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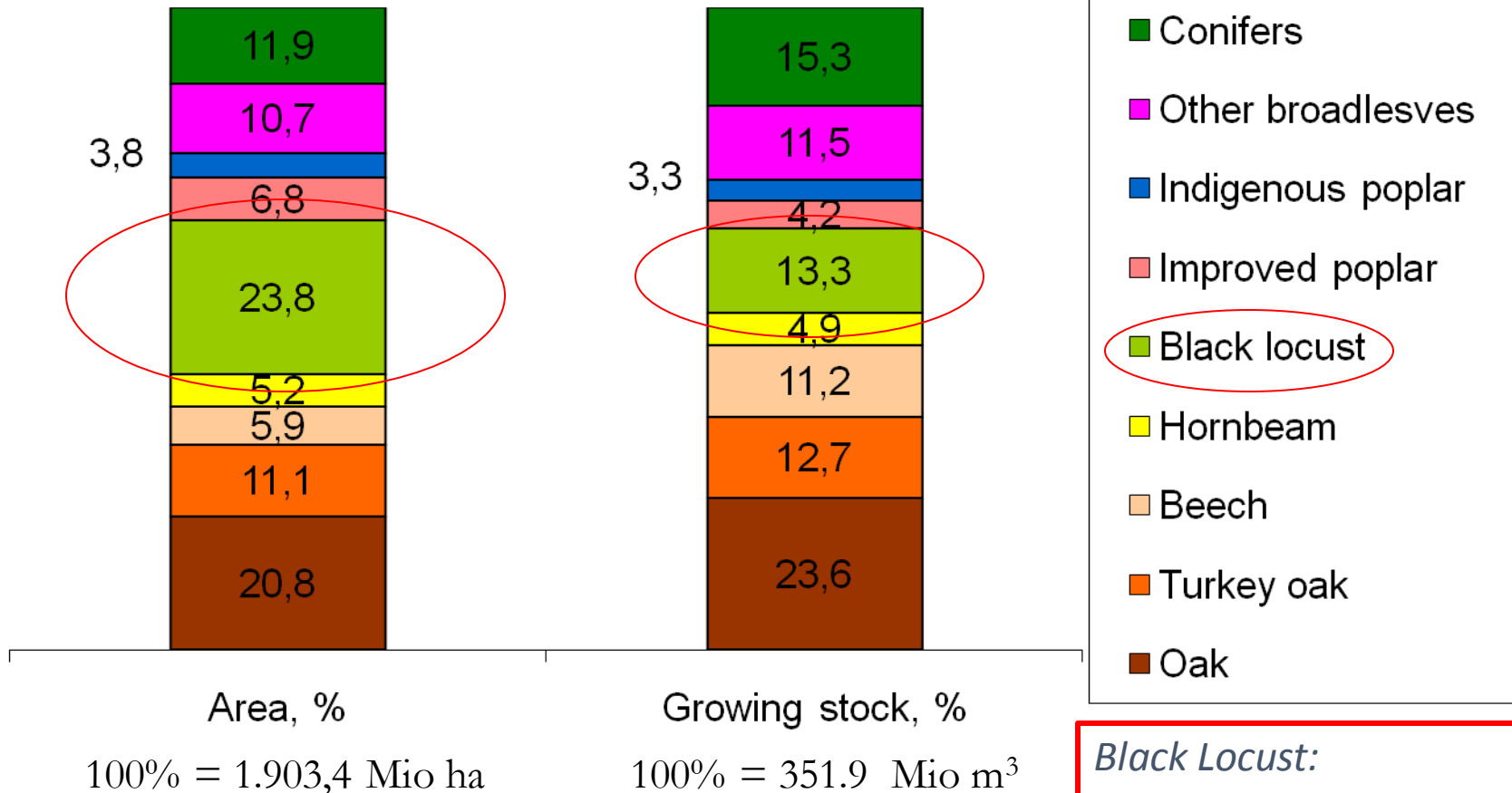
**LONG-TERM IN SERVICE EVALUATION OF STRIP PARQUET WITH
MODIFIED WOOD FACE LAYERS**



Introduction

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Tree species distribution of Hungary



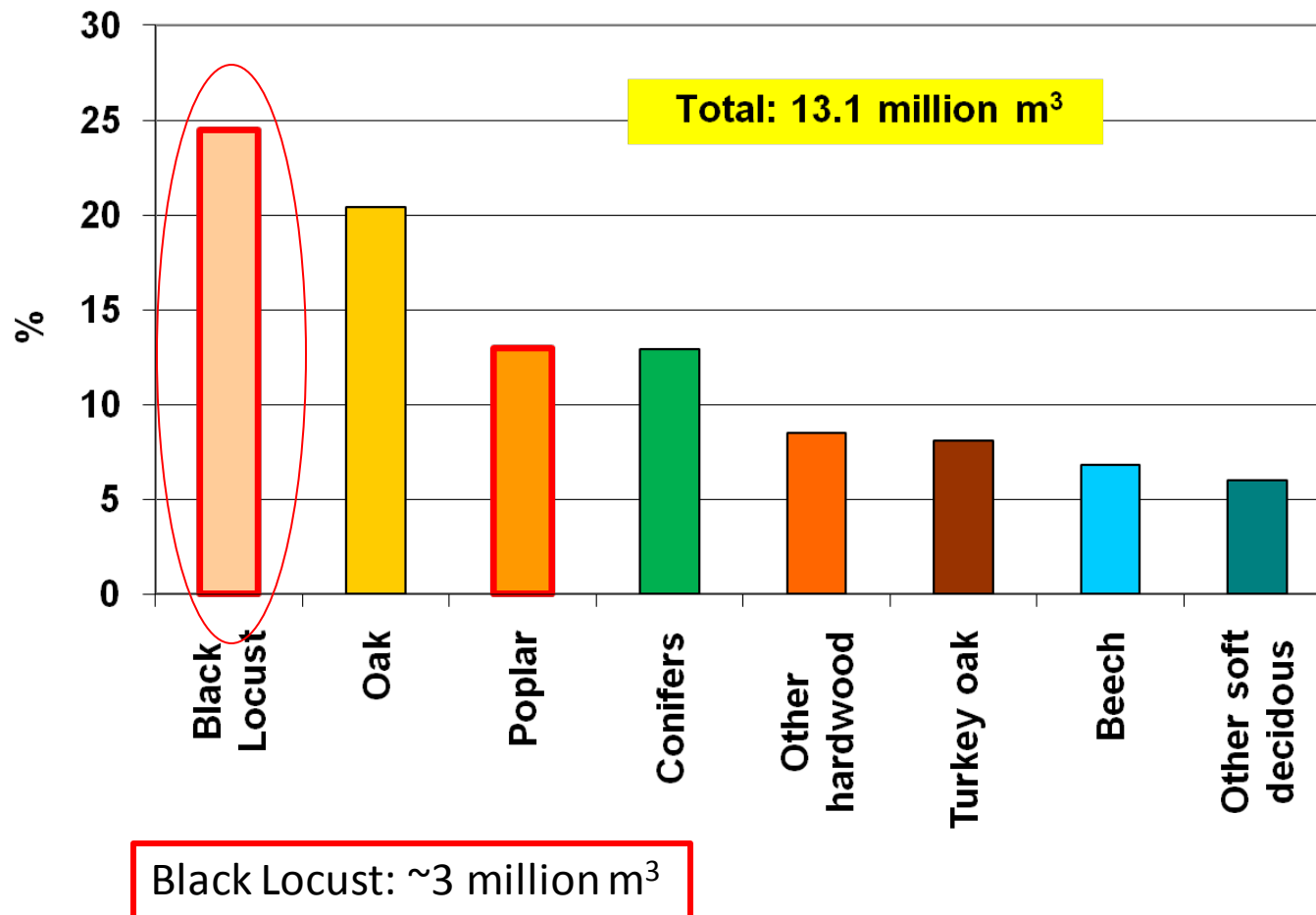
Black Locust:
ca. 450.000 ha
ca. 50.000.000 m³



