitudinal slicing the cut is made analogous to planing, parallel to the fibres. This achieves a very good surface quality. Theoretically, unlimited veneer lengths can be produced. Longitudinal slicing technology can produce veneers with a width of 350 mm wide and more. The thicknesses that can be produced vary between 0.3 mm (in exceptional cases even thinner) and 13 mm. The way in which longitudinal slicing machines function requires rectangular flitches to be processed. Therefore, the variation in achievable veneer matches is limited. This slicing technique, which stems from the Asian region, is also practised in Europe and America; however, it is not used in Germany. Therefore, in Germanspeaking countries, slicing is used as a general term, although transverse slicing is meant.

The four cutting techniques of (transverse) slicing produce different figured or stripy (ribboned, striated, straight-grained) veneer matches.

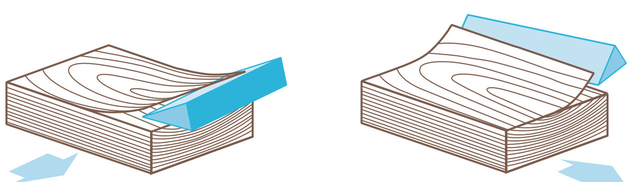


Fig. 9 | Basic diagram of longitudinal and transverse slicing
Source: GWT-TUD GmbH

→ Flat-cut slicing

With flat-cut slicing, a log cut in half lengthwise is fixed onto the slicing table with the heartwood side on the table and is sliced from the outside. The initially cut sheets of veneer have a vivid crown figure, as the annual rings are cut into with a very flat angle. The nearer the cut approaches the middle of the log, the more the annual rings are cut at right-angles, so that an increasingly striped, straight-grained veneer match results (Fig. 10).

→ True quarter-cut slicing

The log is cut into quarters lengthwise for true quarter-cut slicing. It is clamped so that the cut is made at right-angles to the annual rings. This produces a stripy figured, straight-grained veneer match (Fig. 11).

→ False quarter-cut slicing

The log is cut into quarters for false quartercut slicing. The cutting into quarters means that the veneer block has two sides that are perpendicular to each other, which occur in the radial cut. The block is clamped with one of these sides flat and is sliced parallel to it. Due to the slicing of a quarter log, veneer matches are produced semi-figured. As with flat-cut slicing, the annual rings are initially cut at a very flat angle. As the middle of the log (trunk) is approached, striped, straight-grained figures are produced (Fig. 12). By symmetrically jointing several semi-figured veneer sheets, figured veneers (crown figure) can be produced.

→ Flat quarter-cut slicing

Flat-quarter-cut slicing is the same as flat-cut slicing, except that a quarter log is sliced. The result is a veneer match with virtually pure, figured crown („cathedral") structure. (Fig. 13)

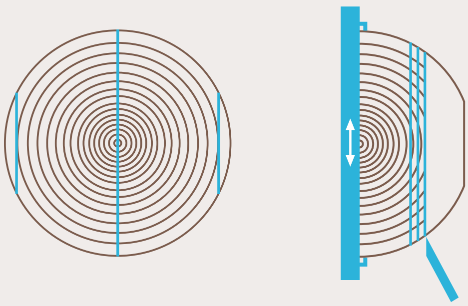



Fig. 10 | Flat slicing

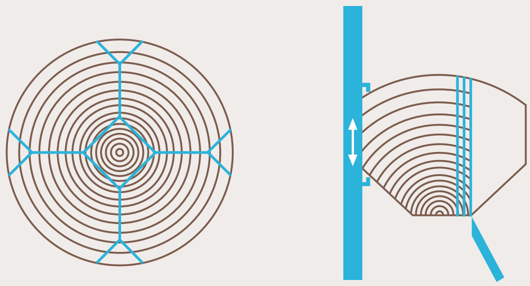
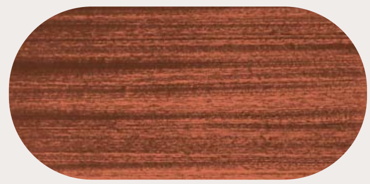



Fig. 11 | Quarter-cut slicing

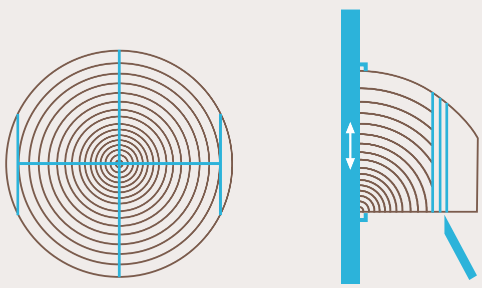



Fig. 12 | False quarter-cut slicing

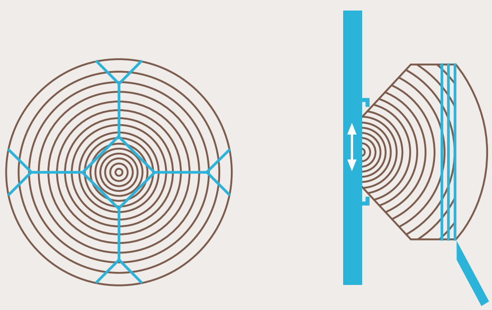



Fig. 13 | Flat quarter-cut slicing

Fig. 10 – 13 | Cutting technique and resulting veneer match
Source: Danzer Group

2.

PEELING

With peeling, the veneer block rotates and the veneer sheet is cut from the block during the rotational movement.

→ Rotary peeling

With rotary peeling the round log is processed. It is clamped along its central axis and is peeled spirally from the outside. This peeling technique is used, among other things, to produce decorative, figured (fancy patterned, variegated) veneers. The result is veneer matches with irregular crown figure or with pockets of wild structures, e.g. birds eye maple (Fig. 15).

→ Stay-log peeling

With stay-log peeling a halved log is mounted in the lathe fixed with its heart side mounted on a "stay log" and is peeled from the outside. The rotating of the half-log clamped at the pith (medulla) causes eccentric rotational movement of the block, which is why this peeling technique is also called eccentric peeling. The annual rings are cut at a very flat angle, so that the resulting veneer match is striped, straightgrained at the sides and figured (crown figure) in the middle (Fig. 16).

→ Rift peeling

The log is cut into quarters for rift peeling. The block is clamped with one of the two flat sides on the lathe and is peeled from the opposite side. The rotary movement of the block is also eccentric. The resulting veneer match is striped (Fig. 17). Striped veneers are preferably produced using this technique.

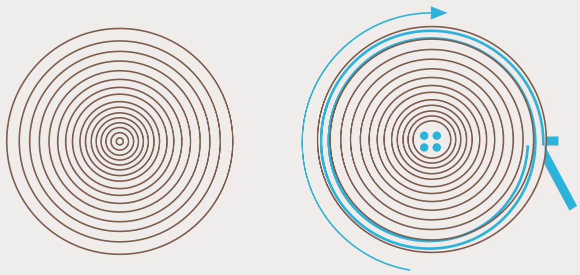
→ "From the heart" peeling

For this peeling technique the log is cut into thirds or quartered. The block is clamped in the lathe with the heart side facing the blade and is peeled outwards from the inside (from the heart). In this way, wider veneer matches can be produced. The resulting veneer match is particularly distinctively figured (Fig. 18).

SAWING

Sawing is the oldest production technique for veneer. Until slicing and peeling machines were developed, all veneers were produced by sawing. Sawing is carried out using a veneer saw frame (saw gate) or a veneer circular saw. The manufacture of sawn (saw-cut) veneers produces up to 50% loss. Nevertheless, sawn veneers are still used today. As the veneer blocks for sawing do not have to be plasticised, sawn veneers have the same colour as the solid wood. Especially for hard woods, which are difficult to make into veneers by slicing, sawing is the alternative production option. With a thickness between 1.2 mm and 2.5 mm, sawn veneers are relatively thick. They are used, e.g. for restoration work, as well as for producing high-quality furniture.

Fig. 14 | Strong sawn veneer for interior fittings or flooring planks.
Photo: Fritz Kohl



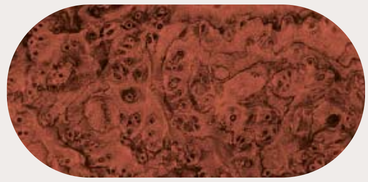


Fig. 15 | Rotary peeling

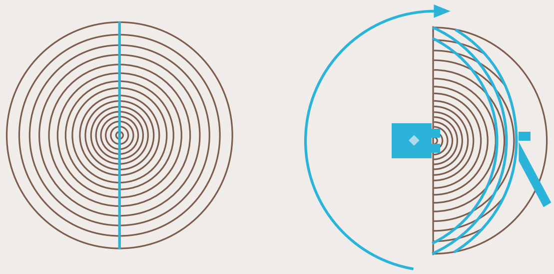


Fig. 16 | Stay-log peeling

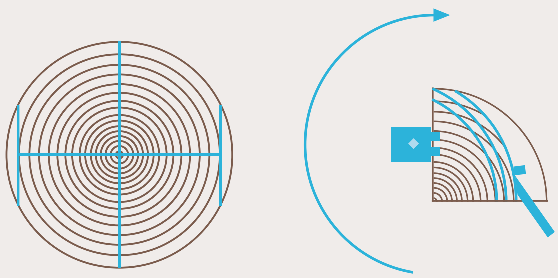


Fig. 17 | Rift peeling

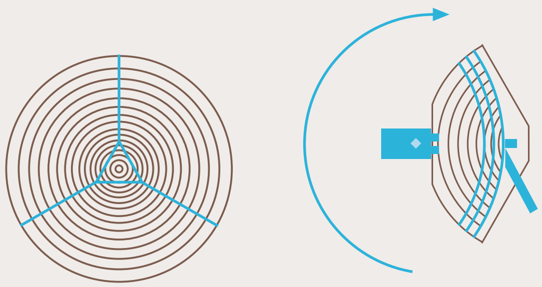


Fig. 18 | From-the heart peeling

Fig. 15 – 18 | Peeling technique and resulting veneer match
Source: Danzer Group

2.

2.2.4 Drying, trimming, bundling

By steaming or cooking the veneer blocks before cutting, the veneers are wet after the cutting process. They are dried to the required final moisture content, generally between 6% and 12%, using hot air at temperatures between 60 °C and 180 °C. The drying usually takes place on belt dryers. The veneers are passed through various dryer zones between two “endless” webbing belts. The throughput times and temperatures vary for each wood species, accordingly wood species-specific programs are run.

Due to the density differences within a sheet, most veneers tend to become warped or buckled (e.g. maple) and must be flattened (smoothed) for further processing. The smoothing is mostly carried out in belt dryers with “ironing” effect (warm press dryer). Additional rolls, which exert a pressure on the veneer, flatten and smoothen the veneer. Highly warped veneer, e.g. beechwood, may have to be smoothed by additional pressing.

Following the drying process, the veneers are cut to size and bundled into packs (flitches) of 16, 24 or 32 sheets (leaves) each. When they are cut to size, the edges are straightened (trimmed) and any growth irregularities are cut out.

2.2.5 Appraising and measuring

Appraising is the term used to describe the defining of a price for a pack of veneer. It is done by assessing the quality and visually measuring the packs of veneer. The size list produced from the measurement records the area contained in each pack. In this way the price per square metre of each pack is defined.

Fig. 19 | Bundled veneer stacks can be stored for years.
Photo: IFN/Schlautmann

2.3. Veneer properties

2.3.1 Production-induced characteristics

During the cutting process of peeling and slicing, the blade moves in the veneer block and cuts a sheet of veneer from the block. A pressure bar is positioned above the blade, and presses against the veneer block immediately before it is cut off. This prevents the wood from splitting and a smoother cut is produced. To ensure continued cutting until the veneer sheet is cut off the veneer block, the veneer is highly curved immediately after the cut into the wood is made. This causes small cracks to form on the side facing the blade during peeling and slicing parallel to the fibres (Fig. 20 and 21).

The crack-free side is called the closed side, the side with cracks is called the open side. The cracks affect both the physical and the veneering properties. The result of coating with liquid systems such as lacquers or adhesives, depending on the presence of cracks, can differ. The gloss or effect of the veneer surface, especially in oblique incident light, can differ between the two sides of a veneer sheet. These effects must be taken into account especially when joining veneer sheets to form a larger figure. With regard to the mechanical properties, it must be noted that the cracks represent weakening of the material. Applying a load (bending or tension) perpendicular to the cracks results in fracture before loading parallel to the cracks. In the case of sawn veneers, no cracks form during production.

