

MASTER
BUILDERS

ADMIXTURES

degussa.
Construction Chemicals

High Early Strength Portland Cement Concrete for Rapid Concrete Repair



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The CalTrans Challenge.....

Find an alternative to proprietary “fast-setting cement” concrete mixtures!

Requirements:

- 📄 Fast setting, user-friendly and cost effective
- 📄 Develop 400 psi (2.8 MPa) within 4 hours after placement

Hence, the Name...



400 psi in 4 hours

4x4™ Concrete: System Components

- Selected local portland cements, and aggregates
 - ↳ manufactured sand
- Synthetic high-range water-reducing admixture - provides fluidity and strength
- Hydration control (extended-set) admixture - provides workability control
- Accelerating admixture - provides early strength



4x4™ Concrete: System Component

Hydration control admixture:

- Hydration control
- Provides unprecedented control over setting
 - ☞ Controls temperature rise
 - ☞ Provides slump retention
 - ☞ Effective in long hauls



Accelerating Admixtures

- Add and mix on site
- Uses portable dispenser system
- Accelerates concrete set and strength development



4x4™ Concrete Applications

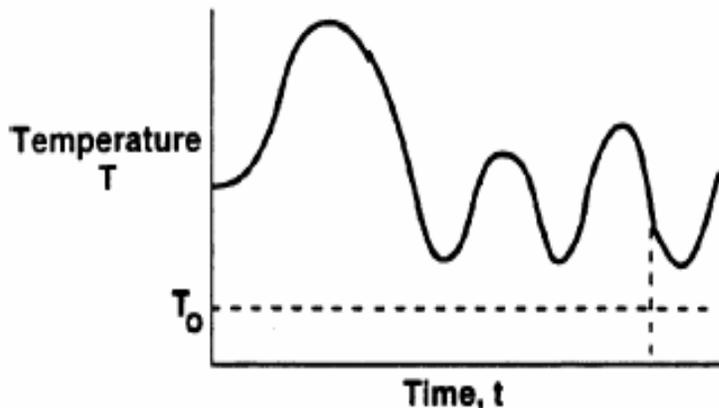
Where Can 4x4 Concrete be Used?

- Full-depth pavement replacement
- New pavement
- Bridge decks
- Overlays
- Where high early strength is required



Opening 4x4™ Concrete to Traffic

Maturity Testing - a better indication of strength development in pavement slab.



