ATFL-1020: INTRODUCTION TO HARD TILE

Cuyahoga Community College

Viewing: ATFL-1020 : Introduction to Hard Tile

Board of Trustees:
October 2024

Academic Term:
Fall 2025

Subject Code
ATFL - Appld Indus Tech - Floorlaying

Course Number:
1020

Title:
Introduction to Hard Tile

Catalog Description:
Introductory course covering ceramic tile installations including tile types, substrate requirements, mortar specifications and backer board selection. Also covered are basics of reading construction drawings and grid layout procedures. Demonstration and application of substrate preparation, mortar selection and mixing and layout and installation practices using ceramic tile is an integral part of this course.

Credit Hour(s):
2

Lecture Hour(s):
2

Requisites

Prerequisite and Corequisite
Departmental approval and a member in good standing in the United Brotherhood of Carpenters and Joiners of America Union UBC.

Outcomes

Course Outcome(s):
I. Discuss the different mortar systems and selection process with respect to various substrate requirements and employ basic layout procedures used to establish floor grids for ceramic tile.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. List and define terms related to hard tile trends.
2. Identify the different mortar setting systems and explain the advantages of each.
3. Assess different substrates for ceramic floor tile and determine specific mortar system with respect to existing conditions.
4. Explain how different concrete admixtures affect bonding ability and concrete hardness including air entrained.
5. List different substrate deficiencies and describe corrective procedures.
6. Review basic 3-4-5 layout procedures used for floor tile installations.
7. Establish control grids for ceramic floor tile and explain the function served.

Course Outcome(s):
II. Review different mortar specifications and ceramic tile installation standards, identify specialty tools, and demonstrate the ability to properly lay-out required grid lines and set different tile sizes.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Review the mortar specifications as prescribed by the Tile Council of America (TCA) to maintain updates on current mortar use recommendations.
2. Explain the importance of proper mortar mixing consistency to maintain good tile bonding.
3. Identify the different trowel types and describe the various uses for mortar application.
4. List the different types of floats and describe respective uses.
5. Demonstrate the ability to properly select and mix mortar and thin set, establish grid lines, and set various specified ceramic tile in accordance with industry standards.

Course Outcome(s):

III. Identify the sheets of construction of drawings including documents and reproduction, tile backer boards and jobsite checklists for project start up procedures.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. List and define terms related to construction drawings, backer board and jobsite checklists.
2. Describe the methods used to draw and reproduce prints.
3. Identify and describe the types of construction drawings and documents.
4. List and explain the information typically found in construction drawing title blocks.
5. List the different types of backer board with respective uses.
6. Describe the substrate requirements with respect to wall and floors to receive backer board and tile.
7. Identify the common work practices as part of a job checklist to ensure project efficiency.

Course Outcome(s):

IV. Discuss the selection process for backer board application including specification research, cutting, and installing backer board with respective fasteners and identify and use specific tools required for layout and drilling operations for ceramic tile.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. List and define terms related to ceramic tile layout and installation including backer board application.
2. Describe the selection process for backer board with respect to standard construction specifications referencing moisture protection and finishes.
3. Describe the procedures followed for backer board applications including expansion allowances and sequence.
4. Identify the tools used for ceramic tile layout including specialty tools and demonstrate the ability to perform specific layout operations.
5. List the specialty tools used for cutting and drilling ceramic tile and demonstrate the ability to operate them in a safe manor.

Course Outcome(s):

V. Demonstrate the ability to install ceramic floor tile including starting point determination, cuts and penetrations and trowel mortar and apply grout.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Select the hand and power tools and equipment needed for tile installation.
2. Establish starting point with respect to gridlines.
3. Determine border tile sizes and cut/dry fit along walls.
4. Layout, drill and install/dry fit floor penetrations, intricate cuts and transitions.
5. Mix and trowel mortar under all cuts and field ceramic tile.
6. Mix and apply grout per specifications at joints and cuts.

Methods of Evaluation:

1. Quizzes
2. Tests
3. Class participation
4. The student will demonstrate the ability to perform installation practices of ceramic tile in accordance with industry standards.

