TreProX: Innovations in Training and Exchange of Standards for Wood Processing

STATUS OF THE POPLAR STANDARDS FOR ICELAND

ÓLAFUR EGGERTSSON

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TreProX
Landbúnaðarháskóli Íslands Agricultural University of Iceland
skógrækt in ICELANDIC FOREST SERVICE
Trétæknirádgjöf slf. Wood Technology
UNIVERSITY OF COPENHAGEN
Linnæus University
Erasmus+

Treprox, Denmark 22. September 2022

Status of the Poplar Standards for Iceland

(Vinna að nýjum staðli fyrir Alaskaösp)

Ólafur Eggertsson and Eiríkur Þorsteinsson

“What is a standard?”

Grading rules for timber

(Regluverk um það hvernig timbur er flokkað fyrir styrk)

Linnæus University

Trétækniráðgjöf slf.
Wood Technology

skógræktin

Grading rules for timber

(Regluverk um það hvernig timbur er flokkað bæði fyrir útlit og styrk)

Two main types of grading:

- Appearance grading (Útlitsflokkun á timbri, söluflokkun)
- Visual Strength grading: (Styrkleikaflokkun fyrir burðarvirki)

Load-bearing structures use construction timber that is sorted **mechanically or visually**.

The grade of wood can be specified using different parameters. Fewer and smaller knots, for example, result in a higher grade.

To evaluate the effect of the knots on strength, the grading regulations specify measurement rules for examples how the size of the knots must be measured and how they are evaluated.

- Size in relation to dimensions of wood (stærð kvista í hlutfalli við mál timburs)
- Positioning of knots (staðsetning kvista)

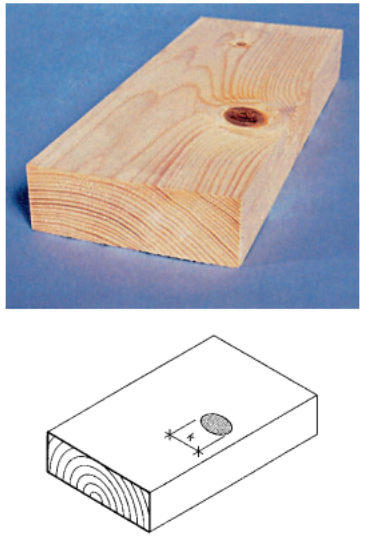
It is also necessary to make a visual valuation of other factors that affect the strength of the wood:

- Tree-ring width (breidd árhringja)
- Checks (sprungur í viðnum)
- Compression wood (þrýstiviður)
- Fungal attack (skemmdir vegna fúasvepps)
- Deformation

The Nordic standard used is INSTA 142. The classes are T0, T1, T2 and T3 and a relative strength class of C14, C18, C24 or C30.

Examples from ÍST INSTA 142:2009

Börkur sem umleikur kvist (yfirvaxinn kvistur) skal mæld-
ur með kvistinum.



Mynd 3 Mæling á kvistum (meginregla)

Ef tveir kvistir eru vegna óreglulegrar trefjastefnu ekki greinilega aðskildir, ætti að mæla þá sem einn kvist.

Kvistir sem eru alveg eða að hluta til í sama fleti í lengd-
arstefnu efnisins eru mældir sem einn kvistur. Þetta gildir einnig þótt kvistirnir séu hluti af kvistahópi. (Sjá mynd 4 og 15).

Kvistir sem eru 7 mm eða minni (í breiðhlið eða kanti) eru ekki mældir.

Bark around a knot (encased knot) is measured together with the knot.

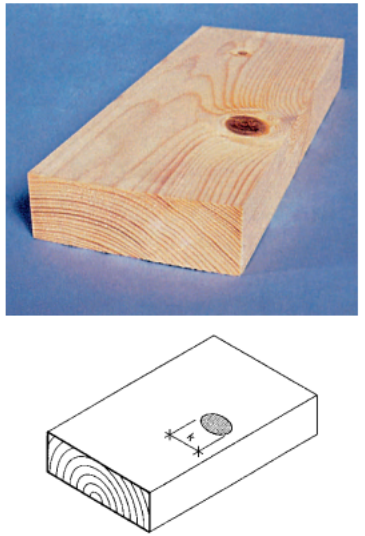


Figure 3: Measurement of knots (main principle)

When due to fibre irregularities two knots are not clearly separated, the knots should be measured together as one.

Knots overlapping in the length direction of the piece are measured as one single knot, i.e. the overlap is measured only once, the overlapping knots in principle constituting a knot cluster (see figures 4 and 15).

Knots that, on one side (face or edge), has the width 7 mm or less are for that side disregarded irrespective of their location.

6.2.2 Timber with thickness ≥ 45 mm or width > 75 mm.

Table 1 – Requirements for strength reducing features.

Strength grade	T3	T2	T1	T0
Single knots	Edge: Not more than 1/3 of the thickness Face: Not more than 1/6 of the width	Edge: Not more than 1/2 the thickness Face: Not more than 1/4 of the width	Edge: Not more than 4/5 of the thickness Face: Not more than 2/5 of the width	Edge: Allowed for the thickness Face: Not more than 1/2 the width
Splay knot with small angle to axis	Not permitted	Edge: Evaluated as a single knot. Face: Length not more than the width of the piece.		Permitted
Knot clusters	Maximum knots measure equal to the sum of largest permitted face knot and largest permitted edge knot			
Knots in squares	Not more than 1/5 of the side	Not more than 2/5 of the side	Not more than 3/5 of the side	Not more than 4/5 of the side
Knot clusters in squares	Maximum knots measure not greater than 4 times the measure of the largest permitted single knot			
Slope of grain	Not more than 1:10	Not more than 1:8	Not more than 1:6	Not more than 1:4
Width of annual rings	Not greater than 4 mm	Not greater than 6 mm	Not greater than 8 mm	No limit
Ring shakes	Not permitted	Permitted to a total width (both sides of the pith) of 50 mm (depth = 25 mm) and up to 0,5 m in length		Permitted up to 1m in length
Checks, not through the piece (aggregated length))	Checks with a depth less than half the thickness of the piece are permitted without limitation.			
	Permitted up to 1,5 min length or 1/2 of the length of the piece, whichever less.		Permitted up to 1 m in length or 1/4 of the length of the piece, whichever less. Not permitted if intersecting an arris.	Permitted up to the full length of the piece.
Checks, through	Permitted only in the ends of the piece to a length equal to the width of the piece or 150 mm, whichever less.			Permitted up the aggregated length 0,5 m. Permitted in the ends of the piece to a length equal to the width of the piece or 150mm, whichever less
Top rupture and curly grain	Permitted up to 1/4 of the width of the piece. Not permitted in the outer 1/4 of the width.	Permitted up to 1/2 of the width of the piece. Not permitted in the outer 1/4 of the width		Not greater than 3/4 of the width.
Compression failure	Not permitted			Minor damage permitted.

Table 29/30 **Grading of construction timber**

Strength class	C14	C16	C18	C20	C22	C24	C27	C30	C35	C40	C45	C50
Visual grading in line with SS 230120	T0		T1			T2		T3				
Mechanical grading in line with SS-EN 338		C16	C18	C20	C22	C24	C27	C30	C35	C40	C45	C50

The strength classes marked in orange are the manufacturing standard for Swedish manufacturers of strength graded construction timber.

Strength class C14 (T0)
Strength class C14 is used for wall studs in load-bearing internal and external walls with deformation requirements that are not too stringent.

