



Full-Depth Repair

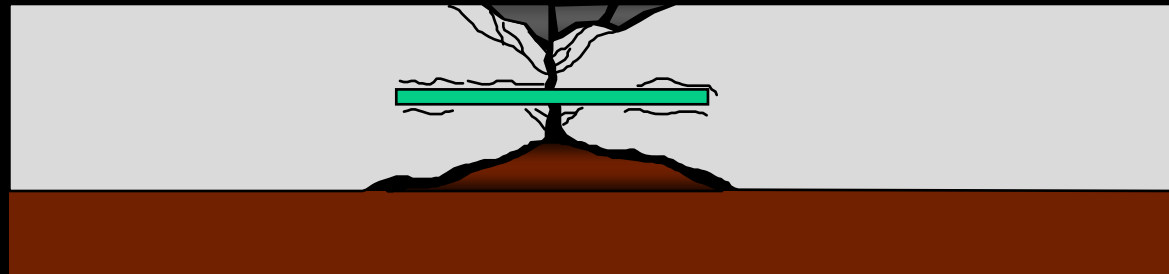
- Purpose
 - Restore structure
 - Restore ride
- Used for:
 - Joint deterioration
 - Transverse cracking
 - Longitudinal cracking
 - Broken slabs & corner breaks



Uses of Full-Depth Repair

Joint Deterioration

- Spalling (also below surface)
- Cracking





Uses of Full-Depth Repair

Transverse Cracking

- “Working cracks” that function as joints develop from:
 - lock-up of dowels
 - rupture or corrosion of steel
 - poor joint spacing design
 - loss of aggregate interlock on crack face
 - excessive deflection from poor support
 - inadequate joint sawing
- May need repair when spalling, pumping, or faulting occurs



Uses of Full-Depth Repair

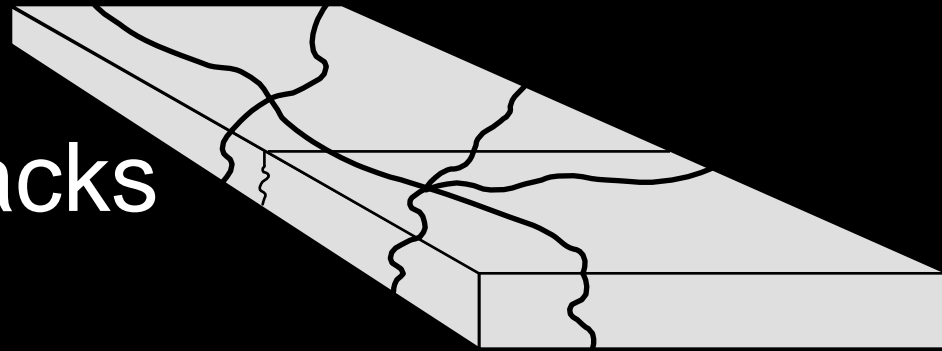
Longitudinal Cracking

- Full-depth repair only necessary when:
 - crack $>13\text{mm}$ wide
 - spalling extends $> 150\text{mm}$ in from crack
 - faulting $>13\text{mm}$
- If conditions less severe:
 - partial-depth repair
 - cross-stitching
 - retrofit dowel bars
 - sawing and sealing

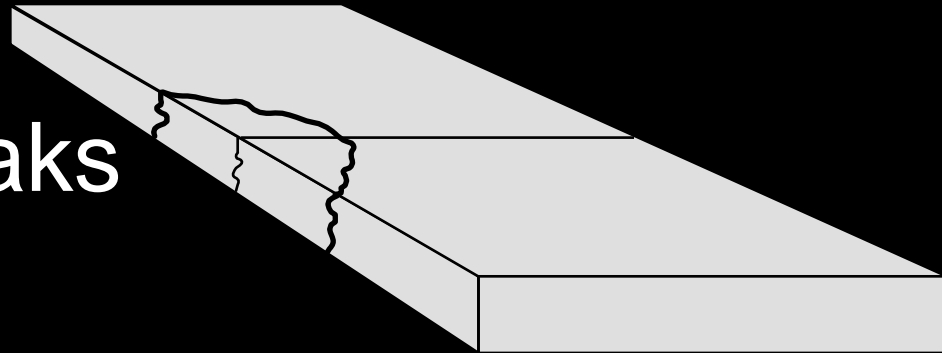


Uses of Full-Depth Repair

Multiple Cracks



Corner Breaks





Design of Full-Depth Repairs

Considerations:

