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Guide for the Specification, Manufacture, and Construction Use of Welded Wire Reinforcement

Reported by ACI Committee 439

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Welded wire reinforcement (WWR) is prefabricated reinforcement consisting of high-strength cold-worked steel wires that are resistance-welded together in square or rectangular grids by continuous automatic welders. This report provides WWR product information, material specifications, and design/detailing recommendations, with an overview of manufacturing, shipping, and construction use in various applications of concrete construction.

Keywords: cast-in-place; cold-working; constructability; deformed reinforcement; mesh; precast; post-tensioned; prestressed; reinforcement; welded wire.

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CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

Welded wire reinforcement (WWR) is a prefabricated reinforcement consisting of a series of cold-worked steel wires that are resistance-welded together in square or rectangular grids by continuous automatic welders, and is one of the recognized and established forms of concrete reinforcement. United States patents covering the production of wires welded in this method were first issued in 1901 (Richardson 2000).

Plain or deformed wires, or a combination of both, may be used in WWR. Plain WWR bonds to concrete by mechanical anchorage at each wire intersection, whereas deformed WWR uses surface deformations plus welded intersections for bond and anchorage. The small-diameter, closely-spaced wires provide uniformly distributed reinforcement and effective crack control in footings, slabs, walls, paving, and roofs, in addition to providing shear resistance and confinement in columns, beams, and girders. WWR is prohibited in special seismic systems where the weld is required to resist stresses in response to confinement, lateral support of longitudinal bars, shear, or other actions in accordance with ACI 318. A wide range of wire sizes and spacings makes it possible to furnish more precise requirements for steel area. The placement of WWR can result in cost savings over non-prefabricated reinforcement. Material savings are obtainable by specifying WWR with high yield strengths as recognized by ACI 318 and ASTM A884/A884M, A1060/A1060M, and A1064/A1064M.

Extensive use was made of WWR in the Empire State Building and World Trade Center Towers in New York, and the Marina City Towers and Standard Oil Building in Chicago. The interstate highway system was built using an extensive amount of WWR in the 1950s and 1960s, and WWR continues to be used today in many transportation structural applications.

1.2—Scope

WWR is prefabricated reinforcement consisting of high-strength cold-worked steel wires that are resistance-welded together in square or rectangular grids by continuous automatic welders. This guide provides WWR product information, material specifications, and design/detailing recommendations, with an overview of manufacturing, shipping, and construction use in various applications of concrete construction.

1.3—W and D designations

Individual wire (plain and deformed) size designations are based on the cross-sectional area of a given wire. Gauge numbers were used exclusively for many years but were eliminated in the 1970s to reduce the confusion caused from misunderstanding the specified gauge size. The prefixes W and D are used in combination with a number. The letter W designates a plain wire, and the letter D denotes a deformed wire. The number following the letter gives the cross-sectional area in hundredths of a square inch (square millimeter). When describing metric wire, the prefix M is added; MW describes metric plain wire and MD metric deformed wire. The wire spacing in metric WWR is given in millimeters (mm) and the cross-sectional area of the wire is in square millimeters (mm^2).

For instance, wire designation W4 (MW26) would indicate a plain wire with a cross-sectional area of 0.04 $in.^2$ (26 mm^2) and a D10 (MD65) wire would indicate a deformed wire with a cross-sectional area of 0.10 $in.^2$ (65 mm^2). The size of wires in WWR is designated in the same manner. This system provides many advantages. Because the design professional knows the cross-sectional area of a wire and the spacing, the total cross-sectional area per unit width can easily be determined. For instance, a D6 (MD39) wire on 4 in. (102 mm) centers would provide three wires per 1 ft (305 mm) with a total cross-sectional area of 0.18 $in.^2$/ft (381 mm^2/m).

Many common wire sizes were developed to reduce peak-season lead times and aid in overall plant efficiency. The most readily available wire sizes along with the nominal diameter, area, and weight per unit length are shown in Table 1.3a (plain wire) and Table 1.3b (deformed wire). Plain wire is smooth cold-worked wire from a hot-rolled steel rod into the size or sizes needed for processing into welded sheets. Deformed wire can be indented or raised ribbed cold-worked wire from a hot-rolled rod into the size or sizes needed for processing into welded sheets. Areas of wire should be checked with the most efficient and readily available material from manufacturers. Other wire sizes are available and many manufacturers are able to produce them in 0.0015 $in.^2$ (1 mm^2) increments.

1.4—Product description

Spacing and size of wire in WWR are identified by style. The following subsections explain the orientation and definition of each part in the makeup of a WWR sheet. When the WWR sheet is designated with uniform or fixed spacing for quotation or order entry, it should be described as follows,

In in-lb units:

6 x 12 – D20.0 x D15.0 (Grade 80) – 78 in. (+12, +6) x 20 ft (24, 12) – 263.53 lb/sheet – 150 sheets needed

In SI units: