TXDOT'S ASR MITIGATION STRATEGIES

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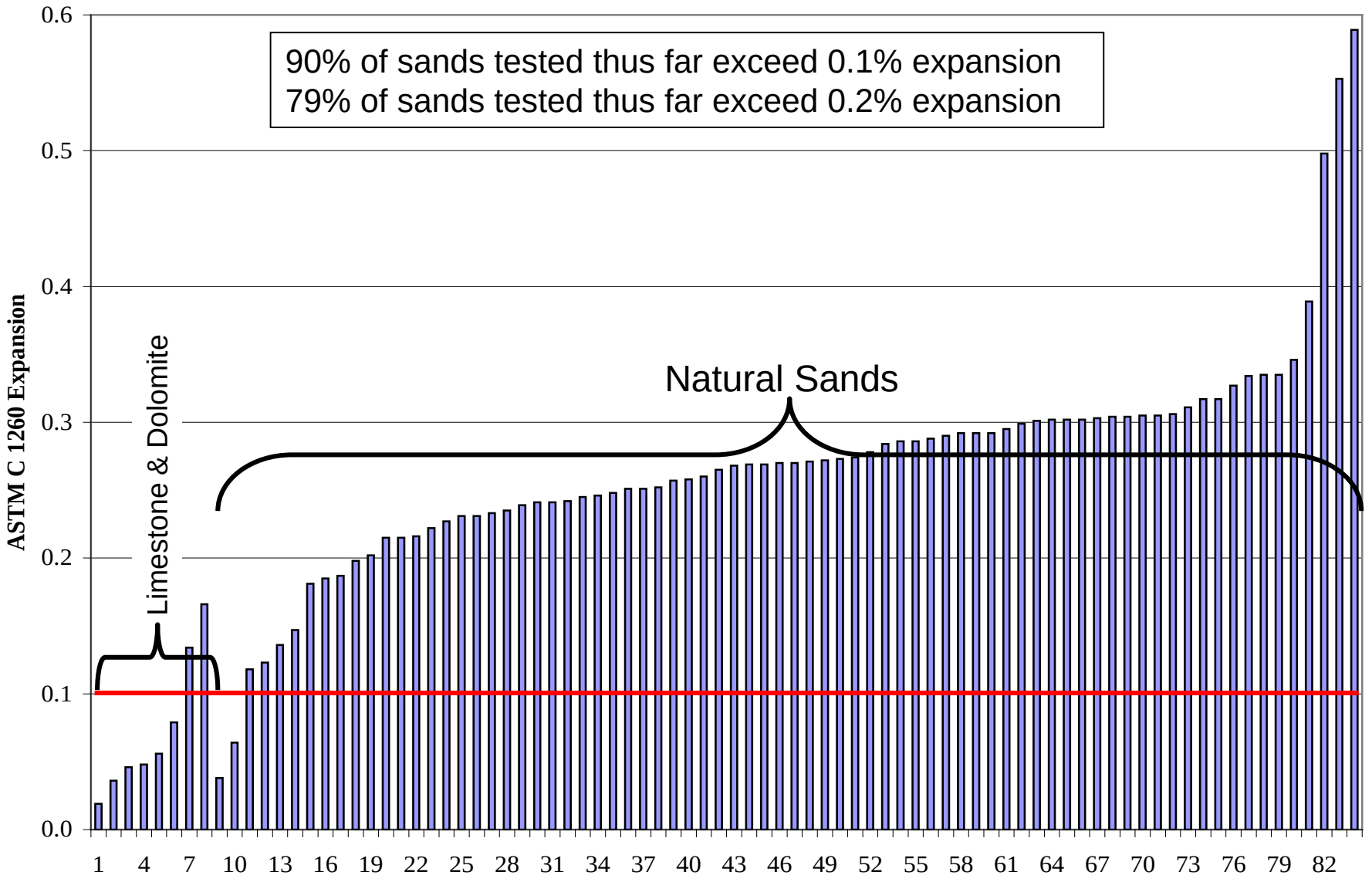
ASR Affected Structures

