ICC-ES Evaluation Report

ESR-3367

Reissued June 2024

This report also contains:

- **CBC Supplement**

Subject to renewal June 2026

DIVISION: 03 00 00—CONCRETE Section: 03 21 00—Reinforcement Bars	REPORT HOLDER: DYWIDAG-SYSTEMS INTERNATIONAL U.S.A., INC. (DSI)	EVALUATION SUBJECT: DYWIDAG GRADE 100 THREADBARS® AND COUPLERS	

1.0 EVALUATION SCOPE

Compliance with the following codes:

■ 2021, 2018, 2015, 2012 and 2009 *International Building Code®* (IBC)

Property evaluated:

■ Structural

2.0 USES

The DYWIDAG Grade 100 Threadbars® are deformed steel reinforcing bars used as nonprestressed steel reinforcement in reinforced normalweight concrete structural members, such as foundations, columns and walls. The bars are an alternative to deformed reinforcement complying with ACI 318-19 and -14 Sections 20.2.1.1 through 20.2.1.3 under the 2021, 2018 and 2015 IBC (ACI 318-11 and -08 Section 3.5.3.2 under the 2012 and 2009 IBC; ACI 318 is referenced in IBC Section 1901.2). The DYWIDAG Grade 100 couplers are used as tension and compression mechanical splices of the DYWIDAG Grade 100 Threadbars®. The splices comply with ACI 318-19 and -14 Section 25.5.7.1 under the 2021, 2018 and 2015 IBC (ACI 318-11 and -08 Section 12.14.3.2 under the 2012 and 2009 IBC). Refer to Figure 1 for a typical installed assembly

3.0 DESCRIPTION

3.1 DYWIDAG Grade 100 Threadbars®:

DYWIDAG Grade 100 Threadbars® are high strength steel reinforcing bars with continuous, uniform, rolled-in pattern of thread-like deformations along the entire length to permit connections with the DYWIDAG Grade 100 couplers. Available bar sizes and properties are provided in Table 1 of this report. Galvanizing, epoxy coatings, or other coatings are not permitted within the scope of applications permitted in this report. See footnote 1 of Table 1 of this report for yield strength determination.

3.2 DYWIDAG Grade 100 Couplers:

The DYWIDAG Grade 100 Couplers are formed from carbon steel and comply with the product specifications in the approved quality documentation. The couplers are produced in a hollow cylindrical configuration to receive bars at each end through internal threads with a pattern matching the steel reinforcing bars. As an option, each coupler may have up to two set screws, one near each end. The set screws are for securing the coupler to the bar during prefabrication and/or erection. Coupler dimensions and corresponding bar sizes are described in Table 2 of this report. Each coupler and the two mechanically spliced DYWIDAG Grade 100

Threadbars® form a mechanical splice system, which complies with the performance requirements in ACI 318-19 and -14 Section 25.5.7.1 for Type 1 mechanical splices under the 2021, 2018 and 2015 IBC (ACI 318-11 and -08 Section 12.14.3.2 for Type 1 mechanical splices under the 2012 and 2009 IBC).

4.0 DESIGN AND INSTALLATION

4.1 Design: DYWIDAG Grade 100 Threadbars® and Couplers:

The DYWIDAG Grade 100 Threadbars®, installed with mechanical splices constructed from DYWIDAG Grade 100 couplers, as applicable, are recognized as longitudinal and transverse reinforcement in reinforced concrete structures that are designed and constructed in accordance with IBC and ACI 318, subjected to the following limitations:

1. The high-strength steel reinforcing bars and couplers are limited for use as (a) longitudinal reinforcement for resisting flexure, axial force, and for shrinkage and temperature, in reinforced concrete structures that are not special seismic systems; (b) lateral support of longitudinal bars or for concrete confinement in reinforced concrete structures that are not special seismic systems; (c) shear reinforcement including shear friction in reinforced concrete structures that are not special seismic systems; (d) torsional reinforcement including longitudinal and transverse reinforcement; (e) anchor reinforcement; and (f) a strut-and-tie method.
2. The high-strength steel reinforcing bars and couplers must not be used in beams or slabs.
3. The high-strength steel reinforcing bars and couplers are used in structures assigned to Seismic Design Categories A and B only.
4. Welding of the bars is prohibited.
5. The bending of the bars is limited to No. 11 and 14 bars only, and No. 18 and No. 20 bars must not be bent. Bending procedures must comply with ACI 318-19 and -14 Sections 25.3 and 26.6.3 under the 2021, 2018 and 2015 IBC (ACI 318-11 and -08 Sections 7.1 through 7.3, under the 2012 and 2009 IBC).
6. The specified concrete compressive strength shall range from either:

   a. 6,000 psi (41.3 MPa) $\leq f'_c \leq$ 12,000 psi (82.7 MPa) without limitation on A_{cc}/A_g

   or,

   b. 12,000 psi (82.7 MPa) $< f'_c \leq$ 18,000 (124.1 MPa) psi where $A_{cc}/A_g \geq 0.8$.

