

DIVISION 4 - CONCRETE

SECTION 4.1 CONCRETE

4.1.1 CONCRETE GENERAL

All concrete construction shall conform to this section and to the detail requirements of the following paragraphs. Concrete finishes shall conform to paragraph 4.15 (Finishes and Finishing) and shall be as noted on the drawings.

The structures shall be located as shown on the drawings or as otherwise designated. The sequence of construction of the structures shall be subject to approval of the Contracting Officer. All structures shall be built to the prescribed lines, grades, and dimensions: Provided, That the dimensions of each structure as shown on the drawings will be subject to such modifications as may be found necessary by the Contracting Officer to adapt the structure to the conditions disclosed by the excavation or to meet other conditions. The Contractor shall be entitled to no additional allowance above the unit prices offered in the schedule by reason of the dimensions fixed by the Contracting Officer or by reasons of any modifications or extensions of a minor character to adapt the structures to the structure site, as determined by the Contracting Officer.

The relocation, addition, or elimination of any construction joint shall be subject to written approval of the Contracting Officer.

The Contractor shall place and attach to each structure all metal, or other accessories necessary for its completion as shown on the drawings. The cost of such work, for which specific unit prices are not provided in the schedule, shall be included in the unit prices offered in the schedule for the work to which they are appurtenant.

4.1.2 CONSTRUCTION OF STRUCTURES

The structures to be constructed or improved include the following:

- a. Access road, including 12 kilometers of grading an unmaintained county road and pioneering an access road down the creek channel approximately 900 meters.
- b. Additions to existing fish barrier.
- c. Aprons upstream and downstream from existing fish barrier.
- d. Steel cladding of downstream apron.

The item of the schedule for concrete in structures includes all cast-in-place concrete in the structures listed in b. and c. above.

Cast-in-place concrete for the structures shall conform to the requirements of section 4. (Concrete, General). Miscellaneous metalwork and other items forming a part of the structures are provided for elsewhere in these specifications.

The structures shall be built to the lines, grades, and dimensions shown on the drawings. The dimensions of each structure as shown on the drawings will

be subject to such modifications as may be found necessary by the Contracting Officer to adapt the structure to the conditions disclosed by the excavation or to meet other conditions.

Where necessary, as determined by the Contracting Officer, the Contractor will be furnished additional detail drawings of the structures to be constructed. The Contractor will not be entitled to any additional allowances above the prices offered in the schedule by reason of the dimensions fixed by the Contracting Officer or by reasons of any modifications or extensions of a minor character to adapt a structure to a structure site, as determined by the Contracting Officer.

The Contractor shall place and attach to each structure, all metal, and other accessories necessary for its completion, as shown on the drawings.

The cost of furnishing all materials and performing all work for installing metal, and other accessories for which specific prices are not provided in the schedule shall be included in the applicable prices offered in the schedule for the work to which such items are appurtenant.

SECTION 4.1.3 COMPOSITION

a. General. - Concrete shall be composed of cement, pozzolan, sand, coarse aggregate, water, and Contracting Officer approved admixtures, all well mixed and brought to the proper consistency. Additionally, the Concrete material and mix design shall meet the more stringent of this paragraph or the requirements set forth under the latest edition of Arizona Department of Transportation's "Standard Specification for Road and Bridge Construction" for a class "S" concrete at indicated Section No. 1006. Contractor shall pigment the concrete to match existing concrete and to blend with the rock at the site. Contracting officer to approve the color selected from the color chart submitted with the mix design.

b. Nominal maximum size of aggregate. - The coarse aggregate to be used in concrete shall have a nominal maximum size of 38 mm, and shall meet the requirements set forth under the latest edition of Arizona Department of Transportation's "Standard Specification for Road and Bridge Construction" for Class S concrete and shall conform to the size designation and grading requirements of AASHTO M 43. The sand and coarse aggregate shall consist of clean, hard, dense, durable, uncoated rock fragments that are free from injurious amounts of dirt, organic matter, and deleterious substances. The sand shall also meet the requirements set forth under the latest edition of Arizona Department of Transportation's "Standard Specification for Road and Bridge Construction" Section 1006-2.063 Paragraph (B) for Fine Aggregate. The sand and coarse aggregate shall be obtained from an approved supply source prior to use in the concrete mix.

c. The design strength at 28 days shall be 27,560 kilopascal, or as indicated on the drawings. Additionally, the Contracting officer will test concrete for compliance with the specifications and proportions. The mix design shall be sufficient to ensure that each mix meets the following requirements:

1. Ninety percent of test cylinders shall have a compressive strength at 28 days of 27,560 kilopascal.

d. Consistency. - The slump of the concrete at the placement shall not exceed 100 mm plus or minus 100 mm for concrete in the fish barrier or walls.

e. Mixing - The concrete ingredients shall be thoroughly mixed in mixers designed to assure uniform distribution of all the component material throughout the concrete at the end of the mixing period. The use of buckets, chutes, hoppers, pumps, transit mix trucks, or other equipment which will not readily handle and place concrete of the specified slump will not be permitted.

Uniformity in concrete consistency from batch to batch will be required. To maintain concrete at the proper consistency, the amount of water and aggregates batched for concrete shall be adjusted to compensate for variations in the moisture content or grading of the aggregates as they enter the mixer. Addition of water in excess of the design water content to compensate for stiffening of the concrete after mixing, known as retempering, will not be permitted.

f. Submittal - All submittals (RSN-C19) for concrete and aggregate shall be submitted in accordance with the requirement of this paragraph and paragraph 1.1.6 Submittal Requirements.

g. Payment - Payment of concrete shall be included in the applicable unit price offer in the schedule for the Concrete.

4.1.4 JOINTS AND EDGES IN CONCRETE

a. Construction joints. - Construction joints are joints which are purposely placed in concrete to facilitate construction; to reduce initial shrinkage stresses and cracks; to allow time for the installation of embedded metalwork; or to allow for the subsequent placing of other concrete. Bond is required at construction joints regardless of whether or not reinforcement is continuous across the joint.

The location of all construction joints in concrete work shall be subject to approval of the Contracting Officer, and the joints shall be constructed in accordance with paragraph 4.5.1 (Preparations for Placing) and 4.11.1 (Placing).

Control joints shall be constructed as provided in subparagraph a. above for construction joints: Provided, That reinforcing bars are always continuous across control joints.

Edges shall be chamfered to prevent feather edges if the angle between the top surface of the concrete and the rock is less than 40 degrees.

b. Cost. - The cost of furnishing all materials and performing all work for constructing construction joints, and control joints, and for tooling or chamfering concrete edges shall be included in the applicable prices offered in the schedule for Reinforced Concrete for which the joints and edges are required.

SECTION 4.1.5 PREPARATIONS FOR PLACING

a. General. - No concrete shall be placed until all formwork, installation of items to be embedded, and preparation of surfaces involved in the placement have been approved.

All surfaces of forms and embedded materials shall be free from curing compound, dried mortar from previous placements, and other foreign substances before the adjacent or surrounding concrete placement is begun.

