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ESR-4058

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Issued 06/2017
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DIVISION: 04 00 00—MASONRY
SECTION: 04 05 19.16—MASONRY ANCHORS

REPORT HOLDER:

ITW RED HEAD

700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139

EVALUATION SUBJECT:

ITW RED HEAD TRUBOLT+ WEDGE ANCHORS FOR USE IN MASONRY

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

ITW RED HEAD
700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139
(800) 848-5611
www.itw-redhead.com
techsupport@itwccna.com

ADDITIONAL LISTEE:

ITW BRANDS
955 NATIONAL PARKWAY, SUITE 95500
SCHAUMBURG, ILLINOIS 60173
(877) 489-2726
www.itwbrands.com

EVALUATION SUBJECT:

ITW RED HEAD TRUBOLT+ WEDGE ANCHORS FOR USE IN MASONRY

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2015, 2012, 2009 and 2006 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

Property evaluated:

Structural

2.0 USES

The ITW RED HEAD Trubolt+ Wedge Anchors is used to anchor building components to resist static, wind, and seismic tension and shear loads in uncracked fully grouted concrete-masonry unit (CMU) construction.

The Trubolt+ Wedge Anchors is an alternatives to cast-in-place anchors described in Section 8.1.3 of 2013 TMS 402/ACI 530/ASCE 5, or Section 2.1.4 of 2011, 2008, and 2005 TMS 402/ACI 530/ASCE 5 as referenced in Section 2107.1 of the IBC. The anchors are permitted to be used in structures regulated by the IRC, provided an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 General:

The RED HEAD Trubolt+ Wedge Anchor (U.S. patent 9541116) is a torque controlled, wedge-type mechanical expansion anchor. The Trubolt+ Wedge Anchor is available in $^1/_4$-inch (6.4 mm), $^3/_8$-inch (9.5 mm), $^1/_2$-inch (12.7 mm), $^5/_8$-inch (15.9 mm) and $^3/_4$-inch (19.1 mm) diameters. The Trubolt+ Wedge Anchor consists of a high strength threaded anchor body, expansion clip, hex nut and washer. The anchor body is manufactured from high strength carbon steel. Anchor bodies are zinc plated -in accordance with ASTM B633, SC1, or are hot-dip galvanized per ASTM A153 Class C. The expansion clip is fabricated from carbon steel. The standard hexagonal steel nut conforms to ASTM A563, Grade A and the washer conforms to ASTM F884. The Trubolt+ Wedge anchor body consists of a threaded section and a wedge section. The expansion clip is formed around the anchor, just above the wedge and consists of a split cylindrical ring. During torqueing of the anchor, the expansion clip is designed to grip the walls of the concrete hole as the wedge portion of the stud is forced upward against the interior of the clip. The Trubolt+ Wedge anchor is illustrated in Figure 1 of this report.

3.2 Grouted-filled Concrete Masonry:

The masonry must be fully grouted complying with Chapter 21 of the IBC. The compressive strength of masonry, f'_m, at 28 days must be a minimum of 1,500 psi (10.3 MPa) at the time of anchor installation. Fully grouted masonry walls must be constructed from the following materials:

- **Concrete Masonry Units (CMUs):** Fully grouted concrete masonry units must be minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units (CMUs) conforming to ASTM C90. Minimum allowable nominal size of the CMU must be 8-inch-wide (203 mm) by 8-inches-high (203 mm) by 16-inches-long (406 mm).

- **Grout:** Concrete masonry units must be fully grouted with grout complying with Section 2103.3 of the 2015 IBC, Section 2103.13 of the 2012 IBC, Section 2103.12 of the 2009 and 2006 IBC, Section R606.2.11 of the 2015 IRC, or Section R609.1.1 of the 2012, 2009 and 2006 IRC, as applicable. Alternatively, the grout must have a minimum compressive strength, when tested in accordance with ASTM C1019, equal to its specified strength, but not less than 2,000 psi (13.8 MPa).

■ **Mortar:** Mortar must be Types M, S or N prepared in accordance with Section 2103 of the IBC, Section R606.2.7 of the 2015 IRC, or Section R607.1 of the 2012, 2009 and 2006 IRC, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Allowable Stress Design (ASD):

4.1.1 General: Allowable tension and shear capacity values, installation torque, embedment depth, critical and minimum edge and end distances, and critical and minimum spacing requirements for anchors installed in fully-grouted concrete masonry unit construction are noted in Table 1 of this report. Allowable load reduction factors for anchors installed at distance less than critical edge distance or critical spacing are noted in Table 2 of this report. Allowable loads for anchors installed within 1-$^1/_4$ inches (31.7 mm) of the vertical head joint are outside the scope of this report. Figures 2 and 3 of this report provide additional details.