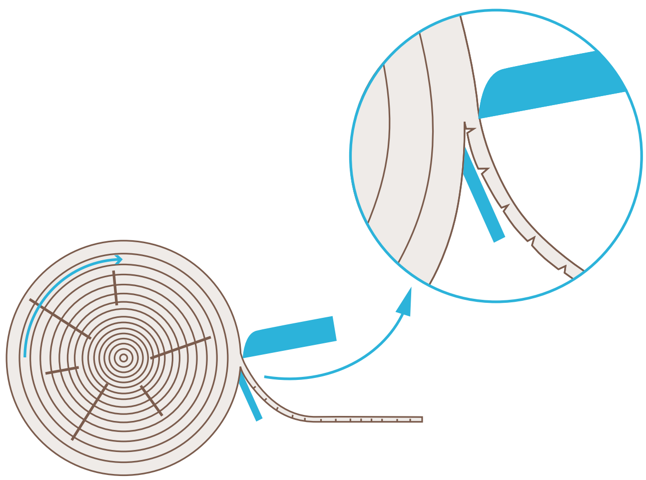


Fig. 20 | Diagram showing how cracks are formed during peeling and slicing
Source: Becker KG

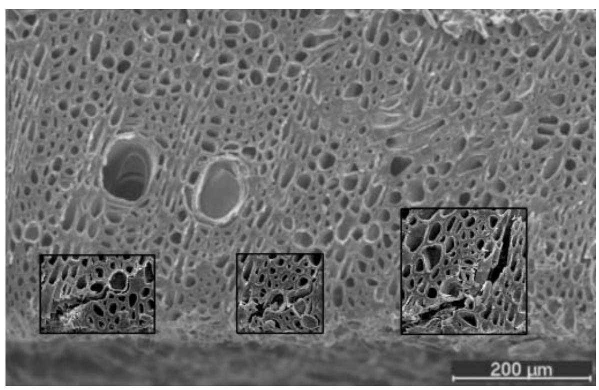


Fig. 21 | Microscopic image of cracks in walnut veneer
Source: TU Dresden

2.

2.3.2 Mechanical properties

There is currently no German standard, describing standard tests for determining the mechanical properties of veneer as there are for solid wood. Tests for determining mechanical properties are therefore made based on test standards from the paper industry or under individual test conditions.

Table 2 shows values for tensile strengths and module of elasticity for veneers made of European beech (Fagus sylvatica L.) and European oak (Quercus robur L. / Quercus petraea Liebl.). As veneers cannot be precisely assigned to the radial or tangential direction in the wood, a differentiation is only made between the direction parallel and perpendicular to the direction of the fibres (grain direction) to determine the characteristic values. The veneers were produced using longitudinal slicing methods.

The values determined for beechwood veneer, where available, lie within the range usual for solid wood, although they tend towards the lower limit. The values for oakwood veneer are smaller than those of the solid wood, which is due to structural effects.

In the case of this wood species, with partially large vessel cells and wood (xylem) rays occasionally only 2 – 3 vessels in the crosssection lie on top of each other in 0.5 mm thick samples. Between them there are only very thin cell walls. Such a constellation reduces the strength drastically. As the veneers become thinner, the influence of individual structural parts can be expected to increase, which can result in premature fracture, i.e. reduced strength compared to solid wood.

The 3-point bending test is not suitable for determining the bending strength of veneers of normal thickness. Due to the small thickness, the veneers sag very far bend with the ratio of span to veneer thickness of 15:1 required in DIN 52186 for wood. This means that the boundary conditions for the standard calculation of the bending strength with the 3-point bending test are no longer fulfilled and an incorrect result is calculated.

Table 2 | Mechanical characteristic values from the tensile test for veneers made from European beech and European oak
Source: TU Dresden

Wood species	Direction of fibres	Average veneer thickness	Tensile strength in N/mm², MV (SD)	Modulus of elasticity in N/mm², MV (SD)
European beech	parallel perpendicular	0,48 mm 0,52 mm	71,0 (9,4) 7,9 (1,0)	12000 (600) 630 (20)
European oak	parallel perpendicular	0,50 mm 0,52 mm	41,3 (3,3) 1,0 (0,2)	7400 (600) 270 (70)

MV = Mean value **SD = Standard deviation**

Due to their irregular structure, burl (burr) figured veneers do not have any defined fibre (grain) directions. Their mechanical characteristics depend on the figure and intensity of the burls. The characteristic values shown in Table 2.2 for walnut burl veneers with conspicuous burls, were determined from tensile tests.

These values clearly show the effect of the cracks produced during peeling on the side facing the blade. If the cracks run perpendicular to the load, far lower values are achieved for the modulus of elasticity and strength than with loading parallel to the cracks.

Fig. 22 | The storage of stacked veneer sheets is a natural UV protection.
Photo: IFN/Schlautmann

Table 3 | Results of the tensile tests on walnut burl veneer in various directions
Source: TU Dresden

Test direction		Modulus of elasticity in N/mm² MV (SD)	Ultimate strength in N/mm² MV (SD)	Elongation at break in % MV (SD)
perpendicular to the cutting ←	cracks parallel to the test direction	1600 (203)	8,9 (1,4)	0,57 (0,08)
parallel to the cutting ↓	cracks perpendicular to the test direction	760 (170)	6,0 (0,8)	0,72 (0,14)

MV = Mean value **SD = Standard deviation**

Fig. 23 | Veneer also works great as panelling for a sauna.
Source: J. Grabner, Lorenz Masser Fotografie

2.

2.3.3 Colours and visual properties

The natural colours of veneers are wide-ranging. They extend from yellowy – white through to black. In table 4, the colour classification of several veneer woods is summarised (Fig. 24 a to d). The visual properties of veneers generally correspond to those of solid wood. They are very highly dependent on the wood species. All timbers discolour under the effect of atmospheric oxygen and sunlight.

This colour change, also called yellowing, is primarily unwanted in light-coloured wood species. Timbers naturally darker coloured, such as walnut, turn grey. However, additional darkening can also cause an improvement in colour to occur (e.g. in larchwood). Such a change in colour can also be produced deliberately through the surface treatment, or so-called priming. In this case the wood colour is intensified and darkened, and even contrasts in the wood are shown to better advantage.

a | Maple (light)

b | Wild service (reddish)

c | Oak (medium brown)

d | Walnut (dark brown)

Fig. 24 | Wood species with different colours
Source: TU Dresden

Table 4 | Colours of different wood species

Colour	**a | light**	**b | reddish**	**c | medium brown**	**d | dark brown**
Wood species	Maple Birch Lime Spruce Pine Alder Horse chestnut	European beech Cherry Wild service Plane Larch Pear Red oak	Oak Elm	Walnut Bog oak

2.

2.3.4 Figures

→ Plain figure

Plain figure is the name given to a uniform wood figure without conspicuous coloured or visual effects (Fig. 25). Typical wood species with plain texture are maple, alder, birch, plane and lime.

Fig. 25 | Plain texture in birch
Source: Holzatlas

→ Crown (cut) figure or figured

Crown (cut) (curved, oval, looped, etc.) is the name given to the parabola-shaped, bay-shaped or serrated pattern of the wood in the tangential cut. It is produced by conspicuous early/late wood contrast of the annual rings, which are cut with a tangential cut due to their conical tapering towards the top of the log and produce a typical figure (Fig. 26). All coniferous woods (softwoods), as well robinia, walnut, ash, oak or elm have a crown texture.

Fig. 26 | Crown figure in larch
Source: Holzatlas

→ Striped, straight-grained figure

The highly contrasting annual rings or annual ring transitions are also responsible for a striped, straight-grained figure. In the radial cut they cause the longitudinally striped pattern of the wood (Fig. 27). Typical indigenous wood species with striped figure are the coniferous woods as well as robinia, walnut, ash, oak or elm.

Fig. 27 | Striped, straight-grained figure in elm
Source: Holzatlas

→ Ripple, wavy or fiddleback figure

Ripple, wavy or fiddleback figure is the name given to wood rays cut in the radial cut. Colour highlighted, shiny wood rays running across the direction of the fibres, produce a wavy texture (Fig. 28). Typical wood species with wavy figure are oak and plane.

Fig. 28 | Wavy, rippled figure in elm
Source: Holzatlas

→ Wavy, block figure

Striped wood pattern running across the fibre (grain) direction and produced by wavy, tangential fibre direction and different light reflections (Fig. 29). Wavy, block texturing only becomes visible with a radial cut. Typical wood species with wavy, block figure are maple and ash.

Fig. 29 | Wavy, block figure in maple
Source: Holzatlas

→ Crotches and buttresses figure

The crotches and buttresses ("pyramid") figure describes a y-shaped pattern of the wood (Fig. 30). It occurs in the area of trunk or branch forks as well as in the radial and in tangential cut. Typical wood species, in which a crotch or buttress ("pyramid") figure is to be found are walnut and pear.

Fig. 30 | Crotches and buttresses in walnut
Source: Holzatlas

→ Burl figure

Burl or burr growth is a growth anomaly on the trunk or on the root, in which the wood structure is highly changed. It causes increased formation of buds, which are continuously overgrown. Veneers with burled figures can be produced by peeling the resulting abnormal growth or excrescence (gall). The burl or burr is caused by the irregular, turbulent to circular fibre direction (Fig. 31). Not all wood species form burls or burrs. Typical wood species are ash, elm, plane, walnut and birch.

Fig. 31 | Burl figure in elm
Source: Holzatlas

→ Bird's eye figure

Growth faults can produce small round, point-like structural changes, which are like fine knots. Peeling can produce a bird's eye figure from them (Fig. 32). A typical representative with this figure is the bird's eye maple wood veneer.

Fig. 32 | Bird's eye figure in bird's eye maple wood veneer
Source: Holzatlas

2.

2.3.5 Growth features

Each wood species and each piece of timber have individual, growth-induced features. These growth features are not defects, but instead are typical for wood. They make an important contribution to its characteristic surface.

→ Discoloration

Discolorations are local changes in colour in the wood, which are produced through growth or can be caused by foreign bodies. Growth-induced discolorations are, e.g. pith flecks, reaction wood, wound tissue or red heart in beech. Pith flecks are small dark stripes, which are formed by fly larvae in several hardwoods from deciduous trees (Fig. 33). They are characteristic for birch and alder. Reaction wood, wound tissue or red heart are large, dark (reddish) discolorations (Fig. 34).

Such discolorations can be found in a range of wood species, e.g. in maple, beech, ash, pine, cherry and walnut. Small black spots to ribbons between the annual rings, caused by pockets and veins of resin inclusion, are also called gum pockets/gum veins. They mainly occur in American cherry. Light-coloured, round or oval fields on the other hand are called pommele. They can occur in maple or ash. So-called “water veins” are conspicuously light-coloured annual rings in beech or oak. They occur in years in which the water supply was not optimal.

→ Knots

Knots are small, round or oval, solid deformed initial branch growth. They interrupt the direction of the fibre (grain). Knots occur e.g. in maple, birch, beech, oak, alder, ash, cherry and walnut (Fig. 35).

→ Flashes

Flashes are individual stria or rays running across the direction of the fibres (Fig. 36). They can occur in maple, oak, ash, cherry and walnut.

→ Resin pockets (galls)

Resin pockets (galls or excrescences) are voids filled with resin, which are mostly created by coniferous woods, mostly in the latewood (summerwood). They run parallel to the annual rings and have a yellow to Bernstein colour.

Fig. 33 | Pith flecks in alder
Source: TU Dresden

Fig. 34 | Red heart in European beech
Source: Schorn & Groh GmbH

Fig. 35 | Knots in cherrywood
Source: Schorn & Groh GmbH

Fig. 36 | Flashes in ash
Source: Schorn & Groh GmbH

Fig. 37 | Curved Bark House poplar tree bark together with noble door veneer
Source: Freund GmbH, Rooms GmbH, Joinery Raab, Photo: Andreas Schwarz

2.

2.4 Quality assurance, grading and marking

Quality assurance in veneer production begins with the trunk (log) selection, where only raw timber with quality class a is potential so-called veneer wood.

Whether a trunk or log is suitable for the production of veneer depends on various factors. High requirements are set for the “trunkness” (straight and well-rounded shape), dimensions, colour and structure. In addition, attention is paid to visible defects such as branches, rotting, heartwood and stress crack. In individual wood species, specific minimum dimensions and additional quality criteria are commonly required. If the requirements are met, including with regard to the customer’s wishes, the log is assigned the designation F (veneer quality). This careful selection of the raw timber lays the cornerstone for the production of the most defects-free veneers possible with little cutting waste.

During production and processing, the veneer quality is often checked using opto-electronic testing. To this end, scanner systems with image processing programs are used. Defects that occur on the surface of the veneer, such as cracks, branches and colour flecks or stains, are marked after passing through the scanner and are automatically removed.

