DESIGN CONSIDERATIONS TO IMPROVE PARKING GARAGE RESILIANCY

Question today

imagine tomorrow

Create for the future

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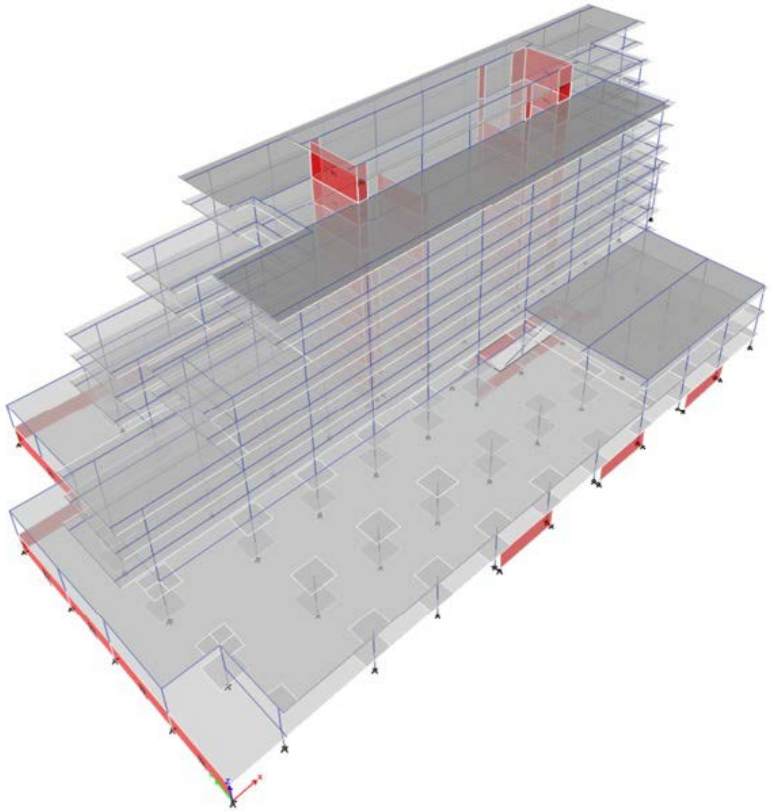
Intro

- We develop creative, comprehensive and sustainable engineering solutions for a future where society can thrive. Equipped with an intimate understanding of local intricacies, world-class talent and proactive leadership, we plan, design, manage and engineer long lasting and impactful solutions to uniquely complex problems.

- Expertise includes parking garage condition surveys, concrete deterioration assessments, expansion joint seal repairs, traffic topping upgrades or replacement, concrete repairs, repair design services, preparation of tender documents, construction review and contract administration.

Case Study

- Two-Storey Parking Garage Beneath Office Towers
- Conventionally Reinforced Concrete Structure
- Significant Concrete Restoration:
  - Mostly full slab replacement



Case Study

- Physical Environment
  - ±45 Years Old
  - Canadian/Northern Temperatures
  - De-icing Salts

- Socio-Economic Environment
  - 24/7 Need for Parking
  - Parking Revenue
  - Cost of Repairs / Loss of Use

Background

- Primary concern is structure and life safety
- Look at building improvements, not looking to change the environment in which they operate
- Environmental sustainability (LEED/etc.) not directly considered

Expectations and Objectives

- From Owner Perspective:
  - Maximize life cycle, minimize interventions
  - Minimum disruption to revenue stream
  - Limit liability (Life safety and Property)
  - Satisfied tenants (if applicable)
- From Tenant Perspective:
  - Parking at work
  - Feels safe
- From Consultant/Engineer Perspective:
  - Restore structure to original design, or better

Garage Repairs

Existing Concrete Conditions

- Design compressive strength: 27.5MPa (4000PSI)
- No corrosion inhibiting admixtures
- Carbonation front at or beyond depth of reinforcing
- Chloride contaminated
- No air-entrainment (heated garage)

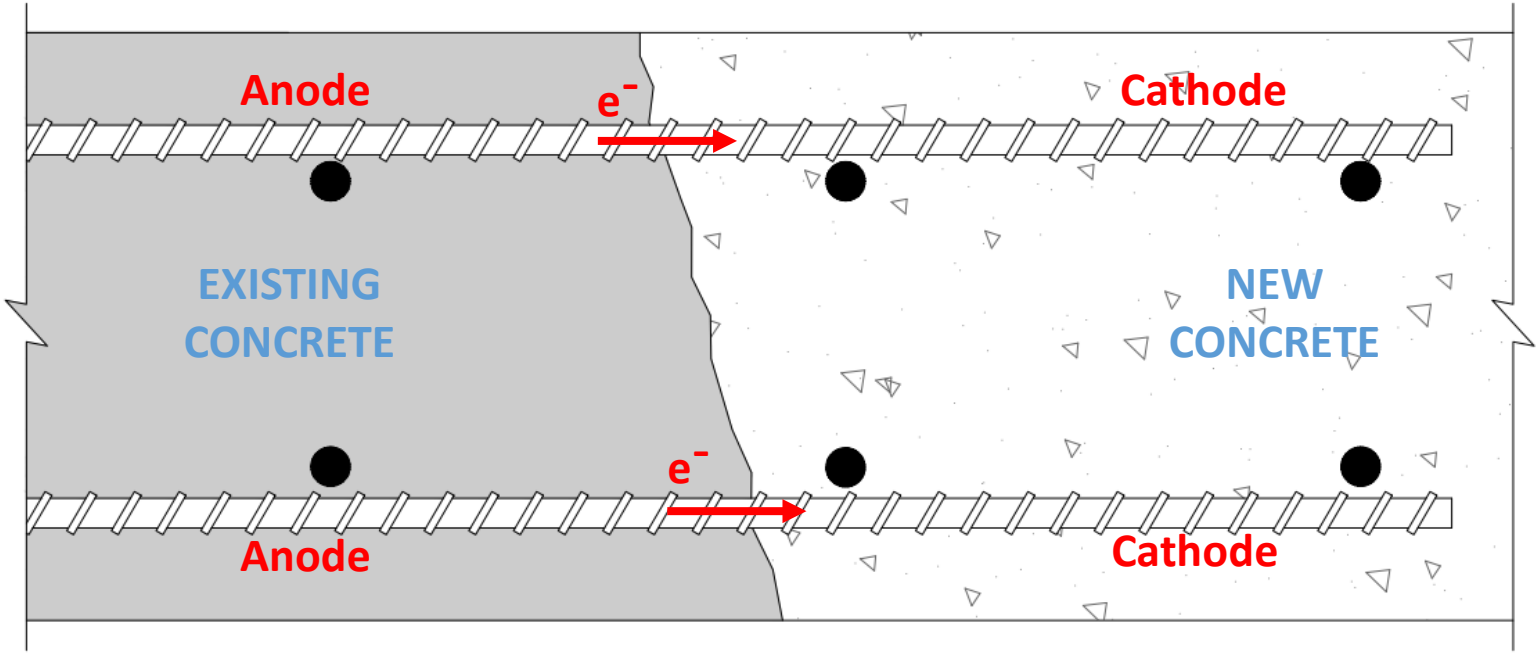
Within Repair Area:

