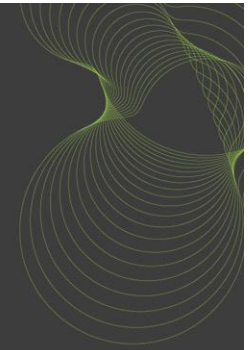


# Maximising the potential of Scots Pine falling boards

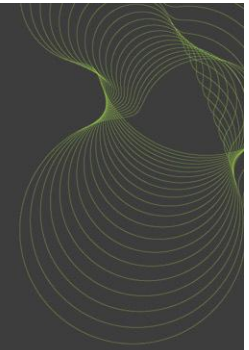
Barney Freke & Geoff Cooper

## Alternative uses for board material



- Falling board material often goes to the lower value markets
  - Pallet production
  - Fencing
- When in fact, this material is some of the better quality material in the log, being stronger, stiffer & clearer than most centre material

# Scottish Sitka spruce

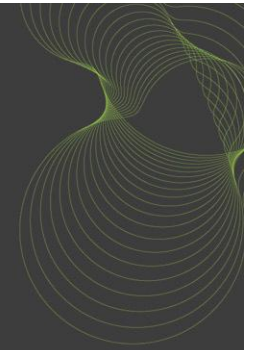


- Results from laminating C18 falling board material (visually graded)

	<b>Strength (N/mm<sup>2</sup>)</b>	<b>Stiffness (N/mm<sup>2</sup>)</b>	<b>Density (kg/m<sup>3</sup>)</b>
<b>Actual</b>	23.97	10177	410.7
<b>C24 Strength class (EN 338)</b>	24	11000	420

## Four main work tasks

- Define the resource
- Identify two test products and manufacture
- Evaluate demonstration products
- Review results on improving the measured performance

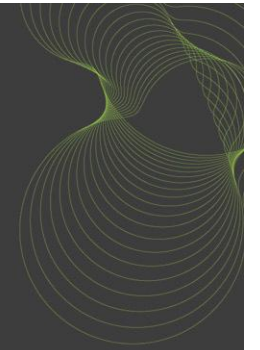


## Material requirements

- 168 logs (from 7 locations)
- 200 - 250 mm max top-diameter under bark
- Log length approx 3600 mm
  
- Board dimensions (19/22 mm x 75/100/125/150 mm)
- 75 mm boards not used

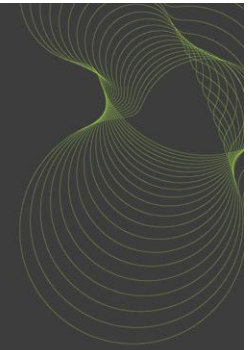


## Defining the resource



- Material will be appearance graded according to BS EN 1611-1:2000, Sawn timber - Appearance grading of softwoods – Part 1: European spruces, firs, pines, Douglas fir and larches
- Material graded above will also be compared to BS 4978 (visual strength grading standard)

# BS EN 1611-1:2000 appearance grading rules



- Five grades
  - G4-0
  - G4-1
  - G4-2
  - G4-3
  - G4-4
- Grade G4-0 being the highest grade (clearer material)
- Grade G4-4 being the lower grade (larger more frequent knots)