TxDOT ASR Mitigation Strategy

- Consider ALL Aggregates Reactive
  - Evens the playing field for all aggregate suppliers – No premium for “non-reactive” aggregate

ASTM C 1260 for Fine Aggregates

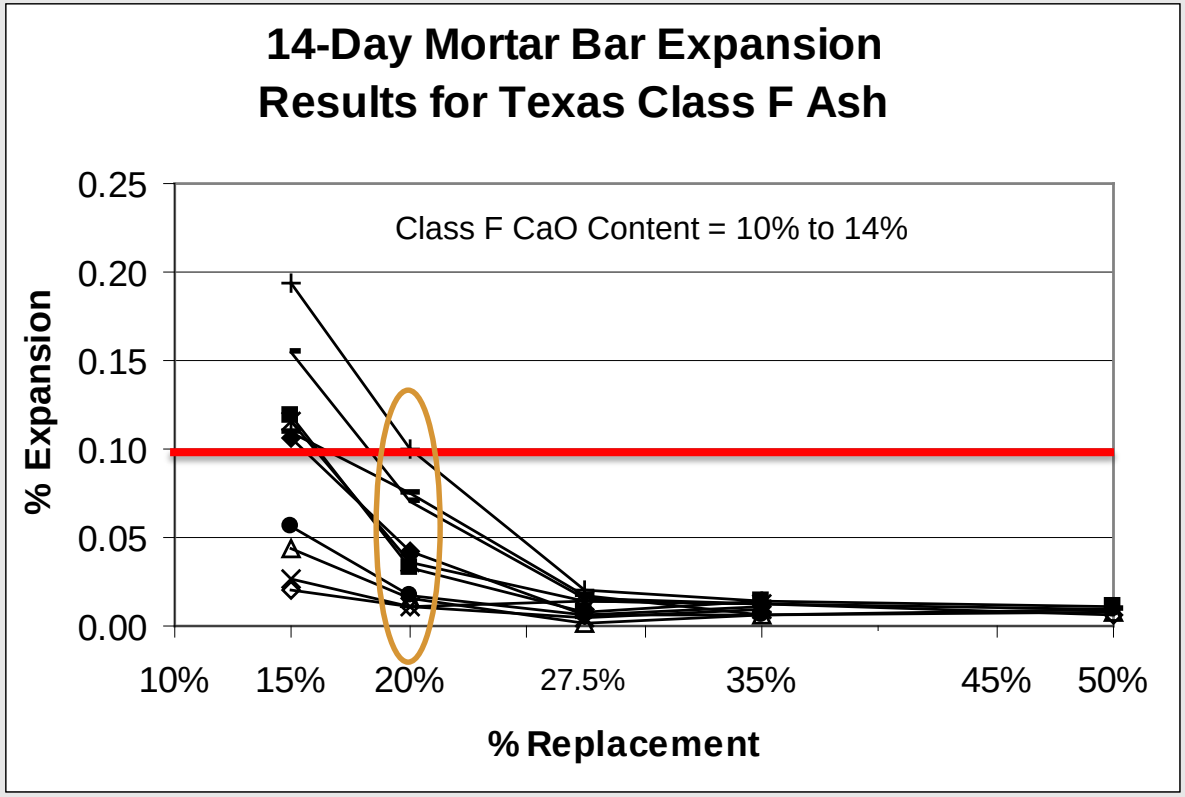


TxDOT ASR Mitigation Strategy

- Consider **ALL** Aggregates Reactive
  - Evens the playing field for all aggregate suppliers – No premium for "non-reactive" aggregate
  - No aggregate reactivity testing – eliminates the discussion of whether ASTM C 1260 or ASTM C 1293 is the proper test to conduct.
  - Requires all concrete mixtures to incorporate a mitigation option
- Eight ASR Mitigation Options
  - If mixture contains 520 lb/cy of cement or less, than Class C fly ash can be used in lieu of Class F fly ash for non-structural classes of concrete
  - Options 1-5 & 7 are prescriptive methods
  - Option 6 & 8 require performance testing

Concrete Mix Design Options

- Option 1: Replace at least 20% to 35% of the cement with Class F Fly Ash.