Strength class C18: (T1)
Strength class C18 can be used for load-bearing structures that do not require high strength, or where it is possible to use large dimensions or short lengths.

Strength class C24: (T2)
Strength class C24 is used in load-bearing structures that require high strength, such as roof trusses and floor systems. Construction timber in strength class C24 is available in most timber stores.

Strength class C30: (T3)
Strength class C30 is suitable for load-bearing structures that require high strength but cannot make use of large dimensions.

The Nordic standards

The Nordic standard **INSTA 142: 2008** is a revision of **INSTA 142:1997**

In the former standard INSTA 142:1997 Populus was included in the standard but removed when it was reviewed in 2008.

From INSTA 142:2009

A.1.1 Structural timber visually graded to T-timber The standard covers the species spruce (Picea abies), sitka spruce (Picea sitchensis), pine (Pinus sylvestris), fir (Abies alba), douglas fir (Pseudotsuga menziezii) and larch (Larix decidua, Larix eurolepis, Larix kaempferi).
Other species can be added after evaluation by the INSTA 142 Technical Committee.

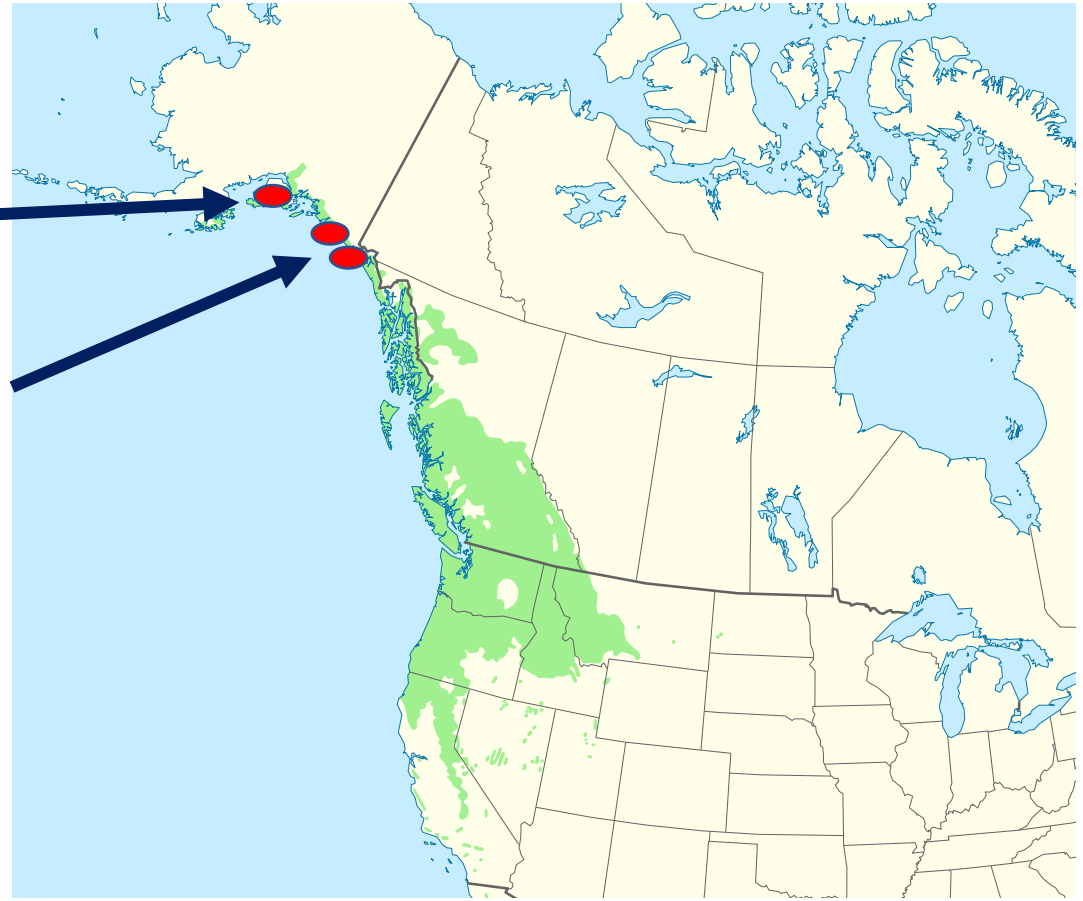
Black cottonwood in Iceland (Alaska poplar)

Places of origin of poplars (Populus trichocarpa) in South-Alaska

Kenai-peninsula, the first collection, in 1944 (Sensitive to spring frost)

Cordova and **Yakutat** regions are mainly used in Iceland now. Most of them are from a collection in 1963

- Alaskan poplar is a large deciduous tree belonging to the willow family (Salicaceae).
- It is one of the largest of some 40 species of *Populus* and is the tallest, fastest-growing hardwood in the western United States.



Populus trichocarpa range map

Cottonwood is a common tree along rivers and streams throughout the West USA

Poplars are the only broadleaved trees that can be used in Icelandic forestry except the native rowan and birch

- They are well suited for breeding programs
- Poplars are fast growing, the fastest growing tree species in Icelandic forestry.
- There is a lot of (marginal) land available for poplar in Iceland
- There is a good market for the products from Alaska poplar, e.g., in industry.

An example of an ongoing breeding program in south Iceland

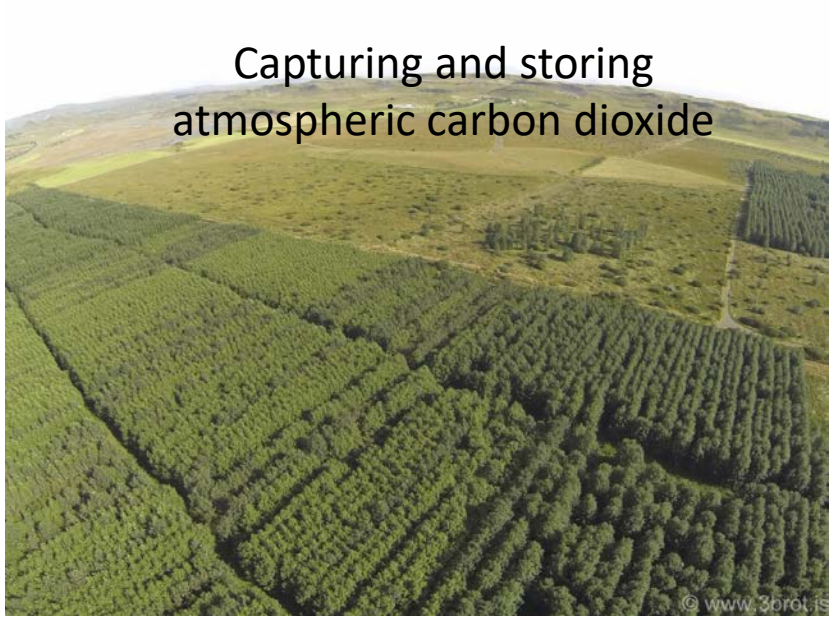
Breeding in order to obtain clones with:

- increased yield.
- improved resistance against diseases and pests.

