

## **INFLUENCING PARAMETERS IN SELECTING THE TYPE OF FLOOR AND KIND OF ADHESIVE IN WOODEN FACILITIES**

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### **ABSTRACT**

Wooden facilities can be applied for the holidays and living. Depending on the usage, construction technique, and the required quality and durability of the building, different types of flooring and the adhesives are used. The paper presents the parameters that influence the choice of the floor and adhesive to achieve the desired quality of living in the facilities and the durability of the facility.

**Key words:** types of floors, types of adhesives

### **1. INTRODUCTION**

Properly designed, constructed and maintained wooden floors belong to the most decorative floor surfaces. Wood is actually the one visible, the final layer of composite floor, and it is also an element of architecture. When selecting wood, except for colours and types, a crucial role should have a anticipated place of installation and improvement of loads that will take effect on it within a specified period of usage. When embedded into the floors it is particularly important for wood to be adjusted with the tone and tradition of the region for usage. Many people choose wooden floors instead of the textile ones because of traditional applications of typical floor elements, such as parquet floors, in residential areas during the last few generations. However, the choice of a particular type of wood for the floor is often based on its colour, rather than on technical characteristics. Colour of the floor is determined by fashion, so every few years we are convinced that bright and shiny colours are required, or dark and dull species of wood. Wood flooring are glued to the surface by various adhesives. Commonly being used adhesives are dispersion, reactive and elastomeric adhesives. Dispersion adhesives are usually made based on aqueous dispersion of polyvinyl acetate, the ones that react are usually made of polyurethane or epoxy, production of Elastomeric adhesive is mostly based on synthetic rubber. Adhesives for bonding floors to the substrate must be compound and ready so to be able to, on the cohesion and adhesion base, connect wood with the ground in a satisfactory manner.

### **2. CHARACTERISTICS AND PARAMETERES OF WOODEN FLOOR SELECTION**

One of the segments of the usage of wood in construction is the construction of floors, on the traditional way from solid wood or the more modern, which includes the creation and installation of various types of industrial wood, such as plywood, laminates, etc. Floors and floor coverings by nature of their position in the area are objects that need to withstand the most adverse conditions.

This is the main reason why it must be made of high quality, healthy and long-lasting materials. Floors can be classified by material (wooden, concrete, etc.), methods of

implementation (self-founded), form elements (parquet, decking), or by various other properties (hot, hygienic, wear-resistant, waterproof, swimming, etc.).

Wooden flooring is also important for natural lighting and indoor air quality. If the floor area in front of windows or glazed doors is not covered with a thin floor covering, lacquered floor will boost the glow of natural light further into the room. You need to find a middle ground between a matte surface and excessive gloss that can be undesirable as much as the repressed natural light. Patch on the floor can replace flooring ornament.

The most famous examples are the parquet floor mosaics that are processed on CNC machines in various forms. The development of technology every day erases the distinction between the floors of solid natural wood and composite wood-based products that are produced by using the most modern technologies and make the synthesis of the best features of wood and artificial materials. On the other hand, and totally natural wood is treated and processed so that its characteristics are improved and more similar to artificial materials.

We distinguish the following types of wooden floors [4]:

- Suspended floor in which the panel of the floor is attached to a series of beams,
- Floating floor where the floor panel is attached to the insulation layer above the settlement below the floor or on a series of beams (bush) between which stands a layer of insulation,
- Top panel that is attached to the existing floor (usually floating) to improve surface quality and to improve the sound insulation,
- Raised floors where the floor segments are supported by short pillars to allow access of cables positioned below the roadway lining and,
- Industrial floors with platforms that include semi floor and deposit of floor bearing.

Depending on the permissible stresses three types of flooring are projected [4]:

- floors of residential buildings for which the maximum load does not exceed 1,5 [kN/m<sup>2</sup>] and the maximum concentrated load does not exceed the value of 2,7 [kN/m<sup>2</sup>],
- lightweight non-residential floors where the maximum load of 2,5 [kN/m<sup>2</sup>], and the maximum concentrated load of 2,7 [kN/m<sup>2</sup>],
- non-residential hard floors where the maximum load greater than 2,5 [kN/m<sup>2</sup>] and the maximum concentrated load of 2,7 [kN/m<sup>2</sup>].

Selecting the right floor is one of the most important aspects of designing facilities. The criteria that must be considered when choosing flooring should have been taken [5]:

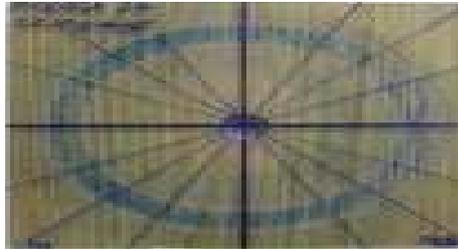
- Impact resistance,
- Elasticity of lacquer,
- Wear resistance,
- Thickness of film,
- Adhesion.

