Thermal Stresses in Mass concrete addressing Owners requirements and simplification

Mass challenges

Create a simple specification

Item Change

We modified the pay adjustment formula for under strength concrete to one that is not as harsh. Example, Cost - $650/CY.

% Rdctn	Old Pay adj	New Pay
2.5 %	$121.57	$ 17.62
5.0 %	$145.03	$ 39.60
7.5 %	$167.88	$ 65.95
10.0 %	$190.13	$96.66

Risks vs. Reward

Mass Concrete - Poorly charted territory from an application basis

Temperature cracks

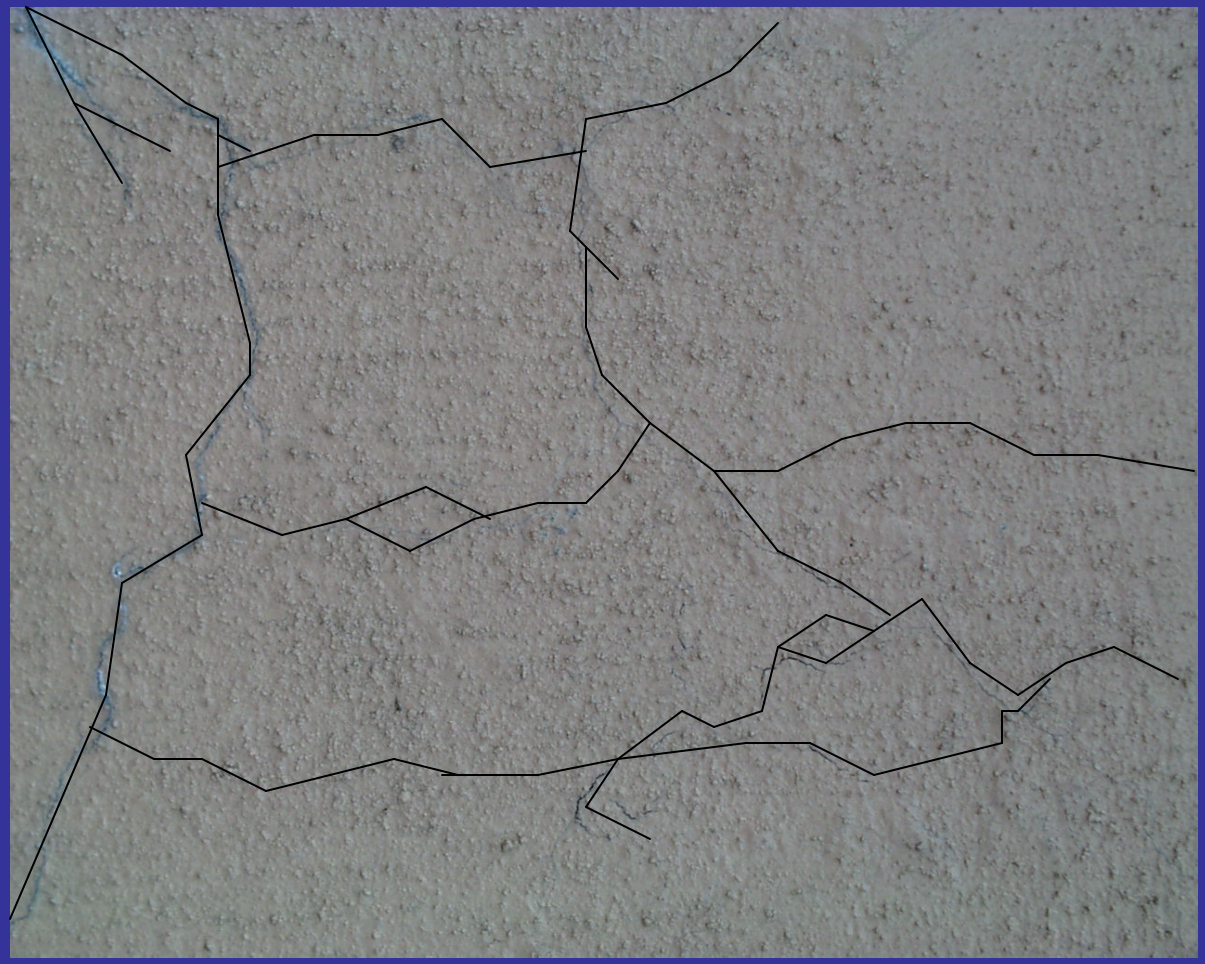
Stress cracked column

Stress cracking due to Early form removal or temperature

- Run Temperature animation and Cracking probability.

