

STATE OF MAINE



State Highway Commission

Standard Specifications

Revision of 1945

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PART I
GENERAL REQUIREMENTS
AND PROVISIONS

SPECIFICATIONS

DEFINITION OF TERMS

SECTION 1

1. **Definitions.** Whenever in these specifications and contract the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

2. **"State."** State of Maine.

3. **"Commission."** State Highway Commission of the State of Maine.

4. **"Engineer."** Chief Engineer of the State Highway Commission, acting directly or through an authorized representative.

5. **"Inspector."** An authorized representative of the Engineer assigned to make necessary inspections of the work and materials.

6. **"Bidder."** Any individual, firm or corporation submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

7. **"Contractor."** Party of the second part of the contract, acting directly or through his agents or employees.

8. **"Proposal."** The written offer of the Bidder, submitted in approved form, to perform the work contemplated.

9. **"Proposal Guaranty."** The security designated in the proposal, to be furnished by the Bidder as a guaranty of good faith to enter into a Contract with the State, if the Contract is awarded to him.

10. **"Surety."** The corporate body, individual, or body of individuals bound with and for the Contractor, who is previously liable, which corporate body, individual, or body of individuals engages to be responsible for his payment of all debts pertaining to, and for his acceptable performance of the work for which he has contracted.

11. **"Plans."** General and detail plans including such working plans as may be furnished or approved by the Engineer from time to time as the work progresses.

12. **"Specifications."** The direction, provision and requirements contained herein, together with all written agreements made or to be made pertaining to the method and manner of performing the work, or to the quantities and qualities of materials to be furnished under the Contract.

13. **"Contract."** The agreement covering the performance of the work and the furnishing of materials for the proposed construction. The Contract shall include the "Proposal," "Plans," "Specifications" and "Contract Bond," also any and all supplemental agreements which reasonably could be required to complete the construction in a substantial and acceptable manner.

14. **"Right of Way."** The whole strip of land reserved for and secured to the use of the traveling public, within the boundary lines of the highway as laid out.

15. **"Lines of Improvement."** Lines through the points farthest from the center line of the road to which the finished grading, ditching, or other work will be extended.

16. **"Laboratory."** The official testing laboratory of the Commission or any other testing laboratory which may be designated by the Engineer, acting through the Engineer.

17. **"Bridges."** Structures of over 10-foot Span measured under the copings along the center line of the road and multiple span structures when the combined clear spans exceed ten (10) feet.

18. **"Culverts."** All water ways not defined as bridges.

19. **"Work."** All work including the furnishing of materials, tools, equipment, etc., to be performed by the Contractor under the terms of the Contract, Plans and Specifications.

20. **"Contract Bond."** The approved form of security furnished by the Contractor and his Surety as a guarantee of good faith on the part of the Contractor to execute the work in accordance with the terms of the Contract.

21. **"Notice to Proceed."** A notice to the Contractor of the date on or before which he is to begin the prosecution of the work.

22. **"Working Day."** Any day not excluded by Section 8, Paragraph 6.

23. **"A.A.S.H.O."** The American Association of State Highway Officials.

24. **"A.S.T.M."** The American Society for Testing Materials.

25. In order to avoid cumbersome and confusing repetition of expressions in these specifications, whenever it is provided that anything is, or is to be done, if, or as, or when, or where "contemplated," "required," "directed," "specified," "authorized," "ordered," "given," "designated," "indicated," "considered necessary," "deemed necessary," "permitted," "suspended," "approved," "acceptable," "unacceptable," "suitable," "unsuitable," "satisfactory," "unsatisfactory," or "suffi-

cient," it shall be taken to mean and intend "contemplated," "required," "directed," "specified," "authorized," "ordered," "given," "designated," "indicated," "considered necessary," "deemed necessary," "permitted," "suspended," "approved," "acceptable," "unacceptable," "suitable," "unsuitable," "satisfactory," "unsatisfactory," or "sufficient" by or to the Engineer.

26. It should be understood thoroughly by all concerned that all things contained herein, the "Notice to Contractors," the "General Requirements and Provisions," the "Construction Details," the "Proposal," the "Notice to Proceed," the "Plans," the "Contract Bond," as well as any papers attached to or bound with any of the above, also any and all supplemental agreements made or to be made are hereby made a part of these Specifications and Contract and are to be considered as one instrument. The intent is to make them explanatory one of the other. No papers attached to or bound with any of the above shall be detached therefrom, as all are a necessary part thereof.

PROPOSAL REQUIREMENTS AND CONDITIONS

SECTION 2

1. Interpretation of Approximate Estimate of Quantities

The Bidders' attention is called to the fact that the estimate of quantities of work to be done and materials to be furnished under these specifications, as shown on the plans and in the proposal form, is approximate and is given only as a basis of calculation for comparing bids and awarding contract. The Commission assumes no responsibility, whatsoever, that the quantities given shall obtain in the construction, and reserves the right to in-

crease or diminish the quantities shown or to omit any of them, as it deems necessary. Final payment will be made for the actual quantities of work done and materials furnished at the unit prices set forth in the contract for each item of work and no allowance will be made for loss or anticipated profits due to an increase or decrease in quantities.

2. Familiarity with Proposed Work

The Bidder should make a careful examination of the site of the proposed work, the proposal, plans, specifications and contract form before submitting a proposal. He should full inform himself as to the quality and quantity of materials required and the character of the work, and he should further investigate the location and make a careful examination of the source of supply for materials. The Commission will assume that he has satisfied himself as to the conditions to be encountered, as to the character, quality and quantities of work to be performed and materials to be furnished, and as to the requirements of these specifications and contract. The Bidder will be held responsible for his failure or neglect to observe or comply with these instructions.

3. Familiarity with Laws, etc.

The Bidder is assumed to have made himself familiar with all Federal and State laws and local by-laws, ordinances and regulations, which in any manner affect those engaged or employed on the work, or the materials or equipment used in the work, or in any way affecting the conduct of the work, and no plea of misunderstanding will be considered on account of ignorance thereof. If the Bidder or Contractor shall discover any provision in the plans, specifications or contract which is contrary to or inconsistent with any such law, by-law, ordinance or regulation, he shall forthwith report it to the Engineer in writing.

4. Contents of Proposal Forms

The Bidder will be furnished by the Commission with proposal forms which will state the location and description of the contemplated construction, and which will show the approximate estimate of the various quantities of work to be performed and materials to be furnished, and the date, time and place of the opening of proposals. It will also state any special provisions or requirements which vary from or are not contained in these specifications. All papers bound with or attached to the proposal forms are necessary parts thereof, and must not be detached.

5. Preparation of Proposal

The Bidder must submit his proposal on the forms furnished by the Commission. The blank spaces in the proposal must be filled in correctly, where indicated, for each and every item for which a quantity is given and the Bidder must state the prices (written in ink, both in words and numerals) for which he proposes to do each item of the work contemplated. He shall also show the products of the respective unit prices and quantities in the column provided for that purpose and the total amount of the proposal obtained by adding the amounts of each item. The Bidder shall sign his proposal correctly. If the proposal is made by an individual, his name and address must be shown. If made by a firm or partnership, the name and address of each member of the firm or partnership must be shown. If made by a corporation the person signing the proposal must sign in the name of the corporation, per his name as an official of said corporation, and the names, titles and business addresses of the President, Secretary and Treasurer must be given. All writings and figures on proposals must be in ink.

6. Irregular Proposals

Proposals that contain omissions, erasures, alterations, or additions not called for, conditional or alternate bids

unless called for, or that contain irregularities of any kind, or proposals otherwise regular which are not accompanied by a certified check, may be rejected as informal. The Commission reserves the right to waive technicalities as to changes or reservations, and make the award for the best interests of the State.

7. Proposal Guaranty

No proposal will be considered unless accompanied by certified check in the sum of one thousand dollars (\$1,000) payable to the Treasurer of the State of Maine.

8. Delivery of Proposals

Each proposal must be submitted in a special envelope furnished by the Commission with the proposal form. The blank spaces on the envelope must be filled in correctly so as to clearly indicate its contents. If forwarded by mail, the above mentioned envelope shall be enclosed in another addressed to the "State Highway Commission, Augusta, Maine," preferably by registered mail; if forwarded otherwise than by mail it shall be delivered at the office of the Engineer. Proposals will be received until 10 o'clock, A.M. of the date set for the opening thereof, unless otherwise specified in the published notice to Contractors.

9. Withdrawal of Proposals

Bidders will be given permission to withdraw a proposal after it has been deposited with the Commission, provided the Bidder makes his request in writing to the Commission or Engineer before the time set for opening the bids.

Any Bidder or his duly authorized agent, who has submitted proposals on more than one project at any one letting may, at his option and upon written request, withdraw any or all of his additional proposals after the official of the State Highway Commission opening and reading the bids has announced that such Bidder has submitted the lowest proposal on the project for which

bids have last been read. When this option is exercised, the proposals for other projects in the letting will be returned to the Bidder unopened. No returned bids will be considered after the Bidder has exercised his privilege to withdraw the same, nor will any bids be considered which have not been deposited with the Commission prior to the time indicated in the advertisement. Any Bidder exercising the privilege of so withdrawing his bid or bids waives all claims that may arise should it be found that his opened proposal is informal or for any other reason is unacceptable to the Commission. The Commission will open and read bids on projects in the order in which they are drawn, and not in the order in which projects are advertised.

10. Opening of Proposals

Proposals will be publicly opened and read at the time and place set in the "Notice to Contractors." Bidders, or their authorized agents, are invited to be present.

11. Disqualification of Bidders

More than one proposal from an individual, a firm or partnership, a corporation or an association under the same or different names will not be considered. Reasonable ground for believing that any Bidder is interested in more than one proposal for the work contemplated, will cause the rejection of all proposals in which such Bidder is interested. Any or all proposals will be rejected if there is reason for believing that collusion exists among the Bidders, and any participant in such collusion will not be considered in future proposals for the same work. Proposals in which the prices obviously are unbalanced may be rejected. No contract will be awarded except to responsible Bidders capable of performing the class of work contemplated. The Bidder shall furnish a complete statement of his experience and of the amount of capital and equipment available for the proposed work, if so requested by the Commission. Only sealed bids will be accepted.

12. Material Samples

Before any contract is awarded, the Bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials to be used in the construction of the work, together with samples, which samples may be subject to the tests provided for in these specifications to determine their quality and fitness for the work.

13. Payments

Payments will ordinarily be made on monthly estimates.

14. Time Limit

The number of working days for completing the contract shall be indicated in the proposal by the Engineer.

AWARD AND EXECUTION OF CONTRACT

SECTION 3

1. Consideration of Bids

The Commission reserves the right to reject any or all proposals, to waive technicalities, and to advertise for new proposals, or proceed to do the work otherwise, as the Commission may deem best for the interests of the State. The bids will be compared on the correct summation of items at prices bid.

2. Award of Contract

The contract will be awarded by the Commission as soon as practicable after the opening of the bids, to the lowest responsible Bidder whose proposal shall comply with all the provisions required to render it formal. The successful Bidder will be notified in writing, by mail or otherwise, that his bid has been accepted and that he has been awarded the contract.

3. Return of Proposal Guaranty

All proposal guaranties except that of the successful Bidder will be returned within three (3) days following the award of the contract. When the award is deferred for a period of time longer than ten (10) days after the opening of the proposals, all guaranties except those of the three (3) lowest bidders will be returned. Should no award be made within thirty (30) days, all proposals will be rejected and all guaranties returned.