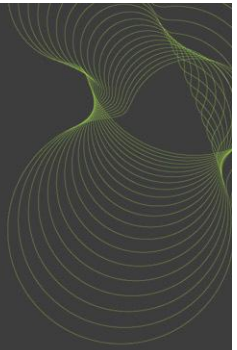
G4 - 0

G4 - 1

G4 - 2

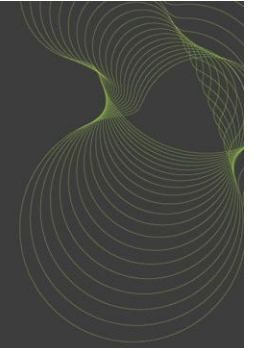
G4 - 3

G4 - 4



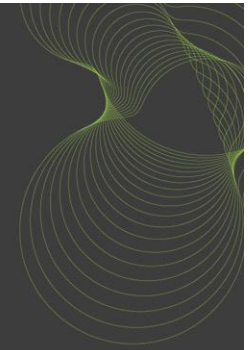


# BS 4978: 1996 strength grading rules

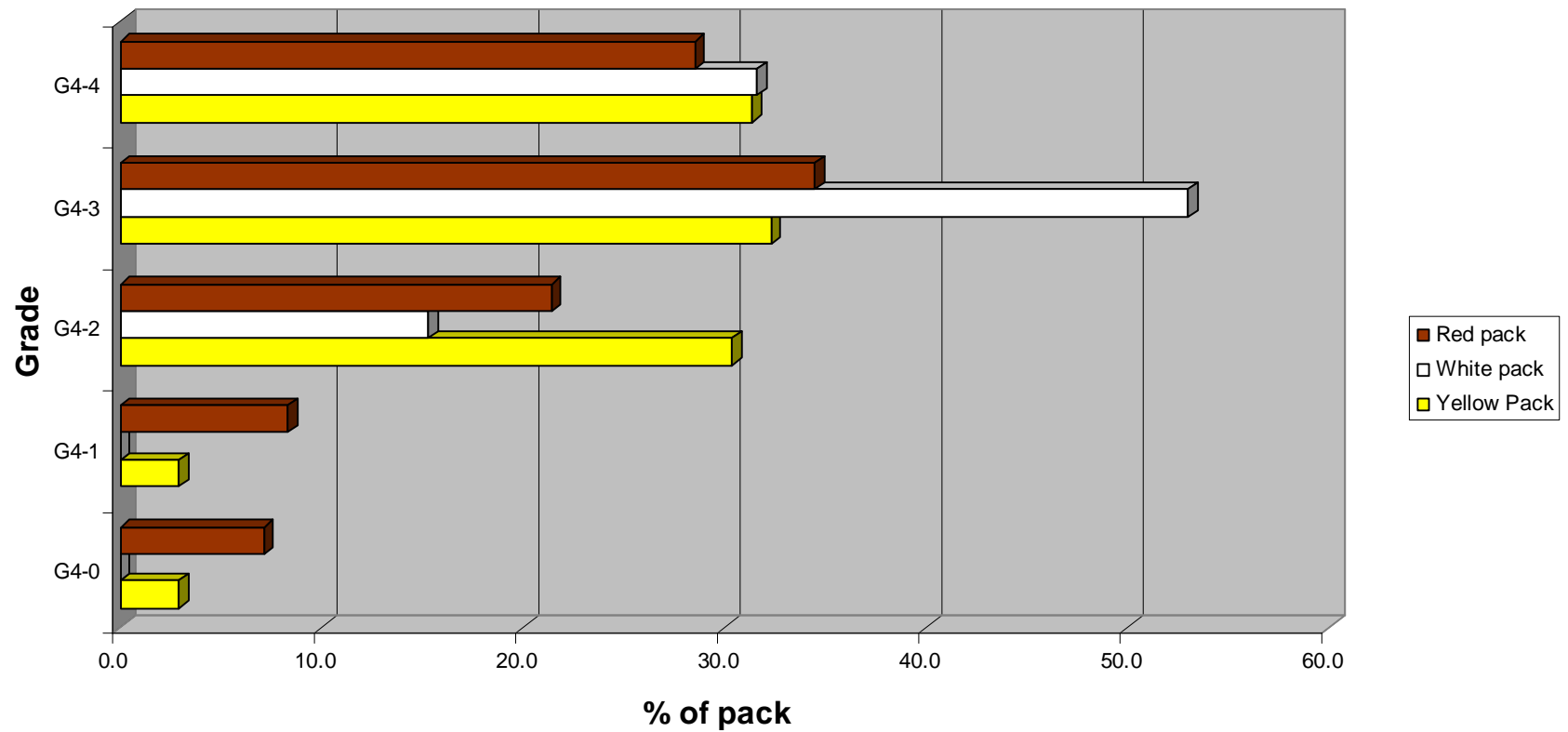


- Two visual strength grades
  - GS (general structural grade)
  - SS (special structural grade)
- These grades equate to a structural grade of:
  - GS – C14
  - SS – C22