Column removal

Thermal Shock

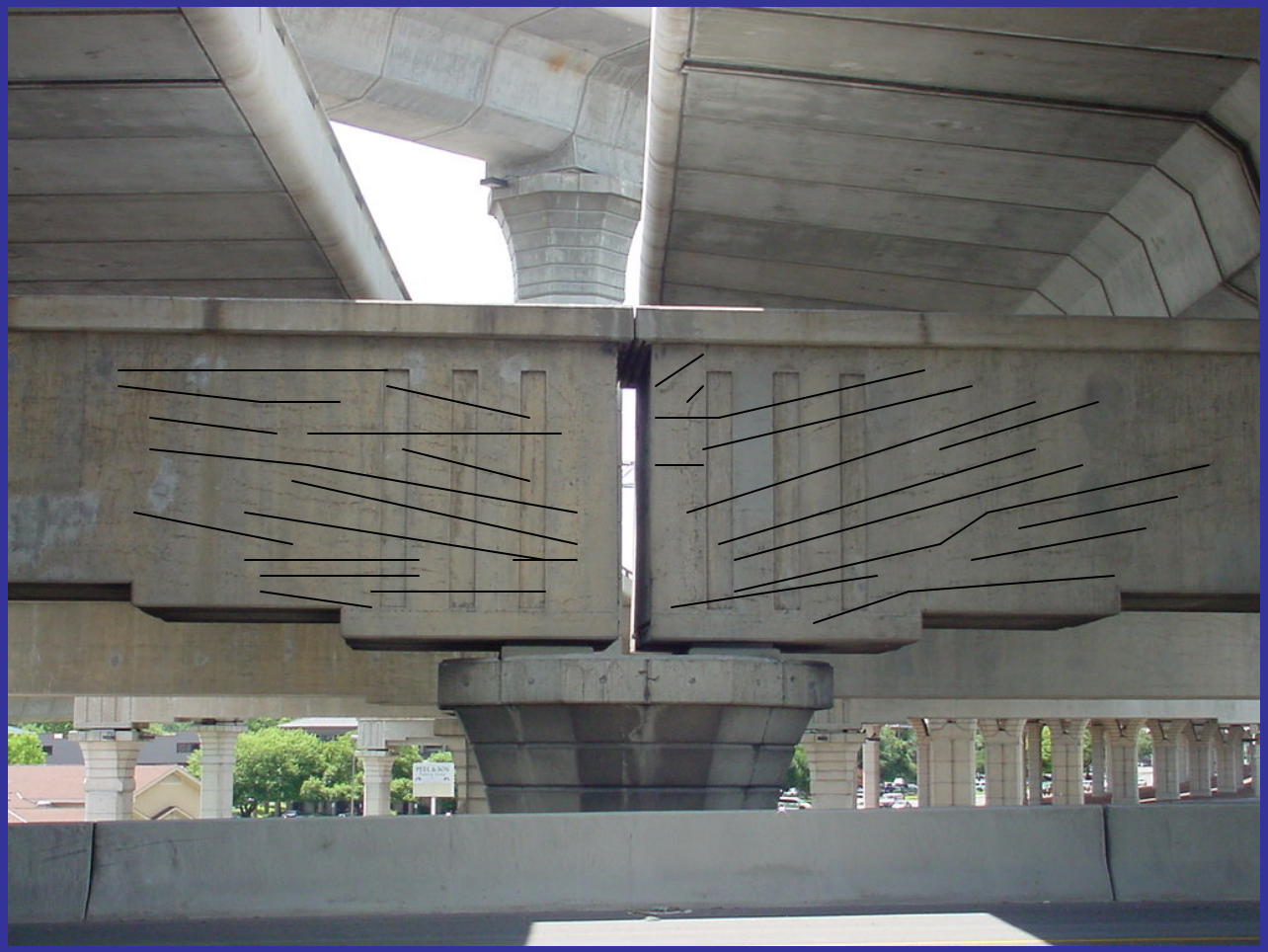


DEF Damage

DEF Damage

Alkali Silica Reaction (ASR)

Controlling ASR



How do we control the deterioration mechanisms created by heat?