Use of poplars in Iceland

- Street trees
- Shelter
- Land reclamation
- Wood production
- Biomass and energy
- Carbon sequestration

Street trees



Capturing and storing atmospheric carbon dioxide

Wood production

Biomass

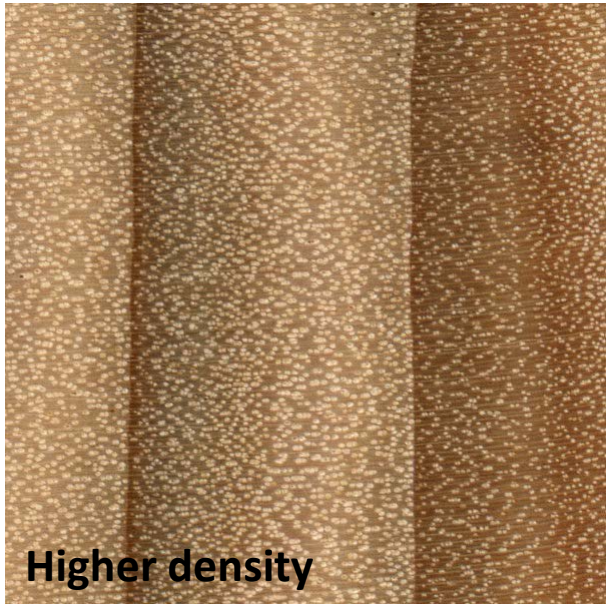
Land reclamation

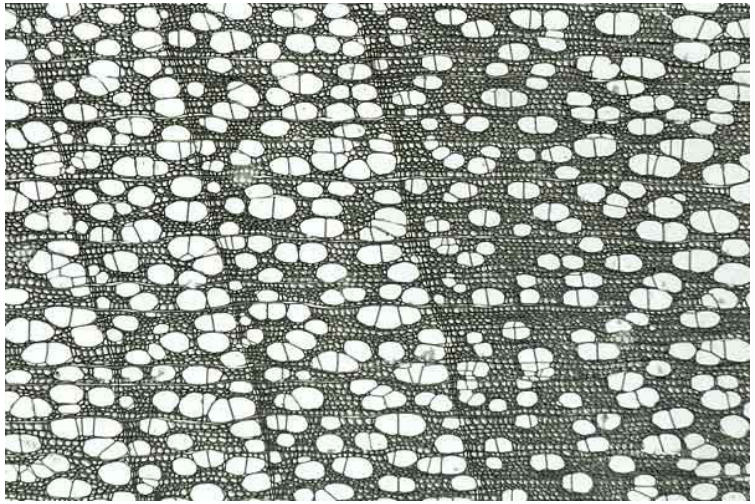
The wood anatomy of Alaskan Poplar

(Viðarfræði Alaskaaspar)

- The wood tends to be a light brown to white , often with a “false” dark brown heartwood (kjarna).
- They all have relatively small pores
- Anatomically, the Alaskan poplar is diffuse porous.

Alaska poplar “false” heartwood





Can we use e.g Alaskan poplar for constructions

For that we need a “standard” for Alaskan poplar.

The first step is to study the following parameters in Alaskan poplar.

- **Basic density** (grunneðlisþyngd):
- **Bending strength (MOR)** (beygjutogþol): is a measure of a wood's strength before rupture (brake).
- **Modulus of elasticity (MOE)** (stífni):is a measure of the stiffness of the wood.

CE

Identification number of FPC certification body

Producer identification

Marking year

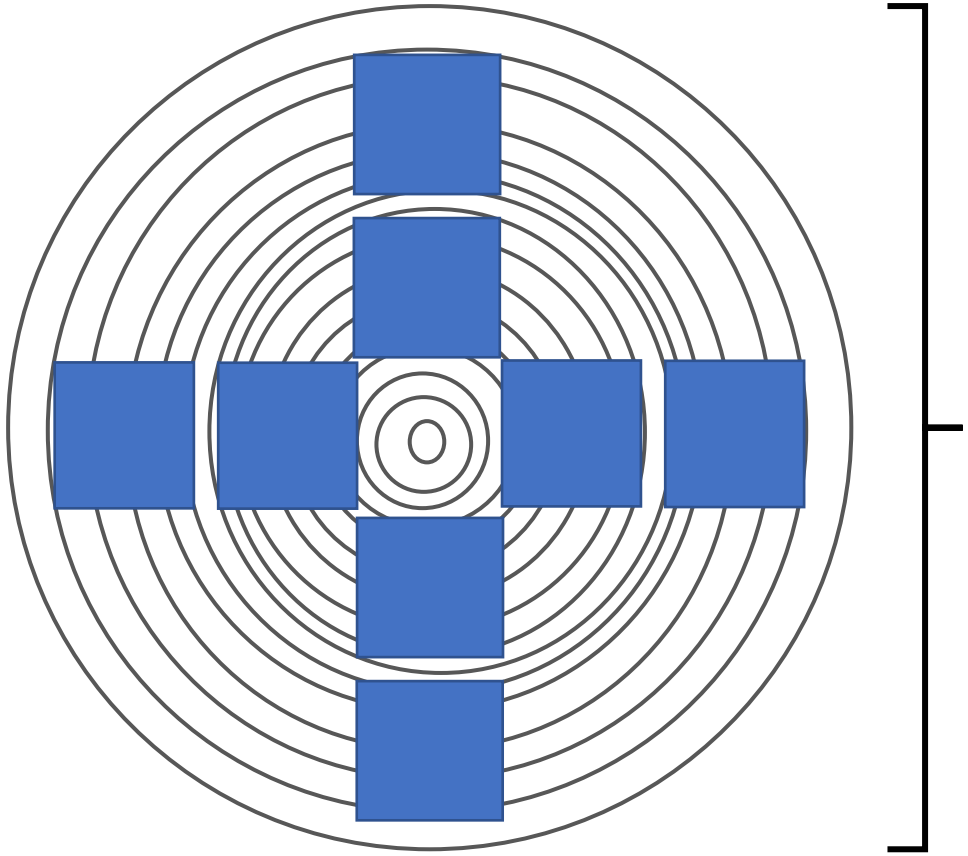
FPC certificate number

EN 14081-1	
Structural timber	
Strength class	C24 (S10)
Species code	Spruce (PCAB)
Grading standard	EN 338 and DIN 4074-1
Reaction to fire	D-s2, d0
Durability class	4

