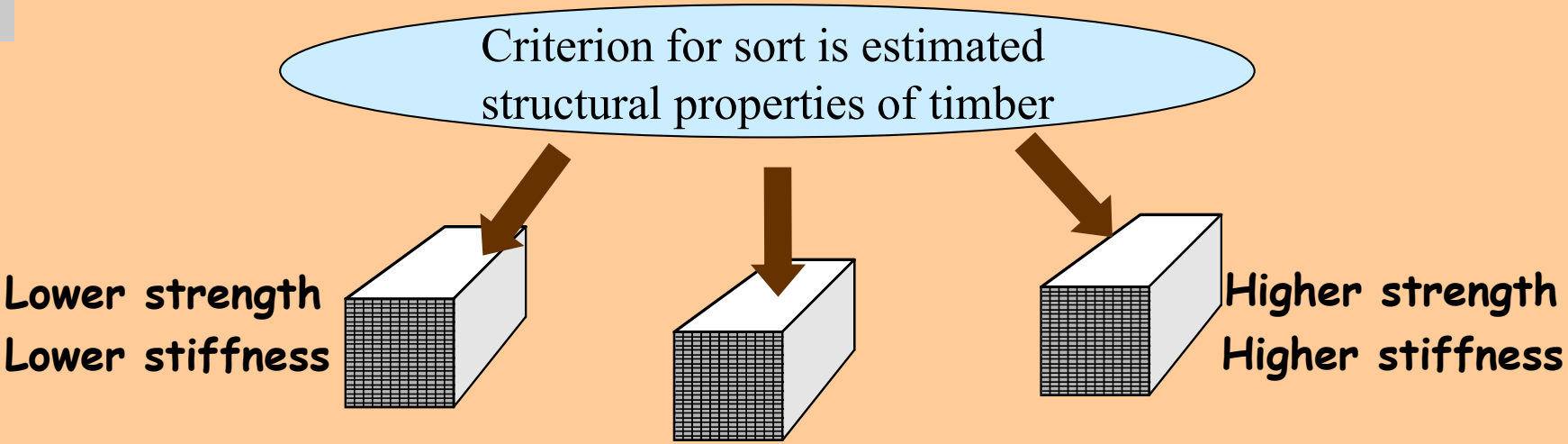
Structural Grading

Criterion for sort is *estimation of structural properties*

- Classification of timber used for
  - Load carrying members
  - Framing in houses & MRTFC
  - Substructures for floors
  - Timbers for bridges, wharfs
- Important where products carry
  - Construction loads
  - Building self-weight
  - Wind loads
  - Imposed actions

Structural Grading

- Used for classification of timber with defined structural properties
- Each grade associated with a suite of structural properties



Timber Stress Grades

Stress Grade

Structural properties

Strength

Bending
Tension
Compression
Shear

Stiffness

Deflection

Timber Stress Grades

Structurally graded products need to be assigned properties for designers to use

TABLE 2.4
STRUCTURAL DESIGN PROPERTIES FOR F-GRADES

From AS1720.1

Stress Grade	Characteristic strength, MPa					Characteristic short duration average modulus of elasticity parallel to grain, Mpa (E)
	Bending (f'_b)	Tension parallel to grain (f'_t)		Shear in beam (f'_s)	Compression parallel to grain (f'_c)	
		Hardwood	Softwood			
F34	100	60	50	7.2	75	21 500
F27	80	50	40	6.1	60	18 500
F14	40	25	21	3.7	30	12 000
F11	35	20	17	3.1	25	10 500
F8	25	15	13	2.5	20	9 100
F7	20	12	10	2.1	15	7 900
F5	16	9.7	8.2	1.8	12	6 900
F4	13	7.7	6.5	1.5	9.7	6 100

Properties of Stress Grades

High Stress grade = High strength and stiffness

Each grade associated with a suite of structural properties

- strength - characteristic value based on 5th %ile (conservative - involves safety)
- stiffness - characteristic value close to average (realistic for most applications)

Properties of Stress Grades

Grade name relates to properties

- **F-grades** - number relates to bending strength (around 1/3 of f'_b)
- **MGP grades** - number relates to stiffness (around 1/1000 of E)

Timber Stress Grades

Limited number of grade descriptions

- **F- grade system - general visually graded timber**
- **MGP grades - machine graded seasoned softwoods**
- **GL grades - glued laminated timber**
- **A - grades - visually graded seasoned Victorian Ash**

Timber Stress Grades

Used by producers	Used by designers
Grading method	Design properties AS 1720.1
• F- grades (visual, machine)	• F- grades
• MGP grades (machine)	• MGP grades
• GL grades (manufacture)	• GL grades
• A - grades (visual)	• A - grades

