

KNOWLEDGE SHARING

PATCH REPAIR & REBAR TREATMENT



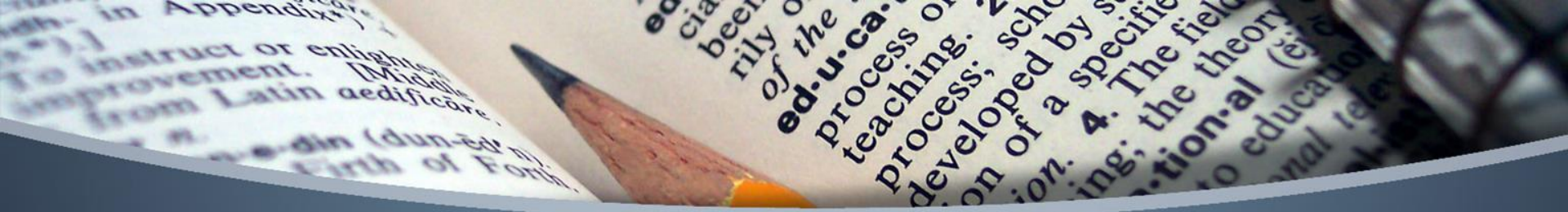
INTRODUCTION OF BUILDING DEFECTS

- Definition of defects
 - Something that does not come up to the expectations of the clients, falls below the prescribed standard for things of its kind, less acceptable than it ought to be or the result of an error (Puller-Strecker, 1990)
 - A fault in an element, material or component of a building. On the other hand, a building failure is here meant as a consequence of such a defect/ fault (James Douglas et. al., 2007)



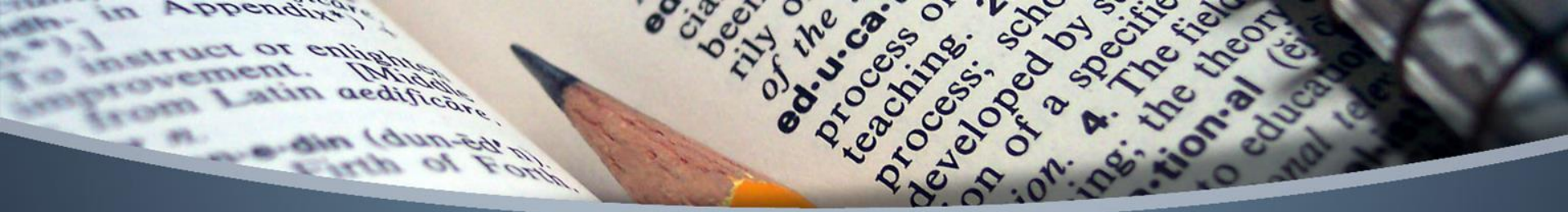
INTRODUCTION OF BUILDING DEFECTS

- Categories of errors (CIDB 1993)
 - Pre-design errors – poor or inadequate brief
 - Design errors – unusual or awkward details leading to leaks
 - Construction errors – bad workmanship
 - Maintenance errors - lack of regular/ scheduled maintenance



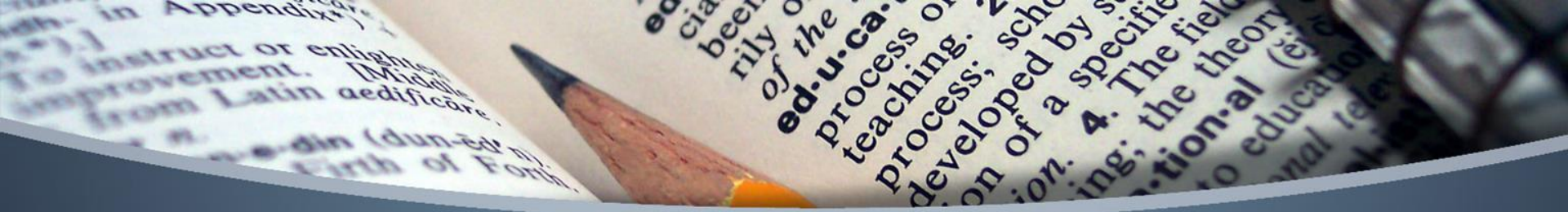
INTRODUCTION OF BUILDING DEFECTS

- Type of defects
 - Honey combing
 - Delamination/ spalling
 - Cracks
 - Corrosion
 - Material deterioration
 - Sulphate attack
 - Acid attack



