Field Notes on Durisol Building

July 2001

I visited David's house in Lancaster, MA this evening to learn as much as I could about their experience in using the Durisol material for the construction of their house. It is a large 2-family building, Durisol running from footing to roof.

The building has quite a number of angled walls. David is acting as General Contractor, using a crew of masons experienced in commercial work using concrete masonry.

David made the following observations:

1. The masons have come to like and enjoy working with the Durisol material. They are basically positively disposed towards it. They like the fact that the drystack blocks go up quickly. (They are using 3-core blocks with only 1.5 inches of mineral wool insulation insert)
2. The masons found that the "biscuit" groove (a recent Dursiol innovation) is virtually useless, because it controls the block alignments too greatly and resists shimming and shifting to maintain alignment.
3. They have found that the use of dabs of "liquid nailer" on each of the four corners of the block is most useful for alignment.
4. Every four courses they snap lines to check horizontal alignment, and use chainsaws or belt sanders to cut down any high spots.
5. David's experience is that drilling and doweling wall reinforcing steel into the footing is better than casting them in the first instance. (They cast the dowels in and regretted it because the alignments were unsatisfactory.)
6. Perhaps the most important lesson they've learned to date is that the "cores rule" - i.e. that however the blocks are cut and dry stacked, the most important criteria is to maintain the continuity of the block cores - and therefore maintain the structural integrity of the wall system.
7. The material from the Idaho-based architectural firm that specializes in using Durisol has been invaluable to their process. In addition, the continued technical support offered by this firm has also been invaluable. I saw the two sheets of standard details that were provided by this firm and they appeared to be intelligent and practical. In some instances, their details deviated slightly from ours - including the following:

   - A double LVL ledger below the joist, which apparently eliminates the conflict of joist hangers and ledger attachment bolts.

- Alignment of the top of the 2" concrete topping slab with the top of a block course - the upper 2" of the inside wall form wythe was cut down to allow the slab to extend in and lock in to the wall core.
- 2x4 window sill nailer cast into the block core
- A detail to attach interior partitions to the exterior Durisol wall.
- A lintel detail using twin angles in a T-configuration, with the upward projecting angle legs extending into the center core of the block. Note that the blocks require shaving to compensate for the thickness of the lintel angle flange.

8. David has found chainsaws the most effective tool for cutting blocks. He uses a standard chainsaw blade with which he cuts approximately 100 blocks before sharpening is necessary.
9. Carpenters would, he feels, be better at this activity than masons. David's experience is that masons make a less than ideal (though functionally acceptable) job of angled cuts on blocks.
10. David has had no problems with Durisol's delivery schedules. They have always delivered the ordered blocks in a timely manner.

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For the Fredericks house in Great Barrington, a crew of masons laid up the wall forms, and I found them to be unnecessarily fussy. I thought that they behaved as though they were laying load-bearing block rather than the forms for load-bearing concrete core to be poured inside. The result, I think, was that my client paid for more than she needed— the concern for a smoothly planing exterior for stucco-ing assumes that an undulation-free wall plane is desired (not usually true for people freed for the tyranny of drywall), or that there is not a simpler way of achieving planarity (such as working over projecting block corners with a planer).

Wallform Lay-up:

- Peter Jessop (Integrity Builders) and I decided to erect the wall forms using carpenters because they might have a better sense how to spend their time most effectively.
- It took a full day to move the 620 blocks from pallets deposited around the perimeter down into the excavation (620 blocks; 1240 S.F.; 14 man-hours— 90 S.F. per man-hours for block moving). The first course, bedded in mortar on the concrete footing, took two men a day to do (168 blocks; 136 S.F.; 16 man-hours — 8.5 S.F. per man-hour; 68 S.F. per man-day). Laying up subsequent courses, including locating horizontal and vertical steel reinforcement was approximately four times faster (31 S.F. per man-hour; 248 S.F. per man-day). The rate of lay-up for the body of the wall could have been at least doubled (to 500 s.f/man-day) if the vertical reinforcing was omitted during the lay-up and placed during the core concrete pour as recommended by Durisol for the above grade walls. However, the greater precision required to locate these bars just an inch from the inside of the core

(plus the fact that we had a building jacked 5' above the top of wall) lead us to the prior placement.
None involved had used this material before.