The material that was tested

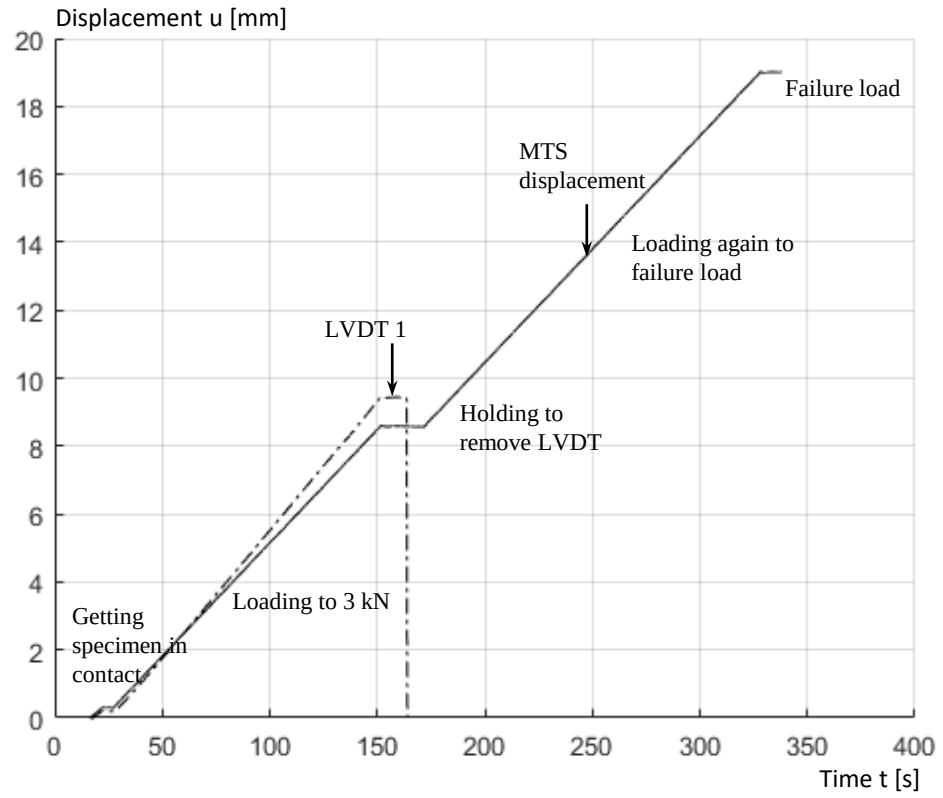
The material was collected and tested according to ISO 3129 and ISO 13061 standards for small clear wood specimens. Tested at Linnaeus University in Sweden and Límtré vírnet ehf.

The size of tested pins is 30*30*400 mm

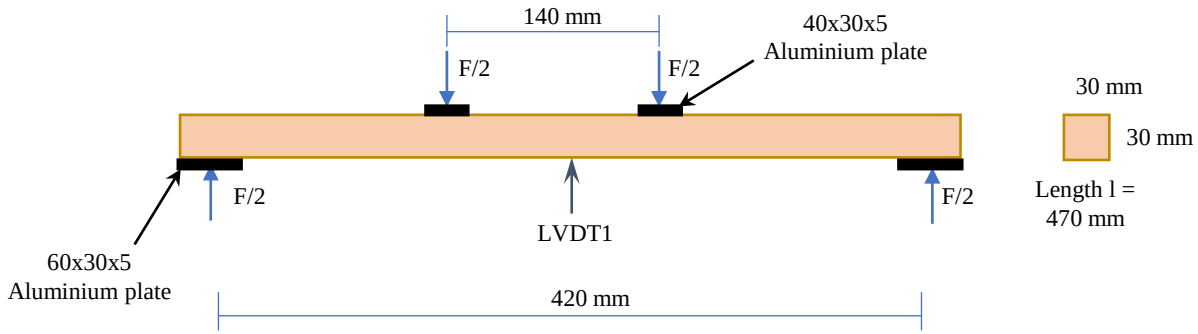


Experiment setup

4 point bending Test



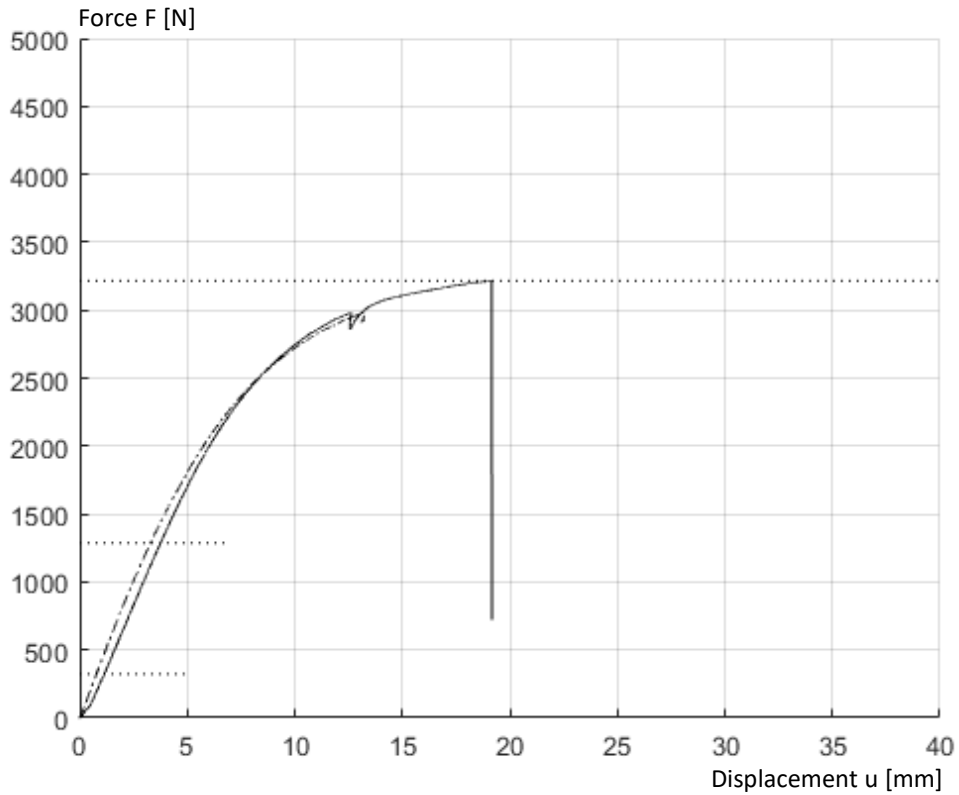
Displacement time curve for load procedure



