Construction

Scope

- Paving methods and concrete requirements
- Sideform construction
- Slipform construction

CEMENT & CONCRETE SA

Scope (cont.)

- Surface texturing and curing
- Joint construction
- Joint sealing
- Protection and opening to traffic

CEMENT & CONCRETE SA

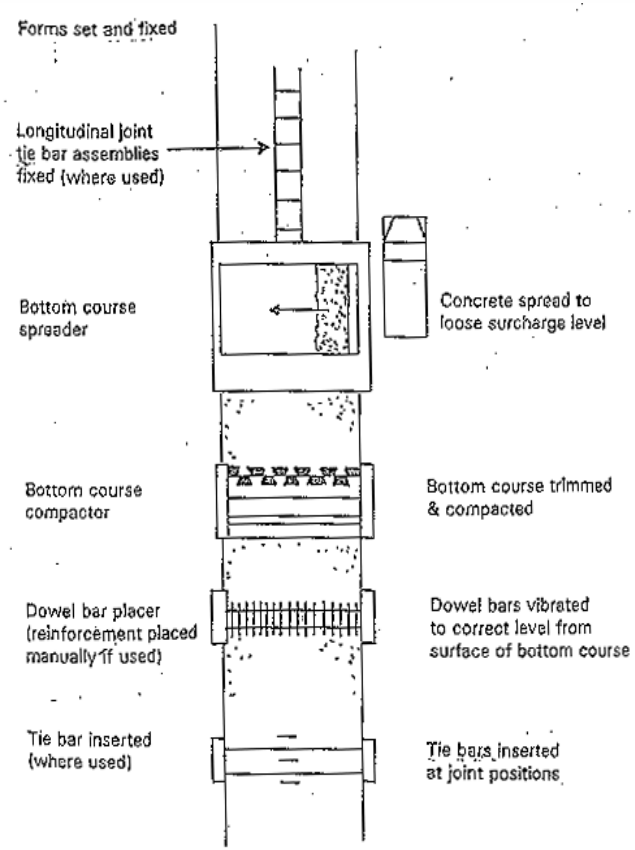
Paving methods

Fixed Form Paving

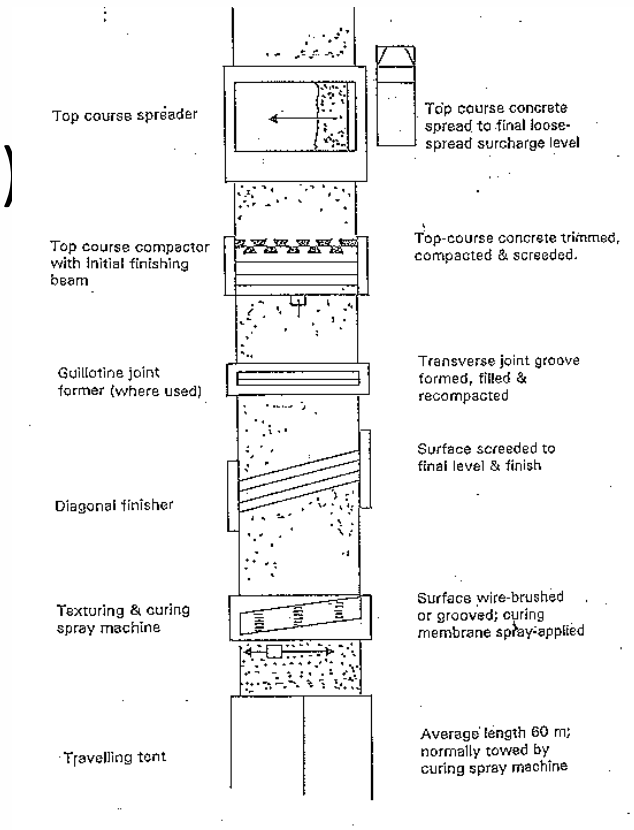
- Paving form is the mold
  - Holds concrete in place
  - Establishes grade and alignment
  - Serves as tracks for paving equipment

CEMENT & CONCRETE SA

Fixed form paving



Fixed form paving (cont)



CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Slipform

- Consolidate
- Form into a Shape
- Finish the Surface

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Sideform vs Slipform

- Number of forms to handle
- Slipform complex
- Volumes and production
- Site layout
- Geometry
- Labour requirements
- Width changes

CEMENT & CONCRETE SA

Sideform construction

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Forms

- Mold that determines
  - Pavement depth
  - Pavement width
  - Pavement smoothness

CEMENT & CONCRETE SA

Forms

- Typical form - steel section
  - Wide, flat base for stability
  - Rail to carry paving equipment
  - Pin (stake) holes to anchor to base
  - Connections for adjacent forms
  - Normally, height same as pavement thickness

CEMENT & CONCRETE SA

Forms

- Specification trueness: not more than
  - Top of form: 3 mm in 3 m
  - Face of form: 6 mm in 3 m
  - Check with a straightedge or stringline

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Setting Forms

- Form setting is critical construction step
  - Uniform support
  - Proper maintenance
- Proper alignment and elevations contribute to smooth pavement

CEMENT & CONCRETE SA

Setting Forms

- Keyway strips
  - Attach to face of forms
  - Secure tie bars
  - Adjust keyways to match between forms

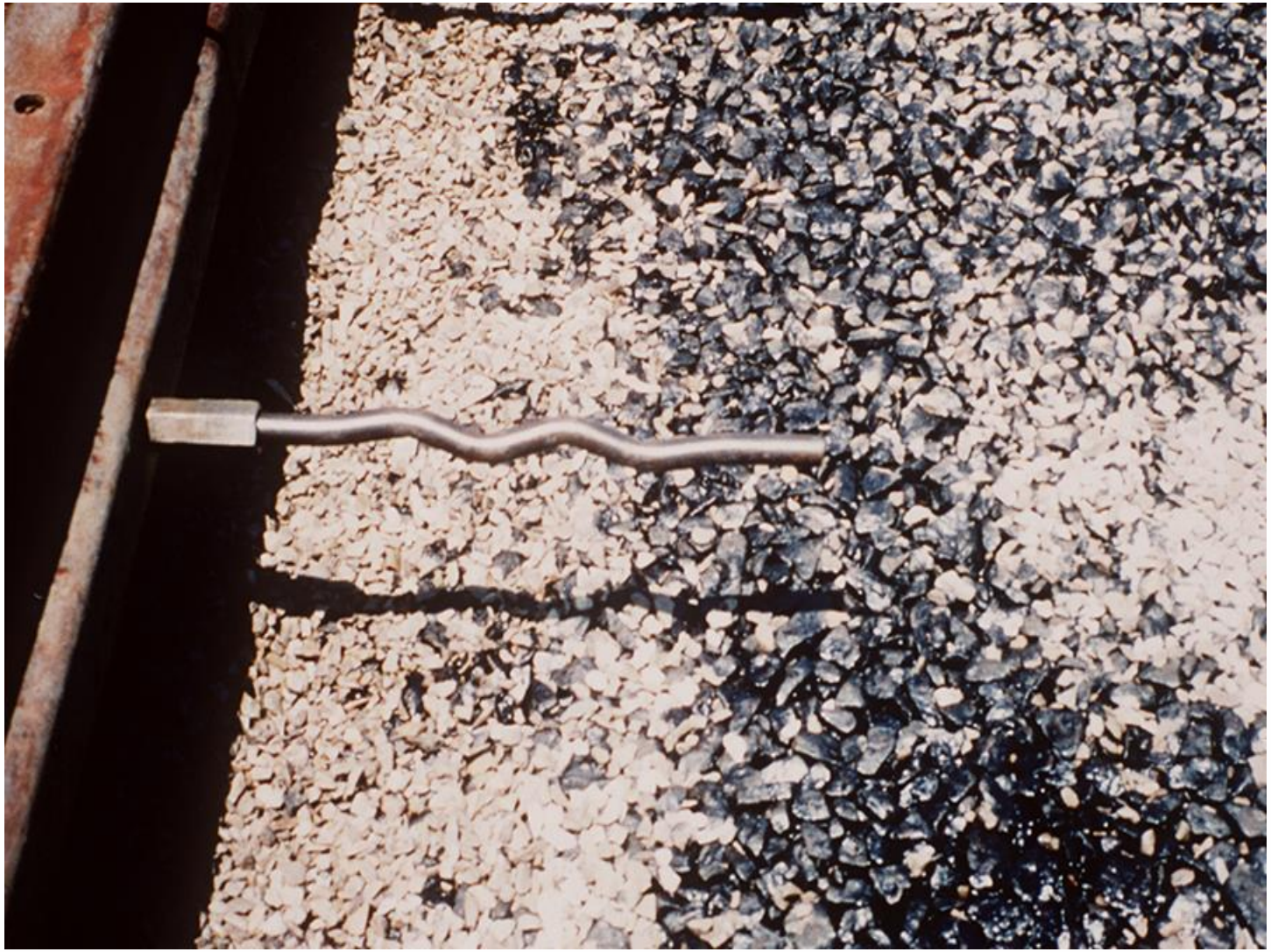
CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

