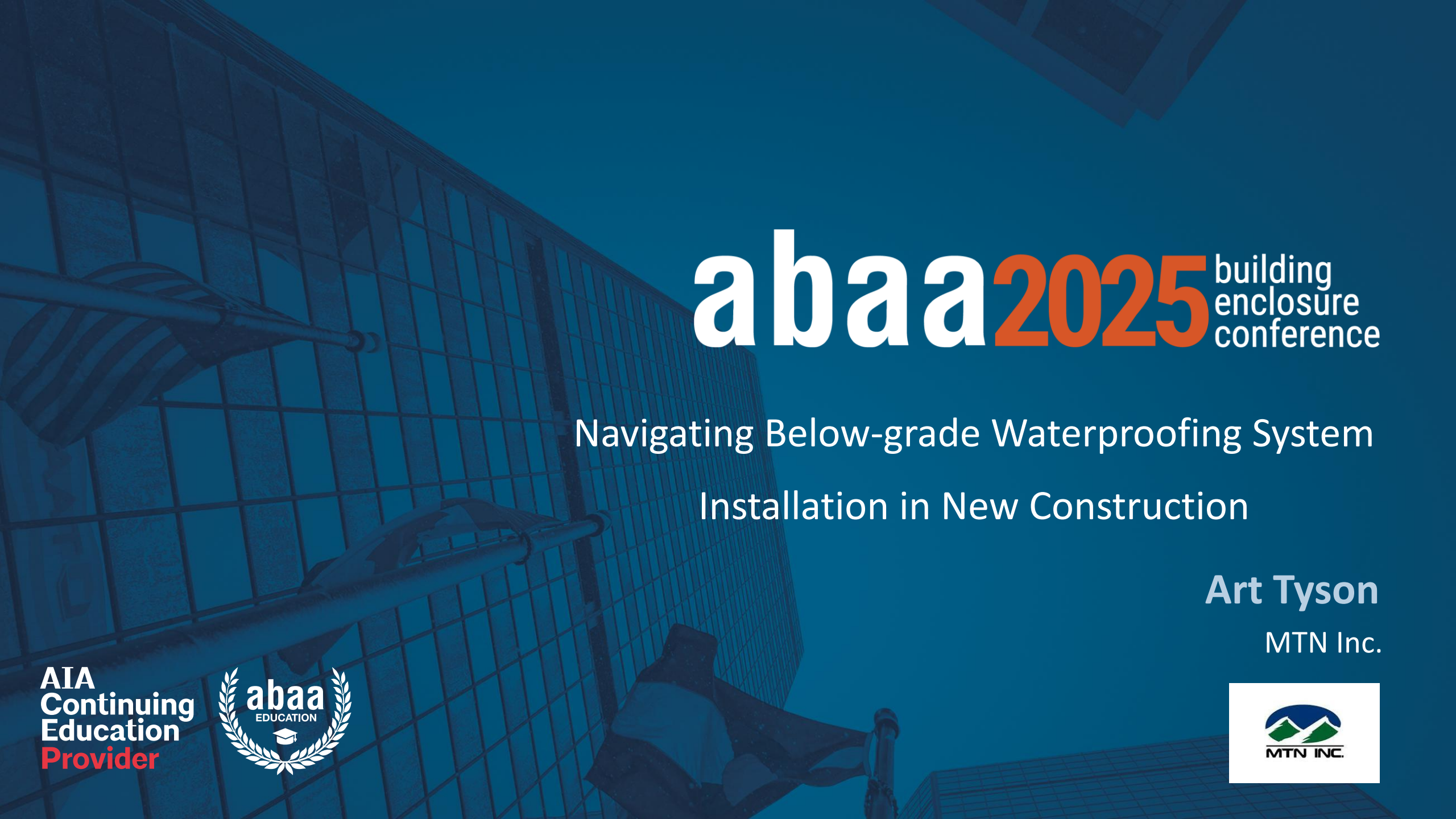

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Navigating Below-grade Waterproofing System Installation in New Construction

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MTN INC.

Navigating Below-grade (BG) Waterproofing System Installation in New Construction

Learning Objectives

1. Review Role & Importance of BG Waterproofing in Building Structures' Longevity
2. Identify & Compare Common BG WP'ing Material Types & Methods
3. Appreciate Pre-Installation and Preparation Req's for Application Substrates
4. Understand Necessary Sequencing & Mutual Coordination Amongst Interfacing Trades at Jobsite

