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	<p>Construction</p> <p>Quality Assurance Representative's Guide Pile Driving, Dams, Levees and Related Items</p>	
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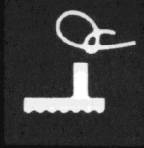
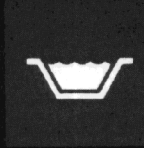
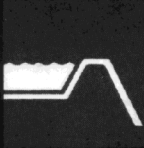
**US Army Corps  
of Engineers**

EP 415-1-261

Volume 2

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# Quality Assurance Representative's Guide



Pile Driving , Dams, Levees and  
Related Items

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Chapters numbered in the guides contain the same subject information as the numbered divisions in the specifications for both military and civil works construction projects. They are identified by specific volume as follows:

<u>Chapter Number</u>	<u>Volume 1</u>	<u>Subject</u>
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CHAPTER 2G  
PILE CONSTRUCTION  
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CHAPTER 2G  
PILE CONSTRUCTION

2G-01. GENERAL

Information contained in this chapter applies in general to pile driving on any project; specific information pertaining to a particular project should be obtained from your supervisor and from the plans and specifications. If a conflict exists between this chapter and the contract plans and specifications, the contract will govern.

2G-02. GENERAL REQUIREMENTS

- a. Check use of pile. i.e.. point bearing or friction.
- b. Check whether piles are to be driven to refusal, a specified bearing or depth.
- c. Check workmanship, materials, and line and grade of completed work.
- d. Maintain all required records.
- e. Reject unsatisfactory materials.
- f. Check testing of materials.
  - (1) At source of supply
  - (2) On site
- g. Checks Prior to Driving
  - (1) Check pile lengths required and bearing capacity of piles.
  - (2) Check borings to determine the driving resistances to be expected and types of materials to be encountered.
  - (3) Check piles as delivered to site and mark piles which are not acceptable.
  - (4) Check piles for length and have lengths indicated on piles near top.
  - (5) Check piles made up for specific locations; have the piles location number painted on the pile.
  - (6) Check out pile driving equipment for size and condition. Check boiler inspection certificate and other safety requirements where steam or compressed air is used. Continue checking daily.
  - (7) Obtain and study the brochure printed by the pile hammer manufacturer pertaining to the hammer being used in order to learn of hammer capabilities and limitations.
  - (8) Check types of special piles and obtain the brochures or pamphlets put out by the manufacturers of these piles to become familiar with the methods of handling, inspecting and driving.

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(9) Check for pile numbering plan. Enter in your report the order driven.

(10) Check that heads are flat and smooth and are normal to the longitudinal axis.

h. Checks During Driving

(1) Check care in handling piles, overdriving, hitting obstructions, driving out of plumb, retardation of stroke and sequence of driving.

(2) Check strata into which piles are driven and depths. Check against profile of borings.

(3) Check that records include type of pile, length used, type and size of hammer, manufacturer, strokes per minute, blows per foot, number of blows per inch of penetration, elevations of pile butt and tip after driving.

(4) Check that approval is obtained for relocation of piles or driving additional piles.

(5) Check the behavior of the pile during driving.

(a) Check hardness of driving at various depths against the strata shown on the boring log.

(b) Check for deviations which indicate broken piles, obstructions or driving irregularities. Check inside length against outside markings.

(6) Check steel driving shoes used on wood or concrete piles. Check damage to pile tip by pulling an occasional pile.

(7) Check that piles are driven continuously. If driving is suspended, note the tip grade at the time of the shutdown and the duration of the delay.

(8) Check uplift on piles.

(a) Check when piles are driven in groups or clusters for heaving of earth around the piles.

(b) Check grade on piles after they are driven and later rechecked.

(c) Check with your supervisor if heaving occurs.

(9) Check that use of small tips is avoided. Check damage to tips on wood piles by pulling an occasional pile.

(10) Check for preparation of pile schedule and lengths.

(a) Drive several piles adjacent to boring locations.

(b) Note blows per foot for each foot.

(c) Compare (b) with boring data.

(11) Check that piles are set vertically, or, if batter piles, on the axis which they are to follow. Check that the hammer is centered over the pile.

(12) Check use of templates or timber bracing for guiding piles when driving without leads.

(a) Check deviation from proper location. Cut off and abandon and drive new pile.

(b) Pull and redrive.

(13) Check jetting is used only with approval of supervisor.

(a) Check depth jetting permitted.

(b) Check for walking out of plumb and loosening of piles previously driven.

(c) Check that piles are redriven after jetting in area is completed.

(d) Check possibility of damage to existing structures if jetting permitted.

(14) Check lagging is used only with prior approval.

(15) Check piles are not driven within 100 feet of concrete less than 7 days old.

(16) Check ownership and payment of pile cut-offs. Check if cut-off lengths are excessive.

(17) Make sure your records indicate pay lengths.

(18) Check deviations from pile schedule; notify your supervisor.

(19) Ensure pile driving is not started until approval is given as to the type and weight of the hammer to be used.

i. Site Conditions. Inspection of Equipment

(1) Check for unfavorable conditions such as rock, ledge, boulders not indicated on drawings, excessive soft spots, crusts, old foundations disclosed during construction, and report to your supervisor.

(2) Check site conditions, including lines, grades, foundation preparation, all available boring information, right-of-way, roadways, streams or other waterways, terrain, and all driving conditions.

(3) Check equipment proposed for use by the contractor will produce the finished work of requirement standards within the scheduled time.

(a) Check size of hammer.

(b) Check type of driving hammer bases, anvils and caps against type of piling.

(c) Check followers are used only with the approval of your supervisor.

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(d) Check condition of hammer for wear, improper adjustment, poor lubrication, long hose lengths, leaks and drops in steam pressure.

(e) Check double-acting and differential-acting hammers are run at manufacturer\*s rated speeds.

j. Pile Driving Procedure

(1) Check with supervisor procedure to be followed.

(2) Check formula to be used as a guide in determining bearing capacity.

(3) Check minimum bearing value to be obtained if not stated.

(4) Check with supervisor for blows per inch (or fraction of an inch penetration) for the last ten blows to be obtained when driving to refusal.

2G-03. TESTS AND RECORDS

a. Tests

(1) Check test piles to be driven and method of loading.

(2) Check time required between driving and testing.

(3) Check test pile operation and log all data.

b. Records-Check daily job records of pile driving operations are complete and contain the following information:

(1) Site

(a) Depth of water (if any). (Condition of bottom if pile driver is in water).

(b) Elevation of water surface, tidal and stream flow or current observations.

(c) Elevation of ground surface.

(d) Ground-water elevation.

(e) Character of surface soil.

(f) Effect of pile driving on elevation of soil surface.

(g) Weather-Temperature, precipitation, high winds.

(h) Ground surface- Depth of frost (if any), wet, muddy, or dry.

(2) Location of Pile

(a) Identification by reference number on plan approved for field use.

(b) Actual location as driven and length of pile driven.

(3) Driving Record



- (a) Pile Data - type and length used.
- (b) Hammer Data - type and size and manufacturer of hammer used.
- (c) Driving Data - blows per inch penetration, and elevation of butt and tip after driving.

2G-04. INSPECTION

a. Steel Pile - H Piles. Pipe Piles. Sheet Piling

- (1) Check upon delivery grade and type of steel and mill certificates.
- (2) Check diameter, weight and type.
- (3) Check surface condition, condition of interlocks, condition of pile point and pile head reinforcing or shaping.
- (4) Check bends of flange injuries in shipment or handling.
- (5) Check for defective rivets or welds, and fit at splices.
- (6) Check certification of welders.
- (7) Check number of splices per pile.
- (8) Check storage and handling methods.
- (9) Check interlock dimensions for interchange and placing of piles for location, spacing, direction and threading of interlock of sheet piles.
- (10) Check that driving operations do not rupture interlock.
- (11) Check on enclosed sheet pile structures for accuracy of initial pile location and plumbness.
- (12) Check last closure pile is driven free without jamming or causing damage of interlocks.
- (13) Check splices are staggered, and allowable splices per pile.
- (14) Check cutoff elevations and allowable tolerances.
- (15) Check handling and pulling holes are provided.
- (16) Check expansion and contraction allowances on walers.
- (17) Check caps are not placed before sway bracing, welding, etc. is completed.
- (18) Check concrete is not dumped in pipe piles through water.
- (19) Check sheet piling is left slightly higher than cutoff elevation.

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(20) Check every tenth sheet pile is pinned to prevent walking and to maintain plumbness.