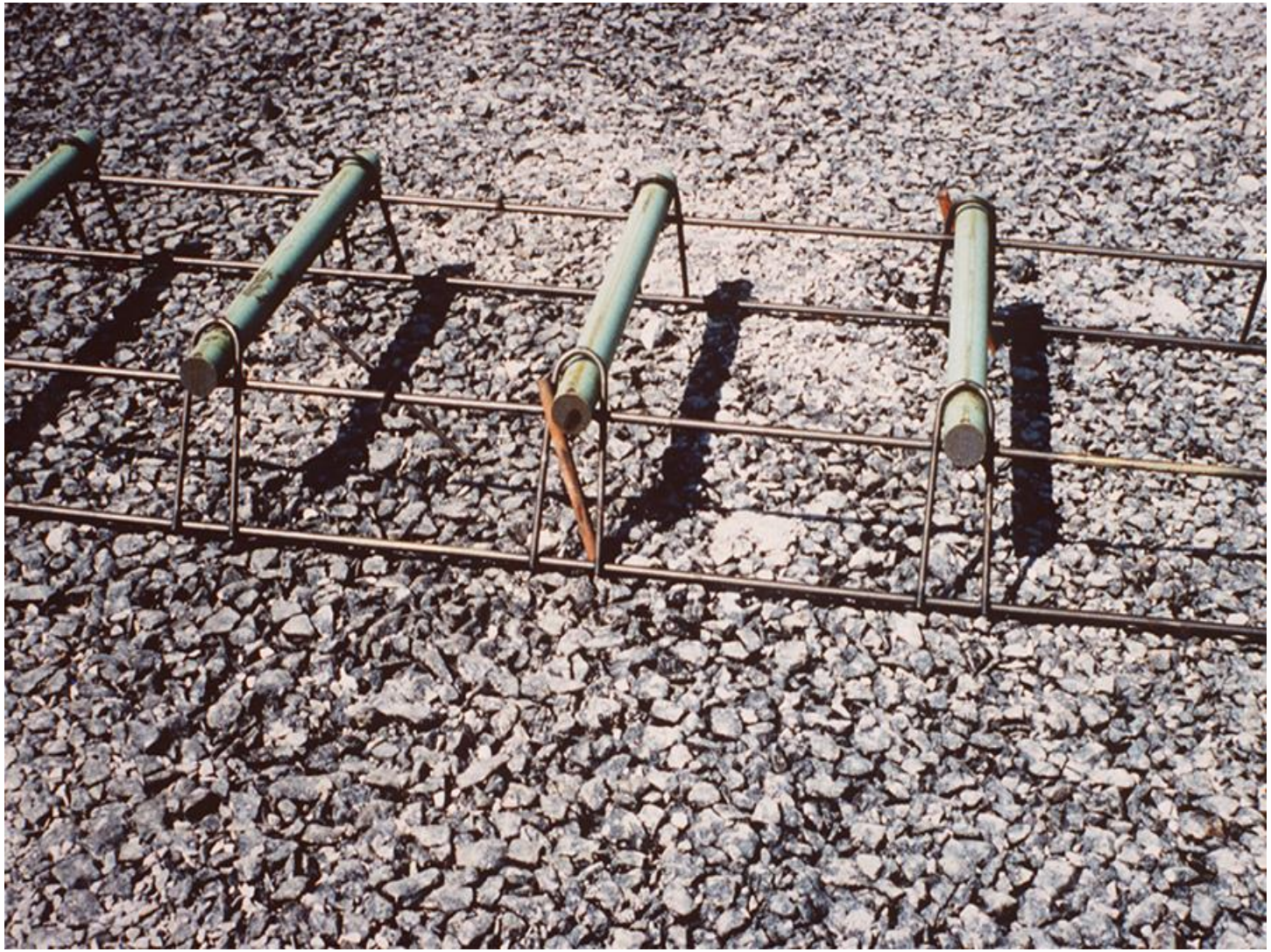


CEMENT & CONCRETE SA

Reinforcement

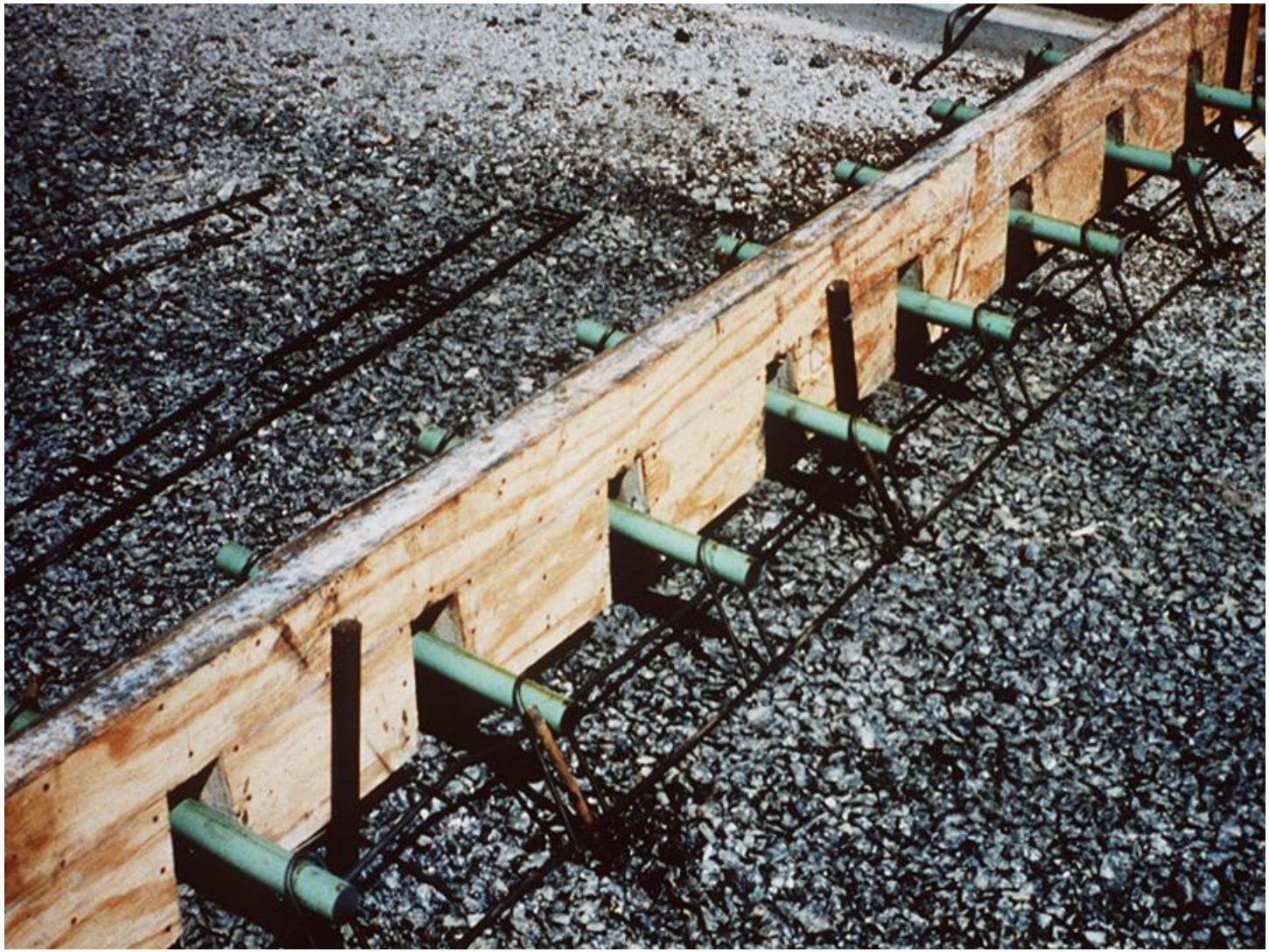
- Dowel baskets
  - Locate perpendicular to pavement
  - Anchor in place
  - Mark for future reference
- Headers - proper placement
  - Beginning of slab
  - Interrupted operations
  - End of slab

