



July 19, 2001

Mr. Ted Dial  
Dac-Art Corporation  
PO Box 6130  
Mobile, AL 36660

dacology@aol.com

Phone: (251) 476-4001  
Fax: (251) 476-6960

**Potential for Moisture Migration through Exterior Dac-Art Walls  
CTL Project No. 180029**

Dear Mr. Dial:

As requested in your letter received on April 30, 2001, CTL has prepared this summary on the potential for moisture migration through exterior walls constructed using the Dac-Art building system.

**WALL DESCRIPTION**

A cross-section of a Dac-Art block is provided in Drawing No. FW\_F\_S\_123020 provided by you in an email to CTL dated April 10, 2001. A copy of this drawing is attached. According to the drawing and information provided by you, the outside faces of the block are normal weight concrete. The inside faces of the concrete may or may not be lined with  $\frac{3}{4}$ -in. expanded polystyrene insulation (EPS or beadboard). The interior is filled with normal weight concrete during construction of a typical building. In the  $12\frac{1}{4}$  -in.-thick block, the thickness of the outside faces of the block varies from  $2\frac{1}{4}$ -in. to  $3\frac{3}{4}$ -in. depending on the location within the block and whether insulation is provided. The blocks are stacked in a relatively tight manner. The hooks that extend upwards from one block and are used to seat the block being placed on top. You have indicated that sealant is used to fill the notched portion adjoining two blocks.

**MOISTURE MIGRATION**

Moisture migration through exterior walls of buildings can cause damage to the walls and interiors of buildings. In warm US climates, damage generally occurs in one of four ways. A brief, simplified description of the four mechanisms follows along with an explanation of how Dac-Art is expected to perform. Our opinion of the performance is based on the above-referenced drawing and the properties of normal weight concrete.

- 1.) **Moisture-laden air infiltration.** In warm climates, air infiltration from outside to inside carries moisture that can condense within walls, beneath vinyl wall coverings on indoor surfaces, or on cold surfaces within the occupied areas. Moisture-laden air infiltration is not expected to be a problem for the Dac-Art system because the blocks sit tightly on top of one another and are filled with normal weight concrete. The concrete fill in the center of the block, which prevents air penetration, will stop any air that is able to work its way through the sealant and between the blocks. Moisture-laden air infiltration and subse-



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quent damage is most common in wood frame cavity walls or unfilled concrete block walls where air is free to move within walls. As long as the interiors of the blocks are completely filled with concrete, the Dac-Art building system does not have air cavities that allow exchange of air or moisture-laden air infiltration. Moisture does not damage concrete in southern climates.

- 2.) **Water vapor transmission through walls.** Water vapor is transmitted through building materials when a difference in vapor pressure is present between the indoor and outdoor environment. This water vapor differential is generally present due to different temperatures and relative humidities indoors and outdoors. The water vapor permeance of the block with concrete fill and no insulation is 0.26 perms<sup>(1)</sup>. Assuming ¾-in. EPS insulation is present in each face, the permeance of the block is also approximately 0.26 perms.<sup>(2)</sup> Including the effects of a coating would further reduce the permeance. A material or system with a permeance less than 1.0 perm is considered “nonbreathing” or a vapor retarder. Water vapor will not readily be transmitted through the material under normal temperature and relative humidity conditions.
- 3.) **Wind-driven rain.** In this case water enters through small openings in wall exteriors and can cause damage to the walls or interiors of buildings. Like the case with moisture-laden air, wind-driven rain will not likely penetrate the Dac-Art system. Damage due to wind driven rain is most common in wood frame cavity walls where water can accumulate within walls. As long as the interiors of the blocks are completely filled with concrete, the Dac-Art building system does not have air cavities that allow rain water to accumulate. Any water that slips between blocks will be stopped by the insulation or interior concrete fill. However, if insulation is present, and the sealant fails and the blocks are not tightly held together, there is a potential for the insulation to get wet. This would degrade the energy performance of the insulation and could potentially cause mold and mildew within the wall. However, we anticipate the same mechanism that would allow the moisture to enter the wall would allow it to dry out, especially since there are no cavities to allow significant amounts of moisture accumulation.
- 4.) **Poor details at windows and doors.** Water can penetrate exterior walls at windows and doors if details are not properly designed to prevent intrusion of moisture. CTL has not reviewed window and door details for the Dac-Art building system. However, edge blocks, which provide concrete surfaces at openings, will act as a primary defense against moisture entering the wall at window and door openings.

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<sup>(1)</sup>The water vapor permeance of an inch of concrete is 3.2 perms (2001 ASHRAE Fundamentals Handbook, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, p. 25.16.) The water vapor permeance of 12.25 in. of concrete is  $3.2/12.25 = 0.26$  perms.

<sup>(2)</sup>The water vapor permeance of an inch of EPS is in the range of 2.0 to 5.8 perms (2001 ASHRAE Fundamentals Handbook, p. 25.16.) Assuming the permeance of the EPS and concrete is 3.2 perms, the permeance of the block is 0.26 perms. Using a conservative value of 5.8 perms for the EPS, the water vapor permeance of the block is  $1/((10.75/3.2) + (1.5/5.8)) = 0.28$ .



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In hot and humid climates it is recommended that vinyl wallcoverings not be used on the interior surfaces of concrete walls, including Dac-Art walls. Moisture of construction will be present in the walls that could migrate to the block surface behind the wallcovering and cause mold and mildew problems. The moisture from the walls will escape to the indoor and outdoor air, and not be detrimental as long as vinyl wallcoverings or other “nonbreathing” materials or coatings are not applied to the block surfaces<sup>(3)</sup>. Gypsum products should not be placed in direct contact with the wall as these products can expand and degrade in the presence of moisture. Also, like all concrete buildings, a higher than normal relative humidity of the indoor air may be experienced during the first year. This can be alleviated by adequate ventilation and dehumidification.

### SUMMARY

The Dac-Art building system was reviewed by CTL for potential moisture-related problems. The system reviewed does not have potential problems due moisture-laden air infiltration or water vapor transmission. Wind-driven rain could potentially cause insulation to get wet if the sealant failed and the blocks were not tightly fitted together, but we anticipate the insulation would dry. Care must be taken to prevent water intrusion at window and door openings. Vinyl wallcoverings or other nonbreathing materials or coatings on the block surfaces are not recommended.

We appreciate this opportunity to conduct specialized engineering services for you.

Sincerely,

**CONSTRUCTION TECHNOLOGY LABORATORIES, INC.**

A handwritten signature in black ink that reads "M G Van Geem".

Martha G. VanGeem, PE  
Principal Engineer  
Materials Engineering  
mvangeem@CTLgroup.com

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<sup>3</sup> “Nonbreathing” materials generally have a permeance of less than 1.0 perm, and “breathing” materials generally have a permeance of 5.0 or more perms. If more than one material is applied, such as wallboard and paint, the permeance of the combination needs to be determined. More information is available in ASTM C755-97, “Standard Practice for Selection of Vapor Retarders for Thermal Insulation.”