Experiment setup

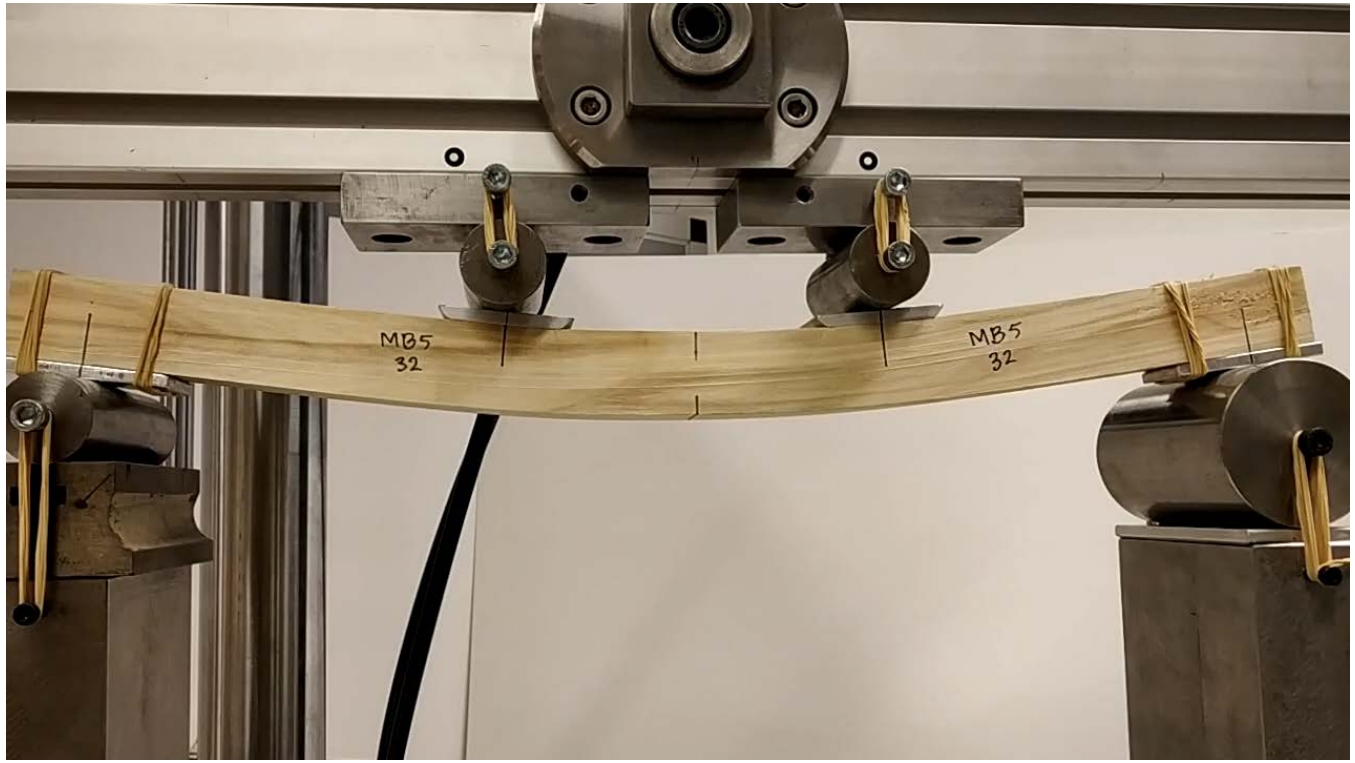
Linnæus University

Sampel video, Alaskan Poplar



Force displacement curve

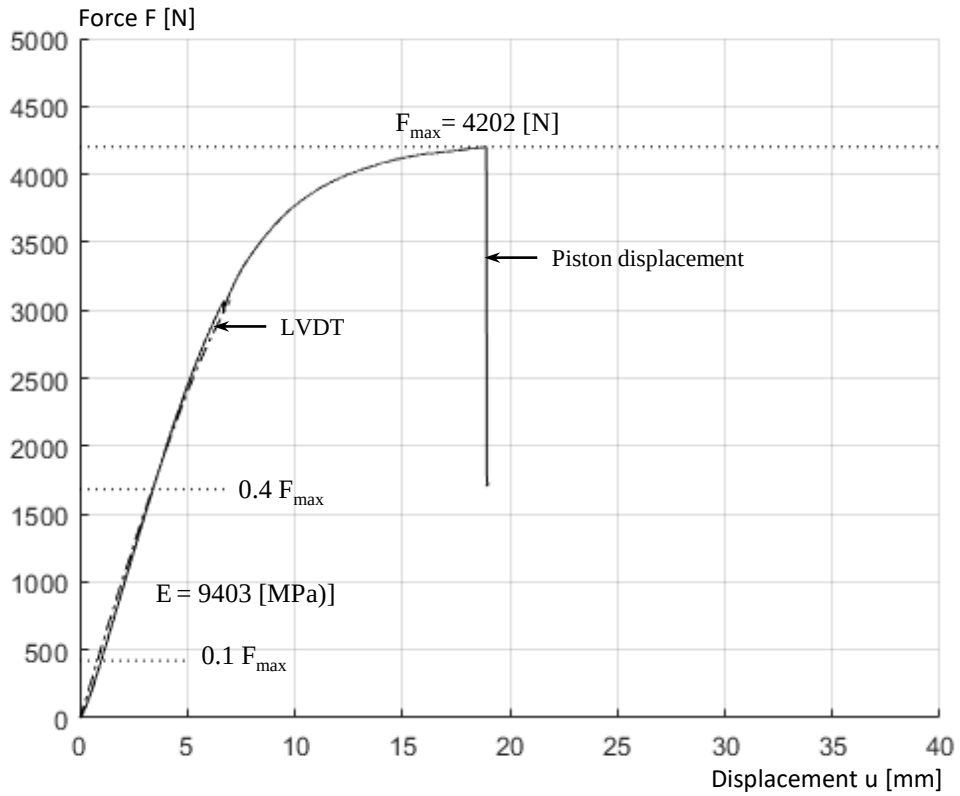
rate of loading 6 mm/min



Linnæus University

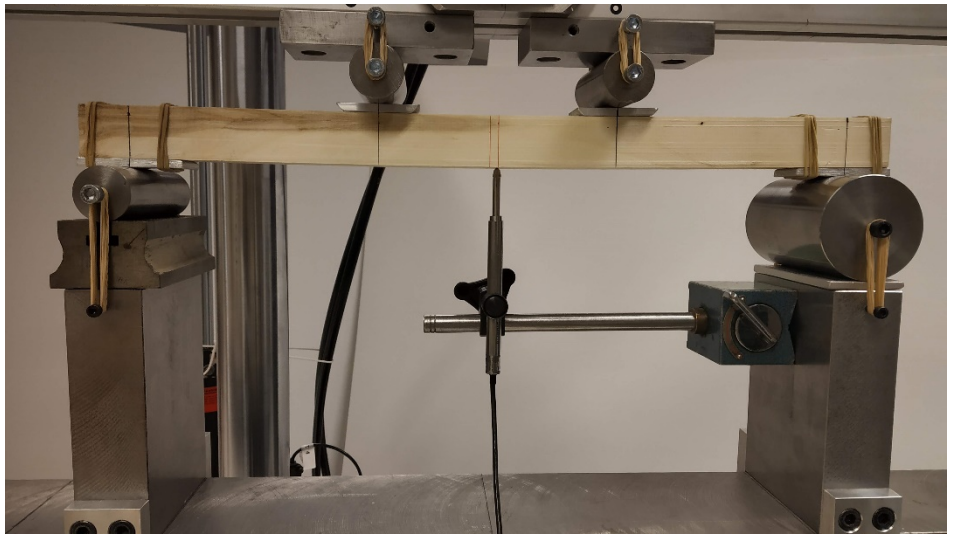
4 point bending Test

Specimen 08, CB9



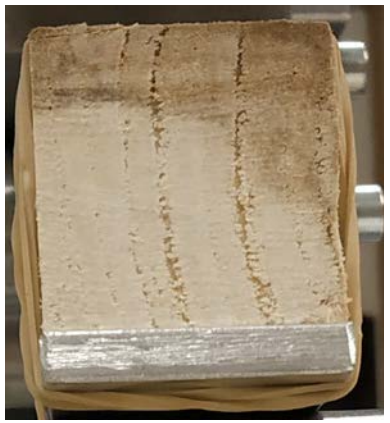
Force displacement curve

rate of loading 5 mm/min

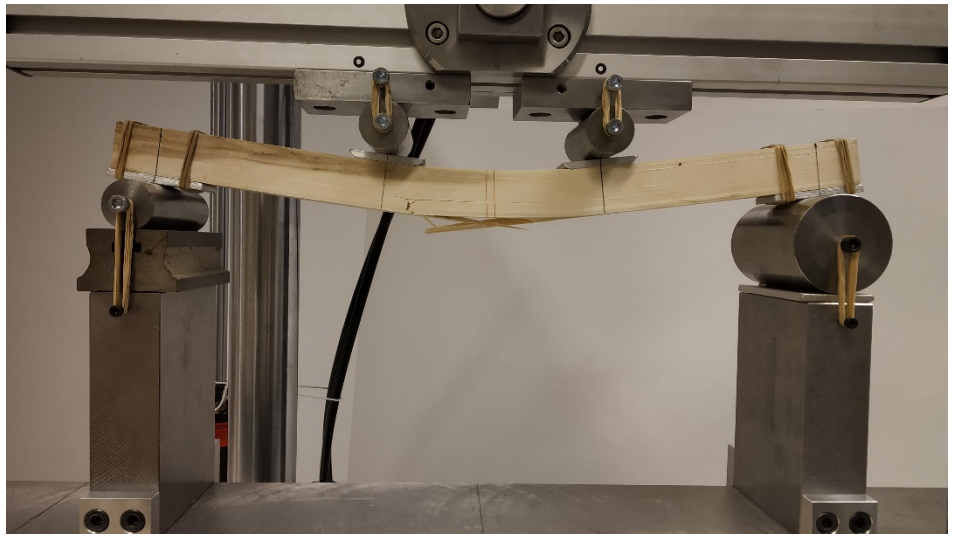


