



TECHNICAL BULLETIN FC-15

ENGINEERING DESIGN TABLES FOR NUDURA® ICF WALLS WITH TUF-STRAND SF™

EUCLID CHEMICAL

With the recent advancements in the use of macrofibers for concrete reinforcement and their acceptance within design guides such as ACI 544-4R, these products can now be used as a true replacement to conventional steel rebar and wire mesh in many projects, and specifically into wall applications. Historically, Insulated Concrete Form (ICF) walls have been reinforced by conventional rebar that have been engineered to resist forces from soil, wind, and other loading conditions. Euclid Chemical has partnered with Nudura, a manufacturer of expanded polystyrene forms for the wall construction market, to develop engineering tables determining the correct dosage of TUF-STRAND SF macrofiber to replace conventional steel in Nudura's ICF wall systems. The use of these tables shows the replacement of horizontal steel bar only where temperature and shrinkage crack control is needed or for the replacement of both horizontal and vertical steel for engineered bending moment design. These tables have been developed for both USA and Canada and are stamped by engineering firms and are only applicable to TUF-STRAND SF, where ASTM standardized test data and the performance of this fiber in concrete has been taken into consideration. The tables are also only applicable to one and two story residential and light commercial structures that conform to the requirements of the 2015 and 2018 IRC and referenced design guides.



While the tables provide dosages of TUF-STRAND SF for varying reinforcement configuration, there are also portions of the tables where fibers are not recommended due to high amounts of fiber required that are not considered feasible in typical concrete wall mixtures due to workability or mix design adjustment needs. For questions or clarification on the use of these tables, applicable stamps, loading areas or fiber dosages, please contact your local Euclid Chemical or Nudura technical sales representative at your convenience. Two examples of how to correctly use these tables are as follows:

**EXAMPLE 1:** Determine the correct TUF-STRAND SF fiber dosage for a below grade wall system with a height of 9', backfill depth of 8' and a wall thickness of 8". The selected dosage must also be made for the correct earthen fluid pressure (45 psf for this example) and a seismic design category of A, B or C as described within the notes of the tables.

From Page 10 of the Synthetic Fiber Reinforcing Tables, Design Limitations and Tables for Above and Below Grade Walls with Fiber-Reinforcement (Valid in USA only and where engineering stamps have been provided):

Below-Grade Walls Built with Nudura Insulated Concrete Forms for Seismic Design Categories A, B, and C										
Wall Height	Backfill Height	Required Dosage (lb/yd <sup>3</sup> ) to Replace Vertical & Horizontal Steel								
		Equivalent Fluid Pressure								
		30 psf/ft			45 psf/ft			60 psf/ft		
ft	ft	6" Wall	8" Wall	10" Wall	6" Wall	8" Wall	10" Wall	6" Wall	8" Wall	10" Wall
8	4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	5	4.0	4.0	4.0	4.5	4.0	4.0	6.0	4.0	4.0
	6	4.5	4.0	4.0	7.0	4.0	4.0	9.5	5.0	4.0
	7	6.5	4.0	4.0	10.0	5.5	4.0	-	7.5	4.5
	8	9.0	4.5	4.0	-	7.0	4.5	-	9.5	6.0
9	4	4.0	4.0	4.0	4.0	4.0	4.0	4.5	4.0	4.0
	5	4.0	4.0	4.0	5.5	4.0	4.0	7.0	4.0	4.0
	6	5.5	4.0	4.0	8.0	4.0	4.0	10.5	5.5	4.0
	7	7.5	4.0	4.0	11.5	6.0	4.0	-	8.0	5.0
	8	-	4.0	4.0	-	8.0	5.0	-	11.0	7.0
9	-	7.0	4.0	-	-	6.5	-	-	8.5	

- Notes
- 1) Shaded data indicates reinforcing for estimating purposes only. Wall heights exceed IRC prescriptive limits. A local design professional shall be consulted for additional review for these wall heights.
  - 2) This table is to be used in conjunction with the "Design Limitations" prepared by Keystone Structural Solutions.
  - 3) Refer to the "Design Limitations" for information on Codes, construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, and additional design and installation requirements
  - 4) If ONLY the horizontal steel is to be replaced the required dosage is 4.0 lb/yd<sup>3</sup> for all conditions. See the steel reinforcement tables for required vertical steel.