(21) Check that steel pipe tops frayed or battered during driving are cut off.

b. Timber Pile (Round)

(1) Check type of timber as delivered.

(2) Check dimensions and straightness of the pile.

(3) Check for decay, knots, splits, shakes, crooks and bends.

(4) Check preparation of points and heads for driving.

(5) Check methods and amount of treatment required.

(6) Check removal of bark.

(7) Check treated timber piling is not handled with cant dogs, spike poles, or hooks.

(8) Check all cuts and breaks are treated.

(9) Check use of collars or bands.

(10) Check the head of a timber pile is recut, if broomed.

(11) Check that driving of piles beyond the point of refusal is not permitted.

(12) Check cutoffs for all structures.

(13) Check bolt holes.

(a) Check holes bored for drift bolts are 1/16-inch smaller in diameter than the drift bolt.

(b) Check holes in treated piles and timbers are filled with hot creosote and where not used tightly closed by a treated plug.

(c) Check that holes are not bored or spikes driven in treated piles to support scaffolding.

(14) Check treated piles are cut off only during favorable weather.

(15) Check cutting of treated spreaders, walers and piles is not done to permit fitting, unless approved.

(16) Check ends of bolts and tie rods extending more than 3 inches beyond the nut are cut off to that length. Ends of all bolts shall be bent or battered after the nut is tight.

(17) Check bolts and tie rods have at least 3 inches of threads remaining under the nut after tightening the nut.

(18) Check walers for overlap, each on each, and that proper number of piling is included in the overlap.

(19) Check washers for make, weight, shape and size.

c. Timber Pile (Sheet)

(1) Check on-site fabrication (Wakefield) for surfacing, grade and size of lumber; size and length of nails, spikes or bolts; proper dimensioning of fabricated work (tongue-and-groove dimensions); required nailing or fastening procedures.

(2) Check used Wakefield piling for tongue-and-groove dimensions, suitability of piling and proper lengths.

(3) Check painting of piles.

(4) Check nailing of driven piles is such as to prevent springing.

(5) Check liners and caps installation.

d. Concrete Sheet Piling

(1) Check tongue-and-groove interlocks are not chipped, cracked or broken.

(2) Check units are of uniform shape, true, and straight. Warped, bent or broken piles shall be rejected.

(3) Check interlocks are fully grouted, where watertightness is required.

e. Precast Concrete Piling

(1) Check quality of the concrete.

(a) Record concrete mix used.

(b) Check for conformance with approved mix.

(2) Check reinforcement is free from rust and scale and placed properly.

(3) Check casting yard operations for the following:

(a) Casting floor will be firm.

(b) Width of pallet boards.

(c) All cut ends of reinforcing tie wire are turned away from form surface.

(d) All inside surfaces of forms are smooth and clean.

(e) Chamfer strip (if required) is in place and firmly attached to form.

(f) Bracings and blocking between and around each piling firm.

(g) Check pile forms are level and straight with no openings.

(h) Check placing is continuous from start to completion, beginning at the head and working toward point.

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(i) Check top surface is secreted and brushed to a uniform, even texture similar to that produced by the forms.

(j) Check upon completion of placement, each pile is stamped or marked on head and point to indicate date and length.

(k) Check as soon as practical that the lifting and stack points are painted on each pile.

(1) Check curing.

(m) Check handling of pile is not permitted until the required strength has been attained.

(n) Check lifting cables are provided with some device to equalize the pull at all lifting points.

f. Cast-In-Place Concrete Piles

(1) Check quality of the concrete.

(a) Record concrete mix used.

(b) Check for conformance with approved mix.

(2) Check reinforcement for cleanliness and placement.

(3) Check the prepared pile hole, before placing reinforcement, to check full dimensions and to see that no swelling or movement of the soil occurs before placing concrete.

(4) Check identification of casings as delivered with those inspected and accepted at the manufacturer\*s plant.

(5) Check the driven casing for ruptures and plumbness before placing reinforcement or concrete, when the casing is to be left in the ground.

(6) Check that prepared pile hole is free of water before placing concrete.

(7) Check the elapsed time after placing concrete before placing the load on the pile.

2G-05. INSTALLATION

a. General

(1) Check layout location for piles.

(2) Check template for sturdiness and elevation.

(3) Check pile hammer data before driving commences.

(4) Check boiler certificate is obtained from contractor if steam is used.

(5) Check handling of piles. Insist that pickup points be used.

(6) Check length and size of each pile for required location.

(7) Check penetration of pile immediately after setting and record in Daily Driving Log.

(8) Check alignment laterally, longitudinally and vertically; also batter lines (if battered piles are required).

(9) Check cushion condition beneath during actual driving operation.

(10) Check continuous driving until required depth or penetration is attained.

b. Concrete Pile

(1) Check that precast concrete piles are protected by means of driving heads.

(2) Check cast-in-place unit shells are thoroughly cleaned out with air or water jets and all water removed before concrete is placed.

(3) Check reinforcing steel is rigidly assembled, lowered into the shell, and adequately secured in proper position until concrete is placed. Loose bars shall not be permitted.

(4) Check provisions and method of cutting and splicing.

c. Driving for Resistance

(1) Check that the ram is operating at full stroke, rated speed, and under full recommended pressure.

(2) Check any evidence of slowing down of hammer.

(3) Check cushioning materials for conformance with those anticipated in the designer's resistance formulas.

(4) Check carefully the readings taken immediately after resumption of driving.

(5) Check inside piles are driven first, when piles are to be driven in groups.

d. Overdriving

(1) Check against overdriving when specific depths of penetration are unattainable due to some unforeseen condition underground.

(2) Check sound and character of vibration of the pile during driving for evidence of overdriving.

(3) Check bouncing of hammer or dissipation of the energy of the blow in bending or kinking of the pile, as indications of overdriving.

(4) Check with supervisors the advisability of pulling an occasional pile to check for damage from overdriving.

e. Tolerances

(1) Check permissible tolerances are maintained.

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(2) Check guides and templates are used to secure proper alignment until penetration is sufficient to determine its course.

(3) Check springing of piles during driving to bring them into proper alignment.

(4) Check tolerance in aligning and plumbing foundation piles which are to be buried.

(5) Check accuracy of line and plumbness for trestles, docks, small column footings and wall footings.

(6) Check piling is not trimmed or cut to facilitate the framing of sway or longitudinal bracing.

CHAPTER 2H  
LEVEE CONSTRUCTION AND  
EARTH EMBANKMENT CONSTRUCTION FOR DAMS  
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CHAPTER 2H  
LEVEE CONSTRUCTION AND  
EARTH EMBANKMENT CONSTRUCTION FOR DAMS

2H-01. GENERAL

This chapter covers all operations in connection with preparing the embankment, blanket foundations and placement and compaction of all permanent fills and backfills. If a conflict should exist between this guide and the contract specifications, the contract will govern. All conflicts will be reported to you: supervisor.

2H-02. GENERAL PROVISIONS

a. Lines and Grades

(1) Check extent of survey work to be performed by the contractor and by the Government.

(2) Check whether or not Government survey obligations have been met.

(3) Check, prior to start of work, location of vertical and horizontal control markers established by the Government.

(4) Check that work area limits are plainly marked prior to start of construction operations.

(5) Check work area limits against real estate property limits to determine ownership status.

(6) Check actual conditions of the site of the proposed work for agreement with the drawings.

(7) Check contractor\*s layout for accuracy, control and agreement with lines and grades on contract drawings.

(8) Check that original cross sections are taken before start of construction.

b. Conduct of the Work

(1) Check penetration of material, work and existing structures.

(2) Check that haul roads are approved prior to use and maintained during construction.

(3) Check rate of excavation from approved borrow sources or areas of required excavation.

(4) Check contractor\*s Environmental Protection Plan.

(a) Is stockpiling required?

(b) Do not permit unauthorized wasting or borrowing.

(5) Check on the type and frequency of tests the contractor is required to perform in accordance with the contractor\*s quality control plan. (QC)

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(6) Check on the type and frequency of tests the Government is to perform for quality assurance. (QA)

(7) Check to insure that contractor quality control tests and Government quality assurance tests are performed at the specified frequency.

c. Records

(1) Check with your supervisor prior to the start of work as to type of reports required, frequency, and data to be included.

(2) Check on reason for reports and end use.

2H-03. CLEARING AND GRUBBING

Refer to chapter 2A.

2H-04. STRIPPING

a. Area Limits - Check.

b. Use of Topsoil

(1) Check stockpiling or borrowing.

(2) Check work in place.