Grading is link between producer & designer

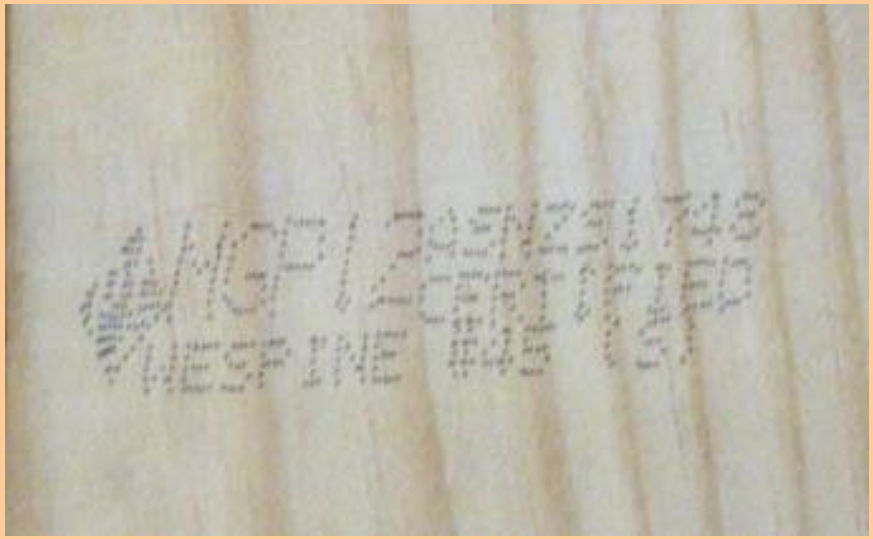
Stress Grades

- Stress grade is assigned to a package of timber
- Stress grade gives structural properties
  - Each piece in a package can be taken to have those properties
  - In most cases, timber has significantly greater strength than the stress grade (5th%ile)
  - Stiffness is frequently close to the stiffness assigned to the stress grade (mean)

Stress Grades

Each piece marked with Stress Grade at grading

- Coloured marks (machine stress grading) indicate F-grades
- Laser printed or roller stamp MGP grades



Structural Grading Methods

Structural grading is based on correlation between strength and a *grading parameter*

- **Visual stress** grading - presence or absence of natural characteristics

AS 2858 Softwood

AS 2082 Hardwood

- **Machine stress** grading - stiffness on flat (minor axis MoE)

AS 1748

- **Proof grading** - ability to take a proof load. Each piece passed through machine, bending applied at about characteristic strength level. Broken pieces fail - unbroken ones pass

AS 3519

- **Quality control** - verification of grade properties by testing

AS 4063

Visual Stress Grading

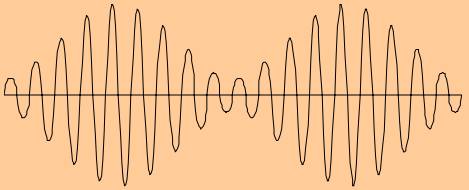
- Very different to appearance grading-
  - different characteristics are important
  - different sizes & location of each feature are allowed
- Each piece of timber examined by a **trained grader** for characteristics known to decrease strength, stiffness or utility
  - **knots** - size, location, angle and position in relation to others
  - **slope of grain** - on each face or edge
  - **splits and checks**

    (Checks that may be important to appearance grading may not be important here)

Machine Stress Grading

- Relies on correlation between a measured structural property and all others
- Minor axis *E* most commonly used
  - each piece tested in non-destructive bending about minor axis over most of the length
  - minimum *E* value determines grade (F-grade, MGP grade) of whole piece
  - grade stamp often automatically applied by the machine (visual check after grading can over-ride machine grade stamp to downgrade piece)

Scanning



- Electromagnetic radiation passed through timber
- Gives indication of
  - density
  - slope of grain
  - internal imperfections
- Potential for the development of very sophisticated grading methods

