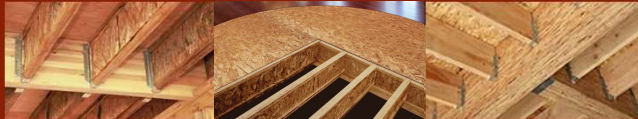


APA

Quality Floors From Start to Finish: Choosing and Preparing Wood Subfloors for Finish Floorings



By Robert Kuserk, PE

1

APA – The Engineered Wood Association is a registered provider of AIA-approved continuing education under Provider Number G023. All registered **AIA CES** Providers must comply with the AIA Standards for Continuing Education Programs. Any questions or concerns about this provider or this learning program may be sent to **AIA CES** (cessupport@aia.org or (800) AIA 3837, Option 3).

This learning program is registered with **AIA CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

AIA continuing education credit has been reviewed and approved by **AIA CES**. Learners must complete the entire learning program to receive continuing education credit. AIA continuing education Learning Units earned upon completion of this course will be reported to **AIA CES** for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

**AIA
Continuing
Education
Provider**

APA

2

2

Webinar Attendee Survey




Robert Kuserk, PE

APA

3

3

Training Objectives

Objectives

- Understand APA products and how they relate to the installation of various finish flooring systems
- Understand building tolerances for the different finish flooring systems
- Learn how moisture affects different finish flooring systems
- Understand the importance of conditioning materials when installing various finish flooring systems

APA

4

4

Agenda

- Terms and Definitions
- Moisture Effects on Wood Structural Panels
 - Drying and shrinkage in floor systems
 - Measurement of moisture content
- Preparation of Subfloor for Finish Flooring
 - Framing details to avoid
 - Fastener performance
 - Acclimation
- Tile Assemblies

APA

5

5

What's the Problem?



APA

6

6

What's the Problem?

Cracked Tile Telegraphing Gaps Cupping

APA

7

Definitions

Plywood v. OSB
Veneers v. Strands
PS-1 Prescriptive or PS-2 Performance Standard
Both OSB and Plywood
Alternating Layer Direction
Moisture-Resistant Adhesive
Wet and Dry Structural Performance Tests
Available in Exposure 1 and Exterior Bond Classifications

8

8

Definitions – Under the floor

- Subfloor – Rated Sheathing or Sturd-I-Floor
- Underlayment
- Sturd-I-Floor

FIGURE 1
APA PLYWOOD UNDERLAYMENT
 Provide 1/32" space between underlayment butt joints
 APA Plywood Underlayment
 Stagger end joints in underlayment panels
 APA Rated Sheathing, APA Rated Sturd-I-Floor, or board subflooring


APA

9

9

Definitions – Flooring Types

- **Wood Flooring**
 - Solid Wood Flooring
 - Engineered Wood
 - Composite Engineered Wood



10

10

Definitions – Flooring Types

- **Vinyl Flooring**
 - Standard, Sheet or Solid Vinyl Tile
 - Luxury Vinyl Plank (LVP)
 - Luxury Vinyl Tile (LVT)