(3) Check wasting.

c. Stripping - Check depths.

d. Drainage Provisions - Check after stripping.

2H-05. FILL MATERIALS

a. General

(1) Check sources.

(2) Check material in place for classification.

(3) Check that unsuitable materials are not placed.

(4) Check various types of fills and the locations of each.

2H-06. EXCAVATION

a. General

(1) Check use of suitable materials.

(2) Check disposal of materials to be wasted.

(3) Check location of work limits,

(4) Check controls, horizontal and vertical.

(5) Check grades on "cut" stakes.

b. Specific

- (1) Check line and grade of foundation excavation.
- (2) Check excavated section of channels and ditches.
- (3) Check removal of unsuitable material.
- (4) Check fill material from borrow.
- (5) Check excavation areas for drainage.
- (6) Check use of interceptor ditches to control runoff.
- (7) Check finished slopes as excavation progresses.
- (8) Check slope tolerances as the work progresses.
- (9) Check for provisions and certification of monitoring equipment and operator.

c. Excavation Where Blasting is Employed

- (1) Check contractor\*s blasting pattern against contractor\*s approved plan.
- (2) Check use of test blasts before starting a full scale blasting program. Monitor the test blast program prior to full scale blasting, if required in the contractor.
- (3) Keep a record of quantity of powder used per blast, the number of the fuse delays used, blasting caps, and the depth and spacing of the holes.
- (4) Check finished slopes in the blasting area for fractures due to over blasting.
- (5) Check size of blasted rock.
- (6) Check on need of changing blasting pattern.
- (7) Check that requirements for monitoring blasts are being carried out.

2H-07. PREPARATION OF FOUNDATION

a. Fill - Fill depressions with soil material which is to be placed immediately above the foundation.

b. Loosen Soil Foundation - Check that the area is scarified, plowed or harrowed.

c. Cleanup - Check soil foundation is compacted after removal of roots or other debris turned up in the process of loosening.

d. Rock Foundation Preparation

- (1) Check that all loose material is removed.
- (2) Checks of area to be in contact with impervious materials.

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(a) Rock Surface - Thoroughly cleaned by washing and brooming.

(b) Cracks, joints and crevices cleaned out using air and/or air-water jets.

(c) Cleaned joints and cracks completely filled with portland cement mortar.

(d) Depressions or cavities satisfactorily filled with specified material and compacted. Cavities that cannot be satisfactorily filled with earth shall be filled with lean concrete according to specifications.

(e) No mortar of lean concrete applied or left on smooth rock surfaces.

(f) Remove all overhanging rock sections existing on the rock foundation excavated slope.

(g) Tie fill concrete to excavated rock face with anchors if and as required by specifications.

(h) Remove abrupt vertical changes in foundation slope as specified to preclude excessive differential settlement or stress concentrations.

#### 2H-08. PLACEMENT

##### a. Rolled Fill

###### (1) General

(a) Check embankment foundation prior to placement of fill and bonding of foundation material and fill.

(b) Check during placement that the embankment is free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material.

(c) Check that fill is not placed on frozen material, snow or ice, and that frozen earth is not placed in the embankment.

(d) Check grade of temporary construction slopes.

(e) Check types of materials:

1. Keep at same level unless otherwise specified.

2. Check mixing of materials.

(f) Check layer thickness and compaction of hand placed material.

(g) Check layer thickness and compaction of machine-dumped material and machine compaction.

(h) Check surface drainage of completed portions.

###### (2) Controlling Factors

(a) Check loose or compacted thickness of layers specified.

- (b) Check material, being placed, for gradation at specific location.
- (c) Check moisture content specified "after compaction".
- (d) Check rate of placement.
- (e) Check removal of oversize boulders.
- (f) Check scarifying or wetting layers per specifications exclusive of the rock fill.
- (g) Compaction by rolling Equipment - Check as follows:
  - 1. Type of roller.
  - 2. Number of passes.
  - 3. Number of rows when tamping rollers used in tandem. Note limitation on tandem rollers in true alignment.
  - 4. Overlap of each pass.
  - 5. Method used when compaction by roller impossible.

b. Hydraulic Fill for Dams

- (1) General
  - (a) Check for segregation during placement.
  - (b) Check gradation of materials.
  - (c) Check slopes of impervious central core and pervious shells.
  - (d) Check rate of construction.
- (2) Controlling Factors
  - (a) Check gradation of the material being supplied for the sluicing or pumping.
  - (b) Check the gradation of material in the core.
  - (c) Check material in the shell.
  - (d) Check core width.
  - (e) Check core is free of sand lenses.
  - (f) Check location of discharge lines.
  - (g) Check consolidation of core.
  - (h) Check depth of core pool.

2H-09. MOISTURE CONTROL-ROLLED FILLED SECTIONS

a. General

- (1) Check moisture content of materials to be placed.

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(2) Check moisture content limits.

b. Impervious Sections

(1) Check for dryness.

(2) Check method of wetting:

(a) In borrow pit.

(b) On fill-Check uniform distribution.

(3) Check for too wet material in fill. Dry each layer.

(4) Check need for water meter.

(5) Check moisture content after compaction.

c. Random Sections - Check that same control is used as for impervious material or pervious material.

d. Pervious Sections

(1) Check that water is added after material has been spread on the embankment.

(2) Check method of wetting.

(3) Check that fines are not washed out when wetted.

e. Filter Drainage Layers - No moisture control required.

f. Rock Fill Sections-No moisture control required.

2H-10. COMPACTION

a. General

(1) Check compaction requirements for various soils prior to start of work.

(2) Check testing.

(3) Check that compaction is obtained within moisture content limits.

(4) Check to insure that the contractor\*s compaction effort is visually inspected at all times for the required number of passes of the compaction equipment.

b. Soil Types as Related to Compaction

(1) Check specific types - Cohesionless, Cohesive and In Between

(2) Check methods of compaction for various types.

c. Methods of Compaction - Compaction can be accomplished by the following methods:

(1) Surface Rolling - Check that fills are built up in thin layers.

(2) Vibration - Check use for foundation work, utilizing thin layers and cohesionless soils.

(3) Water

(a) Check this method carefully on other than controlled hydraulic fill operation.

(b) Check for use in areas that cannot be reached by other methods.

d. Types of Compacting Equipment

(1) Tamping Sheepsfoot Roller

(a) Check for weight per linear foot of drum, weighted and empty.

(b) Check number of units.

(c) Check length and diameter of drums.

(d) Check length of projection of feet from drum.

(e) Check face area of feet.

(f) Check spacing and staggering of feet.

(g) Check device for cleaning feet.

(h) Check rolling units on multiple-type tamping rollers for use on uneven ground surfaces and independent rotation.

(i) Check speed of rolling.

(2) Rubber-tired Roller

(a) Check load per wheel.

(b) Check number of wheels.

(c) Check tires for size and operating pressures.

(d) Check position of wheels.

(e) Check spacing of wheels.

(f) Check speed of rolling.

(3) Crawler-Type Tractor

(a) Check size and weight.

(b) Check for use on cohesionless soils.

(4) Electrical Vibrators

(a) Check vibrations per minute.

(b) Check area of contact.

(c) Check thickness of layers.

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(5) Air Tampers

- (a) Check coverage by operator.
- (b) Check for use in restricted areas.
- (c) Check for thin lifts.

(6) Gasoline Driven Tamper

- (a) Check for use in trenches.
- (b) Check coverage by operator.
- (c) Check for thin lifts.

(7) Grid Roller

- (a) Check for use in highway work.
- (b) Check contact pressures.

(8) segmented Roller

- (a) Check for use on subbase and bases.
- (b) Check size.

(9) Vibratory Roller

- (a) Check weight and number of vibrations.
- (b) Check for use on cohesionless soils.
- (c) Check speed of rolling.

e. Moisture Density Relationship

- (1) Check relationship between moisture content and dry density under a given compactive effort.
- (2) Check results of laboratory data and field compaction.
  - (a) Check by field test section.
  - (b) Check by regular fill operation at start of job.

2H-11. HYDRAULIC FILL FOR LEVEES

a. Hydraulic Placement - Check method against approved plan of operations.

b. Outlets

- (1) Check that waste water is conducted away from embankment.
- (2) Check frequency of outlets.
- (3) Check that no obstruction is between end of discharge pipe and outlet.
- (4) Check for transverse retaining dike.



(5) Check pollution of stream at waste water outlet.

c. Damage - Check discharge of waste water.

d. Rehandling of Hydraulic Material

(1) Check method, non-compacted or semi-compacted.

