

\*\*\*\*\*  
USACE / NAVFAC / AFCEC / NASA                      UFGS-03 20 00.00 10 (May 2014)  
Change 1 - 08/14  
-----  
Preparing Activity:    USACE                      Superseding  
   UFGS-03 20 00.00 10 (August 2010)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2018

\*\*\*\*\*

### SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 20 00.00 10

CONCRETE REINFORCING

05/14

#### PART 1    GENERAL

- 1.1    UNIT PRICES
  - 1.1.1    Deformed Steel Bars
    - 1.1.1.1    Payment
    - 1.1.1.2    Measurement
    - 1.1.1.3    Unit of Measure
  - 1.1.2    Fabricated Deformed Steel Bar Mats
    - 1.1.2.1    Payment
    - 1.1.2.2    Measurement
    - 1.1.2.3    Unit of Measure
  - 1.1.3    Butt-Splices in Deformed Steel Bars
    - 1.1.3.1    Payment
    - 1.1.3.2    Measurement
    - 1.1.3.3    Unit of Measure
  - 1.1.4    Steel Welded Wire Reinforcement
    - 1.1.4.1    Payment
    - 1.1.4.2    Measurement
    - 1.1.4.3    Unit of Measure
  - 1.1.5    Resplicing Bars
    - 1.1.5.1    Payment
    - 1.1.5.2    Measurement
    - 1.1.5.3    Unit of Measure
  - 1.1.6    Accessories
- 1.2    REFERENCES
- 1.3    SUBMITTALS
- 1.4    QUALITY ASSURANCE
  - 1.4.1    Welding Qualifications
  - 1.4.2    Qualification of Steel Bar Butt-Splicers
  - 1.4.3    Qualification of Butt-Splicing Procedure
- 1.5    DELIVERY, STORAGE, AND HANDLING

#### PART 2    PRODUCTS

- 2.1    DOWELS

- 2.2 FABRICATED BAR MATS
- 2.3 REINFORCING STEEL
  - 2.3.1 Zinc-Coated (Galvanized) Bars
  - 2.3.2 Epoxy-Coated Bars
  - 2.3.3 Mechanical Butt-Splices
- 2.4 WELDED WIRE REINFORCING
- 2.5 WIRE TIES
- 2.6 SUPPORTS
- 2.7 SYNTHETIC FIBER REINFORCEMENT
- 2.8 TESTS, INSPECTIONS, AND VERIFICATIONS
  - 2.8.1 Reinforcement Steel Tests
  - 2.8.2 Non-Destructive Testing of Welds

## PART 3 EXECUTION

- 3.1 REINFORCEMENT
  - 3.1.1 Placement
  - 3.1.2 Placing Tolerances
  - 3.1.3 Splicing
    - 3.1.3.1 Lap Splices
    - 3.1.3.2 Butt-Splices
      - 3.1.3.2.1 Welded Butt Splices
      - 3.1.3.2.2 Mechanical Butt-Splices
- 3.2 WELDED-WIRE REINFORCEMENT PLACEMENT
- 3.3 DOWEL INSTALLATION
- 3.4 FIELD TESTS AND INSPECTIONS
  - 3.4.1 Identification of Splices
  - 3.4.2 Examining, Testing, and Correcting
    - 3.4.2.1 Visual Examination
    - 3.4.2.2 Tension Tests
    - 3.4.2.3 Non-destructive Testing of Welded Splices
    - 3.4.2.4 Correction of Deficiencies
    - 3.4.2.5 Supplemental Examination

-- End of Section Table of Contents --

\*\*\*\*\*  
USACE / NAVFAC / AFCEC / NASA                      UFGS-03 20 00.00 10 (May 2014)  
Change 1 - 08/14  
-----  
Preparing Activity:    USACE                      Superseding  
   UFGS-03 20 00.00 10 (August 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2018

\*\*\*\*\*

SECTION 03 20 00.00 10

CONCRETE REINFORCING  
05/14

\*\*\*\*\*

NOTE: This specification covers the requirements for concrete reinforcement, including welded wire reinforcement and fibrous reinforcing.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

\*\*\*\*\*

PART 1    GENERAL

\*\*\*\*\*

NOTE: Use this Section in conjunction with Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE

\*\*\*\*\*

1.1    UNIT PRICES

\*\*\*\*\*

NOTE: If Section 01 22 00.00 10 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title (UNIT PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 22 00.00 10.