Prior to beginning concrete placement, the Contractor shall make ready a sufficient number of properly operating vibrators and operators, and shall have readily available additional vibrators to replace defective ones during the progress of the placement. The Government inspector at the placement may require that the Contractor delay the start of the concrete placement until the number of working vibrators available is acceptable.

c. Foundation surfaces. - All surfaces upon or against which concrete is to be placed shall be free from frost, ice, water, mud, and debris.

(1) Rock surfaces shall be free from oil, objectionable coatings, and loose, semidetached, and unsound fragments. Immediately prior to placement of concrete, surfaces of rock shall be cleaned with a Hydrobroom (air-water jet) and shall be brought to a uniform surface-dry condition. Concrete shall not be placed in standing water.

d. Construction joints. - A construction joint is defined as a planned joint where two placements of concrete meet, across which development and maintenance of bond are required, and through which any reinforcement that may be present is not interrupted. All construction joints shall be roughened and all latency removed in preparation for placing adjoining concrete. Methods of roughening surfaces and removing latency may include mechanical abrasion or cutting, sandblasting, acid etching, or high-pressure water jetting of hardened (not green) concrete. Water jetting will normally be at pressures of at least 40 000 kPa. All methods are subject to the approval of the Contracting Officer. Construction joints shall be thoroughly cleaned of loose or defective concrete, coatings, sand, curing compound, and other foreign material on the surface.

After this initial cleanup and at the last opportunity prior to placing concrete, concrete surface shall be thoroughly cleaned with a Hydrobroom or air-water jets, and shall be uniformly surface dried.

SECTION 4.1.6 BATCHING, MIXING AND TRANSPORTING

a. General. - The concrete ingredients shall be thoroughly mixed in mixers designed to assure uniform distribution of all the component materials throughout the concrete at the end of the mixing period.

b. The concrete, as discharged from the mixer, shall be uniform in composition and consistency from batch to batch. Mixers will be examined regularly by the Government for changes in condition due to accumulation of hardened concrete or mortar or to wear of blades. The adequacy of the mixing will be determined by the Government in accordance with the concrete uniformity requirements of ASTM C 94, annex A1. Samples of concrete for such tests will be taken from any size batch which is commonly mixed during concrete production. For testing purposes, the Contractor shall mix, in the mixers to be tested, the size of batch directed by the Government inspector at the batch plant, and shall assist in collection of required samples from that batch.

Any mixer that at any time produces unsatisfactory results shall not be used until repaired. If repair attempts are unsuccessful, a defective mixer shall be replaced.

Batch size shall be at least 10 percent of, but not in excess of, the rated capacity of the mixer.

The Government will increase the minimum mixing time required as need is indicated by results of the concrete uniformity tests. Excessive overmixing which requires additions of water to maintain the required concrete consistency will not be permitted.

The mixing equipment shall conform to the following additional requirements:

c. Truck mixers. - Truck mixers shall be equipped with a watermeter, accurate to within 1 percent of the total mix water, located between the water supply and mixer. The watermeter shall have a dial or digital indicator. Truck mixers shall also be equipped with a reliable revolution counter for indicating the total number of revolutions of the drum for each batch. The revolution counter shall be visible from the operator control area and shall be reset to zero for each batch. Truck mixers shall have a metal plate attached in a prominent place indicating the manufacturer's recommended drum capacities, in terms of volume, and the maximum and minimum speeds of rotation for both mixing and agitating.

Initial mixing shall be continued for not less than 70 revolutions nor more than 100 revolutions of the drum after all the ingredients, except approximately 5 percent of the water which may be withheld for tempering, are in the drum. The mixing speed shall be not less than 12 revolutions per minute nor more than 22 revolutions per minute. Except as specified, additional water shall not be added to the concrete after the initial introduction of mixing water to the batch. Additional tempering water may be added to the batch on arrival at the placement when the concrete slump is less than specified; however, the design water content and specified slump shall not be exceeded. After this tempering, additional water shall not be added to the concrete. After addition of tempering water, mixing shall be continued at the specified mixing speed for a minimum of 30 revolutions. After a prolonged period of agitation, 10 to 15 revolutions of the drum at mixing speed will be required just prior to discharging. Discharge of the concrete shall be completed before the drum has revolved a total of 300 revolutions.

Each batch of concrete, when delivered at the jobsite from commercial ready-mix plants, shall be accompanied by a batch ticket in accordance with ASTM C 94.

4.1.7 REINFORCING BARS

a. General. - Reinforcing bars shall be cut, bent, and placed in the concrete where shown on the drawings or where directed. The Contractor shall furnish all reinforcing bars, accessories and usual inserts required for completion of the work.

b. Materials. -

(1) Reinforcing bars. - Reinforcing bars shall be deformed bars conforming to ASTM A 615, grade 60 or ASTM A 617, grade 60.

c. Placing reinforcing bars. The reinforcement shall conform to the requirements shown on drawing (40-D-6263).

Splices shall be located where shown on the drawings: Provided, That the location of splices may be altered subject to the written approval of the Contracting Officer.

Subject to the written approval of the Contracting Officer, the Contractor may, for the Contractor's convenience, splice bars at additional locations other than those shown on the drawings. In order to meet design and space limitations on splicing, some bent bars may exceed usual shipping clearances. Cutting and bending of such bars from stock lengths may be required at the site.

Unless otherwise prescribed, placement dimensions shall be to the centerlines of the bars. Reinforcement will be inspected for compliance with requirements as to size, shape, length, splicing, position, and amount after it has been placed.

Before reinforcement is embedded in concrete, the surfaces of the bars and the surfaces of any supports shall be cleaned of heavy flaky rust, loose mill scale, dirt, grease, or other foreign substances which, in the opinion of the Contracting Officer, are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap, or equivalent treatment, is considered objectionable.

Reinforcement shall be accurately placed to meet the following tolerances:

- (1) The amount of concrete cover protecting reinforcement shall not deviate from that specified by more than 15 mm if the specified cover is more than 63 mm, nor by more than 6 mm if the cover specified is 63 mm or less.
- (3) The spacing of reinforcing bars shall not deviate from the required spacing by more than 25 mm.

Reinforcement shall be secured in position so that it will not be displaced during the placing of the concrete, and special care shall be exercised to prevent any disturbance of the reinforcement in concrete that has already been placed. Bars shall not be field bent to the extent of permanent set, nor straightened, except as approved by the Contracting Officer or shown on the drawings. Bars bent without approval shall be replaced. Welding or tack welding of reinforcing bars will not be permitted except at locations shown on the drawings or where approved by the Contracting Officer. Chairs, hangers, spacers, and other supports for reinforcement shall be of concrete, metal, or of other approved material. Where portions of such supports will be exposed on concrete surfaces designated to receive F2 finish, the exposed portion of the supports shall be galvanized or of other corrosion-resistant material, except that concrete supports will not be permitted. Unless otherwise shown on the drawings, reinforcement in structures shall be so placed that there will be a clear distance of at least 25 mm between the reinforcement and form ties, or other embedded metalwork.