- Pavement Type
- Patch Size
- Load Transfer
- Concrete Materials



Sizing a Patch

- Go beyond deterioration
- Remember to check for below-surface spalling
- Minimum length 1.8m
- Adjust as necessary
- Combine closely spaced patches



Field Adjustments to Patch Size

If Patch Boundary:

- Falls within 1.0m of transverse joint
 - Then extend to include joint
- Falls on or very near a doweled joint
 - Then extend beyond joint 300mm to remove the dowels
- Falls on a crack
 - Then extend beyond crack by 75mm

Combine Patches!!





Load Transfer

Jointed Pavements:

- Pavement thickness / 8
- At least 175mm of embedment on either side
- Corrosion resistance necessary if deicing chemicals will be used



Patch Materials

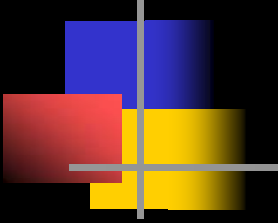
- ASTM C 150 Types I, II, or III portland cement (CAN/CSA A5-M88)
- Target slump: 50 - 100 mm
- Entrained air: 4.5 - 7.5%
- Accelerators common for early strength gain
 - Non-chloride accelerators will cause early set time (within 30 minutes)
 - workability decreases with accelerators

Construction of Full-Depth Repairs

7 steps:

- Isolate deteriorated area
- Remove old concrete
- Remove any wet base materials
- Provide load transfer at joint faces
- Place & finish new concrete
- Cure & insulate concrete
- Saw & seal perimeters

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



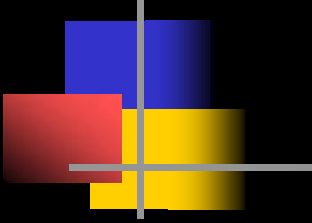
Carbide-Tooth Wheel Saw

Only for:

- Pressure relief cuts
- Cuts along asphalt shoulder



Pressure Relief Cuts





Removal

- Method of removal up to contractor
- Liftout
 - Lift pin and chain
 - Forklifts
 - Torque claws
 - Lateral-pressure lifts

If contractor causes damage during removal he re-cuts beyond the limits of damage at his own expense

Liftout



Pin and Chain

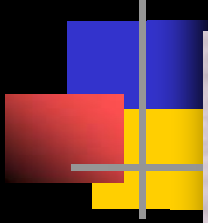


Torque Claw

Lateral Pressure



Liftout Damage





Preparing Patch Area

- Add and compact new base material if necessary (Contractors option)
- Use 17-27 kN vibratory plate compactors
- Drain rainwater as necessary