\*\*\*\*\*

### 1.1.1 Deformed Steel Bars

#### 1.1.1.1 Payment

Payment will be made for costs associated with furnishing and placing deformed steel bars for concrete reinforcement. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

#### 1.1.1.2 Measurement

Deformed Steel Bars for Concrete Reinforcement will be measured for payment based upon the quantity of kilograms pounds in place. The measured lengths will be converted to weights for the size of bars listed by the use of the nominal weights per linear meter foot specified in ASTM A615/A615M.

#### 1.1.1.3 Unit of Measure

Unit of measure: per kilogram pound.

### 1.1.2 Fabricated Deformed Steel Bar Mats

#### 1.1.2.1 Payment

Payment will be made for costs associated with furnishing and placing fabricated deformed steel bar mats for concrete reinforcement. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

#### 1.1.2.2 Measurement

Fabricated Deformed Steel Bar Mats for Concrete Reinforcement will be measured for payment based upon the quantity of kilograms pounds in place. Determine the weights by weighing or by manufacturer's or catalog weights when weighing is not practicable.

#### 1.1.2.3 Unit of Measure

Unit of measure: per kilogram pound.

### 1.1.3 Butt-Splices in Deformed Steel Bars

#### 1.1.3.1 Payment

Payment will be made for costs associated with making butt-splices in deformed steel bars for concrete reinforcement. No separate payment will be made for test splices, tension testing, or non-destructive testing of butt-splices since these costs are included in the contract unit price for Butt-Splices in Deformed Steel Bars for Concrete Reinforcement.

#### 1.1.3.2 Measurement

Butt-Splices in Deformed Steel Bars for Concrete Reinforcement will be measured for payment based upon each butt-splice in place.

#### 1.1.3.3 Unit of Measure

Unit of measure: each.

#### 1.1.4 Steel Welded Wire Reinforcement

##### 1.1.4.1 Payment

Payment will be made for costs associated with furnishing and placing steel welded wire reinforcing for concrete. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

##### 1.1.4.2 Measurement

Steel Welded Wire Reinforcing for Concrete will be measured for payment based upon the quantity of kilograms pounds in place. Determine the weights by weighing or by manufacturer's or catalog weights when weighing is not practicable.

##### 1.1.4.3 Unit of Measure

Unit of measure: per kilogram pound.

#### 1.1.5 Resplicing Bars

##### 1.1.5.1 Payment

Payment will be made for costs associated with resplicing bars selected for supplemental examinations and tests for those splices found to be acceptable. No payment will be made for costs associated with resplicing bars selected for supplemental examinations and tests for those splices found to be defective. No payment will be made for costs associated with the supplemental examinations and tests performed by the Government.

##### 1.1.5.2 Measurement

Resplicing Bars, selected for examinations and tests and found to be acceptable, will be measured for payment based upon 150 percent of the applicable contract unit price for pay item Butt-Splices in Deformed Steel Bars for Concrete Reinforcement. Resplicing Bars, selected for examinations and tests and found to be defective, will not be measured for payment.

##### 1.1.5.3 Unit of Measure

Unit of measure: each.

#### 1.1.6 Accessories

No payment will be made for costs associated with furnishing and placing accessories incidental to and included in the payment for other items of work.

#### 1.2 REFERENCES

\*\*\*\*\*

**NOTE: This paragraph is used to list the**

publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

\*\*\*\*\*

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
----------------	--

ASTM INTERNATIONAL (ASTM)

ASTM A1035/A1035M	(2016a) Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A184/A184M	(2017) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A370	(2017a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A675/A675M	(2014) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A884/A884M	(2014) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

#### CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed; Errata) Manual of Standard Practice
------------	---

### 1.3 SUBMITTALS

\*\*\*\*\*

**NOTE:** Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army

projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

\*\*\*\*\*

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Butt-Splices; G[, [\_\_\_\_\_]]

SD-02 Shop Drawings

Reinforcement; G[, [\_\_\_\_\_]]

SD-03 Product Data

Mechanical Butt-Splices; G[, [\_\_\_\_\_]]

Reinforcing Steel; G[, [\_\_\_\_\_]]

