

Cottonwood Springs Fish Barrier  
**DESCRIPTION OF WORK AND SPECIFICATION REQUIREMENTS**

**General Scope**

The general scope of work for this construction contract consists of modifying an existing grade stabilization structure across Sonoita Creek. The structure is constructed of steel pipe posts and wire mesh fence backfilled with riprap on both sides of the fence. The structure will be modified by the placement of a reinforced concrete barrier drop structure with downstream scour apron. All modification work to the existing grade structure will be performed downstream of the wire mesh and pipe fence. No changes will be required to the fencing or to the riprap upstream of the fencing.

**II. Removal and Salvage of Existing Riprap Material**

The Contractor is required to remove the existing riprap located within the stream channel, on the downstream side of the wire mesh pipe fence. The downstream riprap is to be removed only within the limits indicated to facilitate construction of the new concrete barrier drop structure and apron slab, across a length of approximately 70 feet. An estimated total of 50 cubic yards of riprap material is to be removed from the downstream side of the existing grade stabilization structure, and stockpiled for later use as erosion protection downstream of the concrete apron slab and as slope protection along the abutment side slopes.

The Contractor shall remove and stockpile the existing riprap carefully so as to minimize contamination of the material with excessive fines and to provide a relatively clean supply of riprap material to be reused.

The Contractor shall use extreme care during riprap removal operations to avoid disturbance and damage to the existing steel pipe posts and wire mesh fencing of the structure. Any damage to the existing grade structure will be repaired at the Contractor's expense, as directed by the onsite Government representative.

**III. Import and Placement of Additional Riprap Material**

The Contractor is required to import and place an estimated total of 75 cubic yards of riprap material from an offsite source in addition to the riprap material salvaged and stockpiled. It is the Contractor's responsibility to coordinate the delivery of riprap material onsite with his subcontractors and suppliers. Stockpiling of imported riprap material will be allowed at the worksite within use areas designated in the field by the onsite Government representative.

The rock supplied for riprap material shall be hard, dense, angular, and durable. The rock shall be imported from an offsite source, and may be quarried rock or boulders. River run material is not acceptable. Riprap shall have a specific gravity of 2.64 or greater. The riprap shall contain rock from a maximum size of 52 inches down to a minimum size of 18 inches. The rock shall be well graded, meeting the gradation specified in the "Riprap Gradation Table" shown below:

**RIPRAP GRADATION TABULATION**

Percent Passing the Specified Size (%)	Rock Diameter (inches)
100	52
85	40 to 52
50	34 to 40
30	26 to 34
15	18 to 26

The Contractor is required to submit information on the riprap material to be imported for review and approval 10 days prior to delivery onsite. This submittal shall contain the name of the riprap supplier, the source where the riprap material is being produced, and certification that the riprap material meets the specification requirements and is suitable for its intended use as erosion and scour protection within the stream channel. Reference "Submittals" and "Submittal Tabulation" for information and details regarding required submittals.

The rock for riprap shall be dumped and placed with heavy earth moving equipment. Avoid excessive drop heights from heavy equipment while stockpiling and placing riprap to avoid rock breakage. Rocks shall be moved into position to ensure that the material when in place is stable and without tendency to slide, and so there will be no unreasonably large unfilled voids within the riprap. The

inclusion of rock spalls or gravel in an amount to fill the voids in the riprap will be required, but not in excess of that amount as determined by the onsite Government representative.

The Contractor shall select appropriate methods and carefully place riprap material to prevent damaging or spalling of the structure concrete by heavy equipment or rocks during placement operations. The placing procedures and sequence are subject to approval by the onsite Government representative. Any concrete damage observed shall be repaired by the Contractor at his expense, in accordance with the Bureau of Reclamation's "Standard Methods of Concrete Repair" manual and as directed by the onsite Government representative. The costs of all associated concrete repairs shall be included in the unit price per cubic yard bid in the schedule for placement of the reinforced concrete barrier drop structure.