After drying and cutting, special qualities are pre-graded by the producer according to the customer’s specifications regarding dimensions, structure and price. This is mostly done log or pack-wise. There are no guidelines regarding the quality for veneer grading. Different manufacturers classify the quality differently and it depends on the veneerer and the customer’s wishes, as well as on the wood species and type of veneer or the planned use. One possible classification would be the intended use for furniture, doors, panels and floorings. Within this classification, a further classification into A, B, C and D often occurs, although this is manufacturer-specific. The differentiation into these classes generally depends on the number and distribution of branches, cracks, pockets and deformities.

The colour, structure and proportion of discolorations also play a role here. Table 5 shows a classification of veneers by way of example. Various certifications now exist for wood and veneer wood; the manufacturer can be asked for this certification. Most manufacturers can prove that they are certified with the FSC seal (Forest Stewardship Council) or the PeFC (Programme for the Endorsement of Forest Certification schemes). These are forest certification systems to promote sustainable forest management, which guarantee that the products pass through a continuously traceable processing chain, from the forest to the processor through to the dealer. The objective is to achieve environmentally friendly, socially acceptable and economically useful utilisation of the forest. Both organisations now operate worldwide.

For the manufacturers and sellers of veneered product, there is a quality seal that they can use free of charge, “Das Beste vom Holz – Furnier” (“The best of wood – veneer”), of the *Initiative Furnier und Natur e.V.* (IFN). As the layperson often finds it difficult to tell the difference between real wood veneer and plastic imitations, this seal should ensure more transparency and consumer certainty (Fig. 38).

Abb. 38 | FSC-Siegel, PEFC-Siegel, Qualitätssiegel der IFN

Table 5 | Exemplary classification of veneers

Characteristic	Quality A	Quality B	Quality C	Quality D
colour/structure	uniform	slight variations acceptable	variations allowed	no requirements
stria/stripes	not acceptable	light-coloured stria acceptable	acceptable	acceptable
branches, healthy deformations	not acceptable	1 per ¼ m^2	acceptable	acceptable
pin knots (cats eyes)	1 per ¼ m^2 up to 2 mm Ø	3 per ¼ m^2 up to 32 mm Ø	acceptable	acceptable
closed cracks/galls (pockets)	cracks up to 20 mm, galls (pockets) not allowed	cracks up to 50 mm, galls up to 20 mm long and 1 mm wide	cracks up to 100 mm, galls up to 40 mm long and 2 mm wide	acceptable
open cracks/galls	not acceptable	up to 10 mm long and 1 mm wide	up to 40 mm long and 2 mm wide	up to 150 mm long and 10 mm wide
heartwood	not acceptable	light brown heart up to 10% of the area	light brown and red heart up to 20% of the area	acceptable

Fig. 39 | Individual and harmonious veneer selection in a modern design for wall, soundproof ceilings and furniture.
Source: interfood office building, Decospan

3.

VENEERING

Veneering essentially includes joining the veneer sheets to form a size sheet (the layon), attaching these size sheets to substrates and their surface treatment.

Analogous to the veneer production, a large number of different surfaces can also be offered when producing size sheets. Here too, veneerers offer their customers the opportunity of joint sampling to limit the selection. To this end, manufacturers, veneerers and designers/clients examine different veneer surfaces, in order to agree the surface match in detail. The designer/client should make use of the opportunity of sampling, i.e. examining veneer examples, and therefore the ability to discern the expertise of the veneerer, in order to avoid misunderstandings when defining the appearance of the surfaces.

When veneering, remember that different materials are brought together, which can have a different swelling and shrinkage behaviour if the ambient humidity changes. The makes for particular challenges when working with these materials, with regard to the dimensional stability that the veneerers have to take into account.

Table 6 shows the swelling and shrinkage dimensions of selected wood species depending on the change in ambient humidity.

The differential shrinkage is used to determine the dimensional change per percentage change in wood moisture content. The following example should clearly show the extent of swelling and shrinkage movements.

On a summer's day with a room climate of 25 °C and 65% rel. humidity, the wood moisture content is roughly 7.5%, on a winter's day with a room climate of 20 °C and 40% rel. humidity it is around 11.5%. The difference of 4% wood moisture content causes the wood to shrink. This means, e.g. for a veneer sheet made of European beech, 1 m long and 12 cm wide, that it shortens by 0.6 mm lengthwise and by 1.1 mm in the tangential direction.

In order to compensate for the swelling and shrinkage movements of the different materials, adhesives appropriate for the requirements are used (see Chapter 3.2). Therefore, the veneerers have to be aware of the use conditions (ambient humidity and temperature) of the end product.

Table 6 | Swelling and shrinkage of selected wood species
Source: Holzatlas

Wood species	**Differential shrinkage in % per % change in wood moisture**	
	Longitudinal direction	**Tangential direction**
Maple	0,018	0,220
European beech	0,014	0,410

3.1 Cutting and jointing veneer

Precisely cut edges are indispensible for jointing veneer sheets to form a veneer layon with larger dimensions or other shapes. The individual veneer sheets (aka leaves) are cut to size using different tools or cutting techniques Straight, parallel outer edges can be achieved using so-called veneer guillotine or jointing cutters. Veneers up to approx. 1 mm thick are usually cut to size and trimmed using guillotines. Thicker veneers are cut to size and trimmed using a chip removal cutting method, as otherwise unwanted „pre-splitting“ can occur. Curved or freely-shaped contours are produced using computer-aided mechanical cutting (CNC). The tools used are lasers or special blades. With these computer-controlled cutting techniques, individual patterns through to inlays can be produced cost-effectively and rationally (Fig. 40).

Before the veneers can be applied as a decorative overlay on substrates, they must be joined. In order to obtain a visually attractive overlay match, the veneers should be jointed in the order they were made during slicing. The joining of the consecutive veneer sheets or leaves of a pack (flitch) or log to form a large veneer layon is called veneer matching. The following different techniques are used for veneer matching:

A decorative surface appearance with a mirror-image veneer arrangement is achieved through book matching. Single book matching is the term used for successive turning over of two veneer leaves on top of each other in the flitch (like the pages in a book) and edgejoining them along a longitudinal or transverse joint. Accordingly, in double book matching, every second of four veneer leaves lying on top of each other in the flitch is folded open about a vertical and horizontal joint. This is how veneer matches with cross-joints are produced, which can also be diagonal.

Fig. 40 | Modern inlays combine different materials such as veneer and metal.
Source: IFN/Fritz Kohl

3.

In slip matching (also push or pull), the leaves on top of each other in the flitch are removed from the stack without turning them over and are slipped alongside each other. The result is a repetition of the veneer grain without symmetry.

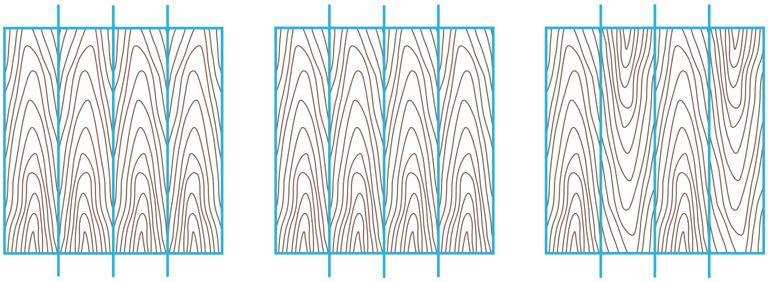
In slip matching with leaf turning (also called reverse slip matching) the veneer leaves are slip matched and then every second leaf is turned end to end. The result is a uniform symmetrical pattern (Fig. 42).

Jointing the individual veneer leaves requires gluing the veneer edges. Various technologies exist for this. In zigzag stitching the veneer leaves are joined using a glue thread. The thermoplastic thread is heated during the jointing process and as it alternately applied to both veneer sheets as it passes through. Butt joining (splicing) is a method, in which the edges of the veneers are wettened with adhesive and are glued together. Both joining methods can be used to join the veneer leaves lengthwise and crosswise.

Joining veneers to produce visually successful and cost-effective veneer surfaces is generally carried out by experts as a fixed-size production. The term veneer fixed-size or veneer finished-size is used for made to order production of veneer layons. The use of modern machines and the high degree of specialisation of the fixed-size manufacturers enable diverse design options, for example, with mixed materials or high-quality figure veneering.

Fig. 41 | Inlays as a combination of materials, here veneer and felt, which are ideal sound-absorbing elements.
Source: IFN/europlac

Abb. 42 | Joining techniques
Source: GWT-TUD GmbH



3.2 Laminating and overlaying

A range of semi-finished products are produced by laminating and overlaying all kinds of different substrates with veneer. Some of the semi-finished goods even have an end product character.

Laminating is the term used to describe backing the veneer with non-wovens or papers. The resulting composite material is easier to use in further processing and is more stable than raw veneer. Two-dimensional deformations, such as bending, can also be achieved more easily and without cracks (Fig. 43).

Laminated veneers are used, for example, for steering wheels and gear sticks in cars. These materials can also be successfully used to overlay door rebates and to cover profiled strips. The choice of adhesive can also additionally improve the moisture and temperature resistance of the composite material, so that it can also be used in projects with higher fire safety requirements.

Laminate is the term used to describe a composite material consisting of several layers. A real wood laminate in this sense consists of backing veneer with synthetic resin impregnated paper and a surface coating using a high-quality lacquer system or a melamine resin coat (overlay) (Fig. 45). The result is a material that can be processed like high-pressure laminates (HPL), but which is significantly more smooth and supple. As with non-woven laminated veneer, the material is made more flexible by the overlay; curved components or structural members can be overlaid.

Due to the surface finish, there is no need for subsequent sanding and lacquering or varnishing in processing.

Fig. 43 | Non-woven laminated veneers
Source: Schorn u. Groh GmbH

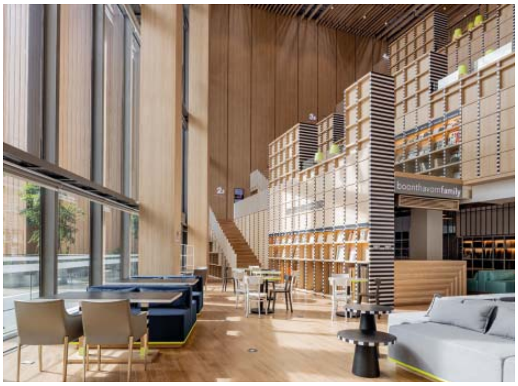


Fig. 44 | On a global scale veneer scores as a climate-friendly surface material in interior design.
Source: Foto onion.co.th

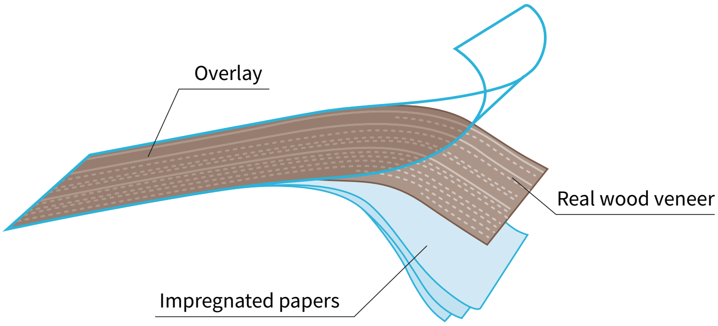


Fig. 45 | Schematic diagram of a real wood laminate
Source: www.oberflex.fr

3.

Paint-free HPLs with real veneer are also used for facade panels. The panel core is made of impregnated cellulose fibres. The authentic surface has a long durability, colourfastness and is resistant to chemical attack. The facade panels are classified as fire class B1. Such panels can also be used for interior work in indoor swimming pools, large canteen kitchens or other rooms with moist conditions – even with sporadic spray water.

To create a decorative surface, the jointed veneers or semi-finished products such as non-woven laminated veneers or real wood laminates, are glued onto panel substrates. Substrates are usually particleboards or fibreboards. Fibreboards are more high-quality, particleboards are less expensive. Particleboards are sold with a density around 680 kg/m³, fibreboards with densities around 750 kg/m³. Fibreboards (e.g. MDF) are easier to edge trim and with better results, due to their more homogeneous structure. Both wood-based material variants react like would to changes in ambient humidity, but are also available in moisture-resistant qualities and therefore, compared to solid wood, provide significantly improved swelling and shrinkage behaviour.

To compensate for the different swelling and shrinkage behaviour of the substrate and veneer, depending on the subsequent use conditions (ambient humidity and temperature), suitable adhesives must be selected accordingly. To this end, the standards EN 204 for thermoplastic and EN 12765 for thermosetting adhesives, define classification by climate conditions and areas of use (Tab. 7). The symbol "D" is used for thermoplastic adhesives and "C" is used for thermosetting adhesives, the group classification with numbers is identical for both types of adhesive.