Concrete Mix Design Options

- Option 2: Replace 35% to 50% of the cement with slag or MFFA.
- Option 3: Replace 35% to 50% of the cement with a combination of Class F fly ash, slag, MFFA, metakaolin, or silica fume. No more than 35% may be fly ash and no more than 10% maybe silica fume.
- Option 4: Use Type IP or IS cement (also allows additional 10% replacement with Class F fly ash, slag, or silica fume)
  - Type IP is required to contain at least 20% Class F fly ash
  - Type IS is required to contain at least 35% slag
- Option 5: Replace 35% to 50% of the cement with a combination of Class C fly ash and at least 6% silica fume, UFFA, or metakaolin. No more than 35% may be fly ash and no more than 10% maybe silica fume.

Concrete Mix Design Options

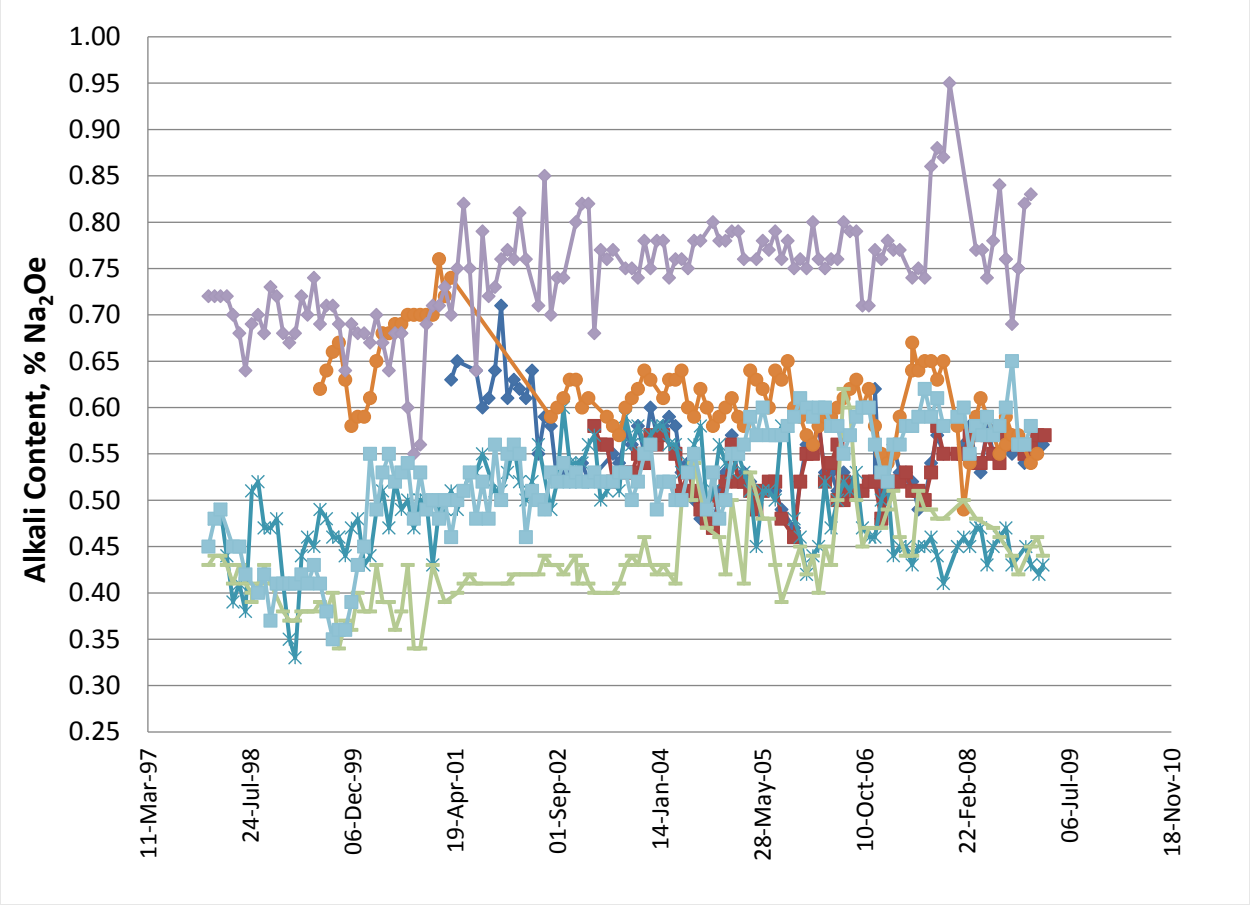
- Option 6: Use of Lithium Admixture
  - Never Been Used On TxDOT Project: $$$$
  - Previously required a dosage of 0.55 gal/lb of alkali – dosage not always effective
  - New spec requires modified ASTM C 1260 testing to determine lithium dosage: minimum dosage of 0.55 gal/lb of alkali
  - Depending on initial results, may require ASTM C 1293 testing to determine dosage: 2 year test

