



MCC STUDY

“SCALING OF LATE SEASON

CONCRETE PLACEMENT”

RECAP

Presented by Dan Vruno, P.E.
For the MCC Research Committee



Independent Variables

Three independent variables will be considered at two levels:

1. Curing time
2. Type of sealer
3. Deicer exposure



Dependent Variable

The dependent variable (that is, responses) was scaling, which was determined by ASTM C672, “Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.”

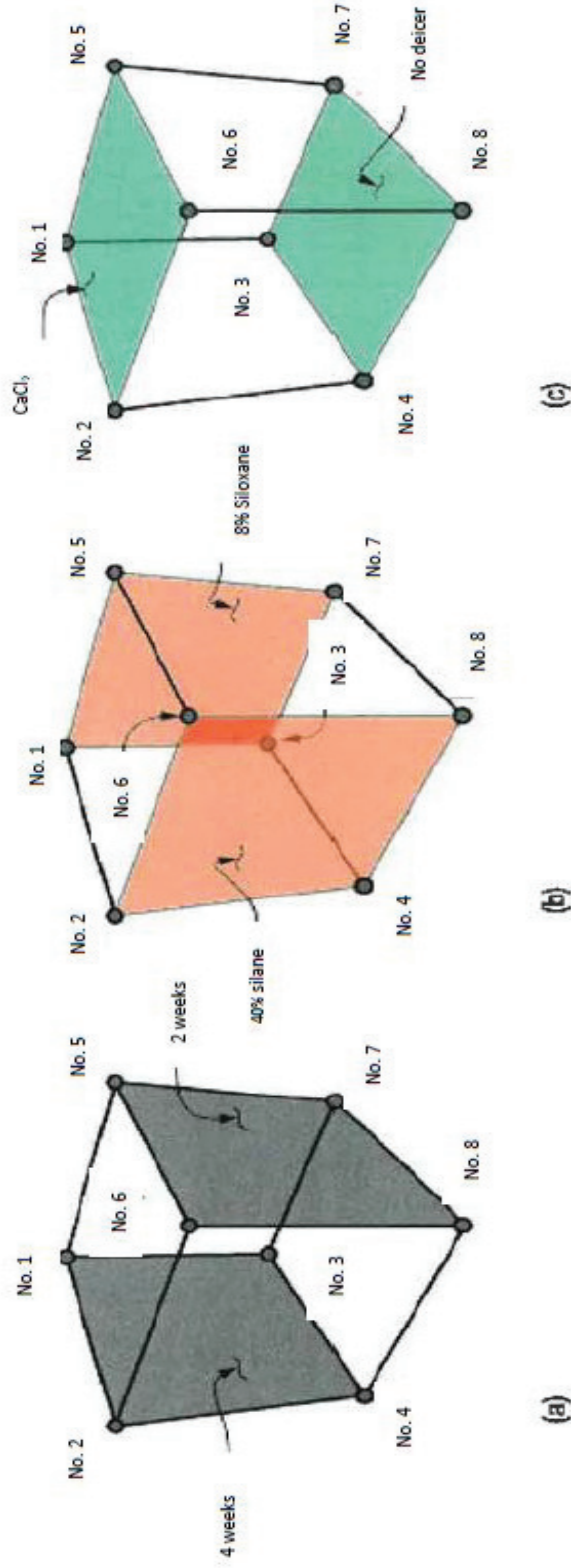


Independent Variables Studied in the Laboratory Phase

Factorial Points	Curing	Sealer	Deicer Exposure
1	4 weeks	8% siloxane	CaCl ₂
2	4 weeks	40 % silane	CaCl ₂
3	4 weeks	None	None
4	4 weeks	None	CaCl ₂
5	2 weeks	8% siloxane	CaCl ₂
6	2 weeks	40 % silane	CaCl ₂
7	2 weeks	None	CaCl ₂
8	2 weeks	None	None
9	3 weeks	8% siloxane	CaCl ₂
10	3 weeks	40 % silane	CaCl ₂



2^3 Factorial Design

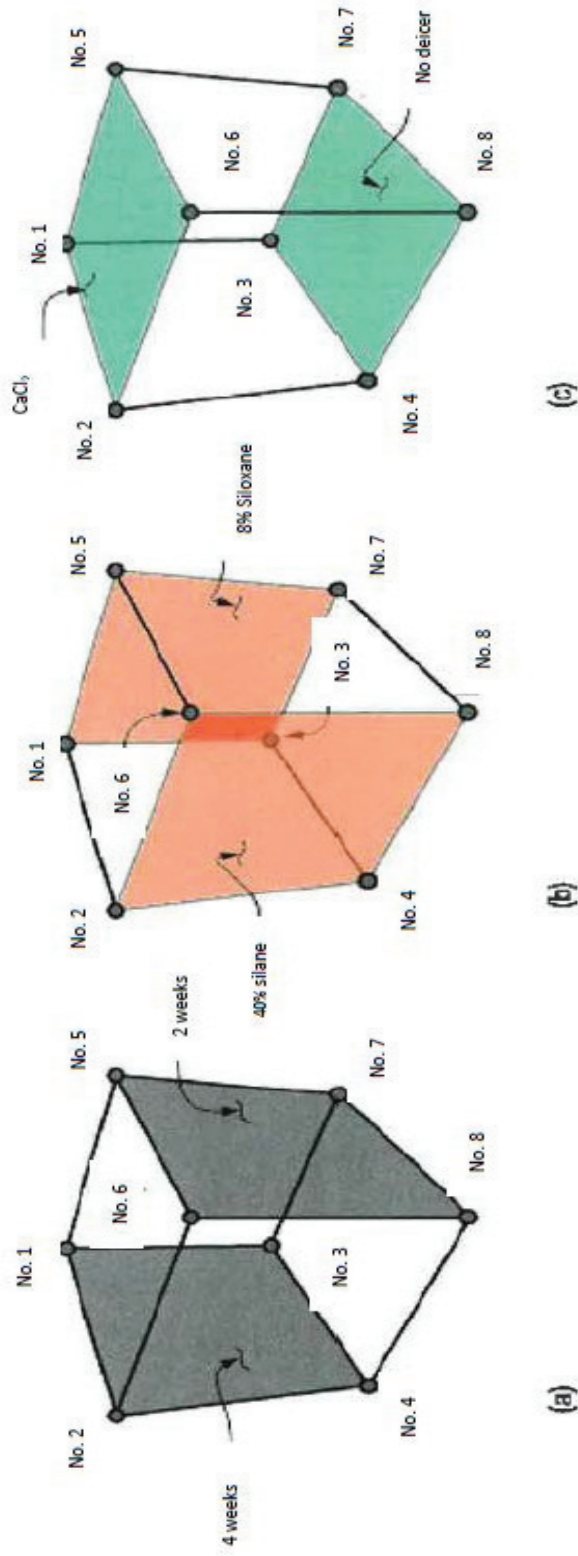


Independent Variables Studied in the Laboratory Phase

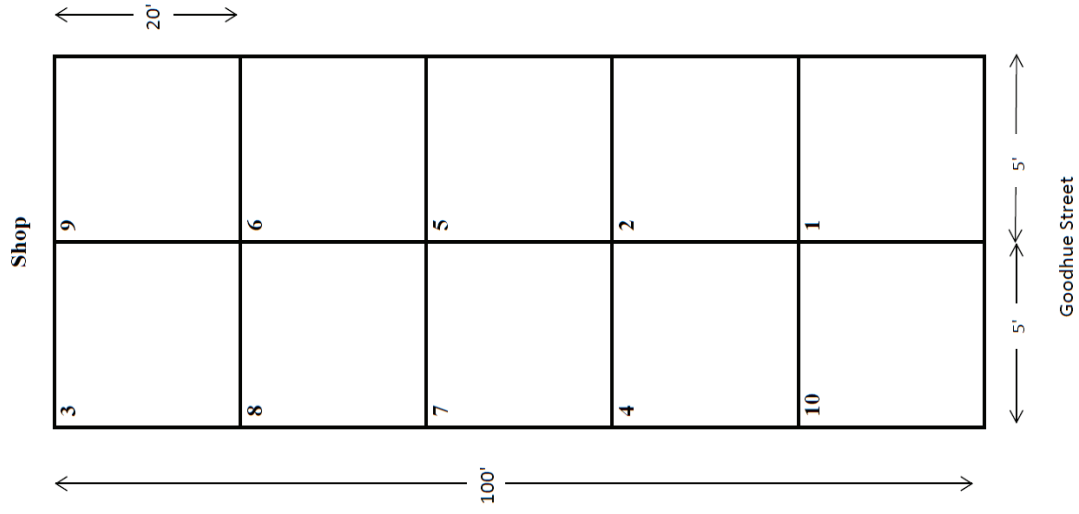
Factorial Points	Curing	Sealer	Deicer Exposure
1	4 weeks	8% siloxane	CaCl ₂
2	4 weeks	40 % silane	CaCl ₂
3	4 weeks	None	None
4	4 weeks	None	CaCl ₂
5	2 weeks	8% siloxane	CaCl ₂
6	2 weeks	40 % silane	CaCl ₂
7	2 weeks	None	CaCl ₂
8	2 weeks	None	None
9	3 weeks	8% siloxane	CaCl ₂
10	3 weeks	40 % silane	CaCl ₂