INTRODUCTION OF BUILDING DEFECTS

- Type of cracks
 - Cracks due to corrosion of steel reinforcement
 - Carbonation
 - Chloride attack
 - Cracks due to intrinsic movement in concrete
 - Shrinkage
 - Creep
 - Hydration
 - Changes in temperature



INTRODUCTION OF BUILDING DEFECTS

- Type of cracks
 - Cracks due to load-induces
 - Deficiency in design
 - Imposed loading greater than the intended load
 - Construction fault
 - Cracks due to settlement

TYPE OF DEFECTS

Honeycomb



Popouts



TYPE OF DEFECTS

Delamination



Spalling





TYPE OF DEFECTS



Cracks due to load-induce

Bending failure



Shear failure



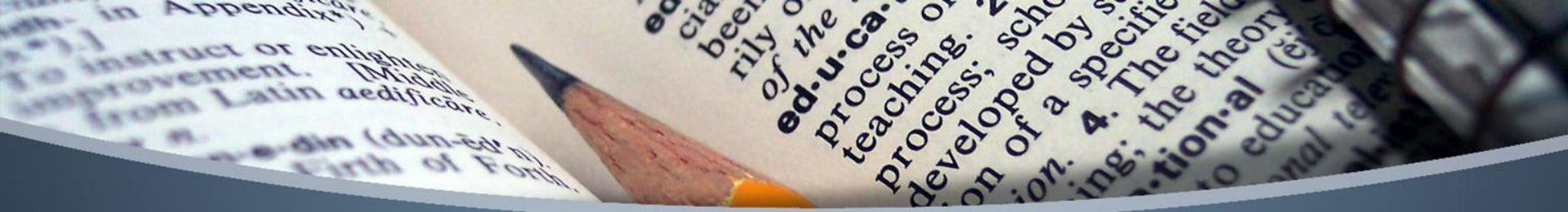
Cracks due to intrinsic movement

Plastic shrinkage cracks



Alkali-aggregate reaction





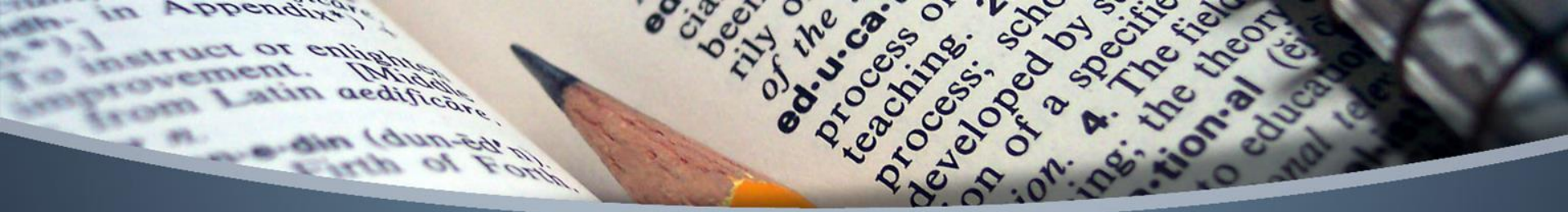
Cracks due to settlement





INTRODUCTION OF BUILDING DEFECTS

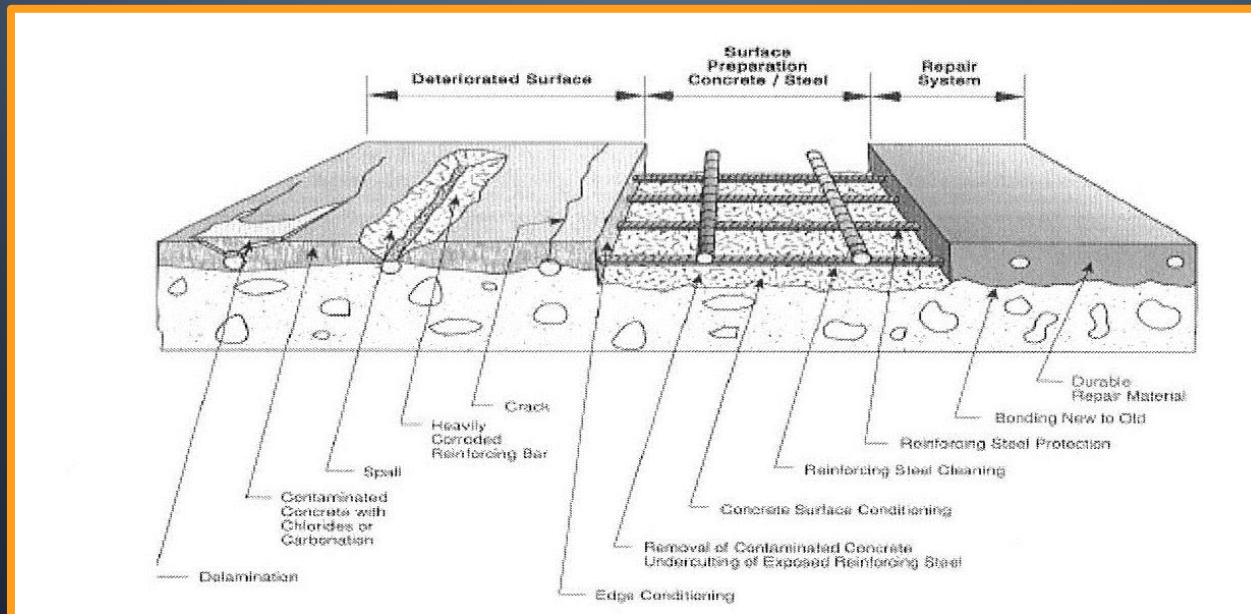
- General process for assessment of concrete structure:
