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www.CTLGroup.com

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**Nudura ICF as an Air Barrier System
CTLGroup Project No. 312065**

Dear Mr. Rector:

At your request, CTLGroup has prepared this letter explaining why a Nudura Wall System functions as an air barrier and does not require the addition of another air barrier. The intent of this letter is to address air barriers, not secondary weather membranes.¹

THE NUDURA WALL SYSTEM

According to information on your website (www.Nudura.com), the Nudura insulated concrete form (ICF) wall system consists of two panels of expanded polystyrene insulation approximately 2½ -in. thick separated by a continuous core of concrete. The overall thickness of the wall is approximately 9, 11, 13, 15, or 17 in. thick with a concrete core of 4, 6, 8, 10, or 12 in., respectively. The polystyrene layers are held in place by high-density polypropylene ties.

AIR BARRIERS

According to ASTM E1677-95², an air retarder or barrier is “a material or system in building construction that is designed and installed to reduce air leakage either into or through the opaque wall.” This standard also states that air barrier film materials such as Tyvek® HomeWrap® and other building wraps must have an air permeability not greater than 0.06 cfm/ft² under a pressure differential of 0.3 in. water³. These types of products generally have air leakage or permeability of 0.0022 – 0.71 cfm/ft² under a pressure differential of 0.3 in. water. Concrete has no measurable air permeability or leakage.⁴ The expanded polystyrene insulation in the ICF meets the requirement of an air barrier with an air leakage rate of 0.023.⁵

¹ Building wraps are often used as a secondary weather membrane in wood and metal frame walls.

² ASTM E1677-95 (2000), “Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls,” ASTM, www.ASTM.org

³ Products must be properly installed to achieve these values in practice.

⁴ Advanced Buildings E Benchmark, New Buildings Institute, 2003. www.newbuildings.org

⁵ Based on a material density of 1.3pcf from www.Nudura.com and a classification of Type II insulation according to ASTM C578-04, “Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.” Air leakage rate from article by Wagdy Anis, “Commissioning the Air Barrier System,” ASHRAE Journal, March 2005, www.ashrae.org.

In addition, air barriers should be continuous, able to withstand the forces that act on them during and after construction, and be durable for the expected life of the building.

Continuity. An air barrier needs to be continuous to be effective. The Nudura ICF wall system provides this continuity. Gypsum wallboard and building wraps can act as an air barrier in a frame wall system, but all joints between sheets of material must be tightly sealed. The Nudura ICF wall system provides a triple air barrier. The concrete in the Nudura ICF wall is continuous around the building and does not have joints that need to be sealed when concrete is placed according to manufacturer's instructions. The rigid insulation on each side of the concrete in the Nudura wall also meets the requirements of an air barrier. The interlocking nature of the insulation provides continuity as an air barrier.

Others have suggested that shrinkage cracks form in the concrete in the vicinity of the ICF webs, thus allowing air leakage. CTLGroup experience during multiple research programs on ICFs shows no evidence of shrinkage cracks in the concrete at ICF webs.⁶ Shrinkage cracks are caused by drying of the concrete. CTLGroup studies have shown that the insulation dramatically slows the rate of drying of concrete in ICFs, therefore minimizing the extent of possible shrinkage cracking. Furthermore, the purpose of reinforcing steel in concrete is to keep any cracks that form in concrete tightly closed. Therefore, any cracks that form would not allow appreciable air leakage. Furthermore, if cracks did form at the webs, the insulation would prevent air leakage through the wall. Note that the ICF webs and joints in the insulation do not occur at the same place. The interlocking nature of the insulation at its interface with the concrete prevents the passage of air along this plane. There is no path for air to pass through a concrete crack at an ICF web and through the wall. The combination of concrete and two layers of insulation provides a triple, continuous air barrier in the Nudura ICF wall system. Air penetrating one of these must penetrate the other two.

Load capacity and durability. The air barrier needs to resist positive and negative pressures induced by wind, fan, and stack effects. If the air barrier system for a frame wall system is made of building wrap or flexible membranes, then it must be supported on both sides by materials capable of resisting the peak air pressure loads. Alternatively, it must be made of self-supporting materials, such as board products adequately fastened to the structure. Tape and sealant must also resist these pressures and have long-term resistance. Concrete is the ideal material for an air barrier because of its continuity, and durability, and strength in resisting these loads. Properly constructed concrete in walls is expected to last the life of the building.

CONCLUSION

Nudura ICF walls act as an air barrier and do not require an additional air barrier material on either the inside or outside of the wall, regardless of the interior or exterior finishes applied to the wall, due to the following:

- 1.) Nudura walls contain a continuous layer of concrete and two layers of insulation forming a triple air barrier.

⁶ CTLGroup has also performed studies on ICFs where the insulation is removed from the panels to determine the condition of the concrete. These studies have shown no evidence of shrinkage cracking at the webs.

- 2.) Concrete has a lower air permeability or leakage than materials such as Tyvek® building wrap traditionally sold as air barriers. The expanded polystyrene used in Nudura ICFs meets the definition of an air barrier.
- 3.) The reinforcing steel in concrete is designed to keep cracks tightly closed.
- 4.) If cracks in the concrete were large enough to allow the passage of air, the air would be stopped by the two layers of expanded polystyrene. The point of weakness in the polystyrene is at the joints, and the joints in the polystyrene are not aligned with the ICF webs, which is the proposed (by others) point of weakness in the concrete.
- 5.) Tyvek® building wrap, and other air barrier membranes are useful for wood or metal frame walls because they otherwise lack a continuous air barrier within them.

This conclusion is valid for all climates.

Please contact me if you have any questions or comments.

Sincerely



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