Curing Practices for Modern Concrete Production

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Problems with Curing?
Curing Practices - Need for Revisions??

- Review major points of current practice
- Discuss effects of newer concrete practice
Purpose of Curing

- Conserve water
- Maintain favorable temperatures
Current Practice

- Protect fresh concrete
- Apply final curing
  - After finishing
  - After sheen gone
- Duration of Curing
- Curing materials specs
Protect Fresh Concrete

- Critical evap rate
  - 0.5, 1.0 kg/m²/h
- Based on “old time” bleeding rates

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To use this chart:
1. Enter with air temperature, move up to relative humidity
2. Move right to concrete temperature
3. Move down to wind velocity
4. Move left to read approx. rate of evaporation
Low w/c Concrete

- Low w/c concretes
  - Evap rates <0.5 kg/m²/h
- Action: More care to reduce drying
- Cool concrete
- Evap reducers
- Misting

**Graph:**

- Early-Age Water Losses
- Evap Rate = 0.50 kg/m²/hr

**Graph Axes:**
- Time, hr
- Mass loss, kg/m²/hr

**Graph Legend:**
- bleed water
- total water, no CC
- total water, lt CC
Action

- Action: reduce evaporation
- Cool concrete

![Graph showing cumulative bleeding or evaporation over time](image)

- **Cumulative Bleeding or Evaporation, kg/m²**
- **Time, hr**
- **Evap 30 C**
- **Evap 25 C**
- **Bleed**

**Time of setting**
Current Practice

- Protect fresh concrete
- **Apply final curing**
  - After finishing
  - After sheen gone
- Duration of Curing
- Curing materials specs
Apply Final Finishing

- After finishing
- After sheen disappears
Problem

- Pavements
  - Little bleed
  - Finishing ~ placing
- Curing compounds
  - Applied soon after placing
  - May not perform
Uniformity of Application
Early Application of Curing Compound

Early-Age Water Losses
Evap Rate = 0.50 kg/m²/hr

mass loss, kg/m²/hr

0 0.2 0.4 0.6 0.8 1.0 1.2

time, hr

0 1 2 3 4 5

bleed water
total water, no CC
total water, lt CC
Early Application of Water, Mats

- If before TOS
  - Erosion
  - Marring
Resolution

- Delay application??!!
- Live with consequences
Current Practice

- Protect fresh concrete
- Apply final curing
  - After finishing
  - After sheen gone
- **Duration of Curing**
- Curing materials specs
Duration of Curing

- Corps of Engineers - prescriptive
  - Based on cement type
  - Presence of pozzolan
- State DoT’s – prescriptive
  - Based on time – 3 – 10 days
- ACI – mixed spec
  - Time
  - % f’c
Emerging Technologies

- Maturity
  - ASTM C 1074 based
- NDT
  - ultrasonic
Current Practice

- Protect fresh concrete
- Apply final curing
  - After finishing
  - After sheen gone
- Duration of Curing
- Curing materials specs
Curing Materials – Curing Compounds

• Water Retention
  – CE: 0.31 kg/m² @ 7 days
  – Old Bu Rec: 0.86 kg/m² @ 7 days
  – ASTM:
    – C 309: 0.55 kg/m² @ 3 days
    – C 1315: 0.40 kg/m² @ 3 days
  – State DoT’s: <0.3 kg/m² @ 3 days

Drying Time – 4 hours
Water Retention (?, Loss?)
Requirements

• True value??
  – Some early work – 0.7 kg/m²
  – Other work - 1.0 kg/m² in several days

• Major problems with testing
  – Often not done
  – Precision of TM (C 156)
    – $d_{2s} = 0.20$ kg/m²
Drying Time Problems
Low VOC Materials
Evaporation Reducers

- No Specs
- No TM’s
- ASTM C 9.22
The End!