



# LIGHTWEIGHT INSULATING CONCRETE (LWIC), A JOBSITE- PRODUCED ROOF DECK SYSTEM

By Mark J. Bates

**L**ightweight insulating concrete (LWIC) is one of the most efficient, accommodating roof deck systems available. Its versatility allows for a fast and easy solution for custom drainage designs, working over various substrates in the most difficult slope-to-drain projects. Consultants, however, seem to become frustrated when comparing one LWIC contractor with another due to differences in production, methods of application, and material quality. Certainly, the right contractor can greatly benefit the outcome of a project, favorably affecting its budget, schedule, and quality. Specialized on-site batch plant equipment is required to produce LWIC, and the condition of the equipment will determine the production rate and quality of LWIC materials.

## LWIC BATCH PLANT EQUIPMENT

LWIC batch plant equipment (*Figure 2*) is designed to mix and batch LWIC at a constant, consistent mix, while continuously pumping material to the roof substrate. The batch plant may be small and simple or it may be large and complex; depending on the



*Figure 2 – LWIC batch plant equipment is designed to mix and batch LWIC at a constant, consistent mix.*

type, the batch capacities vary from 0.75 to 2 cubic yards. Well-maintained, properly functioning equipment is vital to providing productivity and quality LWIC product. The accuracy of measuring devices, sealed mixer doors, mixer paddles, and pumping units is important in producing a quality LWIC.

- **Load cells** are used to determine the weight of the Portland cement that is used in each batch of concrete. Faulty load-cell readings can provide inconsistent densities at the point of placement, leaving the LWIC with inconsistent compressive strengths.
- **Water metering devices** are used to determine the amount of water that is used in each batch of concrete. A defective water meter can cause concrete mix designs to be too fluid and/or too tight, creating an inconsistent mix and making it difficult for the finisher to provide a smooth, consistent surface. The National Roof Deck Contractors Association's (NRDCA) 300-page document titled *Procedures to Determine the Accuracy of Measuring Equipment for LWIC* is a great source to determine the accuracy of load cells and water meter devices.
- **Mixer doors.** After producing each concrete batch, a mixer door opens and dispenses the concrete into a hopper; once emptied, the door is returned to the closed position, allowing the operator to produce another batch of concrete. A proper functioning mixer door should be leak-free; when mixer doors leak, diluted concrete escapes, falling into the holding hopper and providing a product of inconsistency at point of placement.
- **Mixer paddles** accurately distribute material throughout the concrete mix and properly wet the cement and aggregate particles. Broken or missing paddles can prevent materials from being thoroughly mixed, providing a material that falls short of project requirements.
- **Pumping Unit.** The pumping unit is a progressive, cavity-type pump made of two main parts: a rotor and stator. From the hopper, the LWIC is driven into the cavities created between the rotor and stator. As the rotor turns and advances forward,

the LWIC is pumped through the concrete hose to the point of placement, delivering a smooth, pulse-free material at a high flow rate of application. The rotor and stator are wear items that require replacement several times a year; worn rotors and stators can cause loss of viscosity, reduced concrete discharge, loss of pressure, and erratic density changes.

For best performance and reliability, the following application guidelines are based on evaluations from successful tested assemblies, experience, and research.

#### SLURRY COATS

Slurry coats are commonly the weak link in these systems. The slurry coat is a layer of LWIC placed between the receiving substrate and the EPS holey board insulation. Proper application of slurry coat is essential for optimum performance of any LWIC system. Insulation boards should be placed in such a manner as to cause full contact of the board surface with the freshly placed slurry. The concrete should enter into the keying holes of the holey board, and the boards should be placed in a running bond pattern of staggered joints butted tightly together. After placement, the insulation boards should be walked in to firmly set the board in slurry coat. Once complete, all foot traffic (including the consultant, building inspectors, and all other trades) should be eliminated from the freshly placed insulation board surface until the following day. It is of the greatest importance that this slurry coat set is not disturbed until the concrete hardens to provide an adequate bond between the slurry coat and the board surface, a bond that typically develops overnight.

