



Industrial Floors And Big Box Construction



Rick Smith
Structural Services, Inc
www.ssiteam.com

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Who is SSI?



3



What Is SSI?



Engineers
Industrial Floor Finishers
Concrete Technicians

4



Who Do We Service?



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Our Professional Affiliations

- ACI – American Concrete Institute
 - Sustaining Members
 - ACI 302, ACI 330, ACI 360, ACI 117, ACI 223, ACI 640

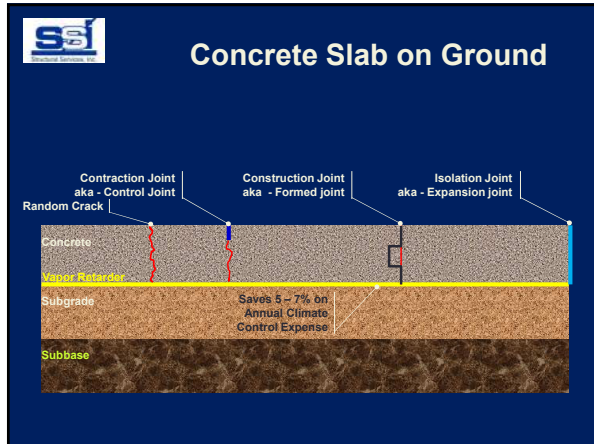


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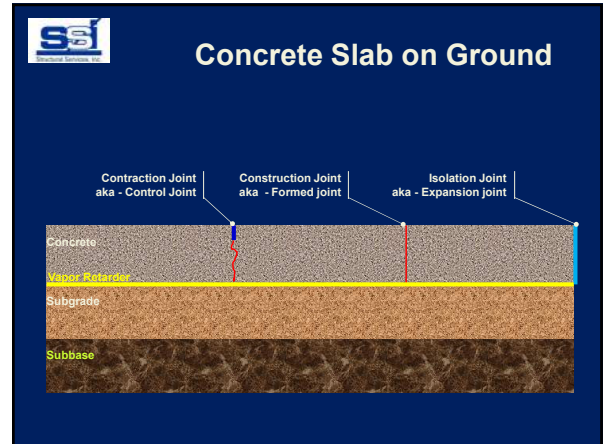