4. Requirements of Contract Bond

The successful Bidder, at the time of the execution of the contract, must furnish a bond payable to the Treasurer of the State of Maine, or his successors in office, in the sum of seventy-five (75) per cent of the amount of the contract awarded, in case a surety company bond is provided, or fifty (50) per cent of the amount of the contract awarded if a certified check or other security is provided, as noted below. The form of bond shall be that provided by the Commission and the Surety shall be acceptable to the Commission. This bond shall guarantee due execution and faithful performance and completion of the work to be done under the contract, and the payment in full of all bills and accounts for material and labor used in the work, and for all other things contracted for or used in connection with the contract; the contract shall not be considered in force until such bond has been filed and accepted by the Commission. If a surety company bond is provided it shall be procured from an insurance company licensed to do business in the State of Maine and must be executed or countersigned on the part of such surety company by an agent resident in the State of Maine. If a surety company bond is not provided, a certified check payable to the Treasurer of the State of Maine, or other security acceptable to the Commission, in the sum of fifty (50) per cent of the contract awarded shall be deposited with the Treasurer of the State of Maine.

5. Execution of Contract

The individual, firm or corporation to whom or to which the contract has been awarded shall sign the necessary agreements entering into contract with the Commission, and return them to the office of the Commission, at Augusta, Maine, within ten (10) days after the notice of award of contract. No proposal shall be considered binding upon the Commission until the execution of the contract by the Commission.

6. Failure to Execute Contract

Should the successful Bidder fail to execute the contract agreement and file the contract bond within the time stated, the guaranty accompanying his proposal will be retained, not as a penalty, but as liquidated damages, by the Commission.

7. Triplicate Copies of Contract

The contract shall be executed in triplicate; one copy shall be kept by the Commission, one copy shall be delivered to the State Controller, and one to the Contractor.

SCOPE OF WORK

SECTION 4

1. Intent of Plans and Specifications

It is the intent that the plans and specifications shall prescribe a complete work or improvement. The Contractor shall do all the clearing and grubbing, make all excavations and embankments, do all shaping and surfacing, construct all drainage structures and other appertaining structures, as indicated in the proposal and on the plans, remove all obstructions from within the lines of the improvement, and shall do such additional, extra and incidental work as may be considered necessary to complete the work in a substantial and acceptable manner.

The Contractor shall do all the work and furnish and pay for all materials, machinery, labor, board of workmen, water, tools, equipment, teams, trucks, automobiles, freight, fuel, light and power and for all other things, except as herein otherwise provided and specified, directly or indirectly necessary or proper for the execution of the work required by this contract in the manner and within the time herein specified. The work will not be considered as completed until the borrow pits and all ground occupied by the Contractor in connection with the work shall be cleared of all rubbish, equipment, excess materials and temporary structures. In short, the Contractor shall construct the entire work in strict accordance with the plans, specifications and contract, and, when completed, shall leave it in a neat and finished condition.

2. Special Work

Should any construction or conditions which are not covered by these specifications be anticipated on any proposed work, "Special Provisions" for such work will be prepared, and will be referred to in the proposal form or attached thereto, and shall be considered a part of these specifications and contract as though contained fully therein. Should any special provision or requirement conflict with these specifications, the special provisions shall govern.

3. Increased or Decreased Quantities

The right is reserved for the engineer to make such alterations in the plans or in the character of the work as he may deem necessary or desirable from time to time during the progress of the work, to omit such quantities as he may find unnecessary, to increase or decrease quantities, and to shorten or extend the limits of the contract, in order to complete the project fully and satisfactorily. Such changes shall not increase or diminish the total original contract amount by more than twenty-five per cent. Compensation to the contractor for such changes shall be made as provided in Section 9, Paragraph 3.

4. Extra Work

The Contractor shall perform extra work for which there is no quantity and price included in the contract, whenever, to complete fully the work as contemplated, it is deemed necessary or desirable, and such extra work shall be done in accordance with the specifications, or in a workmanlike manner as directed by the Engineer.

5. Maintenance of Detours

On all contracts, unless otherwise specified, construction work shall be carried on in such a manner as to provide safe passage at all times for the public travel and with the least obstruction to traffic. The convenience of the general public and of residents along and adjacent to the highway shall be provided for in an adequate and satisfactory manner. The Contractor shall provide and maintain, at his own expense, in a safe and passable condition, such temporary by-passes and temporary bridges as may be necessary to accommodate the traffic on the road under construction, and shall provide and maintain in a safe condition, temporary approaches to, and crossings of, intersecting highways.

When, in the opinion of the Commission, a road should be closed to public travel during construction, a clause will be inserted under "Special Provisions" in the proposal stating that a detour will be provided. Whenever a road is so closed, the Contractor must carry on his work in such a manner that local travel and abutters will be inconvenienced as little as possible. When a detour road is so provided, the expense of its maintenance will be paid by the Commission, unless otherwise specified.

6. Roads Damaged to be Repaired

Damage caused to any road or structure by equipment including trucks used in the prosecution of this work shall be repaired by the Contractor at his expense to the satisfaction of the Commission.

7. Removal and Disposal of Structures and Obstructions

Existing structures, such as drainage pipes, bridges and culverts found within the lines of the improvement, which are not to remain in place shall be removed by the Contractor, unless otherwise provided in the Specifications and Contract. When their location is such as not to interfere with the work the removal shall not be done until the new structures replacing them are ready for traffic or until the Engineer shall permit. Any material from the existing structures requiring removal whether deemed fit for use elsewhere or not shall remain the property of the State, and shall be removed without damage, in sections which may be readily transported and piled neatly within the right-of-way as directed by the Engineer, the haul not to exceed two thousand (2000) feet. Unless otherwise shown on the plans, bridge and culvert substructures shall be removed to the level of the original ground surface or the low water line. In case the remaining portions would interfere with the new work, the entire substructure shall be removed. It is to be understood that the Contractor may make use of the existing structures or portions of them during construction, but no material which is considered available for use elsewhere shall be cut, bent, broken or otherwise damaged. Stone masonry or similar material which is not to remain in place, and is suitable for the purpose may be used in the new structure. All discarded material, rubbish or debris shall be removed from the work and disposed of as directed by the Engineer.

8. Rights in the Use of Material Found on the Work

The Contractor, with the approval of the Engineer, may use in the construction of this work any suitable earth, stone, gravel or sand found in the excavation. He will be paid for the removal of such material at the contract unit price for excavation of the classification in which it properly comes. "Whenever such excavated

material is allowed to be used for any other item for which there is a contract unit price, such as gravel surface, gravel base, stone base, crushed stone base, surface courses or concrete, such material may be purchased by the Contractor from the Commission at the contract unit price for borrow, or in case there is no borrow price, it may be purchased at the contract unit price for excavation. The Contractor shall not excavate or remove any material which is not within the excavation as indicated by the plans, slope stakes and grade lines, without being authorized in writing. No excavated material suitable for use, shall be wasted unless as directed by the Engineer.

9. Unauthorized Work

Work done without lines and grades being given, work done beyond the lines and grades shown on the plans or as given, except as herein provided, or any extra work done without written authority, will be considered as unauthorized and at the expense of the Contractor, and will not be measured or paid for. Work so done may be ordered removed and replaced at the Contractor's expense.

10. Final Cleaning Up

Upon completion of the work and before acceptance and final payment shall be made, the Contractor shall clean and remove from the highway, lawns and adjacent property all surplus and discarded materials, rubbish and temporary structures, restore in an acceptable manner all property, both public and private, which has been damaged during the prosecution of the work and shall leave the highway in a neat and presentable condition. The Contractor shall leave no equipment in the right of way without written permission from the Engineer.

CONTROL OF WORK

SECTION 5

1. Authority of Engineer

To prevent misunderstanding and litigation, the Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed, and as to the manner of performance and rate of progress of said work, and shall decide all questions which may arise as to the interpretation of any or all plans relating to the work and of the specifications, and all questions as to the acceptable fulfillment of the contract on the part of the Contractor, and the Engineer shall determine the amount and quantity of the several kinds of work performed and materials furnished which are to be paid for under the contract, and such decision and estimate shall be final and conclusive, and such estimate in case any question shall arise, shall be a condition precedent to the right of the Contractor to receive any money due under the contract. Any doubt as to the meaning of, or any obscurity as to the wording of these specifications and contract will be explained by the Engineer, and all directions and explanations requisite or necessary to complete, explain or make definite any of the provisions of the specifications or contract and to give them due effect, will be given by the Engineer.

2. Plans

The approved plans, profiles and sections in the office of the Commission, will show the location, details and dimensions of the work contemplated, which work shall be performed in strict accordance therewith and in accordance with the specifications. All supplemental plans shall be approved by the Engineer and shall be considered a part of the Plans and Specifications.

3. Conformity with the Plans and Allowable Deviations

The lines, grades and typical cross-sections contained in the plans shall be implicitly followed, except where conditions make it necessary or desirable for the Engineer to modify the same, in which case all deviations or changes shall be authorized by the Engineer in writing.

4. Co-ordination of Specifications, Plans and Special Provisions

Any and all requirements in either the specifications, plans or special provisions shall be binding.

Plans shall govern over specifications, special provisions shall govern over plans.

On all plans, drawings, etc., the figured dimensions shall govern in the case of discrepancy between the scaled dimensions and figures. The Contractor shall take no advantage of any error or omission in the plans or of any discrepancy between the plans and specifications, and the Engineer shall make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the specifications and of the plans as construed by him, and his decision shall be final.

5. Co-operation by Contractor

The Contractor will be supplied by the Commission with two copies of the plans and of the specifications and he shall have available on the work at all times during the prosecution of the work, one copy each of said plans and specifications. The contractor shall give his personal attention to the faithful prosecution of the work and shall keep the same under his personal control. He shall have at all times competent and reliable English-speaking superintendents or foremen on the work, authorized to receive orders and act for him, and shall co-operate with the Commission in every way possible. The Engineer's orders and instructions shall be obeyed by the superintendents or foremen in all cases.

He shall provide all reasonable facilities and furnish the Commission the information, assistance and samples required by the Engineer and inspector for proper inspecting or testing of materials and workmanship. No materials for which samples and tests are required shall be used until the samples have been tested and approved. He shall also co-operate in setting and preserving stakes, bench marks, etc., used in laying out the work.

The Contractor, as far as possible, shall arrange his work and dispose of his materials so as not to interfere with the operations of other contractors engaged upon adjacent work. He shall also join his work to that of others or to existing work in a proper manner, and in accordance with the spirit of the plans and specifications, and shall perform his work in the proper sequence in relation to that of other contractors, and as may be directed by the Engineer.

6. Construction Stakes

The Engineer will establish sufficient points to fix the location, alignment and grades. The Contractor shall furnish free of charge all templates and such temporary structures as may be necessary for marking and maintaining points and lines given by the Engineer for the building of the work and shall give the Engineer such facilities, labor and materials for giving the lines and points as he may require. The Contractor shall be held responsible for the preservation of all stakes and marks. Finished surfaces, in all cases, shall conform with the lines and grades given and as shown on the approved plans. Engineer's grade stakes will be furnished by the State.

7. Authority and Duties of Inspectors

The Engineer may appoint such assistants and representatives as he desires and they shall be granted full access to the work or to mills and factories in which work is being done for use under the contract. They shall

have authority to give directions pertaining to the work or to the safety and convenience of the public, to approve or reject materials, to make measurements of quantities, to keep records of costs, suspend work and otherwise represent the Engineer. The Contractor may, however, appeal from their decision to the Engineer himself, but any work done pending settlement is at the Contractor's own risk. The assistants and representatives shall not be authorized to revoke, alter, enlarge, relax or release any requirements of these specifications, nor to issue instructions contrary to the plans and specifications, nor shall they act as foremen for, or interfere with the management of the work by the Contractor.

