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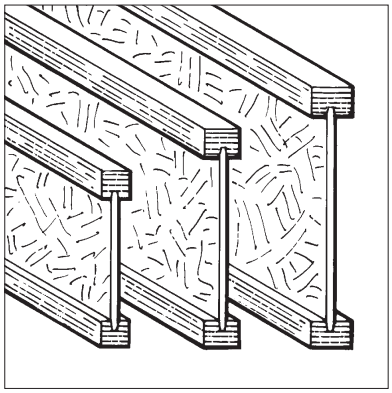
James Jones & Sons Ltd
(Timber Systems Division)

Certificate No 99/3633

DETAIL SHEET 2

JJI-JOISTS

Product



- *THIS DETAIL SHEET RELATES TO JJI-JOISTS COMPRISING SOLID TIMBER OR LAMINATED VENEER LUMBER (LVL) FLANGES AND ORIENTED STRAND BOARD (OSB) WEBS.*
- *JJI-Joists are for use as structural members, for example as floor or roof joists, beams, rafters, wall studs or ceiling ties.*

This Detail Sheet must be read in conjunction with the Front Sheets, which give the product's position regarding the Building Regulations, general information relating to the product, and the Conditions of Certification, *respectively.*

Technical Specification

1 Description

1.1 JJI-Joists are of composite construction with structural softwood or LVL flanges and OSB webs (see Figure 1). Flange sizes may vary in width from 45 mm to 97 mm and depth from 45 mm to 60 mm. Joist depths may vary from 145 mm to 450 mm. Joists of any dimension may be manufactured within these limits, however a standard range of sizes is given in Table 1. Lengths of joists may be limited by handling or transportation but may be up to 12 m. Figure 2 details the marking used for JJI-Joists. The tolerances (in mm) on member sizes are:

Overall joist length	±3.0
Overall joist height	±1.5
Flange depth	±1.5
Flange width	±1.5

1.2 The softwood flange is planed all round (PAR) and of strength class C16 to C30, either machine-graded to BS EN 519 : 1995 or visually graded to BS 4978 : 1996. Where necessary the flanges are finger-jointed to length with the finger-joint being manufactured in accordance with BS EN 385 : 1995. The LVL flange is BBA approved. The standard range of JJI-Joists is set out in Table 1.

1.3 The web is 9 mm thick, grade 3 OSB to BS EN 300 : 1997 and is placed in the beams in 2400 mm long sections with the direction of the strands oriented parallel to the span. The OSB sections have glued tongue-and-groove joints to form a continuous web.

1.4 The web-to-flange connection is made by glueing the web into a groove in the centre of the inner face of the flange. Phenol-resorcinol adhesive is used in all joints.

Table 1 Standard JJI-Joist range

Joist designation(1)	Flange size (depth x width)	Weights (24 flanges) (kgm^{-1})	Depth (mm)
JJI 145A (24) or (K)	45 x 45	2.06	145
JJI 195A (24) or (K)	45 x 45	2.09	195
JJI 195B (24) or (K)	45 x 60	2.77	
JJI 195BV (24) or (K)	60 x 45	2.75	
JJI 195C (24) or (K)	45 x 72	3.31	
JJI 195D (24) or (K)	45 x 97	4.43	
JJI 220A (24) or (K)	45 x 45	2.11	220
JJI 220B (24) or (K)	45 x 60	2.78	
JJI 220C (24) or (K)	45 x 72	3.32	
JJI 220D (24) or (K)	45 x 97	4.45	
JJI 245A (24) or (K)	45 x 45	2.12	245
JJI 245B (24) or (K)	45 x 60	2.80	
JJI 245C (24) or (K)	45 x 72	3.34	
JJI 245D (24) or (K)	45 x 97	4.46	
JJI 300A (24) or (K)	45 x 45	2.16	300
JJI 300B (24) or (K)	45 x 60	2.83	
JJI 300C (24) or (K)	45 x 72	3.37	
JJI 300D (24) or (K)	45 x 97	4.50	
JJI 350C (24) or (K)	45 x 72	3.40	350
JJI 350D (24) or (K)	45 x 97	4.53	
JJI 400C (24) or (K)	45 x 72	3.44	400
JJI 400D (24) or (K)	45 x 97	4.56	
JJI 450D (24) or (K)	45 x 97	4.59	450

(1) 24 denotes C24 timber flanges.
K denotes LVL flanges.
(See Table 2 for marking details).