(2) Check dryness of material.

#### 2H-12. DRESSING

a. Overbuilding of Embankment - Check that sufficient material is placed to permit settlement and dressing to grade.

b. Final Grade - Check full section obtained, considering tolerances.

c. Roughness of Surface - Check that surface is free of depressions and has uniform grade.

#### 2H-13. STONE PROTECTION

a. Material - Check stone against approval for quality and size.

b. Placement

(1) Check base for compaction and grade.

(2) Check depth.

(3) Check gradation after placement.

(4) Check surface grades.

c. Gravel Surfacing

(1) Check for gradation, coverage and depth.

(2) Check for segregation.

#### 2H-14. ZONING OF MATERIALS IN LEVEES

a. Homogeneous Material - Check use in section.

b. Nonhomogeneous Material

(1) Check use of impervious material.

(2) Check use of most pervious in landside berms.

(3) Check whether pervious or impervious to be used in riverside berms.

(4) Check soil type of riverside impervious facing.

#### 2H-15. GRADE TOLERANCE AND SHRINKAGE ALLOWANCE FOR LEVEES

a. Tolerances - Check permissible amount in final dressing.

(1) Check grade of crown and side slopes.

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(2) Check no abrupt changes or depressions.

b. Shrinkage Allowance

(1) Check shrinkage allowance for that portion constructed by the uncompacted fill method.

(2) Check shrinkage allowance for the portion constructed by the semi-compacted fill method.

2H-16. SETTLEMENT MONITORING DEVICES FOR LEVEES AND EMBANKMENTS

a. Installation - Check type, arrangement and spacing of these devices.

b. Records and Maintenance

(1) Check recording readings are taken.

(2) Require maintenance of devices during construction.

(3) Check payment provisions in event of failure.

CHAPTER 2I  
RELIEF WELL CONSTRUCTION  
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2I-11

PROTECTION OF EXPOSED METAL  
SURFACES

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CHAPTER 2I  
RELIEF WELL CONSTRUCTION

2I-01. GENERAL

This chapter covers exploratory drilling and the construction of relief wells to relieve the subsurface hydrostatic pressure and to control underground seepage created by the presence of a pervious strata that lies close to the ground surface.

a. Location

(1) Check location of wells in field against the contract drawings. Tie-in location to local survey control.

(2) Check number and spacing of wells. Secure permission from design engineers if number and spacing must be changed to meet conditions.

2I-02. EXPLORATORY DRILLING

a. Method of Sampling

(1) Check procedures for dry sampling or undisturbed sampling.

(2) Check depth at which sample is obtained.

(3) Check if required continuous sampling is maintained.

b. Sampling Equipment

(1) Check type and size of sampler against specification.

(2) Check use of core retainer in cohesive soils.

(3) Check use of flap valve in non-cohesive soils.

c. Advancing the Boring

(1) Check use of temporary casing.

(2) Check use of a drilling fluid as specified.

(3) Check use of wash water during boring.

(4) Check that boring is not advanced below planned or sampled depth. Sample should be taken below casing bottom for undisturbed sample.

(5) Check that washing is not done through the sampler.

(6) Check cleaning of bore hole prior to sampling.

d. Samples

(1) Check that all specimens of each type of soil in sampler are retained.

(2) Check packing and labeling of each sample.

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e. Records

(1) Check that boring log is kept for each hole.

(2) Check that boring log record and label on sample container agree.

f. Backfilling - Check hole is backfilled and compacted.

2I-03. RELIEF WELL COMPONENTS

a. Material

(1) General

(a) Check length of well screen, length of riser pipe, the well discharge elevation and the gradation of the gravel filters against schedule.

(b) Check varying the depth of the well to permit use of predetermine lengths of screen and riser pipe without field cutting.

(2) Well Screen

(a) PV Well Screen

1. Check type, dimensions and schedule.

2. Check screen for lengths of slotted pipe, dimensions of screen slots, blockage of slots, cracks, and imperfections.

3. Check method of installations.

4. Check joints for:

a. Type and fit.

b. Obstructions.

c. Fastening procedure - screen, poprivets, and/or glue.

d. Fastening with metal screws, spaced evenly.

(b) Metal Screens - Check the Following:

1. Screens constructed of correct metal.

2. Metal of correct gauge.

3. Diameter of screen.

4. Screen openings for size, shape, pattern and spacing.

5. Treatment for corrosion.

(c) Bottom Plug for Well Screens - Check bottom plug of screen for same material as the screen.

1. Check wooden plugs for preservative treatment, diameter, thickness, fastening.

2. Metal Plugs - Check for standard commercial plugs.

(3) Riser Pipe - Check relief well riser pipe for type and size.

(a) Wood Stave Pipe - Check that material and manufacture are same as screen except for openings.

(b) Metal Pipe - Check material, gauge and protective coating.

(4) Gravel Pack

(a) Check Type of material - washed gravel or crushed stone.

(b) Check gradation.

(c) Check hardness.

(d) Check cleanliness.

(5) Outlet for Relief Well - Check material and method of construction.

#### 2I-04. RELIEF WELL CONSTRUCTION

##### a. Drilling

(1) Check method used for placement of screen, riser pipe and gravel pack.

(2) Check that drilling does not cause excessive displacement or reduce yield.

(3) Check diameter of hole.

(a) Check size of drill unit.

(b) Check for minimum thickness of gravel pack.

(4) Check that ample water supply is available.

(5) Check need for temporary casing.

(a) Use steel casing only.

(b) Prevent cavities outside of casing.

(c) Check diameter - Get minimum thickness of gravel pack.

(d) Check thickness of material.

1. Check distortion.

2. Remove if distorted.

(e) Check that casing extends to minimum depths.

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(6) Check type of drilling fluid.

(a) Remove fluid during surging.

(b) Do not permit use of drilling muds with bentonite.

(7) Note obstructions encountered on well log.

(a) Check depth of obstruction.

(b) Check whether partial well will be utilized or abandoned.

(c) Check that abandoned well hole is backfilled.

(d) Check relocating replacement well adjacent to abandoned well.

#### 2I-05. INSTALLATION OF RISER PIPE AND SCREEN

##### a. Assembly

(1) Check condition and fastening of riser pipe and screen.

(2) Check accurate placement of pipe and screen in pervious strata.

(3) Check number and placing of spiders.

(4) Check that space is available for insertion of tremie to bottom of hole.

##### b. Joints

(1) Check for approval and shop drawings covering method of making joints.

(2) Check approved method of lowering pipe and screen.

(3) Check that joints do not open when lowering casing.

##### c. Placement

(1) Check gravel pack material is placed at the bottom of well prior to placement of well screen and riser.

(2) Check that no damage to assembled riser pipe and screen occurs during placing.

(3) Check plug at bottom of the well screen.

(4) Check elevation of top of riser pipe.

(5) Check construction of gravel pack after the screen and riser pipe have been placed.

(6) Check each well for straightness and plumbness.

(7) Check clearance for installation of the pumping equipment for testing the wells.



2I-06. GRAVEL PACKING

a. Gradation - Check prior to placement.

- (1) Check for segregation in stockpiles.
- (2) Check gradation of filter material used in conjunction with gravel pack material.

b. Placement

- (1) Check bottom and top depth of the gravel pack.
- (2) Check use of tremie.
- (3) Check minimum segregation.
- (4) Check elevation.
- (5) Check elevation of tremie is above water surface.

2I-07. SURGING AND PUMPING OPERATION

Check that prior to surging and pumping the well screen is cleaned. Check on proper care and disposal of drilling fluids during drilling and well development.

a. Alternate Surging and Pumping Method

- (1) Check that fines and drilling mud are removed.
- (2) Check draw down.
- (3) Check flow.

b. Simultaneous Surging and Pumping Method

- (1) Check equipment.
- (2) Check procedures.
- (3) Check damage to screen and/or plug.
- (4) Check addition of gravel pack material due to settlement.
- (5) Monitor for continuing excessive amount of fines. Consider recommending possible abandonment because of excessive fines.

2I-08. BACKFILLING OPERATIONS

a. Material Placement

- (1) Check placing of sand layer on gravel pack.
- (2) Check backfilling from sand layer to finished grade.
- (3) Check concrete backfill.
  - (a) Do not resurge after concrete is placed.
  - (b) Use tremie for concrete placement under water.

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- (4) Check removal of temporary casing.
- (5) Check filling of all pits.
- (6) Check disposal of surplus material.