- 75%+ delaminated slab top side
- 50%+ delaminated slab soffit

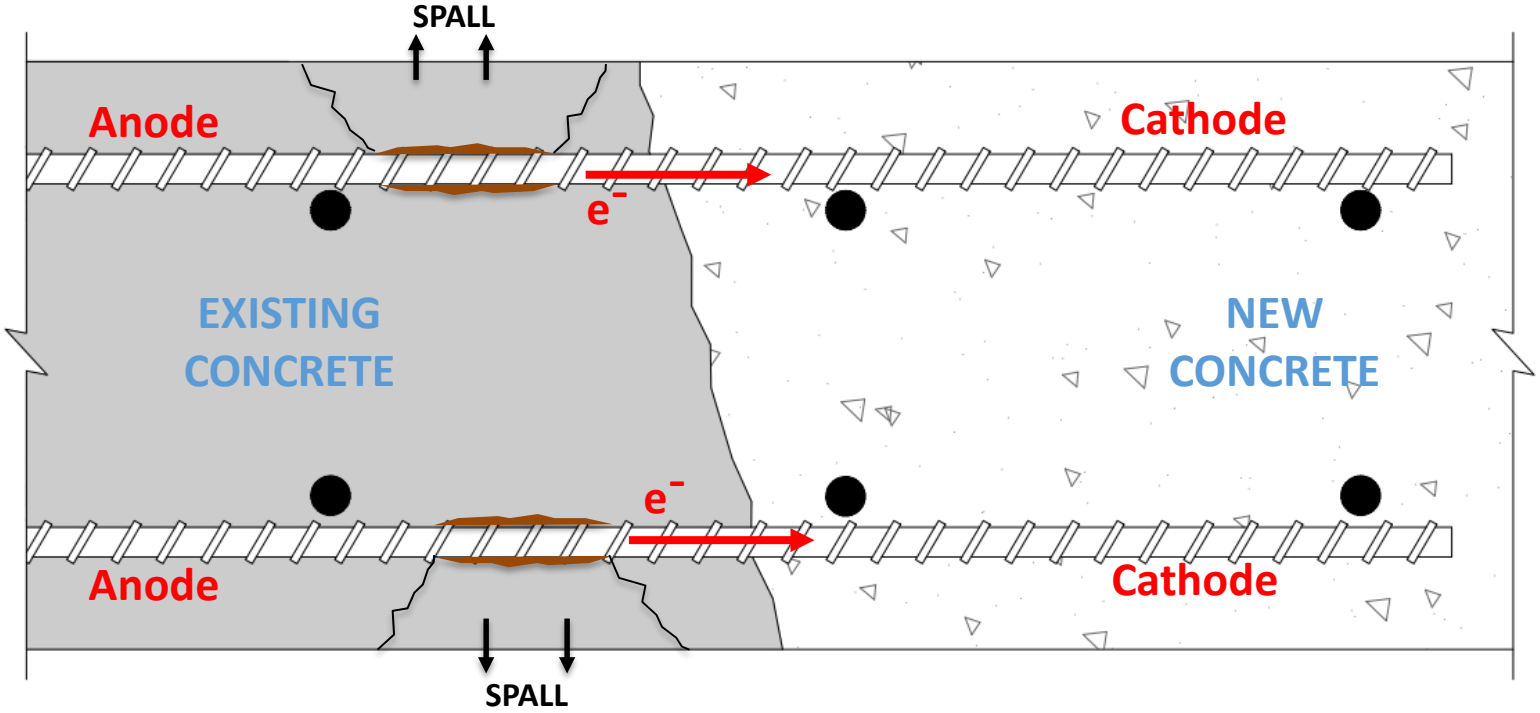
Repair Methodology

- Typical Repairs (Chip, Prep, Patch)
- Potential Upgrades
  - Corrosion Protection
  - Corrosion Inhibitors
  - Anti-Carbonation Coatings
  - Waterproofing

