HANDBOOK OF FINNISH PLYWOOD

HANDBOOK OF FINNISH PLYWOOD

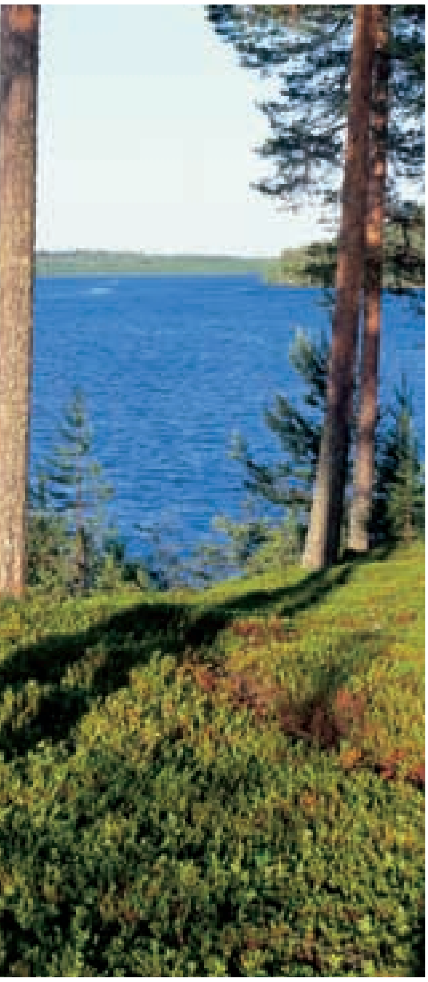
® FINNISH FOREST INDUSTRIES FEDERATION
Printed by Kirjapaino Markprint Oy, Lahti, Finland, 2002
ISBN 952-9506-63-5
Paper: Galerie Art Silk 130 g
Cover: Avanta Ultra 240 g

CONTENTS

FOREWORD

The implementation of CE marking and Eurocode 5 design rules for the structural use of timber and wood based panel products has lead to the publication of this completely revised Handbook of Finnish Plywood. The revised publication has been prepared by the Finnish Forest Industries Federation in co-operation with the Finnish plywood manufacturers: Schauman Wood Oy, Finnforest Oyj, Koskisen Oy and Visuvesi Oy. This new edition of the Finnish Plywood Handbook cancels and replaces the previous edition published in 1991 by the Association of Finnish Plywood Industry (AFPI).

The information published in this edition of the Handbook complies with the requirements of the current European standards (EN) and the requirements of Eurocode 5 design rules for the structural use of plywood. In addition to the constructions listed herein, some manufacturers of Finnish plywood have additional special plywood constructions developed for specific end uses.



FINNISH PLYWOOD 1

Finland has developed its expertise as the major European plywood producer over the last 100 years. Today Finnish processed birch plywood is one of the most advanced wood based panel products for a wide variety of demanding end uses in the construction, vehicle and other specialist industries. The other main plywood product range is based on spruce as its raw material. The Finnish industry has introduced during recent decades new more efficient and environmentally friendly technology to produce excellent spruce plywood mainly to meet the needs of the construction industry.

1.1 WOOD, THE MOST IMPORTANT RAW MATERIAL

The most important raw material for plywood is a renewable natural resource - wood. Finnish birch (*Betula pendula*, hardwood) and spruce (*Picea abies*, softwood) are the most important raw materials in the plywood process. Trees grow slowly in Finland's climate and thus the wood it produces is close-grained and of consistent high quality.

Birch is of uniform consistency and it has excellent strength, peeling and gluing properties. Spruce is a less dense and more economical wood species for spruce throughout plywood and in special constructions of mixed birch and spruce veneers.

1.2 GLUE

The vast majority of Finnish plywood is of cross-banded construction bonded with phenol resin adhesive. Normal gluing quality is suitable for use in exterior (service class 3) situations when properly protected. A small part of Finnish cross-banded plywood production is bonded with urea formaldehyde glue. These boards are suitable for use in dry (service class 1) or humid (service class 2) conditions.

The phenol formaldehyde gluing fulfils the requirements of EN 314-2 class 3 exterior. The gluing quality may still be referred to earlier national classification such as DIN 68705: BFU 100 or BS 6566: WBP.

Finnish phenol formaldehyde glued plywood products exhibit very low levels of formaldehyde emissions. Urea formaldehyde glued products have slightly higher values but they still fulfil the requirements of the most demanding European standards relating to formaldehyde emission and content.

1.3 QUALITY CONTROL AND SAFETY MANAGEMENT

Finnish plywood producers apply advanced management and quality assurance system to their production. At all stages of manufacture the plywood is controlled for veneer thickness, glue spread, dimensional accuracy, overall thickness, bonding strength and other requirements. In addition Finnish plywood undergoes unique independent quality control under the supervision of VTT (Technical Research Centre of Finland). Industrial standards are strictly followed to meet the requirements of the European standards (EN) for plywood.

Finnish industrial culture is advanced in many respects. Whilst manufacturing quality and competitiveness have been major concerns for the industry, safety issues have not been neglected. Basic regulations are set by government and other authorities, and production audited by external bodies. Its own safety management systems take care of the continuous development of safe, effective and high quality production.

In addition most of the Finnish plywood manufacturers have certified quality and environmental management systems to ISO 9000 and 14001 standards.

1.4 FORESTS AND THE ENVIRONMENT

Finland's forests cover 23 million hectares (nearly two thirds of its land area) and represent the country's most important natural resource. The beginning of active forest management dates back to the 19th century, creating a firm basis for the development of the country's forest products industry. Thanks to good forestry practices and sustainable forest management, the annual growth of Finnish forests exceeds the amount harvested. The total growing stock of commercial forests in Finland at present amounts to about 1900 million cubic metres. As a result of efficient forest management, combined with a pioneering forest products industry, Finland has developed into one of the world's leading forest industry countries. One third of the Finland's export earnings come from its forests.

Family forestry is the cornerstone of the Finnish wood industry. Three quarters of the wood raw material used by its industry comes from private forests. Ownership is divided over a broad spectrum of the population, every fifth Finnish family owning some forest. Another cultural aim, in addition to maintaining the growing stock, is to preserve a natural

DNV

DET NORSKE VERITAS

QUALITY SYSTEM CERTIFICATE

CERTIFICATE

This is to certify that

THE QUALITY SYSTEM

has been found to conform to the Quality System Standard
ISO 9001 ed. 1994

This Certificate is valid for the following product or service ranges:

MARKETING, SALES, PRODUCT DEVELOPMENT AND MANUFACTURING OF STANDARD AND PROCESSED PLYWOODS AND VENEERS

Place and date
Helsinki, 1 December 1999

This Certificate is valid until
30 November 2002

for the Accredited Certification Body
DNV Certification OY/AB

Original Certificates to units issued between 2 February 1993 and 10 February 1999

Aila Valkila
Management Representative

Certification has been performed by Lead Auditor
Kimmo Haarala

habitat for the diverse flora and fauna in their forests. As a result of the whole Finnish forest management programme, the forest's ability to absorb carbon dioxide, helping to reduce global warming, is improving all the time.

FOREST CERTIFICATION

The FFCS (The Finnish Forest Certification System) is well suited to Finland's small forest owners. Certification through compliance with the FFCS system indicates impartially and reliably that the forests and forest ecosystems are being used and managed sustainably.

In addition to a forest certificate, product or Eco-labelling also calls for a certification system for companies processing wood. This can be used to establish the origin of any timber. The FFCS is not embodied in a national product label, but is designed to be incorporated into international labelling schemes.

It is possible to apply for the PEFC (The Pan-European Forest Certification) label for those wood products which originate from forests certified according to the FFCS. PEFC standards are based on the Pan-European criteria and indicators set for sustainable forest management.

DESCRIPTION OF FINNISH PLYWOOD PRODUCTS

2

2.1 COMPOSITION OF STANDARD PLYWOODS

Finnish plywood is made up of thin multiple cross-banded veneers. In addition to standard cross-banded construction a range of orientated special constructions, aimed at specific end uses are available. The nominal thickness of birch and conifer veneers is 1.4 mm and thick conifer veneers range from 2.0 - 3.2 mm thickness.

THE STANDARD FINNISH PLYWOODS

Birch: Birch veneers throughout the construction.

Combi: Two birch veneers on each face and alternate inner veneers of conifer and birch.

Combi mirror: One birch veneer on each face and alternate inner veneers of conifer and birch.

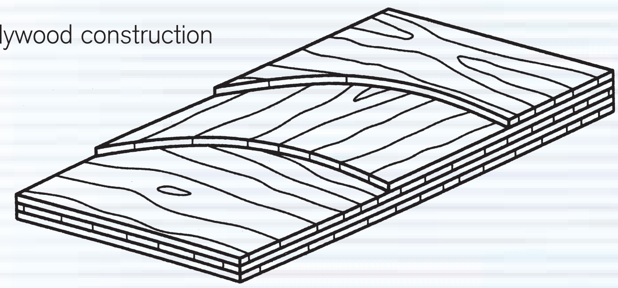
Conifer: Conifer veneers throughout the construction. Face veneers of spruce or occasionally pine.

2.2 APPEARANCE OF STANDARD PLYWOODS

Standard Finnish plywood is classified according to the grades of its face veneers which comply with Standard EN 635. These grade categories are based on the recommendations of the International Organisation for Standardisation (ISO 2426). Full descriptions of face grades are given in Finnish standard SFS 2413 which is in some respects more demanding than EN 635 and is specifically formulated for Finnish birch plywood.

Surface grades do not have any significant effect upon the structural performance of a panel.

Cross-banded plywood construction



GRADES OF FINNISH BIRCH FACE VENEERS IN ACCORDANCE WITH SFS 2413

B (I) Pin knots permitted. Other knots and holes permitted up to 6 mm diameter, limited to a cumulative diameter of 12 mm per m^2. Closed splits and checks permitted up to an individual length of 100 mm and one per metre of panel width. Slight discoloration and streaks permitted. Other defects strictly limited.

S (II) Pin knots permitted. Sound intergrown knots permitted up to an individual diameter of 20 mm, limited to a cumulative diameter of 50 mm per m^2. Other knots and repaired holes permitted up to 10 mm diameter, limited to a cumulative diameter of 25 mm per m^2. Repaired splits and checks up to 2 mm width, length 200 mm limited to one per metre of panel width. Closed splits and checks permitted up to 200 mm length and two per metre of panel width. Discoloration and coloured streaks permitted. One wooden patch/m^2 permitted.

BB (III) Pin knots permitted. Sound knots permitted up to 25 mm diameter, limited to a cumulative diameter of 60 mm per m^2. Other knots and holes permitted up to 6 mm diameter, limited to a cumulative diameter of 25 mm per m^2. Open splits

Grade B (I)

Grade S (II)

Grade BB (III)

and checks, repaired, permitted up to 2 mm wide and 200 mm long not exceeding 1 per metre of panel width. Discoloration, roughness and sanding through permitted if all slight. Wooden patches permitted up to 3 % of area. Glue penetration limited to 5 % of panel surface.

WG (IV) Pin knots and sound knots permitted up to 65 mm diameter, limited to a cumulative diameter of 600 mm per m^2. Other knots and holes up to 15 mm diameter limited to a cumulative diameter of 100 mm per m^2. Open splits and checks up to 4 mm wide and 2 per metre width of panel. Discoloration, streaks, roughness, slight sanding through, glue penetration and patches are permitted.

Table 2-1.
Face grade combinations of birch faced plywoods (B=I, S=II, BB=III and WG=IV)

B/B	S/S	BB/BB	WG/WG
B/S	S/BB	BB/WG	
B/BB	S/WG		
B/WG			

Grade WG (IV)

GRADES OF FINNISH CONIFER FACE VENEERS

I Pin knots limited to 3 per m^2. Sound inter grown knots up to 10 mm diameter with cumulative diameter 30 mm per m^2. Splits and checks limited to 3 mm width and properly filled. Other defects strictly limited. Available in pine only.

II Pin knots permitted without restriction. Sound intergrown knots up to an individual 40 mm diameter. Non adhering knots and holes permitted up to 5 mm diameter, and when filled or repaired up to 60 mm diameter. Open splits and checks permitted up to 6 mm width when filled. Wooden patches and slight discoloration permitted.

III Pin knots and sound knots up to 50 mm diameter permitted. Other knots and holes permitted up to 40 mm diameter, with a cumulative diameter up to 500 mm per m^2. Open splits and checks permitted up to 10 mm wide. Sanding through permitted to 1 % of panel surface. Inserts, roughness, hollows and discoloration permitted if slight.

Grade I

Grade II

IV All knots and holes permitted. Splits, open joints and checks permitted. Inbark, resin pockets, streaks and discoloration permitted. Patches, overlaps, roughness, glue penetration and sanding through permitted.

Table 2-2.
Face grade combinations of conifer faced plywoods

I/I	II/II	III/III	IV/IV
I/II	II/III	III/IV	
I/III	II/IV		
I/IV			

Grade III

Grade IV

2.3 OVERLAID AND COATED PLYWOODS

Birch, combi, combi mirror and conifer plywood panels can all be supplied overlaid or coated to meet specific user requirements. The main types of surfaced panels manufactured by the Finnish plywood industry are as follows.

PHENOLIC FILM FACED, SMOOTH

A phenolic resin impregnated film is pressed on both surfaces of the board under high pressure and temperature. All panels are edge sealed to minimise moisture penetration. Film faced plywood panels have improved resistance to abrasion, moisture penetration, chemicals, insects and fungi. They have a smooth, hygienic, easy to clean surface. The colour is normally dark brown but panels are also available in light brown, green, yellow, grey, red or black. Panels can also be supplied with heavier films than the usual 120 g/m^2 film, e.g. 170 g/m^2, 220 g/m^2 and their combinations.

PHENOLIC FILM FACED, TEXTURED

Plywood panels overlaid with phenol resin impregnated film. An additional textured pattern is pressed onto one or both surfaces. Imprinted wire mesh pattern improves slip resistance characteristics. A wide variety of coatings as well as embossed surface patterns to provide slip resistance is available.

PAINTING FILM FACED

Plywood overlaid with phenol resin impregnated film suitable for painting. This film provides a sealed, stable base for painting operations and may not necessarily require priming or other preparation. Recommended for all exterior applications. Also available ready primed.

MELAMINE FILM FACED

Plywood panels with a variety of melamine resin film surfaces which are ideal for many decorative and industrial applications including the food industry. The most common colours are white and light grey.

SPECIAL PRODUCTS

In addition to these more common overlaid plywoods produced by all Finnish plywood manufacturers there is a wide variety of other special products produced only by some mills. These products include: painted and stained plywood, veneered plywood, CPL or HPL laminate faced plywood, polypropylene plastic foil coated plywood, glass fibre reinforced surfaces, metal and mineral aggregate faced plywood and plywood provided with sound insulation.

SCARF JOINTED MAXI SIZE PANELS

Both unsurfaced and overlaid panels are available in giant sizes. Standard panels are scarf jointed in the face grain direction and then bonded together with a special resin. The maximum panel size varies according to the plywood type and surface finish required. The largest panel available is about 13000 mm x 3000 mm.

MACHINED PANELS

Panels can be drilled, profiled and machined to order using modern CNC technology at the plywood mill.

2.4 DIMENSIONS AND TOLERANCES

SIZES AND THICKNESSES RELATING TO A MOISTURE CONTENT OF 10±2 %.

Table 2-3. Standard plywood products

Plywood					Birch		Combi, Combi mirror		Conifer (thin veneers)		Conifer (thick veneers)	
Face					Birch		Birch		Conifer		Conifer	
Core					Birch		Birch&Conifer		Conifer		Conifer	
Nominal thickness* mm	EN 315 thickness tolerance mm		Finnish plywood thickness tolerance** mm		No of plies	Weight*** kg/m²	No of plies	Weight*** kg/m²	No of plies	Weight*** kg/m²	No of plies	Weight*** kg/m²
	min	max	min	max								
4	3.5	4.3	3.5	4.1	3	2.7			3	2.1		
6.5	5.9	6.9	6.1	6.9	5	4.4	5	4.0	5	3.4		
9	8.3	9.5	8.8	9.5	7	6.1	7	5.6	7	4.7	3	4.1
12	11.2	12.6	11.5	12.5	9	8.2	9	7.4	9	6.2	5/4	5.5
15	14.2	15.7	14.3	15.3	11	10.2	11	9.3	11	7.8	5	6.9
18	17.1	18.7	17.1	18.1	13	12.2	13	11.2	13	9.4	7/6	8.3
21	20.0	21.8	20.0	20.9	15	14.3	15	13.0	15	10.9	7	9.7
24	22.9	24.9	22.9	23.7	17	16.3	17	14.9	17	12.5	9/8	11.0
27	25.2	28.4	25.2	26.8	19	18.4	19	16.7	19	14.0	11/9	12.4
30	28.1	31.5	28.1	29.9	21	20.4	21	18.6	21	15.6	13/10	13.8
35	33.5	36.1	33.5	35.5	25	23.8						
40	38.4	41.2	38.8	41.2	29	27.2						
45	43.3	46.4	43.6	46.4	32	30.6						
50	48.1	51.5	48.5	51.5	35	34.0						

Table 2-4. Panel sizes****

Standard sizes****, mm x mm
1200 x 1200 / 2400 / 2500 / 3000 / 3600
1220 x 1220 / 2440 / 2500 / 3050 / 3660
1250 x 1250 / 2400 / 2500 / 3000 / 3600
1500 x 1500 / 2400 / 2500 / 3000 / 3600
1525 x 1525 / 2440 / 2500 / 3050 / 3660
2400 x 1200
2440 x 1220
2500 x 1250

Table 2-5. Panel tolerances

Length/Width******, mm	Tolerance, mm
< 1000	±1
1000….2000	±2
> 2000	±3
EN 315 Squareness of panels	1 mm/m
EN 315 Straightness of edges	1 mm/m

* *Other thicknesses on request.*

** *These tolerances fulfil the EN and ISO requirements and are in part more strict.*

*** *Approximate weights are based on max number of plies. Birch 680 kg/m³, combi 620 kg/m³, conifer (thin veneers) 520 kg/m³ and conifer (thick veneers) 460 kg/m³.*

**** *For plywood, the grain of the face veneer runs parallel to the first dimension stated. For Finnish plywood this is generally the shorter dimension of standard panels. Conifer plywood can have the face grain in either direction.*

***** *Other sizes on request up to 1900 mm x 4000 mm. See also chapter 2.3 for scarf jointed maxi sizes.*

****** *Length and width of panel is within tolerance at 95 % probability level.*

TECHNICAL PROPERTIES OF FINNISH PLYWOOD

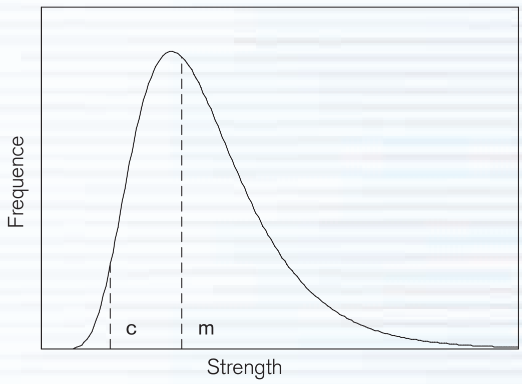
3

3.1 MECHANICAL PROPERTIES

In addition to strength, modulus of elasticity and shear modulus the density and section properties are needed as input values in the design process. These properties have been determined for Finnish plywood by VTT (Technical Research Centre of Finland) in co-operation with the plywood producers.

Plywood was representatively sampled from all Finnish plywood mills. Prior to testing the panels were conditioned in climate controlled rooms held at a steady relative humidity of 65 % and temperature of 20°C. Tests were carried out in accordance with EN 789. In testing the duration of load was 5 minutes. Based on the test results the mean and characteristic values were determined in accordance with EN 1058. The characteristic value is related to the population 5-percentile value obtained from the test results.

Frequence diagram of a lognormal distribution



Strength values:
m = mean
c = characteristic

In addition, bending tests were carried out in accordance with the test method given in EN 310. This method results in higher bending strength values and lower modulus of elasticity values but is only suitable for quality control purposes and is therefore not used as a basis for any design data.

The mean and characteristic values of density to be used in design calculations are given in Table 3-1. For other purposes, e.g. the transportation of plywood, other values may be used.

The lay-ups as well as thickness, area, section modulus and second moment of area of the cross sections of sanded plywood are given in Table 3-2 to Table 3-6. For unsanded plywood these values will give rise to conservative design.

The mean modulus of elasticity as well as characteristic strength values in bending, tension and compression are given in Table 3-2 to Table 3-6. These values are given both along and across the grain direction of the face veneers. The mean shear modulus and characteristic strength values in panel and planar (rolling) shear are given in Table 3-7 to Table 3-11.

Table 3-1. Density to be used in design. The values are given at a relative humidity of 65 %

Plywood	Mean	Characteristic
	kg/m^3	kg/m^3
Birch (1.4 mm plies)	680	630
Combi (1.4 mm plies)	620	560
Conifer (1.4 mm plies)	520	460
Conifer (thick plies)	460	400

Symbols used in Table 3-2 to Table 3-11

t = thickness	f_c = compression strength	| (green) = birch veneer cross grained
A = area	f_v = panel shear strength	— (green) = birch veneer long grained
W = section modulus	f_r = planar shear strength	| (red) = spruce veneer cross grained
I = second moment of area	E_m = modulus of elasticity in bending panel	— (red) = spruce veneer long grained
II = parallel to the face grain	E_t = modulus of elasticity in tension	
⊥ = perpendicular to the face grain	E_c = modulus of elasticity in compression	
f_m = bending strength	G_v = modulus of rigidity in panel shear	
f_t = tension strength	G_r = modulus of rigidity in planar shear	

LAY-UP, THICKNESS, AREA, SECTION MODULUS, SECOND MOMENT OF AREA AS WELL AS BENDING, TENSION AND COMPRESSION PROPERTIES OF CROSS SECTIONS OF SANDED FINNISH PLYWOOD TO BE USED IN DESIGN.
ALL VALUES ARE GIVEN FOR THE FULL CROSS SECTION.

Table 3-2. Birch plywood

	Section properties						Characteristic strength: Bending		Compression		Tension		Mean modulus of elasticity: Bending		Tension and compression	
Lay-up	Nominal thickness	Number of plies	t mean mm	A mm²/mm	W mm³/mm	I mm⁴/mm	$f_{m\parallel}$ N/mm²	$f_{m\perp}$ N/mm²	$f_{c\parallel}$ N/mm²	$f_{c\perp}$ N/mm²	$f_{t\parallel}$ N/mm²	$f_{t\perp}$ N/mm²	$E_{m\parallel}$ N/mm²	$E_{m\perp}$ N/mm²	$E_{t/c\parallel}$ N/mm²	$E_{t/c\perp}$ N/mm²
│—│	4	3	3.6	3.6	2.16	3.89	65.9	10.6	31.8	20.2	45.8	29.2	16471	1029	10694	6806
│—│—│	6.5	5	6.4	6.4	6.83	21.8	50.9	29.0	29.3	22.8	42.2	32.8	12737	4763	9844	7656
│—│—│—│	9	7	9.2	9.2	14.1	64.9	45.6	32.1	28.3	23.7	40.8	34.2	11395	6105	9511	7989
│—│...│—│	12	9	12.0	12.0	24.0	144	42.9	33.2	27.7	24.3	40.0	35.0	10719	6781	9333	8167
│—│...│—│	15	11	14.8	14.8	36.5	270	41.3	33.8	27.4	24.6	39.5	35.5	10316	7184	9223	8277
│—│...│—│	18	13	17.6	17.6	51.6	454	40.2	34.1	27.2	24.8	39.2	35.8	10048	7452	9148	8352
│—│...│—│	21	15	20.4	20.4	69.4	707	39.4	34.3	27.0	25.0	39.0	36.0	9858	7642	9093	8407
│—│...│—│	24	17	23.2	23.2	89.7	1041	38.9	34.4	26.9	25.1	38.8	36.2	9717	7783	9052	8448
│—│...│—│	27	19	26.0	26.0	113	1465	38.4	34.5	26.8	25.2	38.7	36.3	9607	7893	9019	8481
│—│...│—│	30	21	28.8	28.8	138	1991	38.1	34.6	26.7	25.3	38.5	36.5	9519	7981	8993	8507
│—│...│—│	35	25	34.4	34.4	197	3392	37.6	34.7	26.6	25.4	38.4	36.6	9389	8111	8953	8547
│—│...│—│	40	29	40.0	40.0	267	5333	37.2	34.7	26.5	25.5	38.3	36.8	9296	8204	8925	8575
│—│...│—│	45	32	44.2	44.2	326	7196	37.0	34.7	26.5	25.5	38.2	36.8	9259	8241	8914	8586
│—│...│—│	50	35	48.4	48.4	390	9448	36.8	34.8	26.4	25.6	38.1	36.9	9198	8302	8895	8605

Table 3-3. Combi plywood

	Section properties						Characteristic strength: Bending		Compression		Tension		Mean modulus of elasticity: Bending		Tension and compression	
Lay-up	Nominal thickness	Number of plies	t mean mm	A mm²/mm	W mm³/mm	I mm⁴/mm	$f_{m\parallel}$ N/mm²	$f_{m\perp}$ N/mm²	$f_{c\parallel}$ N/mm²	$f_{c\perp}$ N/mm²	$f_{t\parallel}$ N/mm²	$f_{t\perp}$ N/mm²	$E_{m\parallel}$ N/mm²	$E_{m\perp}$ N/mm²	$E_{t/c\parallel}$ N/mm²	$E_{t/c\perp}$ N/mm²
│—│—│	6.5	5	6.4	6.4	6.83	21.8	50.8	29.0	24.5	22.8	19.1	32.8	12690	4763	8859	7656
│—│—│—│	9	7	9.2	9.2	14.1	64.9	43.9	32.1	22.5	23.7	17.5	34.2	10983	6105	8141	7989
│—│...│—│	12	9	12.0	12.0	24.0	144	40.0	33.2	21.5	24.3	16.7	35.0	10012	6781	7758	8167
│—│...│—│	15	11	14.8	14.8	36.5	270	37.5	33.8	20.8	24.6	16.2	35.5	9386	7184	7520	8277
│—│...│—│	18	13	17.6	17.6	51.6	454	35.8	34.1	20.4	24.8	15.8	35.8	8950	7452	7358	8352
│—│...│—│	21	15	20.4	20.4	69.4	707	34.5	34.3	20.0	25.0	15.6	36.0	8628	7642	7240	8407
│—│...│—│	24	17	23.2	23.2	89.7	1041	32.9	34.4	19.8	25.1	15.4	36.2	8381	7783	7151	8448
│—│...│—│	27	19	26.0	26.0	113	1465	31.2	34.5	19.6	25.2	15.3	36.3	8185	7893	7081	8481
│—│...│—│	30	21	28.8	28.8	138	1991	29.9	34.6	19.5	25.3	15.1	36.5	8026	7981	7024	8507

