Rigid Pavement Repair

Larry Scofield

International Grooving and Grinding Association


MASONS
LOCAL
343
MORTAR

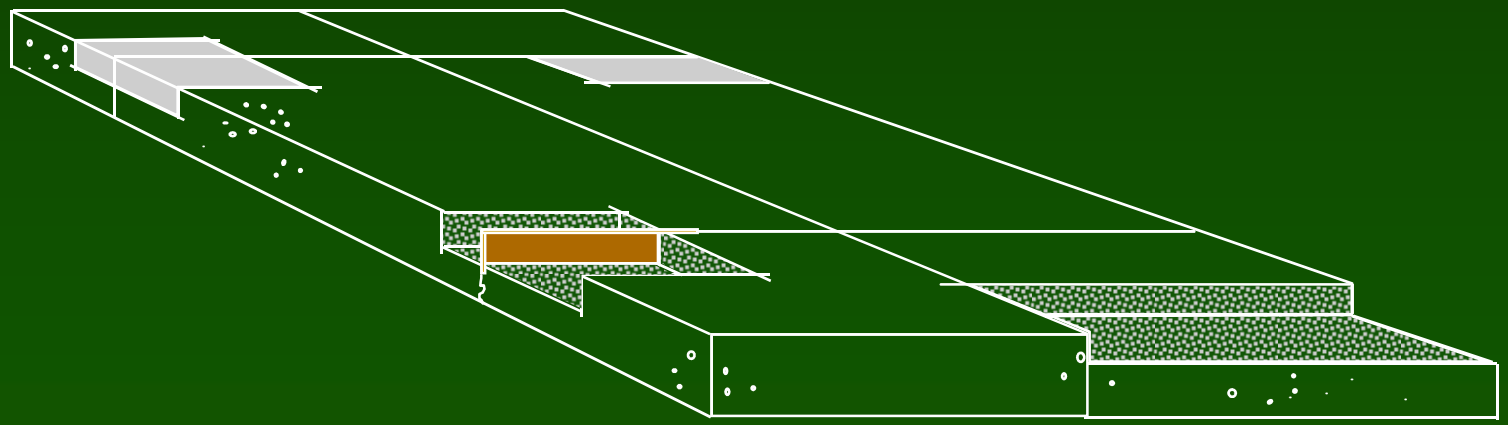
PCCP Repair Techniques

- Full-depth repair
- Partial-depth repair
- Slab stabilization
- Retrofitting dowels
- *Cross-stitching longitudinal cracks/joints*
- *Diamond grinding*
- *Joint & crack resealing*

Partial Depth Patching

Partial Depth Repairs

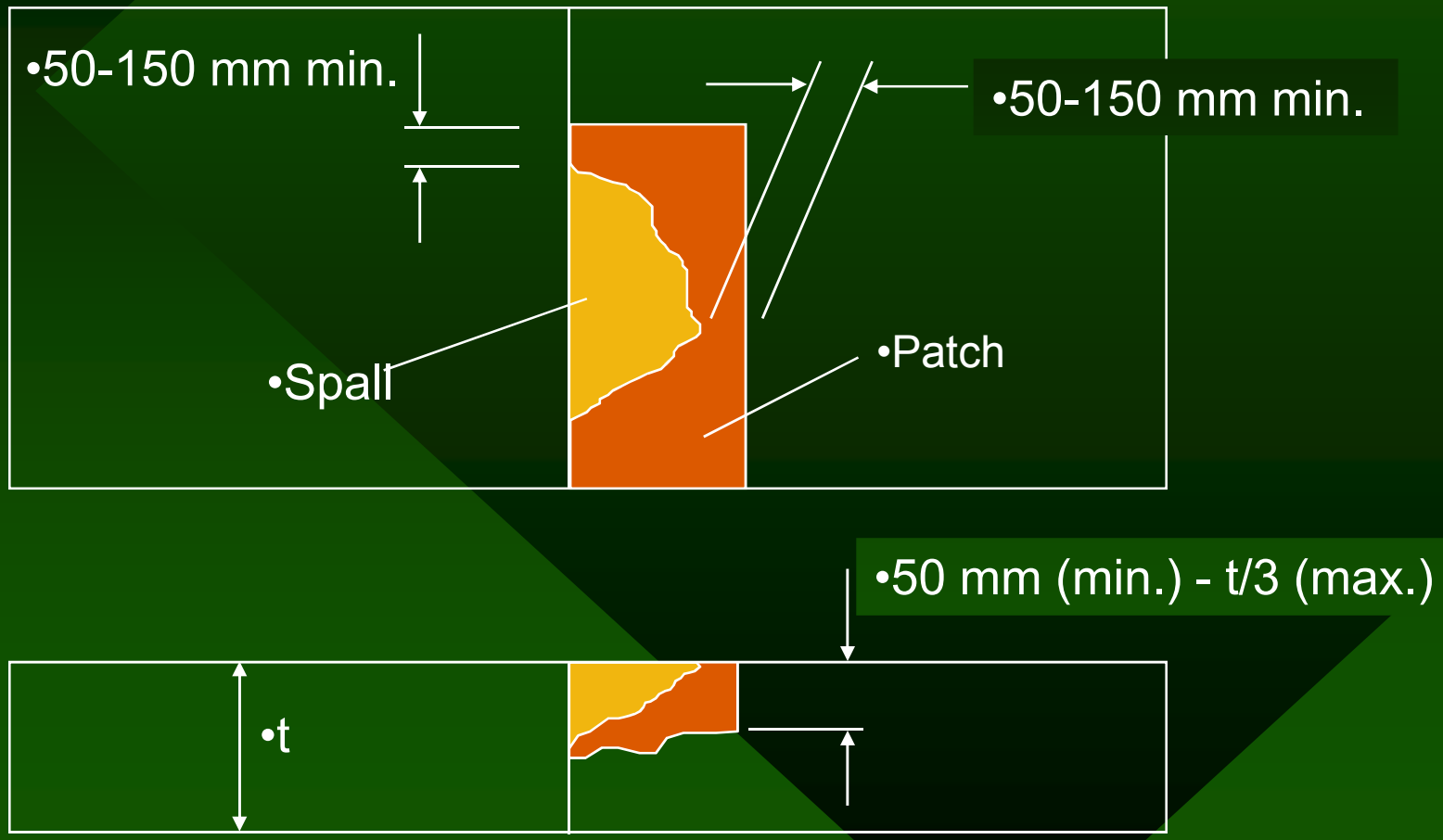
- Repairs deterioration in the top 1/3 of the slab.
- Generally located at joints, but can be placed anywhere surface defects occur.



Size of Patches

- Minimum length 300 mm
- Minimum width 100 mm
- Go beyond problem by 75-100 mm
- Combine close patches (<0.6 m)
- Repair entire joint if more than 2 patches

Patch Layout



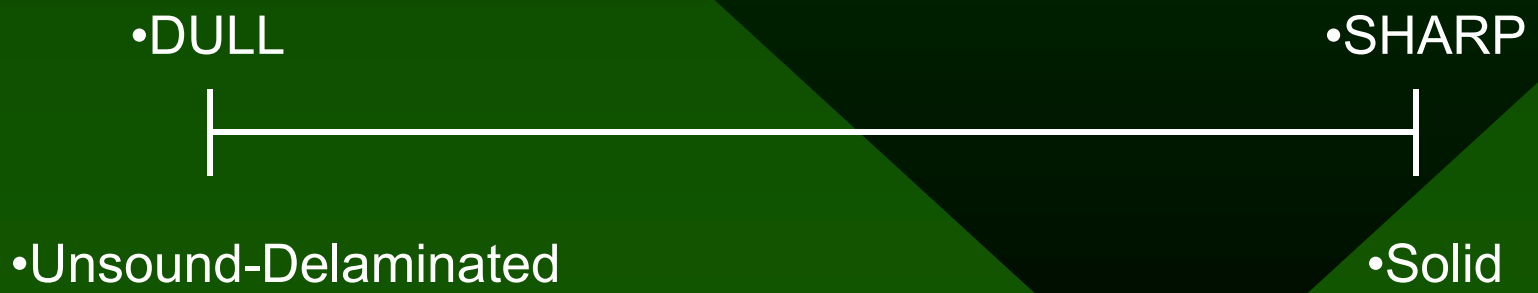
Patch Materials

- Normal Set PCC
- High-Early Strength PCC
- Rapid Strength Proprietary Materials
- Epoxy Resin Mortar or Epoxy Concrete