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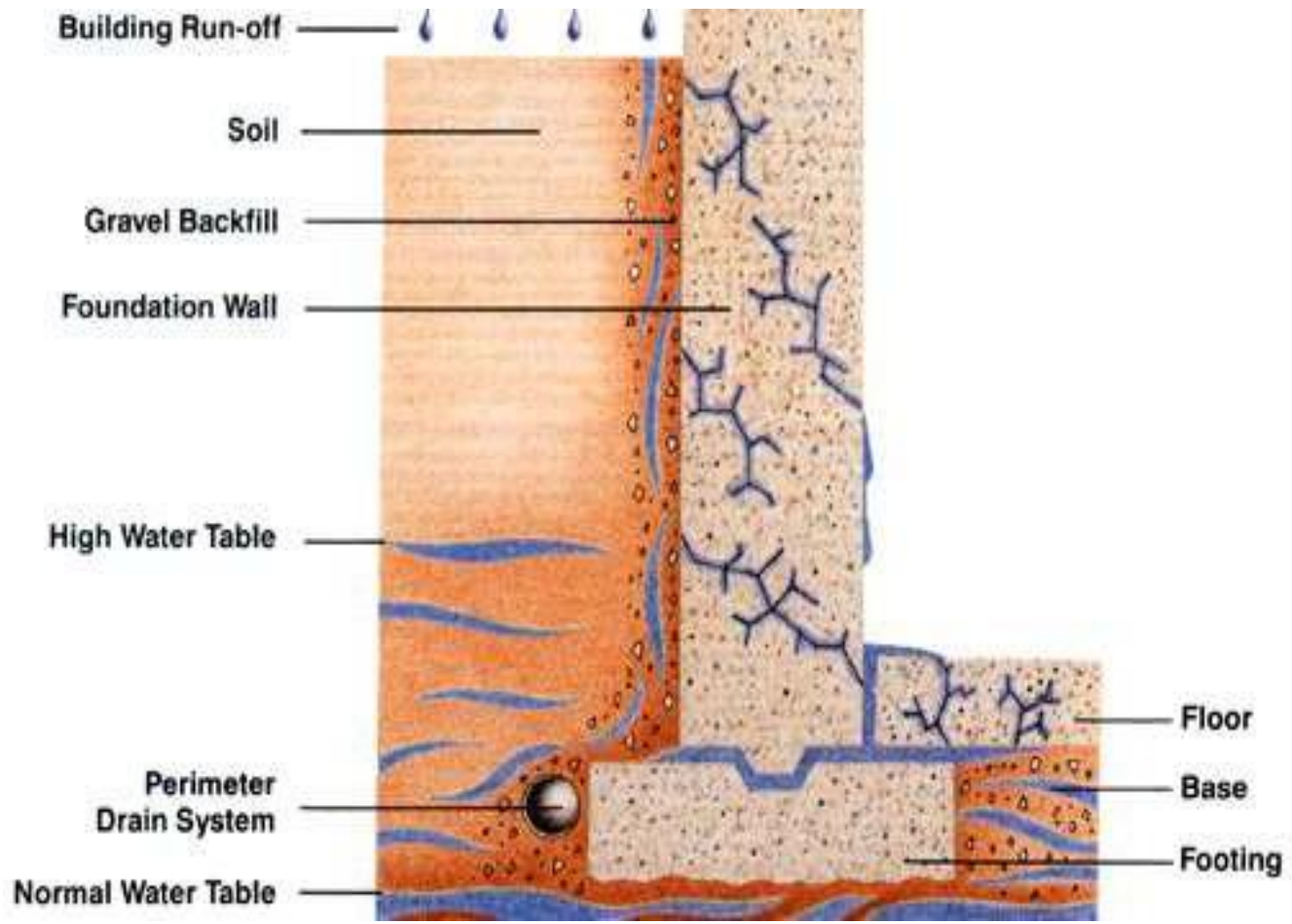
Overview:

- Why below-grade waterproof?
- General BG waterproofing methods
- Common BG waterproofing material types
- Waterproofing challenges
  - “Lesson’s Learned”

Why waterproof a structure?

. . . Substrates crack!