4.1.2 Design of Anchors Installed in Fully Grouted CMU Masonry: Allowable loads for the Trubolt+ wedge anchor installed in fully-grouted concrete masonry subjected to combined tension and shear forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)^{5/3} + \left(\frac{V_s}{V_t}\right)^{5/3} \leq 1.0 \qquad \text{(Eq-1)}$$

Where:

P_s = Applied service tension load.

P_t = Allowable service tension load.

V_s = Applied service shear load.

V_t = Allowable service shear load.

4.2 Installation: Installation parameters are provided in Table 1 and in Figures 2 and 3 of this report. Anchor locations must comply with this report and specifications approved by the code official. Trubolt+ wedge anchors must be installed in accordance with the manufacturer's published instructions and this report. Anchors must be installed in holes drilled into the base material using carbide-tipped drill bits conforming to ANSI B212.15. Nominal drill bit diameters must be equal to the nominal diameter of the anchors and holes must be drilled to a depth allowing proper embedment. Drilled holes must be cleaned, with all dust and debris removed using compressed air. Anchors, nuts, and washers must be assembled so that the top of the nuts is flushed with the top of the anchors. Anchors must be driven into the hole using a hammer until the proper embedment depth is achieved. Nuts and washers must be tightened against the base material or material to be fastened until the appropriate installation torque value specified in Table 1 of this report is achieved.

4.3 Special Inspections: Special inspection under the IBC and IRC must be provided in accordance with Sections 1704 and 1705.

The special inspector must be on the jobsite initially during anchor installation to verify anchor description, including anchor type, anchor dimensions, drill bit size, masonry type and compressive strength, masonry thickness, mortar type, anchor location (spacing and edge distance), anchor embedment, hole description and verification of drill bit compliance with ANSI B212.15-1994, and adherence to the manufacturer's published installation instructions.

5.0 CONDITIONS OF USE

The ITW RED HEAD Trubolt+ Wedge Anchor described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Anchors are identified and installed in accordance with the manufacturer's published installation instructions and this report.

5.2 Design of anchors installed in fully grout-filled uncracked concrete masonry to resist static, wind and seismic load applications must be in accordance with Section 4.1 of this report.

5.3 For installations in CMU construction, anchors are recognized to resist static, earthquake, and wind loads. When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads are not permitted to be increased for seismic or wind loading. When using the alternative basic load combinations from the 2009 and 2006 IBC Section 1605.3.2 that include wind or earthquake loads, the allowable tension and shear loads shown in Table 1 for Trubolt+ anchors installed in the fully grouted concrete masonry may be increased by 33 $^1/_3$ percent. Alternatively, the load combinations in IBC Section 1605.3.2 may be multiplied by a factor of 0.75. For the 2015 and 2012 IBC, the allowable loads or load combinations may not be adjusted. Refer to Table 3 of this report.

5.4 Anchors must be installed in accordance with Section 4.2, and the holes for the anchors must be predrilled with carbide-tipped masonry drill bits complying with ANSI 8212.15-1994 into the approved substrate, and have the same diameter as the nominal diameter of the anchor.

5.5 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors subjected to fatigue and shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.

5.6 Where not otherwise prohibited by the code, anchors are permitted for installation in fire-resistance-rated construction provided at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support fire-resistance-rated construction or gravity load-bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.7 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors in cracked masonry is unavailable at this time, the use of anchors must be limited to installation in uncracked grout-filled concrete masonry. Cracking occurs when $f_t > f_r$, due to service loads or deformations.

5.8 Calculations and details demonstrating compliance with this report must be submitted to the code official for approval.

5.9 Using of zinc-plated Red Head Trubolt+ anchors must be limited to dry, interior location. Using hot-dip galvanized Trubolt+ anchors is permitted in exterior-exposure or damp environments.