All transactions between the Contractor and the representatives of the Engineer which are liable to protest or where payments are involved shall be made in writing. Any advice which the assistants or representatives of the Engineer may give the Contractor shall in no wise be construed as binding the Engineer or the Commission in any way, nor releasing the Contractor from the fulfillment of the terms of the contract.

8. Inspection

The Commission, the Engineer, agents and employees of the Commission may at all times and for any purpose enter upon the work and premises used by the Contractor. The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his contract as prescribed by the plans and specifications. Neither the inspection of the Commission or Engineer or any of its agents or employees, nor any order, measurement or certificate by the Engineer, nor any order by the Commission for the payment of money, nor any payment for, nor acceptance of the whole or any part of the work by the Engineer or Commission, nor any extension of time, nor any possession taken by the Commission or its agents or employees, shall operate as a waiver of any of the provisions of the contract or of any power reserved by

the Commission; nor shall any waiver of a breach of the contract be held to be a waiver of any other or subsequent breach.

The Contractor shall furnish the Engineer or his representatives with every reasonable facility for ascertaining whether or not the work as performed is in accordance with the requirements and intent of the specifications and contract. If requested by the Engineer, the Contractor shall, at any time before the acceptance of the work, remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good the parts removed, shall he paid for as "Extra Work," but should the work so exposed or examined prove unacceptable, the uncovering or removing, and the replacing of the covering or making good of the parts removed, shall be at the Contractor's expense. Any work done or materials used without suitable supervision or inspection by the Engineer or his representatives may be ordered removed and replaced at the Contractor's expense.

9. Engineer's Office

The Contractor shall supply for the Engineer's and Inspector's use a building independent of any building used by himself or his employees. This building shall be plainly but substantially built, with floor, roof, and sides weatherproof. Side walls shall be plain T & G lumber, and the roof shall be covered with roofing felt. The floor space afforded shall be at least 8' x 12' and the height at the eaves above the floor shall be at least 6'-0". Inside there shall be provided a wooden locker, located in one corner, for storage of engineering instruments, tools, etc., and a bracketed wall table 3'-0" wide by 6'-0" long. When required on account of cold weather, this building

shall be fitted with a small stove complete and satisfactory for the burning of either coal or wood as local conditions may require and the necessary fuel shall be furnished by the Contractor. The wall shall be fitted with one door, and screened sliding windows on at least two sides to insure good natural ventilation; each window shall provide approximately 4 square feet of area.

10. Removal of Defective and Unauthorized Work

All defective work shall be made good, and unsuitable materials may be rejected, notwithstanding that such work and materials have been previously inspected by the Engineer and accepted or estimated by him for payment. If the work or any part thereof or any material shall be found defective at any time before the final acceptance of the whole work, the Contractor, at his own expense, shall forthwith make good such defect in a manner satisfactory to the Engineer, and if any material brought upon the ground for use in the work or selected for the same shall be condemned by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove such materials from the vicinity of the work. Upon the failure of the Contractor to remove and properly dispose of rejected materials or work, and to replace the same immediately after being notified, the Engineer may employ labor and remove and replace such material or work and charge the cost of the same to the Contractor, which shall be deducted from any moneys due him or to become due him.

11. Final Inspection

Upon completion and final clearing up of the work, the Engineer shall make a final inspection and if it is found that the Contractor has completed his contract in accordance with the plans and specifications he shall notify the Contractor that the work has been accepted.

CONTROL OF MATERIALS

SECTION 6

1. Source of Supply and Quality

The source of supply of each of the materials shall be approved by the Engineer before delivery is started. Representative preliminary samples of the character and quality herein described shall be submitted by the Contractor when indicated or directed, for examination or test; and written approval of the quality of such samples shall be received by the Contractor prior to obtaining materials from the respective sources of supply. Only materials conforming to the requirements of these specifications shall be used in the work.

All materials proposed to be used may be inspected at any time during the progress of their preparation and use. All materials shall be approved before being incorporated in the work. Representative samples of all materials requiring laboratory tests shall be taken and such materials shall be used only after written approval has been received by the Commission's representative in charge of the work, and only so long as the quality of said materials remains equal to the requirements. If, after trial, it is found that partially developed quarries, banks or other sources of supply, which have been approved upon samples or otherwise, do not furnish a uniform product, or if for any reason, the product from any source, at any time before commencing or during the prosecution of the work, proves unacceptable, the use of such materials shall immediately cease and approved materials from other sources shall be furnished. After approval, any material which has become mixed with or coated by dirt or other foreign substance during its delivery and handling, shall not be used in the work.

2. Samples and Tests

Where, in the opinion of the Engineer, or called for in the specifications, tests of materials are necessary,

such tests shall be made by and at the expense of the Commission. Tests shall be made in accordance with the latest revised methods of the A.A.S.H.O., unless otherwise specified. The Contractor shall provide such facilities as the Engineer may require for collecting and forwarding samples, and shall in all cases furnish the required samples without charge.

3. Storage

Materials shall be so stored as to insure the preservation of their quality and fitness for the work. When considered necessary they shall be placed on wooden platforms, or other hard clean surfaces and not on the ground, and shall be placed under cover when directed. Stored materials shall be located so as to facilitate prompt inspection. Lawns, grass plots, or other private property shall not be used for storage purposes without written permission of the owner or lessee.

4. Defective Materials

Materials not conforming to requirements of the specifications shall be rejected and removed from the work as directed by the Engineer. Should the Contractor fail to remove defective material within the time indicated in writing, the Engineer shall have authority to cause the materials to be removed at the Contractor's expense.

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

SECTION 7

1. Laws to be Observed

The Contractor at all times shall observe and comply with all Federal and State Laws, and local by-laws, ordinances and regulations controlling or limiting in any way the acts of those engaged in the work or affecting the

materials employed in it, or the manner in which the work shall be done; and shall indemnify and save harmless the State and all its officers, agents and employees against any claim or liability arising from or based on the violation of any such laws, by-laws, ordinances or regulations, whether by himself or his employees.

The Contractor shall maintain such insurance as will protect him from claims under Workmen's Compensation acts and from any other claims for damages for personal injury, including death, which may arise from operations under this contract, whether such operation be by himself or by any sub-contractor, or any one directly or indirectly employed by either of them. Certificates of such insurance shall be filed with the State Highway Commission, if they so require, and shall be subject to their approval for adequacy of protection.

2. Permits and Licenses

The Contractor shall procure all permits and licenses, pay all charges and fees and give all notices necessary and incident to the due and lawful prosecution of the work.

3. Patented Devices, Materials and Processes

If the Contractor is required or desires to use any design, device, material or process covered by letters patent or copyright, he shall provide for such use by suitable legal agreements with the patentee or owner, and a copy of this agreement shall be filed with the Commission. The Contractor and the Surety shall indemnify and save harmless the Commission from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trade-mark or copyright, in connection with the work agreed to be performed under the contract, and shall indemnify the Commission for any costs, expenses and damages which it may be obliged to pay by reason of any such infringement at any time during the prosecution of the work or after the completion of the work.

4. Restoration of Surfaces Opened by Permit

Any individual, firm or corporation wishing to make an opening in the highway must secure a permit from the Commission and will be required to deposit security with the Commission in a suitable amount to cover the cost of making the necessary repairs, and the Contractor shall not allow any person or persons to make an opening, unless a duly authorized permit of the Commission is presented. Until the acceptance of the work performed under these specifications and contract, the Contractor shall make all necessary repairs, within the time indicated in writing by the Engineer and in an acceptable manner, at any point or points in the roadway where any opening or openings have been made by authority of the Commission. Such repair work will be paid for by the commission as "Extra Work" as provided for in these specifications and said work shall be subject to the same conditions as the original work performed. Should the Contractor refuse or neglect to make the said repairs at such point or points within the time specified, then the Commission shall have authority to cause such repairs to be made, in which case the Contractor shall not be relieved in any way from his responsibility for the work performed by him.

5. Federal Participation

When the United States Government is to pay all or a portion of the cost of the work covered by the Contract, the work shall be under the supervision of the State but subject to the inspection and approval of the proper officer of the United States government and in accordance with the applicable Federal Statutes, and rules and regulations made pursuant thereto. Such inspection and approval shall in no sense make the Federal Government a party to the Contract, and will in no way interfere with the rights of either party hereunder.

6. Sanitary Provisions

The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the State and local Boards of Health or of other bodies having jurisdiction therewith. Public nuisances will not be permitted.

7. Public Convenience and Safety

The Contractor at all times shall conduct the work in such a manner as to insure the least obstruction to traffic practicable. The convenience of the general public and of the residents along and adjacent to the highway shall be provided for in an adequate and satisfactory manner. Materials stored upon the highway shall be placed so as to cause no more obstructions to the traveling public than is considered necessary. The Contractor shall provide and maintain at his expense in passable condition such temporary by-passes as may be necessary to accommodate the traffic on the roadway under construction and shall provide and maintain in a safe condition temporary approaches to all crossings of intersecting highways, unless otherwise provided in the specifications.

Fire hydrants on or adjacent to the highway shall be kept accessible to the fire apparatus at all times. Footways, gutters, sewers, inlets and portions of highways adjoining the work under construction shall not be obstructed more than is absolutely necessary.

8. Barricades and Warning Signs

The Contractor shall provide, erect and maintain all barricades, suitable and sufficient red lights, danger signals and signs, provide a sufficient number of watchmen and take all necessary precautions for the protection of the work and safety of the public.

Highways closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs.

The Contractor shall provide and maintain acceptable warning and detour signs at all closures, intersections and along the detour routes, directing the traffic around the closed portion or portions of the highway so that the temporary detour route or routes shall be indicated clearly throughout its or their entire length. All barricades and obstructions shall be illuminated at night and all lights shall be kept burning from sunset to sunrise. The Contractor will be held responsible for all damage to the work due to the failure of signs and barricades to protect properly the work from traffic, pedestrians, animals and from all other sources.

9. Use of Explosives

When the use of explosives is necessary for the prosecution of the work, the Contractor shall observe the utmost care not to endanger life and property, and whenever directed, the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly "DANGEROUS—EXPLOSIVES," and shall be in care of competent watchmen at all times. The method of storage and handling explosives and highly inflammable materials shall conform with all the State laws and regulations.

10. Protection and Restoration of Property

The Contractor shall use every precaution to prevent injury or damage to trees, shrubbery, crops, fences along and adjacent to the right of way, all underground structures, such as pipes, conduits, etc., within or without the right of way; shall protect and carefully preserve all property marks until an authorized agent has witnessed or otherwise referenced their location. He shall be responsible for injury or damage to property of any character resulting from neglect, misconduct, or omission in his manner or method of execution or non-execution of said work, or for defective work or materials, and said

responsibility shall not be released until the road shall have been completed and accepted. Whenever any such damage or injury is done to public or private property the Contractor shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done by repairing, rebuilding, or otherwise restoring, as may be directed, or he shall make good such damage or injury in an acceptable manner. If he fails to do so the Engineer may, after forty-eight (48) hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the Contractor under the Contract.

11. Responsibility for Damage Claims.

The Contractor shall assume the defense of, and indemnify and save harmless the State and the Commission and their officers and agents from all claims, suits or actions of any character, name and description on account of injuries to any person, persons, property, firm or corporation, received or sustained by or from the Contractor and his employees in doing the work, or in consequence of any improper materials, implements or labor, used therein; and for any act, omission or neglect of the Contractor and his employees therein.