- The first course was set in mortar and guided by 2 x 3 fastened to the footing all the way around. As well as a string line for the top alignment. This course was set with 1/16"± at each corner. This is why it took so much longer.
- The wall form, once the first course had been accurately laid down, proceeded very smoothly. We used two "biscuits" per 600mm block (Durisol recommends using one, but we found using two was an improvement — it allowed us to proceed faster and with greater confidence that the blocks had been accurately located). We found a large-ish 4-lb hammer to be the ideal tool for tapping blocks into place. Smaller framing hammers appear more likely to damage the block, especially deforming the biscuit groove.
- There was a noticeable difference in the ease of placement of the biscuits in the wallform blocks with the thinner insulation (we used blocks with 1.5" of insulation for the lower six courses to gain more concrete in the core (more lateral strength), and wallforms with 3" of insulation for the top two courses (to improve thermal performance where it mattered most). The latter blocks — every single one of them — had biscuit grooves that were narrower and shallower …. And setting these wallform blocks took twice as long and was less satisfactory, than setting those with thinner insulation. I have to believe that this was some glitch in Durisol's production process.
- We did not use a single shim in the 8 courses of dry stacking. Top corners were within 7/16" of horizontal accuracy. A reasonably good result with no fussing.
- The dry stack wall retained reasonable horizontal alignment — reasonable means within 1" to 1 1/2" of a string. We did not set strings after the first course because we figured that we could align the top of the wall afterwards in the shoring phase. This proved correct— (see below)— but stringing a line after completing the 4th course might have been a good idea, maybe we were just lucky.
- Vertical alignment: we just lay-up the wallforms by eye, starting in from each corner and cutting to fit at mid-point. (I think we may have checked for vertical at each face of each corner at the 4th course. We completed the lay-up with each face of each corner within 1/4". No story pole was used for our 8' 0" wall…Again maybe we were just lucky, or have impeccable judgment.

Vertical steel wall reinforcement (further to above):

- We cut our bars in 4' lengths and installed them after the first course leaning 6" (we should have lapped 12") down the core to make a tied connection. This way we avoided lifting the blocks too high to place them over the reinforcing.
  We wonder what alternatives exist in vertical wall reinforcement placing for below grade

wall reinforcement where prior placement seems necessary, and the amount of vertical rebar is around three to four times that required in the above grade condition.

- *Durisol adds:*
  The vertical rebar placed prior to pouring concrete is done in situations like yours (basements and retaining walls) , where the placement of the vertical rebar is critical. In above-grade walls, where the walls are designed for bending in both directions, the vertical rebar is designed to be positioned in the center of the core. in these applications, inserting the vertical rebar after the pour is OK as the average position of the entire wall should be in the center as intended. Also, by alternating the horizontal rebar from one side to the other, a path is created for the vertical rebar to be "thread" between the alternating horizontal rebars

- Tie-ing lapped vertical reinforcement proved a challenge. Working with wire ties in the cavity is abrasive and time consuming. We used plastic zip tie. A better solution would be a plastic snap junction …

Horizontal reinforcement: — Should this be lifted into the concrete core or laid down on the wall form material?

- *Durisol responds as follows:*
  The horizontal rebar is not in the center of core, but there are two reasons why this is OK.
  1. The reason for adequate concrete cover is so that stresses can be transferred between the concrete and steel. The 230mm of concrete between the web locations (i.e. at 300mm spacing) is sufficient for this transfer of stresses to take place.
  2. The walls are designed to span vertically from top to bottom, in which case the vertical steel is the structural reinforcing. The horizontal rebar is placed primarily for crack control - an aesthetic non/structural issue, that is minor especially since the concrete is complete encased in Durisol (so that cracks aren't visible).

Wastage: : We found that wastage was small — 1% for breakage during shipping and handling; 4% cutting. Durisol have a similar estimate, however they seem to add contingency at both price/proposal stage and the order/shipping stage. Since I also had figured in a wastage estimate of 5%, I ended up with 60 or 70 blocks left over!