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Delivery of Concrete

- Consistent quality
- Consistent rate
- Rate compatible with
  - Placement
  - Surface finishing operations

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Paving Operations

- UNIFORMITY & CONSISTENCY is the key in
  - Placing
  - Consolidating
  - Finishing

CEMENT & CONCRETE SA

Paving Operations

- Consistent - uniform head of concrete
- Consistent vibration pattern

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Small Screeds/Hand Placement

- Vibratory screeds
  - hand operated
  - self-propelled

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Small Screeds/Hand Placement

- Care required in placement - finishing
- Hand work - hand poker vibration - overlap
- Hand work - floats, highway straight edges
- Be consistent with operations
- Establish consistent procedure - follow it

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Key Elements Placement

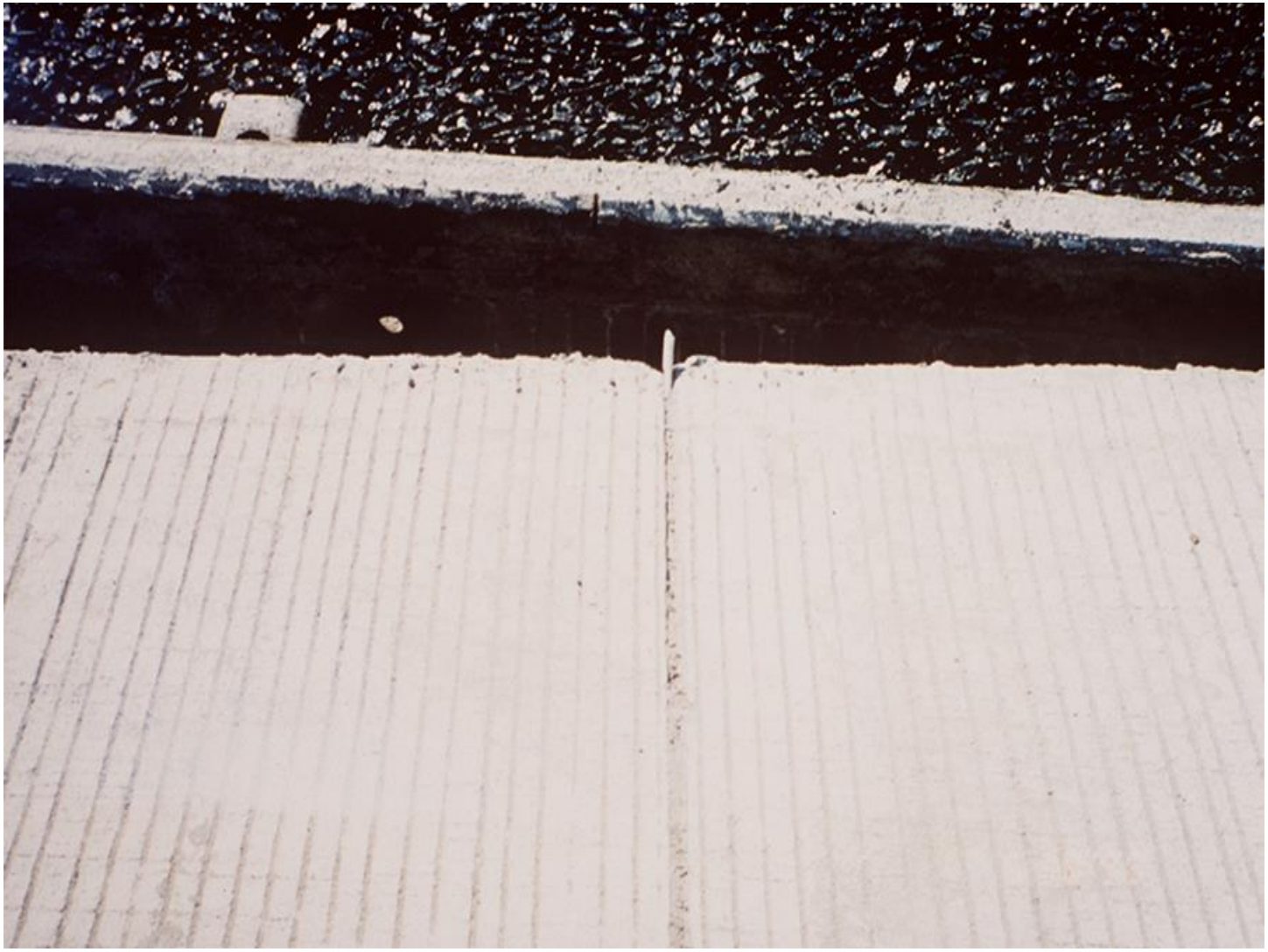
- Place uniformly
- Vibration adequate for consolidation
- Keep vibrating screed moving forward

CEMENT & CONCRETE SA

Form Removal

- Remove timely
- Pull pins
- Tap lightly before removal
- Check edge for honeycomb
- Cure edges

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

Critical Factors Fixed Form Paving - Ride Quality

- Timely delivery
- Proper placement mix on grade
- Keep within proper distance from spreading operations

CEMENT & CONCRETE SA

Critical Factors Fixed Form Paving - Ride Quality

- Adequate vibration - consolidation
- Care in placement and vibration
  - dowel baskets
  - keyways
  - fixtures
  - boxouts
  - headers

CEMENT & CONCRETE SA

Critical Factors Fixed Form Paving - Ride Quality

- Proper machine adjustments
- Steady machine progress
- Avoid excessive finishing
- Avoid excessive water on surface
- Straightedge check of slab

CEMENT & CONCRETE SA

Slipform Paving

CEMENT & CONCRETE SA

Slipform

- Consolidate
- Form into a Shape
- Finish the Surface

CEMENT & CONCRETE SA

CEMENT &
CONCRETE SA

CEMENT & CONCRETE SA

Set Stringline

- Rigid stakes
- Quality line
- No perceptible sagging
- Eyeball for staking errors
- Re-survey staking errors
- Adjust stake spacing to fit conditions

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Track Line

- Extend base one meter beyond outside edge of pavement
- Construct parallel to base cross slope
- Durable for paving train
- Keep it clean

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Internal Vibration of Concrete