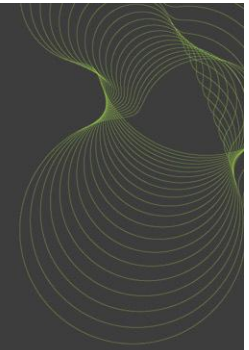
# Board grades – BS EN 1611-1:2000



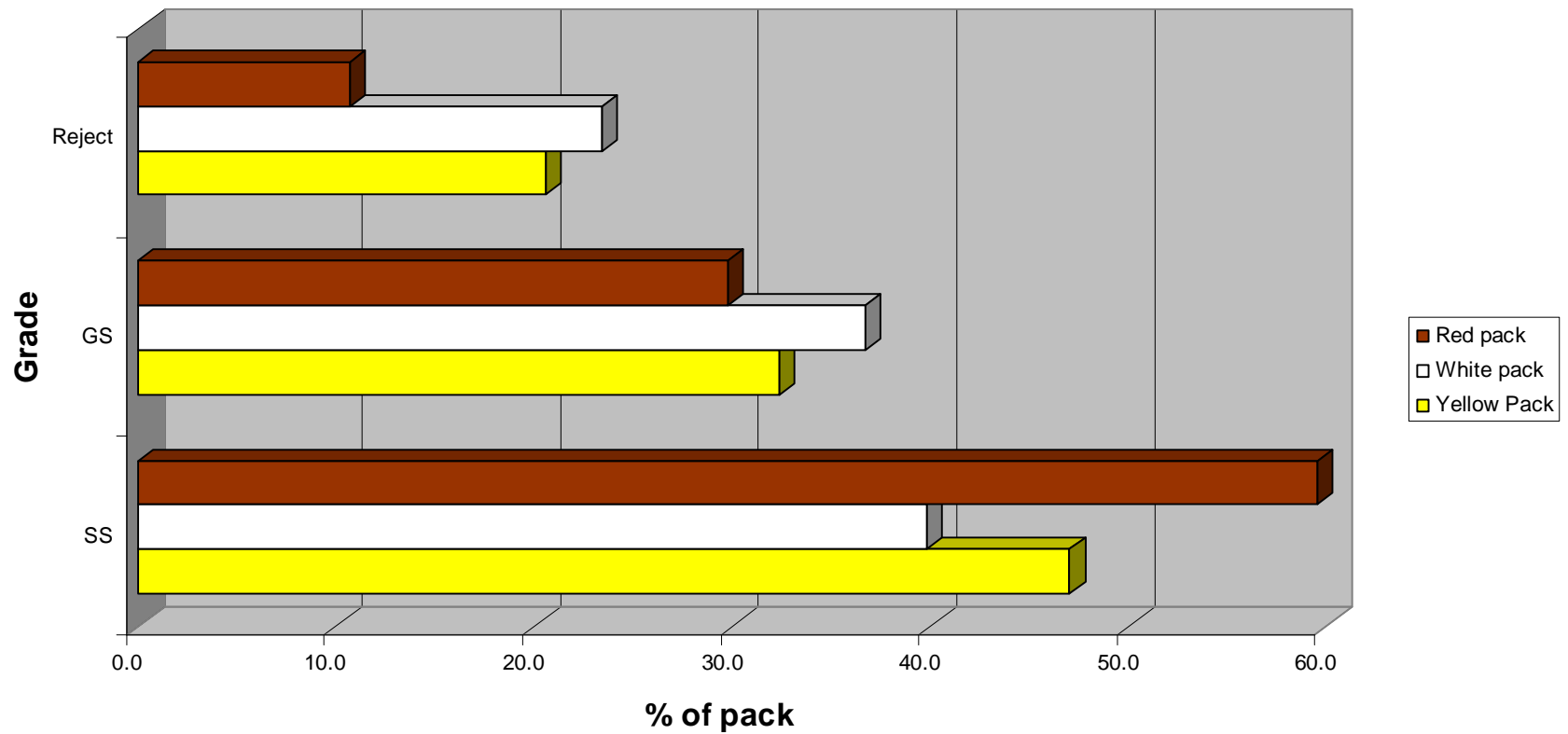
Appearance Grade Distribution



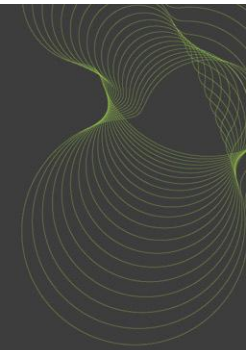
# Board grades – BS 4978: 1996



Structural Grade Distribution



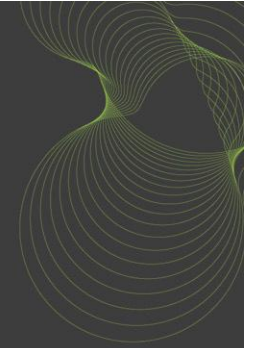
# Single Board Characterisation



- Single boards tested to EN 408 and graded to EN 338
- Results compared to expected strengths defined from visual grading and EN 1912