5.10 Special inspection must be provided in accordance with Section 4.3 of this report, where applicable.

5.11 Trubolt+ wedge anchors are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), dated November 2015.

7.0 IDENTIFICATION

The ITW RED HEAD Trubolt+ wedge anchors are identified by dimensional characteristics and packaging. A length letter code, visible after installation, is stamped on each anchor on the exposed threaded stud end. Table 4 summarizes the length code identification system. Packages are identified with the product name, type and size, the company name and the evaluation report number (ICC-ES ESR-4058).

TABLE 1—ALLOWALE TENSION AND SHEAR LOADS FOR THE TRUBOLT+ WEDGE ANCHORS INSTALLED IN FULLY GROUTED CMU CONSTRUCTION[1,2,3]

Anchors Installed in the Face of Fully Grouted CMU Construction								
Anchor Diameter (inches)	Embedment Depth[4] (inches)	Installation Torque (ft-lbf)	Anchor Location[5,6] (inches)				Allowable Loads For Anchors Installed At Distances ≥ Critical Edge Distance, C_{cr}, And Critical Spacing, S_{cr} (lbf)	
			Edge/End Distance		Spacing			
			Critical C_{cr}	Minimum C_{min}	Critical S_{cr}	Minimum S_{min}	Tensions[5,7]	Shears[5,7]
1/4	1 1/8	5	12	4	8	4	183	273
	2 1/4	8					311	
3/8	1 5/8	15	12	4	8	4	276	638
	2 3/4	25					552	
1/2	2 1/4	45	12	4	8	4	550	907
	3 3/4						706	985
5/8	2 3/4	70	12	4	8	4	816	1600
	4 1/2						1274	
3/4	3 1/4	100	12	4	8	4	893	1615
	5						1195	

Anchors Installed in the Top of Fully Grouted CMU Construction										
Anchor Diameter (inches)	Embedment Depth[4] (inches)	Installation Torque (ft-lbf)	Anchor Locations (inches)					Allowable Loads For Anchors Installed At Distances > Critical End Distance, $C_{cr\text{-}End}$, Critical Spacing, S_{cr}, Minimum Edge Distance, C_{min}, (ibf)		
			End Distance		Spacing		Edge Distance	Tension[7,8]	Shear	
			Critical $C_{cr\text{-}End}$	Minimum $C_{min\text{-}End}$	Critical S_{cr}	Minimum S_{min}	Minimum C_{min}		⊥ To Wall[7,8]	// To Wall[7,8]
3/8	2 1/2	25	12	4	8	4	1 3/4	669	233	562
1/2	3	45	12	4	8	4	2 1/4	1021	289	871
5/8	4 1/2	70	12	4	8	4	2 3/4	1203	466	1134

For **SI**: 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa.

[1]Tabulated loads are for anchors installed in fully grouted CMU wall construction consisting of materials in compliance with Section 3.2 of this report. The specified compressive strength of masonry, f'_m, is minimum 2,000 psi (13.8 MPa) at 28 days.
[2]Allowable loads are based on periodic special inspection being provided during anchor installation. Special inspection requirements must comply with Section 4.3 of this report.
[3]Allowable loads may be increased in accordance with Section 5.3 and Table 3 of this report, where permitted by the IBC or its referenced standards.
[4]Embedment depth is measured from the outside face of the masonry to the end of the mandrel.
[5]Critical and minimum edge distances and critical and minimum spacing must comply with this table. Refer to Figure 2. Critical edge distance and critical spacing are valid for anchors resisting the tabulated allowable tension or shear loads. Table 2 tabulates allowable tension and shear load reduction factors for anchors installed between critical and minimum edge distances and spacing.
[6]Figure 2 illustrates permitted and prohibited anchor installation locations. Section 4.2 of this report provides additional installation details.
[7]Tabulated allowable loads are based on a factor of safety of five (5).
[8]Critical and minimum end distance, critical and minimum spacing, and minimum edge distance must comply with this table and Figure 3. Critical end distance and critical spacing are valid for anchors resisting the tabulated allowable tension or shear loads. Table 2 for allowable tension and shear load reduction factors for anchors installed between critical and minimum end distances and spacing.