[ SD-04 Samples

Epoxy-Coated Bars

]

SD-06 Test Reports

Tests, Inspections, and Verifications; G[, [\_\_\_\_\_]]

SD-07 Certificates

Reinforcing Steel

Qualified Welders



## Qualification of Steel Bar Butt-Splacers

### 1.4 QUALITY ASSURANCE

\*\*\*\*\*  
**NOTE: Delete this paragraph and submittal requirement under SD-03 when welding is not permitted. Welding will not be specified in blast-resistant structures.**  
\*\*\*\*\*

#### 1.4.1 Welding Qualifications

Welders are required to be qualified in accordance with AWS D1.4/D1.4M. Perform qualification test at the worksite and notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.

#### 1.4.2 Qualification of Steel Bar Butt-Splacers

Qualification of steel bar butt-splacers are required to be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splacers prior to commencing butt-splicing.

#### 1.4.3 Qualification of Butt-Splicing Procedure

As a condition of approval of the butt-splicing procedure, make three test butt-splices of steel bars of each size to be spliced using the proposed butt-splicing method, in the presence of the Contracting Officer. Tension tested to destruction these test butt-splices and unspliced bars of the same size, with stress-strain curves plotted for each test. Test results must show that the butt-splices meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

### 1.5 DELIVERY, STORAGE, AND HANDLING

Store reinforcement and accessories off the ground on platforms, skids, or other supports.

## PART 2 PRODUCTS

\*\*\*\*\*  
**NOTE: Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.**  
\*\*\*\*\*

#### 2.1 DOWELS

Provide dowels conforming to ASTM A675/A675M, Grade 80[ or ASTM A1035/A1035M ]. Steel pipe conforming to ASTM A53/A53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.[

Provide plate dowels conforming to ASTM A36/A36M, of size and spacing

indicated. Plate dowel system must minimize shrinkage restraint by [using a tapered shape] [or] [formed void] [or] [by having compressible material on the vertical faces with a thin bond breaker on the top and bottom dowel surfaces.]]

## 2.2 FABRICATED BAR MATS

Fabricated bar mats conforming to ASTM A184/A184M.

## 2.3 REINFORCING STEEL

\*\*\*\*\*

**NOTE:** Grades and sizes of reinforcing steel will be shown on the drawings. Low-alloy steel conforming to ASTM A706/A706M is specified for its special qualities such as bending ability and ease of welding.

Specially coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient. ASTM A1035/A1035M may also be considered in highly corrosive environments.

Certified mill reports should be obtained when welding is specified or permitted. On minor projects with no welding, submittal SD-07 may be deleted.

\*\*\*\*\*

Reinforcing steel of deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grades and sizes as indicated. Cold drawn wire used for spiral reinforcement must conform to ASTM A1064/A1064M.

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

### [2.3.1 Zinc-Coated (Galvanized) Bars

Zinc-coated (galvanized) bars complying with the requirements of ASTM A767/A767M, Class II coating, galvanized after fabrication.

### ]2.3.2 Epoxy-Coated Bars

Epoxy-coated steel bars complying with the requirements of ASTM A934/A934M, including written certifications for coating material and coated bars, sample of coating material, and 700 g 1.5 pounds of patching material.

### ]2.3.3 Mechanical Butt-Splices

Mechanical butt splices must be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type, and develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. In addition to this strength requirement, the additional deformation of number 45 14 and smaller bars due to slippage or other movement within the splice sleeve cannot exceed 0.38 mm (unit strain 0.0015 mm/mm)( 0.015 inches unit strain 0.0015

inches/inch) beyond the elongation of an unspliced bar based upon a 250 mm 10 inch gage length spanning the extremities of the sleeve at a stress of 200 MPa 30,000 psi. The additional deformation of number 55 18 bars must not exceed 0.75 mm(unit strain 0.003 mm/mm) 0.03 inches (unit strain 0.003 inches/inch) beyond the elongation of an unspliced bar based upon a 250 mm 10 inch gage length spanning the extremities of the sleeve at a stress of 200 MPa 30,000 psi. Determine the amount of the additional deformation from the stress-strain curves of the unspliced and spliced bars tested as required in paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure.