Durisol adds:
We typically recommend using block wastage between 3% - 5%. As you mentioned, more complex buildings may go as high as 10%.

Wall Form shoring: Our principal concerns for shoring were as follows:

- To prevent corner blow-outs: Generally speaking, wall forms are especially stable, to suggest that very little shoring is required and certainly far less than has been apparently used for the polystyrene ICF systems. The Durisol wall forms are simply heavier and the biscuited joint offers us some minimal resistance to lateral dislodgment.
- To prevent uplift and thereby concrete leaking out the horizontal joints: We applied 2x4 at 8' on center along the wall, securing with screws at 4 or 5 points up and down to tie the courses and prevent any potential for buoyant uplift that might allow concrete to seep

through the horizontal joints. Our efforts in this regard appeared superfluous. (I subsequently discussed the need to deal with this contingency with John Straube, Design Consulting Engineer to the Durisol Company. He felt that there was no practical possibility that such buoyant uplift could occur with a wall form material of this density.)

- To align and stabilize the top course: We found that the wall forms can readily be aligned to achieve a straight and true top course, especially using a robust hammer and jolting the individual blocks from four or five courses below on up in the general area where realignment is required. That, together with some horizontal pressure on the shoring 2x4 wood pieces, is all that is required to achieve a true alignment. An element of shoring that we neglected, but shouldn't have, was stabilizing openings against the ravages of the swinging boom / chute of the concrete pumper truck. This massive pendulum is capable of dislodging the more sensitive parts of the stacked wall form assembly, especially if the operator is not paying sufficient attention.

Concrete core filling:

- Whereas Durisol specify at 2,500 psi strength mix as being sufficient, the mix will typically be increased to 3,000 psi if a pump truck is involved. Apparently the pumping needs the additional lubricant capabilities of the richer cement mix. (Durisol advised that the reason for the 2,500 psi specification is so that it can be installed in California without triggering a special permitting / inspection regime that kicks in above that limit.)
- We laid the wall forms to their full height and then poured the core in three lifts in a single pumping operation. This avoids the additional expense of remobilizing the pump truck and even on our 130' total perimeter, the mix had sufficiently stiffened such that as the pumping operation returned to add the second 32" lift, the first pour had stabilized.
- Whereas I had previously assumed that the wall forms required a vertical delivery of concrete to avoid dislodging their alignment, it's apparent that the wall forms laid up reinforced, particularly with the biscuit joints, and with a minimal amount of shoring, are strong enough to accept concrete delivered directly by chutes in the back of the concrete truck, thereby avoiding the expense of a pump operation. This, however, will only apply to the foundation wall stage and will inevitably require the concrete truck to circulate around the perimeter of the construction. Any protection necessary to avoid undue soil compaction may end up costing more than the pump truck, which enables the concrete delivery truck to be constrained to a single location.
- We didn't use any vibrator, not even a "pencil" vibrator recommended by Durisol. The concrete operators involved were uncomfortable at such a prospect. I think this might have much to do with their entire experience being with polystyrene dry-stacked wall forms. The Durisol material appears considerably more robust. Nonetheless, they recommended amore gentle alternative — affix a soft pad to a reciprocating saw and use that on the surface of the wall form as the vibrating agent, if any is deemed necessary.
- We determined that the cores were full simply based on the calculated amount of concrete needed and the high correlation between that and the amount consumed.

Waterproofing : The Delta MS polyethylene dimple mat is quite compatible with the Durisol wall system.

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- The biscuit grooves are still insufficiently well-formed (just as we experience with the barn project earlier in the year - required cleaning out with a screwdriver.

- Phil also found that it pays to straighten the wall up at the end of the lay up rather than in the middle — again consistent with our experience with the Coldham barn project.

- The blocks vary by 1/8" to 1/4". The module that we set up was exceeded by 2 1/2 inches in 46'. See whether we can establish a constant, and perhaps the module is not 300 mm but 303 mm or some such. They had to do a lot of cutting which has slowed them down considerably.

- The electrician worked in tandem with the lay up crew. Phil made the cuts for the electrical boxes. The electrician routed the blue conduit in the wall cores. We kept most of the electrical out of the exterior wall.

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