   Where:
   A_{cc} = cross-sectional area of concrete column or wall center-to-center of transverse reinforcement.
   A_g = gross area of column or wall concrete section.
   If neither a. or b. is satisfied, sectional strength must be calculated in accordance with the additional mandatory modifications to ACI 318-19 and -14 following Section 4.2.
7. Concrete compressive strengths less than 6,000 psi (41.3 MPa) and greater than 18,000 psi (124.1 MPa) are not covered by this report.
8. The high-strength steel reinforcing bars are used as steel reinforcement under the provisions of ACI 318 described in Table 3 of this report.
9. The high strength steel reinforcing bars must be uncoated, and installed in normalweight concrete.
10. For the purpose of providing lateral support of longitudinal steel reinforcing bars and for providing concrete confinement, the yield strength of high-strength steel bars used for design calculations must not exceed 100,000 psi (689 MPa) for spirals, and 80,000 psi (551 MPa) for non-spiral reinforcing bars (or lateral ties) in accordance with Section 20.2.2.4 and Table 20.2.2.4a of ACI 318-19 and -14 under the 2021, 2018 and 2015 IBC (Section 9.4 of ACI 318-11 and -08 under the 2012 IBC and 2009 IBC).
11. For the purpose of providing shear and torsional resistance, the yield strength of high-strength steel bars used for design calculations must not exceed 60,000 psi (413 MPa) in accordance with Section 20.2.2.4 and Table 20.2.2.4a of ACI 318-19 and -14 under the 2021, 2018 and 2015 IBC (Sections 11.4.2, 11.5.3.4 and 11.6.6 of ACI 318-11 and -08, under the 2012 and 2009 IBC).
12. The splice locations must comply with applicable code requirements and must be detailed in the approved construction documents.
13. All required clearance and concrete protection (cover) described in applicable code provisions must be measured from the outside of the couplers.

4.2 Mandatory Modifications to ACI 318-19 and -14:

(Mandatory Modification to ACI 318-11 and -08 are provided in Section 4.3.)

4.2.1 C1.1 Definitions: Modify Section 2.2 of ACI 318-19 and -14 to add the following notation:

α_1 = factor relating magnitude of uniform stress in the equivalent rectangular compressive stress block to specified compressive strength of concrete.

χ_1 = factor relating mean concrete compressive stress at axial load failure of concentrically loaded columns to specified compressive strength of concrete.

A_{cc} = cross-sectional area of concrete column or wall center-to-center of transverse reinforcement.

4.2.2 C1.2 Equivalent Rectangular Concrete Stress Distribution: Modify ACI 318-19 and -14 Section 22.2.4:

Section 22.2.2.4 The equivalent rectangular concrete stress distribution in accordance with Section 22.2.2.4.1 through Section 22.2.2.4.3 satisfies Section 22.2.2.3.

Section 22.2.2.4.1 Concrete stress of $\alpha_1 f'_c$ shall be assumed uniformly distributed over an equivalent compression zone bounded by edges of the cross-section and a line parallel to the neutral axis located a distance a from the fiber of maximum compressive strain, as calculated by:

$$a = \beta_1 c \qquad (22.2.2.4.1)$$

Section 22.2.2.4.2 Distance from the fiber of maximum compressive strain to the neutral axis, c, shall be measured perpendicular to the neutral axis.

Section 22.2.2.4.3 Values of α_1 shall be in accordance with Table 22.2.2.4.3a and values of β_1 shall be in accordance with Table 22.2.2.3.3b.

Table 22.2.2.4.3a – Values of α_1 for Equivalent Rectangular Concrete Stress Distribution

f'_c (psi)	α_1	
2500 ≤ f'_c ≤ 4000	0.85	(a)
4000 < f'_c < 17,000	$0.85 - \frac{0.010\,(f'c - 4000)}{1000}$	(b)
f'_c ≥ 17,000	0.72	(c)

Table 22.2.2.4.3b – Values of β_1 for Equivalent Rectangular Concrete Stress Distribution

f'_c (psi)	β_1	
2500 ≤ f'_c ≤ 4000	0.85	(a)
4000 < f'_c < 18,000	$0.85 - \frac{0.013(f'c - 4000)}{1000}$	(b)
f'_c = 18,000	0.668	(c)

Concrete compressive strengths less than 6,000 psi (41.3 MPa) and greater than 18,000 psi (124.1 MPa) are not covered by this report. Other values for f'c are shown for completeness.