Table 3-4. Combi mirror plywood

	Section properties						Characteristic strength: Bending		Compression		Tension		Mean modulus of elasticity: Bending		Tension and compression	
Lay-up	Nominal thickness	Number of plies	t mean mm	A mm²/mm	W mm³/mm	I mm⁴/mm	$f_{m\parallel}$ N/mm²	$f_{m\perp}$ N/mm²	$f_{c\parallel}$ N/mm²	$f_{c\perp}$ N/mm²	$f_{t\parallel}$ N/mm²	$f_{t\perp}$ N/mm²	$E_{m\parallel}$ N/mm²	$E_{m\perp}$ N/mm²	$E_{t/c\parallel}$ N/mm²	$E_{t/c\perp}$ N/mm²
│—│—│	6.5	5	6.4	6.4	6.83	21.8	50.9	16.6	29.3	15.8	42.2	12.3	12737	3538	9844	5688
│—│—│—│	9	7	9.2	9.2	14.1	64.9	45.6	18.3	28.3	16.4	40.8	12.8	11395	4535	9511	5935
│—│...│—│	12	9	12.0	12.0	24.0	144	42.9	19.0	27.7	16.8	40.0	13.1	10719	5037	9333	6067
│—│...│—│	15	11	14.8	14.8	36.5	270	41.3	19.3	27.4	17.0	39.5	13.2	10316	5337	9223	6149
│—│...│—│	18	13	17.6	17.6	51.6	454	40.2	19.5	27.2	17.2	39.2	13.4	10048	5536	9148	6205
│—│...│—│	21	15	20.4	20.4	69.4	707	39.4	19.6	27.0	17.3	39.0	13.5	9858	5677	9093	6245
│—│...│—│	24	17	23.2	23.2	89.7	1041	38.9	19.7	26.9	17.4	38.8	13.5	9717	5782	9052	6276
│—│...│—│	27	19	26.0	26.0	113	1465	38.4	19.7	26.8	17.4	38.7	13.6	9607	5863	9019	6300
│—│...│—│	30	21	28.8	28.8	138	1991	38.1	19.8	26.7	17.5	38.5	13.6	9519	5928	8993	6319

Table 3-5. Conifer plywood, thin veneers

Lay-up	Nominal thickness	Number of plies	t mean mm	A mm^2/mm	W mm^3/mm	I mm^4/mm	$f_{m\parallel}$ N/mm^2	$f_{m\perp}$ N/mm^2	$f_{c\parallel}$ N/mm^2	$f_{c\perp}$ N/mm^2	$f_{t\parallel}$ N/mm^2	$f_{t\perp}$ N/mm^2	$E_{m\parallel}$ N/mm^2	$E_{m\perp}$ N/mm^2	$E_{t/c\parallel}$ N/mm^2	$E_{t/c\perp}$ N/mm^2
	Section properties						Characteristic strength: Bending		Compression		Tension		Mean modulus of elasticity: Bending		Tension and compression	
|—|	4	3	3.6	3.6	2.16	3.89	37.6	6.0	22.0	14.0	17.1	10.9	12235	765	7944	5056
|—|—|	6.5	5	6.4	6.4	6.83	21.8	29.1	16.6	20.3	15.8	15.8	12.3	9462	3538	7313	5688
|—|—|—|	9	7	9.2	9.2	14.1	64.9	26.0	18.3	19.6	16.4	15.2	12.8	8465	4535	7065	5935
|—|...|—|	12	9	12.0	12.0	24.0	144	24.5	19.0	19.2	16.8	14.9	13.1	7963	5037	6933	6067
|—|...|—|	15	11	14.8	14.8	36.5	270	23.6	19.3	19.0	17.0	14.8	13.2	7663	5337	6851	6149
|—|...|—|	18	13	17.6	17.6	51.6	454	23.0	19.5	18.8	17.2	14.6	13.4	7464	5536	6795	6205
|—|...|—|	21	15	20.4	20.4	69.4	707	22.5	19.6	18.7	17.3	14.5	13.5	7323	5677	6755	6245
|—|...|—|	24	17	23.2	23.2	89.7	1041	22.2	19.7	18.6	17.4	14.5	13.5	7218	5782	6724	6276
|—|...|—|	27	19	26.0	26.0	113	1465	22.0	19.7	18.6	17.4	14.4	13.6	7137	5863	6700	6300
|—|...|—|	30	21	28.8	28.8	138	1991	21.8	19.8	18.5	17.5	14.4	13.6	7072	5928	6681	6319

Table 3-6. Conifer plywood, thick veneers

Lay-up	Type	Nominal thickness	Number of plies	t mean mm	A mm^2/mm	W mm^3/mm	I mm^4/mm	$f_{m\parallel}$ N/mm^2	$f_{m\perp}$ N/mm^2	$f_{c\parallel}$ N/mm^2	$f_{c\perp}$ N/mm^2	$f_{t\parallel}$ N/mm^2	$f_{t\perp}$ N/mm^2	$E_{m\parallel}$ N/mm^2	$E_{m\perp}$ N/mm^2	$E_{t/c\parallel}$ N/mm^2	$E_{t/c\perp}$ N/mm^2
	Section properties							Characteristic strength: Bending		Compression		Tension		Mean modulus of elasticity: Bending		Tension and compression	
—|—	9/3-3.0	9	3	8.4	8.4	11.8	49.4	28.6	3.8	19.3	10.7	11.6	6.4	11453	547	7714	4286
—|—	9/3-3.2	9	3	9.0	9.0	13.5	60.8	28.7	3.8	19.3	10.7	11.6	6.4	11461	539	7733	4267
—||—	12/4-3.0	12	4	11.4	11.4	21.7	123	25.6	8.3	14.2	15.8	8.5	9.5	10250	1750	5684	6316
—|—|—	12/5-2.6	12	5	12.4	12.4	25.6	159	22.8	11.4	17.4	12.6	10.5	7.5	9124	2876	6968	5032
—|—|—	15/5-3.0	15	5	14.4	14.4	34.6	249	22.9	11.3	17.5	12.5	10.5	7.5	9179	2821	7000	5000
—|—|—	15/5-3.2	15	5	15.4	15.4	39.8	304	23.0	11.2	17.5	12.5	10.5	7.5	9201	2799	7013	4987
—|— —|—	18/6-3.0	18	6	17.4	17.4	50.5	439	21.4	12.5	19.7	10.3	11.8	6.2	8556	3444	7862	4138
—|—|—|—	18/7-2.6	18	7	17.6	17.6	51.6	454	20.4	13.0	16.7	13.3	10.0	8.0	8170	3830	6682	5318
—|—|—|—	21/7-3.0	21	7	20.4	20.4	69.4	707	20.6	12.8	16.8	13.2	10.1	7.9	8222	3778	6706	5294
—|—|—|—	21/7-3.2	21	7	20.6	20.6	70.7	728	20.6	12.8	16.8	13.2	10.1	7.9	8243	3757	6716	5282
—|— — — —|—	24/8-3.0	24	8	23.4	23.4	91.3	1068	20.4	12.5	22.3	7.7	13.4	4.6	8156	3844	8923	3077
—|—|—|—|—	24/9-2.6	24	9	22.8	22.8	86.6	988	19.1	13.6	16.3	13.7	9.8	8.2	7658	4342	6526	5474
—|—|—|—|—	27/9-3.0	27	9	26.4	26.4	116	1533	19.3	13.5	16.4	13.6	9.8	8.2	7703	4297	6545	5455
—|—|—|—|—|—	27/11-2.6	27	11	25.6	25.6	109	1398	14.8	16.7	14.8	15.2	8.9	9.1	5903	6097	5906	6094
—|—|— —|—|—	30/10-3.0	30	10	29.4	29.4	144	2118	18.8	13.7	17.8	12.2	10.7	7.3	7512	4488	7102	4898
—|—...—|—	30/13-2.6	30	13	30.8	30.8	158	2435	14.7	16.4	14.8	15.2	8.9	9.1	5893	6107	5922	6078

SHEAR PROPERTIES OF SANDED PLYWOOD TO BE USED IN DESIGN. ALL VALUES ARE GIVEN FOR THE FULL CROSS SECTION.

Table 3-7. Birch plywood

Nominal thickness	Characteristic strength: Panel shear		Planar shear		Mean modulus of rigidity: Panel shear		Planar shear	
mm	$f_{v\parallel}$ N/mm^2	$f_{v\perp}$ N/mm^2	$f_{r\parallel}$ N/mm^2	$f_{r\perp}$ N/mm^2	$G_{v\parallel}$ N/mm^2	$G_{v\perp}$ N/mm^2	$G_{r\parallel}$ N/mm^2	$G_{r\perp}$ N/mm^2
4	9.5	9.5	2.77	–	620	620	169	–
6.5	9.5	9.5	3.20	1.78	620	620	169	123
9	9.5	9.5	2.68	2.35	620	620	206	155
12	9.5	9.5	2.78	2.22	620	620	207	170
15	9.5	9.5	2.62	2.39	620	620	207	178
18	9.5	9.5	2.67	2.34	620	620	206	183
21	9.5	9.5	2.59	2.41	620	620	206	186
24	9.5	9.5	2.62	2.39	620	620	206	189
27	9.5	9.5	2.57	2.43	620	620	205	190
30	9.5	9.5	2.59	2.41	620	620	205	192
35	9.5	9.5	2.57	2.43	620	620	204	193
40	9.5	9.5	2.56	2.44	620	620	204	195
45	9.5	9.5	2.55	2.46	620	620	203	195
50	9.5	9.5	2.54	2.46	620	620	203	196

Table 3-8. Combi plywood

Nominal thickness	Characteristic strength				Mean modulus of rigidity			
	Panel shear		Planar shear		Panel shear		Planar shear	
mm	$f_{v\parallel}$ N/mm²	$f_{v\perp}$ N/mm²	$f_{r\parallel}$ N/mm²	$f_{r\perp}$ N/mm²	$G_{v\parallel}$ N/mm²	$G_{v\perp}$ N/mm²	$G_{r\parallel}$ N/mm²	$G_{r\perp}$ N/mm²
6.5	7.0	7.0	3.20	1.14	600	600	169	41
9	7.0	7.0	2.68	1.51	593	593	206	52
12	7.0	7.0	2.78	1.42	589	589	207	57
15	7.0	7.0	2.62	1.53	586	586	207	59
18	7.0	7.0	2.67	1.50	584	584	206	61
21	7.0	7.0	2.59	1.55	583	583	206	62
24	7.0	7.0	2.62	1.53	582	582	206	63
27	7.0	7.0	2.57	1.56	581	581	205	63
30	7.0	7.0	2.59	1.54	581	581	205	64

Table 3-9. Combi mirror plywood

Nominal thickness	Characteristic strength				Mean modulus of rigidity			
	Panel shear		Planar shear		Panel shear		Planar shear	
mm	$f_{v\parallel}$ N/mm²	$f_{v\perp}$ N/mm²	$f_{r\parallel}$ N/mm²	$f_{r\perp}$ N/mm²	$G_{v\parallel}$ N/mm²	$G_{v\perp}$ N/mm²	$G_{r\parallel}$ N/mm²	$G_{r\perp}$ N/mm²
6.5	7.0	7.0	2.05	1.78	581	581	66	123
9	7.0	7.0	1.72	2.35	579	579	69	155
12	7.0	7.0	1.78	2.22	578	578	69	170
15	7.0	7.0	1.68	2.39	577	577	69	178
18	7.0	7.0	1.71	2.34	577	577	69	183
21	7.0	7.0	1.66	2.41	577	577	69	186
24	7.0	7.0	1.68	2.39	577	577	69	189
27	7.0	7.0	1.65	2.43	576	576	68	190
30	7.0	7.0	1.66	2.41	576	576	68	192

Table 3-10. Conifer plywood, thin veneers

Nominal thickness	Characteristic strength				Mean modulus of rigidity			
	Panel shear		Planar shear		Panel shear		Planar shear	
mm	$f_{v\parallel}$ N/mm²	$f_{v\perp}$ N/mm²	$f_{r\parallel}$ N/mm²	$f_{r\perp}$ N/mm²	$G_{v\parallel}$ N/mm²	$G_{v\perp}$ N/mm²	$G_{r\parallel}$ N/mm²	$G_{r\perp}$ N/mm²
4	7.0	7.0	1.77	–	530	530	56	–
6.5	7.0	7.0	2.05	1.14	530	530	66	41
9	7.0	7.0	1.72	1.51	530	530	69	52
12	7.0	7.0	1.78	1.42	530	530	69	57
15	7.0	7.0	1.68	1.53	530	530	69	59
18	7.0	7.0	1.71	1.50	530	530	69	61
21	7.0	7.0	1.66	1.55	530	530	69	62
24	7.0	7.0	1.68	1.53	530	530	69	63
27	7.0	7.0	1.65	1.56	530	530	68	63
30	7.0	7.0	1.66	1.54	530	530	68	64

Table 3-11. Conifer plywood, thick veneers

Nominal thickness	Characteristic strength				Mean modulus of rigidity			
	Panel shear		Planar shear		Panel shear		Planar shear	
Type	$f_{v\parallel}$ N/mm²	$f_{v\perp}$ N/mm²	$f_{r\parallel}$ N/mm²	$f_{r\perp}$ N/mm²	$G_{v\parallel}$ N/mm²	$G_{v\perp}$ N/mm²	$G_{r\parallel}$ N/mm²	$G_{r\perp}$ N/mm²
9/3-3.0	3.5	3.5	0.98	–	350	350	45	–
9/3-3.2	3.5	3.5	0.98	–	350	350	45	–
12/4-3.0	3.5	3.5	0.95	–	350	350	35	–
12/5-2.6	3.5	3.5	1.13	0.61	350	350	50	30
15/5-3.0	3.5	3.5	1.13	0.61	350	350	50	29
15/5-3.2	3.5	3.5	1.13	0.61	350	350	51	29
18/6-3.0	3.5	3.5	1.22	0.64	350	350	71	25
18/7-2.6	3.5	3.5	0.97	0.82	350	350	52	38
21/7-3.0	3.5	3.5	0.98	0.82	350	350	52	38
21/7-3.2	3.5	3.5	0.98	0.82	350	350	51	40
24/8-3.0	3.5	3.5	1.50	–	350	350	144	25
24/9-2.6	3.5	3.5	1.01	0.78	350	350	52	42
27/9-3.0	3.5	3.5	1.01	0.78	350	350	52	41
27/11-2.6	3.5	3.5	0.90	0.92	350	350	52	48
30/10-3.0	3.5	3.5	1.04	0.72	350	350	63	35
30/13-2.6	3.5	3.5	0.92	0.89	350	350	51	49

3.2 MOISTURE PROPERTIES

THE MOISTURE CONTENT OF PLYWOOD

The moisture content of plywood is normally 7-12 % when leaving the mill. After delivery the moisture content of plywood may change (usually increasing) during transportation, storage and further processing. Like all other wood-based materials, plywood is a hygroscopic product and exhibits visco-elastic mechanical behaviour. For these reasons, it is necessary to take moisture conditions into consideration when loading plywood.

The moisture content (H) is defined by the following formula

$$H = \frac{m_H - m_O}{m_O} \cdot 100$$

where m_H is the initial mass of the test piece
m_O is the mass of the test piece after drying

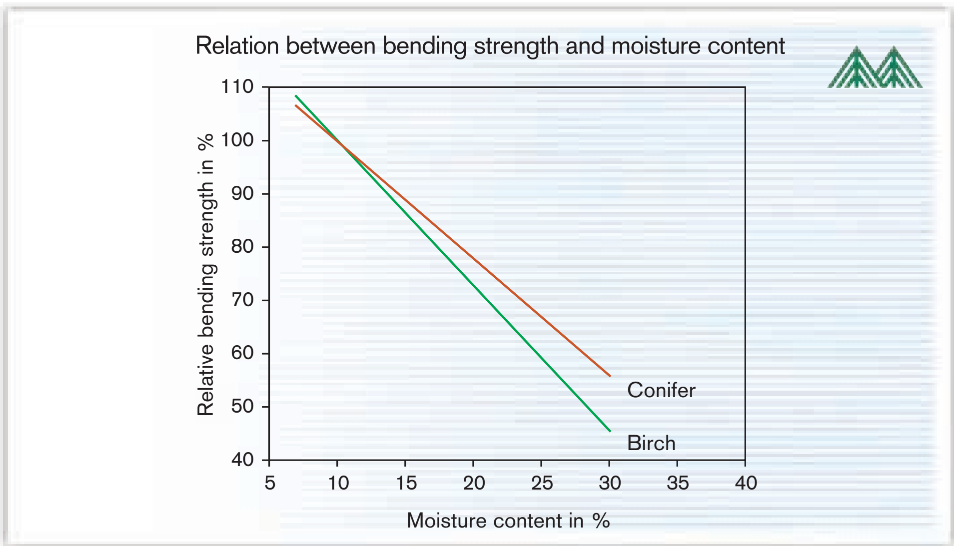
Plywood has a balanced moisture content under given conditions of relative humidity (RH) and air temperature (T). In the basic condition defined in Eurocode 5: with T = 20°C and RH = 65 %, the equilibrium moisture content of thin-veneer plywood (Birch, Combi, Conifer) is around 12 % and thick-veneer Conifer plywood 10 %.

RELATION BETWEEN MECHANICAL PROPERTIES AND MOISTURE CONTENT

The mechanical properties given in section 3.1 correspond to a moisture content between 10 % and 12 % of the plywood product. An increase in moisture content will result in a decrease in the strength, modulus of elasticity and shear modulus values.

However, unlike some other wood-based panel products, exterior quality Finnish Plywoods will normally revert to their original strengths and moduli when returned to their original moisture content.

Table 3-12 gives modification factors by which the basic values should be multiplied to obtain values applicable to plywood when the moisture content is about 20 %.



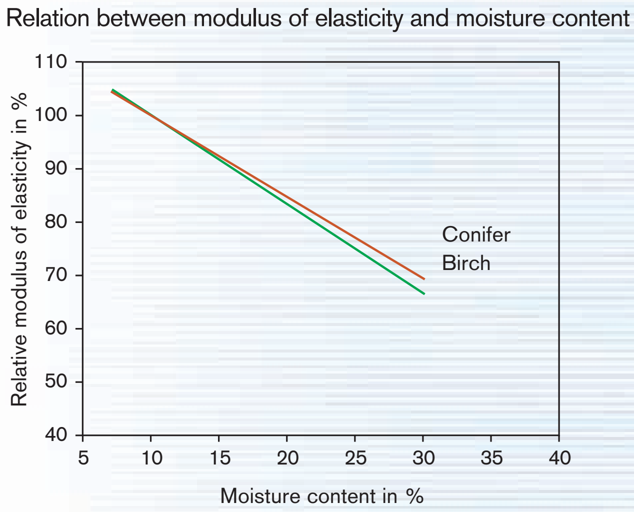


Table 3-12. Modification factors for correcting of mechanical properties to 20 % moisture content conditions

Property	Modification factor
Bending strength	0.75
Planar shear strength	0.80
Modulus of elasicity in bending	0.85
Planar shear modulus	0.65

DIMENSIONAL VARIATIONS

The dimensional changes in and across the face grain direction of Finnish exterior plywood averages 0.015 % increase per 1 % increase of moisture level of plywood, throughout the working range of moisture content of 10 - 27 %. Changes in board thickness over the same working range of moisture content will average 0.3-0.4 % increase per 1 % increase of moisture level.

MOISTURE PASSAGE

The moisture permeability of panels is important in, for example the design of composite external walls and roofs of buildings. The coefficient of vapour permeability of plywood expresses the amount of vapour diffused through the plywood panel per unit of time when there is a different relative humidity of air and a specific vapour pressure difference on either side of the panel. The values in Table 3-13 have been determined in accordance with standard BS 3177 using the coefficient of vapour permeability of plywood.

Table 3-13. Moisture transmission through the faces of Finnish plywood (BS 3177)

Plywood	Thickness, mm	Transmission rate g/($m^2 \cdot 24h$)
Combi	6.5	16.4
	9	15.7
	15	9.1
	21	7.0
Film-faced Combi plywood	6.5	3.5
	9	3.3
	15	2.9
	21	2.9
Conifer	9	14.8

The vapour permeability of plywood is dependent on its moisture content. When the moisture content of plywood increases, the vapour permeability is also greater. Table 3-14 shows the vapour permeance of plywood k_d determined in accordance with DIN 53122 at different plywood moisture contents.

Table 3-14. Vapour permeance of Finnish plywood (DIN 53122)

		RH 53 %		RH 90 %	
	Thickness mm	Moisture content, %	Vapour permeance k_d kg/(Pa · s · m^2 · 10^{12})	Moisture content, %	Vapour permeance k_d kg/(Pa · s · m^2 · 10^{12})
Birch	12	5.7	53	27	500
Combi	12	6.5	50	27	460
Spruce	12	6.0	50	27	460
Film-faced plywood:					
Combi	12			16	88
Spruce	12	7.1	59		

3.3 BIOLOGICAL DURABILITY

PLYWOOD IN EXTERIOR CONDITIONS

In general, the biological durability of plywood is as good as the wood species that the panel is made from. Although Finnish plywood is bonded with exterior phenol formaldehyde glue, the weather resistance in exterior conditions of unsurfaced plywoods where edges have not been sealed is limited. In permanent exterior structures Finnish plywood must be properly surfaced, edge sealed, installed and maintained to provide extra protection against the adverse effects of weather. Overlaid and edge sealed Finnish birch faced plywoods also meet the requirements of Standard EN 636-3.

Decay in wood is caused by fungal attack. Fungi will only grow if there is sufficient moisture, oxygen and a temperature range of +3...+40°C. In practice, if the moisture content of plywood is higher than 20 % (RH is over 85 %) and oxygen is available, it is at risk from fungal attack.

The risk of fungal attack to plywood can be avoided by using the correct construction methods to eliminate some of the above factors. In addition, the resistance to rot of Finnish plywood can be improved by the application of a wood preservative (usually during manufacture, in the phenol formaldehyde glue). Preservative-treated plywood is manufactured in accordance with DIN 68800, Teil 2 and Teil 5.

BLUE-STAIN, MOULD AND INSECTS

Both blue-stain fungi and mould cause discoloration of plywood. Mould grows only on the surface of wood. Blue-stain lives on the soluble substances in the wood cells, but it does not significantly weaken the strength of plywood.

The insect most harmful to wood is usually the termite. Birch, spruce and pine plywoods are not inherently resistant to termite attack, but can be made resistant by adding suitable preservatives during manufacture.

UV LIGHT

The use of unprotected standard plywoods in exterior applications may lead to their prolonged exposure to strong sunlight which includes ultraviolet radiation. In extreme cases, such exposure can ultimately lead to breakdown of the wood fibres. Correctly protected Finnish plywood with an appropriate weatherproof cover gives excellent protection against UV radiation and other adverse effects of the weather.

3.4 THERMAL PROPERTIES

THERMAL INSULATION

The thermal conductivity of plywood is dependent on its moisture content. Table 3-15 shows the thermal conductivity coefficient of Finnish plywood in two different humidity conditions.

Table 3-15. Thermal conductivity coefficient of Finnish plywood (BS 2750)

		RH 47 %		RH 93%	
Plywood	Thickness mm	Moisture content, %	Conductivity λ W/(m · K)	Moisture content, %	Conductivity λ W/(m · K)
Birch	40	9.3	0.147	26	0.175
Combi	40	8.8	0.188	25	0.145
Conifer	40	10.4	0.110	25	0.132

THERMAL DEFORMATION

Plywood has excellent dimensional stability under heat, far superior to that of metals and plastics. In practice, the thermal deformation of plywood is so small, that it can generally be disregarded.

USEABLE TEMPERATURE RANGE FOR PLYWOODS

Standard Finnish plywood and most coated plywood products are suitable for use at temperatures of 100°C and many up to 120°C. The supplier should be consulted for applications at high temperatures, especially if the plywood is load carrying. Plywood endures cold even better than heat and can be used at sustained temperatures as low as -200°C.

3.5 FIRE PERFORMANCE

Although plywood burns it can have better fire resistance than many materials which do not burn. Plywood has an optimal dimensional stability under heat and a low rate of combustion, better than solid wood.

The temperature at which plywood will ignite when exposed to a naked flame is about 270°C whilst a temperature of over 400°C is needed to cause spontaneous combustion. When exposed to a fully developed fire, plywood chars at a slow and predictable linear rate (about 0.6 mm per minute), which enables it to be used in certain fire resisting constructions. This property can be improved by impregnation or coating the plywood with proprietary formulations or by facing with non-combustible foils.

3.6 SOUND INSULATION

Sound is transmitted through air and through structures. Airborne sound insulation is dependent on the density of the insulating material. Plywood is a good insulating material in relation to its weight. For these reasons plywood is a good material for acoustic improvement solutions. The average measured sound reduction index (for the frequency range 100-3200 Hz) for single panels of Finnish plywood is given in table 3-16.

Table 3-16. Sound reduction index of Finnish plywood

Nominal thickness, mm	Sound reduction index, dB
6.5	20.0
18	23.8
24	25.3

The sound insulation of plywood can be improved by using sandwich construction and by avoiding gaps between elements.

3.7 EMISSION OF FORMALDEHYDE

Formaldehyde emission from phenol formaldehyde resin adhesive bonded plywood is very low and measured values are below even the tightest national requirements. When determined according to EN 717-2, the formaldehyde emission from unsurfaced exterior birch plywood is 0.4 mg HCHO/($m^2 \cdot h$), significantly lower than the requirements of class E1 (the best class). Also Finnish plywood meets requirements of the formaldehyde emission limits of EN 1084, release class A (the best class).

3.8 CHEMICAL RESISTANCE

Finnish plywood has good resistance to many dilute acids and acid salt solutions. Alkalis tend to cause softening. Direct contact with oxidising agents such as chlorine, hypochlorites and nitrates should be avoided. Alcohols and some other organic liquids have an effect similar to water, producing swelling and slight loss of strength. Apart from discoloration, petroleum oils have no effect. Phenol films and glass fibre reinforced plastics improve the chemical resistance of plywoods.

DESIGN 4

4.1 GENERAL

The design guidance given is based on the limit state design principles of Eurocode 5 (ENV 1995-1-1) published in 1993. The partial safety factors as well as factors taking into account the load duration and the moisture content on the strength and stiffness properties of plywood given in Eurocode 5 are used when tabulated load resistance values are given. Furthermore, formulas for correcting the tabulated resistances for other assumptions are also given. These formulas make it possible to extend the use of this Handbook to cover a wide range of design calculations not directly covered by the tabulated values.

The limit state design approach is to provide adequate resistance to certain limit states, namely the ultimate limit state and the serviceability limit state. Ultimate limit state refers to the maximum load carrying capacity of the construction while serviceability limit state refers to the normal use of the construction.

In ultimate limit state design it shall be verified that the design stress σ_d is less than the design strength f_d

$$\sigma_d < f_d \qquad (4\text{-}1)$$

The design stress σ_d is calculated using the design value of the load F_d. For design situations with only one variable load, for example snow or impose load, the design load is given by

$$F_d = 1.35F_{k,perm} + 1.5F_{k,var} \qquad (4\text{-}2)$$

where $F_{k,perm}$ is the characteristic value of the permanent load and $F_{k,var}$ is the characteristic value of the variable load. For design situations with two or more variable loads the design load is given by

$$F_d = 1.35F_{k,perm} + \sum 1.35F_{k,var} \qquad (4\text{-}3)$$

The most unfavourable design load shall be used.

The partial safety factors for loads γ_q given in Equations (4-2) and (4-3) may be reduced from 1.35 to 1.20 and from 1.5 to 1.35 for one-storey constructions with moderate spans that are only occasionally occupied.