Proof Grading

Grade verification technique

Timber initially sorted
using a documented process

Significant major axis bending load applied

Pass

Fail

broken pieces rejected

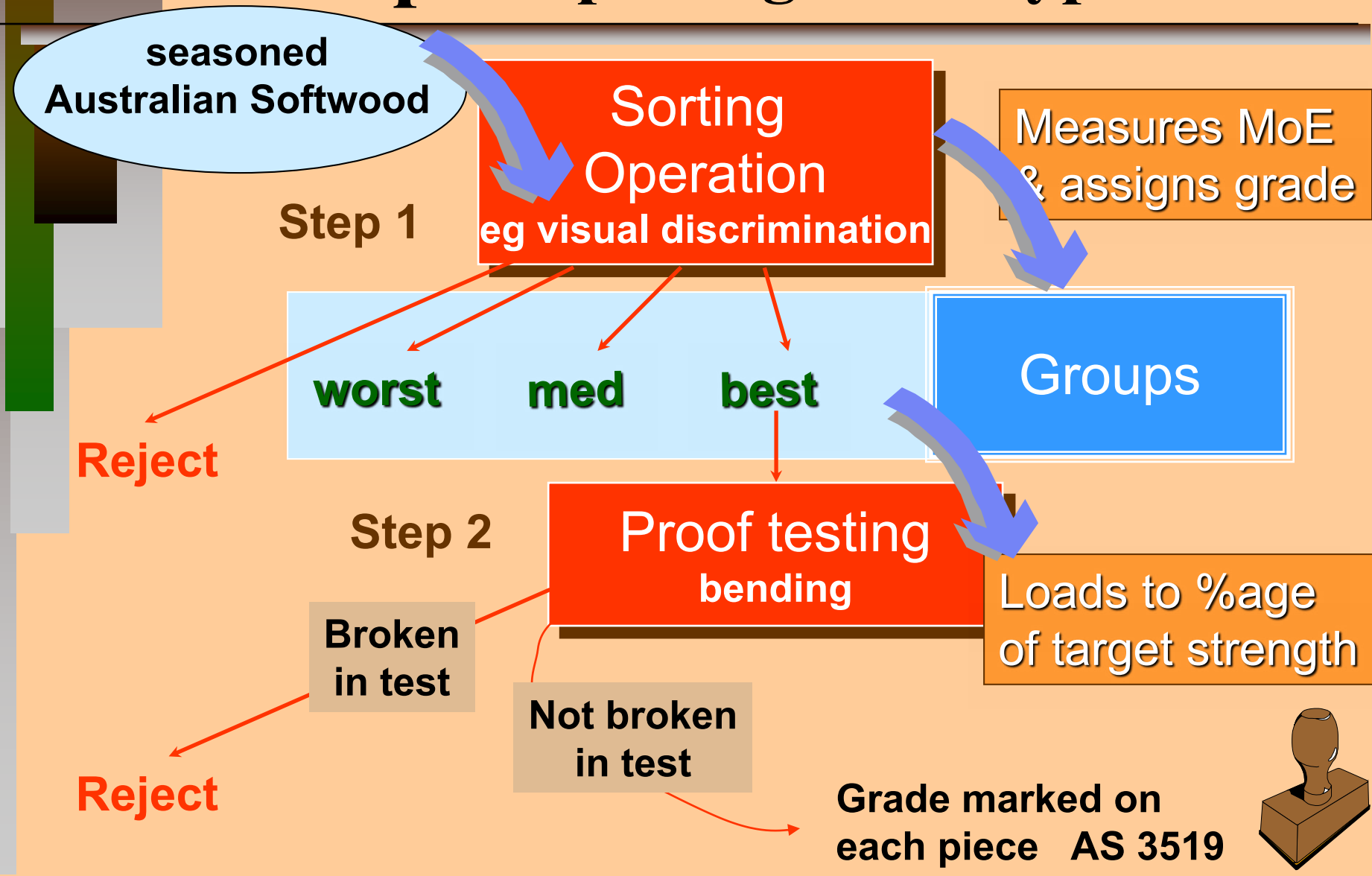
Grade verified

Pieces sold as
Proof graded timber

AS 3519

If too many pieces fail, producer must adjust initial sorting process

Example - proof graded cypress



Grading - the vital link

Producer

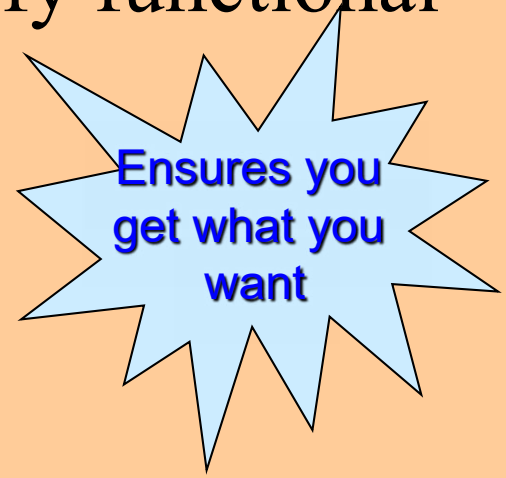
- **sorts** timber into groups with similar characteristics and properties
- **grades** timber - product with similar properties assigned a grade (structural properties give stress grade)
- **stamps** timber to clearly indicate stress grade, species, moisture content, treatment, type of grading