2I-09. PUMPING TESTS

- a. Equipment - Check that all necessary equipment is on hand.
- b. Records - Maintain prescribed records of test results.
- c. Operation
  - (1) Check continuous pumping is maintained.
  - (2) Check that sand or other material collected in well is removed.
  - (3) Check that no other pumping is done in vicinity until full recovery in original well.
  - (4) Check final cleanup and backfill of excavated areas.

2I-10. PIEZOMETERS/WELLPOINTS

- a. Material
  - (1) Check pipe for grade of material, nominal diameter, type of coupling and preservative treatment.
  - (2) Check well point for grade, length and mesh screen size.
  - (3) Check guard posts for size, length and type of cap.
- b. Installation
  - (1) Check locations and elevations.
  - (2) Check method of drilling.
  - (3) Check need for guard posts.
  - (4) Check filling with water after installation.
    - (a) Check rate at which the water falls in the tube.
    - (b) Check that piezometer is in a pervious stratum in hydraulic contact with the pumping zone.
    - (c) Check for clogged tubes - Remove and reinstall.

2I-11. PROTECTION OF EXPOSED METAL SURFACES

Check that exposed surfaces are galvanized or painted.

CHAPTER 2J  
DRILLING FOR SURFACE INVESTIGATIONS  
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CHAPTER 2J  
DRILLING FOR SUBSURFACE INVESTIGATIONS

2J-01. GENERAL

This chapter covers the investigation of the distribution, type, and physical properties of subsurface materials. These investigations pertain to foundations, borrow, and ground water.

Subsurface investigations are usually accomplished by drilling, auger boring, or excavating test pits, trenches, or shafts.

2J-02. GENERAL REQUIREMENTS

a. Type of Investigation - Check purpose, depth, type of materials, ground water conditions, underground utilities prior to start.

b. Equipment

(1) Check that requirements to be used will serve intended purpose.

(2) Study usages of various types of equipment.

c. Reports

(1) Check with supervisor as to reports required and data to be submitted.

(2) Understand reasons for report data requirements.

d. Markers - Check for installation of permanent exploration markers.

2J-03. SURVEY CONTROL

a. Location

(1) Check each exploration is located accurately by tie-in to survey grids or established base lines.

(2) Check elevations are established from existing vertical control.

(3) Check permissible variation of locations.

(a) Foundation Exploration - Minor only.

(b) Borrow Exploration - Reasonable.

2J-04. SAMPLES

a. Type

(1) Representative disturbed

(2) Undisturbed

(3) Bedrock.

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b. Handling

(1) Check sample to assure it is representative of the material. Do not scalp over, undersize, or blend materials from layers or lenses.

(2) Check that all samples are protected from jarring, vibration, and exposure to heat or frost.

(a) Check method of packing.

(b) Check transportation.

(3) Check that each sample is identified.

(4) Check need for moisture content testing.

2J-05. OPERATION

a. General

(1) Check that written permission for right of entry has been obtained from landowner, if appropriate.

(2) Check for authorization from installation commander.

(3) Check requirements for fencing, covering, or closure of pits.

(4) Check backfilling and grading of excavation.

b. Drilling and Sampling

(1) Recheck purpose versus type of equipment.

(a) Record penetration resistance.

(b) Apply soils classification to soil samples.

(c) Check cleaning out of casing prior to undisturbed sampling.

(d) Check use of drilling mud in lieu of casing.

(e) Check level table during drilling.

c. Drilling Grout and Drain Holes

(1) Check drill hole location plan.

(2) Check that peripheral grout holes are drilled and grouted according to the specified grouting plan.

(3) Check that drain holes are not drilled until all adjacent grout holes have been completed.

d. Drilled Water Wells

(1) Check for placement of casing pipe in overburden portion of well.

(2) Check that pipe extends above ground surface.

- (3) Check for inner casing if required.
- (4) Check for grouting between casings.
- (5) Check for alignment and plumbness of casing and rock hole.
- (6) Check setting of well screen in well drilled only in soil.
- (7) Check that well is capped if permanent pump is not installed.

e. Test of Wells for Yield and Drawdown

- (1) Check depth of static water before pumping.
- (2) Check volume pumped.
- (3) Check depth after pumping.
- (4) Check recovery rate.
- (5) Monitor observation wells, if available, frequently.

CHAPTER 2K  
LOCK GATE ERECTION  
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CHAPTER 2K  
LOCK GATE ERECTION

2K-01. GENERAL

a. Controls - Check controls are set up for checking gates during fabrication and erection.

b. Shop and Erection Drawings

(1) Check markings of material for agreement with drawings.

(2) Check delivery of equipment against erection sequence.

(3) Check drawings to make sure contractor has indicated where, when, and how the various components will be erected.

(4) An erection procedure should be required.

c. Match Marks

(1) Check all components are match marked.

(2) Check during erection, that items assembled have the same match marks aligned.

2K-02. INSPECTION REQUIREMENTS. GENERAL

a. Structural Members

(1) Check prior to erection, for damage such as warps, bends, twists, etc.

(2) Check all machined surfaces are protected.

(3) Check all materials have been shop inspected and passed necessary shop tests.

(4) Check all steel is match marked and erection marked.

(5) Check metal surfaces inaccessible after assembly have been painted.

b. Embedded Items - Check anchor bolts, sill angles and bearing plates, are aligned, properly located, and set at the correct elevations.

c. Appurtenant Items - Check the installation and adjustment of appurtenant parts of the gates such as seals, quoins, and miter blocks and mitering devices.

d. Painting - See Chapter 9A.

a. Tests and Trials - Each complete machinery and structural unit should be tested and operated as required by the specifications to demonstrate that it meets the requirements of the specifications in all respects.

2K-03. RIVETED CONSTRUCTION

a. Temporary Erection Connections



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(1) Check surfaces bolted together have completed metal to metal contact.

(2) Check sufficient erection bolts are used to hold connecting members in specified alignment.

(3) Check sufficient number of drift pins are used to obtain alignment of components without distortion of connection holes.

b. Riveted Joints

(1) Check for loose rivets.

(2) Check for rivet heads not snugged up to metal.

(3) Check rivets for improper heating.

(4) Check rivets for proper length.

2K-04. WELDED CONSTRUCTION

See chapter 5B.

2K-05. MITER GATES

a. Check pintle base for accurate setting.

b. Check prior to start of gate assembly that pintle base, pintle, and pintle bushing are thoroughly clean and lubricated.

c. Check alignment and grade of gate framework. Continuous checking of this framework is recommended.

d. Check sleeve nuts of the top anchorage are correctly centered.

e. Check top anchorage for assembly, cleanliness, and lubrication.

f. Check installation of gudgeon pin for fit, cleanness and lubrication.

g. Check gate diagonal prestressing operation after complete welding and/or riveting of the gate leaf and assembly of top anchorage.

h. Check gate leaf is cleared of all blocking and ties upon completion of assembly, and operated through the limits of travel. Check bottom girder for travel in a horizontal plane and that miter end of leaf is plumb. Check center of gudgeon pin for centering over center of pintle.

i. Check gate leaves in closed or mitered position for setting of fixed quoin post. Check during grouting operation of quoin post for any movement.

j. Check setting of the quoin and miter contact blocks for alignment, contact, etc.

(1) Check that contractor follows closely his approved plan during placement of zinc around these blocks.

(2) Check preheating of the blocks and surrounding metal, also the heating of the zinc.

(3) Check gate leaves during zincing operation for any warping or tendency to move out of plumb.

(4) Check contact blocks several times during zincing operation for maintenance of correct contact with mating blocks.

(5) Check anchor bolts, adjusting bolts, castings, etc., that are in contact or placed near zinc, for damage that might occur during zincing operation.

(6) Check after completion of zincing operations and when gate is cool, all bearing blocks, at both quoin and miter ends, for correct contact between mating blocks.

#### 2K-06. VERTICAL LIFT GATE

a. Check erection of gate frame or skeleton at least once each day for alignment and grade. Check before start of riveting and/or welding operation, for alignment and grade, and alignment of girders, plates, etc., which take bearing loads and/or gate seals.

b. Check lifting cables for equal stress under load after erection of gate and connection to machinery.

c. Check ends of gate are at same elevation throughout limits of gate travel.

d. Check gate for proper clearances with masonry, bearing plates, and guides.

