

# ICC-ES Evaluation Report

**ESR-2352**

Issued March 1, 2010

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**DIVISION:03—CONCRETE**  
**Section: 03210—Reinforcing Steel****DIVISION:04—MASONRY**  
**Section: 04080—Masonry Anchorage and Reinforcement****REPORT HOLDER:****BAUTECH®, INC.**  
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[www.bautech.com](http://www.bautech.com)**ADDITIONAL LISTEE:****DELTA BUILDING SYSTEMS (HK) LTD.**  
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VISTA, CALIFORNIA 92081  
[www.baugridusa.com](http://www.baugridusa.com)**EVALUATION SUBJECT:****BAUGRID® REINFORCEMENT aka BAUGRID® WELDED REINFORCEMENT GRID (WRG™)****1.0 EVALUATION SCOPE****Compliance with the following codes:**

- 2006 *International Building Code*® (IBC)
- 1997 *Uniform Building Code*™ (UBC)

**Property evaluated:**

- Structural

**2.0 USES**

BauGrid® Reinforcement, also known as BauGrid® Welded Reinforcement Grid (WRG™), is used as lateral or transverse reinforcement, such as ties, cross-ties, and hoops, to confine longitudinal or primary reinforcing bars in concrete shear walls and longitudinal or primary reinforcing bars in concrete columns, as permitted in applicable sections of the IBC and UBC. BauGrid® Reinforcement is also used as lateral or transverse reinforcement, such as stirrups, to confine longitudinal or primary reinforcing bars in concrete beams of moment frames and as shear reinforcement to confine longitudinal or primary reinforcing bars in concrete beams as permitted in applicable sections of the IBC and UBC. Ladder-type BauGrid® Reinforcement is used as vertical and horizontal

reinforcement in concrete structural walls as permitted in applicable sections of the IBC and UBC.

**3.0 DESCRIPTION****3.1 General:**

BauGrid® Reinforcement consists of four or more intersecting high-strength plain steel wires complying with ASTM A 82, resistance-welded into rectilinear grids. Additional wires may be added to provide confinement cells within the assembly. Two types, BauGrid® Reinforcement and Ladder-type BauGrid® Reinforcement, are available. Examples of the products and their applications are illustrated in Figures 1 through 11. The resulting grids comply with ASTM A 185 and supplementary requirements described in the BauTech®, Inc., quality assurance manual, with a maximum dimensional tolerance of  $\pm 1/8$  inch (3 mm).

**3.2 BauGrid® Reinforcement:**

BauGrid® Reinforcement is manufactured with plain wire complying with ASTM A 82. The wires are arranged at right angles to each other and resistance-welded together at intersections into various rectilinear grid-like shapes. Table 1 represents the available wire sizes.

**3.3 Ladder-type BauGrid® Reinforcement:**

BauGrid® Reinforcement is manufactured with plain wire complying with ASTM A 82. The wires are arranged with cross wires and longitudinal wires at right angles to each other and resistance-welded together at intersections into various rectilinear ladder-like shapes. Table 1 represents the available wire sizes.

**3.4 Concrete:**

Normal-weight concrete must conform to Sections 1903 and 1905 of the IBC and UBC, as applicable. Concrete used in special moment frames and special concrete walls must also comply with requirements in ACI 318 Section 21.4.4. The maximum compressive strength for design must comply as follows:

- Columns: 12,000 psi (82.74 MPa).
- Beam-column connections: 7,500 psi (51.71 MPa).
- Walls: 10,000 psi (68.95 MPa).

**4.0 DESIGN AND INSTALLATION****4.1 Design:**

**4.1.1 Concrete:** The BauGrid® Reinforcement and Ladder-type BauGrid® Reinforcement must be designed

by a registered design professional as alternatives to confinement ties, hoops and stirrups. Ladder-type BauGrid® Reinforcement also may be used as primary reinforcement as permitted in applicable sections of the IBC or UBC. One- and Two-cell BauGrid® reinforcement used as transverse reinforcement in concrete coupling beams and prestressed concrete is outside the scope of this report. Three-cell BauGrid® reinforcement, as shown in Figure 5 (Beam), BauGrid® Reinforcement System Typical Applications, is allowed in coupling beams. The BauGrid® Reinforcement must be designed for applications in accordance with the IBC or UBC as shown in Table 2 for reinforced concrete.