The design strength f_d is given by

$$f_d = k_{mod} \frac{f_k}{\gamma_m} \quad (4\text{-}4)$$

where f_k is the characteristic value of strength and γ_m is the partial safety factor for the material. For plywood as for other wood and wood based materials the value of γ_m is 1.3. k_{mod} is a factor taking into account the effect of duration of load and moisture content (service class). Values of k_{mod} are given in Table 4-1.

LOAD DURATION CLASSES

Permanent in which the duration of load is more than 10 years
Long-term in which the duration of load is between 6 months and 10 years
Medium-term in which the duration of load is between 1 week and 6 months
Short-term in which the duration of load is less than 1 week
Instantaneous in which the load is of accidental character

SERVICE CLASSES

Service class 1 is characterised by a moisture content in the materials corresponding to a temperature of 20°C and a relative humidity of the surrounding air only exceeding 65 % for a few weeks per year. Service class 1 corresponds to a plywood equilibrium moisture content ≤ 12% of plywood.
Service class 2 is characterised by a moisture content in the materials corresponding to a temperature of 20°C and a relative humidity of the surrounding air only exceeding 85 % for a few weeks per year. Service class 2 corresponds to a plywood equilibrium moisture content ≤ 18% of plywood.
Service class 3 is characterised by climatic conditions leading to higher moisture contents than service class 2. Service class 3 corresponds to a plywood equilibrium moisture content > 18% of plywood.

In serviceability limit state design it shall be verified that the design deflection u_d is less than a pre-set deflection value u_{preset}

$$u_d < u_{preset} \quad (4\text{-}5)$$

The design deflection u_d is given by

$$u_d = (1 + k_{def}) \cdot u_{inst} \quad (4\text{-}6)$$

where k_{def} is a factor taking into account the effect of duration of load and moisture content. Values for k_{def} are given in Table 4-2. The instantaneous deflection u_{inst} is calculated using the design value of load F_d given by

$$F_d = F_{k,perm} + \sum F_{k,var} \quad (4\text{-}7)$$

Furthermore, the design modulus of elasticity and shear modulus values equal to the mean values are used.

The pre-set deflection value depends on the construction and it is usually given as a deflection related to the span (L), for example L/300 or L/200. However, absolute pre-set deflection values may also be given.

Table 4-1. Values of k_{mod}

Load duration class	Service class		
	1	2	3
Permanent	0.60	0.60	0.50
Long-term	0.70	0.70	0.55
Medium-term	0.80	0.80	0.65
Short-term	0.90	0.90	0.70
Instantaneous	1.10	1.10	0.90

Table 4-2. Values of k_{def}

Load duration class	Service class		
	1	2	3
Permanent	0.80	1.00	2.50
Long-term	0.50	0.60	1.80
Medium-term	0.25	0.30	0.90
Short-term	0.00	0.00	0.40
Instantaneous	-	-	-

4.2 ROOFS

Roofs are usually designed to service class 2 and load duration class medium-term. Consequently, the same load resistance values given for floors in Tables 4-3 to 4-32 can be used. Furthermore, the deflection values given in Tables 4-3 to 4-32 shall be multiplied by

$$k_{def,\ corr} = \frac{1+0.30}{1+0.25} \bullet 1 = 1.04 \qquad (4\text{-}8)$$

4.3 FLOORS

Based on the general design principles, tabulated load resistance values for floors of different spans and thicknesses are given. Furthermore, information is given as to whether the bending or shear strength is design governing. Finally, the deflection related to the load resistance is given. The following support and load cases are included:

- A uniformly distributed load on a continuous plate strip with one and two equal span lengths, Tables 4-3, 4-4, 4-9, 4-10, 4-15, 4-16, 4-21, 4-22, 4-27 and 4-28.
- A concentrated load over an area of 50 x 50 mm on a continuous plate strip with one and two equal span lengths, Tables 4-6, 4-7, 4-12, 4-13, 4-18, 4-19, 4-24, 4-25, 4-30 and 4-31.
- A uniformly distributed load on a simply supported plate, Tables 4-5, 4-11, 4-17, 4-23 and 4-25.
- A concentrated load over an area of 50 x 50 mm on a simply supported plate, Tables 4-8, 4-14, 4-20, 4-26 and 4-32.

THE LOAD RESISTANCES AND DEFLECTIONS WERE CALCULATED ACCORDING TO THE FOLLOWING ASSUMPTIONS:

γ_q = 1.5, the partial safety factor for load

γ_m = 1.3, the partial safety factor for the material

k_{mod} = 0.80, the factor taking into account the effect of duration of load and moisture content

k_{def} = 0.25, the factor taking into account the effect of duration of load and moisture content

Hence, the characteristic load acting in service class 1 and load duration class medium-term shall not exceed the tabulated values. For other assumptions the tabulated load resistance values shall be multiplied by a correction factor $k_{load,\ corr}$ given by

$$k_{load,\ corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \bullet \frac{1.3 \bullet 1.5}{0,80} \qquad (4\text{-}9)$$

while the tabulated deflection values shall be multiplied by a correction factor $k_{def,\ corr}$ given by

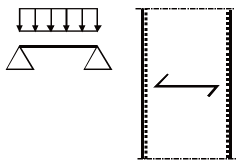
$$k_{def,\ corr} = \frac{1 + k_{def}}{1 + 0.25} \bullet k_{load,\ corr} \qquad (4\text{-}10)$$

REMARK

If there are high loads over a small contact area, compression perpendicular to face of plywood could be critical. In most practical cases the following values can be used.

Bearing on face
Birch plywood 9 N/mm^2
Combi plywood 5 N/mm^2
Spruce plywood 4 N/mm^2

LOAD RESISTANCE q [kN/m²] or F [kN] AND CORRESPONDING DEFLECTION u [mm] VALUES FOR FINNISH PLYWOOD TO BE USED IN THE DESIGN OF FLOORS.



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m²

u given in mm

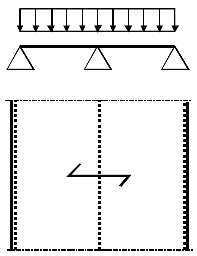
⟵ grain direction of surface veneers

Table 4-3. Birch plywood

Load resistance for a uniformly distributed load on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	q		u	q		u	q		u	q		u	q		u	q		u
300	23	b	4.4	38	b	3.5	55	b	2.9	76	b	2.5	96	s	2.2	111	s	1.8
400	13	b	7.6	21	b	6.0	31	b	4.9	43	b	4.2	56	b	3.7	72	b	3.4
500	8	b	11.8	14	b	9.2	20	b	7.5	27	b	6.4	36	b	5.6	46	b	5.1
600	6	b	16.9	9	b	13.1	14	b	10.7	19	b	9.1	25	b	7.9	32	b	7.1
750	4	b	26.3	6	b	20.3	9	b	16.6	12	b	14.0	16	b	12.2	20	b	10.8
1000	2	b	46.7	3	b	35.9	5	b	29.2	7	b	24.6	9	b	21.3	11	b	18.9
1200	1	b	67.1	2	b	51.6	3	b	41.9	5	b	35.3	6	b	30.5	8	b	27.0
1500	1	b	104.8	2	b	80.4	2	b	65.3	3	b	55.0	4	b	47.5	5	b	41.9

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u
300	122	s	1.5	136	s	1.3	161	s	1.1	187	s	0.9	199	s	0.8	224	s	0.7
400	89	b	3.1	102	s	2.8	121	s	2.1	140	s	1.7	149	s	1.5	168	s	1.3
500	57	b	4.6	69	b	4.3	97	s	3.7	112	s	2.9	119	s	2.7	134	s	2.2
600	39	b	6.4	48	b	5.9	68	b	5.1	90	b	4.6	100	s	4.2	112	s	3.5
750	25	b	9.7	31	b	8.9	43	b	7.6	58	b	6.8	66	b	6.4	84	b	5.9
1000	14	b	16.9	17	b	15.4	24	b	13.1	33	b	11.4	37	b	10.8	47	b	9.7
1200	10	b	24.2	12	b	21.9	17	b	18.6	23	b	16.1	26	b	15.2	33	b	13.6
1500	6	b	37.5	8	b	34.0	11	b	28.6	14	b	24.8	16	b	23.2	21	b	20.8



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m²

u given in mm

⟵ grain direction of surface veneers

Table 4-4. Birch plywood

Load resistance for a uniformly distributed load on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	q		u	q		u	q		u	q		u	q		u	q		u
300	23	b	2.0	38	b	1.6	55	b	1.4	69	s	1.2	77	s	1.0	89	s	0.9
400	13	b	3.3	21	b	2.7	31	b	2.3	43	b	2.0	56	b	1.9	66	s	1.6
500	8	b	5.1	14	b	4.0	20	b	3.4	27	b	2.9	36	b	2.6	46	b	2.4
600	6	b	7.2	9	b	5.6	14	b	4.7	19	b	4.0	25	b	3.6	32	b	3.3
750	4	b	11.1	6	b	8.6	9	b	7.1	12	b	6.1	16	b	5.4	20	b	4.8
1000	2	b	19.5	3	b	15.1	5	b	12.3	7	b	10.5	9	b	9.2	11	b	8.2
1200	1	b	28.0	2	b	21.6	3	b	17.6	5	b	14.9	6	b	13.0	8	b	11.5
1500	1	b	43.6	2	b	33.6	2	b	27.3	3	b	23.1	4	b	20.0	5	b	17.7

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u
300	97	s	0.7	109	s	0.7	129	s	0.6	149	s	0.5	159	s	0.5	179	s	0.5
400	73	s	1.4	82	s	1.2	97	s	1.0	112	s	0.9	119	s	0.8	134	s	0.8
500	57	b	2.3	65	s	2.1	77	s	1.6	90	s	1.4	96	s	1.3	108	s	1.1
600	39	b	3.0	48	b	2.9	64	s	2.5	75	s	2.1	80	s	1.9	90	s	1.6
750	25	b	4.4	31	b	4.1	43	b	3.7	58	b	3.4	64	s	3.2	72	s	2.7
1000	14	b	7.4	17	b	6.8	24	b	5.9	33	b	5.3	37	b	5.1	47	b	4.7
1200	10	b	10.4	12	b	9.5	17	b	8.2	23	b	7.3	26	b	6.9	33	b	6.3
1500	6	b	15.9	8	b	14.5	11	b	12.4	14	b	10.9	16	b	10.3	21	b	9.3

b = bending strength limitation
s = planar shear strength limitation

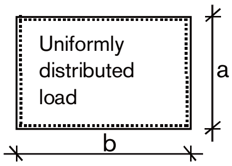
Table 4-5. Birch plywood

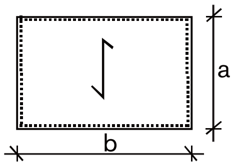
Load resistance for a uniformly distributed load on a simply supported plate.

Span c/c mm a x b	9 q		9 u	12 q		12 u	15 q		15 u	18 q		18 u	21 q		21 u	24 q		24 u
	Nominal thickness (mm)																	
300x300	57	b	4.2	98	b	3.2	145	s	2.5	179	s	1.9	204	s	1.4	236	s	1.1
300x600	27	b	4.2	45	b	3.2	67	b	2.6	93	b	2.2	114	s	1.7	131	s	1.4
300 x ∞	23	b	4.2	38	b	3.2	55	b	2.6	76	b	2.2	96	s	1.8	111	s	1.4
400x400	32	b	7.5	55	b	5.8	84	b	4.7	119	b	3.9	153	s	3.2	177	s	2.5
400x800	15	b	7.4	25	b	5.7	37	b	4.6	52	b	3.9	69	b	3.3	89	b	2.9
400 x ∞	13	b	7.4	21	b	5.7	31	b	4.6	43	b	3.9	56	b	3.3	72	b	2.9
500x500	21	b	11.8	35	b	9.0	54	b	7.3	76	b	6.1	103	b	5.3	133	b	4.7
500x1000	10	b	11.6	16	b	8.9	24	b	7.2	33	b	6.1	44	b	5.2	57	b	4.6
500 x ∞	8	b	11.6	14	b	8.9	20	b	7.2	27	b	6.1	36	b	5.2	46	b	4.6
600x600	14	b	16.9	25	b	13.0	37	b	10.5	53	b	8.8	71	b	7.6	92	b	6.7
600x1200	7	b	16.7	11	b	12.8	17	b	10.4	23	b	8.7	31	b	7.5	39	b	6.6
600 x ∞	6	b	16.7	9	b	12.8	14	b	10.4	19	b	8.7	25	b	7.5	32	b	6.6
750x750	9	b	26.5	16	b	20.3	24	b	16.4	34	b	13.8	46	b	11.9	59	b	10.5
750x1500	4	b	26.2	7	b	20.1	11	b	16.3	15	b	13.7	20	b	11.8	25	b	10.4
750 x ∞	4	b	26.1	6	b	20.0	9	b	16.3	12	b	13.7	16	b	11.8	20	b	10.4
1000x1000	5	b	47.1	9	b	36.1	13	b	29.2	19	b	24.6	26	b	21.2	33	b	18.6
1000x2000	2	b	46.5	4	b	35.6	6	b	28.9	8	b	24.3	11	b	20.9	14	b	18.4
1000 x ∞	2	b	46.5	3	b	35.6	5	b	28.9	7	b	24.3	9	b	20.9	11	b	18.4
1200x1200	4	b	67.8	6	b	51.9	9	b	42.1	13	b	35.4	18	b	30.5	23	b	26.8
1200x2400	2	b	67.0	3	b	51.3	4	b	41.6	6	b	35.0	8	b	30.1	10	b	26.5
1500x1500	2	b	105.9	4	b	81.1	6	b	65.8	8	b	55.3	11	b	47.6	15	b	41.9
1500x3000	1	b	104.6	2	b	80.2	3	b	65.0	4	b	54.6	5	b	47.1	6	b	41.5

Span c/c mm a x b	27 q		27 u	30 q		30 u	35 q		35 u	40 q		40 u	45 q		45 u	50 q		50 u
	Nominal thickness (mm)																	
300x300	262	s	0.8	294	s	0.7	352	s	0.5	410	s	0.4	438	s	0.4	495	s	0.2
300x600	145	s	1.1	162	s	0.9	193	s	0.6	224	s	0.5	239	s	0.5	269	s	0.3
300 x ∞	122	s	1.1	136	s	0.9	161	s	0.7	187	s	0.5	199	s	0.5	224	s	0.3
400x400	196	s	2.0	220	s	1.7	264	s	1.2	307	s	0.9	328	s	0.9	371	s	0.6
400x800	108	s	2.6	121	s	2.1	144	s	1.5	168	s	1.1	179	s	1.2	202	s	0.8
400 x ∞	89	b	2.6	102	s	2.2	121	s	1.6	140	s	1.2	149	s	1.3	168	s	0.8
500x500	157	s	3.9	176	s	3.2	211	s	2.3	246	s	1.7	263	s	1.8	297	s	1.1
500x1000	71	b	4.1	86	b	3.7	116	s	2.9	134	s	2.2	143	s	2.4	162	s	1.5
500 x ∞	57	b	4.1	69	b	3.7	97	s	3.1	112	s	2.3	119	s	2.5	134	s	1.6
600x600	116	b	6.0	143	b	5.4	176	s	3.9	205	s	2.9	219	s	3.2	248	s	2.0
600x1200	49	b	5.9	60	b	5.3	85	b	4.5	112	s	3.8	119	s	4.1	135	s	2.6
600 x ∞	39	b	5.9	48	b	5.3	68	b	4.5	90	b	3.8	100	s	4.3	112	s	2.7
750x750	74	b	9.3	91	b	8.4	130	b	7.1	164	s	5.7	175	s	6.2	198	s	3.9
750x1500	31	b	9.2	38	b	8.3	54	b	7.0	73	b	6.0	83	b	7.0	106	b	5.0
750 x ∞	25	b	9.2	31	b	8.4	43	b	7.0	58	b	6.0	66	b	7.0	84	b	5.0
1000x1000	42	b	16.6	51	b	15.0	73	b	12.6	99	b	10.8	113	b	12.6	145	b	8.9
1000x2000	18	b	16.4	22	b	14.8	30	b	12.4	41	b	10.7	47	b	12.5	59	b	8.8
1000 x ∞	14	b	16.4	17	b	14.8	24	b	12.4	33	b	10.7	37	b	12.5	47	b	8.8
1200x1200	29	b	23.9	36	b	21.6	51	b	18.1	69	b	15.5	79	b	18.1	101	b	12.8
1200x2400	12	b	23.6	15	b	21.4	21	b	17.9	28	b	15.4	32	b	17.9	41	b	12.7
1500x1500	19	b	37.3	23	b	33.8	33	b	28.3	44	b	24.3	50	b	28.3	64	b	20.1
1500x3000	8	b	36.9	10	b	33.4	14	b	28.0	18	b	24.0	21	b	28.0	26	b	19.9

b = bending strength limitation
s = planar shear strength limitation





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

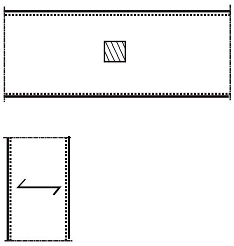
$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

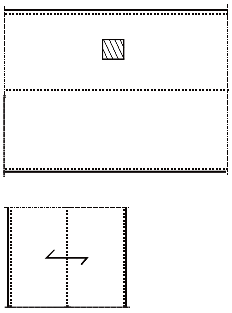
⟵⟶ grain direction of surface veneers

Table 4-6. Birch plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	F		u	F		u	F		u	F		u	F		u	F		u
300	1.0	b	2.8	1.6	b	2.1	2.4	b	1.7	3.4	b	1.5	4.5	b	1.3	5.3	s	1.0
400	0.9	b	4.6	1.5	b	3.5	2.2	b	2.8	3.0	b	2.4	4.0	b	2.1	5.2	b	1.8
500	0.8	b	6.8	1.4	b	5.2	2.0	b	4.2	2.8	b	3.5	3.8	b	3.0	4.9	b	2.7
600	0.8	b	9.3	1.3	b	7.1	1.9	b	5.7	2.7	b	4.8	3.6	b	4.1	4.6	b	3.6
750	0.7	b	13.7	1.2	b	10.4	1.8	b	8.4	2.5	b	7.1	3.4	b	6.1	4.3	b	5.4
1000	0.7	b	22.7	1.1	b	17.3	1.7	b	14.0	2.4	b	11.7	3.1	b	10.1	4.0	b	8.9
1200	0.6	b	31.3	1.1	b	23.8	1.6	b	19.3	2.3	b	16.2	3.0	b	13.9	3.8	b	12.2
1500	0.6	b	46.4	1.0	b	35.4	1.5	b	28.7	2.1	b	24.0	2.8	b	20.7	3.7	b	18.2

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	F		u	F		u	F		u	F		u	F		u	F		u
300	5.8	s	0.8	6.5	s	0.7	7.8	s	0.5	9.0	s	0.3	9.6	s	0.3	10.9	s	0.2
400	5.8	s	1.4	6.5	s	1.2	7.8	s	0.8	9.0	s	0.6	9.6	s	0.5	10.9	s	0.4
500	5.9	s	2.3	6.6	s	1.9	7.8	s	1.3	9.1	s	1.0	9.7	s	0.9	10.9	s	0.7
600	5.7	b	3.2	6.6	s	2.7	7.8	s	1.9	9.1	s	1.4	9.7	s	1.2	10.9	s	1.0
750	5.4	b	4.8	6.6	s	4.3	7.8	s	3.0	9.1	s	2.2	9.7	s	1.9	10.9	s	1.5
1000	5.0	b	7.9	6.1	b	7.1	7.8	s	5.4	9.1	s	4.0	9.7	s	3.5	10.9	s	2.7
1200	4.8	b	10.9	5.9	b	9.9	7.8	s	7.8	9.1	s	5.8	9.7	s	5.0	11.0	s	3.9
1500	4.6	b	16.2	5.6	b	14.6	7.8	s	12.1	9.1	s	9.0	9.7	s	7.8	10.9	s	6.1



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵⟶ grain direction of surface veneers

Table 4-7. Birch plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	F		u	F		u	F		u	F		u	F		u	F		u
300	1.1	b	2.5	1.8	b	1.9	2.7	b	1.5	3.6	s	1.2	4.0	s	0.9	4.7	s	0.7
400	1.0	b	4.0	1.6	b	3.1	2.4	b	2.5	3.3	b	2.1	4.2	s	1.7	4.8	s	1.3
500	0.9	b	5.9	1.5	b	4.5	2.2	b	3.6	3.1	b	3.1	4.1	b	2.6	5.0	s	2.2
600	0.8	b	8.1	1.4	b	6.1	2.1	b	5.0	2.9	b	4.2	3.9	b	3.6	5.0	s	3.1
750	0.8	b	11.8	1.3	b	9.0	2.0	b	7.3	2.7	b	6.1	3.6	b	5.3	4.7	b	4.6
1000	0.7	b	19.5	1.2	b	14.9	1.8	b	12.0	2.5	b	10.1	3.4	b	8.7	4.3	b	7.6
1200	0.7	b	26.8	1.2	b	20.4	1.7	b	16.5	2.4	b	13.9	3.2	b	11.9	4.1	b	10.5
1500	0.7	b	39.7	1.1	b	30.3	1.6	b	24.5	2.3	b	20.5	3.0	b	17.7	3.9	b	15.5

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	F		u	F		u	F		u	F		u	F		u	F		u
300	5.2	s	0.6	5.8	s	0.5	6.9	s	0.3	8.0	s	0.2	8.5	s	0.2	9.6	s	0.2
400	5.3	s	1.1	6.0	s	0.9	7.1	s	0.6	8.3	s	0.5	8.8	s	0.4	10.0	s	0.3
500	5.5	s	1.7	6.1	s	1.4	7.3	s	1.0	8.5	s	0.7	9.0	s	0.6	10.2	s	0.5
600	5.5	s	2.5	6.2	s	2.1	7.4	s	1.4	8.5	s	1.1	9.1	s	0.9	10.3	s	0.7
750	5.6	s	4.0	6.3	s	3.3	7.5	s	2.3	8.7	s	1.7	9.3	s	1.5	10.5	s	1.2
1000	5.4	b	6.8	6.4	s	6.0	7.6	s	4.2	8.9	s	3.1	9.4	s	2.7	10.7	s	2.1
1200	5.1	b	9.3	6.3	b	8.4	7.6	s	6.0	8.8	s	4.5	9.4	s	3.9	10.6	s	3.1
1500	4.9	b	13.8	6.0	b	12.5	7.5	s	9.3	8.7	s	6.9	9.3	s	6.0	10.5	s	4.7

b = bending strength limitation
s = planar shear strength limitation

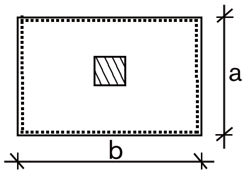
Table 4-8. Birch plywood

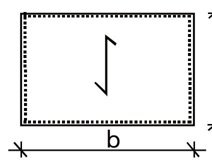
Load resistance for a concentrated load central over an area of 50 x 50 mm on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9			12			15			18			21			24		
	F		u	F		u	F		u	F		u	F		u	F		u
300x300	1.1	b	2.6	1.9	b	1.9	2.9	b	1.6	4.1	s	1.3	4.7	s	1.0	5.4	s	0.7
300x600	1.0	b	2.8	1.6	b	2.1	2.4	b	1.7	3.4	b	1.4	4.5	b	1.2	5.3	s	1.0
300 x ∞	1.0	b	2.8	1.6	b	2.1	2.4	b	1.7	3.4	b	1.5	4.5	b	1.3	5.3	s	1.0
400x400	1.0	b	4.2	1.7	b	3.1	2.6	b	2.5	3.7	b	2.1	4.7	s	1.7	5.4	s	1.3
400x800	0.9	b	4.6	1.5	b	3.5	2.2	b	2.8	3.1	b	2.4	4.1	b	2.0	5.3	b	1.8
400 x ∞	0.9	b	4.6	1.5	b	3.5	2.2	b	2.8	3.0	b	2.4	4.0	b	2.1	5.2	b	1.8
500x500	0.9	b	6.0	1.6	b	4.5	2.4	b	3.6	3.4	b	3.0	4.5	b	2.6	5.3	s	2.1
500x1000	0.8	b	6.7	1.4	b	5.1	2.1	b	4.1	2.9	b	3.5	3.8	b	3.0	4.9	b	2.6
500 x ∞	0.8	b	6.8	1.4	b	5.2	2.0	b	4.2	2.8	b	3.5	3.8	b	3.0	4.9	b	2.7
600x600	0.9	b	8.1	1.5	b	6.2	2.3	b	5.0	3.2	b	4.1	4.2	b	3.5	5.3	s	3.0
600x1200	0.8	b	9.2	1.3	b	7.0	1.9	b	5.7	2.7	b	4.8	3.6	b	4.1	4.7	b	3.6
600 x ∞	0.8	b	9.3	1.3	b	7.1	1.9	b	5.7	2.7	b	4.8	3.6	b	4.1	4.6	b	3.6
750x750	0.8	b	11.8	1.4	b	9.0	2.1	b	7.2	2.9	b	6.0	3.9	b	5.2	5.1	b	4.5
750x1500	0.7	b	13.6	1.2	b	10.4	1.8	b	8.4	2.6	b	7.0	3.4	b	6.0	4.4	b	5.3
750 x ∞	0.7	b	13.7	1.2	b	10.4	1.8	b	8.4	2.5	b	7.1	3.4	b	6.1	4.3	b	5.4
1000x1000	0.7	b	19.3	1.3	b	14.7	1.9	b	11.8	2.7	b	9.9	3.6	b	8.4	4.7	b	7.4
1000x2000	0.7	b	22.5	1.1	b	17.2	1.7	b	13.9	2.4	b	11.6	3.2	b	10.0	4.1	b	8.8
1000 x ∞	0.7	b	22.7	1.1	b	17.3	1.7	b	14.0	2.4	b	11.7	3.1	b	10.1	4.0	b	8.9
1200x1200	0.7	b	26.3	1.2	b	20.1	1.8	b	16.2	2.6	b	13.5	3.4	b	11.6	4.4	b	10.1
1200x2400	0.7	b	31.1	1.1	b	23.7	1.6	b	19.1	2.3	b	16.0	3.0	b	13.8	3.9	b	12.1
1500x1500	0.7	b	38.7	1.1	b	29.5	1.7	b	23.8	2.4	b	19.9	3.2	b	17.0	4.2	b	14.9
1500x3000	0.6	b	46.2	1.0	b	35.2	1.5	b	28.4	2.2	b	23.8	2.9	b	20.5	3.7	b	18.0