Upon completion of riprap placement operations, the Contractor shall perform minor grading and contouring at the transition of riprap with the existing stream channel and abutment side slopes. The stream channel along the perimeter edges of the placed riprap material shall be graded to drain and contoured to match the surrounding ground conditions with the final grade of riprap. The Contractor shall limit the area of disturbance as much as practical during grading and contouring operations so as to minimize damage to existing vegetation.

#### **IV. Common Excavation for Concrete Barrier Drop Structure**

The contractor shall perform common excavation for construction of the concrete barrier drop structure and scour apron to the lines and grades specified on the drawings. All structure excavation is anticipated to be in earthen material, with no rock excavation required. An estimated total of 200 cubic yards is required to be excavated. A maximum excavation depth of 7-feet is required in the vicinity of the abutment blocks. A minimum excavation depth of 3-foot is specified below the apron slab in the stream channel, with an additional 3-foot depth of excavation required within the limits of the apron slab turndown.

Excavated material is to be disposed of onsite, upstream of the concrete barrier drop structure along the banks of the stream channel. No hauling of excavated material offsite is required. Waste material shall be graded and contoured to match the existing ground conditions of the channel banks so as not to restrict or impede runoff flows. The Contractor shall minimize the disturbance of natural habitat and vegetation as much as practical during disposal of waste material to protect the existing aesthetic appearance of the surrounding area.

In-place foundation material disturbed during excavation beneath the concrete structure (abutments, barrier wall drop, and apron slab), shall be compacted to provide a firm foundation for placement of structural concrete. Compaction may be obtained by wheel rolling with 6 passes of heavy equipment, hand tamping, or by other suitable methods found acceptable to the onsite Government representative. If in the opinion of the onsite Government representative the Contractor's compaction efforts are not achieving the desired results, the Government may perform compaction testing on the foundation material. The Contractor shall perform additional compaction effort or alter compaction methods if deemed necessary by the onsite Government representative. The costs for compaction of disturbed foundation material shall be included in the unit costs bid in the schedule for common excavation of the structure.

Should unsuitable foundation material be discovered during excavation operations for the structure, the Contractor will be directed to perform over-excavation of the foundation to remove the unsuitable material. After removal of the unsuitable material, the Contractor will be required to place compacted backfill material to bring the grade of the excavation back up to the design foundation grade indicated on the drawings. Any over-excavation which exceeds a depth of one foot will be addressed by the Government's Contracting Officer.

The Contractor may encounter minor seepage through the existing riprap grade control structure which could present complications during compaction required for the foundation subgrade. The Contractor is responsible for performing any unwatering of the foundation necessary to achieve compaction of the subgrade and provide a firm foundation until placement of the structural concrete. The costs for unwatering the foundation subgrade during construction shall be included in the lump sum price bid in the schedule for stream unwatering.

#### **V. Reinforcement Steel for Concrete Barrier Drop Structure**

Reinforcing bars shall be deformed reinforcement bars conforming to ASTM A 615 or A 617, grade 60.

The reinforcement steel shall be installed as shown on drawing #344-331-39, and to the tolerances and details specified on the

Attachment No. 2

## Cottonwood Springs Fish Barrier

standard reinforcement reference drawing #40-D-6263. The spacing of reinforcing bars shall not deviate from the required spacing by more than 1 inch. Place reinforcement so that the clear distance between face of concrete and the nearest reinforcement is 2 inches for bars ranging from #6 through #8 in size. Provide 3 inch clear distance to reinforcement from the face of unformed concrete for all bars when the concrete is placed against earth or rock.

Before being placed, surfaces of reinforcement bars shall be cleaned of heavy, flaky rust, loose mill scale, dirt, grease, and other foreign substances. Reinforcement shall be accurately placed and secured in position to prevent movement during the placement of concrete. After reinforcement bars have been placed, the bars will be inspected for proper size, shape, length, splicing, spacing, and position. No concrete shall be placed until final acceptance of reinforcement steel is acknowledged by the Government.