11

11

Definitions – Flooring Types

- **Tile**
 - Ceramic
 - Stone
- **Carpet and Pad**

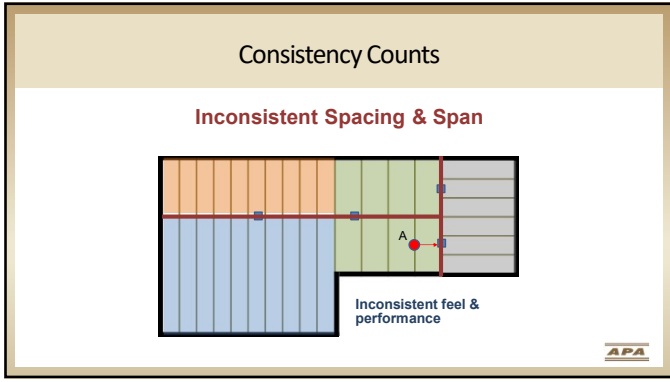


12

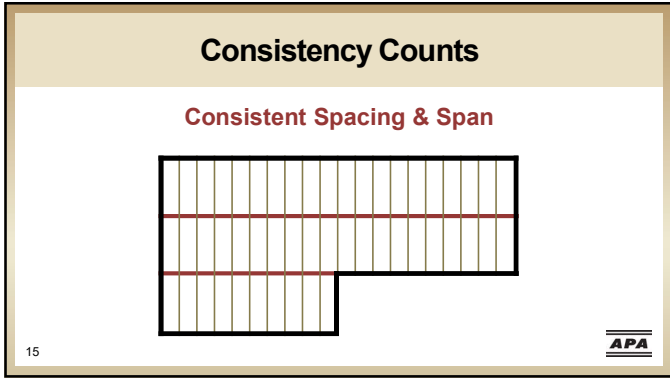
12



13



14



15

Panel Spacing

EXAMPLES OF TONGUE-AND-GROOVE (T&G) JOINTS*

1/8" space

Approximately 1/16" space

In Glued Floor Systems, use adhesives conforming with ASTM D3498 or AFG-01.

* T&G profiles and installation recommendations can vary among APA members. Check with individual manufacturer for specific recommendations – otherwise, APA recommends 1/8" spacing at time of installation for all panel edges.

19

19

Wood Moves

- Panels spaced 1/8 inch at installation

1/8" min.

1/2" Bearing min.

20

20

Minimum Sheathing Fastening Recommendation

- **Minimum Nailing**
- Panel ends - 6" on center
- Intermediate - 12" on center
- Edge distance - 3/8 inch

Sheathing
Framing lumber
Slant nail

Panel ends 6" o.c. min.


Intermediate Supports 12" o.c. min.

21

21

How flat is your floor?

- **North American Laminate Flooring Association (NALFA)**
 - The subfloor surface must be flat. Flat means no low spots or ridges in excess of allowances in the manufacturer's instructions.
 - 3/8" on a 6' radius
- **Manufacturer Recommendations**
 - 1/32" in 1' and 3/16" in 10'
 - 1/8" in 6'
 - 1/16" in 1' or 3/16" in 10'

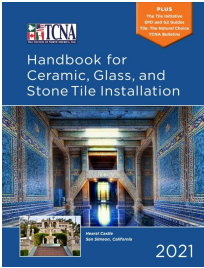


APA

25

How flat is your floor?

- **Tile Council of North America (TCNA)**
 - 1/4 inch in 10 feet for tiles with edges shorter than 15 inches
 - 1/8 inch in 10 feet for tiles with at least one edge greater than 15 inches