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Gross annual increment

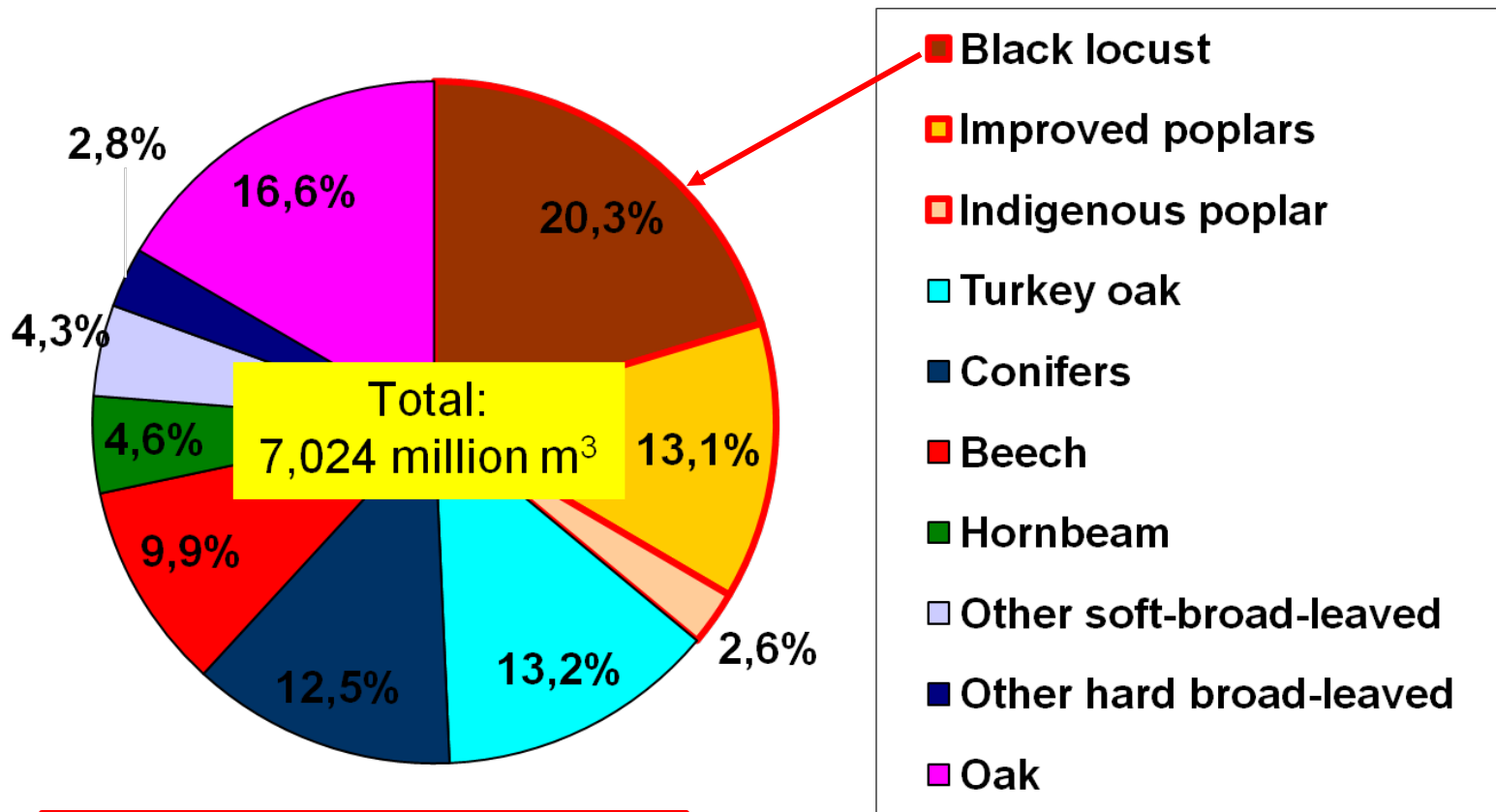




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Fellings by tree species



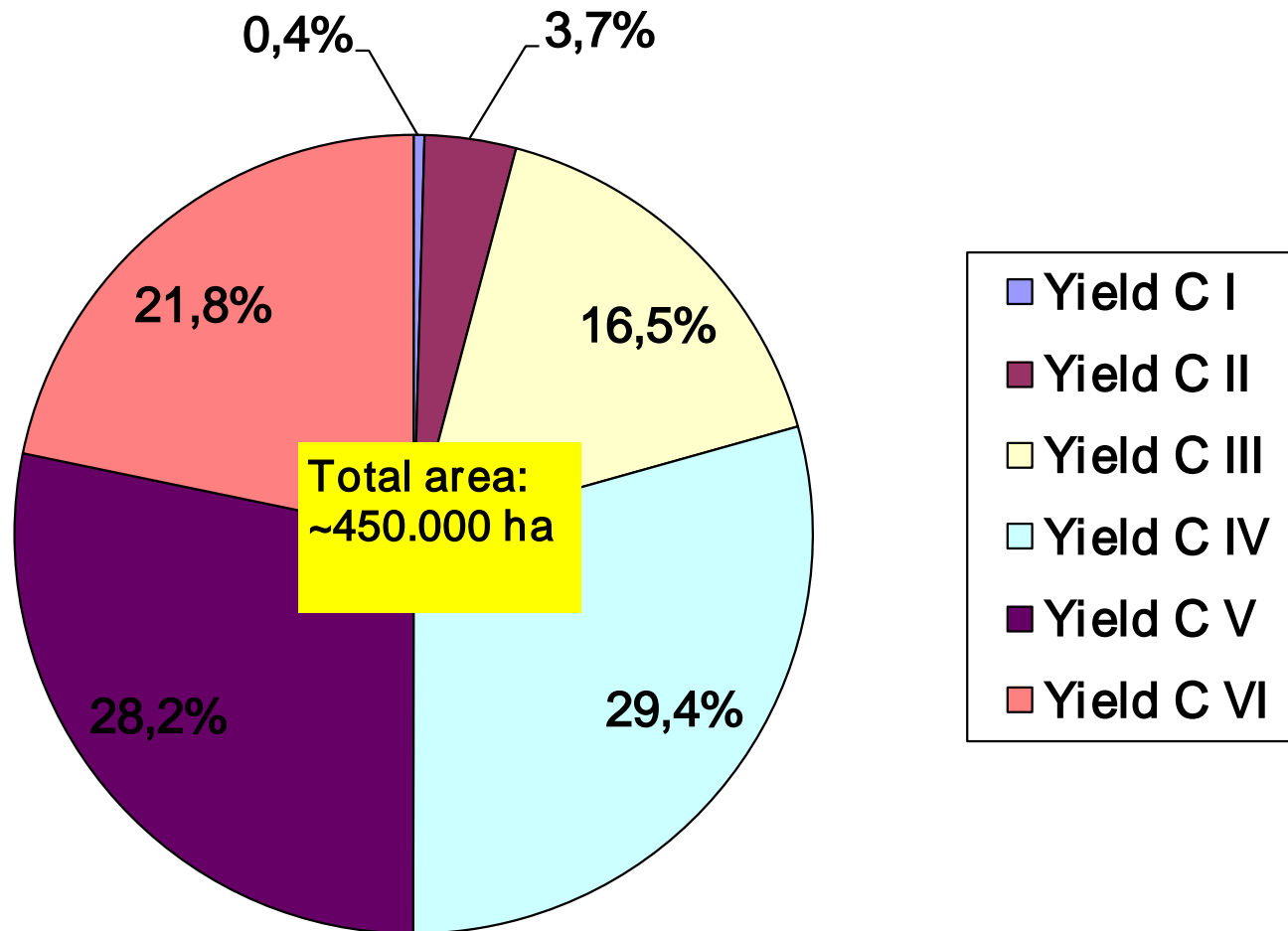
Black locust: ~1,5 million m³



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Area of Robinia forests by Yield Class





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Physical and mechanical properties of robinia

	Oak	Robinia
Density (kg/m ³)	690	770
Bending strength (MPa)	110	140
Surface hardness (MPa)	66	78
	34	38
MOE (Mpa)	12000	14000
Radial shrinkage (%)	5,47	3,2 - 4,6
Tangential shrinkage (%)	7,87	5,4 - 7,2
Longitudinal shrinkage (%)	0,39	0,49
Volumetric shrinkage (%)	13,35	11,4 - 12,2



Objectives

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- The overall goal of this study was to investigate the behaviour of **Black Locust flooring under service and in laboratory conditions** with different cover top layers (untreated as well as light and dark steamed Black Locust, plus oak for comparison).

The specific objectives are the following:

- to investigate the changes in appearance of pre-fab flooring in long term (5 years) indoor service and
- to test selected properties of pre-fabricated flooring in the laboratory.



Materials and methods