ANATOMY OF A FLOOR SLAB

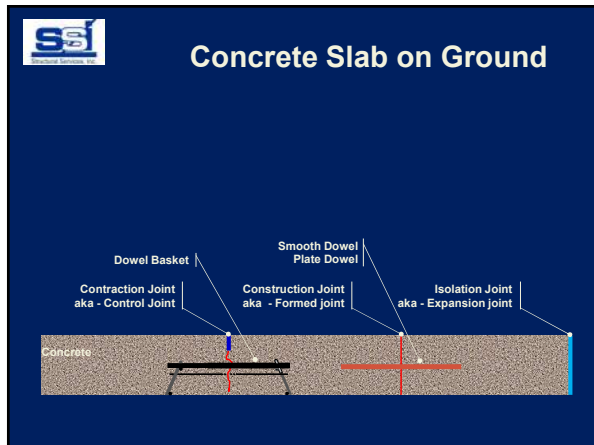
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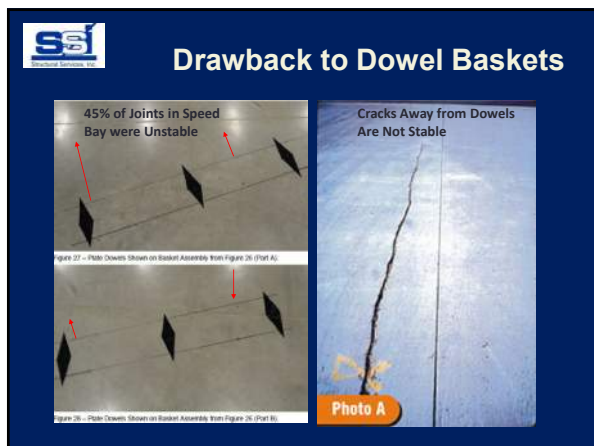
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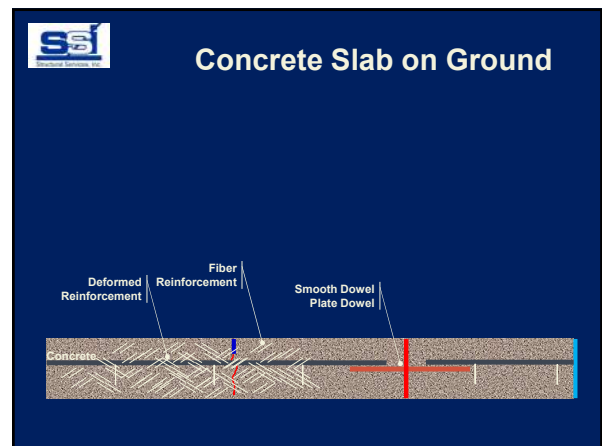
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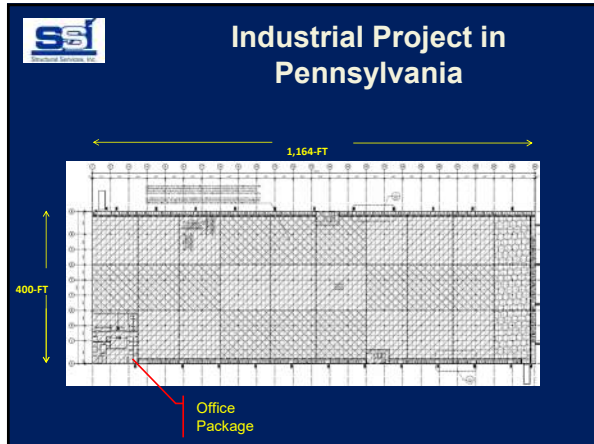
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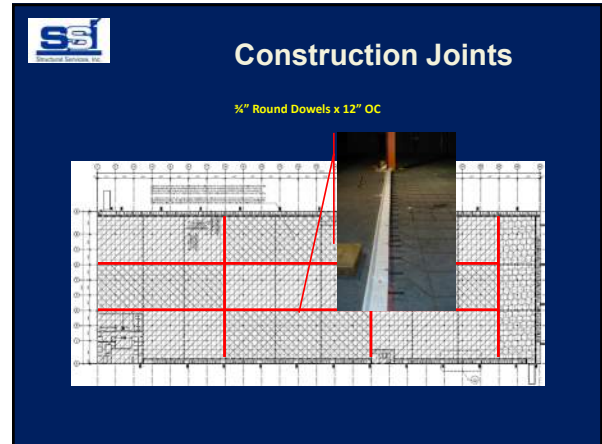
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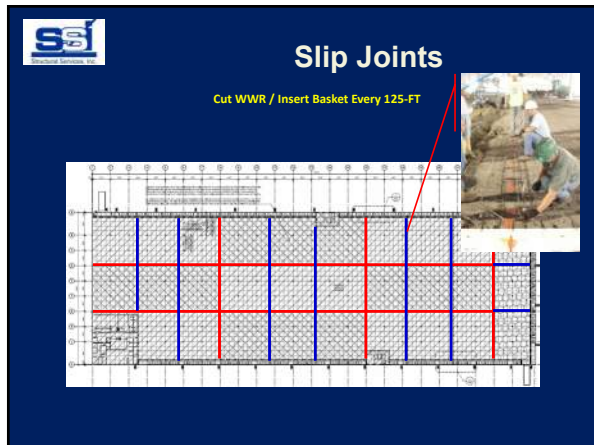
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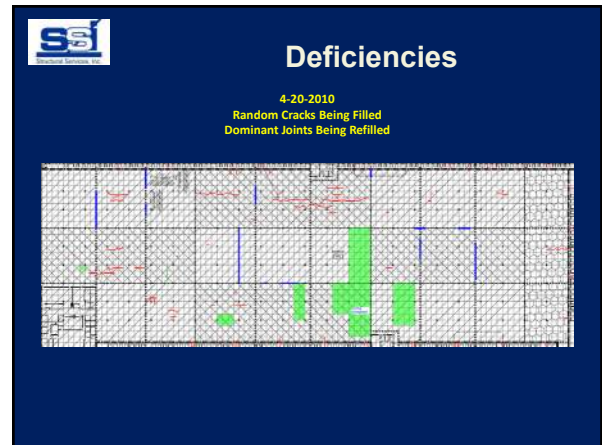
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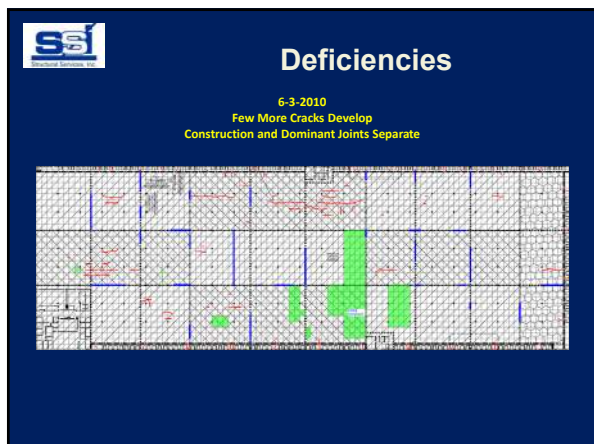
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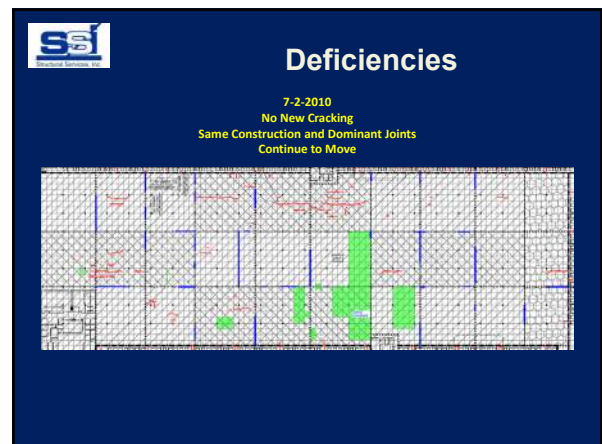
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Deficiencies

8-5-2010
Relative Humidity = 68.3%, Temperature = 79.3°F
No New Cracking
Continued Construction and Dominant Joint Movement

A grid map of a floor slab with various colored regions (green, blue, red) indicating different construction phases or joint locations. A red arrow points to a specific joint on the grid.

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Deficiencies Caused By Shrinkage and Thermal

8-5-2010
Relative Humidity = 68.3%, Temperature = 79.3°F
Floor Expands
Joint Filler at Dominant and Construction Joints Extrudes Upward

A grid map similar to slide 31, with a red arrow pointing to a joint. Below the grid is a photograph showing a hand holding a white plastic joint filler strip that has extruded upwards from a joint in a concrete floor.

