Lightweight Insulating Concrete

Pocket Field Guide

siplast®

Table of Contents

Equipment - Various Components

DeckMate

1. Mixer
2. Hydraulic controls
3. Water meter
4. Transmission (gear shift)
5. Clutch
6. Material dump gate
7. Wet material hopper and pump
8. Ground dry material hopper and auger

Calibrations

Calibrate the water meter by resetting to zero and filling a 55-gallon drum with water. Note the water meter reading. A meter reading of more than 5% ± of the expected 55 gallons indicates that the meter should be repaired and recalibrated.

Check the speed of the paddles in the mixer. Mark one of the paddle sprockets with a spray paint dot and count the revolutions during the mixing process for one minute. The paddles should make between 42 and 45 revolutions per minute.

Cement Bulker

1. Power (as controlled from the DeckMate).
2. Cement is blown into the contractor’s bulker.
   - This “fluffs” it up - making measuring by volume accurate.
   - It also creates a lot of dust.
3. Bulker vent - needs to have a filter bag over it to control the dust.
4. Load cell.

Calibrations

Cement should be weighed, not added by volume (“eyeballing” a mark in the hopper). The load cell calibration can be checked by placing bagged cement into the hopper. If bagged cement is not available, put an item of known comparable weight into the hopper. Obviously, this is an approximation. But it will uncover gross inaccuracies, if they are present. Volumizing cement will result in varying weights, depending on how long the cement has been in the bulker (freshly loaded cement has a lower bulk density due to entrained air).

Foam Generator

1. Compressed air supply
2. Dilution tank
3. Fluid pump

4. Mixing block
5. Air pressure controls
6. Delivery nozzle
7. Timer control box on the pump

Calibrations

The most critical parameter to know is the foam density (specification = 3.0 ± 0.4 pcf). If the density of the foam is too high, it will be fluid and runny, and it will be very difficult to get the concrete density low enough to be within spec. If the foam density is too low, the concrete will probably be "popcorny" or frothy and of low density. Foam flow rate is helpful for start-up. The addition time can be fine-tuned by measuring concrete density at the point of placement.

The following are procedures for determination of foam flow rate and density.

Foam Rate Determination

This procedure will provide the rate of foam production in gallons per minute (gpm) to enable the machine operator to determine time of foam injection into the concrete mixer. It is recommended that foam rate be tested at least once per week and each time the machine is relocated.

Items needed:

1. Clean 55-gallon drum, top removed
2. Stopwatch

Method:

1. Set electric timer to 60 seconds and set selector switch on automatic.
2. Hold foam nozzle away from empty drum.
3. Push start button. Begin generating foam.
4. When nozzle produces uniform foam in a steady stream, fill 55-gallon drum, taking precautions to not entrap large air voids. With stopwatch, time and record this operation. Stop foam generation when drum is full.
5. Make calculation: gpm = $\frac{S60}{t}$
   where gpm = nozzle output, gal/min
   S = size of drum in gallons
   t = seconds to fill drum
6. gal/min can be converted to cubic feet/sec as follows:
   $\frac{gpm}{(7.49)(60)}$ = cubic feet/sec

Foam Rate Determination

Insulcel foam should weigh 2.6 to 3.4 pounds per cubic foot. A simple test method will permit the machine operator to calculate foam weight.

Items needed:

1. Clean 5-gallon plastic pail.
2. Scale: 50-pound capacity, readable to 0.1 pounds.
3. Supply of freshly generated foam.

Method:

1. Weigh pail empty and also completely filled with water. Subtract pail weight from filled weight. Contents of pail will be: $\frac{\text{Filled - empty wt. in lb}}{62.4}$ = Volume in cu ft.
2. Empty water from pail. Fill with freshly generated foam from 55-gallon drum. Screed foam flush with top of pail and remove any foam on pail exterior.
3. Weigh filled pail. Foam density is: $\frac{\text{Filled pail - empty wt in lb}}{\text{Pail volume in cu ft}} = \text{lbs/ft}^3$.

If foam is outside specified range, refer to the generator manual to correct. This normally involves adjustment of air and/or fluid pressure.

Batching

Check the mix design. It is easy to check whether the proper ratio of materials is being used. If the proper ratio is not being used, the situation is simple to correct. Just observe the mixing process and note the pounds of cement, the number of bags of aggregate, and the amount of water added to the mixer.

Typical sequencing of material addition - water, cement, aggregate, and/or foam

1. The cement hopper is charged with cement until the load cell reads the correct weight for the given mix design.
2. The mixer paddles are turned on to rotate in the mixing direction.
3. A valve is opened, allowing water to flow into the mixing drum until the water meter reads the correct gallons.
4. The previously weighed cement is augered into the mixer.
5. As the cement level goes down in the hopper, bags of ZCA or NVS are cut open and poured into the hopper.
6. The mixing paddles continue to turn until all cement and aggregate are augered into the mixing drum.
7. The concrete is mixed for an additional 20-60 seconds after all materials enter the drum.
8. The cement hopper is charged again until the load cell reads the proper weight.
9. The gate is opened in the mixing drum, forcing all concrete into the pump hopper.
10. The mixing drum gate is closed, the water meter is reset to zero, and the paddles are turned to mix again.

11. The pump is turned on slowly, forcing the mixed concrete through a hose for final placement on the roof deck.
12. The mixing process starts over again while the pump is draining the materials out of the pump hopper.
13. When second batch is mixed, enough material has been pumped to empty the mixing drum into the hopper.
14. Reset the water meter again and begin mixing the third batch.

Batch sizes can vary - IT IS THE RATIO OF MATERIALS THAT IS IMPORTANT!

Shown below are typical quantities used in a 1-cubic yard Strong DeckMater. Note that the batch yields are not all the same.

	1:4 ZIC	**1:6 ZIC**	**NVS**	**ZONOCEL**	**INSULCEL**
Cement (lb)	564	376	564	658	658
Cement (Bags)	6	4	7	7	7
Aggregate (Bags)	6	6 (ZIC)	6 (NVS)	2 (ZIC)	0
Foam (CF)	0	0	0	13	18
Water (Gal)	90	90	90	50	40
Yield (CF)	24	24	21.0	24	27

NOTES:

- One bag of Portland cement - 94 lb = one cubic foot bulk density.
- ZCA comes in 4-cubic foot bags - minimum bag weight is 26 lb.
- NVS comes in 3.5-cubic foot bags - minimum bag weight is 35 lb.
- Water - needs to be adjusted to obtain proper pouring consistency.
- Insulcel may be batched in almost any volume as long as the proper wet density is being attained (this is primarily controlled by foam addition).
- Zonocel mix must be as shown to be the product approved by Factory Mutual, Underwriters Laboratories, and the building codes.
- Foam volumes shown are approximate. The quantity of foam must be adjusted so that the wet density of Insulcel and Zonocel fall within the ranges of the wet density specifications.

Wet Density Specifications

ZIC: 44-60 pcf (705 to 961 kg/m^3)
NVS: 60-68 pcf (960 to 1089 kg/m^3)
Zonocel: 43-53 pcf (689 to 849 kg/m^3)
Insulcel: 38-48 pcf (609 to 769 kg/m^3)

Pouring

Slurry Coat

- Ensure proper thickness, do not scrape to the substrate surface.

Insulperm Placement

- Stagger joints (brick pattern).
- Walk the boards into the slurry.
- Establish stair-step.
- Place board into the slurry within 30 minutes of slurry pour.

Pouring Topcoat

- Maintain minimum thickness over Insulperm or substrate.
- If floating to strings, check for “bird baths.”
- Touch up finishing between runs or screed paths as soon as possible. Always pour to a vertical form at the end of the day. Cold joints should be square-edged.

Density Measurement

Always perform a wet density test. Whenever a problem is encountered in the field, this should be your first course of action. It is the only means of determining the basic characteristics of the placed concrete prior to deck completion. Obviously, it is easier to address and correct problems at this stage than days later when the deck is cured and hard.

Typically, a 10-qt steel pail (1/3 cf) is used. However, any pail of similar size will work as long as it does not deform when filled with material and lifted.

To perform a wet density test:

1. Weight the pail full of water.
2. Net weight/62.43 = volume in cubic feet.
3. Factor to calculate density in pcf from net bucket weight = 1/bucket volume.

Calibration
Example: 22 lb = net wt of bucket full of water
22/62.43 = 0.352 cubic feet
1/0.352 = 2.83 = factor to multiply net bucket weight by to get density in pcf.

Density
Example: 21 lb = net weight of bucket full of concrete
(21)(2.83) = 59.4 pcf wet density

Always calibrate the scale to be used with a known weight to ensure accuracy.

Wet-Dry Density Relationships

The point to remember is that the dry density and the final physical properties are a direct result of the wet density. If the wet density is not within specified ranges, the dry density will be out of spec and physical properties (nail withdrawal, surface hardness, etc.) may not be acceptable. Climatological conditions and cement chemistry can (and do) have a modifying influence, but the only controllable variable that the contractor has is the wet density.

Yield

The concept of yield is to provide a mechanism to measure how much actual volume is being created from the quantity of material being used. This is a measure of how much area can be covered by the mixtures, confirmation that the proper physical properties will be achieved, and that the economics used by the contractor to bid the job are actually being achieved.

To Calculate Yield

Information needed:

Total weight of materials in the mix -

Accurate wet density measurement

Yield = total batch weight/wet density

Example: 1:6 ZIC

Cement	376 lb
Aggregate	168 lb (24 cf x 7 pcf)
Water	834 lb (100 gal x 8.34 lb)
Total Batch Weight	1,378 lb

Measured Wet Density: 56.0 lb

Yield (cf) = 1,378 lb / 56 lb per cf = 24.6 cf

Yield (%) = 24.6/24 x 100 = 102%

Diagnostics

There are several requirements that lightweight insulating concrete roof decks must meet. These include finish, attachment, strength, and thickness.

What if we get low fastener withdrawal test results?

- Test the surrounding areas. This will help you evaluate whether the situation exists over the entire deck or simply in a localized area.
- Check the nails. Testing with the wrong size or type of nail may drastically decrease the withdrawal values.
- Check the equipment you are testing with to ensure it is reporting the correct value and is calibrated.
- Be sure that the nail is seated properly when driven through the testing strap. If the nail bounces or is not driven completely, the test can result in low withdrawal strengths.
- If the nail withdrawals consistently return values below 40 lb, the deck has probably not had sufficient time to achieve optimal strength. Retest the area in a few days. Most likely, the nail withdrawals will have achieved the desired strength or at least improved considerably.

What if we still get low test results after retesting?

- Verify that regular density tests were performed and recorded in the pouring audit log. Contractors must have a method of evaluating wet densities on site. The densities taken should be within Siplast specifications for the corresponding concrete type (See **Mixing and Placement**, pages 1-9.)

- Is the cement scale calibrated and working properly? A poorly functioning or incorrectly calibrated scale can cause the cement content to be low and therefore result in a low density deck. Check to see if the scale reads zero when no cement is present in the hopper.
- For cellular concrete, verify that the foam density and volume meet Siplast specifications (See procedures in Mixing and Placement.) It is critical that a contractor check both foam density and flow rate. Weak concrete can result from a surplus of foam. The volume of foam is regulated by the foam rate, and therefore a contractor must have a method of timing the foam injection.
- If the areas of weak nail withdrawal are localized, then the area that is out of spec should be marked and removed. Refer to SLIC Technical Bulletin #5 on page 49.

What happens if the lightweight nails bounce?

- First, verify that the correct nail is being used. If the contractor is attempting to pull Zono-tite fasteners in an NVS pour, then bouncing will likely occur.
- If the correct nail is being used, then it is likely that the topcoat thickness is too thin and does not meet Siplast specifications. It may be necessary to cap the deck in order to achieve proper thickness. A cut should be taken and topcoat thickness measured.

- Insulperm boards that are not firmly attached to the slurry coat can also cause fasteners to bounce. This usually occurs in localized areas. These boards should be removed and replaced with a proper slurry coat to ensure wind uplift values.

What happens if a deck is too hard?

- If a deck is too hard to insert a fastener, then it is recommended that you contact your local District Field Technical Manager. An alternative method of fastening is a likely option.
- If the job is still in progress, verify that all of the equipment parameters discussed earlier are being met. A deck that is too hard occurs when too much cement is added to a batch or insufficient amounts of aggregate or foam are introduced.
- The contractor should check the concrete densities and adjust equipment to ensure the density is in spec.

What if a deck gets rained on before it sets?

- If a deck is simply pitted or dimpled, the integrity of the deck is most likely not compromised. The strength of the deck should be verified with nail withdrawal tests.
- If a deck is rained on before it reaches initial set, then “washing” may occur. “Washing” will have a detrimental effect on the concrete system. “Washing” is diagnosed by the apparent movement of concrete to the low areas of the roof and the grainy appearance of the deck surface. The concrete must be removed and replaced.

Insulperm boards may be reused as long as they are firmly attached to the slurry coat. If moderate washing occurs, it may be possible to clean and cap the affected areas.

What happens when a deck freezes?

- If a deck freezes hard during the first 24 hours after application, it is possible that a thin layer (1/18”-1/8”) of concrete will spall or scale off the surface. This scaling can be swept off and the deck roofed as normal, if the proper amount of concrete thickness remains after cleaning. If nails bounce due to the loss of thickness, then it is necessary to cap the concrete with a 1-inch minimum pour.
- If a contractor anticipates cool weather at the time of the pour, they should follow the guidelines contained in SLIC Technical Bulletin on #12 page 77.

How can I tell if Insulperm is properly attached to the slurry coat?