- The flooring material was processed and coated in a regular production line of a Hungarian company (Drávaparkett, Barcs).
- Surface treatment: hard natural oil, in order to reduce the influence of coatings on surface wear and to control its influence on abrasion
- The pre-fab flooring material is defined as follows:

Surface treatment - Oil:

primer: transparent oil
(35-40g/m²)

top: transparent oil, high solid
(25-30g/m²),

Manufactured by Waterlox Coating Corporation

Materials:

O - oak

N - natural Black Locust

L - light steamed Black L.
85°C / 48h

D - dark steamed Black L.
95°C / 48h

Core layer: spruce

Bottom layer: spruce



Cross sectional structure of the flooring

tenon

notch



208 mm



→ 4 mm

→ 6 mm

→ 4 mm



- **Abrasion resistance:**

Investigation of the abrasion behaviour of the **four different types** of pre-fab floorings.

Standard used: ASTM D4060-95

Specimen dimensions: 100x100mm²

Sample size: 30 units per each flooring type

- Measurements were done by weight loss and by thickness loss (at four points) after 400 rotations both on oil treated and untreated floorings.

- **BM-hardness**

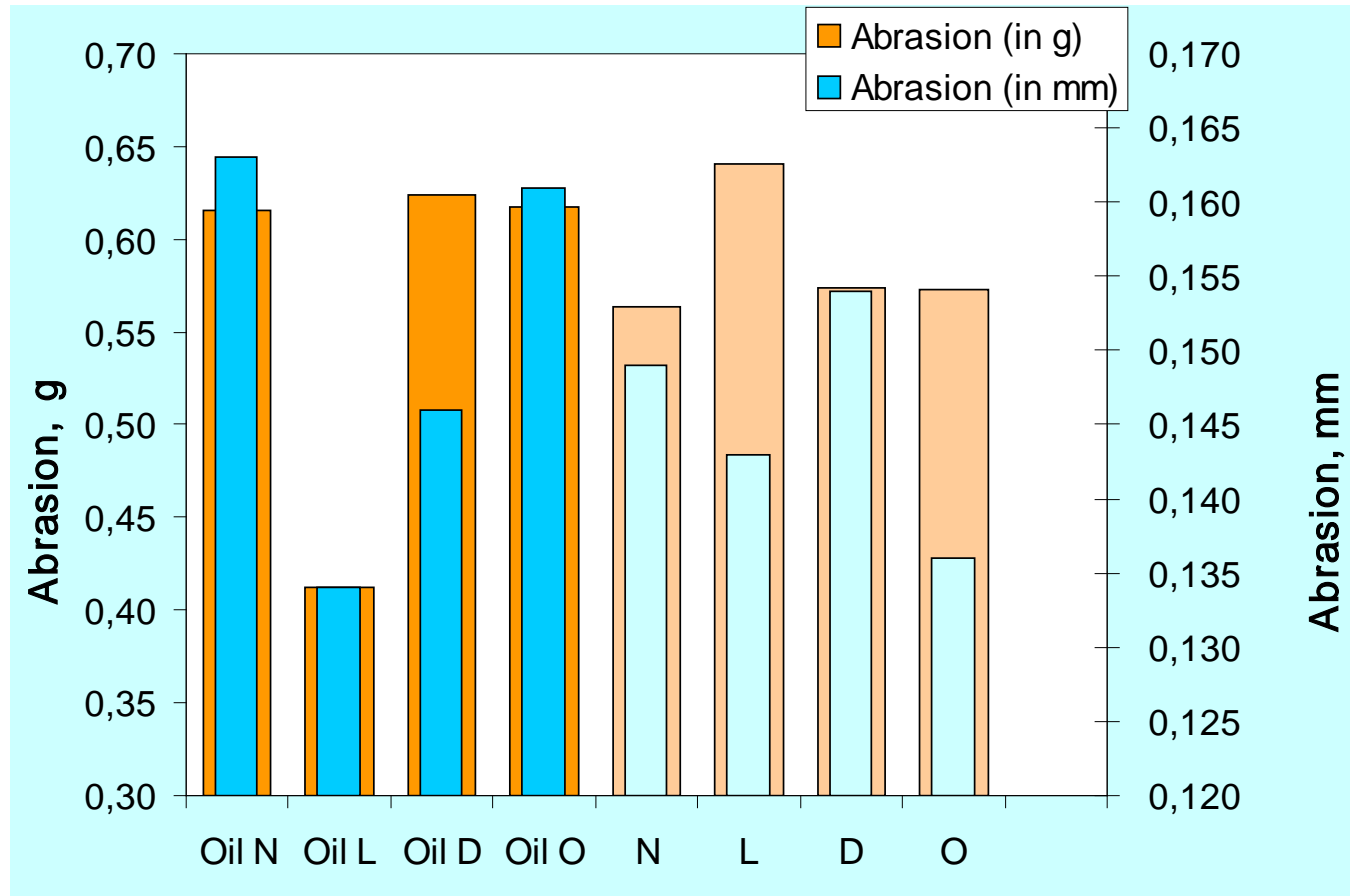
On the same specimen



Mean abrasion values by treatment and measurement method

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(Laboratory Test)