Measurement for payment will include reinforcing bars placed as shown on the drawings and reinforcing bars in splices located as shown on the drawings, and in relocated splices that are approved by the Contracting Officer. No measurement for payment will be made of reinforcing bars in additional splices allowed for the convenience of the Contractor. Except as otherwise provided below, the quantities of reinforcing bars regardless of the amount of reinforcing bars placed, payment will be made only on the basis of the quantities of reinforcing bars shown on the drawing.

Payment for furnishing and placing reinforcing bars will be made at the unit price per kilogram offered therefor in the schedule for Reinforcing Bars, of preparing all necessary bar lists and cutting lists; of furnishing and

attaching wire ties or other approved supports; and of cutting, bending, cleaning, and securing and maintaining in position reinforcing bars as shown on the drawings.

SECTION 4.1.8 FORMS

a. General. - Forms shall be used, wherever necessary, to confine the concrete and shape it to the required lines. The Contractor shall set and maintain concrete forms to ensure that completed work is within all applicable structural deviations, surface tolerances, and finish requirements. If a type of form does not consistently perform in an acceptable manner, the type of form shall be changed and the method of erection shall be modified.

A sufficient number of properly installed plumb and string lines shall be installed before, and maintained during, concrete placement for use by Contractor's personnel and Government inspectors. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in proper position. The design of formwork and placing rate of concrete containing type F or G chemical admixtures shall be adjusted to compensate for the greater hydraulic pressures exerted on the forms by concrete of high fluidity. Where form vibrators are to be used, forms shall be sufficiently rigid to effectively transmit energy from the form vibrators to the concrete, while not damaging or altering positions of forms. Surfaces and joints of forms shall be sealed sufficiently to prevent absorption of water into forms or loss of mortar from the concrete. Chamfer strips shall be placed in the corners of forms and at the tops of wall placements to produce beveled edges on permanently exposed concrete surfaces. Interior angles of intersecting concrete surfaces and edges of construction joints shall not be beveled except where indicated on the drawings.

b. Form sheathing - Wood sheathing shall be softwood or plywood of such kind and quality, or shall be so treated or coated, that there will be no deterioration or discoloration of the formed concrete surfaces due to chemical action, contamination, or uneven absorption of water from concrete. Plywood used for form sheathing or lining shall be concrete form, class 1, grade B-B, exterior, mill oiled and edge sealed, in accordance with the latest edition Product Standard PS1 of the U.S. Department of Commerce. Softwood lumber used for form sheathing shall meet applicable requirements of the latest edition of the Grading Rules for Western Lumber as published by the Western Wood Products Association for dressed lumber or worked lumber of the specified grade. All common boards shall be surfaced on both edges (S2E) in accordance with the standard grading rules.

The ability of form sheathing and lining to withstand distortion caused by placement and vibration of concrete shall be such that formed surfaces will conform with specified structural deviations, surface tolerances, and finish requirements.

Materials used for form sheathing or lining shall conform to the requirements of table 4-A (Form sheathing or lining material requirements) below, or may be other materials producing equivalent results.

Table 4-A. - Form sheathing or lining material requirements

Required finish of formed surface	Wood sheathing or lining	Steel sheathing or lining*
F1	Any grade common board, or plywood	Steel sheathing permitted Steel lining permitted
F2	No. 2 common or better, shiplap, or plywood	Steel sheathing permitted Steel lining permitted if approved

* Steel "sheathing" denotes steel sheets not supported by a wood backing. "Lining" denotes thin sheets supported by a wood backing.

c. Uniformity of forming material. - Forms for exposed concrete surfaces to receive finishes F2 shall be constructed to produce a uniform and consistent texture and pattern on the face of the concrete. Metal patches on forms for these surfaces will not be permitted. The form sheathing or lining shall be placed so that all horizontal form marks are continuous across the entire surface. If forms are constructed of plywood form lining or of panels of shiplap, the vertical form marks shall be continuous for the entire height of the surface. If forms for concrete surfaces to receive F2 finishes are constructed of shiplap that is not paneled, the boards shall be cut square, and the vertical joints in the boards shall be staggered and shall be made only at studs. The Contractor shall use one type of form material for all exposed F2 surfaces. If the Contractor elects to use shiplap for forms for F2 surfaces, the lumber shall either be all 150 mm or all 200 mm wide lumber.

a. Form ties and form anchors. - Embedded ties for holding forms shall remain embedded and, except where F1 finish is permitted, shall terminate not less than 2 diameters or twice the minimum dimension of the tie, whichever is greater, from the formed surfaces of the concrete.

The ties shall be constructed so that removal of the ends or end fasteners can be accomplished without causing appreciable spalling at the faces of the concrete. Form anchors shall be provided in sufficient number, subject to approval by the Contracting Officer, to ensure that concrete surfaces, after the forms have been stripped, are within applicable tolerances. Form anchors embedded in concrete which are loosened prior to placement of adjoining concrete shall be replaced by other supports firmly embedded in the hardened concrete.

b. Cleaning and oiling of forms. - At the time the concrete is placed in the forms, the surfaces of the forms shall be free from encrustations of mortar, grout, or other foreign material. Before concrete is placed, the surfaces of the forms shall be coated with a form oil that will effectively prevent sticking and will not soften or stain the concrete surfaces, or cause the surfaces to become chalky or dust producing.

d. Removal of forms. - To facilitate satisfactory progress with the specified curing and to allow the earliest practical repair of surface imperfections, forms shall be removed within 24 hours after the concrete has hardened sufficiently to prevent damage by careful form removal, and specified repair and curing shall commence immediately thereafter. It is the Contractor's responsibility to design and build adequate forms and to leave them in place until the forms can be safely removed. The Contractor shall be liable for damage and injury caused by removing forms before the concrete has gained sufficient strength.

e. Payment. - The payment for furnishing all materials and performing all work for constructing forms, including any necessary treatment or coating of forms, shall be included in the prices offered therefore in the schedule for reinforced concrete.

SECTION 4.1.9 STRUCTURAL DEVIATIONS AND SURFACE TOLERANCES FOR CONCRETE CONSTRUCTION

a. General. - Structural deviations are defined as allowable variations from specified lines, grades, and dimensions. Allowable variations from specified lines, grades, and dimensions are listed in table 4B (Deviations from specified lines, grades, and dimensions) in subparagraph b. below. Surface tolerances are the maximum allowable magnitude of the surface irregularities. Allowable magnitudes for concrete surface irregularities are specified in table 4-C (Concrete surface tolerances) in subparagraph d. below.

The intent of this paragraph is to establish structural deviations and surface tolerances that are consistent with modern construction practice, yet are governed by the effect that permissible variations may have upon a structure. The Government reserves the right to diminish the structural deviations and/or surface tolerances set forth herein if such variations impair the structural action, operational function, or architectural appearance of a structure or portion thereof.

Concrete shall be within all stated variations even though more than one may be specified for a particular concrete structure: Provided, That the specified variation for one element of a structure shall not apply when it will permit another element of the structure to exceed its allowable variation. Where variations are not specified or shown on the drawings for a particular structure, variations shall be those specified for similar work. As an exception to the clause in subsection I.1 entitled "Order of Precedence - Construction - Reclamation," specific tolerances shown on the drawings in connection with any dimension shall govern. The Contractor shall be responsible for finishing the concrete and for setting and maintaining concrete forms within the limits necessary to ensure that the completed work will be within the variations specified. Concrete work that does not conform to the limits specified shall be remedied in accordance with subparagraphs d. and e. below.

b. Structural deviations. - Variations from specified lines, grades, and dimensions in hardened concrete structures shall be checked by the Contractor and will be subject to such inspection and measurement as needed to determine that the structures are within the tolerances specified in table 4-B (Deviations from specified lines, grades, and dimensions).