2³ Factorial Design



Field Study Layout



Day of Placement - 10/31/14

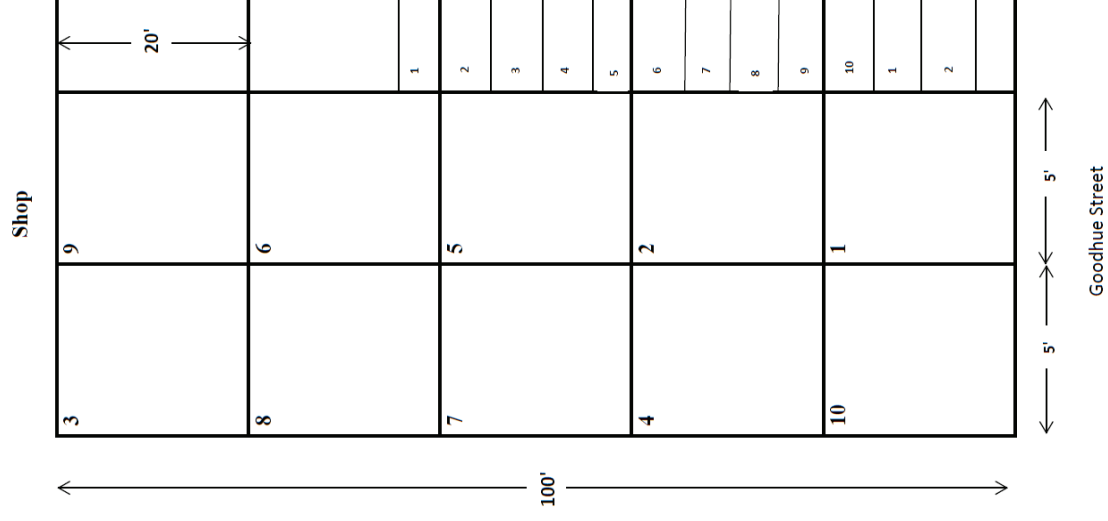


Finishing Tools





Ancillary Study



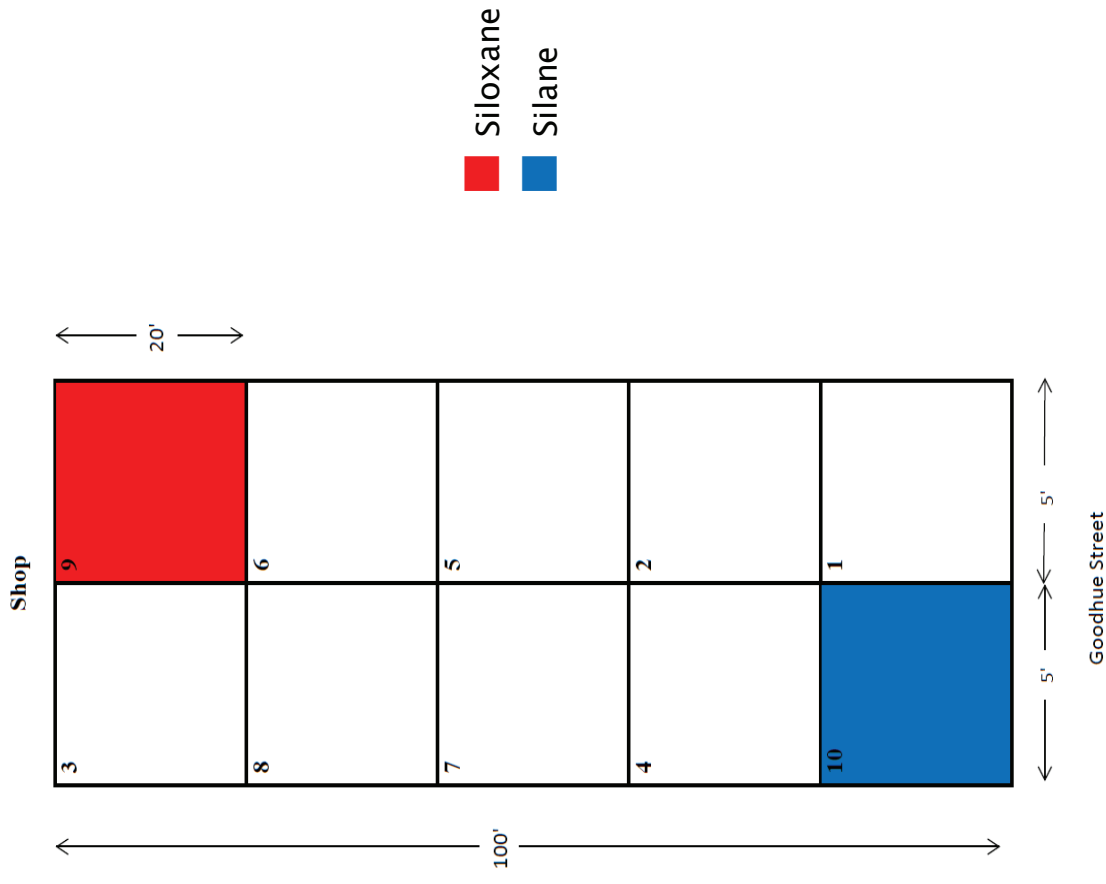
Date of Placement - 11/1/14



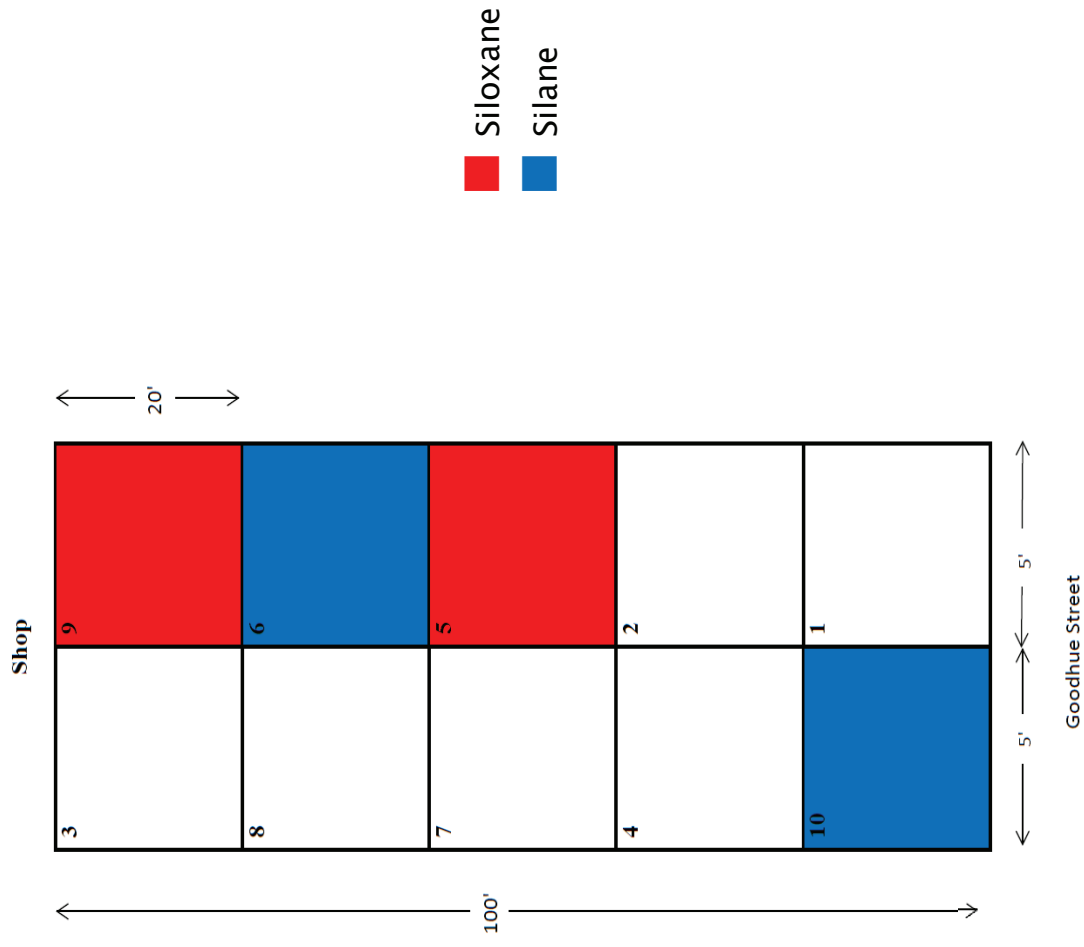
November 2, 2014



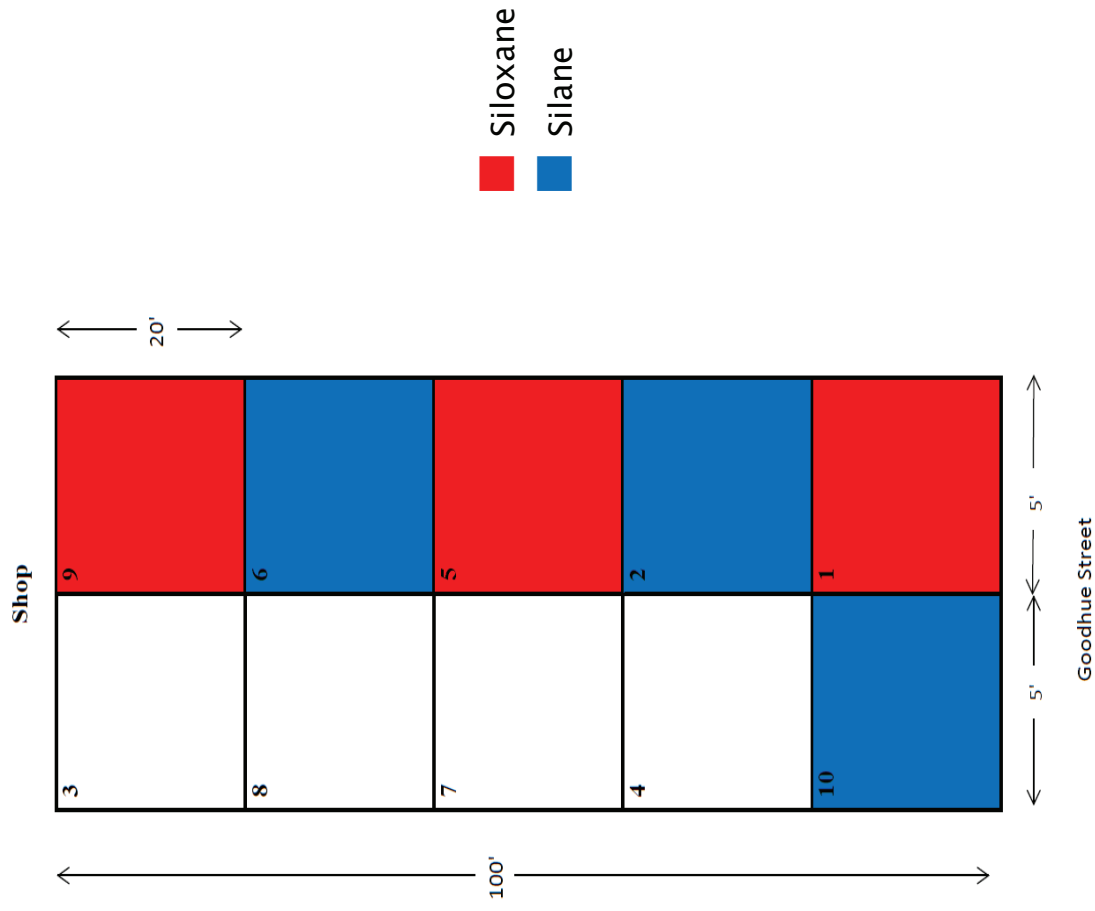
Two Week Sealer Addition



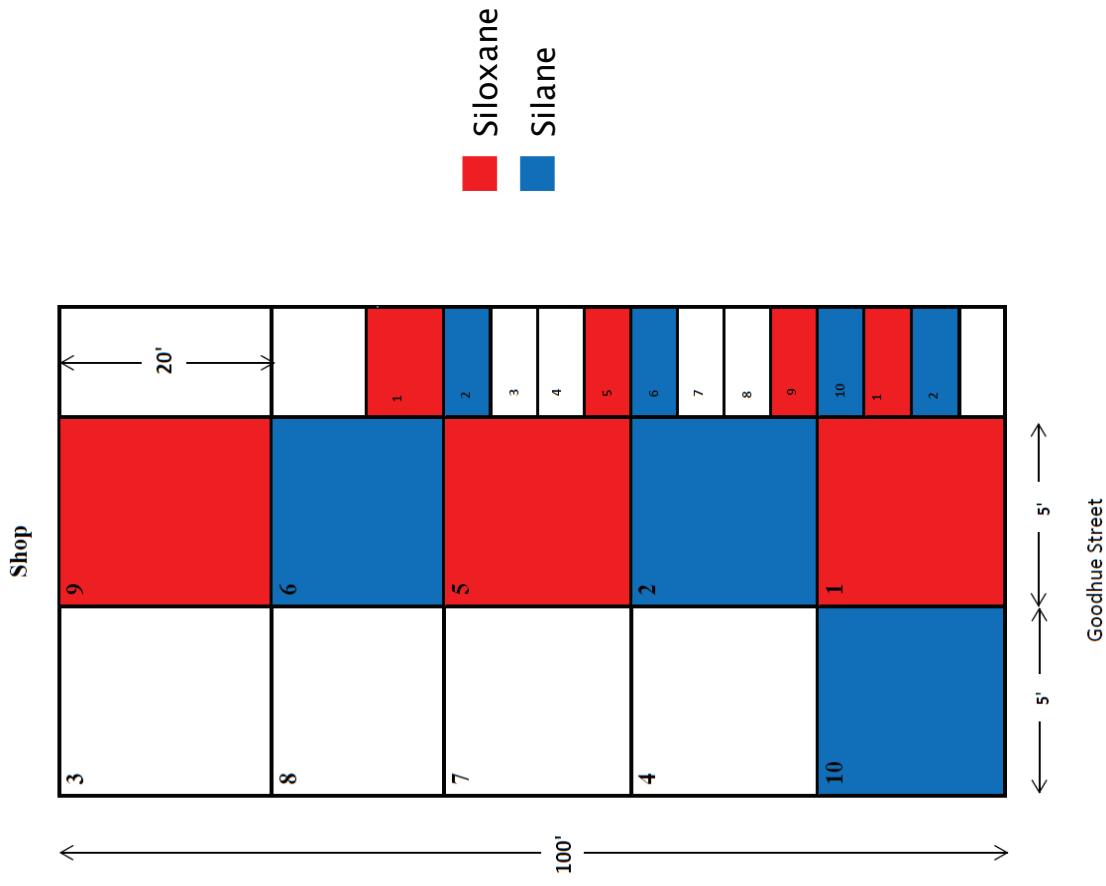
Three Week Sealer Addition



Four Week Sealer Addition