Fig. 46 | The boiserie is thermally insulated and, in combination with the almost floor-to-ceiling block frame door, a modern solution.
Source: Lualdi.it

Fig. 47 | Veneer as a functional and sensual surface for modern highboard.
Source: IFN/Kettnaker Möbelmanufaktur

PVAc adhesives (thermoplastic) or urea formaldehyde resins (UF resins, thermosetting) are usually used for gluing veneers. Both are characterised by a light-coloured glue line, which enables various colourings. If UF resins are used, only low resistances to moisture effects can be achieved (durability class C1 or C2). Therefore, if the end products are used in areas with higher moisture resistance requirements (e.g. bathrooms, durability class C3 or C4), melamine-reinforced UF resins are used. PVAc adhesives are offered for all durability classes (D1 – D4).

Adhesives based on, for example, epoxy resins or polyurethane, are used for other applications, such as bonding metal or glass with veneers.

The following should be noted regarding the problem of formaldehyde: The particleboards and fibreboards offered for sale on the market in Europe and therefore in Germany too must satisfy emissions class E1. This corresponds to a maximum formaldehyde equilibrium concentration of 0.1 ppm.

For the Japanese market, a system exists with the designation F Four star (F****), with which the emissions values are only 30% to 35% of the E1 limits.

Since 01/01/2009, the requirements of the CARB system (Californian Air Resources Board) have been important for the manufacturers of wood-based materials. Compared to the E1 limits, the CARB system contains significantly more stringent requirements for formaldehyde emissions, especially with regard to particleboards (0.06 ppm to 0.65 ppm) and plywood (0.03 ppm to 0.04 ppm). Furniture manufacturers, who supply the North American market, must note that they must be able to prove that the wood-based materials used by them for their products are certified under the CARB system and that they comply with the required limits (in addition to the increased requirements for own and external monitoring).

Table 7 | Durability classes for adhesives (EN 204 and EN 12765)

Durability class	Examples of the service climate conditions and areas of use
C1 or D1	➲ Indoor area, maximum wood moisture content 15%
C2 or D2	➲ Indoor area with occasional short-term effect of flowing water or condensation and/or occasional high humidity with an increase in wood moisture content up to 18%
C3 or D3	➲ Indoor area with frequent short-term effect of flowing water or condensation and/or effect of high humidity ➲ Outdoor use, protected from the weather
C4 or D4	➲ Indoor area with frequent sustained effect of flowing water or condensation ➲ Outdoor area, which is exposed to the weather, but with appropriate surface protection

3.

The IKEA group has adopted large parts of the CARB system requirements and has even increased some. The requirements named in the corresponding IKEA standard "IOS-MAT-0003: Formaldehyde requirements of wood based materials und products"" apply to all IKEA suppliers since 01/09/2009 and are also significantly below the requirements of the emission class E1.

Because of the increased formaldehyde limit requirements, for the overlaying of substrates, it is important to know that use of urea formaldehyde resins (including when reinforced with melamine) can result in an increase in the formaldehyde emission values, while no problems are to be expected in this respect if PVAc or PUR adhesives are used.

With regard to their fire performance, particleboards and plywood are classified as "normally flammable" (construction material class B 2 to DIN 4102); however, if necessary, they are also available in "flame resistant" quality (construction material class B 1 to DIN 4102).

Veneer, blockboard and solid wood can also be used as substrates. Lighter weight substrates are also increasingly on offer (e.g. honeycomb boards, low density MDF). Transparent plastic and glass have a particularly decorative effect when used as substrate. By using laminated safety glass, this material can be used as a facade, in interiorwork, for furniture design and even for trade air stand construction.

If the narrow side surfaces of the substrate are visible, in most cases they are overlaid separately. To this end, narrow veneer strips in the matching wood species or even glue-on solid wood or plastic edging strips of different thicknesses and visual appearances (different colours, metallic look) are attached. The edge shape can either be straight or profiled.

After the substrates have been completely overlaid, the veneered surfaces are sanded and are coated with lacquer to protect them. When substrates are veneered, defects can occur in the surface of the component. Table 8 shows the most frequent veneering defects.

Fig. 48 | Plywood consists of several layers of veneer and is a popular material in ecological furniture construction.
Source: MIDMINI – Plywood Furniture, Lettland

Fig. 49 | Veneer is also the first choice as a surface for walls and furniture in high-end hotel furnishings.
Source: www.onion.co.th

Occasionally, the growth features so typical for veneer are thought to be veneering errors. The difference between defects and errors can be determined by a sworn expert.

Guidelines and regulations for the evaluation of veneered surfaces only exist for pieces of furniture (RAL GZ 430 or DIN/EN standards). Based on these standards, the following procedure should be used to check whether a defect exists in veneered surfaces:

The visible parts of the veneered surfaces are viewed from a distance of 50 cm in diffuse daylight. The evaluation of the veneered surface should take into account whether the parts concerned are possibly secondary and whether or not the harmonious overall impression of the room is impaired.

Guidelines cannot be drawn up for natural characteristics. Several rules are summarised in Table 8 for the evaluation of conspicuous surface features

Table 8 | Veneering defects

Designation	Description	Causes
Blister	Local bubble or prominence on the component, caused by area in which there is too much adhesive between the veneer and substrate.	➔ no or too little glue ➔ large veneer thickness tolerance ➔ indentation in the substrate ➔ contamination/soiling of the substrate
Glue bead	Local bubble or high spots/lifting on the component, caused by area in which there is too much adhesive between the veneer and substrate.	➔ non-uniform glue application ➔ viscosity too low or too much adhesive applied ➔ error when applying the press pressure
Glue penetration	Glue penetration through the veneer and therefore appearance on the surface.	➔ viscosity of the adhesive too high or too much ➔ adhesive applied ➔ use of open-grained (large-pore) veneers
Open joints or joints pushed on top of each other	Gaps or high spots/lifting in the joints of the veneer.	➔ error when jointing ➔ use of buckled or wavy veneer
Indented/pressed in areas	Local depressions on the component.	➔ pieces of veneer or other material between the component and pressing plate
Discolorations in the veneer	Discolorations as a result of the overlaying process.	➔ pressing time too long ➔ pressing temperature too high ➔ discolorations caused by the release agent
Cracks in the veneer		➔ use of buckled or wavy veneer ➔ use of veneer that is too moist ➔ insufficient protection of the end grains against cracks/tears
Showing through the veneer	Stained, flecked, patchy or nonuniformly stained surface.	➔ clear lettering on veneer or substrate ➔ too thin, light-coloured veneers glued onto dark substrate

3.

3.3. Finishing veneer

3.3.1 Colour and veneer match

Staining and dying

The oldest variant of colouring wood is staining. Staining makes it possible to change the colour, to enhance the natural colour and to increase contrasts in the wood grain of the veneer surface. Nowadays every type of colouring wood is called staining. In staining, a differentiation is made between wood dye and chemical stains. Dyes are made by dissolving or dispersing dyes or pigments in water or organic solvents. They produce a so-called negative grain pattern on the wood surface, as the denser latewood can absorb less dye than the less dense earlywood. As a result, the otherwise lighter earlywood zones are more highly dyed. On the other hand, when chemical staining is used a reaction takes place between the wood constituents and the wood stain, which produces a positive grain pattern.

Another option is to use through-dyed veneers (Fig. 50). Here the colour is not only on the surface. The advantage of this is that the colour is not removed by sanding, which is especially important when machining the surfaces. The veneers are immersed in the dye solution for several hours, without pressure, and are therefore completely through-dyed. Further advantages of this technology are that high-quality veneers can be produced from veneer qualities that are not perfect and that the veneers acquire a regular and repeatable colour.

Fig. 50 | Birch veneer, stained, TABU
Source: www.tabu.it

If veneers are dyed during the surface treatment, it is necessary to ensure that the coating material and veneer are compatible, otherwise unwanted discolorations can occur. It is advisable to treat samples first and to observe them for a while. The coating supplier should always be aware of the substrate the coatings are to be used on.

Table 9 | Notes on the evaluation of conspicuous surface features

Not acceptable on visible surface:
➲ glue penetration ➲ visible glued joints, which can be detected from a distance of 50 cm in normal daylight conditions ➲ resin pockets (galls) ➲ loose, overlapped and sanded through areas and cracks ➲ spurious deviations in the overall match
Acceptable on visible surface:
➲ slight, healthy deformities in the veneer, which are natural
Proofs of authenticity are:
➲ silver figures, e.g. in oak ➲ lime pockets, e.g. in walnut ➲ cross-cracking at branches ➲ gum in american cherry

Thermally modified veneer

Anyone who uses very dark wood, but does not want to use tropical wood, can fall back on thermally modified veneers of domestic wood species. There are different methods for making the modification, but they are all based on modifying the wood substance through the effect of heat. Depending on the intensity of treatment, it is possible to produce different dark colours and shades (Fig. 51). Thermally modified veneers definitely have a less marked swelling and shrinkage behaviour and are less susceptible to wood-destroying fungi, as the -OH groups of the wood constituents are broken down. This means water molecules can no longer be stored.

Smoking veneer

Another way of producing darker veneer is socalled smoking. Smoking is a staining method that was already in use 150 years ago. With this method the wood is steamed with ammonia for several weeks. All woods rich in tannin are suitable for smoking, for example, oak, pine, larch, wild service, apple and Douglas fir. The reaction of the acid in the wood with ammonia as a base produces the dark colouring (Fig. 52).

The discoloration remains absolutely stable to aging and largely stable to light. Incompletely formed heartwood remains light coloured in the sapwood area.

Fig. 51 | Colours of thermally treated wood
Source: Mirako GmbH

Fig. 52 | Colours of smoked oaks
Source: Mehling & Wiesmann GmbH

3.

→ Printing veneers

Another option for producing vivid designs and for upgrading the veneer surface is to print it using digital printing techniques. Here the options range from wood imitation through to free image design. New plants enable absolute photo-realistic printing with a resolution of 460 dpi and a feed speed of up to 30 m/min to be achieved. For example, it is possible to produce high-quality palisander veneer from a domestic wood species of industrial quality. The existing wood structure and feel in conjunction with the printing produce an authentic and high-quality surface. Another advantage is the lightfastness of the print. It should be noted that if wavy veneers are printed, deviations from the ideal image can occur.

With the wood grain printing method, a further printing method, in addition to printing with paint profiled rolls are used. This means that in addition to the colour, the veneer also acquires a new texture.

→ Imaginative veneers and veneer matches

The options provided by so-called industrial veneers are also very diverse. These veneers are also called Fineline veneers or multilaminar wood. In this process, veneers of different wood species or dyed veneers of different shapes and compositions are glued together to form veneer blocks, from which new veneers are sliced. Apart from replicating different wood species to those used, striped, figured, crown and even coloured or variegated imaginative patterns can be produced (Fig. 53a and 53b). The colour and structure of the veneers sliced from the block correspond to those of the natural model or the wanted look. The number and build-up of the figures can be freely selected and the suitable colour can be produced.

Fig. 53a | Striped veneer, ALPI
Source: TU Dresden

Fig. 53b | Cluster veneer, ALPI
Source: TU Dresden

Fig. 54 a + b | Geometrically arranged veneer tiles always produce a multitude of looks.
Source: IFN/europlac, Villa Karla, Slovakia

Fig. 55 | Veneers made from composite strips
Source: Vinterio AG

3.

3.3.2 Shaping and designing

→ 3D veneer

The term 3D veneer stands for three dimensional deformable veneer, which enables deep-drawing comparable to sheet metal forming. To achieve this deformability, the veneer is machined and reinforced with glue threads on the back. The veneer match is completely retained. The veneer is only made stable by the extensive gluing. It is approx. 1.15 mm thick. Due to the large veneer thickness, the bending radii possible in the longitudinal fibre (grain) direction are limited. Woods that are suitable for use as a face veneer in 3D veneering are, e.g. beech, European oak or Fineline veneers. 3D veneer can be used not only to produce shaped laminated wood, such as moulded seats, but also for overlaying shaped surfaces (Fig. 56).

Fig. 56 | "Woodon" cherry, Design: Möller Büro für Gestaltung
Source: Reholz GmbH

→ Laminated veneers

Veneers with a special non-woven or paper backing are a further refinement of the nonwoven laminated veneers described in Chap. 3.2. They are particularly suitable for multidimensional deformations and difficult to work surfaces. The composite material is made more flexible by sanding it to a small final thickness. Thinner materials are more easily shaped than thicker materials. The non-woven lamination increases the strength of the material. All wood species are suitable for processing to produce such veneers. Even figured veneers become completely smooth and can be easily further processed. The non-woven laminated fixed sizes can be lacquered, sanded or given a finished surface.