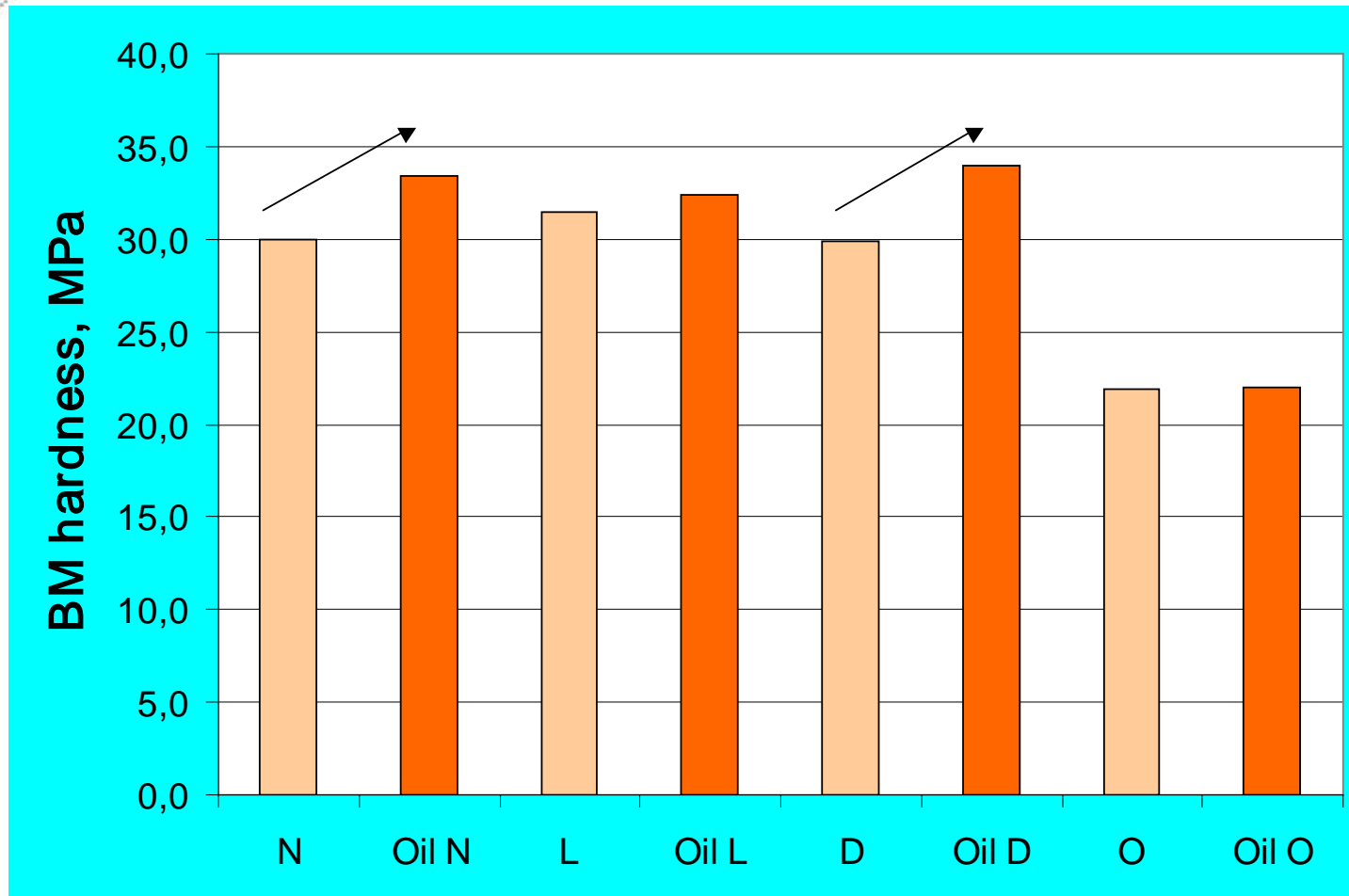
Steaming has a noticeable effect on abrasion resistance by oil treated material. Light steamed black locust wood had the lowest thickness loss -- highest resistance.



Mean BM-hardness values by treatment and measurement method

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(Laboratory Test)

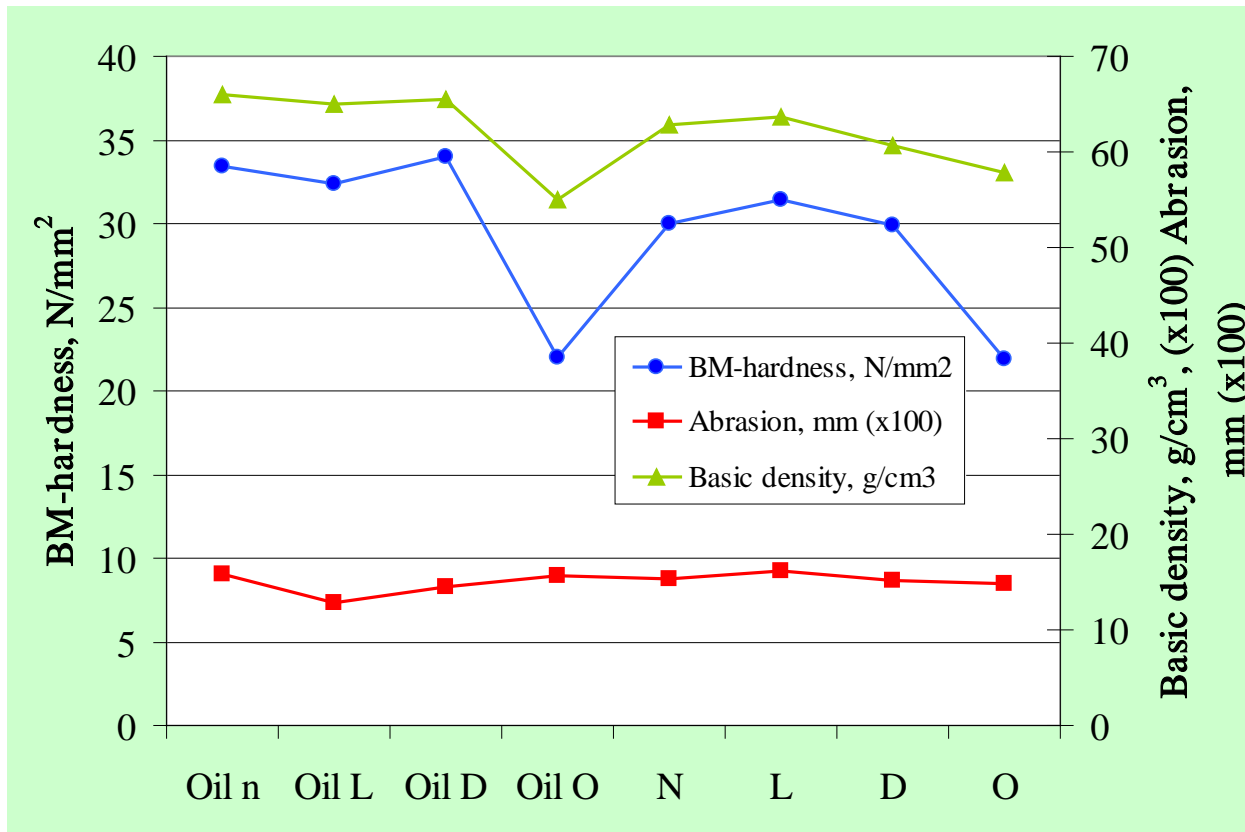


Steaming does not have significant effect on the BM-hardness.
Oiling slightly increased the hardness by natural and dark steamed Black Locust.
Oak-layer showed the lowest BM-hardness.