**4.1.2 Masonry:** Masonry design in accordance with TMS 402 is outside the scope of this report. Masonry columns, masonry shear walls, and masonry boundary elements of shear walls must be designed by a registered design professional and constructed as reinforced concrete, with the masonry serving as a nonstructural element outside the concrete core and used as formwork, weather protection, or fire-resistance protection in accordance with applicable requirements of the IBC and UBC.

**4.2 Installation:**

The BauGrid® Reinforcement must be installed in accordance with this report and plans and specifications prepared by a registered design professional and approved by the code official. Details and placement must comply with the applicable requirements for stirrups, ties, cross-ties, and hoops in IBC Sections 1907, 1908, 2106, 2107, and 2108; ACI 318-05 Chapters 7 and 21; TMS 402-05 Chapters 1, 2, 3, and 4; and UBC Sections 2104, 2106, 2107, and 2108. The BauGrid® Reinforcement must be placed with longitudinal reinforcing bars, in shear wall boundary elements, columns or beams passing through the grids and held tightly in position at the intersections of the wires of the ladders and grids. Ladder-type BauGrid® Reinforcement must be placed horizontally or vertically in concrete walls. The wire elements of the grids must not be bent unless approved by the registered design professional and the code official.

**4.3 Special Inspection:**

Special inspection for concrete must be in accordance with Section 1704.4 of the IBC. The special inspector must verify reinforcement identification, wire type, size and grade; grid dimensions; grid placement; support; clearance; concrete cover; and the test certificate required in accordance with Section 1903.1 of IBC.

**5.0 CONDITIONS OF USE**

The BauGrid® Reinforcement and Ladder-type BauGrid® Reinforcement described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 BauGrid® Reinforcement, used as ties, cross-ties, hoops, and stirrups, must be designed, manufactured and installed in accordance with this report and the IBC or UBC.
- 5.2 Special inspection must be provided in accordance with Section 4.3 of this report.
- 5.3 BauGrid® Reinforcement used to reinforce concrete shear walls and concrete moment frames serving as the lateral force-resisting system for building structures, must be designed in accordance with this report.
- 5.4 The BauGrid® Reinforcement must be manufactured at the Delta Building Systems (HK) Ltd. facilities in Shenzhen, China, under a quality control program with inspections by Smith-Emery Laboratories (AA-554).

**6.0 EVIDENCE SUBMITTED**

Data in accordance with the ICC-ES Acceptance Criteria for BauGrid® Reinforcement (AC403), dated October 2008.

**7.0 IDENTIFICATION**

The grids are identified by an attached ticket bearing the company names (BauTech®, Inc., and Delta Building Systems HK Ltd.), the name “BauGrid®”, the wire size, the designation “ASTM A 185”, the evaluation report number (ICC-ES ESR-2352), and the name of the inspection agency (Smith-Emery Laboratories).

TABLE 1—AVAILABLE WIRE SIZES

Size Number (ASTM A 82)	Wire Diameter in. [mm]	Wire Area in.2 [mm2]
W11	3/8 [9.50]	0.110 [71]
W20	1/2 [12.70]	0.200 [127]
W31	5/8 [15.88]	0.310 [198]
W45	3/4 [19.10]	0.450 [287]

