Key Takeaways for Modules 1.1–1.10, 2.1–2.6, 3.1–3.5, 4.1–4.2

CTU Online Anytime Module 1.1 - Verify the Substrate

Surface Preparation 101

Surface preparation is the first and most critical step of any tile installation and it begins with assessing the substrate.

Importance of the Substrate

The material needed to complete the project successfully depends on the existing condition of the substrate and the type of surface preparation that will be required to make the substrate meet standards.

Suitable Substrates

- Substrates generally accepted for direct bonding of tile (if they meet ANSI standards):
    - Cementitious leveling compounds
    - Concrete mortar beds and masonry blocks
    - Cement backer boards
    - Exposure 1 or external grade plywood
    - Gypsum wallboard and underlayments
    - Existing well bonded ceramic tile
    - Existing well bonded sheet vinyl flooring
    - Plastic laminates
    - Cement or epoxy terrazzo
    - Steel decking

ANSI Standards and Verifying the Substrate

- Substrate condition needs to be qualified as acceptable prior to installation.
    - Always consult the ANSI (American National Standards Institute) for installation standards.
    - Tile contractors are advised to follow the V.A.L.U.E. chain and verify the substrate.
    - When on a job, it is the responsibility of the tile contractor confirm the substrate is suitable.
- The substrate must meet the standard ANSI A108.02 - 4.0, “General Requirements for Tile Installations.”
- ANSI A108.02 - 4.1.1 states all surfaces shall be structurally sound, clean, dry, and free of oily or waxy films and all foreign matter. Concrete surface shall be free from oil, curing compound, laitance and cracks.
    - Three keys points to remember:
        - Sound and stable – can support the tile assembly
        - True and smooth – substrate must meet tolerances
        - Ready to accept bonding materials – clean and absorptive
- ANSI A108.01 - 2.1, “Preparation by Other Trades” states the quality and cost of ceramic tile installations are influenced by the stability, permanence and precision of installation of the backing or base material.

Almost all substrates will require some surface preparation to meet the requirements.

CTU Online Anytime Module 1.2 - Concrete Checklist

Slab Requirements

Refer to ANSI A108.01 – 3.2.1 Requirements for concrete masonry: preparation by other trades to confirm that a concrete slab is suitable for tile installation.

Slab Requirement Checklist

1. Cure Time – at 28 days, a large proportion of water has left concrete and installation can begin without moisture causing damage to flooring system.
2. Sound and Stable – any substrate that does not appear sound and stable should be reported to the General Contractor.
3. Cracks – no structural cracking is acceptable. Some shrinkage cracking is permissible. Displaced or heaved concrete is structural in nature and should be addressed by a structural engineer. Additionally, cracks greater than 1/8" wide should be referred to appropriate party to have a structural engineer evaluate.
4. Contamination – No curing compounds, release agents or efflorescence on concrete slabs are acceptable before tiling. CUSTOM Technical Bulletin 92 explains what a curing compound is and why it can be a challenge during installations. A.C.I. defines a curing compound as a monomolecular film that forms over the bleed water from a freshly placed concrete slab. The challenge when bonding tile to curing compounds is that the film does not have a strong bond to the concrete. Before tiling, curing compounds need to be mechanically removed.
    - ASTM F3191 Porosity test can show if a curing compound is present on the substrate. A droplet of water beading up for sixty seconds or more may indicate the presence of a curing compound.
5. Clean, Hard and Dense
    - Clean – Free from curing compounds, adhesive residue, debris from other trades, dust and moisture
        - Dust is the number one bond breaker
            - Scrape, sweep, vacuum and then sponge to clean dust from substrate
    - Hard – Weak or chalky on surface (visual or light scraping can help determine)
    - Dense – Visual Observation (including ASTM F3191 droplet test)

CTU Online Anytime Module 1.3 – The Nature of Concrete

- **Concrete Curing**
    - Concrete is cost effective and readily available but typically needs surface preparation.
    - It is said there are two types of concrete: already cracked and going to crack.
    - A concrete slab acts like a sponge; flat when wet and contracts and curl as it dries.
    - Approximately 35% of the water used in concrete is used for hydration, while the remaining 65% deemed “water of convenience” is evaporated. This evaporation can lead to shrinkage.

- As concrete cures, slab movement is greatest in the first 12-18 months. Crack isolation membranes help to manage this movement and protect the tile assembly.

- **Flat vs. Level**
  - When it comes to flat versus level, flat is the primary goal. However, levelness may be included in the specifications.
  - Flatness is defined by ASTM E1155 and ACI 117. F numbers indicate flatness on day one.
  - The concrete industry uses F-numbers to qualify flatness, while the tile industry uses a 10-foot straight edge.
  - Concrete contractor executes flatness during finishing stage on day one.
  - Once concrete is placed and begins to cure, it experiences mass change
  - Flatness requirements depend on tile size, according to ANSI 108.02.4.1.4.3.1 Sub-floor surfaces
    - Traditional tile (all edges shorter than 15 inches) maximum variation allowed:
      - $\leq$ 1/4" in 10 feet
      - $\leq$ 1/16" in 1 foot
    - Large format tile (any edge longer than 15 inches) maximum variation allowed:
      - $\leq$ 1/8" in 10 feet
      - $\leq$ 1/16" in 2 feet
  - Estimated Ff number versus straight edge measurements

F-Number	Gap Under 10' straight edge
12	1/2"
20	5/16"
25	1/4"
32	3/16"
50	1/8"

  - It is important to note that surface prep is usually required to meet standards.

- **Division 3 vs. Division 9**
  - Concrete contractors are responsible for meeting the floor flatness requirements of Division 3.
  - Tile contractors are responsible for meeting the floor flatness requirements of Division 9.
  - ASCC Position Statement #6 recognizes the differences between Division 3 and Division 9 and recommends owners provide bid allowance to meet Division 9 requirements.