Is the BM-hardness test a reasonable approach for abrasion resistance? – Correlation tests

(Laboratory Test)



Abrasion/BM hardness:
 $R^2=0,23$

From that kind of investigations can be concluded, that however the **BM-test** are more convenient than the abrasion test, it **gives no reasonable results regarding the abrasion.**



- Element dimensions: 850 x 208 mm²
- Sample size: 6 units (taps) per each flooring type
- Relative humidity steps:
65% ⇒ 33% ⇒ 84%
- Determination of:
 - a/ Form stability in accordance with the German Standard of DIN 52181
 - b/ Dimensional stability (shrinking/swelling) in accordance with the Standard of EN 318/193



Performance of each sample was ranked into four classes. The material showing the least deformation/shrinking/BM hardness/abrasion resistance was ranked number 1 and that showing the highest was ranked number 4.

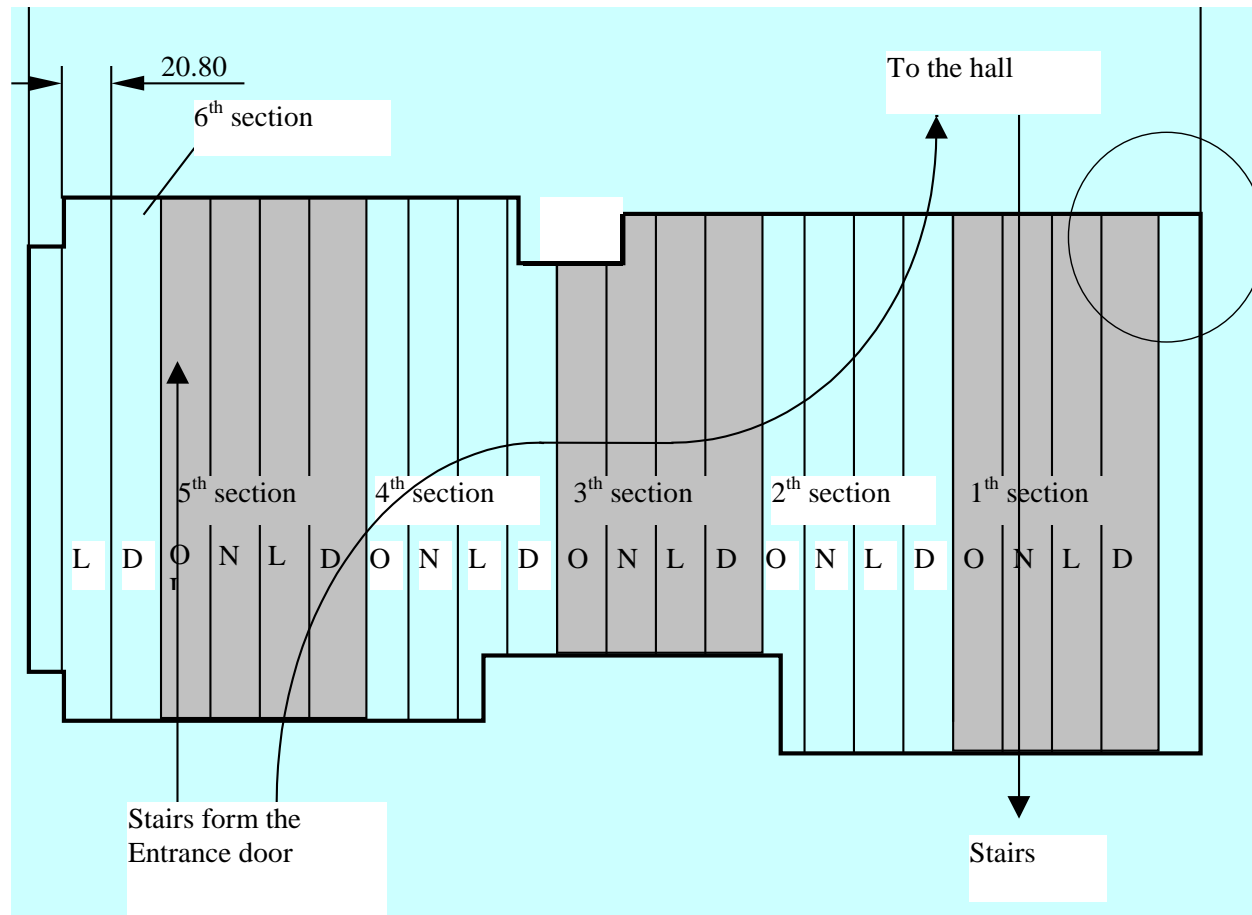
Mate-rial	Incr. in width		Incr. in length		Curv. in L.			Curv. in W.			BM-h	Abr. res.	Sum of classification numbers
	RH%		RH%		RH%			RH%					
	33	84	33	84	65	33	84	65	33	84			
L	2	2	1	1	1	2	1	2	1	1	1	1	16
N	2	2	1	1	3	1	2	3	1	1	1	2	20
O	1	2	1	1	2	4	3	1	1	1	2	2	21
D	2	1	1	1	4	3	4	3	1	1	1	2	24

In the table can be seen, that the flooring elements with **dark steamed** black locust top layer reached the highest scores, thus this material is the **most sensitive** against moisture changing and abrasion.

While elements with **light steamed** BL top layer showed the **highest stability** and abrasion resistance.



Indoor service test



Set up plan of pre-fab flooring layout

View of the pre-fab floor in the test area



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(Indoor service Test)





Indoor service test

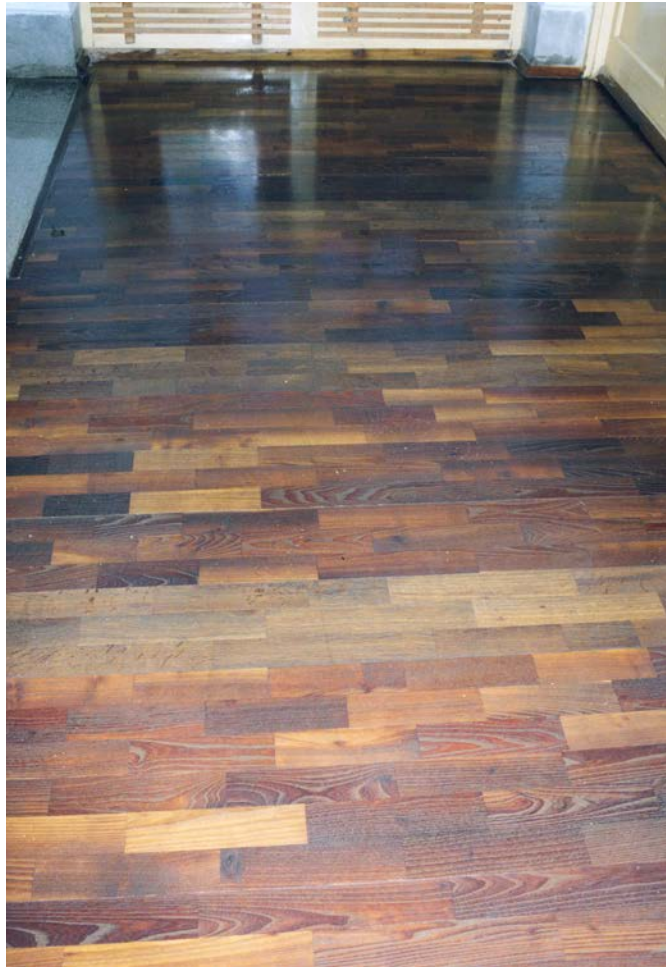
- Visual observations were recorded every three months.
- Intensified abrasion + extreme moisture changes