Ancillary Popout Study



No sealer



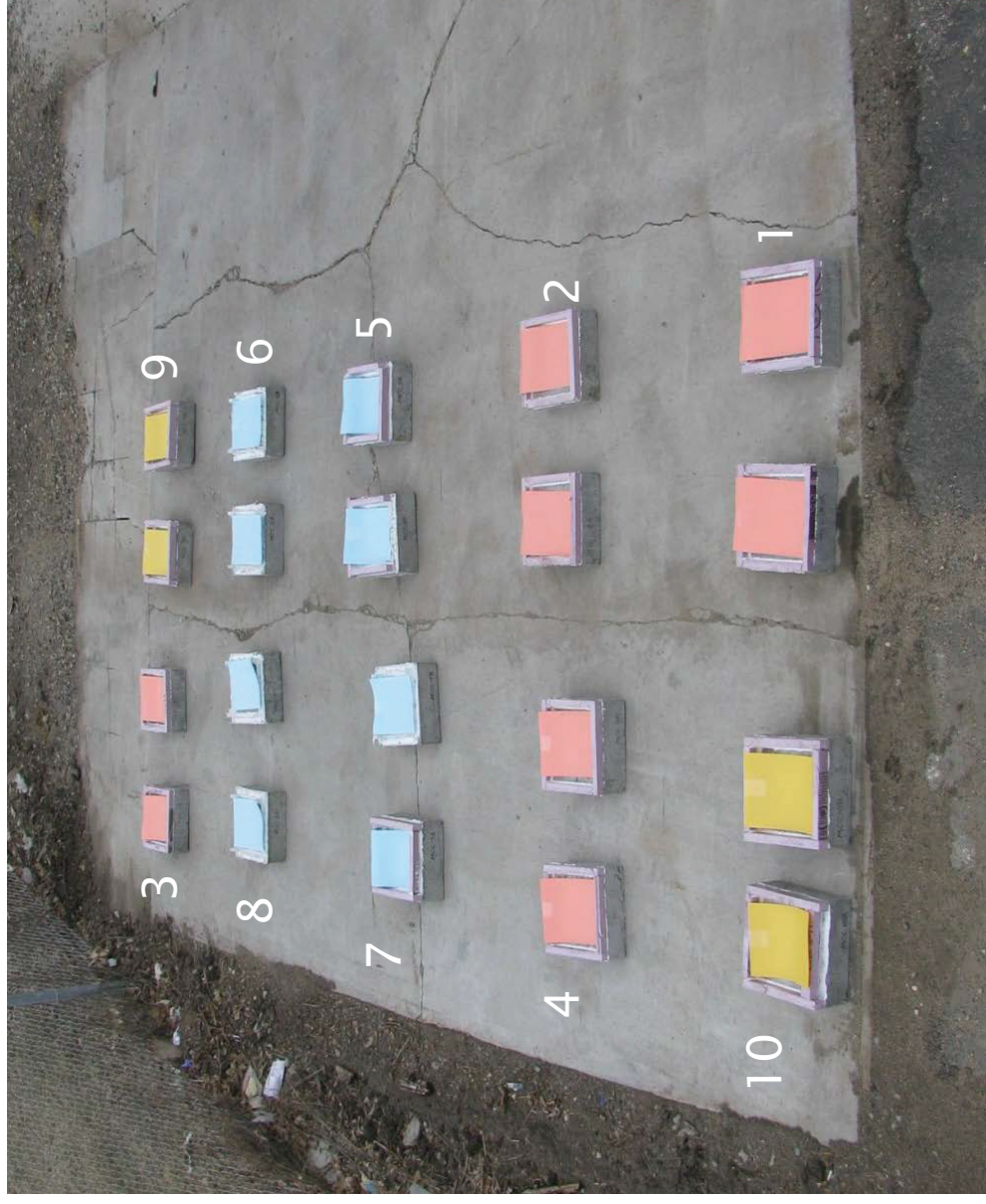


Independent Variables Studied in the Laboratory Phase

Factorial Points	Curing	Sealer	Deicer Exposure
1	4 weeks	8% siloxane	CaCl ₂
2	4 weeks	40 % silane	CaCl ₂
3	4 weeks	None	None
4	4 weeks	None	CaCl ₂
5	2 weeks	8% siloxane	CaCl ₂
6	2 weeks	40 % silane	CaCl ₂
7	2 weeks	None	CaCl ₂
8	2 weeks	None	None
9	3 weeks	8% siloxane	CaCl ₂
10	3 weeks	40 % silane	CaCl ₂