The following day, field inspections are performed. An indication of inadequate slurry coats or incomplete insulation board contact with the slurry is that the boards will freely move when walked on, or one can lift the board from the slurry with ease. The consultant may discover that boards had contact with only the top of the flutes in the metal decking. If these are left in place, the LWIC topcoat application will not flow into these empty voids (*Figures 3A and 3B*).

Empty voids that are left are cause for concern. After the completion of the roof deck and prior to the installation of the roof membrane system, these systems can sometimes contain intruded water when



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Figures 3A and 3B – Slurry coats with contact at top flutes only.



exposed to heavy rains. The amount of water intrusion will vary from manufacturer to manufacturer. Water intrusion collects in low areas under the system; for reroof or concrete substrates, it is strongly suggested that prior to the start of the LWIC system, all points are noted on project drawings (Figure 4). This water also collects in voids left from inadequate slurry coats. Water that remains in these voids will vent out at a slow pace and can cause water droplets to form on the underside of the metal deck. The use of slotted or perforated metal decking may or may not be helpful in addressing this problem (Figure 5).

Prevention is key to averting these voids; provide a suitable slurry coat, and, if in question, more is better. Remember that when the insulation boards are walked in to the slurry coat, any excess material will come up through the holes of the insulation, leaving a uniform slurry coat thickness. When applying the slurry coat, it is important to not allow it to set before the insulation boards are installed. Contractors should never get too far ahead of themselves. A good rule of thumb is to discontin-

ue placement of the slurry coat after 2 to 3 cubic yards are placed, then proceed with installation of the insulation until all boards are set in the fresh concrete. Then walk the boards down, and repeat the process.

For best performance, slurry coats are

required to set overnight before applying the topcoat. Often, contractors feel compelled to begin the top pour within hours after the slurry coat placement; when contractors are questioned, a common reply is that “it might rain.” The thought is, if the topcoat is placed and rained on, there will be less remedial work to do the following day. When adverse weather conditions are threatening, normally the last two hours of placement are most vulnerable to rain damage. The best defense against adverse weather conditions is proper slurry coat application.

When exposed insulation boards are subjected to rain, the insulation board must be inspected to confirm adhesion to the substrate. Any loose insulation boards should be removed, and standing water should be removed by vacuuming. Apply a new slurry coat over the substrate and reinstall the insulation boards in such a manner as to