Impact resistance tests consist of putting the balls of a certain mass and diameter that falls from various heights on the tested surface. The drop height is increased in steps of 50 mm to the determination of the maximum height of those height that do not yet led to the formation of any cracks on the impacted place. Relevant concentric circular cracks length is greater than 2 mm.



**Figure 1.** Impact resistance test method [5]

Elasticity of lacquer is determined by indentation on the surface of steellacquer block on whose face stands out 12 cones of different angles and heights (from 0.4 mm to 2.6 mm). Block is pressed on the universal machine for mechanical testing of wood with working speed of motion of the working head of 10 + 5 mm / min until complete contact of blocks'base with the face of probe.



**Figure 2.** Elasticity of lacquer testing [5]

There are a number of methods for determining the resistance to wear (abrasion), but appreciated is the use of the device for testing Taber used with a variety of abrasive (friction) wheels. Generally, the test is carried out so that the probe is placed on a rotating table, load by testing abrasive wheels and additional weights and is submitted to rotation.

Dry film thickness provides the desired aesthetic appearance, but also affects the technical characteristics as well as the durability of wooden flooring. It directly depends on the amount of sediment, the depth of penetration of the base deposit, content of lacquer substance, the amount of film removed by grinding and the number of layers.

One of the most important quality features of varnished flooring is adhesion i.e. grit of adhesion of hardened film on the surface. Result of poor adhesion is often peeling of dry film which can occur very soon after the curing of lacquer, even in conditions of normal use.

When choosing wood for the production of walkway covering relevant are those properties of wood, which ensures good stability and durability of the floor structure and the most important feature is the resistance of the load. Persistent and permanent walkway coverings are made of wood with higher density (700 – 800 [kg/m<sup>2</sup>]). [4]

Wooden floor installation began with mechanical fixation (in the past have wooden flooring nailed to the surface) or drenched in sticky bitumen pitch. Later they stiff glues for wood floors appeared as well as a system of floating installation without fixing the laminate and completed floors.

All these methods of installation have occasional drawbacks, such as: cracking, creaking mechanically fixed floors, the effect of rocking high-reflective sound in space with floating floors installed, plus damage to the surface caused by the transfer of stresses in bonding wooden floors with rigid adhesives. Therefore, it is accepted optimal method and most professional way to set up wooden flooring glued with elastic adhesives.

Proper surface preparation is the base for the successful laying of floor coverings. This work includes the use of the product for impregnating of absorbent surfaces. Because it often happens that users accept with scepticism the manufacturer's data about consumption of parquet adhesive. It is often forgotten that the data on the consumption of adhesive is only valid when the surface is flat and impregnated.

The importance and advantage of using impregnation before bonding parquet is following:

- impregnation firms substrate (penetrate deeply into the substrate and thus connect and fix any loose particles and reduces surface dust,

- impregnations reduce and equalize the absorption of surface (thus significantly reducing the consumption of adhesive that allows the formation of a compound with a smaller and more equal amount of adhesive).

When it comes to bonding parquet on non-absorbent substrates such as ceramic or stone, water from dispersion adhesive absorbs only the parquet, and then it almost certainly leads to a lifting of parquet. Proper selection is a two component adhesive that contains no water and quickly crystallizes. So, regardless of whether it is a dispersion or two-component adhesives surface should be well prepared for gluing to be successful. If the flooring is applied only to the levelling mass it is mandatory to follow the manufacturer's instructions depositing of mass and its preparation for bonding parquet.

### 3. TYPES AND CHARACTERISTICS OF ADHESIVE THAT ARE USED IN MAKING AND INTAGRATION OF PARQUET FLOORING

Adhesives in the timber industry are an important factor in the rationalization of raw materials and finished materials. Since ancient times, man has used the natural glue or glues based on starches, blood and other natural binders that are not toxic or emit substances that contaminate the working environment or the product. However, in the era of industrialization began production of synthetic glues and other adhesives that are based on a variety of chemical substances. These adhesives initially had only the task to provide a chemical and mechanical bond. However, 70 s and 80 s regulations regarding to quality and emissions of toxic substances have set a number of restrictions on chemical and mechanical properties of the adhesive, and permitted concentrations of certain substances, flammability and explosiveness for various types of adhesives. [1]

#### 3.1. Adhesives and process of bonding

Adhesives are materials that in certain circumstances, either because of chemical reactions, either because of the influence of temperature in terms of heating and cooling are characterized by hardening (solidification) and mutual strong bonding of identical or different materials. The main substance of each adhesive is binder that has animal, mineral and synthetic origin. In addition to binders, adhesives have other components such as solvents, plasticisers, fillers and hardeners.