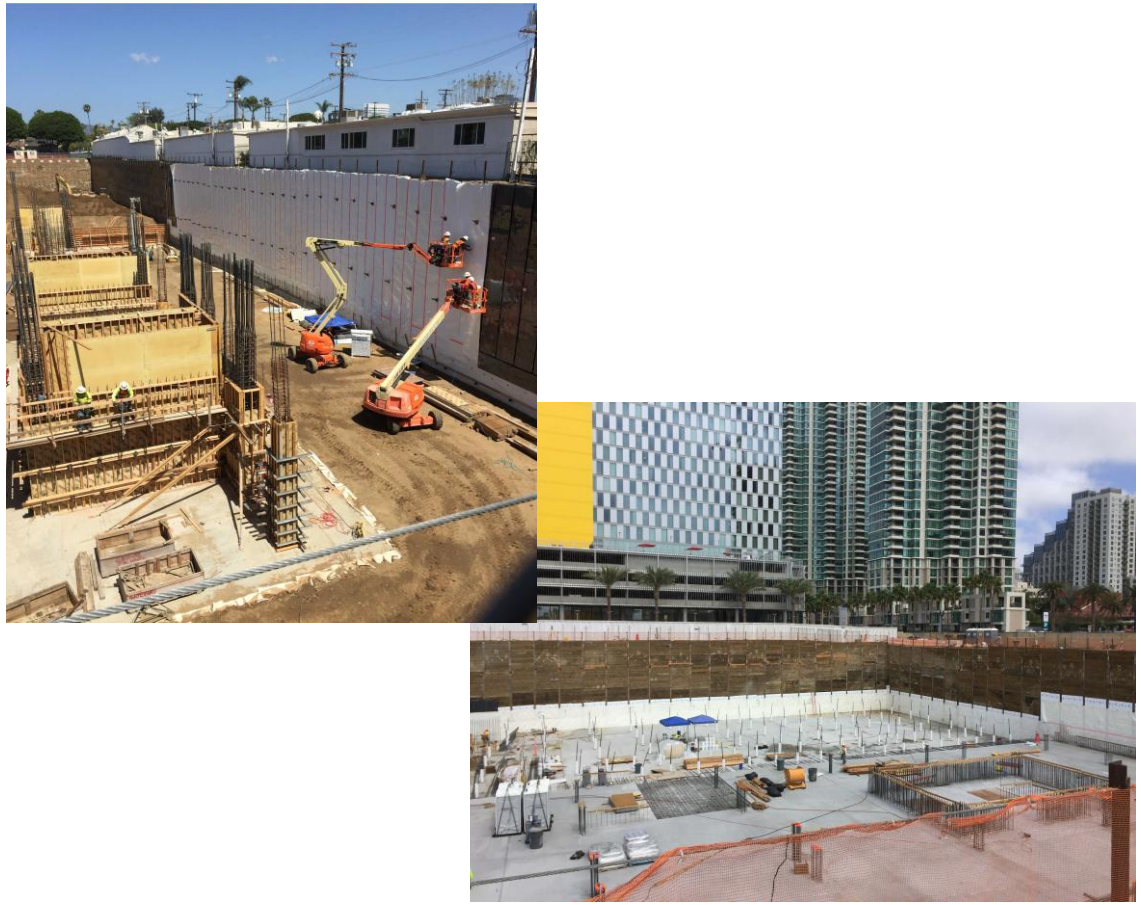
Why waterproof a structure?

. . . Challenge to mitigate!

Leaks into a building create liability, reduce durability, degrade structural integrity, and are expensive and time consuming to fix.

Methods of waterproofing – Pre-applied:

- **A.k.a. "*Blindside*" – Applied before foundation structure built**



Pros:

- Allows for maximum use of project footprint – more real estate for owner
- Ability to resist large hydrostatic force

Cons:

- Based on level & qty of detailing, may require more preplanning

Methods of waterproofing – Post-applied:

- **"*Positive Side*" – Applied to structure's foundation exterior**

Pros:

- Typically, least problematic
- Project team has ability to inspect all laps, joints, details prior to backfill

Cons:

- Requires access to outside of the structure and large/safe laydown area

Methods of waterproofing – Post-applied:

- **"*Negative Side*" – Applied to structure's interior**

Pros:

- Typically, remedial method – problem solving vs problem prevention
- Ease of application

Cons:

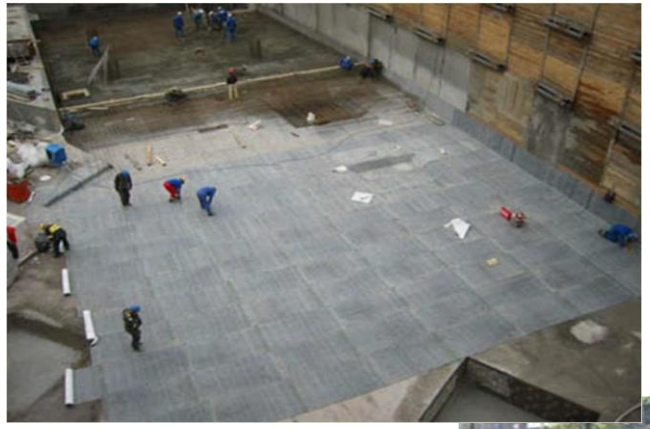
- Not as effective as positive side waterproofing due to movement and cracking
- *Poor choice for hydrostatic conditions*

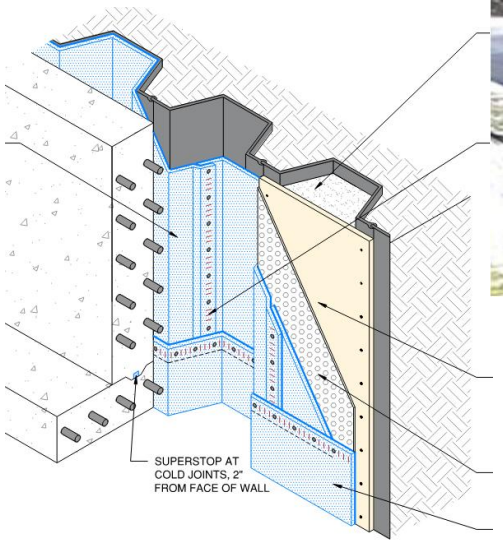
Common types of waterproofing materials:

Bituminous Sheet Membrane:

- Foundation walls, Tunnel Lids, Balconies (under tile or thin-slab)
- Positive side, “peel & stick”
- Primers typically required
- Long history and proven track record
- Requires substrate prep
- Typically, simple and easy detailing

Common types of WP'ing materials (cont'):