TABLE 2—APPLICABLE CODE SECTION REFERENCES FOR BAUGRID® REINFORCEMENT IN CONCRETE

DESCRIPTION	REQUIREMENT	ACI 318-05	2006 IBC <sup>1</sup>	1997 UBC
General	Notations	2.1		1909.2, 1909.3
Concrete wall	General Design of Walls	14.2		1914.2
	Minimum Reinforcement	14.3		1914.3
	Wall Designed as Compression Member	14.4		1914.4
	Empirical Design Method	14.5		1914.5
	Alternate Design Slender Walls	footnote 2		footnote 2
	Shear Wall Reinforcement	21.7.2		1921.6.2
	Boundary Element	21.7.6		1921.6.6.6
	Coupling Beam	12.13.2.4		1907.11
	Wall Piers	footnote 2		footnote 2
Concrete ties	Ties for Compression Members	7.10.5	1907.10	1907.10.5
	Lateral Reinforcement For Flexural Members	7.11	1907.11	1907.11
	Ratio of Spiral Reinforcement	10.9.3		1910.9.3
	Structural Wall Shear Strength	21.7.4		1921.6.5
Concrete stirrups	Shear Strength Provided by Shear Reinforcement	11.5, 11.6		1911.5
Concrete hoops	Transverse Reinforcement—Flexural Members	21.3.3, 21.3.4	1908.1.7	1921.3.3
	Transverse Reinforcement—Bending and Axial Loaded Members	21.4.4		1921.4.4
	Transverse Reinforcement for Joints of Moment Frames	21.5.2		1921.5.2
Special inspection	Reinforcement Steel	1.3.2	1704.4	1701.5.4
Test certificate	Tests Of Materials	3.1		1903.1

<sup>1</sup>Where blank spaces occur under the IBC column, requirements are as set forth under the ACI 318 column.

<sup>2</sup>Use of BauGrid® Reinforcement for this requirement is outside the scope of this report.

# BAUGRID® REINFORCEMENT SYSTEM TYPICAL APPLICATIONS

\*NOT TO SCALE

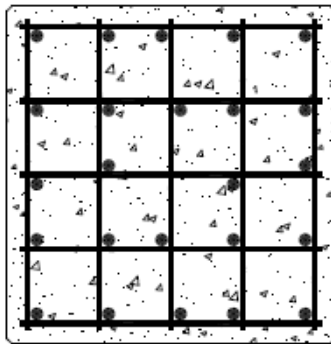


FIG. 1. 16 CELL COLUMN

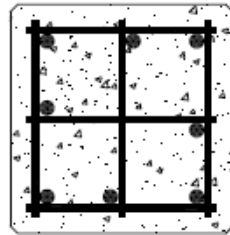


FIG. 2. 4 CELL COLUMN

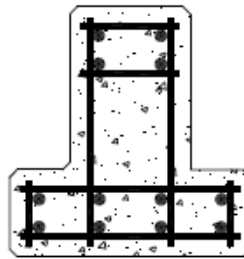


FIG. 3. INVERTED TEE BEAM

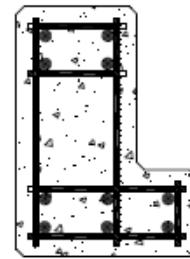


FIG. 4. SPANDREL BEAM

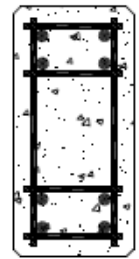


FIG. 5. BEAM

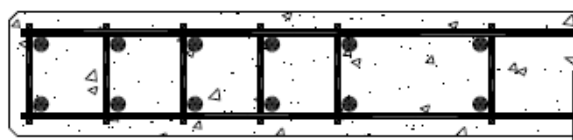


FIG. 7. SHEARWALL BOUNDARY ELEMENT AND HORIZONTAL WALL REINFORCEMENT

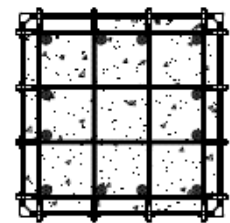


FIG. 10. PREFORMED 9 CELL COLUMN BAUGAGE

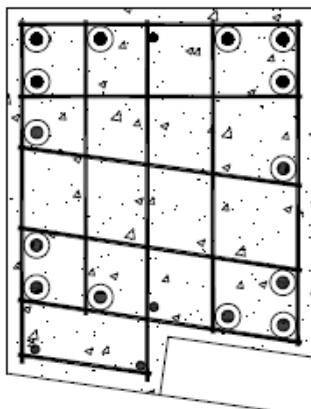


FIG. 6. CUSTOM DESIGNED COLUMN

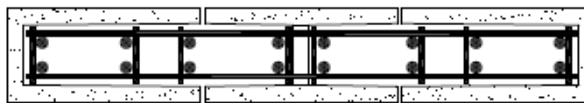
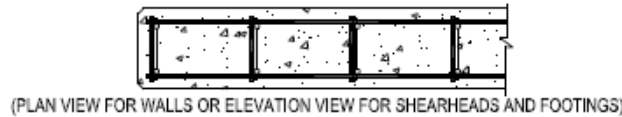