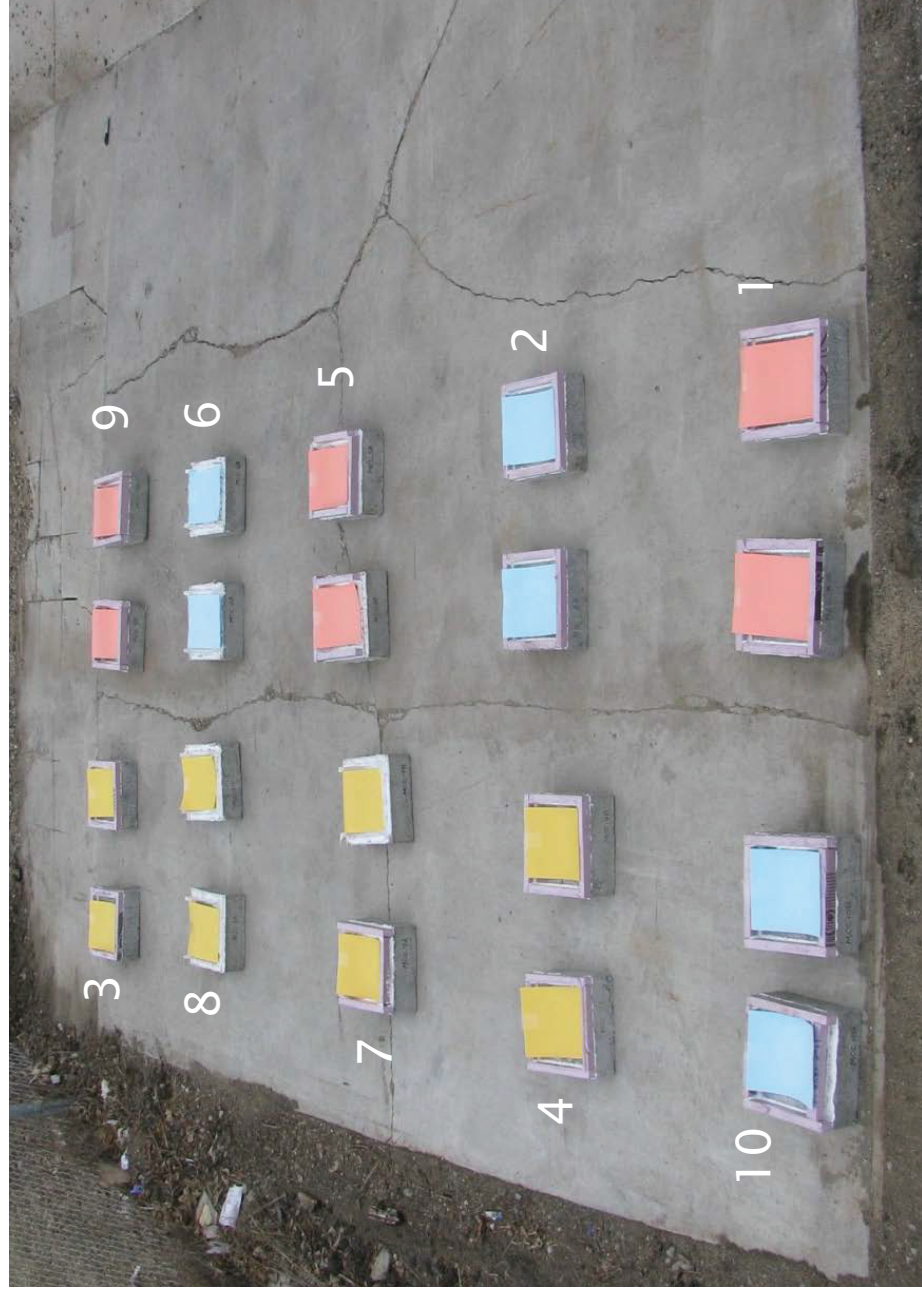
Time of Curing



4 weeks –  3 weeks –  2 weeks – 



Type of Sealer Placed



8% Siloxane–



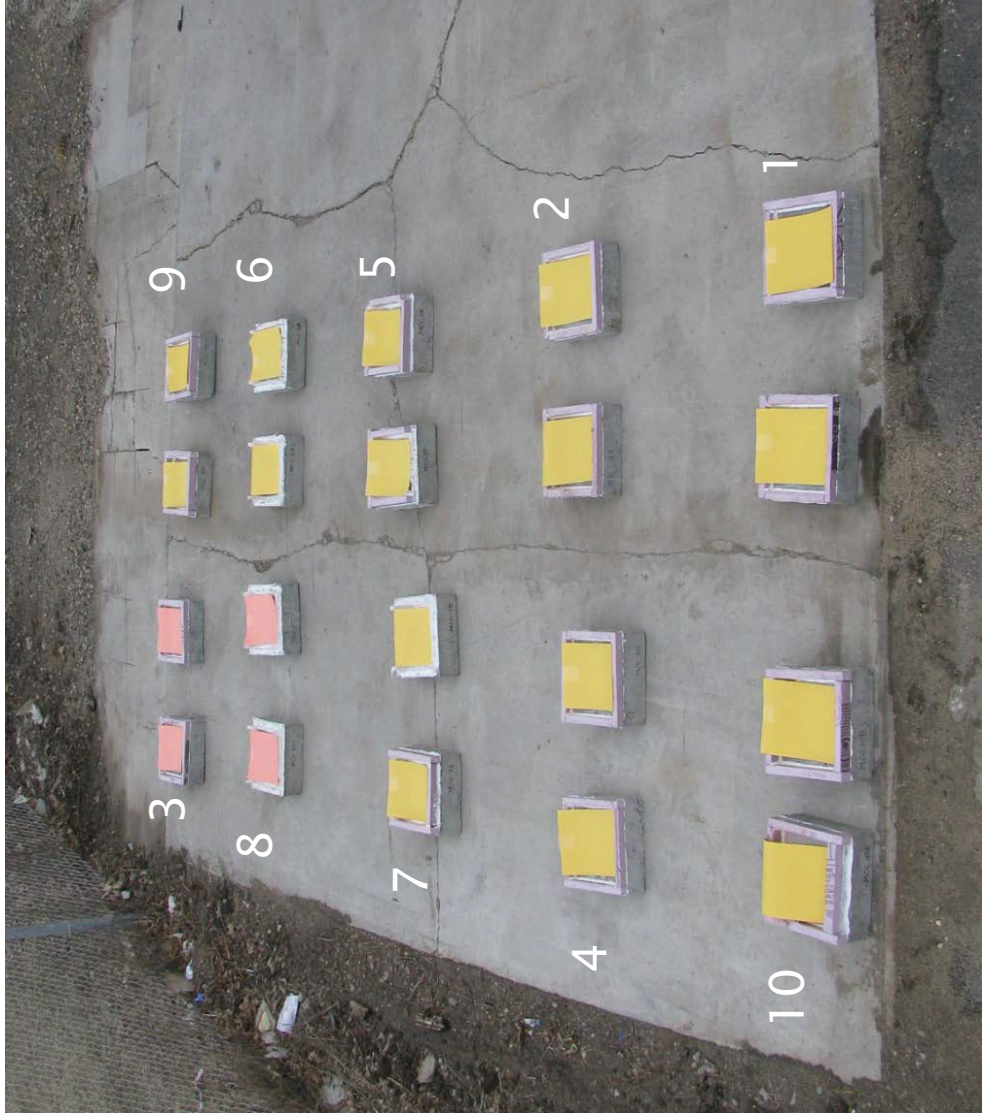
40% Silane–



None–



Deicer Exposure



CaCl_2 -

None-



Scaling Rating

Per ASTM C672 / C672M

- 0 – no scaling
- 1 – very slight scaling (3 mm depth, no coarse aggregate visible)
- 2 – slight to moderate scaling
- 3 – moderate scaling (some coarse aggregate visible)
- 4 – moderate to severe scaling
- 5 – severe scaling (coarse aggregate visible over entire surface)