CTU Online Anytime Module 1.4 – Suitable and Unsuitable Substrates

- Direct Bonding Tile Installation
  - Substrates suitable for direct bonding tile installation
    - Cement backer boards
    - Cement masonry units

        - Mortar beds
        - Cementitious self-leveling underlayments
    - Note that all suitable substrates still must meet ANSI standards.
- Interfaceable Substrates
    - Substrates suitable if properly prepared with specific materials and methods
        - Exposure 1 Plywood (Exterior Grade)
        - Cement and epoxy terrazzo
        - Gypsum wall board and underlayments
        - Oriented Strand Board (OSB)
        - Existing well-bonded ceramic tile
        - Existing well-bonded sheet vinyl flooring
        - Steel decking
- Bonding directly to plywood can be achieved under the following requirements
    - Must be rated Exposure 1 (Exterior Grade)
    - Only direct bond on floors
    - Subject to requirements and provisions per ANSI A108.01 Part 3.4
    - Sheets need to be gapped 1/8" with 1/4" at abutments
    - Floor framing and joist spacing must meet applicable building code provisions for floors and floor loading
    - Care must be taken as plywood expands and contracts more than concrete
    - Reference TCNA Handbook for additional details
        - Environmental exposure classification Res1 or Com1 can be specified
        - Interior, dry, residential and light commercial use only
- Terrazzo, cement / epoxy require specific materials and methods
    - Surface coatings must be removed and surface bonding primer or liquid crack isolation membrane must be installed
    - If metal divider strips are present (many not conducive to tile design movement joint pattern), a sheet crack isolation membrane can be used in conjunction with a new architect- or engineer-designed joint pattern.
- Gypsum wallboard can be used according to ANSI A108.01.3.5
    - Board must be properly installed, flat and plumb with any loose particles removed.
    - Any oil based coatings must be encapsulated with bonding primer or liquid applied crack isolation membrane
- Gypsum-based underlayments
    - Suitable if installed by licensed applicator per the manufacturers installation instructions with sealer-primer
    - Sealer coat must be properly applied. If not present, a primer will need to be applied.
    - Due to excessive absorptive properties, a water droplet test should be done before and after primer applied to determine suitability
- OSB is not suitable for direct bonding due to probability of bond failure when under load
- Interface materials are also known as surface preparation materials. They include:

    - Cement patches
    - Cement backer board
    - Cementitious self-leveling underlayments
    - Liquid-applied and sheet membranes
- Cement backer boards, such as Wonderboard® Lite, are one of the most popular inter-faceable materials
    - These boards are good for interior and exterior use, are resistant to water and suitable for wet area applications. Wonderboard® Lite exceeds performance requirements of ANSI A118.9.
- Tiling over existing tile or vinyl flooring is possible, using the appropriate interfacing techniques.
    - TCNA TR418, TR420, TR711, TR712 and TR713 address tiling over existing tile or vinyl floors
    - Additionally, a ready to use, water based primer such as CUSTOM® MBP Multi-Surface Bonding Primer can be used as an interface material vs. mechanical preparation method
- Examples of unsuitable substrates that should never be covered include:
    - Fiberglass or other plastics, Hardwood or parquet wood floors, Luan plywood, chemically contaminated substrates, particle board, Masonite, dimensionally unstable metals, self-adhesive vinyl tile, sponge backed vinyl, carpet, wall coverings and oil based paint.

CTU Online Anytime Module 1.5 – Achieving Flatness

- Every job requires some amount of surface preparation
- Flatness requirements can be found in ANSI A108.02; Section 4
    - ¼" variation in 10 feet for tile under 15 inches
    - 1/8" in 10 feet for large format tile longer than 15 inches on any side
        - No more than 1/16" within 2 feet
- A sound, stable and flat surface helps prevent lippage, cracks and breakage
    - This becomes even more critical under large format tiles – the most common type
- Per ANSI 118.4, an engineered patching or leveling compound is required to patch and flatten surface
    - Thin-set mortar should not be used
    - A patching and finishing compound, such as CUSTOM® SkimCoat & Patch™ or SpeedFinish™ are ideal for this use
- Patching compounds and trowel-applied products can be used for small repairs such as small shrinkage cracks under 1/8", filling divots, walls or creating ramps or skim coats
    - Larger or deeper repairs should be assessed and may be better handled by the use of a leveler
- Self-leveling underlayments are ideally suited for larger applications
    - Always be sure to prime the area before applying the leveler (products must be used together)
- It is important to read the Technical Data Sheet before installing any product

- Primers work by a) binding micro dust particles, b) consolidating the surface of the substrate, c) suppressing moisture absorptive properties on the surface, d) promoting cement curing, and e) providing adhesion between SLU and substrate
    - An acrylic primer, such as CUSTOM® LevelQuik® Advanced Acrylic Primer, is ideally suited for use on both porous and non-porous substrates. Note: Apply and allow to dry before leveling
    - For time sensitive jobs, rapid-setting CUSTOM LevelQuik RS levels up to 1.5" in one pour and is walkable in 4 hours. Rated for extra heavy duty use, this product exceeds TCNA requirements
    - CUSTOM LevelLite® is 40% lighter than standard SLUs and can be used on projects where weight load is an issue. Can be poured up to 2" deep, walkable in 4 hours. Exceeds TCNA requirements.
- SLU Tips for Success
    - Have a plan – start to finish
    - Have the proper tools
    - Have the personnel to mix, pour, spread and smooth
    - Know the depth and weight of the pour
    - Prep by priming and damming edges and openings
    - Do not over- or under-water the underlayment
- When applying, always add wet material into wet material until the finish point is reached
    - Make use of gauge rakes or squeegees to move the material around. Be sure to keep edge wet
    - When finishing, be sure to use a smoothing tool or spiked roller to break surface tension
    - Allow SLU to fully cure before tiling or applying membrane prior to tiling

CTU Online Anytime Module 1.6 – Role of Membranes: Crack Isolation

- Choosing a membrane
    - Identify why and when a membrane is used
    - Understand ANSI categories and performance characteristics of each class
    - Fit the membrane to the performance needed in the service conditions
- Membrane Uses
    - Waterproofing
    - Crack isolation
    - Impact sound transmission
    - Thermal break
    - Interface non-standard substrate
    - Moisture vapor transmission reduction
    - Improved warranty terms through added performance
- Facts to remember about membranes
    - Membranes are not always specified when they should be
    - They are often listed as optional in the TCNA handbook as conditions vary
    - Different membranes have different service ratings

