Repair Concrete With Concrete

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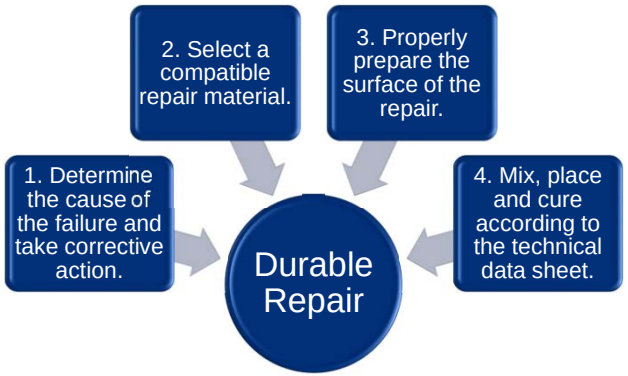
Concrete Repair Strategy

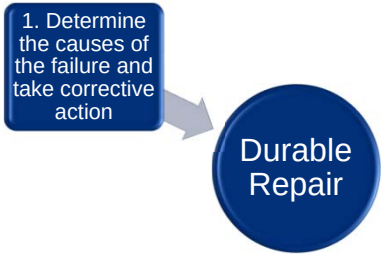
Concrete? Repair Mortar? Grout?

Question is? Why wouldn't you use concrete?

Concrete Repair Strategy



Concrete Repair Principles



Concrete Repair Strategy

Deterioration Causes

What is the cause of the deterioration?

- Design Issues
- Construction Errors
- Lack of Maintenance
- Material Defects
- Lack of Concrete Cover
- Environment



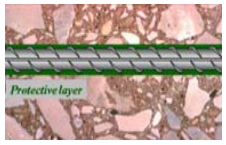


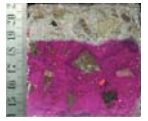
Concrete Repair Strategy

Deterioration Types

What is the type of deterioration?

- Corrosion
- Freezing & Thawing
- Salt Scaling
- Moisture Intrusion
- Chemical Attack

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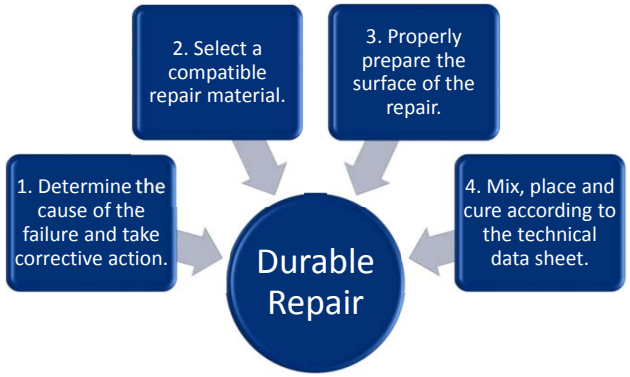
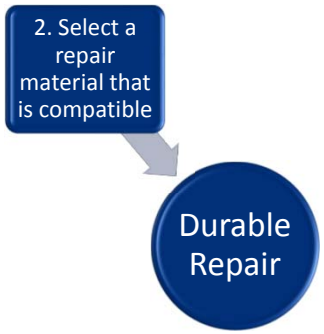


Concrete Repair Strategy



Concrete Repair Strategy

Material Selection

Repair Strategy | Repair Material Selection ⟷ Repair Method Selection

Things to consider during selection process:

- Substrate
- Depth of repair
- Type of repair
- Exposure Conditions

Concrete Repair Strategy

Material Selection

- Compatibility Properties
  - Modulus of Elasticity
  - Thermal Coefficient of Expansion
  - Shrinkage
- Durability Properties
  - Resistance to Freeze/Thaw Cycles
  - Resistance to Salts Scaling due to De-icing Salts
  - Porosity and Resistance to Chloride Ions Penetration

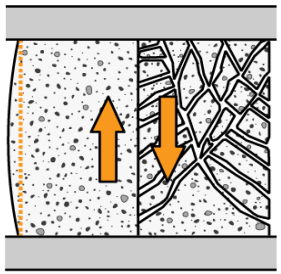
Concrete Repair Strategy

Material Selection

Modulus of Elasticity

The Deformation of Concrete Under Load

DESIGN CRITERIA: Engineer designs the repair with a specific load carrying capacity



COMPABILITY PROBLEM If the repair material deforms at a different rate than the parent concrete, the repair will fail

- Similar stiffness & strain capacity

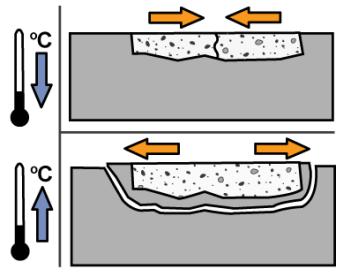
Concrete Repair Strategy

Material Selection

Coefficient of Thermal Expansion

The Rate at Which Concrete Expands and Contracts During Changes in Temperature

As temperatures fall, surrounding concrete contracts



As temperatures rise, surrounding concrete expands

COMPABILITY PROBLEM If the repair material expands or contracts at a different rate than the parent concrete, the repair material will crack or the bond between the repair material and the parent concrete will fail