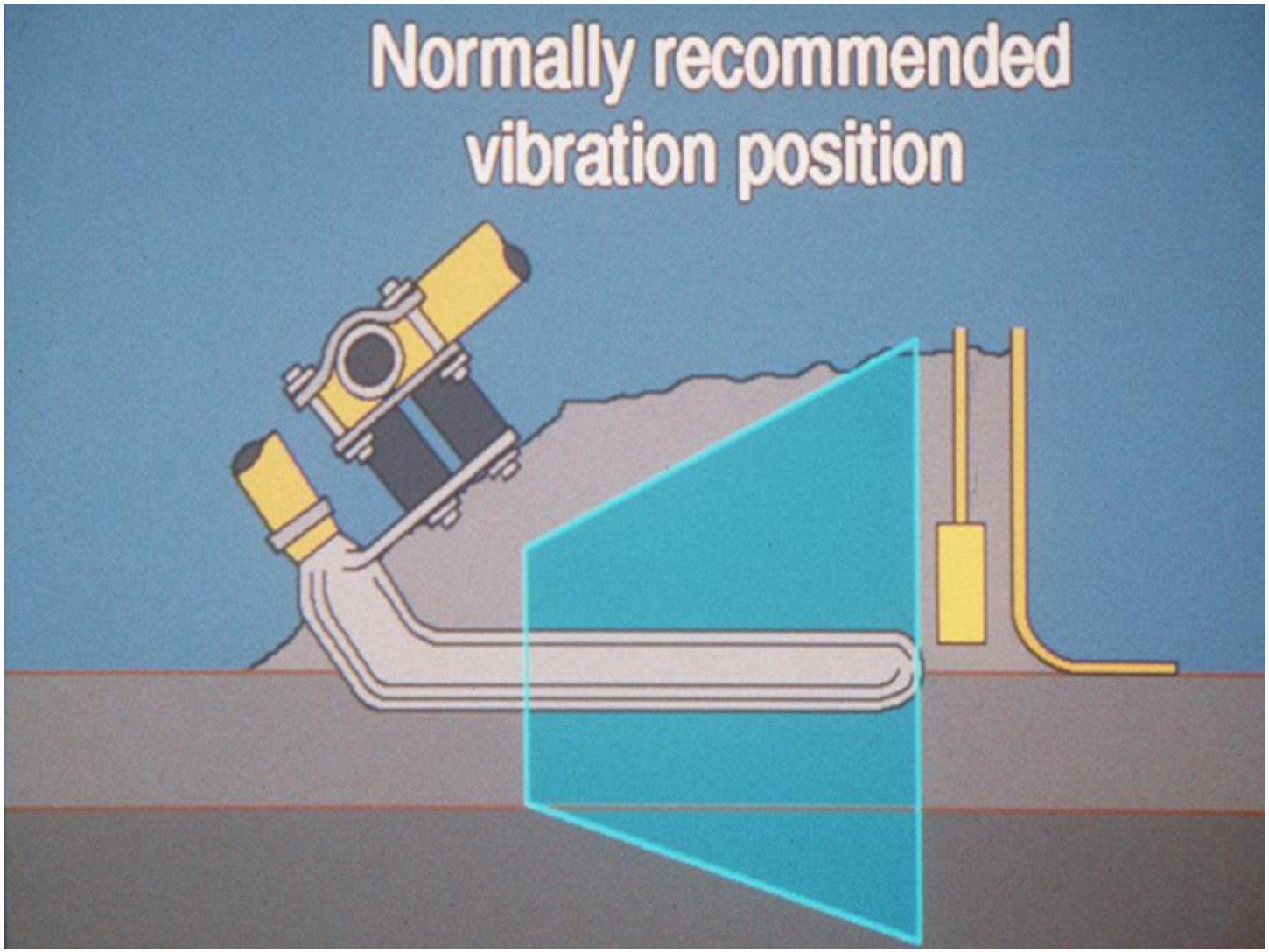
CEMENT & CONCRETE SA

Purpose of Vibration

- Consolidate Concrete Mass
- Fluidize the Concrete Mass

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

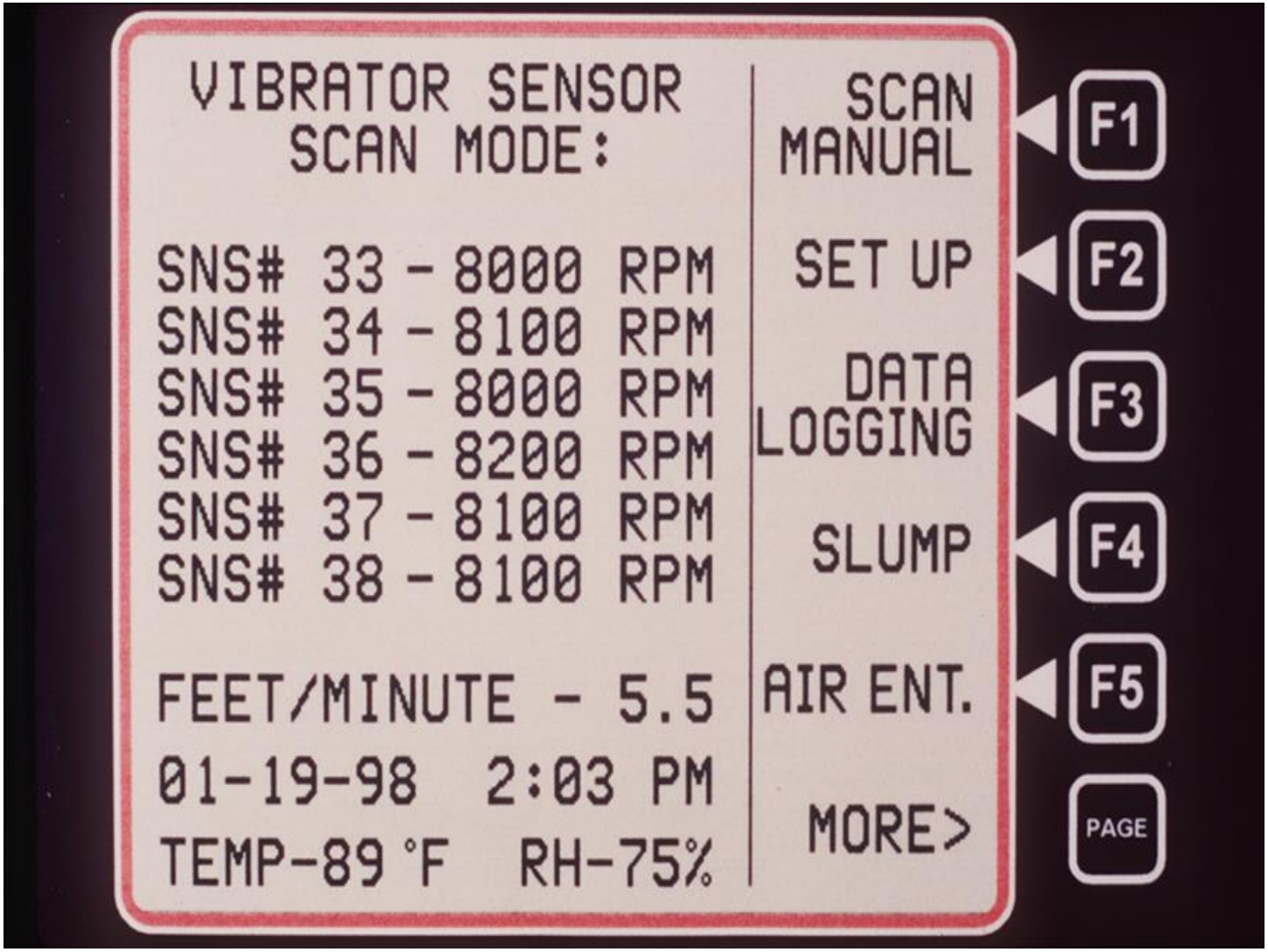


CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

Pavement Steel

- Dowel bars
- Tie bars
- Reinforcing mesh
- Continuous reinforcement

CEMENT & CONCRETE SA

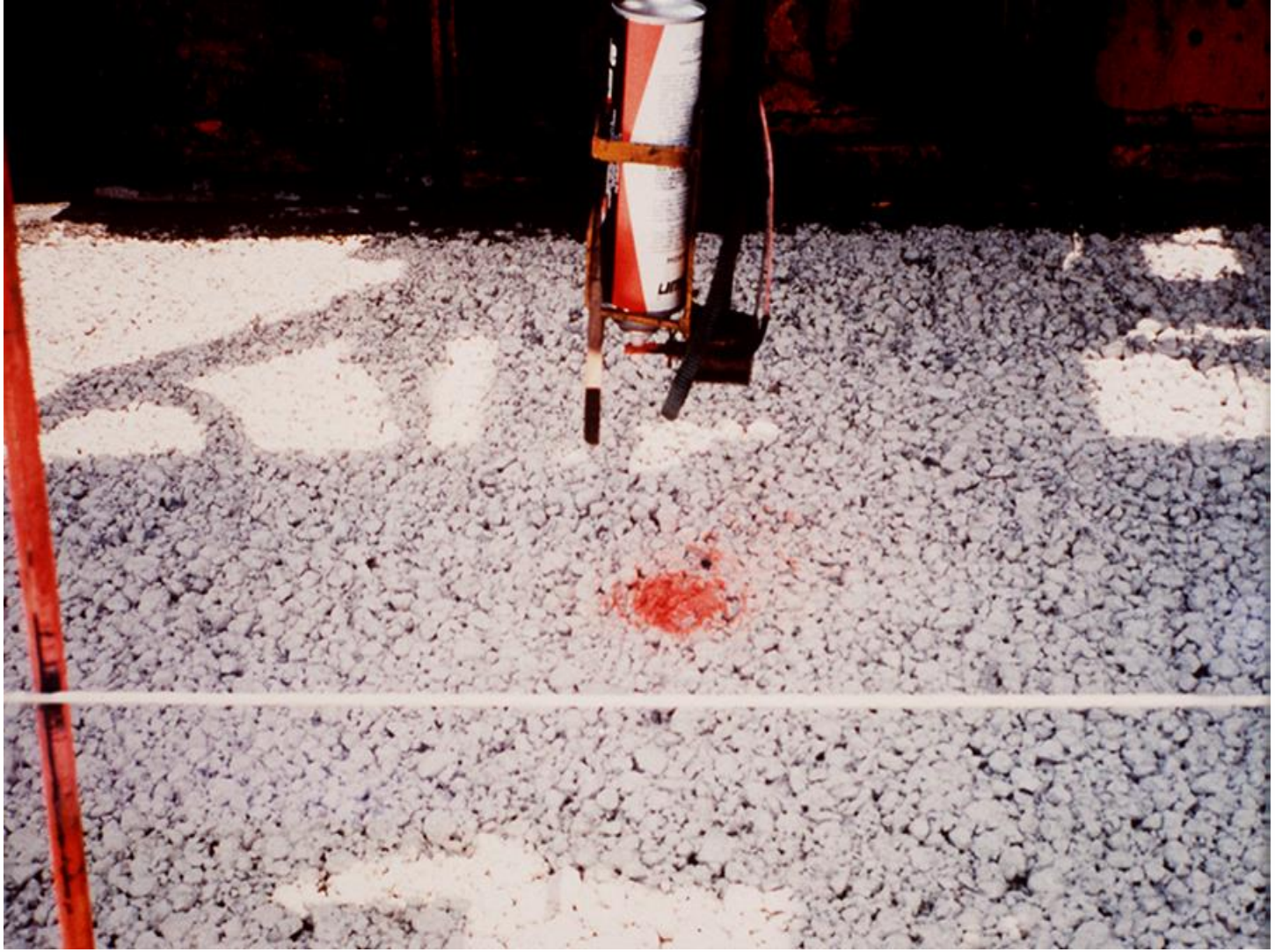
Placing Dowel Bars

- Basket assemblies
- Dowel bar inserters

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

Tie Bars

- Set on chairs
- Insert in fresh concrete

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Reinforcing Mesh