Construction of Partial-Depth Patches

Finding Unsound Concrete

- Sounding the pavement:
  - Hammer
  - Steel rod
  - Steel chain



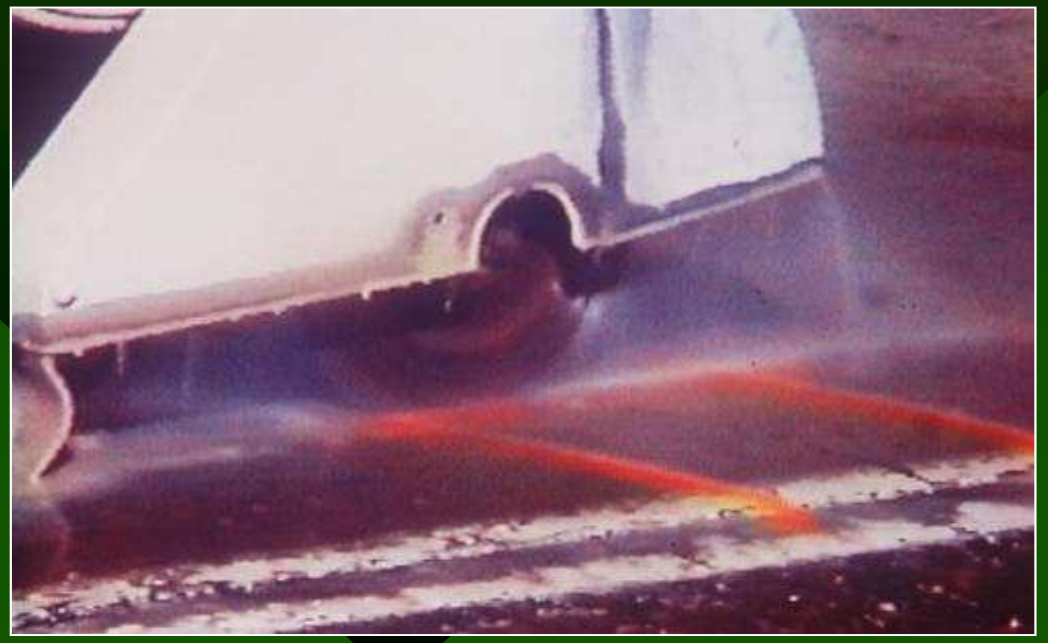
•Sounding the Pavement

Concrete Removal

- Sawing and chipping
- Carbide milling
  - Transverse
  - Longitudinal

Sawing

- Vertical cut at perimeters
- Diamond blade
- Depth to 50 mm
- Overcut slightly



Chipping

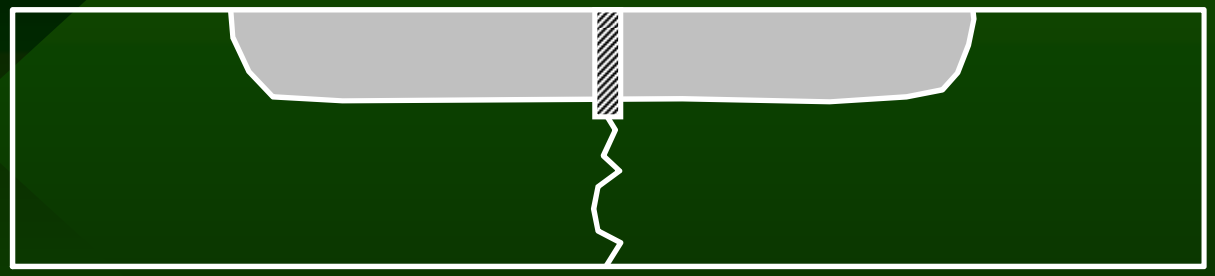
- Break to minimum depth of 35 mm (1/3 slab thickness maximum)
- 13.5 kg maximum hammer
- 7 kg hammer preferable for control
- Spade bits preferable to gouge bits
- Do not expose dowels

Removal of Concrete with Jackhammer

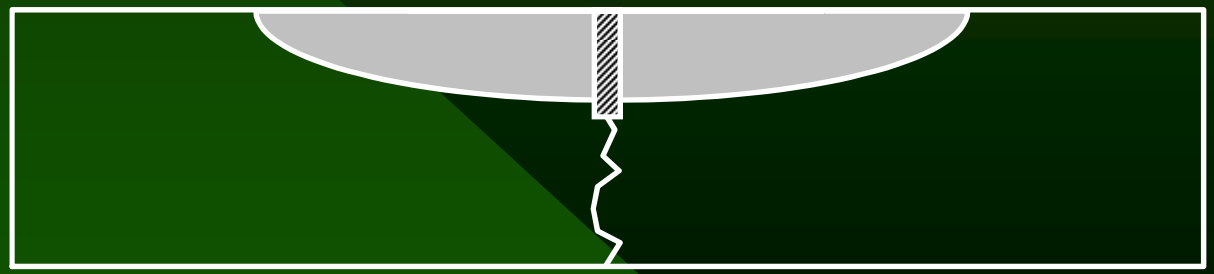
Milling Machine

- Requirements:
  - High kilowatt (horsepower) rating
  - 300-450 mm milling head width
  - Wheels preferable to tracks
- Transverse orientation
- Longitudinal orientation

Removal of Material



- Transverse Milling (small head, moves along joint)



- Longitudinal Milling (wide head, pick up & move over)

Transverse Orientation

Longitudinal Orientation

Repair Area After Longitudinal Orientation Milling

Cleaning

- Sound to check for weak spots before cleaning
  - Chip out with 7 kg hammer if necessary
- Sandblast bottom and sides
- Waterblast acceptable alternative:
  - 100 - 200 MPa pressure
  - Waiting period to dry

Chipping out weak spots

Sandblasting

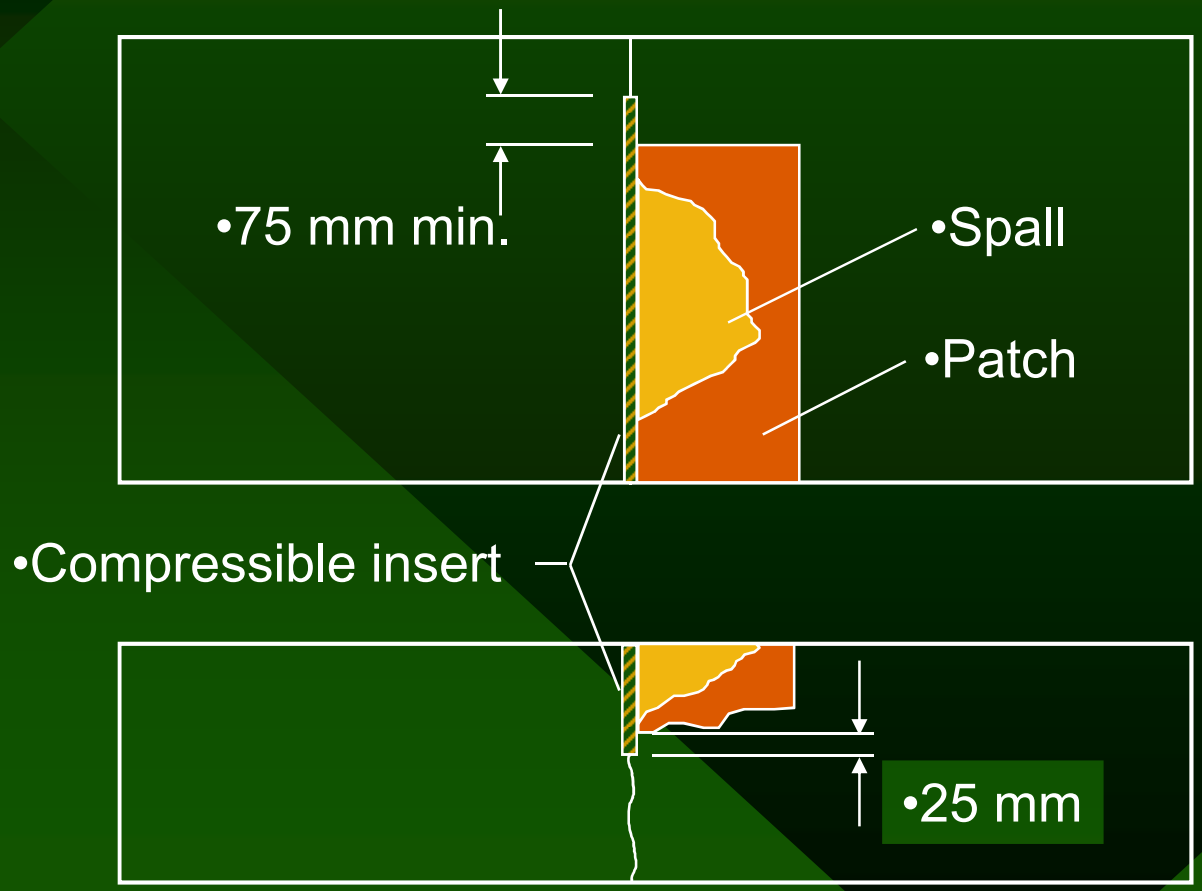
Blowing Compressed Air to Remove Debris

Joint Insert

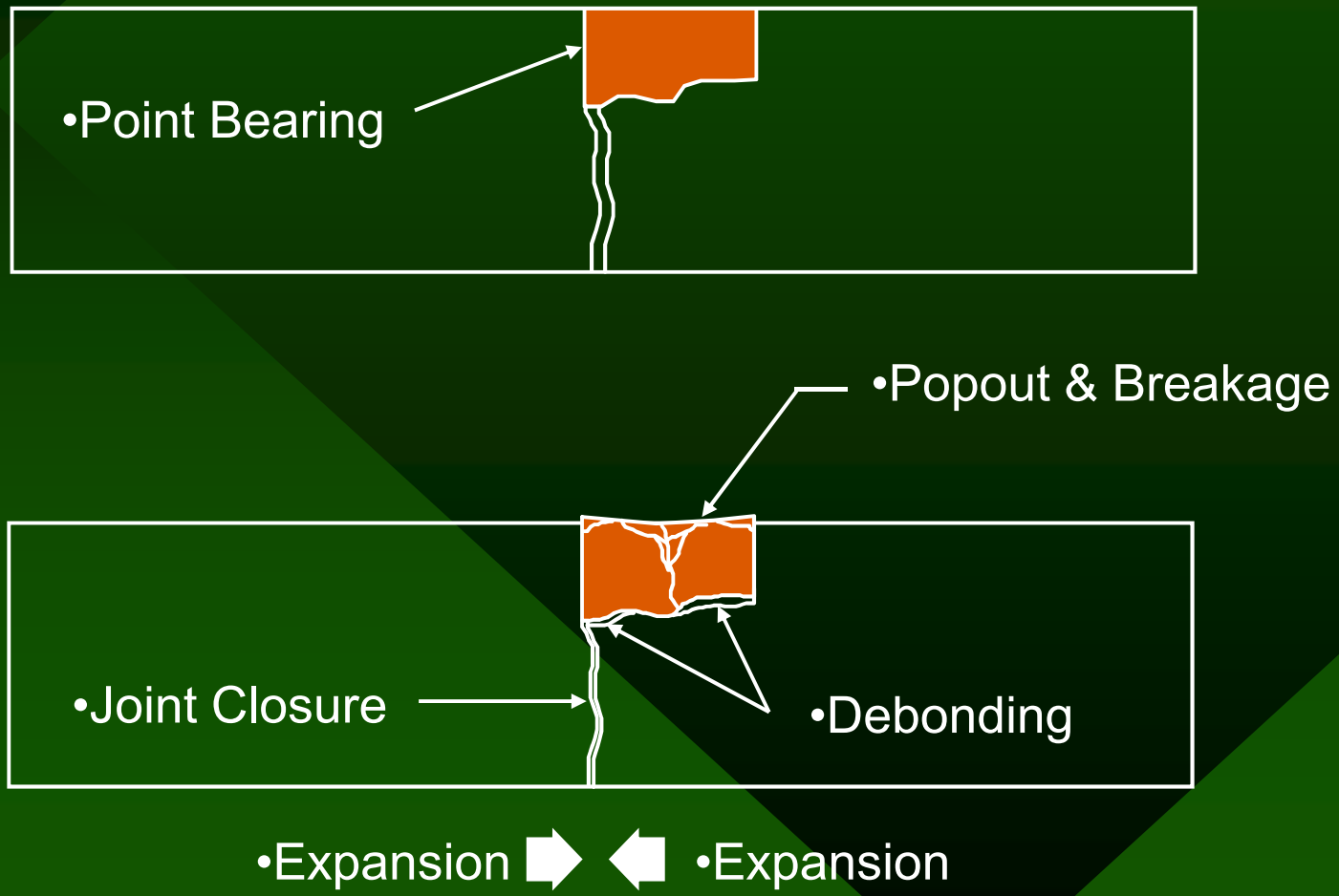
- Separates patch from adjacent concrete
- Reforms joint reservoir
- Provides uniform sealing reservoir
- MUST get below patch material
- Acceptable materials:
  - Styrofoam
  - Asphalt-impregnated fiberboard
  - Fiberboard

Compressible Joint Insert

Compressible Insert



If Insert Not Used...



