Concrete Floors – Coat, Cover, or Polish?

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Webinar Learning Objectives

• Identify various types of coatings and coverings used on floors
• Recognize the pros, cons, and installation costs of coatings, coverings, and polishing
• Identify floor inspections that are useful when determining whether coatings, coverings or polishing are appropriate
Introduction

• Concrete is most common commercial building construction material
• The decision to specify a concrete floor is easy
• The decision on whether to coat, cover, or polish it are much more complicated
• Floor finishing selection criteria:
  - Suitable for the service environment
  - Suitable for the existing condition of the concrete (texture, moisture)
  - Meets maintenance expectations
  - Depicts company’s brand image
  - Within budget
Floor Finish Options

- Coatings
- Coverings
- Concrete Polishing
## Floor Coatings

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical resistant</td>
<td>Some systems not tolerant to hydrostatic pressure</td>
</tr>
<tr>
<td>Controls contaminants</td>
<td>Not slip resistant without additives</td>
</tr>
<tr>
<td>Seamless, fills irregularities in concrete</td>
<td>Dependent on proper surface preparation</td>
</tr>
<tr>
<td>Endless color options, reflective, improves lighting</td>
<td>Many require skilled installation - Performance issues if improperly applied</td>
</tr>
<tr>
<td>Static dissipating options</td>
<td>Requires reapplication</td>
</tr>
</tbody>
</table>
Floor Coatings (cont'd)

- Floor Coating Selection Factors
  - Aesthetics
  - Bond strength
  - Abrasion resistance
  - Impact resistance
  - Chemical resistance
  - Non-skid properties
  - Static dissipating properties
  - Reflectivity
  - Weatherability
  - Cleanability
  - Secondary containment
  - USDA/FDA compliance
  - Microbial control
  - Maintenance requirements
Floor Coatings (cont'd)

• Floor Coating Types
  - Thin Film Coatings (sealers, stains, dyes, single-component acrylics, epoxies)
  - Thick Film Coatings hi-build epoxies, polyurethane, polyurea, hybrids
  - Slurry systems (cementitious and resin)
  - Broadcast Systems (quartz aggregate, color chip, metallic)
  - Mortar systems (toppings, overlays)
Floor Coatings (cont'd)

- Floor Coating Costs – installed prices vary by coating type, thickness, number of coats, but general ranges are:
  - Thin film systems $1.00-$3.50/sq.ft.
  - Thick film systems $3.50-$7.00/sq. ft.
  - Mortar systems up to $20.00/sq.ft.

- Service life – average typically 5 to 10 years depending on coating type and use
Floor Covering Types
- Vinyl (VCT, LVT, Sheet)
- Natural stone
- Terrazzo
- Ceramic tile
- Porcelain tile
Floor Coverings (cont'd)

- Floor Covering Types
  - Carpet
Floor Coverings (cont'd)