Vibratory Plate Compactor





Drilling Dowel Holes

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



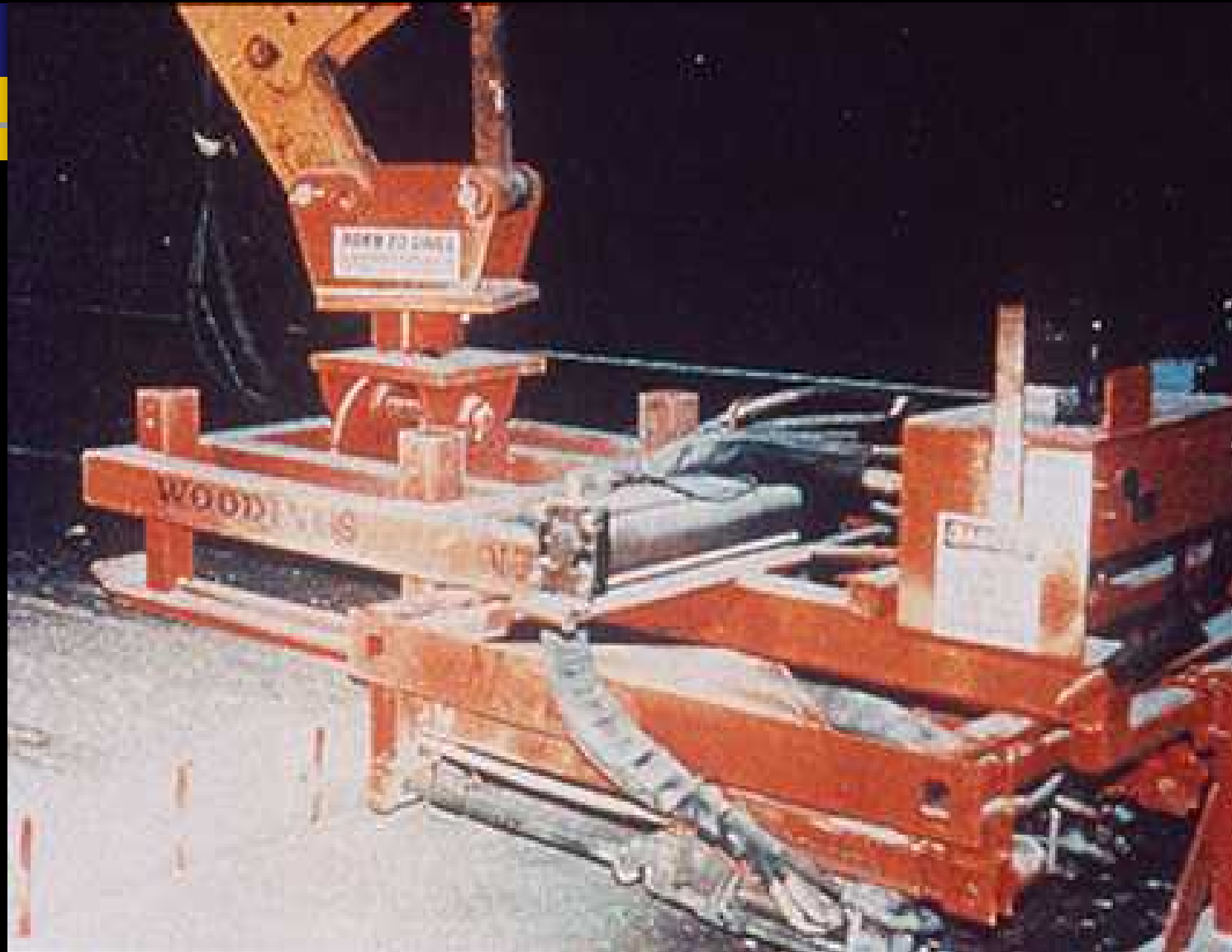
Drilling Dowel Holes

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

Self-Propelled Slab Reference



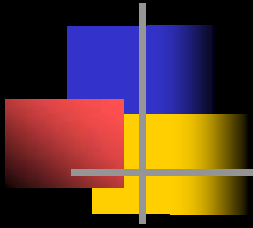
Boom-Mounted Slab Reference





Cleaning Holes

- Compressed air
- Insert air wand to back of hole
- Check compressor for moisture and oil contamination with clean cloth
- **This is very important**