The correct dosage of TUF-STRAND SF to match the selected criteria is 8.0 lb/yd<sup>3</sup> (4.7 kg/m<sup>3</sup>) to replace the vertical and horizontal reinforcement. If ONLY the horizontal steel is to be replaced the required dosage is 4.0 lb/yd<sup>3</sup> (2.4 kg/ m<sup>3</sup>) with a note provided directly beneath the table. It is not necessary to add the two dosages together if replacing both steel configurations.



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**EXAMPLE 2:** Determine the correct TUF-STRAND SF fiber dosage for a one-story, above grade wall structure with a height of 12', thickness of 6", Exposure B Category with wind speed up to 180 mph and seismic design category A, B or C.

From Page 14 of the Synthetic Fiber Reinforcing Tables, Design Limitations and Tables for Above and Below Grade Walls with Fiber Reinforcement (Valid in USA only and where engineering stamps have been provided):

Above Grade Walls: Vertical and Horizontal Steel Reinforcement for Walls Built with Nudura Insulated Concrete Forms									
Wall Height	Required Dosage (lb/yd <sup>2</sup> ) to Replace Vertical Steel				Required Dosage (lb/yd <sup>3</sup> ) to Replace Horizontal Steel Only		Required Dosage (lb/yd <sup>3</sup> ) to Replace Vert. & Horiz. Steel		
	180 mph Basic Wind Speed (3 second gust), Exposure B								
	Seismic Design Category A, B, or C								
One Story Concrete Structure or Top Floor of 2 Story Concrete Structure Supporting Wood Frame Roof									
ft	4" Wall	6" Wall	8" Wall	10" Wall	4" Wall	6", 8", 10" Wall	4" Wall	6", 8", 10" Wall	
8	5.0	4.0	4.0	4.0	6.5	4.0	6.5	4.0	
9	6.5	4.0	4.0	4.0	6.5	4.0	6.5	4.0	
10	8.5	4.0	4.0	4.0	6.5	4.0	8.5	4.0	
12	-	5.0	4.0	4.0	-	4.0	-	See Vert. Dosage	
14	-	7.5	4.0	4.0	-	4.0	-	See Vert. Dosage	
16	-	9.5	5.0	4.0	-	4.0	-	See Vert. Dosage	

Notes

- 1) Shaded data indicates reinforcing for estimating purposes only. Wall heights exceed IRC prescriptive limits. A local design professional shall be consulted for additional review for these wall heights.
- 2) This table is to be used in conjunction with the "Design Limitations" prepared by Keystone Structural Solutions.
- 3) Refer to the "Design Limitations" for information on Codes, construction methods, material specifications, design loads, additional wall reinforcing requirements around openings, minimum wall length, and additional design and installation requirements.
- 4) For 180 mph Exposure C conditions, consult with a local design professional.

The correct dosage of TUF-STRAND SF to match the selected criteria is 5.0 lb/yd<sup>3</sup> (3.0 kg/m<sup>3</sup>) to replace the vertical and horizontal reinforcement. If ONLY the horizontal steel is to be replaced, the required dosage is 4.0 lb/yd<sup>3</sup> (2.4 kg/m<sup>3</sup>) with a note provided.

The preceding examples are for ICF walls with TUF-STRAND SF fiber in the USA only. For both above and below grade walls, any additional steel reinforcement around doors, openings, lintels or concentrations of additional stress should have conventional reinforcement remain in place. Similar tables have been provided for Canada with slightly different dosages based on local and national building code requirements. These tables have also been stamped by a licensed firm for most provinces.

At all times, it is the responsibility of all parties involved, including the builder and subcontractors, to review the applicability of these tables and notes to the project specific conditions. Nudura and Euclid Chemical assume no responsibility regarding the misinterpretation or misuse of the provided tables.

The use of TUF-STRAND SF in a Nudura ICF wall system can assist the contractor by reducing labor to install conventional steel, increase speed, provide better onsite job safety, lower the environmental impact and reduce overall cost. Fiber use may alter the concrete rheology and Euclid Chemical can provide technical assistance to ensure proper mixing, placement, and consolidation of TUF-STRAND SF in Nudura ICF wall systems. Typical mixture adjustments may include the use of chemical admixtures to offset or assist in flow and placement requirements.

For more information on Euclid Chemical's line of fiber products, including TUF-STRAND SF, please contact Euclid Chemical Company or visit our website at [www.euclidchemical.com/products/concrete-fibers/](http://www.euclidchemical.com/products/concrete-fibers/)

For more information on Nudura ICF systems, visit [www.nudura.com](http://www.nudura.com)