Span c/c mm a x b	Nominal thickness (mm) 27			30			35			40			45			50		
	F		u	F		u	F		u	F		u	F		u	F		u
300x300	6.0	s	0.6	6.7	s	0.5	8.0	s	0.3	9.3	s	0.2	9.9	s	0.2	11.2	s	0.2
300x600	5.8	s	0.8	6.5	s	0.6	7.8	s	0.5	9.0	s	0.3	9.6	s	0.3	10.9	s	0.2
300 x ∞	5.8	s	0.8	6.5	s	0.7	7.8	s	0.5	9.0	s	0.3	9.6	s	0.3	10.9	s	0.2
400x400	6.0	s	1.1	6.7	s	0.9	7.9	s	0.6	9.2	s	0.4	9.8	s	0.4	11.1	s	0.3
400x800	5.9	s	1.4	6.5	s	1.2	7.8	s	0.8	9.1	s	0.6	9.6	s	0.5	10.9	s	0.4
400 x ∞	5.8	s	1.4	6.5	s	1.2	7.8	s	0.8	9.0	s	0.6	9.6	s	0.5	10.9	s	0.4
500x500	5.9	s	1.6	6.6	s	1.4	7.9	s	0.9	9.2	s	0.7	9.8	s	0.6	11.0	s	0.5
500x1000	5.9	s	2.2	6.6	s	1.9	7.8	s	1.3	9.1	s	1.0	9.7	s	0.8	10.9	s	0.7
500 x ∞	5.9	s	2.3	6.6	s	1.9	7.8	s	1.3	9.1	s	1.0	9.7	s	0.9	10.9	s	0.7
600x600	5.9	s	2.4	6.6	s	2.0	7.9	s	1.4	9.1	s	1.0	9.7	s	0.9	11.0	s	0.7
600x1200	5.8	b	3.2	6.6	s	2.7	7.8	s	1.9	9.1	s	1.4	9.7	s	1.2	10.9	s	1.0
600 x ∞	5.7	b	3.2	6.6	s	2.7	7.8	s	1.9	9.1	s	1.4	9.7	s	1.2	10.9	s	1.0
750x750	5.9	s	3.7	6.6	s	3.1	7.9	s	2.1	9.1	s	1.6	9.7	s	1.4	11.0	s	1.1
750x1500	5.5	b	4.7	6.6	s	4.2	7.8	s	3.0	9.1	s	2.2	9.7	s	1.9	10.9	s	1.5
750 x ∞	5.4	b	4.8	6.6	s	4.3	7.8	s	3.0	9.1	s	2.2	9.7	s	1.9	10.9	s	1.5
1000x1000	5.8	b	6.6	6.6	s	5.5	7.9	s	3.8	9.1	s	2.8	9.7	s	2.5	11.0	s	1.9
1000x2000	5.1	b	7.8	6.2	b	7.1	7.8	s	5.3	9.1	s	3.9	9.7	s	3.4	11.0	s	2.7
1000 x ∞	5.0	b	7.9	6.1	b	7.1	7.8	s	5.4	9.1	s	4.0	9.7	s	3.5	10.9	s	2.7
1200x1200	5.5	b	9.0	6.6	s	7.9	7.8	s	5.5	9.1	s	4.1	9.7	s	3.5	11.0	s	2.8
1200x2400	4.8	b	10.8	5.9	b	9.7	7.8	s	7.6	9.1	s	5.6	9.7	s	4.9	10.9	s	3.8
1500x1500	5.2	b	13.3	6.4	b	11.9	7.9	s	8.6	9.1	s	6.4	9.7	s	5.5	11.0	s	4.3
1500x3000	4.6	b	16.0	5.6	b	14.5	7.8	s	11.9	9.1	s	8.8	9.7	s	7.7	11.0	s	6.0

b = bending strength limitation
s = planar shear strength limitation





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

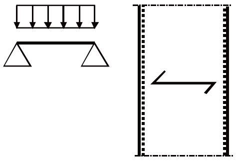
u given in mm

⟵ grain direction of surface veneers

Table 4-9. Combi plywood

Load resistance for a uniformly distributed load on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	23	b	4.4	35	b	3.4	50	b	2.9	67	b	2.5	87	b	2.2	108	b	2.0	122	s	1.8	136	s	1.6
400	13	b	7.6	20	b	5.9	28	b	4.9	38	b	4.2	49	b	3.7	61	b	3.3	72	b	2.9	85	b	2.6
500	8	b	11.8	13	b	9.1	18	b	7.5	24	b	6.4	31	b	5.6	39	b	4.9	46	b	4.3	54	b	3.9
600	6	b	16.9	9	b	13.0	12	b	10.7	17	b	9.0	22	b	7.9	27	b	6.9	32	b	6.0	38	b	5.4
750	4	b	26.3	6	b	20.2	8	b	16.5	11	b	14.0	14	b	12.1	17	b	10.5	21	b	9.2	24	b	8.2
1000	2	b	46.6	3	b	35.8	4	b	29.1	6	b	24.6	8	b	21.3	10	b	18.4	12	b	16.1	14	b	14.2
1200	1	b	67.0	2	b	51.5	3	b	41.8	4	b	35.3	5	b	30.5	7	b	26.4	8	b	23.0	9	b	20.3
1500	1	b	104.6	1	b	80.3	2	b	65.2	3	b	54.9	3	b	47.5	4	b	41.0	5	b	35.6	6	b	31.5



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

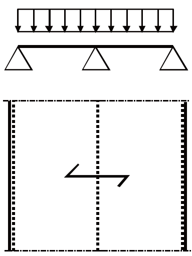
u given in mm

⟵ grain direction of surface veneers

Table 4-10. Combi plywood

Load resistance for a uniformly distributed load on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	23	b	2.0	35	b	1.6	50	b	1.4	67	b	1.3	77	s	1.1	89	s	1.0	97	s	0.8	109	s	0.8
400	13	b	3.3	20	b	2.6	28	b	2.2	38	b	2.0	49	b	1.8	61	b	1.6	72	b	1.5	84	s	1.4
500	8	b	5.1	13	b	4.0	18	b	3.3	24	b	2.9	31	b	2.6	39	b	2.3	46	b	2.1	54	b	1.9
600	6	b	7.2	9	b	5.6	12	b	4.6	17	b	4.0	22	b	3.5	27	b	3.1	32	b	2.8	38	b	2.6
750	4	b	11.1	6	b	8.6	8	b	7.0	11	b	6.0	14	b	5.3	17	b	4.7	21	b	4.1	24	b	3.7
1000	2	b	19.5	3	b	15.0	4	b	12.3	6	b	10.4	8	b	9.1	10	b	7.9	12	b	7.0	14	b	6.2
1200	1	b	28.0	2	b	21.5	3	b	17.5	4	b	14.9	5	b	12.9	7	b	11.2	8	b	9.8	9	b	8.8
1500	1	b	43.6	1	b	33.5	2	b	27.2	3	b	23.0	3	b	19.9	4	b	17.3	5	b	15.1	6	b	13.4



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-11. Combi plywood

Table A3. Load resistance for a uniformly distributed load on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9 q	9 u	12 q	12 u	15 q	15 u	18 q	18 u	21 q	21 u	24 q	24 u	27 q	27 u	30 q	30 u
300x300	56 b	4.2	80 s	2.8	102 s	1.9	116 s	1.3	137 s	1.0	151 s	0.7	171 s	0.6	187 s	0.5
300x600	27 b	4.2	42 b	3.2	61 b	2.6	84 b	2.2	110 b	1.9	136 b	1.6	145 s	1.3	162 s	1.1
300 x ∞	23 b	4.2	35 b	3.2	50 b	2.6	67 b	2.2	87 b	1.9	108 b	1.6	122 s	1.4	136 s	1.2
400x400	31 b	7.5	53 b	5.8	77 s	4.5	87 s	3.1	103 s	2.3	114 s	1.8	128 s	1.4	140 s	1.2
400x800	15 b	7.4	24 b	5.7	34 b	4.6	47 b	3.9	62 b	3.3	77 b	2.9	92 b	2.5	108 b	2.2
400 x ∞	13 b	7.4	20 b	5.7	28 b	4.6	38 b	3.9	49 b	3.4	61 b	2.9	72 b	2.5	85 b	2.2
500x500	20 b	11.7	34 b	9.0	51 b	7.3	70 s	6.0	82 s	4.5	91 s	3.4	103 s	2.8	112 s	2.3
500x1000	10 b	11.6	15 b	8.9	22 b	7.2	30 b	6.1	39 b	5.2	49 b	4.5	59 b	3.9	69 b	3.5
500 x ∞	8 b	11.6	13 b	8.9	18 b	7.2	24 b	6.1	31 b	5.2	39 b	4.5	46 b	3.9	54 b	3.5
600x600	14 b	16.9	24 b	13.0	36 b	10.5	50 b	8.8	66 b	7.6	76 s	5.9	86 s	4.8	94 s	3.9
600x1200	7 b	16.7	11 b	12.8	15 b	10.4	21 b	8.7	27 b	7.5	34 b	6.5	41 b	5.6	48 b	5.0
600 x ∞	6 b	16.7	9 b	12.8	12 b	10.4	17 b	8.7	22 b	7.5	27 b	6.5	32 b	5.6	38 b	5.0
750x750	9 b	26.4	15 b	20.2	23 b	16.4	32 b	13.8	43 b	11.9	54 b	10.3	65 b	8.9	75 s	7.7
750x1500	4 b	26.1	7 b	20.0	10 b	16.2	13 b	13.7	18 b	11.8	22 b	10.2	26 b	8.8	31 b	7.8
750 x ∞	4 b	26.1	6 b	20.0	8 b	16.2	11 b	13.7	14 b	11.8	17 b	10.2	21 b	8.8	24 b	7.8
1000x1000	5 b	47.0	8 b	36.0	13 b	29.2	18 b	24.5	24 b	21.1	30 b	18.2	37 b	15.8	43 b	13.9
1000x2000	2 b	46.4	4 b	35.6	6 b	28.8	8 b	24.3	10 b	20.9	12 b	18.1	15 b	15.7	17 b	13.8
1000 x ∞	2 b	46.4	3 b	35.6	4 b	28.8	6 b	24.3	8 b	20.9	10 b	18.1	12 b	15.7	14 b	13.8
1200x1200	3 b	67.7	6 b	51.8	9 b	42.0	12 b	35.3	17 b	30.4	21 b	26.3	25 b	22.8	30 b	20.1
1200x2400	2 b	66.9	3 b	51.2	4 b	41.5	5 b	35.0	7 b	30.1	9 b	26.0	10 b	22.5	12 b	19.9
1500x1500	2 b	105.7	4 b	81.0	6 b	65.6	8 b	55.2	11 b	47.6	13 b	41.0	16 b	35.6	19 b	31.4
1500x3000	1 b	104.5	2 b	81.1	2 b	64.9	3 b	54.6	4 b	47.1	5 b	40.6	7 b	35.2	8 b	31.1

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

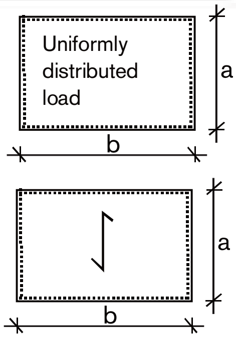


Table 4-12. Combi plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	9 u	12 F	12 u	15 F	15 u	18 F	18 u	21 F	21 u	24 F	24 u	27 F	27 u	30 F	30 u
300	0.9 b	2.8	1.2 s	1.7	1.6 s	1.2	1.8 s	0.9	2.2 s	0.7	2.4 s	0.5	2.7 s	0.4	3.0 s	0.3
400	0.9 b	4.6	1.2 s	3.1	1.6 s	2.2	1.8 s	1.6	2.2 s	1.2	2.4 s	0.9	2.7 s	0.8	3.0 s	0.6
500	0.8 b	6.8	1.2 s	4.8	1.6 s	3.5	1.8 s	2.4	2.2 s	1.9	2.4 s	1.5	2.7 s	1.2	3.0 s	1.0
600	0.8 b	9.3	1.2 s	7.0	1.6 s	5.0	1.8 s	3.5	2.2 s	2.8	2.4 s	2.1	2.7 s	1.7	3.0 s	1.4
750	0.7 b	13.7	1.1 b	10.4	1.6 s	7.9	1.8 s	5.6	2.2 s	4.3	2.4 s	3.3	2.7 s	2.7	3.0 s	2.2
1000	0.7 b	22.6	1.1 b	17.2	1.6 b	13.9	1.8 s	10.1	2.2 s	7.8	2.4 s	6.0	2.8 s	4.9	3.0 s	4.0
1200	0.6 b	31.2	1.0 b	23.8	1.5 b	19.2	1.9 s	14.7	2.2 s	11.4	2.5 s	8.8	2.8 s	7.2	3.1 s	5.9
1500	0.6 b	46.3	1.0 b	35.3	1.4 b	28.5	1.9 s	23.4	2.3 s	18.2	2.5 s	14.0	2.9 s	11.4	3.1 s	9.4

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

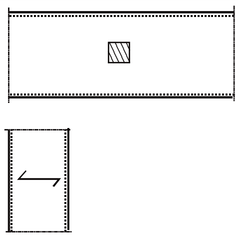
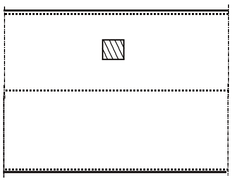
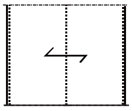


Table 4-13. Combi plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	9 u	12 F	12 u	15 F	15 u	18 F	18 u	21 F	21 u	24 F	24 u	27 F	27 u	30 F	30 u
300	1.0 b	2.5	1.3 s	1.4	1.6 s	1.0	1.9 s	0.7	2.2 s	0.6	2.5 s	0.4	2.8 s	0.3	3.1 s	0.3
400	0.9 b	4.0	1.3 s	2.5	1.6 s	1.8	1.9 s	1.3	2.2 s	1.0	2.5 s	0.8	2.8 s	0.6	3.1 s	0.5
500	0.9 b	5.9	1.3 s	4.0	1.6 s	2.9	1.9 s	2.0	2.2 s	1.6	2.5 s	1.2	2.8 s	1.0	3.1 s	0.8
600	0.8 b	8.0	1.3 s	5.9	1.7 s	4.2	1.9 s	3.0	2.3 s	2.3	2.5 s	1.8	2.9 s	1.5	3.2 s	1.2
750	0.8 b	11.8	1.2 b	9.0	1.7 s	6.7	1.9 s	4.7	2.3 s	3.7	2.6 s	2.9	2.9 s	2.3	3.2 s	1.9
1000	0.7 b	19.4	1.1 b	14.8	1.7 b	12.0	2.0 s	8.7	2.4 s	6.8	2.6 s	5.2	3.0 s	4.3	3.3 s	3.5
1200	0.7 b	26.7	1.1 b	20.4	1.6 b	16.4	2.1 s	12.9	2.5 s	10.1	2.7 s	7.8	3.1 s	6.4	3.4 s	5.2
1500	0.6 b	39.6	1.0 b	30.1	1.5 b	24.3	2.1 b	20.4	2.6 s	17.0	3.0 s	13.1	3.4 s	10.8	3.7 s	8.8





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

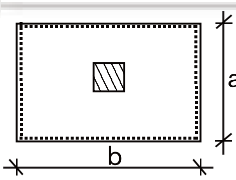
u given in mm

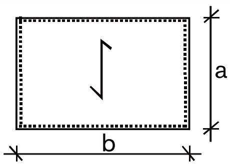
⟵ grain direction of surface veneers

Table 4-14. Combi plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9 F	9 u	12 F	12 u	15 F	15 u	18 F	18 d	21 F	21 u	24 F	24 u	27 F	27 u	30 F	30 u
300x300	1.0 s	2.4	1.2 s	1.3	1.6 s	0.9	1.8 s	0.6	2.2 s	0.5	2.4 s	0.4	2.7 s	0.3	3.0 s	0.2
300x600	0.9 b	2.8	1.2 s	1.7	1.6 s	1.2	1.8 s	0.8	2.2 s	0.7	2.4 s	0.5	2.7 s	0.4	3.0 s	0.3
300 x ∞	0.9 b	2.8	1.2 s	1.7	1.6 s	1.2	1.8 s	0.9	2.2 s	0.7	2.4 s	0.5	2.7 s	0.4	3.0 s	0.3
400x400	1.0 b	4.1	1.2 s	2.3	1.6 s	1.6	1.8 s	1.1	2.2 s	0.8	2.4 s	0.6	2.7 s	0.5	3.0 s	0.4
400x800	0.9 b	4.6	1.2 s	3.0	1.6 s	2.2	1.8 s	1.5	2.2 s	1.2	2.4 s	0.9	2.7 s	0.7	3.0 s	0.6
400 x ∞	0.9 b	4.6	1.2 s	3.1	1.6 s	2.2	1.8 s	1.6	2.2 s	1.2	2.4 s	0.9	2.7 s	0.8	3.0 s	0.6
500x500	0.9 b	6.0	1.2 s	3.6	1.6 s	2.5	1.8 s	1.7	2.1 s	1.3	2.4 s	1.0	2.7 s	0.8	3.0 s	0.7
500x1000	0.8 b	6.7	1.2 s	4.7	1.6 s	3.4	1.8 s	2.4	2.1 s	1.9	2.4 s	1.4	2.7 s	1.2	3.0 s	1.0
500 x ∞	0.8 b	6.8	1.2 s	4.8	1.6 s	3.5	1.8 s	2.4	2.2 s	1.9	2.4 s	1.5	2.7 s	1.2	3.0 s	1.0
600x600	0.9 b	8.2	1.2 s	5.2	1.6 s	3.6	1.8 s	2.5	2.1 s	1.9	2.4 s	1.5	2.7 s	1.2	3.0 s	1.0
600x1200	0.8 b	9.2	1.2 s	6.9	1.6 s	4.9	1.8 s	3.5	2.1 s	2.7	2.4 s	2.1	2.7 s	1.7	3.0 s	1.4
600 x ∞	0.8 b	9.3	1.2 s	7.0	1.6 s	5.0	1.8 s	3.5	2.2 s	2.8	2.4 s	2.1	2.7 s	1.7	3.0 s	1.4
750x750	0.8 b	12.0	1.2 s	8.2	1.6 s	5.7	1.8 s	4.0	2.2 s	3.0	2.4 s	2.3	2.7 s	1.9	3.0 s	1.5
750x1500	0.7 b	13.6	1.2 b	10.3	1.6 s	7.8	1.8 s	5.4	2.2 s	4.2	2.4 s	3.3	2.7 s	2.7	3.0 s	2.2
750 x ∞	0.7 b	13.7	1.1 b	10.4	1.6 s	7.9	1.8 s	5.6	2.2 s	4.3	2.4 s	3.3	2.7 s	2.7	3.0 s	2.2
1000x1000	0.7 b	19.6	1.2 b	14.7	1.6 s	10.3	1.8 s	7.1	2.2 s	5.5	2.4 s	4.2	2.8 s	3.4	3.0 s	2.8
1000x2000	0.7 b	22.5	1.1 b	17.1	1.6 b	13.8	1.8 s	9.8	2.2 s	7.6	2.4 s	5.8	2.8 s	4.8	3.0 s	3.9
1000 x ∞	0.7 b	22.6	1.1 b	17.2	1.6 b	13.9	1.8 s	10.1	2.2 s	7.8	2.4 s	6.0	2.8 s	4.9	3.0 s	4.0
1200x1200	0.7 b	26.8	1.2 b	20.1	1.6 s	15.0	1.8 s	10.3	2.2 s	7.9	2.4 s	6.0	2.8 s	4.9	3.0 s	4.0
1200x2400	0.6 b	31.0	1.0 b	23.6	1.5 b	19.0	1.8 s	14.2	2.2 s	11.0	2.4 s	8.5	2.8 s	6.9	3.0 s	5.7
1500x1500	0.7 b	39.3	1.1 b	29.7	1.6 b	23.6	1.9 s	16.4	2.2 s	12.6	2.5 s	9.6	2.8 s	7.8	3.1 s	6.4
1500x3000	0.6 b	46.0	1.0 b	35.0	1.4 b	28.2	1.9 s	22.5	2.2 s	17.5	2.5 s	13.4	2.8 s	11.0	3.1 s	9.0





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

b = bending strength limitation
s = planar shear strength limitation

F given in kN

u given in mm

⟵ grain direction of surface veneers

Table 4-15. Combi Mirror plywood

Load resistance for a uniformly distributed load on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	23	b	4.8	38	b	4.0	45	s	2.9	55	s	2.3	62	s	1.9	71	s	1.7	78	s	1.5	87	s	1.4
400	13	b	8.1	21	b	6.5	31	b	5.5	41	s	4.8	46	s	3.8	53	s	3.2	59	s	2.7	65	s	2.4
500	8	b	12.2	14	b	9.7	20	b	8.1	27	b	7.1	36	b	6.4	43	s	5.5	47	s	4.6	52	s	4.1
600	6	b	17.4	9	b	13.6	14	b	11.3	19	b	9.8	25	b	8.7	32	b	8.0	39	s	7.4	44	s	6.4
750	4	b	26.8	6	b	20.8	9	b	17.2	12	b	14.7	16	b	13.0	20	b	11.7	25	b	10.7	31	b	10.0
1000	2	b	47.1	3	b	36.4	5	b	29.8	7	b	25.3	9	b	22.1	11	b	19.8	14	b	17.9	17	b	16.5
1200	1	b	67.5	2	b	52.1	3	b	42.5	5	b	36.0	6	b	31.3	8	b	27.9	10	b	25.2	12	b	23.0
1500	1	b	105.2	2	b	80.9	2	b	65.9	3	b	55.7	4	b	48.3	5	b	42.8	6	b	38.5	8	b	35.1

Medium-term loading

Service Class 1

k_{mod} = 0.80

k_{def} = 0.25

γ_q = 1.5

γ_m = 1.3

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

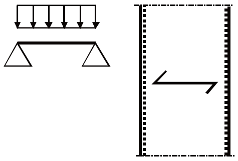


Table 4-16. Combi Mirror plywood

Table A2. Load resistance for a uniformly distributed load on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	23	s	2.4	31	s	1.9	36	s	1.4	44	s	1.3	49	s	1.1	57	s	1.0	63	s	1.0	70	s	0.9
400	13	b	3.8	21	b	3.3	27	s	2.6	33	s	2.2	37	s	1.9	43	s	1.7	47	s	1.5	52	s	1.4
500	8	b	5.6	14	b	4.6	20	b	4.1	26	s	3.6	30	s	3.0	34	s	2.6	38	s	2.3	42	s	2.1
600	6	b	7.7	9	b	6.2	14	b	5.4	19	b	4.9	25	s	4.5	28	s	3.9	31	s	3.4	35	s	3.0
750	4	b	11.6	6	b	9.2	9	b	7.8	12	b	6.9	16	b	6.3	20	b	5.9	25	s	5.6	28	s	4.9
1000	2	b	20.0	3	b	15.7	5	b	13.1	7	b	11.3	9	b	10.1	11	b	9.2	14	b	8.6	17	b	8.1
1200	1	b	28.5	2	b	22.2	3	b	18.3	5	b	15.8	6	b	13.9	8	b	12.6	10	b	11.6	12	b	10.8
1500	1	b	44.1	2	b	34.2	2	b	28.1	3	b	23.9	4	b	21.0	5	b	18.8	6	b	17.1	8	b	15.8

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

k_{mod} = 0.80

k_{def} = 0.25

γ_q = 1.5

γ_m = 1.3

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

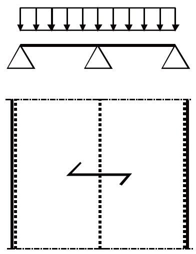
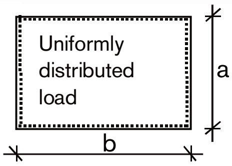
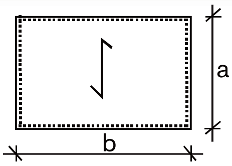


Table 4-17. Combi Mirror plywood

Load resistance for a uniformly distributed load on a simply supported plate

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
a x b	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300x300	42	b	3.5	71	b	2.7	85	s	1.7	105	s	1.2	120	s	0.9	139	s	0.7	154	s	0.6	173	s	0.5
300x600	26	b	4.2	43	b	3.2	51	s	2.1	62	s	1.5	70	s	1.1	81	s	0.9	90	s	0.7	100	s	0.6
300 x ∞	23	b	4.2	38	b	3.2	45	s	2.1	55	s	1.6	62	s	1.2	71	s	0.9	78	s	0.7	87	s	0.6
400x400	24	b	6.2	40	b	4.8	60	b	3.8	79	s	3.0	90	s	2.2	104	s	1.7	116	s	1.3	130	s	1.1
400x800	15	b	7.4	24	b	5.7	36	b	4.6	47	s	3.6	53	s	2.7	61	s	2.1	67	s	1.7	75	s	1.4
400 x ∞	13	b	7.4	21	b	5.7	31	b	4.6	41	s	3.8	46	s	2.8	53	s	2.2	59	s	1.7	65	s	1.4
500x500	15	b	9.7	26	b	7.4	39	b	6.0	54	b	5.0	72	s	4.2	84	s	3.3	93	s	2.6	104	s	2.2
500x1000	10	b	11.6	16	b	8.9	23	b	7.2	32	b	6.1	42	s	5.2	49	s	4.1	54	s	3.3	60	s	2.7
500 x ∞	8	b	11.6	14	b	8.9	20	b	7.2	27	b	6.1	36	b	5.2	43	s	4.3	47	s	3.4	52	s	2.8
600x600	10	b	14.0	18	b	10.7	27	b	8.6	38	b	7.1	50	b	6.1	64	b	5.3	77	s	4.6	86	s	3.8
600x1200	7	b	16.7	11	b	12.8	16	b	10.4	22	b	8.7	29	b	7.5	38	b	6.6	45	s	5.7	50	s	4.7
600 x ∞	6	b	16.7	9	b	12.8	14	b	10.4	19	b	8.7	25	b	7.5	32	b	6.6	39	s	5.9	44	s	4.9
750x750	7	b	21.8	11	b	16.7	17	b	13.4	24	b	11.2	32	b	9.5	41	b	8.3	51	b	7.4	63	b	6.6
750x1500	4	b	26.2	7	b	20.1	10	b	16.3	14	b	13.7	19	b	11.8	24	b	10.4	30	b	9.2	37	b	8.4
750 x ∞	4	b	26.1	6	b	20.0	9	b	16.3	12	b	13.7	16	b	11.8	20	b	10.4	25	b	9.2	31	b	8.4
1000x1000	4	b	38.8	6	b	29.7	10	b	23.8	14	b	19.8	18	b	17.0	23	b	14.8	29	b	13.1	35	b	11.8
1000x2000	2	b	46.5	4	b	35.7	6	b	28.9	8	b	24.3	11	b	20.9	14	b	18.4	17	b	16.4	21	b	14.9
1000 x ∞	2	b	46.5	3	b	35.6	5	b	28.9	7	b	24.3	9	b	20.9	11	b	18.4	14	b	16.4	17	b	14.8
1200x1200	3	b	55.9	4	b	42.8	7	b	34.3	9	b	28.6	13	b	24.4	16	b	21.3	20	b	18.9	24	b	17.0
1200x2400	2	b	67.0	3	b	51.3	4	b	41.6	6	b	35.0	7	b	30.2	9	b	26.6	12	b	23.7	14	b	21.4
1500x1500	2	b	87.3	3	b	66.9	4	b	53.6	6	b	44.6	8	b	38.1	10	b	33.3	13	b	29.5	16	b	26.6
1500x3000	1	b	104.6	2	b	80.2	3	b	65.1	4	b	54.7	5	b	47.1	6	b	41.5	8	b	37.0	9	b	33.4