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Deficiencies

Pour Back Separation and Spalling
Pour Back Strip Starts to Breakdown

A grid map with a red arrow pointing to a joint. Below the grid is a photograph showing a cross-section of a concrete joint where the pour back material has separated and spalled, with a white SSI scale placed below for reference.

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Deficiencies

Typical Joint Separation
Some Can Be Refilled
Nosing Repair Recommended in Traffic Lanes

A grid map with a red arrow pointing to a joint. Below the grid is a photograph showing a joint separation in a concrete floor with a white SSI scale placed below for reference.

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Deficiencies

Armored Joint Repairs Required

A grid map with a red arrow pointing to a joint. Below the grid is a photograph showing a joint repair with a metal reinforcement strip (armored joint) installed, with a white SSI scale placed below for reference.

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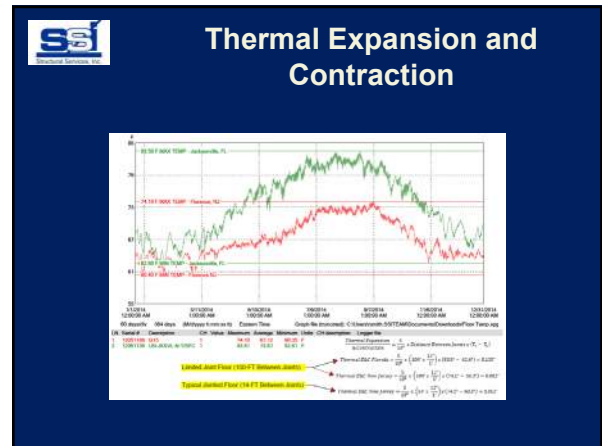
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Two Forces in Play

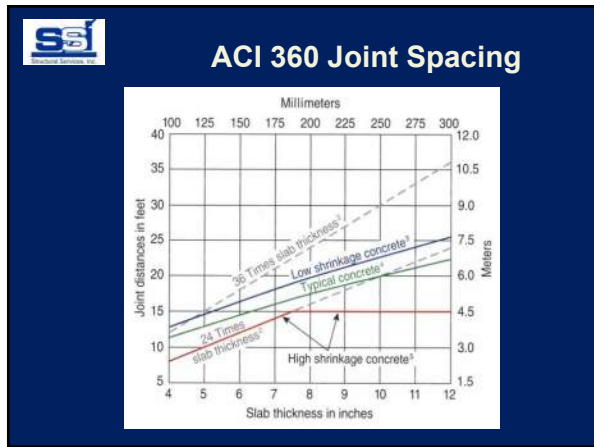
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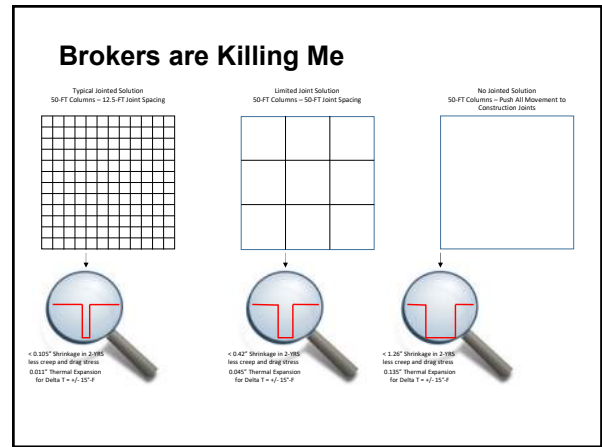
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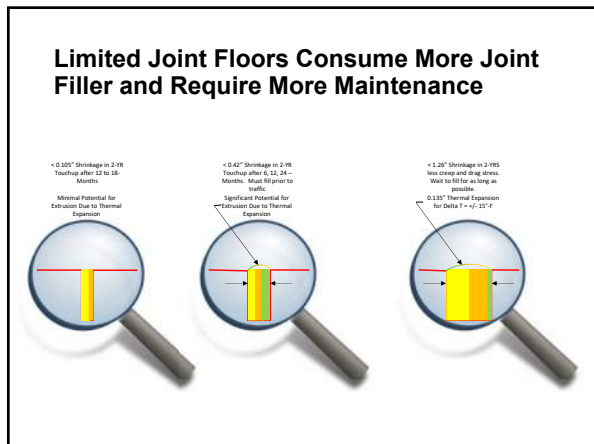
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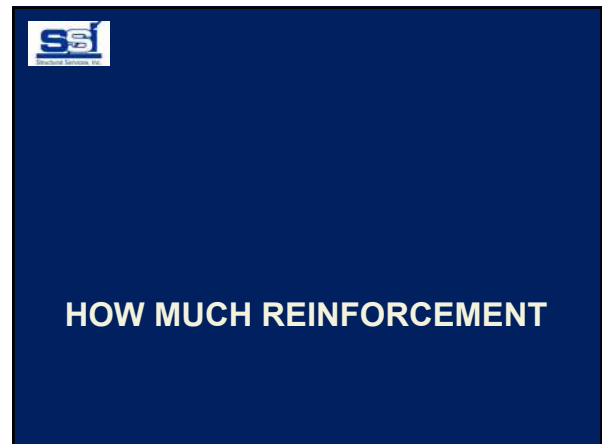
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Buildings are Getting Taller

EXHIBIT 3401.1
RACKING LAYOUT FOR SLAB ON GROUND DESIGN

Labels in diagram: 1/2" OF STEEL PLATES, 4" DIMENSION PALLETS, BRIDGE RACKING LAYS BOTTOM LEVEL FOR PALLET STOWAGE, 40" PALLETS STORED ON SLAB, 30" CULR, 36" CULR, 48" CULR, 60" CULR, 100" ABLE.

