

STANDARD SPECIFICATIONS

for

GENERAL CONCRETE CONSTRUCTION

City of La Crosse, Wisconsin

| <u>Contents</u> | <u>Page</u> |
|---------------------------------------|-------------|
| 1. SCOPE OF WORK | 9.1 |
| 2. MATERIALS | 9.1-9.2 |
| 3. FORMS | 9.2 |
| 4. FORM TIES | 9.3 |
| 5. OILING FORMS | 9.3 |
| 6. REMOVING FORMS | 9.3 |
| 7. PROPORTIONING | 9.3-9.4 |
| 8. MIXING | 9.4 |
| 9. CENTRAL OR TRANSIT MIXED CONCRETE | 9.4 |
| 10. PREPARATIONS FOR PLACING | 9.5 |
| 11. HANDLING | 9.5 |
| 12. PLACING CONCRETE | 9.5 |
| 13. CONSTRUCTION JOINTS | 9.5 |
| 14. DEPOSITING AGAINST OTHER CONCRETE | 9.6 |
| 15. PROTECTION AND CURING | 9.6 |
| 16. DEPOSITING IN COLD WEATHER | 9.6 |
| 17. DEFECTIVE WORK | 9.7 |
| 18. SURFACE FINISH OF CONCRETE | 9.7-9.8 |
| 19. FLOOR FINISH | 9.8 |
| 20. TESTING AND REPAIRS | 9.8-9.9 |
| 21. JOINTS | 9.9 |
| <u>STEEL REINFORCEMENT</u> | |
| 1. GENERAL | 9.9 |
| 2. DESCRIPTION | 9.9 |
| 3. MATERIALS | 9.9 |
| 4. CONSTRUCTION METHODS | 9.9-9.10 |
| 5. FLOOR SLABS | 9.10 |
| 6. MINIMUM CLEAR SPACING | 9.10 |

Up-dated December 2006

1. SCOPE OF WORK:

The work covered by this specification shall consist of furnishing all labor, materials, permits, and related miscellaneous work necessary to complete the work as specified herein or as shown on the drawings. The concrete work under this specification shall include all clearing and grubbing, preparation of subgrade, furnishing and placing concrete, shouldering, and construction of fills and embankments, unless such items appear of the proposal to be bid separately.

It is the intent of these specifications that a sub-grade of uniform stability be obtained by a suitable construction method for placement of concrete.

2. MATERIAL:

A. Delivery, Storage, and Handling:

All materials shall be so delivered, stored, and handled as to prevent the inclusion of foreign materials and the damage of materials by water or breakage. Package materials shall be delivered and stored in original packages until ready to be used. Packages or materials showing evidence of water or other damage shall be rejected.

B. Water:

Water for concrete construction shall be clean and free of oil, acids, salts, or other deleterious materials. All city water used by the Contractor shall be paid for by the Contractor under rules and regulations of the La Crosse Water Utility.

C. Portland Cement:

- (1) Portland cement shall conform to ASTM Standard Specifications C 150 Type I or Type 1A latest edition.
- (2) High-Early strength Portland shall conform to ASTM Standard Specification s C 150 Type III or Type IIIA.
- (3) All cement poured under extreme heat conditions shall use ASTM Standard Specifications C-150 Type II.
- (4) White Portland Cement shall conform to U.S. Governmental Federal Specifications SS-C-181 latest edition.

D. Sand (or Fine Aggregate):

Sand for concrete work shall be capable of developing 80% of the tensile strength of Ottawa sand. It shall be well graded from coarse to fine aggregate and not contain more than 1% clay or 1% coal or lignite when tested according ASTM methods. It shall not show darker than light amber when tested by the colormetric test method.

All fine aggregate shall conform to the following requirements:

| <u>Sieve Size</u> | <u>% Passing</u> |
|-------------------|------------------|
| 3/8 inch | 100% |
| No. 4 | 95-100% |
| No. 16 | 45-80% |
| No. 50 | 5-30% |
| No. 100 | 0-10% |

E. Coarse Aggregate:

Coarse Aggregate shall be composed of hard, strong crystalline rock free from shale or other soft materials and free from any adherent coating or vegetable matter.