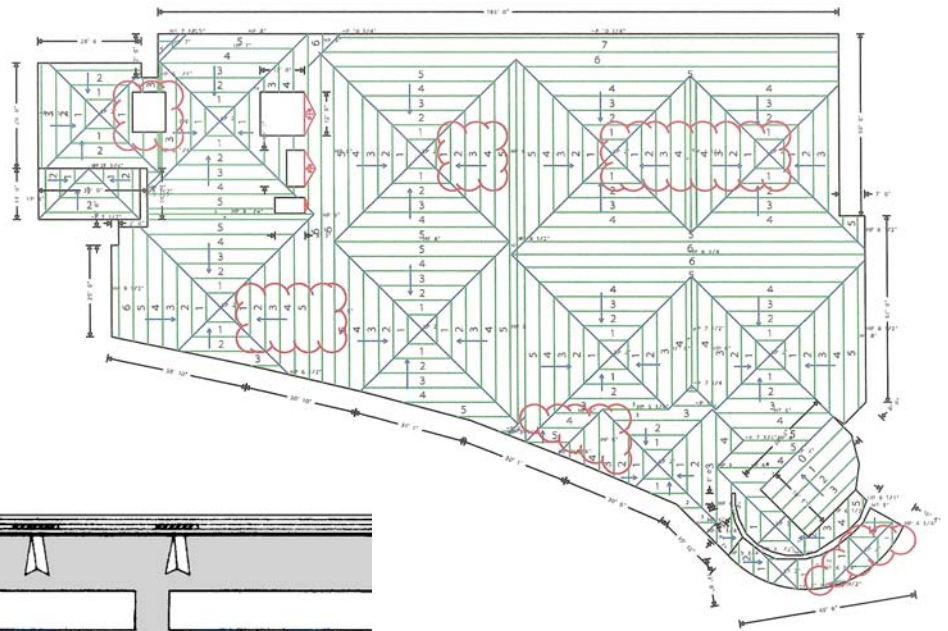


Figure 4 – Note existing low points on project drawings.

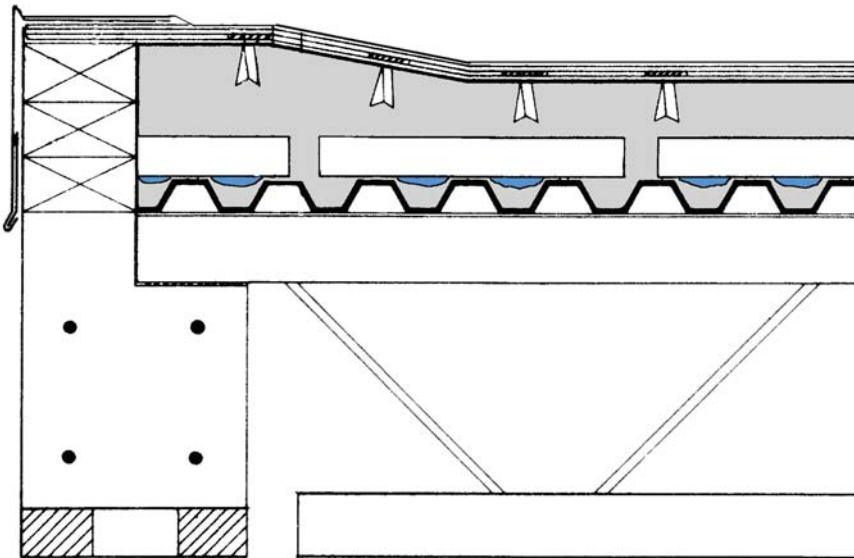


Figure 5 – Rainwater collects at empty voids.

cause full contact of the board surface with the plasticized concrete (Figure 6).

Same-day topcoat applications have proven to be problematic if the slurry is not allowed to set before the topcoat application. Insulation boards have a tendency to float toward the top surface, leaving the insulation board with questionable bond to the substrate. Another problem is insignificant topcoat thickness for base ply fasteners to properly set. There are no cost advantages to allowing the slurry to set overnight versus placing the topcoat the same day, unless the project is so small that the contractor is able to complete the project in one workday instead of having to return the following day to complete the topcoat. When approached with guidelines stating the topcoat may be placed later the same day as the slurry coat, any claims should be accompanied with documentation of successful testing.

#### FINISHING TOOLS

LWIC finishing tools and screeds are used to establish the grade for the topcoat placement. Square tube screeds are used to support a straight edge, and when pulled, the straight edge will create a finished surface. Screeds are set to ensure the LWIC is applied to the required depth. When removed, the area is then finished to a smooth trowel finish. The finish should be smooth enough to receive the roof membrane cover. Screeds are made of aluminum square tubing and should be used in place of heavy, round steel pipe. Steel pipes are difficult to handle and maintain, having a tendency to roll away when the concrete is placed. Screed should be used whenever possible. String lines should be considered only when screeds could not be used and/or over irregular surfaces or intricate, sloped sections. Screeds and straight-edged floats ensure proper minimum coverage.