0 Rating



#1

4 weeks

Siloxane

Deicer

#2

4 weeks

Silane

Deicer



1 Rating



#3

4 weeks

No sealer

No deicer

#8

2 weeks

No sealer

No deicer



2 Rating



#5	2 weeks	Siloxane	Deicer
#10	3 weeks	Silane	Deicer



3 Rating



#4	4 weeks	No sealer	Deicer
#6	2 weeks	Silane	Deicer



4 Rating



#4	4 weeks	No sealer	Deicer
#7	2 weeks	No sealer	Deicer



5 Rating



#7

2 weeks

No sealer

Deicer



0-5 Rating

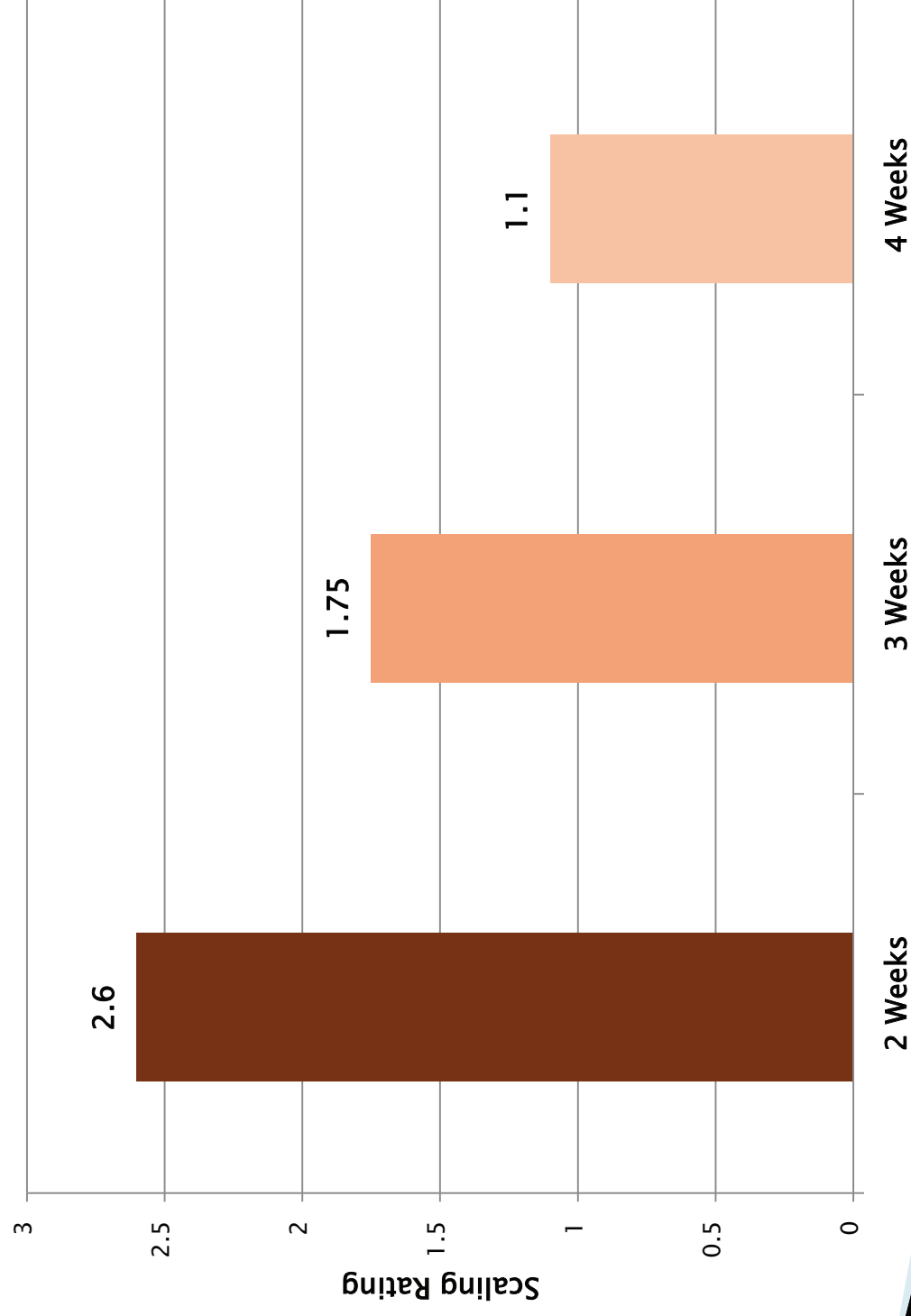


Responses of the Laboratory Phase

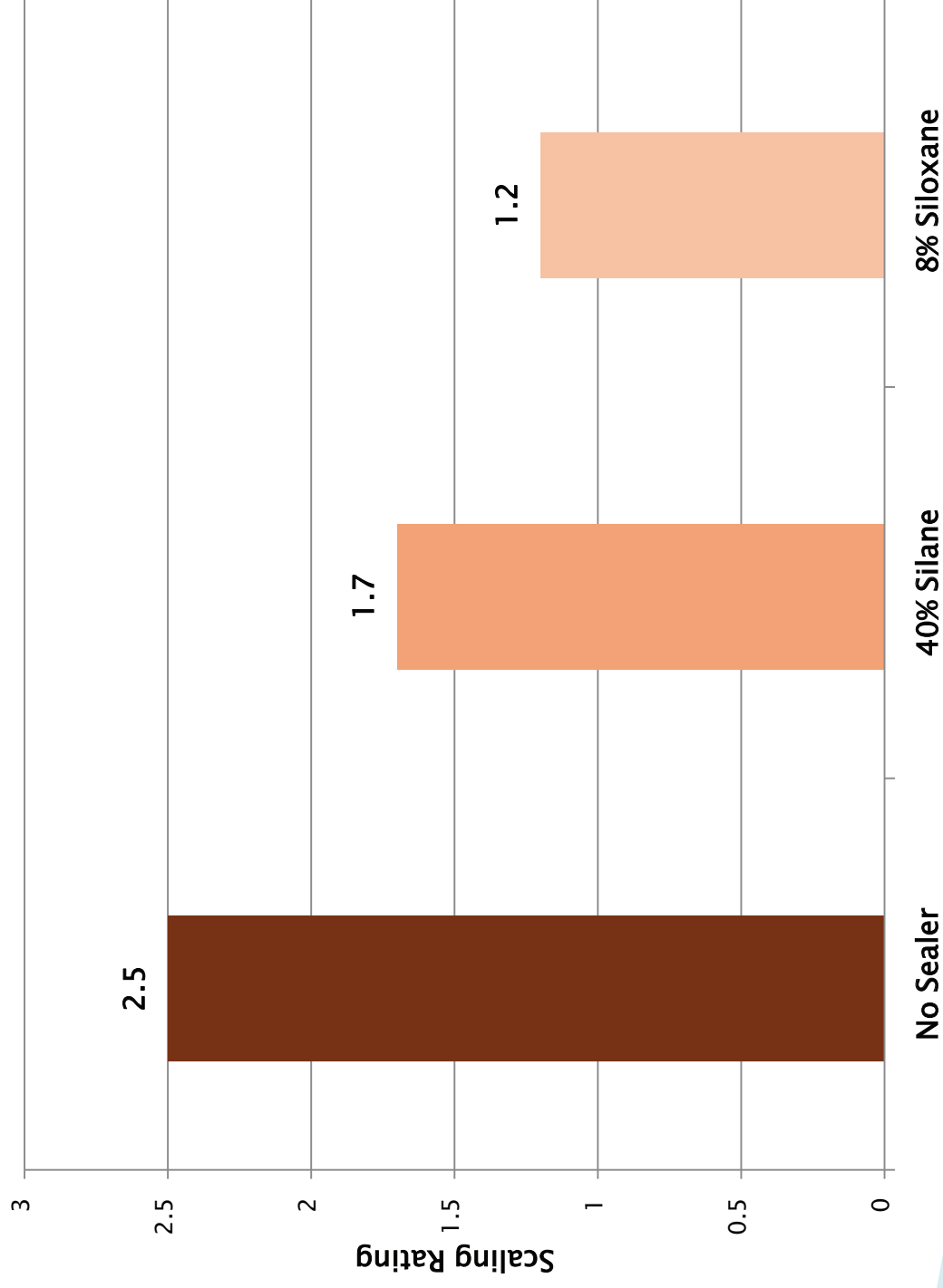
Factorial Points	Curing	Sealer	Deicer Exposure	Scaling Rating
1	4 weeks	8% siloxane	CaCl ₂	0
2	4 weeks	40 % silane	CaCl ₂	0
3	4 weeks	None	None	1
4	4 weeks	None	CaCl ₂	3.5
5	2 weeks	8% siloxane	CaCl ₂	2
6	2 weeks	40 % silane	CaCl ₂	3
7	2 weeks	None	CaCl ₂	4.5
8	2 weeks	None	None	1
9	3 weeks	8% siloxane	CaCl ₂	1.5
10	3 weeks	40 % silane	CaCl ₂	2