- Floor Covering Types
  - Hardwood/laminate

- Some coverings are attached with adhesives or grout, or snap together to form a “floating floor.”
## Floor Coverings (cont'd)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpet</td>
<td>Quiet, sound deadening</td>
<td>Soils and stains in high traffic areas</td>
</tr>
<tr>
<td></td>
<td>Comfort</td>
<td>Unsterile surface</td>
</tr>
<tr>
<td></td>
<td>Non-slip surface</td>
<td>Short life</td>
</tr>
<tr>
<td>Hardwood/Laminates</td>
<td>Natural, warm look</td>
<td>Vulnerable to moisture</td>
</tr>
<tr>
<td></td>
<td>Can be refinished</td>
<td>Gaps and warping due to movement</td>
</tr>
<tr>
<td></td>
<td>Long-lasting</td>
<td>Some finishes wear quickly and unevenly</td>
</tr>
<tr>
<td>Vinyl (LVT)</td>
<td>Easy and fast installation</td>
<td>High Maintenance</td>
</tr>
<tr>
<td></td>
<td>Light reflective</td>
<td>Scratches and gouges with heavy traffic</td>
</tr>
<tr>
<td>Vinyl (VCT)</td>
<td>Low cost</td>
<td>Not slip resistant if improperly maintained</td>
</tr>
<tr>
<td>Ceramic or Porcelain tile</td>
<td>Water and stain resistant</td>
<td>Grout lines can be hard to clean</td>
</tr>
<tr>
<td></td>
<td>Durable, long life</td>
<td>May chip or break with point loads</td>
</tr>
<tr>
<td></td>
<td>Porcelain has through-body color</td>
<td>Glossy tiles can be slippery when wet</td>
</tr>
<tr>
<td>Stone</td>
<td>Natural look</td>
<td>High initial cost</td>
</tr>
<tr>
<td></td>
<td>Long life</td>
<td>Difficult to repair and color match</td>
</tr>
<tr>
<td></td>
<td>Environmentally friendly</td>
<td>Certain varieties absorb stains and dirt</td>
</tr>
<tr>
<td>Terrazzo</td>
<td>Non-porous seamless floor</td>
<td>Difficult to install and maintain</td>
</tr>
<tr>
<td></td>
<td>Withstands high traffic</td>
<td>High initial cost</td>
</tr>
<tr>
<td></td>
<td>Variety of colors and designs</td>
<td>Can be slippery when wet</td>
</tr>
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</table>
## Floor Coverings (cont'd)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COST (INSTALLED) sq. ft.</th>
<th>AVERAGE SERVICE LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpet</td>
<td>$1.50 - $3.00</td>
<td>3-10 years</td>
</tr>
<tr>
<td>Hardwood/ Laminates</td>
<td>$4.00 - $18.00*</td>
<td>Varies widely 3-50 years</td>
</tr>
<tr>
<td>Vinyl (LVT)</td>
<td>$5.00 - $6.50**</td>
<td>10-15 years</td>
</tr>
<tr>
<td>Vinyl (VCT)</td>
<td>$1.75 - $3.75**</td>
<td>10-15 years</td>
</tr>
<tr>
<td>Ceramic or Porcelain tile</td>
<td>$4.00 - $12.00*</td>
<td>20 years</td>
</tr>
<tr>
<td>Stone</td>
<td>$8.00 - $50.00**</td>
<td>20-40 years</td>
</tr>
<tr>
<td>Terrazzo</td>
<td>$13.00 - $23.00***</td>
<td>20-40 years</td>
</tr>
</tbody>
</table>

*www.wfca.org
**www.armstrong.com/common/c2002/content/files/69544.pdf
***www.trend-group.com
Polished Concrete

- Mechanical and chemical process
- Concrete surface is polished through a multi-stage grinding process, or
- A topping can be applied to concrete that is subsequently polished
Polished Concrete (cont'd)

• Abrasive Polished Concrete
Polished Concrete (cont'd)

- Burnished Concrete
Polished Concrete (cont'd)

- Hybrid
Polished Concrete (cont'd)

• Dye can be added during the polishing process
Polished Concrete (cont'd)

- CPPA (Concrete Polishing Association of America) classes are based on aggregate exposed during polishing.

Polished Concrete (cont'd)

- CPPA gloss levels

  Level 1 - Flat (Ground) Diffused reflection – < 100 Grit
  Level 2 - Satin (Honed) Matte appearance – 100-400 Grit
  Level 3 - Semi-Polished - High Shine – 800+ Grit
  Level 4 - Highly-Polished – Glossy, Mirror-like Finish – 1500-3000 Grit
### Polished Concrete (cont'd)