View of the pre-fab floor in the test area

(Indoor service Test)



Initial condition



After 5 years in service

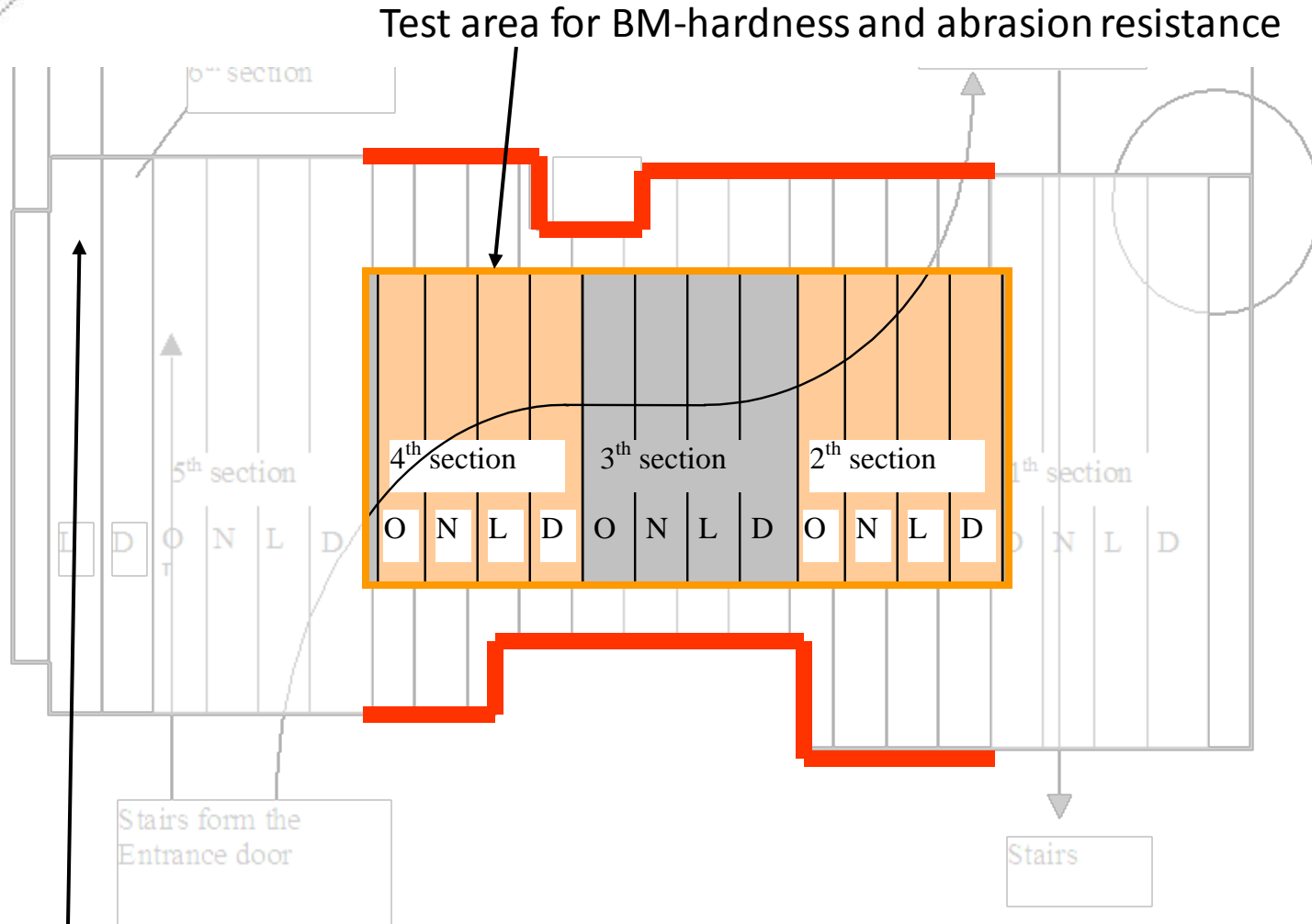


- Duration: 5 years
- 1st year (October) -
wet spots along the joints between taps and elements, by rainy weather and after cleaning.
- 2nd year (May) - colour became **grey** (in dry cond.).
Oiling wore down after 6 months.
- 2nd year (May) – 4th year (February) - no other noteworthy changes
- 4th year (May) -
top layer became **humpbacked** on 6 places regardless the wood species and position. Average area: 20-50 cm².



Designation of the measurement layout /after 5 years in service/

(Indoor service Test)