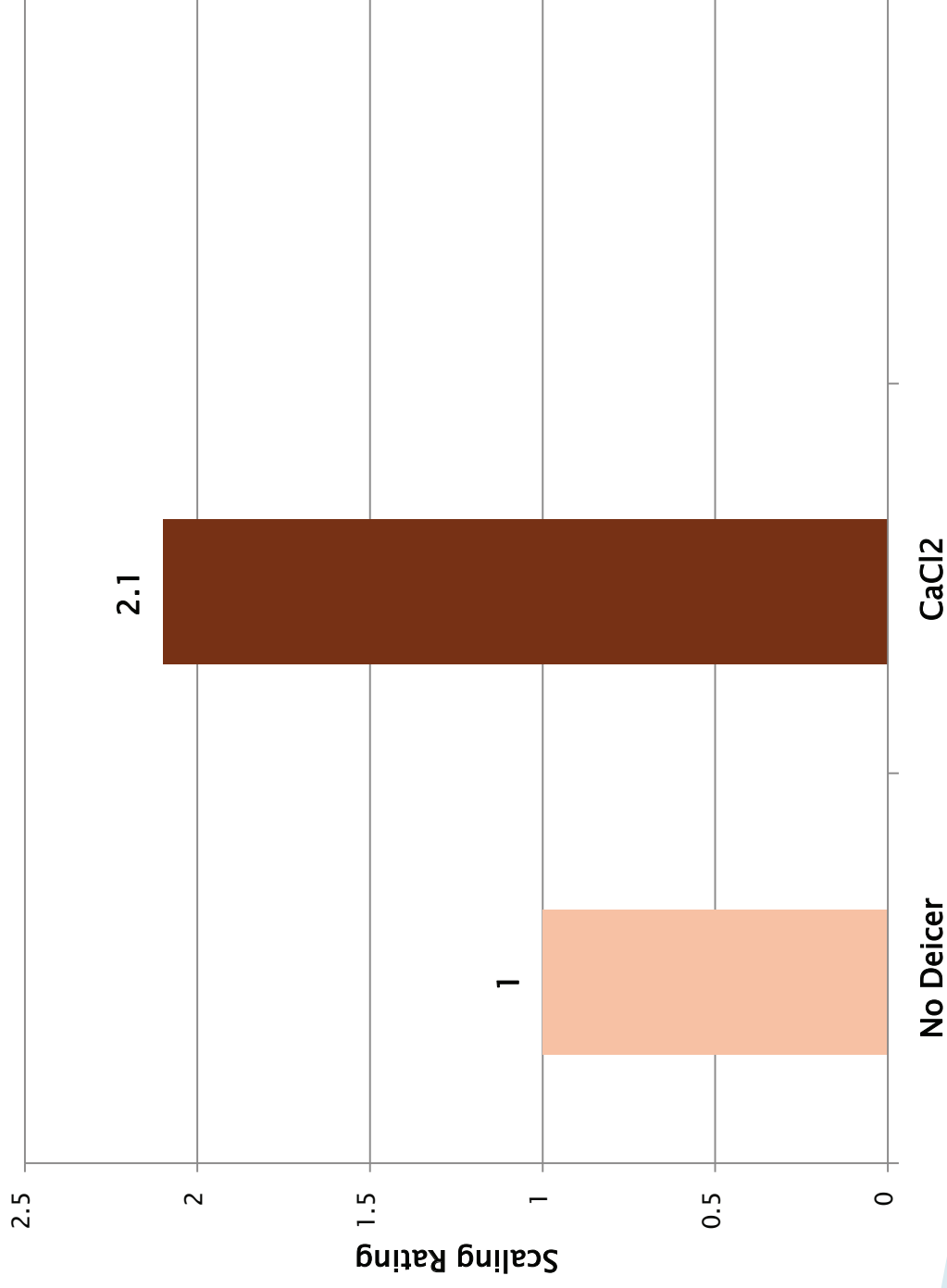
Curing Time



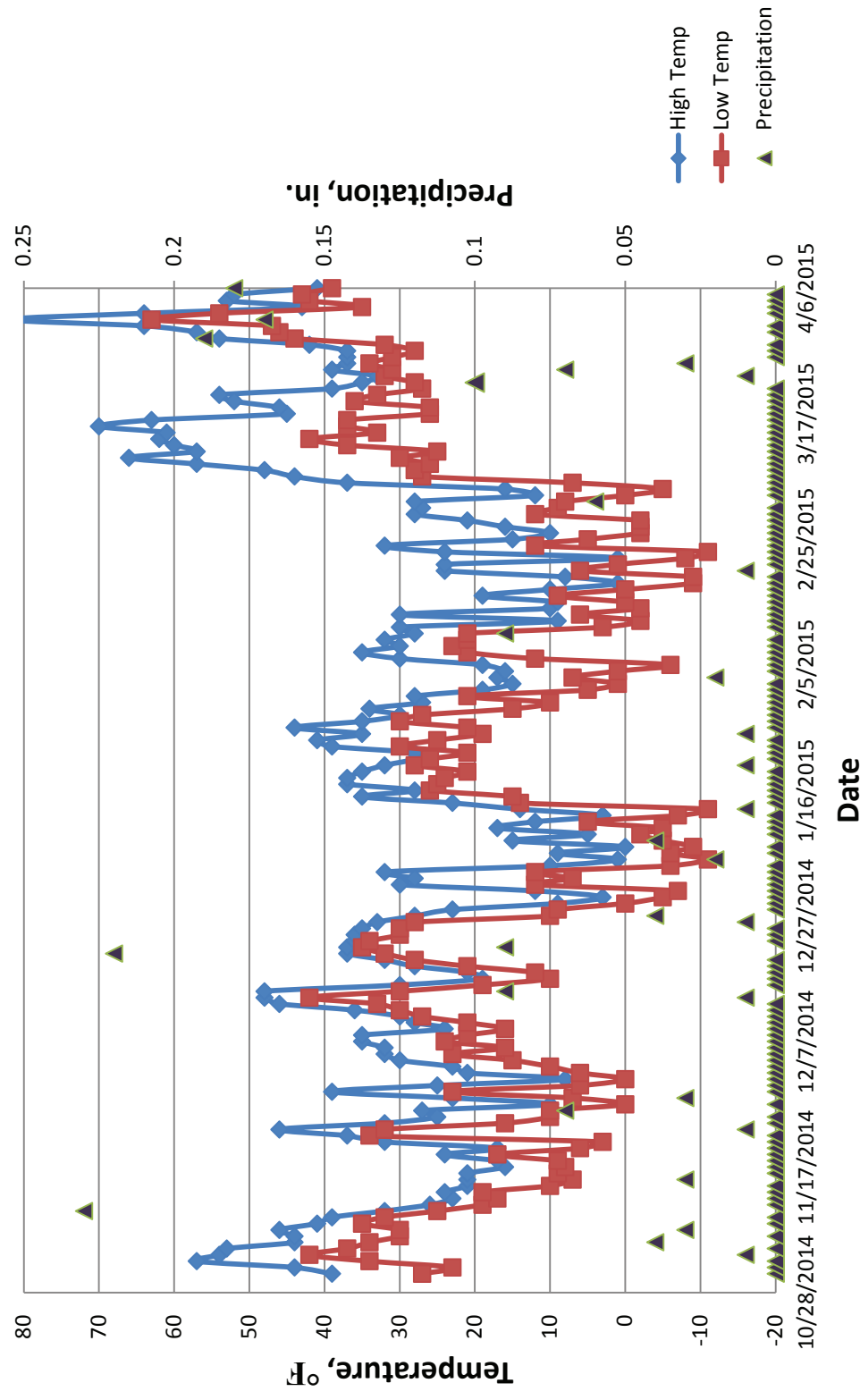
Type of Sealer