In general, reinforcement bars shall be tied in-place with a minimum of 100% single-ties or 50% double-ties. The Government may request that additional ties be installed for securing reinforcement steel, based on the Contractor's selected placement methods and satisfactory performance observed in the field.

A total quantity of 12,500 pounds of reinforcement steel is estimated to be required for construction of the concrete barrier structure. Reinforcement details and splice locations shown on drawing No. 344-331-39 are based on the assumption that the maximum length of individual bars would be limited to 30 feet. If the maximum length of bars selected for use by the Contractor differs from that assumed by the Government, no adjustment in costs will be allowed for the addition or reduction of the number of splices required. Any alteration to the splice locations indicated on the drawings will be subject to approval by the Government.

The Government will not furnish supplemental bar-placing diagrams, bar lists, and bar-bending diagrams. Supplemental diagrams and bar lists of this type which the Contractor may require to facilitate the fabrication and placement of reinforcement shall be provided by the Contractor or subcontractor. The costs of preparing supplemental diagrams and bar lists if needed and the costs for furnishing and installing reinforcing steel shall be included in the unit price per cubic yard bid in the schedule for placement of the reinforced concrete for the barrier drop structure.

## VI. Concrete Requirements for Concrete Barrier Drop Structure

### A. General

The contractor shall furnish all materials for use in concrete, including cementitious materials, water, sand, coarse aggregate, and specified admixtures, and shall furnish all reinforcing bars and materials for curing concrete. Cementitious materials shall be interpreted to mean the cumulative total of Portland cement and pozzolan combined together.

Concrete shall be provided by a commercial source regularly engaged in the business of batching and transporting concrete to construction sites. Batching onsite will not be permitted.

### B. Submittals

The Contractor is required to submit information for review and approval regarding the structural concrete to be used for construction of the concrete barrier drop structure and scour apron. Reference "Submittals" and "Submittal Tabulation" for information and details regarding required concrete submittals.

No later than 10 days prior to placement of any concrete, the Contractor shall submit the name of the manufacturer and source of each cementitious material, aggregate, and admixture proposed for use in batching and mixing structural concrete. In addition, the Contractor must submit a specific concrete mix design and certification of compliance of the materials for each concrete mixture proposed for use during construction of the concrete barrier drop structure and scour apron. The Government reserves the right to require submission of manufacturer's test data and/or samples of any concrete materials for testing prior to or during placement of concrete.

All structural concrete placed for construction of the concrete barrier drop structure and scour apron shall be tinted with a color additive integrally mixed into the concrete during the batching process. Staining of the exposed hardened concrete surfaces after placement will not be permitted. The Contractor shall submit the manufacturer's product data complete with recommended mixing proportions and color chips or color charts for the proposed color additive to be used during mixing of the concrete. An appropriate

color tint which blends into the surrounding color of the stream channel will be selected by the Government from the manufacturer's information and color chips provided in the submittal.

#### C. Materials and Composition

The structural concrete components provided shall meet the requirements of the following standards:

1. Cement B ASTM C 150 for Type II, low-alkali.
2. Pozzolan B ASTM C 618 for Class N, F, or C.
3. Water B ASTM C 94.
4. Sand and Coarse Aggregate B ASTM C 33 grading for size No. 57 (1-inch to #4 sieve).
5. Air Entrainment Admixture B ASTM C 260.
6. Water Reducing/ Set Controlling Admixture B ASTM C 494 for Type A, D, F, or G.
7. Plasticizing Admixture B ASTM C 1017 for Type I or II.
8. Reinforcing Bars B ASTM A 615 or A 617, Grade 60.
9. Curing Compound B ASTM C 309.
10. Color Tint Additive B ASTM C 979.

Pozzolan may be used to replace a maximum 20% by weight of Portland cement. The concrete mix design and water/cement ratio shall be appropriate to provide a finished concrete product having a minimum 4,000 psi compressive strength when tested by the Government in accordance with ASTM C 31 and ASTM C 39 for 6-inch by 12-inch cast cylinders. The slump of the concrete when placed shall not exceed 3-inches, plus or minus 1-inch. The temperature of the concrete shall be between 50 and 90 degrees Fahrenheit at the time of placement. Air-entraining admixture shall be added during concrete batching in an amount to produce 4% to 6% entrained air by volume at the discharge point of concrete into the placement.