 - Review of engineering data (e.g design, past performance)
 - Condition survey (visual inspection)
 - Testing works (in-situ & lab)
 - Report and recommendation



INTRODUCTION OF BUILDING DEFECTS

- Common NDT (in situ & lab)
 - Cover meter survey
 - Pull of test
 - Carbonation test
 - Density
 - Rebound hammer
 - Ultrasonic pulse velocity
 - Half cell potential
 - Coring test

INTRODUCTION TO STRUCTURAL REPAIR

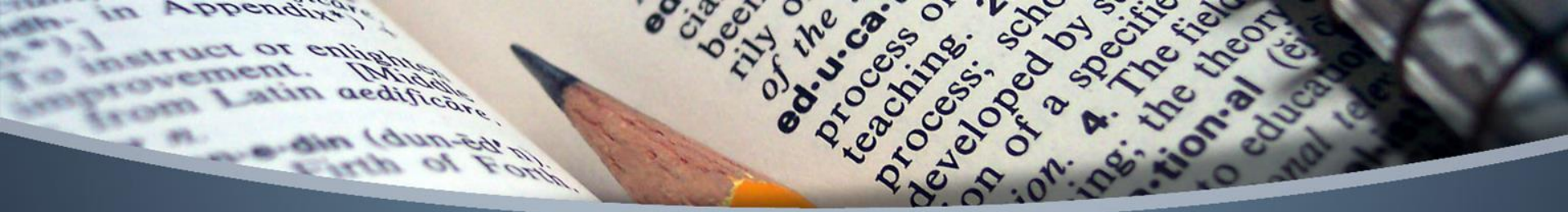


Anatomy of Surface Repairs



INTRODUCTION TO STRUCTURAL REPAIR

- Selection of repair materials
 - Strength & durability
 - Differential volume behavior
 - Appearance & compatibility



INTRODUCTION TO STRUCTURAL REPAIR

- Repair materials
 - Cementitious based
 - Cementitious grouts, mortars & concrete
 - Polymer modified cementitious grouts & mortars
 - Superfluid micro-concrete
 - Resin based
 - Epoxy resin grouts & mortars
 - Polyester resin grouts & mortar