4.2.3 C1.3 Maximum axial compressive strengths: Modify ACI 318-19 and -14 Section 22.4.2.2:

Section 22.4.2.2 For nonprestressed members and composite steel and concrete members, P_o shall be calculated by:

$$P_o = \chi_1 f'_c (A_g - A_{st}) + f_y A_{st} \qquad (22.4.2.2a)$$

Where:

A_{st} = total area of nonprestressed longitudinal reinforcement

$\chi_1 = 0.9\,[\gamma + (1\text{-}\gamma)(A_{cc}/A_g)] \leq 0.85$ and ≥ 0.65 (22.4.2.2b)

And

$$\gamma = 1.1 - \frac{f'c}{20{,}000} \leq 0.80, \text{ where f'c is in psi} \qquad (22.4.2.2c)$$

4.3 C2.0 Modifications to ACI 318-11 and ACI 318-08

4.3.1 C2.1 Definitions: Modify Section 2.1 of ACI 318-11 and ACI 318-08 to add the following notation:

α_1 = factor relating magnitude of uniform stress in the equivalent rectangular compressive stress block to specified compressive strength of concrete.

χ_1 = factor relating mean concrete compressive stress at axial load failure of concentrically loaded columns to specified compressive strength of concrete.

A_{cc} = cross-sectional area of concrete column or wall center-to-center of transverse reinforcement.

4.3.2 C2.2 Equivalent Rectangular Concrete Stress Distribution: Modify ACI 318-11 and ACI 318-08 Section 10.2.7:

Section 10.2.7 Requirements of Section 10.2.6 are satisfied by an equivalent rectangular concrete stress distribution defined by the following:

Section 10.2.7.1 Concrete stress of α_1 f'_c shall be assumed uniformly distributed over an equivalent compression zone bounded by edges of the cross-section and a straight line located parallel to the neutral axis at a distance $a = \beta_1 c$ from the fiber of maximum compressive strain.

Section 10.2.7.2 Distance from the fiber of maximum strain to the neutral axis, c, shall be measured in a direction perpendicular to the neutral axis.

Section 10.2.7.3 For f'_c between 2500 and 4000 psi, β_1 shall be taken as 0.85. For f'_c above 4000 psi, β_1 shall be reduced linearly at a rate of 0.013 for each 1000 psi of strength in excess of 4000 psi, but β_1 shall not be taken less than 0.668.

Section 10.2.7.4 For f'_c between 2500 and 4000 psi, α_1 shall be taken as 0.85. For f'_c above 4000 psi, α_1 shall be reduced linearly at a rate of 0.010 for each 1000 psi of strength in excess of 4000 psi, but α_1 shall not be taken less than 0.72.

Concrete compressive strengths less than 6,000 psi (41.3 MPa) and greater than 18,000 psi (124.1 MPa) are not covered by this report. Other values for f'_c are shown for completeness.

4.3.3 C2.3 Maximum axial compressive strength: Modify ACI 318-11 and ACI 318-08 Section 10.3.6.1:

Section 10.3.6 Design axial strength ϕP_n of compression members shall not be taken greater than $\phi P_{n,\,max}$ computed by Eq. (10-1) or (10-2).

Section 10.3.6.1 For nonprestressed members with spiral reinforcement conforming to Section 7.10.4 or composite members conforming to Section 10.13:

$$\phi P_{n,\,max} = 0.85\,\phi\,[\chi_1\, f'_c\,(A_g - A_{st}) + f_y\, A_{st}] \qquad (10\text{-}1)$$

where:

$$\chi_1 = 0.9\,[\gamma + (1\text{-}\gamma)(A_{cc}/A_g)] \le 0.85 \text{ and } \ge 0.65 \qquad (10\text{-}1a)$$

and

$$\gamma = 1.1 - \frac{f'c}{20{,}000} \le 0.80, \text{ where f'c is in psi} \qquad (10\text{-}1b)$$

Section 10.3.6.2 For nonprestressed members with tie reinforcement conforming to Section 7.10.5:

$$\phi P_{n,\,max} = 0.80\,\phi\,[\chi_1\, f'_c\,(A_g - A_{st}) + f_y\, A_{st}] \qquad (10\text{-}2)$$

where:

χ_1 is computed by Eq. (10-1a) and Eq. (10-1b).