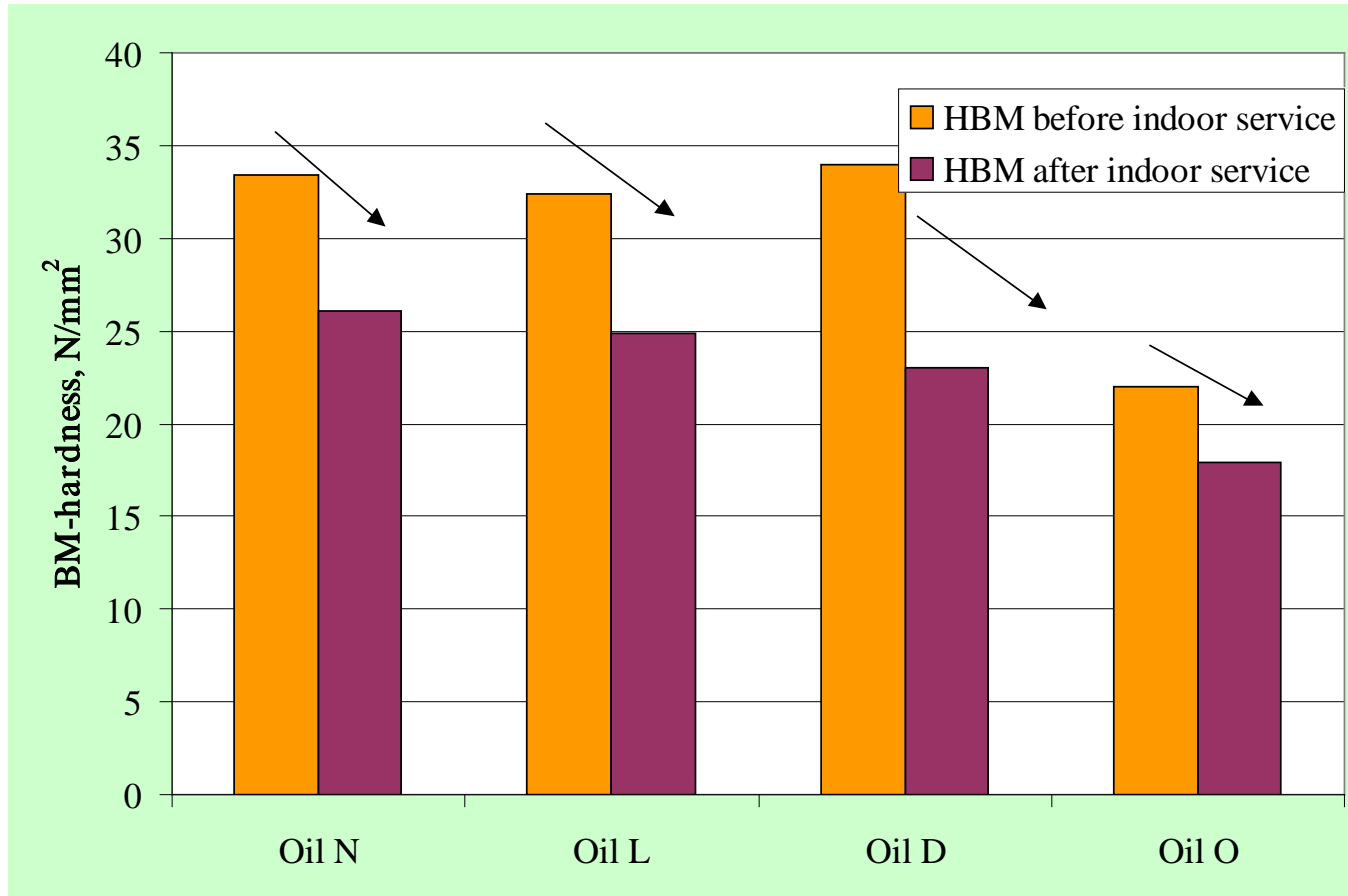


Without abrasion - control for thickness of the top layer



BM-hardness values after 5 years in service

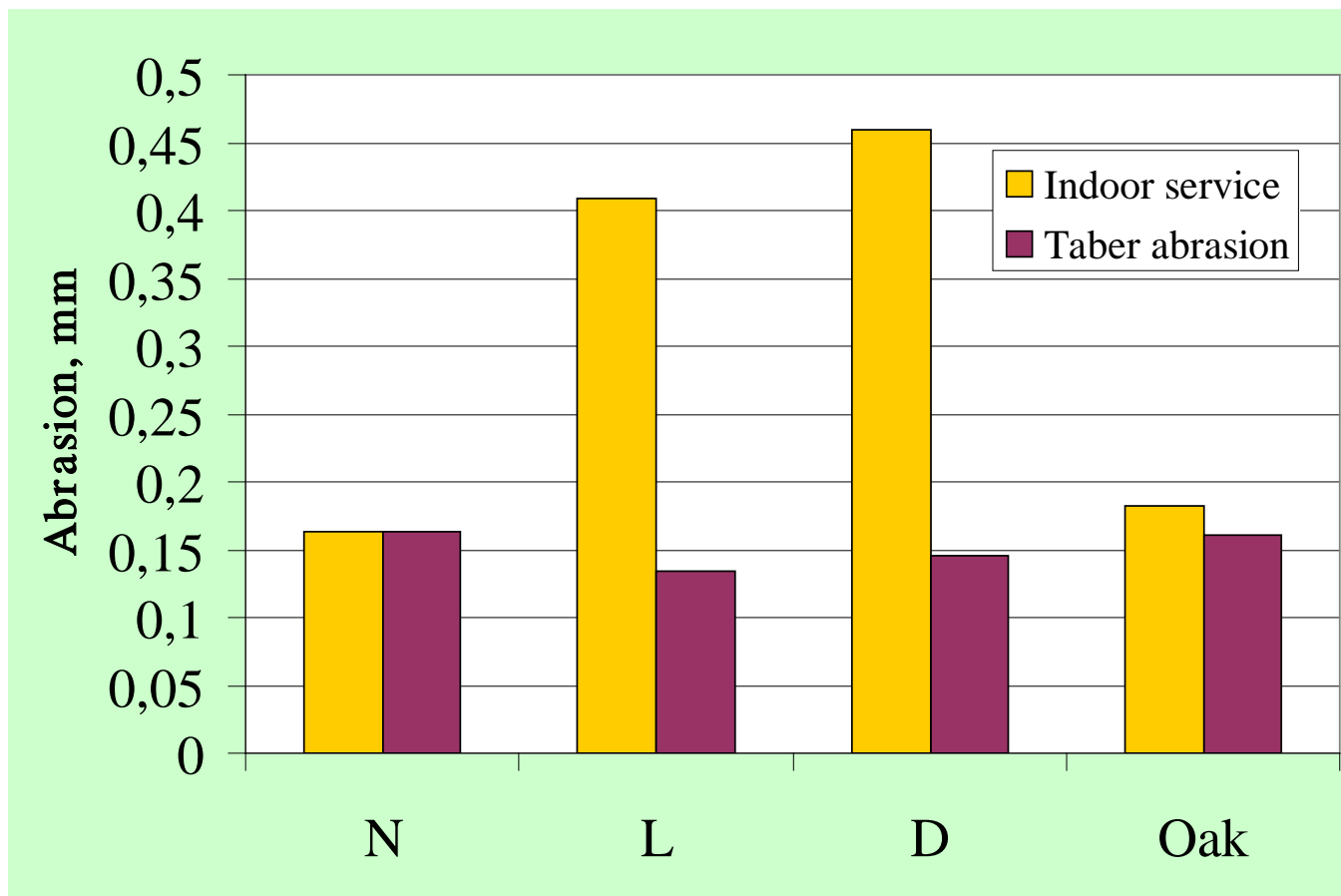
(Indoor service Test)





Abrasion values after 5 years in service

(Indoor service Test)



By natural BL and by oak nearly the same values.
By steamed BL higher abrasion after indoor service.

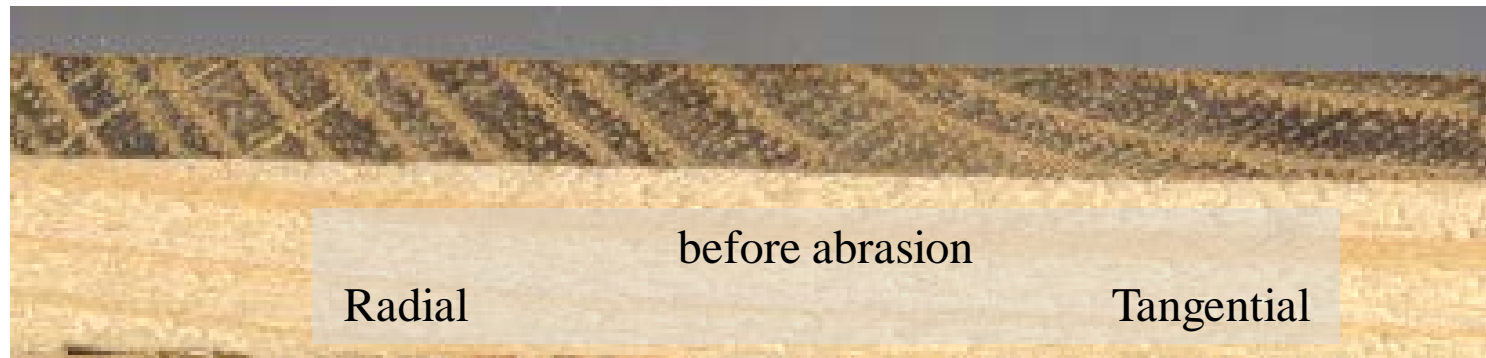


Surface character of the flooring after indoor service

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(Indoor service Test)

Radial and tangential sections from Black Locust



Differences between radial and tangential sections

- Radial section: rough surface, because of narrow early and late wood zones
- Tangential section: relative smooth and waved surface, because of wide late and early wood sections