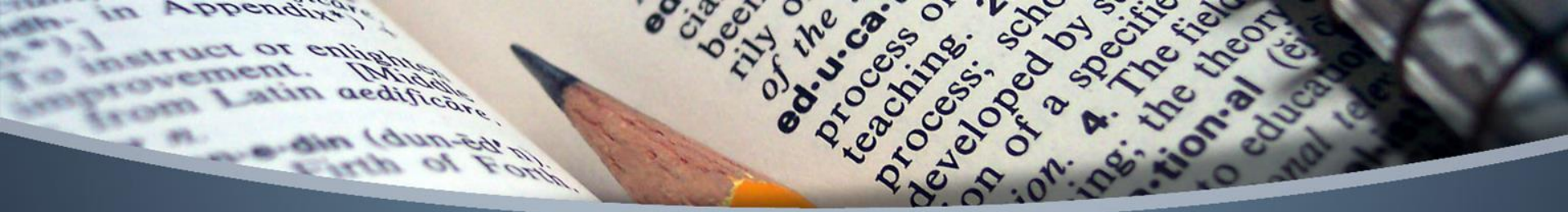
INTRODUCTION TO STRUCTURAL REPAIR

- Material properties
 - Cementitious based
 - Increase bond strength, tensile strength, compressive strength & flexural strength
 - Relatively faster curing time
 - Less permeable; better durability
 - Shrinkage compensating



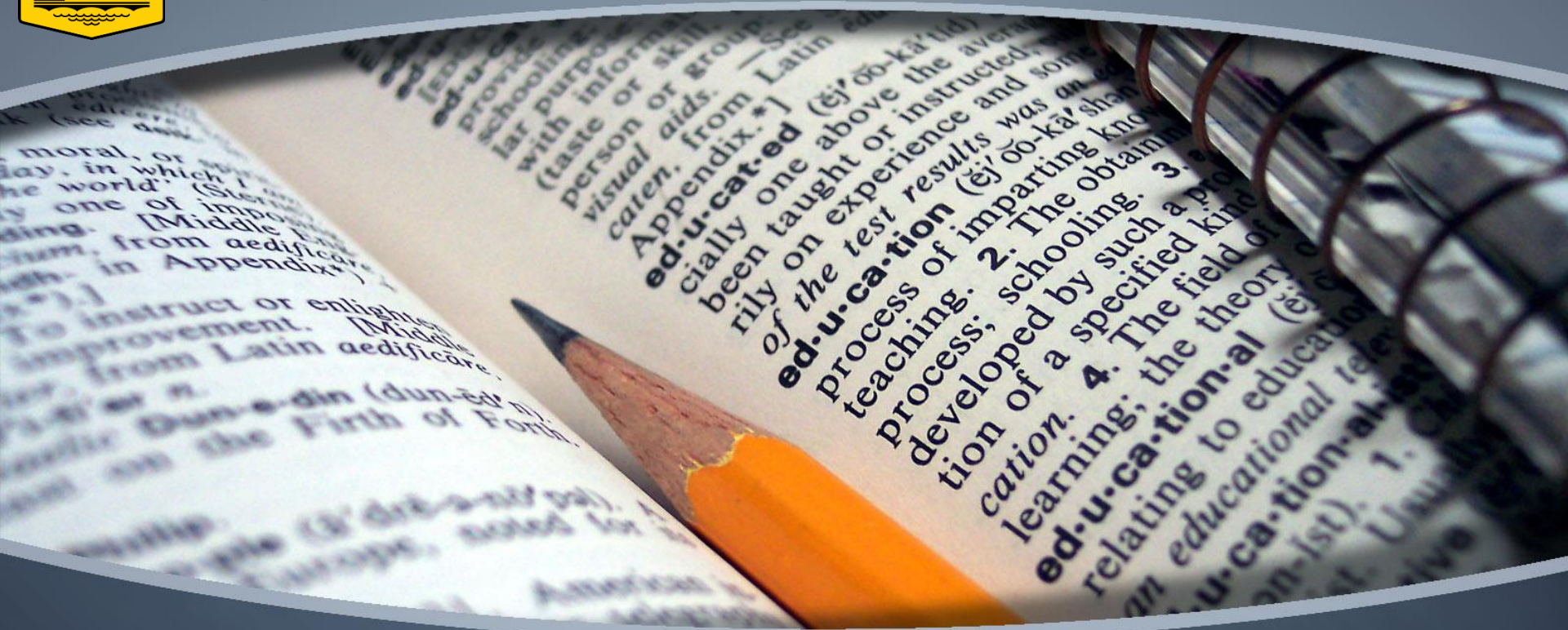
INTRODUCTION TO STRUCTURAL REPAIR

- Material properties (cont'd)
 - Resin based
 - High bond strength, excellent adhesion strength
 - Fast curing time
 - Less permeable; better durability
 - Shrinkage compensating