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Slab Thickness & Reinforcement

Tables of Safety for Slab Thickness, Modulus of Subgrade Reaction and L, L, and P Factor Positions

Slab Thickness (ft)	0.100 gpf				0.150 gpf				0.200 gpf			
	0.100 gpf	0.150 gpf	0.200 gpf	0.250 gpf	0.100 gpf	0.150 gpf	0.200 gpf	0.250 gpf	0.100 gpf	0.150 gpf	0.200 gpf	0.250 gpf
4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
7	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
8	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
9	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
10	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

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More Steel is Not Better

COURTHOUSE ZONE !!

Annotations: Courthouse zone when reinforcement is stopped or continued through joints, Economical zone, Cracked design, Continuously reinforced slab, Reinforcement is not sufficient to keep cutting cracks to acceptable widths.

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Too Much Rebar (0.11 – 0.3%)

If Thickness = 6" #4's @ 18" OCEW = 0.19%

Annotations: Enough Steel to Inhibit Joint Activation, Insufficient Steel To Limit Crack Widths.

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DOMINANT JOINT AVOIDANCE

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Dominant Joint Location

Measurement: 13/16"

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Concrete will Respond to Thermal Expansion & Contraction

Shave or Hone Joint Flush Semi-Rigid Epoxy or Polyurea will Extrude Upwards

53

Hybrid Construction Joint

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Joint Free "Limited Joint Floors"

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F_{min} Superflat

6-FT Wide Aisles Note Wheel Path Has Been Ground

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Heavy Racks in Seismic Areas? (CA, OR, WA, MO) Look at Velocity Report

Selective Rack / Cantilever

Range	Frequency	Relative Intensity
0.00 - 0.05	0.050	22.7%
0.05 - 0.10	0.100	21.3%
0.10 - 0.20	0.200	15.3%
0.20 - 0.30	0.300	12.8%
0.30 - 0.40	0.400	10.7%
0.40 - 0.50	0.500	9.2%
0.50 - 0.60	0.600	8.0%
0.60 - 0.70	0.700	7.0%
0.70 - 0.80	0.800	6.2%
0.80 - 0.90	0.900	5.6%
0.90 - 1.00	1.000	5.1%
Total	85.5%	100.0%

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Limited Joint Floor Applications

Very Heavy Loads on Hard Wheels Pile Supported Slabs

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SSI **Ground Improvement Sites**

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SSI **Limited Joint Floor Applications**

Floors with Strict Curvature Requirements

Suspended Slabs for Robotics

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SSI **Suspended Slabs Designed for Serviceability**

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SSI **Shrinkage Compensating Concrete**

Armored Joint to Protect Edges

Small Wheels Have No Impact on Joint

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SSI **Changes in Material Handling Equipment**

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SSI **Limited Joint Floors**

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Limited Joint Floors

1/2" Radius Edger
Filler Is Not Protecting Shoulder

Original Joint Filler
Touch Up Filler
New Distress

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Concrete Slab on Ground

Joint Filler
 Semi Rigid
 Semi Soft

Specified Flatness (F_r)
Levelness (F_l)
Spectral Gloss
Distinctness of Image
Slip Resistance
Roughness

Curing Compound
Sealer
Chemical Densifier
Mineral or Metallic Flake

Concrete

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CONCRETE MIX DESIGN

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Concrete Mixture Components

Sand
 ASTM C33
 Natural
 Manufactured Blend

Aggregate
 ASTM C33

Water

Cement
 ASTM C 150
 Type I, II, III, V
 Now w/5%
 Inter-ground
 Limestone

Chemical Admixtures

Mineral Admixtures
 Fly Ash
 GGBFS
 Silica Fume

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Concrete Components

Cement – Enough to Coat the Aggregates, Make Strength and Provide Good Set Time

Aggregates – Largest, Well Blended Combination Available. Fractured Faces Are Better.

Sand – ACI 302 Blend with Limits on Fineness & Percent Manufactured

Water – Enough to Produce 2.5 to 3" Slump Prior to Addition of Admixtures

Air < 3%

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ACI 302.1R

Guide for Concrete Floor and Slab Construction

Table 6.1—Recommended strength and maximum slump at point of placement for concrete floors

Floor class ^a	Specified compressive strength, f' _c on 28-day tests, psi (MPa)	Maximum slump at placement ^b , in. (mm)
1, 2, and 3	3000 (21)	5 (125)
4, 5, and 6	3500 (24)	5 (125)
7 base	3500 (24)	5 (125)
7 bonded topping ^c	5000 (35)	3 (75)
8 unbonded topping ^d	4000 (28)	3 (75)
9 superflat	4000 (28)	5 (125)

^aRefer to Table 2.1 for floor class definitions.
^bMaximum slump is assumed to be achieved using a Type A water-reducing admixture.
^cThe strength specified will depend on the severity of usage.
^dMaximum aggregate size not greater than 1/3 the thickness of unbonded topping.