All crushed stone or gravel for concrete work shall be well graded and shall pass the following sieve analysis:

| <u>Sieve Size</u> | <u>% Passing</u> |
|-------------------|------------------|
| 2 inch | 100% |
| 1-1/2" | 90-100% |
| 1 inch | 20-55% |
| 3/4 inch | 0-15% |
| 3/8 inch | 0-5% |
| No. 4 | 0% |

F. Base:

Unless the plans show differently, the base under all concrete work shall be a minimum of 6 inches deep and shall be constructed of selected gravel or crushed stone of such size that 100% will pass a 2 inch sieve and 98% will be retained on a No. 200 sieve. All gravel shall be uniformly graded between these limits and rolled with a 3 to 5 ton roller until no yielding or creeping occurs under the roller.

G. Reinforcing Steel:

See "Steel Reinforcement" Specifications

H. Joint Sealing Materials:

For slabs or pavements exposed to the weather, asphalt filler shall be used conforming to the latest revision of AASHTO Specification M-18 Type A an approved master filler.

3. FORMS:

Forms shall conform to the shape, lines grade and dimensions indicated on the drawings. They shall be substantial and sufficiently tight to prevent leakage of mortar, and shall not deflect under the weight of the wet concrete or construction loads. They shall be properly braced or tied together so as to maintain position and shape, and insure the safety of workmen and passerby. All forms shall be cleaned and oiled each time they are used.

Temporary openings shall be provided to facilitate cleaning and inspection immediately before depositing concrete. Forms shall be assembled in such a manner as to facilitate their removal without damage to the concrete.

In the case of structures, unlined forms may be used for the face of all walls that are not exposed to view after the structure is completed. Suitable moldings, bevels, or chamfer strips shall be placed in angles. Or exposed edges of forms, to round or bevel corners or edges which may become chipped. The placement of such chamfer or bevel strips shall be directed by the Engineer.

Plywood panel forms or steel forms may be used with the approval of the Engineer.

When the inside is erected and reinforcing is in place, the Engineer shall be notified and the outside form shall not be placed until work and reinforcing already done has been approved.

Forms shall not be disturbed until the concrete has hardened adequately to carry its own weight and other loads that may occur.

4. FORM TIES:

Form ties approved by the engineer shall be used. These ties shall be adjustable in length and of such types as to leave no metal closer than one and one-half inches of the concrete surface. Ties shall not be fitted with any lugs, cones, washers, or other devices to act as a spreader within the form which will leave a hole larger than seven-eighths inch in diameter. Wire ties will not be permitted unless the engineer gives a written order.

Ties that are to be pulled from the wall shall be coated with cup grease or other approved material to facilitate removal. Tie rod holes shall be properly plugged.

5. OILING FORMS:

The inside surface of wood forms shall be oiled before any concrete is placed. All forms shall be greased with an approved form oil or with a good grade cup grease thinned with kerosene. All excess grease shall be wiped off with rags to leave the surface of the forms just oily to the touch.

6. REMOVING FORMS:

All wall forms shall be removed when the concrete has thoroughly hardened, but in no case in less than 4 days except when High-Early-Strength cement is used, in which forms may be removed after 2 days. Other forms and shorings shall remain undisturbed until the concrete has attained sufficient strength to sustain its own weight in addition to any temporary or permanent load that may be placed on it during construction.

PROPORTIONING:

The proportions specified are based on surface dry aggregate, and Portland cement in standard unopened cloth or paper sacks as packed by the manufacturer considered as weighing 94 pounds per sack.

All measurements of cement fine and coarse aggregate shall be made separately. Measurements shall be based on the weight of actual dry loose weight per cubic foot of fine and coarse aggregates used. Weighing equipment shall be arranged to permit making compensation for changes in the weight of aggregates due to moisture. Weighing equipment shall be accurate within 1% and meet the approval of the Engineer.

Water shall be measured in an approved device capable of accurately measuring one pint plus or minus of the total amount of water required per batch.

All concrete shall be proportioned on the basis of water-cement ratio, which is defined as the ratio of the total quantity of water in the mixture, including moisture carried by the aggregate, to the quantity of cement. The ratio is expressed in U.S. gallons (8-1/3 pounds to the gallon) of water per 94 pounds each of cement.

The mix shall be as dry as possible to work the concrete. In no case shall there be more than 6-1/2 gallons of water per bag of cement used.

Moisture in the aggregate shall be measured by a method satisfactory to the Engineer, and will give results within one pound for each 100 pounds of aggregate.

The proportioning of fine and coarse aggregate shall be such that the ratio of coarse to fine shall be no less than 1 to 1 or more than 2 to 1. The aggregate shall be obtained from a source, which will insure uniform quality, gradation, and moisture content during any single days operation.