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

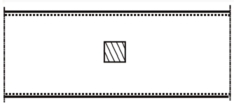
u given in mm

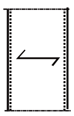
⟵ grain direction of surface veneers

Table 4-18. Combi Mirror plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	F		u	F		u	F		u	F		u	F		u	F		u	F		u	F		u
300	0.7	b	2.3	1.2	s	1.8	1.4	s	1.1	1.8	s	0.8	2.0	s	0.6	2.3	s	0.5	2.6	s	0.4	2.9	s	0.3
400	0.6	b	3.6	1.1	b	2.9	1.5	s	2.0	1.8	s	1.5	2.0	s	1.1	2.3	s	0.9	2.6	s	0.7	2.9	s	0.6
500	0.6	b	5.1	1.0	b	4.2	1.5	s	3.2	1.8	s	2.4	2.0	s	1.7	2.3	s	1.4	2.6	s	1.1	2.9	s	0.9
600	0.5	b	6.9	0.9	b	5.6	1.5	s	4.6	1.8	s	3.4	2.0	s	2.5	2.3	s	2.0	2.6	s	1.6	2.9	s	1.3
750	0.5	b	10.0	0.9	b	8.1	1.3	b	6.7	1.8	s	5.4	2.0	s	3.9	2.3	s	3.1	2.6	s	2.4	2.9	s	2.0
1000	0.4	b	16.2	0.8	b	13.1	1.2	b	10.9	1.7	b	9.3	2.0	s	7.0	2.3	s	5.5	2.6	s	4.4	2.9	s	3.6
1200	0.4	b	22.0	0.7	b	17.8	1.1	b	14.8	1.6	b	12.6	2.0	s	10.1	2.3	s	8.0	2.6	s	6.3	2.9	s	5.2
1500	0.4	b	32.2	0.7	b	26.1	1.1	b	21.7	1.5	b	18.5	2.0	s	15.8	2.3	s	12.5	2.6	s	9.8	2.9	s	8.1





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-19. Combi Mirror plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300	0.8 s	1.9	1.1 s	1.2	1.3 s	0.8	1.6 s	0.6	1.8 s	0.4	2.0 s	0.3	2.3 s	0.3	2.5 s	0.2
400	0.7 b	3.1	1.1 s	2.3	1.3 s	1.5	1.6 s	1.1	1.8 s	0.8	2.1 s	0.6	2.3 s	0.5	2.6 s	0.4
500	0.6 b	4.3	1.1 b	3.5	1.4 s	2.4	1.7 s	1.7	1.9 s	1.3	2.2 s	1.0	2.4 s	0.8	2.7 s	0.7
600	0.6 b	5.8	1.0 b	4.7	1.4 s	3.5	1.7 s	2.6	1.9 s	1.9	2.2 s	1.5	2.4 s	1.2	2.7 s	1.0
750	0.5 b	8.4	0.9 b	6.8	1.4 s	5.5	1.7 s	4.1	1.9 s	3.0	2.2 s	2.4	2.4 s	1.9	2.7 s	1.5
1000	0.5 b	13.5	0.8 b	10.9	1.3 b	9.1	1.7 s	7.4	2.0 s	5.4	2.3 s	4.3	2.5 s	3.4	2.8 s	2.8
1200	0.4 b	18.4	0.8 b	14.9	1.2 b	12.3	1.7 b	10.5	2.0 s	7.9	2.3 s	6.2	2.5 s	4.9	2.8 s	4.1
1500	0.4 b	26.8	0.7 b	21.6	1.1 b	17.9	1.6 b	15.3	1.9 s	12.2	2.3 s	9.6	2.5 s	7.6	2.8 s	6.3

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

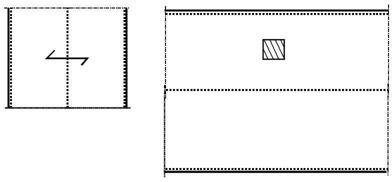


Table 4-20. Combi Mirror plywood

Load resistance for a concentrated central load over an area of 50 x 50 mm on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300x300	0.7 b	1.8	1.2 b	1.4	1.5 s	0.9	1.8 s	0.7	2.0 s	0.5	2.4 s	0.4	2.6 s	0.3	2.9 s	0.2
300x600	0.7 b	2.3	1.2 s	1.7	1.4 s	1.1	1.8 s	0.8	2.0 s	0.6	2.3 s	0.5	2.6 s	0.4	2.9 s	0.3
300 x ∞	0.7 b	2.3	1.2 s	1.8	1.4 s	1.1	1.8 s	0.8	2.0 s	0.6	2.3 s	0.5	2.6 s	0.4	2.9 s	0.3
400x400	0.6 b	2.8	1.1 b	2.2	1.5 s	1.6	1.8 s	1.2	2.0 s	0.9	2.4 s	0.7	2.6 s	0.5	2.9 s	0.4
400x800	0.6 b	3.6	1.1 b	2.9	1.5 s	2.0	1.8 s	1.5	2.0 s	1.1	2.3 s	0.9	2.6 s	0.7	2.9 s	0.6
400 x ∞	0.6 b	3.6	1.1 b	2.9	1.5 s	2.0	1.8 s	1.5	2.0 s	1.1	2.3 s	0.9	2.6 s	0.7	2.9 s	0.6
500x500	0.6 b	4.0	1.0 b	3.1	1.5 b	2.5	1.8 s	1.8	2.0 s	1.3	2.3 s	1.1	2.6 s	0.8	2.9 s	0.7
500x1000	0.6 b	5.1	1.0 b	4.1	1.5 s	3.2	1.8 s	2.3	2.0 s	1.7	2.3 s	1.3	2.6 s	1.1	2.9 s	0.9
500 x ∞	0.6 b	5.1	1.0 b	4.2	1.5 s	3.2	1.8 s	2.4	2.0 s	1.7	2.3 s	1.4	2.6 s	1.1	2.9 s	0.9
600x600	0.5 b	5.4	0.9 b	4.2	1.4 b	3.4	1.8 s	2.7	2.0 s	1.9	2.3 s	1.5	2.6 s	1.2	2.9 s	1.0
600x1200	0.5 b	6.8	0.9 b	5.5	1.4 b	4.6	1.8 s	3.4	2.0 s	2.5	2.3 s	2.0	2.6 s	1.5	2.9 s	1.3
600 x ∞	0.5 b	6.9	0.9 b	5.6	1.5 s	4.6	1.8 s	3.4	2.0 s	2.5	2.3 s	2.0	2.6 s	1.6	2.9 s	1.3
750x750	0.5 b	7.9	0.8 b	6.2	1.3 b	5.0	1.8 s	4.2	2.0 s	3.0	2.3 s	2.4	2.6 s	1.9	2.9 s	1.5
750x1500	0.5 b	9.9	0.9 b	8.0	1.3 b	6.6	1.8 s	5.3	2.0 s	3.9	2.3 s	3.1	2.6 s	2.4	2.9 s	2.0
750 x ∞	0.5 b	10.0	0.9 b	8.1	1.3 b	6.7	1.8 s	5.4	2.0 s	3.9	2.3 s	3.1	2.6 s	2.4	2.9 s	2.0
1000x1000	0.4 b	12.8	0.8 b	10.0	1.2 b	8.1	1.6 b	6.8	2.0 s	5.4	2.3 s	4.3	2.6 s	3.3	2.9 s	2.8
1000x2000	0.4 b	16.0	0.8 b	12.9	1.2 b	10.7	1.7 b	9.1	2.0 s	6.9	2.3 s	5.5	2.6 s	4.3	2.9 s	3.6
1000 x ∞	0.4 b	16.2	0.8 b	13.1	1.2 b	10.9	1.7 b	9.3	2.0 s	7.0	2.3 s	5.5	2.6 s	4.4	2.9 s	3.6
1200x1200	0.4 b	17.5	0.7 b	13.7	1.1 b	11.1	1.5 b	9.3	2.0 s	7.8	2.3 s	6.1	2.6 s	4.8	2.9 s	4.0
1200x2400	0.4 b	21.8	0.7 b	17.6	1.1 b	14.6	1.6 b	12.5	2.0 s	10.0	2.3 s	7.9	2.6 s	6.2	2.9 s	5.1
1500x1500	0.4 b	25.7	0.7 b	20.1	1.0 b	16.3	1.5 b	13.7	1.9 b	11.8	2.3 s	9.6	2.6 s	7.6	2.9 s	6.2
1500x3000	0.4 b	32.0	0.7 b	25.8	1.1 b	21.4	1.5 b	18.2	2.0 s	15.6	2.3 s	12.4	2.6 s	9.8	2.9 s	8.1

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

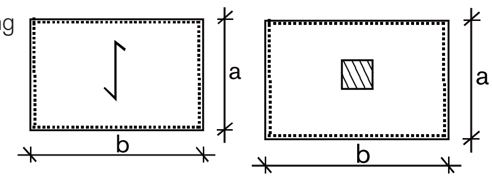
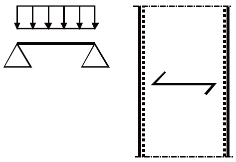


Table 4-21. Conifer plywood, thin veneers

Load resistance for a uniformly distributed load on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	13	b	3.6	21	b	2.9	31	b	2.5	43	b	2.3	57	b	2.1	71	s	2.0	78	s	1.7	87	s	1.6
400	8	b	6.1	12	b	4.8	18	b	4.1	24	b	3.6	32	b	3.3	41	b	3.0	51	b	2.9	62	b	2.8
500	5	b	9.3	8	b	7.3	11	b	6.1	16	b	5.3	20	b	4.7	26	b	4.3	33	b	4.0	40	b	3.8
600	3	b	13.2	5	b	10.3	8	b	8.5	11	b	7.3	14	b	6.5	18	b	5.9	23	b	5.4	27	b	5.1
750	2	b	20.4	3	b	15.8	5	b	13.0	7	b	11.1	9	b	9.7	12	b	8.7	14	b	8.0	18	b	7.4
1000	1	b	36.0	2	b	27.8	3	b	22.8	4	b	19.3	5	b	16.8	7	b	14.9	8	b	13.5	10	b	12.4
1200	1	b	51.7	1	b	39.9	2	b	32.5	3	b	27.5	4	b	23.9	5	b	21.2	6	b	19.1	7	b	17.4
1500	1	b	80.6	1	b	62.1	1	b	50.5	2	b	42.7	2	b	36.9	3	b	32.6	4	b	29.4	4	b	26.7



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

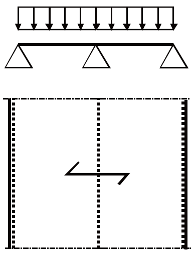
u given in mm

⟵ grain direction of surface veneers

Table 4-22. Conifer plywood, thin veneers

Load resistance for a uniformly distributed load on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300	13	b	1.8	21	b	1.5	31	b	1.4	43	b	1.4	49	s	1.2	57	s	1.1	63	s	1.0	70	s	1.0
400	8	b	2.8	12	b	2.3	18	b	2.1	24	b	2.0	32	b	1.9	41	b	1.9	47	s	1.7	52	s	1.6
500	5	b	4.1	8	b	3.4	11	b	2.9	16	b	2.7	20	b	2.5	26	b	2.4	33	b	2.3	40	b	2.3
600	3	b	5.7	5	b	4.6	8	b	3.9	11	b	3.5	14	b	3.2	18	b	3.0	23	b	2.9	27	b	2.8
750	2	b	8.7	3	b	6.9	5	b	5.8	7	b	5.1	9	b	4.6	12	b	4.2	14	b	4.0	18	b	3.8
1000	1	b	15.2	2	b	11.9	3	b	9.8	4	b	8.5	5	b	7.5	7	b	6.8	8	b	6.3	10	b	5.9
1200	1	b	21.7	1	b	16.9	2	b	13.9	3	b	11.9	4	b	10.4	5	b	9.4	6	b	8.6	7	b	8.0
1500	1	b	33.7	1	b	26.1	1	b	21.4	2	b	18.2	2	b	15.8	3	b	14.1	4	b	12.8	4	b	11.8



Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-23. Conifer plywood, thin veneers

Load resistance for a uniformly distributed load on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9 q	u	12 q	u	15 q	u	18 q	u	21 q	u	24 q	u	27 q	u	30 q	u
300x300	33 b	3.3	56 b	2.5	86 b	2.0	114 s	1.6	130 s	1.2	152 s	0.9	168 s	0.7	188 s	0.6
300x600	16 b	3.2	26 b	2.5	38 b	2.0	53 b	1.7	70 b	1.4	84 s	1.2	93 s	0.9	104 s	0.8
300 x ∞	13 b	3.2	21 b	2.5	31 b	2.0	43 b	1.7	57 b	1.4	71 s	1.2	78 s	1.0	87 s	0.8
400x400	18 b	5.8	32 b	4.4	48 b	3.6	68 b	3.0	92 b	2.6	114 s	2.2	126 s	1.7	141 s	1.4
400x800	9 b	5.7	14 b	4.4	21 b	3.6	30 b	3.0	39 b	2.6	51 b	2.3	63 b	2.0	77 b	1.8
400 x ∞	8 b	5.7	12 b	4.4	18 b	3.6	24 b	3.0	32 b	2.6	41 b	2.3	51 b	2.0	62 b	1.8
500x500	12 b	9.0	20 b	6.9	31 b	5.6	44 b	4.7	59 b	4.1	76 b	3.6	96 b	3.2	113 s	2.8
500x1000	6 b	8.9	9 b	6.9	14 b	5.6	19 b	4.7	25 b	4.0	32 b	3.5	40 b	3.2	49 b	2.9
500 x ∞	5 b	8.9	8 b	6.8	11 b	5.6	16 b	4.7	20 b	4.0	26 b	3.5	33 b	3.2	40 b	2.9
600x600	8 b	13.0	14 b	10.0	21 b	8.1	30 b	6.8	41 b	5.9	53 b	5.2	66 b	4.6	82 b	4.2
600x1200	4 b	12.8	6 b	9.9	10 b	8.0	13 b	6.7	18 b	5.8	22 b	5.1	28 b	4.6	34 b	4.1
600 x ∞	3 b	12.8	5 b	9.9	8 b	8.0	11 b	6.7	14 b	5.8	18 b	5.1	23 b	4.6	27 b	4.1
750x750	5 b	20.3	9 b	15.6	14 b	12.7	19 b	10.6	26 b	9.2	34 b	8.1	43 b	7.2	52 b	6.5
750x1500	3 b	20.1	4 b	15.4	6 b	12.5	8 b	10.5	11 b	9.1	14 b	8.0	18 b	7.1	22 b	6.4
750 x ∞	2 b	20.1	3 b	15.4	5 b	12.5	7 b	10.5	9 b	9.1	12 b	8.0	14 b	7.1	18 b	6.4
1000x1000	3 b	36.1	5 b	27.7	8 b	22.5	11 b	18.9	15 b	16.3	19 b	14.3	24 b	12.8	29 b	11.6
1000x2000	1 b	35.7	2 b	27.4	3 b	22.2	5 b	18.7	6 b	16.1	8 b	14.2	10 b	12.7	12 b	11.4
1000 x ∞	1 b	35.7	2 b	27.4	3 b	22.2	4 b	18.7	5 b	16.1	7 b	14.2	8 b	12.7	10 b	11.4
1200x1200	2 b	52.0	4 b	39.9	5 b	32.4	8 b	27.2	10 b	23.4	13 b	20.6	17 b	18.4	20 b	16.6
1200x2400	1 b	51.4	2 b	39.5	2 b	32.0	3 b	26.9	4 b	23.2	6 b	20.4	7 b	18.2	9 b	16.5
1500x1500	1 b	81.3	2 b	62.4	3 b	50.6	5 b	42.6	7 b	36.6	8 b	32.2	11 b	28.8	13 b	26.0
1500x3000	1 b	80.3	1 b	61.7	2 b	50.0	2 b	42.1	3 b	36.2	4 b	31.9	4 b	28.5	5 b	25.7

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m²

u given in mm

grain direction of surface veneers

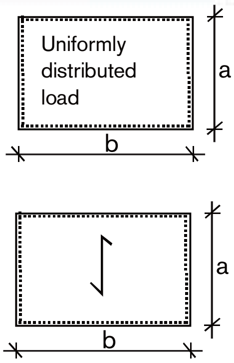


Table 4-24. Conifer plywood, thin veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300	0.6 b	2.2	0.9 b	1.7	1.4 b	1.3	1.8 s	1.1	2.1 s	0.8	2.4 s	0.6	2.7 s	0.5	3.0 s	0.4
400	0.5 b	3.5	0.8 b	2.7	1.2 b	2.2	1.7 b	1.8	2.1 s	1.4	2.4 s	1.1	2.7 s	0.9	3.0 s	0.7
500	0.5 b	5.2	0.8 b	4.0	1.2 b	3.2	1.6 b	2.7	2.1 s	2.3	2.4 s	1.8	2.7 s	1.4	3.0 s	1.2
600	0.4 b	7.1	0.7 b	5.4	1.1 b	4.4	1.5 b	3.7	2.0 b	3.2	2.4 s	2.6	2.7 s	2.0	3.0 s	1.7
750	0.4 b	10.5	0.7 b	8.0	1.0 b	6.5	1.4 b	5.5	1.9 b	4.7	2.4 s	4.1	2.7 s	3.2	3.0 s	2.6
1000	0.4 b	17.4	0.6 b	13.3	1.0 b	10.8	1.3 b	9.0	1.8 b	7.8	2.3 b	6.8	2.7 s	5.7	3.0 s	4.7
1200	0.4 b	24.0	0.6 b	18.3	0.9 b	14.8	1.3 b	12.5	1.7 b	10.7	2.2 b	9.4	2.7 s	8.2	3.0 s	6.8
1500	0.4 b	35.6	0.6 b	27.2	0.9 b	22.0	1.2 b	18.5	1.6 b	15.9	2.1 b	14.0	2.6 b	12.5	3.0 s	10.6

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

grain direction of surface veneers

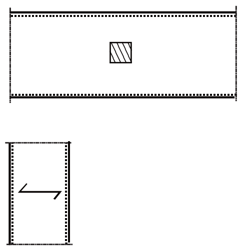
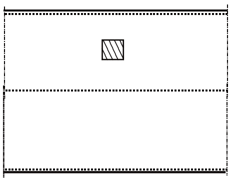


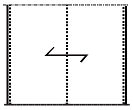
Table 4-25. Conifer plywood, thin veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a double span plate strip

Span c/c mm	9 F	9 u	12 F	12 u	15 F	15 u	18 F	18 u	21 F	21 u	24 F	24 u	27 F	27 u	30 F	30 u
300	0.6 b	1.9	1.0 b	1.5	1.3 s	1.0	1.6 s	0.8	1.8 s	0.6	2.1 s	0.4	2.4 s	0.3	2.6 s	0.3
400	0.6 b	3.1	0.9 b	2.4	1.4 b	1.9	1.7 s	1.4	1.9 s	1.0	2.2 s	0.8	2.4 s	0.7	2.7 s	0.5
500	0.5 b	4.5	0.9 b	3.5	1.3 b	2.8	1.7 s	2.3	2.0 s	1.7	2.3 s	1.3	2.5 s	1.0	2.8 s	0.9
600	0.5 b	6.2	0.8 b	4.7	1.2 b	3.8	1.7 b	3.2	2.0 s	2.5	2.3 s	1.9	2.5 s	1.5	2.8 s	1.3
750	0.5 b	9.1	0.8 b	6.9	1.1 b	5.6	1.6 b	4.7	2.0 s	3.9	2.3 s	3.1	2.6 s	2.4	2.9 s	2.0
1000	0.4 b	15.0	0.7 b	11.4	1.0 b	9.2	1.4 b	7.8	1.9 b	6.7	2.4 s	5.6	2.6 s	4.4	2.9 s	3.7
1200	0.4 b	20.6	0.7 b	15.7	1.0 b	12.7	1.4 b	10.7	1.8 b	9.2	2.4 b	8.1	2.6 s	6.4	2.9 s	5.3
1500	0.4 b	30.4	0.6 b	23.3	0.9 b	18.8	1.3 b	15.8	1.7 b	13.6	2.2 b	11.9	2.6 s	9.9	2.9 s	8.2

Nominal thickness (mm)





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

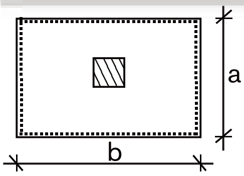
⟵⟶ grain direction of surface veneers

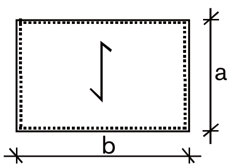
Table 4-26. Conifer plywood, thin veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a simply supported plate

Span c/c mm a x b	9 F	9 u	12 F	12 u	15 F	15 u	18 F	18 u	21 F	21 u	24 F	24 u	27 F	27 u	30 F	30 u
300x300	0.7 b	2.0	1.1 b	1.5	1.6 s	1.1	1.9 s	0.8	2.2 s	0.6	2.5 s	0.5	2.8 s	0.4	3.1 s	0.3
300x600	0.6 b	2.2	0.9 b	1.6	1.4 b	1.3	1.8 s	1.1	2.1 s	0.8	2.4 s	0.6	2.7 s	0.5	3.0 s	0.4
300 x ∞	0.6 b	2.2	0.9 b	1.7	1.4 b	1.3	1.8 s	1.1	2.1 s	0.8	2.4 s	0.6	2.7 s	0.5	3.0 s	0.4
400x400	0.6 b	3.2	1.0 b	2.4	1.5 b	1.9	1.8 s	1.4	2.1 s	1.1	2.5 s	0.8	2.7 s	0.6	3.0 s	0.5
400x800	0.5 b	3.5	0.8 b	2.7	1.3 b	2.2	1.8 b	1.8	2.1 s	1.4	2.4 s	1.1	2.7 s	0.9	3.0 s	0.7
400 x ∞	0.5 b	3.5	0.8 b	2.7	1.2 b	2.2	1.7 b	1.8	2.1 s	1.4	2.4 s	1.1	2.7 s	0.9	3.0 s	0.7
500x500	0.5 b	4.6	0.9 b	3.5	1.4 b	2.8	1.8 s	2.2	2.1 s	1.6	2.4 s	1.3	2.7 s	1.0	3.0 s	0.8
500x1000	0.5 b	5.2	0.8 b	3.9	1.2 b	3.2	1.6 b	2.7	2.1 s	2.2	2.4 s	1.8	2.7 s	1.4	3.0 s	1.1
500 x ∞	0.5 b	5.2	0.8 b	4.0	1.2 b	3.2	1.6 b	2.7	2.1 s	2.3	2.4 s	1.8	2.7 s	1.4	3.0 s	1.2
600x600	0.5 b	6.3	0.9 b	4.8	1.3 b	3.8	1.8 b	3.2	2.1 s	2.4	2.5 s	1.9	2.7 s	1.5	3.0 s	1.2
600x1200	0.4 b	7.1	0.7 b	5.4	1.1 b	4.4	1.6 b	3.7	2.1 b	3.1	2.4 s	2.5	2.7 s	2.0	3.0 s	1.7
600 x ∞	0.4 b	7.1	0.7 b	5.4	1.1 b	4.4	1.5 b	3.7	2.0 b	3.2	2.4 s	2.6	2.7 s	2.0	3.0 s	1.7
750x750	0.5 b	9.1	0.8 b	6.9	1.2 b	5.6	1.7 b	4.6	2.1 s	3.7	2.4 s	2.9	2.7 s	2.3	3.0 s	1.9
750x1500	0.4 b	10.4	0.7 b	8.0	1.0 b	6.4	1.5 b	5.4	1.9 b	4.6	2.4 s	4.0	2.7 s	3.1	3.0 s	2.6
750 x ∞	0.4 b	11.5	0.7 b	8.0	1.0 b	6.5	1.4 b	5.5	1.9 b	4.7	2.4 s	4.1	2.7 s	3.1	3.0 s	2.6
1000x1000	0.4 b	14.8	0.7 b	11.3	1.1 b	9.1	1.5 b	7.6	2.1 b	6.5	2.4 s	5.2	2.7 s	4.1	3.0 s	3.4
1000x2000	0.4 b	17.3	0.6 b	13.2	1.0 b	10.7	1.4 b	9.0	1.8 b	7.7	2.3 b	6.8	2.7 s	5.6	3.0 s	4.6
1000 x ∞	0.4 b	17.4	0.6 b	13.3	1.0 b	10.8	1.3 b	9.0	1.8 b	7.8	2.3 b	6.8	2.7 s	5.7	3.0 s	4.7
1200x1200	0.4 b	20.2	0.7 b	15.5	1.0 b	12.4	1.5 b	10.4	2.0 b	8.9	2.4 s	7.5	2.7 s	5.9	3.0 s	4.8
1200x2400	0.4 b	23.9	0.6 b	18.2	0.9 b	14.7	1.3 b	12.3	1.7 b	10.6	2.2 b	9.3	2.7 s	8.1	3.0 s	6.7
1500x1500	0.4 b	29.7	0.6 b	22.7	1.0 b	18.3	1.4 b	15.3	1.8 b	13.1	2.4 b	11.5	2.7 s	9.3	3.0 s	7.6
1500x3000	0.4 b	35.4	0.6 b	27.0	0.9 b	21.9	1.2 b	18.3	1.6 b	15.7	2.1 b	13.8	2.6 b	12.4	3.0 s	10.4

Nominal thickness (mm)





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵⟶ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-27. Conifer plywood, thick veneers

Load resistance for a uniformly distributed load on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9/3 ply q		u	12/4 ply q		u	12/5 ply q		u	15/5 ply q		u	18/6 ply q		u	18/7 ply q		u
300	12	b	3.4	9	b	1.3	21	b	2.5	29	b	2.3	39	s	1.9	31	s	1.7
400	7	b	5.6	5	b	2.0	12	b	4.0	16	b	3.6	22	b	3.0	22	b	3.1
500	4	b	8.5	3	b	3.0	8	b	6.0	10	b	5.3	14	b	4.4	14	b	4.5
600	3	b	12.0	2	b	4.1	5	b	8.3	7	b	7.3	10	b	6.1	10	b	6.2
750	2	b	18.4	1	b	6.2	3	b	12.7	5	b	11.1	6	b	9.2	6	b	9.2
1000	1	b	32.3	1	b	10.8	2	b	22.1	3	b	19.2	4	b	15.9	3	b	15.9
1200	1	b	46.3	1	b	15.4	1	b	31.6	2	b	27.3	2	b	22.7	2	b	22.5
1500	0	b	72.0	0	b	23.8	1	b	49.0	1	b	42.3	2	b	35.1	2	b	34.8

Span c/c mm	Nominal thickness (mm) 21/7 ply q		u	24/8 ply q		u	24/9 ply q		u	27/9 ply q		u	27/11 ply q		u	30/10 ply q		u	30/13 ply q		u
300	36	s	1.4	64	s	1.3	42	s	1.3	49	s	0.8	42	s	1.2	56	s	1.0	52	s	1.0
400	27	s	2.7	38	b	2.2	31	s	2.5	36	s	1.6	32	s	2.3	42	s	1.8	39	s	1.9
500	19	b	4.1	24	b	3.2	22	b	3.8	29	s	3.0	21	b	3.4	33	s	3.0	31	b	3.1
600	13	b	5.6	17	b	4.5	15	b	5.1	20	b	4.1	15	b	4.5	25	b	4.2	21	b	4.0
750	8	b	8.2	11	b	6.8	10	b	7.4	13	b	6.2	9	b	6.6	16	b	6.0	14	b	5.8
1000	5	b	14.0	6	b	11.8	5	b	12.5	7	b	10.6	5	b	11.2	9	b	10.0	8	b	9.6
1200	3	b	19.7	4	b	16.8	4	b	17.7	5	b	15.1	4	b	15.8	6	b	14.0	5	b	13.4
1500	2	b	30.4	3	b	26.0	2	b	27.2	3	b	23.3	2	b	24.3	4	b	21.4	3	b	20.4