- Checking patch cleanliness

Application of Grout Bonding Agent

Placing Patch Material

- Mix in small quantities
- Place from wheelbarrows or buggies soon after bonding grout
- Slightly overfill the patch area
- Use small spud vibrators (<25 mm)
  - Hold at 15-30 degrees
  - Do not drag!!

Placing Patch Material

Finishing & Texturing

- Match surrounding elevation
- Work tool from center toward edges
- Texture similar to surrounding pavement
- Seal saw-cut runouts with grout or liquid epoxy

Applying Curing Compound

Joint Sealing

- Resealing joints will help prevent further damage
- Saw & air blast all joint faces before sealing
- Seal according to agency specifications (silicone, hot pour, etc.)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Opening to Traffic

- 2 methods:
  - Specified minimum strength
  - Specified minimum time after completing placement
- Time method acceptable

Summary

- Limit use to top 1/3 of slab
- Avoid “point bearing”: Use a compressible insert in joints & cracks
- Cure properly
- Reseal Joints

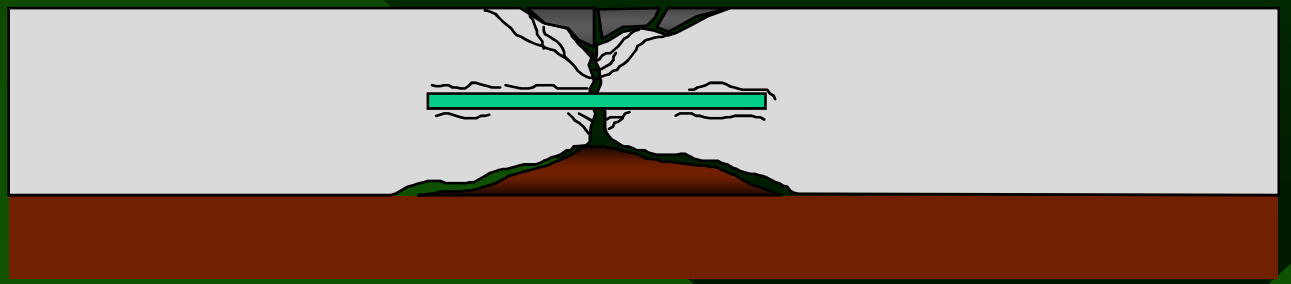
Full Depth Patching

Full-Depth Repair

- Purpose
  - Restore structure
  - Restore ride
- Used for:
  - Joint deterioration
  - Transverse cracking
  - Longitudinal cracking
  - Broken slabs & corner breaks

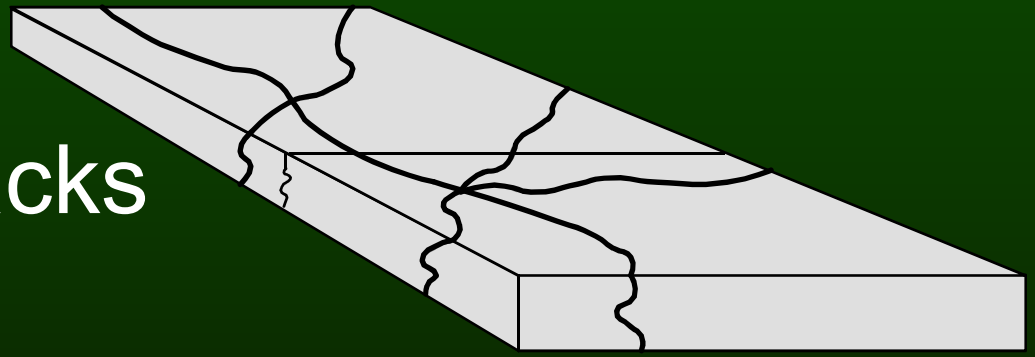
Uses of Full-Depth Repair

- Joint Deterioration
  - –Spalling (also below surface)
  - –Cracking

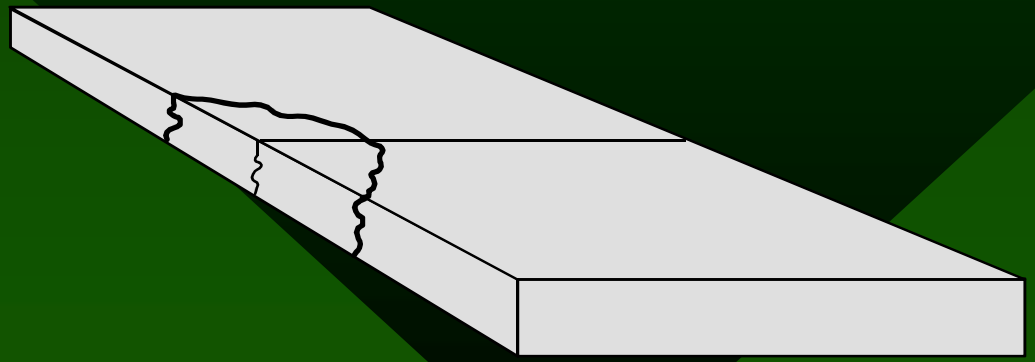


Uses of Full-Depth Repair

- Multiple Cracks



- Corner Breaks



Sizing a Patch

- Go beyond deterioration
- Remember to check for below-surface spalling
- Minimum length 2 meters
- Adjust as necessary
- Combine closely spaced patches

Field Adjustments to Patch Size

- If Patch Boundary:
- Falls within 2 m of transverse joint
  - Then extend to include joint
- Falls on or very near a doweled joint
  - Then extend beyond joint 0.3 m to remove the dowels
- Falls on a crack
  - Then extend beyond crack by 0.15 m

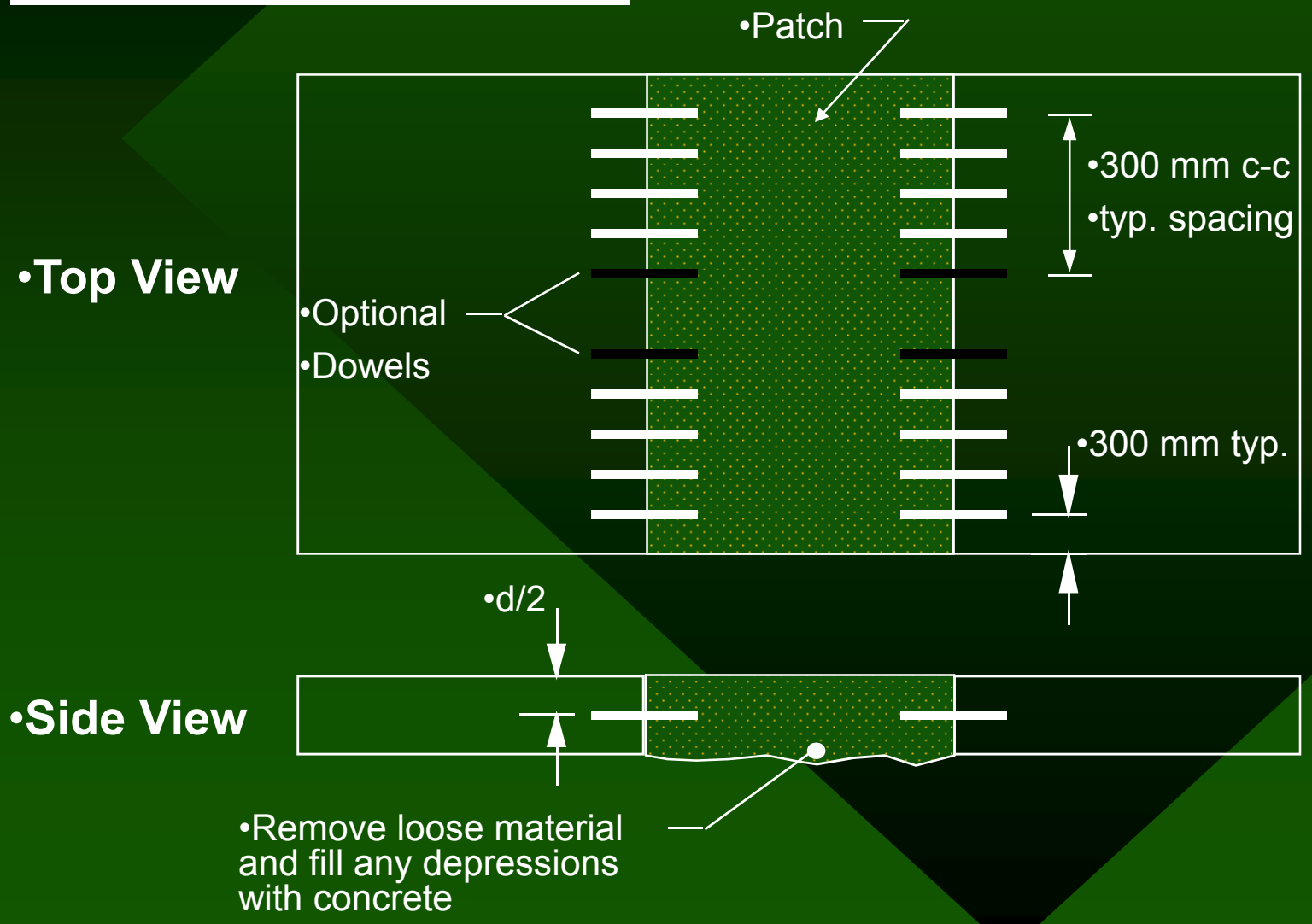
Combine Patches!!