Incipient Anode Effect



Incipient Anode Effect



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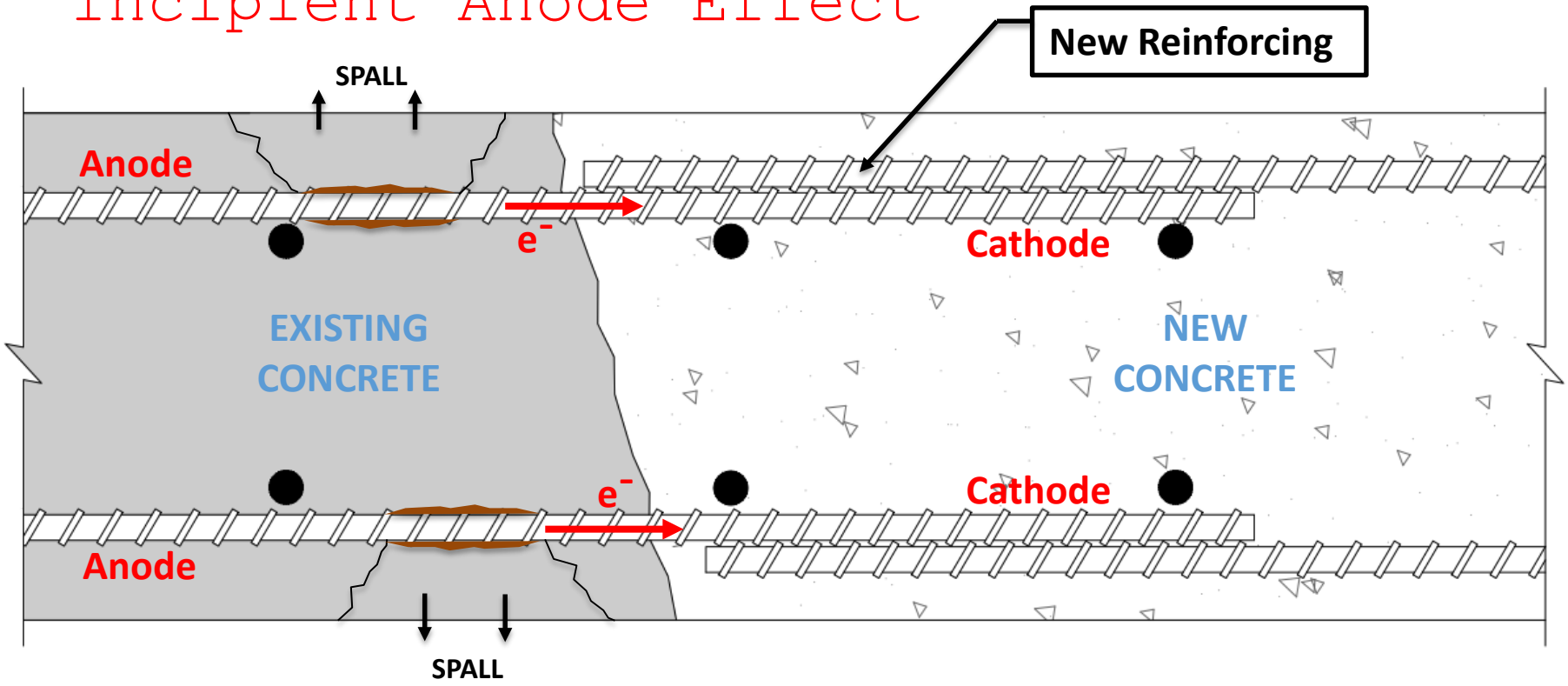
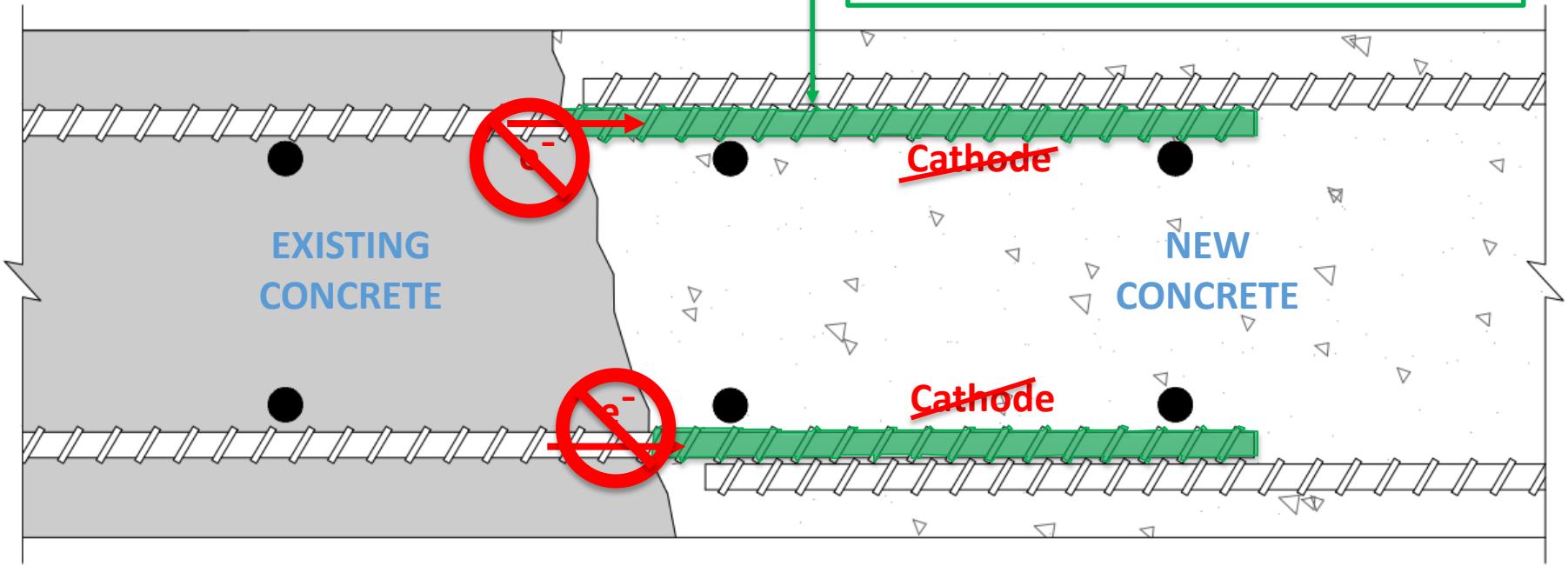


So, how do we mitigate this risk?

Corrosion Protection

Epoxy coating electrochemically isolates existing bars from new concrete, eliminating electrical flow.