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

$M(t)$ = Temperature-time factor

Δt = Time interval

T_a = Avg. temperature during Δt

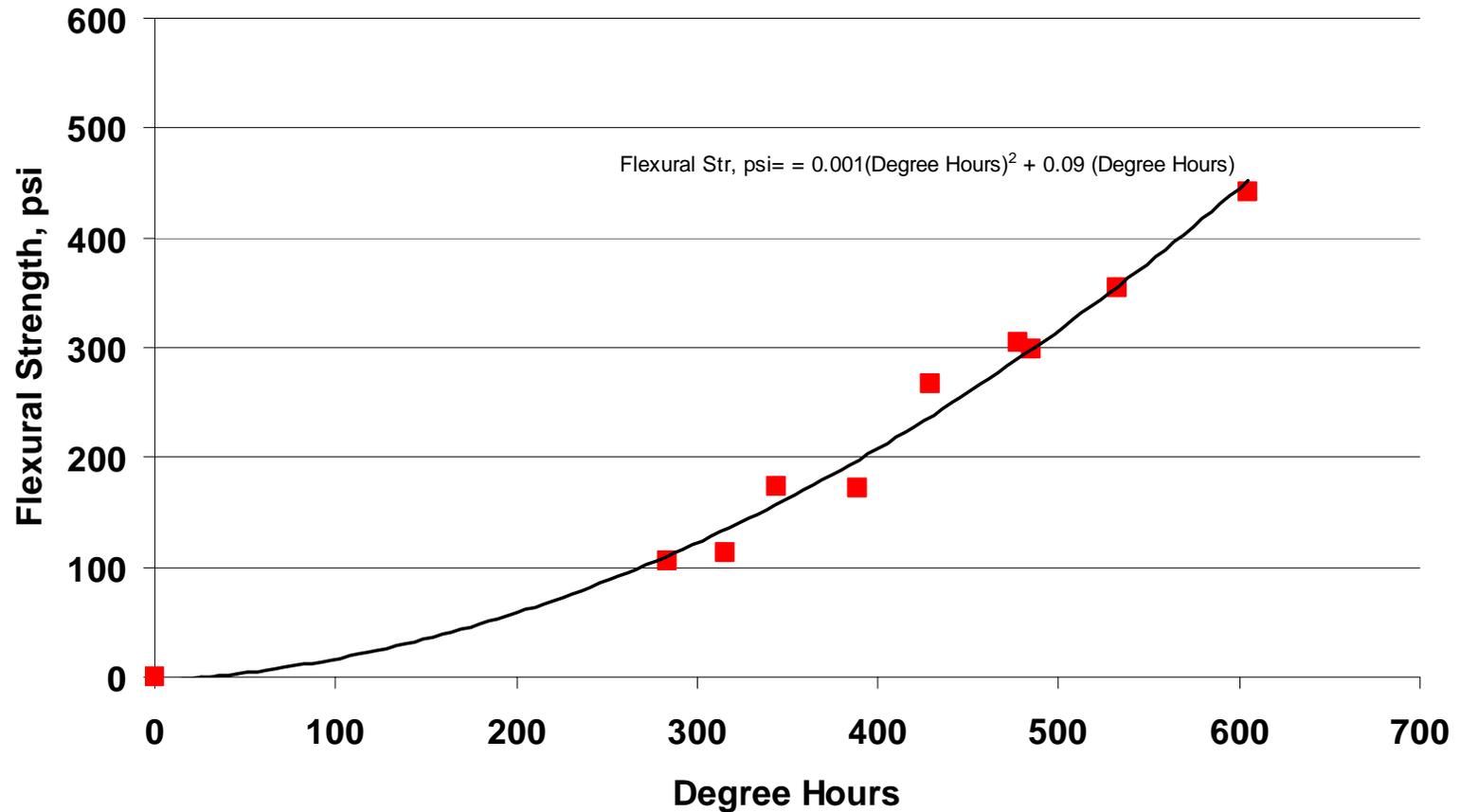
T_o = Datum Temperature



I-5, CA: Actual HES Data

4x4 Concrete: I-5 in Los Angeles

3/3/02



I-5 in CA: Actual HES Data

4x4™ Concrete:

| <u>Flexural Strength</u> | <u>psi</u> | <u>MPa</u> |
|-----------------------------|------------|------------|
| 4-hour | 480 | 3.3 |
| 24-hour | 855 | 5.9 |
| 28-day | 1250 | 8.6 |
| <u>Compressive Strength</u> | | |
| 4-hour | 4130 | 28.5 |
| 24-hour | 7740 | 53.4 |
| 28-day | 8250 | 56.9 |



4x4TM Concrete: Conduct a Trial Slab

Fully-loaded truck on slab
4 hours after placement !!!



*400 psi
Flexural
Strength
in 4 hours*



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4x4™ Concrete Projects



4x4 Concrete Project

Alamo Truck Stop:

- ✦ Ultra-Thin WhiteTopping application - Sparks Nevada

Challenge:

- Truck stop is a major source of revenue
- Rutted asphalt entering and exiting weigh scale
- Minimize scale closure time

Solution:

- Air-entrained 4x4 Concrete @ a 8 in. slump (200 mm) as an ultra-thin whitetopping



Deteriorated and rutted asphalt



Alamo Truck Stop

Benefits:

- Very user-friendly and easy to place
- Weigh scale opened to traffic quickly
- Minimized closure time resulted in increased revenue
- 4x4 Concrete is expected to provide significantly longer service life compared to the asphalt



4x4 Concrete Project

Poplar Street Bridge:

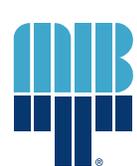
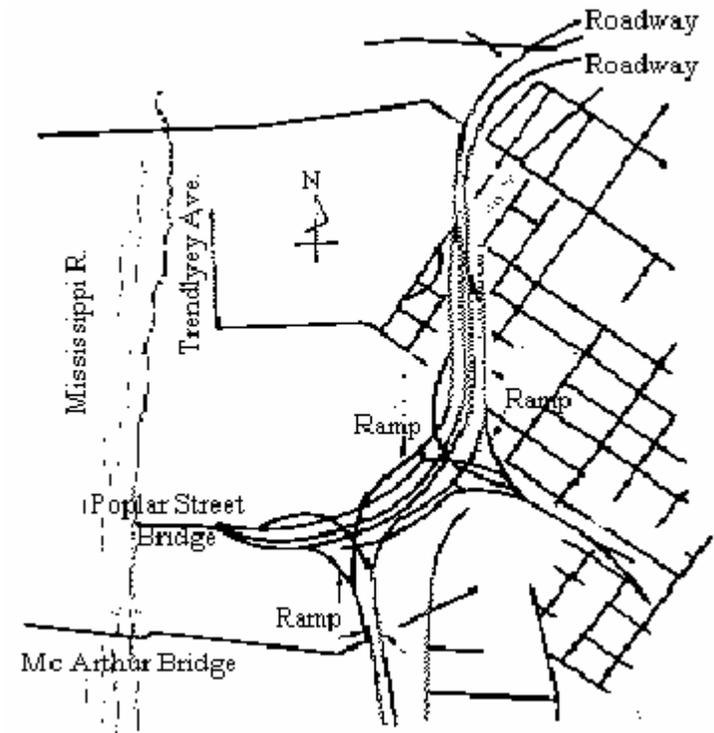
↖ Deck Repair - St Louis, Missouri