Bentonite Sheet Membrane:

- Under-slab, Foundation walls
- Blindside or positive side (for walls)
- Loose laid, taped or weldedseams
- When exposed to water, bentonite will swell and operate as a waterproofing membrane
- Inexpensive…
- *Requires confinement to work*
- Prone to premature hydration during rain events during installation
- *Protection-slab may be req'd*

Common types of WP'ing materials (cont'):

HDPE adhesive surfaced membranes:

- Under-slab, Foundation walls
- Single layer of HDPE w/ adhesive layer that *bonds* to concrete & structure
- Strong chemical resistance
- Strong resistance to lateral water migration
- Excellent resistance to hydrostatic pressure
- Blindside (pre-apply) only

Common types of WP'ing materials (cont'):

Sheet/liquid system designed for shotcrete foundation wall:

- Consists of textile sheet good and fluid chemical grout
- *Fills exterior-side surface voids*
- Excellent hydrostatic resistance to pressure
- Eliminates the damage commonly seen to traditional systems by other trades
- Blindside only

Common types of WP'ing materials (cont'):

Fluid Applied:

- Plazas or Podium Decks, Green Roof, Balconies
- Split-slab, Pedestal pavers, Planters
- Often *over occupied space*
- *Hot* or *Cold* Fluid-apply
- Spray, roll or squeegee applied

Common types of WP'ing materials (cont'):

Water-stops:

- Construction/pour joints, Penetrations
- Swellable (hydrophilic): Block or Gun-grade (caulk-able)
- Injectable (hydrophobic or hydrophilic):
  - Chemical grout (urethane, acrylate)

Waterproofing Challenges:

1) Where's the water-table? → What does geo-tech report say?
   a) Groundwater:
      - High water levels? Fluctuate? From above and/or below?
      - Brackish?, Perched?
      - Dewatering means, system, concerns?
   b) Contaminants: E.g., Hydrocarbons
   c) Soil type:
      - Easily displaced? Ground settlement? Expansive?
   d) Seismic issues (?)
   e) Soil retention system(s)?

2) Level of Risk – What is it..? Who is responsible?
   a) Waterproofing solution/product ability
   b) Water-table location
   c) Degree of Building Envelope (BE) Barrier, and "Continuity":
      - Full "bath-tub" w/ walls.., vs Walls only (full) vs Walls only (partial)
   d) Warranty type?: Material, Labor (Installer, Manufacturer)

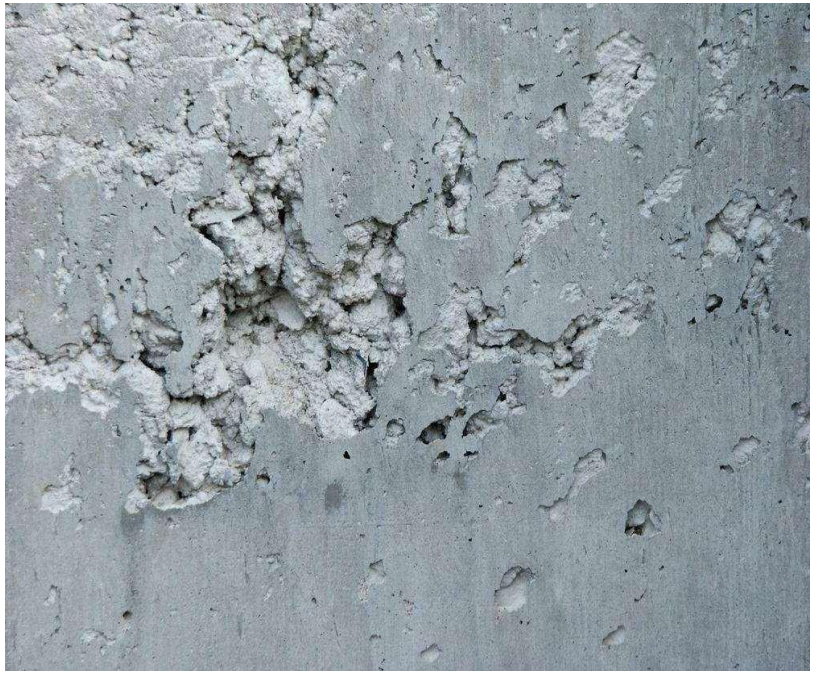
Waterproofing Challenges:

Congestion, Insufficient Access/Sequencing = Nonproductivity, poor quality. a) Sufficient protection from water, debris, traffic, staging?.., b) Who doing what/when, and who responsible?