The Contractor shall promptly pay all bills for labor, materials, machinery, board of workmen, water, tools, equipment, teams, trucks, automobiles, freight, fuel, light and power and for all other things, contracted for or used by him on account of the work herein contemplated, and if at any time during the progress of the work or before final payment of any money due the Contractor under the terms of this contract, any claim for labor, materials, board of workmen, water, tools, equipment, teams, trucks, automobiles, freight, fuel, light and power, or for any other things specified as aforesaid, or for damages by reason of any acts, omissions or neglect of said

Contractor in the prosecution of the work, shall be presented to said Commission, the Commission may retain such sum or sums from the moneys due the Contractor under this contract as would be necessary to discharge all such claims whether for labor or materials or for damages as aforesaid, and until the validity of such claims shall be established and finally determined, and if determined and finally established as valid, all such claims shall be paid from the amount so retained if it be sufficient for that purpose; otherwise, or if at any time the Commission shall be satisfied that any of such claims are invalid and groundless, any amount so retained shall be paid to said Contractor, or in case of default of contract to the contractor's surety, and neither the said Commission nor any member thereof shall be liable to any individual, firm or corporation making such claim for failure or refusal to hold and retain any money due under this contract for the purpose of payment of such claim. If the moneys so retained under this contract are insufficient to pay all such claims presented to said Commission and adjudged by any court of competent jurisdiction to be valid obligations of said Contractor, the Commission may at its discretion pay the same and the Contractor shall repay the Commission all sums so paid. The Commission, at its option, may also on the written consent of the Contractor use any moneys due or to become due under this contract for the purpose of paying any claims presented to said Commission for labor and materials used in the work.

12. Opening of Section of Highway to Traffic

Whenever, in the opinion of the Engineer, any portion of the work is in acceptable condition for travel, it shall be opened to traffic as may be directed by the Engineer and such opening shall not be held to be in any way an acceptance of the work, or any part of it, or as a waiver of any of the provisions of these specifications and contract. Necessary repairs or renewals made on any

section of the work due to its being opened to travel under instructions of the Engineer, to defective materials or work, natural causes, to ordinary wear and tear or otherwise, preceding completion and acceptance of the work, shall be performed at the expense of the Contractor. The Contractor shall maintain the completed sections of the road, until final acceptance of the whole work, in a manner approved by the Engineer. The Contractor shall not permit hauling or other traffic over any portion of the work until authorized by the Engineer.

13. Contractor's Responsibility for Work

Until final acceptance of the work by the Engineer, it shall be under the charge and care of the Contractor, and he shall take every necessary precaution against injury or damage to the work by the action of the elements, or from any other cause whatsoever, whether arising from the execution or from the non-execution of the work, and especially when blasting is to be done, seasonable notice thereof shall be given to the operating official of the company or companies owning poles and wires in danger of being injured by the blasting, and shall take proper precaution to prevent such injury by the use of sufficient dunnage. The Contractor shall bear all losses resulting to him on account of the amount or character of the work, or because the nature of the land in or on which the work is done is different from what was estimated or expected, or on account of the weather, elements, or other causes. The Contractor shall rebuild, repair, restore and make good, at his own expense, all injuries or damages to any portion of the work occasioned by any of the above causes before the completion and acceptance of the contract. Issuance of any estimate on any part of the work done shall not be considered as final acceptance of any work completed up to that time.

14. Personal Liability of Public Officials

No member of the State Highway Commission or any of their agents or employees assumes any obligation

or liability for any of the work done under this contract or for the manner in which the same is done or for any negligence or omission on the part of the Contractor or for any liabilities whatsoever arising under this contract.

15. No Waiver of Legal Rights

No estimates, payments or acceptance of work shall be taken as a waiver, upon the part of the Commission of its right, at any time, of showing the true and correct amount and character of the work performed and materials furnished by the Contractor, and of demanding and recovering from the Contractor such damages as may be sustained by reason of his failure to have complied with the plans, specifications and contract.

16. Preferred Employees

Other conditions being equal, the Contractor in the construction of the work shall give preference in employment of citizens of the town in which the work is located. After meeting this requirement, the Contractor shall give preference to the employment of citizens of the State of Maine. To enforce these preferences the Contractor must submit to the Engineer the names and positions of all people from outside the State whom he proposes to employ. The Engineer reserves the right to reject any such persons, if in his opinion, the position can be suitably filled by a person residing in the State of Maine.

17. An Act Relating to Minimum Wages for Laborers

In the employment of laborers in the construction of public works, including state highways, by the State, or by persons contracting therewith for such construction, preference shall first be given to citizens of the State who are qualified to perform the work to which the employment relates, and, if they cannot be obtained in sufficient numbers, then to citizens of the United States; and every contract for such work shall contain a provision to this effect. The wages for a day's work paid to laborers em-

played in the construction of public works, including state highways, as aforesaid shall be not less than the prevailing rate paid by the state for similar work done by the Highway Commission. Any Contractor who knowingly and wilfully violates this section shall be punished by a fine of not more than \$100. Each day that any Contractor employs a laborer at less than the wage minimum herein stipulated shall constitute a separate violation of this section.—Approved March 30, 1933. Chapter 238, Public Laws 1933.

18. Rental of Publicly Owned Equipment

On all projects which are paid for in whole or in part from Federal Highway funds the Contractor shall not use any equipment for which a rental is paid, either directly or indirectly, to the State or any County or Municipality.

PROSECUTION AND PROGRESS

SECTION 8

1. Subletting or Assignment of Contract

The Contractor shall not assign by power of attorney or otherwise or sublet the work or any item for which there is a bid price except as herein stated. With the previous written consent of the Commission, the Contractor may sublet the Guard Rail, Fencing, Right of Way Monuments, and Project Markers, or in cases of extreme emergency other items. The Contractor shall not either legally or equitably assign any of the moneys, payable under the contract or his claim thereto, unless by and with the consent of the Commission. Should the Commission give written permission to the Contractor to sublet any part, or parts of the work, it shall not relieve the Contractor of any of his liabilities and obliga-

tions under this contract. All transactions with the Commission or the Engineer must be through the Contractor or Party of the Second Part to this contract.

2. Prosecution of Work

The Contractor shall begin work on such date, as the Engineer shall notify him to proceed. Commencement of work by the Contractor shall be deemed and taken as a waiver of this notice. The Contractor shall begin work at such points as the Engineer may direct, and shall thereafter prosecute the work at such points and in such order as the Engineer may from time to time prescribe. If at any time during the progress of the work satisfactory progress shall not have been made, the Contractor upon request of the Engineer shall increase the force, machinery and equipment as directed by the Engineer, but the failure of the Engineer to make such demand shall not relieve the Contractor of his obligation to complete the work within the time specified in this Contract. Should the prosecution of the work for any reason be discontinued by the Contractor, with the consent of the Engineer, he shall notify the Engineer at least twenty-four (24) hours before again resuming operations.

3. Limitations of Operations

The Contractor shall limit his operations so that he will not have, in the opinion of the Engineer, an unnecessarily large section of the roadway under construction at any one time and unduly inconvenience the traveling public.

4. Character of Workmen and Equipment

The Contractor shall employ such superintendents, foremen and workmen as are careful and competent and the Engineer may demand the dismissal of any person or persons employed by the Contractor in, about or upon the work, who shall misconduct himself, or be incompetent or negligent in the due and proper performance of his or their duties or any of them, or neglects or refuses

to comply with the directions given, and such person or persons shall not be employed again thereon without the written consent of the Engineer. Should the Contractor continue to employ or again employ such person or persons, the Engineer may withhold all estimates which are or may become due, or the Engineer may suspend the work until such orders are complied with.

The Contractor shall furnish such equipment as is considered necessary for the prosecution of the work in an acceptable manner and at a satisfactory rate of progress. Equipment used on any portion of the work shall be such that no injury to the roadway, adjacent property or other highways will result from its use.

5. Temporary Suspension of Work

The Engineer shall have the authority to suspend the work wholly or in part, for such period or periods as he may deem necessary, due to unsuitable weather or such other conditions as are considered unfavorable for the suitable prosecution of the work, or for such time as is necessarily due to the failure on the part of the Contractor to carry out orders given, or perform any or all provisions of the contract. If it should become necessary to stop work for an indefinite period, the Contractor shall store all materials in such manner that they will not obstruct or impede the traveling public unnecessarily nor become damaged in any way, and he shall take every precaution to prevent damage or deterioration of the work performed, provide suitable drainage of the roadway by opening ditches, shoulder drains, etc., and erect temporary structures where necessary. The Contractor shall not suspend the work without written authority, and shall not remove any equipment, tools, lumber or other materials without written permission of the Engineer.

6. Determination and Extension of Contract Time for Completion

The Contractor shall perform fully, entirely and in an acceptable manner the work contracted for within the time stated in the contract. The number of working days specified in the Proposal and Contract for the completion of the work shall be adjusted for the days on which the weather or the condition of the ground make it impossible for the Contractor to use at least fifty per cent (50%) of the usual man hours during regular working hours, and the days on which the work has been delayed or suspended by any act or omission of the Commission or Engineer and not by any fault of the Contractor; such days shall be allowed the Contractor and excluded from the computation to determine the actual number of working days taken to complete the work. Sundays shall be allowed the Contractor and excluded from the computation of the number of working days. Patriots Day, Memorial Day, Independence Day, Labor Day and Armistice Day shall be allowed the Contractor if no work, except of an emergency nature, is performed on these days and shall be excluded from the number of working days. The period from November 15th to April 15th, inclusive, shall be allowed the Contractor and shall be excluded from the number of working days. If in order to comply with Federal or State laws, rules or regulations, the Contractor works less than six days a week only those days on which work is performed will be counted as working days. No allowance shall be made for delay or suspension of the prosecution of the work due to the fault of the Contractor. The contract time shall begin on the date set in the Engineers "Notice to proceed."

If the satisfactory execution and completion of the Contract shall require work or materials in greater amounts or quantities than those set forth in the Contract, then the Contract time shall be increased in the same proportion as the additional work bears to the original work contracted for.

7. Failure to Complete Work on Time

Time is an essential element in this Contract. As the prosecution of the work will incommode the public, obstruct traffic, and interfere with business, it is important that the work be pressed vigorously to completion; also the cost to the State of the administration of the Contract, including inspection, engineering and supervision, will be increased as the time occupied in the work is lengthened.

It is agreed by the Contractor that there shall be deducted from the moneys due the Contractor, not as a penalty, but as liquidated damages, the sum stipulated in the contract for each working day that the work shall remain uncompleted after the time specified in the Proposal and Contract and allowed by the Engineer for the completion of the work. Should the amount otherwise due the Contractor be less than the amount of such ascertained and liquidated damages, the Contractor and his Surety shall be liable to the State for such deficiency.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, shall in no way operate as a waiver on the part of the State of Maine of any of its rights under this Contract.

8. Annulment of Contract

If at any time the work shall be abandoned, sublet or assigned by the Contractor, or if at any time the Engineer shall be of the opinion and shall so certify to the Commission in writing that the work is not progressing at a rate to insure its completion within the time specified in this contract, or that the work or any part thereof is being unnecessarily delayed by the Contractor, or that the Contractor is violating any of the provisions of this contract by him to be performed and fulfilled, the Commission may notify the Contractor in writing by depositing such notice in the mail directed to said Contractor's last known business address, or by delivery in hand, setting forth in what respect the conditions of this contract are

not being fulfilled as certified to by the Engineer, and should the Contractor fail to satisfy the Commission within three days from the mailing or delivery of such notice, that such failure or neglect to comply with the terms and conditions of this contract would no longer continue and that the work will thereafter be conducted at a rate to insure its completion within the time specified herein, the Commission may notify the Contractor to discontinue at once all such work or any part thereof. Thereupon the Contractor shall forthwith discontinue the work, or such part thereof as the Commission may designate, and the Commission may thereupon by contract or otherwise, as it may determine, complete the work or such part thereof as it ordered discontinued and shall charge the expense thereof to the Contractor and may take possession of and use such materials, animals, machinery, implements and tools of every description as may be found upon the work, allowing therefor a fair rental value. The expenses so incurred shall be deducted and paid by the Commission out of any moneys then due or to become due the Contractor under this Contract or any part thereof, and in case such expense is less than the sum which would have been payable under this contract if the same had been completed by the Contractor, then the Contractor shall be entitled to receive the difference, and in case such expense shall exceed the sum which would have been payable under this Contract, the Contractor and the Surety shall be liable and shall pay the amount of such excess to the Treasurer of State of Maine.