Course Content Outline:

1. Mortar systems, substrates, and grids
    a. Terminology
        i. Large format tile
        ii. Porcelain
        iii. Natural stone
        iv. Levelling products
        v. Mastic
        vi. Epoxy
        vii. Dry set
        viii. Pot life
        ix. Potable water
        x. Slake time
        xi. Polymer modified
        xii. Admixture
        xiii. Grid
        xiv. Substrate
        xv. Hawk
        xvi. Mortar system
        xvii. Air entrained
        xviii. Retarding admixture
        xix. 3-4-5
    b. Setting mortar systems
        i. Types
            1. Mastic
            2. Epoxy mortar
            3. Cement mortar
                a. Dry set
                b. Polymer modified
    c. Advantages/applications
        i. Mastic
            1. Interior application
            2. Wall/floor
            3. Ready to use
            4. Easy spread
            5. Limited use
        ii. Epoxy mortar
            1. 100% solid
            2. Moisture sensitive tile
            3. Stone/marble use
            4. Chemical resistant

5. Stain
6. High temperature areas

iii. Cement mortar substrate
1. Concrete substrate
2. Interior drywall
3. Concrete drywall
4. Areas without freeze-thaw concerns

iv. Cement: polymer modified
1. Increased bond strength
2. Increased flexural strength
3. Increased tensile strength
4. Water resistant
5. High freeze- thaw tolerance
6. Greater flex substrate application
7. Improved handling characteristics

d. Substrate and mortar system
i. Substrate
1. Wood
a. Spacing
b. Plywood
c. Oriented strand board OSB
2. Concrete
a. Deflection concerns
b. Flatness
c. Finishing
3. Backer board

ii. Mortar system
1. Medium bed
a. Concrete
b. Wood
2. Thinset: tile 18” x 18” or less
3. Epoxy
a. Mortar
b. Grout
4. Mastic
a. Wall/floor
b. Minimal water exposure

2. Admixtures: Bonding, hardness and air entrained
a. Bonding
i. Concrete defects
1. Scaling
2. Micro cracking

ii. Excessive porosity
1. Moisture
2. Drying

b. Hardness
i. Accelerator admixtures
1. Speeds curing
2. Calcium chloride

ii. Retarders
1. Increased rate of hardening
2. Difficult setting materials

c. Air entrained
i. Uses less water
ii. Improves workability
iii. Less sand required
iv. Improved flatness

3. Substrate: deficiencies and corrective procedures

   a. Deficiencies
      i. Curling
      ii. Shrinkage cracks
      iii. Excessive flatness deviations
      iv. Structural cracks: ≥ 1/16”
      v. Excessive internal moisture
4. Surface imperfections
   a. Laitance
   b. Scaling
   c. Dusting
   d. Crazing
   e. Aggregate segregation
   f. Contamination
   g. Improper surface troweling
5. Corrective procedures
   a. Proper drainage
   b. Damp curing
   c. Additional steel reinforcement
   d. Control joint placement
   e. Slab protection
      i. Wind
      ii. High humidity
   f. Controlled concrete finishing
   g. Broom finish
   h. Elimination of contaminates
   i. Floor slab cleaning
6. 3-4-5 Layout
   a. Predominate wall determination
   b. Room measurements
   c. Establish control lines
   d. Mid-point selection
   e. Perpendicular line build
   f. Repeat
7. Control grids
   a. Purpose
      i. Maintain grout line/tile bond line alignment
      ii. Versatile installations
      iii. Allows for continuous border cutting
   b. Establishment
      i. Determine grid size
      ii. Establish centerlines
      iii. Verify grid squareness
      iv. Grid layout
      v. Diagonal crosscheck
8. Mortar: Specifications, Standards, Tools and Installation
9. Specifications
   a. Tile Council of America TCA
      i. On grade concrete
         1. Service rating
         2. Heave use
         3. Limited rating/fragile tile
         4. Membrane options
      ii. ANSI requirements
         1. Ceramic tile
         2. Glass tile
         3. Cementitious
         4. Crack isolation membrane
   b. Environmental exposure
10. Standards: mortar mixing

a. Slake time
    i. Manufacturers' recommendations
    ii. Minimum set
    iii. Maximum set
b. Pot life
    i. Variables
    ii. Minimum
    iii. Maximum
c. Mixing practices
    i. Low speed
    ii. Paddle size by manufacturer
    iii. Potable water
    iv. Water introduced first
    v. Lump free
    vi. Trowel check