Waterproofing Challenges (cont'):

Method of concrete placement:

- **Cast-in-place (CIP) -**
  - Longer (typically) schedule
  - Desired from wp'ing perspective
  - Less penetrations in wall system (pre vs post-apply wp'ing)
  - Voids if not well consolidated
  - Oversplash



Poor consolidation voids = Migration pathway → Repair substrate

Waterproofing Challenges (cont'):

Method of concrete placement:

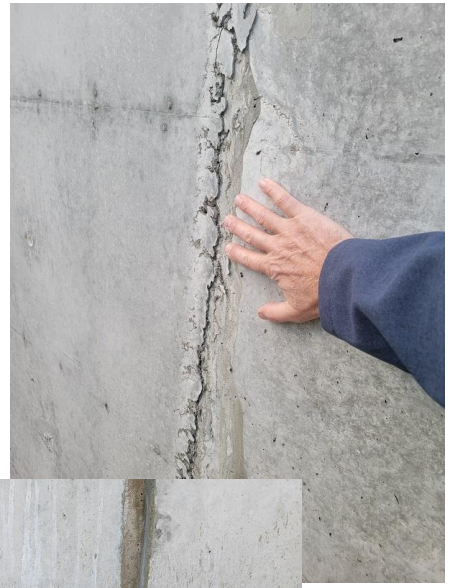
- **Shotcrete -**
  - Shorter schedule
  - Challenging from wp'ing perspective:
    - "Rebar shadowing"
    - Stabilizing the rebar cage
  - Overspray

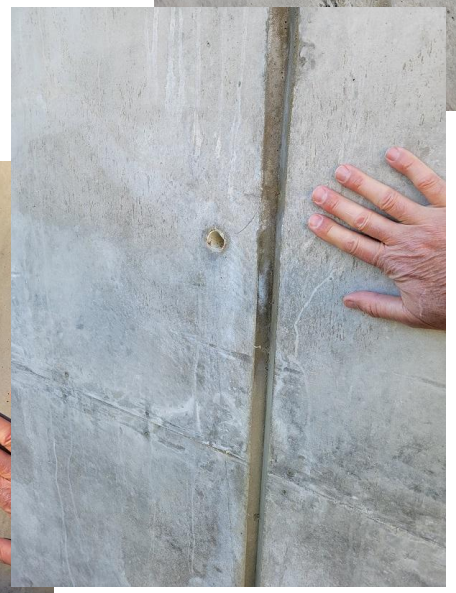
Shadowing = Migration pathway → Assure ACI shotcrete placement (Difficult remediation)

Waterproofing Challenges (cont'):

Soldier-pile lagging substrate (pre-apply) = Uneven, large gaps? → Membrane isn't as strong as formwork (to contain concrete); May require further build-up & pre-repair.

Waterproofing Challenges (cont'):





Concrete substrate (*post-apply)* = *Large* gaps, non-sound surface? → Membrane won't follow uneven contour; May require pre-repair.

Waterproofing Challenges (cont'):

Void-form substrate = Stable? → Can't move nor get wet (if cardboard design)

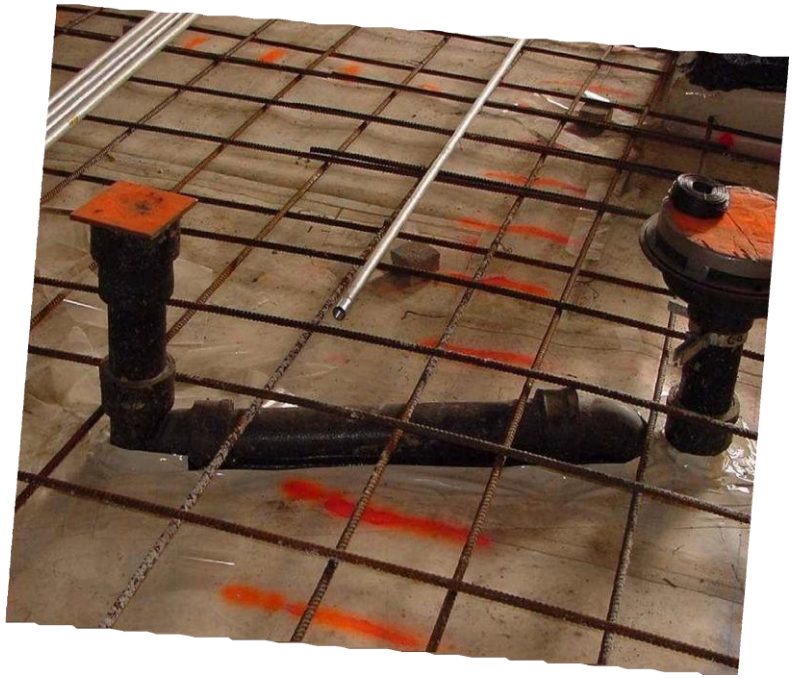
Waterproofing Challenges (cont'):

Over-splash, overspray = Creates unwanted CJ's → Provide sufficient protection; clean or wash off before set

Waterproofing Challenges (cont'):

Rebar Chairs = Strong enough?.., dissipate loading enough? → Concrete dobies typically best (if not req'd)

Waterproofing Challenges (cont'):