Figure 1 Section

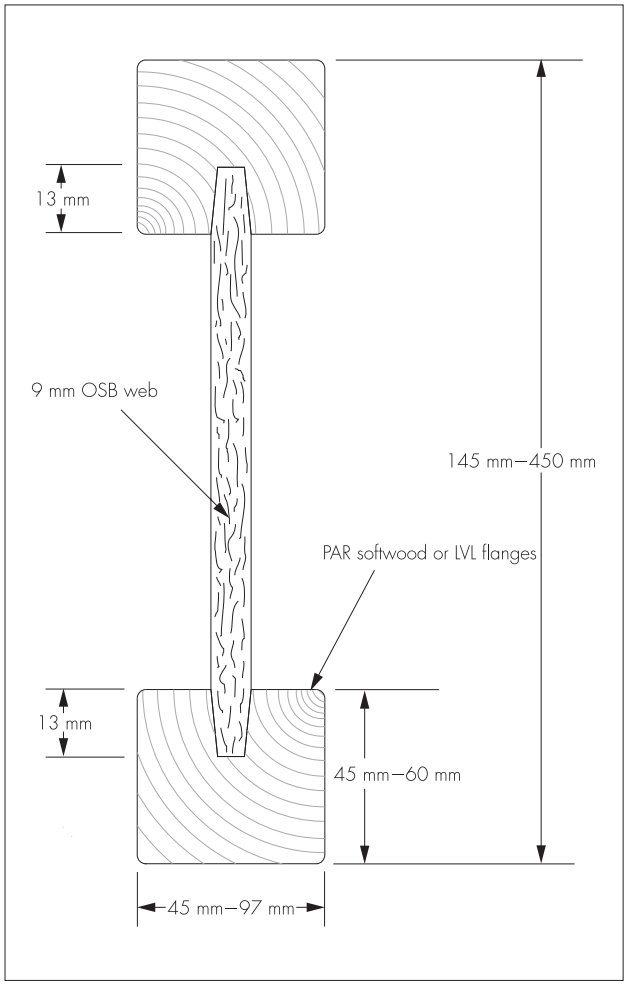


Figure 2 Marking for JJI-Joists

JJI	220	B	V	– 24
JJI	=	JJI-Joist		
220	=	Joist depth (mm)		
B	=	Flange size:	A	= 45 x 45
			B	= 45 x 60
			C	= 45 x 72
			D	= 45 x 97
V	=	Flange placed such that the major dimension is vertical		
24	=	Flange strength class:	16	= C16
			18	= C18
			22	= C22
			24	= C24
			26	= TR26
			27	= C27
			30	= C30
			K	= LVL

1.5 The components are machine-assembled in one pass.

1.6 Quality control includes checks on flange and web materials, before and after preparation, for quality and dimensional accuracy. Process control includes checks on glue spread, fit for component parts and curing temperature. Regular tests are made for tightness of web-flange connections and strength of completed joists.

Design Data

2 Structural performance

2.1 The structural properties of JJI-Joists within the ranges for joist depth and flange specification given in sections 1.1 and 1.2, may be calculated using James Jones & Sons Ltd design procedures *Design Protocol for the Evaluation of Permissible Long-term Structural Properties of JJI-Joists*, dated August 1999 which is approved by the BBA. For the standard range of JJI-Joists (see Table 1) the design properties given in Tables 2 to 4 have been calculated using these procedures. Tables 2 to 4 together with these design procedures apply only in the internal conditions of service class 1 or 2 environments as defined in BS 5268 : Part 2 : 1996.

2.2 The structural performance of the joists relies upon adequate lateral restraint to the compression flanges. To achieve this the maximum centres between lateral restraint points should be 360 mm for flange widths less than 60 mm and 450 mm for flange widths greater than or equal to 60 mm. Lateral restraint is readily achieved for simply-supported beams where battens, boarding or similar provide restraint to the top flange at satisfactorily close intervals. However, in certain conditions additional lateral restraint is required, for example the lower flange can be in compression and therefore may not have boarding, etc to act as lateral restraint. Continuous beams and members subject to wind uplift both fall into this category and may require the addition of diagonal braces or similar to provide the necessary restraint.