TABLE 2—LOAD REDUCTION FACTORS FOR TURBOLT+ WEDGE ANCHORS INSTALLED IN FULLY GROUTED CMU CONSTRUCTION[1,2,3]

Anchors Installed in the Face of Fully Grouted CMU Construction							
Anchor Diameter (inches)	Embedment Depth (inches)	Edge Distance			Spacing		
		Critical Edge/End Distance, C_{cr}	Minimum Edge/End Distance, C_{min}		Critical Spacing, S_{cr}	Minimum Spacing, S_{min}	
		Tension or Shear	Tension	Shear	Tension or Shear	Tension	Shear
1/4	1 1/8	1.00	0.92	1.00	1.00	1.00	0.85
	2 1/4	1.00	0.85		1.00	0.85	0.90
3/8	1 5/8	1.00	0.93	0.86	1.00	0.91	0.85
	2 3/4	1.00	0.88		1.00	0.81	0.90
1/2	2 1/4	1.00	0.94	0.71	1.00	0.81	0.85
	3 3/4	1.00	0.91		1.00	0.76	0.90
5/8	2 3/4	1.00	0.87	0.53	1.00	0.75	0.85
	4 1/2	1.00	0.87		1.00	0.88	0.90
3/4	3 1/4	1.00	0.79	0.35	1.00	0.68	0.85
	5	1.00	0.83		1.00	1.00	0.90

Anchors Installed in the Top of Fully Grouted CMU Construction										
Anchor Diameter (inches)	Embedment Depth (inches)	End Distance				Spacing				Minimum Edge Distance C_{min}
		Critical End Distance $C_{cr\text{-}End}$	Minimum End Distance $C_{min\text{-}End}$			Critical Spacing, S_{cr}	Minimum Spacing S_{min}			
		Tension or Shear	Tension	Shear ⊥ to Wall	Shear // to Wall	Tension or Shear	Tension	Shear ⊥ To Wall	Shear // To Wall	Tension
3/8	2 1/2	1.00	0.83	0.85	0.61	1.00	0.77	0.68	0.76	0.57
1/2	3	1.00	1.00	0.90	0.52	1.00	0.58	0.68	0.76	0.57
5/8	4 1/2	1.00	0.92	1.00	0.52	1.00	0.70	0.68	0.76	0.86

For **SI**: 1 inch = 25.4 mm; 1 lbf = 0.0044 kN, 1 ksi = 6.894 MPa.

[1]The load reduction factors in this table are applicable to the allowable loads shown in Table 1 of this report.
[2]Reduction factors are cumulative. Multiple reduction factors for more than one spacing or edge distance are calculated separately and multiplied together.
[3]Load reduction factors for anchors loaded in tension or shear with edge distances, end distances and spacing between critical and minimum are obtained by linear interpolation.

TABLE 3—PERCENT ALLOWABLE LOAD INCREASE FOR WIND AND EARTHQUAKE LOADING CONDITIONS[1,2]

Anchor	Substrate	Percent Allowable Load Increase for Short Term Loading Conditions	
		Tension	Shear
Trubolt+ Wedge Anchor	Fully Grouted CMU	33 1/3	33 1/3

[1]When using the basic load combinations for allowable stress design in accordance with IBC Section 1605.3.1 allowable loads must not be increased for wind or earthquake loading.
[2]When using the alternative basic load combination for allowable stress design in IBC Section 1605.3.2 that include wind or earthquake loads, the allowable shear loads may be increased by the tabulated percentage increase. As an option, the alternative basic load combinations for allowable may be reduced by multiplying them by 0.75 when using IBC Section 1605.3.2 as applicable.

TABLE 4—LENGTH IDENTIFICATION MARKINGS

Length (inches)	ID Marking on Anchor Head																			
	A+	B+	C+	D+	E+	F+	G+	H+	I+	J+	K+	L+	M+	N+	O+	P+	Q+	R+	S+	T+
From	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	11.0	12.0
Up to, but not including	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	11.0	12.0	13.0