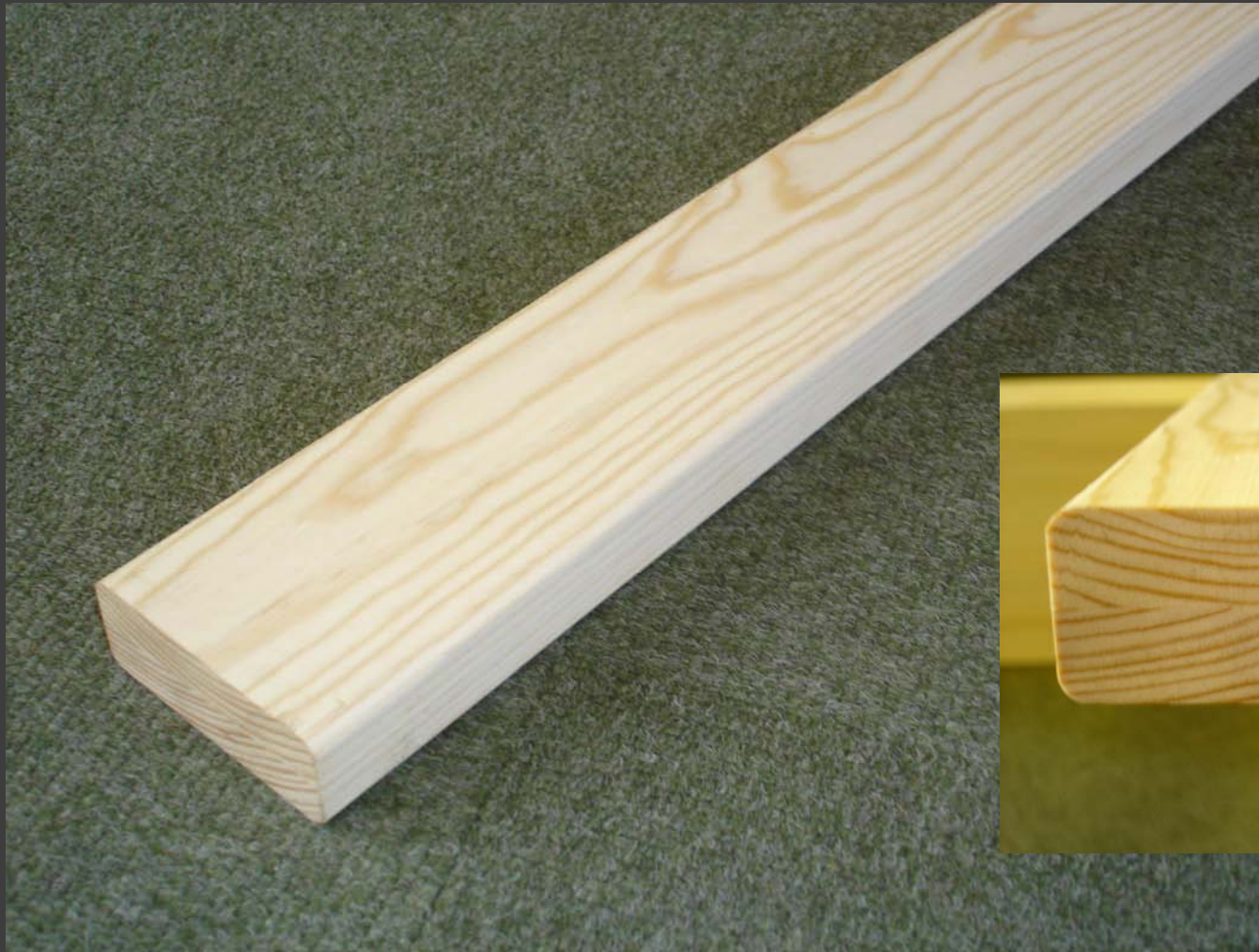
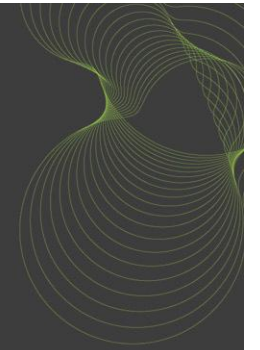
	EN 1912 Strength Grade	EN 338 Strength Grade	Strength (N/mm <sup>2</sup> )	Stiffness (N/mm <sup>2</sup> )	Density (Kg/m <sup>3</sup> )
GS	C14	C16	16.3	9188	525
SS	C22	C20	19.75	10764	548