9. Termination of Contractor's Responsibility

Whenever the work provided for by the contract shall have been completely performed on the part of the Contractor and all parts of the work have been approved and accepted by the Engineer, and the final estimate paid, the Contractor shall then be released from further obligations except as set forth in his bond.

MEASUREMENTS AND PAYMENTS

SECTION 9

1. Measurement of Quantities

The measurement of the quantity of the work performed will be computed by the Engineer based on measurements taken by the Engineer or his assistants, and these measurements shall be final and binding. All work completed under the Contract shall be measured by the Engineer according to the United States Standard Measurements and Weights.

2. Scope of Payments

The Commission shall pay and the Contractor shall receive and accept the compensation as herein provided, in full payment for furnishing all materials, labor, tools and equipment and for performing all work contemplated and embraced under the contract, also for all loss or damage arising out of the nature of the work, or from the action of the elements, or from any unforeseen difficulties or obstructions which may arise or be encountered during the prosecution of the work until its final acceptance by the Engineer, and for all risks of every description connected with the prosecution of the work, also for all expenses incurred by, or in consequence of the suspension or discontinuance of the said prosecution of the work as herein specified, and for any infringement of patent, trade-mark or copyright, and for completing the work in an acceptable manner according to the plans and specifications.

The payment of any current or final estimate, or of any retained percentage shall in no way constitute an acknowledgment of the acceptance of the work or in no way or in no degree prejudice or affect the obligation of the Contractor, at his own cost and expense, to repair, correct, renew or replace any defects and imperfections in the construction of, or in the strength of, or quality of materials used in or about the construction of the work

under contract and its appurtenances, as well as all damage due or attributable to such defects; which defects, imperfections or damages shall have been discovered on or before the final inspection and acceptance of the work. The Engineer shall be the sole judge of such defects, imperfections, or damages and the Contractor shall be liable to the Commission for failure to correct the same as provided herein. Before final payment the Contractor must satisfy the Engineer as to liquidation of all bills.

3. Payment for Increased or Decreased Quantities

Should it be necessary to alter the plans and should such alterations result in an increase or decrease in the quantity of work to be performed, the Contractor shall accept payment at the contract unit prices for actual work done, in the same manner, as if such work had been included in the original estimated quantities. No allowance will be made for anticipated profits.

4. Extra and Force Account Work

In connection with the work covered by this contract, the Engineer may, at any time during the progress of the work, order, in writing, other work or material incidental thereto, other than provided herein. All such work and materials which do not appear on the proposal or contract as an explicit item accompanied by a unit price, and which are not included under the prices bid for other items in the contract, shall be designated as "Extra Work." Extra work may be paid for at a unit price or lump sum to be agreed upon previously in writing by the parties to this contract, or on a "Force Account" basis.

All extra work done on a "Force Account" basis will be paid for in the following manner:

(a) For all labor, teams and trucks engaged in the specific operations, the Contractor shall receive the current local rate of wage for each and every hour that said labor, teams and trucks are actually engaged in such work, to which shall be added an amount equal to twenty

(20) per cent of the sum of the teams and trucks and twenty-five (25) per cent of the sum of the labor, which percentages shall include all insurance, surety bond, taxes and other expense.

Foremen may be included in the cost of such extra work, if, in the opinion of the Engineer, such supervision is necessary, but no other charge for superintendence, organization, or overhead expenses will be allowed.

(b) For all materials used, the Contractor shall receive the actual cost of such materials, including freight and delivery charges, as shown by original receipted bills.

(c) Whenever it is necessary to use any of the Contractor's equipment, except teams, trucks or small tools, the Engineer shall allow the Contractor a reasonable rental price to be agreed upon in writing before such work is begun, for each and every hour that said equipment is in use on such work, and to which no percentage shall be added.

No rental will be paid on small tools such as picks, shovels, etc.

(d) The compensation as herein provided shall be received by the Contractor in full for extra work done on a force account basis. He shall present daily to the Engineer the actual cost of labor, rentals and materials for that day and once each month file with the Commission an itemized signed statement, made in duplicate, showing the actual cost of each separate piece of extra work.

Extra work paid for on the unit price, lump sum, or force account basis, shall be done in accordance with the requirements of these specifications, as directed by the Engineer, and only when ordered by him in writing. The determination of the Engineer shall be final upon all questions of the amount and value of extra work.

5. Supplemental Agreement

The Engineer may, with the approval of the Commission, enter into a supplemental agreement with the Con-

tractor to do certain work, not included in the original proposal, at unit prices or a lump sum specified in the supplemental agreement. Such an agreement when executed shall immediately become a part of the original contract and shall be subject to all general or special provisions governing it.

6. Omitted Items

The Engineer may order omitted from the work any items found unnecessary to the improvement; such omission shall not be a waiver of any condition of the contract nor invalidate any of the provisions thereof.

7. Partial Payments

The Engineer shall, once in each month, make an estimate, in writing, of the total amount of the work done at the time of such estimate and the value thereof. The Commission shall retain twelve and one-half (12½) per cent of such estimated value as part security for the fulfillment of this contract by the Contractor, and shall monthly pay to the Contractor, while carrying on the work, the balance not retained, as aforesaid, after deducting therefrom all previous payments and all sums to be kept or retained under the provisions of this contract. No such estimate of payment shall be required to be made when in the judgment of the Engineer the work is not proceeding in accordance with the provisions of this contract, or when in his judgment the total value of the work done since the last estimate amounts to less than \$300.

The Commission may, if it deems it expedient to do so, cause estimates to be made more frequently than once in each month, and it may cause payments to be made more frequently to the Contractor. The Commission may, at its option, retain temporarily or permanently a smaller amount than as aforesaid, and may cause the Contractor to be paid temporarily or permanently from time to time, such portion of the reserve as it deems equitable. In addition to the above, an estimate may,

at the discretion of the Commission, be made for payment of the value of acceptable reinforcing steel, structural steel, stone, gravel, sand, or any other non-perishable materials delivered on the work or in acceptable storage places and not used at the time of such estimate. Such materials, when so paid for by the Commission, shall become the property of the Commission and in the event of default on the part of the Contractor, the Commission may use or cause to be used such materials in the construction of the work provided for in the contract. The amount thus paid by the Commission shall go to reduce estimates due the Contractor as the material is used in the work.

8. Acceptance and Final Payment

The Engineer shall as soon as practicable, after the completion of this contract, make a final estimate of the amount of work done thereunder and the value of such work, and the Commission shall at the expiration of thirty (30) days from and after such final estimate is so made and is approved by the Commission, pay the entire sum so found to be due hereunder, after deducting therefrom all previous payments and all amounts to be kept and all amounts to be retained under the provisions of this contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment. The acceptance by the Contractor of the last payment made as aforesaid shall operate as and shall be a release to the State of Maine, the Commission, Engineer or other employees or agents thereof from all claims and liability under such contract for anything done or furnished or relating to the work or for any act or neglect of said State of Maine, said Commission, Engineer or any of its agents or employees relating to or affecting the work, excepting the claim against the State of Maine for the remainder, if any there be, of the amounts retained under the provisions of this contract.

The retent of twelve and one-half ($12\frac{1}{2}$) per cent retained by the Commission from each monthly estimate or the remainder of such retent, provided any part thereof shall have been previously paid, may be held by the Commission for a period of thirty (30) days after the approval of the final estimate or until such time as the Contractor submits satisfactory evidence that all bills for labor and materials used under this contract have been paid; should the Contractor neglect to pay any undisputed claim made in writing to the Commission within thirty (30) days after the completion of the work but continuing unsatisfied for a period of ninety (90) days the Commission may pay such claim and deduct the amount thereof from the balance due the Contractor.

PART II
CONSTRUCTION DETAILS
EARTH WORK

EARTH WORK

SECTION 10

1. Description

Earthwork shall consist of all clearing and grubbing, roadway and drainage excavation, excavation for structures, stone fill, embankment, disposal of surplus material, borrow, completion of subgrade, shoulders, and subsidiary work, all of which shall be done and paid for in accordance with these specifications and plans.

No overhaul will be allowed except as specified under section 75 for gravel borrow, gravel sub-base, gravel base and gravel surface.

CLEARING AND GRUBBING

SECTION 11

1. Description

The ground shall be cleared of all trees, stumps, brush, weeds, roots, sod, and other objectionable material within the limits of the lines of improvements, as directed by the Engineer. Timber and wood, which it may be necessary to cut, shall be piled neatly on the abutting property, unless otherwise directed. Any timber which may be designated as marketable shall be cut in suitable lengths. All branches of trees extending within the lines of improvement shall be trimmed as directed and branches which hang within sixteen (16) feet of the roadway surface in all cases shall be removed, all of which shall be done carefully.

All excavations made below the subgrade surface by removal of trees, stumps, etc., shall be filled with suitable material, which shall be compacted thoroughly so as to make the surface at these points conform to the surrounding subgrade.

In embankments of two (2) feet or less in depth, measured below subgrade of the road and shoulders, all stumps, roots and other objectionable material shall be grubbed and removed.

In embankments of over two (2) feet in depth measured below subgrade of the road and shoulders, and in fills outside the shoulders, stumps, roots, etc., may be left in place provided they are cut close to the ground.

The Contractor shall burn or otherwise dispose of all stumps, brush, weeds, etc., and all sod taken from the excavation, in a satisfactory manner and shall remove all rubbish and refuse to such point or points beyond the limits of the roadway, as may be directed. All slopes of cuts, embankments, ditches and waterways, and all culverts, whether old or new, shall be cleaned and cleared of all obstructions in a satisfactory manner, and shall be left in a neat and trimmed condition.

Should it be desired to clear more of the surface of the right-of-way than is included within the lines of improvement, all stumps outside the lines of improvement shall be cut off close to the ground.

The cost of all clearing and grubbing required herein shall be borne by the Contractor unless an item is given therefor in the proposal except as provided for the removal of single trees under "Excavation."

2. Measurement and Payment

(a) Clearing and grubbing when called for in the proposal will be paid for at the contract unit price per acre for "Clearing and Grubbing," which price shall include all materials, equipment, tools, labor and work incidental thereto, provided as follows:

(b) Whenever the Engineer shall direct the Contractor to clear lines of sight or to do work of a similar character outside the lines of improvement, or outside the right of way, it shall be paid for as extra work when no pay item is included in the proposal for clearing and grubbing, and

at the contract unit price for "Clearing and Grubbing" when such pay item is included in the proposal.

(c) If any item for "Clearing and Grubbing" appears in the proposal form the areas to be paid for under the item will be shown on the plans within station limits, and payment under this item shall include the removal of trees of all sizes within the above specified limits.

(d) Payment will not be made under the item of "Clearing and Grubbing" when no item for "Clearing and Grubbing" is included in the proposal nor for such work done in areas outside the above mentioned station limits, except for clearing lines of sight or doing work of a similar character outside the lines of improvement.

(e) Payment for "Clearing and Grubbing" when such item does not appear in the proposal, and for such work done outside the station limits specified under the item of "Clearing and Grubbing," shall be included in the contract unit price for "Excavation" or "Borrow," except as hereinafter provided for the removal of single trees.