#### D. Mixing and Batching

The Government may request an adjustment to the concrete mix design at any time. The proportions of ingredients will be adjusted during the progress of the work whenever a need for such adjustment is indicated by results of testing of the aggregates and/or concrete.

When delivered at the jobsite, each load of concrete shall be accompanied by a batch ticket in accordance with ASTM C 94. The batch ticket shall be provided to the Government's field representative at the jobsite as each batch is delivered.

The Contractor is responsible to ensure that the owner of any approved commercial source of aggregate the Contractor plans to use has obtained all necessary Federal, State, and local permits, is in compliance with said permits, and is in compliance with all applicable Federal, State, and local laws. The Contractor shall ensure that suppliers of any sand or coarse aggregate used in performance of this contract, are in compliance with sections 401 and 404 of the Clean Water Act.

#### E. Preparations and Placing

No concrete shall be placed until all formwork, installation of reinforcement steel, and preparations of surfaces involved in the placement have been approved. All foundation surfaces upon or against which concrete is to be placed shall be free from frost, ice, standing water, mud, and other debris. Rock surfaces shall be free from oil, objectionable coatings, and loose semidetached unsound fragments. Surfaces of rock shall be cleaned thoroughly by washing with an air-water jet, and the surface brought to a uniform surface-dry condition immediately prior to placement of concrete. Wash-water containing oil shall be removed from the jobsite and not allowed to enter any watercourses, flowing or dry. Earth foundations shall be dampened but not muddy prior to placement of concrete against them.

A construction joint is defined as a planned joint between two individual concrete placements, across which development and maintenance of a bond are required, and through which any reinforcement that may be present is not interrupted. All construction joints shall be roughened and all laitance removed in preparation for placing adjoining concrete. Methods of roughening surfaces and removing laitance may include mechanical abrasion or cutting, sandblasting, or high-pressure water jetting of hardened concrete at a minimum pressure of 6,000 psi. Green cutting of fresh concrete is not allowed. After this initial cleanup and immediately prior to placing adjoining concrete, the concrete surface shall be thoroughly washed with water to provide a uniform surface saturated dry

condition free of standing water.

Unless inspection is waived for a specified placement, placing of concrete shall be performed in the presence of an authorized government inspector. Placement shall not begin until all preparations are completed and the concrete placement check-out card has been signed by the Contractor and the onsite Government representative, indicating authorization and approval to place concrete.

Retempering of concrete will not be permitted. Concrete which has become so stiff, for whatever reason, that proper placing methods and consolidation by vibration cannot be assured shall be wasted at the Contractor's expense.

Concrete shall be deposited as near as practical to its final position and shall not be allowed to flow in such a manner that lateral movement will cause segregation of the coarse aggregate from the concrete mass. Methods and equipment employed by the Contractor for depositing concrete in-place shall be subject to approval of the Government. Various placing methods may be used, including buckets, chutes, hoppers, pumps, transit mix trucks, or other equipment, and shall be selected to readily handle and place concrete of the specified slump and to minimize clusters of coarse aggregate.

To minimize segregation of aggregate during placing, dropping of concrete from a height greater than 10-feet will not be permitted, unless the Contractor incorporates the use of drop chutes, tremies, or other suitable means to prevent segregation of aggregate.

Forms shall be adequately constructed and braced to prevent movement during placement of concrete, and to ensure the finished concrete product conforms to the lines and grades shown on the drawings. Forms shall be constantly monitored and their position adjusted as necessary during the placement of concrete. Forms shall be cleaned and oiled prior to each use to facilitate stripping and prevent spalling of concrete during form removal.

