Glue types

These are broken down into:
- Structural
- Non structural
- As well as been classified by the durability
What is a Structural glue?

- A adhesive that can withstand a continuous load without deforming (Moving or creeping)
- A PVAc is not a structural glue because it creeps.

Glue can be also broken down based on requirements like

- The colour of the glue
- It’s resistance to a fire
- It’s resistance to chemical attack
- It’s resistance to biological attack
Common Structural glues

• Approved by AS4364;1996
  – Resorcinol and phenol resorcinol resins
  – Melamine and Melamine urea resins
• Other structural adhesives
  – Aqueous polymeric isocyanate
  – 1 component PUR
  – 2 component PUR

Common non structural glues

• Polyvinyl acetate (PVAc)
• Aqueous polymeric isocyanates
• 1 component polyurethane
• 2 component polyurethane
• Melamine and Melamine urea resin
• Epoxy
• Casein
• Urea resins
GLUE BOND TROUBLE SHOOTING

By Alex Bruce

Introduction:
"If anything can go wrong it will" Murphy's law.
The bonding of one piece of wood to another piece of wood involves many variables. If any one of these variables is out of control a poor adhesive bond may be formed.

The variables that need to be controlled/understood:

- The choice of the correct adhesive type for the final application based on durability, assembly conditions, timber species, etc.

- That the glue mix is made correctly. This requires the correct amounts of resin, hardener, fillers and water to be added and completely mixed.

- The nature of the two pieces of wood being jointed, moisture content, surface condition, timber thickness, timber treatment, wood species, timber temperature.

The way in which the adhesive joint is prepared:

- The glue is used within its pot life, the spread rate is correct, assembly times are correct and ambient conditions are suitable for use with the adhesive.

- The curing of the adhesive joint:

For an adhesive joint to be properly formed it must be cured for a sufficient period of time appropriate for the glue line temperature. During this curing period the glue line must be kept under pressure. The adhesive bond then needs to be conditioned for an appropriate period of time at an appropriate temperature for full adhesive bond strength to develop.

Faults in any one of these factors or a combination of two or more may cause the quality of the adhesive bonded product to be less than satisfactory.
TROUBLE SHOOTING INVOLVES:

Defining the source of the problem

↓

Recommending a solution (corrective action)

↓

Evaluating if the solution has solved the problem

Ensure a problem exists. ie. Not a special cause.

↓

Problem solved
SKILLS REQUIRED TO TROUBLE SHOOT A PROBLEM

• Being able to identify the common bonding failures.

• Determining the causes of bonding problems.

• Having gluing records which detail:
  ▪ Adhesive type used
  ▪ Glue mixing records
  ▪ Information on the pieces of timber being glued.
  ▪ Conditions under which the adhesive joints are prepared.
  ▪ The conditions used to cure and age the adhesive joints.

• An understanding of the customers process, machinery and factory limitations.

TYPES OF JOINT FAILURE

Delamination (falling apart) }  
Gaps in glue lines } Visual test
Thick glue lines }  

Poor durability }  
Low shear strength } Physical test
Joint movement (creep) }  
Low % wood failure }
**COMMON BONDING PROBLEMS:**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Dry out</td>
<td>Lack of glue flow.</td>
</tr>
<tr>
<td>Wash out/over penetration</td>
<td>Excessive glue flow into the wood. This leads to a starved joint.</td>
</tr>
<tr>
<td>Surface inactivation</td>
<td>Wood surface not wettable by adhesive.</td>
</tr>
<tr>
<td>Under cure</td>
<td>Adhesive not sufficiently cross linked to form a bond.</td>
</tr>
<tr>
<td>Thick and thin timber</td>
<td>Timber thickness varying too much.</td>
</tr>
<tr>
<td>Pre cure</td>
<td>Adhesive cured before adhesive joint brought into contact.</td>
</tr>
<tr>
<td>Bleed through</td>
<td>Resin bleeds through a veneer surface leading to discolouration.</td>
</tr>
<tr>
<td>Low pressure</td>
<td>Insufficient pressure to bring the two surfaces into contact.</td>
</tr>
</tbody>
</table>
DELAMINATION (FALL APART)

Identified By:

1. Glue lines opening up

Possible Causes:

1. Hardener not added to adhesive leading to insufficient cure.
2. Wet timber leading to wash out/over penetration of the adhesive into the timber.
3. To lower glue spread leading to dry out of the glue film and no adhesive transfer.
4. Insufficient pressure leading to poor contact of the two pieces of wood.
5. Gluing temperature being too cold leading to insufficient resin cure.
GAPS IN GLUE LINES

Identified By:

• Lack of squeeze out along the glue line.
• Visual gap part way along a glue line.