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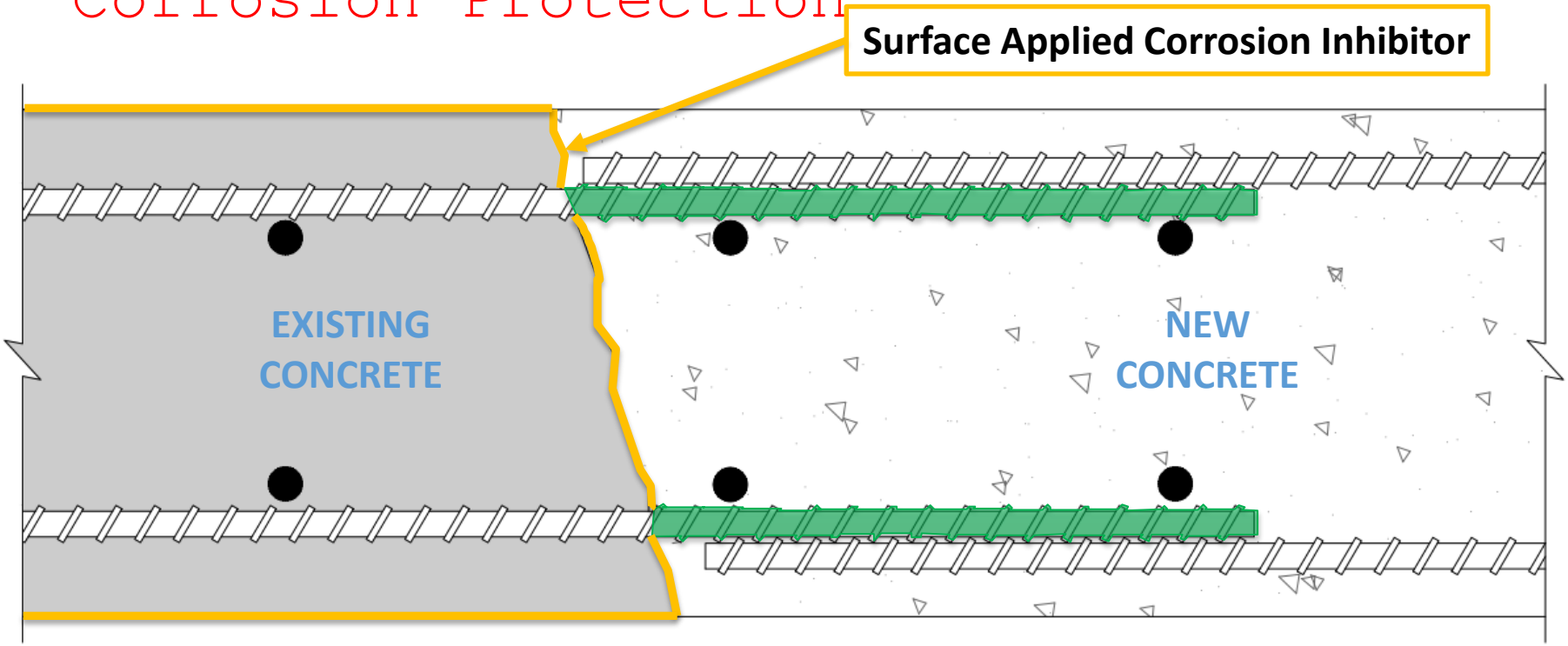

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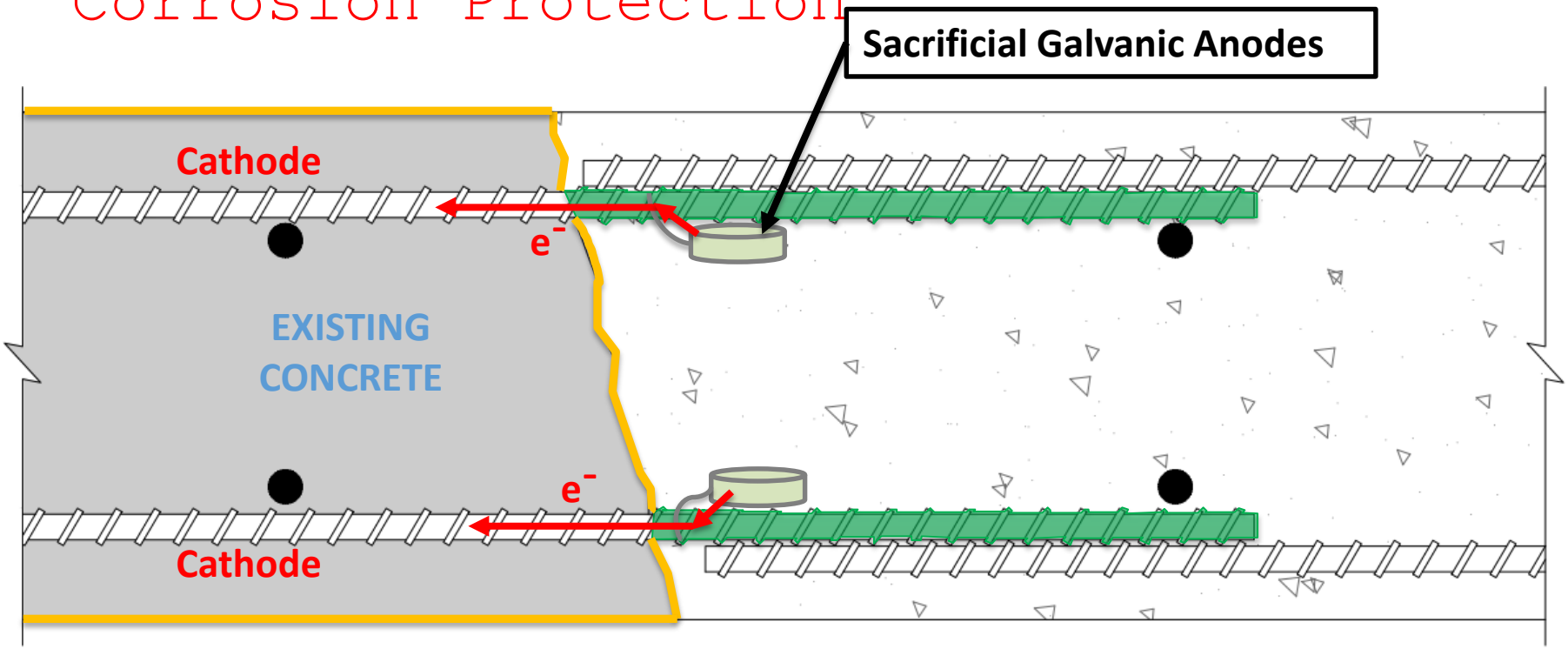