    - When being specified, cost vs. risk of not using a membrane is evaluated
- ANSI A118.12: Specification for crack isolation membranes. Key points to remember:
    - Isolate tile or stone from minor in-plane substrate cracking
    - Membranes cannot prevent substrate movement
    - Standard performance grade: >1/16" up to <1/8"
    - High performance grade: ≥ 1/8" up to manufacturer limit
- Membrane installation is detailed in TCNA F125 and describes partial and full coverage methods
    - Partial installation method
        - Install only over existing crack. Tile that spans the crack is supported by the membrane.
        - Movement joints required for both grout joints on tile that spans crack
    - Full coverage method (entire substrate)
        - Best option for large format tile (LFT) or shrinkage cracks
            - Benefits of full coverage over partial coverage can be seen in reduced labor, more robust protection and overall better performance
        - Design professional needs to identify Full or Partial coverage method
    - Either treatment must be used in conjunction with TCNA EJ171 for movement joints
- Crack Buster® Pro is an example of a best-in-class crack isolation membrane
    - Installed using peel and stick backing in conjunction with a primer
    - Isolates crack up to 3/8"
    - Achieves an extra heavy duty service rating
    - Exceeds ANSI A118.12 high performance requirements
    - Meets ANSI A118.3 to reduce impact sound transmissions
- A crack isolation membrane should not be used in the following situations:
    - Concrete is displaced or heaved
    - Cracks in concrete are over 1/8" wide, as they can be structural in nature

CTU Online Anytime Module 1.7 – Role of Membranes: Impact Sound Reduction

- ANSI A118.13 is the specification for bonded sound reduction membranes
    - These membranes lower the transmission of impact sound from one room to the room below
    - Tile can transmit noise from assembly to room below
    - There are two types of sound transmission classes to consider
        - Impact Insulation Class (IIC) – Impact sounds such as footfalls
        - Sound Transmission Class (STC) – Airborne sounds (voice, radio, etc.)
    - Membranes only address Impact Sounds (IIC)
    - Per ASTM E2179, membranes must reduce impact sound from room above by minimum of 10 decibels
        - ΔIIC = number of decibels contributed by the membrane according to E492
        - Floor and ceiling assembly in test consists of 6" concrete slab

- Custom Building Products offers membranes of with a range of ΔIIC (delta) decibels conforming to IBC and IRC codes
- The highest level of performance can be found in CUSTOM's EasyMat® membrane
  - Meets or exceeds ANSI A118.12: Protects against in-plane cracks up to ¼"
  - Meets or exceeds A118.13: 3mm = 16ΔIIC, 5mm = 20ΔIIC, 12mm = 23ΔIIC
  - Set with mortar or primer with peel and stick backing
  - Will not shrink, rot or absorb water
  - Creates thermal break for radiant heat systems
  - Can be used in place of cement or fiber board over OSB or non-standard substrates
  - Interface material

CTU Online Anytime Module 1.8 – Waterproofing Membranes with Crack Isolation

- Multi-purpose membranes
  - Combination membranes offer multiple benefits and add value
    - Crack Isolation: isolation from in-plane movement caused by concrete shrinkage or movement from plywood assemblies
      - Not suitable for use over deep or wide cracks (over 1/8" may be structural)
      - Not suitable over vertically displaced or heaved concrete
      - Not for use over true expansion joints
    - Waterproofing
      - ANSI A118.10: Load bearing, bonded membrane functions as a barrier to positive water migration
      - Can be bonded to variety of substrates
      - Can be applied as sheet, by trowel or rolled on as a liquid
  - Liquid-applied membrane Pros and Cons
    - Liquid-applied Pros
      - Monolithic coverage for any size or shape area
      - Easy to apply, similar to paint
      - No precutting of inside/outside corners
      - Bonds directly to drain assemblies
      - Can be used for interior and exterior
    - Liquid-applied Cons
      - Two coats in different directions required for waterproofing (to avoid pin-holes)
      - Each coat must fully dry before applying additional coat or bonding materials
      - Coverage must be sufficient and consistent to meet ANSI standards
      - Not always appropriate for F125 partial coverage method
    - RedGard® is Custom Building Products' leading liquid-applied membrane
      - It's ready to use and as easy to apply as paint

- Provides a continuous, monolithic waterproof barrier
- Suitable for cracks up to 1/8"
- Extra heavy-duty service rating
- Exceeds ANSI A118.10 and A118.12
- Suitable for interior and exterior applications
    - Suitable for swimming pools, decks and veneers
    - Use a primer over gypsum-based underlayments
    - Can be used as moisture vapor control system
    - IAPMO approved as a shower pan liner

- Uncoupling Membranes
    - Plastic membrane geometrically configured to provide airspace between tile assembly and substrate (approx. 1/8" thick)
        - Allows for independent movement between substrate and system
        - Minimizes the transfer of stress from substrate to tile system
        - Can be used over plywood or OSB (16" OC and 19" OC)
        - Suitable for use over young/green concrete
- RedGard® Uncoupling Mat is Custom Building Products' uncoupling membrane
    - Meets ANSI A118.10 and A118.12
        - Waterproofing and vapor management capabilities
            - Use RedGard® Seam Tape for moisture barrier
        - Crack isolation capabilities prevents cracks in tile and grout

CTU Online Anytime Module 1.9 – Showers and Submerged Applications

- The typical U.S. shower sees over 2,500 inches of water each year
- Water creates the potential for building damage as well as health risks
- These surface preparation steps can help with water management:
    - Slope ¼" per foot towards the drain to avoid any puddling
    - Apply a continuous membrane from top of system down to the drain and tie into drain assembly
    - Reinforcing mesh should be used for changes of plane and around plumbing protrusions
- TCNA Detail B421 is the recommended method for water management
    - A continuous membrane over the mortar bed helps to eliminate:
        - Mortar bed being soaked from continuous exposure
        - Leaching of calcium and other minerals from mortar bed into weep holes
        - Clogging of weep holes and drain assembly
    - RedGard® Waterproofing and Crack Isolation membrane is suitable for systems conforming to TCNA Detail B421. Product benefits include:
        - Continuous waterproof barrier
        - Outstanding adhesion to drains

        - Listed as IAPMO shower pan liner
        - First low-perm liquid-applied moisture vapor barrier
- TCNA Detail SR 614 is the recommended method for use in steam rooms and showers. Key system elements:
    - Sloped ceiling so condensation runs down walls
    - Moving slip joint
    - Low perm waterproof membrane (<0.5 perms)
        - RedGard provides 0.3 perms of protection
        - Not all A118.10 membranes are low perm barriers
    - ASTM E96 E determines perm level (test at 100 F and 95% RH)
- Submerged applications with irregular shapes are ideal for liquid applied membranes such as RedGard®
    - Can be trowel, roller and spray applied (when using elastomeric spray rig)
- CUSTOM's Rapid Setting Shower System allows showers to be completed in as little as a day
    - Standard mortar beds take 72-96 hours to cure
    - Rapid setting sloping mortar, such as SpeedSlope® can be used to accelerate installation process
        - Can dry in as little as 1 hour
        - Calcium aluminate formula provides high early strength
        - Use horizontally up to 3" thick
        - Trench up to 5" deep
    - A rapid curing waterproof membrane, such as RedGard® SpeedCoat™ is ideal for fast track installations
        - Cures in as little as an hour
        - Cross-linking moisture cure
        - Suitable for interior use
        - Dries fast even in cool or damp air
        - Requires two coats

CTU Online Anytime Module 1.10 – Planning for Movement

The number one cause for tile assembly failure is lack of and improperly installed movement joints.