- If the slurry coat is set and Insulperm boards are properly embedded, they will not move under your feet, and you will not be able to lift any boards.
- Insulperm boards should be “walked-in” to ensure that complete contact of the underside of the board with the slurry is achieved. When Insulpern is “walked-in,” concrete should be forced up through the holes in the boards. If concrete is not present in the holes, then there is a strong chance that either the boards were not walked in, or there was not a sufficient amount of slurry for attachment.

- If loose boards are detected, then they should be removed and replaced before the topcoat is applied.

What happens if the Insulperm is not attached properly?

- If the Insulperm is not attached properly to the slurry, then it wil float to the surface of wet concrete when the topcoat is applied. These boards are referred to as “floaters.” If the slurry is not allowed to stiffen, then it will not restrain the Insulperm from floating when the topcoat is placed.
- Floaters are visually apparent when walking on a finished job. Floaters are evidenced by “picture framing,” a condition where the perimeter of a board is visible and the holes in the Insulperm are also evident, or part of the board is actually exposed or protruding from the deck.
- Floaters must be removed by cutting away the area and repairing with Zono-Patch or the corresponding concrete, depending on the size of the area and the progress of the job.

What if a deck cracks?

- Cracks are the result of forces created by shrinkage during the curing and drying process. Small cracks generally do not pose a problem to the performance of the deck or the mechanically attached roof membrane.
- Cellular concretes are more susceptible to cracking. Reference SLIC Technical Bulletin on #7 page 56.

What if the surface of the deck is rough?

- Lightweight insulating concrete is easily manipulated even after it has set up. If isolated ridges or protrusions are present on the surface of the deck, simply level the surface by scraping it until it is smooth.
- If substantial depressions, holes, pits, etc. are present, then Zono-Patch must be used to level the surface.

When should a Siplast Lightweight Insulating Concrete System deck be roofed?

- After 48-72 hours, or when the surface will bear foot traffic without damage and yields 40-lb base ply withdrawal resistance. Refer to SLIC Technical Bulletin on #13 page 83.

How long does it take for lightweight insulating concrete to dry out?

- All lightweight insulating concrete products placed over slotted metal (ZIC, Zonocel, or Insulcel) will be dry (at their equilibrium moisture content) within 3-18 months after installation, regardless of weather conditions prior to, or after roofing.
- NVS Concrete installations may take significantly more time to actually reach a dry (equilibrium moisture) condition. The amount of time will depend on the weather conditions prior to roofing and whether proper venting recommendations are followed during the roof installation. The best estimate of time is 6 months to 2 years.
- NVS Concrete is intended to be placed at 1” to 1.5”. When this is done, the moisture content after being open for 3 days’ time in clear weather can be as low as 35% by weight. At this level the NVS will be dry to the touch.

What is Siplast's position on venting of lightweight insulating concrete systems?

See SLIC Technical Bulletin #10 on page 45 for a full explanation and details. In summary:

- ZIC, Zonocel, and Insulcel over slotted metal: vented perimeter and projection details. Topside vents are required only if perimeter venting cannot be accomplished.
- NVS applications require vented perimeter and projection details. If a distance of more than 60" exists between details, a topside vent is required.

Drippers - what causes them, how do we deal with them, and how can they be avoided?

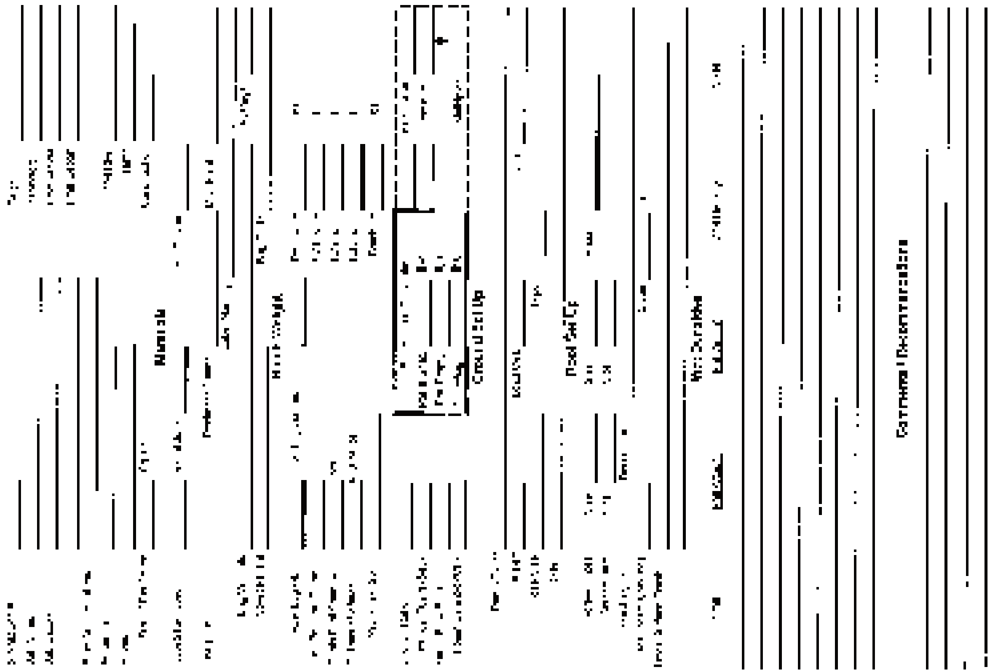
Drippers are created when there is excessive moisture trapped in a non bottom-slotted substrate deck. The moisture condenses and collects in quantities large enough to flow to end laps, etc. and physically drip into the building. They are rare and do not occur over slotted metal substrates. Rainwater intrusion into the cracks on cellular decks is a common cause of drippers. This is the reason that we recommend slotted metal, even with Insulcel.

They stop dripping after some period of time, but can be unpredictable. Forced ventilation under the membrane will speed up the process of removing the moisture.

What about pouring in cold weather?

See SLIC Technical Bulletin on #12 page 77.

Reports



SLIC FIELD ACTIVITY REPORT

Materials

Block Weight

Ground Set Up

Pool Set Up

Comments / Recommendations

siplast INSULATION POURING AUDIT REPORT

PROJECT NAME: ____________________

DATE: ________ SUPERINTENDENT: ____________

APPLICATOR NAME: ____________________

PRODUCT: ☐ ZIC ☐ NVS ☐ IC ☐ ZC

MIX DESIGN:

BAGS AGGREGATE: ____________________

CEMENT: ____________ lb ________ bags

INSULCEL FOAM: ____________________ sec

WATER: ____________________ gal

TIME	NET BUCKET WT.	DENSITY

INSULCEL / ZONOCEL ONLY:

DILUTION RATIO: am ____________ pm ____________

FOAM DENSITY: am ____________ pm ____________

FOAM FLOW RATE: am ____________ pm ____________

Wet density must be brought into compliance by adjusting mix design. Wet densities not correctable, or low yields must be reported immediately.

WATER METER CALIBRATED? ☐ YES ☐ NO

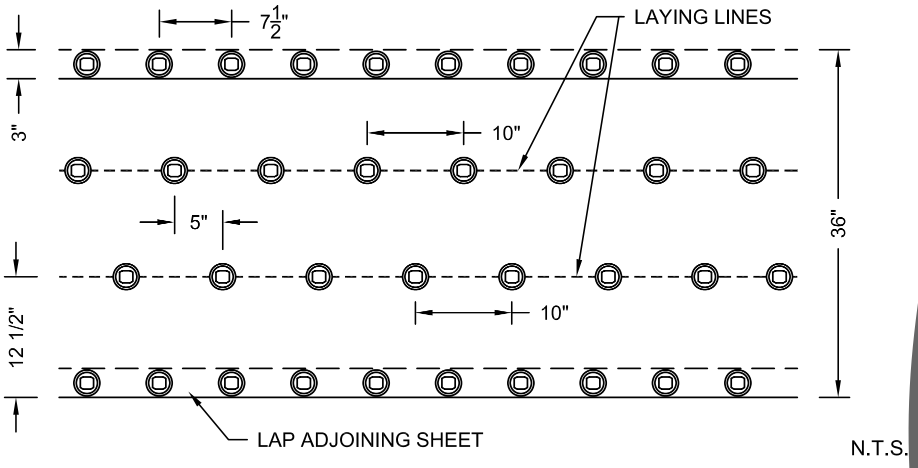
____

Signature

7 1/2” Lap - 2 Rows, 10” Field

FIELD

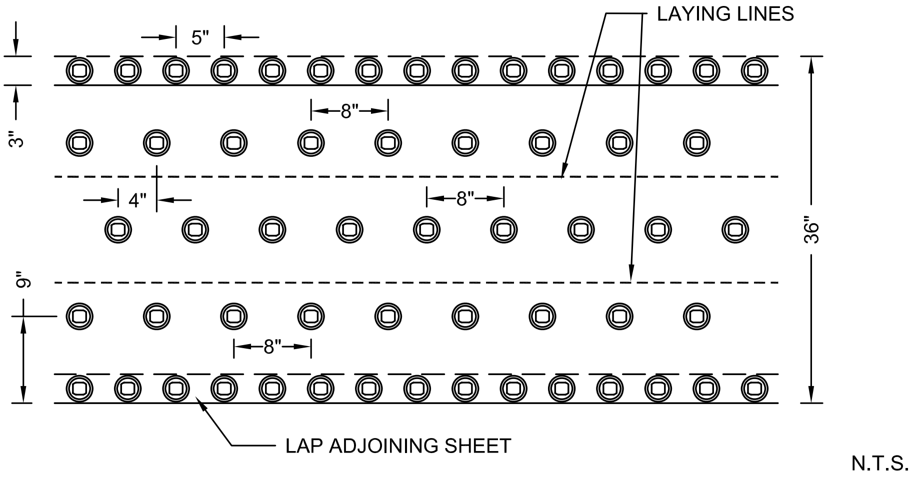
7 1/2" through side laps
2 rows in the field w/ fastener spacing in each row on 10" centers
Approx. 144 fasteners/sq



7 1/2” Lap - 2 Rows, 10” Field

PERIMETER

5" through side laps
3 rows in the field w/ fastener spacing in each row on 8" centers
Approx. 245 fasteners/sq

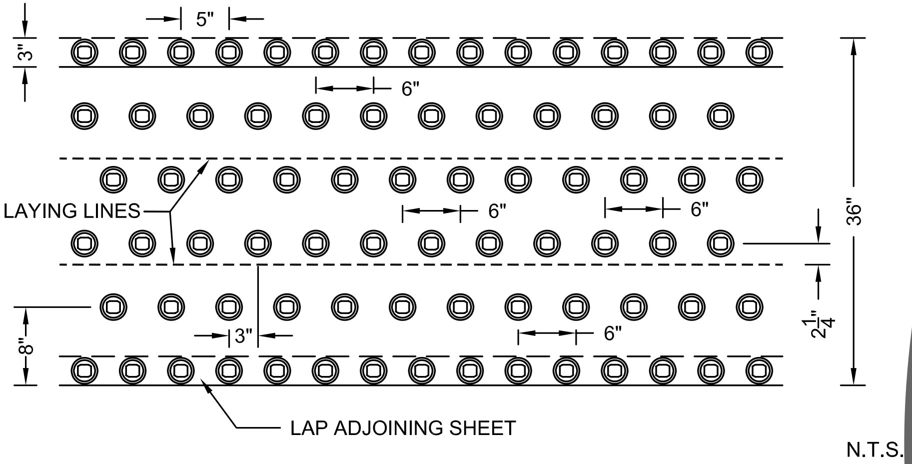


5” Lap - 3 Rows, 8” Field

5” Lap - 4 Rows, 6” Field

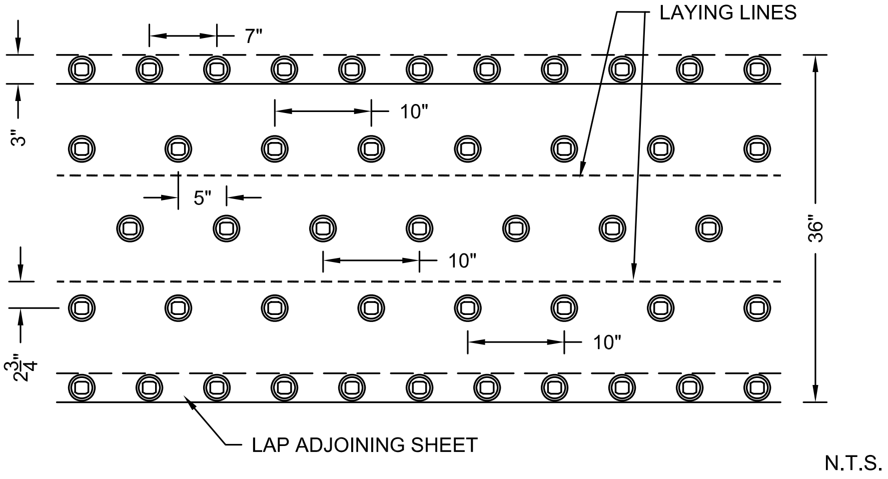
CORNER
(if required)

5" through side laps
4 rows in the field w/ fastener spacing in each row on 6" centers
Approx. 375 fasteners/sq



FIELD

7" through side laps
3 rows in the field w/ fastener spacing in each row on 10" centers
Approx. 191 fasteners/sq

