SE Williams Consulting, LLC
1038 Wren Ave, SE
East Grand Rapids, Michigan 49506

Mr. Erik Kiilunen, President
Neuvokas Corp.
3206 Number 6 Rd,
Ahmeek, MI 49901

RE: Use of GatorBar® in Residential Foundations

Dear Mr. Kiilunen:

It is my professional opinion, as a registered professional engineer in the State of Michigan, that #3 GatorBar® may be substituted for #4 steel rebar in footings, thickened edge slab foundations, and footings with stem walls in one- or two-family residential construction of three stories or less, supporting light framed construction in Seismic Design Categories A to D_2, since it meets or exceeds the intent of the International Building Code (IBC) and the International Residential Code (IRC).

My reasoning for coming to this opinion is as follows:

Steel Reinforcement in Footings and Stem Walls – The IRC Section 403.1.3.5 requires that reinforcement in footings and stem walls have a minimum yield of 40,000 psi.

Footings for Stem Walls and Thickened Edge Slabs - The IRC, which applies to one- and two-family residential dwellings of three stories or less, in Seismic Design Categories A, B, or C, shows, in Tables R403.1(1) to R403.1(3), concrete footings without reinforcement. Spread footings supporting stem walls and thickened edge slabs in Seismic Design Categories D_0, D_1, or D_2 do require reinforcement in the amounts described in R403.1.3.1 and R403.1.3.2. For stem walls this is a #4 bar in the bottom of the footing and for thickened edge slabs this is a #4 bar in the top and bottom of the footing. In neither instance would the footing be considered reinforced concrete by ACI 318, which defines plain concrete as follows: "**Plain Concrete –** Structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete". The specified amount of reinforcement for stem wall and thickened edge slab footings is less than the minimum for reinforced concrete. Therefore, by definition these are plain concrete footings with longitudinal bars included.

Stem Walls – Stem walls are considered as part of the footing/foundation under the IRC and their requirements are included under Section R403 Footings. In Seismic Design Categories D_0, D_1, or D_2 a longitudinal #4 bar is required within the top 12 inches of the stem wall and another longitudinal #4 bar at 3 to 4 inches above the bottom of the footing, as previously described. Additionally, when the stem wall is poured separately from the footing, vertical #4 bars are required at not more than 48 inches on center (much greater than the minimum spacing allowed by ACI 318 for reinforced concrete construction) with hooks extending into the footing and at least 14 inches into the stem wall. This amount of reinforcement is insufficient to qualify this as a reinforced concrete wall. It is a plain concrete wall, with a minimum prescribed amount of reinforcement. For the longitudinal bars, substitution of #3 GatorBar® for #4 steel is acceptable, since they provide greater tensile strength. The vertical bars, since they are only required where the stem wall is placed after the footing, provide some tensile reinforcement to prevent overturning of the wall and some small amount of shear at the construction joint. For this purpose #3 GatorBar® with a tensile strength of 14.6 kips is greater than Grade 40, #4 steel with a tensile yield of 7.85 kips and would be acceptable in my opinion. Direct substitution would meet the apparent design intent of the IRC requirement.

Footings for Residential Foundation Walls - Spread footings used in seismic design code areas D_0 to D_2, supporting foundation walls with light frame construction above, for up to three story residential buildings, must have dimensions as specified in IBC Section 1809.7 and meet ACI 318. ACI 318 Section 22.10.1, states that foundations of structural plain concrete are not allowed in Seismic Design Categories D, E, or F, <u>except</u> for "detached one- and two-family dwellings three stories or less, with stud bearing walls." Plain concrete is allowed by ACI 318 for footings for the excepted category of buildings, which is incorporated by reference into the IBC. The IBC applies to any building type, so it encompasses the limited IRC buildings, which only applies to one- and two-family residential dwellings, three stories and less (IRC R101.). However, in many places, it is customary to provide longitudinal bars and at least one #4 bar is placed in the top and bottom of the footing. Therefore, in these instances, the use of #3 GatorBar® is also acceptable.

The foregoing is my professional opinion based on my reading of the applicable codes and my interpretation of their intent. You have waived any concerns you may have regarding conflict of interest, since I am a shareholder in Neuvokas. Please contact me should you have any questions about this opinion or how it was derived (616-560-3100).

Sincerely,

SE Williams Consulting, LLC

Steven E. Williams, PE