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Welded Deformed Wire Reinforcement Development Length and Lap Splice per ACI 318-19

Welded deformed wire reinforcement (WDWR) is comprised of an orthogonal arrangement of machine-welded deformed wires, with wire sizes between D4.0 and D31.0. The wires themselves have surface deformations along their entire circumferential length. These wire deformations conform to the geometrical requirements established by ASTM A1064 and are capable of developing bond through bearing and friction between deformed wire surface and surrounding hardened concrete.

The development length and lap splice length for an Individual, loose deformed wire is calculated using equations identical to those used for deformed reinforcing bars (rebar).

ACI 318-19 equations applicable to individual, loose deformed wires not part of a WDWR mat:
Tension Development Length – Section 25.4.2
Tension Lap Splice Length – Section 25.5.2

When considering a WDWR mat, there are two attributes that contribute to tension development and lap splice. First, the aforementioned deformed surface of the individual wires, and second, the welded wire-to-wire intersections capable of resisting bearing stresses by way of a shear capacity achieved at the wire-to-wire interface.

ACI 318-19 equations applicable to WDWR relying on surface deformations and welded intersections:
Tension Development Length – Section 25.4.6 (Section 25.4.2 with reduction via Section 25.4.6.3)
Tension Lap Splice – Section 25.5.3.1

The advantage of a WDWR mat that leverages contribution from both surface deformation and welded intersection is that the resulting development length and lap splice length dimensions are considerably shorter than those calculated for individual, loose wires. However, this advantage is only realized if the welded intersections that are relied upon to contribute are positioned strategically relative to the critical section (for development length) and within the lap splice region. Because of this, the specifier must not only be diligent in the detailing of this critical positioning, but it must also be properly enforced in the field. Additionally, it should be understood that for lap splice regions, it will not be possible to avoid stacking or nesting of wires on separate WDWR mats that are essentially trying to occupy the same space; WDWR mats cannot be perfectly coplanar in this scenario, and as such the specifier may need to account for this localized offset of wires when calculating sectional strengths and/or clear cover dimensions.

When welded intersections are not strategically positioned in - or they are altogether absent from – a specific development or lap splice region, the ACI 318-19 calculations for development length and lap splice length are as follows:
Tension Development Length – Section 25.4.6.4 (defaults calculation back to Section 25.4.2)
Tension Lap Splice – Section 25.5.3.1.1 (defaults calculation back to Section 25.5.2)

The specifier needs to weigh the benefit of shorter – but populated – development length and lap splice length regions versus longer extensions of wire that are capable of being placed coplanar and are calculated using comparatively more traditional equations.

For more information on WDWR development lengths and lap splices, refer to ACI 318, AASHTO LRFD Bridge Design Specifications, and AREMA Manual for Railway Engineering, in conjunction with WRI resources found at www.wirereinforcementinstitute.org.