Litium Dosage (gal/lb alkali)

Agg Source	Fine	Coarse
A	0.27	0.25
B	0.37	**Use 1293**
C	0.67	
D		**Use 1293**
E	0.46	
F	0.79	**Use 1293**
G	0.78	0.66
H		**Use 1293**
I		**Use 1293**

Concrete Mix Design Options

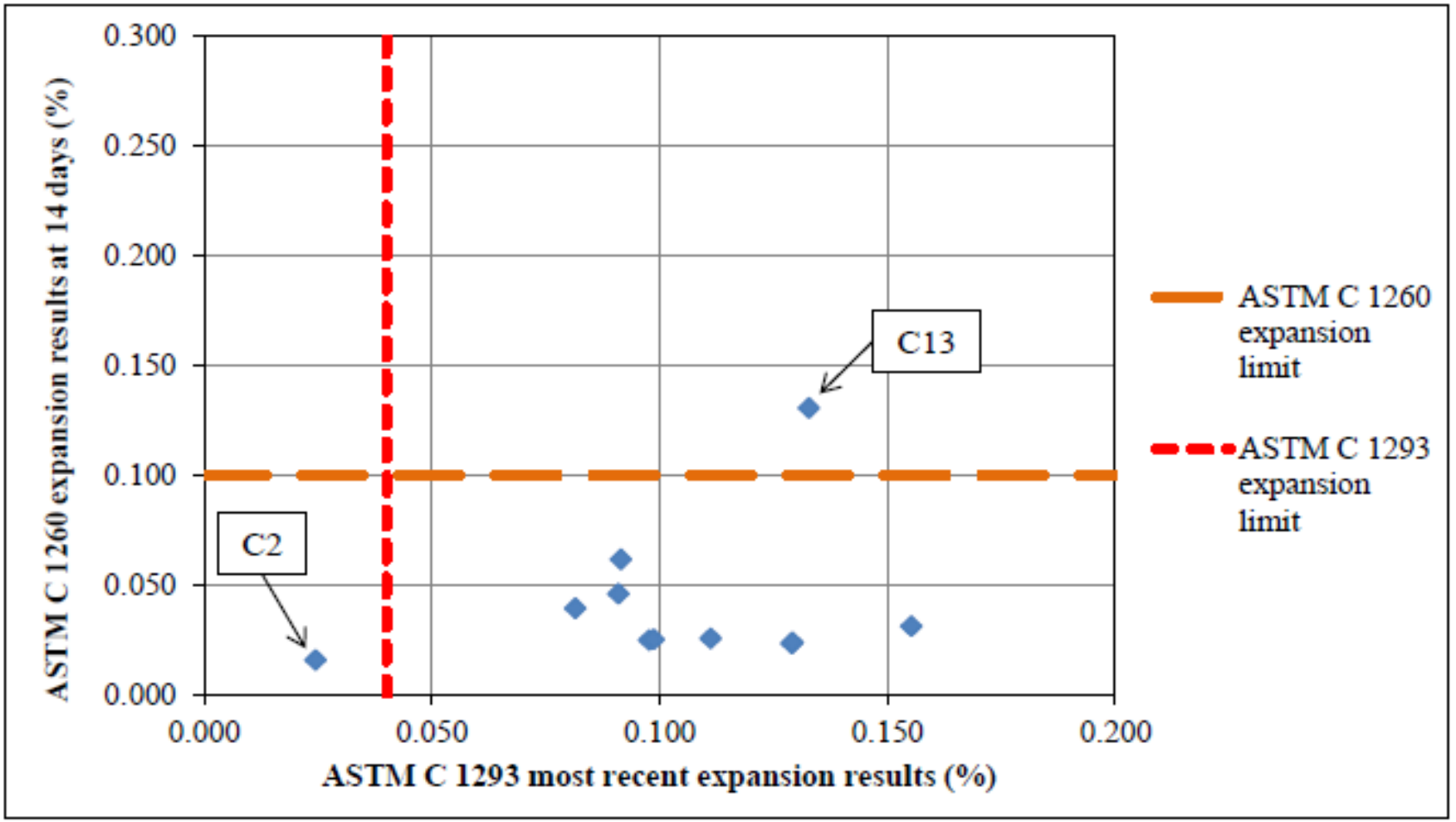
- Option 7: Limits alkali loading to 3.5 lb/cy of concrete for straight cement mixtures.