- Restrict placement temperature to 75ºF
- Limit differential to 35ºF max
- Monitor
- Create a detailed temperature control plan
  - USE CONCRETEWORKS to develop a low heat concrete design and develop a Thermal Control Plan.

Why develop plan?

- To address form stripping and reduce thermal shock cracking. Maintain temperature control methods for 4 days or to the peak of the adiabatic heat gain curve which ever is greater .
- To implement plan if high temperature is exceeded (160º) minimizing interruptions to construction.
- To implement plan if 35ºF differential is not maintained minimizing interruptions to construction.

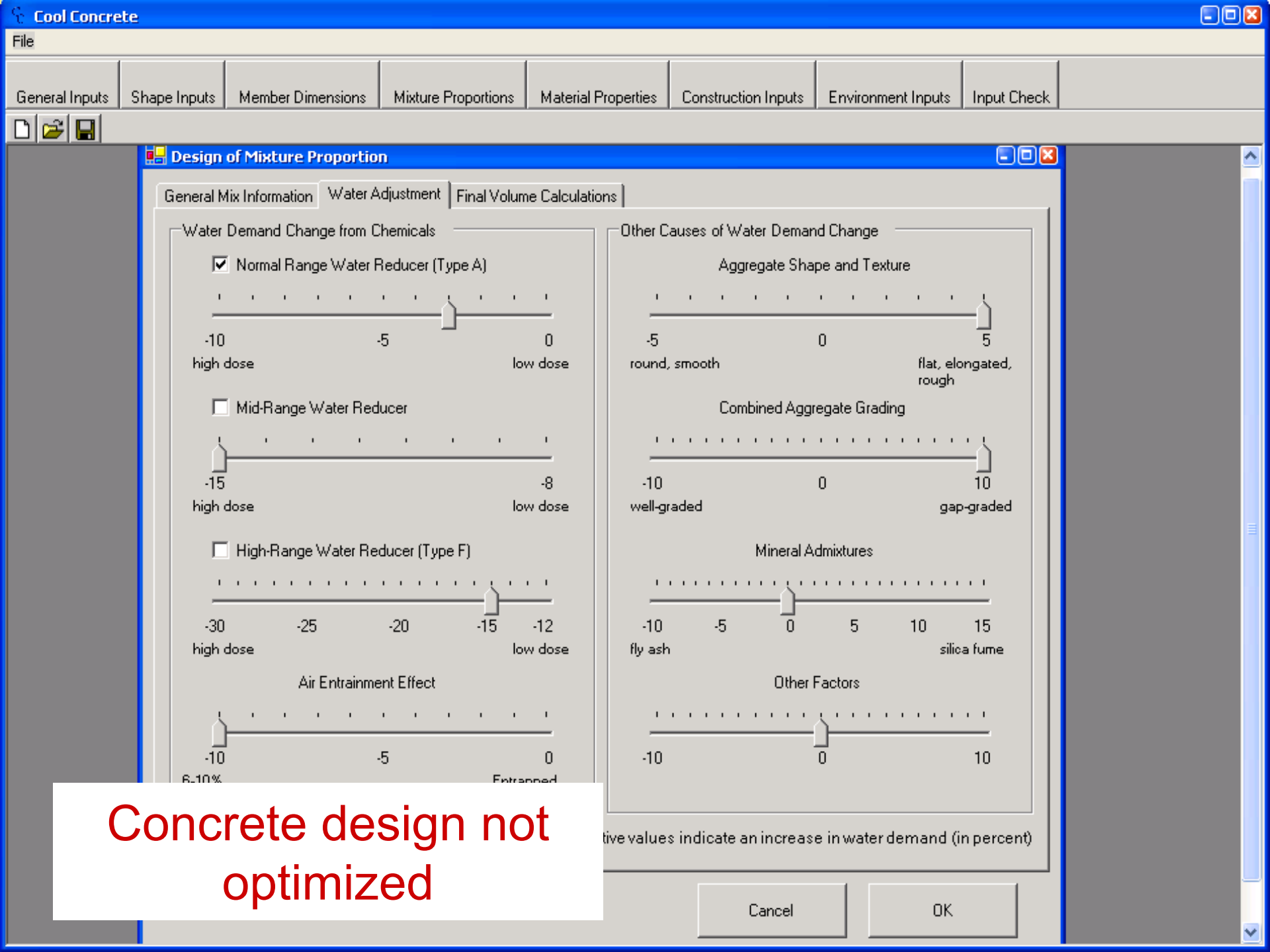
Create a low heat concrete design.