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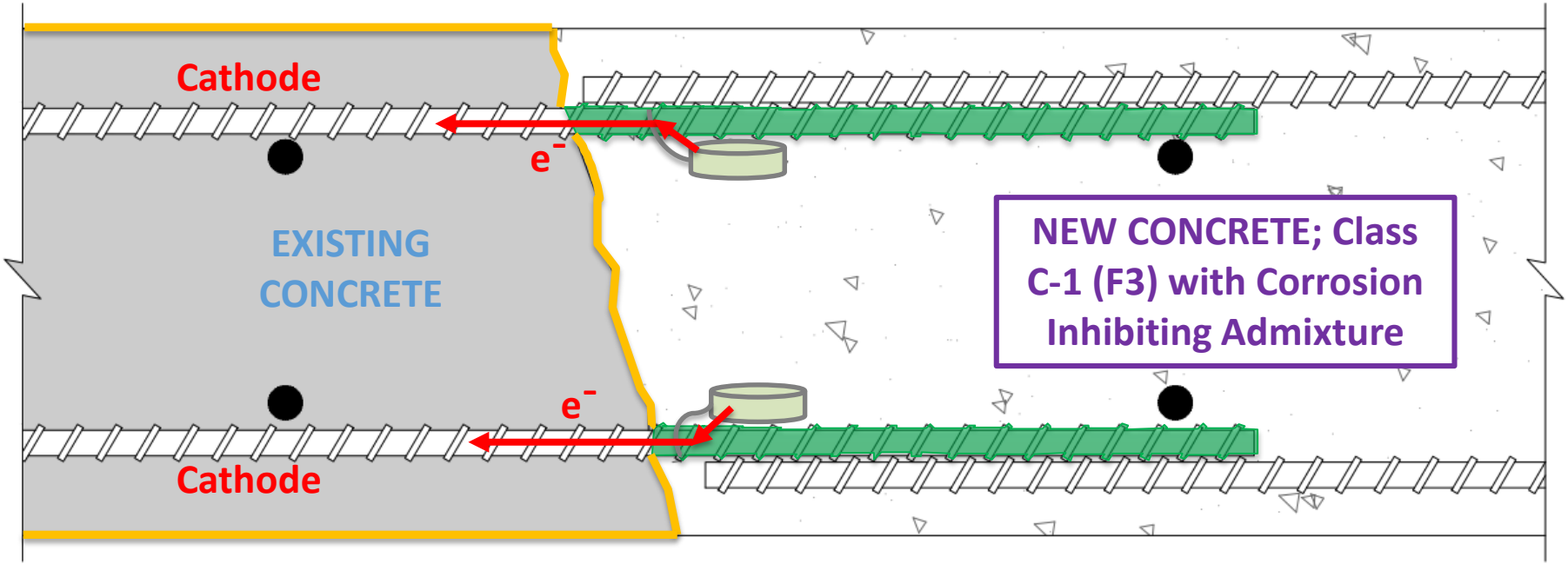
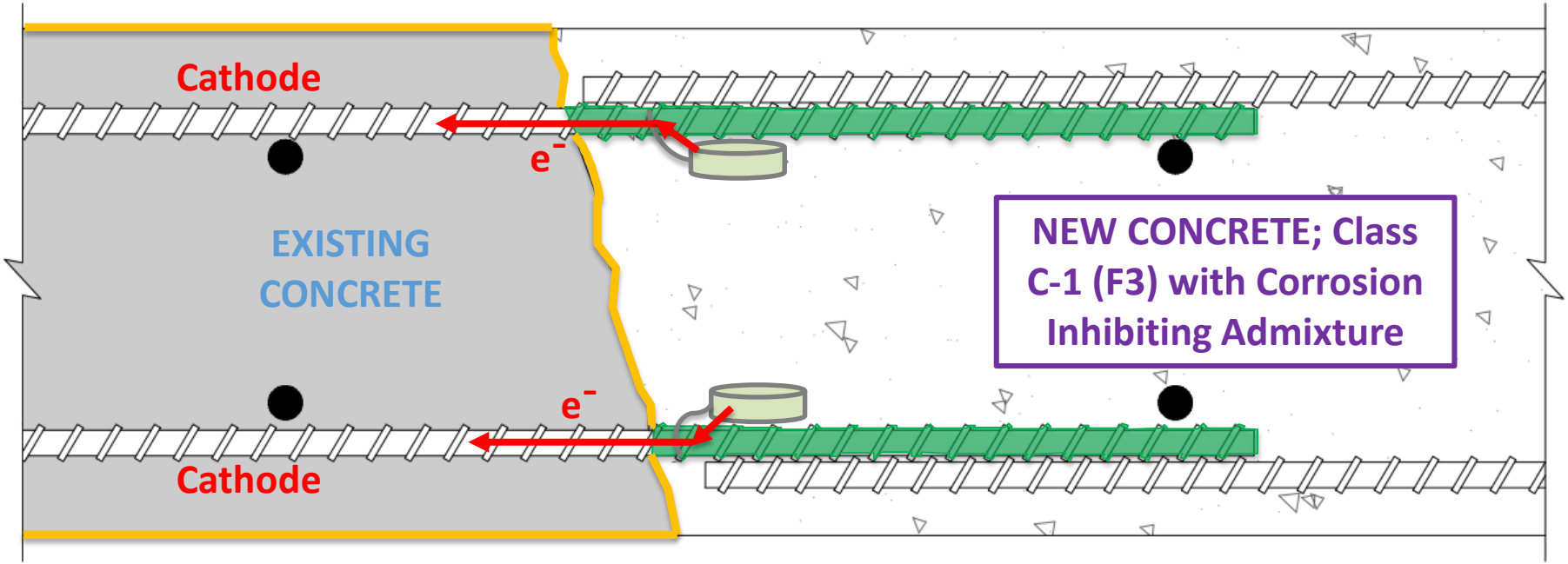