Challenge:

- Deteriorated bridge deck
- Minimize lane closure time
- Night repairs
- Requirement 3,200 psi (22.1 MPa) in 4 hours

Solution:

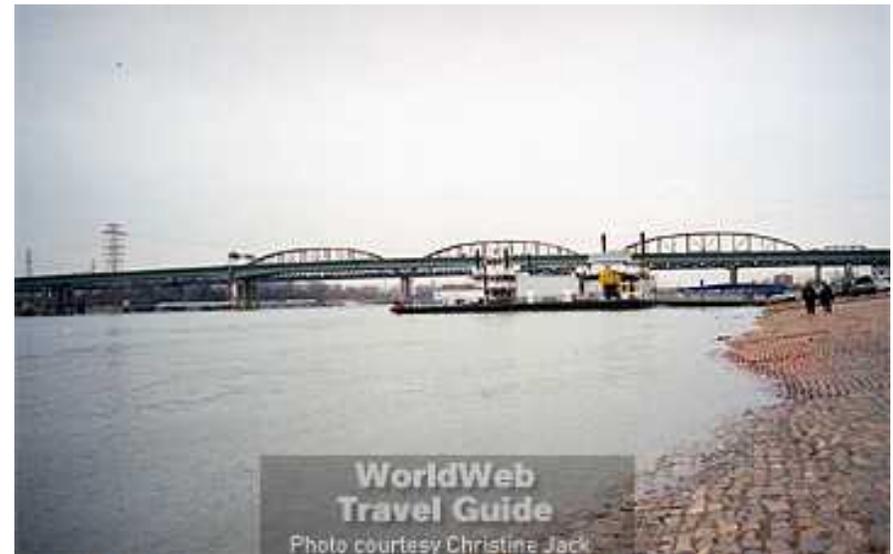
- Air-entrained 4x4 Concrete @ a 8 in. slump (200 mm)
 - ↖ placed as SCC



Poplar Street Bridge

Benefits:

- ❑ Ready mix truck provided mobility to repair areas
- ❑ Contractor optimized resources
- ❑ 4x4 Concrete more economical than conventional repair materials
- ❑ Profitable for producer and contractor
- ❑ Minimized lane closure time
- ❑ MO DOT pleased with results



4x4™ Concrete Project

Merced Intersection Replacement:

↖ Highway 140 and Applegate Road, Merced County, CA

Challenge:

- Minimize disruption to traffic flow and lane closures

Solution:

- 4x4 Concrete @ a 7 in. slump (180 mm)



Merced Intersection Replacement

Benefits:

- ❑ Very user-friendly and easy to place
- ❑ Exceptional high-early strength permitted rapid opening to traffic minimizing lane closures
- ❑ Project was completed in only 4 days!
- ❑ Traffic control savings = \$250,000
- ❑ 4x4 Concrete technology allowed concrete to be used in lieu of asphalt



4x4™ Concrete Project

I-77/I-65 Pavement Replacement:

↖ **West Virginia Turnpike, Beckley
West Virginia**

Challenge:

- Minimize inconvenience to motorists
- Develop high-early strength in cool springtime temperatures

Solution:

- Air-entrained 4x4 Concrete @ a 5 in. slump (125 mm)



I-77/I-65 Pavement Replacement

Benefits:

- ❑ Very user-friendly and easy to place
- ❑ Exceptional high-early strength developed
- ❑ Pavement replaced and opened to traffic from start to finish in only 12 hours!



4x4™ Concrete: In Summary....

- 📄 Producer/contractor friendly
- 📄 Easy to place and finish
- 📄 Set time and strength performance met consistently
- 📄 Save \$\$\$\$ on traffic control and placement
- 📄 No post-grinding for ride quality
- 📄 No cracking to date
- 📄 Win-Win-Win-Win Situation for All Parties !!!

4x4™
CONCRETE Master Builders