Grading - the vital link

Designers and Builders

- rely on producers to grade timber products accurately and consistently
- **specify** and **use** timber by grade to ensure the product used for a specific purpose has appropriate properties to satisfy functional requirements

Ensures Producers, Designers and Builders are all speaking the same language

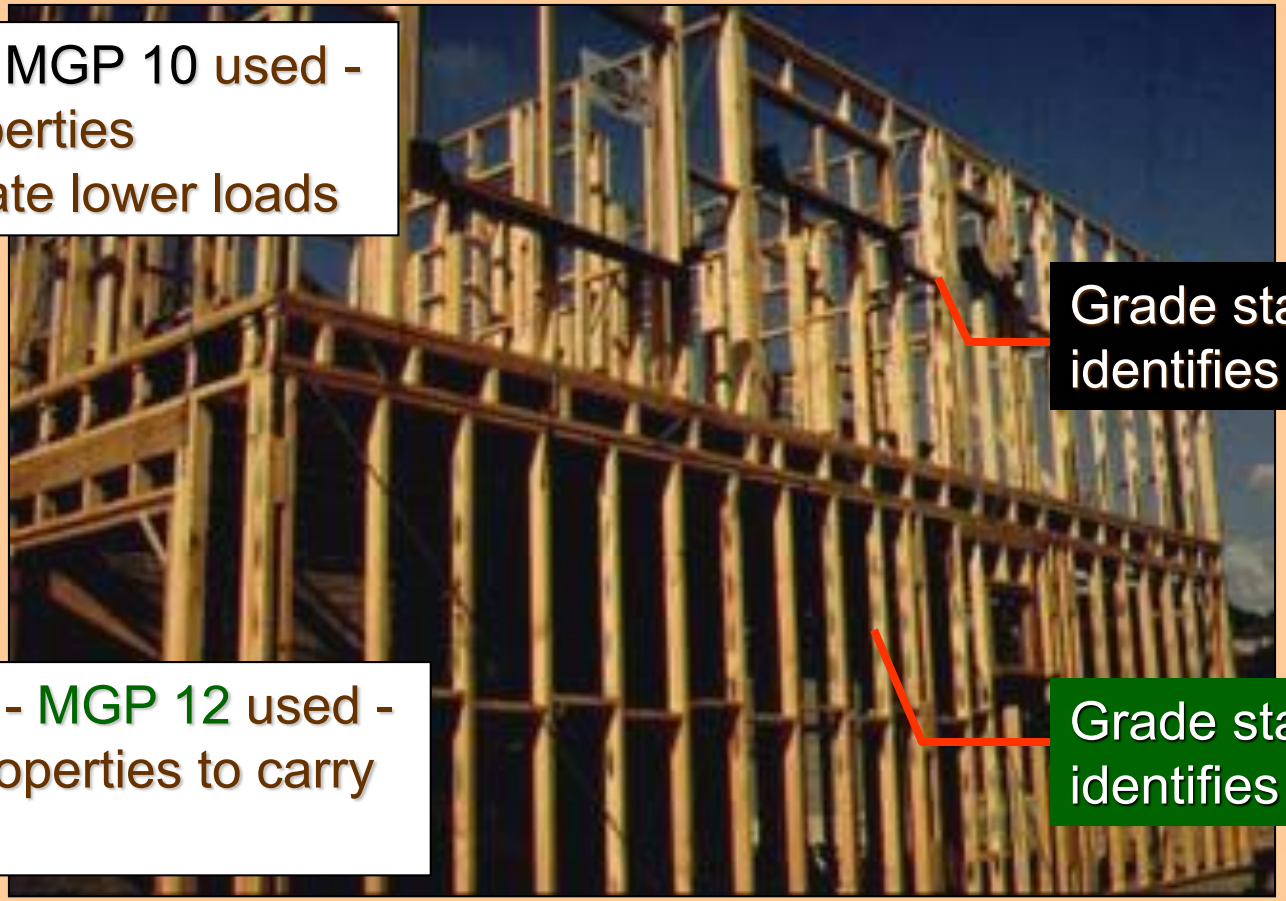


Grading - the vital link

Designer specifies by grade

Builder uses by grade mark

Upper frame - MGP 10 used - adequate properties to accommodate lower loads



Ground frame - MGP 12 used - appropriate properties to carry higher loads

Both designer and builder are confident that timber has desired properties to do the job required