Possible Causes:

• Insufficient pressure.
• Thickness variation in the laminates being glued.
• Foreign matter being present in the glue line.
• Too much side pressure being used to square up the laminates. This stops full top pressure being applied to the glue line.

THICK GLUE LINES

Identified By:

• This is usually identified by the visual inspection of the glue line.
• This is sometimes seen when a glue joint is broken. A thick glue line usually shatters.

Possible Causes:

• Too long an assembly time (double sided glue spread)
• A high glue spread.
• Thick and thin timber.
• Insufficient glue line pressure.
POOR DURABILITY

Identified By:

- Failure on a hot or cold water delamination test eg. JAS boiling water delamination test eg JAS boiling water delamination test.
- Failure of samples in the market.

Possible Causes:

- Adhesive used in wrong application.
- Adhesive incompletely cured.
- Adhesive film has dried out.
- Catalyst/hardener not fully mixed into adhesive e.g isocyanate catalyst used in API.

LOW SHEAR STRENGTH

Identified By:

Low failing load occurring when a shear block test is carried out.

Possible Causes:

- Adhesive is not fully cured. Failure usually occurs in glue line with good adhesive transfer.
- Defect in the wood structure (usually failure occurs in wood).
- Low density wood (usually failure occurs in wood).
- Insufficient glue spread (dry out, pre-cure). This failure usually occurs in the glue line with poor adhesive transfer.
- A starved glue joint due to wash out (wet timber, etc) or excessive pressure.
JOINT MOVEMENT (CREEP)

Identified By:

Adhesive joints continuously moving when subjected to a continuous load.

Possible Causes:

• The use of a thermoplastic resin eg. a PVAc.

Note:

Adhesives which undergo creep are not satisfactory for structural applications. Commonly used formaldehyde based resins do not suffer from creep.

LOW WOOD FAILURE

Identified By:

Poor adhesive performance in a shear block test. Adhesive joints failure when loaded in the glue line.

Possible Causes:

• Adhesive film dried out.

• Poor adhesive penetration (surface inactivation).

• Excessive adhesive penetration (wash-out).

• No adhesive left in the glue line (starved joint).

• Insufficient adhesive cure.

• Gaps in the glue line (thick and thin laminates).

• Insufficient pressure.

• Insufficient glue spread.
DRY OUT

Identified By:

Little or no glue transferred from spread to unspread timber surface ie. poor adhesive wetting of unspread surface.

- No penetration of glue into timber ie. the resin.
- Spreader roller marks visible on spread surface.
- Little or no squeeze out.

Possible Causes:

- Too low glue spread rate.
- Too low a moisture content.
- Warm timber
- Too long an assembly time relative to ambient temperature and humidity.
- Too high glue viscosity.
- Glue mix past its pot life.

Possible Solutions to Dry Out

- Increase glue spread for warm timber, long assembly times; high ambient temperature and/or low humidity.
- If glue mix is past its pot life consider cooling the glue mix and/or making smaller glue mixes.
WASH OUT/OVER PENETRATION

Identified By:

- Good transfer from spread to unspread piece of timber.
- Little or no adhesive left in the glue line. Mainly fillers. Sometimes excessive adhesive penetration can be seen into the timber.
- Excessive squeeze out.

Possible Causes

- Timber with too higher moisture content was used.
- Too high glue spread.
- Too much water put into the glue mix.
- Too short an open assembly time relative to the ambient conditions of temperature and humidity.
- Too colder timber stock.
- Excessive pressure.

Possible Solution-to-Wash Out/Over Penetration

- Check the timber's moisture content and re-dry any material above range.
- Check the glue spread rate and lower it for low ambient temperatures, high humidity or cold timber stock.
- Consider heating up the gluing and timber storage areas. Check the glue mix is correct.
- Check the correct clamping pressure is being used. (Push all the glue out of the glue line).
SURFACE INACTIVATION

Identified By:

- Distinct area of zero bond surrounded by a good bond.
- In the area of the poor bond the adhesive has not wet the timber surface (poor transfer).
- Very little if any adhesive penetration.