Loading specimen

Cross section A



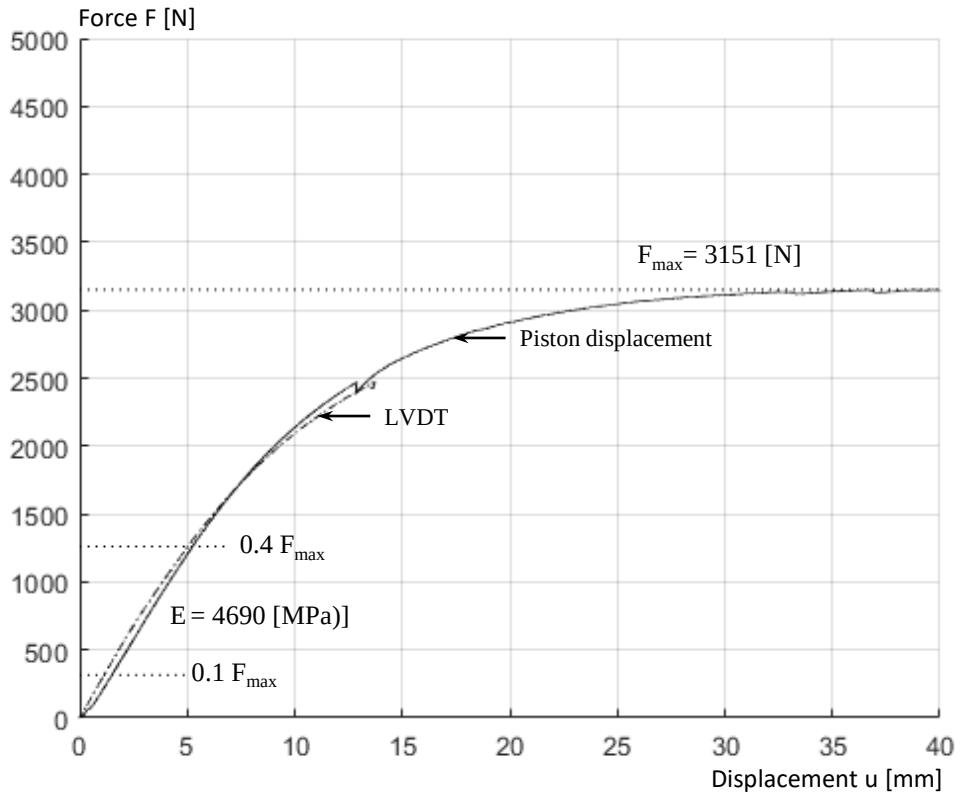
Cross section B



Failure point

Linnæus University

Specimen 19, CA7

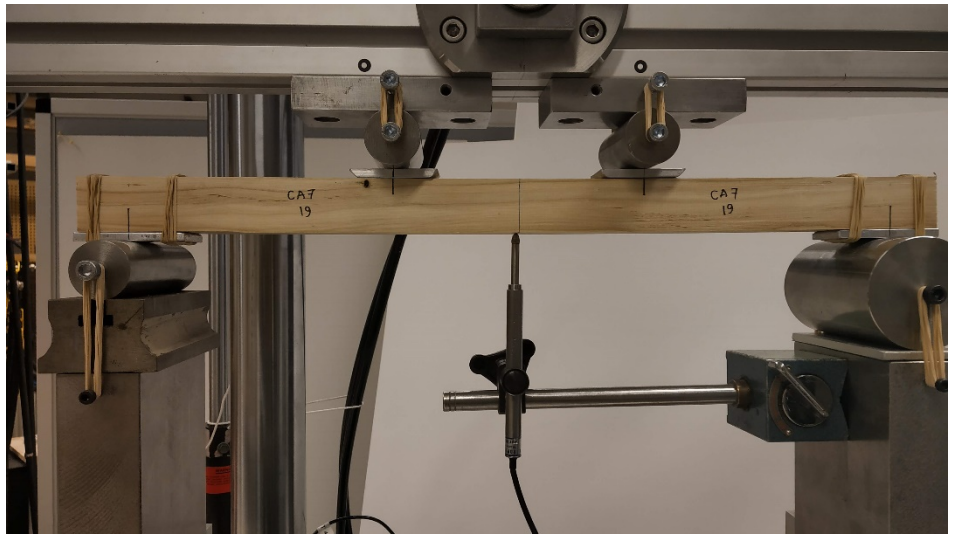


Force displacement curve

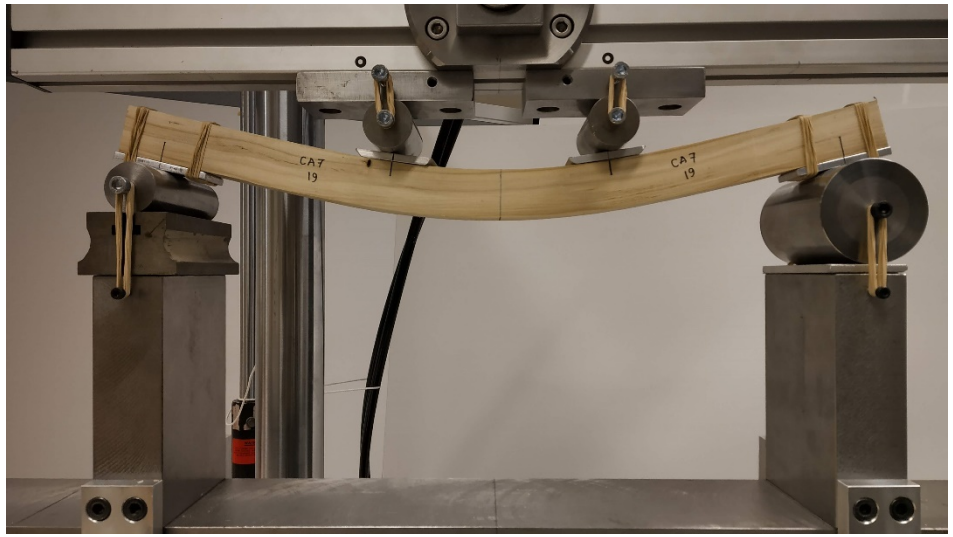
rate of loading 6 mm/min

Cross section A

Cross section B



Loading specimen



Failure point

Linnæus University

Results: Basic density (grunneðlisþyngd):