SSI Prefers a 5 +/- 1" Slump at Placement

Delivery Slump – The slump of the concrete as delivered to the site by the Transport Vehicle.
 Tailgate 5 +/- 1", Pump 6 +/- 1"

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ACI 302.1R

Guide for Concrete Floor and Slab Construction

520 – 540-LBS are Good Starting Points

Table 6.2—Recommended cementitious material contents for concrete floors

Nominal maximum-size aggregate, in. (mm)	Cementitious material content, lb/cyd ³ (kg/m ³)
1-1/2 (37.5)	470 to 560 (280 to 330)
1 (25)	520 to 610 (310 to 360)
3/4 (19)	540 to 630 (320 to 375)
1/2 (12.5)	590 to 680 (350 to 405)
3/8 (9.5)	610 to 700 (360 to 415)

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Gap Graded / Elongated Particles

Cores 1, 2 & 3 – Problem Surfaces

Core 4 – No Issues with Surface or Durability

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Aggregate Shadowing

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Roller Tamper

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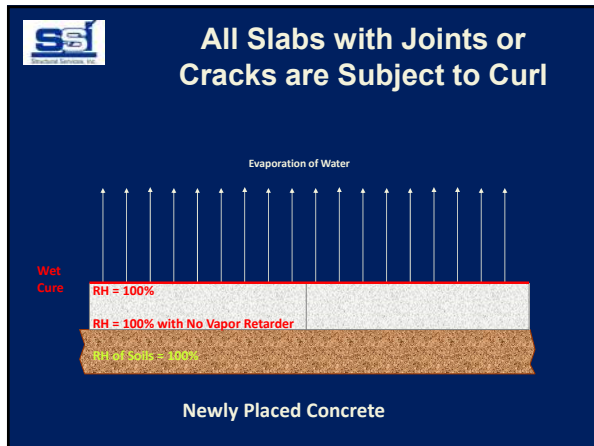
Roller Tamper + Mag Vibe for Polished Floors

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DIFFERENTIAL SHRINKAGE & CURLING