APA

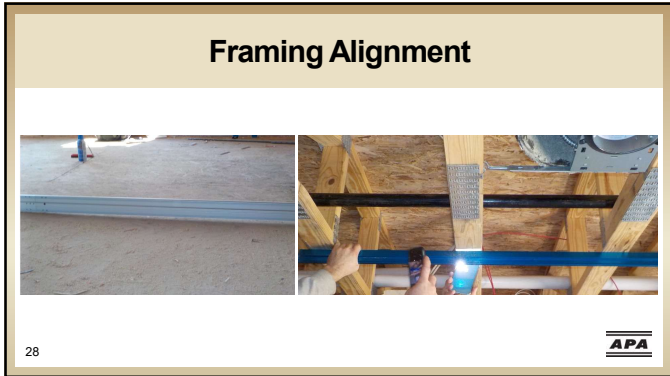
26

Panel Ridging

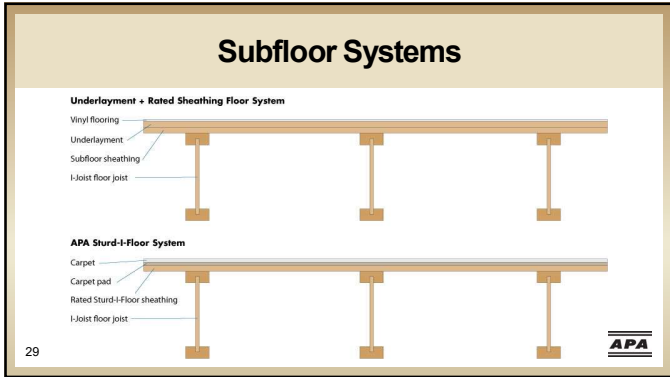


APA

27



28



29

Underlayment

TABLE 2
TYPICAL PANEL FLOOR SPECIFICATIONS BASED ON FINISH FLOOR INSTALLATIONS
(All must meet minimum structural requirements⁽¹⁾ of IBC or IRC)

Finish Floor	Subfloor Construction ⁽²⁾	Example Subfloor Specification ⁽²⁾	Typical Underlayment Panel
Single Layer Construction			
Carpet and Pad	APA Rated Sturd-I-Floor ⁽³⁾ with T&G edges	APA Sturd-I-Floor 24 oc Exposure 1 T&G (for joists spaced 24 inches o.c. or less)	NA
	Double Layer Construction		
	APA Rated Sturd-I-Floor or APA Rated Sheathing	APA Rated Sheathing 48/24 Exposure 1 (for joists spaced 24 inches o.c. or less)	Any Table 1 panel

30 **APA**

30

Underlayment

TABLE 2
TYPICAL PANEL FLOOR SPECIFICATIONS BASED ON FINISH FLOOR INSTALLATIONS
(All must meet minimum structural requirements⁽¹⁾ of IBC or IRC)

Finish Floor	Subfloor Construction ⁽²⁾	Example Subfloor Specification ⁽²⁾	Typical Underlayment Panel
Hardwood Flooring	APA Rated Sturd-I-Floor or APA Rated Sheathing	APA Rated Sturd-I-Floor 24 oc Exposure 1 T&G or APA Rated Sheathing 48/24 Exposure 1 (for joists spaced 19.2 inches o.c. or less) ⁽³⁾	(Optional)
Vinyl (or other thin resilient floor covering) or Glue-down Carpet	APA Rated Sturd-I-Floor ⁽⁴⁾ or APA Rated Sheathing	APA Rated Sturd-I-Floor 24 oc Exposure 1 T&G or APA Rated Sheathing 48/24 Exposure 1 (for joists spaced 24 inches o.c. or less)	Any Table 1 panel ⁽⁵⁾

31



31

Underlayment

TABLE 2
TYPICAL PANEL FLOOR SPECIFICATIONS BASED ON FINISH FLOOR INSTALLATIONS
(All must meet minimum structural requirements⁽¹⁾ of IBC or IRC)

Finish Floor	Subfloor Construction ⁽²⁾	Example Subfloor Specification ⁽²⁾	Typical Underlayment Panel
Ceramic Tile ⁽³⁾	Minimum Performance Category 19/32 APA Rated Sturd-I-Floor Exposure 1 or APA Rated Sheathing Exposure 1	Minimum Performance Category 19/32 APA Rated Sturd-I-Floor Exposure 1 or APA Rated Sheathing Exposure 1 (for joists spaced 16 inches o.c. or less) ⁽⁴⁾	Minimum Performance Category 19/32 APA Rated Sturd-I-Floor Exposure 1 or APA Rated Sheathing Exposure 1 ⁽⁵⁾