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

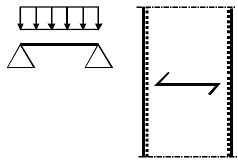


Table 4-28. Conifer plywood, thick veneers

Load resistance for a uniformly distributed load on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9/3 ply q		u	12/4 ply q		u	12/5 ply q		u	15/5 ply q		u	18/6 ply q		u	18/7 ply q		u
300	12	s	1.8	16	s	1.5	20	s	1.4	24	s	1.2	31	s	1.0	25	s	0.9
400	7	b	2.8	11	b	2.6	12	b	2.1	16	b	2.0	22	b	1.7	19	s	1.6
500	4	b	3.9	7	b	3.4	8	b	2.9	10	b	2.7	14	b	2.2	14	b	2.4
600	3	b	5.4	5	b	4.5	5	b	3.9	7	b	3.6	10	b	2.9	10	b	3.1
750	2	b	8.1	3	b	6.5	3	b	5.7	5	b	5.1	6	b	4.2	6	b	4.4
1000	1	b	13.8	2	b	10.7	2	b	9.6	3	b	8.5	4	b	7.0	3	b	7.1
1200	1	b	19.6	1	b	15.0	1	b	13.5	2	b	11.9	2	b	9.8	2	b	9.9
1500	0	b	30.3	1	b	22.9	1	b	20.8	1	b	18.1	2	b	15.0	2	b	15.0

Span c/c mm	Nominal thickness (mm) 21/7 ply q		u	24/8 ply q		u	24/9 ply q		u	27/9 ply q		u	27/11 ply q		u	30/10 ply q		u	30/13 ply q		u
300	29	s	0.8	51	s	0.6	34	s	0.8	39	s	0.4	34	s	0.7	45	s	0.6	41	s	0.7
400	22	s	1.4	38	b	1.2	25	s	1.3	29	s	0.8	25	s	1.2	33	s	1.0	31	s	1.1
500	17	s	2.2	24	b	1.6	20	s	2.1	23	s	1.3	20	s	1.9	27	s	1.5	25	s	1.6
600	13	b	2.9	17	b	2.1	15	b	2.8	19	s	2.0	15	b	2.5	22	s	2.2	21	s	2.3
750	8	b	4.0	11	b	3.1	10	b	3.8	13	b	2.9	9	b	3.3	16	b	3.2	14	b	3.1
1000	5	b	6.4	6	b	5.1	5	b	5.9	7	b	4.7	5	b	5.2	9	b	4.8	8	b	4.7
1200	3	b	8.8	4	b	7.2	4	b	8.0	5	b	6.6	4	b	7.1	6	b	6.5	5	b	6.3
1500	2	b	13.2	3	b	11.1	2	b	11.9	3	b	10.0	2	b	10.7	4	b	9.6	3	b	9.2

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

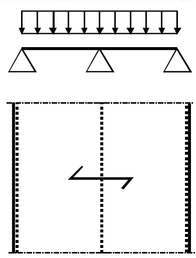
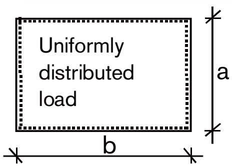


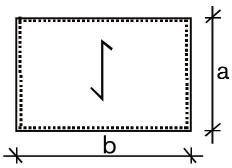
Table 4-29. Conifer plywood, thick veneers

Load resistance for a uniformly distributed load on a single simply supported plate

Span c/c mm a x b	Nominal thickness (mm)																	
	12/5 ply			15/5 ply			18/6 ply			18/7 ply			21/7 ply			24/8 ply		
	q		u	q		u	q		u	q		u	q		u	q		u
300x300	42	b	2.0	49	s	1.5	62	s	1.0	57	s	0.9	66	s	0.7	60	s	0.5
300x600	24	b	1.9	32	b	1.7	43	s	1.3	35	s	1.1	40	s	0.8	67	s	1.1
300 x ∞	21	b	1.9	29	b	1.7	39	s	1.4	31	s	1.1	36	s	0.8	64	s	1.2
400x400	24	b	3.5	32	b	3.0	46	s	2.4	43	s	2.1	50	s	1.6	45	s	1.2
400x800	13	b	3.4	18	b	3.0	25	b	2.5	25	b	2.4	30	s	1.9	44	s	2.3
400 x ∞	12	b	3.4	16	b	3.0	22	b	2.5	22	b	2.4	27	s	1.9	38	s	2.3
500x500	15	b	5.5	20	b	4.7	31	b	3.9	32	b	3.8	40	s	3.1	36	s	2.3
500x1000	8	b	5.4	11	b	4.6	16	b	3.8	16	b	3.8	21	b	3.3	28	s	3.6
500 x ∞	8	b	5.4	10	b	4.6	14	b	3.8	14	b	3.8	19	b	3.3	24	s	3.6
600x600	11	b	7.8	14	b	6.8	21	b	5.6	22	b	5.5	30	b	4.8	30	s	4.0
600x1200	6	b	7.8	8	b	6.7	11	b	5.5	11	b	5.5	15	b	4.7	20	s	5.1
600 x ∞	5	b	7.8	7	b	6.7	10	b	5.5	10	b	5.5	13	b	4.7	17	s	5.1
750x750	7	b	12.3	9	b	10.6	14	b	8.7	14	b	8.6	19	b	7.5	24	s	7.8
750x1500	4	b	12.1	5	b	10.4	7	b	8.6	7	b	8.5	10	b	7.4	12	s	8.0
750 x ∞	3	b	12.1	5	b	10.4	6	b	8.6	6	b	8.5	8	b	7.4	11	s	8.0
1000x1000	4	b	21.8	5	b	18.8	8	b	15.5	8	b	15.4	11	b	13.3	14	s	14.4
1000x2000	2	b	21.6	3	b	18.6	4	b	15.4	4	b	15.2	5	b	13.1	7	s	14.3
1000 x ∞	2	b	21.5	3	b	18.5	4	b	15.4	3	b	15.2	5	b	13.1	6	s	14.3
1200x1200	3	b	31.4	4	b	27.0	5	b	22.4	6	b	22.1	7	b	19.1	10	s	20.8
1200x2400	1	b	31.0	2	b	26.7	3	b	22.1	3	b	21.9	4	b	18.9	5	s	20.6
1500x1500	2	b	49.1	2	b	42.2	3	b	35.0	4	b	34.6	5	b	29.8	6	s	32.5
1500x3000	1	b	48.5	1	b	41.8	2	b	34.6	2	b	34.2	2	b	29.5	3	s	32.1

Span c/c mm a x b	Nominal thickness (mm)														
	24/9 ply			27/9 ply			27/11 ply			30/10 ply			30/13 ply		
	q		u	q		u	q		u	q		u	q		u
300x300	81	s	0.6	93	s	0.4	96	s	0.5	103	s	0.3	113	s	0.3
300x600	48	s	0.7	55	s	0.5	51	s	0.6	64	s	0.4	63	s	0.4
300 x ∞	42	s	0.7	48	s	0.5	42	s	0.7	56	s	0.5	52	s	0.5
400x400	61	s	1.4	70	s	1.0	72	s	1.1	77	s	0.8	85	s	0.8
400x800	36	s	1.7	41	s	1.2	38	s	1.5	48	s	1.1	47	s	1.1
400 x ∞	31	s	1.7	36	s	1.3	31	s	1.6	42	s	1.1	39	s	1.1
500x500	48	s	2.6	56	s	2.0	58	s	2.2	62	s	1.6	68	s	1.5
500x1000	26	b	2.9	33	s	2.4	27	b	2.6	38	s	2.1	38	s	2.1
500 x ∞	22	b	2.9	29	s	3.5	21	b	2.6	33	s	2.1	31	b	2.2
600x600	38	b	4.3	47	s	3.4	48	s	3.8	52	s	2.7	57	s	2.6
600x1200	18	b	4.2	24	b	3.6	19	b	3.8	29	b	3.3	27	b	3.1
600 x ∞	15	b	4.2	20	b	3.6	15	b	3.8	25	b	3.3	21	b	3.1
750x750	24	b	6.7	32	b	5.8	31	b	5.9	40	b	5.2	45	b	4.9
750x1500	11	b	6.6	15	b	5.7	12	b	5.9	19	b	5.1	18	b	4.9
750 x ∞	10	b	6.6	13	b	5.7	9	b	5.9	16	b	5.1	14	b	4.9
1000x1000	14	b	11.9	18	b	10.2	17	b	10.5	23	b	9.2	25	b	8.7
1000x2000	6	b	11.7	9	b	10.1	7	b	10.4	11	b	9.1	10	b	8.7
1000 x ∞	5	b	11.7	7	b	10.1	5	b	10.4	9	b	9.1	8	b	8.7
1200x1200	9	b	17.1	13	b	14.8	12	b	15.1	16	b	13.2	17	b	12.6
1200x2400	4	b	16.9	6	b	14.6	5	b	15.0	7	b	13.1	7	b	12.5
1500x1500	6	b	26.7	8	b	23.0	8	b	23.7	10	b	20.7	11	b	19.7
1500x3000	3	b	26.4	4	b	22.8	3	b	23.4	5	b	20.5	4	b	19.5





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-30. Conifer plywood, thick veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 12/5 ply F		u	15/5 ply F		u	18/6 ply F		u	18/7 ply F		u	21/7 ply F		u	24/8 ply F		u
300	0.6	s	1.1	0.7	s	0.8	0.9	s	0.5	1.0	s	0.6	1.1	s	0.4	0.9	s	0.2
400	0.6	s	1.9	0.7	s	1.4	0.9	s	1.0	1.0	s	1.1	1.1	s	0.8	0.9	s	0.4
500	0.6	s	3.0	0.7	s	2.2	0.9	s	1.5	1.0	s	1.7	1.1	s	1.2	0.9	s	0.6
600	0.6	b	4.2	0.7	s	3.2	0.9	s	2.2	1.0	s	2.4	1.1	s	1.8	0.9	s	0.9
750	0.6	b	6.0	0.7	s	5.0	0.9	s	3.5	1.0	s	3.8	1.1	s	2.8	0.9	s	1.4
1000	0.5	b	9.8	0.7	b	8.3	0.9	s	6.2	1.0	s	6.8	1.1	s	5.0	0.9	s	2.6
1200	0.5	b	13.3	0.6	b	11.3	0.9	s	9.1	1.0	s	9.8	1.1	s	7.3	0.9	s	3.7
1500	0.4	b	19.5	0.6	b	16.5	0.9	s	14.6	1.0	b	15.2	1.1	s	11.4	0.9	s	6.0

Span c/c mm	Nominal thickness (mm) 24/9 ply F		u	27/9 ply F		u	27/11 ply F		u	30/10 ply F		u	30/13 ply F		u
300	1.3	s	0.4	1.5	s	0.3	1.5	s	0.3	1.6	s	0.2	1.8	s	0.2
400	1.3	s	0.7	1.5	s	0.5	1.5	s	0.6	1.5	s	0.4	1.8	s	0.4
500	1.3	s	1.0	1.5	s	0.8	1.5	s	0.9	1.5	s	0.6	1.8	s	0.7
600	1.3	s	1.5	1.5	s	1.1	1.5	s	1.3	1.5	s	0.8	1.8	s	1.0
750	1.3	s	2.4	1.5	s	1.8	1.5	s	2.1	1.5	s	1.3	1.8	s	1.5
1000	1.3	s	4.3	1.5	s	3.2	1.5	s	3.8	1.6	s	2.4	1.8	s	2.7
1200	1.3	s	6.3	1.6	s	4.7	1.5	s	5.5	1.6	s	3.4	1.8	s	3.9
1500	1.4	s	9.9	1.6	s	7.3	1.5	s	8.5	1.6	s	5.5	1.8	s	6.0

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

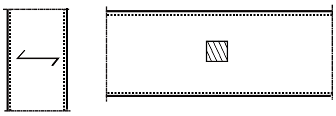


Table 4-31. Conifer plywood, thick veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 12/5 ply F		u	15/5 ply F		u	18/6 ply F		u	18/7 ply F		u	21/7 ply F		u	24/8 ply F		u
300	0.6	s	0.9	0.7	s	0.6	0.9	s	0.4	0.9	s	0.4	1.0	s	0.3	0.9	s	0.2
400	0.6	s	1.5	0.7	s	1.1	0.9	s	0.8	0.9	s	0.8	1.0	s	0.6	0.9	s	0.3
500	0.6	s	2.4	0.7	s	1.8	0.9	s	1.3	0.9	s	1.2	1.1	s	0.9	0.9	s	0.5
600	0.6	b	3.5	0.7	s	2.6	0.9	s	1.8	0.9	s	1.8	1.1	s	1.4	0.9	s	0.8
750	0.6	b	5.1	0.8	s	4.2	0.9	s	2.9	0.9	s	2.9	1.1	s	2.1	0.9	s	1.2
1000	0.5	b	8.2	0.7	b	7.0	1.0	s	5.4	1.0	s	5.3	1.1	s	3.9	1.0	s	2.2
1200	0.5	b	11.2	0.7	b	9.5	1.0	s	7.9	1.0	s	7.7	1.1	s	5.7	1.0	s	3.2
1500	0.5	b	16.3	0.6	b	13.8	1.0	s	12.8	1.0	s	11.9	1.1	s	8.8	1.0	s	5.4

Span c/c mm	Nominal thickness (mm) 24/9 ply F		u	27/9 ply F		u	27/11 ply F		u	30/10 ply F		u	30/13 ply F		u
300	1.2	s	0.3	1.4	s	0.2	1.3	s	0.2	1.6	s	0.2	1.6	s	0.2
400	1.2	s	0.5	1.4	s	0.4	1.4	s	0.4	1.6	s	0.3	1.7	s	0.3
500	1.3	s	0.8	1.5	s	0.6	1.4	s	0.7	1.6	s	0.5	1.7	s	0.5
600	1.3	s	1.2	1.5	s	0.9	1.4	s	1.0	1.6	s	0.7	1.7	s	0.7
750	1.3	s	1.9	1.5	s	1.4	1.4	s	1.6	1.6	s	1.1	1.8	s	1.2
1000	1.3	s	3.4	1.5	s	2.5	1.4	s	2.9	1.7	s	2.0	1.8	s	2.1
1200	1.3	s	4.9	1.5	s	3.7	1.4	s	4.2	1.7	s	3.0	1.8	s	3.0
1500	1.3	s	7.6	1.5	s	5.7	1.4	s	6.5	1.8	s	4.8	1.8	s	4.6

b = bending strength limitation
s = planar shear strength limitation

Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

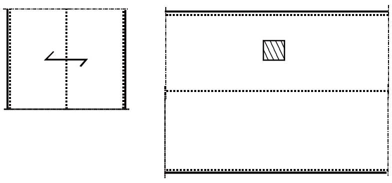
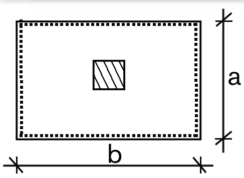


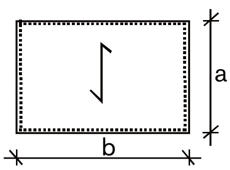
Table 4-32. Conifer plywood, thick veneers

Load resistance for a concentrated central load over an area of 50 x 50 mm on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 12/5 ply			15/5 ply			18/6 ply			18/7 ply			21/7 ply			24/8 ply		
	F		u	F		u	F		u	F		u	F		u	F		u
300x300	0.6	s	0.9	0.7	s	0.7	0.9	s	0.4	1.0	s	0.5	1.2	s	0.4	0.9	s	0.2
300x600	0.6	s	1.0	0.7	s	0.8	0.9	s	0.5	1.0	s	0.6	1.1	s	0.4	0.9	s	0.2
300 x ∞	0.6	s	1.1	0.7	s	0.8	0.9	s	0.5	1.0	s	0.6	1.1	s	0.4	0.9	s	0.2
400x400	0.6	s	1.6	0.7	s	1.2	0.9	s	0.8	1.0	s	0.9	1.2	s	0.6	0.9	s	0.3
400x800	0.6	s	1.9	0.7	s	1.4	0.9	s	1.0	1.0	s	1.1	1.1	s	0.8	0.9	s	0.4
400 x ∞	0.6	s	1.9	0.7	s	1.4	0.9	s	1.0	1.0	s	1.1	1.1	s	0.8	0.9	s	0.4
500x500	0.6	s	2.5	0.7	s	1.9	0.9	s	1.2	1.0	s	1.4	1.2	s	1.0	0.9	s	0.5
500x1000	0.6	s	2.9	0.7	s	2.2	0.9	s	1.5	1.0	s	1.7	1.1	s	1.2	0.9	s	0.6
500 x ∞	0.6	s	3.0	0.7	s	2.2	0.9	s	1.5	1.0	s	1.7	1.1	s	1.2	0.9	s	0.6
600x600	0.6	b	3.5	0.7	s	2.7	0.9	s	1.8	1.0	s	2.0	1.2	s	1.5	0.9	s	0.7
600x1200	0.6	b	4.1	0.7	s	3.1	0.9	s	2.2	1.0	s	2.4	1.1	s	1.8	0.9	s	0.9
600 x ∞	0.6	b	4.2	0.7	s	3.2	0.9	s	2.2	1.0	s	2.4	1.2	s	1.8	0.9	s	0.9
750x750	0.5	b	5.0	0.7	s	4.2	0.9	s	2.8	1.0	s	3.1	1.1	s	2.3	0.9	s	1.1
750x1500	0.6	b	6.0	0.7	s	4.9	0.9	s	3.4	1.0	s	3.8	1.1	s	2.8	0.9	s	1.4
750 x ∞	0.6	b	6.0	0.7	s	5.0	0.9	s	3.5	1.0	s	3.8	1.1	s	2.8	0.9	s	1.4
1000x1000	0.5	b	8.1	0.7	b	6.9	0.9	s	5.1	1.0	s	5.5	1.1	s	4.1	0.9	s	2.0
1000x2000	0.5	b	9.7	0.7	b	8.2	0.9	s	6.1	1.0	s	6.7	1.1	s	5.0	0.9	s	2.5
1000 x ∞	0.5	b	9.8	0.7	b	8.3	0.9	s	6.2	1.0	s	6.8	1.1	s	5.0	0.9	s	2.6
1200x1200	0.5	b	11.1	0.6	b	9.5	0.9	s	7.3	1.0	s	7.9	1.1	s	5.9	0.9	s	2.9
1200x2400	0.5	b	13.2	0.6	b	11.2	0.9	s	8.9	1.0	s	9.7	1.1	s	7.2	0.9	s	3.6
1500x1500	0.4	b	16.3	0.6	b	13.9	0.9	s	11.6	1.0	b	12.3	1.1	s	9.2	0.9	s	4.7
1500x3000	0.4	b	19.4	0.6	b	16.5	0.9	s	14.0	1.0	b	15.2	1.1	s	11.3	0.9	s	5.8

Span c/c mm a x b	Nominal thickness (mm) 24/9 ply			27/9 ply			27/11 ply			30/10 ply			30/13 ply		
	F		u	F		u	F		u	F		u	F		u
300x300	1.3	s	0.3	1.5	s	0.2	1.5	s	0.2	1.5	s	0.2	1.8	s	0.2
300x600	1.3	s	0.4	1.5	s	0.3	1.5	s	0.3	1.5	s	0.2	1.8	s	0.2
300 x ∞	1.3	s	0.4	1.5	s	0.3	1.5	s	0.3	1.5	s	0.2	1.8	s	0.2
400x400	1.3	s	0.5	1.5	s	0.4	1.5	s	0.4	1.5	s	0.3	1.8	s	0.3
400x800	1.3	s	0.7	1.5	s	0.5	1.5	s	0.6	1.5	s	0.4	1.8	s	0.4
400 x ∞	1.3	s	0.7	1.5	s	0.5	1.5	s	0.6	1.5	s	0.4	1.8	s	0.4
500x500	1.3	s	0.8	1.5	s	0.6	1.5	s	0.6	1.5	s	0.4	1.8	s	0.4
500x1000	1.3	s	1.0	1.5	s	0.8	1.5	s	0.9	1.5	s	0.6	1.8	s	0.6
500 x ∞	1.3	s	1.0	1.5	s	0.8	1.5	s	0.9	1.5	s	0.6	1.8	s	0.7
600x600	1.3	s	1.2	1.5	s	0.9	1.5	s	0.9	1.5	s	0.6	1.8	s	0.6
600x1200	1.3	s	1.5	1.5	s	1.1	1.5	s	1.3	1.5	s	0.8	1.8	s	0.9
600 x ∞	1.3	s	1.5	1.5	s	1.1	1.5	s	1.3	1.5	s	0.8	1.8	s	1.0
750x750	1.3	s	1.8	1.5	s	1.4	1.5	s	1.4	1.5	s	1.0	1.8	s	1.0
750x1500	1.3	s	2.3	1.5	s	1.7	1.5	s	2.1	1.5	s	1.3	1.8	s	1.5
750 x ∞	1.3	s	2.4	1.5	s	1.8	1.5	s	2.1	1.5	s	1.3	1.8	s	1.5
1000x1000	1.3	s	3.3	1.5	s	2.4	1.5	s	2.6	1.5	s	1.8	1.8	s	1.8
1000x2000	1.3	s	4.2	1.5	s	3.1	1.5	s	3.7	1.5	s	2.3	1.8	s	2.6
1000 x ∞	1.3	s	4.3	1.5	s	3.2	1.5	s	3.8	1.6	s	2.4	1.8	s	2.7
1200x1200	1.3	s	4.8	1.5	s	3.6	1.5	s	3.7	1.6	s	2.6	1.8	s	2.6
1200x2400	1.3	s	6.1	1.5	s	4.5	1.5	s	5.3	1.6	s	3.4	1.8	s	3.8
1500x1500	1.3	s	7.6	1.6	s	5.6	1.5	s	5.8	1.6	s	4.1	1.8	s	4.1
1500x3000	1.3	s	9.6	1.6	s	7.2	1.5	s	8.3	1.6	s	5.3	1.8	s	5.9





Medium-term loading

Service Class 1

$k_{mod} = 0.80$

$k_{def} = 0.25$

$\gamma_q = 1.5$

$\gamma_m = 1.3$

F given in kN

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

4.4 VEHICLE FLOORS

Based on general design principles, tabulated load resistance values for floors exposed to loads from wheels of different spans and thicknesses are given. Also, information is given whether the bending or shear strength is design governing. Finally, the deflection related to the load resistance is given. The following support and load configuration systems are included:

– A concentrated load over an area of 80 x 180 mm on a continuous plate strip with one and two equal span lengths, Tables 4-33, 4-34, 4-36 and 4-37.

– A concentrated load over an area of 80 x 180 mm on a simply supported plate, Tables 4-35 and 4-38.

Since it is reasonable to use a lower reliability in design the load resistances and deflections were calculated according to the following assumptions:

$\gamma_q = 1.0$

$\gamma_m = 1.0$

$k_{mod} = 0.90$

$k_{def} = 0.00$

Hence, the characteristic load acting in service class 2 and load duration class short-term shall not exceed the tabulated values. For other assumptions the tabulated load resistance values shall be multiplied by a correction factor $k_{load,\ corr}$ given by

$$k_{load,\ corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \bullet \frac{1.0 \bullet 1.0}{0{,}90} \qquad (4\text{-}11)$$

while the tabulated deflection values shall be multiplied by a correction factor $k_{def,\ corr}$ given by

$$k_{def,\ corr} = \frac{1 + k_{def}}{1 + 0.00} \bullet k_{load,\ corr} \qquad (4\text{-}12)$$

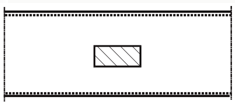
LOAD RESISTANCE F [kN] AND CORRESPONDING DEFLECTION u [mm] VALUES FOR FINNISH PLYWOOD WHICH CAN BE USED IN THE DESIGN OF FLOORS EXPOSED TO LOADS CAUSED BY FORK LIFT TRUCKS.