## Identify two test product



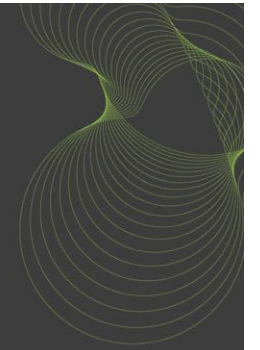
- Two products
  - A twin laminate re-engineered structural member (C24, TR26, C30 or better)
  - A traditional glulam style beam (100 mm x 200 mm x 4000 mm)

# Laminated product examples



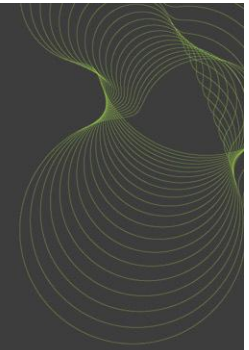


# Laminated product examples



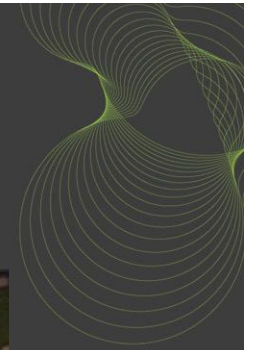
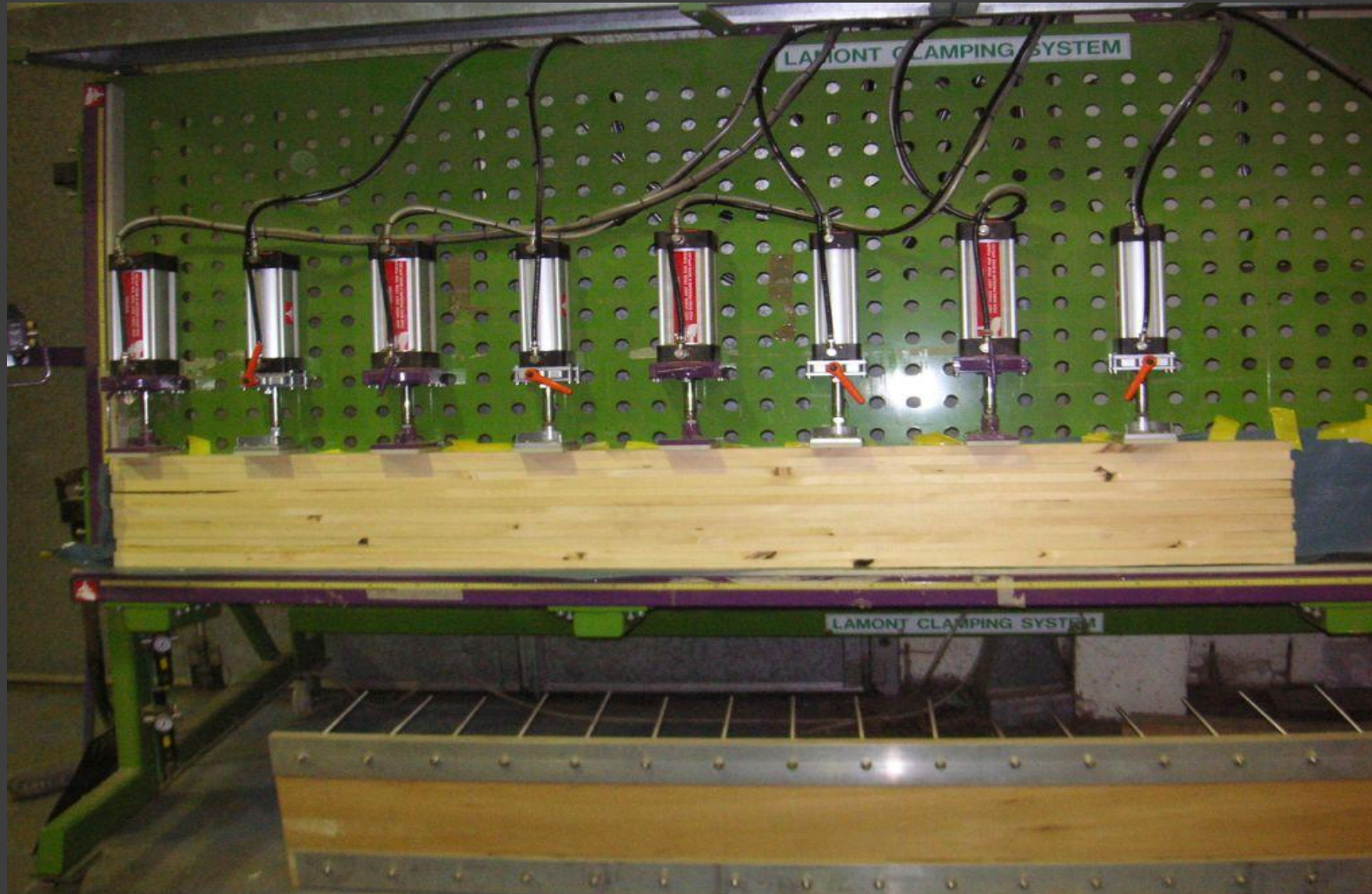
## Manufacture of test product