2.3 Compared to solid timber joists the strength and stiffness of I joists in the minor axis is considerably less than in the major axis. As such, care must be taken to ensure that adequate bracing/diaphragm action is provided to resist horizontal loads acting on the structural element.

2.4 Long-term moment capacities are given in Table 2 and long-term shear resistances are given in Table 3. Bending moment capacities and shear resistances for different durations of loading can be evaluated by multiplying the values in these tables by the appropriate value of the K_3 modification factor given in BS 5268 : Part 2 : 1996.

2.5 The values tabulated for loadsharing systems relate to a modification factor K_8, of 1.04 (except moment capacities of joists with softwood flanges where a value of 1.07 is applicable), as defined in BS 5268 : Part 2 : 1996 where four or more joists of the same cross-section are spaced a maximum of 610 mm centre to centre, and have adequate provision for the distribution of loads by means of purlins, binders, boarding, battens, etc.

2.6 The flexural rigidities and shear rigidities, required for the purpose of evaluating deflections are given in Table 2 for the standard JJI-Joist range listed in Table 1. The maximum deflection at mid span of a uniformly loaded I joist can be evaluated by:

$$y = \frac{5wL^4}{384EI} + \frac{wL^2}{8G_wA_w}$$

where
w = uniform load
L = effective span
EI = flexural rigidity
G_wA_w = web shear rigidity.

2.7 Lightweight I joist floors may require stricter deflection control to avoid undue vibration. Generally the deflection criterion 0.003 times the span will not impair the strength of the structure nor lead to unsightly damage to the finishes. The manufacturer's literature should be consulted regarding recommended deflection control limits. Consideration of the deflection criterion should be agreed between interested parties at the design stage.

2.8 JJI-Joists are typically installed at 14% flange moisture content. For internal uses up to service class 2 there will be little variation in moisture content. Where the designer considers there to be a risk of fluctuating moisture content beyond normal service class 1 or 2 conditions, the effect of creep deflection is to be included. For all JJI-Joists a creep effect of 2.0 times the initial deflection is suggested. The manufacturer should be consulted in these situations.

2.9 The minimum bearing lengths for all types of JJI-Joist, irrespective of whether web stiffeners are present, are 45 mm for end supports and 89 mm for intermediate supports.

2.10 Long-term bearing capacities with and without web stiffeners, over end and intermediate supports are given in Table 4 for both non-loadsharing and loadsharing joists. Bearing capacities for different durations of load can be evaluated by multiplying the values in Table 4 by the appropriate value of the K_3 modification factor given in BS 5268 : Part 2 : 1996.

2.11 Details of the minimum permissible specifications for web stiffeners are given in Figure 3.

2.12 Holes in the web will reduce the shear capacity of the joists. The manufacturer's literature should be consulted for guidance on the size of hole permitted and the reduction in shear capacity.