To use ACI 211 Mod which is in the ConcreteWorks program the inputs needed are as follows:

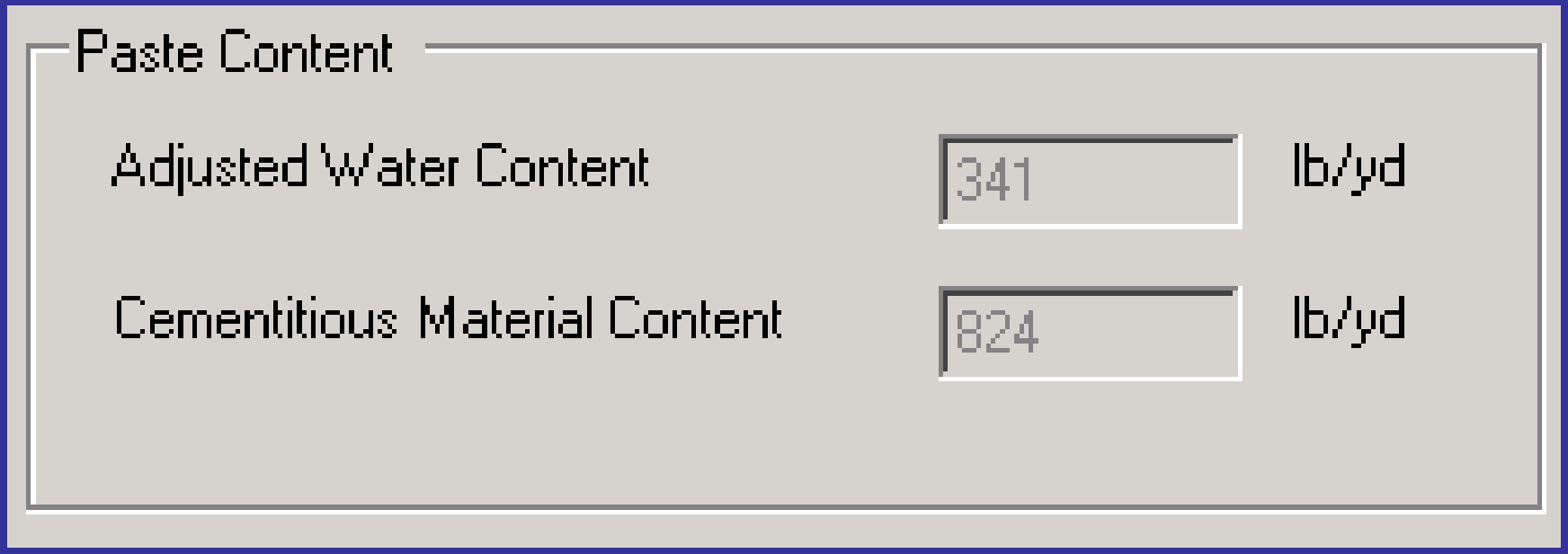
- Slump
- Air
- Strength
- Mixture deviation
- Environment
- ASTM aggregate gradation

What do you do to improve a mix design for mass concrete with heat problems?