- Two lift construction
- Mesh depressor

Continuous Reinforcing

- Set on chairs
- Tube feeder

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

TO EXTRUDE:

“To shape a material by forcing it through a mold.”

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Discharging

- Place directly on grade
- Place with spreader
- Place with belt placer
- Safety first

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Paver Operation

- Constant uniform motion
- Constant uniform motion
- Constant uniform motion
- Constant uniform motion

Finishing

CEMENT & CONCRETE SA

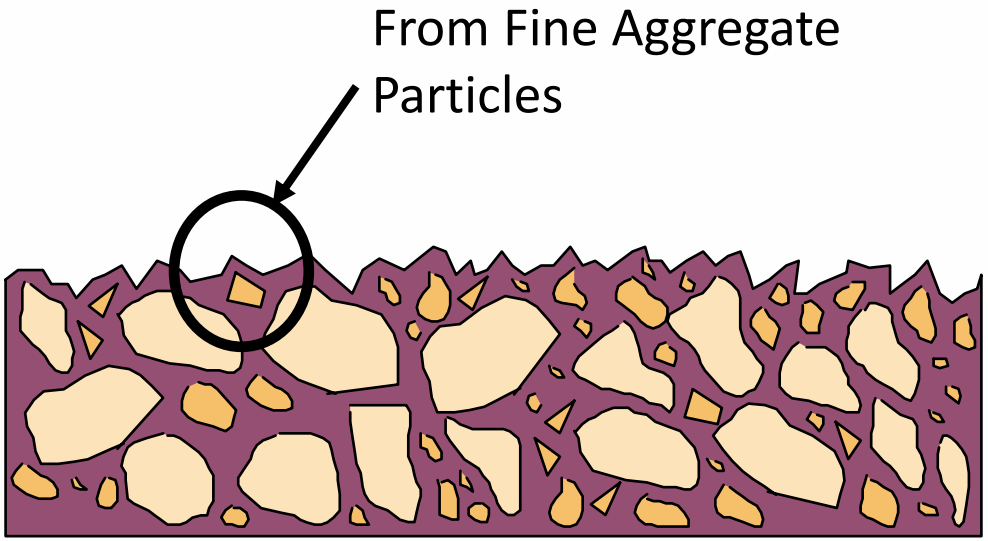
CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