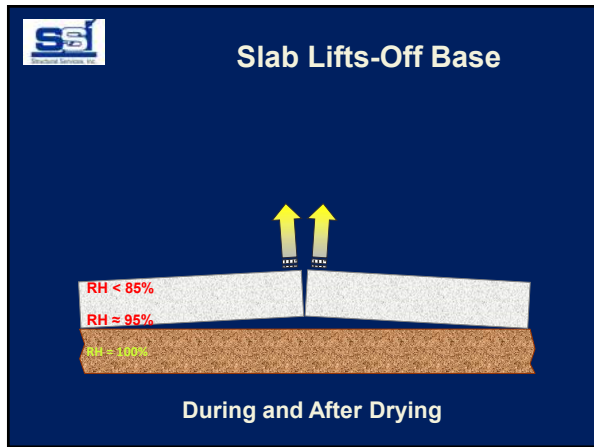
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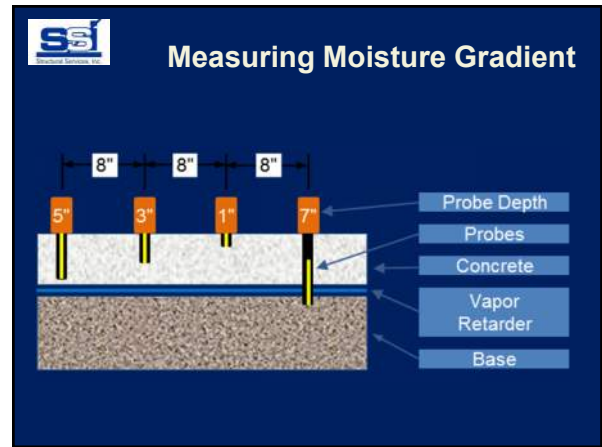
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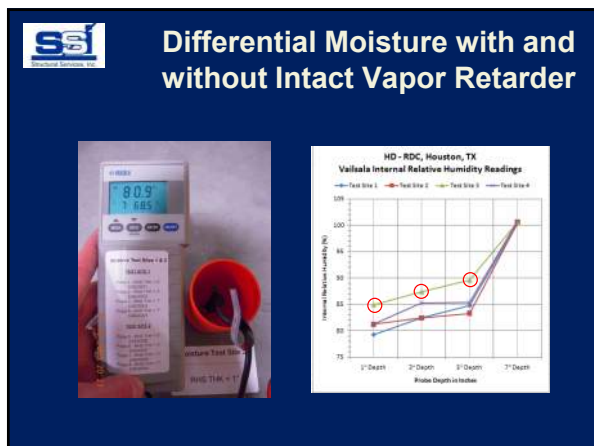
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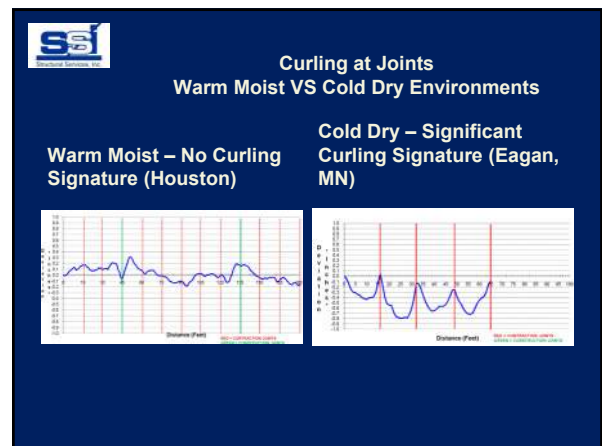
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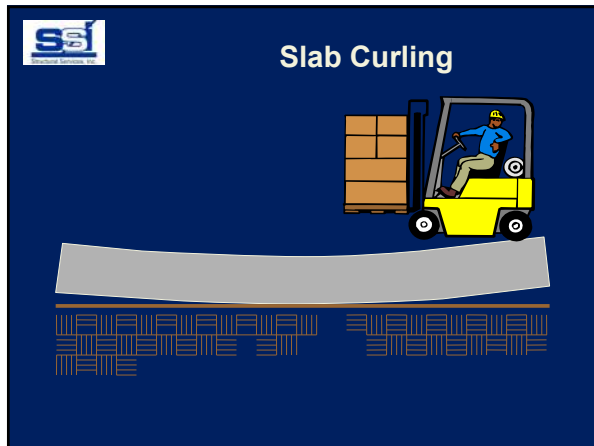
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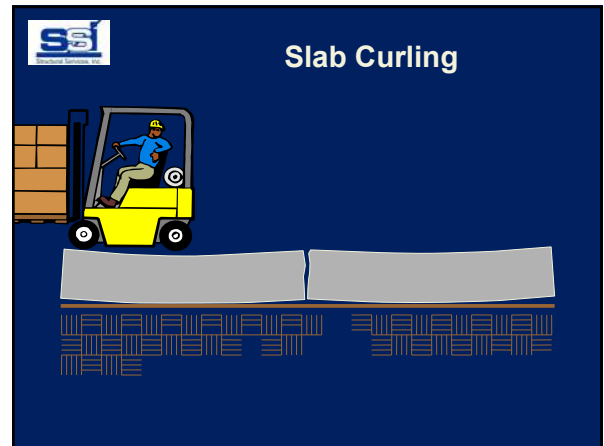
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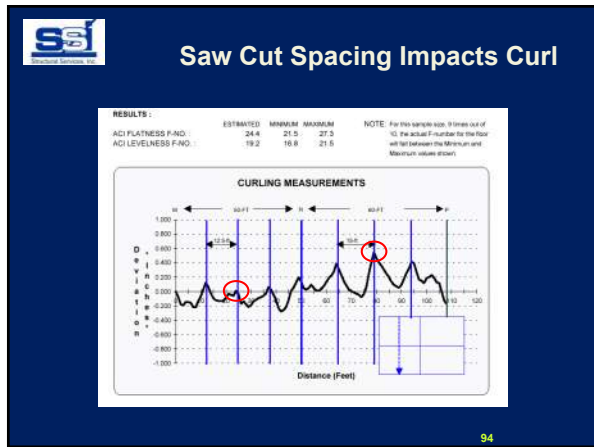
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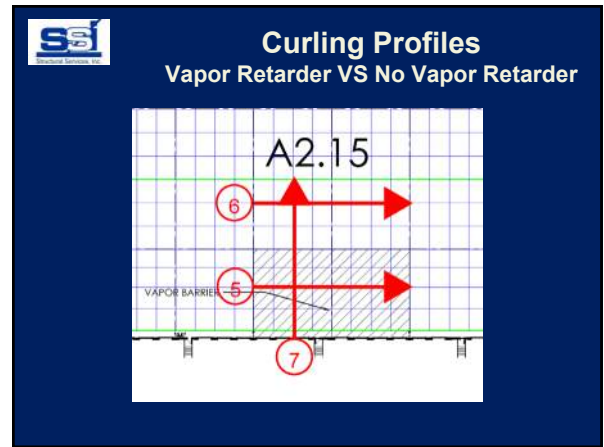
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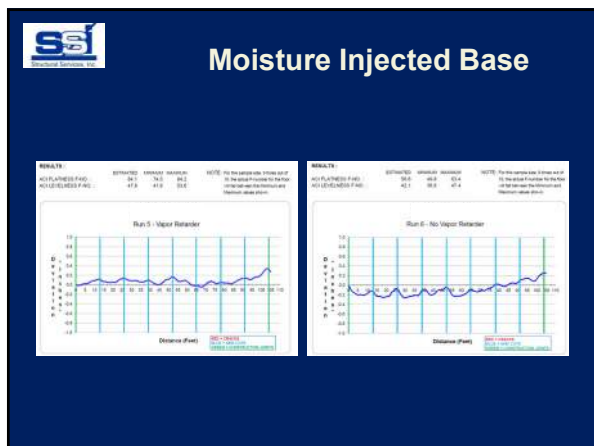
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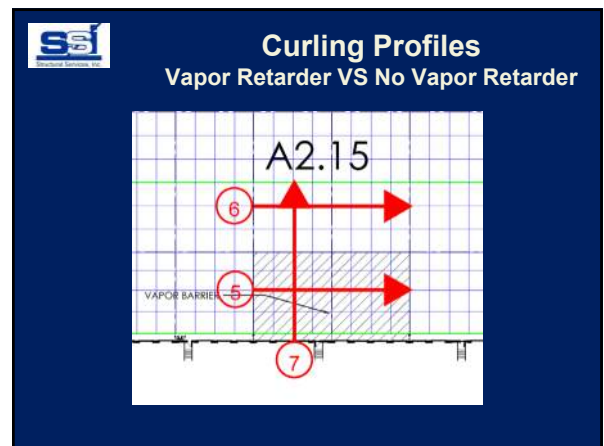
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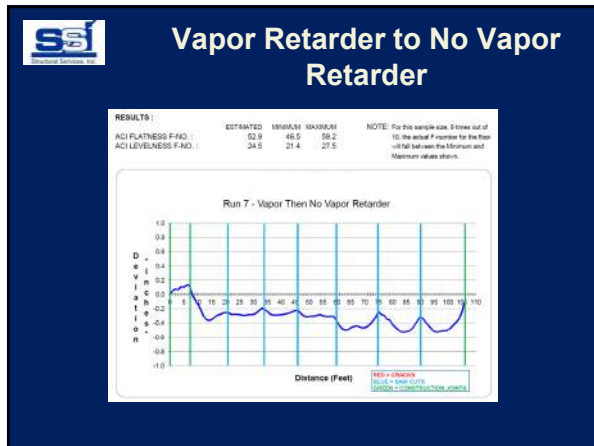
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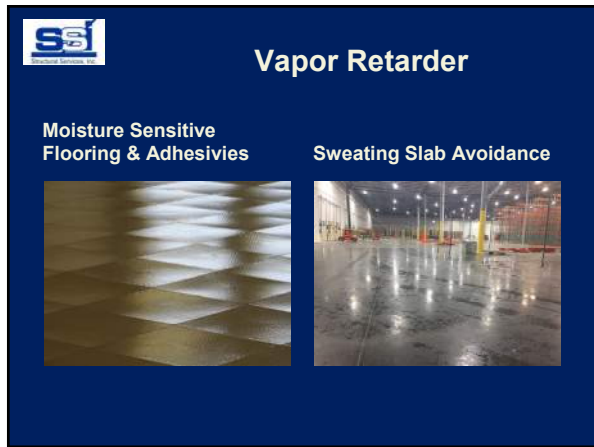
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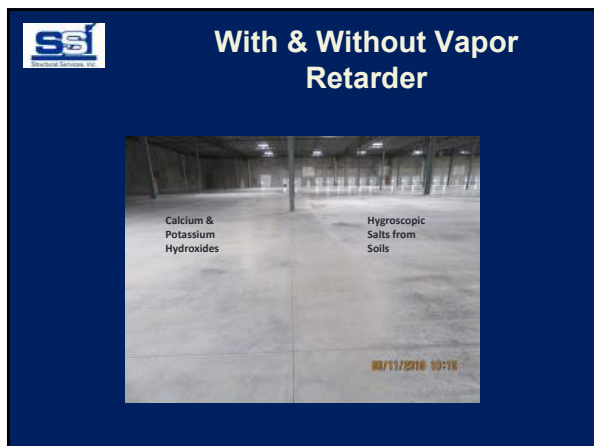
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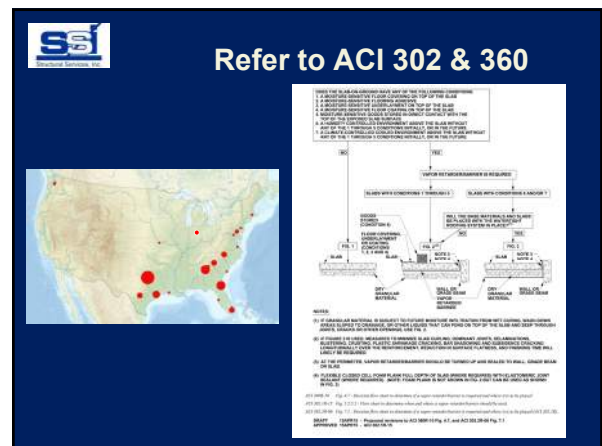
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Install it Properly