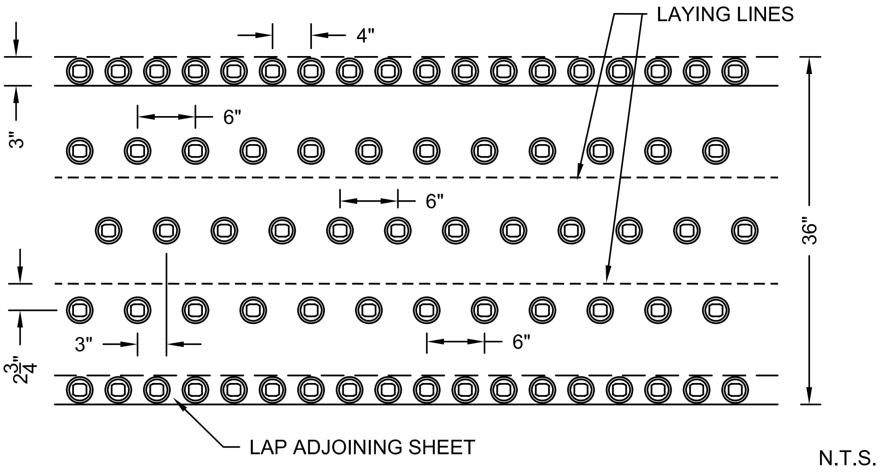


7” Lap - 3 Rows, 10” Field

4” Lap - 3 Rows, 6” Field

PERIMETER

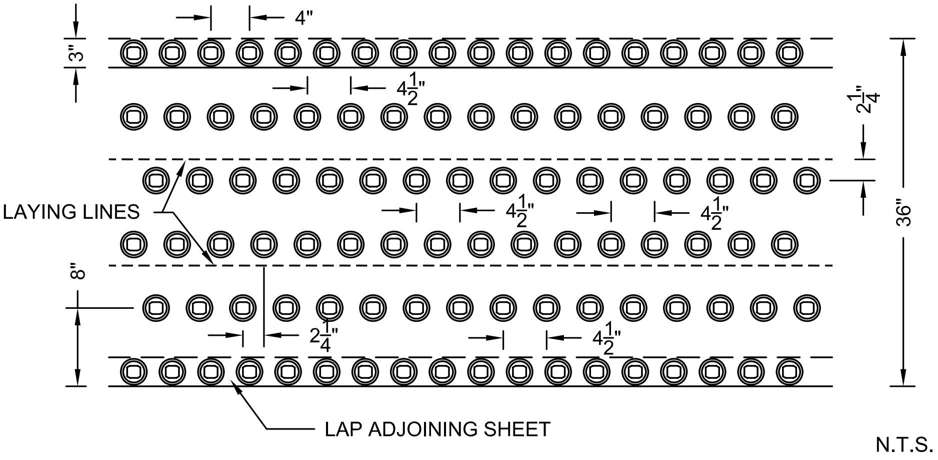
4" through side laps
3 rows in the field w/ fastener spacing in each row on 6" centers
Approx. 325 fasteners/sq



4” Lap - 3 Rows, 6” Field

CORNER
(if required)

4" through side laps
4 rows in the field w/ fastener
spacing in each row on
4 1/2" centers
Approx. 497 fasteners/sq



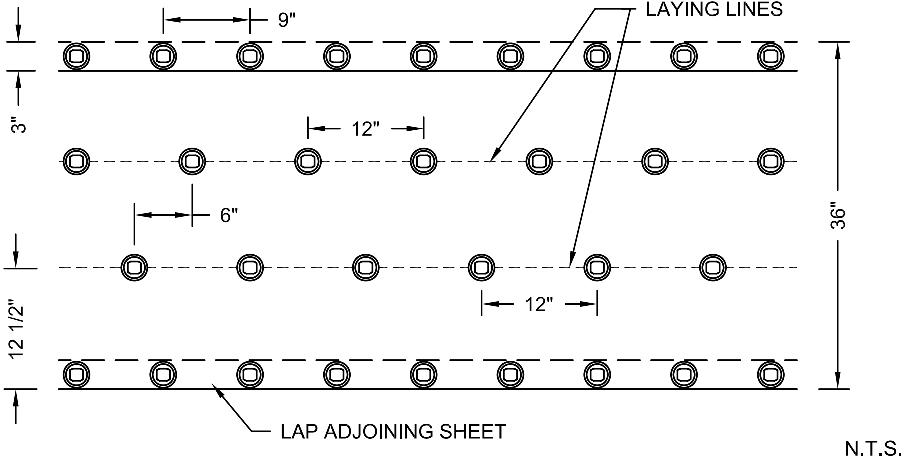
4” Lap - 4 Rows, 4 1/2” Field

FIELD

9" through side laps

2 rows in the field w/ fastener spacing in each row on 12" centers

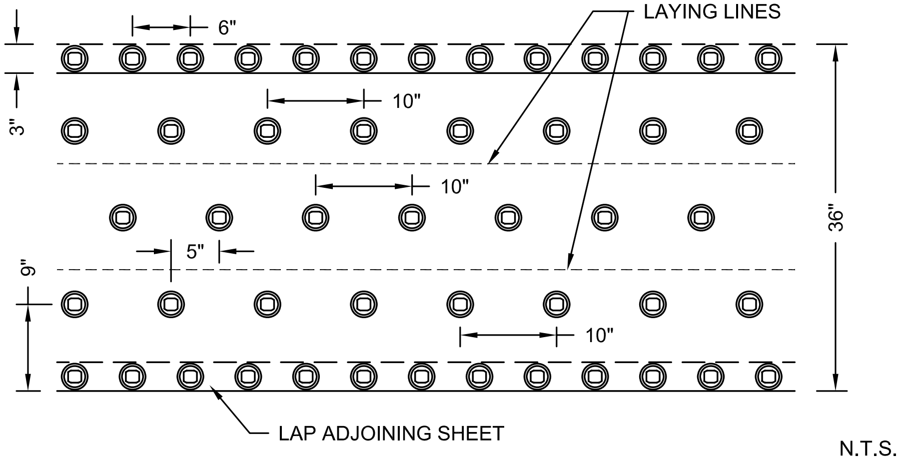
Approx. 120 fasteners/sq



9” Lap - 2 Rows, 12” Field

PERIMETER

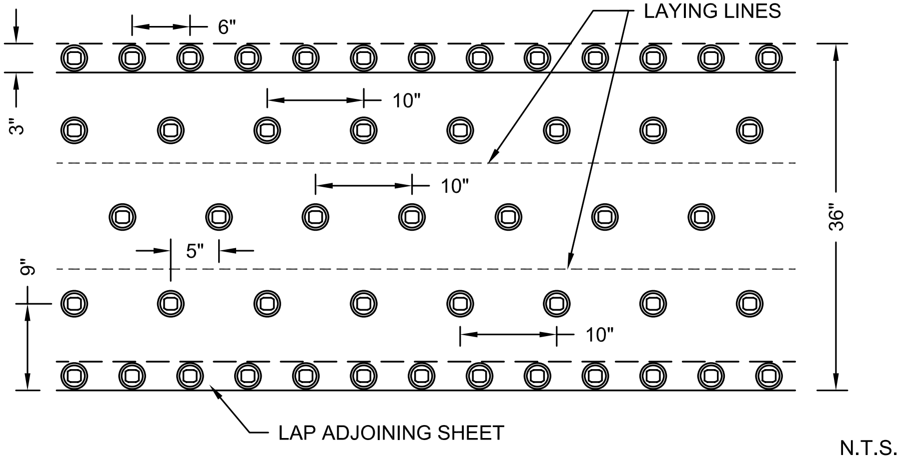
6" through side laps
3 rows in the field w/ fastener
spacing in each row on 10"
centers
Approx. 204 fasteners/sq



6” Lap - 7 Rows, 10” Field

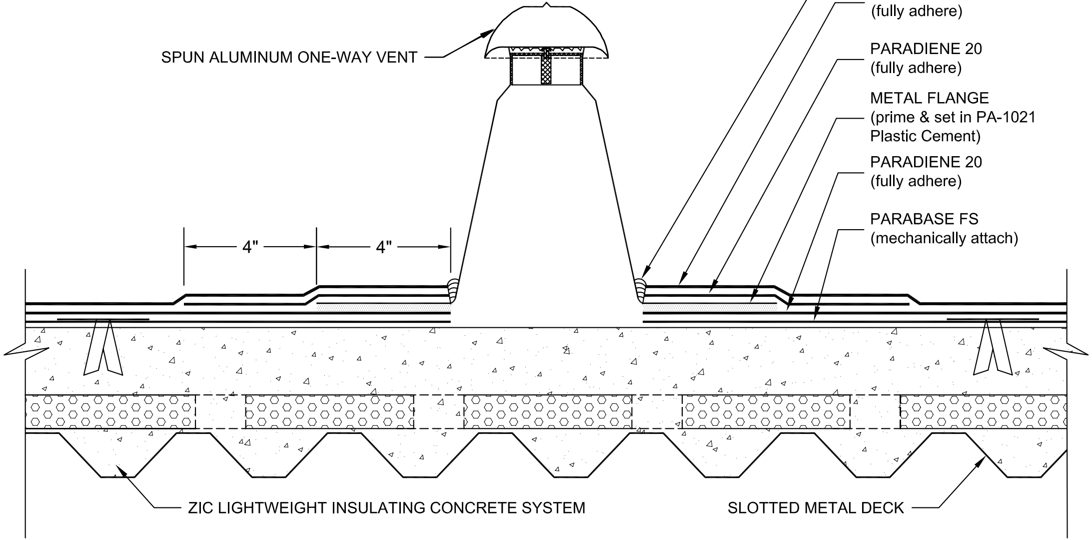
PERIMETER

6" through side laps
3 rows in the field w/ fastener spacing in each row on 10" centers
Approx. 204 fasteners/sq



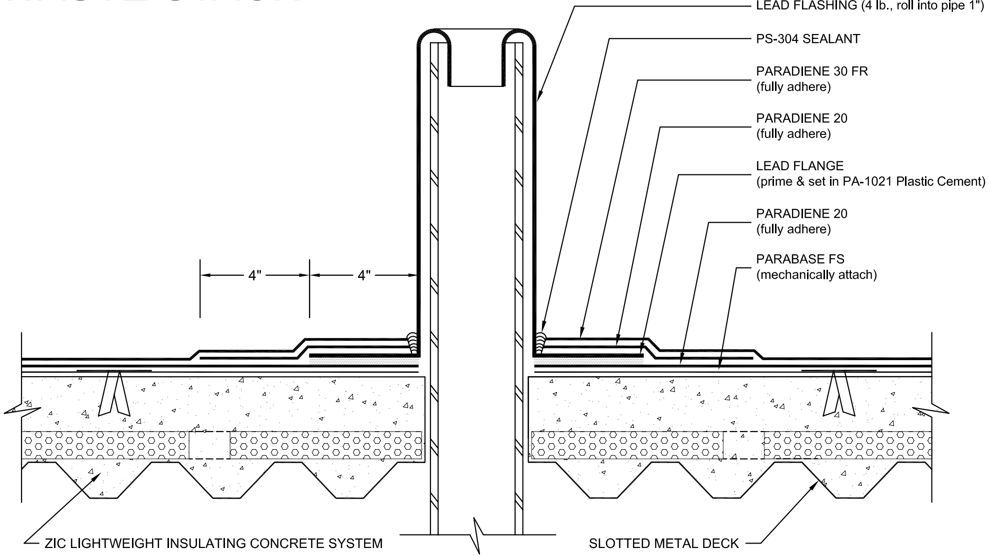
6” Lap - 3 Rows, 10” Field

ROOF VENT



NOTES:
1. ONE WAY VENTS SHOULD BE PREFABRICATED FROM SPUN ALUMINUM. PLASTIC VENTS ARE NOT ACCEPTABLE.
2. VENTS SHOULD BE INSTALLED IN ACCORDANCE WITH THE MOST RECENT VERSION OF THE TECHNICAL BULLETIN FOR VENTING SIPLAST ROOF MEMBRANE AND ROOF INSULATION SYSTEMS.
3. WHERE PRIMER IS INDICATED TO MAINTAIN PROPER ADHESION, TA-119 PRIMER IS REQUIRED FOR ALL PARADIENE 20 SA FLASHING REINFORCING AND STRIPPING PLY APPLICATIONS. USE PA-1125 OR PA-917 LS FOR ALL NON-PARADIENE 20 SA APPLICATIONS. CONTACT SIPLAST FOR SPECIFIC REQUIREMENTS.
4. REQUIREMENTS AND RECOMMENDATIONS DETAILED IN SIPLAST SPECIFICATIONS SHALL APPLY IN ADDITION TO THE ABOVE DRAWING.