Variation is defined as the distance between the actual position of the structure or any element of the structure and the specified position in plan for the structure or the particular element. Plus or minus

variations, shown as plus (+) or minus (-), indicate a permitted actual position up or down and in or out from the specified position in plan. Variations not designated as (+) or (-) indicate the maximum deviation permitted between designated successive points on the completed element of construction.

Specified position in plan is defined as the lines, grades, and dimensions described in these specifications or shown on the drawings or as otherwise prescribed by the Contracting Officer.

TABLE 4B. DEVIATIONS FROM SPECIFIED LINES, GRADES, AND DIMENSIONS

1. Reduction in thickness from that specified	5 percent
Reduction of specified thickness not to exceed	25 mm
2. Variation from plumb or specified batter for lines and surfaces of wall when overall height of line or surface is less than 3 meters	+/- 6 mm
3. Variation from level or specified grades for slabs:	
a. when overall length of line or surface is:	
Less than 3 meters.....	+/- 6 mm
3 to 6 meters, inclusive	+/- 10 mm
More than 6 meters	+/- 20 mm
4. Variation in cross-sectional dimensions or thicknesses of slabs and walls from those specified	+12 mm/-6 mm
5. Variation from specified elevation for top of fish barrier and wing walls.	+/-12 mm
6. Variation in cross-sectional dimension from those specified for slabs and walls.	+12 mm/-6 mm
7. Variations from level or specified grades for slabs, beams and horizontal groves when overall length of line or surface is:	
Less than 3 meters... Exposed...	+/- 10 mm
... Buried....	+/- 20 mm
3 meters or more Exposed...	+/- 12 mm
.... Buried ...	+/- 25 mm

(1) General. - Bulges, depressions, and offsets are defined as concrete surface irregularities (or roughness). Concrete surface irregularities are classified as "abrupt" or "gradual" and allowable tolerances are listed in table 4-C (Concrete surface tolerances). A concrete surface tolerance is designated by a capital "T" followed by a number 1 through 5. Concrete surface tolerance designations are separate from concrete surface finishes and concrete structural deviations.

(2) Abrupt surface irregularities. - Abrupt surface irregularities are defined herein as offsets such as those caused by misplaced or loose forms. Abrupt surface irregularities are further defined as isolated irregularities in which the maximum dimension of the irregularity perpendicular to the surface is greater than the maximum dimension of the irregularity in the plane of the surface. Also, abrupt surface irregularities include all incidences of isolated surface irregularities

which exceed the gradual irregularity specifications set forth herein. Abrupt surface irregularities are measured as specified in subparagraph f. below.

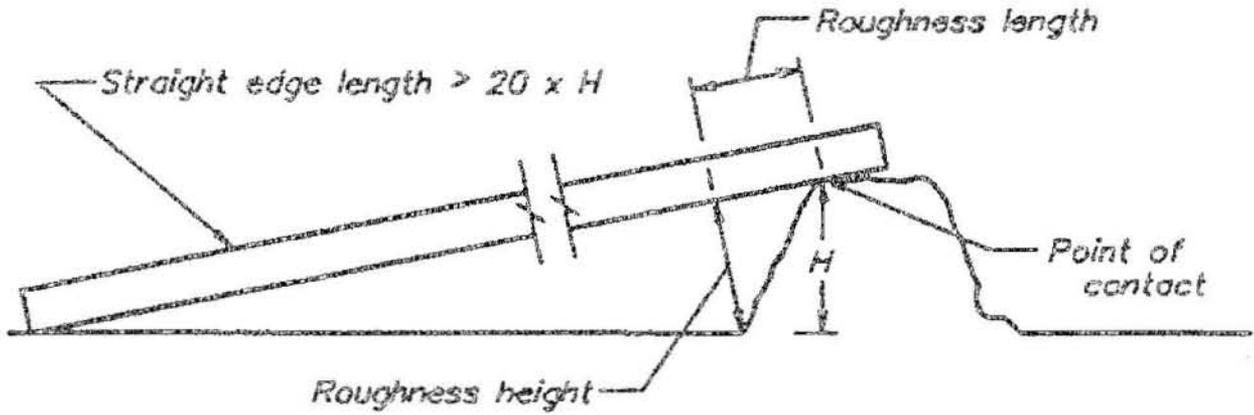
(3) Gradual surface irregularities. - Gradual surface irregularities are defined herein as bulges and depressions resulting in gradual changes on the concrete surface. Gradual surface irregularities are further defined as isolated undulations on the concrete surface. The maximum dimension of the undulation perpendicular to the surface is small relative to the maximum dimension of the undulation in the plane of the surface. Gradual surface irregularities are measured as specified in subparagraph f. below.

(4) The magnitude of surface irregularities of formwork and finished concrete surfaces shall be checked by the Contractor to ensure that the concrete surfaces are within specified tolerances. The Government will also make such checks of hardened concrete surfaces as determined necessary to ensure compliance with these specifications.

c. Concrete surface tolerances. -

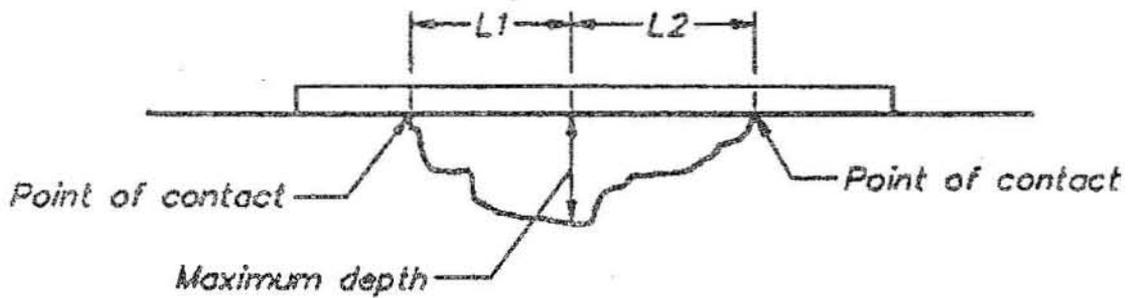
TABLE 4-C. - CONCRETE SURFACE TOLERANCES

Concrete Surface tolerance	Maximum allowable concrete surface irregularity	
	Abrupt	Gradual
T1	25 mm	1/4 mm/mm
T2	12 mm	1/8 mm/mm
T3	6 mm	1/16 mm/mm
T4	3 mm	1/32 mm/mm
T5	1 mm	1/120 mm/mm



CASE 1

$$\text{Roughness slope} = \frac{\text{Roughness depth}}{\text{The shortest distance } L1 \text{ or } L2}$$



CASE 2

FIGURE 2

d. Repair of hardened concrete not within specified tolerances. - Hardened concrete which is not within specified tolerances shall be repaired to bring it within those tolerances. Such repair shall be in accordance with paragraph 4.14.1 (Repair of Concrete) and shall be accomplished in a manner approved by the Contracting Officer. Concrete repair to bring concrete within tolerances shall be done only after consultation with a Government inspector regarding the method of repair. The Contractor shall notify the Government as to the time when repair will be performed.