Load Transfer

- Jointed Pavements:
  - 38mm dowels
  - At least 175mm of embedment on either side
  - Minimum of 4 dowels in each wheelpath
  - Corrosion resistance necessary if deicing chemicals will be used

Load Transfer

- Jointed Pavements:



Patch Materials

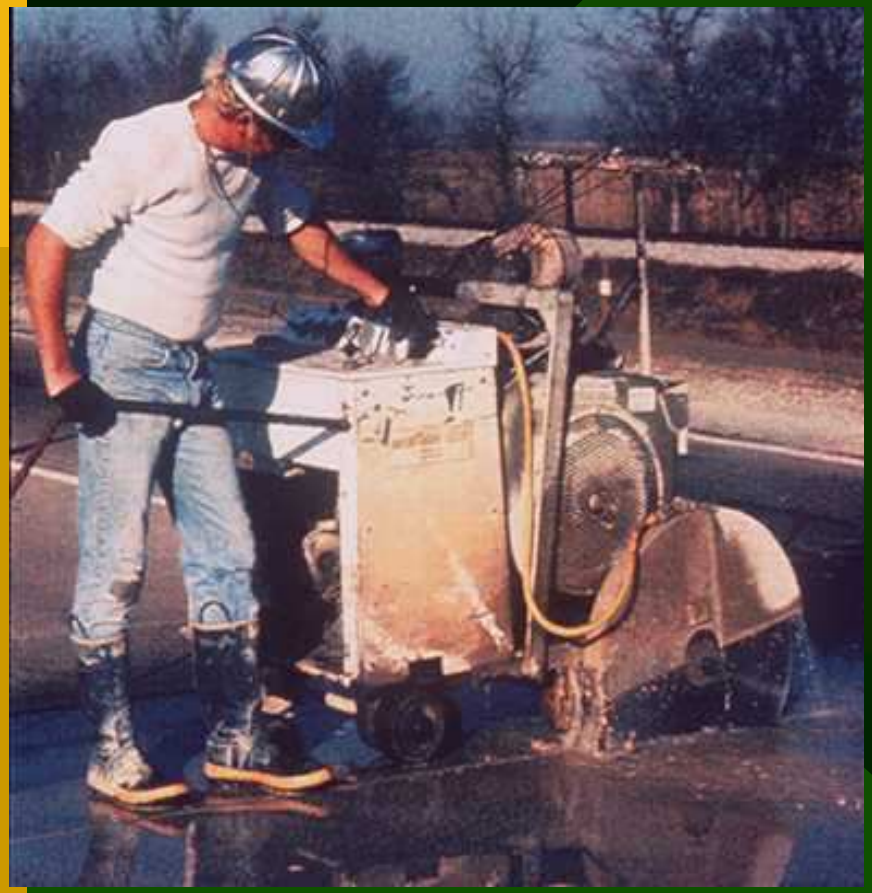
- ASTM C 150 Types I, II, or III portland cement (CAN/CSA A5-M88)
- Target slump: 50 - 100 mm
- Entrained air: 4.5 - 7.5%
- Accelerators common for early strength gain
  - $CaCl_2$ accelerator may cause early set time (within 30 minutes)
  - workability decreases with accelerators

Defining Repair Limits

Sawing Boundaries

- Use diamond bladed saws
- Saw full-depth through the joints so base of blade reaches boundary (except where aggregate interlock needed)
- Isolate transverse, longitudinal and shoulder
- Provide pressure-relief cut within patch if saws bind

Sawing Boundaries



Removal

- Liftout
  - Lift pin and chain
  - Forklifts
  - Torque claws
  - Lateral-pressure lifts
- Breakup
  - Handheld pneumatic hammers (small projects)
  - Drop hammers or hydraulic rams (large projects)

Liftout

- Pin and Chain

- Torque Claw

- Lateral Pressure

Liftout Damage

Vibratory Plate Compactor

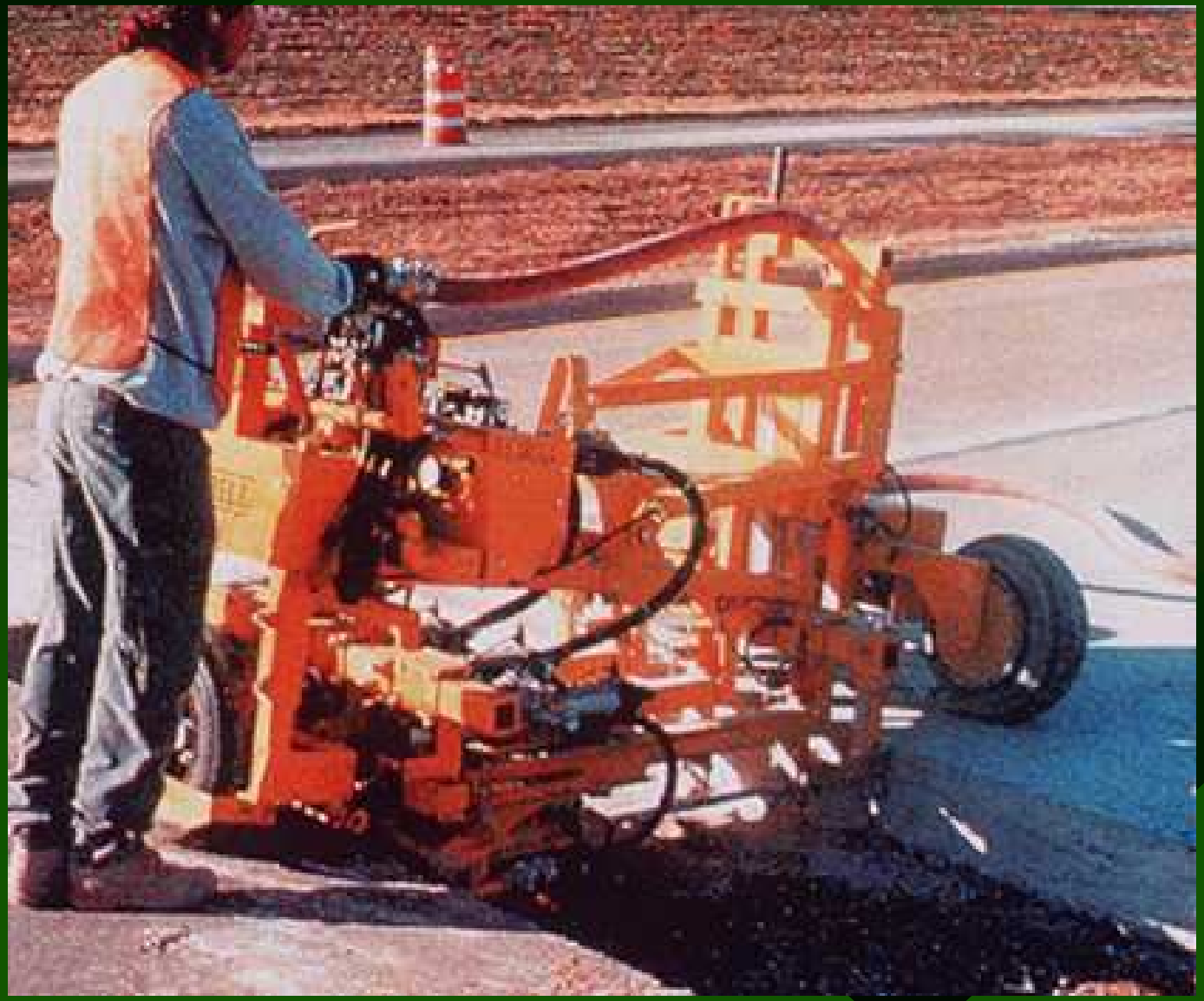
Drilling Dowel Holes

- Use gang-mounted drill rig
  - Consistent holes
  - Alignment jig
  - Improved productivity
- Slab reference preferable
- Hydraulic or pneumatic drills O.K.

Drilling Dowel Holes

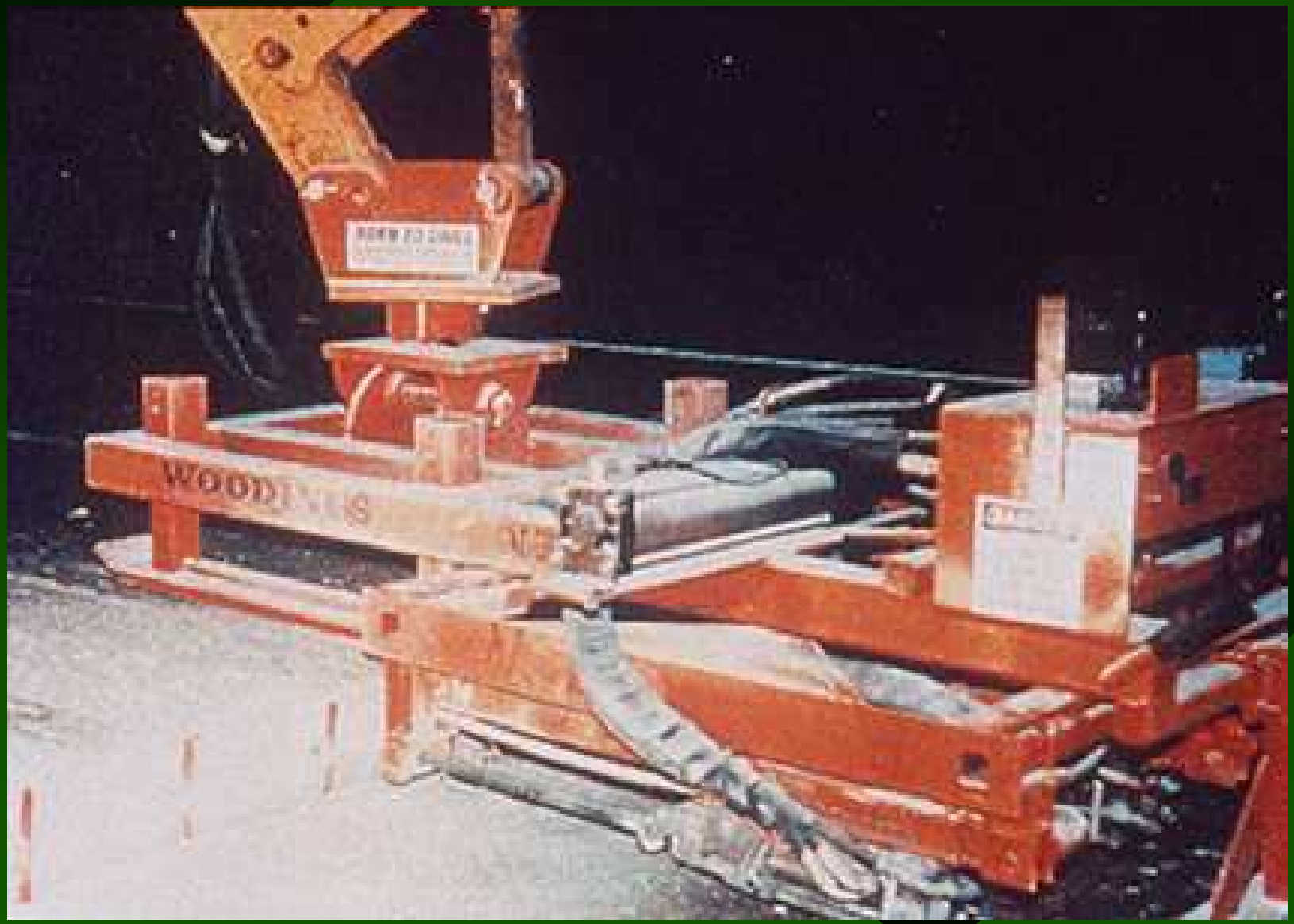
- Adjust location of hole for:
  - Cracks
  - Embedded steel
  - Major spalling
- Size hole diameter for grout
  - Cement-based use *DOWEL DIA.* + *5 mm*
  - Epoxy use *DOWEL DIA.* + *2 mm*