Section 10.3.6.3 For prestressed members, design axial strength ϕP_n, shall not be taken greater than 0.85 (for members with spiral reinforcement), or 0.80 (for members with tie reinforcement) of the design axial strength at zero eccentricity, ϕP_o, assuming concrete stress of χ_1 f'_c uniformly distributed across the entire depth of the concrete section.

4.4 Installation:

4.4.1 General: The steel reinforcing bars, and its splice system must be located in the structure as set forth in the approved construction documents. Reinforcement details, such as surface conditions, bar placement, clear spacing, offsets, spirals and ties, must comply with the applicable provisions in IBC and ACI 318. Bar development length and mechanical splices must comply with IBC and ACI 318, except as modified by Section 4.2.2 of this report.

4.4.2 DYWIDAG Grade 100 Couplers: The Threadbar® ends must be cut to square within 1.5 degrees of a right angle to the axis of the bars. If the coupler comes with optional set screws, make sure that they are elevated and will not interfere with installation of the bars. The overall length of the coupler is measured. Each of the bar ends, which are to be spliced to the coupler, is marked with an engagement mark that is located from the bar end with a distance of one-half of the coupler total length. The coupler must be first screwed onto the first bar, and the second bar must be screwed to engage full bearing with the first bar. The coupler is reverse-screwed until the engagement marks on both bars are exposed. The two bar ends must be tightened until the torque in Table 2 of this report is attained. After torquing, the optional set screws in the coupler, when provided, must be set, and movement or rotation of the bar is prohibited.

4.5 Special Inspection:

Special inspection is required in accordance with 2021, 2018, 2015 and 2012 IBC Section 1705 (2009 IBC Section 1704). The special inspector must, at a minimum, verify the following:

1. The high strength steel reinforcing bars are of the type, grade and size specified, and are labeled in accordance with this report.
2. The installation of high strength steel reinforcing bars and couplers, such as bar surface conditions, bending, locations, spacing, protection (cover), embedment, and installation torque, complies with IBC, ACI 318, approved construction documents and this report.
3. The coupler identification is in accordance with this report.

5.0 CONDITIONS OF USE:

The DYWIDAG Grade 100 Threadbars® and Couplers described in this report comply with, or are suitable alternatives to what is specified in, the codes indicated in Section 1.0 of this report, subject to the following conditions:

5.1 The bars and couplers must be installed in accordance with the applicable code, the manufacturer's instructions and this report. In case of conflict between the manufacturer's published instructions and this report, the most restrictive requirement governs.

5.2 Limitations in Section 4.1 of this report must be observed.

5.3 The high-strength steel reinforcing bars and couplers are recognized for use in structures assigned to Seismic Design Categories A and B only. Recognition of the high-strength steel reinforcing bars and couplers for use in structures assigned to Seismic Design Category C, D, E, or F is outside the scope of this evaluation report.

5.4 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.5 Special inspection must be provided in accordance with Section 4.5 of this report.

5.6 The DYWIDAG Grade 100 Threadbars® and Couplers are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Threaded High-strength Steel Bars for Concrete Reinforcement (AC237), dated August 2018 (editorially revised June 2021).

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Splice Systems for Steel Reinforcing Bars (AC133), dated October 2020.

7.0 IDENTIFICATION

7.1 Each bar is identified by a set of marks rolled onto the surface of one side of the bar to denoting the following: "GG" – Gerdau mill designation, "U" – St. Paul manufacturing location, a two digit number to signify bar size such as "20" for No. 20 bar, "S" – ASTM A615 steel type, and "100" – for minimum yield strength designation. Each bar bundle is identified with two metal or reinforced fabric tags, with each tag includes the point of origin, batch or heat number, the report holder's name (DYWIDAG-System International U.S.A., Inc.), the ICC-ES evaluation report (ESR-3367), grade, size, order number and length of Threadbars®. Each coupler is identified with a stamped "D" to indicate DYWIDAG.Each carton of couplers is identified with a label that includes heat number, "BxxH70751" with "xx" signifying bar size, "100" – for corresponding reinforcing bar grade designation, and ICC-ES evaluation report number (ESR-3367).