Item 11--Clearing and Grubbing

ROADWAY AND DRAINAGE EXCAVATION

SECTION 12

1. Description

Roadway and drainage excavation shall mean the grading of the roadway, by cutting and filling, and shall include the removal and satisfactory disposal of all materials taken from within the limits of the highway necessary for the construction and preparation of the roadbed, embankment, subgrade, shoulders, slopes, side ditches, intersections, approaches and private entrances, to the lines and grades shown on the plans, or as indicated and directed by the Engineer.

Classification of Excavation

All material excavated shall be classified as "Rock Excavation," "Earth Excavation," "Unclassified Excavation" or "Muck Excavation," unless otherwise specified in the special provisions.

(a) **Rock excavation** shall mean hard ledge rock or boulders of more than one-half ($\frac{1}{2}$) cubic yard volume.

(b) **Earth excavation** shall include boulders of one-half ($\frac{1}{2}$) cubic yard or less volume, and all soft and disintegrated rock which can be removed with ordinary excavating machinery, and all other materials which do not come under the classification of "Rock Excavation" or "Muck Excavation."

(c) **Unclassified excavation** shall mean both rock excavation and earth excavation as above designated.

(d) **Muck excavation** shall mean all excavation, within station limits designated on the plans, as "Muck Excavation."

2. Construction Methods

All materials of suitable quality removed from the excavation shall be used in the formation of the embankment, subgrade, shoulders, and at other places as directed by the Engineer.

No excavated material shall be wasted without permission and when necessary to waste such material it shall be disposed of as directed by the Engineer.

All overbreakage and slides shall be removed by the Contractor and disposed of as directed. All soft clay and spongy material which will not consolidate under the roller shall be removed to such depth as the Engineer shall direct and the space thus made shall be filled with suitable material as ordered by the Engineer.

All connections with driveways and branch roads shall be made to conform to the lines and grades given by the Engineer.

If during excavation, material is excavated of such character as appears to conform to the provisions of the classification of rock excavation, the Contractor shall call the Engineer's attention to the same, and shall provide ample opportunity for him to investigate and make such measurements as are necessary to ascertain the volume of the material in question.

Rock excavation shall be made four (4) inches below the lines indicating the subgrade surface extended through the shoulders as shown on the typical cross-sections and plans and shall be backfilled with suitable material as directed by the Engineer.

All rock excavated shall be used in formation of embankment unless otherwise directed by the Engineer. All rock used in embankment shall be broken to sizes suitable for that purpose and shall be placed as directed by the Engineer and at any point on the work, but the Contractor will not be required to break rock to fit a fill when the depth of the rock fill is less than three (3) feet.

No rock excavation shall be wasted unless as directed by the Engineer.

The Contractor shall remove all obstructions, such as walls, fences and buildings within the limits of the work, and all manholes, catch basins, water gates, and similar structures, which are below grade or project above grade, shall be raised or lowered to fit the finished grade of the road.

The side ditches or gutters shall be built according to the lines, grades and cross-sections shown on the plans or given by the Engineer and shall have suitable side outlets to carry the water quickly away from the highway.

During the construction, the roadbed shall be maintained in such condition that it will be well drained at all times.

3. Method of Measurement

All excavation will be measured in its original position by measurements taken before and after removal by the

cross-section method. Cross-sections shall include all overbreakage or slides, which have been removed, and which are not due to carelessness on the part of the Contractor, and all masonry walls and stone fences.

The volume of excavation shall be computed by the average end area method. Measurements to determine the volume of rock excavation will be made after the rock has been uncovered and again after removal.

Allowance for rock excavation will be made only to the lines and grades shown on the plans and typical sections except as otherwise specified.

Measurement allowance for rock excavation in special ditches shall be four (4) inches in depth below the finished surface of the ditch.

No allowance will be made for any material excavated from beyond or below the lines and grades shown on the plans or called for by the specifications, except in the case of soft, spongy material directed by the Engineer to be removed, or slides or overbreakage which in the opinion of the Engineer were unavoidable, in which case, all of such material outside of the slope lines, and which the Contractor actually removes, shall be paid for as excavation of the classification involved, provided, however, the cuts shall be widened when ordered by the Engineer, in which case material removed will be paid for as excavation.

Clearing and grubbing, the removal of timber and metal fences, buildings and other obstructions will not be measured, but payment will be included in the price of excavation unless otherwise specified.

Allowance will be made for the removal of such trees as have the shortest diameter, as measured three (3) feet above the ground of nine (9) inches or more, including the removal of stumps and roots thereof; but this allowance shall not apply to the removal of trees in areas for which an item for clearing and grubbing is specified.

4. Basis of Payment

(a) Payment for the foregoing work will be made as follows: All roadway excavation, including excavation of all intersecting roadways, driveways, approaches and ditches appertaining to the construction of the roadway, except as otherwise specified, shall be paid for at the contract unit price per cubic yard for "Earth Excavation," "Rock Excavation," "Unclassified Excavation," or "Muck Excavation," which price shall include, unless otherwise specified, all clearing and grubbing, the removal, unless otherwise specified, of all structures and obstructions and all excavation within the lines of improvement, formation of embankments, disposal of surplus materials, preparation of subgrade and shoulders; and the furnishing of all equipment, tools, labor and all work incidental thereto.

(b) Excavation for structures shall be paid for at the contract unit price for "Excavation for Structures."

(c) Filling of the space caused by the excavation of soft, spongy material will be paid for as excavation, borrow or base according to the classification of work involved.

(d) The removal of such trees as have the shortest diameter, as measured three (3) feet above the ground, of nine (9) inches or more, including the removal of stumps and roots thereof, shall be paid for at the contract unit price each.

Item 12-A--Earth Excavation

Item 12-B--Rock Excavation

Item 12-C--Unclassified Excavation

Item 12-D--Muck Excavation

Item 12-E--Trees Removed (9 inches and over)

EXCAVATION FOR STRUCTURES

SECTION 13

1. Description

Excavation for structures shall include all excavation on account of stone or concrete masonry, pipe culverts, catch basins, drop inlets and all other structures, and for inlet and outlet ditches to culverts, and for berm ditches at the top of slopes, except as otherwise provided; this work shall include the removal of old superstructures, substructures, the disposal of all material obtained from such excavation, and all backfilling except as otherwise provided. It shall also include all necessary bailing, pumping, sheeting, bracing, and the construction of cribs and cofferdams if found necessary.

2. Construction Methods

All fences and structures of any character not necessary or suitable for the work, or other obstructions upon or within the limits of the work shall be carefully removed by the Contractor, and the materials so removed shall be piled on the right-of-way adjacent to the abutting property, neatly and in an acceptable manner, or otherwise disposed of as required by the Engineer, within a haul of two thousand (2000) feet.

Any stone in the old structure which is to be removed, and which is suitable for use in the new structure, may be used by the Contractor in the new structure unless otherwise specified.

The excavation lines and elevations shown on the plans shall be considered as approximate only, and the Engineer may order such changes in the dimensions or elevations as may be necessary to secure a satisfactory foundation.

Foundation pits shall be excavated to permit the placing of full widths and lengths of footings shown on the plans, or ordered by the Engineer. Rounded or undercut corners and edges of footings will not be permitted.

If rock bottom is secured, the excavation shall be done in such a manner as to allow the rock to be exposed and prepared in horizontal beds or otherwise shaped as directed by the Engineer. All rock or hardpan foundation surfaces shall be freed from loose or disintegrated pieces, thin strata shall be removed, and the surfaces cut to firm bearing and cleaned to the satisfaction of the Engineer. All seams shall be cleaned out and filled with concrete, mortar or grout as directed by the Engineer.

When concrete or masonry is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and final removal of the material to grade shall not be made until just before the concrete or masonry is to be placed.

When the excavation is at the required depth, water if present shall be pumped out, if possible, for cleaning the foundation bed for inspection.

In case the foundation material is soft or otherwise unsatisfactory, the Engineer may require the Contractor to excavate to a greater depth and to backfill with approved material which shall be thoroughly tamped.

All pits and trenches in which piles are to be driven shall be completed before driving is commenced, and following its completion, all loose soil and chips, bark or other foreign material shall be removed from the excavation before any concrete or other substructure material is placed therein.

All foundations, where practicable, shall be constructed by open excavation, and when necessary the foundation openings shall be properly shored, braced, or protected by cofferdams.

Whenever possible all foundation excavation shall be pumped dry and the concrete or masonry placed in the open; when this is not possible a seal of concrete of sufficient thickness to resist uplift shall be deposited under water as directed by the Engineer; the foundation shall then be pumped out and the balance of the masonry

placed in the dry. Pumping to unwater a seal of concrete as above described shall not commence in less than seven (7) days after the concrete has been placed or such additional length of time as the Engineer may direct.

Piling shall be used when footings cannot, at reasonable expense, in the opinion of the Engineer, be carried to rock or other satisfactory foundation.

In excavation and preparation of the bed for pipe culverts a trench shall be excavated to the depth and grade shown on the plans or established by the Engineer. The bottom of the trench shall be shaped to conform to the bottom of the pipe and to afford a firm and uniform bearing throughout the entire length of the pipe culvert. Recesses shall be excavated to receive the hubs. Care shall be taken that no stones or points of rock are within six (6) inches of the pipe. The trench for the pipe shall not be wider than necessary to properly place the pipe, make the joints, and allow sufficient tamping of the backfilling.

If, in the opinion of the Engineer, the material in the bottom of the excavation for pipe culverts is of such a character as to cause unequal settlement along the length of the pipe, or is too soft to support the pipe, the trench shall be excavated below the given grade to such a depth as ordered by the Engineer and backfilled with gravel or other suitable material and thoroughly tamped. When the trench is in solid rock or other hard material, it shall be excavated to a depth of four (4) inches below the grade established for the bottom of the pipe, and this additional excavation shall be backfilled with suitable material and thoroughly tamped.

All timber, sheeting and other similar material used in excavation for structures shall be removed unless otherwise ordered by the Engineer.

After each excavation is completed the Contractor shall notify the Engineer, and no concrete, masonry or pipe shall be placed until after the Engineer has approved the depth of foundation and character of materials.

After structures have been completed in place the excavated areas shall be backfilled; the filling shall consist of acceptable material free from wood or other organic material or large stones, and shall be placed in horizontal layers not over nine (9) inches thick, and each layer shall be thoroughly compacted by tamping. Fill placed around culverts shall be deposited on both sides to approximately the same level at the same time and thoroughly compacted by tamping or flushing with water as directed by the Engineer, care being taken to prevent any wedging action against the structure.

No filling shall be placed against new concrete until such a time as the Engineer shall approve.

All drainage openings in masonry work shall be covered with at least one foot of large broken stone or clean, coarse gravel while the filling is being placed.

As much of the material excavated for structures as is needed and which is suitable for backfilling shall be used for that purpose; if such material is not suitable the Contractor shall furnish acceptable material. All excavated material not used for backfilling shall be disposed of as directed by the Engineer, the haul not to exceed two thousand (2000) feet. When suitable this material shall, in general, be placed on the approach fills, but material that is unsuitable, or not required for the purpose, shall be disposed of in such a manner as not to impair the appearance or utility of either the roadway or the waterway; in no case shall it be placed in the bed of the stream.

The Contractor shall leave the structure and all adjacent areas affected by his operations in a neat and presentable condition and clean up and remove from the site all temporary structures, horses, falsework, lumber, rubbish and all surplus material, and leave the space under the structure unobstructed and in such shape that drift will not collect or scour be induced.

All inlet and outlet ditches shall be constructed according to lines and grades given by the Engineer.