32



32

Underlayment

TABLE 1
RECOMMENDED PLYWOOD GRADES FOR UNDERLAYMENT⁽¹⁾ APPLICATIONS

Grade ⁽¹⁾⁽²⁾	Exposure Durability Classification	Look for These Special Notations in Panel Trademarks ⁽³⁾	Typical Trademarks	Grade ⁽¹⁾⁽²⁾	Exposure Durability Classification	Look for These Special Notations in Panel Trademarks ⁽³⁾	Typical Trademarks
APA Underlayment ⁽⁴⁾	Exposure 1 or Exterior	Sanded Face ⁽⁵⁾		APA A-C Underlayment APA B-C Underlayment	Exterior		
APA C-C Plugged APA Underlayment C-C Plugged	Exterior	Sanded Face ⁽⁵⁾		APA Rated Sturd-I-Floor ⁽⁶⁾	Exposure 1 or Exterior	Sanded Face ⁽⁵⁾	
APA A-C APA B-C APA A-D APA B-D	Exterior Exterior Exposure 1 Exposure 1	Plugged Crossbands Under Face ⁽⁷⁾		APA Marine Grade	Exterior	(MARINE-A-A, EXTER-C, EXTER-B, -APA-100-19, 15B-15B, 15C)	

33




33

Underlayment?

TABLE 3
APA UNDERLAYMENT FASTENING RECOMMENDATIONS


Application	Minimum Performance Category	Fastener Size and Type ⁽¹⁾	Maximum Fastener Spacing (in.) ⁽²⁾	
			Panel Edges ⁽³⁾	Intermediate
Over smooth subfloor	1/4	3d x 1-1/4-in. ring- or screw-shank nails min. 12-1/2 gage (0.099 in.) shank dia. ⁽⁴⁾	3	6 each way
Over lumber subfloor or uneven surfaces	11/32	3d x 1-1/4-in. ring- or screw-shank nails min. 12-1/2 gage (0.099 in.) shank dia. ⁽⁴⁾	6	8 each way

(1) See APA Engineered Wood Construction Guide, Form E30, for nail dimensions.
 (2) Fasteners for 5-ply plywood underlayment panels and for panels with a Performance Category greater than 1/2 may be spaced 6 inches on center at edges and 12 inches each way intermediate.
 (3) Fasten panels 3/8" from panel edges.
 (4) Use 4d x 1-1/2" ring- or screw-shank nails, minimum 12-1/2 gage (0.099") shank diameter, for underlayment panels with a Performance Category of 19/32 to 3/4.

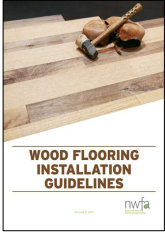
34 


34

Underlayment?



Joist Spacing	Minimum Subfloor Performance Category	Minimum Span Rating
≤ 16"	19/32 plywood or 23/32 OSB	40/20 or 20 oc
> 16" and ≤ 19.2"	23/32 plywood or OSB	48/24 or 24 oc
> 19.2" and ≤ 24"	7/8 plywood or OSB	60/32 or 32 oc



35 

35

Luxury Vinyl Underlayment

- **Wood Subfloor**
 - Must meet local building codes, be structurally sound and deflection free
 - Repair squeaks
 - Sand or plane high spots
 - Fill low spots
 - Manufacturers' recommendations always supersede the recommendations in this publication



36 

36

Luxury Vinyl Underlayment


- **Manufacturer “A” Recommendations**
 - If the surface of the wood subfloor is not smooth, a 1/4” underlayment panel should be installed over the subfloor. Any panels selected as an underlayment must meet the following criteria.
 - Be dimensionally stable
 - Have a smooth, full-sanded face so the graining or texturing will not show through
 - Be resistant to both static and impact indentation
 - Be free of any surface components that may cause staining such as plastic fillers, marking inks, sealers, etc.



37

Luxury Vinyl Underlayment

- **Manufacturer “B” Recommendations**
 - **Acceptable Subfloor Types:**
 - OSB – At least 3/4” thick, PS-2-92 rated or PS-1-95 rated.
 - Underlayment Grade Particleboard (Minimum 40 lb. Density) – Glue down/floating floors only
 - CDX Plywood – At least 5/8” thick for joist spacing up to 16” on center, minimum 3/4” thick for joist spacing greater than 16” on center (19.2” maximum). Plywood subfloors installed over concrete must be installed in accordance with the guidelines set forth by the National Wood Flooring Association.