Concrete which will be exposed to public view shall be repaired in a manner which will result in a concrete surface with a uniform appearance.

A simple measuring device can be constructed to perform the surface tolerance measurements and evaluation process directly and quickly. Information concerning concrete tolerance measuring devices can be obtained from the Bureau of Reclamation, Attn D-3730, PO Box 25007, Denver, CO 80225, telephone (303) 236-5989.

e. Prevention of repeated failure to meet tolerances. - When concrete placements result in hardened concrete that does not meet specified tolerances, the Contractor shall, upon request, submit to the Government an outline of all preventive actions, such as modifications to modified procedure for setting screeds, and different finishing techniques, to be implemented by the Contractor to avoid repeated failures. The Government reserves the right to delay concrete placements until the Contractor implements preventive actions which have been approved by the Contracting Officer.

SECTION 4.1.10 PLACING

a. General. - The Contractor shall notify the Contracting Officer before batching begins for placement of concrete. Unless inspection is waived for that specific placement, placing shall be performed only in the presence of an authorized Government inspector. Placement shall not begin until all preparations are complete and the concrete placement check-out card has been signed by the Contractor or the Contractor's Representative and the authorized representative of the Contracting Officer, substantiating completion of all preparations for that placement.

All surfaces upon or against which concrete is to be placed shall be prepared in accordance with paragraph 4.5.1 (Preparation for Placing). Retempering of concrete will not be permitted. Concrete which has become so stiff that proper placing cannot be assured shall be wasted.

Concrete shall not be placed in standing water except with written permission from the Contracting Officer, and the method of placing shall be subject to approval.

Concrete shall not be placed in running water, and shall not be subjected to running water until after the concrete has hardened. Concrete shall be deposited as nearly as practical in its final position and shall not be allowed to flow in such a manner that the lateral movement will cause segregation of the coarse aggregate from the concrete mass. Methods and equipment employed in depositing concrete in forms shall minimize clusters of coarse aggregate. Clusters that occur shall be scattered before the concrete is vibrated.

Forms shall be constantly monitored and their position adjusted as necessary during concrete placement in accordance with paragraph 4.9.1 (Forms).

All concrete shall be placed in approximately horizontal layers. The depths of layers shall not exceed 500 mm. The Government reserves the right to require lesser depths of layers where concrete cannot otherwise be placed and consolidated in accordance with the requirements of these specifications. Exposed construction joints shall be made straight and level or plumb except as shown otherwise on the drawings.

Except as shown otherwise on the drawings, construction joints intersecting sloping exposed concrete surfaces shall be inclined near the exposed surface to prevent featheredges. The angle between such an inclined surface and the form shall be not less than 50°degrees nor more than 130°degrees, and that surface angle shall extend into the concrete member for at least 75 mm.

A cold joint is an unplanned joint resulting when a concrete surface hardens before the next batch is placed against it. Cold joints are undesirable and should be avoided. However, in the event of equipment breakdown or other unavoidable prolonged interruption of continuous placing when it appears that unconsolidated concrete may harden to the extent that later vibration will not fully consolidate it, the Contractor shall immediately consolidate such concrete to a stable and uniform slope.

If delay of placement is then short enough to permit penetration of the underlying concrete, placement shall resume with particular care being taken to thoroughly penetrate and revibrate the concrete surface placed before the delay. If concrete cannot be penetrated with a vibrator, the cold joint shall then be treated as a construction joint if the design requirements are such that a construction joint is practical. If a construction joint will impair the structural integrity, as determined by the Contracting Officer, the concrete shall be repaired as determined by the Contracting Officer. Repairs in some instances will include removal of all or a portion of the previously placed concrete and the Contractor will not be entitled to any payment for such work.

Care shall be taken to prevent cold joints when placing concrete in any part of the work. The concrete-placing rate shall ensure concrete is placed while the previously placed, adjacent concrete is plastic so that the concrete can be made monolithic by normal use of the vibrators.

Concrete shall not be placed in rain sufficiently heavy or prolonged to wash mortar from concrete. A cold joint may necessarily result from prolonged heavy rainfall.

b. Transportation. - Normally, concrete shall be deposited in its final position in the placement within 90 minutes after the introduction of the mix water and cement into the mixer. This limitation may be waived if the concrete is of such slump and workability, and contains the specified entrained air content after the 90-minute time limit that it can be satisfactorily placed without the addition of water. Furthermore, a time limit less than 90 minutes may be invoked during hot weather or under conditions contributing to quick stiffening of the concrete. The methods and equipment used for transporting concrete from the batch plant and the elapsed time during transportation shall not cause measurable segregation of coarse aggregate or slump loss exceeding 50 mm.

Concrete shall be deposited as near as practical to its final position by use of buckets, chutes, conveyors, or concrete pumps. The use of aluminum pipe or aluminum chutes for delivery of concrete will not be permitted. Concrete buckets shall be capable of promptly discharging concrete of the specified mix design, and the dumping mechanism shall be capable of discharging at one location repeated small portions of concrete from a full bucket. Buckets and conveyors shall be designed for attaching drop chutes or tremies which shall be used to deposit concrete whenever the concrete must be dropped more than 3 000 mm from the bucket to the placing surface.

Buckets, chutes, hoppers, pumps, transit mix trucks, and other equipment shall readily handle and place concrete of the specified slump. The Contractor shall, when directed, replace inadequate transporting equipment with acceptable equipment.

c. Consolidation. - Concrete shall be consolidated by internal vibration. The vibration shall be sufficient to remove all undesirable air voids from the concrete, including the air voids trapped against forms and construction joints. Close attention and additional effort may be required to adequately consolidate concrete adjacent to construction joints and sloping surfaces. Such close attention and additional effort required to consolidate concrete adjacent to construction joints and sloping surfaces shall be at no additional cost to the Government. After consolidation, the concrete shall be free of rock pockets and honeycomb areas, and shall be closed snugly against all surfaces of forms, construction joints, and embedments.

After concrete has been deposited, the mounds or high spots shall be leveled by vibration. Except as hereinafter provided, consolidation of all concrete shall be by immersion-type vibrators operated in nearly vertical position. The vibrating head shall penetrate and revibrate the concrete in the upper portion of the underlying layer. Care shall be exercised to avoid contact of the vibrating head with embedded items and with formed surfaces which will later be exposed to view. Concrete shall not be placed upon other plastic concrete until the previously placed concrete has been thoroughly consolidated.

Vibrator operators shall establish a pattern of vibrator insertions. The pattern shall be such that the distance between insertions will be about 1-1/2 times the radius of action, or such that the area visibly affected by the vibrator overlaps the adjacent just-vibrated area by a few inches. The radius of action for properly maintained and operated internal vibrators is shown in table 4-D (Radius of action for internal vibrators).