- Appearance and structural grades combined
- Boards cut to 2.4 m length
- Some 150/125 boards used
- 1 face planed flat
- Paired boards bonded with Polyurethane adhesive
- Boards installed in press and allowed to cure
- Laminated boards machined to give straight edge

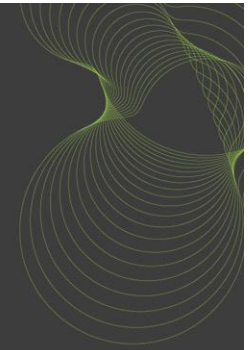




# Laminating rig

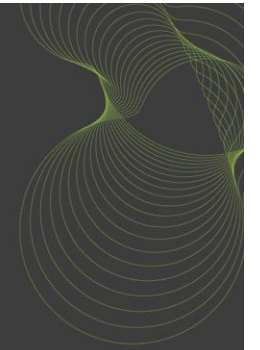


# Evaluation of demonstration products

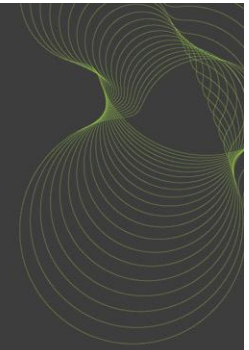


- Both products will undergo testing according to EN 408 to establish
  - Bending strength
  - Stiffness
  - Density
- Products will be compared to strength classes in EN 338 to demonstrate compliance with the prediction of performance (Glulam product, compared to design methods BS 5268, EN 1194 & Eurocode 5)

# 4-point bend test rig



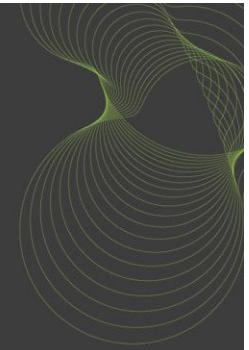
# Twin laminate results



		Strength (N/mm <sup>2</sup> )	Stiffness (N/mm <sup>2</sup> )	Density (kg/m <sup>3</sup> )
GS	C14	14	7000	350
SS	C22	22	10000	410
GS				
SS				

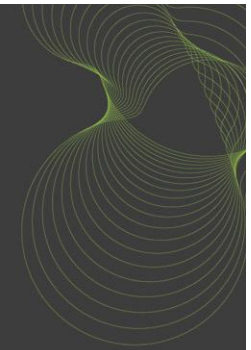


## Twin laminate results



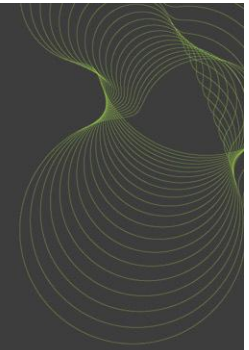
		Strength (N/mm <sup>2</sup> )	Stiffness (N/mm <sup>2</sup> )	Density (kg/m <sup>3</sup> )
GS	C14	14	7000	350
SS	C22	22	10000	410
GS		33.4	11422	515.6
SS		42.0	12724	543.5

## Twin laminate results



		Strength (N/mm <sup>2</sup> )	Stiffness (N/mm <sup>2</sup> )	Density (kg/m <sup>3</sup> )
GS	C14	14	7000	350
SS	C22	22	10000	410
GS	C27/ TR26	33.4	11422	545.6
SS	C35	42.0	12724	543.5

## Deep section results



	Strength (N/mm <sup>2</sup> )	Stiffness (N/mm <sup>2</sup> )	Density (Kg/m <sup>3</sup> )
GS	41.2	11112	520
SS	57.6	13010	538

- Strength adequate for C30 and C40 grades
- Stiffness below C30 and C40 grade boundaries
- Beams usually designed specifically for purpose

## Potential markets

- The potential of UK grown material to exceed C27 has not been widely considered
- Market must provide the correct financial returns proportional to grade of material
- Potential markets
  - I-beam & press metal web beam flanges
  - Bottom cords for attic truss rafter components
  - Ring beams
  - Solid wood panelling