STANDARD METHOD OF REPAIR

- Crack repair
- Small (patch) repair
- Large repair
 - Drypack
 - Form & cast in place
 - Form & pump
 - Preplaced aggregate
- Surface protective coating
- Cathodic protection



PATCH REPAIR & BAR TREATMENT



APPLICATION CRITERIA

- Inactive defects due to honeycomb, spalling, cavity etc.
- Localised/ small defect
- Spalling/ defective area not more than 0.5m^2
- Causes
 - Poor workmanship
 - Minimal carbonation
 - Inadequate cover



REPAIR PROCESS

- Removal of defective concrete
- Reinforcement preparation
 - Removal of corrosion products
 - Lap new reinforcement (for loss >10%)
 - Priming
- Apply bonding agent
- Place repair material
- Protective coating



REMOVAL OF DEFECTIVE CONCRETE

- Mark areas to be removed
- Concrete removal by jack hammers or waterjet
 - Removal must not damage rebar
 - Removal must be 20mm behind rebars
 - Removal additional 50mm beyond corroded rebar
- Saw cut edges of repair area by 10mm – 20mm deep (no feather edges)
- Clean remaining concrete surface
- Removal only on alternate columns/ beams within same span

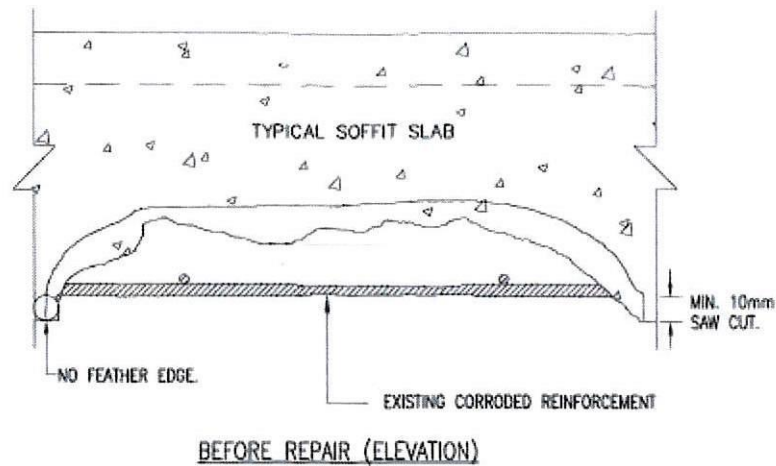


REINFORCEMENT PREPARATION

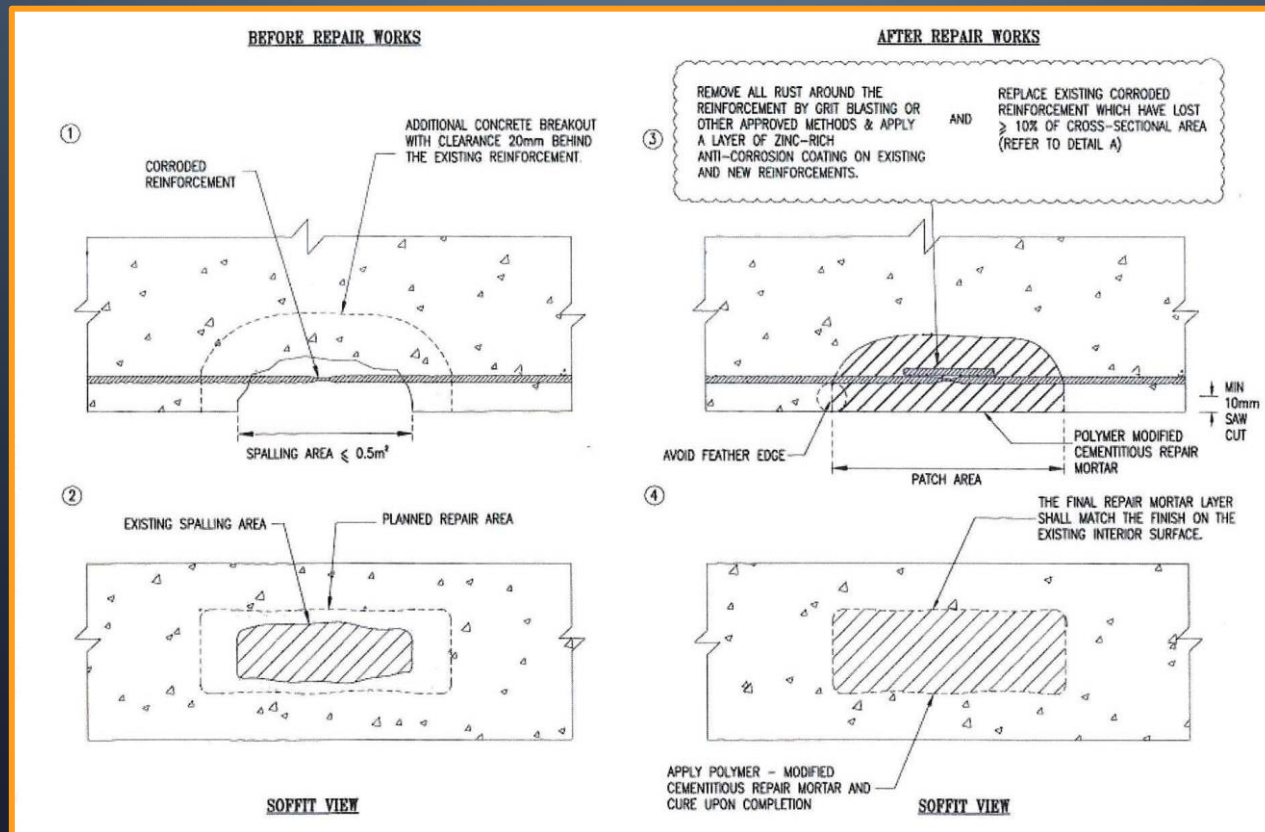
- Remove all corrosion products
- Rebar corrosion more than 10% has to be supplemented
 - Minimum lap length = $42\varnothing$
- Prime rebar within 2 hours of cleaning using zinc-rich type primer