The proportioning of fine and coarse aggregate may be varied with the approval of the Engineer, but in no case shall the sum of their volumes exceed that called for nor shall the 28-day strength of the concrete fall below the following:

| Type or Location of Construction | Min. Comp. Psi at 28 Days | Min. Cement bags per cubic yards |
|--|---------------------------------|--|
| Foundations, columns, beams and slabs not Exposed to weather or freezing. | 3000 | 5.0 |
| Foundation walls, exterior walls and other Concrete work exposed to weather or freezing | 4000 | 6.0* |
| Concrete floors and stairs subject to heavy foot traffic | 4000 | 6.0* |
| Driveways, walks, garage floors, porches, etc., Exposed to weathering or freezing | 4000 | 6.0* |

**Air-entrained concrete only.

The air content of the concrete shall be 6% plus or minus 1% by volume based on measurements made on concrete immediately after discharge from the mixer in accordance with ASTM, C-138, C-173 or C-231.

8. MIXING:

Concrete shall be mixed in a batch mixer for not less than 1-1/2 minutes after all the materials are in the mixer drum. Mixing shall continue until there is a uniform distribution of materials and the mass is homogenous in consistency and color. The mixer shall rotate at a peripheral speed of about 200 feet per minute. Mixer shall be equipped with a locked timing and locked water-measuring device.

No hand mixing or re-tempered concrete will be allowed.

A full size trial batch shall be made using the aggregates and correct proportions selected for the job. If the desired workability is not obtained, then the proportions of aggregates shall be adjusted until the mix meets the approval of the Engineer.

9. CENTRAL OR TRANSIT MIXED CONCRETE:

Concrete from a central plant or mixed in transit mixer trucks may be used if it complies with these specifications. The Engineer will have free access to the batching plant and mixing plant at all times to sample all materials and inspect the work performed for this project. Concrete shall be delivered in watertight containers, which will not permit segregation of materials. When delivered, the concrete shall be uniform throughout the mass.

Cement used in transit mixed concrete shall be the same brand and type throughout the project. If, in the opinion of the Engineer, the transit mix concrete has excessive amounts of lumpy concrete, it shall be removed from the site immediately. Transit mix concrete shall not be in the truck or hopper more than 60 minutes after batch is started.

10. PREPARATIONS FOR PLACING:

Before beginning a run of concrete, all water shall be removed from all trenches and foundations, all equipment and forms shall be cleaned and oiled, and reinforcement shall be cleaned of ice or other foreign coatings. Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position, no until all sleeves, hangers, pipes, conducts, bolts, or any other fixture required to be embedded therein has been placed and anchored by the Contractor. Concrete shall not be placed until the forms have been inspected and approved by the Engineer, and placed under the direct supervision of the Engineer.

11. HANDLING:

Concrete shall be handled from the mixer to forms as rapidly as possible by methods, which shall prevent any separation or loss of ingredients while transporting the concrete. Concrete shall be handled from the mixer in carts, buggies, or conveyors and shall not be delivered by spout or trough or dumped with a free fall of more than 5 feet. Runway supports for buggies or delivery carts shall not bear upon reinforcing steel or fresh concrete.

12. PLACING CONCRETE:

Placing concrete before initial set has occurred, and in no event after it has contained its water content for more than one hour. Place all concrete on clean, damp surfaces, free from water, or upon properly consolidated fills, but never upon soft mud, dry porous earth, or frozen ground.

Deposit concrete continuously and as rapidly as practical until the unit of operation is completed.

Consolidate all concrete by vibration so that the concrete is thoroughly worked around the reinforcement, around imbedded items, and into corners of forms, eliminating all air or stone pockets which may cause honey-combing, pitting, or planes of weakness. Use mechanical vibrators with a minimum frequency of 7,000 revolutions per minute, operated by competent workmen. Use of vibrators at many points from 18 to 30 inches apart for a 5 to 10 second duration. Keep a spare vibrator on the job during all concrete placing operations.

Exercise care in placement of concrete for slabs or grade over a vapor barrier. Avoid puncturing or tearing vapor barrier during transportation and placement.

13. CONSTRUCTION JOINTS:

The placing of concrete shall be carried on continuously between construction joints shown on the drawings. If for any reason it shall become necessary to stop the placing of concrete at places other than those indicated on the drawings, such places shall have the approval of the Engineer and the manner of making the joint shall be approved. Extra reinforcing may be required if additional construction joints are used.