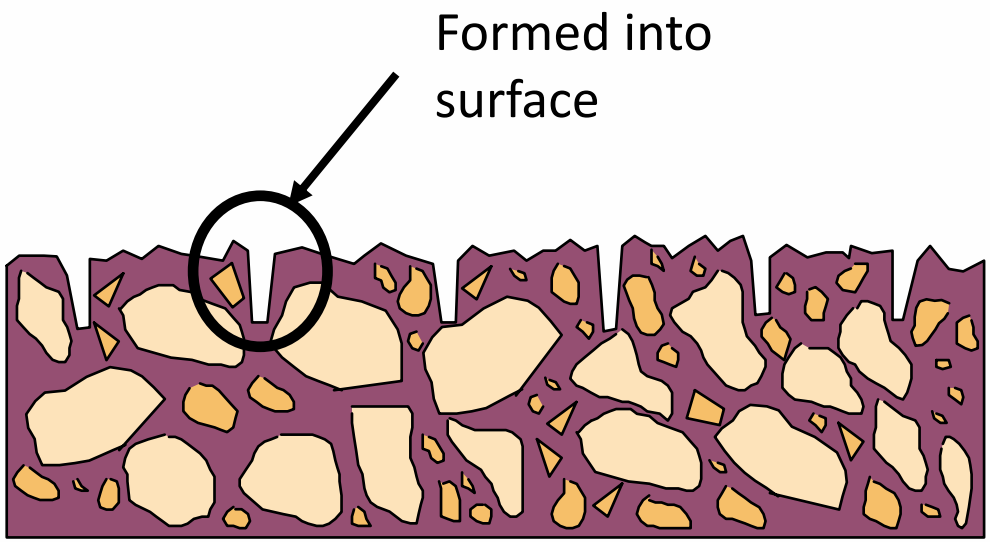
CEMENT & CONCRETE SA

Texturing and curing

Microtexture



Macrotexture

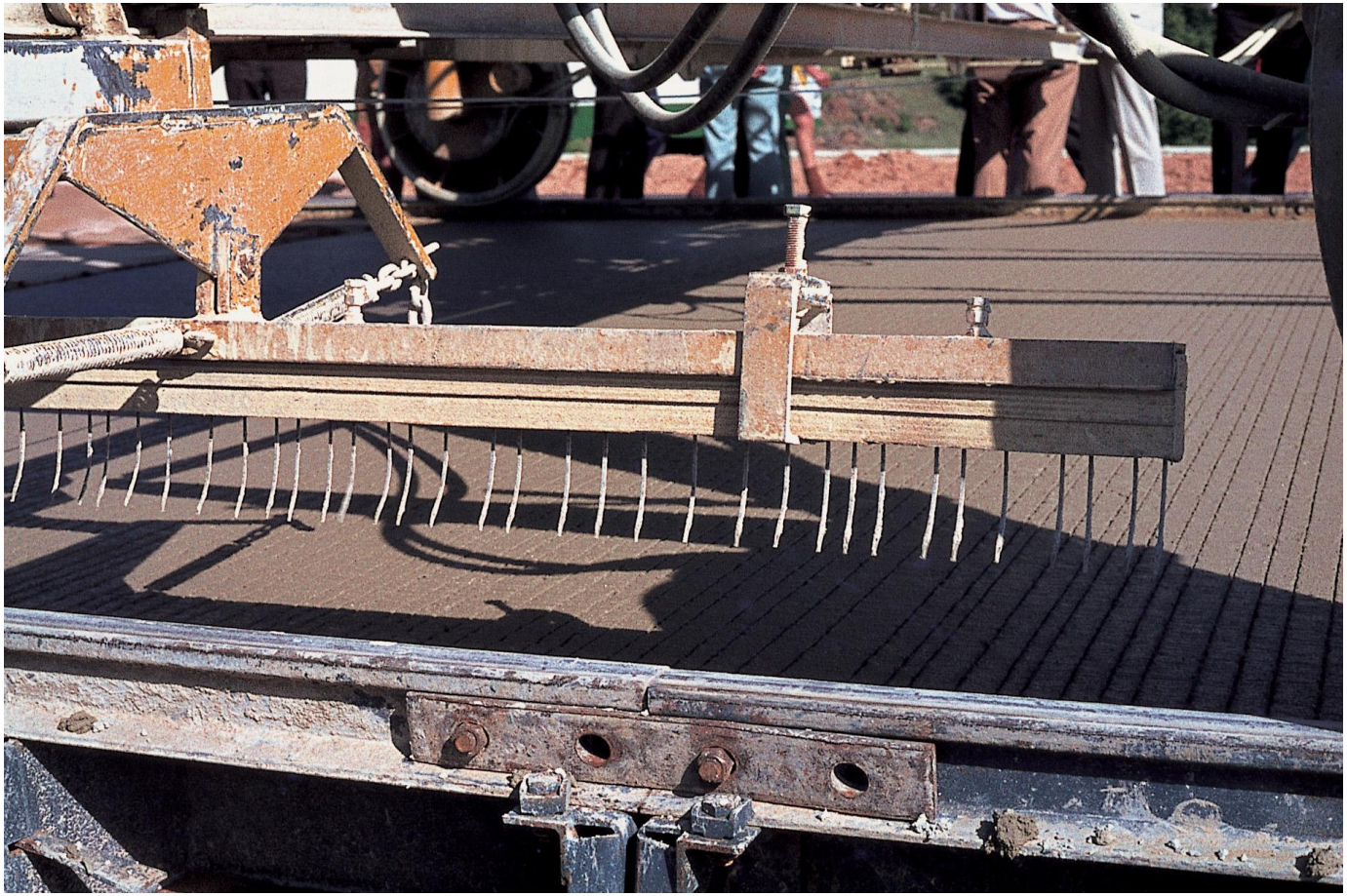


CEMENT & CONCRETE SA

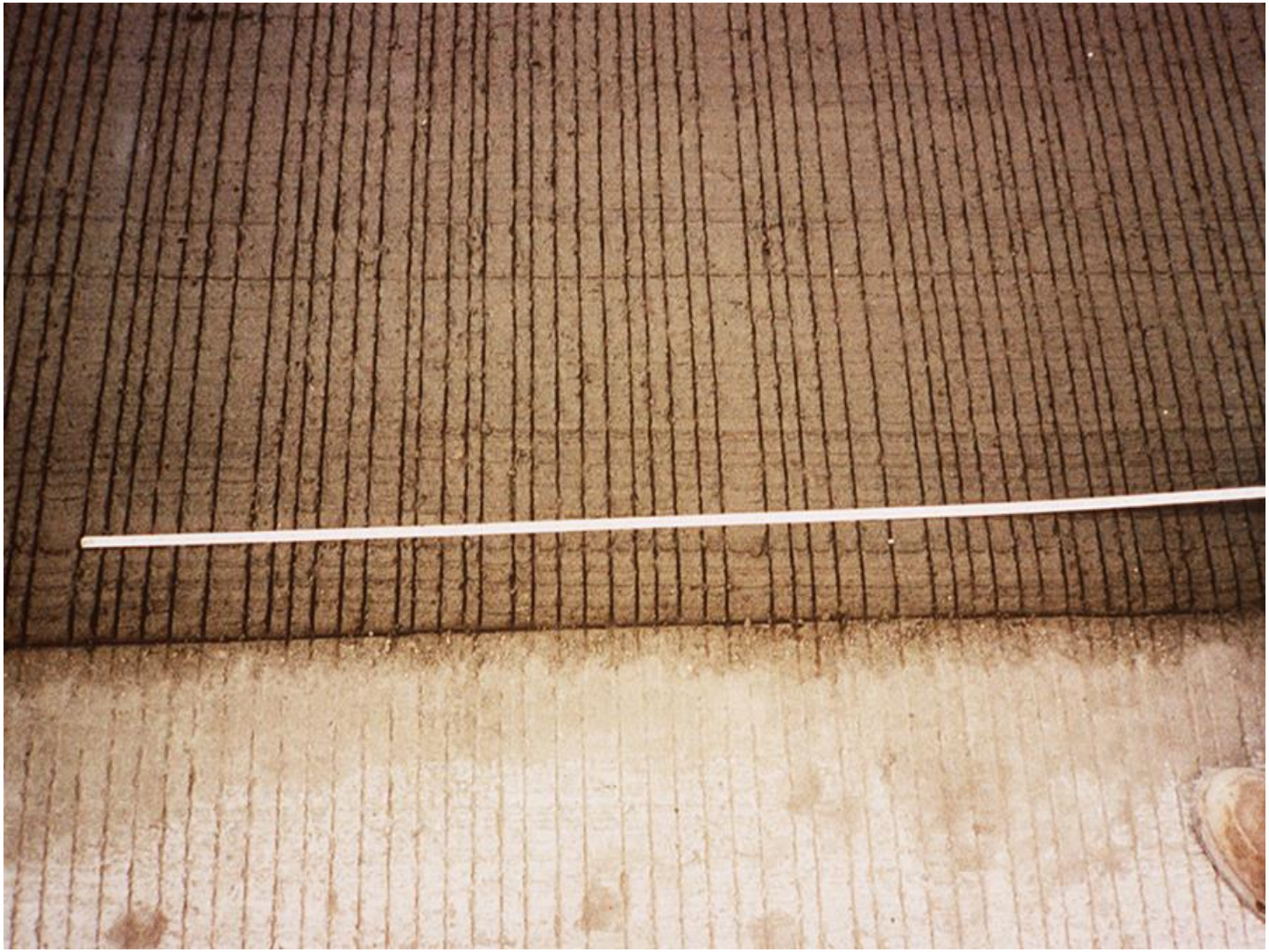
CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Curing

Curing

- Uniform
- Timely
- Check yield

Curing

- Rate according to specifications
- Uniform application
- Timely application
- Cure edges after form removal

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Joint construction

CEMENT & CONCRETE SA

Types of Saw Cuts

- Initial Saw Cut (Crack control)
- Widening Cut (Joint sealant reservoir)

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Sawing Equipment and Application