- Sub. Cl F fly ash for cement
- Sub. GGBFS for cement
- Lower the cement content
- Lower placement temp.
- Change aggr types
- Improve aggr gradation

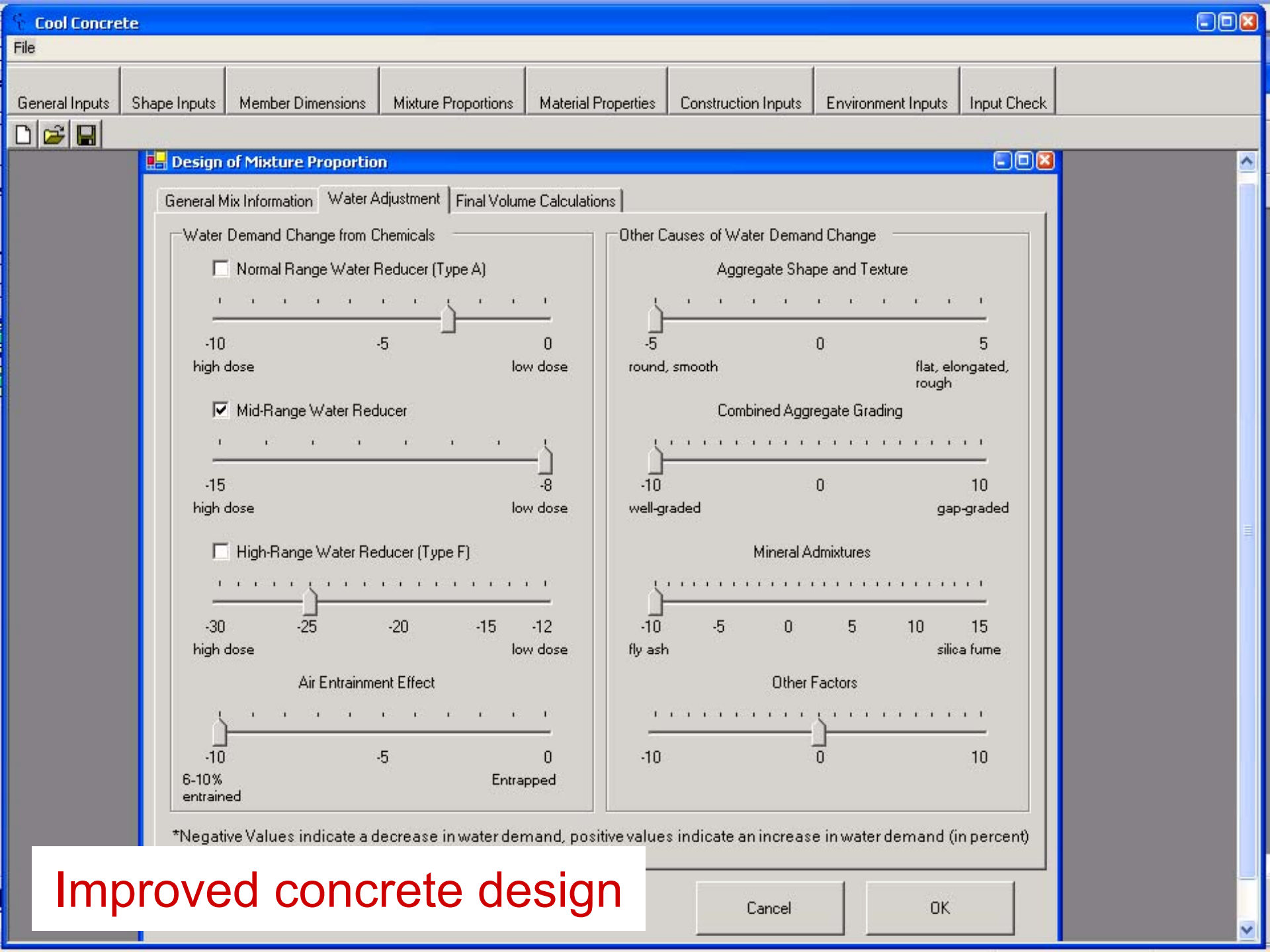

Cool Concrete
File
General Inputs
Shape Inputs
Member Dimensions
Mixture Proportions
Material Properties
Construction Inputs
Environment Inputs
Input Check
Design of Mixture Proportion
General Mix Information
Water Adjustment
Final Volume Calculations
Water Demand Change from Chemicals
Normal Range Water Reducer (Type A)
-10
-5
0
high dose
low dose
Mid-Range Water Reducer
-15
-8
high dose
low dose
High-Range Water Reducer (Type F)
-30
-25
-20
-15
-12
high dose
low dose
Air Entrainment Effect
-10
-5
0
Other Causes of Water Demand Change
Aggregate Shape and Texture
-5
0
5
round, smooth
flat, elongated, rough
Combined Aggregate Grading
-10
0
10
well-graded
gap-graded
Mineral Admixtures
-10
-5
0
5
10
15
fly ash
silica fume
Other Factors
-10
0
10
tive values indicate an increase in water demand (in percent)
Cancel
OK
Concrete design not optimized