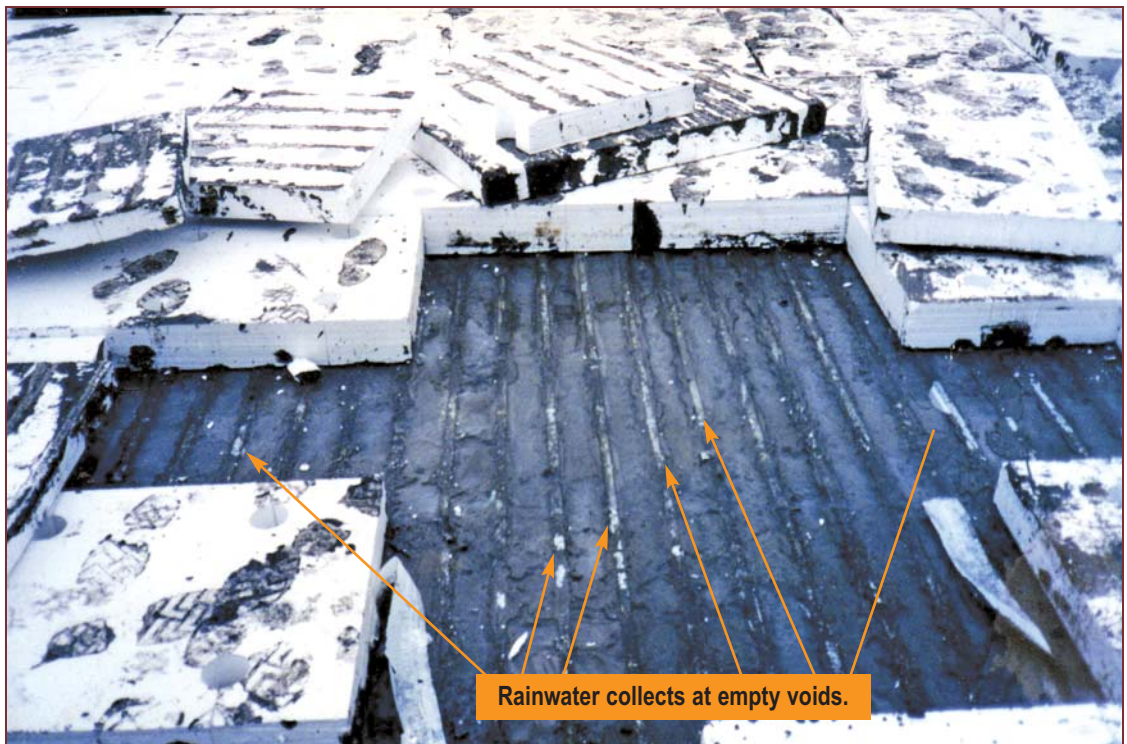


Figure 6 – Inadequate slurry coat. The only contact of the EPS boards with the slurry coat is at the metal deck's top flute.



Figure 7 – Cold joint formed using a square aluminum screed.



Figure 8 – End-of-the-day cold joint for following day tie-in.



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Figure 9 – Low compressive strength decreases fastener resistance.

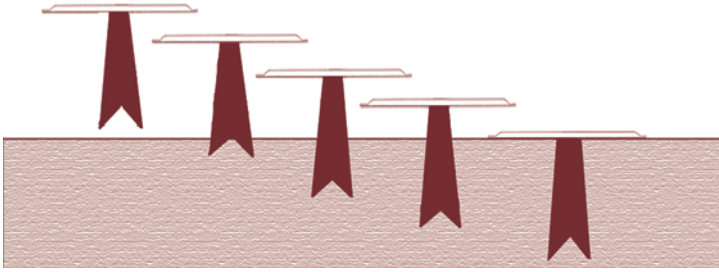
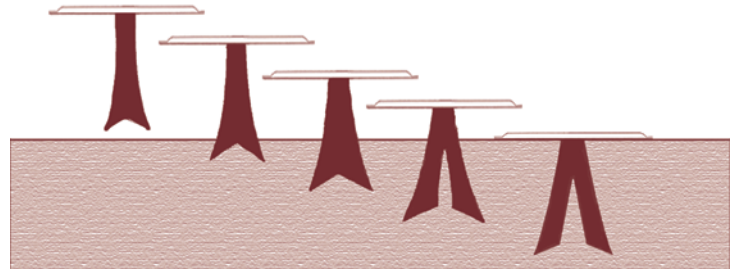


Figure 10 – High compressive strength increases fastener resistance values.