The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of the walls, a strip of 1" sheathing shall be tacked to the forms at the outside surface of the wall. The concrete shall be carried about ½" above the underside of the strip. About 1 hour after the concrete is placed, the strip shall be removed and any irregularities in the joint line shall be leveled off with a wood float and laitance shall be removed. Wherever horizontal construction joints are made, ties or bolts shall be provided 3 to 6 inches below the joint with which to tighten the forms against the hardened concrete.

Keys shall be provided between footings and foundations where shown on the plans or called for in the Special Specifications.

14. DEPOSITING AGAINST OTHER CONCRETE:

Before depositing new concrete on or against concrete that has hardened, the forms shall be retightened, the surface of the hardened concrete shall be roughened as required, thoroughly cleaned of foreign matter, and moistened with water.

To insure sufficient mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and moistened surface of the hardened concrete, including vertical and inclined surfaces, shall first be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its initial set. Concrete for first 6 inches of the next layer shall consist of a mix having one-half the amount of coarse aggregate in the regular mix.

15. PROTECTION AND CURING:

Provide adequate protection against rain, sleet, and snow before and during placement and finishing of concrete. Provide adequate protective measures to maintain the temperature of the concrete as specified.

Immediately after finishing operations have been completed, the entire surface of the concrete shall be sealed by spraying thereon an impervious membrane. The liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation, M0148, Type 2, White Pigmented. Unless a greater rate of coverage is specified by the manufacturer, it shall be at 200 square feet per gallon of curing agent. Within 30 minutes after forms are removed, the concrete shall be coated with curing compound.

In lieu of curing compound above specified, the contractor may protect the concrete from premature drying by utilizing the following methods for a period of seven days: Ponding or continuous sprinkling, absorptive mats or fabrics kept continuously wet, or covering with a non-staining polyethylene film with all joints and edges weighted to prevent wind penetration.

If High-Early-Strength Cement is used, the curing period may be reduced to three days.

16. DEPOSITING IN COLD WEATHER:

Do not place concrete when the atmospheric temperature is below 40 degrees F., or when the concrete is likely to be subjected to freezing temperatures within 24 hours after it has been deposited unless adequate temporary heating has been provided. Maintain the concrete at a temperature not lower than 70 degrees F. for 3 days or 50 degrees F. for 5 days after placing, except when High-Early-Strength cement or concrete is used, the temperature must be maintained at not less than 70 degrees F. for 2 days or 50 degrees F. for 3 days. The methods of heating the materials and protecting the concrete shall be approved by the Engineer. Salt, chemicals, or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing. Forms shall be enclosed and heated at 50 degrees f. to 70 degrees F. for 2 days before the pour is made.

17. DEFECTIVE WORK:

Any concrete work not formed as shown on the plans or for any reason is out of alignment or level or shows a defective surface shall be considered as not conforming with the intent of these specifications and shall be removed from the job by the Contractor at his expense unless the Engineer grants permission to patch the defective area which shall be done in accordance with the following procedure. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require complete removal of the defective work if the patching does not, in his opinion, satisfactorily restore the quality and appearance of the surface.

Immediately after removing forms all concrete surfaces shall be inspected and any poor joints, voids, stone pockets, honeycomb, or other defective areas permitted by the Engineer to be patched and all the tie holes shall at once be patched before the concrete is thoroughly dry. Defective area shall be stripped away to a depth of not less than one inch with the edges perpendicular to the surface. The area to be patched and a space at least 6 inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. The patch shall be made of the same material and of the same proportion as used for the concrete except that the coarse aggregate shall be omitted and white cement shall be substituted for a part of the gray cement to match the color of the surrounding concrete. The amount of water used in mixing the mortar shall be as little as consistent with the requirements of handling and placing. The mortar shall be re-tempered without the addition of water by allowing it to stand for a period of one hour during which time it shall be mixed with a trowel to prevent setting.

The mortar shall be thoroughly compacted into place and screeded off so as to leave the patch slightly higher than the surrounding surface. It shall be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. The patch shall be finished in such a manner as to match the adjoining surface. On exposed surfaces where unlined forms have been used, the final finish shall be obtained by striking off the surface with a straight edge spanning the patch and held parallel to the direction of the form marks.

Tie holes left by withdrawal of rods or the holes left by removal of end of ties shall be filled solid with mortar. For holes passing entirely throughout the wall, a plunger type grease gun or other device shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.