WASTE STACK



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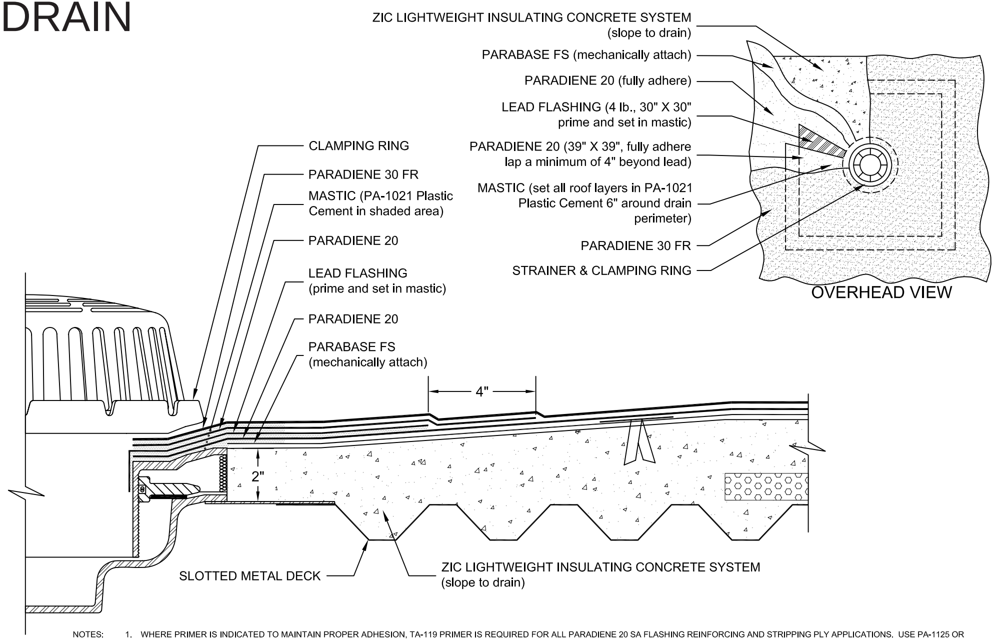
ROOF DRAIN



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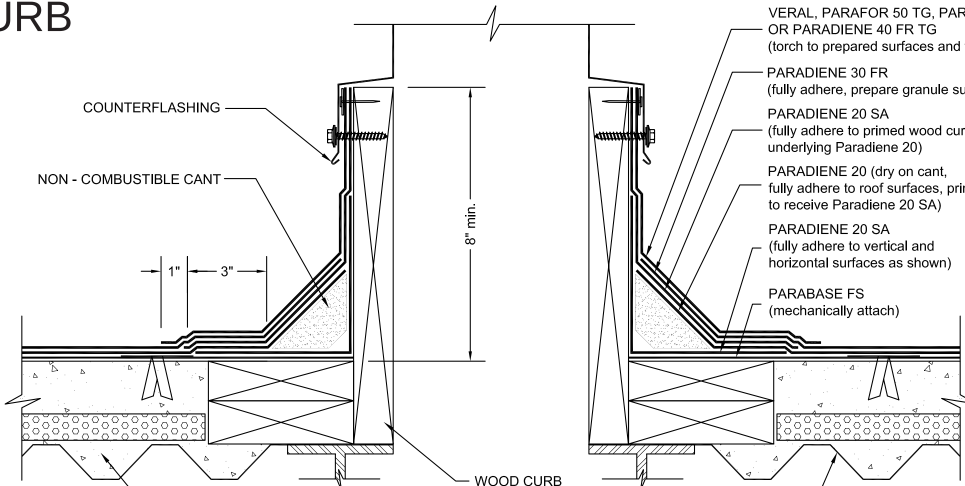
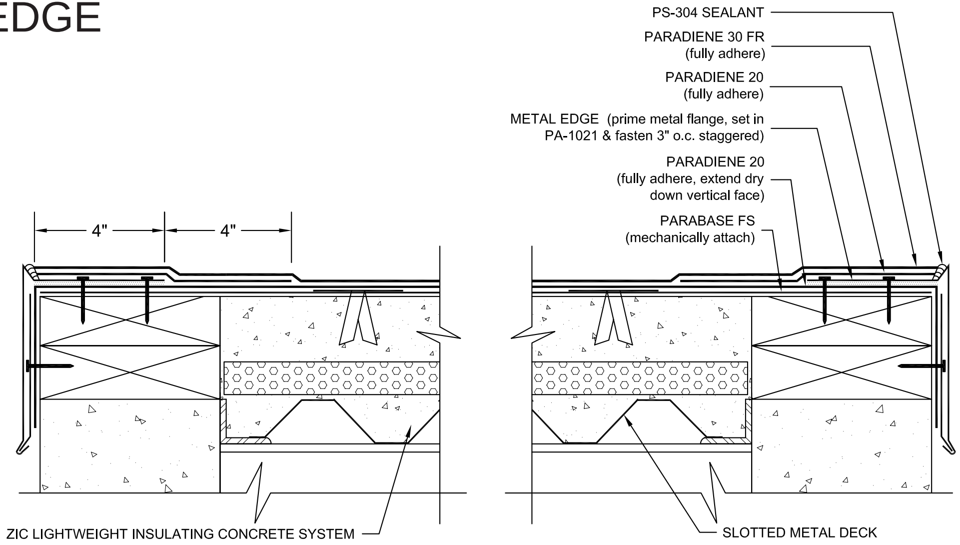
2. ROOF DRAIN COMPONENTS AND INSTALLATION GUIDELINES ARE SUPPLIED BY THE DRAIN MANUFACTURER.
3. REQUIREMENTS AND RECOMMENDATIONS DETAILED IN SIPLAST SPECIFICATIONS SHALL APPLY IN ADDITION TO THE ABOVE DRAWING.

CURB



NOTES:
1. PREPARE GRANULE SURFACES UNDER FLASHING BY TORCH PREPARATION.
2. WHERE PRIMER IS INDICATED TO MAINTAIN PROPER ADHESION, TA-119 PRIMER IS REQUIRED FOR ALL PARADIENE 20 SA FLASHING REINFORCING AND STRIPPING PLY APPLICATIONS. USE PA-1125 OR PA-917 LS FOR ALL NON-PARADIENE 20 SA APPLICATIONS. CONTACT SIPLAST FOR SPECIFIC REQUIREMENTS.
3. THE CARPENTRY AND METAL WORK SHOWN DEPICTS SHOP FABRICATION AND JOB-SITE ASSEMBLY. THESE COMPONENTS SHOULD BE DESIGNED/FABRICATED/INSTALLED ACCORDING TO GENERALLY ACCEPTED INDUSTRY PRACTICES, STANDARDS, AND APPROVALS.
4. DISSIMILAR METAL TYPES SUBJECT TO ELECTROLYTIC REACTION SHOULD BE PHYSICALLY SEPARATED.
5. REQUIREMENTS AND RECOMMENDATIONS DETAILED IN SIPLAST SPECIFICATIONS SHALL APPLY IN ADDITION TO THE ABOVE DRAWING.

ROOF EDGE



NOTES:
1. WHERE PRIMER IS INDICATED TO MAINTAIN PROPER ADHESION, TA-119 PRIMER IS REQUIRED FOR ALL PARADIENE 20 SA FLASHING REINFORCING AND STRIPPING PLY APPLICATIONS. USE PA-1125 OR PA-917 LS FOR ALL NON-PARADIENE 20 SA APPLICATIONS. CONTACT SIPLAST FOR SPECIFIC REQUIREMENTS.
2. THE CARPENTRY AND METAL WORK SHOWN DEPICTS SHOP FABRICATION AND JOB-SITE ASSEMBLY. THESE COMPONENTS SHOULD BE DESIGNED/FABRICATED/INSTALLED ACCORDING TO GENERALLY ACCEPTED INDUSTRY PRACTICES, STANDARDS, AND APPROVALS.
3. DISSIMILAR METAL TYPES SUBJECT TO ELECTROLYTIC REACTION SHOULD BE PHYSICALLY SEPARATED.
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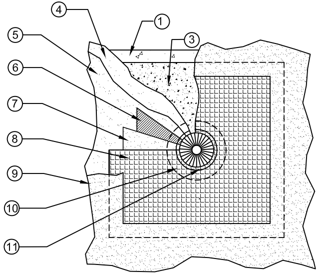
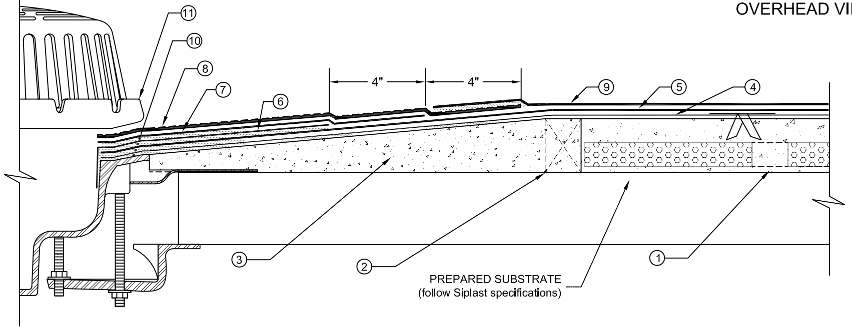
SUMPED ROOF DRAIN

1. NVS LIGHTWEIGHT INSULATING CONCRETE SYSTEM
2. WOOD BLOCKING (use as a pour-stop for the NVS System and remove prior to application of Zono-Patch)
3. ZONO-PATCH (apply in drain sump)
4. PARABASE FS (mechanically attach in field, spot bond using mastic in sump area)
5. PARADIENE 20 (fully adhere)
6. LEAD FLASHING (4 lb., 30" X 30" - prime and set in mastic)
7. PARADIENE 20 (39" X 39" - fully adhere, extend 4" beyond lead)
8. VERAL (48" X 48" - apply in SFT Cement, prime foil around edge min. 4 ")
9. PARADIENE 30 FR (fully adhere, set in mastic over Veral sheet)
10. MASTIC (set Paradiene layers in PA-1021 Plastic Cement 6" around drain perimeter)
11. STRAINER AND CLAMPING RING



OVERHEAD VIEW



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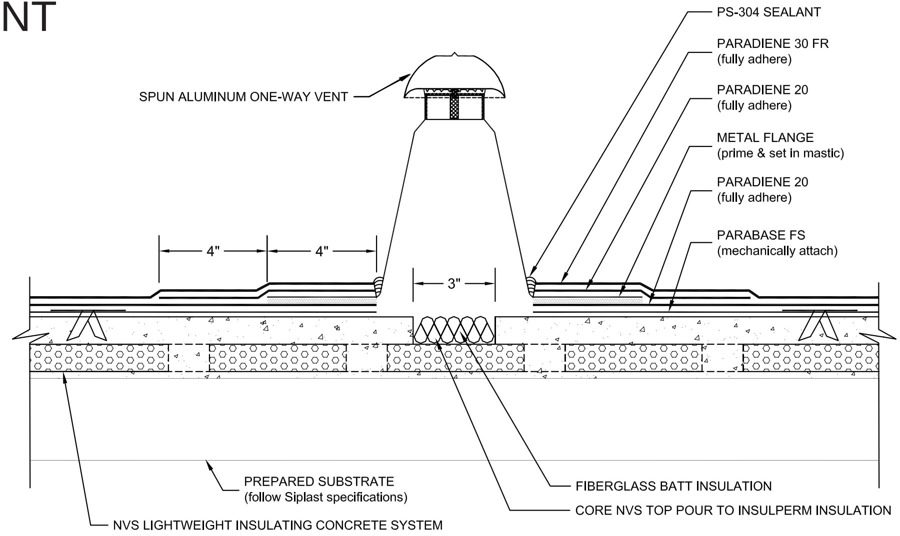
2. ROOF DRAIN COMPONENTS AND INSTALLATION GUIDELINES ARE SUPPLIED BY THE DRAIN MANUFACTURER.
3. VERAL MUST BE USED IN DRAIN SUMP APPLICATIONS. LAP VERAL OUTSIDE OF DRAIN BOWL AREA.
4. REQUIREMENTS AND RECOMMENDATIONS DETAILED IN SIPLAST SPECIFICATIONS SHALL APPLY IN ADDITION TO THE ABOVE DRAWING.

ROOF VENT



NOTES:
1. ONE WAY VENTS SHOULD BE PREFABRICATED FROM SPUN ALUMINUM. PLASTIC VENTS ARE NOT ACCEPTABLE.
2. VENTS SHOULD BE INSTALLED IN ACCORDANCE WITH THE MOST RECENT VERSION OF THE TECHNICAL BULLETIN FOR VENTING SIPLAST ROOF MEMBRANE AND ROOF INSULATION SYSTEMS.
3. WHERE PRIMER IS INDICATED TO MAINTAIN PROPER ADHESION, TA-119 PRIMER IS REQUIRED FOR ALL PARADIENE 20 SA FLASHING REINFORCING AND STRIPPING PLY APPLICATIONS. USE PA-1125 OR PA-917 LS FOR ALL NON-PARADIENE 20 SA APPLICATIONS. CONTACT SIPLAST FOR SPECIFIC REQUIREMENTS.
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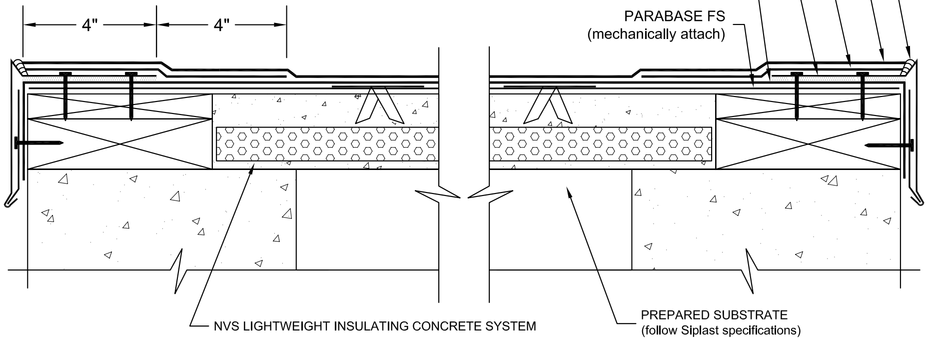

