



TECHNICAL NOTE

Formwork Plywood for Class 2 and Class 3 Surface Finishes
to AS 3610

PRODUCT CERTIFIED



JAS-ANZ

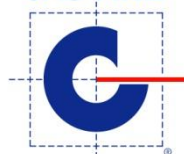


TABLE OF CONTENTS

Contents

Introduction	3
The Formply Product.....	3
Wrap and Twist in Formply	4
How to minimise Distortion (Bow and Twist) in Formply	5
Staining in Formply.....	7
How to identify rust stains	7
Grain Raising or Surface Swelling.....	8
Summary	11
Principles to minimise potential problems with Class 2 and Class 3 off form Surface Finishes.....	11

Introduction

This technical note has been developed in response to market problems and failures relating to the quality of off form finishes being achieved from formwork plywood in the Australian market.

Most issues relate to Class 2 surface finishes as defined in AS 3610, but issues do from time to time occur in Class 3.

This Technical Note discusses some common formwork plywood problems and lists a number of “good practices” required to reliably and consistently achieve a Class 2 or Class 3 surface finish.

The Formply Product

Formply is manufactured from wood veneers glued with synthetic adhesives and overlaid with “phenolic impregnated papers”, also called phenolic surface films. The phenolic surface film is often referred as “plastic face”.

The Australian Standard for formply is AS 6669 “Plywood Formwork”. This standard specifies requirements for:

- Quality of the outer surface i.e. Class 2, Class 3 etc.
- Bond quality and durability
- Thickness, length, width
- Flatness at the time of manufacture
- Stress grading and structural properties
- Quality of the overlay
 - o Water permeability
 - o Bonding
 - o Alkaline resistance

Formply is usually sold on the basis of surface class, stress-grade and bond quality. For example “Class 2 F17 A Bond”.

This indicates that the formwork plywood is intended to provide a Class 2 surface finish, has a stress-grade of F17 and has a Type A bond.

AS 6669 permits three (3) bond types as follows:

- A Bond – Durable for 50 years weather exposure

- B Bond – Durable for 2-5 years weather exposure
- C Bond – Durable for 1-2 years weather exposure

Currently, all formply manufactured in Australia is Type A or Type B bond.

Stress-grades range from F7 to F34. Stress grades F11, F14, F17, F22 and F27 are the most common.

AS 6669 specifies four (4) surface qualities Class 2, Class 3, Class 4 and Class 5. These surface qualities are aligned with AS 3610.

The most common surface classes from AS 6669 for formply manufactured in Australasia are:

- Class 2
- Class 3
- Good 1 side - Class 2 one surface, Class 5 the alternate surface

Normally only one (1) Class 2 pour can be reliably achieved per side due to exposure of the surface, wear and abuse on the jobsite. However, if protected and handled carefully, a number of Class 2 pours can often be achieved.

Note that formply is not recommended for Class 1 surface finishes.

Wrap and Twist in Formply

AS 6669 provides a 30mm flatness limitation for formply sheets. To measure flatness, formply sheets are placed concave down on a flat surface and any bow or twist exceeding 30mm above the flat fails the product Standard.

In addition, sheets must be able to be pushed flat using “palm pressure”, of approximately 15kg.

Formwork plywood supplied to the market with flatness outside the limitations of AS 6669 is non-compliant, should not be used and returned to the manufacturer.

However, experience has shown that most bow, twist and distortion in formwork plywood is the result of weather exposure, not manufacturing problems with the plywood.

The phenolic surface film is not “water proof”; it only slows the uptake and release of moisture. Given sufficient wetter or drying, moisture will penetrate or move through the surface film. The ingress of moisture causes swelling across and along the sheet, which in turn causes bow and twist.

It is the nature of timber and timber products to distort when subjected to changes in moisture content. If the change in moisture content is large, bow and twist is unavoidable, regardless of the quality and grade of the formwork plywood.

The period of October to January each year is particularly savage on exposed formwork decks, especially in locations from Sydney to North Queensland.

The weather conditions usually involve very hot days followed by thunder storms or heavy rain. Such conditions drive moisture into the outer veneers of formwork plywood. It is hardly surprising that most issues with distorted plywood occur at locations from Sydney North in October to January each year.

