"ANCHORING" TILT-WALL BRACES WITH HELICAL GROUND ANCHORS: A STRUCTURAL UNSTABLE CONDITION

By Mark Duckett, PE

It has become "common practice" to utilize helical ground anchors to be affixed to the bottom of tilt-wall braces where the wall bracing is on the exterior of a building (i.e., when wall braces are not placed on the interior of a building and are not connected to a concrete slab-on-grade). This practice has recently gained popularity due to it's rapid installation and the fact that the helical anchors may be re-used only serves to increase the cost-efficiency of this type of a system, especially when compared to a concrete "deadman" system which needs to be excavated, formed, reinforced, cast and perhaps even removed after the wall braces are removed.

However, this system does not admit to rational analysis and is, in fact, structurally unstable.

The intended structural "model" for the helical anchor at the end of a tilt-wall brace is to provide a point of support (pinned connection) for the tilt-wall brace; one that resists the tension and compression forces imparted upon it by the tilt-wall brace. Tilt-wall braces are designed as simple columns with pinned end conditions. The definition of a pinned end condition is one that allows rotation but restricts translation of the end of the column member (i.e., fixed, laterally…no "sideways" movement of the support).

The first structural anomaly encountered when attempting to "justify" the use of a helical anchor as the support at the bottom of the tilt-wall brace is the fact that the top of the helical anchor is laterally unstable. In fact, geotechnical engineers will state that the point of fixity for a helical anchors occurs at, or very near, the lowest helix. This, alone, invalidates the intended use of the helical anchors.

Since the top of the helical anchors are laterally unsupported, the structural "model" is now revised to represent a longer, "built-up" column. The newly constructed "composite" column consists of the wall brace and the helical anchor; the increase in length is due to the fact that the composite column is comprised of the "original" column (wall brace), plus the length of the helical anchor. Generally, the length of a helical anchor is around 5'-0", but that length will be increased if/when "extensions" are used to increase the length of the helical anchor (required if/when capacities of helical anchors are not achieved in "single-piece" installation…site dependant).

Even more structurally incongruous than the composite column and the increase in length is the fact that the helical anchor is **not** co-linear with the tilt-wall brace **and** the fact that the connection between these two "sub-column" members is made with a single 3/4" diameter bolt (see attached…copy of typical details provided by supplier for this system). As indicated in the literature attached, the helical anchor may be installed up to 5 degrees "off-axis" from the tilt-wall brace. This creates a "P-Δ" effect, generating a bending moment upon the composite column. To make matters even worse (structurally), the connection between the "sub-columns" members (i.e., the helical anchor and the wall brace member) is achieved via a pinned connection…the single 3/4" diameter bolted connection is incapable of resisting **any** moment (moment capacity = 0.0).

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In addition to the arguments presented above *clearly* demonstrating the structural deficiencies of the system and the inherent structural instability of the system, the following issues should also be considered as points for 'rejection" of the use of this system:

- To actually install a helical anchor in exactly the correct location, in exactly the proper orientation (angle) in nearly impossible. Consider the fact that, during the installation of the anchor, the wall is not yet erected so there is no real "point-of reference" (especially regarding the installation angle). The author finds it difficult to believe that the angle of the installed helical anchor will be within 5 degrees of the axis of the wall brace. Obviously, the farther "off" the anchor is from being in-line with the axis of the wall brace, the greater the P-Δ effect becomes (hence the greater generated moment…resulting in an "increase in instability").
- While it may be possible to verify (inspect) the location of the helical anchor with respect to it's "coupled" wall brace, it is virtually impossible to verify (inspect) that the helical anchor has been installed at the proper orientation (in-line with the brace axis). The fact that it is "non-verifiable" should (alone) rule out its use!
- There have been documented cases wherein the installation torque for the helical anchors have been achieved, but the capacity of the anchor was not as it was assumed. For example, when a helical anchor encounters limestone, it is possible for the lowest helix to "drill a hole" into the formation. In some cases, the helix does not "thread" itself into the limestone, instead creating a hole into which it progresses. If this occurs and the helix then (temporarily) engages a harder portion of the limestone, it would "deliver" a higher torque reading to the installer which might then be interpreted as a "proper" installation (i.e., anchor capacity, under NORMAL conditions is determined by installation torque). In the case presented herein, however, the anchor will have a significantly reduced tension capacity and would very likely be unsafe. Readers are reminded that Florida has numerous limestone formations, many of which are found close to the ground surface.

In summary, the use of helical anchors to "anchor" tilt-wall braces is an unsafe method. It does not admit to rational analysis nor to sound engineering judgment, it is not verifiable in the field (cannot be inspected) and the installation of helical anchors for this use should be discontinued.

Respectfully submitted,

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