38

Luxury Vinyl Underlayment

- **Manufacturer “C” Recommendations**
 - **C. Wood Subfloors**
 - Resilient floors are recommended on suspended (or raised with a minimum 18” well-ventilated air space below) subfloors with a 1/4” underlayment
 - Loading requirements for subfloors are normally set by various building codes
 - Note: When installing directly over wood subfloors, the moisture content of the subfloor should be less than 13%.



39

Luxury Vinyl Underlayment

- **Manufacturer “C” Recommendations (Cont'd)**
 - **Wood Subfloors**
 - **1. APA Rated STURD-I-Floor**
 - Panel can be manufactured as conventional plywood, as a composite or as oriented strand board.
 - Single-layer wood subfloor increases the potential for staining from panel components, coated nails, construction adhesives, spills, overspray and show-through from the texture and mechanical or water damage when resilient floors are installed directly to single-layer STURD-I-Floor.

40

40

Luxury Vinyl Underlayment

- **Manufacturer “C” Recommendations (Cont'd)**
 - **Wood or Board-Type Underlayment**
 - **Plywood**
 - APA trademarked plywood or equivalent agency certified plywood rated as suitable underlayment for resilient floor coverings such as tile or sheet vinyl. It should have an Exterior or Exposure 1 exposure durability classification and a fully sanded face. APA plywood underlayment grades recommended for areas to be covered with resilient non-textile flooring are A-C, B-C, C-C Plugged, or C-C Plugged EXT when marked “sanded face.”

41

41

Ceramic Tile Underlayment

TECHNICAL TOPICS
Ceramic Tile Over Wood Structural Panel Floors

APA is a registered trademark of APA Engineered Wood Association. All other trademarks are the property of their respective owners. © 2018 APA Engineered Wood Association. All rights reserved.


Table 9. Assemblies Listed in TCNA's Handbook for Ceramic Tile Installation

TCNA No.	Service Classification**	Max. Joint Spacing (in. m.c.)	Underlayment Layer	Subfloor Layer	Comment
F141	Light Commercial	16	Marble bed (3-1/2" minimum, 2" maximum)	19/32" Exposure 1 T&G plywood	---
F142	Residential	16	Exposure 1 plywood	19/32" Exposure 1 T&G plywood	---
F143	Residential or Light Commercial	16	Light commercial Exposure 1 plywood	19/32" Exposure 1 T&G plywood	15/32" plywood underlayment layer gives "Residential" performance
F144	Residential or Light Commercial	16	Commercial backer units or fiber cement underlayment	23/32" Exposure 1 T&G plywood	19/32" plywood subfloor gives "Residential" performance
F145	Light Commercial	16	3/8" Maximum to 1 1/2" minimum mortar bed	23/32" Exposure 1 T&G plywood	Change membrane plus metal lath
F146	Light Commercial	16	Coned glass-mat backer board	19/32" Exposure 1 T&G plywood	---
F147	Residential	24"	Exposure 1 plywood plus uncoupling membrane	23/32" Exposure 1 T&G plywood	4" x 4" or larger tile only