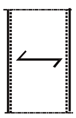
Table 4-33. Birch plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9 F		u	12 F		u	15 F		u	18 F		u	21 F		u	24 F		u
300	3.0	b	6.0	5.0	b	4.6	7.4	b	3.7	10.3	b	3.1	13.7	b	2.7	17.6	b	2.4
400	2.6	b	10.0	4.3	b	7.6	6.4	b	6.2	9.0	b	5.2	11.9	b	4.4	15.3	b	3.9
500	2.4	b	14.7	3.9	b	11.2	5.9	b	9.0	8.2	b	7.6	10.9	b	6.5	13.9	b	5.7
600	2.2	b	20.1	3.7	b	15.3	5.5	b	12.4	7.6	b	10.4	10.1	b	8.9	13.0	b	7.9
750	2.0	b	29.6	3.4	b	22.5	5.1	b	18.2	7.0	b	15.2	9.4	b	13.1	12.0	b	11.5
1000	1.9	b	48.7	3.1	b	37.0	4.6	b	29.9	6.4	b	25.1	8.5	b	21.6	11.0	b	19.0
1200	1.8	b	66.8	2.9	b	50.8	4.4	b	41.1	6.1	b	34.4	8.1	b	29.6	10.4	b	26.0
1500	1.7	b	98.5	2.7	b	75.0	4.1	b	60.6	5.7	b	50.8	7.6	b	43.7	9.7	b	38.4

Span c/c mm	Nominal thickness (mm) 27 F		u	30 F		u	35 F		u	40 F		u	45 F		u	50 F		u
300	21.9	b	2.1	26.7	b	1.9	37.8	b	1.6	45.9	s	1.2	48.9	s	1.1	55.3	s	0.8
400	19.1	b	3.5	23.3	b	3.1	33.0	b	2.6	44.3	b	2.3	49.7	s	2.1	56.2	s	1.6
500	17.4	b	5.1	21.2	b	4.6	30.1	b	3.9	40.4	b	3.3	46.0	b	3.1	56.6	s	2.6
600	16.2	b	7.0	19.8	b	6.3	28.0	b	5.3	37.7	b	4.5	43.0	b	4.2	54.8	b	3.7
750	15.0	b	10.3	18.3	b	9.3	25.9	b	7.8	34.8	b	6.7	39.7	b	6.2	50.6	b	5.5
1000	13.6	b	16.9	16.7	b	15.2	23.6	b	12.8	31.7	b	10.9	36.2	b	10.2	46.2	b	9.0
1200	12.9	b	23.2	15.8	b	20.9	22.4	b	17.5	30.1	b	15.0	34.3	b	14.0	43.7	b	12.4
1500	12.1	b	34.2	14.8	b	30.9	21.0	b	25.8	28.2	b	22.2	32.2	b	20.7	41.1	b	18.3





Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

$\gamma_q = 1.0$

$\gamma_m = 1.0$

b = bending strength limitation
s = planar shear strength limitation

F given in kN

u given in mm

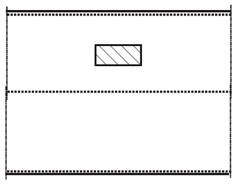
⟵ grain direction of surface veneers

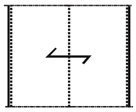
Table 4-34. Birch plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9 F		u	12 F		u	15 F		u	18 F		u	21 F		u	24 F		u
300	3.5	b	5.4	5.8	b	4.1	8.6	b	3.4	11.9	b	2.8	15.8	b	2.4	20.3	b	2.1
400	3.0	b	8.9	4.9	b	6.8	7.3	b	5.5	10.2	b	4.6	13.6	b	4.0	17.4	b	3.5
500	2.7	b	13.0	4.4	b	9.9	6.6	b	8.0	9.2	b	6.7	12.2	b	5.8	15.7	b	5.1
600	2.5	b	17.8	4.1	b	13.5	6.1	b	10.9	8.5	b	9.2	11.3	b	7.9	14.5	b	6.9
750	2.3	b	26.0	3.8	b	19.8	5.6	b	16.0	7.8	b	13.4	10.4	b	11.5	13.3	b	10.1
1000	2.0	b	42.5	3.4	b	32.3	5.1	b	26.1	7.0	b	21.9	9.3	b	18.8	12.0	b	16.5
1200	1.9	b	58.1	3.2	b	44.2	4.8	b	35.7	6.6	b	29.9	8.8	b	25.7	11.3	b	22.6
1500	1.8	b	85.3	3.0	b	64.9	4.4	b	52.4	6.2	b	43.9	8.2	b	37.8	10.6	b	33.2

Span c/c mm	Nominal thickness (mm) 27 F		u	30 F		u	35 F		u	40 F		u	45 F		u	50 F		u
300	22.7	s	1.7	25.4	s	1.4	30.2	s	1.0	35.0	s	0.7	37.3	s	0.6	42.2	s	0.5
400	21.7	b	3.1	26.5	b	2.8	32.8	s	2.0	38.1	s	1.5	40.5	s	1.3	45.8	s	1.0
500	19.5	b	4.5	23.9	b	4.1	33.8	b	3.4	40.0	s	2.6	42.6	s	2.3	48.1	s	1.8
600	18.1	b	6.2	22.1	b	5.6	31.3	b	4.7	41.3	s	3.9	44.0	s	3.4	49.7	s	2.7
750	16.6	b	9.0	20.2	b	8.1	28.7	b	6.8	38.5	b	5.8	43.9	b	5.5	51.2	s	4.4
1000	15.0	b	14.7	18.3	b	13.3	25.9	b	11.1	34.8	b	9.5	39.7	b	8.9	50.6	b	7.9
1200	14.1	b	20.1	17.2	b	18.2	24.4	b	15.2	32.8	b	13.0	37.4	b	12.2	47.7	b	10.8
1500	13.2	b	29.6	16.1	b	26.7	22.8	b	22.3	30.6	b	19.2	34.9	b	17.9	44.5	b	15.8





Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

$\gamma_q = 1.0$

$\gamma_m = 1.0$

F given in kN

u given in mm

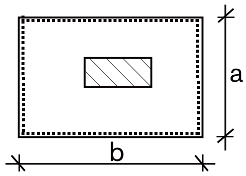
grain direction of surface veneers

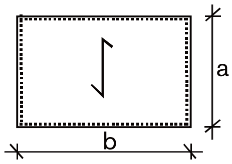
Table 4-35. Birch plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a simply supported plate

Span c/c mm a x b	Nominal thickness (mm) 9 F		u	12 F		u	15 F		u	18 F		u	21 F		u	24 F		u
300x300	3.9	b	5.7	6.7	b	4.3	10.1	b	3.4	14.2	b	2.9	19.0	b	2.5	24.6	b	2.2
300x600	3.1	b	6.0	5.0	b	4.6	7.5	b	3.7	10.5	b	3.1	13.9	b	2.7	17.9	b	2.4
300 x ∞	3.0	b	6.0	5.0	b	4.6	7.4	b	3.7	10.3	b	3.1	13.7	b	2.7	17.6	b	2.4
400x400	3.3	b	9.3	5.5	b	7.0	8.3	b	5.6	11.7	b	4.7	15.7	b	4.0	20.2	b	3.5
400x800	2.6	b	10.0	4.4	b	7.6	6.5	b	6.1	9.1	b	5.1	12.1	b	4.4	15.6	b	3.9
400 x ∞	2.6	b	10.0	4.3	b	7.6	6.4	b	6.2	9.0	b	5.2	11.9	b	4.4	15.3	b	3.9
500x500	2.9	b	13.5	4.9	b	10.2	7.4	b	8.1	10.4	b	6.8	13.8	b	5.8	17.8	b	5.1
500x1000	2.4	b	14.6	4.0	b	11.1	5.9	b	9.0	8.3	b	7.5	11.0	b	6.5	14.2	b	5.7
500 x ∞	2.4	b	14.7	3.9	b	11.2	5.9	b	9.0	8.2	b	7.6	10.9	b	6.5	13.9	b	5.7
600x600	2.7	b	18.4	4.5	b	13.8	6.7	b	11.0	9.5	b	9.2	12.6	b	7.9	16.3	b	6.9
600x1200	2.2	b	20.1	3.7	b	15.3	5.5	b	12.3	7.7	b	10.3	10.3	b	8.9	13.2	b	7.8
600 x ∞	2.2	b	20.1	3.7	b	15.3	5.5	b	12.4	7.6	b	10.4	10.1	b	8.9	13.0	b	7.9
750x750	2.4	b	26.8	4.1	b	20.1	6.1	b	16.1	8.6	b	13.4	11.4	b	11.5	14.8	b	10.0
750x1500	2.1	b	29.5	3.4	b	22.4	5.1	b	18.1	7.1	b	15.1	9.5	b	13.0	12.2	b	11.4
750 x ∞	2.0	b	29.6	3.4	b	22.5	5.1	b	18.2	7.0	b	15.2	9.4	b	13.1	12.0	b	11.5
1000x1000	2.2	b	43.7	3.6	b	32.7	5.5	b	26.1	7.7	b	21.7	10.2	b	18.6	13.2	b	16.3
1000x2000	1.9	b	48.5	3.1	b	36.8	4.6	b	29.7	6.5	b	24.9	8.6	b	21.4	11.1	b	18.8
1000 x ∞	1.9	b	48.7	3.1	b	37.0	4.6	b	29.9	6.4	b	25.1	8.5	b	21.6	11.0	b	19.0
1200x1200	2.0	b	59.6	3.4	b	44.5	5.1	b	35.6	7.2	b	29.6	9.6	b	25.3	12.3	b	22.2
1200x2400	1.8	b	66.5	2.9	b	50.5	4.4	b	40.8	6.1	b	34.1	8.2	b	29.3	10.5	b	25.8
1500x1500	1.9	b	87.3	3.2	b	65.2	4.7	b	52.1	6.7	b	43.3	8.9	b	37.0	11.5	b	32.4
1500x3000	1.7	b	98.1	2.8	b	74.5	4.1	b	60.1	5.8	b	50.3	7.6	b	43.3	9.8	b	38.0

b = bending strength limitation
s = planar shear strength limitation





Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

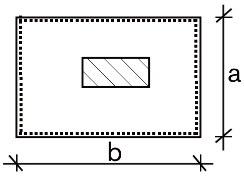
$\gamma_q = 1.0$

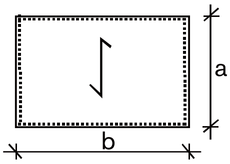
$\gamma_m = 1.0$

F given in kN

u given in mm

grain direction of surface veneers





Span c/c mm a x b	Nominal thickness (mm) 27 F	u	30 F	u	35 F	u	40 F	u	45 F	u	50 F	u
300x300	30.7b	1.9	37.7 b	1.7	45.1 s	1.2	52.4 s	0.9	55.8 s	0.8	63.1 s	0.6
300x600	22.3b	2.1	27.3 b	1.9	38.6 b	1.6	46.4 s	1.2	49.4 s	1.1	55.8 s	0.8
300 x ∞	21.9b	2.1	26.7 b	1.9	37.8 b	1.6	45.9 s	1.2	48.9 s	1.1	55.3 s	0.8
400x400	25.3b	3.1	31.0 b	2.8	43.3 s	2.3	50.2 s	1.7	53.5 s	1.5	60.5 s	1.2
400x800	19.4b	3.5	23.7 b	3.1	33.6 b	2.6	45.1 b	2.2	50.0 s	2.0	56.5 s	1.6
400 x ∞	19.1b	3.5	23.3 b	3.1	33.0 b	2.6	44.3 b	2.3	49.7 s	2.1	56.2 s	1.6
500x500	22.3b	4.5	27.3 b	4.1	38.9 b	3.4	49.3 s	2.7	52.5 s	2.4	59.3 s	1.9
500x1000	17.6b	5.1	21.6 b	4.6	30.6 b	3.8	41.1 b	3.3	46.8 b	3.1	56.8 s	2.6
500 x ∞	17.4b	5.1	21.2 b	4.6	30.1 b	3.9	40.4 b	3.3	46.0 b	3.1	56.6 s	2.6
600x600	20.4b	6.1	25.0 b	5.5	35.5 b	4.6	47.8 b	3.9	51.9 s	3.5	58.7 s	2.7
600x1200	16.4b	6.9	20.1 b	6.3	28.5 b	5.2	38.3 b	4.5	43.6 b	4.2	55.7 b	3.7
600 x ∞	16.2b	7.0	19.8 b	6.3	28.0 b	5.3	37.7 b	4.5	43.0 b	4.2	54.8 b	3.7
750x750	18.5b	8.9	22.6 b	8.0	32.1 b	6.7	43.3 b	5.7	49.4 b	5.3	58.2 s	4.3
750x1500	15.2b	10.2	18.5 b	9.2	26.3 b	7.7	35.3 b	6.6	40.3 b	6.2	51.4 b	5.4
750 x ∞	15.0b	10.3	18.3 b	9.3	25.9 b	7.8	34.8 b	6.7	39.7 b	6.2	50.6 b	5.5
1000x1000	16.5b	14.4	20.2 b	13.0	28.7 b	10.8	38.6 b	9.3	44.1 b	8.6	56.3 b	7.6
1000x2000	13.8b	16.7	16.9 b	15.1	23.9 b	12.6	32.1 b	10.8	36.7 b	10.1	46.8 b	8.9
1000 x ∞	13.6b	16.9	16.7 b	15.2	23.6 b	12.8	31.7 b	10.9	36.2 b	10.2	46.2 b	9.0
1200x1200	15.4b	19.7	18.9 b	17.7	26.8 b	14.7	36.1 b	12.6	41.2 b	11.8	52.7 b	10.4
1200x2400	13.1b	22.9	16.0 b	20.7	22.6 b	17.3	30.4 b	14.9	34.7 b	13.9	44.3 b	12.3
1500x1500	14.3b	28.7	17.5 b	25.9	24.9 b	21.6	33.5 b	18.4	38.2 b	17.2	48.8 b	15.2
1500x3000	12.3b	33.8	15.0 b	30.6	21.2 b	25.5	28.5 b	21.9	32.6 b	20.5	41.6 b	18.1

Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

$\gamma_q = 1.0$

$\gamma_m = 1.0$

F given in kN

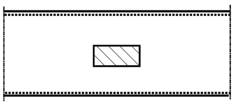
u given in mm

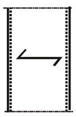
⟵ grain direction of surface veneers

Table 4-36. Combi plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a single span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300	2.9 b	6.0	4.7 b	4.6	6.8 b	3.7	9.4 b	3.1	12.3 b	2.7	15.2 b	2.3	18.3 b	2.0	21.5 b	1.8
400	2.5 b	10.0	4.1 b	7.6	6.0 b	6.1	8.2 b	5.1	10.7 b	4.4	13.3 b	3.8	16.0 b	3.3	18.8 b	2.9
500	2.3 b	14.7	3.7 b	11.1	5.4 b	9.0	7.4 b	7.5	9.7 b	6.5	12.1 b	5.6	14.5 b	4.8	17.1 b	4.3
600	2.2 b	20.1	3.5 b	15.3	5.1 b	12.3	6.9 b	10.3	9.1 b	8.9	11.3 b	7.7	13.6 b	6.6	16.0 b	5.8
750	2.0 b	29.5	3.2 b	22.4	4.7 b	18.1	6.4 b	15.2	8.4 b	13.0	10.5 b	11.2	12.6 b	9.7	14.8 b	8.6
1000	1.8 b	48.5	2.9 b	36.9	4.3 b	29.7	5.8 b	24.9	7.7 b	21.4	9.5 b	18.5	11.4 b	16.0	13.5 b	14.1
1200	1.7 b	66.6	2.8 b	50.6	4.0 b	40.8	5.5 b	34.2	7.3 b	29.4	9.0 b	25.3	10.8 b	21.9	12.7 b	19.3
1500	1.6 b	98.3	2.6 b	74.6	3.8 b	60.2	5.2 b	50.5	6.8 b	43.4	8.5 b	37.4	10.2 b	32.3	12.0 b	28.5





b = bending strength limitation
s = planar shear strength limitation

Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

$\gamma_q = 1.0$

$\gamma_m = 1.0$

F given in kN

u given in mm

⟵ grain direction of surface veneers

Table 4-37. Combi plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a double span plate strip

Span c/c mm	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300	3.4 b	5.4	5.4 b	4.1	7.9 b	3.3	10.8 b	2.8	14.5 s	2.4	17.6 s	2.1	21.0 s	1.8	22.9 s	1.5
400	2.9 b	8.9	4.7 b	6.8	6.8 b	5.5	9.3 b	4.6	12.2 b	3.9	15.1 b	3.4	18.1 b	2.9	20.9 s	2.5
500	2.6 b	13.0	4.2 b	9.9	6.1 b	8.0	8.4 b	6.7	11.0 b	5.8	13.6 b	5.0	16.3 b	4.3	19.2 b	3.8
600	2.4 b	17.7	3.9 b	13.5	5.6 b	10.9	7.7 b	9.1	10.1 b	7.8	12.6 b	6.8	15.1 b	5.8	17.8 b	5.2
750	2.2 b	25.9	3.5 b	19.7	5.2 b	15.9	7.1 b	13.3	9.3 b	11.4	11.6 b	9.9	13.9 b	8.5	16.3 b	7.5
1000	2.0 b	42.4	3.2 b	32.2	4.7 b	25.9	6.4 b	21.7	8.4 b	18.7	10.5 b	16.1	12.5 b	13.9	14.7 b	12.3
1200	1.9 b	57.9	3.0 b	44.0	4.4 b	35.5	6.0 b	29.7	7.9 b	25.6	9.8 b	22.0	11.8 b	19.0	13.9 b	16.8
1500	1.7 b	85.1	2.8 b	64.6	4.1 b	52.1	5.6 b	43.7	7.4 b	37.5	9.2 b	32.3	11.0 b	28.0	13.0 b	24.7

Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

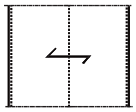
$\gamma_q = 1.0$

$\gamma_m = 1.0$

F given in kN

u given in mm

⟵ grain direction of surface veneers



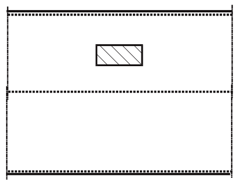


Table 4-38. Combi plywood

Load resistance for a concentrated central load over an area of 80 x 180 mm on a simply suported plate

Span c/c mm a x b	Nominal thickness (mm) 9 F	u	12 F	u	15 F	u	18 F	u	21 F	u	24 F	u	27 F	u	30 F	u
300x300	3.8 b	5.6	6.4 b	4.2	9.5 b	3.4	12.7 s	2.7	15.0 s	2.1	16.5 s	1.6	18.7 s	1.3	20.4 s	1.0
300x600	3.0 b	6.0	4.8 b	4.6	7.0 b	3.7	9.6 b	3.1	12.5 b	2.7	15.6 b	2.3	18.7 b	2.0	22.0 s	1.8
300 x ∞	2.9 b	6.0	4.7 b	4.6	6.8 b	3.7	9.4 b	3.1	12.3 b	2.7	15.2 b	2.3	18.3 b	2.0	21.5 b	1.8
400x400	3.2 b	9.2	5.3 b	6.9	7.8 b	5.5	10.9 b	4.6	14.3 s	3.9	15.9 s	3.0	18.0 s	2.4	19.6 s	2.0
400x800	2.6 b	9.9	4.1 b	7.5	6.1 b	6.1	8.3 b	5.1	10.9 b	4.4	13.6 b	3.8	16.3 b	3.3	19.2 b	2.9
400 x ∞	2.5 b	10.0	4.1 b	7.6	6.0 b	6.1	8.2 b	5.1	10.7 b	4.4	13.3 b	3.8	16.0 b	3.3	18.8 b	2.9
500x500	2.8 b	13.4	4.6 b	10.1	6.9 b	8.0	9.6 b	6.7	12.7 b	5.7	15.4 s	4.7	17.4 s	3.8	19.0 s	3.1
500x1000	2.3 b	14.6	3.8 b	11.1	5.5 b	8.9	7.6 b	7.5	9.9 b	6.4	12.3 b	5.5	14.8 b	4.8	17.4 b	4.2
500 x ∞	2.3 b	14.7	3.7 b	11.1	5.4 b	9.0	7.4 b	7.5	9.7 b	6.5	12.1 b	5.6	14.5 b	4.8	17.1 b	4.3
600x600	2.6 b	18.3	4.3 b	13.7	6.3 b	10.9	8.7 b	9.0	11.6 b	7.7	14.5 b	6.6	17.0 s	5.6	18.6 s	4.6
600x1200	2.2 b	20.0	3.5 b	15.2	5.1 b	12.2	7.0 b	10.3	9.2 b	8.8	11.5 b	7.6	13.8 b	6.6	16.2 b	5.8
600 x ∞	2.2 b	20.1	3.5 b	15.3	5.1 b	12.3	6.9 b	10.3	9.1 b	8.9	11.3 b	7.7	13.6 b	6.6	16.0 b	5.8
750x750	2.3 b	26.6	3.9 b	19.9	5.7 b	15.8	7.9 b	13.1	10.5 b	11.2	13.1 b	9.6	15.8 b	8.3	18.3 s	7.2
750x1500	2.0 b	29.4	3.2 b	22.3	4.7 b	18.0	6.5 b	15.0	8.5 b	12.9	10.6 b	11.1	12.8 b	9.6	15.0 b	8.5
750 x ∞	2.0 b	29.5	3.2 b	22.4	4.7 b	18.1	6.4 b	15.2	8.4 b	13.0	10.5 b	11.2	12.6 b	9.7	14.8 b	8.6
1000x1000	2.1 b	43.4	3.4 b	32.3	5.1 b	25.7	7.1 b	21.3	9.3 b	18.2	11.7 b	15.5	14.1 b	13.4	16.5 b	11.8
1000x2000	1.8 b	48.3	2.9 b	36.6	4.3 b	29.5	5.9 b	24.7	7.8 b	21.2	9.7 b	18.3	11.6 b	15.8	13.7 b	13.9
1000 x ∞	1.8 b	48.5	2.9 b	36.9	4.3 b	29.7	5.8 b	24.9	7.7 b	21.4	9.5 b	18.5	11.4 b	16.0	13.5 b	14.1
1200x1200	2.0 b	59.2	3.2 b	44.0	4.8 b	34.7	6.6 b	29.0	8.7 b	24.7	10.9 b	21.2	13.1 b	18.2	15.5 b	16.1
1200x2400	1.7 b	66.3	2.8 b	50.3	4.1 b	40.5	5.6 b	33.9	7.3 b	29.1	9.2 b	25.1	11.0 b	21.7	12.9 b	19.1
1500x1500	1.8 b	86.7	3.0 b	64.4	4.4 b	51.1	6.1 b	42.4	8.1 b	36.1	10.1 b	30.9	12.2 b	26.6	14.3 b	23.5
1500x3000	1.6 b	97.8	2.6 b	74.1	3.8 b	59.7	5.3 b	50.0	6.9 b	43.0	8.6 b	37.0	10.3 b	32.0	12.1 b	28.2

b = bending strength limitation
s = planar shear strength limitation

Short-term loading

Service Class 2

$k_{mod} = 0.90$

$k_{def} = 0.00$

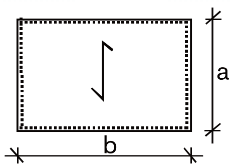
$\gamma_q = 1.0$

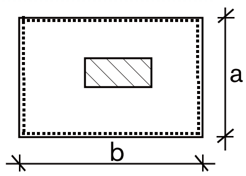
$\gamma_m = 1.0$

F given in kN

u given in mm

⟵ grain direction of surface veneers





4.5 CONCRETE FORMWORK

The majority of Finnish plywood used in concrete formwork is phenol film surfaced. The strength of the formwork board depends on the type of plywood used. Based on general design principles, tabulated load resistance values for continuous plate strips with equal spans used as concrete formwork are given, Tables 4-39 to 4-48. Information is also given whether the bending or shear strength is design governing. Finally, the deflection related to the load resistance is given.

The load resistances and deflections were calculated according to the following assumptions:

$\gamma_q = 1.2$

$\gamma_m = 1.3$

$k_{mod} = 0.70$

$k_{def} = 0.40$

The characteristic load acting in service class 3 and load duration class short-term shall not exceed the tabulated values. For other assumptions the tabulated load resistance values shall be multiplied by a correction factor $k_{load,\,corr}$ given by

$$k_{load,\,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \bullet \frac{1.3 \bullet 1.2}{0,70} \qquad (4\text{-}13)$$

while the tabulated deflection values shall be multiplied by a correction factor $k_{def,\,corr}$ given by

$$k_{def,\,corr} = \frac{1 + k_{def}}{1 + 0.40} \bullet k_{load,\,corr} \qquad (4\text{-}14)$$

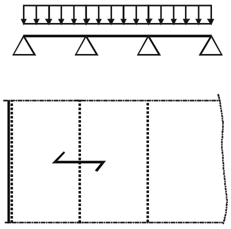
LOAD RESISTANCE q [kN/m2] AND CORRESPONDING DEFLECTION u [mm] VALUES FOR FINNISH PLYWOOD TO BE USED IN THE DESIGN OF CONCRETE FORMWORKS.

Table 4-39. Birch plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths. Face grain parallel to span

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	q		u	q		u	q		u	q		u	q		u	q		u
100	123	s	0.3	166	s	0.3	193	s	0.2	234	s	0.2	263	s	0.2	303	s	0.2
150	82	s	0.8	111	s	0.6	129	s	0.4	156	s	0.4	176	s	0.3	202	s	0.3
200	61	s	1.6	83	s	1.1	97	s	0.8	117	s	0.7	132	s	0.6	152	s	0.5
250	46	b	2.7	67	s	2.0	77	s	1.4	94	s	1.1	105	s	0.9	121	s	0.8
300	32	b	3.7	51	b	3.0	64	s	2.2	78	s	1.8	88	s	1.4	101	s	1.2
350	24	b	5.0	38	b	4.0	55	b	3.4	67	s	2.6	75	s	2.1	87	s	1.7
400	18	b	6.4	29	b	5.0	42	b	4.2	58	b	3.7	66	s	2.9	76	s	2.4
500	12	b	9.8	18	b	7.6	27	b	6.4	37	b	5.5	49	b	4.9	61	s	4.3
600	8	b	13.9	13	b	10.8	19	b	8.9	26	b	7.7	34	b	6.8	43	b	6.1

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u
100	333	s	0.2	372	s	0.2	441	s	0.2	511	s	0.1	544	s	0.1	613	s	0.1
150	222	s	0.3	248	s	0.3	294	s	0.3	340	s	0.2	363	s	0.2	409	s	0.2
200	167	s	0.5	186	s	0.4	220	s	0.4	255	s	0.4	272	s	0.3	306	s	0.3
250	133	s	0.7	149	s	0.6	176	s	0.6	204	s	0.5	218	s	0.5	245	s	0.5
300	111	s	1.0	124	s	0.9	147	s	0.8	170	s	0.7	181	s	0.7	204	s	0.6
350	95	s	1.5	106	s	1.3	126	s	1.1	146	s	0.9	155	s	0.9	175	s	0.8
400	83	s	2.0	93	s	1.8	110	s	1.4	128	s	1.2	136	s	1.1	153	s	1.0
500	67	s	3.6	74	s	3.1	88	s	2.4	102	s	1.9	109	s	1.8	123	s	1.5
600	54	b	5.6	62	s	4.9	73	s	3.7	85	s	3.0	91	s	2.7	102	s	2.3



Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

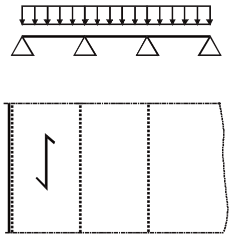
⟵ grain direction of surface veneers

Table 4-40. Birch plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths. Face grain perpendicular to span

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24		
	q		u	q		u	q		u	q		u	q		u	q		u
100	108	s	0.4	133	s	0.3	176	s	0.2	205	s	0.2	245	s	0.2	276	s	0.2
150	72	s	1.1	89	s	0.7	118	s	0.5	137	s	0.4	163	s	0.4	184	s	0.3
200	51	b	2.3	66	s	1.3	88	s	1.0	103	s	0.8	123	s	0.6	138	s	0.5
250	33	b	3.4	53	s	2.4	71	s	1.7	82	s	1.3	98	s	1.0	111	s	0.9
300	23	b	4.8	40	b	3.6	59	s	2.8	68	s	2.0	82	s	1.6	92	s	1.3
350	17	b	6.4	29	b	4.7	45	b	3.8	59	s	3.0	70	s	2.4	79	s	1.9
400	13	b	8.2	22	b	6.1	35	b	4.9	49	b	4.2	61	s	3.4	69	s	2.7
500	8	b	12.7	14	b	9.2	22	b	7.4	32	b	6.2	43	b	5.4	55	s	4.8
600	6	b	18.2	10	b	13.1	15	b	10.4	22	b	8.7	30	b	7.5	38	b	6.7

Span c/c mm	Nominal thickness (mm) 27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u
100	315	s	0.2	346	s	0.2	417	s	0.2	487	s	0.2	525	s	0.1	594	s	0.1
150	210	s	0.3	231	s	0.3	278	s	0.3	324	s	0.2	350	s	0.2	396	s	0.2
200	158	s	0.5	173	s	0.4	208	s	0.4	243	s	0.4	262	s	0.4	297	s	0.3
250	126	s	0.8	138	s	0.7	167	s	0.6	195	s	0.5	210	s	0.5	237	s	0.5
300	105	s	1.1	115	s	1.0	139	s	0.8	162	s	0.7	175	s	0.7	198	s	0.6
350	90	s	1.6	99	s	1.4	119	s	1.1	139	s	0.9	150	s	0.9	170	s	0.8
400	79	s	2.3	87	s	1.9	104	s	1.5	122	s	1.2	131	s	1.2	148	s	1.0
500	63	s	4.0	69	s	3.3	83	s	2.5	97	s	2.0	105	s	1.9	119	s	1.6
600	48	b	6.0	58	s	5.4	69	s	4.0	81	s	3.2	87	s	2.9	99	s	2.4



Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

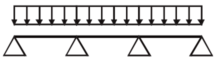
⟵ grain direction of surface veneers

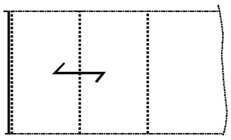
b = bending strength limitation
s = planar shear strength limitation

Table 4-41. Combi plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths. Face grain parallel to span