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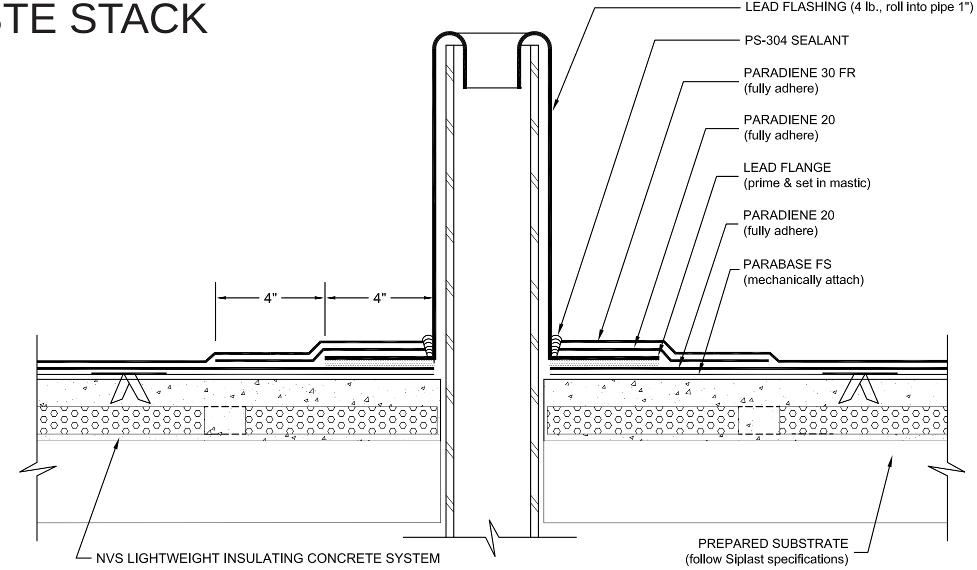
WASTE STACK



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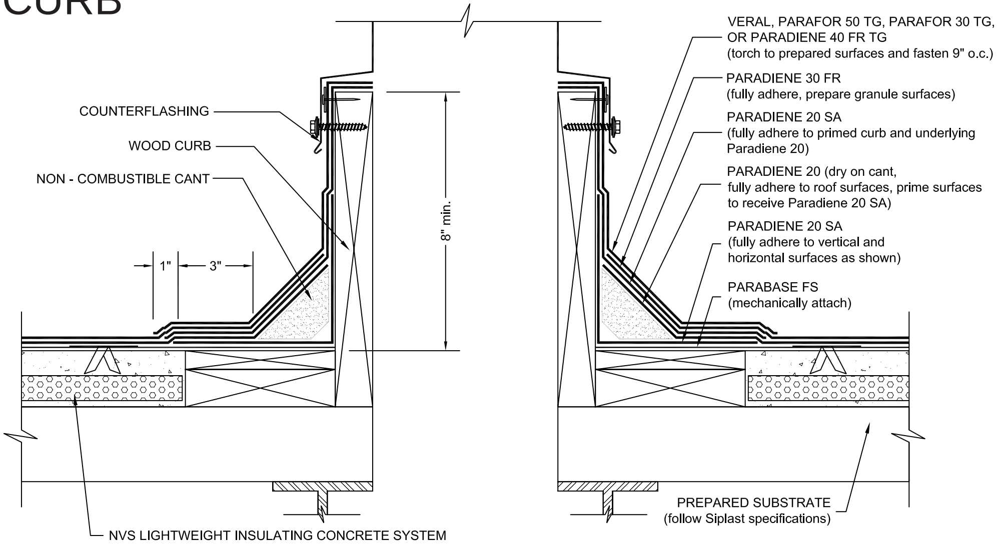
CURB



NOTES:
1. PREPARE GRANULE SURFACES UNDER FLASHING BY TORCH PREPARATION.
2. WHERE PRIMER IS INDICATED TO MAINTAIN PROPER ADHESION, TA-119 PRIMER IS REQUIRED FOR ALL PARADIENE 20 SA FLASHING REINFORCING AND STRIPPING PLY APPLICATIONS. USE PA-1125 OR PA-917 LS FOR ALL NON-PARADIENE 20 SA APPLICATIONS. CONTACT SIPLAST FOR SPECIFIC REQUIREMENTS.
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PAINTING WELDS

Updated August 1, 2006 – SRIS-962

Painting welds on roof decks where Siplast lightweight insulating concrete is to be poured is neither required nor recommended. The alkaline nature of cement inhibits rust formation. Welded decks, when welds are encased in concrete, show outstanding performance without paint. Siplast Lightweight Insulating Concrete Systems have a long history demonstrating this.

Lightweight insulating concrete achieves its bond to the substrate via two mechanisms:

1. The primary bond is achieved by the natural reaction of the zinc in the galvanized coating on the metal deck with the alkaline constituents in Portland cement. This is a chemical bond.
2. An additional bond is achieved by the mechanical attachment of the concrete to the irregular surface of the deck, laps and protruding weld washers.

Lightweight insulating concrete does not bond predictably to painted surfaces. A roof deck system that has lightweight concrete poured over painted welds could, therefore, be compromised at all weld points.

UL and Factory Mutual tests are conducted on lightweight concrete roof deck systems with decks that do not have painted welds. Therefore, a system with painted welds would not be in accordance with UL and Factory Mutual tests.

Bulletin #1

INSULCEL ON SLOTTED METAL

Updated August 1, 2006 – SRIS-963

Siplast's position on placing Insulcel over metal deck is as follows: The preferred metal is bottom-slotted with a nominal open area of 0.5%. Non-slotted metal is an acceptable substrate and should be used in hot, arid climates. Both decks meet guarantee criteria.

The primary reason for using slotted metal is to assist in the alleviation of incremental moisture from exposure to rain prior to roofing. This moisture enters the cellular concrete systems via their natural curing cracks.

Placing Insulcel over slotted metal with open area reduced to approximately 0.5% minimizes the amount of run-through at time of placement while eliminating moisture entrapment that may occur from rainwater intrusion.

QUALITY CONTROL ACCEPTANCE CRITERIA FOR GUARANTEED DECKS AND SYSTEMS

Updated August 1, 2006 – SRIS-964

Siplast recommends an on-site program of physical inspection and testing of the deck for confirmation that the Siplast Lightweight Insulating Concrete pour is acceptable.

We believe that this is a sound approach to ensuring that the in-place deck meets the intended requirements. Proper timing of the inspection will allow any necessary corrective action to be taken before roofing begins.

Proper on-site inspection consists of two components:

1. Base ply fastener withdrawal testing.
2. Overall visual inspection of the deck surface.

The acceptance criteria for issuance of a performance guarantee are as follows:

1. Minimum base ply fastener withdrawal of 40 pounds per fastener. Frequency of one withdrawal test per 100 squares. A minimum of four withdrawal tests per roof area.
2. Lightweight insulating concrete surface acceptable for receiving the roofing membrane.

A fastener withdrawal test procedure using a commercial fastener withdrawal device, such as a Com-Ten Scale, model #301W-1M or #361W-0100, or a spring scale is acceptable.

Refer to SLIC Bulletin #5 for further information.

Bulletin #3

TESTING INSULATING CONCRETE CYLINDERS

Updated July 3, 2012 – SRIS-965

This bulletin is to provide guidance for conducting compressive strength and density testing of lightweight insulating concrete cylinders.

There are two ASTM procedures that apply to lightweight insulating concrete. They are: ASTM C 495 for 3-inch by 6-inch cylinders taken at the time of pour and ASTM C 513 for samples taken from a deck that is in place. Copies of both standard test methods are attached.

Experience has made us aware of several issues that can come into play during testing and may result in erroneous test results. The following three topics should be discussed with the testing laboratory if they are not familiar with testing lightweight insulating concrete. (Most laboratories are very familiar with testing structural concrete, but may not be well versed in testing lightweight insulating concrete.)

1. Curing Conditions

ASTM C 495 specifies the following curing sequence:

1 day at 70°F+/- 10°F.

6 days at 73°F +/- 3°F. under moist conditions.

18 days at 70°F +/- 10°F. and 50+/-30 % relative humidity.

3 days oven dried at 140°F.
Sample cooled and tested at room temperature at 28 days.

The most common departures from these conditions have been:

1. Sample is moist cured until testing, not dried and, sometimes, even cured in lime water. **It is absolutely critical that the samples be dried prior to testing.** The most practical way to moist cure for the first 7 days is to leave the samples in the mold. Strip after 7 days and store in the proper environment for the following 18 days.

2. Testing Machine

ASTM recognizes that the accuracy of the testing machine is critically important in determining the correctness of the test results.

The maximum load required to break the sample should not be less than 10% of the maximum load range being used. Frequently, testing laboratories use equipment that has the loading capability to break structural concrete. The load to break a lightweight insulating concrete cylinder can be well below 10% of the most sensitive range available on these large machines.

For example, the load to break a 3-inch by 6-inch, 125 psi 1:6 ZIC cylinder will be approximately 880 pounds. A testing machine with a maximum load range of 10,000 pounds is not appropriate for testing this material. (10% of the range equals 1,000 pounds. This is greater than the expected result.)

Bulletin #4

A testing machine with a load range of 6,000 pounds is appropriate to use when testing lightweight insulating concrete.

3. Cylinder Area

The diameter of the 3-inch by 6-inch cylinder must be measured. It is not unusual for the actual diameter to be 2.9 inches. When this is translated into the bearing area for calculation of the compressive strength, the result reflects a 6.5% error. Assuming the diameter to be 3 inches when it is actually 2.9 inches will result in a compressive strength 6.5% lower than it should be.

SAMPLE FORMATION

The preparation of samples (casting cylinders or taking material from an existing deck) can have profound effects on the results of testing. The Siplast Job Superintendents Guide gives proper procedures for casting cylinders in the quality control section.

These procedures should be reinforced with field crews. This will ensure that test results are truly representative of the materials being placed.

If the cylinders are being cast by testing lab personnel, be sure they are aware of the proper sampling techniques by providing them with a copy of this bulletin.

EVALUATION AND REPAIR
EXISTING LIGHTWEIGHT INSULATING CONCRETE ROOF SUBSTRATES

Preparation of Existing Substrates for New Pour of SLIC

Updated August 1, 2006 – SRIS-969

Lightweight insulating concrete has proven to be a reusable roofing substrate at the time of roof membrane replacement. In many cases, very little preparation of the existing concrete surface is required in order to make the substrate acceptable for installation of the new membrane system. The following recommendations are guidelines for evaluating existing lightweight insulating concrete substrates for reroofing and/or a new pour of Siplast Lightweight Insulating Concrete Systems.

First, if the reroofing specifications call for a new system that represents a higher weight than that of the previous assembly, structural loading issues should be addressed by a licensed, professional engineer. The engineer should evaluate the structural capability of the building and verify that the added weight of the new construction is within the acceptable loading standards of the local building code.

The condition of the existing lightweight insulating concrete (LWIC) substrate for new membrane system application should be evaluated for suitability using the following inspection and testing procedures and repair guidelines:

1. The existing LWIC should be inspected by making core cuts through the existing membrane system (a core cut

size of 12 inches by 12 inches is recommended) in enough locations on the roof to provide a sufficient understanding of the overall substrate condition. Once the inspection of the area is completed, the cored roofing material should be replaced and the area patched with appropriate materials to restore the roof to a watertight condition.

2. An acceptable LWIC surface is firm and should support the weight of foot traffic. Areas where the LWIC has the appearance of loose sand are typically the result of excessive moisture exposure from continuing roof membrane leaks. Such areas should be removed and replaced. Some limited surface spalling may be noticed (particularly after the roof membrane is completely removed during reroofing operations). In such areas where approximately 1/16-inch to 1/8-inch of the material has flaked loose from the surface, the spalled material should be swept and removed. Areas where the spalling is in excess of this thickness should be capped using the LWIC mix and method outlined in items 5 & 6 below.

3. The most practical means of conducting a field evaluation of the strength of LWIC is through base ply fastener withdrawal tests in all areas where test cuts are made. Appendix A describes the recommended procedures for conducting these tests. The minimum recommended withdrawal resistance for an approved LWIC base ply fastener is 40 pounds.

4. Small depressions (6 inches or less in diameter) or holes left by removed fasteners can be patched using Zono-Patch. Gypsum-based materials should not be used.

5. Replacement of existing LWIC that has become damaged should be accomplished at the time of reroofing. The material in each affected area should be removed to the structural substrate or to where the existing LWIC is sound. The removed areas must

be a minimum of 1 inch deep and be square cut around the edges; feather edging is not acceptable. All loose material should be removed and any LWIC surfaces wetted prior to application of the capping material.

6. The capping material should be NVS Lightweight Insulating Concrete, or a LWIC mix having a 1:4 cement/aggregate volume ratio. The patching mix should yield a minimum design compression strength of 250 psi. Patched areas should be applied level with surrounding surfaces and with sufficient slope to maintain proper drainage. The concrete patch mix should be allowed to cure sufficiently prior to application of the roof membrane system. Patched areas that are adequately cured should allow for foot traffic without footprints.

The roofing specifications, including installation and venting, should follow the requirements of the roofing membrane manufacturer. For more detailed recommendations, contact Siplast at 1-800-922-8800.

Appendix A
Base Ply Fastener Withdrawal Procedure

<u>Equipment Needed</u>

1. Zono-tite® base sheet fasteners or equivalent.
2. Pulling strap. The pulling strap can be fabricated from 24 to 26 gauge sheet metal. See Figure 1.
3. Retainer cord with a circumference of 30 inches can be made from 3/8-inch diameter nylon cordage.

4. Spring scale with a "maximum value obtained" indicator. The pulling capacity should be 0-50 pounds or 0-100 pounds. Chatillion is one example of a quality scale.
5. Mallet or magnetic "stick" driver designed for installing nailable concrete fasteners.
6. SRIS Insulation Inspection Report form.
7. Safety glasses for eye protection.

Procedure

1. Drive the fastener through the center hole of the pulling strap.
2. Place one end of the loop of the retainer cord over the pulling strap. Carefully bend each end of the pulling strap upward, centered over the head of the fastener, to create a hooking eyelet for the spring scale hook. See Figure 1.
3. Insert a foot through the opposite loop of the retainer cord to restrain the pulling strap once the fastener is pulled free of the concrete substrate. Hook the spring scale through the eyelet. Pull the strap upward at a right angle to the concrete substrate in a continuous motion until the fastener is completely withdrawn. See Figure 2.
4. Record the maximum force obtained for withdrawal.