Concrete shall be placed in relatively uniform horizontal lifts not exceeding 18-inches in depth. The Government may require lesser lift depths where concrete cannot otherwise be placed and consolidated in accordance with the specification requirements. Each concrete placement shall progress from the lowest point to the highest point in the placement, unless otherwise approved. No concrete shall be deposited in standing or running water without prior permission and approval of the authorized Government representative. Concrete shall not be placed during rainfall sufficiently heavy or prolonged to wash excessive mortar from the concrete. Inclement weather which begins during a placement may necessitate the forming of a cold joint in the concrete.

The concrete-placing rate shall ensure concrete is placed while the previously placed adjacent concrete is still plastic, so that the concrete can be made monolithic by normal use of the vibrator. A cold joint is an unplanned joint resulting when a concrete surface hardens before the next batch can be placed against it. Cold joints are undesirable and should be avoided. 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 the concrete to a stable uniform slope. If the delay of placement is short enough to permit penetration of the underlying concrete, the placement shall resume with special emphasis taken to thoroughly penetrate and revibrate the concrete surface placed before the delay. If the concrete cannot be penetrated with a vibrator, the placement shall be discontinued and the cold joint treated as a standard construction joint. If the Government deems that the unplanned construction joint will impair the structural integrity, the concrete shall be repaired or removed as determined by the Government's field representative. In such instances, the Contractor will not be entitled to any additional time or payment compensation.

Normally, concrete shall be deposited at its final position in the placement within 90-minutes after the introduction of the mix water into the cementitious materials. This 90-minute time limitation may be waived if the concrete is of such slump and workability, and contains the specified air entrainment content, that it can be satisfactorily placed and properly consolidated. A time limit less than 90-minutes may be invoked during hot weather or under conditions contributing to quicker stiffening of the concrete mix.

Concrete shall be consolidated in-place by vibration, using internal immersion-type vibrators intended for this purpose. The vibration shall be sufficient to remove all undesirable air voids from the concrete, including air entrapped against the forms and construction joints. Vibrators are to be operated in the near vertical position, with a uniform penetration pattern spaced close enough to ensure complete consolidation of the concrete. The vibrating head shall penetrate and revibrate the concrete in the upper portion of the underlying layer. Concrete shall not be placed against other plastic concrete until the previously placed concrete has been thoroughly consolidated. After consolidation, the concrete shall be free of rock pockets and honeycomb areas, with minimal bug holes evident on the formed surfaces of the exposed structure.

The Contractor shall give special attention to consolidating concrete at construction joints to achieve a tight bond and prevent

unwanted water seepage through the structure at the joints. In addition, special vibrating emphasis will be necessary along the upstream face of the barrier wall drop adjoining to the existing grade stabilization structure, so concrete flows into the riprap voids and around the steel pipe wire mesh fencing to ensure the new concrete structure is sufficiently tied into the existing structure.

Waste concrete can be temporarily stored onsite outside of the stream channel, as approved by the Government field inspector. Waste concrete shall be transported to an approved landfill in accordance with the section entitled "CONSTRUCTION CLEANUP."

#### F. Structural Deviations and Surface Tolerances

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.

Structural deviations are defined as allowable variations from the specified lines, grades, and dimensions shown on the drawings. 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 indicate a permitted actual position up or down and in or out from the specified position in plan.

Allowable Structural Deviations:

1. Barrier Drop Wall

- a. Variation from plumb for downstream face..... ± ¼-inch
- b. Variation of crest elevation thru notch..... ± ¼-inch
- c. Variation of crest elevation elsewhere..... ± ½-inch
- d. Variation of depth.....-½ -inch, +2-inches

2. Apron Slab Including Turndown

- a. Variation from specified grade.....± ½-inch
- b. Variation of depth or thickness.....-½ -inch, +2-inches

Surface tolerances are the maximum allowable magnitude of the surface irregularity of the finished concrete. Surface irregularities can be classified into two distinct categories, either "abrupt" or "gradual" irregularities. Abrupt irregularities are defined as offsets such as those caused by misplaced or loose forms, 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. Gradual surface irregularities are defined as bulges or depressions resulting in gradual changes on the concrete surface or isolated undulations in the concrete surface.