Compression load only

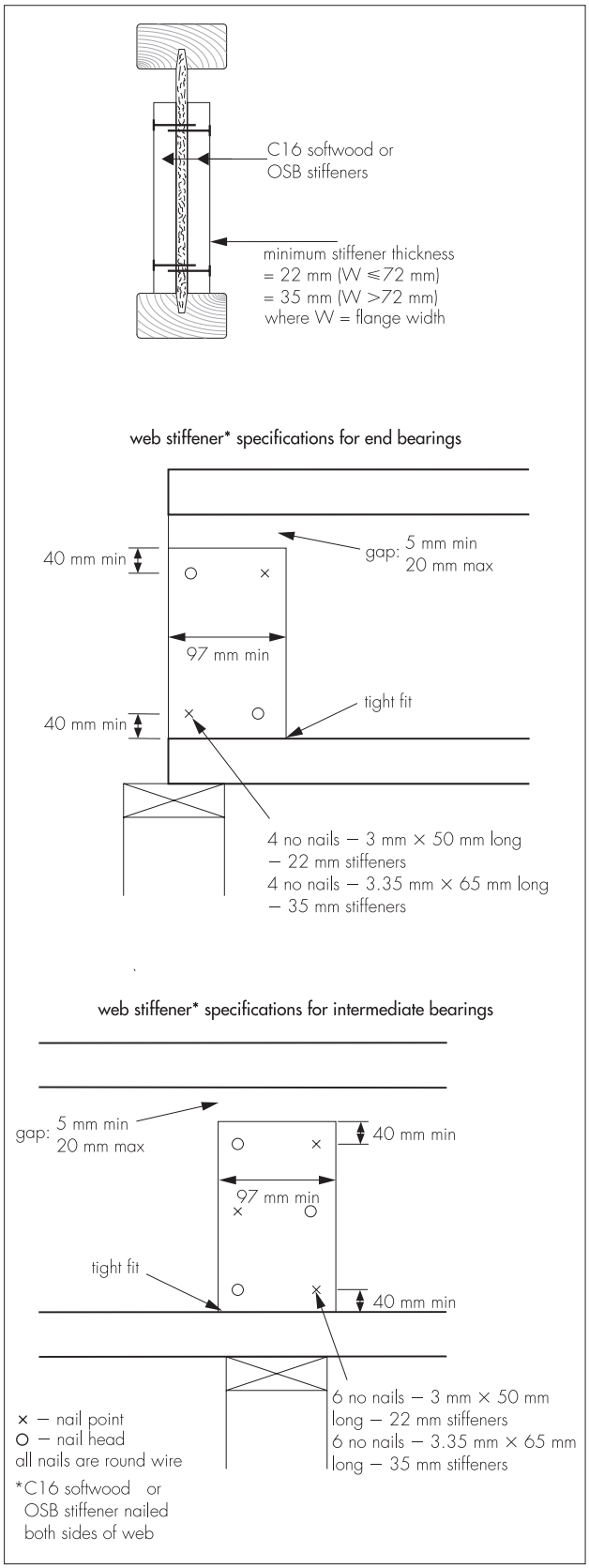
2.13 When using JJI-Joists as a strut, the flange section only is to be considered and the compression stress value is to be used and modified according to the relevant lateral restraint points and guidance given in BS 5268 : Part 2 : 1996. The long-term grade compression stress parallel to the grain $\sigma_{c,\,grade,\,II}$ should be taken as that relating to the strength class of the flange material for solid timber or from the relevant BBA Certificate in the case of LVL.

The design compression stress should be taken as:

$$\sigma_{c\ adm} = \sigma_{c,\,grade,\,II} \times K_3 \times K_{12}$$

where
K_3 = duration of load factor
K_{12} = buckling factor.

Figure 3 Web stiffener details



Tension load only

2.14 When using JJI-Joists as a tie, the flange section only values are to be used and modified according to the guidance given in BS 5268 : Part 2 : 1996. The admissible long-term tension grade stress parallel to the joist span should be taken as that relating to the strength class of the flange material being used in solid timber or from the relevant BBA Certificate in the case of LVL.

Combined axial and bending loads

2.15 JJI-Joists subjected to a small component of axial load in addition to an applied moment must be designed such that each flange satisfies the appropriate interaction formula of BS 5268 : Part 2 : 1996.