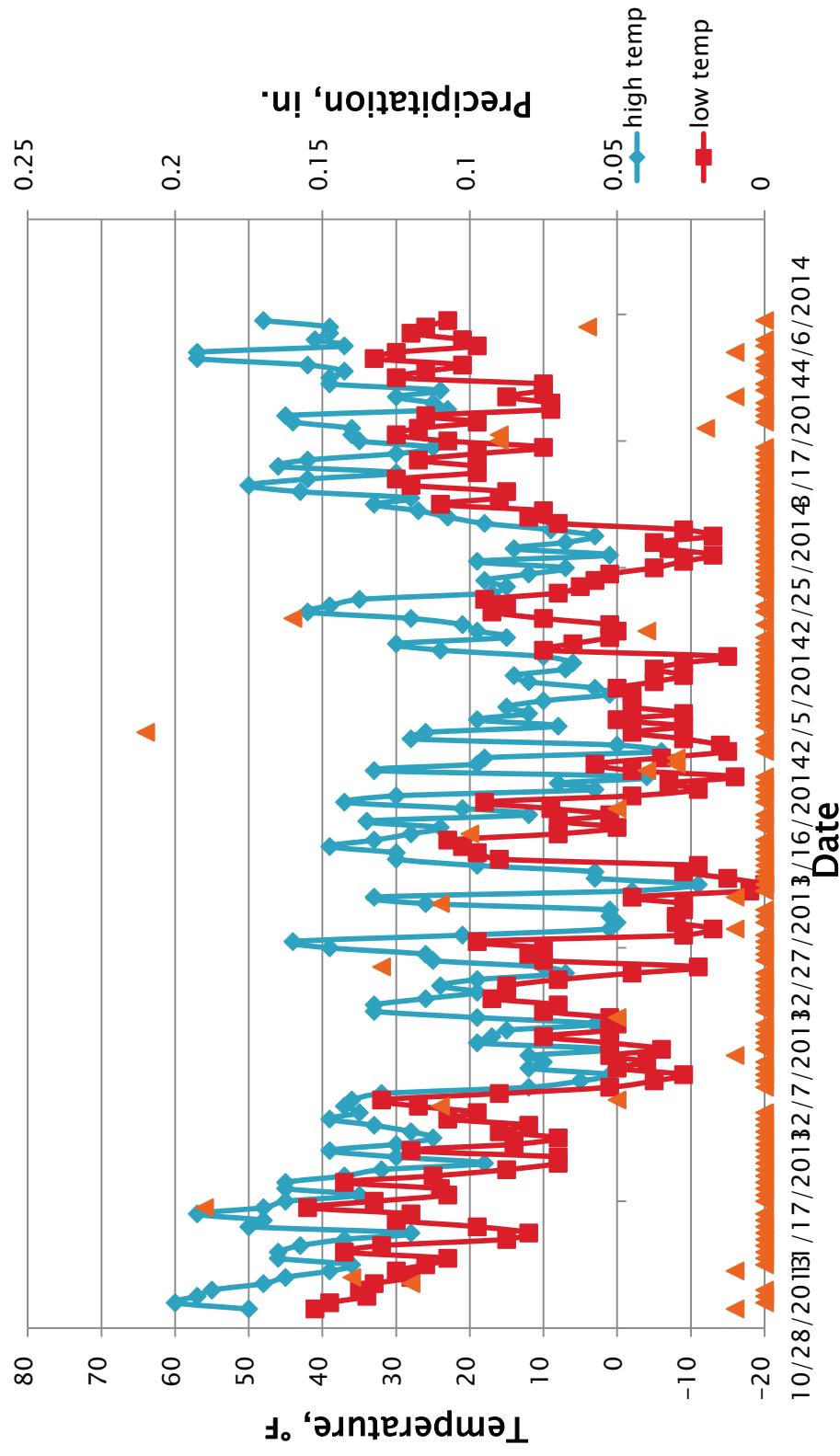
Deicer Exposure



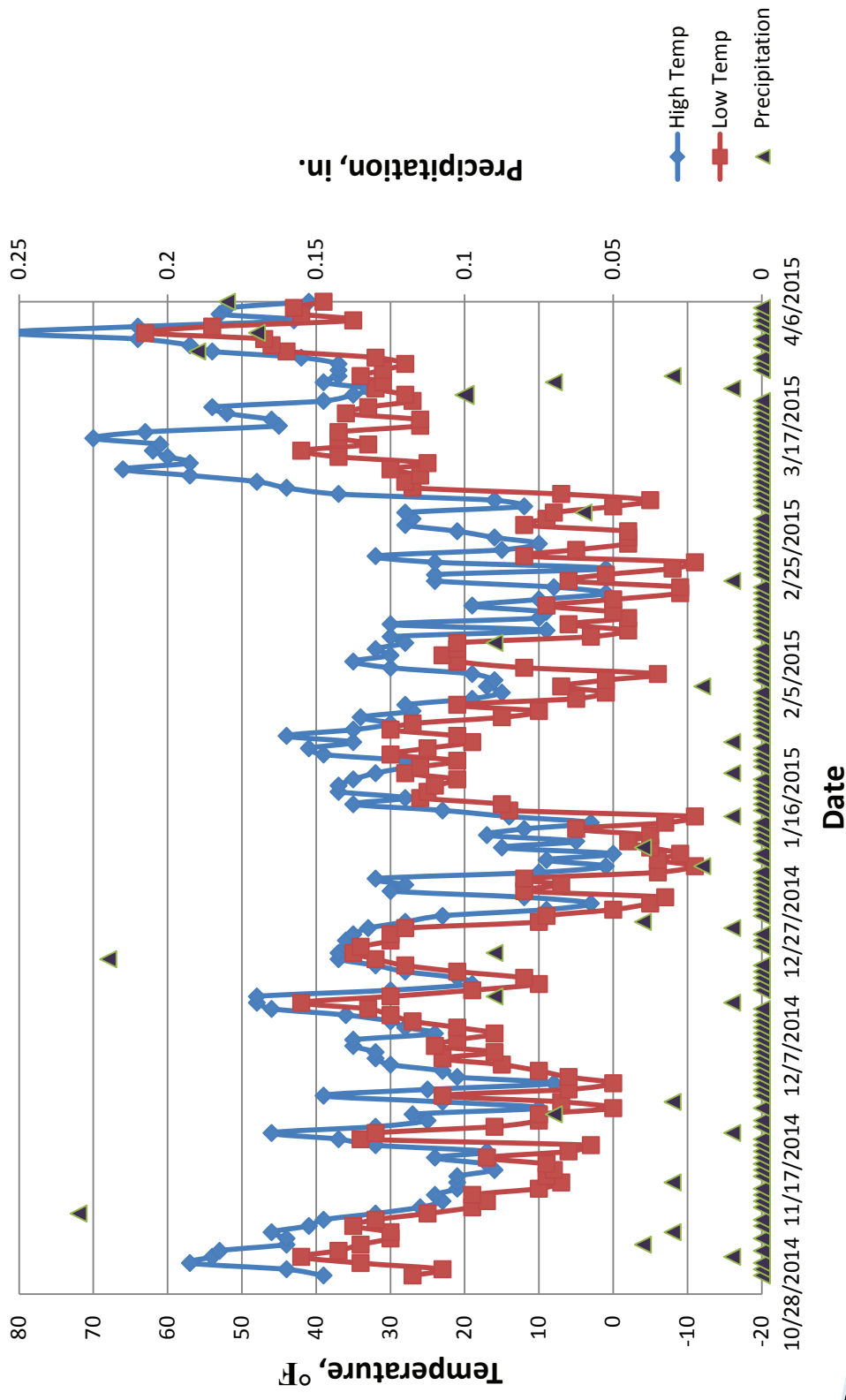
Daily High and Low Temperatures 10/31/14 to 4/6/15