#### 2K-07. SECTOR GATE

a. Check setting and grouting of the pintle.

b. Check pintle is clean and coated with lubricant before bronze bearing and upper pintle casting are set.

c. Check framework frequently during gate assembly for alignment, recheck gate for alignment, before any skin plating is applied and before field welding is started.

d. Check after gate erection, installation of top anchorage connection to embedded anchorage. Center of gudgeon will be in vertical alignment with center of pintle.

e. Check installation of sill plate and side seal members for assembly and clearances with gate.

f. Check that gate has clearances with masonry, bearing plates, etc.

g. Check setting of trunnion assembly before grouting in place. Check cleaning and lubrication of trunnion and trunnion bearing surfaces at time of assembly.

h. Check framework frequently during gate assembly for correct alignment, recheck gate for alignment before any skin plating is applied and before any welding is started.

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i. Check setting of fixed side and bottom seal plates.

(1) Check centurion of gate when gate is opened and closed.

(2) Check gate during travel for any unusual noise, vibration, jerk, or bump.

(3) Check for clearances between gate and masonry or embedded plates, beams, etc.

#### 2K-08. TAINTER VALVE

a. Check setting of trunnion assembly before grouting in place. Check cleaning and lubrication of trunnion and trunnion bearing surface at time of assembly.

b. Check framework frequently during gate assembly for alignment. Recheck gate for correct alignment before any skin plating is applied and before any welding is started.

c. Check setting of fixed side and bottom seal plates after assembly is completed.

(1) Check centurion of gate travels in a vertical plane when gate is raised and lowered.

(2) Check gate during travel for any unusual noise, vibration, jerk, or bump.

(3) Check for clearance between gate and masonry or embedded plates, beams, etc.

#### 2K-09. GATE OPERATING MACHINERY

a. Check embedded anchor bolts and leveling devices for location, cleanness, and lubrication.

(1) Check that second pour concrete recesses are thoroughly cleaned of old concrete forms, oil, grease, and all debris.

(2) Check location and size of second pour concrete recessed.

d. Check machinery installation.

c. Check cleaning and lubrication of machinery parts as they are assembled.

d. Check assembly of machinery for position, alignment, grade, and clearances between gears, pinions and shafts.

e. If applicable, check to insure that all hydraulic valves and controls are in the proper operating positions. Verify adequate flushing of hydraulic lines and insure that filters are installed and checked.

f. Check operation of gate through several cycles of travel. Before testing gate operating machinery, verify protective devices.

(1) Check machinery operation for any unusual noise, vibration, binding, rubbing, etc.

(2) Check meshing of gears and pinions.

(3) Check motors, speed reducers or pumps and bearings for any overheating or malfunction.

(4) If applicable, check hydraulic system for leaks.

g. Check that clearances of movable parts of the machine are maintained with masonry.

h. If applicable, check brake operation.

i. Check grouting or concreting of machinery into permanent position after checking and adjusting.

j. Check cleaning, lubricating and painting operations.

k. Check guards are in place.

l. Take care that during welding operations, machinery (bearings, etc.) is not subject to stray currents.

CHAPTER 2L  
DAM GATE ERECTION  
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CHAPTER 2L  
DAM GATE ERECTION

2L-01. GENERAL

This chapter covers the erection and installation of tainter, broome, truck and sliding dam gates. It is to be noted that in some instances gates are assembled or fabricated in the field and then installed. In other cases, the gates arrive on the job completely assembled, ready for installation in the structure.

Gates assembled or fabricated in the field require a more detailed, thorough inspection of a specialized nature. The nature of the inspection necessary to accomplish a thorough job borders on the shop-type of inspection rather than that with which the construction inspector is normally acquainted. It is, therefore, mandatory that during the erection of the gate more frequent assistance from a mechanical inspector or engineer be requested.

2L-02. INSPECTION REQUIREMENTS

a. General

(1) Check all gates, gate materials and accessories at delivery for damage and shortages.

(2) Check all approved shop drawings have been received and are available for use.

(3) Check all bearings and finished metal surfaces are protected.

(4) Check storage of materials. If adequate storage for equipment is not called for in the contract, the QAR should notify his immediate superior for necessary action.

(5) Check all embedded items prior to placement of concrete for elevation, location, alignment and rigid attachment.

(6) Check cleaning and protection from damage and corrosion of all machined finished surfaces and seals immediately after formwork removal.

(7) Check vertical guides, tracks, etc. for alignment and plumb.

(8) Check after concrete placing operations all clearances between moving and stationary items of the gates.

(9) Check seal clearances and contact area between seals.

(10) Check movement of gates through full length of lift for binding.

b. Tainter Gates

(1) Check installation of trunnion anchorage assembly. Particular attention should be to avoidance of welding in vicinity of prestressing steel, assembly of anchorage end of

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prestressing steel, calibration and approval of jacking equipment, following approved abstentionist procedure, and submission of gauge pressure and elongation records.

(2) Check parallel operation of gates with respect to side seals.

(3) Check that both ends of gates rise together and at a uniform rate.

(4) Check that hoisting cables are properly rigged and fastened.

(5) Check sill seal and side seals for degree of compression when gate is in closed position.

c. Broome Type Gates

(1) Insure angle of inclination for seal was properly set.

(2) Check removal of mortar, concrete, and dirt from seals prior to placing gate in frame.

(3) Check seals for uniformity of contact.

(4) Check cleaning of all roller pads and surfaces of rollers.

(5) Check rigging of cable for twist and twisting of sheaves.

(6) Check record setting of all limit switches.

(7) Check cleaning of hoisting cables prior to lubrication.

(8) Check that hoisting cable does not scuff against sides of openings through floor slabs.

(9) Assure adequate lubrication (usually water) to prevent damage to rubber seals.

d. Truck Type Gates

(1) Check wheel bearings for cleanliness and lubrication.

(2) Check gauge of truck wheels against guide track for alignment.

(3) Check that gate hangs plumb.

(4) Check wheel adjustment such that proper seal contact is maintained with gate in fully closed position.

(5) Check all running clearances between tracks and wheels through full travel of gate.

e. Sliding Gates (Stem Operated)

(1) Check that gate is centrally located in guides prior to setting anchor bolts, embedded items above gate for bearings, guides, etc.

(2) Check anchor bolt setting in operating room floor slab by plumbing up of center of stem opening in gate.

(3) Check hoist stems for plumb.

(4) Check cleaning of internal nut threads in hoists and threads on stem prior to assembling hoist into stem.

(5) Check that stem travel through hoist is parallel to surface of stem nut.

(6) Check application of a protective coating to all finished ferrous surface and lubrication of threads and bearings.

#### 2L-03. WELDING

Refer to Chapter 5B.

#### 2L-04. GATE OPERATING MACHINERY

##### a. Drum Hoists

(1) Check lay of cable on drums for overlapping, jumping, or scuffing when gates are raised or lowered.

(2) Check level of hoist assembly.

(3) Check that proper residual turns are adequate per shop drawings with gate in closed position.

(4) Check ropes of hoists using ribbon wound multiple hoist ropes for equal load distribution.

(5) Check gate indicator against actual gate position.

(6) Check alignment of all gearing for even bearing area and correct contact area.

##### b. Motorized Screw Hoists

(1) Check location of center of hoist with center of point of attachment of stem on gate.

(2) Check that hoist is plumb and level.

(3) Check cleanliness of all moving parts prior to operation.

(4) Check for binding between keyway in stem and key in torque plate.

(5) Check rotation of motor drive prior to operation and before stem is in place.

(6) Set and check limit switch operation.

#### 2L-05. FINAL INSPECTION

##### a. Material and Equipment

(1) Check that brakes, limit switches and safety devices are functioning.



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(2) Check that all moving parts have been lubricated.

(3) Check that all seals are clean and adjusted.

(4) check that all temporary blocking supports have been removed.

b. Operation

(1) Recheck clearances over entire travel of gates.

(2) Operate gate at first through short distance of travel.

(3) Check for bindings, overloading of motors, uneven travel of gates, and noise.

(4) Test gates through complete cycle of operation.

(5) Check gate and seals for water-tightness.

CHAPTER 2M  
PENSTOCKS, SURGE TANKS AND TUNNEL LINERS  
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CHAPTER 2M  
PENSTOCKS. SURGE TANKS AND TUNNEL LINERS

2M-01. GENERAL

This chapter covers the fabrication, erection, and testing of penstocks, surge tanks, and tunnel liners. The full scope would be monumental; therefore, the following items are intended only to assist the QAR in the performance of his work. Contract specifications will govern in all cases of conflict, and any conflict will be reported to your supervisor.

2M-02. APPROVALS

a. Approval of materials to be incorporated into the finished product must be made before the start of work.

(1) List approved and unapproved materials.

b. Contractor's plant layout and equipment must coincide with approved plans.