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
100	123	s	0.3	166	s	0.3	193	s	0.2	234	s	0.2	263	s	0.2	303	s	0.2	333	s	0.2	372	s	0.2
150	82	s	0.8	111	s	0.6	129	s	0.4	156	s	0.4	176	s	0.3	202	s	0.3	222	s	0.3	248	s	0.3
200	61	s	1.6	83	s	1.2	97	s	0.8	117	s	0.7	132	s	0.6	152	s	0.5	167	s	0.5	186	s	0.4
250	44	b	2.7	67	b	2.0	77	s	1.4	94	s	1.1	105	s	0.9	121	s	0.8	133	s	0.7	149	s	0.6
300	31	b	3.7	48	b	3.0	64	s	2.2	78	s	1.8	88	s	1.4	101	s	1.2	111	s	1.0	124	s	0.9
350	23	b	4.9	35	b	3.9	50	b	3.3	67	b	2.6	75	s	2.1	87	s	1.7	95	s	1.5	106	s	1.3
400	17	b	6.4	27	b	5.0	38	b	4.2	52	b	3.7	66	b	2.9	76	s	2.4	83	s	2.0	93	s	1.8
500	11	b	9.7	17	b	7.6	25	b	6.3	33	b	5.4	43	b	4.8	53	b	4.3	63	b	3.8	74	b	3.5
600	8	b	13.9	12	b	10.8	17	b	8.9	23	b	7.6	30	b	6.7	37	b	5.9	44	b	5.2	52	b	4.7





Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

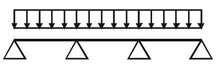
u given in mm

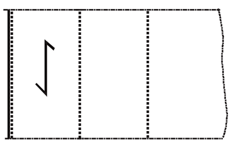
⟵ grain direction of surface veneers

Table 4-42. Combi plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths. Face grain perpendicular to span

Span c/c mm	Nominal thickness (mm) 9			12			15			18			21			24			27			30		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u	q		u
100	69	s	0.5	85	s	0.4	113	s	0.3	132	s	0.3	158	s	0.3	177	s	0.3	202	s	0.3	221	s	0.3
150	46	s	1.1	57	s	0.7	75	s	0.6	88	s	0.5	105	s	0.5	118	s	0.5	135	s	0.5	147	s	0.4
200	35	s	2.0	42	s	1.2	56	s	1.0	66	s	0.8	79	s	0.8	88	s	0.7	101	s	0.7	111	s	0.6
250	28	s	3.4	34	s	2.0	45	s	1.6	53	s	1.3	63	s	1.1	71	s	1.0	81	s	1.0	88	s	0.9
300	23	b	5.4	28	s	3.1	38	s	2.4	44	s	1.8	53	s	1.6	59	s	1.4	67	s	1.3	74	s	1.2
350	17	b	7.0	24	s	4.6	32	s	3.4	38	s	2.6	45	s	2.2	51	s	1.9	58	s	1.7	63	s	1.5
400	13	b	8.9	21	s	6.5	28	s	4.8	33	s	3.5	39	s	2.9	44	s	2.4	51	s	2.2	55	s	1.9
500	8	b	13.3	14	b	10.0	22	b	8.3	26	s	6.1	32	s	4.9	35	s	4.0	40	s	3.5	44	s	3.0
600	6	b	18.8	10	b	13.9	15	b	11.3	22	s	9.8	26	s	7.8	29	s	6.2	34	s	5.3	37	s	4.5





Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-43. Combi Mirror plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths.
Face grain parallel to span

Span c/c mm	Nominal thickness (mm) 9 q		u	12 q		u	15 q		u	18 q		u	21 q		u	24 q		u	27 q		u	30 q		u
100	79	s	0.4	106	s	0.4	124	s	0.3	150	s	0.3	169	s	0.3	194	s	0.3	214	s	0.3	238	s	0.3
150	53	s	0.8	71	s	0.7	83	s	0.6	100	s	0.5	113	s	0.5	130	s	0.5	143	s	0.5	159	s	0.4
200	39	s	1.4	53	s	1.1	62	s	0.9	75	s	0.8	84	s	0.7	97	s	0.7	107	s	0.7	119	s	0.6
250	32	s	2.3	43	s	1.8	50	s	1.3	60	s	1.2	68	s	1.0	78	s	1.0	86	s	0.9	95	s	0.9
300	26	s	3.6	35	s	2.7	41	s	2.0	50	s	1.7	56	s	1.4	65	s	1.3	71	s	1.2	79	s	1.1
350	23	s	5.4	30	s	3.9	35	s	2.8	43	s	2.3	48	s	1.9	56	s	1.7	61	s	1.6	68	s	1.5
400	18	b	7.0	27	s	5.4	31	s	3.8	38	s	3.1	42	s	2.6	49	s	2.3	53	s	2.0	60	s	1.9
500	12	b	10.4	18	b	8.5	25	s	6.7	30	s	5.3	34	s	4.3	39	s	3.7	43	s	3.2	48	s	2.9
600	8	b	14.6	13	b	11.7	19	b	9.9	25	s	8.5	28	s	6.7	32	s	5.6	36	s	4.8	40	s	4.3

Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

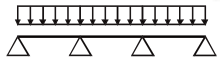
$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

grain direction of surface veneers



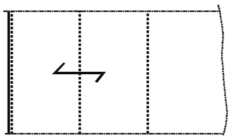


Table 4-44. Combi Mirror plywood

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths.
Face grain perpendicular to span

Span c/c mm	Nominal thickness (mm) 9 q		d	12 q		d	15 q		d	18 q		d	21 q		d	24 q		d	27 q		d	30 q		d
100	108	s	0.5	133	s	0.3	176	s	0.3	205	s	0.2	245	s	0.2	276	s	0.2	315	s	0.2	346	s	0.2
150	51	b	1.0	89	s	0.8	118	s	0.6	137	s	0.5	163	s	0.4	184	s	0.4	210	s	0.3	231	s	0.3
200	29	b	1.7	51	b	1.3	79	b	1.1	103	s	0.9	123	s	0.8	138	s	0.6	158	s	0.6	173	s	0.5
250	19	b	2.6	33	b	1.9	51	b	1.6	72	b	1.4	98	b	1.3	111	s	1.0	126	s	0.9	138	s	0.8
300	13	b	3.6	23	b	2.7	35	b	2.2	50	b	1.9	68	b	1.7	88	b	1.5	105	s	1.4	115	s	1.2
350	9	b	4.8	17	b	3.6	26	b	2.9	37	b	2.4	50	b	2.2	65	b	2.0	81	b	1.8	99	s	1.7
400	7	b	6.3	13	b	4.6	20	b	3.7	28	b	3.1	38	b	2.7	50	b	2.4	62	b	2.2	77	b	2.1
500	5	b	9.7	8	b	7.0	13	b	5.6	18	b	4.7	24	b	4.0	32	b	3.6	40	b	3.3	49	b	3.0
600	3	b	13.9	6	b	10.0	9	b	7.9	13	b	6.6	17	b	5.6	22	b	5.0	28	b	4.5	34	b	4.1

b = bending strength limitation
s = planar shear strength limitation

Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

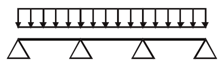
$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

grain direction of surface veneers



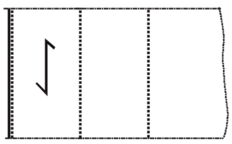
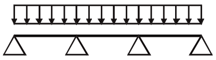
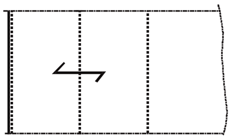


Table 4-45. Conifer plywood, thin veneers

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths.
Face grain parallel to span

Span c/c mm	Nominal thickness (mm) 9 q		9 u	12 q		12 u	15 q		15 u	18 q		18 u	21 q		21 u	24 q		24 u	27 q		27 u	30 q		30 u
100	79	s	0.4	106	s	0.4	124	s	0.3	150	s	0.3	169	s	0.3	194	s	0.3	214	s	0.3	238	s	0.3
150	53	s	0.9	71	s	0.7	83	s	0.6	100	s	0.6	113	s	0.5	130	s	0.5	143	s	0.5	159	s	0.5
200	39	s	1.7	53	s	1.3	62	s	1.0	75	s	0.9	84	s	0.8	97	s	0.7	107	s	0.7	119	s	0.7
250	26	b	2.4	42	b	2.1	50	s	1.6	60	s	1.4	68	s	1.2	78	s	1.1	86	s	1.0	95	s	0.9
300	18	b	3.2	29	b	2.7	41	s	2.4	50	s	2.0	56	s	1.7	65	s	1.5	71	s	1.3	79	s	1.3
350	13	b	4.1	22	b	3.4	32	b	3.1	43	s	2.8	48	s	2.3	56	s	2.0	61	s	1.8	68	s	1.7
400	10	b	5.2	16	b	4.3	24	b	3.7	33	b	3.4	42	s	3.1	49	s	2.7	53	s	2.3	60	s	2.1
500	7	b	7.8	11	b	6.3	15	b	5.4	21	b	4.8	28	b	4.4	36	b	4.1	43	s	3.8	48	s	3.4
600	5	b	11.0	7	b	8.7	11	b	7.3	15	b	6.4	19	b	5.8	25	b	5.4	31	b	5.1	38	b	4.9





Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

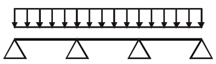
u given in mm

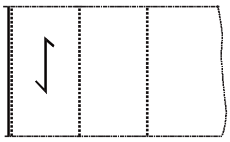
⟵⇁ grain direction of surface veneers

Table 4-46. Conifer plywood, thin veneers

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths.
Face grain perpendicular to span

Span c/c mm	Nominal thickness (mm) 9 q		9 u	12 q		12 u	15 q		15 u	18 q		18 u	21 q		21 u	24 q		24 u	27 q		27 u	30 q		30 u
100	69	s	0.6	85	s	0.4	113	s	0.4	132	s	0.3	158	s	0.3	177	s	0.3	202	s	0.3	221	s	0.3
150	46	s	1.3	57	s	0.8	75	s	0.7	88	s	0.6	105	s	0.5	118	s	0.5	135	s	0.5	147	s	0.5
200	29	b	2.1	42	s	1.5	56	s	1.2	66	s	1.0	79	s	0.9	88	s	0.8	101	s	0.7	111	s	0.7
250	19	b	2.9	33	b	2.4	45	s	1.9	53	s	1.5	63	s	1.3	71	s	1.1	81	s	1.0	88	s	1.0
300	13	b	4.0	23	b	3.1	35	b	2.7	44	s	2.2	53	s	1.9	59	s	1.6	67	s	1.4	74	s	1.3
350	9	b	5.2	17	b	4.0	26	b	3.4	37	b	3.1	45	s	2.6	51	s	2.2	58	s	1.9	63	s	1.7
400	7	b	6.6	13	b	5.0	20	b	4.2	28	b	3.7	38	b	3.4	44	s	2.9	51	s	2.6	55	s	2.2
500	5	b	10.0	8	b	7.5	13	b	6.1	18	b	5.3	24	b	4.7	32	b	4.4	40	b	4.2	44	s	3.6
600	3	b	14.2	6	b	10.5	9	b	8.4	13	b	7.2	17	b	6.4	22	b	5.8	28	b	5.4	34	b	5.1





Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

⟵⇁ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

Table 4-47. Conifer plywood, thick veneers

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths.
Face grain parallel to span

Span c/c mm	Nominal thickness (mm) 9/3 ply q		u	12/4 ply q		u	12/5 ply q		u	15/5 ply q		u	18/6 ply q		u	18/7 ply q		u
100	41	s	0.3	54	s	0.3	70	s	0.3	81	s	0.3	106	s	0.2	85	s	0.2
150	27	s	0.6	36	s	0.6	47	s	0.5	54	s	0.5	71	s	0.4	57	s	0.4
200	21	s	1.0	27	s	0.9	35	s	0.9	41	s	0.8	53	s	0.6	43	s	0.6
250	16	s	1.7	22	s	1.4	28	s	1.4	32	s	1.2	42	s	0.9	34	s	0.9
300	14	s	2.6	18	s	2.0	23	s	2.0	27	s	1.7	35	s	1.3	28	s	1.2
350	12	s	3.9	15	s	2.8	20	s	2.9	23	s	2.4	30	s	1.8	24	s	1.7
400	9	b	5.0	13	s	3.8	16	b	3.7	20	s	3.2	26	s	2.5	21	s	2.2
500	6	b	7.3	10	b	6.1	10	b	5.3	14	b	4.9	19	b	4.0	17	s	3.8
600	4	b	10.2	7	b	8.2	7	b	7.2	10	b	6.5	13	b	5.4	13	b	5.6

Span c/c mm	Nominal thickness (mm) 21/7 ply q		u	24/8 ply q		u	24/9 ply q		u	27/9 ply q		u	27/11 ply q		u	30/10 ply q		u	30/13 ply q		u
100	100	s	0.2	175	s	0.1	115	s	0.2	133	s	0.2	115	s	0.2	152	s	0.2	141	s	0.2
150	66	s	0.4	117	s	0.2	77	s	0.4	89	s	0.4	77	s	0.3	102	s	0.3	94	s	0.3
200	50	s	0.6	88	s	0.4	57	s	0.6	66	s	0.5	57	s	0.5	76	s	0.5	71	s	0.5
250	40	s	0.8	70	s	0.6	46	s	0.8	53	s	0.7	46	s	0.7	61	s	0.7	57	s	0.7
300	33	s	1.1	58	s	0.9	38	s	1.0	44	s	0.9	38	s	0.9	51	s	1.0	47	s	0.9
350	28	s	1.4	50	s	1.2	33	s	1.4	38	s	1.2	33	s	1.3	44	s	1.3	40	s	1.1
400	25	s	1.9	44	s	1.7	29	s	1.8	33	s	1.6	29	s	1.6	38	s	1.7	35	s	1.4
500	20	s	3.1	33	b	2.9	23	s	2.9	27	s	2.4	23	s	2.6	30	s	2.9	28	s	2.2
600	17	s	4.8	23	b	3.9	19	s	4.5	22	s	3.6	19	s	4.1	25	s	4.5	24	s	3.3

b = bending strength limitation
s = planar shear strength limitation

Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

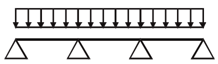
$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m²

u given in mm

⟵⟶ grain direction of surface veneers



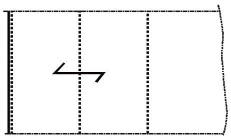
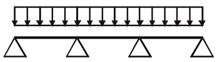


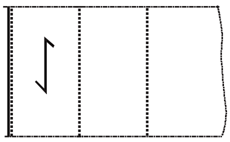
Table 4-48. Conifer plywood, thick veneers

Load resistance for a uniformly distributed load on a continuous plate strip with three equal span lengths. Face grain perpendicular to span

Span c/c mm	Nominal thickness (mm) 12/5 ply q		u	15/5 ply q		u	18/6 ply q		u	18/7 ply q		u	21/7 ply q		u	24/8 ply q		u
100	38	s	0.2	44	s	0.2	56	s	0.1	72	s	0.2	83	s	0.2	57	s	0.1
150	25	s	0.5	29	s	0.4	37	s	0.3	48	s	0.4	56	s	0.4	38	s	0.1
200	19	s	0.9	22	s	0.8	28	s	0.5	36	s	0.7	42	s	0.6	28	s	0.2
250	15	s	1.6	18	s	1.3	23	s	0.8	29	s	1.1	33	s	0.9	23	s	0.3
300	13	s	2.6	15	s	2.0	19	s	1.3	24	s	1.6	28	s	1.3	19	s	0.5
350	11	b	3.9	13	s	3.1	16	s	1.9	21	s	2.3	24	s	1.9	16	s	0.7
400	8	b	4.9	11	s	4.4	14	s	2.7	18	s	3.3	21	s	2.6	14	s	1.0
500	5	b	7.4	7	b	6.6	11	s	4.9	12	b	4.9	16	b	4.4	11	s	1.9
600	4	b	10.4	5	b	9.2	8	b	7.0	8	b	6.8	11	b	6.0	9	s	3.1

Span c/c mm	Nominal thickness (mm) 24/9 ply q		u	27/9 ply q		u	27/11 ply q		u	30/10 ply q		u	30/13 ply q		u
100	89	s	0.2	103	s	0.2	117	s	0.2	106	s	0.1	137	s	0.2
150	59	s	0.3	68	s	0.3	78	s	0.3	70	s	0.2	91	s	0.3
200	44	s	0.5	51	s	0.5	59	s	0.5	53	s	0.3	68	s	0.5
250	35	s	0.7	41	s	0.7	47	s	0.7	42	s	0.4	55	s	0.6
300	30	s	1.0	34	s	0.9	39	s	1.0	35	s	0.6	46	s	0.8
350	25	s	1.4	29	s	1.2	34	s	1.3	30	s	0.7	39	s	1.1
400	22	s	1.9	26	s	1.6	29	s	1.6	26	s	0.9	34	s	1.3
500	18	s	3.3	21	s	2.7	23	s	2.6	21	s	1.4	27	s	2.1
600	15	b	5.3	17	s	4.3	20	s	4.1	18	s	2.1	23	s	3.1





Short-term loading

Service Class 3

$k_{mod} = 0.70$

$k_{def} = 0.40$

$\gamma_q = 1.2$

$\gamma_m = 1.3$

q given in kN/m^2

u given in mm

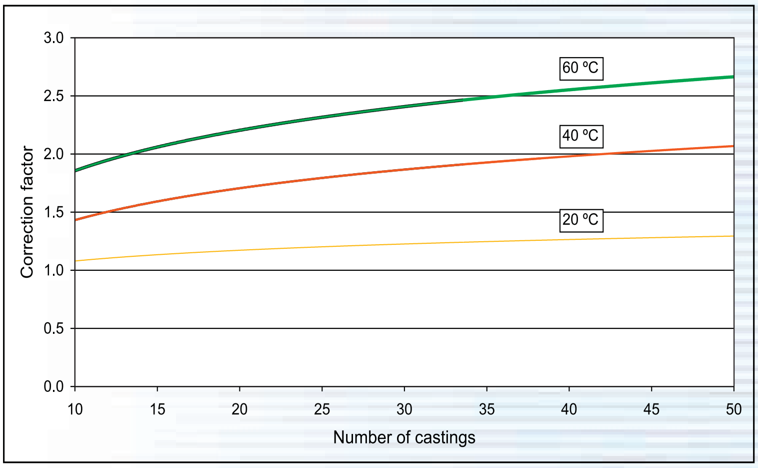
⟵ grain direction of surface veneers

b = bending strength limitation
s = planar shear strength limitation

PLYWOOD FORMWORK IN COLD CONDITIONS

In colder climates it is sometimes necessary to heat concrete formwork when in use to avoid frost problems. When the concrete mass casting temperature is above + 20°C (for example in winter concreting) increased temperature can cause additional deflection of the plywood. The deflection of birch plywood as a function of castings can be calculated using the correction factor $k_{temp,\ corr}$ as shown in the Figure below.

Deflection correction factor ($k_{temp,\ corr}$) for birch plywood in winter concreting



The final deflection u_{fin} in winter concreting is given by

$u_{fin} = u \bullet k_{temp,\ corr}$ where u is the deflection from Tables 4-39 to 4-48.

INSTRUCTIONS 5

5.1 USAGE

BIRCH PLYWOOD

Birch plywood is characterised by its excellent strength, stiffness and resistance to creep. It has a high planar shear strength and impact resistance, which make it especially suitable for heavy-duty floor and wall structures. Oriented plywood construction has a high wheel carrying capacity. Birch plywood has excellent surface hardness, damage and wear resistance. Sanded birch plywood has a smooth and durable surface. Its pleasant, light-coloured visual appearance offers the best base for finishing. Properly surfaced and edge sealed birch plywood also offers excellent weather and moisture resistance.

Typical end uses of birch plywood are concrete formwork systems, floors, walls and roofs in transport vehicles, container floors, floors subjected to heavy wear in various buildings and factories, scaffolding materials, shelves, load bearing special structures, traffic signs, furniture and die boards.

COMBI PLYWOOD

Combi plywood is characterised by its strength and stiffness properties which are in many respects virtually the same as those of birch plywood. The strength and stiffness properties on its major axes are quite similar, which ensures a balanced structure. An exception to this is planar shear, where the strength in the cross-grain direction of the face veneer is clearly inferior to the strength in the grain direction. Combi plywood has a smooth and durable birch face and surface hardness and damage resistance are comparable to those of birch plywood. Its pleasant, light-coloured visual appearance offers a good base for finishing. Properly surfaced and edge sealed, combi plywood offers excellent weather and moisture resistance.

Typical end uses of combi plywood are concrete formwork systems, floors, walls and roofs in housing constructions, farm buildings and related structures, vehicle floors, walls and roofs, furniture, fixtures and shelves, scaffolding materials and packages.

SPRUCE PLYWOOD

Spruce plywood is characterised by its less dense surface when compared with birch, a prominent grain structure and a larger number of knots. The panel has a low weight and is easy to work and nail. Strength and stiffness properties are reasonably good and dimensional changes when subjected to moisture variations are minimal.

Typical end uses of spruce plywood are floors, walls and roofs in house constructions, wind bracing panels, vehicle internal body work, packages and boxes, hoarding, fencing and temporary works.

5.2 TRANSPORT

Panels must be properly protected during transport from the mill to the customer and stored at all times under dry conditions to protect the panels from rain, splashing or ground water. When a fork-lift truck is used to handle panel packs, care must be taken to prevent them being damaged or the strapping bands being broken. Plywood stacks must not be pushed by the tines of the fork lift truck and must be transported and stored in a horizontal position.

5.3 HANDLING

Panels should be unloaded so that no damage to pallets or bundles will occur. Metal slings, hooks or chains should not be in contact with the panels. The panels should be

removed from pallets or bundles by hand, taking care not to damage edges or faces by dropping them or dragging them along the ground. When lifting panels by fork-lift truck care must be taken to prevent the panels being damaged.

5.4 STORAGE

Panels should be stored horizontally under cover in their original packing in conditions of moisture and temperature similar to those in which they are to be used. Increased moisture content and temperature variation may cause internal stresses, thickness swelling or surface defects. Stack panels on a firm raised base, with enough bearers to prevent sagging. Cover the stack to protect the top and the edges from moisture penetration.

During prolonged storage it is recommended to relieve the original strapping to prevent leaving a mark on the top and bottom panels in the stack.

If film-faced formwork panels need to be stored temporarily outdoors cover them with

tarpaulins. Care must be taken to prevent the panel edges being subjected to rain, splashing or ground water.

5.5 DISPOSAL OF PLYWOOD

The service life of plywood is generally long, and there are several methods of disposal. It should be noted, however, that the instructions for disposal of panels may vary in different countries depending on current legislation.

Recycling is the preferred way to dispose of most products. Used plywood could be utilised in some other application. This recycling must not burden the environment more than any other method of disposal, nor should it be more expensive than using a new product.

If the fuel value of plywood can be utilised, the burning of plywood is equivalent to recycling. At a combustion temperature of at least +700°C, plywoods uncoated, coated with phenol or melamine resin films or with commonly used paints, do not produce any more hazardous combustion residues than those produced by wood. It is not recommended to burn plywood in an open fire, because burning at a lower temperature releases more harmful combustion residues. When plywood is burnt, its higher density compared with unprocessed wood means a higher fuel value is achieved.

Almost all plywood can be composted. Panels have to be chipped and the long duration of the composting process has to be taken into consideration.

Nearly all plywood products can be taken to the refuse dump. It must be checked if other substances contained in or on the plywood can be taken to the dump. Plywood products rot very slowly.

Standard Finnish plywoods contain nothing classified as hazardous waste.

5.6 CE MARKING

The Construction Product Directive (CPD) was adopted by the European authorities in 1988. The aim of the CPD is to abolish the great number of technical barriers to trade in order to create a single European market for construction products. For the purposes of the CPD, a construction product is defined as “any product which is produced for incorporation in a permanent manner in construction works, including both building and civil engineering works”. Thus, construction products can be for both structural and non-structural uses.

The CPD requires that all construction products shall bear the CE marking before being placed on the market. CE marking will show that the product complies with all necessary legal requirements and will, in principle, allow the product to be placed on the entire EU construction market. The EU Member States will not be allowed to require any other marks by law. On the other hand, the manufacturer will still have the possibility to put additional quality marks on his product, provided these do not hamper the legibility of the CE marking and do not confuse the user. Exact requirements for the CE marking are defined in harmonised standards. The harmonised standard for wood-based panels for use in construction is EN 13986.

5.7 EN STANDARDS

FINNISH PLYWOOD COMPLIES WITH THE FOLLOWING EUROPEAN STANDARDS:

EN 310	Wood-based panels - Determination of modulus of elasticity in bending and of bending strength
EN 313-1	Plywood - Classification and terminology - Part 1: Classification
EN 313-2	Plywood - Classification and terminology - Part 2: Terminology
EN 314-1	Plywood - Bonding quality - Part 1 : Test methods
EN 314-2	Plywood - Bonding quality - Part 2: Requirements
EN 315	Plywood - Tolerances for dimensions
EN 318	Wood-based panels - Determination of dimensional changes associated with changes in relative humidity
EN 321	Wood-based panels - Determination of moisture resistance under cyclic test conditions
EN 322	Wood-based panels - Determination of moisture content
EN 323	Wood-based panels - Determination of density
EN 324-1	Wood-based panels - Determination of dimensions of boards - Part 1 : Determination of thickness, width and length
EN 324-2	Wood-based panels - Determination of dimensions of boards - Part 2 : Determination of squareness and edge straightness
EN 325	Wood-based panels - Determination of dimensions of test pieces
EN 326-1	Wood-based panels - Sampling, cutting and inspection - Part 1 : Sampling and cutting of test pieces and expression of test results
EN 326-2	Wood-based panels - Sampling, cutting and inspection - Part 2 : Quality control in the factory
EN 326-3	Wood-based panels - Sampling, cutting and inspection - Part 3 : Inspection of a consignment of panels
EN 635-1	Plywood - Classification by surface appearance - Part 1 : General
EN 635-2	Plywood - Classification by surface appearance - Part 2 : Hardwood
EN 635-3	Plywood - Classification by surface appearance - Part 3: Softwood
ENV 635-4	Plywood - Classification by surface appearance - Part 4 : Parameters of ability for finishing
EN 635-5	Plywood - Classification by surface appearance - Part 5 : Methods for measuring and expressing characteristics and defects
EN 636-1	Plywood - Specifications - Part 1 : Requirements for plywood for use in dry conditions
EN 636-2	Plywood - Specifications - Part 2 : Requirements for plywood for use in humid conditions
EN 636-3	Plywood - Specifications - Part 3 : Requirements for plywood for use in exterior conditions
ENV 717-1	Wood-based panels - Determination of formaldehyde release - Part 1 : Formaldehyde emission by the chamber method
EN 717-2	Wood-based panels - Determination of formaldehyde emission - Part 2 : Formaldehyde release by the gas analysis method
EN 717-3	Wood-based panels - Determination of formaldehyde emission - Part 3 : Formaldehyde release by the flask method
EN 789	Timber structures - Test methods - Determination of mechanical properties of wood based panels
EN 1058	Wood-based panels - Determination of characteristic values of mechanical properties and density
EN 1072	Plywood - Description of bending properties for structural plywood
EN 1084	Plywood - Formaldehyde release classes determined by the gas analysis method
ENV 1099	Plywood - Biological durability - Guidance for the assessment of plywood for use in different hazard classes
ENV 1995-1-1	Eurocode 5 - Design of timber structures - Part 1-1: General rules and rules for buildings
EN 13986	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking
SFS 2413	Quality requirements for appearance of plywood with outer plies of birch