#### 12.4 WELDED WIRE REINFORCING

Welded wire reinforcing conforming to ASTM A1064/A1064M. When directed by the Contracting Officer for special applications, use welded wire reinforcing conforming to ASTM A884/A884M. For wire with a specified yield strength (fy) exceeding 400 MPa 60,000 psi, fy must be the stress corresponding to a strain of 0.35 percent.

#### 2.5 WIRE TIES

Use wire ties that are 16 gauge or heavier black annealed steel wire.[ Ties for epoxy-coated bars must be vinyl-coated or epoxy-coated.][ Use zinc-coated ties for zinc-coated bars.]

#### 2.6 SUPPORTS

\*\*\*\*\*  
**NOTE: Do not use the first paragraph for Civil Works projects, use only the second paragraph.**  
\*\*\*\*\*

Design bar supports for formed surfaces in accordance with CRSI 10MSP and fabricate of steel or precast concrete blocks. Provide precast concrete blocks with wire ties and not less than 100 by 100 mm 4 inches square when supporting reinforcement on ground. Precast concrete block must have compressive strength equal to that of the surrounding concrete. Coat steel supports for coated or galvanized bars with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bar. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, use galvanized, plastic protected or stainless steel supports within 13 mm 1/2 inch of concrete surface. Concrete supports used in concrete exposed to view must have the same color and texture as the finish surface. For slabs on grade and topping slabs on steel deck, supports use precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.[

Provide bar supports complying with the requirements of ACI SP-66. Provide plastic-coated wire, stainless steel or precast concrete supports for bars in concrete with formed surfaces exposed to view or to be painted. Use wedge-shaped precast concrete supports, not larger than 90 by 90 mm 3-1/2 by 3-1/2 inches, of thickness equal to that indicated for concrete cover and with an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view must be the same quality, texture and color as the finish surfaces.]

## 2.7 SYNTHETIC FIBER REINFORCEMENT

Polypropylene synthetic fiber with a denier less than 100 and a nominal fiber length of 50 mm 2 inches.

## 2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Perform and certify tests, inspections, and verifications and certify. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

### 2.8.1 Reinforcement Steel Tests

Perform mechanical testing of steel in accordance with ASTM A370 except as otherwise specified or required by the material specifications. Perform tension tests on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. From chemical analyses of steel heats report the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

### 2.8.2 Non-Destructive Testing of Welds

Perform non-destructive testing of welds in accordance with AWS D1.4/D1.4M Section 7, except that radiographic testing is not permitted.

## PART 3 EXECUTION

### 3.1 REINFORCEMENT

\*\*\*\*\*  
**NOTE: There may be special cases where reinforcing bars, at determined intervals, will be added across expansion, isolation or construction joints to provide continuity of reinforcement in meeting lightning protection criteria. The structural designer should coordinate this requirement with the electrical designer to minimize reinforcement across the joints.**  
\*\*\*\*\*

Fabricate and place reinforcement steel and accessories as specified, as indicated, and as shown on approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown must be in accordance with ACI SP-66 and ACI 318M ACI 318. Cold bend reinforcement unless otherwise authorized. Bending may be accomplished in the field or at the mill.[ Mill bend zinc-coated and epoxy-coated bars prior to coating. Bend all steel cold unless authorized.] Do not bend bars after embedment in concrete. Place safety caps on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Face wire tie ends away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Show support details including types, sizes and spacing.

### 3.1.1 Placement

Reinforcement must be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Place reinforcement in accordance with ACI 318M ACI 318 at locations indicated plus or minus one bar diameter. Do not continue reinforcement through expansion joints and place as indicated through construction or contraction joints. Cover with concrete coverage as indicated or as required by ACI 318M ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, requires approval before concrete is placed.

### 3.1.2 Placing Tolerances

Conform bar spacing and concrete cover to ACI 117.

### 3.1.3 Splicing

Conform splices of reinforcement to ACI 318M ACI 318 and make only as required or indicated. Bars may be spliced at alternate or additional locations at no additional cost to the Government subject to approval. Splicing must be by lapping or by mechanical or welded butt connection; except that lap splices must not be used for bars larger than No. 35 No. 11 unless otherwise indicated.

#### 3.1.3.1 Lap Splices

Place lapped bars in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Do not space lapped bars farther apart than  $1/5$  the required length of lap or 150 mm 6 inches.