*Table 1. Classification of adhesives by the ability of adhesion*

| Adhesive type | Class       | Reach of temperature (°C) |
|---------------|-------------|---------------------------|
| 1             | 1P, 1H, 1PH | - 60 do + 70              |
| 2             | 2P, 2H, 2PH | - 60 do + 70              |
| 3             | 3P          | - 60 do + 70              |
| 4             | 4P, 4H, 4PH | - 60 do + 150             |
| 5             | 5P          | - 60 do + 220             |
| 6             | 6P          | - 60 do + 350             |

The number of species is determined by the ability of adhesion to satisfy specific criterion forces (For elastic bending and flaking) for period of exposure to 1 000 h at maximum temperature for each type.

Letters for class are defined by this classes [3]:

- CLASS P- gripping panels on the panel at the junction (according BS185),
- CLASS H- gripping to the surface on the surface of,

- CLASS PH – gripping suitable to class P and class H.

Under gluing of wood implies a firm surface connecting of two wooden surfaces by glue. Between these surfaces is a thin (optimal) adhesive. Given that is the wood surface, wooden surfaces is porous, the adhesive layer goes into the pores of the wood and when the adhesive layer hardens, it creates a network of branches in the pores of both wooden surfaces. When connecting or bonding of wood attractive forces called cohesion and adhesion interact, so that they create a chemical-mechanical connections that provide strength of adhesive joint.[2]

Therefore, wood and glue must be in very close touch by the external pressure while the glue is still in a liquid state. It is important that the adhesive layer moisturize wood during the gluing process and penetrates into the wood, and to establish contact between the two substances. If the adhesive does not moisturize the wood, there is a repulsive acting force between the molecules and the creation of dispersion forces. Given that most of the wood adhesive are colloid solution that in the process of bonding change from liquid into a gel, and then harden, so that it becomes a strong adhesive compound.

This compound is reversible (if the adhesive layer is dissolved in water), or vice versa irreversible. Penetration of glue into the pores of the wood depends on the viscosity of the adhesive, the size and duration of the pressure. Viscosity of adhesive quickly decreases when the temperature increases, so you should take care of the optimum viscosity for all kinds of applications in bonding.

### 3.2. Characteristics and types of adhesives for parquet installation

In general, bonding in many areas of human needs and in the economy represents a very important area which satisfies the needs of some relatively large economic sectors and citizens. In the last 30 years, it tremendously increased usage of adhesives globally. This was mostly contributed by enormously increased consumption of wood, which is related to the increase in people's living standards and the mismatch between the need for permanent preservation of the wooden stock and satisfaction of human needs for wood. [1]

Characteristics of each adhesive determine its use and purpose. They can be summarized as follows:

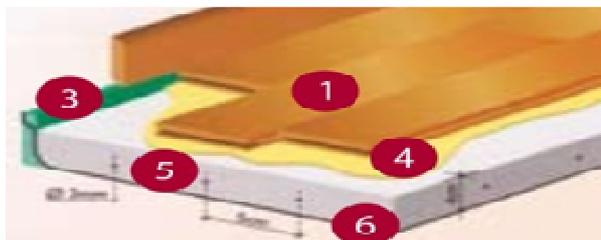
- Open time,
- Bonding time,
- Viscosity and thixotropy,
- Pot life,
- The impact on the dimensional stability of wood,
- The flexibility and resilience,
- Resistant to aging and heat resistance,
- Resistant to moisture,
- The strength of bonding,
- Compatibility with adhesive screed and type of wood,
- conditions of deposit.

Given the scope, technology requirements and conditions for the quality and consistency of quality of bonding there is large number of adhesives, so that we can use for a wide selection and it is only necessary to know the technical and other requirements, and they can be obtained without difficulty and successfully applied.

With regard to the composition, the adhesive used for bonding parquet can be divided into the following three groups:

- Dispersion adhesives,
- Solvent Adhesives,
- The reaction adhesives.

It is generally used two types of adhesive when laying wooden flooring: dispersion glues and adhesives with reactive resins. Whenever applicable, dispersion adhesive must be given priority over other products because of its environmental friendliness.