CEMENT & CONCRETE SA

Types of Sawing

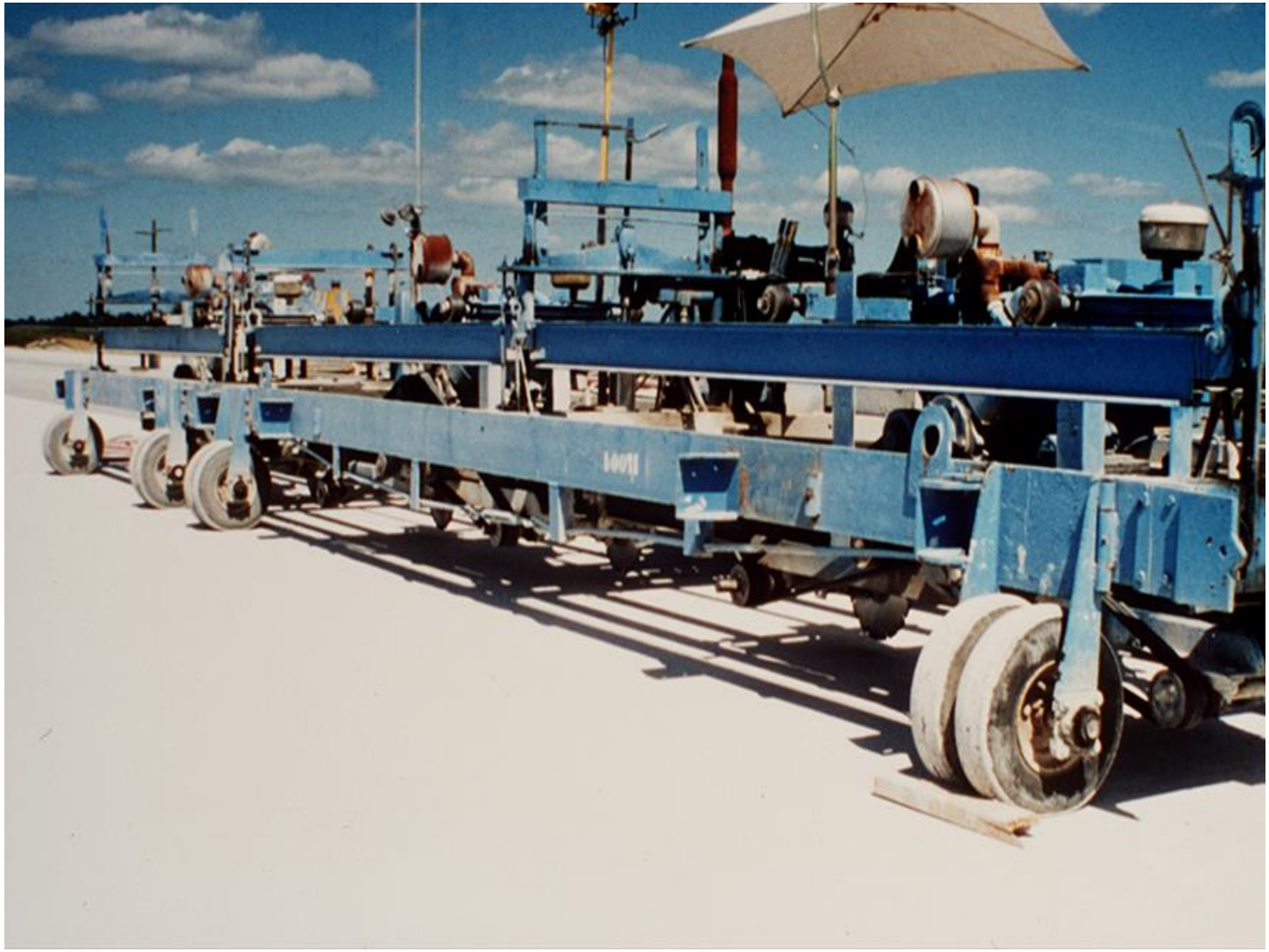
- Wet sawing
  - Diamond blades
- Dry sawing
  - Abrasive blades
  - Diamond blades

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

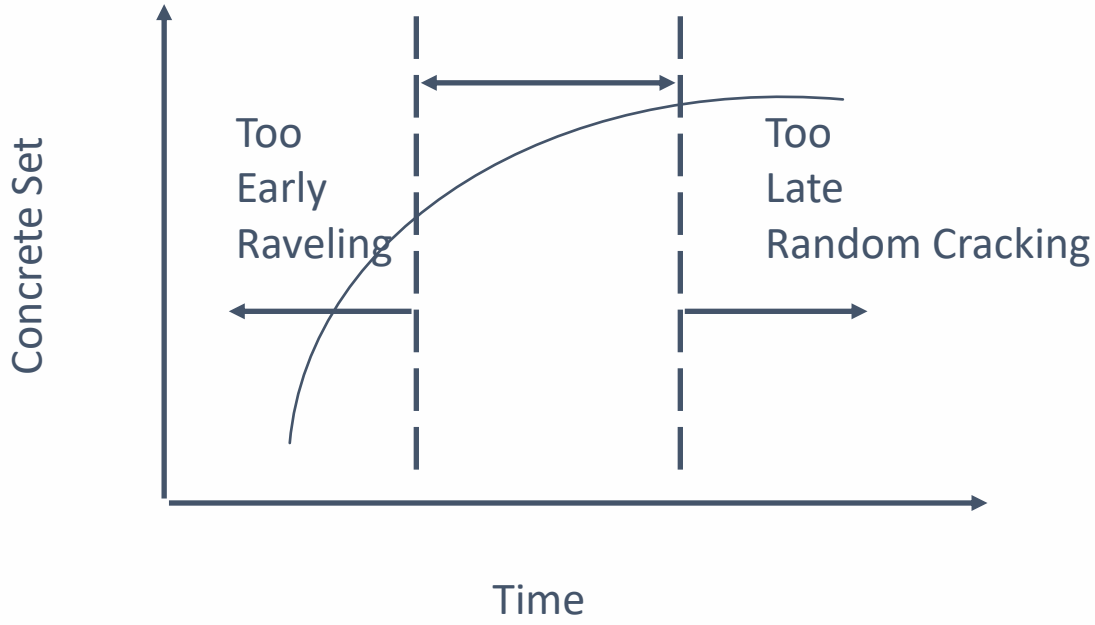
CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