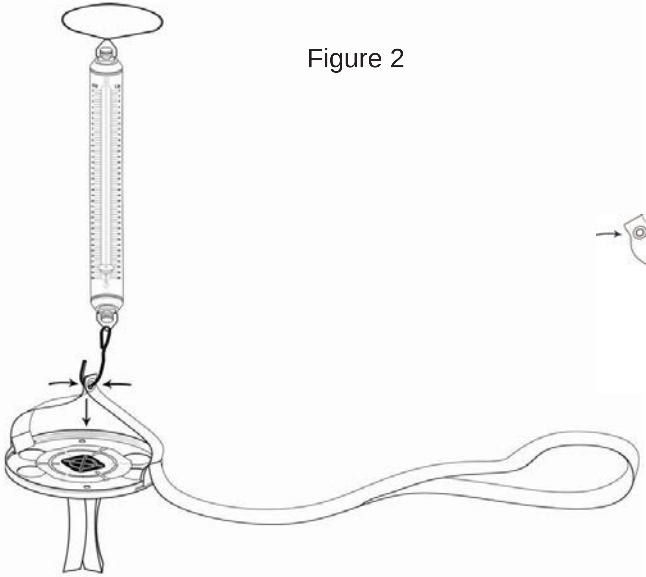

Figure 2

Figure 1

ROOFING-RELATED EXPANSION JOINTS & CONTROL JOINTS

Updated August 1, 2006 – SRIS-9610

Expansion joints incorporated into roof constructions are designed to isolate structural movement from the elements of the roof system. A correctly designed expansion joint assembly is anchored to the structural members or deck of the building, and extends through the roof insulation and membrane components. This practice allows for both expansion and contraction on the horizontal plane of the roof, and the shearing forces between junctures to occur without affecting the integrity of the insulation and membrane systems.

Siplast Lightweight Insulating Concrete Systems have proven for over 60 years to be stable roofing substrates. Properly formulated lightweight insulating concrete has a very low coefficient of thermal expansion and contraction. As a result, Siplast requires no specific expansion-contraction treatment, except where standard construction design practice dictates the inclusion of an expansion joint assembly. In such cases, expansion joints are required where appropriate in all Siplast guaranteed installations to avoid unnecessary isolated stress conditions. In general, the designer should consider expansion joints in the following situations:

1. Where the roof deck spans change direction.
2. Junctures where changes in deck material occur.
3. Where building additions are connected to existing buildings.
4. Where the roof changes directions such as "U" or "L" shaped buildings.

5. Deck junctures with walls or other vertical surfaces where independent movement between adjoining surfaces is anticipated.
6. Every 200 feet of continuous deck (length or width).
7. Wherever provisions for expansion joints occur in the building structure.

The situations indicated above are typical industry parameters for roof expansion joint design. In all cases, Siplast recommends that each project be specifically evaluated by the designer for potential movement between structural elements. Roof expansion joint constructions should be individually tailored to meet the actual job conditions.

A control joint is different from an expansion joint in that a control joint does not go through the rooftop structure. The control joint is an expansion/contraction area within the roof insulation, usually at the perimeter of the building, that is used for insulation products that have a high coefficient of expansion or contraction. Since Siplast Roof Insulation Systems have a very low coefficient of expansion, the use of control joints is not necessary.

COMPARISON OF VERMICULITE-BASED INSULATING CONCRETE (ZIC) & CELLULAR (INSULCEL) CONCRETE

Updated August 1, 2006 – SRIS-9611

Siplast offers a complete line of lightweight insulating concrete systems including both aggregate and cellular based products. Each type of product has its own unique set of application and performance characteristics. Unfortunately, these differences have become blurred in the market, causing the products to be incorrectly seen as interchangeable. The differences between aggregate and cellular based concretes can have a significant impact on ultimate product performance.

While ZIC and Insulcel Cellular are both lightweight insulating concretes, they have different performance/application characteristics, and should not be considered equal or interchangeable. This Technical Bulletin is intended to be a reference guide outlining product and performance comparisons between ZIC and cellular, and to clarify Siplast's recommended usage for each product.

PRODUCT DESCRIPTION

ZIC is a lightweight insulating concrete composed of vermiculite concrete aggregate, Portland cement, air entrainment, and water.

Insulcel concrete is generically referred to as cellular concrete. It is composed of Portland cement, pregenerated foam, and water.

Both ZIC and Insulcel are placed with Insulperm Insulation Board to create a Siplast Lightweight Insulating Concrete System. The primary differences between ZIC and cellular are: 1.) the amount of Portland cement in each product (cellular contains approximately

1.7 times as much Portland cement as ZIC) and 2.) the presence of vermiculite aggregate in ZIC. These compositional differences are the reason that the two products perform differently, especially in hot, arid climates.

PRODUCT PERFORMANCE

To go beyond a simple compositional comparison of ZIC to Insulcel, this section will review the performance of each product in five key areas: water retention, shrinkage/cracking, weather effects, workability, and weight.

Water retention

ZIC develops its strength through the hydration of the Portland cement present in its composition. This hydration process is a chemical reaction that takes place between the constituents of Portland cement and the mix water over a period of time (weeks) after the material is poured. The vermiculite aggregate in ZIC helps retain, via capillary forces, the amount of mix water necessary for the cement to properly hydrate. In other words, the vermiculite aggregate creates controlled hydration.

If water is not available to the cement during the curing period, proper hydration will not occur, and the resulting strength of the concrete will be affected. Because it does not have vermiculite aggregate in its composition, cellular does not have a mechanism to aid in water retention during the hydration process. This lack of vermiculite aggregate, combined with the relatively high percentage of Portland in its composition, means that cellular concrete is best used in temperate weather conditions. Applied under hot, arid or windy climactic conditions, cellular concrete may not properly hydrate, and the quality of the finished deck will be affected.

Shrinkage/cracking

Curing and drying shrinkage are inherent characteristics of Portland cement. In structural concrete, mixtures of coarse and fine aggregates are used to distribute the stresses created by the shrinkage of the cement paste. The aggregates also serve to interfere with the creation of macroscopic cracks (larger cracking that is visible to the naked eye).

The vermiculite aggregate present in ZIC serves the same purpose as the coarse and fine aggregates in structural concrete. It helps to distribute the stresses caused by shrinkage, thereby disrupting the creation of macroscopic cracks. The strength achieved by ZIC during the hydration process described above also helps resist cracking.

With a higher cement concentration and without vermiculite aggregate to distribute shrinkage stresses, it is inevitable that cellular concrete will develop visible cracks. The extent and severity of the cracking is affected by the weather conditions that the concrete is exposed to during the hydration period. Cracking in cellular concrete is normal; it does not necessarily indicate a bad pour. The potential for problems with the cracks occurs when the deck is exposed to rain prior to roofing -- before the building is watertight. Water can enter through a crack and percolate through the concrete, settling on the substrate, where it can remain after application of the roofing membrane. This is commonly referred to a rainwater intrusion. Percolated water contains alkali from the cement, and can leave dark stains and/or white deposits (efflorescence) on the metal deck and structural supports.

Weather

Extreme heat, low humidity and wind all contribute to the removal of the mix water that is needed for cement hydration. The presence of vermiculite aggregate in ZIC helps retain mix water, making ZIC less susceptible to such weather conditions at time of placement and during the early hours of curing. Cellular concrete does not contain aggregate to retain mix water; increasing the chances for incomplete cement hydration. If cement hydration is incomplete, the concrete may not develop acceptable strength and may develop severe cracking.

ZIC is also more versatile than cellular concrete during application under cold conditions. Mix water may be heated to accelerate the early set of ZIC. Heating the mix water for application of cellular concrete causes the air cells to abnormally expand. As the material cools, air cell shrinkage occurs, potentially resulting in unacceptable thickness and density variations.

Workability
On jobs where the roof has crickets, or is a special shape (such as a barrel or dome), the fluidity of ZIC can be adjusted because of the presence of aggregate. This adjustability makes it easier to hold a slope with ZIC than with cellular. ZIC can be poured successfully on very high slopes (4 in 12 is not unusual), whereas cellular is more suited for roofs with a slope not greater than 1/4 in 12.

Weight
Because the dry density of ZIC is lower than that of cellular, using ZIC results in less dead load on the structural system.

Application Predictability
The composition of ZIC makes its performance during application very predictable and consistent. In contrast, the application of cellular concrete requires close monitoring by the contracting crew. The pregenerated foam present in cellular must

be monitored on-site for quality, and the poured density of the concrete must be checked continuously. Adjustments to the foam quantity need to be made on a continual basis to ensure that the proper density is being placed.

Cost

Cellular concrete is generally less expensive than ZIC. Often, this is the motivating factor for its use. However, the decision to use cellular should be based on its suitability for a particular application. Lower material cost does not justify the use of a product under conditions ill-suited for its characteristics and composition.

Membrane Longevity

Research has shown that ZIC Systems provide the lowest membrane aging value. Further information can be found in SLIC Bulletin #14.

<u>SUMMARY</u>

The use of Insulcel cellular should be strictly limited to those jobs located in climates that are conducive to proper curing of cellular concrete. Insulcel should not be used in the hot, arid or windy conditions that threaten the quality of the end result. If cellular is used carefully under appropriate climatic conditions, it can provide owners with an excellent monolithic surface for roofing. The end product of a ZIC pour is extremely predictable and consistent. ZIC is less prone to being affected by curing conditions, and ZIC mixing and application techniques are less complicated than the constant monitoring required by cellular concrete. For these reasons, Siplast encourages the use of ZIC (rather than cellular) in most circumstances. If you have any questions about which Siplast Lightweight Insulating Concrete System is best for a specific project, contact Siplast at 1-800-922-8800.

DESIGNING SIPLAST ROOF INSULATION SYSTEMS TO CARRY UNIFORM LIVE LOADS ON STEEL DECK AND EXISTING ROOF ASSEMBLIES

Updated August 1, 2006 – SRIS–973

Siplast Roof Insulation Systems are designed to be placed over galvanized metal deck in new construction and over existing roofing assemblies in reroofing constructions. In both cases, the live load capacity of the substrate must be considered. This bulletin will discuss important issues to consider in either of the aforementioned design situations.

New Metal Deck Construction

First and foremost, metal deck designed to receive lightweight insulating concrete must be coated with a minimum G-60 galvanized coating. In many building code jurisdictions, a G-90 galvanized coating must be used. Note: Lightweight insulating concrete must never be directly placed on a painted metal deck.

Two types of metal deck are used with lightweight insulating concrete. They are referred to by the metal deck manufacturers as "roof deck" (1.5 to 3-inch deep A, B, or N Deck profile) or "metal centering" (9/16 to 1 5/16-inch deep corrugated metal deck). Metal centering is also referred to as "form deck" by some manufacturers. Both of these basic decks are rolled in various thickness gauges to accommodate the loads and spans for which the building is designed.

Typically, "roof deck" is designed to carry the vertical loads imposed by building design without regard to any composite action that may result by screwing rigid insulation boards to the metal deck. These "roof deck" products are manufactured by rolling 18, 20, or 22-gauge steel with a fiber stress of 33 ksi and a design fiber stress of 20 ksi.

Typically, "metal centering" is manufactured using steel with a fiber stress of 80 ksi and a design fiber stress of 36 ksi. This increase in design fiber stress results in metal centering being able to hold the design loads with thinner gauges and lower metal profiles. Because of the design advantage of thinner gauges and lower profiles, "metal centering" has been the metal deck of choice for a large portion of the insulating concrete industry. Today, higher side wall wind loads as well as seismic loads must be considered in the design process, which may dictate using roof deck profiles with insulating concrete systems.

Designing For Uniform Live Loads In New Construction

When designing for uniform loads, the metal deck selected must meet both stress limited loads and deflection limited loads. In most cases, deflection limitations will control the metal deck selected.

A typical metal manufacturer’s load and span table is shown below for metal centering with deflection loads limited to l/240. Although the stress limiting design may provide the load capacity required, it may not have the deflection limiting capacity.

The table below shows one manufacturer’s maximum allowable uniform loads in psf based on stress with the steel fb limited to 36 ksi and deflection limited to 1/240. Please consult steel deck manufacturers’ catalogs for design data for the steel deck being used on a given project.

Metal Centering Load / Span Table
Maximum Allowable Uniform Load psf - Three Span Condition

Type	Design Condition	3’-0"	3’-6"	4’-0"	4’-6"	5’-0"	5’-6"	6’-0"	6’-6"	7’-0"	7’-6"	8’-0"
26-Gauge 15/16” Nominal Depth	Stress 36 ksi	244	179	138	108	88	73	61	52			
	Deflection 1/240	168	106	71	50	36	27	21	17			
22-Gauge 1-5/16" Nominal Depth	Stress 36 ksi			343	271	220	182	153	130	112	98	86
	Deflection 1/240			226	159	116	87	67	53	42	34	28

As stated earlier, roof deck must be chosen on the basis of both the stress and deflection limitation of the metal deck profile and span. In the case of lightweight insulating concrete, the bond created between the metal centering and the lightweight insulating concrete results in higher composite loads based on stress and lower deflection than that provided by the metal deck itself. The composite that is created is due to the chemical bond developed between the galvanized metal and the cement matrix of the lightweight insulating concrete. The magnitude of this chemical bond ranges from 5 to 10 psi (720 to 1440 psf). The following example will illustrate this phenomenon.

Example

Problem: Design the metal deck required to withstand a total load of 55 psf at a 6-foot span with deflection limited to l/240.