#### 3.1.3.2 Butt-Splices

Use butt-splices only for splicing size 45 and 55 14 and 18 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Butt-splices must develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Clean bars of all oil, grease, dirt, rust, scale and other foreign substances and flame dry before splicing. Provide jigs and clamps or other devices to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Include properties and analyses of steel bars and splicing materials in the submitted procedure. Report physical properties of splicing sleeves to include length, inside and outside diameters, and inside surface details.

##### 3.1.3.2.1 Welded Butt Splices

Fabricate welded butt splices in accordance with AWS D1.4/D1.4M.

##### 3.1.3.2.2 Mechanical Butt-Splices

Fabricate mechanical butt-splices in accordance with the mechanical splicing device manufacturer's recommendations. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut

provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Clean surfaces to be enclosed within a splice sleeve or coupling by wire brushing or other approved method prior to splicing. Make splices using manufacturer's standard jigs, clamps, ignition devices and other required accessories. Longitudinally stagger tension splices of number 45 14 or smaller bar a minimum of 1500 mm 5 feet or as otherwise indicated so that no more than half of the bars are spliced at any one section. Longitudinally stagger tension splices of number 55 18 bars a minimum of 1500 mm 5 feet so that no more than 1/3 of the bars are spliced at any one section.

### 3.2 WELDED-WIRE REINFORCEMENT PLACEMENT

Place welded-wire reinforcement in slabs as indicated. Reinforcement placed in slabs on grade must be continuous between expansion, construction, and contraction joints. Reinforcement placement at joints must be as indicated.

May lap splices in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm 2 inches. Stagger laps to avoid continuous laps in either direction. Wire or clip together reinforcement at laps at intervals not to exceed 1.2 m 4 feet. Position reinforcement by the use of supports.

### 3.3 DOWEL INSTALLATION

Install dowels in slabs on grade at locations indicated and at right angles to joint being doweled. Accurately position and align dowels parallel to the finished concrete surface before concrete placement. Rigidly support dowels during concrete placement. Coat one end of dowels with a bond breaker.[

Install plate dowels according to the manufacturer's recommendations.]

### 3.4 FIELD TESTS AND INSPECTIONS

#### 3.4.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.

#### 3.4.2 Examining, Testing, and Correcting

\*\*\*\*\*  
NOTE: If the total number of butt-splices exceed  
5,000, the number of tension tests may be decrease  
to one test specimen for every 50 splices in excess  
of the first 5,000 splices provided that no splices  
are rejected in the last 500 splices made and the  
splicing operation will not be interrupted for more  
than 3 months.  
\*\*\*\*\*

Perform the following during the butt-splicing operations as specified and as directed:

#### 3.4.2.1 Visual Examination

Visually examine all welded splices as required by AWS D1.4/D1.4M. Respliced connections resulting from correction of visual defects may be examined by non-destructive testing at the option of the Contracting Officer as specified in paragraph SUPPLEMENTAL EXAMINATION. Visually examine exothermic mechanical butt-splices to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more than 10 mm 3/8 inch occupied by packing.

#### 3.4.2.2 Tension Tests

Perform tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction on one test specimen made in the field for every 25 splices made. Test specimens must be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Furnish stress-strain curves for each butt-splice tested.

#### 3.4.2.3 Non-destructive Testing of Welded Splices

Examine not less than one of each 25 welded splices selected at random by the Contracting Officer by non-destructive testing and evaluate for defects in accordance with AWS D1.4/D1.4M Section 7, except that radiographic testing is not permitted.

#### 3.4.2.4 Correction of Deficiencies

Do not embed splice in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. Remove all splices having visible defects or represented by test specimens which do not satisfy the tests or examinations. If any of the tension test specimens fail to meet the strength requirements or deformation limitations cut out two production splices from the same lot represented by the test specimens which failed and tension test. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. Cut off the bars of rejected splices outside the splice zone of weld metal, filler metal contact, coupling or sleeve. Finish the cut ends as specified, resplice and reinspect the joints.

#### 3.4.2.5 Supplemental Examination

The Contracting Officer may require additional or supplemental non-destructive testing and/or tension test of any completed splice. For costs of such examinations and tests see paragraph UNIT PRICES.

-- End of Section --