REPAIR PROCESS

CONCRETE PATCH REPAIR FOR CORRODED REINFORCEMENT

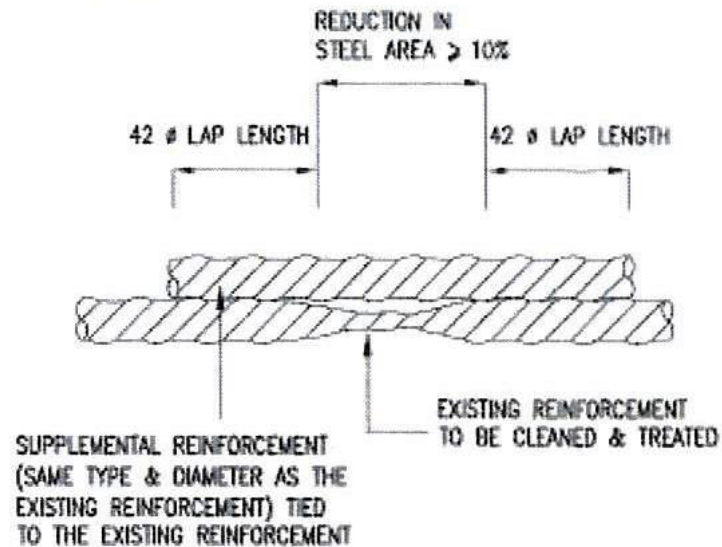


REPAIR PROCESS



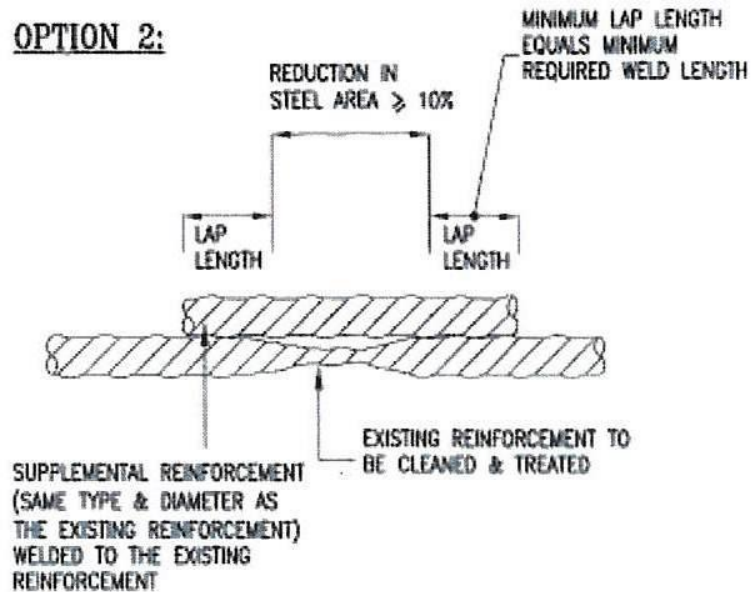
LAPPING OF NEW REBAR

OPTION 1:



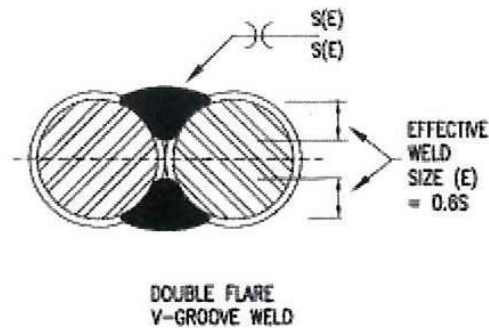
LAPPING OF NEW REBAR

OPTION 2:



LAPPING FOR NEW REBAR

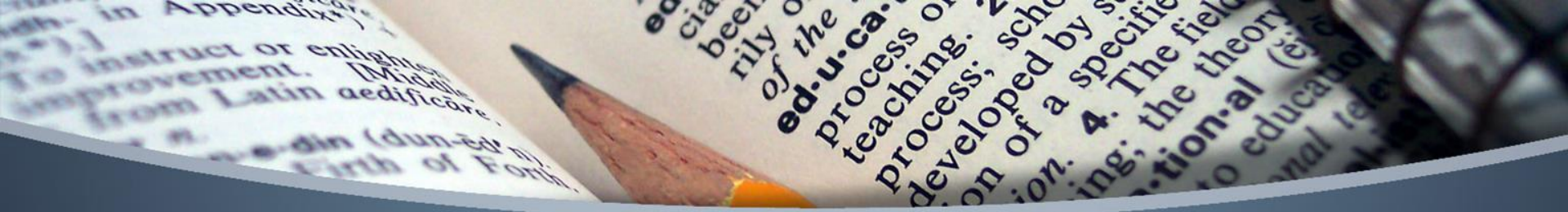
MINIMUM REQUIRED WELD LENGTHS FOR STEEL REINFORCEMENT	