Finishing tools should be the type used to finish the LWIC to smooth-troweled finish in order to receive the roof membrane cover. Cold joints should be formed at the end of the day by using a square aluminum screed bar; after a short set time, they are removed, leaving a nice, clean tie-in for the following workday. *Figures 7 and 8* provide excellent examples of how to form a cold joint using a square aluminum screed.

#### **COLD JOINTS**

Cold joints and/or pour lines are intersections between two LWIC pours, one old and one new. When improper techniques are used or when equipment mechanical

breakdowns occur, cold joints become a common point of concern. Some are noncritical and are considered as surface imperfections unacceptable to receive roof membrane covers due to the surface roughness. Typically, scraping and a thin layer of patch material minimizes the concerns. Others will require the removal of unsound material consisting of flaking, soft, powdery, unbounded mate-

rials, which should be replaced in accordance with manufacturer-approved materials and guidelines.

#### **INDUSTRY STANDARDS FOR FASTENERS**

Industry standards state the lightweight



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insulating concrete fastener withdrawal shall have a minimum resistance of 40 pounds at the time of roofing. This is also a Florida Building Code requirement. Does this longstanding standard make any sense when faced with wind speed designs of 150 mph? In a word, "no." Long before 12-ft. x 24-ft. wind uplift tables came into being and long before ASCE 7 was authored, it was generally believed that monolithic roof decks (including LWIC decks) were airtight and therefore not subject to the positive pressures generated on the underside of roof membranes. Accordingly, the industry discounted applicable uplift requirements by one-third for monolithic structures, the thought being that two-thirds of the forces on the roof membrane were generated from above, and the one-third that was thought to be exerted from below was negated by the impervious monolithic deck. With Class I-60 being the most frequently encountered "standard" for wind uplift performance, and a typical fastening pattern of one fastener per sq. ft. (100 fasteners per square), an average fastener withdrawal of 40 lbs. was necessary to achieve compliance.

Today's product approval listings fail to mention the minimum fastener resistance requirements, only stating the number of days before roofing begins; others simply state "after several days." Depending on ambient temperatures, roof deck manufacturers may wait several days before roofing begins, in anticipation of fastener resistance values. As the LWIC cures, it gains compressive strength and, as such, increases fasteners' resistance values. When base ply fasteners are installed, the fastener's dual legs diverge as they wedge and anchor into the LWIC (*Figures 9 and 10*). Compressive strengths and fastener spacing will vary, depending on applicable uplift requirements. Individual roof deck manufacturers have specific requirements that need to be addressed before roofing begins. Prior to roofing, field withdrawal testing should always be performed to evaluate the ability of the LWIC to retain the base ply fasteners. When test results fall below project requirements, a modified fastener spacing pattern should be considered.

A basic understanding of the LWIC substrate, common sense, flexibility, and simple, rudimentary math skills are necessary to fine-tune fastening patterns based on the level of performance actually encountered on each specific LWIC roof deck. New dual-legged fasteners address today's higher wind uplift requirements. These fasteners

often make marginal assemblies viable and viable assemblies safer and more secure.

Taking the time to understand the char-

acteristics of the material will lead to better installations and more satisfied customers.



### Mark J. Bates

Mark J. Bates is the director of product development for Quantum Roof Deck Systems. He has over 27 years of experience in all aspects of the LWIC industry and personally designed and built one of the country's largest LWIC batch plants. Bates is a past president of Celcore, Inc. and served as president of the Florida Roof Deck Association (FRDA) from 2008-2010.