→ Flexing

Another option for increasing flexibility is socalled flexing of non-woven laminated veneers. Here the laminated veneers are subjected to special print pressure treatment in a flexer (roller press). As a result of this pressure treatment, the wood microstructure is broken down and changed so that it becomes very supple and flexible. The result is a material with which very tight bending radii can be overlaid and which has post-forming quality. The appearance of flexed veneers does not differ from that of normal veneers; however, due to the changed microstructure their strength is reduced.

3.3.3 Special properties

→ Fire safety

Untreated veneer, just like solid wood, is classified as normally flammable to DIN 4102 Part 4 and is therefore a class B2 construction material. Therefore, attaching an unprotected veneer to a substrate with “flame resistant” quality finish results in loss of the fire safety performance, especially with regard to the spread of fire via the surface. It is therefore necessary to finish the veneer to the same quality or to test the fire performance of the composite material. Special substrates are normally used if requirements exist with regard to fire loads. For particleboard panels with construction class B1, according to DIN 4102 Part 16 it is specified that if the surface is overlaid with real wood veneer, the fire performance of the composite material must be tested.

The flammability of veneers is mainly affected by the surface coating. Here it is possible to use lacquers that form insulating layers. So-called intumescent agents are synthetic resin-based fire retardants which, if exposed to high temperatures, form a protective foam layer on the wood surface, which acts as a heat insulator. This impedes the penetration of oxygen into the wood and therefore prevents the surface from bursting into flames. In addition, it is also possible to impregnate the veneer with flame retardants containing salts (e.g. ammonium phosphate), in order to fulfil the fire safety requirements.

In general, if flame retardants are applied in or onto the veneers, it is necessary to check the compatibility of the retardant with the coatings or adhesives to be used.

Flame resistant formed wood that conforms to construction material class B1 is already used to produce shaped laminated wood, such as moulded seats of chairs and can be produced using real wood veneers as the top layer.

Decorative, inflammable veneered fireproof panels are produced as semi-finished products for interiors. They can be used for wall and ceiling panelling, panels, cabinet walls or for fire doors. Non-flammable boards with construction material class 2 are produced using a special production method in combination with a lacquer.

→ Sound insulation

The absorption properties of wood generally depend on the wood species, the density of the wood and the size of the pores. Due to its small thickness, veneer has little effect on the acoustic properties of the component and cannot make any primary contribution to sound insulation. However, it should be noted that continuously veneered surfaces have a negative effect on absorption performance.

In general if such requirements exist, drillholes or slots/chasing should be distributed over the whole area to increase the degree of absorption.

3.

→ Moisture resistance

To improve the moisture resistance and therefore the dimensional stability of materials made of veneer, options have been developed, which are currently limited to use in laminated formed wood (moulded seats). The background to these developments is the possibility of using chairs made of laminated wood in outdoor areas.

One option for producing weatherproof laminated formed woods is to use veneer, which is made moisture resistant by introducing a solution. This solution contains so-called crosslinking molecules, which penetrate the cell walls of the veneer and cause cross-linking of the cellulose fibres. The subsequent pressing to produce laminated formed wood, creates a permanently moisture resistant moulded part.

A further option for producing such laminated formed wood is to use thermally treated veneers. The so-called thermo-formed wood is changed by the thermal modification to the cell structure so that the swelling an shrinkage behaviour reduces by approx. 50%.

With both modification methods, laminated formed woods with durability class 1 (very durable) are achieved.

→ Electrical conductivity

The electrical conductivity of wood depends on the wood moisture content. As the wood moisture content reduces, the electrical resistance increases sharply. This property is mainly important for flooring surfaces. Here it must be noted that the surface treatment of the wood especially affects its electrostatic behaviour. Relevant characteristics for the electrostatic behaviour of a flooring are the chemical composition and structure of the surface coating of the materials that touch each other (shoe soles and floor surface) and their electrical resistance, walking speed and humidity. Wood floorings treated with oil or wax are usually antistatic and therefore prevent the building up of higher electrostatic charges.

One exception is UV cured oils, which allow higher charges. Lacquered wood surfaces also charge somewhat higher if no measures are taken to reduce the charge.

Fig. 57 | The rediscovered ecological birch bark veneer as flooring also works in damp rooms, such as the bathroom.
Source: Nevi.io

3.4. Surface treatment of veneered surfaces

3.4.1 Pretreatment methods

→ Pre-sanding before lacquering

Flat veneered surfaces must be finished with fine sanding (where possible by machine, or by hand) before the surface treatment. Cross-grinding should be used to produce high-quality surfaces. The veneer is sanded across the grain first and then parallel to it. Depending on the surface coating, the grit size of the sanding paper must be chosen according to the manufacturer's instruction. For example, water-based lacquer systems require finer sanding (grit size 180–220 depending on wood species) than for solvent-containing lacquer systems (grit size 150–180). The sanding should be carried out as near as possible as the surface coating (max. 24 h), to enable good adhesion of the veneer substrate with the coating. Special edge and profile sanding machines exist for veneered narrow or profiles surfaces, to level out any unevenness in the surface.

→ Measures for required colour stability or difficult to coat wood species

Bleaching methods can be used to balance colours in a veneer surface, to remove stains or flecks and to reduce subsequent colour changes. Bleaching is an oxidative process, in which a hydrogen peroxide solution is used together with a bleach activator. The surface is then cleaned with water or steam and dried.

Partial deresinification of the surface of wood species rich in resin also takes place before the stain or lacquer is applied. Alkaline or alkalifree wood soaps (including potash or soda) or organic solvents are used for this.

3.4.2 Types of surface treatments

→ Staining veneered surface

Solvent-containing or water-based stains can be used stain the surface, in order to emphasise the grain of the wood or to balance colours. In this way, all kinds of different effects can be used. A positive effect is said to be achieved if earlywood zones retain their light colour ad late wood zones are dark stained. A farmhouse effect exists if the pores of open grain woods, such as oak, are stained intensively and therefore highly contrast with the remaining area.

Wood stains can also be used to level out colour differences or to improve the light fastness of the veneer substrate.

The application method to be used for staining is specified by the manufacturer. All stains (except wax stains) do not provide sufficient surface resistance and require subsequent lacquering.

Fig. 58 | Staining veneer can enhance or soften the natural color tones.
Source: IFN/HWB, photo: Simone Ahlers for JOI-Design

3.

→ Oils and waxes

Oils and waxes are based on natural raw materials, such as oxidative curing linseed oils or carnauba or bees wax. They make the wood surface look and feel as natural as possible (natural look). "UV curing oils" also imitate this effect of the natural appearance, without containing any oxidative curing natural constituents.

Natural oils penetrate deep into the wood, but not form a film on the surface. They are therefore relatively sensitive to dirt, light and water. Waxes on the other hand form thin films on the surface, which improve abrasion, water and dirt resistance. However, the films have little chemical resistance. Combinations of both coatings are often used in industrial coating, in order to produce more resistant and breathable surfaces.

Hard oils or hard waxes are produced using special compositions of the oils or waxes (e.g. by using carnauba wax), which lead to harder, more mechanically resistant surfaces, but are by no way comparable to the resistance of lacquered surfaces.

Shellac is a special form of coating with natural raw materials, which is still in use in some craft firms and producers of bespoke products.

→ Lacquers and varnishes

Lacquers and varnishes for veneered surfaces can be divided into water-based and solventcontaining coating by the type of solvent used. Depending on the type of drying or cross-linking, a further differentiation can also be made between physically drying, chemically crosslinking or radiation-curing lacquer systems or their combinations (double cure systems).

Lacquers and varnishes are used both in craft trades and industrially. Compared to lacquers, varnishes form smaller coat thicknesses in interior areas. They are often slightly pigmented and let the wood surface show through.

Typical representatives of solvent-containing lacquers are cellulose nitrate lacquers (mostly called NC lacquers), acid-curing lacquers (SH lacquers), two-pack polyurethane lacquers (2K PUR or DD lacquer) and solvent-containing UV lacquers. Important advantages of solventcontaining systems are easy use, significant priming of the wood and less sanding work.

Solvent emissions during use and from the end product are a disadvantage. Use of acid-curing lacquer systems is in sharp decline due to their formaldehyde emissions.

Usable water-based lacquer systems are non-self cross-linking and self cross-linking 1 pack water-based lacquers, 2 pack polyurethane water based lacquers and UV curing water-based lacquers. They have far better environmental and health properties, but require significantly greater time and effort for their application and drying. The visual appearance of the surface is often poorer than with solvent-containing systems.

A special form is the “100% UV lacquers”, which contain virtually no solvent. They are industrially applied to level surfaces in rolling processes and are then radiation-cured. The surfaces have very good mechanical and chemical resistances.

→ Melamine-resin based overlays

In rare cases, e.g. for moulded seat parts made of veneer or semi-finished products (real wood laminates), melamine resin impregnated overlay papers are pressed with the veneer during production. They cure under temperature and pressure to form a highly resistant, transparent, thermosetting surface. They therefore provide high protection against attrition and scratches and are also resistant to perspiration.

Fig. 59 | European beechwood with different lacquer systems
Source: (IHD)

3.4.3 Recommendations for the choice of application methods and surface treatments

→ Selection depending on the required surface look

The chosen application method affects the surface look. For example, rolling the coatings on flat components can produce very fine groove-like structures, which are unwanted, especially in high-quality interiorwork. Use of the spraying method usually produces better levelling properties.

Depending on the wood species, the surface should be “primed”, i.e. the wood structure emphasised. If using water-based lacquers, it should be noted that these almost always result in less priming of the surface. In the case of light-coloured veneers, e.g. maple, this is mostly not a disadvantage, as it means that existing colour differences levelled out. Good priming is desirable in dark veneers, e.g. cherry (Fig. 59). Here the use of additional stains or dyed lacquers can be beneficial.

Fig. 60 | This plain stool features a wavy/ribbed finish of the oak veneer for stability on the side panels. The Japanese designer wanted to accomplish as thin a stool as possible.
Source: https://www.kouichikurome.com/

3.

The gloss units or colour of surface coatings are usually matched with the interior according to taste. In the case of high-quality veneered office surfaces it should be noted that certain surface gloss and colour ranges must be complied with by law to protect the eyesight of the office users.

The users, designers and manufacturers should agree the required look by producing specimen lacquering using the planned application techniques and surface layups.

Selection depending on the expected use intensity and the place of use

The listed surface treatments have different resistances to mechanical, chemical, climatic and other loads (e.g. light). In the case of horizontal surfaces, e.g. work or tabletops, they can be exposed to heat, attrition, scratches, impact or chemical loads. The best protection against these is provided by UV lacquers or two-pack lacquer systems which, due to their greater degree of cross-linking, provide greater resistance than one-pack systems (non cross-linking single pack waterbased or NC lacquer). Natural coating systems have significantly lower resistances to mechanical effects. However, they do offer the advantage of easier renovation, which should also be wanted by the end user. Worktop oils also provide acceptable resistance to stains.

In places of use with occasional influence of water or high humidity, for example, restaurant installations, coating systems with higher water repellence or lower water vapour permeability are required. Solvent-containing 2 pack PUR systems best satisfy these requirements. They should be applied to all sides with large coat thickness (dry coat thickness approx. 80–100 µm). Edge areas must also be properly sealed, especially to prevent the transport of moisture in the direction of the wood's fibres or grain, which can cause greyness or swelling.

High-quality interiors of boats are exposed to large climate fluctuations. Here highly-resistant but also very elastic lacquer systems (e.g. two pack systems) should be used.

In the case of veneered surfaces exposed to strong sunlight, lacquer systems containing sunscreening agents can be used, which significantly reduce the speed of the colour change. However, these systems are considerably more effective with light coloured wood species than with dark veneers.

To define the surface requirements, DIN 68861 Parts 1 to 8 provide a relatively comprehensive testing and evaluation system for furniture surfaces. Surface requirements for kitchen furniture are defined in DIN 68930; RAL GZ 430 should be used as a guideline for other furniture.

Fig. 61 | The backlighting of veneer can be enhanced and nuanced depending on colors, pickling and varnishes
Source: (IHD)

Consideration of environmental and health aspects

It should be noted that lacquer systems can emit solvents, and this can last for a long time. Therefore, use of lacquer systems with low solvent content and almost completely solventfree 100% UV lacquers or lacquers with low solvent content, e.g. water-based lacquers, is advisable for environmental and health reasons, if their properties allow them to be used.

Natural coating systems are also recommended under environmental aspects. Nonetheless, they can also contain natural solvents or give off odour-intensive residual emissions, which can also be a problem for sensitive people.