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SPECIALIZED SURFACE INSTALLATION

Strategies

HVLS Fans to Warm Surface and Mix Air

Open Pore Voids by Grinding or Shotblasting, Coating Surface

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ViewLinc Sweating Slab Resolution

Measuring Temperature, Humidity, Dew Point and Slab Surface Temperature

Measuring Temperature, Humidity and Dew Point

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Control the Rapid Introduction of Highly Saturated Air

Interlock with Exhaust Fans & Louvers

ViewLinc Measures, Records, Reports and Controls Exhaust Fan Operation

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WHAT ELSE?

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SPECIALIZED SURFACE INSTALLATION

DEAL WITH THE WEATHER

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SSI **Weather / Environment**

Kestrel



Rate of Evaporation Tools

- <http://construction.asu.edu/cim/curing/curingfirstpage.htm>
- <http://www.weatherapp.us/>
- Nomographs
- Deploy strategies when ROE > 0.1-LBS/SF/HR

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SSI **Fog**



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SSI **Watch Thermal Drawdowns**



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SSI **Internal Environment**

CO Detectors

- Vented heaters only
- CO < 15-PPM
- CO2 < 4500-PPM



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SSI **Bigger Trowels = Flatter Floors = Longer Dry Times**




GTL
The size of the trowel controls the rate at which the surface dries. A 12" trowel dries faster.

GTL
This small roller on board produces a more flat finished layer.

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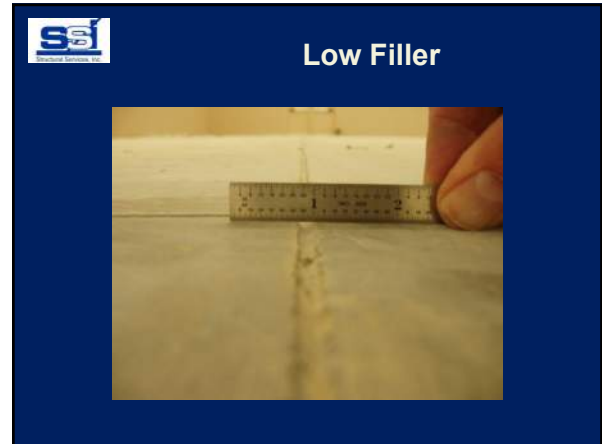
SSI **Do Not Burnish Floors Designed for Moisture Sensitive Floor Finishes**