2M-03. PRELIMINARY INSPECTION

a. Damaged Material

(1) Inspect materials on arrival at site.

(2) Reject damaged items.

b. Storage

(1) Check for orderly storage and accessibility.

(2) Check that material that can be damaged by weather is stored above ground and under cover.

(3) Check that steel stored in steel yard is above ground and blocked, with safe passageways for ready accessibility.

(4) Check storage of welding electrodes in a dry, weathertight storage building, in sealed containers.

(5) Check storage of gas bottles.

(6) Check handling of materials. Damage, in handling, is cause for rejection.

2M-04. FITUP

a. Prefabrication

(1) Check that plate edges are cut to design, within allowable tolerances.

(2) Check that edges are straight, clean, end free of scale.

(3) Check curved plates for even curvature.

(4) Check excessive welding when lugs, pad eyes, blank, nuts, and strong backs are welded to plates or sections.

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- (5) Check heat number on steel plates.
- (6) Check placing of root opening spacers before tack welds are made and removal before root pass is made.
- (7) Check the circumference, diameter, and length of section.
- (8) Check that sheet clamps, or cable slings that bind against plate edges when lifting plates or sections, are not used.
- (9) Check installation of spiders and/or internal bracing in penstock sections and tunnel liner sections.
  - (a) Spider rods must be tight.
  - (b) Internal braces must be secure.
- (10) Check operational procedures.
- (11) Check for positive bearing on rotation rollers when welding penstock sections.
- (12) Check that penstock sections and tunnel-liner sections are not lifted with other than approved cable slings or devices.

#### 2M-5. WELDING

Refer to Chapter 5B for additional check items.

##### a. Preparation

- (1) Check that low-hydrogen electrodes are kept heated between 250 F. to 300 F. after containers have been opened.
- (2) Check that temporary welds are kept to a minimum.
- (3) Check that arcing at ground clamp is given immediate attention and correction.

##### b. Techniques and Practices

- (1) Check that welders are familiar with welding sequence and welding procedures.
- (2) Check need for rejection for departure from specified welding procedures and/or sequence. Disqualification of welder may be necessary.
- (3) Check weld shrinkage of butt joints and correction made.
- (4) Check tack welds. Require chipping or grinding flush, and repair of excessive undercutting.
- (5) Check for approved welding procedures and sequences of welding. Check shrinkage of distortion in welds or metal adjacent to weld.
- (6) Check for protection from rain where welding is being done in the open.

(7) Check contamination of granular flux used with submerged and arc-welding machine.

(8) Verify preheat and posthead (cooling) requirements.

c. Examination of Welded Joints

(1) Check excessive weld reinforcement.

(2) Check use of radiograph.

(3) Check wearing of exposure badges by x-ray operators and assistants.

(4) Check that safe clear distances are set up and limits enforced between x-ray machines in operation and other workmen.

(5) Check taking of test coupons at known defective points in welding, or at suspected defective areas.

(6) Record all repairs made on welds as to unit seam number, direction of seam and location of repair must be examined by a radiograph.

2M-06. ERECTION

a. General

(1) Check accuracy of layout.

(a) Check all ring girders for spacing to coincide with pedestal spacing.

(b) Check anchor bolts and base plates.

(c) Check ring girders and/or saddle locations while fabrications is in progress.

(2) Check that blocking and cribbing are of hardwood; wedges must be of hardwood or iron, flat tapered.

(3) Check wire rope slings, bridles or other gear used by riggers for lifting penstock sections.

(4) Check load capacities of cranes and stiff leg derricks.

(5) Check thickness, size, and welding of temporary pad eyes.

(6) Check ventilation in tunnels and closed spaces where welding and burning are being done. Check need for blowers and exhaust fans.

b. Welded Penstock and Tunnel Liner Sections

(1) Check blocking and cribbing of penstock sections when set in position in tunnel.

(a) Check fitting up to previously placed section or embedded liner for starting.

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(b) Check grade line and concentricity before completion of fitup and start of tack welding.

(c) Check root opening before welding starts.

(2) Check that spiders or internal bracing is not removed until welding of adjacent seam is completed.

(3) Recheck line, grade and concentricity after welding is completed. Check weld shrinkage.

(4) Check grade, line and stationing, before placing concrete saddles or grouting base plates for ring girders.

(5) Check that spider or internal bracing is not removed from open end of penstock until next section is set and fitup and tack welding is done.

(6) Check that butt ends of hacking bars are welded to form a continuous circumferential strip where used on outside of welded tunnel liners.

(7) Use above check items for surge tank risers and morning glories.

c. Surge Tanks

(1) Check sole plate for correct diameter, centering, and grade.

(2) Check each course for plumb and level. Check thickness of spacers for root opening in horizontal seams.

(3) Check welding of vertical seams of each course before welding the circumferential seam.

(4) Check all scaffold brackets, clips and planking. Do not allow overloading of scaffolds with materials.

(5) Check use of wind screens whenever arc is exposed to strong winds. Seams welded by arc exposed to strong winds must be spot checked by radiograph.

(6) Check bottom cushion for firmness, grade, and level.

(7) Check layout and welding sequence of bottom plates.

(8) Check where warping has occurred for cracks in welds. Use heat activated crayon such as "Templ Sticks" to control excessive heating of bottom plates.

d. Cleanup

(1) Check thorough cleaning of shell plates. Check that temporary welds are removed by chipping and grinding smooth.

(2) Check repairs to tears in plates caused by breaking off clips, pad eyes and such, as well as deep gouges.

(3) Check removal of excessive weld reinforcement.

(4) Check removal of stub ends of welding electrodes.

- (5) Check removal of all debris from inverts and bottoms.

#### 2M-07. ARTICULATING JOINTS

a. Check proficiency of welders employed on fabrication of joints.

- (1) Check that welding of joints members is made on a level floor with a securely fixed center.

- (2) Check radius of member during welding process.

b. Check that radiographic examination is made prior to placing the stainless cladding weld metal.

c. Reject joints made up to a poor fit.

d. Check cut and fit of packing.

- (1) Stagger the cut ends of square braided packing.

- (2) Use silicone grease on all working surfaces.

e. Check that joint tightening is done evenly around the circumference of joint.

- (1) Avoid excessive tightening.

- (2) Check for a smooth even fit and for uniform depth of the packing follower ring around the circumference.

- (3) Do not damage back-off bolts.

f. Check that final tightening of joints is made when joint is incorporated into penstock. Check that back-off bolts are free and under no strain while tightening is in progress.

g. Check that joints are not tightened during hydrostatic test of penstock when pressure is greater than 75% of maximum test pressure and still rising. Check procedures for tightening joints while under test.

#### 2M-08. HYDROSTATIC TESTING OF PENSTOCKS

a. Preparation

- (1) Bulkheads and manholes must be constructed as approved with welded joints of the same quality workmanship as used elsewhere.

- (2) Temporary vents with suitable valves will be installed at all high points in penstock and at top of risers. Air must not be trapped at any high point inside pressure vessel being tested.

- (3) Pressure relief valves will be set in accordance with specifications and code practices. Allow for pressure differential between gauge and relief valve.

- (4) Test gauges must be calibrated and certified as to calibration by manufacturer or testing laboratory. Gauges will be installed at designated locations. Test gauges will not be used prior to test.

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(5) Temporary communication system will be installed with instruments readily available to all locations of critical inspection.

(6) Force pumps or pressure pumps must have rated head pressure equal to or greater than pressure to be encountered in making hydrostatic test. Pumps must be in sound working order and adequately powered.

b. Testing

(1) Test team must be thoroughly briefed on procedure to be followed with full consideration to communications and safety while testing is in progress.

(2) Air vents must be open while filling penstock. Do not allow any air to be trapped in penstock or risers.

(3) Close all pitot lines and/or Gibson lines at valves outside penstock.

(4) Examine all articulation joints for leaks while filling penstock and take corrective action as previously outlined if necessary.

(5) Tape and mark articulation joints before pressurizing and check measurements while test is in progress. Record time, movement and pressure when movement or changes are found.

(6) Test pressures will be increased by increments as directed. Time for holding pressure, pressure drop and increasing pressure will be as directed.

(7) Record all operations and happenings that occur while test is in progress. Record time for all pressure changes, delays, noises, and difficulties encountered. Keep a concise, accurate account of all operations in sequence of events.

(8) Visual inspections will be made at intervals as directed. Final inspection will be made after maximum pressure holding time has been accomplished and designated pressure drop made. All safety regulations set up for testing will be strictly adhered to while hydrostatic test is in progress.