42

42

Source of Moisture in Subfloors



Direct Wetting

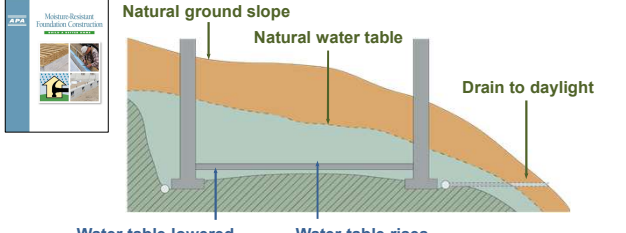


Ambient

43 **APA**

43

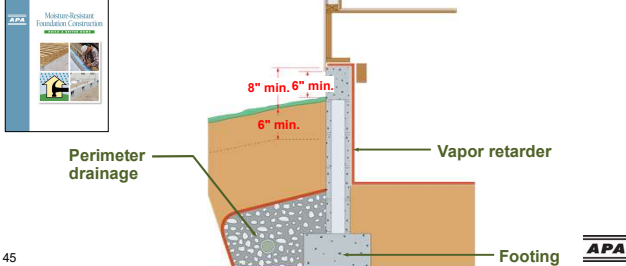
Water Table Slope



44 **APA**

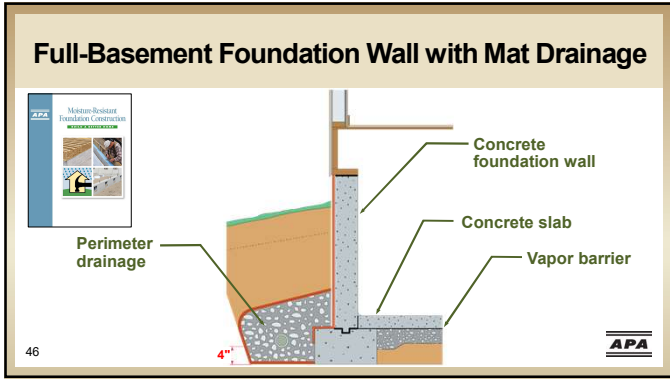
44

Concrete Masonry Crawl Space Foundation

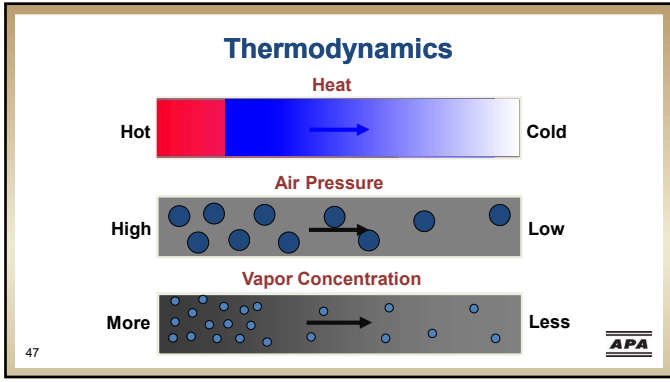


45 **APA**

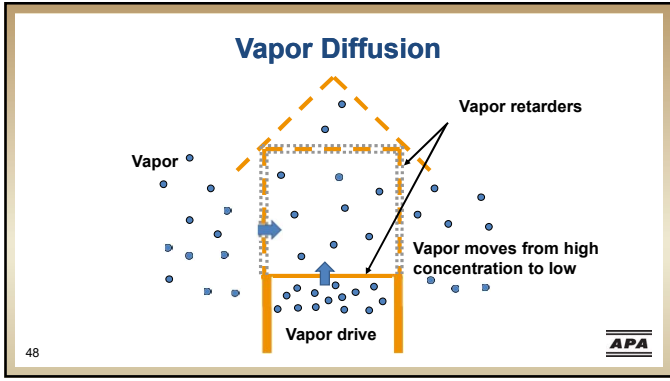
45



46



47



48

Plywood or OSB Subfloor

CAUTION

Finish Flooring Problem Scenario

- Installation

MC = 2-6%

Subfloor

49

APA

The diagram shows a cross-section of a subfloor. A horizontal line indicates the moisture content level, which is labeled as MC = 2-6%. The subfloor is represented by a tan-colored rectangular block. The word 'Subfloor' is written below the block with an arrow pointing to it. The slide includes a yellow 'CAUTION' icon with a triangle and exclamation mark, and the text 'Finish Flooring Problem Scenario' in red. The APA logo is in the bottom right corner.