In most cases, distorted plywood will flatten when the moisture content reduces or stabilises following a few days of dry weather.



PLATE ONE: Bowed Plywood following heavy rain and hot weather

How to minimise Distortion (Bow and Twist) in Formply

1. Do not use any **new** panels showing bow or twist out of the pack. Where distortion exceeds 30mm, these panels fail the product standard. They should not be used and returned to the manufacturer.
2. Prevent/Minimise Exposure to Moisture
Where formply panels that have been supplied flat on site distort, there is only one cause, this is exposure to moisture, or a change in moisture content.

No formply manufacturer provides any warranty where flat plywood sheets distort on a jobsite due to exposure to moisture or weather.

Once installed, it is the responsibility of the formworker to ensure that the formwork plywood is maintained flat to achieve the desired off-form finish.

The following is good practice to minimise distortion due to moisture or weather exposure.

1. Always use form oil. Form oil provides supplementary protection to the phenolic surface film and greatly reduces water permeability and penetration.
2. Remove ponded water as soon as practically possible. Significant distortion takes place where ponded water is allowed to stand for an extended period.
3. Where an extended period of wet weather is expected, or the job site is shutdown (i.e. Christmas shutdown), consideration should be given to protecting the deck from weather by tarping. While this may not be practical for large areas, smaller areas can be protected.
4. Consider the grade of formply. Formply can be manufactured with thicker less permeable phenolic overlays. The standard weight of a phenolic surface film overlay is 60gsm (60 grams grain per meter squared).

Formply can be manufactured with heavier overlays (up to 400gsm) that are less permeable to moisture.

The construction of the formply should also be considered.

Thicker formply with thin face veneers is less prone to distortion. Where adverse weather conditions are expected, using a 19mm or 21mm formply with thin face veneers i.e. 1.0mm or 1.5mm will give superior performance to standard 17mm.

5. Always inspect the deck for distorted sheets immediately before pouring. Any distorted sheets should be nailed or if necessary screwed flat. Do not rely on the weight of the concrete to flatten the sheets.
6. Dealing with cupping
Cupping occurs where the surface veneer (upper most) has lower moisture than the back veneer. The face veneer shrinks and “pulls up” the ends of the sheet causing cupping. Cupping is most common after

heavy rain followed by very hot days. The surface veneer dries and shrinks, but the back veneer remains at higher moisture content.

Cupping can be remedied by hosing the upper surface of the formply sheet to increase the moisture content. This should be done 2-3 hours prior to pouring.

Staining in Formply

The most common stains associated with formply are:

1. Rust staining
2. Tannin staining
3. Pinking - free phenol from the phenolic surface film.

In the writer's experience, most staining is due to rust deposits on the deck at the time of pouring or iron in the aggregate. These stains appear red/brown and are often mistaken for tannin staining.

Tannin staining is the result of extractives from the wood veneer leeching from the formply and discolouring the concrete.

Wood species with high extractive content are much less common than in times past due to weight restrictions on formply sheets. These species have been mostly replaced by plantation pines which have a low extractive content and do not cause tannin staining. In the past decade, tannin staining due to wood species has become very rare.

Pinking is caused by free phenol in the phenolic surface film.

The excess phenol imparts a pink or pale red discolouration to the concrete. AS 6669 requires manufacturers to test for free phenol via the alkaline resistance test. This test is effective in identifying excess free formaldehyde and minimises the potential for formply with excess free formaldehyde to be supplied to the market.

How to identify rust stains

Rust stains can look identical to tannin stains. However, there is a simple method to identify stains associated with rust or oxidised iron. This involves applying "rust converter" to the stain. If the stain fades or disappears, the stain is caused by rust or oxidised iron. If the stain is unaffected by the application of rust converter, the supplier of the formply should be contacted.



PLATE TWO: Rust Staining

Grain Raising or Surface Swelling

Grain raising is caused by moisture penetrating the phenolic surface film and causing swelling of the surface veneer.

The causes of grain raising are:

1. Severe weather exposure
2. Failure to use release agent or form oil
3. Damage to the phenolic surface film i.e. misuse of vibrators, handling damage etc.
4. Faulty phenolic surface film

As mentioned previously, the purpose of the phenolic surface film is to minimise moisture penetration of the surface veneer.