11. Mortar trowels
    a. Pointing
        i. Tile tapping
        ii. Tile alignment
        iii. Difficult placement
    b. Flat
        i. Hawk application
        ii. Mortar transfer
        iii. Spreading mortar
    c. Buttering
        i. Pure cement application
        ii. Larger tile
    d. Margin
        i. Hand mixing
        ii. Small batches
        iii. Cleaning/scraping containers
        iv. Mortar application
12. Floats
    a. Wood
        i. Flat trowel replacement
        ii. Smoothing irregularities
        iii. Floor and walls
            1. Horizontal
            2. Vertical
    b. Grout
        i. Grout/joint application
        ii. Excess removal
    c. Epoxy
        i. Softer float surfaces
        ii. Chemical resistant mortars
13. Hard tile installation
    a. Tools and equipment
        i. Hand tools
            1. Tape measure
            2. Chalk line
            3. Trowels
            4. Floats
        ii. Equipment
            1. Drill motor
            2. Shop vacuum
    b. Tile/mortar selection
    c. Layout: 3-4-5
        i. Establish perpendiculars
        ii. Grid layout
    d. Mortar mixing

i. Determine quantities
1. Water
2. Mortar
ii. Mixing consistencies
iii. Grid line mortar application
e. Tile setting
i. Starting point establishment
ii. Perpendicular/control line
iii. Grout size maintenance
f. Industry standards
i. Interior installation
1. Minimum coverage 80%
2. Border cuts: ½ tile size or greater
ii. Exterior/wet areas
1. 95% mortar coverage
2. Border tile ½ tile or greater

14. Drawings, backer boards and jobsite checklist
a. Terminology
i. Construction drawing
ii. Title block
iii. Plan view
iv. Sections
v. Working sketch
vi. Details
vii. CVU
viii. Backer board
ix. Wet area
x. Grout
xi. Sundry supplies
xii. Jobsite checklist
xiii. Jobsite communication
xiv. Addendum
xv. Staging
xvi. Specifications
b. Prints: draw and reproduce
i. Drawing prints
1. Hand drawn
2. Computer aided design CAD
ii. Drawing reproduction
1. Conventional copy
2. I pad
iii. BIM building information model
c. Drawing types and documents
i. Drawings
1. Architectural
a. Plans
b. Elevations
c. Sections
d. Details
e. Schedules
2. Pictorial
a. Perspective
b. Isometric
c. Oblique
d. Orthographic
e. Exploded
3. Structural
4. Electrical
5. Mechanical

   ii. Documents
      1. Specifications
      2. Addendums
      3. Contracts
      4. Change orders
d. Title block
   i. Job name
   ii. Architect
   iii. Date
   iv. Page numbers
   v. Type of information
   vi. Scale
   vii. Revision dates
e. Backer board
   i. Types
      1. Glass
      2. Mat
      3. Water resistant
      4. Gypsum
      5. Fiber cement
      6. Cementuous foam
      7. Fiber reinforced gypsum
   ii. Uses
      1. Height requirements
      2. Mortar adhesion
      3. Water proofing
      4. Structural
      5. Applications
         a. Ceramic tile
         b. Glass
         c. Stone
f. Substrate requirements
   i. Deflection control: 1/360 if span
   ii. Flatness
      1. 1/8” /6’0
      2. 3/16” /10’0
   iii. Special requirement: 1/180 of span
      1. Marble
      2. Stone
      3. Wood floors: 1 ¼” thickness
      4. Clean, dry and contaminate free
g. Jobsite check list
   i. Project location
      1. Building floor
      2. Wing
      3. Room number
      4. Contact person
         a. General contractor
         b. Superintendent
         c. End user
   ii. Work schedule
      1. Times
         a. Start
         b. Finish
      2. Job meetings
      3. Safety meetings
      4. Progress reports
   iii. Communication

1. Superintendent
2. Foreman
3. Co-workers
4. Working trades

iv. Rules and requirements
1. Requirements
a. Safety data sheets
b. Power source
c. Water
d. Waste handling
e. Emergency
2. Rules
a. Safety training
b. Drug testing
c. Attendance
d. Participation
e. Conduct
f. Dress code
g. PPE
h. Storage procedures
i. Authorized access routes