3. Method of Measurement

The yardage to be paid for shall include all old concrete, stone masonry, sand, gravel, earth, logs, boulders and solid ledge rock, and shall be the yardage, measured in original position, of all such material actually removed as hereinbefore described, except as follows:

No yardage will be included for payment under "Excavation for Structures" of material which is required to be excavated or placed under another item.

No yardage will be included of excavation for masonry or concrete structures outside of a volume bounded by vertical planes eighteen (18) inches outside the neat footings and parallel thereto; nor of excavation for pipe culverts outside of a volume bounded by vertical planes, eighteen (18) inches wider than the outside diameter of the pipe; provided, that when ordered by the Engineer material is excavated beyond the above limits, the material so removed shall be measured for payment. The yardage to be paid for under the item of "Excavation for Structures" shall not include the openings of culverts, bridges or other structures.

No allowance shall be made for solid ledge rock excavated more than six (6) inches below the the bottom of culverts or other structures.

No allowance shall be made for backfilling except as otherwise provided, the removal of existing timber or steel superstructures, timber bents or posts, nor for the construction and removal of temporary bridges, cofferdams and cribs, pumping, bailing, shoring, falsework, or any material or equipment necessary on account of water.

For inlet and outlet and berm ditches the measurements will be to the depths and lines established by the Engineer.

4. Basis of Payment

(a) Payment for all work under this item and measured as provided above shall be made at the contract unit price per cubic yard for "Excavation for Structures"

which price shall be full compensation for furnishing all material, for all labor, equipment, tools and incidentals, necessary to complete the work including backfilling, except as follows:

(b) "Rock Excavation" removed in excavation for structures shall be paid for at twice the contract unit price per cubic yard for "Rock Excavation" (the removal of large stones in old masonry work will be classified and paid for as "Excavation for Structures" and not as "Rock Excavation").

(c) Material for backfilling which is required and furnished in addition to material excavated for structures and used for backfilling, shall be paid for as "Earth Excavation" or "Borrow."

(d) The furnishing and placing of material to take the place of unsuitable material in the preparation of foundations shall be paid for at twice the contract unit price for "Gravel Base." If no item of "Gravel Base" appears in the Proposal, it shall be paid for at twice the contract unit price for "Gravel Borrow."

Item 13--Excavation for Structures

EMBANKMENTS

SECTION 14

1. Construction Methods

Embankments shall be formed of suitable material acceptable to the Engineer. Large stone shall not be allowed nearer than six (6) inches below subgrade elevation. Unless considered impracticable by the Engineer, embankments shall be constructed in successive horizontal layers not exceeding twelve (12) inches in thickness. Each layer shall extend across the entire fill and shall be thoroughly rolled with a three wheel power roller weigh-

ing not less than ten (10) tons, or an approved pneumatic tired roller. Whenever the bottom of the fill is of insufficient width to permit the use of a roller or in places where it is impossible to use a roller, the successive horizontal layers shall be of uniform thickness and shall be thoroughly compacted by distributing the hauling over the entire area or by tamping.

Where guard rail is called for on the plans or ordered by the Engineer, excavated ledge or boulders shall not be used in the shoulders within four (4) feet of the shoulder grade.

Stumps, trees, rubbish, sod, or any other unsuitable materials or substance shall not be placed in the embankment except that sods may be used on the outside of fill slopes if permitted by the Engineer.

When embankments are to be made on a hillside the slope of the original ground on which the embankment is to be placed shall be ploughed or cut into steps before the filling is commenced.

All embankments shall be thoroughly settled before any pavement is laid and no pavement shall be laid on embankments until permission is given by the Engineer.

Embankments shall be made of sufficient height and width that after full shrinkage and sloughing of slopes the elevation and width shall conform to the cross-sections shown on the plans.

The Contractor shall be responsible for the stability of all embankments made by him, and shall replace at his own expense any portions which, in the opinion of the Engineer, have become displaced, due to carelessness or negligent work on the part of the Contractor, or to damage resulting from natural causes, such as storms, cloud-bursts, etc.

All traffic over the work during construction shall be distributed so as to cover the entire surface.

2. Compensation

No payment will be made under "Embankment." Payment for earth excavation, rock excavation, unclassified excavation or borrow excavation shall cover all work of filling or embankment, except as hereinafter provided for "Stone Fill" or "Riprap."

DISPOSAL OF SURPLUS MATERIAL

SECTION 15

1. Disposal of Surplus Material

All surplus excavation shall be used to widen embankments, flatten slopes, and for other purposes if directed, or this material and all materials not permitted in embankments, shoulders, etc., shall be removed from within the limits of the improvement and deposited at such point or points as directed within a haul of two thousand (2000) feet, or if no such point or points are designated, the Contractor shall find suitable dumping places which will not cause unsightly conditions. In no case shall such material be deposited above the grade of the adjacent roadway unless directed by the Engineer.

2. Compensation

Disposal of surplus material will not be paid for directly but will be considered as part of the work included in prices bid for "Excavation" and "Borrow."

STONE FILL

SECTION 16

1. Description

Wherever stone fill is called for on the plans or ordered by the Engineer during the progress of the work, the

Contractor shall furnish all the materials and place the same according to the lines, grades and directions given by the Engineer. The stones may vary from coarse gravel to two-man stone. The larger stones shall be placed at the bottom and all voids chinked with the smaller. The top shall be well filled with coarse gravel or small stone. Stone fill shall be rolled as directed by the Engineer.

2. Basis of Payment.

Stone fill shall be paid for at the contract unit price per cubic yard for "Stone Fill," measured in place in the road by the cross-section method, which price shall include all materials, equipment, tools and labor and all work incidental thereto. If in the opinion of the Engineer the above method of measurement is impracticable due to very soft ground or dumping in deep water, the Stone Fill may be measured in trucks or wagons.

Item 16--Stone Fill

BORROW

SECTION 17

1. Description

The term "Borrow" shall mean material necessarily obtained outside the limits of the right-of-way and shall not include material obtained by grading the necessary slopes, side roads, ditches and driveways. The widening of cuts within the right-of-way shall not be considered as borrow.

(a) **Common Borrow** shall consist of any material of a quality satisfactory to the Engineer not particularly specified as "Gravel Borrow."

(b) **Gravel Borrow.** When gravel is specified for any purpose for which no other pay item is provided, and is

obtained outside the right of way, such gravel shall be classified as "Gravel Borrow."

Gravel Borrow used for base courses shall conform to the specification for "Gravel Base."

All borrow shall be of a satisfactory quality for the purpose for which it is required.

2. Construction Methods

When the material available within the right-of-way, suitable for embankment, is not sufficient in quantity to properly form the embankment, subgrade and shoulders of the road, including the side slopes of the embankment, such necessary additional material shall be obtained, furnished and placed by the Contractor from approved borrow pits, unless otherwise ordered by the Engineer. All surfaces and slopes of borrow pits shall be neatly trimmed and left in such shape as to admit of accurate measurement after the excavation is completed. When practicable they shall be so excavated that no water will collect or stand therein. In order to eliminate unsightly conditions the Contractor shall not obtain borrow from a pit until the location of the same has been approved by the Engineer.

No material shall be taken from borrow pits until such pits have been cross-sectioned by the Engineer.

3. Method of Measurement

Measurements to determine the amount of borrow shall be made in position in the pit by cross-sections made before and after removal and the volume shall be computed by the average end area method. Quantities will not be determined by measurement of the embankment except in cases where it is entirely impracticable to measure the same in the pit.

4. Basis of Payment

(a) Common borrow shall be paid for at the contract unit price per cubic yard for "Common Borrow" which price shall include the furnishing and placing of all mate-

rial, all clearing and grubbing and all equipment, tools, labor and work incidental thereto.

(b) Gravel borrow shall be paid for at the contract unit price per cubic yard for "Gravel Borrow" which price shall include the furnishing and placing of all material, all clearing and grubbing, and all equipment, tools, labor and work incidental thereto except overhaul which shall be paid for under the item of "Gravel Overhaul" at the unit price stipulated in this contract.

Item 17-A--Common Borrow

Item 17-B--Gravel Borrow

SUBGRADE

SECTION 18

1. Description

The bottom of the excavation or the top of the fill, on which base courses or the pavement is to be laid shall be known as the subgrade.

2. Construction Methods

After the earth work has been substantially completed and all drains have been laid, the subgrade shall be properly shaped, rolled and compacted so that it conforms to the lines, grades and cross-sections shown on the plans before any base course or surfacing material is applied. The rolling shall be done with a three wheel roller weighing not less than ten (10) tons or an approved pneumatic tired roller. All depressions which develop during the rolling shall be filled with suitable material and the subgrade shall again be rolled until no depressions develop. All loose rock or boulders found in the earth excavation shall be removed or broken off to a depth of not less than six (6) inches below the surface of the subgrade. The subgrade shall be put in its final condition

for receiving base or surfacing material for a distance of at least two hundred (200) feet in advance of placing of the base course or surfacing material.

When the subgrade is of such material that it will not pack and bond under the roller, the Engineer may order clay, sand or other suitable material to be furnished, placed, sprinkled, rolled and harrowed.

3. Protection of Subgrade

In handling materials, tools and equipment, the Contractor shall protect the subgrade by laying planks thereon when directed, and shall take such other precautions as may be deemed necessary. If ruts are formed the subgrade shall be reshaped and rolled. No storage or stock piling of construction materials will be allowed on the subgrade. At all times the subgrade shall be kept in such condition that it will drain readily. No foundation nor surfacing material shall be deposited on the subgrade, until the subgrade has been checked by the Engineer for proper elevation and cross-section.

4. Compensation

(a) The work prescribed under this item shall not be paid for directly but shall be considered as subsidiary work pertaining to the several items of excavation, borrow, base courses or surface courses.

(b) Clay, sand or other suitable material used for the subgrade as above described shall be paid for at twice the contract unit price for "Earth Excavation" measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor and work incidental thereto.

(c) Sprinkling shall be paid for at the contract unit price for "Sprinkling."

SHOULDERS

SECTION 19

1. Description

Shoulders shall be built on each side of the surfaced portion of the road, conforming to the typical cross-sections shown on the plans or as ordered by the Engineer.

2. Materials

The material for shoulders, unless otherwise particularly called for on the plans or ordered by the Engineer, shall be composed of excavated material or borrow, free from weeds, sod or other unsuitable substances. When material in cuts is suitable it shall be shaped so as to form the shoulders.

When called for on the plans or ordered by the Engineer shoulders shall be constructed of gravel; the gravel shall conform to material specified for "Gravel Base" and "Gravel Surface," according to the class of work involved.

3. Construction Methods

Shoulders shall be built during the preparation of the subgrade, and before any base course or surface course is placed shall be carried to a height not less than the uncompacted edge thickness of such base or surface course, except in the construction of concrete pavements the shoulders need not be constructed to full height until after the pavement has been completed. They shall be thoroughly compacted before gravel is placed on them.

In the construction of gravel shoulders no stones over two and one-half ($2\frac{1}{2}$) inches in diameter shall be placed within six (6) inches of the finished surface of the shoulders.

When the shoulder material cannot be compacted without additional binder, clay or other suitable material shall be furnished, placed, harrowed, sprinkled and rolled until the shoulders are thoroughly compacted.

Shoulders shall be rolled as directed by the Engineer.

At all times construction shall be so carried on that the subgrade, shoulders and adjacent ditches will be effectively and completely drained.

4. Compensation

(a) The work prescribed under this section shall not be paid for directly as shoulders but shall be included in the work to be paid for at the contract unit prices for the several items of "Excavation," "Borrow," "Gravel Base Course" and "Gravel Surface Course."

(b) Clay or other suitable material used for additional binder for shoulders shall be paid for at twice the contract unit price for "Earth Excavation" measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor and work incidental thereto.