18. SURFACE FINISH OF CONCRETE:

General: After removal of forms, all metal devices used to tie forms together and hold them to correct alignment and location shall be removed in such a manner that no metal shall remain within less than 2 inches of the surface of the concrete. The method of removal of such ties shall be such as not to cause excessive injury to the surface of the concrete by spalling. The Contractor shall not burn off rods, bolts, or other metal devices. After the removal of such ties, the opening shall be roughened and all concrete containing any oil removed. In cases where wire ties are used, all wires shall be cut back at least one inch from the surface of the face. Immediately after the removal of forms, all cavities produced by removal of form ties and all other holes, depressions, and honeycomb spots shall be thoroughly saturated with water and carefully pointed with a mixture of cement and fine aggregate mixed in the same proportions used in the concrete being treated and as of as dry a consistency as it is possible to use. Mortar used in pointing shall be not more than one hour old and shall be kept moist for a period of 24 hours after it is placed. Considerable pressure shall be applied in pointing to insure filling all voids. All joints in the completed work shall be carefully tooled and left free from mortar and concrete.

Ordinary Surface Finish: Except as otherwise specified, all formed surfaces shall have an ordinary surface finish. The surfaces of all concrete masonry shall be thoroughly worked during the placing of the concrete. After the forms are removed and pointing completed and after the concrete has hardened, all fins and irregularities shall be removed with a carborundum brick. Should defects appear in the final surface such that, in the judgement of the Engineer, a satisfactory surface has not been secured, the Engineer may order the Contractor to rub finish the surface of such sections as is necessary to produce a finished and workmanlike job.

Rubbed Surface Finish: All exposed concrete for structures shall have a rubbed surface finish. Rubbed surface finish shall be made by carefully rubbing the ordinary surface finish with a fine carborundum brick immediately after removing the forms. The first step in this process shall be to moisten the surface with water and then to immediately rub it with the carborundum brick, using light pressures and a circular motion. Rubbing shall be continued until all air holes and small depressions are filled and an excess of mulch is on the surface. The mulch shall then be brushed out smooth with a long bristle paintbrush. After the concrete has been rubbed smooth and has set for a period of 5 to 8 days, it shall then be lightly moistened and again rubbed with a carborundum brick. Rubbing shall be continued until a smooth surface free from lumber marks and irregularities is obtained. On days when the sun is strong, rubbed surfaces shall be covered with canvas to keep the sun from drying out the surface too rapidly and thus causing checking. Before final acceptance on rubbed surfaces, all lather, powder, and dust on rubbed surfaces shall be removed by rubbing with canvas when the surface is dry.

Mechanical Finish: The concrete shall be struck off and consolidated by a self-propelled spreading and finishing machine equipped with a screen to consolidate the concrete by pressure. At least 3 inches of concrete shall be carried in front of the strike off screen. After the strike off, the surface shall have longitudinal floating with a 12 to 16 foot float. Each floated section shall overlap the previous section by 5 feet.

19. FLOOR FINISH:

The upper face of all floors shall be wood floated and twice steel troweled to a smooth hard surface while the concrete is still in a plastic condition after pouring. This surface shall be obtained insofar as possible by flushing the mortar in the concrete to the surface, although small quantities of mortar may be spread upon the concrete to assist in obtaining the proper surface finish. In all cases, the mortar and concrete shall be placed in one continuous operation in order to prevent separation of the mortar surface from the concrete. On walkways, subsequent to steel troweling, surfaces shall be slightly roughened by dragging burlap across the surface in a zigzag motion.

20. TESTING AND REPAIRS:

When reservoirs, basins, tanks, or other concrete structures for holding water or sewage have been completed, they shall be tested by filling with water. Should leakage become evident at any point, or should the water level be lowered through leakage by any amount greater than one inch in 24 hours, they shall be emptied and the leaks repaired by caulking, grouting, or other means approved by the Engineer. The reservoirs, basins, or tanks shall be again tested and this process shall be continued until satisfactory results are secured. Should caulking and grouting prove ineffective in preventing leakage, the Contractor shall be required to coat the inside surface with cement grout placed by a cement gun under suitable pressure and in sufficient quantity to close all pores. This work shall be done at the sole expense of the Contractor and no additional allowance will be made thereof. The Contractor will furnish water for these tests. Two compression test cylinders from each floor, slab, wall, and footing shall be made under the supervision of the Engineer, and one of each pair shall be crushed at 7 days and the other at 28 days.

This work shall be done at a laboratory approved by the Engineer and reports sent to the Engineer. All work shall be done at the Contractor's expense.

Shop drawings shall be submitted of all reinforcing used showing their dimensions, bending details, stirrup details, and all other details.