49

Plywood or OSB Subfloor

CAUTION

Finish Flooring Problem Scenario

- After heavy rain

MC = 30%

Subfloor expands

50

APA

The diagram shows a cross-section of a subfloor. A horizontal line indicates the moisture content level, which is labeled as MC = 30%. The subfloor is represented by a tan-colored rectangular block. The text 'Subfloor expands' is written below the block with a double-headed vertical arrow indicating the expansion. The slide includes a yellow 'CAUTION' icon with a triangle and exclamation mark, and the text 'Finish Flooring Problem Scenario' in red. The APA logo is in the bottom right corner.

50

Plywood or OSB Subfloor

CAUTION

Finish Flooring Problem Scenario

- Dried-in
- HVAC inactive

MC = 25%

51

APA

The diagram shows a cross-section of a subfloor. A horizontal line indicates the moisture content level, which is labeled as MC = 25%. The subfloor is represented by a tan-colored rectangular block. The slide includes a yellow 'CAUTION' icon with a triangle and exclamation mark, and the text 'Finish Flooring Problem Scenario' in red. The APA logo is in the bottom right corner.

51

Finished Floor Installed

CAUTION

- Wood flooring attached
- HVAC still inactive

Finish Flooring Problem Scenario

MCv = 6–14%

MC = 20%–25%

52

52

Finished Floor In-place

CAUTION

Finish Flooring Problem Scenario

Cupping

Compression

MC = 16%

MC = 18%

Fasteners

- Pulled up by flooring
- Pushed up by subfloor

Subfloor shrinks

53

53

Space Conditioned

CAUTION

- HVAC activated

Finish Flooring Problem Scenario

Reduced cupping

Joints begin to open

MC = 14%

MC = 16%

Fasteners loosen

- Pulled up by flooring
- Pushed up by subfloor – nail pops

Subfloor still shrinking

54

54

Flooring Sanded and Finished

CAUTION

Finish Flooring Problem Scenario

The diagram shows a cross-section of a wood floor with a subfloor. The top layer is labeled 'Floor—Cup or crown?' and has 'MC = 12%' written below it. The subfloor is also labeled 'MC = 12%'. A joint between two floorboards is shown with a gap, labeled 'Joints open'. Red arrows point outwards from the joint, indicating expansion. Below the diagram, it says 'Fastener noises' with sub-points: '- Flooring fasteners' and '- Subfloor fasteners'. The APA logo is in the bottom right corner.

55

Shrinkage of Flooring

The left photo shows a wooden floor with a measuring tape placed across it. The right photo shows a close-up of a gap between two floorboards. The APA logo is in the bottom right corner.

56

Expansion of Flooring

The left photo shows a room with a large gap between floorboards. The right photo shows a hand holding a wooden board. The APA logo is in the bottom right corner.

57

Shrinkage of Flooring

58 **APA**

58

Framing Shrinkage

59 **APA**

59

Floor Shrinkage

60 **APA**

60

Drying of Subfloor



Fans**Dehumidification**

64 

64


Drying of Subfloor




65 

65

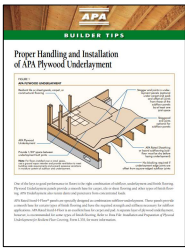
Drying of Subfloor



66 

66

Acclimatization



67

67

Moisture

- **Are we ready to install?**
- Moisture can affect a finished floor
- Dry
- Similar Moisture Content
- What is dry?
- When is it dry enough?
- What are the recommendations?



68

68

Moisture

- **Solid Wood Flooring—NWFA**
 - MC of the subfloor should align with the required conditions in the facility
 - MC of the wood subfloor no more than 4% greater than the MC of solid strip, < 3" widths, and 2% ≥ 3" widths.
- **Manufacturer Specification**
 - Wood subflooring materials must not exceed 12% moisture content. 4% for strips < 3" and 2% for strips ≥ 3".
- **NALFA**
 - Determine what the expected seasonal changes of moisture content are for your geographical location.