Show cementitious quantities with a poor design



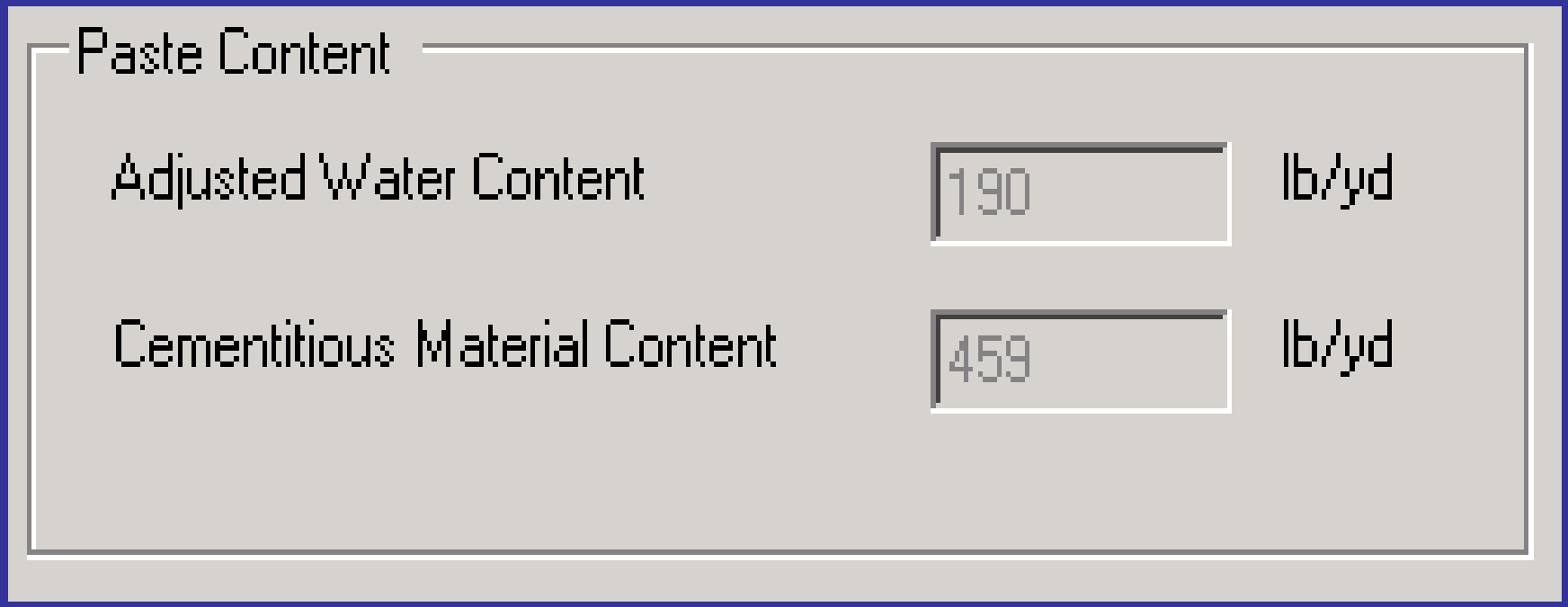
46 gallons of water/yd

8.75 sacks of cement



Improved concrete design

Show cementitious quantity with improved design parameters