Solution: The metal deck properties table above indicates that a 26-gauge, 15/16-inch deep profile would support the load at a 6-foot span based on stress limitation. This profile will carry 61 psf based on stress. However, the deflection limitation indicates that the same profile would only carry a load of 21 psf based on a deflection limitation of l/240. At this point two choices are available. One option is to increase the metal deck to a 22-gauge with a 1 5/16-inch profile since it can carry 67 psf with a deflection limitation of l/240. However, if cost is of concern another alternative is available.

The second alternative is to review the Vertical Load Data section of the Siplast Engineering Design Manual and the Vertical Load Data sheet for ZIC Lightweight Insulating Concrete. The table from this data sheet is reprinted below. It shows the load capacity of the lightweight insulating concrete installed over various metal deck profiles. The table shows both the total load capacity of the composite and the load based on a deflection limitation of l/240.

ZIC Downward Load Table

	ZIC Insulating Concrete Over Corrugated Metal			ZIC Insulating Concrete & Insulperm Over Corrugated Metal			ZIC Insulating Concrete Insulperm Over Slotted Corrugated Metal		
Metal Deck Gauge & Span	Live Load for >= L/240 (psf)	Ultimate Load (psf)	Safety Factor	Live Load for >= L/240 (psf)	Ultimate Load (psf	Safety Factor	Live Load for >= L/240 (psf)	Ultimate Load (psf	Safety Factor
26-ga. Metal 15/16” Profile On 6’0” O.C. Span	148	417	13.9	78	240	8.0	110	256	8.5
24-ga. Metal 1-5/16” Profile On 8’0” O.C. Span	92	290	9.7	54	198	6.6	60	180	6.0

Notes:

1. *Details of construction for the three roof decks are:*
   a. *ZIC Lightweight Insulating Concrete over corrugated metal - two inches of ZIC Lightweight Insulating Concrete is placed over the top of the corrugations of the galvanized metal decking.*

Bulletin #8

b. *ZIC Lightweight Insulating Concrete and Insulperm over corrugated metal – ZIC Lightweight Insulating Concrete slurry coat is used to fill the flutes of the galvanized metal decking and is placed to a depth of 1/8" over the top of the metal deck. Insulperm is embedded in this slurry coat while it is still wet, and a final layer of two inches of ZIC Lightweight Insulating Concrete is placed over the Insulperm.*
c. *ZIC Lightweight Insulating Concrete and Insulperm over corrugated metal - the details of construction are the same as in 1b, except that the galvanized corrugated metal deck is slotted to provide approximately 1.5% open area.*

2. *Safety factor is based on a design live load of 30 psf.*
3. *Test results shown are for a two span-condition.*
4. *Welding patterns were conventional with washers.*

A review of the 26-gauge, 15/16-inch profile metal deck shows that for ZIC Lightweight Insulating Concrete with Insulperm placed over slotted corrugated metal the deflection limited load is 110 psf and the ultimate load is 256 psf. Clearly the deflection limitation load of 110 psf provides sufficient protection for the design condition of 55 psf required in this example. To use this alternative design approach, it must determined if the building code will allow the use of this composite design information. If it does not, the decision will be to increase the metal gauge and depth of the profile as discussed above.

In all cases of metal deck design, all load conditions must be considered. For example, wind uplift loads or seismic design loads will dictate using stronger metal decks than required to handle downward load conditions.

Reroofing Design

Siplast offers two lightweight insulating concrete systems for use on existing roof assemblies. Siplast NVS and Insulcel systems are acceptable for use in reroofing applications to increase the building's insulation value and to correct and improve rooftop drainage. Lightweight insulating concrete is the most economically efficient means of retrofitting for these characteristics. NVS is preferred due to the superior characteristics of its aggregate base and its lower incremental load on the existing structure. Lightweight insulating concrete systems will vary in wet and dry density criteria by system design. An example of these differences is as follows:

	Siplast NVS System (Aggregate Based)	Cellular-Based
Minimum thickness:	1 inch	2 inches
	Densities	
Wet density	60-68 pcf	38-48 pcf
Dry density	35 pcf	30 pcf
	Weight	
Wet	5-5.67 lb/board foot	3.17-4 lb/board foot
Dry	2.92 lb/board foot	2.5 lb/board foot
	Loading (minimum thickness)	
Wet	5-5.67 lb/ft2	6.34 - 8 lb/ft2
Dry	2.92 lb/ft2	5 lbs./ft2

All existing buildings being considered for reroofing incorporating Siplast Lightweight Insulating Concrete should be evaluated by a structural engineer for their ability to withstand the incremental load that will be applied.

Bulletin #8

STORAGE OF ROOF INSULATION SYSTEMS PRODUCT ON JOBSITE

Updated August 1, 2006 – SRIS-981

Section 1.06 Delivery, Storage and Handling of Siplast specifications for ZIC, NVS, Zonocel Lightweight Insulating Concretes, paragraph B includes the following statement:

> "Store bagged concrete aggregate products in a dry location until ready for application. Expanded polystyrene insulation should not be kept in ponded water areas prior to application, but can be exposed to rainwater before application. Expanded polystyrene boards must be clean and free from foreign substances."

Section 1.06 Delivery, Storage and Handling of Siplast specification for Insulcel Lightweight Insulating Concrete, paragraph B includes the following statement:

> Store Insulcel concentrate at temperatures between 52°F and 80°F (11° – 27°C). Expanded polystyrene insulation should not be kept in ponded water areas prior to application, but can be exposed to rainwater before application. Expanded polystyrene boards must be clean and free from foreign substances."

The primary intent of this material storage section is to protect Siplast concrete aggregate packaged in paper bags from rain damage until ready for use. Paper bags that are exposed to moisture may fall apart when handled, thus making jobsite application difficult.

This section has mistakenly been interpreted to include all materials stored on the jobsite, even those that are not readily affected by rain, such as expanded polystyrene.

We trust this bulletin will clarify proper storage requirements for Siplast Lightweight Insulating Concrete Systems.

VENTING SIPLAST ROOF MEMBRANE AND ROOF INSULATION SYSTEMS

March 17, 2008 – T-0802

Siplast Lightweight Insulating Concrete Systems require venting of new pours to ensure the release of any vapor pressure build-up. When Siplast Roof Membrane Systems are used with Siplast Lightweight Insulating Concrete Systems, the following venting conditions are required.

Metal Deck Constructions - Venting Substrates

- ZIC and Zonocel systems require bottom slotted metal decks for downward venting. The amount of bottom venting is 0.75% of the total metal deck surface area.
- Insulcel specifications are preferably installed over bottom slotted metal decks for downward venting. The amount of bottom venting for Insulcel systems is 0.50% of the total metal deck surface area.
- Perimeter and curb venting are required as part of the standard specification.
- Topside vents are required for installations where perimeter venting cannot be utilized.

NVS and Insulcel Systems - Non-Venting Substrates

- The NVS System, by design, is poured over non-venting substrates such as structural concrete, existing roof membranes that are approved for re-cover applications, and other structural units that are approved in advance by Siplast. Where these systems are used, perimeter, curb, and topside venting are required.
- In situations where Insulcel systems are poured over non-venting substrates, perimeter, curb, and topside venting are required.

Insulcel RT Systems

- The Insulcel RT System is poured over venting substrates such as slotted metal decks and over non-venting substrates such as structural concrete, non-slotted metal decks, existing roof membranes that are approved for re-cover applications, and other structural decks that are approved in advance by Siplast.
- The Insulcel RT system is covered by a Paradiene torch grade (TG) membrane system that utilizes a Paradiene 20 TS base ply.
- Perimeter, curb and topside venting are required as part of the standard specification. The installation of topside vents must be completed with each daily application of the Paradiene 20 TS base ply.

Bulletin #10

Perimeter Venting

Perimeter venting can be accomplished following a Siplast detail that allows for vapor pressure relief or is designed for venting purposes. The following Siplast standard details, when configured according to Siplast requirements, utilize perimeter venting: (ZB for venting substrates; NB for non-venting substrates).

1. Venting Masonry Parapet No. 2031ZBW6, 2031NBW6
2. Plywood Veneered Parapet No. 2031ZBW5, 2031NBW5
3. Parapet Non-Wall Supported Deck No. 2031ZBW2, 2031NBW2
4. Roof Edge No. 2031ZBE1, 2031NBE1
5. Paraguard Roof Perimeter Edge No. 2031ZBE3, 2031NBE3
6. Expansion Joint No. 2031ZBC3, 2031NBC3

Topside Venting

Topside vents should be designed for “one-way” venting, and fabricated from spun aluminum having a minimum 4-inch flange. Plastic vents are not acceptable. Configuring the vent with the Siplast membrane system should follow Siplast Roof Vent (venting substrates) detail Ref.#:2030zbP4 for venting through the roof membrane over slotted metal decks, and Siplast Roof Vent (non-venting substrates) detail Ref.#:2030nbP4 for venting through the roof membrane over substrates that do not provide underside venting beneath the system.

Topside vents should be installed on minimum 30-foot centers. Refer to Siplast schematic Roof Vent Placement SRIS V1 for recommended placement.

The following Siplast penetration details, by their design, allow for vapor pressure relief when configured according to Siplast requirements. (2B for venting substrates; NB for non-venting substrates)

1. Waste Stack No. 2031ZBP1, 2031NBP1
2. Equipment Frame No. 2031ZBP2, 2031NBP2
3. Curb No. 2031ZBC1, 2031NBC1
4. HVAC Curb No. 2031ZBC2, 2031NBC2

Specific venting capabilities of the roof perimeter and existing penetrations can be reviewed by Siplast on a job-to-job basis in order to minimize the number of topside vents required. Contact your local Siplast representative or the Siplast Technical Department at (800) 922-8800 for assistance.

INSULATION BOARD QUALITY

Updated August 1, 2006 – SRIS-983

Insulperm Insulation Board is an engineered product that is significantly different from generic holey board. Insulperm's differences improve the performance of the finished lightweight insulating concrete roof deck.

The design of Insulperm features more holes than standard holey board. These additional holes ensure that air is not trapped under the board at the time of application, thereby improving the bonding of the Insulperm to the slurry coat. The additional holes in Insulperm also increase the rate of moisture dissipation from the insulating concrete system. This moisture dissipation may either be in the form of liquid moisture or the form of moisture vapor. The number and distribution of holes is an important difference between standard holey board and Insulperm.

Increasing the number of holes in Insulperm adds to the manufacturing process and therefore, cost. However, these design features significantly improve the bonding, moisture dissipation rate, and adhesion of Insulperm as compared to generic holey board.

Insulperm is manufactured to meet ASTM Standard C 578 Type I criteria. Type I is a level of physical properties that specifies board density range to be 0.9 to 1.0 pcf, the thermal value to be 4.0 R/inch, compression resistance at 10.0 psi, and flexural strength to be 25 psi, minimum. These specifications represent the board quality approved by Factory Mutual, Underwriters Laboratories, and other regulatory agencies. Holey board supplied by commodity manufacturers and suppliers to the job site may not meet ASTM standard

C 578 Type I. Some board manufactured for actual use in the field more closely meets ASTM C 578 Type XI properties. Type XI properties consist of minimum 0.7 pcf density board, a thermal value of 3.3 R/inch, compression resistance at 5.0 psi, and flexural strength at 10.0 psi. Clearly, Type XI board does not provide the physical properties requirements.

EPS board with properties below Type I standards can affect the thermal resistance of the roof assembly. The table below shows the effect of reduced density and thermal value.

	Actual Board Density	R-Value Per Inch	Percent Difference From Claimed 4.0 R/inch
Sample 1	0.85	3.86	-3.5%
Sample 2	0.84	3.84	-4.0%
Sample 3	0.77	3.71	-7.2%
Sample 4	0.76	3.70	-7.6%
Sample 5	0.79	3.75	-6.3%

Clearly, the building owner will not receive the insulating value specified for the job or the long term performance specified, nor will he realize true cost savings from using a lower cost, Type XI EPS board. Instead, over time, he will bear the increased heating and cooling costs associated with the lower thermal resistance of a cheaper board.

There is always a higher initial cost associated with using high quality products that are designed to perform well over time. The informed owner will recognize that the life cycle cost advantages gained by using superior products like Insulperm outweigh a slight upfront premium.

PLACING CONCRETE IN COLD WEATHER

Updated August 1, 2006 – SRIS-985

Insulating concrete has been installed in North America since the early 1940s in all types of weather conditions, with the resulting application performing its function as a stable substrate for the roofing membrane while providing insulation value to the roof system. Cold weather application of lightweight insulating concrete concerns some users because of the fear of the concrete freezing, which they believe will cause roofing problems and construction delays. To address those concerns, this bulletin will discuss:

- Issues relating to cold weather applications.
- Time-proven techniques for successful cold weather applications.
- The temperature range associated with cold weather applications.
- The effects of cold weather on lightweight insulating concrete after application.

Cold Weather Conditions

The American Concrete Institute defines cold weather as "a period when, for more than three consecutive days, the mean temperature drops below 40°F." Normal placement techniques are appropriate at temperatures above 40°F. When temperatures are expected to be 32 to 40°F within 24 hours after placement, the contractor may opt to employ one or more of the recommended precautions reviewed below.

Effects of Freezing Temperatures

Mild freezing temperatures during the first 24 hours after application only affect the top surface of a lightweight insulating concrete application. Freezing temperatures will reduce the rate of strength development, and may cause ice crystals to be formed in the cement matrix of the top surface. Both of these conditions may result in the top 1/8-inch of the surface disbonding from the remaining thickness of insulating concrete. Removing this loose material will leave a hard surface that will provide the designed support and required fastener withdrawal resistance and result in excellent performance throughout the life of the application.