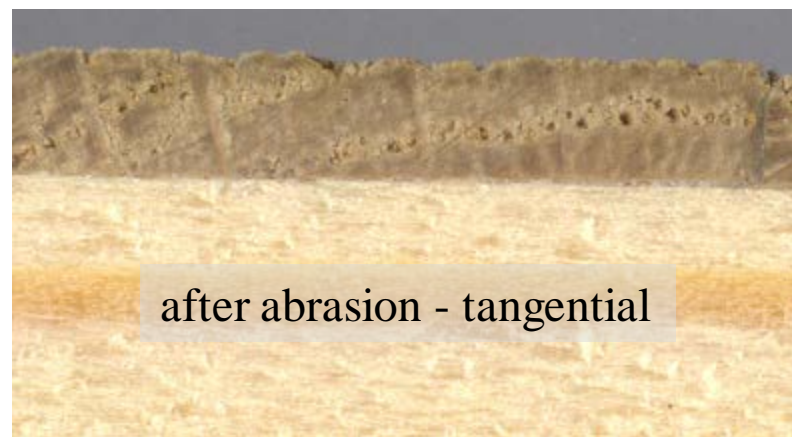
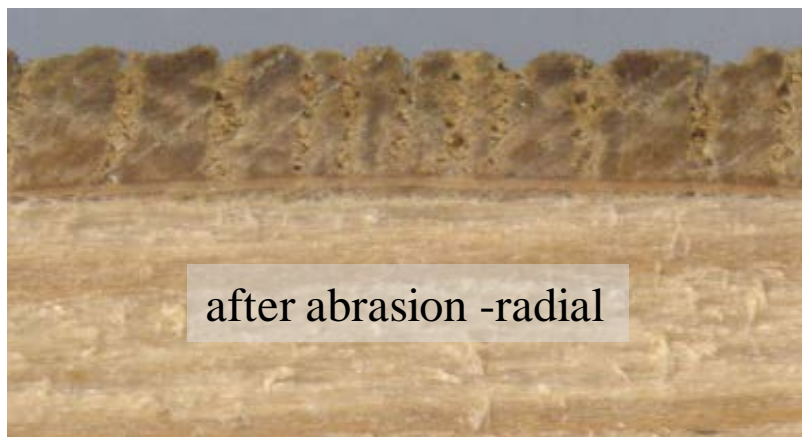
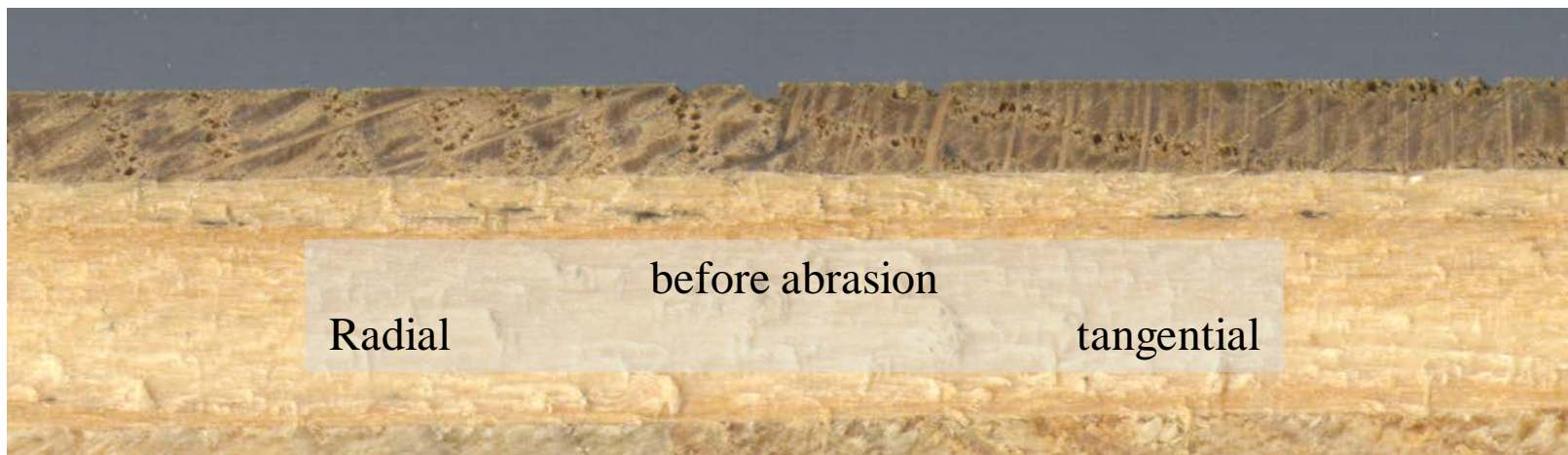


Surface character of the flooring after indoor service

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(Indoor service Test)

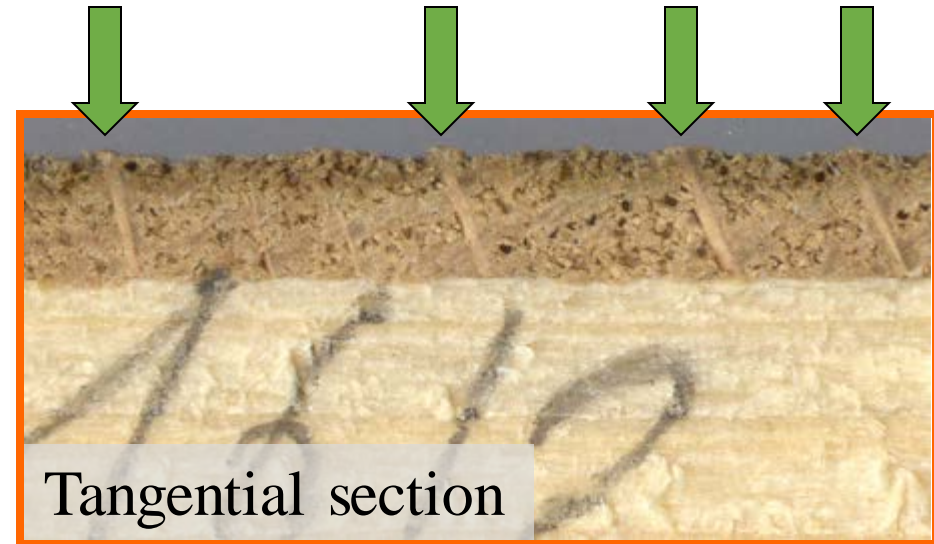
Radial and tangential sections from oak





Influence of large rays by oak

(Indoor service Test)





Conclusions

Laboratory tests

- **Abrasion**

The light steamed and dark steamed BL wood had the highest abrasion resistance.

- **BM-hardness**

Steaming does not have significant effect on the BM-hardness. Oak- layer showed the lowest BM-hardness.

- **Dimensional stability**

Flooring elements with dark steamed Black locust top layer showed the highest shrinking and curvature. Oakwood was the most stable material.

Indoor service

- **Abrasion**

The light steamed and dark steamed Black locust wood had the lowest abrasion resistance.

- **BM-hardness**

Steaming does not have significant effect on the BM-hardness. Oak- layer showed the lowest BM-hardness.

- **Dimensional stability**



Conclusions

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- Anatomical section of the top layer influences not only the appearance but during the service the roughness of the surface too.
- Rays by oak wood are more resistant against abrasion.
- Parquets with steamed Black Locust have comparable properties to parquets with oak top layer and therefore Black locust is safely recommended for substituting of oak.



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Thank you for your attention!