- Similar thermal behaviour

Concrete Repair Strategy

Shrinkage

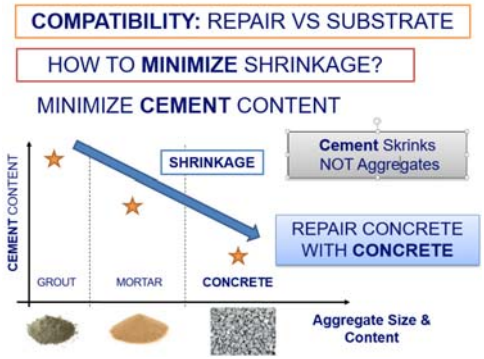
- Types of shrinkage
  - Plastic shrinkage
  - Autogenous shrinkage
  - Drying shrinkage

- All types of shrinkage affect **all** cementitious based materials.

Concrete Repair Strategy

Material Selection

What should we consider before making a material selection?



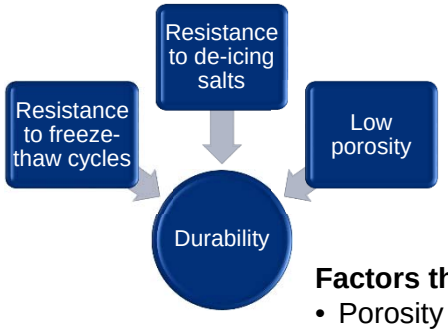
Concrete Repair Strategy

Shrinkage

- Shrinkage can be reduced using several measures
  - Low water/cement ratio
  - Optimum aggregate gradation
  - Optimum cementitious content
  - Proper curing techniques
  - Admixture (shrinkage compensating or expaning)

Concrete Repair Strategy

Durability Factors



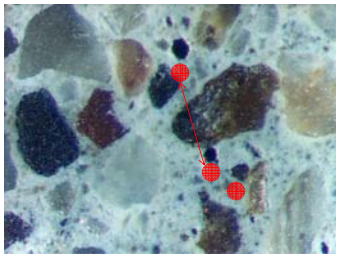
Factors that affect durability

- Porosity of material
- Air void system
- Curing Method

Concrete Repair Strategy

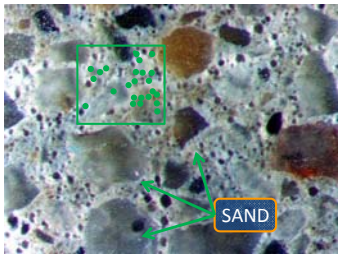
Durability Factors – Air Entrainment

NON AIR ENTRAINED



- LARGE AIR VOIDS (>1 mm)=HIGH SPACING FACTOR
- 1-3% AIR VOLUME IS ENTRAPPED AIR

AIR ENTRAINED



- SMALL AIR VOIDS (0.001 mm-0.5 mm)=LOW SPACING FACTOR
- 4-9% AIR VOLUME IS ENTRAPPED AND ENTRAINED AIR

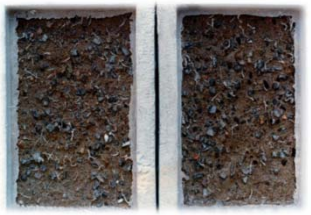
Concrete Repair Strategy

Durability Factor – Freeze / Thaw

AIR ENTRAINED

✓LOW MATERIAL LOSS DURING FREEZE-THAW CYCLING IN THE PRESENCE OF DE-ICING SALTS

NON AIR ENTRAINED



✖ EXCESSIVE MATERIAL LOSS DURING FREEZE-THAW CYCLING IN PRESENCE OF DE-ICING SALTS

Concrete Repair Strategy

Resistance to Chloride Ion Penetration

Low Porosity

- Improves Performances
- Reduces Permeability
- Reduces/Slows Chloride Ingress
- Reduces/Slows water, oxygen and carbon dioxide. (carbonation)
- Improves Durability

ASTM C 1202

COULOMBS	CHLORIDE ION PENETRABILITY
>4000	HIGH
2000-4000	MODERATE
1000-2000	LOW
100-1000	VERY LOW
<100	NEGLIGIBLE

Concrete Repair Strategy

Material Selection

REPAIR CONCRETE WITH CONCRETE

COMPATIBITY IS CRUCIAL

HIGH QUALITY CONCRETE IS THE MOST **COMPATIBLE, DURABLE** AND **COST EFFECTIVE** MATERIAL FOR REPAIRING CONCRETE STRUCTURES

Concrete Repair Strategy

Types of Repair

Material Selection?

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Thank You / Merci

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