Self-Propelled Subbase Reference



Self-Propelled Slab Reference

Boom-Mounted Slab Reference



•Installing Dowels

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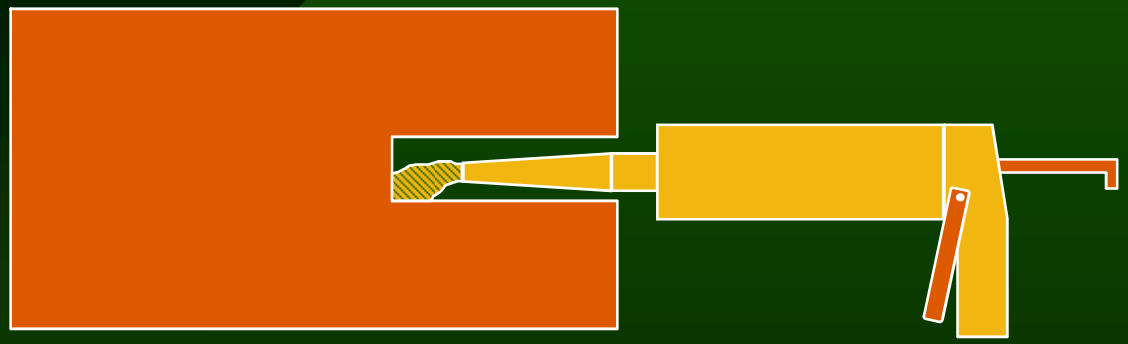
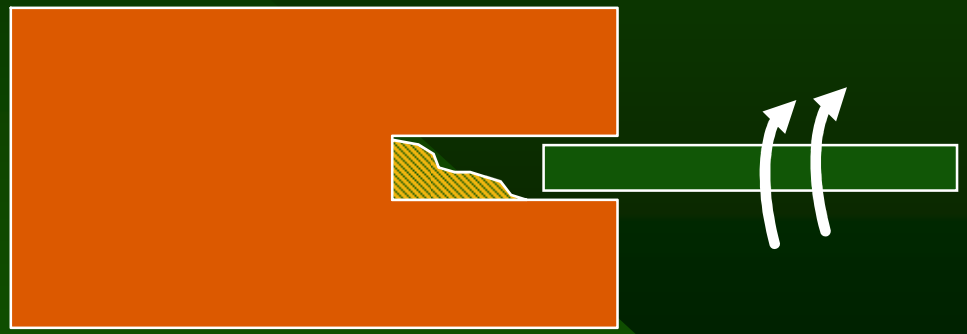


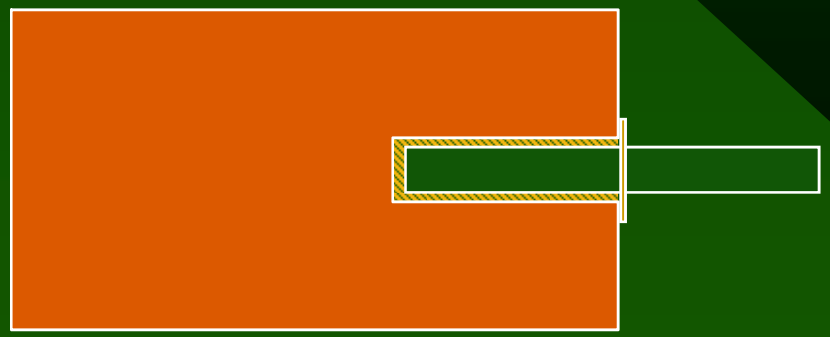
•Inject Grout to Back of Hole

•2



•Twist one turn while pushing in dowel

•3



•Place grout retention disk to hold in grout

Injecting Grout

Grout Retention Disk

Troweling of Grout around Bar

Placement of Bond-Breaking Board

Placing Concrete

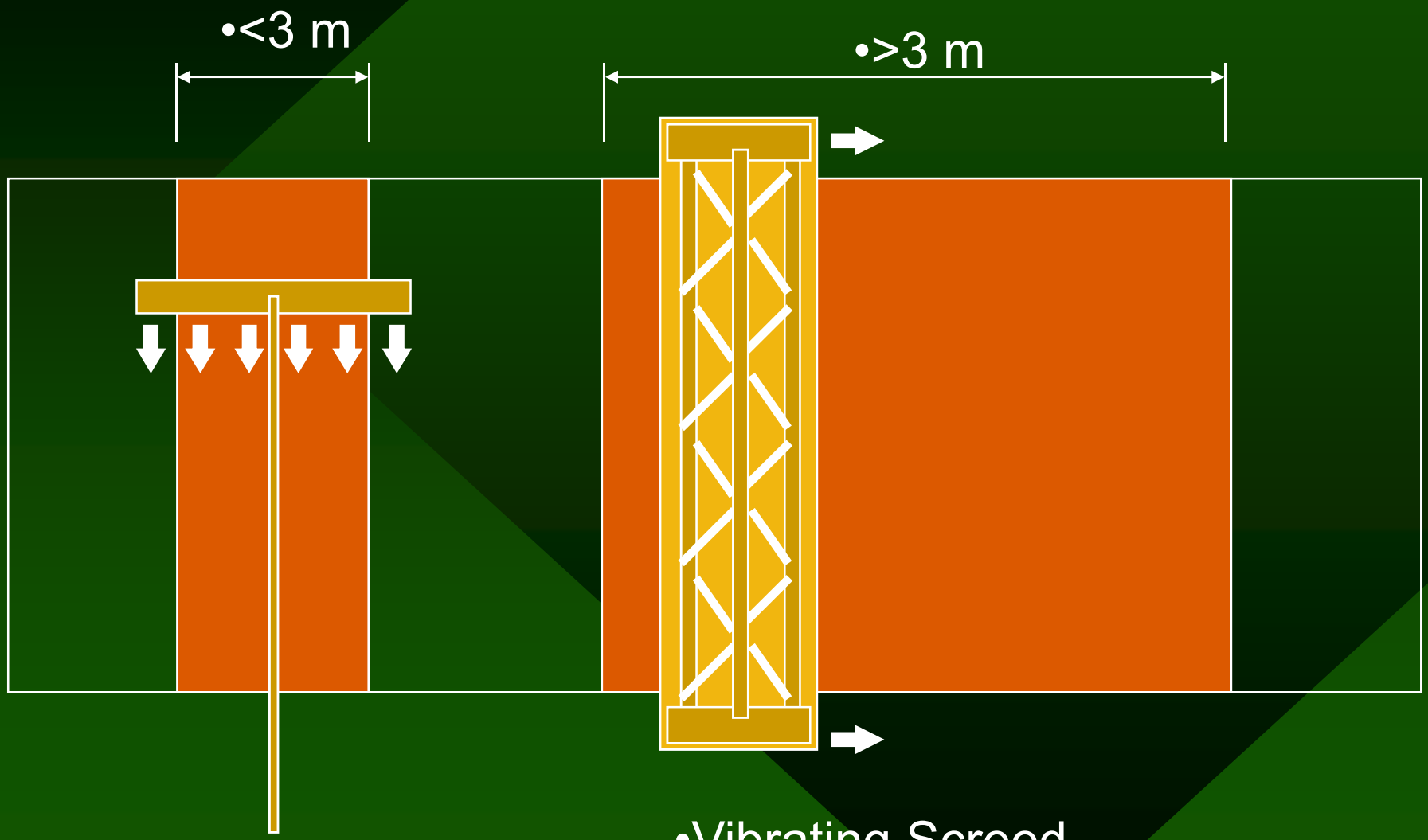
- Distribute evenly
- Avoid excessive shoveling
- Vibrate uniformly
  - Use vertical penetrations of vibrator
  - Do not drag!!