Table 4-D Radius of action for internal vibrators

Diameter of head, mm	Radius of action, mm
20 - 40	75 - 150
30 - 65	130 - 260
50 - 90	175 - 350
75 - 150	300 - 500
130 - 175	375 - 600

Immersion-type vibrators shall be operated at speeds of at least 7,000 vibrations per minute when immersed in concrete. The Contractor shall immediately replace improperly operating vibrators with acceptable vibrators.

d. Payment. - The Contractor shall be entitled to no additional payment, over the unit prices offered in the schedule for concrete, by reason of any limitations in the placing of concrete required under the provisions of this paragraph.

SECTION 4.1.11 PROTECTION

The Contractor shall protect all concrete against damage until final acceptance by the Government. Concrete shall not be loaded, forms and shoring shall not be removed, and backfill shall not be placed against concrete until the concrete has gained sufficient strength to safely support its weight and all imposed loads.

Fresh concrete shall be protected against: erosion from rain, hail, sleet, or snow; contamination from foreign materials; and damage from foot traffic until the concrete has hardened. Hardened concrete surfaces which receive U2 finish shall be protected against damage from foot traffic and other construction activity by covering with protective mats, plywood, or by other effective means. Methods of protection shall be subject to approval by the Government.

Concrete curing membranes shall be kept intact, and other curing materials and processes shall be maintained as necessary to assure continuous curing for the minimum specified curing time. Protection of curing membranes and other curing methods shall be as described in paragraph 4.3.10 (Curing).

SECTION 4.1.12 CURING

a. General. - The Contractor shall furnish all materials and perform all work required for curing concrete.

All concrete surfaces shall be treated as specified to prevent loss of moisture from the concrete until the required curing period has elapsed or until immediately prior to placement of other concrete or backfill against those surfaces. Only sufficient time to prepare construction joint surfaces and to bring them to a surface-dry condition shall be allowed between discontinuance of curing and placement of adjacent concrete.

As soon as unformed concrete surfaces have been finished, as specified, and have attained a dull appearance free from bleed water and moist sheen, they shall be treated as specified herein.

Forms shall be removed within 24 hours after the concrete has hardened sufficiently to prevent structural collapse or other damage by careful form removal. Where required, repair of all minor surface imperfections shall be made immediately after form removal. Minor surface repair shall be completed within 2 hours after form removal and shall be immediately followed by the initiation of curing by the applicable method specified. Concrete surfaces shall be kept continuously moist after form removal until initiation of curing.

The Government will require approved manufacturer's certification of all curing compound prior to use. However, acceptance under clause in subsection I.3 entitled "Inspection of Construction," will not be made until the material has been satisfactorily applied at the jobsite.

b. Submittals. - Submittals of purchase orders, certifications, and samples, (RSN C20) if required, shall be in accordance with this paragraph and paragraph 1.1.6 (Submittal Requirements).

The Contractor shall be responsible for the accuracy of all certifications submitted and data contained therein whether submitted by him, a manufacturer, or a subcontractor. The costs and delays that result from rejection of materials or inadequate certifications shall be the responsibility of the Contractor.

(1) Purchase orders. - At least 20 days prior to shipment of curing compounds the Contractor shall submit two copies of all purchase orders for curing compound the Contractor proposes to furnish.

The Contractor will be informed in writing whether materials covered by each purchase order will be accepted on manufacturer's certification of compliance or if testing by the Government will also be required.

(2) Materials which will be accepted on manufacturer's certification of compliance. - At least 20 days prior to shipment of the curing compound the Contractor shall submit the manufacturer's certification certifying that the material is within 1 percent (by weight of each individual constituent) of the same composition as material which previously has been found to comply with the specifications when completely tested. The certification shall fully identify the manufacturer, batch number, materials identification, and quantity. In addition, compliance certification from the manufacturer of the CRC-101 curing compound shall include the composition of the materials furnished.

Within 10 days after receipt of the certifications, the Government will notify the Contractor whether the certifications conform to specifications requirements.

(3) Materials which require testing by the Government. - At least 45 days prior to shipment of the curing compound the Contractor shall submit samples of curing compound requiring testing by the Government. Each sample shall be 1 liter in size and included with each sample shall be a certification that the sample is from the actual batch from which shipments are to be furnished. Samples and accompanying certifications shall be fully identified by manufacturer's name, batch number, materials identification, and quantity.

c. Materials. - Materials used for curing shall meet the following requirements:

(1) Water. - Water used for curing shall be potable and meet the applicable requirements for water used in mixing and curing concrete.

(2) Curing compound. - Wax-base and water-emulsified, resin-base curing compounds shall conform to the requirements of Water and Power Resources Service "Specifications for Concrete Curing Compound" dated October 1, 1980. Curing compounds shall be of uniform consistency and quality within each container and from shipment to shipment.

(3) Polyethylene film. - Polyethylene film for curing concrete shall be white and shall conform to the requirements of ASTM C 171.

(4) Water curing. - Concrete cured with water shall be kept wet for at least 14 days from the time the concrete has attained sufficient set to prevent detrimental effects to the concrete surfaces. The concrete surfaces to be cured shall be kept wet by covering them with water-saturated material; by using a system of perforated pipes, mechanical sprinklers, or porous hose; or by other methods which will keep all surfaces continuously (not periodically) wet. All curing methods are subject to approval by the Contracting Officer.

(5) Curing with compound. - Curing by wax-base or water-emulsified, resin-base or CRC-101 curing compound shall be by application to designated concrete surfaces to provide a water-retaining film. The curing compound shall be reapplied as necessary to maintain a continuous, water-retaining film on the surface for 28 days. The curing compound shall be mixed thoroughly and spray applied to the concrete surfaces in one coat to provide a continuous, uniform film over the concrete. The coverage rate shall not exceed 3.7 square meters per liter for wax-base or water-emulsified, resin-base compound and 4.9 square meters per liter for CRC-101 compound. On rough surfaces, the coverage rate shall be decreased as necessary to obtain the required continuous film. Special care shall be taken to ensure ample coverage with the compound at edges, corners, and rough surfaces; and to keep curing compound off waterstops and reinforcing bars. Equipment for applying curing compound and the method of application shall be in accordance with the provisions of chapter VI of the Eighth Edition 1981 Revised Reprint of the Bureau of Reclamation "Concrete Manual."

In applying CRC-101 curing compound, care shall be taken to produce a uniform, continuous film, and to avoid sagging, puddling, and excessive thickness. To prevent sagging on surfaces which are not horizontal, application shall consist of two or more passes over each point on the surface, using a cross-spraying technique, and with a time interval between passes not exceeding 30 minutes. The application shall be performed by personnel qualified, as determined by the Contracting Officer, in using the specified spray techniques. The compound shall be applied in a manner conforming with safe control proceedings outlined in the Bureau of Reclamation Occupational Health and Safety data sheet on CRC-101 curing compound.

In order to ensure bond of curing compound, the Contractor shall, where and as directed by the Contracting Officer, remove excessive form oil from concrete surfaces by washing with a solution of trisodium phosphate, followed by a thorough rinsing of the surfaces with clear water. The trisodium phosphate wash will be required when it is determined by the Contracting Officer that the amount of form oil on the concrete will impair the bond of the curing compound or when surfaces are exposed to public view.