15. Ceramic tile: backer boards, layout, and cutting
a. Terminology
i. Expansion zone
ii. Joist spacing
iii. Joint spacing
iv. T-bevel
v. Water level
vi. Trammel point
vii. Angle divider
viii. Wet saw
ix. Nippers
x. Straight edges
xi. Carborundum
xii. Coated glass fiber mesh tape
b. Backer board selection
i. Finish schedule
ii. Specification book
1. Divisions
a. Moisture protection
b. Finishes
2. Shop drawings
c. Backer board: installation and sequence
i. Installation
1. Fasteners
a. Hot dipped galvanized roofing nails
b. Corrosion resistant screws
2. Tools
a. Hand
b. Power
3. Specialty
a. Scoring
b. 6 inch knife
c. Sheers
d. Pneumatic nailer
ii. Sequence
1. Substrate preparation
2. Fitting/cutting
3. Staggered joints

4. Mortar application
5. Anchoring

d. Layout and leveling
   i. Layout
      1. Ceramic tile
      2. Control line/perpendicular
      3. Grid
      4. Tools
         a. Chalk line
         b. Tape measure
         c. Square
         d. Bevel
         e. Angle divider
         f. Compass scribe
         g. Trammel point
   ii. Leveling
      1. Substrate
      2. Surfaces
         a. Vertical
         b. Horizontal
      3. Tools
         a. Spirit level
         b. Water level
         c. Laser
         d. Straight edge
         e. Plumb bob

e. Cutting and drilling
   i. Cutting
      1. Portable saw
      2. Wet saw
      3. Hand tools
         a. Tile cutter
         b. Chipping hammer
         c. Hand saw
         d. Grout saw
         e. Hack saw
         f. Rod saw
         g. Nippers
         h. Rubbing stone
   ii. Drilling
      1. Power tool
         a. Hand drill
         b. Drill motor
         c. Hand grinder
      2. Safety
         a. PPE
         b. Electrical
         c. Housekeeping
         d. Tool operation

16. Application
   a. Tools
      i. Hand tools
         1. Tape measure
         2. Mortar trowel
         3. Chalk line
         4. Margin trowel
         5. Trammel points
         6. Nipppers
         7. Broom

8. Marker
9. 6 inch knife
10. Hammer
11. Stone

ii. Power tools
1. Drill and paddle
2. Wet saw
3. Portable Hand grinder

iii. Equipment
1. Wet saw
2. Laser
3. Tile cutter

b. Starting point
i. Predominate wall determination
1. Longest wall
2. Most visible

ii. Establish control line
1. Centerline of predominate wall
2. Balance border cut tiles
3. Measure/mark center
4. Mark with chalk line

iii. Establish control line perpendicular
1. Determine midpoint
2. Layout perpendicular using 3-4-5 multiple
3. Repeat opposite side of control line
4. Extend line to adjacent walls using 3-4-5 multiples
5. Check for accuracy
6. Check border tile sizes
7. Adjust “cuts” per specifications

c. Border tile
i. Sizes
1. Based on control line
2. Based on perpendicular

ii. Grouting
1. Established per specification
2. Field determined

iii. Dry fit
1. Expansion allowance
2. Determined by grout line

d. Intricate cuts and penetrations
i. Layout
ii. Cut
iii. Dry fit
iv. Transitions
1. Measure and cut
2. Set into mortar

e. Mortar application
i. Mixing
1. Mix per ratio specification
2. Select drill and paddle per manufacturer specifications
3. Mix time
4. Lump free
5. Set for slake
6. Remix

ii. Troweling
1. Selection
2. Key within gridline
3. Directional combing

iii. Set tile within grid

1. Align
2. Straight/balance
3. Flat/ledge free
4. Establish work flow to exit point

f. Grout application
   i. Consistency per ratio
   ii. Float selection
   iii. 45 degree angle spread with respect to grout lines
   iv. Thorough joint penetration
   v. Grout cleaning/sponge
      1. Initial surface removal
      2. Wet sponge post set time
      3. Final wet sponge cleaning

Resources

Tile Council of North America Committee. *TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.*. Current. Tile Council of North America, Anderson, South Carolina, 2024.

National Tile Contractors Association. *NTCA Reference Manual*. 2023/2024 Edition. NTCA Technical Committee, Jackson, Mississippi, 2024. https://www.tile-assn.com/page/ntca-reference-manual

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Carpenters International Training Fund. *United Brotherhood of Carpenters- GS0004M, Carpenters International Training Fund, Carpenters International Training Fund*. Current. Carpenters International Training Fund, Las Vegas, Nevada, 2014.

Resources Other

https://www.ardexamericas.com/products/tsis/adhesives-mortars/

https://www.tecspecialty.com/products/mortars-additives/. 2024.

https://www.carpenters.org/itc/. 2024.

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