Allowable Concrete Surface Tolerances:

- T1 Surfaces.....Abrupt 1-inch and Gradual 1/4-inch per inch
- T2 Surfaces.....Abrupt 1/2-inch and Gradual 1/8-inch per inch
- T3 Surfaces.....Abrupt 1/4-inch and Gradual 1/16-inch per inch
- T4 Surfaces.....Abrupt 1/8-inch and Gradual 1/32-inch per inch
- T5 Surfaces.....Abrupt 1/16-inch and Gradual 1/64-inch per inch

G: Concrete Finishing

Formed Surfaces:

The classes of finish for formed concrete surfaces are designated by the symbols F1, F2, and F3. The requirements for each class of finish shall apply as follows:

1. F1 Finish B Generally applies to formed surfaces upon or against which fill material or grout is to be placed and to construction joints. Form tie rod ends on concrete surfaces which will be in contact with fill material shall be protected from moisture by recessing the tie rod ends and filling the recesses with dry pack or other material approved by the Government.
2. F2 Finish B Generally applies to all formed surfaces not permanently concealed by fill material, grout, concrete, or not required to receive an F3 finish.
3. F3 Finish B Generally applies to formed surfaces with an appearance which is considered by the Government to be of special importance, such as the surfaces of structures prominently exposed to public view. After all required concrete repairs and correction of surface imperfections have been completed, the exposed concrete surfaces shall be sack-rubbed.

Surfaces shall be thoroughly wetted and sack rubbing shall commence while surfaces are still damp. The mortar used shall consist of 1 part cement, 2 parts sand passing the #16 screen, and enough water so that the consistency of the mortar is that of a thick cream. The mortar shall be spread thoroughly over the entire surface with clean burlap or a sponge float so as to fill all pits, bug holes, and other defects. While the mortar in the pits is still plastic, the surface shall be rubbed over with a dry mix of similar proportions, to remove the excess plastic material and place enough dry material into the defects to stiffen and solidify the mortar so that the fillings will be flush with the surface. No excess material shall remain on the surface except that within the pits.

Unformed Surfaces:

Three classes of finish for unformed concrete surfaces are designated by the symbols U1, U2, and U3. The requirements for each class of finish shall apply as follows:

## Attachment No. 2

## Cottonwood Springs Fish Barrier

1. U1 Finish (Screeded) B Generally applies to unformed surfaces that will be covered by fill material, grout, or concrete. Finishing operations shall consist of leveling and screeding to produce an even uniform appearance. The U1 Finish is also used as the first stage of finishes U2 and U3.
2. U2 Finish (Floated or Broomed) B Generally applies to unformed surfaces not permanently concealed by fill material, grout, concrete, or not required to receive an U3 finish. The U2 Finish is also used as the second stage of U3 finish.

Floating may be performed by hand or using 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.

If required, a broom finish shall not be applied until floating has been completed and the water sheen has practically disappeared. The broom finish shall be applied when concrete is in such a condition as to prevent tearing and unduly roughening the surface by the operation. Brooms shall be of a quality, size, and construction for this intended purpose. The broom shall be drawn with even pressure in one consistent direction across the concrete surface, using parallel adjacent strokes slightly overlapping. The finish surface shall have a uniform appearance and shall be free of corrugations exceeding 1/8-inch in depth.

3. U3 Finish (Troweled) B Generally applies to unformed surfaces with an appearance, porosity, or hydraulic significance which is considered by the Government to be of special importance.

After bleed water has disappeared from the previously U2 floated finish and when the concrete surface has hardened sufficiently to prevent an excess of fine material from being drawn to the surface, steel troweling shall be started. Steel troweling shall be performed with firm pressure so as to flatten the floated surface and produce a dense uniform surface, free from blemishes and trowel marks.