Where curing compound is to be applied, formed concrete surfaces shall be kept continuously moist by repeated light spraying with water until immediately prior to application of curing compound. Curing compound shall be applied as soon as the surface film of moisture has disappeared, but while the concrete still has a damp appearance.

After application of the curing compound has been completed and the coating is dry to touch, all remaining required concrete repairs shall be performed without delay in accordance with paragraph 4.15.1 (Repair of Concrete).

Completed repairs shall be moistened and coated with curing compound in accordance with the foregoing requirements.

(6) Polyethylene film curing. - Curing by this method shall be by completely covering the designated concrete surfaces with polyethylene film to provide an airtight, water-retaining film over the entire concrete surface for at least 14 days. As soon as the concrete has hardened sufficiently to prevent damage, all surfaces shall be thoroughly moistened by spraying them lightly with water and then covering them completely with polyethylene film. Edges of the polyethylene strips shall be lapped to effect a seal to adjacent strips and, at the extreme edge of the curing area, held tightly against the concrete surface. The polyethylene film shall be adequately secured to withstand wind and to prevent circulation of air inside the curing film.

(7) Protection of curing membranes. - Curing compound membranes shall be maintained to provide a moistureproof membrane for curing concrete for the minimum period specified. Curing compound that is damaged, or that peels from concrete surfaces within 28 days after application, shall be repaired without delay by moistening the concrete and applying additional compound in a manner satisfactory to the Contracting Officer.

Polyethylene film curing shall be sustained for at least 14 days. The polyethylene film shall be protected as necessary to keep it intact, and the concrete surface shall be kept moist for the full curing period.

Where foot traffic or other construction activity is necessary on concrete being cured by curing compound or polyethylene film, the curing membrane shall be protected by covering with sand or earth not less than 25 mm thick, with plywood, or by other effective means approved by the Contracting Officer. Protective covering shall not be placed on curing compound until the compound is dry. The Contractor shall remove protective coverings before final acceptance of the work.

(8) Cost. - The cost of furnishing all materials and performing all work for curing concrete as required by this paragraph including the submission of submittals shall be included in the applicable price offered in the schedule for reinforced concrete.

SECTION 4.1.13 TEMPERATURE OF CONCRETE

Concrete shall be placed at a temperature between 10°C and 32°C. The temperature will be determined by placing a thermometer in the concrete immediately after sampling at the placement site. Then the temperature of the concrete at the batch plant shall be adjusted to assure that the specified concrete temperature is attained at the placement.

The Contractor shall employ effective means, such as precooling of aggregates and mixing water and placing at night, as necessary to maintain the temperature of the concrete below the specified maximum. The Contractor shall be entitled to no additional compensation due to the foregoing requirements.

SECTION 4.1.14 REPAIR OF CONCRETE

a. General. - Concrete shall be repaired in accordance with this paragraph, paragraph 4.10.1 (Tolerances for Concrete Construction), and Bureau of Reclamation "Standard Specifications for Repair of Concrete," dated March 1, 1990.

b. Method of repair or replacement. - The method of repair or replacement shall be as determined and directed by the Contracting Officer and in accordance with the "Standard Specifications for Repair of Concrete."

c. Cost. - The cost of furnishing all materials and performing all work required in the repair of concrete shall be borne by the Contractor.

SECTION 4.1.15 FINISHES AND FINISHING

a. General. - The classes of finish and the requirements for finishing of concrete surfaces shall be as specified in this paragraph, paragraph 4.8.1 (Forms), and table 4.C (Concrete surface tolerances) of paragraph 4.9.1 (Structural deviations and Tolerances) or as otherwise shown on the drawings. Where finishes are not specified or shown on the drawings for a particular structure or surface, the finish shall be as specified for similar work. The Contractor shall notify the Contracting Officer before finishing concrete. Unless inspection is waived in each specific case, finishing of concrete shall be performed only when a Government inspector is present.

Concrete surface variations will be measured by the Government in accordance with subparagraph 4.9.1.d. (Structural Deviations and Surface Tolerances for Concrete Construction) where necessary to verify that concrete surfaces are within the specified tolerances. Finished concrete which is not within the specified tolerances shall be repaired in accordance with paragraph 4.14.1 (Repair of Concrete).

b. Formed surfaces. - The classes of finish for formed concrete surfaces are designated by the symbols F1 and F2. The classes of finish shall apply as follows:

(1) F1. - Finish F1 generally applies to formed surfaces upon or against which fill material, grout, or concrete is to be placed. Form tie rod ends on surfaces which will be in contact with fill material shall be protected from moisture if they will be below the water table or water line. Protection shall consist of recessing the tie rod ends and filling the recesses with dry pack or other approved material or by a waterproofing system approved by the Contracting Officer. Form tie rod ends on surfaces which will be in contact with concrete or form tie rod ends on surfaces which will be in contact with fill material but will be above the maximum water table elevation may be cut off flush with the formed surfaces or may be recessed without filling.

(2) F2. - Finish F2 generally applies to all formed surfaces not permanently concealed by fill material, grout, or concrete.

c. Unformed surfaces. - The classes of finish for unformed concrete surfaces are designated by the symbols U1 and U2. Interior surfaces shall be sloped for drainage where shown on the drawings or directed. Surfaces which will be exposed to the weather and which would normally be level shall be sloped for drainage. Unless the use of other slopes or level surfaces is indicated on the drawings or directed, narrow surfaces, such as tops of walls, shall be sloped approximately 10 mm per 300 mm of width; and broader surfaces, shall be sloped approximately 6 mm per 300 mm. Unless otherwise specified or indicated on the drawings, these classes of finish shall apply as follows:

(1) U1. - Finish U1 (screeded finish) generally applies to unformed surfaces that will be covered by fill material, grout, or concrete. Finish U1 is also used as the first stage of finishes U2. Finishing operations shall consist of sufficient leveling and screeding to produce even uniform surfaces.

(2) U2. - Finish U2 (floated finish) generally applies to unformed surfaces not permanently concealed by fill material, grout, or concrete. Floating may be performed by use of hand- or power-driven equipment. Floating shall be started as soon as the screeded surface has stiffened sufficiently, but before bleed water forms, and shall be the minimum necessary to produce a surface that is free of screed marks and is uniform in texture.

SECTION 4.1.16 MEASUREMENT OF CONCRETE

Measurement, for payment, of concrete required to be placed directly upon or against surfaces of excavation will be made to the lines for which payment for excavation is made.

SECTION 4.1.17 PAYMENT FOR CONCRETE

a. Payment for all concrete will be made at the unit price per cubic meter offer therefor in the schedule for reinforced concrete which unit price shall include the cost of furnishing all materials except for reinforcing bars which are priced separately, and performing all work required for the concrete construction.