Table 2 Permissible long-term moments, flexural rigidities and shear rigidities

Joist designation	Service class 1 conditions				Service class 2 conditions			
	Resistance moment		Flexural rigidity	Shear rigidity	Resistance moment		Flexural rigidity	Shear rigidity
	Non-loadsharing (kNm)	Loadsharing (kNm)	($Nmm^2 \times 10^9$)	($N \times 10^6$)	Non-loadsharing (kNm)	Loadsharing (kNm)	($Nmm^2 \times 10^9$)	($N \times 10^6$)
C24 timber flanges								
JJI 145A 24	1.63	1.75	115	0.61	1.47	1.57	103	0.52
JJI 195A 24	2.40	2.56	250	0.98	2.16	2.31	225	0.84
JJI 195B 24	3.02	3.23	334	0.98	2.72	2.91	301	0.84
JJI 195BV 24	2.82	3.02	278	0.76	2.54	2.72	250	0.65
JJI 195C 24	3.49	3.73	402	0.98	3.14	3.36	361	0.84
JJI 195D 24	4.41	4.72	542	0.98	3.97	4.25	488	0.84
JJI 220A 24	2.77	2.96	338	1.17	2.49	2.67	304	1.00
JJI 220B 24	3.49	3.73	452	1.17	3.14	3.36	407	1.00
JJI 220C 24	4.04	4.32	543	1.17	3.63	3.89	489	1.00
JJI 220D 24	5.11	5.47	733	1.17	4.60	4.92	660	1.00
JJI 245A 24	3.14	3.36	440	1.36	2.82	3.02	396	1.16
JJI 245B 24	3.96	4.23	588	1.36	3.56	3.81	530	1.16
JJI 245C 24	4.58	4.90	707	1.36	4.12	4.41	636	1.16
JJI 245D 24	5.79	6.20	954	1.36	5.21	5.58	859	1.16
JJI 300A 24	3.93	4.20	716	1.77	3.53	3.78	645	1.51
JJI 300B 24	4.96	5.30	956	1.77	4.46	4.77	860	1.51
JJI 300C 24	5.73	6.14	1147	1.77	5.16	5.52	1033	1.51
JJI 300D 24	7.27	7.77	1546	1.77	6.54	7.00	1392	1.51
JJI 350C 24	6.76	7.23	1644	2.15	6.08	6.51	1480	1.83
JJI 350D 24	8.57	9.16	2214	2.15	7.71	8.25	1992	1.83
JJI 400C 24	7.75	8.30	2235	2.53	6.98	7.47	2012	2.15
JJI 400D 24	9.83	10.52	3005	2.53	8.85	9.47	2704	2.15
JJI 450D 24	11.07	11.85	3922	2.90	9.96	10.66	3530	2.47
LVL flanges								
JJI 145A K	2.27	2.36	135	0.61	2.04	2.12	122	0.52
JJI 195A K	3.55	3.69	294	0.98	3.19	3.32	264	0.84
JJI 195B K	4.77	4.96	393	0.98	4.30	4.47	354	0.84
JJI 195BV K	4.12	4.29	329	0.76	3.71	3.86	296	0.65
JJI 195C K	5.75	5.98	473	0.98	5.18	5.38	426	0.84
JJI 195D K	7.53	7.83	639	0.98	6.78	7.05	576	0.84
JJI 220A K	4.20	4.37	397	1.17	3.78	3.94	357	1.00
JJI 220B K	5.66	5.89	532	1.17	5.09	5.30	479	1.00
JJI 220C K	6.83	7.10	640	1.17	6.14	6.39	576	1.00
JJI 220D K	8.94	9.29	864	1.17	8.04	8.37	778	1.00
JJI 245A K	4.87	5.06	517	1.36	4.38	4.56	465	1.16
JJI 245B K	6.56	6.82	692	1.36	5.90	6.14	623	1.16
JJI 245C K	7.91	8.23	832	1.36	7.12	7.40	749	1.16
JJI 245D K	10.36	10.77	1124	1.36	9.32	9.70	1012	1.16
JJI 300A K	6.34	6.59	840	1.77	5.71	5.93	756	1.51
JJI 300B K	8.55	8.89	1123	1.77	7.70	8.00	1011	1.51
JJI 300C K	10.32	10.73	1349	1.77	9.29	9.66	1214	1.51
JJI 300D K	13.52	14.06	1820	1.77	12.17	12.66	1638	1.51
JJI 350C K	12.53	13.03	1932	2.15	11.27	11.72	1739	1.83
JJI 350D K	16.42	17.08	2604	2.15	14.78	15.37	2343	1.83
JJI 400C K	14.74	15.33	2623	2.53	13.27	13.80	2361	2.15
JJI 400D K	19.34	20.11	3532	2.53	17.40	18.10	3179	2.15
JJI 450 D K	22.26	23.15	4607	2.90	20.03	20.83	4146	2.47

Table 3 Permissible long-term shear strengths

Joist depth	Service class 1 conditions		Service class 2 conditions	
	Permissible shear (kN)		Permissible shear (kN)	
(mm)	Non-loadsharing	Loadsharing	Non-loadsharing	Loadsharing
145	2.51	2.61	2.13	2.22
195	3.17	3.30	2.69	2.81
220	3.50	3.64	2.98	3.09
245	3.83	3.98	3.26	3.38
300	4.55	4.73	3.87	4.02
350	5.21	5.42	4.43	4.61
400	5.87	6.10	4.99	5.19
450	6.53	6.79	5.55	5.77

3 Behaviour in relation to fire

3.1 JJI-Joists have a Class 3 surface spread of flame classification in accordance with BS 476 : Part 7 : 1987.

3.2 In common with other timber products, the joists are combustible and for ignitability purposes they can be designated P in accordance with BS 476 : Part 5 : 1979.

