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Dear Dipayan 23 Jan 02

Your letter w/ manuscript was here when I got back yesterday from a week + a holiday at TRB and a committee meeting in New York City.

You are dealing with Delamination. My view of delamination as related to cracks is not so much the delamination process as how did the concrete acquire a laminar structure i.e. what did the laminae come from that permitted the delamination to take place.

I looked in ACI 116R and found a definition of delamination that covers a lot of ground. But 116R has no definition of laminae or laminar. Presumably these are used in concrete technology have the same meaning they have in the "lay" language — ordinary speech. To me laminae are like pages in a book, cleavage sheets of mica or thin layers in slate or shale. I would not call all the laminae about the [illegible]

Reading the 1st page of your paper it appears you are going to talk about trowelled floors not mentioned in 116R. Maybe you should put floors in the title. You say "floor" and slabs. All floors are slabs (not all slabs are floors), Maybe you mean "floors" and other slabs "(slabs, pavements (?) or pavements?)

When air entrainment was new – and only obtained by air-entraining cement – our lab got the task of explaining the surface scaling ("delamination" I guess) that had happened was air-entraining cement was directly substituted for non-air-entraining cement and the water volume and slump both increased. Hence for standard placing & finishing, the coarse aggregate sank and a layer of laitance/cement paste formed on top which then scaled in freezing and thawing. We called it "manipulation scaling" – i.e. the concrete got too much manipulation in consolidation and finishing than it should have had.

In the last year or so I've heard a lot about coarse aggregate particles standing up after hand trowelling of concrete floors with entrained air – so entrained air is now forbidden in hand trowelled floors when all that was needed was a little more water to sink the rocks a little lower so when trowelled they don't leave take up due to the compression & decompression of the air in the concrete as the trowel passes down on the concrete. My comments on this have been published (I think in Concrete Construction).

A million metres square of airfield apron at Ramstein Germany showed severe paper thin cement paste scaling due to freezing of water in low places due to over finishing of air-entrained concrete with which the Germans were unfamiliar. It all happened the first winter after construction. The USAir Force in Paragraph about small flakes on pavement – they believe, incredibly, that these get sucked up jet engines and do damage. Not so.

I shall now read the manuscript and comment

Q Why "Revisited"? I do not find a reprint by you of a previous visit; so why not "State of the Art" or "Review of Knowledge"?

(2) I don't think very many fields are "cleaned" at floor delamination.

(3) A floor is a slab

(4) Spalling & Scaling are different hence a comma is needed - again all cases of ambiguity with "and" or "or"

(5) When a unit of measure is preceded by a numeral, the unit is identified by an abbreviation or symbol "6 in," NOT "6 inches"

(6) Do not give titles of references in the text

(7) As I have written elsewhere we know that air in concrete is compressible - the pressure method for air content uses this fact; hence unless having trowelled the air is compressed the concrete rises down & bounces back up when the trowel moves on .... all this means is the concrete needs to be a little stiffer - less compressible when heavily trowelled of air entrained. This also applies to coarse aggregate particles near the surface that get pushed down on the pass of trowelling and bounce back up & stick out of the floor surface or pull out and roll around and make trouble.

(8) I don't get the allusion to "chewing gum effect" Why is trowelling like chewing gum?

(9) Bleeding stops only when solids no longer move down (sink) in the water suspension - either because they've dropped as far as they can go or (more likely) because of initiation of setting of cement that changes the water suspension to a rigid framework.

(10) Regarding the frost susceptibility of the densified non-air-entrained slurry - if it has no freezable water and is dense and homogeneous it needs no entrained air (like a non porous rock) but if it is laminated (layered) and water can flow easily between the laminae (as in a slab or deck) it will delaminate - what has nothing to do with whether or not it is air entrained.

(11) I do not see the need for air drying of concrete that has a proper air-void system, frost resistant aggregate, and a strength of 4000 psi - it should be immune to freezing and thawing even when critically saturated. Our lab for to date passes the conformities. Drying before freezing of non-frost-resistant concrete will protect it by avoiding freezing while critically saturated.

(12) There is NO such thing as a water-void (analogous to an air void) in cement paste i.e. a volume of water surrounded by paste - but a quantity will simply be a zone of high W/cm paste, the only discrete volumes of water in hardened concrete bleed water voids beneath aggregate particles or other embedded items that do not sink during bleeding

(13) I do not see how elevated air temp over the slab can increase bleeding - it will accelerate hydration i.e. reduce setting time which terminates bleeding sooner than it would otherwise stop. I also cannot understand how the relativity is wind across the slab can increase the pull of gravity causing solids to sink in the

fresh concrete i.e. increase bleeding rate. It will increase the rate at which bleed water evaporates but not the rate at which it is produced.

(14) The term premature stiffening" see ACI 116R means flash setting or false setting of portland cement due either to insufficient gypsum or partly dehydrated gypsum - and should not be used to mean early time of setting in general.

(15) How do you get an abnormal amount of unhydrated cement and a higher than normal amount of capillary pores since the source of water to hydrate cement is in the capillary pores. You would only get this combination if the water evaporated not only from bleeding but also from the capillary pores - which doesn't usually happen until a day or so after finishing even in dry hot weather, i.e. the internal RH has to drop to ~80% or less for water to become unavailable to hydrate cement by emptying the capillary pores.

(16) I believe the rest of my comments are clear on the marked copy.

This is an exhaustive study. It tells me - and I'm afraid, most people more than they really want to know about delamination but it should be published for the record.

The to me unresolved question is whether you can hand machine trowel a properly proportioned air-entrained concrete floor if you wait until initial setting of the concrete has not only stopped bleeding but also reduced the compressibility of the concrete (due to the air) so it doesn't just drop down & bounce back under the finishing and pump up stuff to make a laminated layer. I suspect you can but I think you want till the heel print only goes in 1/8 in or so! —

Was glad to get to read this. I learned a lot - I that you hope a few bits to learn too and I hope my comments will help.

Best wishes to Bernie.

Jim

Encl 116R 2 pp.
marked copy

Bryan Thatcher