Per TCNA EJ171, "Perimeter and field movement joints within a tile installation are essential and required."

- Movement joints are needed because:
    - Buildings move
    - Concrete creeps and sags over time
    - Wood floor assemblies deflect
    - All materials experience thermal cycling as temperatures change
- Concrete slabs also have movement joints

    - Isolation joints around columns to accommodate vertical movement
    - Control joints/saw cuts for shrinkage
    - Expansion joints for slab and structural movement
    - Cold joints created in between concrete pours
- Thermal cycling of tile systems
    - Tile in sunlight gets hot and expands, putting grout joints under compression
    - Silicone-filled soft movement joints can help accommodate movement
    - 24" Porcelain tile can expand up to 0.3mm in length
- TCNA EJ171 details on movement joints include:
    - Exterior joints must be placed every 8-12 ft
    - Interior joints can be spaced a maximum of every 25 ft
    - Joints are required at all changes of plane
    - Never cover or abridge true expansion joints
    - Perimeter joints are a must to reduce failures
- It is the architect and engineer's responsibility to design the movement joint patterns
    - Exterior joint widths – based on frequency of joint placement and temperature change
    - TCNA handbook gives complete view of all data sets necessary for architect and engineer to design movement joints (tile coefficient of linear expansion vs. temp changes)

- Movement joints should be filled with silicone sealant that conforms to C920. Sealant requirements:
        - Non-sag sealant for vertical applications
        - Exterior rated Class 25 for 25% expansion and contraction
        - Rated for use under pedestrian and vehicular traffic roads (Class T)
        - Custom Building Products' Commercial 100% Silicone Sealant is a suitable product and comes in 40 colors to match all CUSTOM grouts

CTU Online Anytime Module 2.1 – Traditional Cement Mortars

- Mastics (Type I and II) are covered under ANSI A136.1
    - Used for light duty, residential installations
        - Usually used for small wall tile
        - Interior dry areas (and limited water exposure possible)
    - Custom Building Products' OmniGrip® exceeds ANSI A136.1
        - Flexible, lightweight high-polymer adhesive for stone and tile
        - Does not sag when placed on walls
- Cement-based bonding mortars are comprised of sand, cement, retentive compounds and polymer agents
    - Sand (aggregate) – size and shape play a key role in feel and performance of mortar
        - Angled aggregate offers greater compaction but reduced handling feel

        - Rounder aggregate offers smooth and creamy feel
        - Aggregate replacement materials may be lightweight materials
    - Mortars are typically made from two types of cements
        - Portland Cement and Calcium Aluminate Cement (for rapid setting formulations)
            - Cement is the primary means of bonding within a mortar
            - Cement's structure develops mechanical bonds to substrate and back of tile
    - Retentive compounds
        - Retentive compounds retain water in mortar to control pot life and working time
        - Mortars need to slake to allow time for retentive compounds to absorb water into the mixture and transition from powder to gel. At that point, water will remain in mortar mix, rather than be directly absorbed by the substrate.
    - Polymers help provide:
        - Chemical bonding mechanism
        - Improved flexibility
        - Resistance to shock and impact
        - Reduced water absorption into mortar (important in exterior, thermal cycling and freeze thaw environments)
    - Multiple mortars exist to match each application. The ANSI specifications are as follows:
        - A118.1 – Dry Set Cement Mortar (no polymer modification)
            - Open pore structure tiles
        - A118.3 – Tile Setting Epoxy Adhesive
        - A118.4 – Modified Dry-Set Cement Mortar
            - Designed for non-porous tiles
            - 28-day porcelain shear strength >200psi
        - A118.11 – Exterior Glue Plywood (EGP) Cement Mortar
            - Mortars improved from A118.4 category for shock and flexing capacity
            - For bonding to plywood must be >150psi
            - Versabond® Fortified Thinset Mortar meets ANSI 118.1, A118.4, A118.11
        - A118.15 – Improved Modified Dry-Set Cement Mortar
            - See 2.2 module for details

CTU Online Anytime Module 2.2 – Improved Modified Mortars

- Because tile is permanent, it is important to evaluate a contractor on qualifications and not just price.
- By changing the polymer content in mortar, the following properties can be adjusted:
    - Flexibility
    - Water absorption
    - Resistance to shock, seismic movement, thermal cycling, etc.

- Mortar specification is key to the success of a project
    - Improved modified mortars utilize polymers to increase performance
        - Thermal cycling of tile systems – Accommodating expansion requires flexible mortar
    - ANSI A118.15 Improved mortars have:
        - High polymer content
        - Better adhesion
        - Less Water Absorption
        - Greater Impact Resistance
        - >400 psi bond strength
    - Thermal expansion values are unique to the type of tile
        - When tiles expand and contract, they put stress on bonds between the mortar and the tile as well as the mortar and substrate
        - Polymer in the mortar will help with flexibility, allowing the mortar to accommodate movement
    - Ceramic tile is porous while porcelain tile is non-porous
        - ANSI A137.1 outlines water absorption values of the different types of tile
        - Polymer modified mortar is needed to properly bond porcelain tile
    - CUSTOM FlexBond Premium Crack Prevention Thin-Set Mortar is perfect for surfaces that are difficult to bond
        - A premium quality, improved polymer modified mortar with exceptional flexibility and bond strength
        - Ideal for surfaces such as plywood, vinyl and laminates and for hard-to-bond, non-porous tile, such as porcelain and glass