DIVISION 5 - METAL

5.1 GENERAL

The Contractor shall furnish and install miscellaneous metalwork and nonmetallic materials as specified:

5.1.1 STEEL PLATE

The 8 (eight) steel plates shall be - ASTM A 36, each a 19mm x 1 200 mm x 3 000 mm nominal size. Shearing and cutting of steel plate by torch or electric arc shall be performed accurately, and all portions of the work which will be exposed to view after completion shall be finished neatly. All materials shall be straight and true and free from kinks, twists, or warps. If straightening is necessary, it shall be done by methods that will not injure the metal.

a. Submittal. - Submittals shall be in accordance with this paragraph and paragraph 1.1.6 (Submittal Requirements). Prior to placement of steel plates the contractor shall submit (RSN-C21) to the Government the name and manufacturer of the plates.

b. Holes in the steel plate for anchor bolts shall be drilled or punched to a diameter approximately 3mm larger than the diameter of the anchor bolts, and shall be located as shown on drawing 344-330-14840.

c. When steel plate is cut in the field to meet field conditions, flame cutting will be permitted, providing that protrusions on top and bottom surfaces of the plate caused by the flame cutting shall be eliminated by grinding.

d. Steel plate is to overlap expansion or control joints to keep sand and gravel from entering the joints.

e. Payment will be made as a lump sum offered in the schedule for furnishing and placing miscellaneous metal.

5.1.2 ANCHOR BOLTS

Anchor bolts used to secure steel plate to the downstream apron shall be as shown on the drawings and shall meet the requirements of ASTM A 307, grade A. The anchor bolts shall be fabricated from threaded rod. Threads shall be class 2 free fit, American National coarse-thread series.

a. Nuts. - Nuts used on the above anchor bolts shall be a heavy hex nut and meet the requirements of ASTM A 563.

b. Washers. - Washers shall be circular, of carbon steel and shall meet the requirements of ASTM-F436.

c. The Contractor shall drill all holes in concrete required for the installation of anchor bolts. Holes for anchor bolts shall be straight and true and to the diameter shown on the drawings.

d. Submittal. - Submittal (RSN-C22) shall be in accordance with this paragraph and paragraph 1.1.6 (Submittal Requirements).

e. Payment shall be made as part of the lump sum offered in the schedule for miscellaneous metal.

5.1.3 ROCK BOLTS

a. General. - Where shown on the drawings or directed, the Contractor shall drill holes in the rock and existing concrete for rock bolts and grout the bars in place. Rock bolts shall be deformed reinforcing bars and shall be used for anchoring the concrete additions to the existing fish barrier and the concrete apron to bedrock. The Contractor shall furnish the rock bolts and all materials for the grout.

The dimensions of the rock bolts and the locations, diameters, and depths of the rock bolt holes shall be as shown on the drawings or as directed. The diameter of each rock hole shall not be less than 1 and 1/2 times the diameter of the rock bolt specified for that hole.

The depth of holes shown on the drawings for receiving the bolts are minimum depths to be drilled. In overbreak areas, longer bolts will be required to provide a constant embedded length and maintain the top of the rock bolt hook in the position shown on the drawings. Contractor shall maintain the top of the rock bolt hook in the position shown on the drawings.

Where excavation is required in areas where rock bolts will be placed, the holes for the rock bolts shall not be drilled until the excavation has been completed.

b. Materials. - Rock bolts shall be in accordance with paragraph 4.8.1 (Reinforcing bars). Bolts shall be bent to the shapes and dimensions shown on the drawings prior to being grouted in place.

Grout shall consist of cement, water, and sand mixed in the proportions and to the consistency prescribed by the Contracting Officer.

c. Placing. - Rock bolts shall be cleaned thoroughly before being placed. The holes shall be cleaned thoroughly and shall be completely and compactly filled with grout. The rock bolts shall be forced into place before the grout takes its initial set and, where practicable, shall be vibrated or rapped until the entire surface of the embedded portions of the bolts is in intimate contact with the grout. Special care shall be taken to insure against any movement of the bolts which have been placed.

d. Measurement and payment. - Measurement, for payment of drilling holes for rock bolts and grouting bolts in place will be based upon the length of holes required to be drilled to receive the bolts. Payment for drilling holes for rock bolts and grouting bolts in place will be made at the unit price per linear meter offered therefor in the schedule for Rock Bolt Holes, which unit price shall include the cost of furnishing materials for rock bolts and grout, of drilling the holes, and of grouting the bolts in place.

5.1.4 ELASTOMERIC SHEETING

Elastomeric sheeting - The synthetic rubber sheeting shall be dense sheet of EPDM compound. The material shall be compounded and cured to have a shore durometer (type A) of 45 plus or minus 10. The synthetic rubber sheeting shall be formed and cured in such a manner that any cross section will be dense, homogeneous, and free from porosity and other imperfections. Minor surface defects of plus or minus 1mm will be acceptable. Material shall be furnished in sheets 6.35mm x 1 200 mm x 3 000 mm. Length and width tolerance shall be plus or minus 5mm. The sheeting is to be used as a shock

absorber between the steel plate and the concrete apron on the downstream side of the fish barrier, and shall cover the entire area under the steel plate.

a. Fabrication. - All work shall be equal to the best modern practice in the manufacture and fabrication of materials of the type covered by these specifications, notwithstanding any omissions from these specifications or drawings.

b. Submittals. Submittals for elastomeric sheeting (RSN-C23) shall be submitted in accordance with the requirements of this paragraph and paragraph 1.1.6 (Submittal Requirements).

c. Payment. - Payment for furnishing and installing elastomeric sheeting will be included in the lump sum price bid therefore in the schedule for miscellaneous metalwork.

DIVISION 6 - DRAWINGS

SECTION 6.1 - DRAWINGS

6.1.1 DRAWINGS, GENERAL

a. General. - The drawings which form a part of these specifications show the work to be done under these specifications. In the event there are differences as determined by the Contracting Officer between details and dimensions shown on these drawings and those of existing features at the site, the site condition shall govern.

In accordance with the clause in subsection I.2 entitled "Specifications and Drawings for Construction," the Contractor shall advise the Contracting Officer of any discrepancies including errors or omissions discovered on any of the drawings.

b. Additional copies of drawings. - The Contractor will be furnished such additional copies of these specifications and drawings as may be required for carrying out the work. Full-size contact prints of the original drawings from which the attached reproductions were made, will be furnished to the Contractor for construction purposes upon request. The number of prints of each drawing furnished to the Contractor will be limited to 10 contact prints and 1 reproducible.

c. Mailing address. - All drawings and data submitted by the Contractor for which a specific mailing address is not given in these specifications shall be submitted to the Construction Engineer, Bureau of Reclamation, P.O. Box 9980, Phoenix, Arizona 85068-0980

6.1.2 LIST OF DRAWINGS

The following drawings are made a part of these specifications:

TULE CREEK FISH BARRIER REHABILITATION
NEW WADDELL DAM
REGULATORY STORAGE DIVISION, ARIZONA
CENTRAL ARIZONA PROJECT
PHOENIX, ARIZONA

Drawing Number	Description	Page No.
344-330-14837	General	2
344-330-14838	Location Map	3
344-330-14839	Plan and Sections	4
344-330-14840	Sections	5
344-330-14841	Profile and Plan	6
40-D-6263	Reinforcement detailing	7