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<th>PROS</th>
<th>CONS</th>
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<tr>
<td>Low cost, both installed and life cycle</td>
<td>Vulnerable to spills, stains and etching from acidic products (e.g. pickle juice)</td>
</tr>
<tr>
<td>Environmentally friendly</td>
<td>Must be properly maintained</td>
</tr>
<tr>
<td>Not Slippery</td>
<td>Low chemical resistance</td>
</tr>
<tr>
<td>Durable, abrasion resistant</td>
<td>Requires skilled labor and specialized equipment</td>
</tr>
<tr>
<td>Modern and stylish look</td>
<td>Poor air quality on “dusting”slabs</td>
</tr>
<tr>
<td>Good option for floors with high moisture content (except for moisture sensitive dyes)</td>
<td>Cracking is visible</td>
</tr>
</tbody>
</table>
Polished Concrete (cont'd)

• Issues with polished concrete
Polished Concrete (cont'd)

• Issues with polished concrete
Polished Concrete (cont'd)

- Polished Concrete Costs – installed prices vary, but general ranges are:
  
  - No aggregate exposure (5-step process) $1.50-$2.50/sq.ft.
  
  - No aggregate exposure (9-step process) $3.50-$6.00/sq.ft.
  
  - Aggregate exposure – add $1.00-$3.00/sq. ft.
  
  - Dyed floor (without patterns) – add $1.00/sq. ft.
Floor Conditions

• Existing floor condition will influence whether to coat, cover, or polish
  
  – Surface deterioration
  
  – Concrete mix design and flatness
  
  – Placement and curing-related defects
  
  – Aesthetics
  
  – Excessive moisture
Floor Conditions (cont'd)

- Surface Deterioration or locations where previous flooring has been removed (coating or epoxy mortar overlay may be the only viable options)
Floor Conditions (cont'd)

- Surface Deterioration (cont'd)
Floor Conditions (cont'd)

• Concrete Mix Design and Flatness
  - Original mix design may limit choices
  - Certain finishes may have specific requirements for shrinkage, durability, permeability, workability, finishability, and strength
  - Proper mix and flatness/levelness tolerances are particularly important for polished concrete floors
Floor Conditions (cont'd)

• Placement and curing-related defects
  - Excessive carbonation, dusting, and concrete curling can result from improper placement and slab curing
  - Curling can lead to faulting at control joints, a problem for many floor coverings
Floor Conditions (cont'd)

• Aesthetics
  – Condition of existing floor may prohibit polishing
  – Shadowing or ghosting patterns from pre-existing coverings
  – Condition often unknown until existing coverings removed
Floor Conditions (cont'd)

- **Excessive moisture**
  - The absence of a functional vapor retarder and excess moisture vapor emission in the slab can limit the use of flooring options
  - Moisture moves through the slab by capillary action, osmotic movement, hydrostatic pressure
  - Many coatings are not resistant to moisture or hydrostatic pressure
Floor Conditions (cont'd)

- Excessive moisture
  - Some floor covering adhesives are susceptible to moisture
Floor Conditions (cont'd)

• Excessive moisture
  - Floor coverings can be used with the addition of a moisture mitigation membrane - either liquid applied or sheet
  - Membranes can perform on slabs up to 99% RH
Floor Testing

- Moisture
- pH
- Delamination and Hardness
- Carbonation
- Slip Resistance
Floor Testing - Moisture
ASTM Standards for Concrete Floors

• ASTM F1869-11, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

• ASTM F2170-11, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

• ASTM D4263-83 (2005), Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

• ASTM F2659-10, Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using Non-Destructive Electronic Moisture Meter

• ASTM F710-08, Preparing Concrete Flooring to Receive Resilient Flooring
Floor Testing – Moisture (cont'd)
Anhydrous Calcium Chloride

- **ASTM F1869-11**, *Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*

- Expose 20”x20” area of bare concrete to known weight of anhydrous calcium chloride for 60 to 72 hours
- Reweigh the anhydrous calcium chloride after exposure
- Weight gain is converted to moisture vapor emission rate (MVER) expressed as: lbs moisture/1000 ft²/24 hours
- **ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring** recommends a maximum of 3 lb/1,000 ft²/24 hours in the absence of mfg. guidelines
Floor Testing – Moisture (cont'd)