Lacquer systems which are perspiration and saliva-resistant to DIN 53160 and which fulfil the heavy metal migration requirements of EN 71-3 should be used for veneered items of furniture used by children.

If it is known that end users react allergically to specific substances, the coating manufacturer should be asked whether they use these substances in their coating.

3.4.4 Care and maintenance of veneer surfaces

Veneered surfaces have surface protection, which simplify care and emphasise the beauty of the material. Therefore, it is usually not necessary to use wood polishes. Dust or light soiling can be quickly removed with a dry, soft leather cloth (chamois). Greater soiling can be rubbed off using a damp cloth and then rubbed dry without pressure using a soft cloth.

Coffee, tea, alcohol and fruit stains should be removed and rubbed dry immediately using a damp cloth. Even scratches and scrapes can be easily used. They are filled with hard furniture wax with the right colour and are coated with lacquer or varnish. This restores the protective layer.

Fig. 62 | Veneer is wiped with a damp cloth
Photo: IFN

4.

EXAMPLES

4.1 Components

Building elements are generally defined as the individual parts that make up a structure. These can be ceilings, walls, columns or floors. Windows and doors are also included by this definition.

Large-scale wood paneling of walls or ceilings is called "boiserie" and was widely used within 18th century homes. Veneer paneling had a bit of a resurgence in the 1960s and 1970s, but was then perceived as too confining. Boiserie is experiencing another renaissance nowadays because it can serve as thermal insulation and because its look is perceived as modern and elegant. Veneers of oak, bog oak or walnut are mainly used for this purpose. The wall-surface with the sliding door shown in Figure 64 by designer Piero Lissoni, repeats square and rectangular processing techniques. This creates a relief-like and geometric surface that gives the space a lively character. Sliding doors can replace fixed walls and create different zones in one room.

Veneer can also be used as construction elements on the outside of a building structure, as a facade for example. For this purpose, veneer will be made weather-resistant using various processes. The different colors of veneer can playfully be used to accentuate certain parts of a building and therefore shape the visual architecture of a structure very precisely. As an ecological and sustainable material, veneer causes only a fraction of gray energy compared to other decorative materials such as metals or exposed concrete.

Fig. 63 | Cherry veneer as wall paneling has a warm and elegant character.
Source: https://adjo.studio, Photography is by Renaat Nijs

Fig. 64 | Particularly hard types of veneers are suitable as facade surfaces.
Source: Schorn & Groh GmbH | www.sg-veneers.com

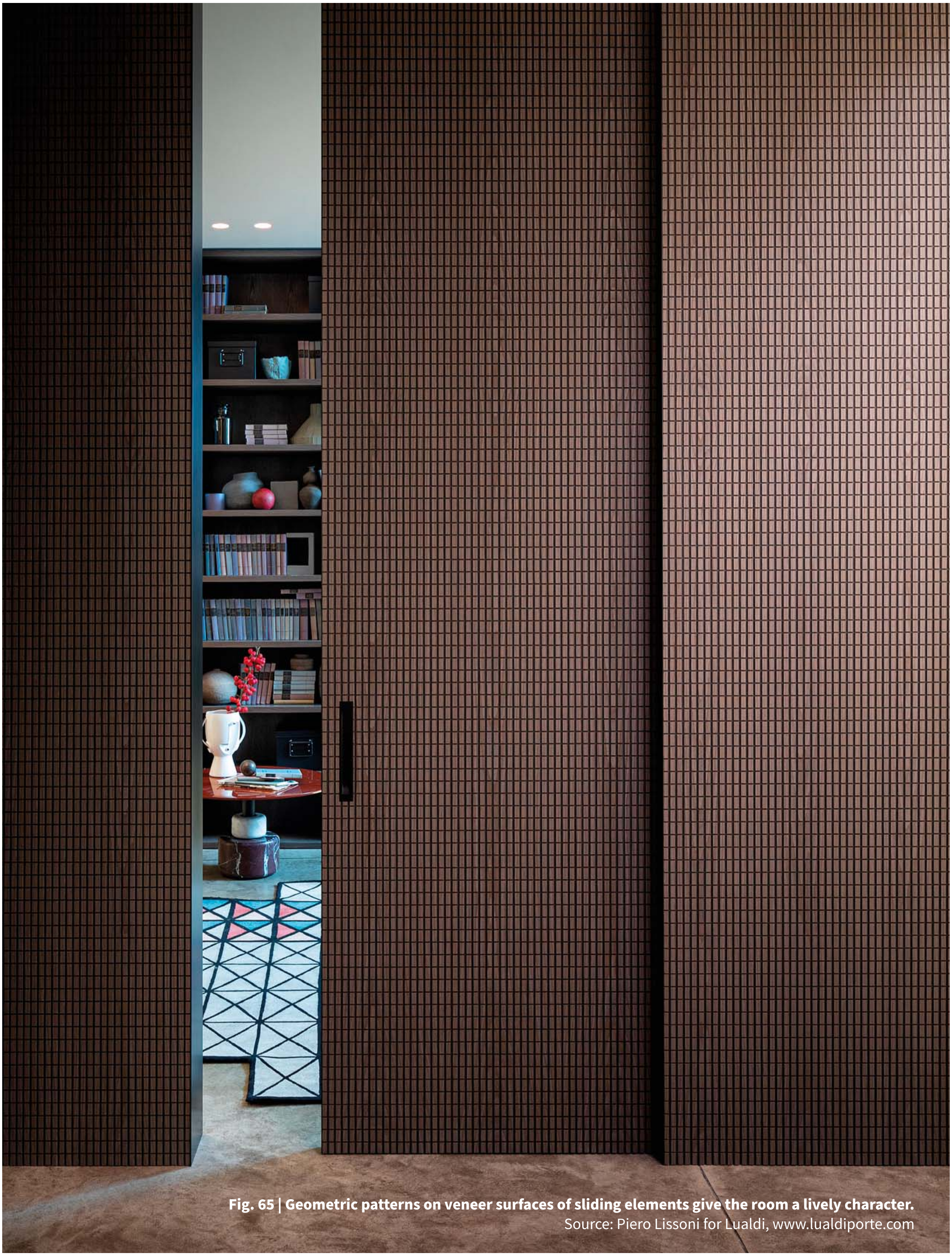


Fig. 65 | Geometric patterns on veneer surfaces of sliding elements give the room a lively character.
Source: Piero Lissoni for Lualdi, www.lualdiporte.com

4.

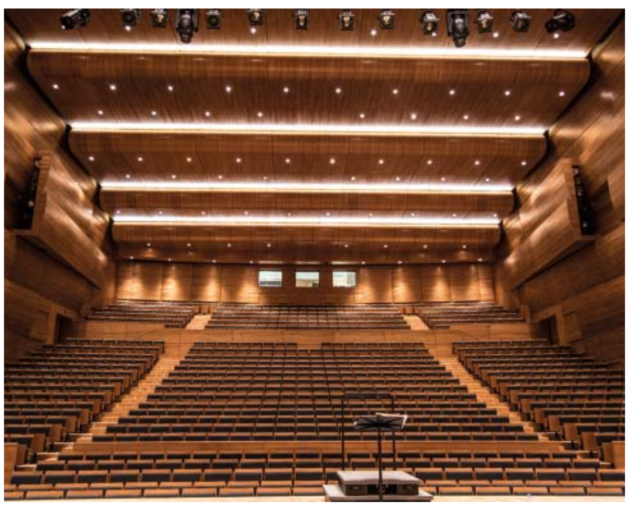
4.2 Interior design

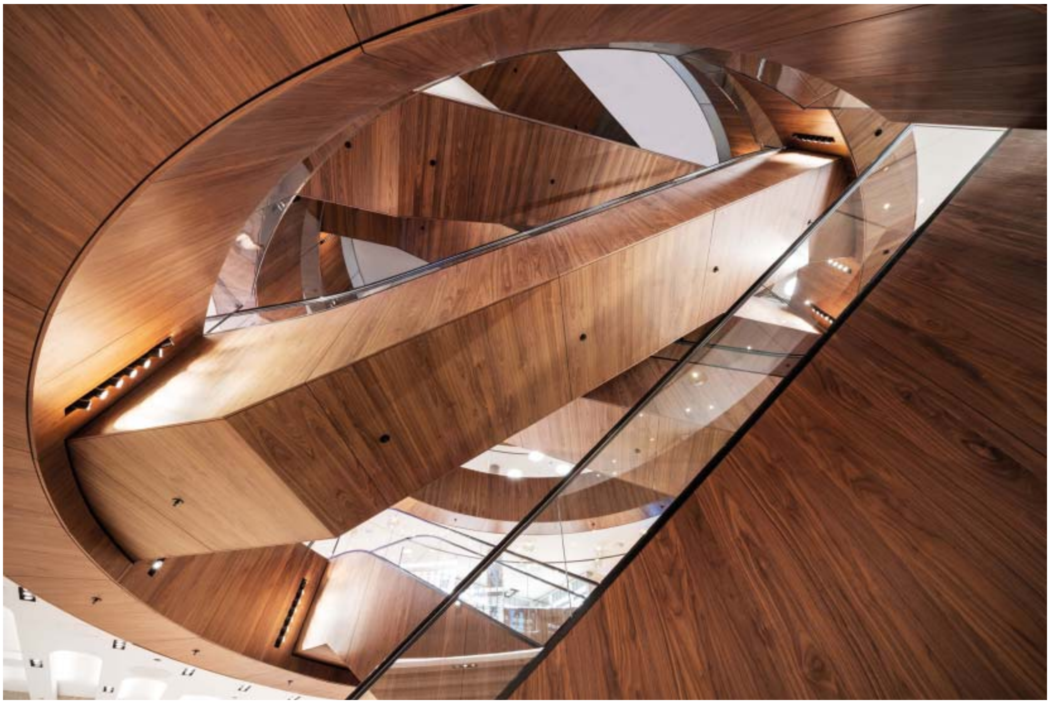
Interior design refers to the design of interior spaces. The illustrations on these pages show rooms in which veneered construction elements have been integrated into the interior design for functional, visual or ecological reasons.

An impressive example is the completely renovated Berlin State Library, where a staggering total of 40,000 m^2 of veneer were used (Fig. 68 + 69). European lime wood was used as the base-veneer. The surfaces of the light variants of veneer were called bleached tineo veneer and the dark variants were called reddish zebrano veneer and they were developed and designed for this particular project. Both were used in the reading rooms, for tables and shelves, the counters and the impressive staircase. The Berlin State Library is the largest scientific library in Germany. It collects and archives manuscripts, printed and digital material from all scientific fields, of all languages and all countries. It was extremely important to those responsible for the renovations of the interior that only natural materials would be used. Being very aware of the ecological responsibility, the people in charge felt that veneer encompassed all their needs and demands from production to processing to its usage.

In music halls veneer has always been used for its great acoustic properties. Veneer is always sound-regulating and pleasantly comfortable. The example of the Macedonian Philharmonic Hall in Skopje shows a modern implementation and breathtaking scenery (Fig 66). With great craftsmanship, around 10,000 square meters of veneer sheets were individually adapted to all architectural challenges. The Philharmonic Orchestra of Northern Macedonia has been unique in the region for over seven decades. In addition to the broad repertoire of classical music, world premieres of works by contemporary composers and works by Macedonian musicians, the new sense of space and clear acoustics contribute to a unique concert experience.

Veneer is also used in interior finishing for complicated construction elements. Thus, even rounded and curved base elements can be clad accurately with veneer. Creating an attractive shopping environment has always been the goal of Berlin's renowned "Kaufhaus des Westens" (KaDeWe) department store (Fig. 67). Since its latest renovation, its architecturally impressive escalators were clad with a good 2,000 square meters of American walnut veneer. The spectacular escalator easily distracts customers from the assortment of goods.