21. JOINTS:

In slabs, platforms, or other exposed slabs where longitudinal, transverse or sawed joints are called for, they shall be placed as shown on the plans and constructed as stated herein.

- A. Longitudinal joints may consist of sawed joints or joints reinforced with bar steel or wire mesh, whichever is called for on the plans. If bar steel is used, it shall be ½ inch round 30-inch long bars at 3 feet on centers and supported by wire chairs approved by the Engineer. If wire mesh is used, it shall be 6/10, #2 gauge wire, 24 inches long.
- B. Transverse joints may consist of sawed or expansion joints. Expansion joints will consist of the installation of ¾ inch preformed expansion joint filler conforming to specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, AASHTO Designation: M153, Type I, II, or III or the Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction, AASHTO Designation: M213 as per State DOT Standard Specification Latest Designation. Also approved for expansion joint filler material is material conforming to ASTM D-1751 Specifications and/or U.S. Federal Specifications HH-F-34le Type 1. It shall be installed ½ inch below the slab surface and extend to the subgrade.
- C. Sawed joints shall be sawed a minimum of 1-1/2 inches deep by 1/8 inch thick and filled with Type JFA asphalt joint filler. Water shall be sprayed on the blades continuously during sawing operations. The joints shall be blown free of all dust and water before joint filler is applied.

STEEL REINFORCEMENT

1. **General:**
All reinforcing steel shall be manufactured from new billet steel, intermediate grade, deformed bars, in accord with Standard Specifications ASTM A 15 latest edition.
2. **Description:**
Steel reinforcement shall consist of furnishing and placing bar steel or steel fabric reinforcements as shown on the plans and required by the contract.
3. **Materials:**
Materials used in this work shall meet the requirements for the class of material named, and as provided in the specifications.
4. **Construction Methods:**
 - a) **Storage and Protection.** Reinforcement shall be stored above ground upon platforms, skids or other supports, and shall be protected so far as practical from mechanical injury and deterioration caused by exposure. Reinforcement offered for use in the work shall be plainly marked to facilitate inspection and checking. When placed in the work, the reinforcement shall be free from detrimental dirt, scale, rust, dust, paint, oil, or other foreign material.
 - b) **Bending.** Bent bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements.

Stirrups and tie bars shall be bent around a pin having a diameter not less than six times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than 6 times the normal diameter except for bars larger than 1 inch, in which case the bends shall be made around a pin of not less than 8 bar diameters.

- c) Splicing. Bar steel reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the written approval of the Engineer. Splices shall preferably be staggered. In cases where permission is granted to splice bars, other than those shown on the plans, the additional material required for the lap shall be furnished by the Contractor at his own expense.

Unless otherwise shown on the plans, bars in beams, girders, and slabs, and in walls, columns, and haunches shall be lapped 24 bar diameters. In lapped splices, the bars shall be placed in contact and wired together so as to hold the bars in position for the full length of the splice. Welding of reinforcement shall be done only if detailed on the plans or if authorized by the Engineer in writing. Welding shall conform to the current specifications for Welded Highway and Railway Bridges of the American Welding Society.

Splices will not be permitted at points where the section is not sufficient to provide a minimum of 2 inches between the splice and the nearest adjacent bar or the surface of the concrete.

Sheets of mesh or bar steel reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

- d) Placing and Fastening. Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete by means of spacer strips, stays, metal chairs, or other approved devices or supports. Bars shall be securely tied at all intersections except where spacing is less than 1 foot in each direction, when alternate intersections shall be tied. The placing and securing of the reinforcement in any unit or section shall be approved by the Engineer before any concrete is placed in any such unit or section.

5. Floor Slabs:

Reinforcement in floor slabs placed on earth the reinforcing shall be supported by masonry blocking of proper height to insure that the reinforcing material will be placed in the center of such slabs.

In all other floor slabs, the reinforcing shall be spaced as shown on the plans. Where wire mesh is used in floor slabs, it shall be 6" by 6" / #6 x #6 gauge welded wire. All mesh shall be lapped a minimum of 6 inches.

6. Minimum Clear Spacing:

Unless the plans show specific spacing, the minimum clear spacing between the edge of the bars and the exterior surface of all poured concrete shall be 1-1/2 times the maximum nominal size of the concrete aggregate. However clear spacing shall not be less than 3" when the concrete is cast against earth. If for any reason, reinforcing steel has to be placed closer than 1-1/2 inches to any form, the Contractor shall obtain the Engineer's approval of such placement before the pour is made.