7.2 The report holder's contact information is the following:

DYWIDAG-SYSTEMS INTERNATIONAL U.S.A., INC. (DSI)
320 MARMON DRIVE
BOLINGBROOK, ILLINOIS 60440
(630) 739-1100
dsiamerica@dsiamerica.com
www.dsiamerica.com

TABLE 1—DYWIDAG GRADE 100 THREADBAR® DIMENSIONS AND PROPERTIES

BAR DESIGNATION NUMBER	NOMINAL DIAMETER[3] (in)	SPECIFIED YIELD STRENGTH[1] (psi)	SPECIFIED TENSILE STRENGTH (psi)	NOMINAL CROSS SECTIONAL AREA[3] (in^2)	MINIMUM ELONGATION[2] (percent)	WEIGHT (lb/ft)
11	$1\frac{3}{8}$ (1.410)	100,000	120,000	1.56	6	5.31
14	$1\frac{3}{4}$ (1.693)	100,000	120,000	2.25	6	7.65
18	$2\frac{1}{4}$ (2.257)	100,000	120,000	4.00	6	13.60
20	$2\frac{1}{2}$ (2.500)	100,000	120,000	4.91	6	16.70

For **SI:** 1 inch = 25.4 mm, 1 psi = 0.006894757 MPa, 1 lb/ft = 14.6 N/m.

[1]Where it can be substantiated that the effects of creep in a reinforced concrete column or wall under sustained, in-situ, unfactored axial compression forces result in sufficient transfer of axial compressive stresses from concrete to longitudinal high-strength reinforcement at the section under consideration, it is permitted to use the specified yield strength for f_y in compression in calculations for flexural and axial compression sectional strength; specified yield strength in compression used in calculations must be taken as the stress corresponding to strain at 0.35 percent. Otherwise, if sufficient internal stress transfer effects cannot be substantiated, f_y in compression used for high-strength reinforcing bars must not exceed 80,000 psi (551 MPa) in the calculation of flexural and axial compression sectional strength.
[2]Elongation is measured along an 8-inch length.
[3]The nominal dimensions of a Threadbar® are equivalent to those of a plain round bar having the same weight per foot as the deformed Threadbar®.

TABLE 2—DYWIDAG GRADE 100 COUPLER DIMENSIONS AND TORQUE REQUIREMENTS

BAR DESIGNATION NUMBER	INSIDE DIAMETER (in)	OUTSIDE DIAMETER (in)	LENGTH (in)	TORQUE (ft-lb)
11	1.436	2.375	8.00	200
14	1.693	2.750	8.250	230
18	2.275	3.625	10.50	260
20	2.511	4.000	12.25	300

For **SI:** 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m.

TABLE 3—APPLICABLE SECTIONS OF ACI 318 UNDER EACH EDITION OF THE IBC

ACI 318-19 (2021 IBC)	ACI 318-14 (2018 and 2015 IBC)	ACI 318-11 (2012 IBC)	ACI 318-08 (2009 IBC)
20.2.1.1-20.2.1.3	20.2.1.1-20.2.1.3	3.5.3.2	3.5.3.2
20.2.2.4 and Table 20.2.2.4a	20.2.2.4 and Table 20.2.2.4a	9.4	9.4
		11.4.2	11.4.2
		11.5.3.4	11.5.3.4
		11.6.6	11.6.6
20.5	20.6	7.7	7.7
25.4.2	25.4.2	12.2	12.2
25.5.7	25.5.7	12.14.3	12.14.3

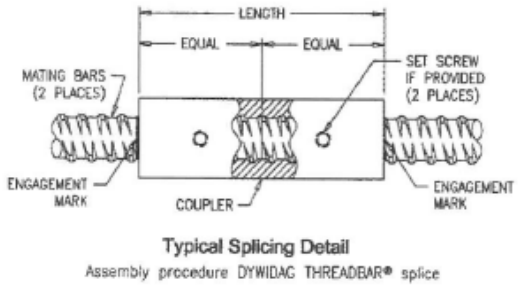

FIGURE 1—ASSEMBLED DYWIDAG GRADE 100 THREADBAR® AND COUPLER

DIVISION: 03 00 00—CONCRETE
Section: 03 21 00—Reinforcement Bars

REPORT HOLDER:

DYWIDAG-SYSTEMS INTERNATIONAL U.S.A., INC. (DSI)

EVALUATION SUBJECT:

DYWIDAG GRADE 100 THREADBARS® AND COUPLERS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the DYWIDAG Grade 100 Threadbars® and Couplers, described in ICC-ES evaluation report ESR-3367, have also been evaluated for compliance with the code noted below.

Applicable code edition:

- 2019 *California Building Code* (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

2.0 CONCLUSIONS

2.1 CBC:

The DYWIDAG Grade 100 Threadbars® and Couplers, described in Sections 2.0 through 7.0 of the evaluation report ESR-3367, comply with CBC Chapter 19, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 16, 17 and 19, as applicable.

2.1.1 OSHPD:

The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA:

The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

This supplement expires concurrently with the evaluation report, reissued June 2024.