Location	No	Klónn/kvæmi	Basic density g/cm³	Staðalfrávik	Number of samples
Hallormsstaður	Tré nr 1	Kenai Lake	0,343	0,027	40
Hallormsstaður	Tré nr 2	Kenai Lake	0,346	0,027	25
Hallormsstaður	Tré nr 3	Kenai Lake	0,345	0,023	20
Hallormsstaður	Tré nr 4	Kenai Lake	0,347	0,028	25
Suðurland	Tré nr 1	Iðunn	**0,437**	0,023	9
Suðurland	Tré nr 2	Iðunn	**0,426**	0,025	8
Suðurland	Tré nr 3	Iðunn	**0,432**	0,025	16
Suðurland	Tré nr 1	Espiflöt	0,344	0,019	32
Suðurland	Tré nr 1	Yakutat 14/20	0,292	0,022	59
Suðurland	Tré nr 1	Cordova 10/3	0,340	0,021	5

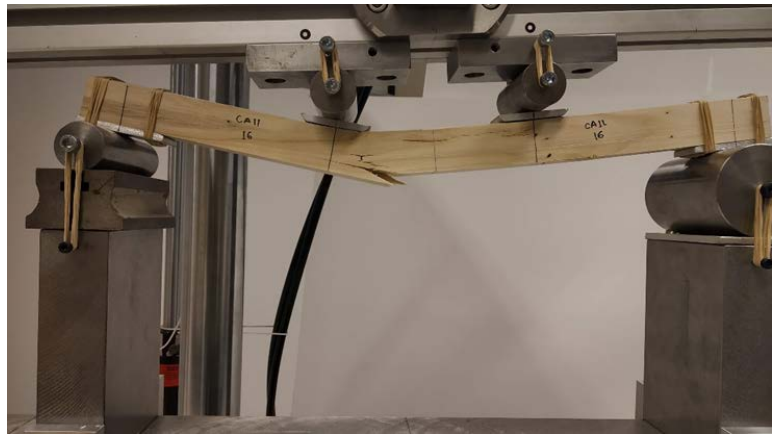
Results: Bending strength (MOR) and Modulus of elasticity (MOE) (stífni)

Location	No	Klónn/kvæmi	Bending strength (MOR) N/mm2	Modulus of elasticity (MOE) N/mm2
Hallormsstaður	Tré nr 1	Kenai Lake	62,51	6064
Hallormsstaður	Tré nr 2	Kenai Lake	65,00	6433
Hallormsstaður	Tré nr 3	Kenai Lake	68,27	5940
Hallormsstaður	Tré nr 4	Kenai Lake	70,12	6204
Suðurland	Tré nr 1	Iðun	**66,58**	5527
Suðurland	Tré nr 2	Iðun	**72,56**	6356
Suðurland	Tré nr 3	Iðun	**72,35**	5937
Suðurland	Tré nr 1	Espiflöt	59,91	4977
Suðurland	Tré nr 1	Yakutat 14/20	**54,39**	5264
Suðurland	Tré nr 1	Cordova 10/3	61,97	5210

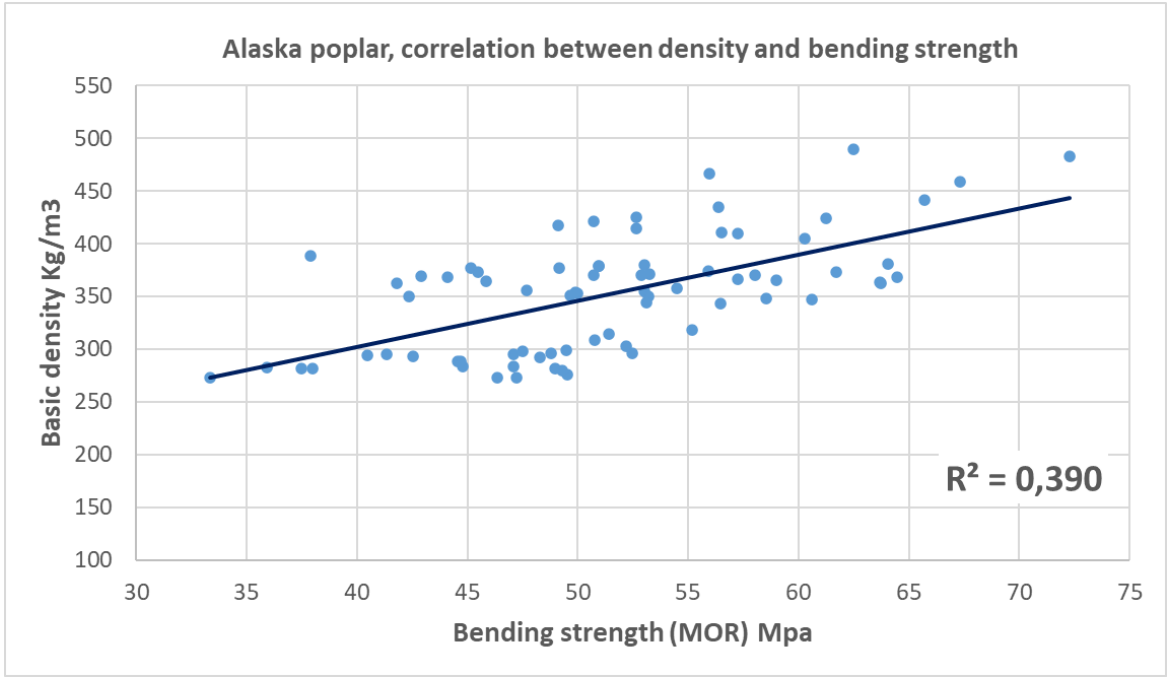
Comparison between species in Icelandic forestry

Tree species	**Bending strength (MOR)** (beygjutogþol)	**Modulus of elasticity (MOE)** (stífni)	**Basic density** (grunneðlisþyngd) Kg/m3
Larix sibirica	92	11697	539
Sitka spruce	74	10444	377
Pinus contorta	71	8278	407
Alaska poplar	**63 (**35-70**)**	**7044 (**3800-9500**)**	**360 (**280-480**)**

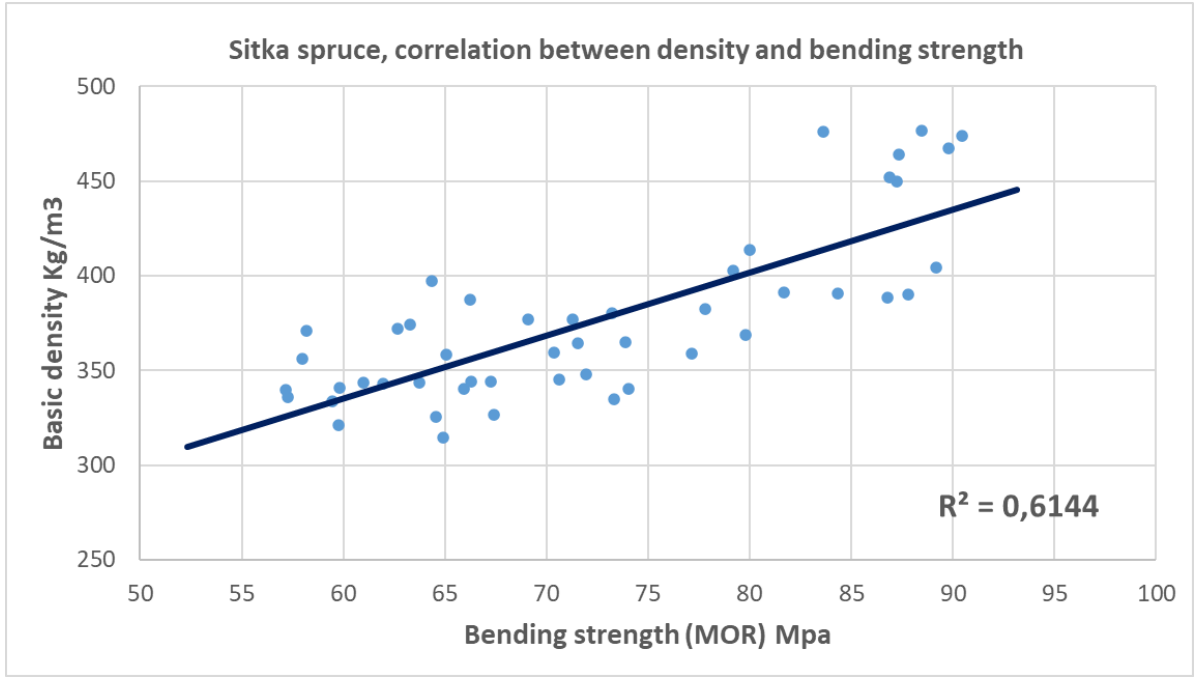
Correlation between **Basic density** (grunneðlisþyngd) and **Bending strength (MOR)** (wood's strength, beygjutogþol)