Reduced 20 gallons of water/yd

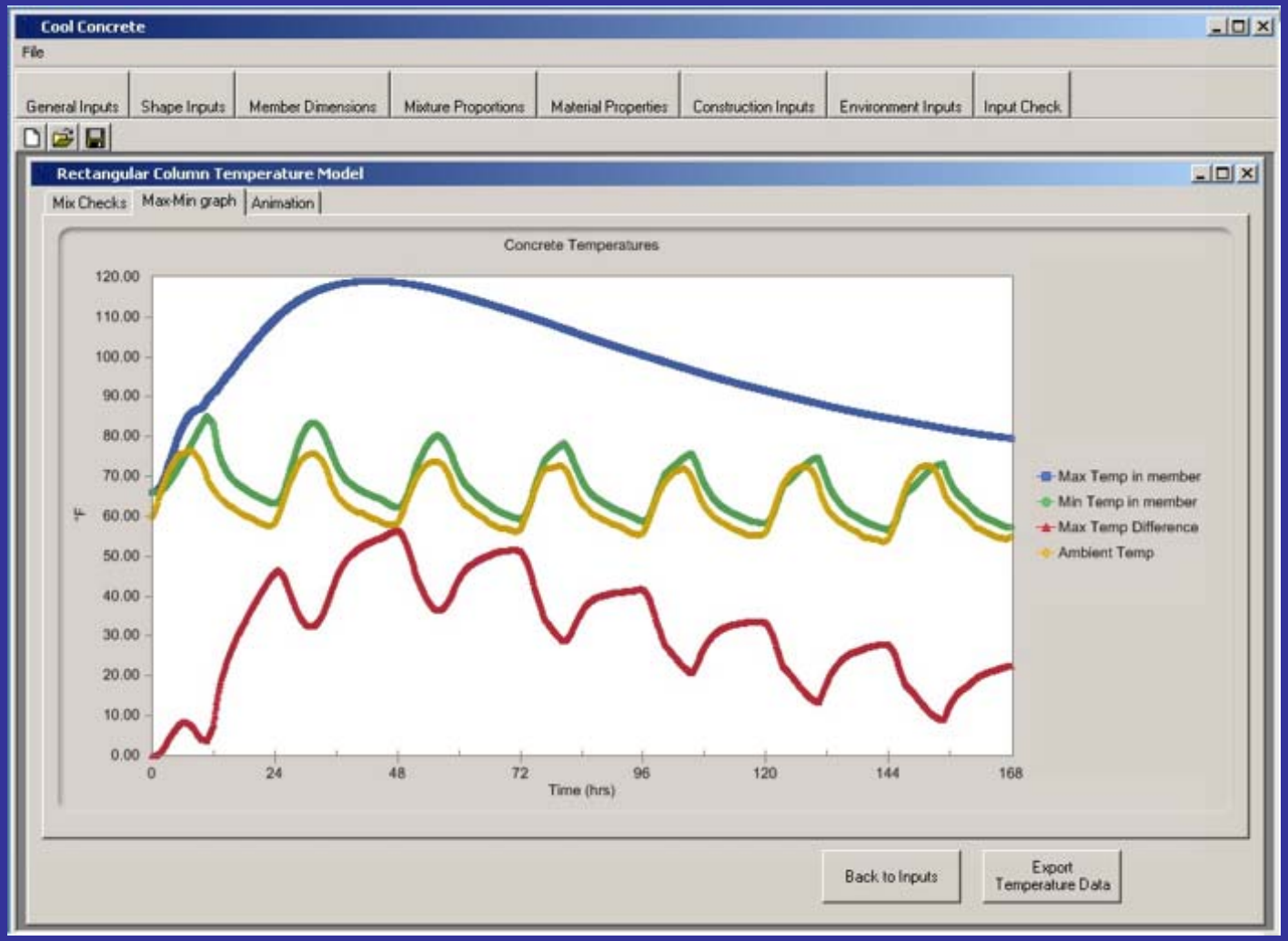
Cement content 4.88 sacks, reduced cement 3.85 sacks

Increase rock content by 520 Lbs

Evaluate - Thermal Control plan before placement. How?