Concrete Placement

Finishing

- Vibratory screeds or 3m straight edges
- For short repairs (<3m), pull finishing tool along transverse boundary
- For longer repairs, finish the concrete longitudinally using vibratory screed

•Finishing



•Finishing

- Texturing

Curing

Joint Sealing

- Form or saw joint sealant reservoirs at all patch boundaries
- Sealed joints reduce spalling

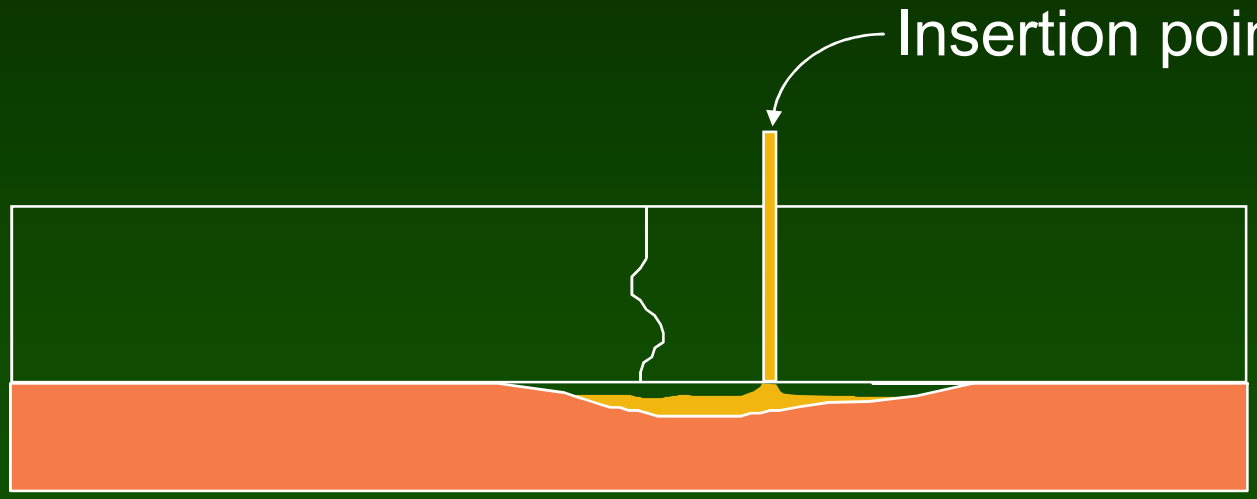
Opening to Traffic

- 3 methods:
  - Specified minimum strength
  - Specified minimum time after completing placement (5 or 10 hour patches)
  - Maturity method (mix specific)
- Strength method preferred
- Variations in air temperature influence strength development

Slab Stabilization/ Jacking

Slab Stabilization / Slab Jacking

- Pressure insertion of flowable material beneath the PCC slab



Slab Stabilization vs. Slab Jacking

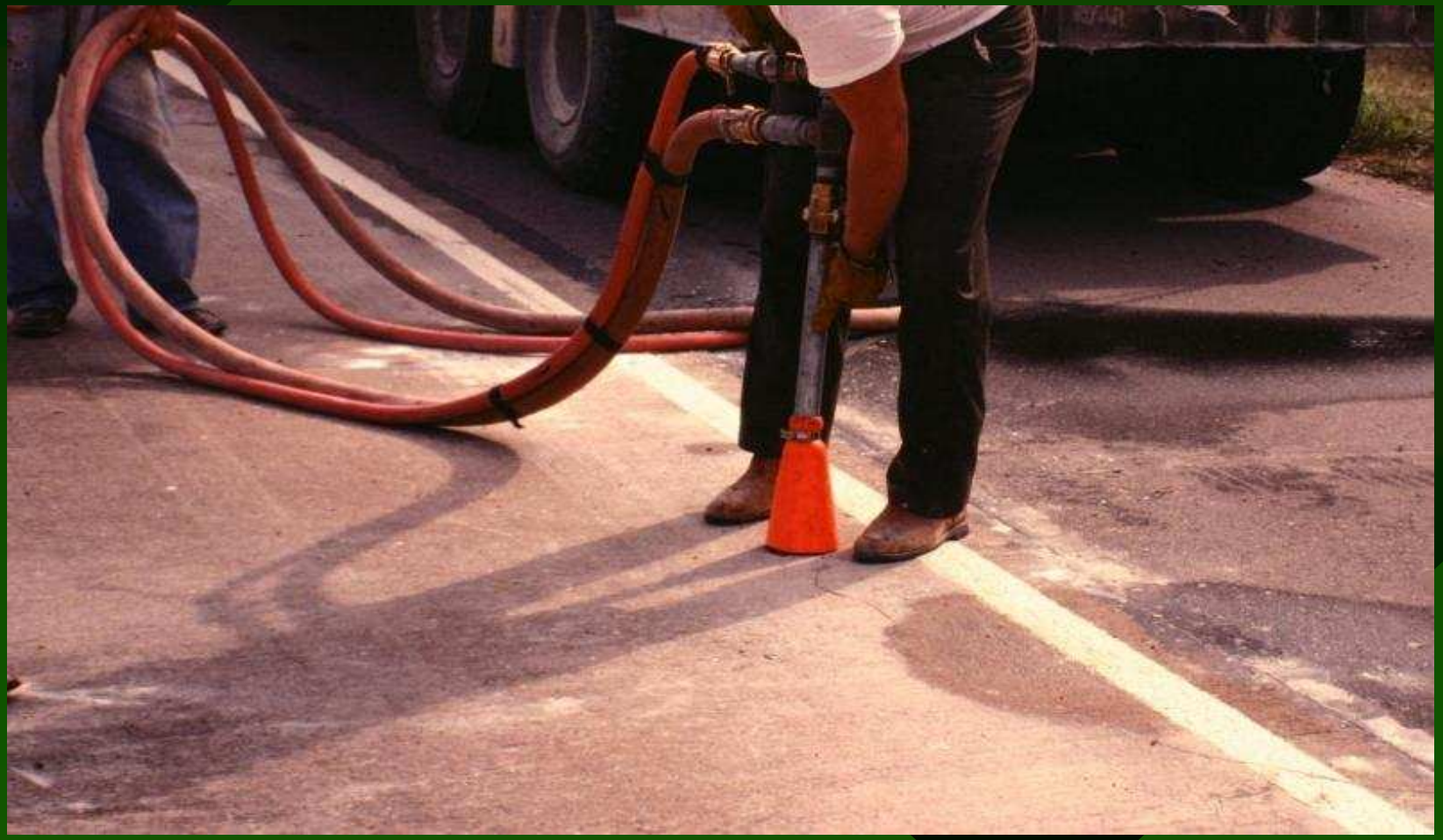
- Slab Stabilization:
  - Pressure insertion of a flowable material to restore support beneath PCC slabs
  - Fills existing voids but does not lift slab
- Slab Jacking:
  - The lifting or raising of a PCC slab by pressure inserting a grout beneath the slab
  - Levels depressed slabs and restores rideability (but not for correcting faulted joints)

Slab Stabilization

Identifying Loss of Support

- Visual distress survey
- Deflection testing
  - Maximum deflections
  - Void detection procedure
- Other methods

Construction
Material Injection



Construction
Operation

Quality Control

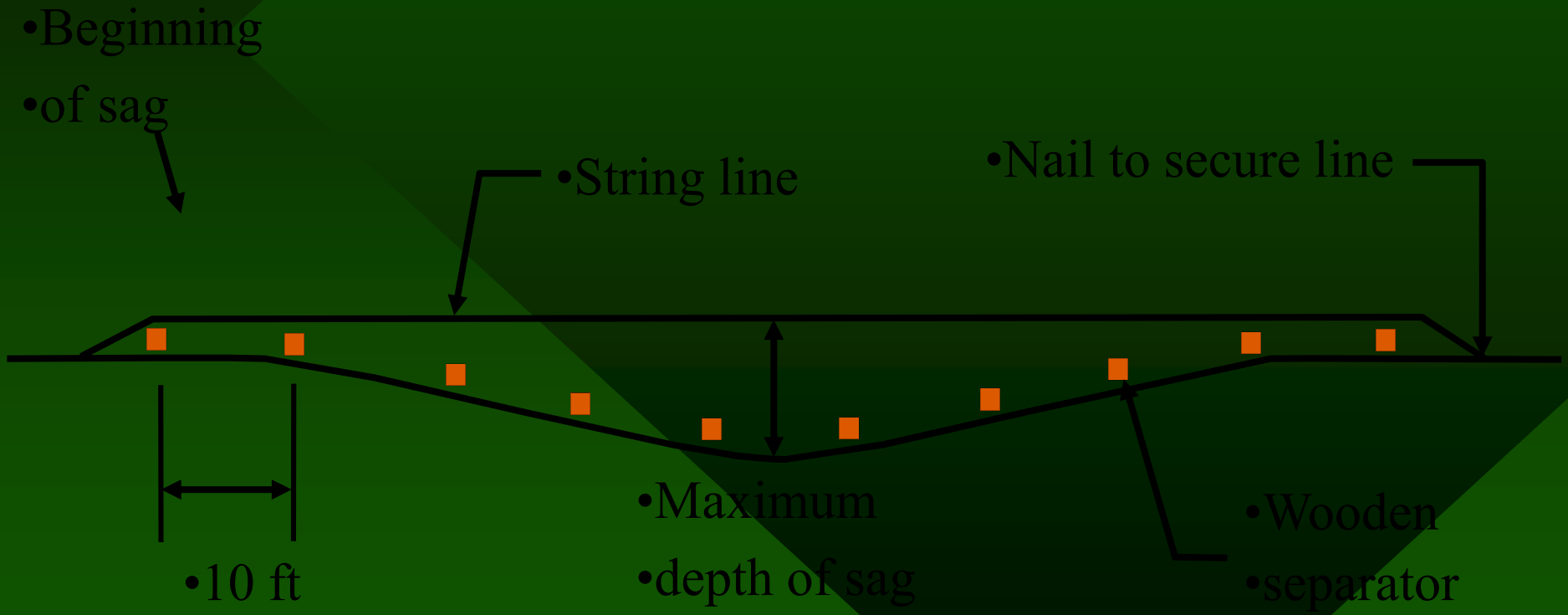
Monitoring Slab Lift

Slab Jacking

Slab Jacking

- Address localized areas of settlement
  - Fill areas
  - Culverts
  - Bridge approaches
- Materials:
  - Cement grouts widely used at one time
  - More recent use of polyurethane materials