Alaska poplar



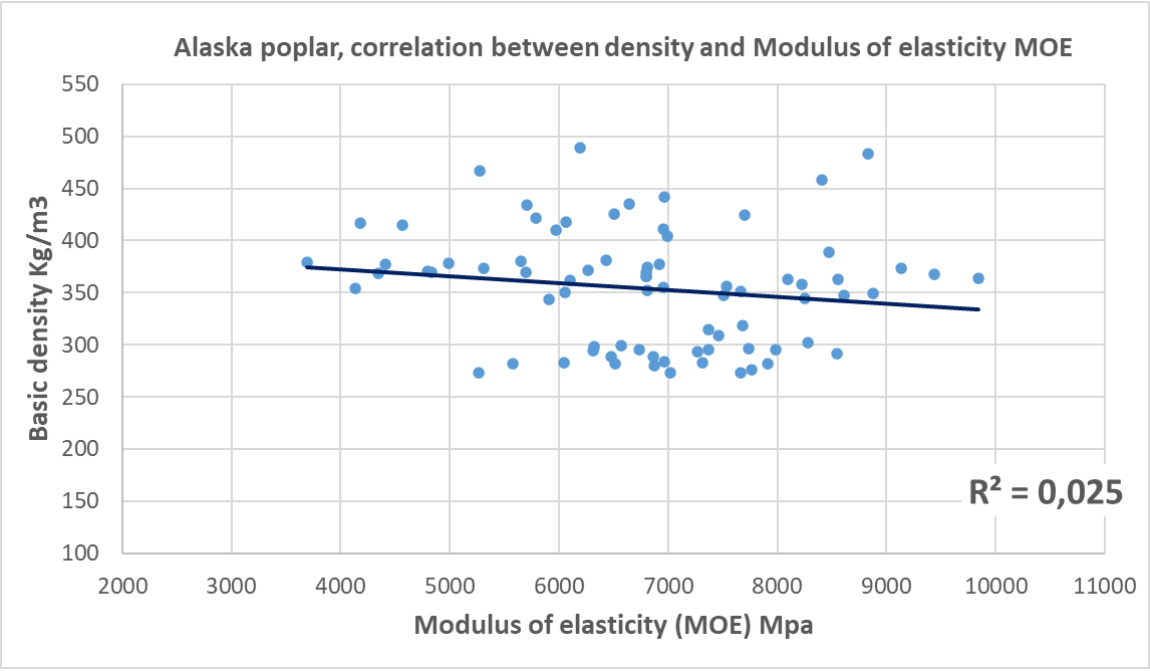
Sitka spruce



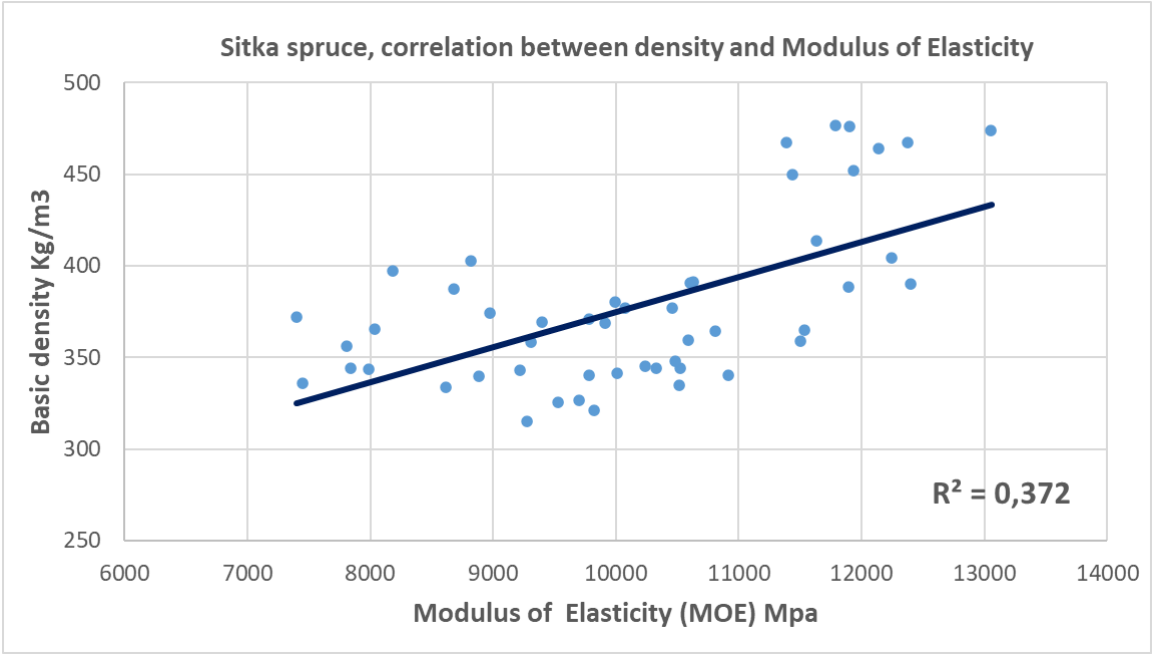
Rather good correlation within both tree species

Correlation between **Basic density** (grunneðlisþyngd), **and Modulus of elasticity (MOE)** (stífni):

Alaska poplar



Sitka spruce



No correlation within Alaska poplar but relatively good correlation for Sitka spruce

Conclusions

- Alaska poplar is the fastest growing tree-species in Icelandic forestry.
- Alaska poplar has relatively low Modulus of elasticity and bending strength values compared to coniferous tree species used in Icelandic forestry.
- The basic density is relatively high and there is a good correlation between bending strength and basic density.
- There is quality difference between clones making it possible to breed for better poplar wood.

According to our results of the Alaska poplar samples to wood can be used as construction timber.

In Italy, the PoplyHouse system, that uses poplar plywood for the design and construction of entire building.
Interior and exterior.

Was awarded in 2021 Sustainability Award of the Agency for Energy and Sustainable Development

Poplar timber House in Finland

https://www.woodmizer-europe.com/Blog/Articles/building-an-aspen-timber-octagonal-house-in-finland

Vallanes East Iceland

A house build nearly entirely form Alaska poplar

Thanks


Trétæknirágjöf slf.
Wood Technology


Erasmus+


Linnæus University


skógræktin
ICELANDIC FOREST SERVICE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Agricultural University of Iceland