3.3 The fire resistance properties of a structure are dependent on the design of the construction incorporating the joists. Where fire resistance is a requirement, an appropriate assessment or test must be carried out by a UKAS (United Kingdom Accreditation Service) approved fire testing laboratory.

Table 4 Permissible long-term bearing strengths for non-loadsharing and loadsharing joists over end and intermediate supports

Joist depth	Service class 1 conditions						Service class 2 conditions					
	End supports				Intermediate supports		End supports				Intermediate supports	
	45 mm bearing length		89 mm bearing length		89 mm bearing length		45 mm bearing length		89 mm bearing length		89 mm bearing length	
(mm)	No web stiffeners	With web stiffeners	No web stiffeners	With web stiffeners	No web stiffeners	With web stiffeners	No web stiffeners	With web stiffeners	No web stiffeners	With web stiffeners	No web stiffeners	With web stiffeners
Non-loadsharing												
145	2.38	—	2.51	—	5.02	—	2.02	—	2.13	—	4.27	—
195	3.00	3.17	3.17	3.17	6.34	6.34	2.55	2.69	2.69	2.69	5.39	5.39
220	3.31	3.50	3.50	3.50	7.00	7.00	2.81	2.98	2.98	2.98	5.95	5.95
245	3.63	3.83	3.83	3.83	7.66	7.66	3.09	3.26	3.26	3.26	6.51	6.51
300	3.51	4.55	4.32	4.55	6.91	8.90	2.98	3.87	3.67	3.87	5.88	7.57
350	3.14	5.21	3.79	5.21	6.06	8.90	2.67	4.43	3.22	4.43	5.15	7.57
400	2.87	5.87	3.39	5.87	5.42	8.90	2.44	4.99	2.88	4.99	4.61	7.57
450	2.65	5.90	3.09	5.90	4.94	8.90	2.25	5.02	2.63	5.02	4.20	7.57
Loadsharing												
145	2.38	—	2.61	—	5.22	—	2.02	—	2.22	—	4.44	—
195	3.00	3.30	3.30	3.30	6.60	6.60	2.55	2.81	2.81	2.81	5.61	5.61
220	3.31	3.64	3.64	3.64	7.28	7.28	2.81	3.09	3.09	3.09	6.19	6.19
245	3.63	3.98	3.98	3.98	7.96	7.96	3.09	3.38	3.38	3.38	6.77	6.77
300	3.51	4.73	4.32	4.73	6.91	8.90	2.98	4.02	3.67	4.02	5.88	7.57
350	3.14	5.42	3.79	5.42	6.06	8.90	2.67	4.61	3.22	4.61	5.15	7.57
400	2.87	5.90	3.39	5.90	5.42	8.90	2.44	5.02	2.88	5.02	4.61	7.57
450	2.65	5.90	3.09	5.90	4.94	8.90	2.25	5.02	2.63	5.02	4.20	7.57

Technical Investigations

4 Investigations

4.1 Results of tests on JJI-Joists composed of various flange grades/sizes:

over shear critical spans were used to establish theoretical predictions of shear strength

over moment critical spans were examined to establish theoretical predictions of bending strength

over bearing critical spans were used to establish theoretical predictions of bearing strength

were used to verify the accuracy of the predictive design equations developed previously and described herein.

4.2 The measured deflections from bending tests were used to confirm theoretical deflection predictions.

4.3 Existing data relating to the durability of timber in the specified environments were examined.

4.4 Assessments, from existing data, were also made of the practicability of installation.

4.5 The manufacturing processes for the complete beams were examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

BS 476 *Fire tests on building materials and structures*
Part 5 : 1979 *Method of test for ignitability*
Part 7 : 1987 *Method for classification of the surface spread of flame of products*

BS 4978 : 1996 *Specification for visual strength grading of softwood*

BS 5268 *Structural use of timber*
Part 2 : 1996 *Code of practice for permissible stress design, materials and workmanship*

BS EN 300 : 1997 *Oriented Strand Boards (OSB) — Definitions, classification and specifications*

BS EN 385 : 1995 *Finger jointed structural timber. Performance requirements and minimum production requirements*

BS EN 519 : 1995 *Structural timber. Grading. Requirements for machine strength graded timber and grading machines*

BBA BRITISH BOARD OF AGRÉMENT
ASSESSMENT OF PRODUCTS FOR CONSTRUCTION

On behalf of the British Board of Agrément

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