69

69

Moisture

- Most areas of the US average 8% EMC, ranging from 6–10% EMC
- Dry Southwest average—6% EMC, ranging from 4–9% EMC
- Damp, Warm, Coast average 11% EMC, ranging from 8–13%



NALFA

6% AVERAGE MOISTURE CONTENT

8% AVERAGE MOISTURE CONTENT

11% AVERAGE MOISTURE CONTENT


APA

70

70

Moisture

- **Hardwood floor is delivered dry or less than 10% MC**
- Upon delivery, take MC on 40 boards up to 1,000 sq. ft. and 4 readings per 100 sq. ft. after the initial readings.
- Check MC of the subfloor at 20 locations for the first 1000 sq. ft. and 4 readings per 100 sq. ft. after the initial readings.



WOOD FLOORING INSTALLATION GUIDELINES

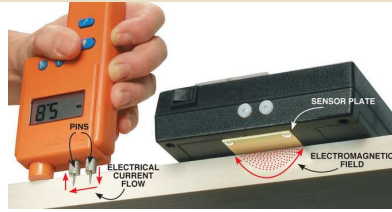
nwfa

www.nwfa.org

71

71

Measuring Moisture



Resistance type meters

Capacitance type meters

APA

72

72

Final Steps


- Structure is fully enclosed
- HVAC systems are operational
- Upon delivery of flooring
 - Initial flooring moisture readings
 - Initial subfloor moisture readings
- Ensure moisture contents meet recommendations prior to installation

73 

73

Recap

- Terms and Definitions
- Moisture Effects on Wood Structural Panels
 - Drying and shrinkage in floor systems
 - Measurement of moisture content
- Preparation of Subfloor for Finish Flooring
 - Framing details to avoid
 - Fastener performance
 - Acclimatization
- Tile Assemblies

74 

74

Recap

Main Takeaways

- Floor flatness
- Moisture
- Follow the details, use the right products

75 

75



76



77

APA Update Newsletter
(www.apawood.org)

November 2020

APAUPDATE
PUBLICATIONS, VIDEOS, CAD DETAILS AND MORE

Note: Due to Covid-19 control measures, we are unable to fulfil orders of printed publications at this time. These publications are available as downloadable PDFs.

EDUCATION

Earn up to 30 CEUs with APA
Are you caught up on your continuing education for 2020? APA has many opportunities for design professionals to earn continuing education credits through AIA, AIBD, ICC or RESNET. Earn up to 30 units with our offerings:

On-Demand Webinars
20 recorded webinars offer credits. Topics include framing for residential and non-residential construction, applications of engineered wood products, wall bracing, disaster-resistant design, sustainability of wood and more.

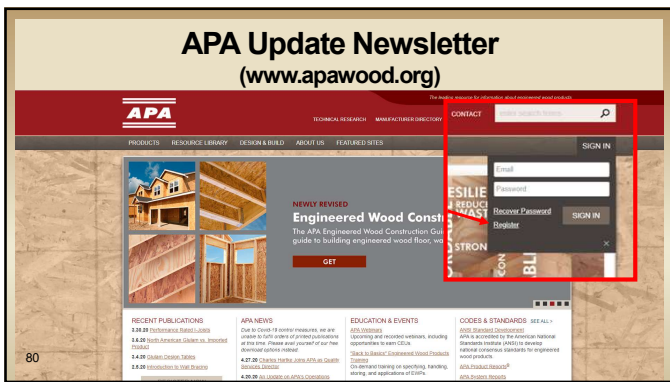
WOODSE+
Wood University
Two courses, Engineered Wood Basics and Design of Wood Connections, offer up to nine units through AIA or AIBD.
\$20+

 The slide features the APA logo in the top right and bottom right corners. It also includes an image of a person's hands on a laptop keyboard, with the laptop screen displaying a website interface.

78



79



80



81



82