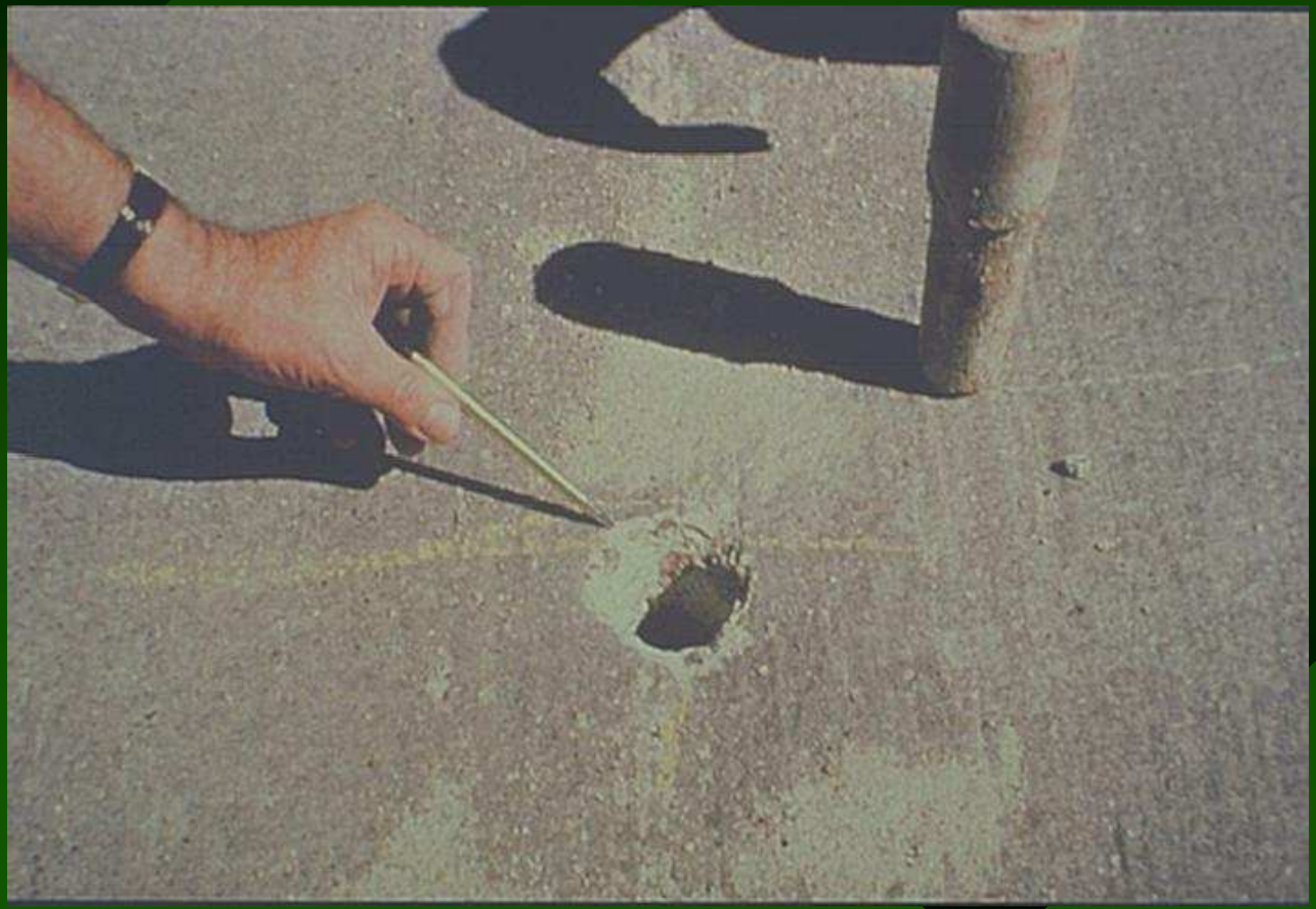
Stringline Method



•Fig. 4.6 on p. 4.11

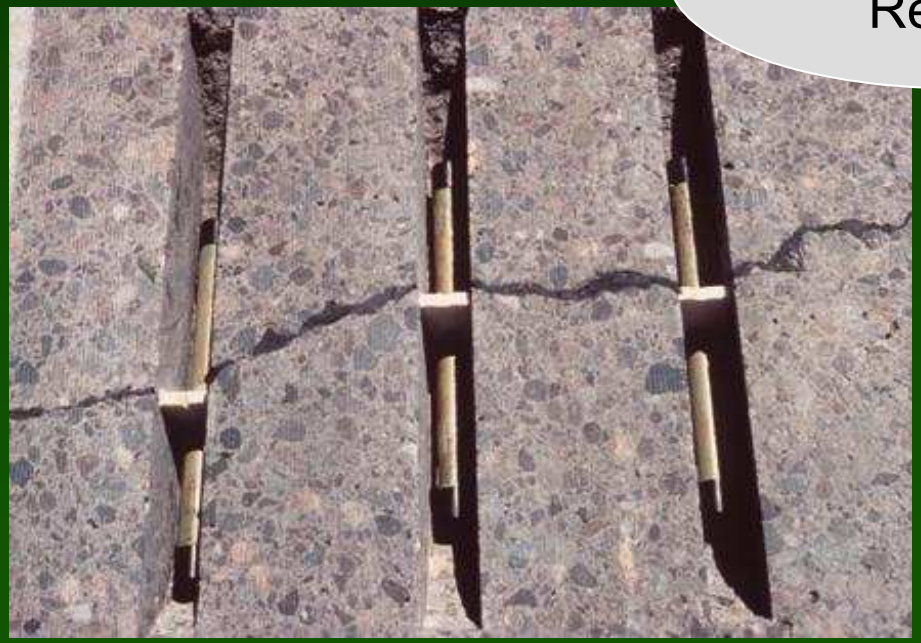
Stringline Method

Grouting Hole and Plug



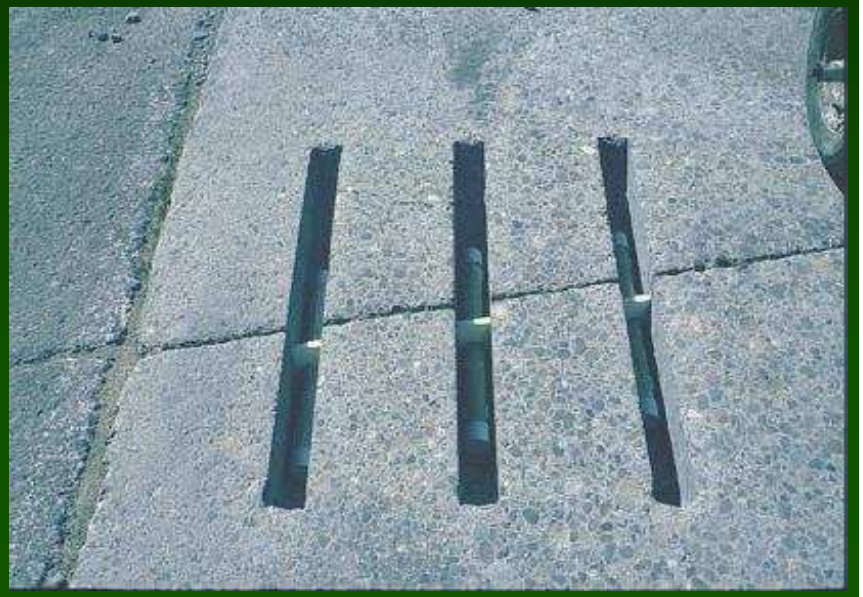
Completed Project

Dowel Bar Retrofit



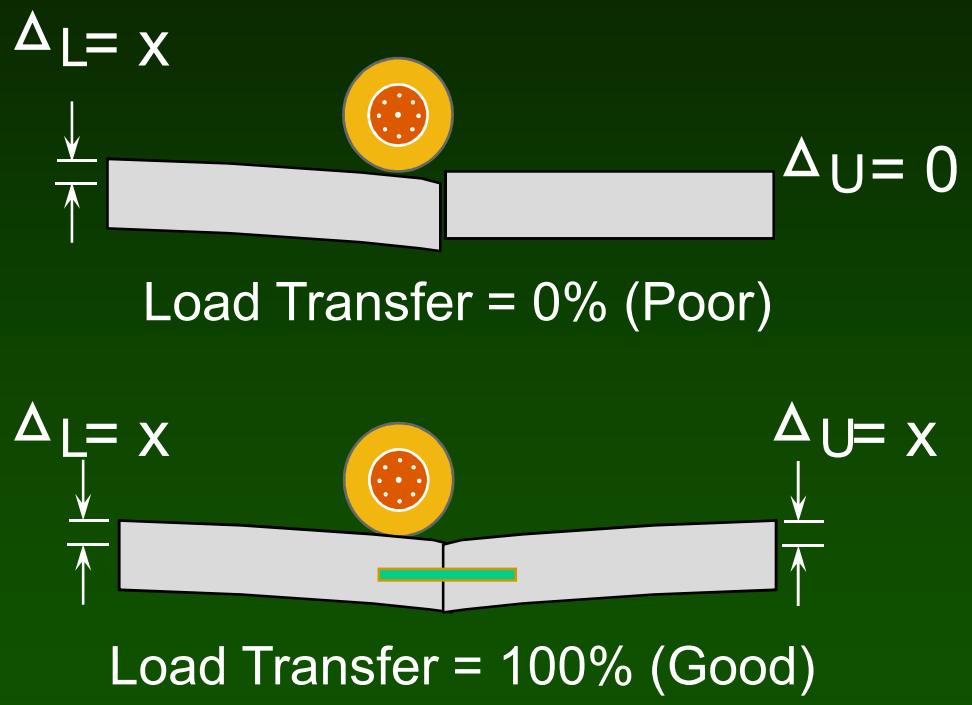
Load Transfer Restoration

- Placement of load transfer devices across joints or cracks of existing pavements
- Candidate projects
  - Poor load transfer (< 70 %)
  - Pumping
  - Faulting
  - Corner breaks