Anti-Carbonation Coating

- Maintain passive layer around reinforcing steel as long as possible.
- Vapour resistant coatings on exposed slab sof

Corrosion Protection



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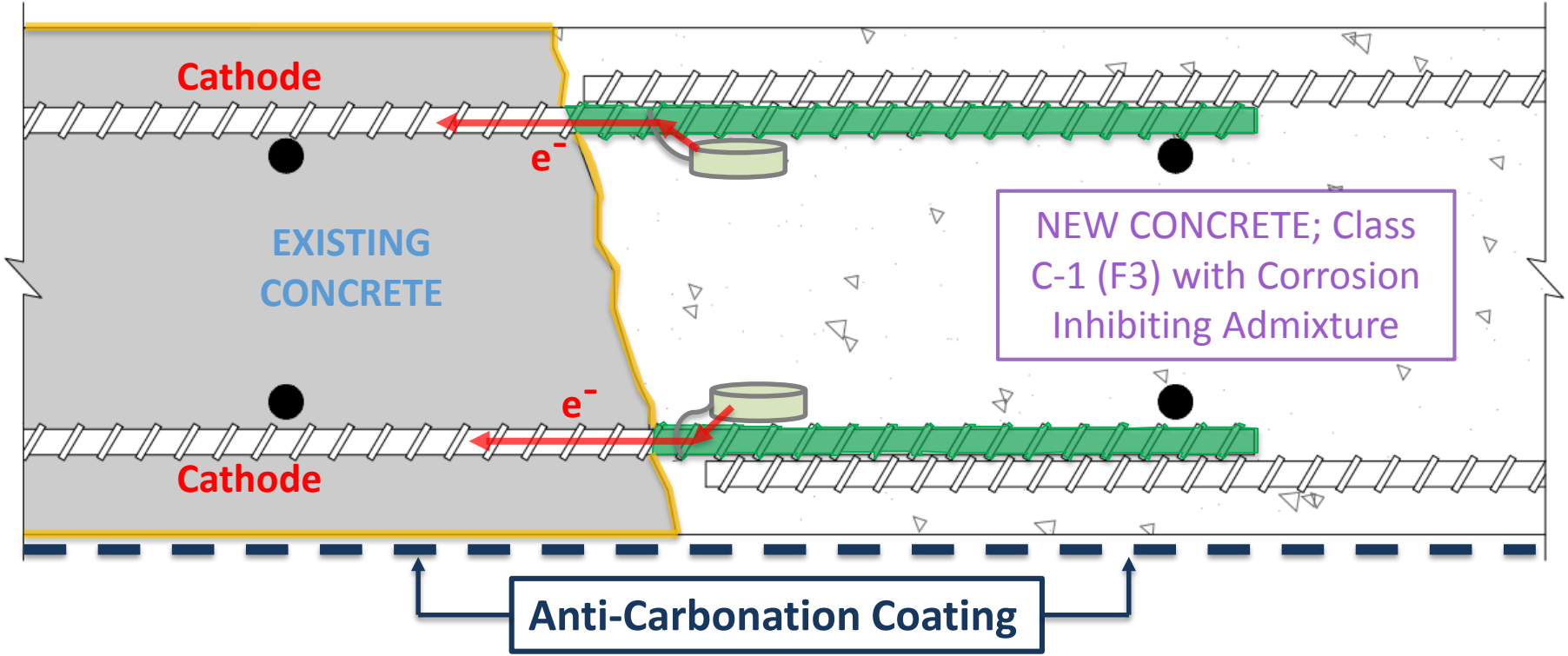