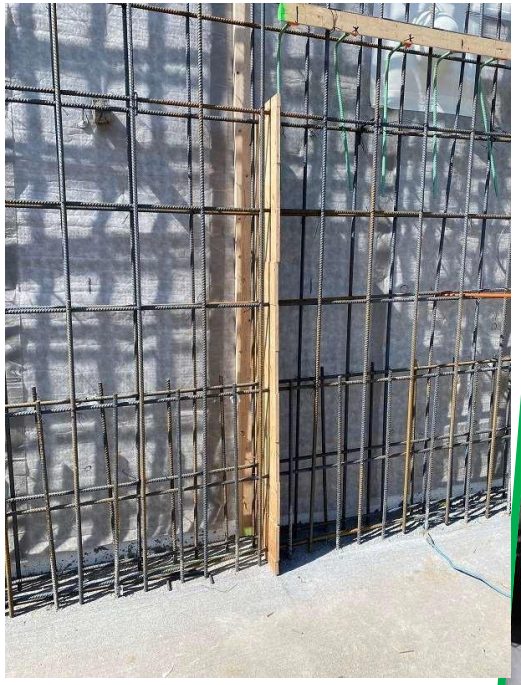


Paint on membrane = Bond-breaker (?) → Too congested to access for repair?

Waterproofing Challenges (cont'):

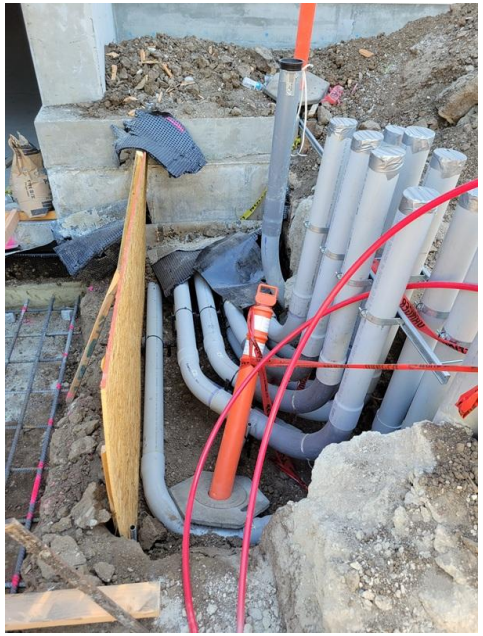
Shoring Design Impact = Tight access → a) Block-outs' de-tension plan, b) Protection plan for over-splash, seepage & over-spray.., water-stops?

Waterproofing Challenges (cont'):



Bulkheads = Tight fasteners, insufficient repair access? → Enable sufficient access for repair by bracing against steel (or min 6" away)

Waterproofing Challenges (cont'):



Penetration Clusters = Accessible for detailing? → Need a) sufficient access, and b) to be continuous, solid & rigid

Waterproofing Challenges (cont'):

Insufficient wp'ing BE (building envelope), or "Discontinuous"? = Acceptable bath-tub design? → Assure BE continuity

Waterproofing Challenges (cont'):

Critical detail areas – Specific:

- Plane changes; Irregular geometry
- Tie-backs, Tie-downs
- Pile & pier caps
- Penetration clusters (utility)
- Protection slab **(**over wp'ing**)**?
- Rakers and walers
- Bulkheads (horiz & vert): W/s's?
- Slab to wall intersection: W/s's, Sequencing; Access for best wp'ing over CJ.
- Terminations at grade

Tie-downs = Many penetrants → Assure sufficient detailing

Walers = Congestion → Assure sufficient sequencing

Waterproofing Challenges (cont'):

Expansion/movement joints, & Covers:

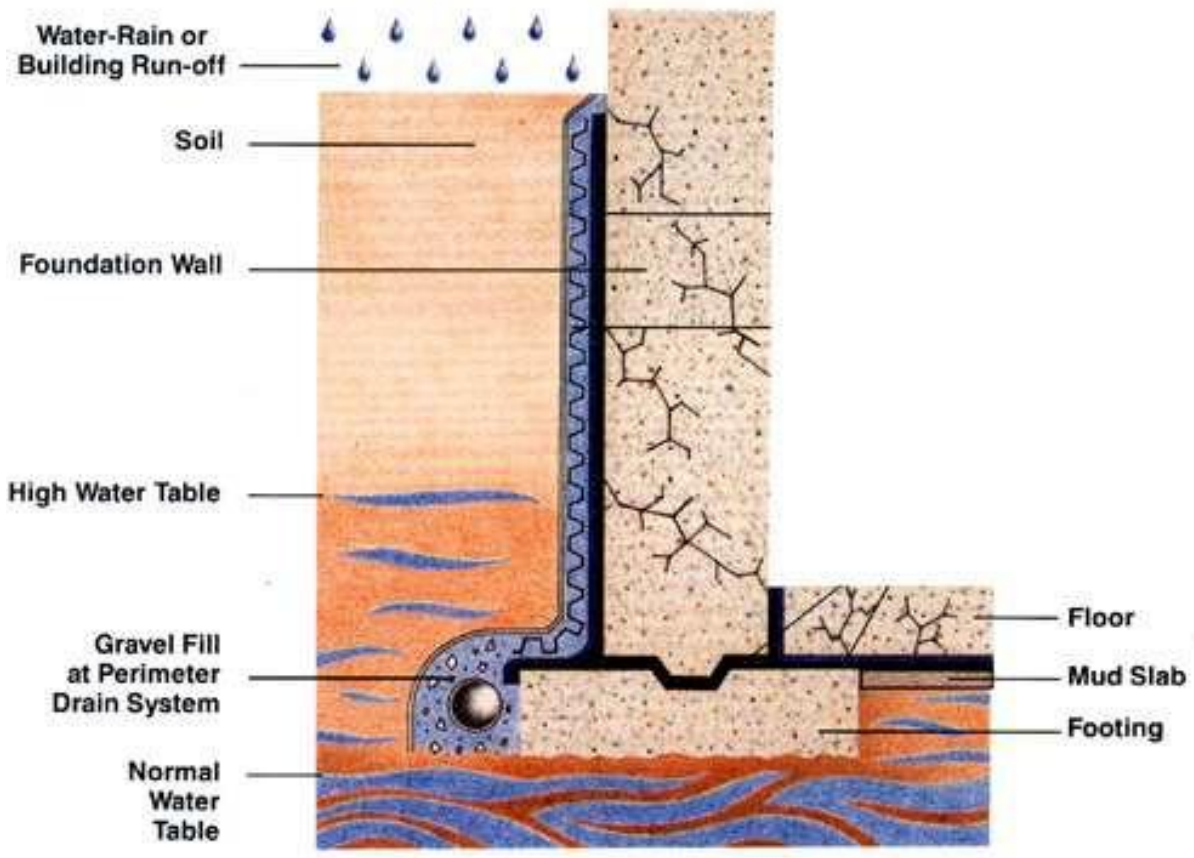
- Building structure type?
  - Large buildings w/ independent structures
  - Additions onto existing buildings
  - Garage wraps
- Who responsible?
- Movement performance req's?
- Floor/deck, Walls, Roof/ceiling.., Interior/Exterior?
- Tie-in?
- Loading?
- Fire-rating?
- Warranty?
- Substrate condition (Surfaces, Gap edges & uniformity, Gap width)?
- Final measurement?

EJ gap discontinuous = Structural cracking? → Assure continuity of casting

EJ gap not aligned = Difficult installation → Assure homogenous alignment

Waterproofing Challenges (cont'):

…Design related: Drainage and Dewatering plans?



Waterproofing Challenges (cont'):

Lessons Learned:

- Substrate: Sound, Solid, Smooth, Won't give way; Mud/Rat slab vs Earth, Void forms
- Penetrations: Qty, Location, Clusters
- Stock details may not fit actual conditions.
- Pits and Grade-beams: Discontinuity?, *Concrete is NOT waterproofing*.
- "Shop Drawings": By who? By when?

Grade-beams = Meet continuous wp'ing design? → Understand plan, Allow sufficient sequence for detailing

Waterproofing Challenges (cont'):

Lessons Learned (cont'):

- Hold pre-construction meetings w/ all trades that'll touch/interface with the waterproofing:
  - Building-envelope location(s); Where's the "dashed line"?
    - ✓ Discontinuities? → Design-team.
  - Water-table: Where?, Fluctuate?, Dewatering
  - Sequencing; Who doing what & when?
  - Mockup?:
    - ✓ Confirm actual critical details, workmanship & sequencing WILL happen!
    - ✓ Separate vs In-place vs None.
  - Protection: Who? What? How?
  - Testing: Water flood vs High-voltage Electronic
  - Inspection req's?