(9) Air vents valves are to be opened before draining of penstock is started. Do not allow a vacuum to be created within the penstock while draining.

2M-09. TESTING SURGE TANKS

a. Surge tanks can be tested directly after completion of hydrostatic test of penstock while riser bulkhead is in place. Valves on riser air vents from penstock must be closed.

b. Drains in surge tank foundation or weep holes must be open to drain sand cushion under tank bottom.

c. Manhole covers must be securely bolted. Temporary manhole covers with pipe headers and valves must fit manhole securely. Do not allow permanent gaskets to be used on temporary manhole covers.



d. Method of filling surge tank and time for holding fill will be as directed.

e. Measure water elevation from top of surge tank and record water elevation at time tank is filled. Measure and record at designated intervals and before tank is emptied.

f. Valve on fill line to surge tank must be locked in closed position after tank is filled. Fill line should be broken at a coupling in fill line.

g. Check foundation drains for leakage in surge tank bottom.

h. Record all time and events while test is in progress. Report any leak immediately to your supervisor.

CHAPTER 2N  
REVETMENTS  
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CHAPTER 2N  
REVETMENTS

2N-01. GENERAL

This chapter covers the construction and maintenance of articulated concrete, asphalt, lumber mattresses and stone fill.

2N-02. MATERIALS

a. Portland Cement Concrete

- (1) Check aggregate gradation.
- (2) Check for approval of mix design.
- (3) Check approval of additives.
- (4) Check dowels and/or wire for size and type of materials.

b. Asphalt Concrete

- (1) Check gradation of aggregate.
- (2) Check approval of mix design.
- (3) Check reinforcement for type and size.

c. Lumber

- (1) Check type and grade.
- (2) Check size and quality when delivered.

d. Stone

- (1) Check approval.
- (2) Check size and quality when delivered.

2N-03. INSTALLATION

a. Plant

- (1) Check that all plants are approved prior to use on work.
- (2) Check that all hauling cables are in good condition, spacing of hauling connections provides equal strain and shackle pins are not worn.

b. Construction

- (1) Check preparation of base to lines and grades.
- (2) Check excavation at toe of revetment.
- (3) Check tie-in to existing bank.
- (4) Articulated mattress

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- (a) Check size and condition of units.
- (b) Check placement.
- (5) Asphalt Mattress and/or Paving
  - (a) Check careful handling.
  - (b) Check any breaks.
  - (c) Check overlap.
  - (d) Check thickness.
  - (e) Check any joints.
  - (f) Check installation of weep holes.
- (6) Lumber Mattress
  - (a) Check spacing of piles.
  - (b) Check penetration.
  - (c) Check placing of willow or other cover material.
- (7) Stone
  - (a) Check placement for excessive voids.
  - (b) Check depth of cover.

2N-04. TESTS

Require all tests of materials prior to and after fabrication. Witness tests and log results.

CHAPTER 20  
DREDGING  
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CHAPTER 20  
DREDGING

20-01. GENERAL

This chapter covers hopper, bucket (dipper and clamshell), hydraulic (pipeline) dredging, and rock drilling and blasting. Any conflict between this guide and the contract plans and specifications shall be reported to your supervisor.

20-02. REGULATIONS

Corps of Engineers and U.S. Coast Guard

- (1) Check special lights, day signals and passing of floating plant.
- (2) Require strict adherence.
- (3) Report violations.

20-03. OPERATIONS

a. Reports - Check with your supervisor as to type, number and frequency of reports.

b. Control

- (1) Check and verify location of both horizontal and vertical control marks as well as tide gages where present.
- (2) Indicate physical location of control points to contractor.
- (3) Require contractor to protect control points.
- (4) Check and verify location of all underwater utilities.
  - (a) Require utility owner\*s representative to be on board while dredging in vicinity of utilities.

c. Dredge Location

- (1) verify and document position at start of watch.
- (2) Verify and document periodically the advance of dredge.
- (3) Verify and document location of dredge or drill boat at each change of position.

d. Hydrographic Surveys

- (1) Verify horizontal and vertical control each day.
- (2) Insure that the surveyors calibrate both positioning and depth sounding systems daily prior to surveying.
- (3) Verify the performance of after dredging surveys.
- (4) Compare after dredging surveys of design channel.

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(5) Inform contractor of shoal areas.

e. Material

(1) Check material removed.

(a) Does it differ from that specified.

(b) Report material suspected to be of different characteristics.

(2) Misplaced Material

(a) Do not permit dumping by scows in dredge areas.

(b) Check for leaks in scows and pipelines.

(c) Check for breaks in disposal area.

(d) Check height of spillway in disposal area.

(e) Sample waste water passing over spillway for percentage of solids.

(f) Locate and report by document misplaced material.

(3) Check size of boulders.

(4) Verify location and document all areas from which dredge cannot remove material.

f. Drilling and Blasting

(1) Check operations of plant for conformance with paragraphs 20-03 (a-e).

(2) Verify quantity of explosives on hand at start of watch.

(3) Check contractor compliance to State, County, Municipal and Coast Guard regulations relative to use, storage and transporting of explosives. Verify contractor blasting plan.

(4) Require strict adherence to safety regulations and blasting plan.

g. Disposal

(1) Check the following for disposal in navigable waters:

(a) Disposal area should be clearly defined by visible and controlled methods.

(b) Proposed disposal of materials should be in compliance with the contract specification.

(c) Verify acquisition of disposal permit (when required).

(d) Prior to the disposal of material each deposition site shall be verified and documented.

(e) Inform contractor and higher authority when noncompliance of contract is noted.

(2) Check the following for disposal in contained areas:

(a) Dredge runoff should be controlled in accordance with the contract specifications.

(b) Periodically inspect dikes, bulkheads and spillways for necessary maintenance.

(c) Verify on contract-furnished disposal areas that permission to dispose material has been granted thin documentation.

h. Cleanup

(1) Verify removal of all dredging buoys, moorings and range markers.

(2) Survey contained areas for contract compliance to final grading specifications.



CHAPTER 2P  
JETTY, BREAKWATER AND GROINS  
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CHAPTER 2P  
JETTY. BREAKWATER AND GROINS

2P-01. GENERAL

This chapter covers the construction or maintenance repairs of jetties, breakwaters and groins. Any conflicts between this guide and the contract plans and specifications shall be reported to your supervisor.

2P-02. REGULATIONS

a. Corps of Engineers and U.S. Coast Guard

- (1) Check special lights, day signals and passing of floating plant.
- (2) Require strict adherence to plans and specifications.
- (3) Report violations.

2P-03. OPERATIONS

a. Reports - Check with your supervisor as to type, number and frequency of reports.

b. Controls

- (1) Check location of horizontal control points, bench marks, and tide gauges.
- (2) Show physical location of control points to contractor.
- (3) Require contractor to protect control points.
- (4) Check for utilities within area of construction.
  - (a) If shown on plan, require ranges to mark locations.
  - (b) If not shown on plans, notify your supervisor.

c. Materials

- (1) Check that all required samples have been submitted and approvals have been made prior to incorporation of material in the work.
- (2) Check test results.
- (3) Removal all rejected material from site of construction.
- (4) Check the following for stone:
  - (a) Check that scales have been sealed and certified.
  - (b) Check for sworn weighter.
  - (c) Check that sufficient equipment is available to meet approved progress scheduled.

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(d) Check tonnage delivered by weight slips, bills of lading of displacement.

(e) Check stone for size, shape and quality.

(f) Check daily tonnages placed and stockpiled.

(g) Check that stone is placed within limits.

1. Do not permit casting.

2. Check interlocking of stone.

3. Eliminate large voids.

(h) Check tonnage placed versus section completed. Determined underruns and overruns at early stages.

(5) Check the following for steel:

(a) Has steel been inspected or are mill certificates available?

(b) Check driving procedures, see Chapter 2G.

(c) Check that full bearing is obtained.

(d) Check and record cutoffs.

(e) Do not permit burning of holes for attachment of walers.

(6) Check the following for timber and lumber:

(a) Check for compliance with grading rules.

(b) Check driving procedure, see Chapter 2G.

(c) Check that full bearing is obtained.

(d) Check and record original lengths and cutoffs.

(e) Check roofing of piles.

(f) Check preservative treatment of timber, cut surfaces and cap covering.

d. Specifications. Require strict adherence to special and technical provisions indicating specific techniques and procedures advisable for the project.

#### 2P-04. CLEANUP

a. Remove all debris.

b. Check removal of buoys, moorings and ranges.

c. Check grading.