SPECIFIED TOLERANCES AND REQUIRED FINISHES  
FOR CONCRETE SURFACES OF SPECIFIC STRUCTURE FEATURES

STRUCTURE FEATURE	SURFACE DESCRIPTION	SPECIFIED TOLERANCE	REQUIRED FINISH
Abutment Blocks	Upstream and Exterior Formed Surfaces	T1	F1
Abutment Blocks	Downstream and Interior Formed Surfaces	T3	F3-Sack Rubbed
Apron Slabs/Turndown	Perimeter of Exterior Formed Surfaces	T1	F1
Apron Slab	Exposed Unformed Top Surface	T3	U2-Broomed
Barrier Wall Drop	Downstream Face Formed Surface	T3	F3-Sack Rubbed
Barrier Wall Drop	Crest Unformed Surface Thru Notch	T4	U3-Troweled
Barrier Wall Drop	Crest Unformed Surface Outside Notch	T3	U2-Broomed

#### H. Concrete Protection and Curing

The Contractor shall protect all concrete surfaces against damage until final acceptance by the Government. Concrete and concrete curing compound shall be protected against heavy foot traffic and other construction activities that would damage the concrete, by covering with plywood, sand, or other suitable material acceptable to the Government.

Concrete shall be protected against freezing temperatures by being kept at a temperature not lower than 50 degrees Fahrenheit for a period of 72-hours after it is placed. In addition, concrete which is water cured shall be protected against freezing temperatures for the duration of the curing period and for the next 72 hours after discontinuance of the water curing. If an artificial heat source is required, the heater shall be vented and precautions taken to prevent the concrete from drying out.

All concrete curing methods are subject to the approval of the Government. All surfaces of the concrete shall be cured with water, polyethylene film, clear water-emulsified resin-base, or clear resin-base curing compounds. Curing compounds shall meet the requirements of ASTM C 309. The application rate shall be as recommended by the manufacturer.

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 or polyethylene film, 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.

Polyethylene film curing methods shall ensure complete covering of the concrete surfaces with the 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. The adjacent joints between individual polyethylene strips shall be overlapped and the extreme edges of the polyethylene film held tightly against the concrete surface. The polyethylene material shall be adequately secured to withstand displacement by wind and prevent the circulation of air beneath the curing film.

If concrete is cured with clear water-emulsified resin-base or clear resin-base curing compounds, the curing compound shall be applied to maintain a continuous water-retaining film on the surfaces for 28 days. The curing compound shall be mixed thoroughly and spray applied to the concrete surfaces to provide a uniform, continuous film over the concrete. Excessive application of curing compound that results in sagging or puddling of the liquid should be avoided. Special care shall be taken to ensure ample coverage of concrete with curing compound at edges, corners, and rough surfaces; and to keep curing compound off protruding reinforcing bars. Spray equipment and its operation will be subject to satisfactory performance in the field, and the Contractor shall repair or replace defective equipment as directed by the Government.

#### I. Repair of Concrete:

Generally, the Contractor shall strip formwork from concrete within 24 hours after placement, or as soon as practical, once concrete has gained sufficient strength to permit stripping of forms without damaging the concrete. Necessary concrete repairs shall commence immediately following form removal to ensure repairs performed achieve the most structurally sound results and desirable appearance of the finished concrete. All concrete aged beyond 7 days from placement shall be repaired using epoxy repair methods.

Concrete shall be repaired to the requirements specified in the "Structural Deviations and Surface Tolerances" paragraphs, and in accordance with the Reclamation's "Standard Specifications for Repair of Concrete". All concrete repair and replacement methods shall be as determined and directed by the Government. No concrete repair/replacement work shall commence until the appropriate method of repair/replacement has been approved by the Government. Unless inspection is specifically waived, all concrete repairs or replacement shall be performed in the presence of the Government field representative. Any concrete repairs or replacement shall be cured in accordance with the "Concrete Protection and Curing" paragraphs upon completion and acceptance by the Government field inspector.

The cost of furnishing all materials and performing all concrete repair work shall be included in the unit price bid per cubic yard for placing reinforced structural concrete, and any associated costs shall be borne by the Contractor.