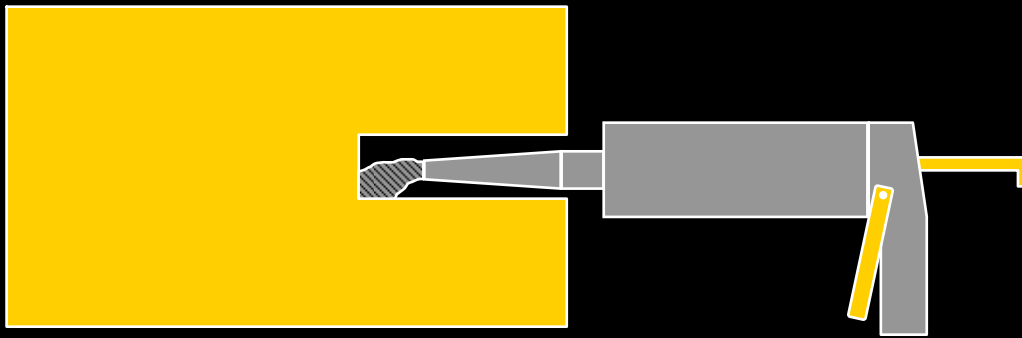


Installing Dowels

- Feed material to back of hole
- Insert dowel properly - twist 1 full revolution to spread epoxy evenly on bar
- Use retention disk, or trowel epoxy around bar if none available