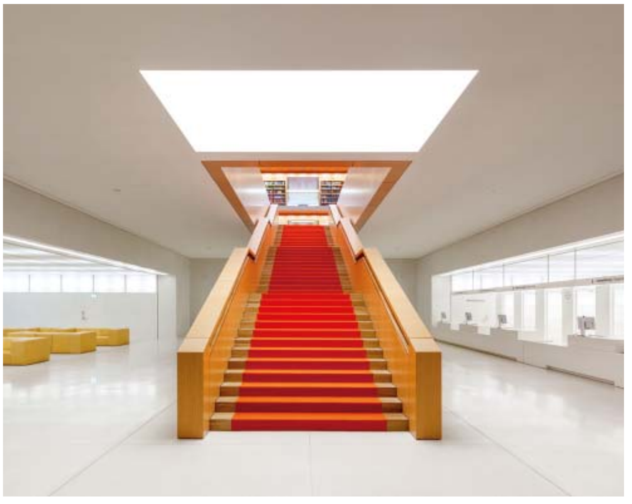


Fig. 66 | The Macedonian Philharmonic Hall in Skopje offers a very special look and unique acoustics thanks to the best veneer.
Photo on the left side: IFN/J. und A. Frischeis

Fig. 67 | Escalator at KaDeWe – looking up reveals all the beauty of the walnut veneer.
Photo above: Marco Cappelletti, Courtesy of OMA, Europlac

Fig. 68 | The veneered bookshelves and reading tables of the Berlin State Library are robust, ecological and timeless.
Photo left side: Staatsbibliothek zu Berlin – PK, J. F. Müller, HWB-Furniere & Holzwerkstoffe GmbH

Fig. 69 | The main staircase of the library impresses with its elegance, because of the beautiful contrast of light real wood veneer with its overlay of orange wool felt.
Photo right side: Staatsbibliothek zu Berlin – PK, J. F. Müller, HWB-Furniere & Holzwerkstoffe GmbH

4.

4.3 Invitations to tender for the interior work

A high-quality interior is individual, so that it is impossible to produce standard texts for general use in tender specifications. On the other hand, it is possible to give a precise description of the appearance and the characteristics of the required surface or fitout.

An invitation to tender should always note that the surface should be made of veneer. The specification of the wood species precisely defines the veneer to be used. If the wood species is not to be explicitly specified, it is possible to limit the choice by providing colour requirements (see Chap. 2.3.3). Details of the veneer's figure, e.g. striped, crown or ribbon (see Chap. 2.3.4) define its appearance, so that the veneer to be used is clearly defined with regard to its appearance.

If a different veneer thickness is required to the standard thickness (see Chap. 1.2), the required thickness must be given. The production of veneers with thicknesses differing from the standard thickness usually involves greater effort and therefore a higher price per square metre.

To produce wall panelling or other veneered surfaces, it is necessary to join the veneer sheets (see Chap. 3.1). The veneer matching specification defines the order of the veneer matches, e.g. book matched or slip matched.

If special requirements are set for the gluing of the veneers, due to the type of building, this must also be noted in the tender specifications. To this end, it is necessary to state whether the building is exposed to frequent short-term effect of condensation or high humidity or whether the frequent, sustained effect of flowing water or condensation is to be expected.

Also, any special requirements regarding fire safety and sound insulation must be noted.

If veneered panels are used, e.g. tabletops, it is necessary to state what is to be used to overlay the edges or narrow surfaces. Veneer edges, solid glued wood edging strips or other materials are possible. Furthermore, it is necessary to state whether the edge is to be concealed (concealed edging strip) or visible (glued edging strip).

Finally, the coating or lacquering of the veneered surface must be described. This requires details of the surface treatment (lacquer, oil, wax) or the lacquer system – closed, high-gloss or open-pored lacquering. Special treatments or effects, such as staining or producing a brushed surface, must also be named here.

Fig. 70 | A classic is the so called drawer stack from 1982 with its diagonally veneered surface in eucalyptus and Santos rosewood.
Source: https://roethlisberger.ch/produkte/schubladenstapel/ Photo: IFN

Examples of wordings to describe a surface are as follows:

- **Surfaces made of cherry veneer with crown figurer**
- **The wall is to be matched, the matching is to be produced by book matching the veneer sheets**
- **Tabletop veneered with cherry, crown figure, edging with stainless steel edge**
- **All gluing must be designed so that they withstand the sustained effect of high humidity**
- **Coating of all surfaces with open-pored lacquering**

The release, i.e. final selection of a surface is usually made following sampling, i.e. examining examples of surfaces to decide on preferences. Here it must be ensured that representative areas are sampled. DIN A3 size samples are commonly used. Areas of this size give a good impression of the visual effect and are also transportable.

Fig. 71 | The combination of light and dark veneers supports high-contrast functional zones.
Photo: europlac

GLOSSARY

A

Alternating spiral grain
The wood fibres run spirally around the trunk axis, where bands of annual rings turn alternately clockwise and anti-clockwise around the middle of the trunk (the axis).

Annual ring
Annual growth zone of a tree with clear separation between the wood produced during the vegetation phase (spring: earlywood) and the vegetation rest period (latewood).

Appled
Term derived from French word “Pommelé” (pomme = apple) denoting a special regular figure in the veneer, which can remind people of apples (rounded or knobbed form, like the pommels of sword hilts).

As-cut pack
A pack made up of all the veneers produced from a complete log or flitch, which are offered and sold as veneers with all the qualities contained in the log (book matched).

B

Backing boards
The veneer block must be clamped in the machine to produce the veneer (slicing). The area clamped in the machine and held by the clamps cannot be made into veneer and is left over.

Bald
Veneer match, which has no figure in places.

Bark pocket
Bark within the heartwood, found mainly in grained woods, which has been overgrown by the heartwood (also called ingrown bark, inbark, bark seam).

Bedroom length
Lengths of round wood (round timber) and veneers between 2.60 m and 3.20 m. Bedroom quality is mostly higher than the panel quality.

Birdseye
Especially in birds’ eye maple, the name given to the eye-shaped figure of the veneer, but can also occur in other species of wood (see Chap. 2.3.4).

Blade check
Cracks in the veneer caused by poorly set pressing bars in veneering machines (also called knife, cutting or lathe check).

Blister
A small bulge in veneer glued over the entire area, which is due to insufficient glue in this area.

Block
Name for a log or part of a login the log or veneer form (also called veneer log, flitch, log segment). Cut figures are friezes with mostly half crowns. Sometimes called heart instead of crown.

Block mottle figure
Irregular form of fiddleback or ripple figure, which runs over the entire area of the veneer.

Blue stain
Blue stains on the surface of the veneer, which can be caused by inadequate removal of water (too low heating output at pressing bar, too fast slicing) during slicing, as water standing on the surface of the veneer reacts with the constituents as a result of oxidation.

Book
Name for a pack of veneer, mainly used by carpenters. This is because the veneer sheets are ordered and fold out like a book.

Book matched
Veneers which are produced from a single trunk/log and in which the matching within the trunk exists.

Book matching
Method used to join veneers, in which consecutive veneer sheets are glued together with alternating front and rear side in order to obtain mirrored matching (see Chap. 3.1).

Bubble
1. Raised spot or area with faulty gluing (see blister)
2. light-coloured natural wood discoloration, round or oval shaped

Buckling
Stresses in the wood mostly lead to wavy or buckled veneers. If the buckling is extreme, the veneer can break when pressed.

Bud/knot
Name for a figure, roundwood or veneer (masur).

Burr
A bulbous growth on a tree trunk. Cut open it produces burr figured veneer (also called burl, knurl, gnaur, excrescence).

Burr figure
Figure or pattern of veneers, made from burrs (see Chap. 2.3.4). Burrs grow above the ground (oak, ash, elm) or as a root burr under the ground (madrona, myrtle, vavona, Californian walnut). Partially figured burrs and logs are called half-burr or clusters.

C

Cancer
Disease in European oak, which causes structural faults in the veneer, in advanced stage appears as an open defect.

"Cathedral" layup
Figure with uniform annual ring spacing and absolutely straight growth. A variation of crown (i.e. perfect arches). Sought after build up of the texture in flamed figure packs. Is considered to be particularly elegant.

Checking
Cracks in the wood, which follow the annual ring. Parts of the log with this defect are not suitable for producing veneer and sawn timber.

Cluster
Only partly grained logs.

Coarse texture
The annual ring structure of quickly grown trunks, which produces an unwanted coarse figure in veneer.

Condensate
Disease in European oak, which causes structural faults in the veneer, in advanced stage appears as an open defect.

Cross-band
Veneer layer, which is glued at right angles to the grain of the top layers of a plywood board.

Cross-banded
Veneer strips which are cut across the fibres (grain) and are used as decorative inlays.

Cross-band veneer
Veneers, which are glued perpendicular to the top layer to improve dimensional stability and are not visible.

Crotches and buttresses
Typical figure of the veneer made from a branch fork. The more exact the crotch (Y) or buttress is formed, the higher the value of the veneer (called pyramid figure in Germany).

Crown figure
See figured

Crown veneer
A name for veneer that has been sliced tangentially from a log and has an oval or arched figure or pattern.

Cutover
Type of processing through the stay log machine.
Also called eccentric peeling.

D

Diffuse-porous
Deciduous wood with hardly conspicuous annual ring.

DIN 4079
Standard applicable in Germany for veneer production, in which the standard thicknesses are defined.

Direction of fibre/fibre
Growth, i.e. longitudinal direction of the tree (grain).

Discoloration
Colours in the veneers differing from the required colour, e.g. green stripiness in cherry.

Door length
Lengths of round wood (round timber) and veneers between 2.05 m and 2.40 m, which are required by the door industry.

Dry density
Abbreviation ρ, the mass of a unit volume of wood, expressed in g/cm^3. The dry density is given for a specific wood moisture content. Most wood properties depend on the dry density (also called apparent density).

Dryer marks
See grid marks

E

Earlywood
The part of the annual ring formed in spring (also called springwood).

End-grain cut
Cross-cut; across or perpendicular to the trunk axis.

F

False quarter
Production technology sliced veneers (see Chap. 2.2.3.1).

Feather figure
Another term for "pyramid" figure (crotches and buttresses).

Figure
Figure, pattern

Figured
Another name for a crowned figure, flat sliced figure (see Chap. 2.3.4). Produced by slicing across the heartwood.

Fire-pored
The pores can only be recognised with a microscope, e.g. in maple, pear, cherry, birch, beech, elm (also called microporous, small-pored, fine-grained, close-grained, finetextured). These woods have a uniform figure.

Flake
Irregular veneer figure, which is mostly unwanted.

Flamed figure
See figured

Flash
Individual figure markings, mostly starting from branches are called flash, also called flares or stria.

Flat-cut
Crown cut, back-sawn, tangential section, plain cut, slash cut (see Chap. 2.1).

Flitch
See block

Foot

Bottom end of log in roundwood or veneer, frequently characterised by coarse annual rings and unwanted colour variations, coming from rootstock.

Foxiness
Coloured changes to the end grains of a log or the entire log if it is stored too long. If facilitated by direct sunlight or excessive dryness. To prevent foxiness from occurring, the log is either waxed at the end grains or is sprinkled with water.

Frieze
Striped veneer match without "figuring" (rift or comb grain).

Furniture quality
Veneers of different lengths of 1 to 4 m within a log, which can be used by the furniture industry.

G

Grid marks
Imprints of the dryer belts on the surface of the veneer, caused by faulty or improperly maintained dryer belts. They can cause difficulties during surface treatment.

Gum
Black, spotted inclusions in black cherry veneer, which can jump from one veneer sheet to another.

H

Hairs
Fine hair-like stains or patches, which especially occur in pear and maple, which can be spread over the entire surface of the veneer and are considered to reduce the quality.

Half-figure
See cluster

Heart
The heart or centre axis of the tree (also called stem axis or log axis).

Heart/heartwood
Inner part of the trunk cross-section, which has a different colour to normal veneer.

Heartwood crack
Stress cracks originating in the middle of the trunk. The location of the heartwood crack is decisive in dividing the log for slicing. Heartwood cracks in the veneer are open and cannot be used for veneer.

Horizontal slicing machine
Slicing machine in which the log/blade movement is horizontal.

I

Inlay
Decorations made from veneer or other materials (e.g. metal or mother of pearl) which are laid in or glued onto wood, very expensive and is used in craft trades.

Inlay banding
A uniform coloured or patterned strip of veneer, which is used for decorative edges (also called inlaid strips, inlay borders).

Inlay borders
Fine veneer strips (also called inlay strips, inlay banding), inserted to separate veneered areas.

Interiorwork length
Lengths of roundwood/logs and veneers over 2.65 m long and with top quality.

Irregular heartwood
Irregularly formed heartwood (false heart).

K

Knots
Small, round or oval, solid deformed buds of branches.

L

Latewood
The part of the annual ring, which grows during the last part of the growth period, i.e. after the spring (also called summerwood).

Log
Section of a tree suitable for veneer or sawing.

M

Marquetry
Inlaid work made by joining together small pieces of veneer to form decorative patterns or pictures.

Matching
The joining of consecutive veneer sheets from a pack (flitch) or an entire log to form a larger veneer area is called veneer matching. Because of their direct, consecutive order, the veneer sheets have approximately the same figure.

Mature wood trees
Do not have a coloured core, but their wood in the core is significantly lower in water content than in the outer layer (pine, spruce, beech, lime).

Mineral
Dark stains or inclusions in the wood, especially in american oak.