Possible Causes:

- Over drying the timber in a (high temperature) kiln.
- Grease, oil or waxes being deposited on the timbers surface.

Possible Solutions:

- If over dried timber is the problem look at a different kiln schedule.
- Reject any suspect material (3) re-plane to remove the surface and check wettability.
UNDER CURE

Identification:

- Good transfer from spread to unspread piece of timber.
- Plenty of adhesive on both surfaces.
- Failure within the adhesive "A cohesive failure".
- Wet thumb test shows it to be sticky.

Possible Causes:

- The glue line curing temperature was too low. This may be caused by a cold ambient temperature or cold timber.
- No hardener was put into the adhesive mix or the incorrect hardener was used.
- The curing/conditioning time is not long enough.

Solution:

- Check the correct hardener and amount was added.
- Increase the clamping time and conditioning time.
- Apply heat to the assembled adhesive joint or pre-heat the timber.
**THICK AND THIN TIMBER**

Identification:

- No transfer in failed area from spread to unspread. A thicker glue line.
- Sometimes the glue surface is very shiny. No adhesive in the failed area (thin timber).
- Usually a distinct cut-off line - good to bad bond near a joint. Often next to a finger joint/knot.

Causes:

- Poor alignment at finger joints.
- Planar skip.
- Warped timber.
- Low pressure.
- Under-sized timber stock

Possible Solutions:

- Check thickness of incoming timber and reject under-sized materials. Ensure an even amount of material is being planed off each surface. Check the pressure being used is correct.
**Identification:**

- No glue transfer or wetting.
- Plenty of adhesive on spread veneers.
- Spreader roller marks.

**Possible Causes:**

- Too low a glue spread.
- Press closing too slow.
- Hot timber.
- No pressure or insufficient pressure at time when glue cures.

**Possible Solutions:**

- Check glue spread is in range and suitable for timber temperature.
- If timber is too hot increase spread/or reduce assembly time.
- Make few panels - speed up press closing times.
ADHESIVE BLEED THROUGH

Identification:

Usually only seen with thin veneer overlays. A proportion of the adhesives flows through the veneer from the glue line and discolouration occurs.

Possible Causes:

• The glue mix viscosity is too low.

• The glue spread is too high.

• The open assembly time is too short.

• The moisture content of the veneers is too high.

Possible Solutions:

• Increase the viscosity of the glue mix.

• Decrease the glue spread and/or increase the open assembly time.

• Check the moisture content of the veneers and if high re-dry or block stack as appropriate.
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<th>Date</th>
<th>Batch number</th>
<th>Resin</th>
<th>Hardener</th>
<th>Weight Resin</th>
<th>Weight Hardener</th>
<th>Weight additives</th>
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<th>Temperature</th>
<th>Viscosity</th>
<th>Gel time</th>
<th>Glue mix</th>
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Specialty Chemicals

HEXION

Quality control records for glue mixes in finger jointing and lamination plants.
# MILL AUDIT REPORT FOR F/J AND GLULAM

## PLANT:

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## AUDITOR:

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### 1.0 LUMBER/HOWS

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<td>1.7 Wood Temperature</td>
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<td>6.6 Glue lines</td>
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Comments

### 2.0 END JOINTS

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<td>2.5 Register</td>
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<td>3.3 Gel Time Test</td>
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<td>3.4 Spread Rate</td>
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<td>8.2 Calibrations</td>
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<td>4.2 Bolts or Jacks</td>
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<td>8.3 Block or Core</td>
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<td>4.3 Spacing</td>
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<td>Shear</td>
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<td>4.4 Application</td>
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<td>8.4 End Joints</td>
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<td>8.8 Quality Manual</td>
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<td>5.3 Clamp Time</td>
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<td>8.8 Previous Report Review</td>
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<td>5.4 Face Bonding Core Time</td>
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<td>8.9 Required Follow-up Items</td>
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<td>5.5 End Joint Core Time</td>
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Comments

Report reviewed with

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Auditor

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Date