Installing Dowels

1



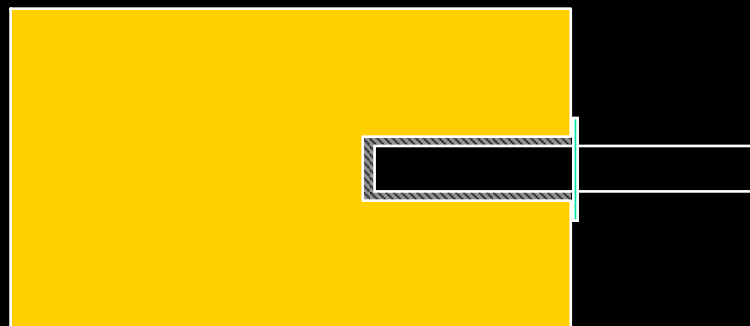
Inject Epoxy
to Back of Hole

2



Twist one turn
while pushing
in dowel

3



Place epoxy
retention disk to
hold in epoxy

Injecting Epoxy



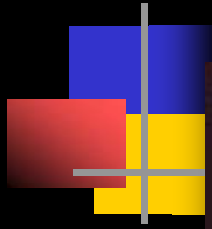
Retention Disk



Troweling of Epoxy 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

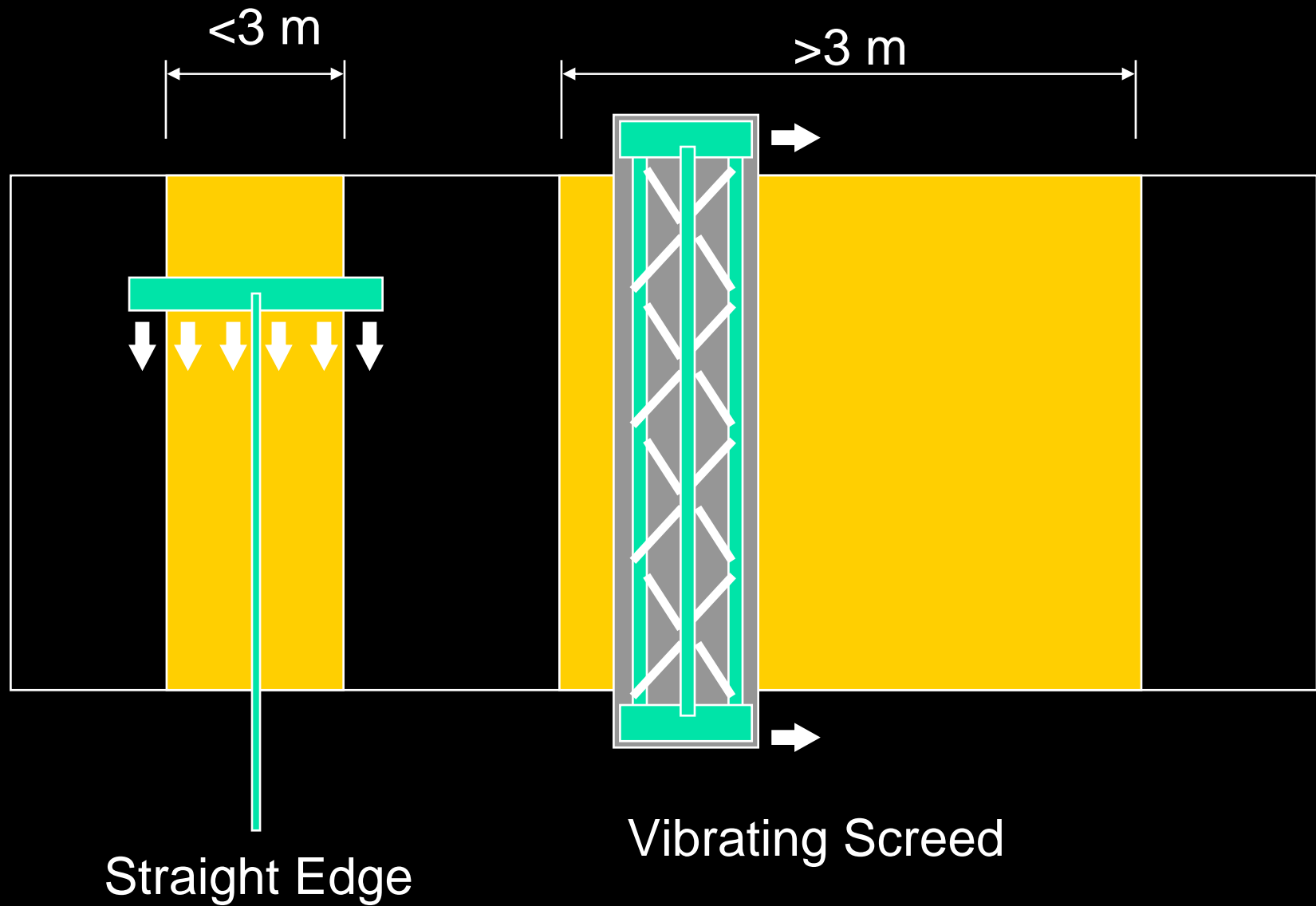




Finishing

- 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
- Tolerance with grinding 5mm if no grinding 3mm

Finishing



Finishing



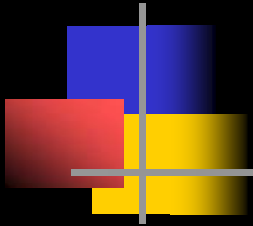


Texturing

- Texture soon after finishing
- Texture similar to surrounding concrete surface
 - burlap drag
 - tine (match spacing)
- Do not delay curing

Texturing



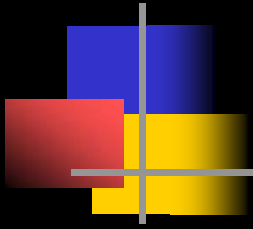


Curing

- Liquid-membrane-forming compound that meets ASTM C 309
- Apply evenly
- Pigment is helpful to see coverage
- Insulation mats useful for:
 - Accelerating strength gain
 - Cold temperatures
- Place polyethylene sheeting between patch and insulation

Curing





Joint Sealing

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



Opening to Traffic

- 2 methods:
 - Specified minimum strength
 - Maturity method (mix specific)
- Variations in air temperature influence strength development

Summary

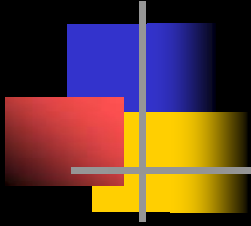
7 steps for Constructing Full-Depth Repairs:

- Isolate deteriorated area
- Remove old concrete
- Repair base (if necessary)
- Provide load transfer and/or ties at joint faces
- Place & finish new concrete
- Cure & insulate concrete
- Saw & seal perimeters

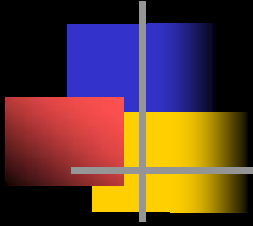


Payment

- Most agencies pay by square meter
- Contractors must account for:
 - Original construction thickness variation if specifications provide thickness tolerances
 - Loss of base materials during concrete removal
 - Extending patch length for damage caused by the contractor



Questions ?



Thank You