CTU Online Anytime Module 2.3 – Setting Large Format and Heavy Tile

- Today's large format and heavy tiles present new challenges, requiring higher performing mortars.
- TCNA classifies LHT/LFT as a tile with any side 15" or longer.
    - These tiles require a flat substrate (1/8" Δ in ten feet).
- As tiles get larger, cupping, warping and doming become more prevalent.
    - ANSI A137.1 outlines allowances for cupping and warping
- Pavers and natural stone tiles need LHT/LFT mortar to support weight and avoid slumping.
- Thin-set mortar should only be used from 1/32" to ¼" thickness, after is tile embedded.
- LHT mortar can be used up to ½" nominally; use most CUSTOM products up to 3/4".
    - LHT mortar helps to avoid slumping and lippage
- Lippage can be seen when tile edges are raised or depressed, creating an uneven surface.
- Pattern layouts in Large Format Tile can reduce lippage (especially in common 12" x 24" tiles and planks).
    - 50% offset (high chance of lippage)

    - 33% offset (substantially reduce possibility of lippage)
    - No offset (lowest chance for lippage)
- Medium bed mortars supported large tile and stone applications by utilizing larger aggregate particles.
    - LHT/LFT mortar was previously known as medium bed mortar.
- New technology is focused on rheology, better flow and hold. Product is easy to trowel and covers well.
- LHT/LFT Mortar will soon become an ANSI Standard.
- Versabond® LFT is an excellent product for setting large format and heavy tiles, especially on floors.
- Non-sag/non-slump mortars keep tiles from sliding down wall and speed installation in the process.
- CUSTOM ProLite® Premium Large Format Tile Mortar is ideal for:
    - ANSI A118.11 and A118.15 (including A118.1 and A118.4) requirements
    - Non-sag. Meets A118.15T (thixotropic) for vertical slip resistance
- MegaLite® Ultimate Crack Prevention Large Format Tile Mortar is for the most challenging applications.
    - 28-day porcelain tile shear up to 725 psi (28-day glazed wall tile shear up to 830 psi)
    - ANSI A118.11 and A118.15 (including A118.1 and A118.4)
    - Exteriors or other demanding locations with conditions like thermal cycling
    - Non-sag. Meets A118.15T (thixotropic) for vertical slip resistance
- Sand is the heaviest item in a bag of traditional mortar.
    - ProLite & MegaLite feature CustomLite® aggregate replacement technology to reduce weight
    - These Products are 40% lighter than traditional mortars (30 lb. bag vs. 50 lb. bag)
    - Both products are Build Green®, GreenGuard Gold® and contribute to LEED certification
    - Rapid setting versions of both mortars are available for fast-track projects.

CTU Online Anytime Module 2.4 – Setting Glass Tile and Moisture-Sensitive Stone

- Glass tile requires its own set of installation materials, methods and standards.
- Since glass tile is often transparent or translucent, a number of installation mistakes can be seen.
    - Trowel ridges
    - Uneven hydration
    - Voids in mortar coverage
- The manufacturing process creates inherent stress within glass tile.
    - This stress can lead to cracking due to thermal cycling or use of the improper mortar
- Glass tile is vitreous, making it smooth, non-porous and difficult to bond to mechanically.
    - Glass is classified as an impervious tile with close to 0% water absorption
        - Requires the use of a modified mortar with high bond strength
    - It is very important to select a mortar with minimal shrinkage. Using a cement-based mortar not designed for glass tile can result in tile cracking due to mortar shrinkage.

    - ANSI A137.2 is the standard for glass tile
        - Always consult the manufacturer be sure that glass tile is appropriate for the project
        - Large format glass is just 3” x 3”
- CUSTOM Glass Tile Mortar is specifically designed for clear or translucent glass (per ANSI A137.2).
    - High bond strength exceeds ANSI A118.15
    - Superior non-sag and non-slip performance
    - Low shrinkage
    - Bright white color to showcase glass designs

- Natural stone tiles that are moisture sensitive or have resin backing require special installation methods.
    - See ISO 14617
        - Class A (Δ <0.3mm): Dimensionally stable. Cement-based mortar is suitable.
        - Class B (0.3mm > Δ <0.6mm): Sensitive to moisture. Rapid setting cement-based mortar is recommended.
        - Class C (Δ >0.6mm): Very sensitive to moisture. Cannot use water-based adhesive or setting material. A 100% solids epoxy is recommended.
    - ANSI A118.3 is the standard for chemically resistant, water cleanable epoxies
        - 100% solids epoxy system can have two or more parts
        - Always clean before epoxy hardens
    - CUSTOM EBM-Lite™ Premium Epoxy Bonding Mortar is specifically designed for such applications and will inhibit warping and staining of moisture sensitive stone.
        - 100% Solids
        - High strength and impact resistance
        - Chemically resistant
        - Contributes to LEED
        - Non-sag, non-slump
        - Exceeds ANSI A118.3

CTU Online Anytime Module 2.5 – Setting Techniques for Success

- CUSTOM teamed with NTCA in 2015 to update the original “Trowel and Error” video to reflect a number of changes, such as larger tile, that have taken place over time.
    - Video demonstrates directional combing and ridge collapse
    - Link to video – English: https://www.youtube.com/watch?v=Way5bMh-eYg
    - Link to video – Spanish: https://www.youtube.com/watch?v=H3Ouv2ULtGk
- Appropriate surface preparation is still required
    - Flatness requirements must be met based on the size of the tile body
- Tiles set without proper mortar coverage are more likely to fail
- Improve success with large format tile by using correct trowel and setting methods
    - Key in a coat of mortar to the substrate

    - Add additional mortar and comb in straight lines that will go across the short side of the tile
    - Back butter large format tile, stone and any tile in exterior or wet conditions
    - Set the tile firmly and move back and forth across ridges to collapse them; no twisting
        - This releases air through the channels and prevents voids than can cause cracks
- Coverage by wet mortar transfer is critical to the success of the job
    - Use the correct notch size for the tile
    - SuperiorBilt® Premium Notch Trowel promotes ridge collapse to gain proper mortar coverage
        - Test for minimum 80% coverage, 95% for stone, wet or exteriors