BAR SIZE (mm)	DOUBLE FLARE V-GROOVE WELD (mm)
10	80
12	100
16	130
20	160
25	200
32	260



LAPPED, WELDED SPLICE DETAIL

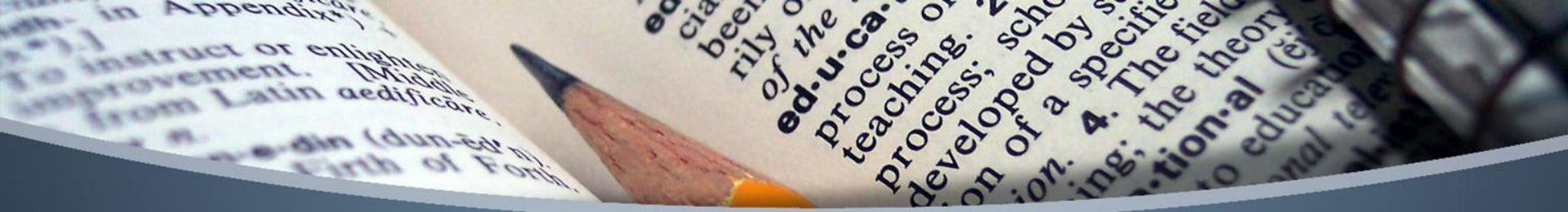
NOTES:

- 1) RADIUS OF STEEL REINFORCEMENT = S .
- 2) THESE ARE SECTIONAL VIEWS. BAR DEFORMATIONS ARE SHOWN ONLY FOR ILLUSTRATIVE PURPOSES.



Removal of defective concrete





Priming the rebar & apply the bonding agent



Place repair material