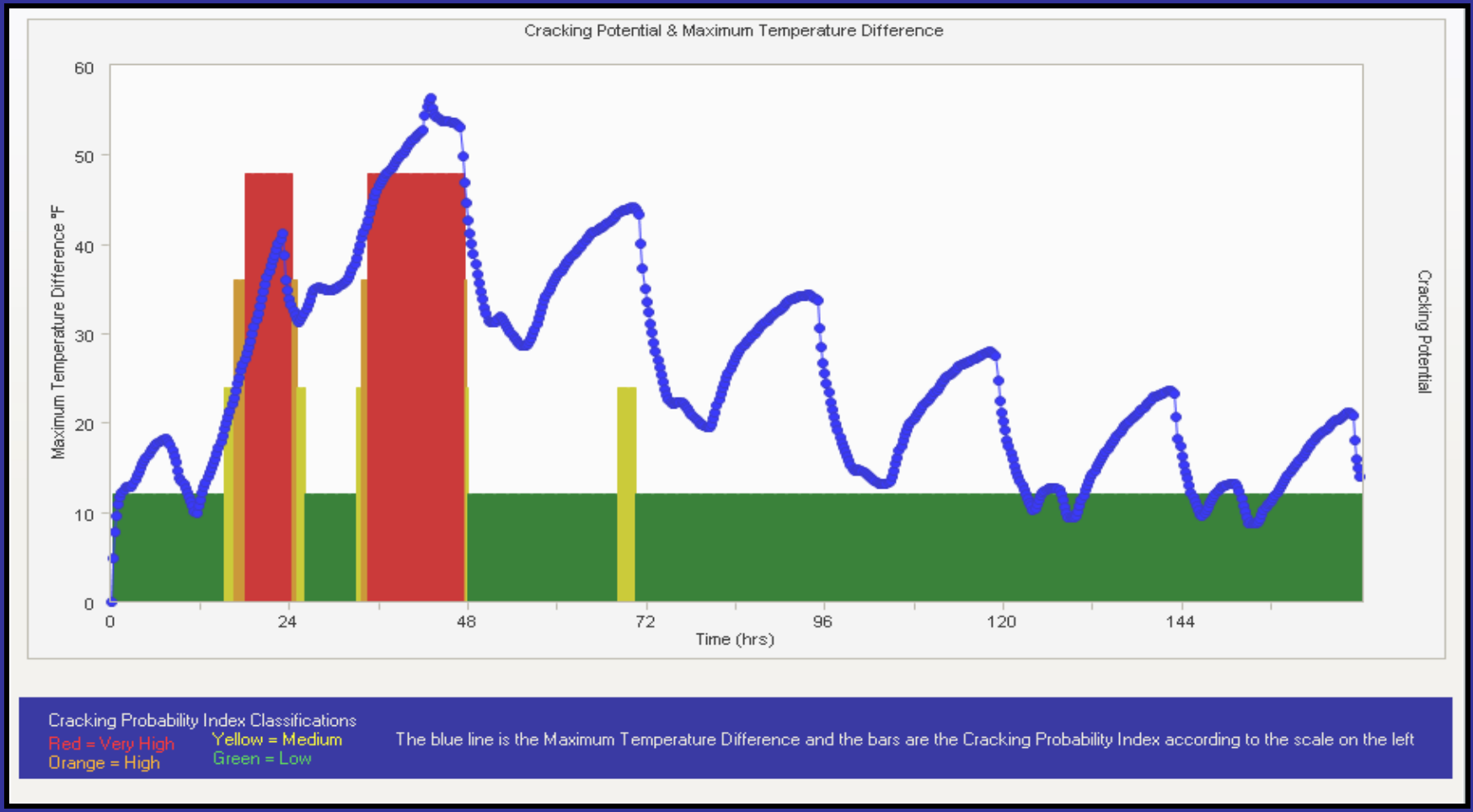
Thermal Control Plan - Results

Max Temp. Difference · Max. Temp. · ASR/DEF Compliance



Cracking Risk

Cracking Risk output



Contractors and suppliers can optimize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NATIONAL COLLEGE OF DUI DEFENSE
Drink, drive - go to jail. Another Government lie.
Responsible drinking is LEGAL.
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