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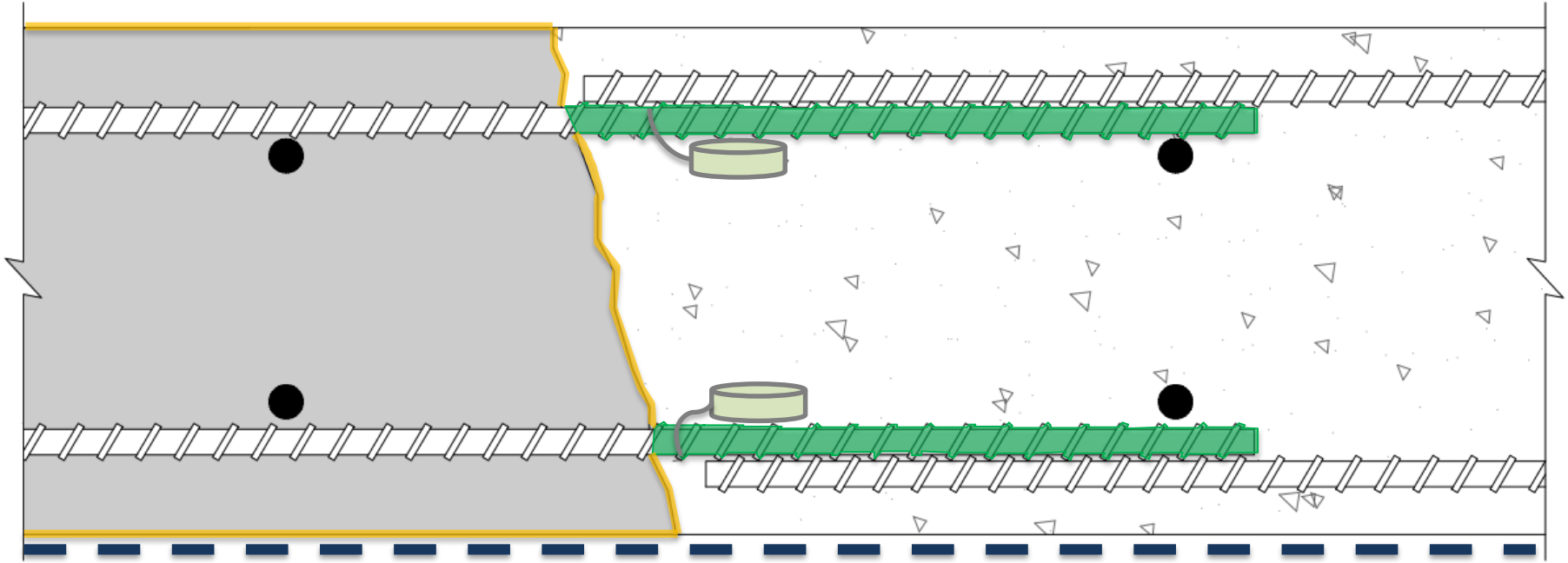
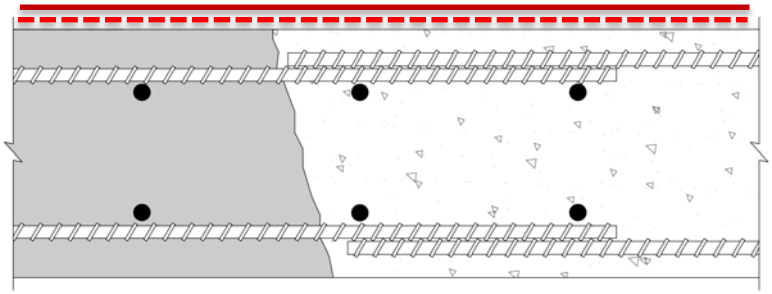
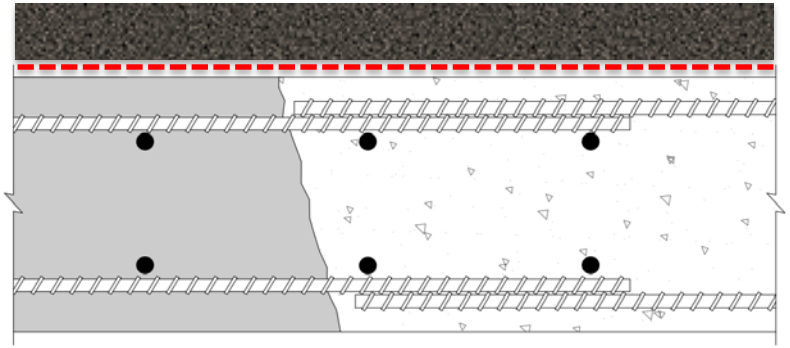


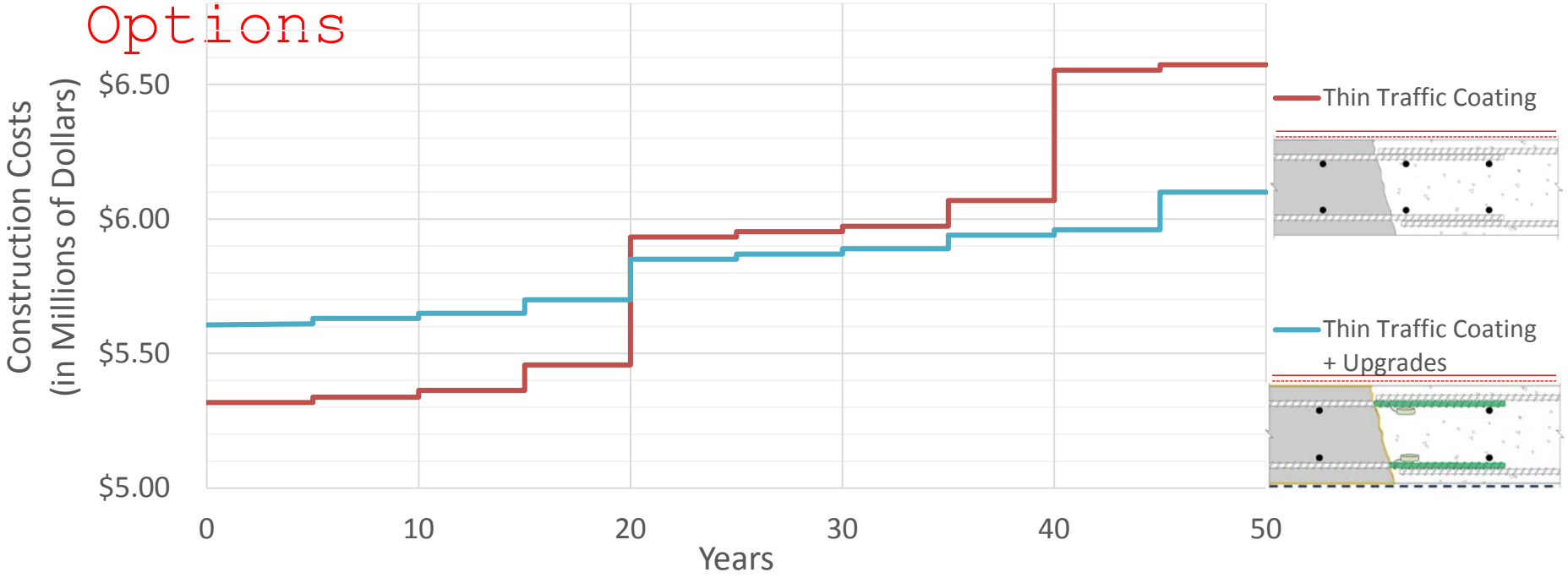
Waterproofing

- Thin Traffic Topping or Thick Traffic Topping?
  - Full Slab Replacement
  - Main Drive Aisles of Garage