Concrete Mix Design Options

- Option 8: Performance Option
  - Used primarily to determine the dosage of Class C fly ash needed to mitigate ASR
  - Require to perform ASTM C 1567 and meet a 14 day expansion of 0.08%
  - Option 8 has been modified in new 2014 specification

Option 8 Supporting Tests



Scenario	ASTM C 1260 Result		Testing Requirements for Mix Design Materials or Prescriptive Mix Design Options[1]
	Mix Design Fine Agg.	Mix Design Coarse Agg.	
A	> 0.10%	> 0.10%	• Determine the dosage of SCM's needed to limit the 14-day expansion of each aggregate[2] to 0.08% when tested individually in accordance with ASTM C 1567, or • Use a minimum of 40% Class C fly ash having a maximum CaO[3] content of 25%.
B	≤ 0.10%	≤ 0.10%	• Use a minimum of 40% Class C fly ash having a maximum CaO[3] content of 25%, or • Use any ternary combination which replaces 35 to 50% of cement.
	≤ 0.10%	ASTM C 1293 1 yr Expansion ≤ 0.04%	• Use a minimum of 20% of any Class C fly ash, or • Use any ternary combination which replaces 35 to 50% of cement.
C	≤ 0.10%	> 0.10%	• Determine the dosage of SCM's needed to limit the 14-day expansion of coarse and intermediate[2] aggregate to 0.08% when tested individually in accordance with ASTM C 1567, or • Use a minimum of 40% Class C fly ash having a maximum CaO[3] content of 25%.
D	> 0.10%	≤ 0.10%	• Use a minimum of 40% Class C fly ash having a maximum CaO[3] content of 25%, or • Use any ternary combination which replaces 35 to 50% of cement.
	> 0.10%	ASTM C 1293 1 yr Expansion ≤ 0.04%	• Determine the dosage of SCM's needed to limit the 14-day expansion of fine aggregate to 0.08% when tested in accordance with ASTM C 1567.

1. Do not use Class C fly ash if the ASTM C 1260 value of the fine, intermediate, or coarse aggregate is 0.30% or greater, unless the fly ash is used as part of a ternary system.
2. Intermediate size aggregates shall fall under the requirements of mix design coarse aggregate.
3. Average the CaO content from the previous ten values as listed on the mill certificate.

Questions?