Mis-slicing
Different thickness veneer sheets and in places different thickness veneers. Mis-sliced sheets cannot be avoided. Up to 5% of a veneer delivery may be mis-sliced.

Mould stain
Mould stains seen as discolouration in the veneer. Also called spots of mould).

O

Open defects
Defects in the veneer that form holes. Loose knots, areas of rot, open heartwood cracks, all have to be removed during processing. Solid deformed branches are not open defects.

Open-grained
The pores are large and can be seen with the naked eye, e.g. in oak, ash, walnut, elm. These woods have a vivid figure.

Outer veneer
Better quality veneer, which is used for the visible top layers (faces) of a workpiece.

P

Pack
Cut packs of veneer, mostly bundled into packs of 16, 24 or 32 sheets or leaves, which contain consecutive veneer sheets. Usually the smaller sales unit (also called flitch, bundle, packet, parcel).

Panel length
Lengths of round wood (round timber) and veneers between 2.55 m and 3.30 m, which are required by the panel industry. Quality is mostly not as high as bedroom lengths.

Parcel
A quantity of veneers prepared for customers, often sorted and assembled with uniform qualities.

Parquet marquetry
A similar process to marquetry. However, here the veneer is cut into geometric shapes, which are joined to form decorative mosaic patterns.

Pattern
Figure and colouring of the veneer march (see also figure).

Peeled veneer
Term used to described veneers made with a specific type of production (see Chap. 2.2.3.2).

Pepper
Black pin knots in yew or European beech veneers, which produce the typical figure of the yew veneer. The more pepper and the more regular it is distributed over the surface, the higher the quality of the veneer.

Piano egg
A sought after layup of the texture in the flamed figure packs. Is required for the fronts and piano lids.

Pith (medulla)
Starting point of the annual rings located in the middle of the tree trunk, brown colour.

Pin branch
Small, mostly very hard branch, which results in slicing nicks, especially in European maple.

Pin knot

Fine, overgrown tiny pin knot (bole sprout), which is very difficult to see on the bark. Appears in the end grain cut as a black mark running across the surface.

Precipitation
See condensate

Pommelé
See appled

Pores
Relatively large cells of deciduous trees. They are more or less visible in the cross-section as round or oval openings and in the longitudinal cut as pore grooves or needle cracks. Their size, number and distribution is species specific.

Price appraisal
Defining the price for a veneer log.

Q

Quarter matching/four-way matching
Method especially common for figured veneer, in order to produce highly decorative areas and figures (fancy pattern, patterned figure). Four consecutive veneer sheets are matched twice and folded up once.

R

Radial veneer
A type of peeled veneer, which is produced by tapered peeling of the end of the log. The method is similar to that of sharpening pencils.

Reaction wood
Anomalous wood tissue, which has a negative effect on the useful value of the wood. The compression wood of the coniferous trees can be recognised by its high proportion of dark coloured latewood. The tension wood of the deciduous trees appears with a lightly silver shine.

Residual planks
See backing boards

Resin pockets (galls)
Pockets of resin inclusion in resinous coniferous trees, which can cause open areas in the veneer and therefore reduce the quality.

Rift
Veneers made from quartered logs. See also frieze.

Rift cut
Radial cut; The cut runs along the medulla rays and perpendicular to the annual rings. The cut surface appears striped (see Chap. 2.1).

Ring pores
Deciduous wood with conspicuous annual rings.

Root knot
Figure in which the burr (knot) forms on the root. The knot is located either entirely or partly under the ground. Root knots are found in, e.g. myrtle, walnut, maple, vavona.

Rose
Overgrown branch, which leaves behind a clearly visible feature in the bark. The earlier the tree threw off the branch, the more difficult it is to identify this feature in the bark.

Rotary peeling
Method of veneer production (see Chap. 2.2.3.2).

Round trunk veneer
The presentation of veneers, which are laid up in the form of the original trunk.

S

Sapwood
The outer, light-coloured part of the wood between the bark and heartwood. In heartwoods different colour of the sapwood. The sapwood is usually cut off for veneers. With several wood species, e.g. palisander and European walnut, the sapwood is used decoratively.

Sawn (saw-cut) veneers
Veneers made by sawing (see Chap. 2.2.3.3).

Sheet quantity
The number of sheets or leaves of veneer in a pack.

Short end
Lengths of round wood (round timber) and veneers less than 1.50 m.

Short length
Lengths of round wood (round timber) and veneers between 1.50 m and 2.00 m.

Shrinkage
The reduction in the dimensions of wood (and accordingly of veneer also) when moisture is given off.

Silver figures
Depending on the cutting angle used for slicing, the cells of the medullar rays become visible in different ways. Visual interruption in the overall pattern, which is desirable in several wood species, e.g. plane tree wood. Particularly marked in oak.

Single packs
Packs of veneer taken out of the regular sequence of a log, so that they no longer match; mostly low qualities or friezes.

Sliced veneer
Term used to described veneers made with a specific type of production (see Chap. 2.2.3.1).

Slicing
Method of veneer production (see Chap. 2.2.3.1).

Slicing nick
A diagonal notch across the veneer sheet caused by a damaged knife. Typical slicing error, which calls into question further use of the veneer.

Slip matching

Method of joining veneers in which the consecutive veneer sheets are glued only with the front side (see Chap. 3.1).

Softwood

Term for wood with low density, usually coniferous trees. However, there are also soft deciduous trees, such as poplar or alder.

Specks

General name for dark, solid colour changes that have formed. Depending on the wood species the cause is differentiated between gum, hairs, resin pockets, bark ingrowth, sugar, etc. Also called spatter or spots.

Spiral grain

Spiral growth of a tree, which is caused by external effects, e.g. wind. Severe spiral grain can cause matching problems because the annual rings detach from each other and leave open spaces, which is why they are mostly sawn.

Starter packs (end packs)

The first and last packs of a flat-sliced log. These packs are mostly figured, are shorter and have a lower value.

Stress crack

Different growth zones and growth speeds (weather side) in a trunk cause density differences to occur, which can cause stresses in the roundwood (log). If the tree is felled, stress cracks can occur, which call its suitability for veneer into question. Problems with beechwood.

Stripiness

More or less clear differently coloured stripes, mostly considered to reduce the quality. Above all, common in European oak.

Stripy grain veneer

See frieze

Stump

Bottom end of a trunk / log (also called stub).

Substrate

The substrate material onto which the veneer is attached.

Swelling

The increase in dimensions of wood (and accordingly of veneer also) when moisture is absorbed as a result of storage of water in the cell wall.

T

Tegernseer Gebräuche

Set of standards commonly recognised in the timber industry in which general rules are defined for the sawing and veneer industry (e.g. quality designations for sawn wood, tolerances regarding veneer thicknesses and defective sheets, etc.).

Tenar

Zones formed by irregular annular ring build-up in coniferous trees, which are particularly hard and therefore cause difficulties during veneering (compression wood, pressure wood, glassy wood, redwood, hard streaks, bullwood).

Thick cut

Veneers that are produced in thicknesses different to those specified in the DIN standard. The usual thicknesses are 0.9 mm, 1.2 mm, 1.5 mm, 2.0 mm and 2.5 mm.

Thickness of veneer

In Europe, thicknesses between 0.5 and 0.65 mm are usual. In Asia, veneers between 0.2 and 0.3 mm are mostly used. Thick cuts are usually 1 to 3 mm thick.

Top log

Top end of a log (roundwood or veneer).

Toughness (viscosity

In irregularly grown or highly stressed trunks, buckling or waviness of the veneers. Can also be seen as darker colouring along the annual rings.

Tractor tracks

Typical block formation, especially in beech; is usually thought to reduce the quality.

True quarter

Production technology sliced veneers (see Chap. 2.2.3.1).

Trunk knot

Figure in which the burr (knot) figure forms aboveground on the trunk. Such knots are : oak, ash, poplar, elm.

Tumbling

Thickness fluctuations caused by vibration of the veneer block on the slicing machine or incorrect pressure setting at the machine, which are regularly spread across the veneer sheet as cross-wise stripes.

Turn over
Presenting a log in which it shown pack for pack.

U

Utility grade veneer
Lowest quality category of veneers, which are mostly used as cross-band veneers or for areas that are not visible. Also called backing grade. Can also be sold by weight.

V

Variegated figure
Irregular veneer match, intensity mostly dependent on incident light. Caused by different growth anomalies, which cause irregular figure.

Veneer sheet
The smallest veneer unit. In most cases they are bundled together to form a pack (packet, flitch, bundle) of 16, 24 or 32 sheets (also called veneer leaf).

Vertical slicing machine
Slicing machine in which the log/blade movement is vertical.

W

Wavy block
See figures Chap. 2.3.4

Wavy/Wavy figure
Ribboning running in a direction across the tree axis in a tangential direction, with wavy fibre and annual ring development. Produces an irregular veneer match (see variegated figure, flake) (also called curly figure).

Whisker
Very fine blade nicks, which disappear during surface sanding of the veneer and therefore do not impair the veneer (also called burr).

Wide-ringed
A name for wide-ringed (coarse-grown, coarsegrained) wood with large pores.

Wild figure
Irregular figure which changes direction and makes the wood difficult to machine.

Wood defects
Each defect, which impairs the appearance of the tree, which makes machining or veneering difficult and which reduces the value of the wood for a specific use; frequently also called a growth feature (e.g. gum in cherry).

Wood rays
Also called medullar rays. Cell tissue, radial in the cross-section of the tree, which depending on the cutting direction is visible as lines, stripes or stria (flake).

Y

Yellow Gum
Yellowy brown flecks in American black cherry, which are considered to reduce the quality, as they are still visible after surface treatment.

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Short profile Initiative Furnier + Natur (IFN)

→ Who is the IFN?

The Initiative Furnier + Natur e. V. (IFN) is the only international advocacy group for manufacturers and traders of veneer and other renewable raw materials. In addition to the ordinary members, the IFN has supporting members such as suppliers, processors, other associations and trade fair companies.

→ What does IFN stand for?

As wood is its primary material, sustainability is very close to the veneer industry's heart. Each company affiliated with IFN take responsibility for the environment and try to fight climate change with their products. "Reduce, Repair and Re-Use" is possible when working with veneer and therefore reduces climate-damaging waste. The main goal is to give preference to ecological veneer and other renewable raw materials over non-sustainable materials and products.

→ What does the IFN do?

The IFN is a network and marketing community for its members. To that end, it publishes significant content for specialist and consumer media throughout the year. IFN representatives are present at all major live events such as trade fair conferences or meetings and the IFN as an association is using all important communication channels and formats to reach as wide an audience as possible.

→ Why is the IFN important?

The IFN gives visibility to its members and shows the competence of the European veneer industry. Furthermore, the IFN increasingly puts more importance on showing and exploring the existence of other renewable raw materials. Therefore, it is perceived rather positively, as an international, future-oriented marketing community and information platform. The IFN is unique and independent.

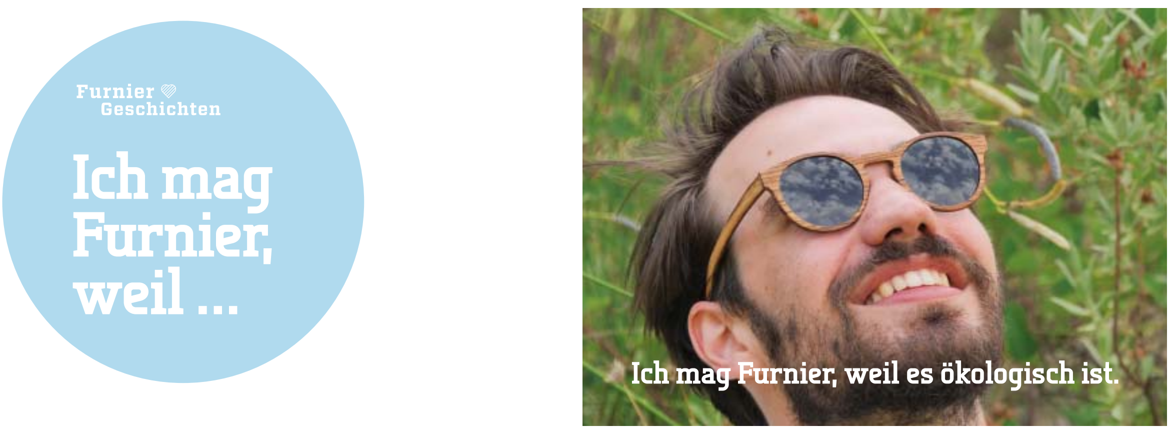

Abb. 72 | IFN campaign – changing people with changing statements from poster to postcard printed on veneer.
Source: IFN

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