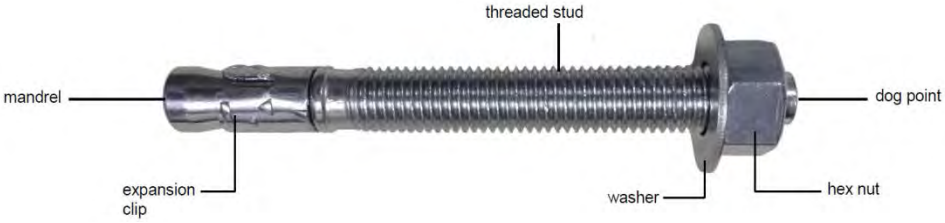

FIGURE 1—ITW RED HEAD TRUBOLT+ WEDGE ANCHOR

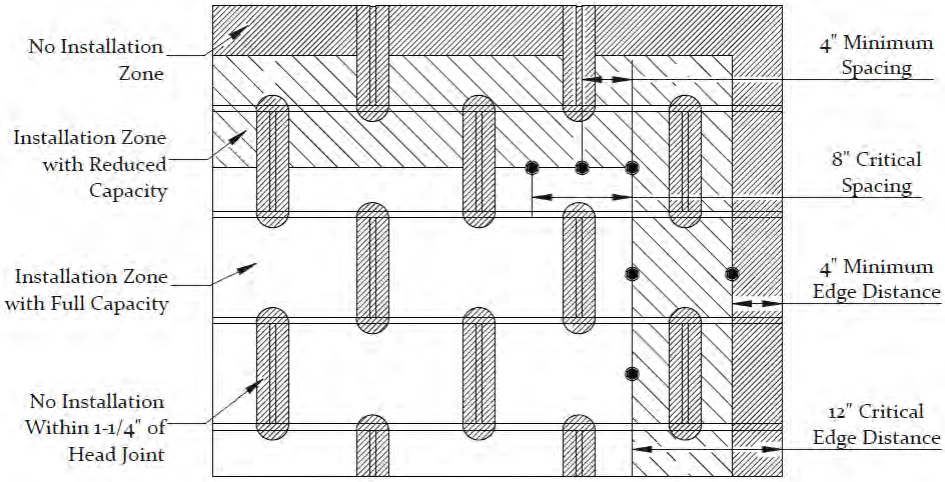

FIGURE 2—TRUBOLT+ WEDGE ANCHOR INSTALLED IN THE FACE OF FULLY GROUTED CMU CONSTRUCTION

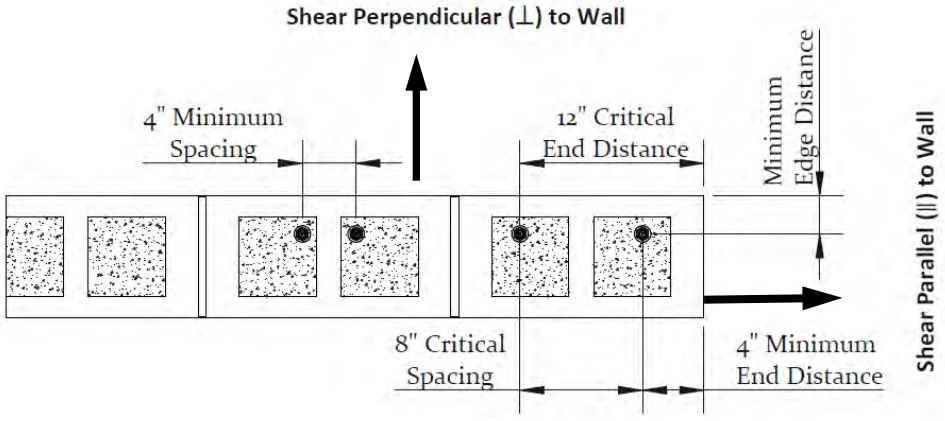

FIGURE 3—TRUBOLT+ WEDGE ANCHOR INSTALLED IN THE TOP OF FULLY GROUTED CMU CONSTRUCTION

ICC-ES Evaluation Report

ESR-4058 FBC Supplement

Issued June 2017

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ITW RED HEAD
700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139
(800) 848-5611
www.itw-redhead.com
techsupport@itwccna.com

EVALUATION SUBJECT:

ITW RED HEAD TRUBOLT+ WEDGE ANCHORS FOR USE IN MASONRY

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the ITW RED HEAD Trubolt+ Wedge Anchors in masonry, recognized in ICC-ES master evaluation report ESR-4058, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The ITW RED HEAD Trubolt+ Wedge Anchors in masonry, described in master evaluation report ESR-4058, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, when designed and installed in accordance with the 2012 *International Building Code®* provisions noted in the master report, and under the following conditions:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the *Florida Building Code—Building*, as applicable.

Use of the ITW RED HEAD Trubolt+ Wedge Anchors in masonry, for compliance with the High-Velocity Hurricane Zone Provisions of the *Florida Building Code—Building* and *Florida Building Code—Residential,* has not been evaluated and is outside the scope of this supplement.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, issued June 2017.