RH Probes

- **ASTM F2170-11**, *Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*

- Small holes are drilled into the concrete
- Sleeves/sensors placed in hole and capped
- Allowed to equilibrate for 72 hours, then temperature and RH are read
- **ASTM F710-08 (Preparing Concrete Floors to Receive Resilient Flooring)** suggests max 75%RH. Finnish and Swedish standards range from 60% to 90% depending on type of covering
Floor Testing – Moisture (cont'd)

Plastic Sheet Test

- **ASTM D4263-83 (2005)**, *Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method*
- The perimeter of an 18” x 18” plastic sheet is firmly taped to the surface
- Test sites – out of direct sunlight or direct heat
- After a minimum of 16 hours, examine the concrete and backside of the plastic for signs of moisture
- Acceptance Criteria – not stated in the standard, but coatings typically not applied if moisture is visibly present
- **ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring** describes a procedure that combines the use of moisture meters and the polyethylene sheet test
Floor Testing – Moisture (cont'd)  
Electronic Moisture Meters

- **ASTM F2659-10**, *Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using Non-Destructive Electronic Moisture Meter*

- Relative moisture content of the concrete ½ to 1 inch depth beneath the instrument
- Acceptance criteria not provided in the standard
Floor Testing – Moisture (cont'd)

Electronic Moisture Meters

- **ASTM F710-08, Preparing Concrete Floors to Receive Resilient Flooring**
  - Addresses many considerations prior to installing resilient flooring, including moisture (anhydrous calcium chloride and RH probes and acceptance criteria)
  - Appendix X2.5 addresses the electrical impedance test (discussed earlier in ASTM F2659-10)

- Appendix X2.4 discusses electrical resistance
  - Electrodes placed on surface, or into 2 pre-drilled holes, 1" deep
  - Manufacturer may recommend inserting concrete nails into the holes and touching the electrode to the ends of the nails
Floor Testing - pH

• pH testing is used to determine the degree of acidity or alkalinity of a material
• Scale - 0 (acidic) to 14 (alkaline)
• pH can effect the selection of some coatings and floor covering adhesives
• Photo shows the use of a pH test strip to determine the pH of the liquid contained within the blister of a failing floor coating
Floor Testing - Delamination and Hardness

• Delamination
  - If concrete delamination is suspected, it can cause any coating or covering to fail, and will not be conducive to polishing unless repaired
  - Delamination can be determined by sound using a “chain test.” Standard chains with ~2” links are dragged across the surface to detect hollow areas

• Hardness (Mohs Hardness)
  - Scratch test used to determine approximate hardness of concrete
  - Scale – 1 (soft) to 10 (hard)
  - Helps to determine if polishing is viable, and if so, selection of the proper tooling
Floor Testing - Carbonation

- If excessive carbonation is suspected, a pH indicator solution can be used to determine the depth.
- Laboratory petrographic examination of concrete cores provides a detailed assessment of the condition of the wearing surface and the presence of excess carbonation.
- The results help to establish the appropriate concrete repair methods, and flooring materials to be used.
Floor Testing – Slip Resistance

- Drag Sled – BOT-3000 popular. Device approved by NFSI.

- Articulated Strut - Excel Tribometer VIT common for lab and field. Measures wet and dry DCOF
Floor Testing – Slip Resistance

• Test walkway surfaces both dry and wet

• Consider slip resistance testing on: Each type of flooring material, entryways, areas subject to change in environment, changes in surface wear and sudden changes in slip resistance

• Utilize flooring materials that have acceptable slip resistance under foreseeable conditions!
Summary

• Floor coatings, coverings, and polishing have distinct advantages and disadvantages

• The condition of the existing floor, the service environment, branding, maintenance expectations, and budget will dictate the viable alternatives

• A number of methods and instruments are can be used to assess the condition of an existing floor to determine the optimum flooring option
Concrete Floors – Coat, Cover, or Polish?

QUESTIONS?

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