Purpose of Load Transfer Restoration

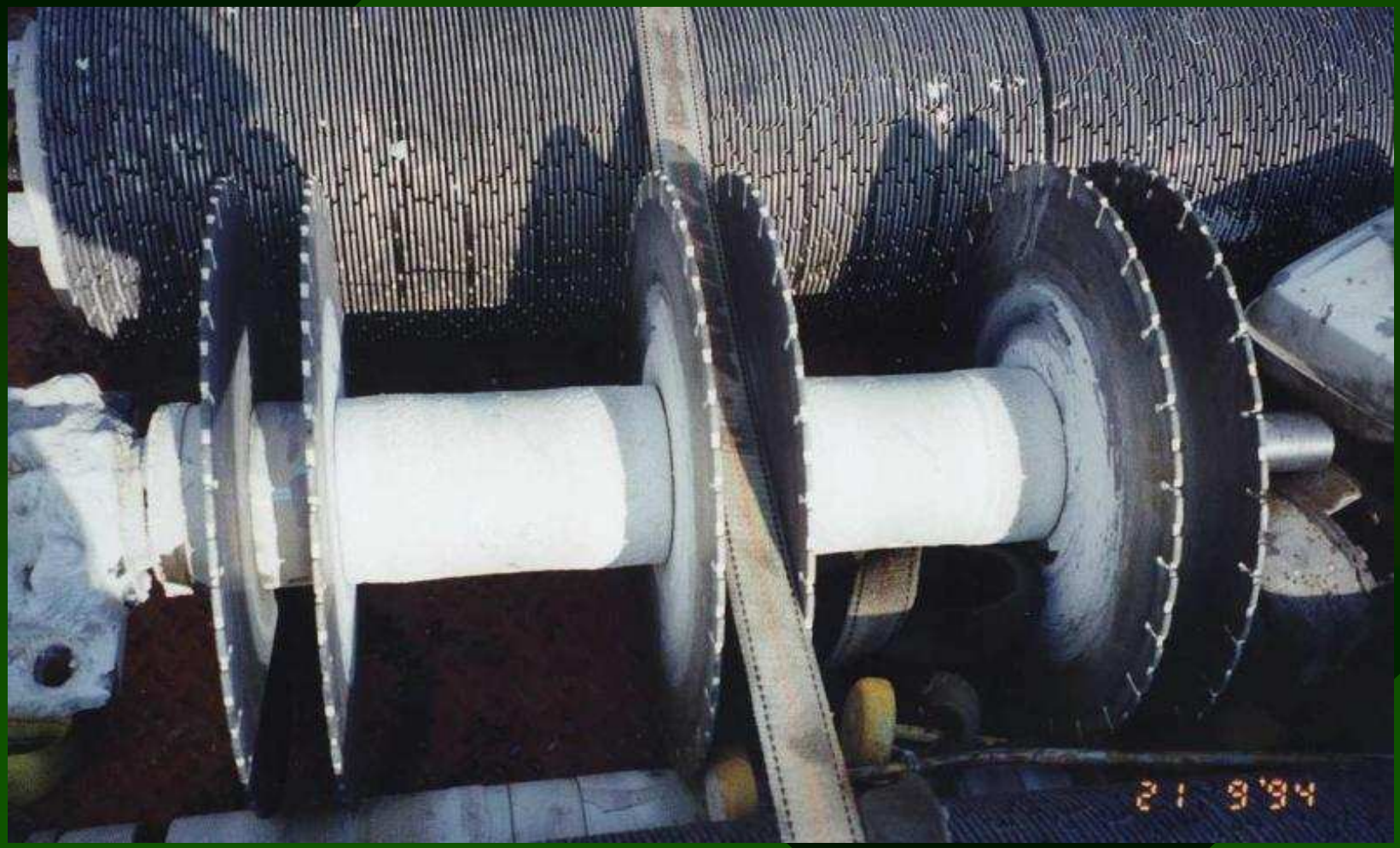
- Reestablish load-transfer across joints or cracks
  - Load-transfer is a slab's ability to transfer part of its load to its neighboring slab
- Used in JRC and JPC pavements to limit future faulting



Cutting the Slots

Diamond saw slot cutter

- Cuts multiple slots in a single pass
- Cuts form the edges of the slots
- Fins are removed later
- Can cut 3 or 6 slots in a single pass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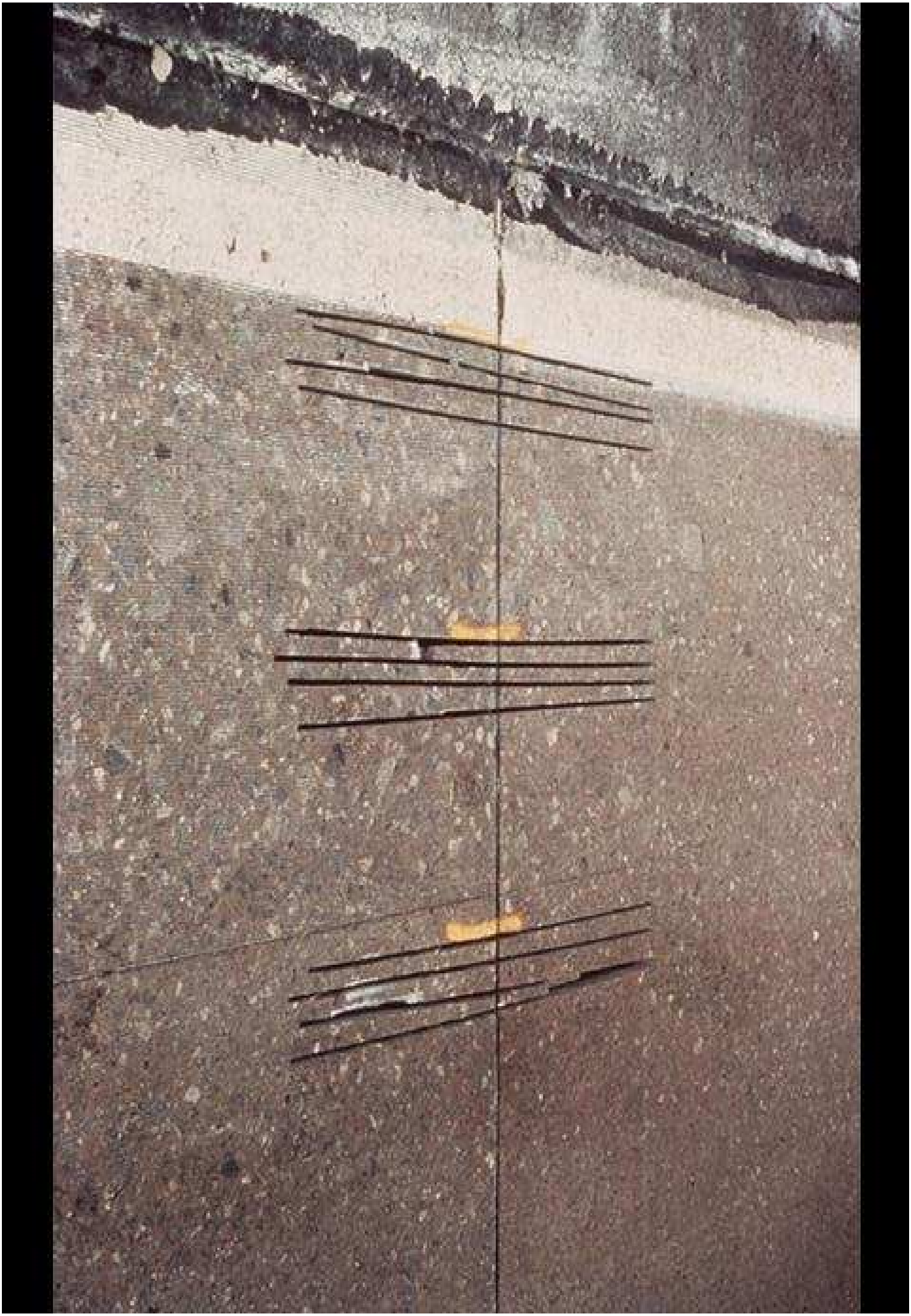
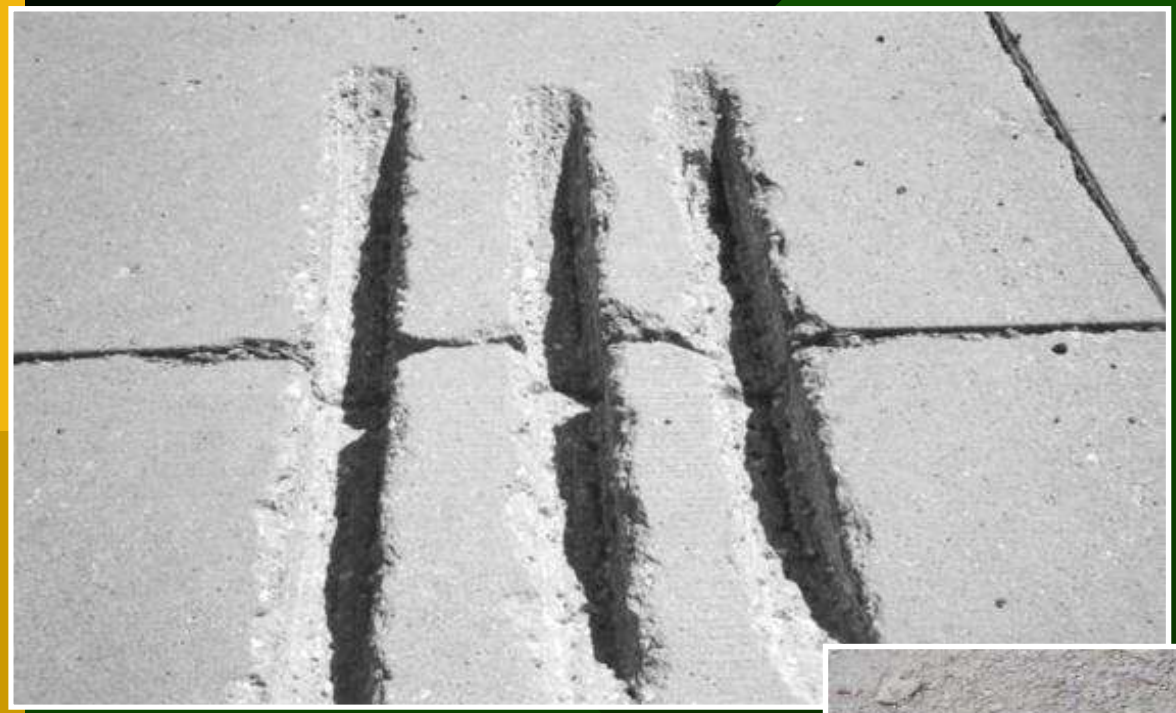
TARGET
TARGET
ABEL



Caution!

Modified milling machines are NOT recommended!

Diamond sawing is the most reliable and proven method. Modified milling has been used experimentally with very limited success.



•Milled slots may cause patches to fail and/or joints to lock up.

- Modified milling machines are demolition tools, not precision cutting instruments.

Questions