Note that the phenolic surface film is not “water proof” and only slows the penetration of moisture to an extent that grain raising becomes manageable.

The use of form oil and release agent is **critical** to prevent grain raising.

No formply manufacturer guarantees a Class 2 surface finish where a release agent has not been used.

The effectiveness of the phenolic surface film is greatly enhanced by the application of form oil.

An additional significant cause of grain raising is damage to the phenolic surface film through careless use of vibrators, handling on site and especially damage from handling of the steel work (See Plate 5).

A damaged surface layer is an entry point for moisture and rapidly leads to severe grain raising. The use of a release agent immediately prior to pouring is effective in minimising moisture penetration by sealing scratches and damaged areas of the surface film.

However, most grain raising is associated with weather exposure. In severe weather conditions, it is practically impossible to eliminate moisture penetration of the surface layer and some grain raising.

In such weather conditions, tarping of the deck to fully protect against weather exposure is the only practical method to prevent both grain raising and distortion.

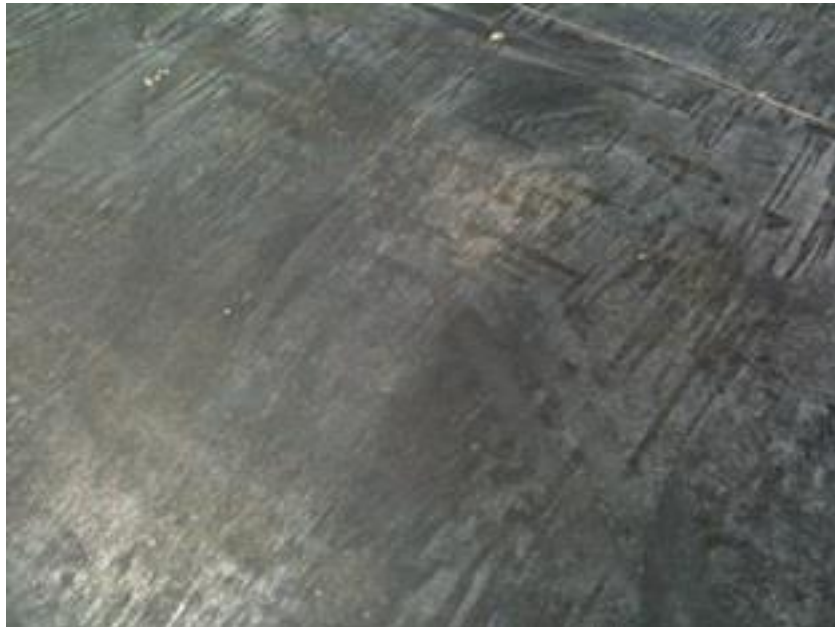


PLATE THREE: Grain Raising of the surface veneer due to weather exposure



PLATE FOUR: Grain Imprint on concrete surface



PLATE 5: Grain Imprint associated with moisture penetration at vibrator Burn

Note: Where grain raising is observed, a release agent has been used and the deck has not been exposed to severe weather, the formply manufacturer should be contacted.

Summary

Principles to minimise potential problems with Class 2 and Class 3 off form Surface Finishes

Principle One: Most issues with off form surface finishes are associated with moisture. Wherever possible protect the formwork from weather. This includes tarping where practical.

Principle Two: The phenolic surface film used on formwork plywood is not impermeable to moisture. To ensure that moisture penetration is minimised, release agent and form oils must be used. Form oils and release agents assist in minimising moisture penetration where the phenolic surface film has been damaged.

Principle Three: Plywood must be supplied to the jobsite flat. Any sheets showing bow or twist greater than 30mm should be returned to the manufacturer.

Principle Four: Where flat plywood has been supplied, the formwork is responsible for any distortion following installation. Decks must be inspected prior to pouring and any distorted sheets likely to cause surface imperfections nailed and screwed flat.

Sheets must be positively fixed. It is not adequate to rely on the weight of the concrete to flatten distorted formwork plywood sheets.

Principle Five: Where severe weather exposure is expected i.e. summer months, consideration should be given to using thicker plywood with a heavier grade of phenolic surface film and a thinner face veneer. This will minimise both distortion and grain raising.

For further advice, please feel free to contact the Engineered Wood Products Association of Australasia directly on +61 7 3250 3700 or www.ewp.asn.au.