Over the years, many applications have demonstrated that the insulating concrete below this top surface is not affected. Insulating concrete contains 80-85% air cells by volume. This high volume of air content provides more than sufficient space for water to expand when it freezes without damaging the remaining thickness of insulating concrete. By contrast, structural concrete that has been freeze-thaw stabilized contains only 5-7% air cell volume and functions quite adequately under freezing conditions.

Providing Resistance To Freeze Damage During Application

The actions required to reduce freeze damage during application relate to increasing the rate of strength gain during the first 24 hours after application. Several factors affect the rate of strength gain. They are:

- Higher air temperature. The higher the air temperature above 32°F, the higher the rate of strength gain. Cloudy conditions will result in higher temperatures than a clear night. Clear nights will cause evaporative cooling of the deck surface to temperatures below that of the outside ambient air.

- Increased quantity of cement. Increasing the quantity of cement increases the rate of strength gain and slightly increases the temperature of the concrete.

- Increased fineness of cement. Portland cement is produced as Type I to Type V. Type I and Type II are the recommended cements for use with lightweight insulating concrete under normal conditions. Type III cements are ground to a finer size and, therefore, increase the rate of strength gain as compared to Types I and II.

- Higher initial concrete temperature. The higher the placement temperature of the concrete, the longer it takes for the mass to cool to freezing conditions. In addition, higher placement temperatures increase the rate of chemical action of the cement, resulting in faster rate of strength gain.

- Chemical admixtures. Today many chemical admixtures are sold as accelerators for use with cement. These materials are designed to be used with structural concrete that has a very low air content when compared to lightweight insulating concrete. None of these materials have been found to be cost effective in accelerating the set time of lightweight insulating concrete. Further, some of these materials contain chloride, which will attack metal and cause it to fail.

DO NOT USE CHLORIDE CONTAINING ACCELERATORS WITH LIGHTWEIGHT INSULATING CONCRETE!

Recommendations

The recommendations listed below are time-proven methods of reducing the effects of freezing temperatures on lightweight insulating concrete applications. The following recommendations apply when the temperatures at time of application are 32-40°F and are not expected to drop below 25°F during the first 24 hours after application. Siplast Lightweight Insulating Concrete Systems should not be placed if temperatures are expected to drop below 25°F during the first 24 hours. Because all of the recommendations may not apply to all types of insulating concrete, a table follows that defines which recommendation is applicable to each product.

1. Increase the thickness of the pour. As stated, the top 1/8-inch thickness may be damaged by freezing conditions. Therefore, increasing the thickness of the top pour to compensate for this lost top 1/8-inch thickness will result in an application that still meets the minimum thickness specified for the project once the loose surface is removed.

2. Increase the application water temperature. Research and field application have demonstrated that heating the mix water to approximately 100°F increases the rate of strength development during the first 24 hours by over 100% for aggregate-based lightweight insulating concrete. This is not recommended for use with cellular concretes. Increasing the mix water temperatures for non-aggregate based lightweight insulating concrete creates conditions of early air cell expansion followed by collapse of the total cement matrix when the mix water cools down. In addition, if the water is too hot, the air cells may burst during the mixing process.

3. Increase the quantity of cement. Increasing the quantity of cement will increase the rate of strength development. Increas-

ing the quantity of cement is product specific since some products already use high quantities of cement. See the chart below for specific recommendations.

4. Use Type III Portland cement. Type III cement is a finer grind cement and will increase the rate of strength development.

5. Increase the temperature of the deck underside. If the building is heated, keeping the structural deck underside warm will increase the rate of strength development. Heat rises, so the temperature of the lightweight insulating concrete above the deck will remain warmer.

6. Install the roofing membrane soon after application. The roofing membrane should be installed as soon as the lightweight insulating concrete can bear foot traffic without causing surface damage. The membrane should always be installed with a nailed base sheet application.

Siplast Product Specific Recommendations

As stated, the above recommendations may not apply to all lightweight insulating concrete products. The following table defines which recommendation is applicable to which Siplast Lightweight Insulating Concrete mix design.

RECOMMENDATIONS	SIPLAST MIX DESIGNS				
	1:6	1:4	NVS	Zonocel	Insulcel
Increase Pour Thickness	X	X	X	X	X
Increase Mix Water Temperature	X	X	X		
Increase Quantity of Cement	Add 15%			Add 15%	Add 15%
Use Type III Cement	X	X	X	X	X
Increase Underside Deck Temperature	X	X	X	X	X
Install Roofing Membrane Soon	X	X	X	X	X

WHEN SHOULD A SIPLAST ROOF INSULATION SYSTEM BE ROOFED?

Updated August 1, 2006 – SRIS-986

Two of the outstanding advantages of Siplast Lightweight Insulating Concrete Systems, when compared to rigid board roof insulation, are superior compressive strength and the monolithic nature of the finished surface. In addition to enhancing long term roof membrane performance, these Siplast Lightweight Insulating Concrete Systems characteristics create the following production and scheduling benefits during construction:

1. Insulation can be installed well ahead of roof membrane installation. This allows faster production rates during the roofing process, benefiting the roofer, general contractor, and the owner.
2. The roof membrane installation and fireproofing can be scheduled independent of one another, because the steel deck does not have to be coated with spray-applied fire protection.
3. Siplast Lightweight Insulating Concrete Systems will withstand some exposure to the elements. This allows a degree of scheduling flexibility.

Unfortunately, the durability of Siplast Lightweight Insulating Concrete Systems sometimes tempts the general contractor to use the lightweight insulating concrete deck as a temporary dry-in or an unprotected work surface prior to roofing. This is a mistake!

Roof membrane installation should begin when the insulating concrete surface is ready for roofing. According to Siplast guidelines, the surface should be ready:

- When the deck will bear foot traffic without damage, generally 48 - 72 hours after pouring.
- When a base ply fastener has 40 pounds of withdrawal resistance, as evidenced by the nail pull test.

Siplast does not recommend leaving the deck exposed for more than 10 days, except in cases where weather conditions are preventing the trades from working.

What are the jeopardies of leaving Siplast Lightweight Insulating Concrete exposed?

- Prolonged exposure to freeze-thaw or wetting and re-wetting can create surface damage to the insulating concrete, including scaling or spalling.
- Excessive work traffic prior to roofing and installation of proper walkways will damage the surface of the insulating concrete.
- Excessive exposure to rain can cause the system to absorb unnecessary amounts of non-construction water. In such cases, ZIC concrete placed over slotted metal deck will dry out quickly. When Insulcel is placed over non-slotted metal, rainwater can take much longer to dissipate. This is because rainwater that has entered through the shrinkage cracks inherent to all cellular concretes can accumulate on the metal.

In summary, Siplast Lightweight Insulating Concrete Systems provide a benefit by allowing flexibility in the construction process. However, it is wise to use good judgment and not over-extend the exposure of the finished roof deck. Siplast offers a Performance Guarantee on Siplast Lightweight Insulating Concrete Systems. The guarantee will not be issued or honored in cases where the lightweight insulating concrete system has been damaged by exposure or excessive roof traffic.

If you have questions regarding this bulletin, please contact the Siplast Technical Department at 800-922-8800.

PLACING SIPLAST INSULATING CONCRETE IN HOT WEATHER

APRIL 10, 2007 - SRIS-0701

As with cold weather, Siplast Lightweight Insulating Concrete (SLIC) applications can be accomplished successfully in hot weather, with proper consideration of the following:

- Ambient, substrate, and material temperatures.
- Relative humidity and wind speed.
- Application techniques.

Hot Weather Conditions

Hot weather is defined by the American Concrete Institute in Publication 305-99 as:

> *Any combination of the following conditions that tend to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration or otherwise causing detrimental results.*
>
> - High ambient temperature.
> - High concrete temperature.
> - Low relative humidity.
> - Wind speed.
> - Solar radiation.

The effect(s) of high ambient temperature, low relative humidity, substrate temperature, and wind can singularly or in combination lead to:

- Difficulty in placement and finishing.
- Rapid buildup of material in batching equipment and hoses.
- Excessive shrinkage cracking.
- Low compressive strength due to rapid and improper hydration of the Portland cement.

Recommendations

The following suggestions can help mitigate the effects of pouring SLIC during hot weather conditions.

- Place SLIC as early as possible in the morning or in the evening to avoid peak sun and heat loads.
- Use ZIC or Zonocel whenever possible to take advantage of the aggregate's natural tendency to retain moisture.
- Mist or sprinkle the deck with water to provide for cooling and proper hydration.
- Clean all mixing equipment thoroughly each day. This will limit build up and help with batch consistency.
- Minimize extended interruptions when placing SLIC. (Do not stop for extended periods of time during/after slurry coat placement, or for crew breaks, etc.)

Proper planning, good jobsite practices, and common sense can preclude challenges associated with hot weather conditions. Please contact Siplast for additional information.

Bulletin #16

Glossary of Siplast Lightweight Insulating Concrete Terms

Aggregate - Granular materials mixed with a cementing binder to form concrete. Aggregates act as fillers and provide dimensional stability to the concrete.

Air Entrainment - A chemical additive that creates small air bubbles in the concrete mix. These bubbles improve the homogeneity, workability, and freeze-thaw durability of aggregate based lightweight insulating concrete.

Auger - A device turned by a hydraulic motor that is used to convey materials to the mixer.

Bulker - A large trailer used to store loose powder cement, usually equipped with a mechanical/hydraulic means of unloading cement into a hopper where it can be weighed and augured into the mixer.

Cant - A special piece of material used to make the transition less severe where horizontal and vertical surfaces intersect.

Calibration - Verifying the accuracy of major components used in mixing lightweight insulating concrete. This is one of the first steps in solving problems associated with mixing products in the field. Installers are encouraged to routinely calibrate their equipment as part of normal equipment maintenance procedures. Field personnel need to know the basics of calibrating a water meter, and load cell.

Cast Density - The weight per unit volume of a material at the point of placement.

Concrete - The weight per unit volume of a material at the point of placement.

Condensation - The process of changing a vapor into liquid. The resultant liquid water is called condensate.

Compressive strength - The ability of concrete to resist compressive force. Structural concrete used in construction of buildings and bridges is usually between 3,000 and 5,000 pounds per square inch. Lightweight insulating concrete products can be as low as 125 pounds per square inch.

Cricket - Sloped area constructed to divert water from a horizontal intersection of the roof with an expansion joint, wall, or other projection.

Density - Weight per unit volume.

Dew Point Temperature - The temperature corresponding to water vapor saturation (100% relative humidity) condensation of vapor to liquid begins at this temperature.

Dry Density - Weight per unit volume of the concrete after curing and drying.

Flame Spread Rate - The rate at which flame travels over the surface of a material. Usually quantified by a Steiner Tunnel Test or Radiant-Panel Test.

Fire Resistance Rating - The time in hours and minutes that a building element will remain structurally sound during exposure to fire as defined in the Standard Fire Test (ASTM E 119).

Linear Shrinkage - A change in length that occurs during hydration or curing of Portland cement concrete.

Load Cell - A scale with a remote readout. It is used by the pump operator to weight the exact amount of cement into a hopper to be loaded into the mixer for each batch of concrete.

Mixer - A trailer mounted piece of equipment consisting of a drum with large paddles to mix lightweight insulating concrete. Designed so that one man can control the amount of water, cement, or pre-generated foam added to each batch of material.

Mix Design - The ratio of cement to vermiculite or foam used to produce Siplast Lightweight Insulating Concrete which will meet the strength and density specifications.

Mixing Time - The time during which water, Portland cement, and aggregates or pre-generated foam are mixed before being dumped into the pump hopper.

Portland Cement - A finely ground mixture of limestone, clays (silicate-containing minerals), and other minor ingredients that undergoes chemical reactions when mixed with water to form a solid mass over time (referred to as the curing period).

Pump - As most commonly used with lightweight insulating concrete, the pump is a constant volume positive rotor/stator device used to push the lightweight insulating concrete onto the roof via various types of hoses.

Saddle - Sloped area between roof drains used to channel water to those outlets.

Screed - A straight edge pulled across screed bars to finish the surface of the concrete.

Screed Bar - A bar or pipe set to the intended thickness to the concrete being placed. The screed is pulled across the screed bars to create the finished slab surface.

Slope - Inclination of a surface expressed as a unit of rise or fall relative to horizontal reference points. An example would be 1/4-inch per foot.

Thermal Conductance - Abbreviated “C”. The thermal transmission, by conductance, of any thickness of homogeneous material, expressed as BTU/hr sq ft °F.

Thermal Conductivity - Abbreviated “k”. The thermal transmission, by conductance, of a 1-inch thickness of a homogeneous material. Expressed as BTU-in/hr sq ft °F.

Thermal Resistance - Abbreviated “R”. The reciprocal of heat transfer values “U” and “C”. It is expressed as °F hr sq ft/BTU. For example, a wall having a “U” value of 0.25 would have a thermal resistance value of 4.0 R.

Thermal Transmittance - Abbreviated “U”. Also known as the overall heat transfer coefficient. It is the reciprocal of the sum of all R-factor contributions from outside air to inside air.

Vermiculite - A micaceous hydrated silicate mineral that expands when heated to produce a low density particulate material that is used as an aggregate in a variety of low density cementitious mixtures.

Yield - A term used to define how much volume of concrete an installer is producing with a certain volume of aggregate. 100% yield is defined as the condition where the wet batch volume is equal to the volume of concrete aggregate used to make the batch. By adding the weight of all materials put into any batch of lightweight insulating concrete prior to mixing and them performing a wet density test on the same concrete at placement, we can calculate the actual volume of material produced in that particular batch. When we compare the volume of the entire batch to the volume of our aggregate used in that batch, we can determine the yield of those products.

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