CTU Online Anytime Module 2.6 – Gauged Porcelain Tile and Panels

- Gauged porcelain tile panels (GPTP) are stronger and lighter than natural stone.
    - A low profile makes them suitable for tile over tile installations
    - Range in thickness from 3.5mm – 12mm thick
    - Range in size from 1m x 3m to 5 ft x 10.5 ft
    - ≥ $1m^2$ is considered a gauged porcelain tile panel or slab
    - < $1m^2$ is referred to as gauged porcelain tile
    - 3.5mm – 4.9mm thick for wall applications
    - 5mm – 6.5mm thick for floors or walls
- ANSI A137.3 is the new standard for gauged porcelain tile panels/slabs.
    - Flatness requirement is the same as LFT tile (⅛" over 10')
    - A flat and stable substrate is critical for GPTP as the panels will show a non-flat substrate
- GPTP do not require the use of an LHT/LFT mortar.
    - Thinner materials translate to less weight load to support
    - An improved, modified mortar is required
- ANSI A108.19 is the new installation standard for GPTP.
    - Standard provides step by step instructions
        - Details methods, such as how to properly trowel (parallel ridges on the substrate)
        - Outlines coverage requirements, including wet mortar transfer
- GPTP are not all the same and utilize different manufacturing methods.
    - Back-layered materials have resin back and in some cases a mesh
    - Confirm mortar or adhesive recommendation from manufacturer of each product match
    - CUSTOM MegaLite® or EBM-Lite may be required for resin or mesh backed GPTP
- Proper installation of GPTP is very different from setting regular sized and LHT/LFT tile.
    - Mortar is applied on the substrate and tile at the same time (combing parallel to one another)
    - Special racks are used to hold and bed GPTP onto substrate
    - Lippage control systems are required for setting GPTP
    - Specific walking pattern is used to move air out from underneath panel. This is done in quadrants.

- Additionally, a palm sander is used to help work rest of air out from underneath panels
- Lippage control systems must have removable cap to clean mortar out while still wet. These are cleaned while mortar is wet. Caps are installed and then left on until curing is complete. Any material over 39” in size requires the use of a lippage control system.
- Tool and clean joint while the mortar is wet
    - The thinner GPTP material results in shallow joints; they must be struck clean.
    - There is a 1/32" joint allowance when installing GPTP
- Grout must be chosen carefully for GPTP installations. Optionally, 100% silicone sealant can be used at every location. Be sure to check GPTP and grout manufacturer’s recommendation.
- ANSI A108.19 requires that installers get specialized training from one of the following:
    - Setting materials manufacturer, such as Custom Building Products
    - GPTP tile manufacturer
    - ACT (Advanced Certified Tile Installers)
- An investment needs to be made for the proper cutting and handling tools to prevent breakage
- Due to large size of panels, traditional trowel designs do not work
    - ANSI recommends use of trowels that promotes ridge collapse
    - CUSTOM SuperiorBilt Platinum Notch Trowel is an excellent choice for GPTP installation
- Planning process is key for installation of GPTP
    - Contact manufacturers (GPTP, setting materials, etc.) to confirm
    - Assess jobsite for accessibility to material delivery and racks
    - Train crew in the proper methods
    - Make sure to have all necessary tools (including how to get tile to jobsite)

CTU Online Anytime Module 3.1 – Choosing the Right Grout

- Grout decision makers are varied and have very different objectives
    - Architects and designers typically select based on color
    - Contractors select on brand preference and crew’s comfort with the grout
    - Residential homeowners often select based on color or texture
    - Large facility owners may get involved due to previous bad experience
    - Developers may get involved with regards to color and maintenance based on service demands

- All parties should choose grout based on the unique service demands of the project
    - The TCNA handbook outlines grout service conditions
        - Use this to match grout with application conditions

- Grout is expected to always perform perfectly and have the following key attributes:
    - Uniform color
    - Hard and consistent when cured
    - Abrasion resistant

    - Optimal flexural strength
    - Optimal tensile strength
    - Cleanable
    - Stain resistant
    - Chemical resistant

- None of the expectations above take into account:
    - Type of tile
    - Variance in absorption ratings
    - Conditions on the jobsite
    - Installer's knowledge

- Grout was developed to fill gaps between stones and tiles to the surface easier to clean
- The current, primary function of grout is to protect the edges and preserve the tile installation
- Due to the long life of tile assemblies, function and performance of grout should be prioritized over cost
    - Per TCNA, tile is the most cost effective flooring system on the market

- Most grouts are available in a wide array of colors; color is not the main consideration
- ANSI has a number of standards to reference when selecting and installing grout
    - A118.3 – Chemical Resistant, Water Cleanable Epoxy
    - A118.6 – Standard Cement
    - A118.7 – High Performance Cement
    - A118.5 – Chemical Resistant Furan
    - TBD – Single Component Grouts

CTU Online Anytime Module 3.2 – Cement Grouts

- Sand, cement and iron oxide pigments were the original components of grout.
- Over time, liquid latex admixtures were added to improve strength, color retention and water absorption.
    - Because of variation in site mixing, performance was inconsistent
    - Spray-dried polymers are now added to grout formulas in the factory to improve consistency
- Cement grouts fall into two categories, ANSI A118.6 and A118.7
- ANSI A118.6 is the classification for Standard Performance Cement Grout
    - Custom Building Products' PolyBlend® Sanded Grout meets A118.6
        - Creates hard, dense joints
        - Grout joints from ⅛" – ½"
        - Suitable for submerged tile

    - PolyBlend® Non-Sanded Grout is ideal for joints less than ⅛" as well as glass, polished stone or other easily scratched tile. It has a durable, non-shrinking formula and meets ANSI A118.6.
    - Portland cement grouts take time to hydrate, are subject to site conditions and are affected by tile porosity. As a result, they can experience the following challenges:
        - Color changes
        - Shading
        - Mottling
        - Weak or powdery joints
        - Efflorescence
    - Efflorescence is a byproduct of Portland cement and occurs as the cement hydrates
- A higher performing class of grouts has been developed to address efflorescence and other issues. These High Performance Cement Grouts meet the performance criteria set forth in ANSI A118.7.
    - Custom Building Products uses calcium aluminate cement in its Prism® Ultimate Performance Grout to prevent problems such as efflorescence. Prism meets ANSI A118.7.
        - Prism® will hydrate faster than Portland cement grouts, eliminating efflorescence
        - Prism® is uniform in color, stain resistant and good for joints from 1/16" to ½" wide
        - Prism® uses CustomLite® lightweight technology that is easy to spread and easy to clean
- ANSI A118.6 Standard Grout and A118.7 High Performance Grout Comparison:
    - Water absorption: A118.6 < 10% vs. A118.7 < 5%
    - Tensile strength: A118.6 > 300psi vs. A118.7 > 500psi
    - Flexural strength: A118.6 > 500psi vs. A118.7 > 1000psi
- The benefits of an A118.7 high performance cement grout versus an A118.6 standard cement grout are:
    - Less efflorescence
    - Better color consistency
    - Higher strength
    - More stain resistant
    - Rapid setting
    - Rapid binding
- New Polyblend® Plus Sanded Grout also meets A118.7 performance standards to provide an additional option when specifying cement grout.
- When selecting a cement grout, the potential costs associated with a lower performing grout should be factored into the job.

