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Anchorage Specifications Engineer's Review

May 30, 2007

SCOPE: Engineer's review of required anchor systems for mounting aluminum ramp systems to cement kiln facility burn floors.

DATA:

1. All installations occur after initial construction and do not allow for cast-in-place anchorage.
2. Reinforced concrete burn floors are 4,000 psi minimum.
3. Anchors specified must meet ASTM-E488 test criteria.
4. Primary anchorage specifications must meet or exceed U.S. Government G.S.A. Specification A-A-1922A & A-A-1923A Type 4.
5. Factory mutual listing only upon individual owner's requirements.
6. This review covers bolt sizes up to 1" diameter only.
7. Brand names reviewed are:
 - a. Hilti
 - b. Red Head
 - c. Confast Products

I. REVIEW:

- a. Anchorage systems into existing reinforced concrete result in two basic anchors:
 - i. A non-removable threaded stud bolt extending above the concrete surface. This requires nut for holding (anchoring) the part being attached.
 - ii. A non-removable thread insert that is usually flush with the concrete. This type requires a bolt for holding.
- b. Both of these style anchors use various methods of attachment into the reinforced concrete. Several of these methods are as follows:
 - i. Wedge Anchors: These require a predetermined size hole drilled into the concrete to a specified depth, and then the stud style anchor bolt is driven with a minimum interference of the split tapered anchor wedge to the bottom of the hole. When the stud is drawn up with a nut, the wedge expands and anchors the bolt permanently in the concrete. Threaded insert style anchors are installed in a similar manner, however, they require a special seating tool to expand the wedge and seat the insert.
 - ii. Self Thread Anchors (i.e. Red Head (LDT[™]): These are single use anchors and are installed with the part to be held in place.
 - iii. Epoxy Anchors: These are available in both stud and insert styles and are fastened by placing a capsule of 2-part epoxy in the hole and driving the stud or insert into the hole, mixing the epoxy as the anchor seats. These require up to a 24 hour cure time prior to applying mounting loads.

II. CAPACITIES:

- a. The capacities of these various anchorage systems is dependent upon three (3) mechanical limits:
 - i. Physical properties and strength of the stud bolt or insert and its related subassembly parts.
 - ii. Strength of the concrete
 - iii. Strength of the adhesive bond when applicable.
- b. When Bricking Solutions equipment requires anchorage, the minimum anchor specified is 1/2" diameter and the most common anchor size specified is 3/4" diameter. For strength, grade V minimum is always used.
- c. The following is a recap of anchorage manufactures capacities (Ultimate Values):

i. Wedge Anchors:	<u>PULL-OUT</u>	<u>SHEAR</u>
1. Red Head Dynabolt ® 1/2"	4,400 lbs	5,000 lbs
2. Red Head Dynabolt ® 3/4"	8,900 lbs	13,100 lbs
3. Confast Drop-in 1/2"	6,000 lbs	5,000 lbs
4. Confast Drop-in 3/4"	13,900 lbs	14,000 lbs
5. Hilti Wedge 1/2"	5,500 lbs	5,500 lbs
6. Hilti Wedge 3/4"	12,500 lbs	13,000 lbs
ii. Self Threading:		
1. Red Head Tapcon (LDT) 1/2"	8,000 lbs	5,000 lbs
2. Red Head Tapcon (LDT) 3/4"	15,000 lbs	13,000 lbs
iii. Epoxy Adhesive: similar values to Wedge Anchors		

III. CONCLUSIONS & RECOMMENDATIONS:

- a. Most suppliers recommend a 4:1 minimum safety factor be applied to the ultimate capacity values. Therefore, the maximum allowable tension (pull-out) values for 3/4" diameter anchors are the 5-6,000 lbs range for wedge, epoxy, and self threading style with maximum embedments.
 - b. The importance of following the anchorage manufacturers' recommendations and instructions can not be over emphasized for these applications on the burn floor.
 - c. The Engineer's recommendation is for use of the wedge expanding threaded inserts. These allow multiple reuse of the anchor without damage or capacity reduction and if properly capped when not being used, reduce cleaning requirements and minimize equipment installation time. We also recommend the maximum embed available from the manufacturer and allowable in the reinforced concrete of the burn floor.
 - d. If an anchorage point is damaged or fails, the owner must following Bricking Solutions recommendations for modifications or changes to the equipment hold down points.
- IV. For questions, please contact Verne Lindberg, P.E. at 425-232-9128.