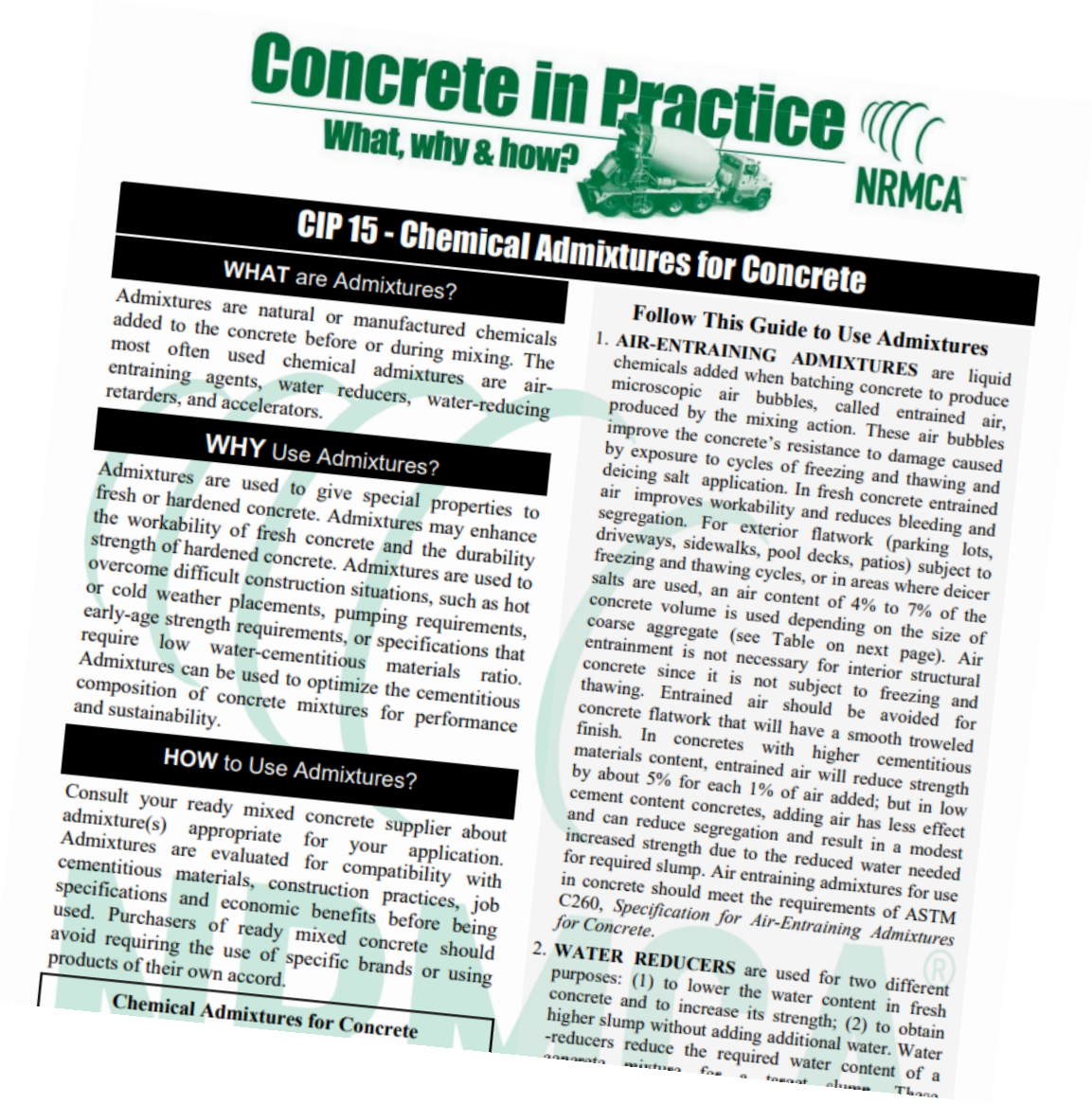
Questions?

Thank You!

Reference

“Concrete In Practice (CIP)”:

- https://www.nrmca.org/association-resources/research-and-engineering/cip/



Concrete in Practice
What, why & how?
NRMCA

CIP 15 - Chemical Admixtures for Concrete

WHAT are Admixtures?

Admixtures are natural or manufactured chemicals added to the concrete before or during mixing. The most often used chemical admixtures are air-entraining agents, water reducers, water-reducing retarders, and accelerators.

WHY Use Admixtures?

Admixtures are used to give special properties to fresh or hardened concrete. Admixtures may enhance the workability of fresh concrete and the durability strength of hardened concrete. Admixtures are used to overcome difficult construction situations, such as hot or cold weather placements, pumping requirements, early-age strength requirements, or specifications that require low water-cementitious materials ratio. Admixtures can be used to optimize the cementitious composition of concrete mixtures for performance and sustainability.

HOW to Use Admixtures?

Consult your ready mixed concrete supplier about admixture(s) appropriate for your application. Admixtures are evaluated for compatibility with cementitious materials, construction practices, job specifications and economic benefits before being used. Purchasers of ready mixed concrete should avoid requiring the use of specific brands or using products of their own accord.

Chemical Admixtures for Concrete

Follow This Guide to Use Admixtures

1. **AIR-ENTRAINING ADMIXTURES** are liquid chemicals added when batching concrete to produce microscopic air bubbles, called entrained air, produced by the mixing action. These air bubbles improve the concrete's resistance to damage caused by exposure to cycles of freezing and thawing and deicing salt application. In fresh concrete entrained air improves workability and reduces bleeding and segregation. For exterior flatwork (parking lots, driveways, sidewalks, pool decks, patios) subject to freezing and thawing cycles, or in areas where deicer salts are used, an air content of 4% to 7% of the concrete volume is used depending on the size of coarse aggregate (see Table on next page). Air entrainment is not necessary for interior structural concrete since it is not subject to freezing and thawing. Entrained air should be avoided for concrete flatwork that will have a smooth troweled finish. In concretes with higher cementitious materials content, entrained air will reduce strength by about 5% for each 1% of air added; but in low cement content concretes, adding air has less effect and can reduce segregation and result in a modest increased strength due to the reduced water needed for required slump. Air entraining admixtures for use in concrete should meet the requirements of ASTM C260, *Specification for Air-Entraining Admixtures for Concrete.*
2. **WATER REDUCERS** are used for two different purposes: (1) to lower the water content in fresh concrete and to increase its strength; (2) to obtain higher slump without adding additional water. Water -reducers reduce the required water content of a

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Art is a Sr. Tech Engr. for MTN Inc., a national Division-7 waterproofing and specialty contractor.

In his previous role, Art spent 17 years with a global building envelope membrane and concrete admixture manufacturer, supporting performance-based design, preconstruction, installation, and post-construction needs for high profile and high risk construction projects.

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