CTU Online Anytime Module 3.3 – Epoxy Grouts

- Epoxy grouts should be used instead of cement grouts when the following conditions exist:
    - High temperature cleaning
    - Harsh chemical exposure
    - Acidic environments

    - Harsh cleansers
- The ANSI standard for epoxy is A118.3. It specifies the material must be:
    - Water cleanable
    - Chemically resistant
    - Shear bond to quarry tile > 1,000 psi
- Custom Building Products' CEG-Lite™ is an ideal commercial grade epoxy
    - Exceeds ANSI A118.3
    - 100% solids epoxy
    - Fast cure time
    - Lightweight formulation is non-sag and non-slump
    - Easier to clean than other epoxy grouts and contributes to LEED certification
- Common locations for epoxy grout include:
    - Industrial plants
    - Commercial kitchens
    - Institutional environments
    - Hospitals
    - Some residential
- Epoxy grout exhibits high performance attributes
- Possible to use with glass tile but must check with glass tile manufacturer before using epoxy grout
- Challenging applications suitable for epoxy:
    - Food and beverage spills that might not be cleaned up
    - Acids (destroys grout and tile)
    - Hot grease
    - Aggressive cleaners
- Custom Building Products' CEG-IG Industrial Grade Epoxy is formulated for harsh commercial environments
    - Exceeds A118.3 & A118.5 (Furan)
    - 100% solids
    - Improved resistance to chemicals, stains and heat for industrial applications

CTU Online Anytime Module 3.4 – Single Component® Grouts

- Demand exists for higher performing grout due to visual issues with current products including:
    - Efflorescence
    - Shading
    - Mottling
    - Inconsistent color
    - Difficult to use (epoxy grouts can be difficult to install and clean during installation)

- Demand exists for a new grout category with improved performance characteristics, such as:
    - Ease of use
    - Cleanability
    - Stain Resistance
- Custom Building Products created and trademarked the new single component grout category and developed Fusion Pro® grout:
    - Ready to Use (No mixing required which means no drill or dust control)
    - Guaranteed stain proof
    - Guaranteed color perfect
    - Easy to spread and clean
    - Crack resistant
    - No sealing
    - Easy to repair and can be used to skim cap over old grout for new look
- Fusion Pro Designer Series offers 8 colors with reflective accents for glamorous projects
- Fusion Pro is comprised of an advanced acrylic, silicone resin, sand and inorganic pigments
- Color in bucket is the same as when cured (environmental conditions do not effect color)
- After 3 days, the Shore D hardness is same as cement grout
- Fusion Pro® Single Component® Grout is suitable for the following applications:
    - Interior and Exterior
    - Walls and Floors
    - Commercial and Residential (incl. high traffic areas)
    - Wet areas
- At this time, Fusion Pro is not suited for:
    - Industrial applications (use epoxy grout)
    - Slabs with high moisture or Moisture Vapor Emissions Rate (MVER)
    - Submerged applications
- Fusion Pro has the highest stain resistance of all grout types when tested according to the CTIOA – T72 stain test
- The only tools needed for grouting with Fusion Pro are:
    - Water (for cleaning)
    - Grout float
    - Sponge and microfiber towel
- Many videos and other instructional tools for using this new type of grout are available at www.custombuildingproducts.com

CTU Online Anytime Module 3.5 – Grout Installation Tips

- Always create a mock up to test grout on the materials before an installation
    - It is important to understand the tile and stone materials being used

    - Check tiles for things like micro-textures, nano-coatings, absorption properties and surface finish
- There are products available to work around any of the challenges stated above
    - Aqua Mix® Grout Release can be used to combat the challenge of micro-textures and pores in polished porcelain or textured surfaces like wood-look planks
        - A film is created on the surface to keep grout from getting into textures and pores
- The number one contributor to grout job failure is over-watering – measure carefully
- The number two contributor to grout job failure is over-washing – less is more
- Cement grout tips:
    - Always mix with clean tools (mixing paddle or trowel and bucket)
    - Always measure the water according to directions (and make sure it is clean)
    - Pre-blend multiple bags of dry powder
    - Never mix with a high speed drill (always mix with low speed or by hand for small batches)
    - Allow grout to slake after mixing
    - Never add water after slaking (this is called re-tempering and can discolor and weaken grout)
    - Stir grout before using
- Grout float selection is critical to success of the installation
    - Stone tile will require softer grout float
    - Epoxy grout will require a resin resistant, rigid float
- Grout should always be applied diagonally across joints to keep them full
- Cement grout set up time varies based on the temperature and relative humidity on the job
    - Check product Technical Data Sheets for information on set time
- Cement grout is ready to be cleaned when:
    - Grout is stiff to the touch
    - Grout does not transfer to fingers when touched
- Less water is better when cleaning grout. Too much water can:
    - Weaken grout
    - Change grout color
- A dry buff can be done after cleaning to remove any residue left in the tile by the sponge
- To offer the highest level of protection to both standard and high performance cement grout systems, a penetrating sealer should be applied after curing
- Epoxy grout tips
    - Apply Grout Release or pre-seal the tile to make clean up easier
    - Start with clean tools
    - No mixing water is needed
    - Do not begin mixing until ready to grout
    - In order to counteract the exothermic reaction of epoxy grout
        - Transfer mixed grout from bucket, making small piles of grout
        - This slows the reaction and lowers the temperature, providing more working time
- Cleaning epoxy grout
    - Allow time for set up (see Technical Data Sheet)
    - Test for stiffness and transfer to gloved finger

    - Use warm water, scrub pad, sponge and microfiber towel
    - Scrub grout on tile and use sponge to remove material
    - Using clean rinse water, drag a damp microfiber towel across the surface of the tile
- Single Component Grout® steps
    - Apply Grout Release or pre-seal porous, coated or textured tile to make clean up easier
    - Spread grout diagonally across the joints then remove excess grout with the float
    - Clean immediately using fresh water and a circular motion with a lightly damp grout sponge
    - Follow by making diagonal passes with a clean, lightly damp grout sponge
    - From separate bucket of water, drag microfiber towel across surface of the tile
    - Move on to next section of tile to grout
- How to handle haze leftover from grout clean up
    - Most cement grouts – use Aqua Mix® Cement Grout Haze Remover
    - Single component or epoxy grout – use Aqua Mix® Non-Cement Grout Haze Remover
    - Stubborn epoxy grout haze – use Aqua Mix® Sealer and Coating Remover
- Movement joint tips
    - Fill joints with a flexible sealant, such as Custom Building Products' 100% Silicone Sealant
    - Consult TCNA Detail EJ171 for complete guidelines