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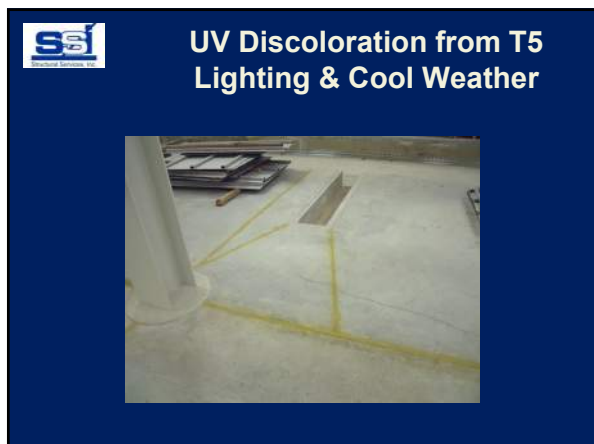
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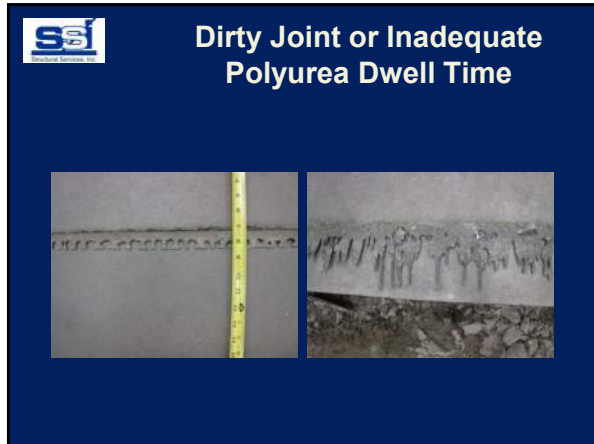
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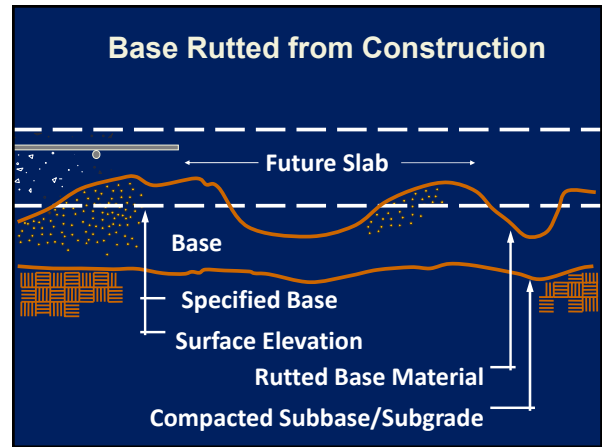
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Impact Echo

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Assess Trends

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MAINTENANCE

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Regularly Inspect Floor

- Year 1
 - Inspect 4X per Year
- Years 2 - 3
 - Inspect 2X per Year
- Years 4 and Beyond
 - Inspect Annually

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Use the Right Brushes

- No Heavy Gauge Silica Carbide
- No Silica Carbide Impregnated
- No Steel Impregnated Cylinder Brushes
- No backup pad holders without the pad!

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Keep it Moving

- Keep the machine moving or lift the brushes!
- Use Soft Nylon, Natural Fiber of Light Duty Polypropylene Brushes for Daily Cleaning

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Use pH Neutral Detergents and Well-Maintained Scrubbers

Don't be a Chemist!

Regularly Scrub to Remove Salts, Dirt, Oils, Carbon Deposits



Products shown: FLO-CLEAN DC, FLO-CLEAN DC, FLO-CLEAN DC, FLO-CLEAN DC.

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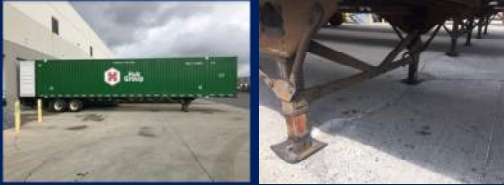
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INDUSTRIAL PAVEMENTS

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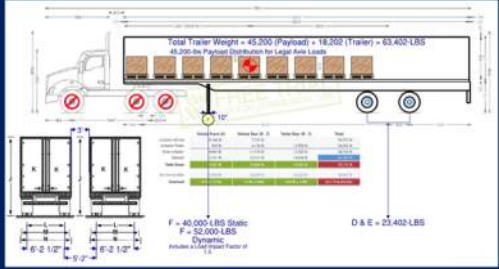
Dolly Pad Loads



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Pavements



Total Trailer Weight = 45,200 (Payload) + 18,200 (Trailer) = 63,400 LBS
45,200 lbs Payload Distribution for Legal Axle Loads

F = 40,000 LBS Static
F = 52,000 LBS Dynamic
Includes a +1.2 Impact Factor of

D & E = 25,400 LBS

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Additional 2 or 3" of Concrete

ACPA AirPave
Pavement Evaluation Report

Summary Information

GENERAL DESIGN INFORMATION
Project ID: HD-40DC - Tracy, CA Operator: Rick Smith
Run Date: 10/14/2019

GENERAL DESIGN INPUT
Slab Thickness: 11.00 in
Units: US Units


Aircraft/Vehicle Summary Table

Aircraft/Vehicle Name	X _{Max}	Y _{Max}	Maximum Axle	Minimum Stress	Stress Ratio	Allowable Total Repetitions
Daily Pad F	0.21	0.00	90.00	336.44	1.1	13,000
Daily Pad F w/ Impact	0.21	0.00	90.00	428.87	1.2	13,000

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Terminal Tractors



Adds 2" of Thickness

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Thank You!

Any Questions?

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