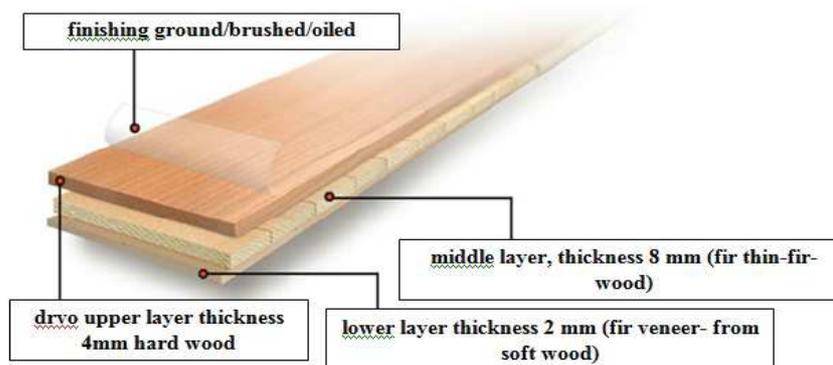
1. Massive parquet; 2. Bond; 3. Corresponding adhesive ; 4. Cemented surface; 5. Under layered panels

**Figure 3.** Laying solid wood parquet [5]

Considering the exposure and complex process for quality usage of adhesive and good use of technological equipment it is necessary to know the basic theory of bonding, properties and characteristics of the adhesive bonding regimes, good blend and conditions in which will be extracted bonded materials or compounds in products and building construction. For good bonding is first necessary to choose the appropriate adhesive depending on materials that are bonded and bonding requirements and desired characteristics of bonded assemblies.

### 3.3. Characteristics and types of adhesives used for construction of finished parquet

The term finished parquet means parquet of different sizes and thickness, which was prepared for the laying and does not require any finishing. To differ from traditional occupations flooring (lamellar, lam-parquet, classic parquet of small and large format, etc. ) For the depositing of flooring a lot of time is not required, because the panels are already drilled, machined and coated. So they just lie on the site and do not require acclimation to the area, which significantly shortens the entire process of installation of parquet. There are four base layer of parquet: We've got film, bonding layer (adhesive), noble layer (wood), and finishing layer (lacquer).



**Figure 4.** Finished three-layer parquet floors [5]

Base layer is the lower part of the parquet, or his rear side. It must provide dimensional and spatial stability, ensuring good adhesion to the substrate with different systems of deposit (gluing, nailing, clinging), but above all, must be resistant to moisture. It can be made of natural wood or composed of multiple layers crossed with each other. It primarily used soft wood, because it contains the resin and is therefore more resistant to moisture, though it can be of different wooden board - hardboard, plywood, the plywood and related panel.

Bonding layer for multilayer finished parquet is the adhesive layer, which must guarantee good bonding and noble bearing layer. Adhesives that can be used for that purpose, depending on the chemical composition and properties of high build, divided into three main groups:

- Urea adhesives, whose bind is based on the chemical reaction of heat (they are the most common),
- Adhesives based on aqueous dispersions,
- Adhesives based on solvent.

In addition to its functional benefits, it should be noted that the aesthetic contribution of multilayer parquet to any space, especially for large rooms, is truly remarkable. This flooring gives exclusiveness to each business area, and to each home naturalness and warmth.

#### 4. CONCLUSION

The natural colour and texture of the wood are the main aesthetic characteristics of wooden floors. Aesthetic values of wood are crucial factors in the competitiveness of wood compared to other flooring materials, such as textiles or ceramics. This is because the wood, in addition to its warmth, has an unusual natural unevenness of colour and texture, i.e. arrangement of anatomical elements on the surface is different. It is likable that each element of the wood floor varies, the wooden floor is variegated.

The epithet "warmth" of wood has a double significance. Some people "warmth" of wood is attached to the tactile sensation, and it's an experience you have when you touch the wooden floor, either by palms or feet. Given that the wood is relatively weak heat conductor, touching not deserve a lot of heat from the surface of the skin, so the sense of "warmth" wood is direct and pleasant. Other people under the warmth of wood include pleasant tones of natural wood colour, which are in widespread commercial tree species generally "warm" yellowish, brownish or reddish colour. This wood colour becomes one of the elements of a complex aesthetic perception of wooden flooring, experiences that are individually different, but mostly pleasant.

On the selection of the flooring main influence has:

- Type of the floor,
- The expected load on the floor,
- Characteristics of materials that the floor is made of,
- Characteristics of floors (toughness, elasticity varnish, wear resistance, film thickness, adhesion).

When installing the flooring it is necessary to pay attention on the preparation of the substrate, i.e. surface should be flat and impregnated as it is achieved:

- strengthens of the foundation (penetrating deep into the substrate and thus connects and fixes all loose particles and reduces surface dusting),
- Reduced and equalized substrate permeability (thus significantly reduces the consumption of adhesive and allows the formation of a compound with a smaller and more equal amount of adhesive).

To install parquet flooring it is used dispersion adhesives, solvent adhesives, reactive adhesives, and are essential to their following features: open time, bonding time, viscosity and thixotropy, time of mixing (pot life), the impact on the dimensional stability of the wood, plasticity and elasticity, resistance to aging and heat resistance, moisture resistance, bond strength, adhesive compatibility with screed and types, the conditions of deposit.

In preparing ready parquet with three layers it is applied urea adhesive that bind the basis of chemical reaction heat (they are the most common), water-based adhesives and solvent based adhesives.

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