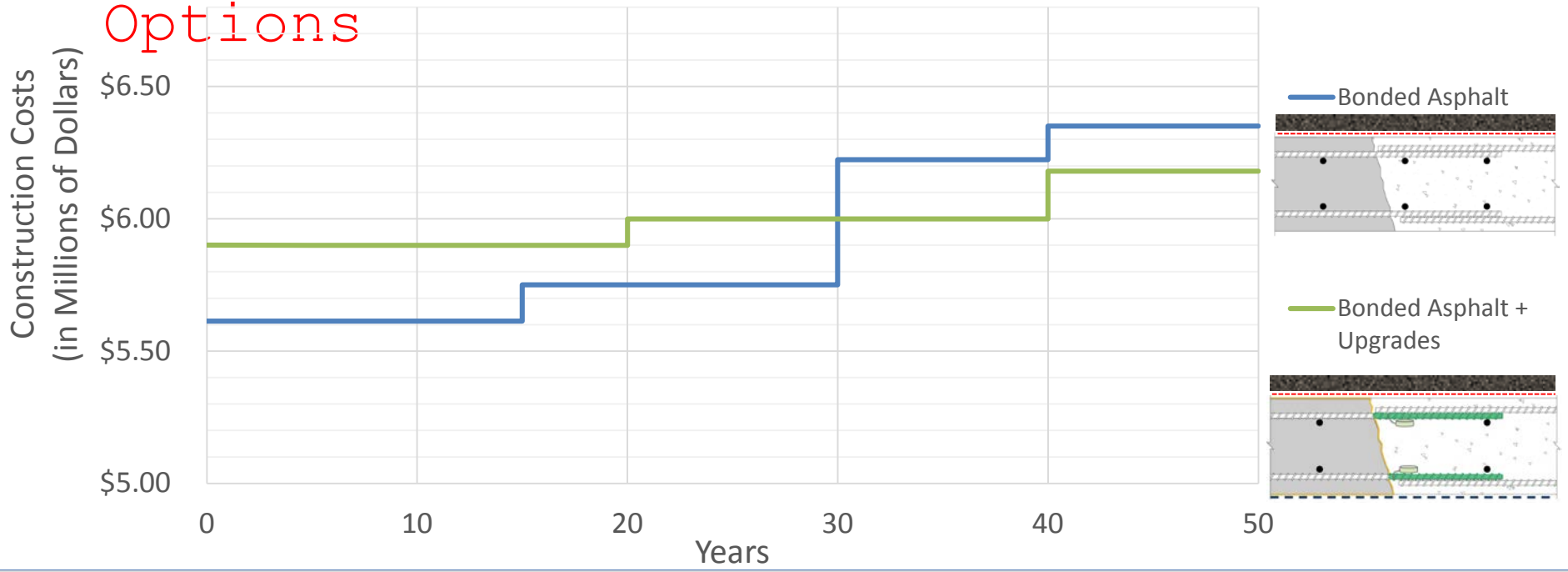




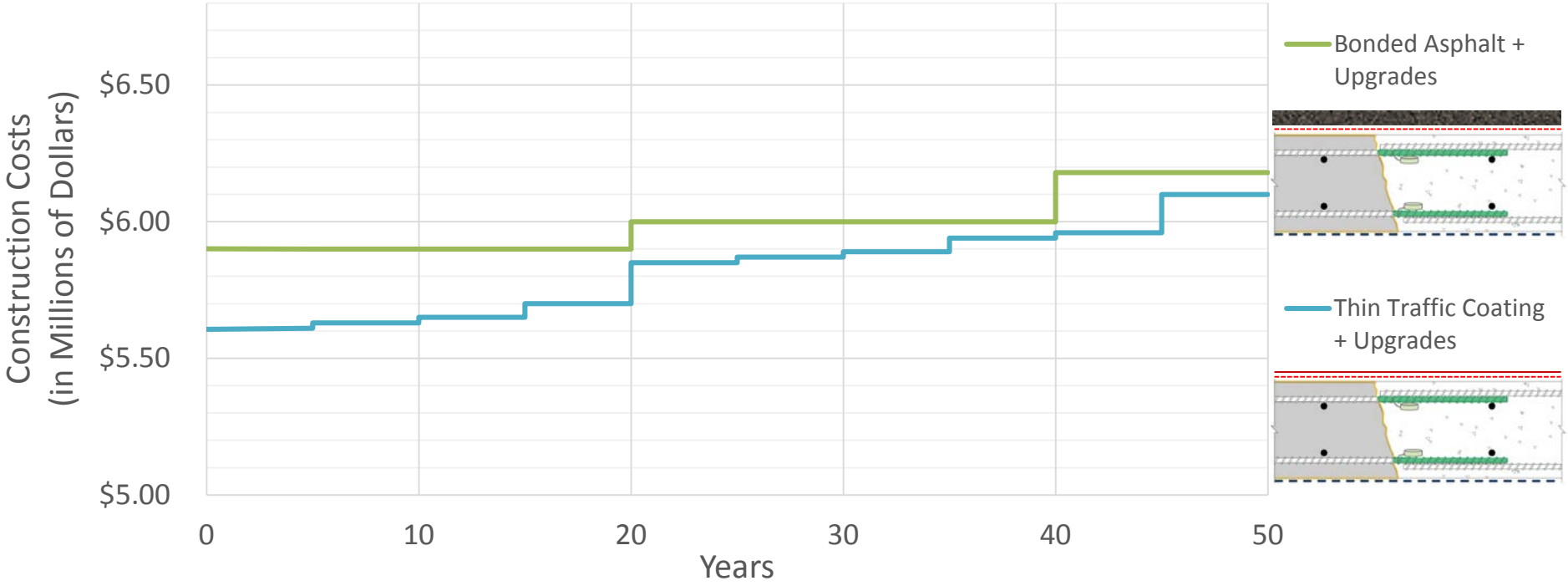
Life-Cycle Analysis
Comparison of Thin Traffic Coating Options



Life-Cycle Analysis
Comparison of Thick Traffic Coating Options



Life-Cycle Analysis
Comparison of Thick vs Thin Systems



QUESTIONS?

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