Sawing Window



Sawing Window

- Concrete mix characteristics
  - Cement type
  - Admixtures
  - Fast Track

CEMENT & CONCRETE SA

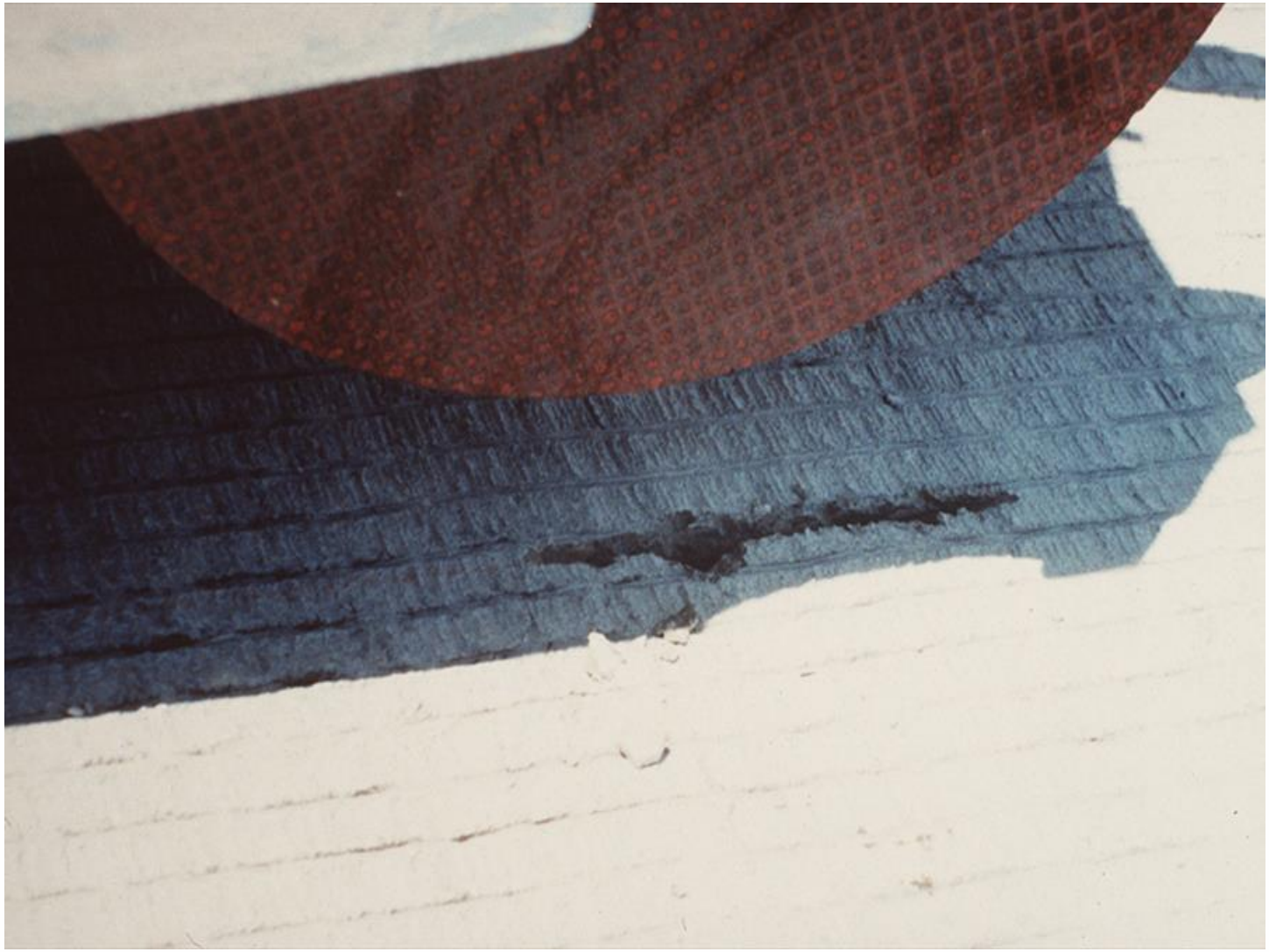
Joint Ravelling

- Early sawing
- Surface texturing
- Compatible equipment
- Equipment condition

CEMENT & CONCRETE SA

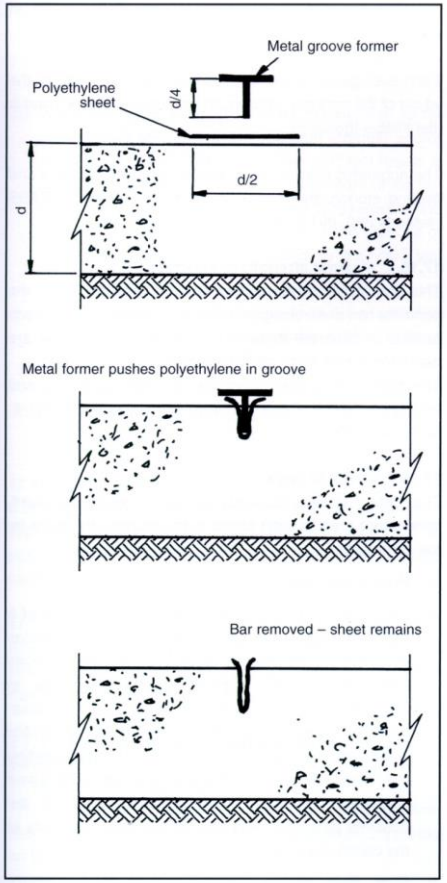
CEMENT & CONCRETE SA

CEMENT & CONCRETE SA



CEMENT & CONCRETE SA

Figure 44: Steps in wet-forming a contraction joint [36]



CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Joint sealing

Formed-In-Place
Joint Preparation

- Flush residue (Widening cut)
- Abrasive Cleaning
- Air Cleaning

CEMENT & CONCRETE SA

Formed-In-Place
Material Installation

- Backer Rod
- Sealant Material

CEMENT & CONCRETE SA

Backer Rod Installation

- Manually or automatic
- Secure fit
- DO NOT STRETCH

CEMENT & CONCRETE SA

Sealant Installation

- Uniform installation
- No moisture
- Recessed below pavement surface
- DO NOT OVERFILL

CEMENT & CONCRETE SA

Sealant Material

- Formed-in-place
  - Cold applied
  - Cold single component
  - Cold double component

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Preformed
Install Material

- Mechanical installation
- No backer rod
- Use of lubricant/adhesive
- DO NOT STRETCH

CEMENT & CONCRETE SA

CEMENT & CONCRETE SA

Protection and opening to traffic

Fast Track

Current Definition:

A series of techniques that decrease concrete pavement construction time

CEMENT & CONCRETE SA

Lane rental contracting

- Cost-plus-time (A+B)
  - Tender project cost
  - Tender time
- Continuous site rental
  - Tender like a completion date contract
- Lane-by-lane rental
  - Tender by occupied lanes or times

CEMENT & CONCRETE SA

Lane rental contracting

Closure or obstruction	Peak period 6:00 – 9:00am 4:00 – 6:00pm	All other times
One lane	RX	0.25(RX)
One Shoulder	0.25(RX)	0.0625(RX)
One lane and one shoulder	1.25(RX)	0.3125(RX)
Two lanes	2.25(RX)	0.625(RX)
Two lanes and shoulder(s)	2.50(RX)	0.6875(RX)

CEMENT & CONCRETE SA

Maturity testing

- ASTM C 1074
- Internal temperature of concrete relates directly to concrete strength
- Develop correlation curve in laboratory
- Precision to baseline cylinders: approx. 5%

CEMENT & CONCRETE SA

Maturity Testing

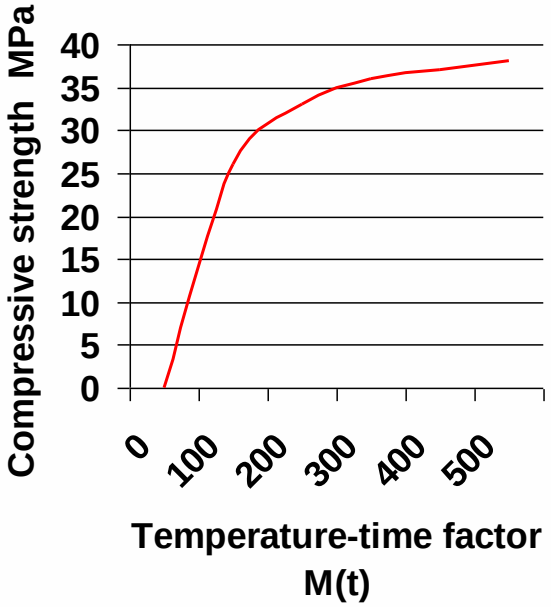
$$M(t) = \Sigma(T_a - T_o)\Delta t$$

M(t) = temperature-time factor

Δt = time interval

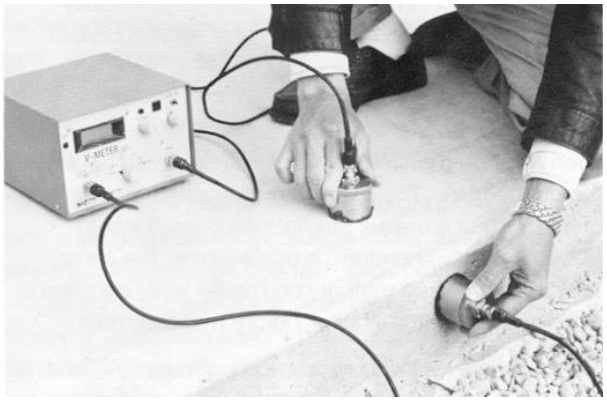
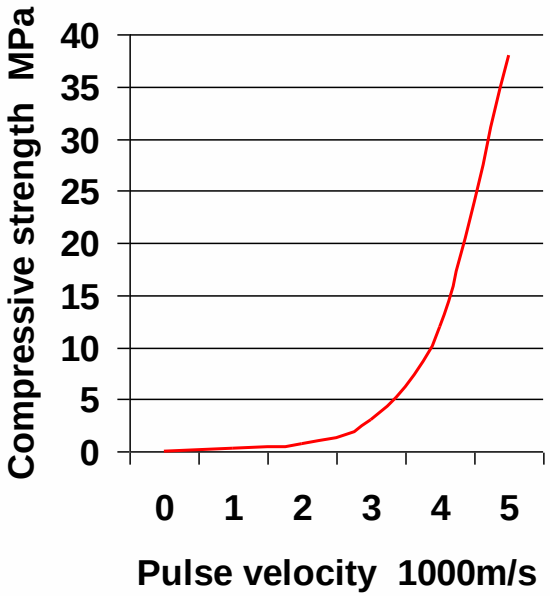
T_a = average concrete temp.

T_o = datum temp. (-10°C)



Pulse velocity testing

- ASTM C 597
- Velocity of sound wave from transducer to receiver through concrete relates to concrete strength
- Develop correlation curve in laboratory
- Precision to baseline cylinders: approx. 10%

CEMENT & CONCRETE SA

Pulse velocity testing