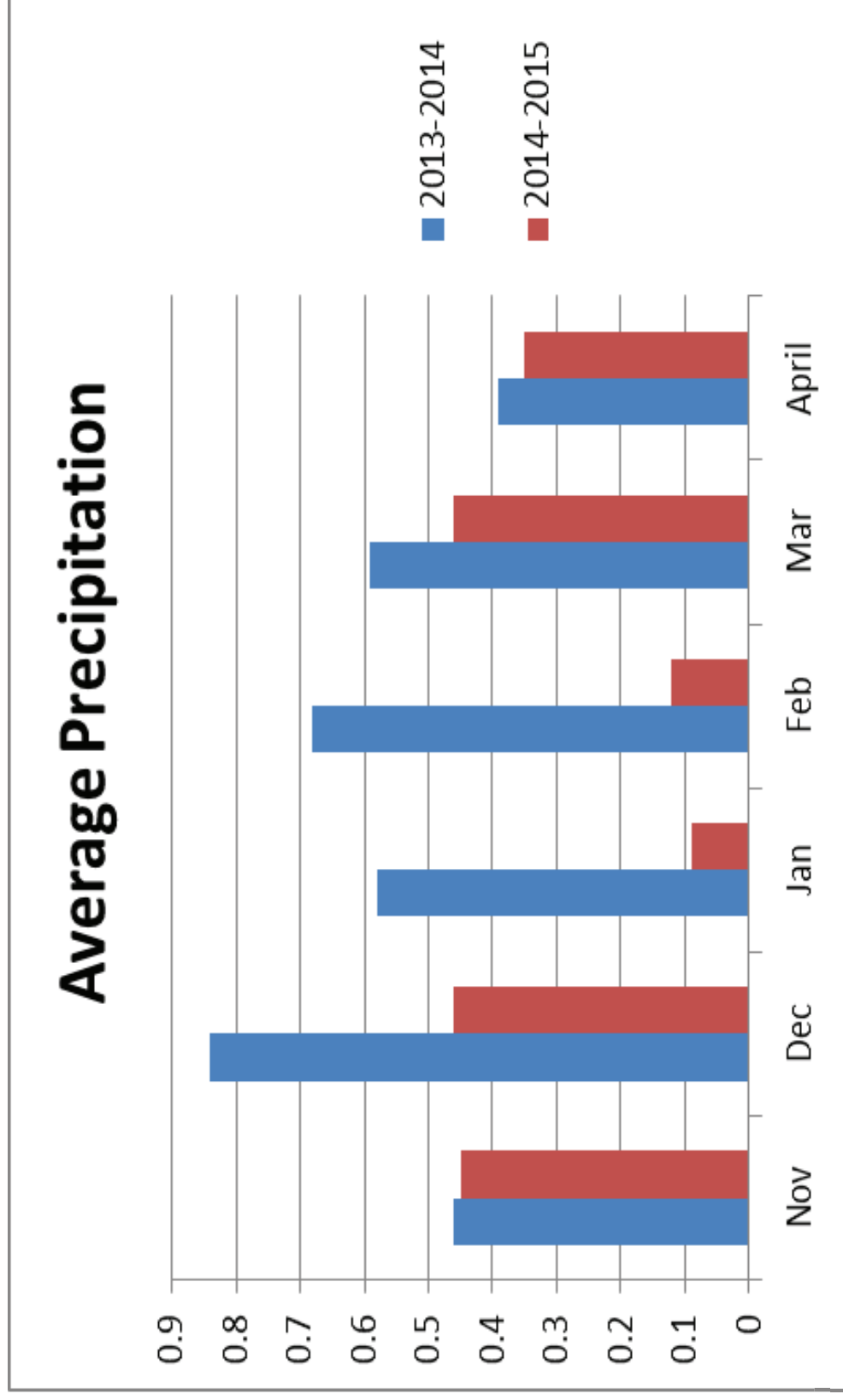
Daily High and Low Temperatures 10/31/13 to 4/6/14



Daily High and Low Temperatures 10/31/14 to 4/6/15



Average Precipitation



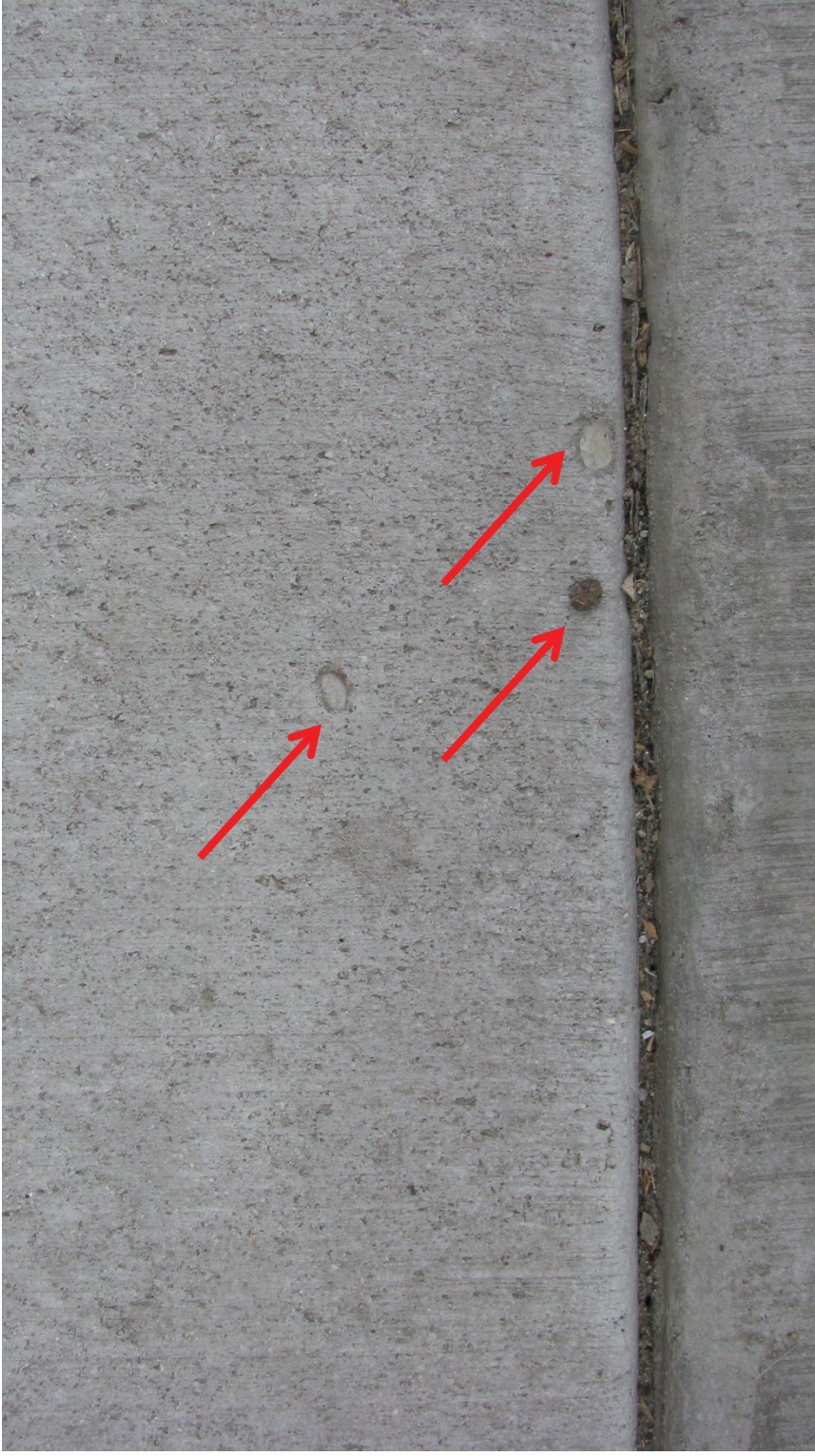
The Dick Stehly Rule of Scaling





MOTHER NATURE HAS CONTROL

Popouts



QUESTIONS?



THANK YOU!