<u>Bonus section: dealing with weather's effect on applying grout</u>

- Environmental conditions on the job can present challenges
    - Hot weather can affect color and shrink cement. Tips to combat the heat include:
        - Use a canopy
        - Grout early or late in the day
        - Use cold water to slow reaction time of grout
    - Cold weather can extend drying times. Some tips to combat the cold include:
        - Heat the area
        - Heat the water
            - Can use an immersible water heater if warm water not available
    - Do not grout in extreme heat or when temperatures are freezing or below. Prevent epoxy or single component grouts from freezing.
    - Wind should be blocked by canopy and tarps, if possible. Excessive wind can cause shrinkage cracks and color changes.
    - Be sure to protect grout from other trades until cured. Caution tape can be used but take care not to put paper on top of fresh grout. Traffic from other trades is covered in ANSI A108.

CTU Online Anytime Module 4.1 – Sealing Tile, Natural Stone and Grout

- When it comes to sealing, understanding and applying a few simple procedures and products will help save time, money and installation challenges. The result will be:

    - Satisfied customers
    - More referrals
    - Reduction in costly callbacks
- Jobs that are not sealed can result in disappointed customers
- Customers appreciate the reduced maintenance and aesthetic benefits of sealers
- Sealer misconceptions:
    - Sealers last forever. A: Sealers do not last forever.
    - They are maintenance free. A: Sealers are not maintenance free.
    - Sealing is permanent. A: Sealers are not permanent.
    - Can withstand any cleaner. A: Neutral pH cleaners are preferred over common harsh cleaners.
- What sealers can do:
    - Provide a given degree of stain resistance and reaction time to clean spills
    - Can change look or not change look, depending on customer preference
    - Reduce ongoing maintenance of tile installation
    - Provide high degree of chemical resistance
- Mock-up and testing of installation materials should be done prior to installation to assess the need and benefit of a pre-sealer or grout release
- Finish look is important to discuss with customer up front. Options are:
    - Natural look – no change in color of tile and grout
    - Enhancer – deep, rich color enhancement
    - Topical sealer – some color enhancement with low to high sheen finish
- For premium protection and performance – Aqua Mix® Sealer's Choice® Gold
    - Industry's most preferred and lasts up to 15 years
    - No fumes or odors
- Aqua Mix® Enrich 'N' Seal®
    - Penetrating seal darkens and enriches color
    - Maximum stain protection that lasts up to 15 years
    - 100% solids (not water or solvent based)
    - Requires half the number of coats of comparable product, saving cost and labor
- There are many variables that determine how long a sealer will last
    - Type of tile or stone and sealer type
    - Service conditions of the installation
    - Cleaner type (most everyday cleaners are too harsh; high in acid or alkalinity)
        - Cleaner with neutral pH needed
        - Cleaner can eat away at stone and grout
- Test installation periodically to see if it needs re-sealing
    - If material darkens and wets-out is good indicator that resealing is needed
- The main purpose of sealer is to give reaction time to clean up spill before a stain occurs

CTU Online Anytime Module 4.2 – Maintenance for the Life of the Tile

- Proper maintenance goes a long way towards preserving the customer's investment
- Sealers can simplify installation and maintain the look of a tile installation, but require maintenance
- A proper maintenance program is critical to ensure maximum performance of a sealer. This translates into maximum performance in the look and function of the tile installation.
- A proper maintenance program consists of:
    - Specifying the correct products
    - Using the proper equipment
    - Adhering to the correct procedures
- The proper cleaning regimen is dependent on:
    - Tile materials
    - Contaminants
    - Traffic Levels
    - Method of cleaning
- A pH neutral cleaner should be used for everyday cleaning of tile installations. Common household cleaners can be either acidic or alkaline, which is harmful to the material in the tile installation.
- The proper cleaning equipment consists of a dry mop, wet mop and/or an auto scrubber for commercial installations. Remember to always use clean water to rinse floors.
- When cleaning floors, take care not to create hazards.
    - Rinse off all cleaners and do not leave residue on tile
    - Do not leave sticky footprints
    - Avoid slippery tiles and slip fall accidents. Block off wet areas if needed.
- Protecting the sealer when cleaning is critical. Harsh cleaners can cut the life of a sealer by up to 75%.
- The Aqua Mix® care and maintenance line is aimed at delivering safe, professional cleaning solutions that preserve the look and life of tile installations.
    - First water-based technology in the industry
    - Countless industry innovations through the years
    - Brand most trusted by contractors
    - Best resources and training available
    - Most effective for cleaning and maintaining tile installations
- The first products introduced by Aqua Mix were:
    - 100% solids sealer
    - Grout colorant
    - Water-based aerosol sealer
    - Water-based abrasive safe for glass
- Aqua Mix® Professional Concentrated Stone & Tile Cleaner is an example of a neutral pH product suited for everyday cleaning.
- AquaShield® is an easy to use, residential spray for cleaning and resealing.
- For stubborn stains, an alkaline product such as Aqua Mix® Heavy-Duty Tile & Grout Cleaner should be used. It works to remove:

    - Grease and grime
    - Smog
    - Mildew and soap scum
    - Suitable for residential or commercial
- Aqua Mix offers full range of cleaners suited for commercial tile and stone installations
- Aqua Mix Professional Concentrated Stone & Tile Cleaner is best suited for commercial applications because 1 quart can make up to 128 gallons of cleaning solution
- Acidic cleaner can help resolve the following problems:
    - Efflorescence
    - Rust
    - Hard water stains
    - Grout residue
    - Mineral-based issues
- Solvent-based cleaners are used for:
    - Epoxy residue
    - Stripping sealers
    - Paints and inks
    - Adhesives
- Aqua Mix's® NanoScrub® is ideal for cleaning micro-textures and micro-pores
    - Water-based abrasive
    - Safe for glass and marble
    - Removes dirt and haze
    - Cleaning booster
    - No fumes

For more information, visit www.custombuildingproducts.com or contact CUSTOM Technical Services at 800-282-8786