FIG. 8. DUCTILE MASONRY PIER



(PLAN VIEW FOR WALLS OR ELEVATION VIEW FOR SHEARHEADS AND FOOTINGS)



(ELEVATION VIEW FOR WALLS OR PLAN VIEW FOR SHEARHEADS AND FOOTINGS)

FIG. 9. LADDERCAGE WITH INTERSECTING LADDERS FOR REINFORCEMENT EACH WAY, EACH FACE FOR WALLS, SHEARHEADS AND FOOTINGS

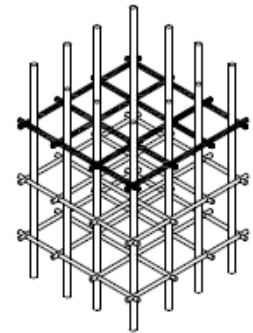
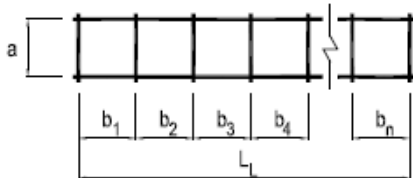
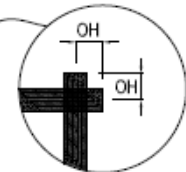
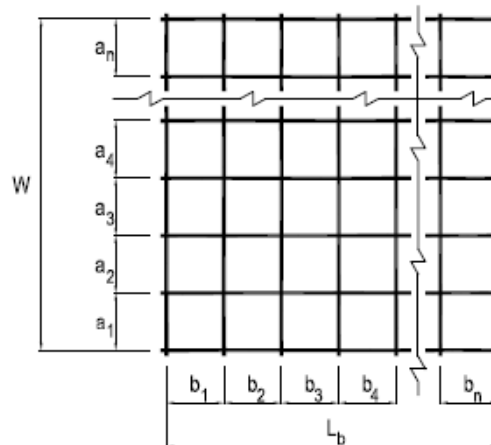


FIG. 11. 9 CELL COLUMN

## LADDER-TYPE BAUGRID®



## BAUGRID®



**NOTES:**

- d: WIRE DIAMETER
- a: LONGITUDINAL WIRE SPACING, CENTER TO CENTER
- b: CROSS WIRE SPACING, CENTER TO CENTER
- W: WIDTH, CENTER TO CENTER
- L<sub>b</sub>: BAUGRID LENGTH, CENTER TO CENTER
- L<sub>L</sub>: LADDER-TYPE BAUGRID LENGTH, CENTER TO CENTER
- OH: OVERHANG, CENTER TO END

TABLE 1: TYPICAL DIMENSION SPECIFICATIONS

d	a	b	W	L <sub>b</sub>	L <sub>L</sub>	OH	Manufacturing Tolerance
3/8"	2" min. 1/4" Increment	2" min. 1/4" Increment	2" min. 3'-6" max	2" min. 7'-6" max	2" min. 18'-0" max	5/8"	±1/8"
1/2"	2" min. 1/4" Increment	2" min. 1/4" Increment	2" min. 3'-6" max	2" min. 7'-6" max	2" min. 18'-0" max	5/8"	±1/8"
5/8"	2-1/2" min. 1/4" Increment	2-1/2" min. 1/4" increment	2-1/2" min. 3'-6" max	2-1/2" min. 7'-6" max	2-1/2" min. 18'-0" max	5/8"	±1/8"
3/4"	3" min. 1/4" increment	3" min. 1/4" Increment	3" min. 3'-6" max	3" min. 7'-6" max	3" min. 18'-0" max	3/4"	±1/4"