GRAVEL SUB-BASE

SECTION 20

1. Description

Whenever called for by the plans and specifications, or during the progress of the work it is considered necessary and is ordered by the Engineer, a gravel sub-base shall be built to conform with the plans, profiles and cross-sections.

2. Material

The gravel shall be furnished by the Contractor and shall be of a quality satisfactory to the Engineer. It shall consist of clean fine gravel or clean coarse sand.

3. Construction Methods

The gravel shall be spread on the prepared subgrade to such a depth, loose, that when compacted the thickness shall be as shown on the plans or as ordered by the Engineer.

When a compacted depth exceeding four (4) inches is required, the sub-base shall be spread and rolled in courses of not more than four (4) inches unless otherwise permitted or ordered by the Engineer.

4. Basis of Payment

(a) Gravel sub-base shall be paid for at the contract unit price per cubic yard for "Gravel Sub-base" measured in place on the basis of compacted measurement, which price shall include the furnishing of all material, labor, equipment, tools, and all work incidental thereto except overhaul which shall be paid for under the item of "Gravel Overhaul" at the unit price stipulated in this contract.

(b) Excavation for gravel sub-base shall be paid for as "Excavation" and excavated material shall be used in filling or embankment as ordered by the Engineer.

Item 20--Gravel Sub-base

PART III

CONSTRUCTION DETAILS

BASE COURSES

BASE COURSES

SECTION 21

1. Description

Base courses shall consist of foundations prepared for surface courses or pavement. They shall be constructed in accordance with the typical cross-sections shown on the plans or as ordered by the Engineer, and upon the subgrade prepared in accordance with these specifications.

RECONSTRUCTED BASE COURSE

SECTION 22

1. Description

This base course shall consist of the reshaping of the existing stone or gravel surface and the addition of the required amount of new stone or gravel, all of which shall be compacted to form a foundation for the surface course or pavement, conforming to the grades and cross-sections shown on the plans or given.

This base course shall be constructed, where indicated on the plans or directed, in accordance with these specifications.

2. Materials

The materials to be used shall consist of crushed rock or gravel conforming to the requirements of "Crushed Stone Base Course," "Gravel Base Course," or "Gravel Surface Course." Tailings will not be allowed.

3. Construction Methods

The existing road surface shall be brought to the established grade and be made to conform to the cross-section indicated on the plans. The old surface shall be scarified to a sufficient depth to eliminate all depressions and irregularities and to permit of uniform reshaping.

After loosening, the material shall be shaped to conform to the required cross-section, rolled if required, and crushed stone or gravel as required of the sizes specified, sufficient to bring this surface to the grade indicated on the plans, shall be added and compacted by rolling. Stone screenings or fine gravel shall be added until the voids are filled and the course is well bonded and firmly set.

4. Method of Measurement

New gravel if paid for under the items of "Gravel Base Course" or "Gravel Surface Course" shall be measured in vehicles at the time of delivery on the road; if paid for under the item of "Gravel Borrow" it shall be measured in the pit if practical to do so, otherwise it shall be measured in vehicles at the time of delivery on the road.

New crushed stone shall be measured in vehicles at the time of delivery on the road.

Additional binding material if ordered by the Engineer shall be measured in vehicles at the time of delivery on the road.

5. Basis of Payment

(a) The work of scarifying and shaping shall be paid for at the contract unit price per square yard for "Reconstructed Base Course" which price shall include all equipment, tools, labor and all work incidental thereto except furnishing new gravel or crushed stone.

(b) Furnishing and placing new gravel shall be paid for under the items of "Gravel Base Course," "Gravel Surface Course" or "Gravel Borrow."

(c) Furnishing and placing new crushed stone shall be paid for under the item of "Crushed Stone Base Course."

(d) Additional binding material ordered by the Engineer shall be paid for under the item of "Gravel Base Course," "Gravel Surface Course" or "Gravel Borrow" in accordance with the item with which used, which price

shall include all materials, equipment, tools, labor, and all work incidental thereto.

Item 22-A--Reconstructed Gravel Base Course

Item 22-B--Reconstructed Crushed Stone Base Course

SAND BASE COURSE

SECTION 23

1. Description

Sand Base Course shall consist of a foundation course of sand and binder, constructed on the sub-grade in accordance with these specifications. Sand base course shall be built to conform with the plans, profiles and cross-sections, wherever called for on the plans, or during the progress of the work is considered necessary and is ordered by the Engineer.

2. Materials

The sand shall be furnished by the Contractor from sources approved by the Engineer. When required, sand pits shall be stripped to the satisfaction of the Engineer.

The sand shall be uniformly graded. It shall all pass a one and one-half ($1\frac{1}{2}$) inch sieve, at least 85% shall pass a one-half ($\frac{1}{2}$) inch sieve and not more than 30% shall pass a 50-mesh sieve.

If the binding material in an acceptable sand is not sufficient to insure satisfactory bonding, the Contractor shall furnish sufficient additional binder of a quality approved by the Engineer, and by satisfactory manipulation incorporate in the base course material.

3. Construction Methods

Whenever the compacted depth of sand base course exceeds six (6) inches, the sand shall be spread and rolled in courses of not more than six (6) inches unless otherwise

ordered by the Engineer. The sand of each course shall be spread uniformly upon the prepared sub-grade or the preceding course. Each course shall be rolled with a ten ton three wheel roller or an approved pneumatic tired roller, and all rolling shall begin at the sides and progress towards the center. If necessary the course shall be sprinkled with water and sufficient binding material shall be harrowed and rolled into each course to permit carrying on construction operations and to provide for handling traffic. The base course shall conform in every respect to the typical cross-sections and be true to the lines and grades given by the Engineer. No irregularities or depressions shall be allowed to remain in any part of the completed course.

Whenever the sand base course is to be used beneath a gravel base course and the depth of the sand base course does not exceed six (6) inches compacted, the sand shall be spread to a sufficient depth to give the required compacted thickness of base course but the course need not be compacted unless required by the Engineer.

Whenever sand base course is constructed, side outlets shall be built at least six (6) feet wide, having a depth and length and on such a grade as will drain into the side ditch or through the shoulder. Such outlets shall be built through the shoulders at point specified by the Engineer and especially at low points on vertical curves and on the inside of superelevated curves. Outlets shall be constructed of screened gravel from one (1) to three (3) inches in diameter, or crushed stone of similar sizes.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Sand Base Course" measured in place, after completion in accordance with typical sections and plans, which price shall include all material (except additional binding material), equipment, tools, labor, and work incidental thereto, except:

(b) Gravel, or crushed stone, used in side outlets shall be paid for at the contract unit price per cubic yard for "Base Outlets," Item 24-B.

(c) Excavation for sand base course shall be paid for at the contract unit price for "Excavation" and excavation for side outlets shall be paid for at the contract unit price for "Excavation for Structures."

(d) No allowance shall be made for extra sand when the subgrade does not conform to the lines and grades given by the Engineer or when the material is driven into the subgrade by rolling.

(e) Additional binding material ordered by the Engineer shall be paid for at twice the contract unit price per cubic yard for "Earth Excavation" measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor and all work incidental thereto.

(f) Overhaul shall be paid for under the item of "Gravel Overhaul" at the unit price stipulated in this contract.

(g) Sprinkling shall be paid for at the contract unit price for "Sprinkling."

Item 23--Sand Base Course

GRAVEL BASE COURSE

SECTION 24

1. Description

Gravel Base Course shall consist of a foundation course of gravel and binder, constructed on the subgrade in accordance with these specifications. Gravel base course shall be built to conform with the plans, profiles and cross-sections, wherever called for on the plans, or during the progress of the work is considered necessary and is ordered by the Engineer.

2. Materials

The gravel shall be furnished by the Contractor from sources approved by the Engineer and shall be composed of hard, sound durable fragments of rock, together with fine material, such as sand, clay, or other material approved as binder by the Engineer. When required gravel pits shall be stripped to the satisfaction of the Engineer.

The gravel shall be uniformly graded and shall be of such sizes that no individual stone shall exceed in its greatest dimension one-third ($\frac{1}{3}$) of the compacted thickness of the base, and shall contain not more than fifty (50) per cent of material passing a one-quarter ($\frac{1}{4}$) inch opening.

If the binding material in an acceptable gravel is not sufficient to insure satisfactory bonding, the Contractor shall furnish sufficient additional binder of a quality approved by the Engineer, and by satisfactory manipulation incorporate it in the base course material.

3. Construction Methods

Whenever the compacted depth of gravel base course exceeds eight (8) inches, the gravel shall be spread and rolled in courses of not more than eight (8) inches unless otherwise ordered by the Engineer.

The gravel of each course shall be spread uniformly upon the prepared subgrade or the preceding course, care being taken that no segregation of large or fine material occurs. Each course shall be rolled with a ten (10) ton three-wheel roller or an approved pneumatic tired roller, and all rolling shall begin at the sides and progress towards the center.

The bonding of each course shall be produced by sprinkling with water when required, the addition of binding material if necessary, and harrowing and rolling until a smooth, hard surface has been obtained, conforming in every respect to the typical cross-sections, and true to the lines and grades given by the Engineer. No irregu-

larities or depressions shall be allowed to remain in any part of the completed course.

Whenever gravel base course is constructed, side outlets shall be built at least six (6) feet wide, having a depth and length and on such a grade as will drain into the side ditch or through the shoulder. Such outlets shall be built through the shoulders at points specified by the Engineer and especially at low points on vertical curves and on the inside of superelevated curves. Outlets shall be constructed of screened gravel from one (1) to three (3) inches in diameter, or crushed stone of similar sizes.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Gravel Base Course" measured in place, after completion in accordance with typical sections and plans, which price shall include all material (except additional binding material), equipment, tools, labor, and work incidental thereto, except:

(b) Gravel or crushed stone used in side outlets shall be paid for at the contract unit price per cubic yard for "Base Outlets."

(c) Excavations for gravel base course shall be paid for at the contract unit price for "Excavation" and excavation for side outlets shall be paid for at the contract unit price for "Excavation for Structures."

(d) No allowance shall be made for extra gravel when the subgrade does not conform to the lines and grades given by the Engineer or when the material is driven into the subgrade by rolling.

(e) Additional binding material ordered by the Engineer shall be paid for at twice the contract unit price per cubic yard for "Earth Excavation" measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor, and all work incidental thereto.

(f) Overhaul shall be paid for under the item of "Gravel Overhaul" at the unit price stipulated in this contract.

(g) Sprinkling shall be paid for at the contract unit price for "Sprinkling."

(h) When through no fault of the Contractor, a surface treated gravel base lays over the winter and requires scarifying or the addition of new material, the work shall be paid for under the item of "Reconstructed Base Course."

Item 24-A--Gravel Base Course

Item 24-B--Base Outlets

STONE BASE COURSE

SECTION 25

1. Description

Stone Base Course shall consist of a foundation course of stone constructed on the subgrade or other completed base course in accordance with these specifications. Stone base course shall be built to conform with the plans, profiles and cross-sections, wherever called for on the plans or ordered by the Engineer.

2. Materials

Materials for this course shall consist of hard, sound, field or quarry stone napped or broken to proper sizes, and gravel.

(a) **Large Stone.** Stones shall not exceed eight (8) inches in their greatest dimension. Round cobble stones or screened gravel may be used provided at least fifty (50) per cent of the stones are over six (6) inches in diameter.

(b) **Gravel.** The gravel used for filling voids in the larger stone shall vary in sizes from coarse sand to two and one-half ($2\frac{1}{2}$) inches and shall be practically free from loam or clay.

3. Construction Methods

Wherever a stone base course is called for by the plans and specifications, or during the progress of the work is considered necessary and is ordered by the Engineer, the Contractor shall furnish all materials and place the same on the subgrade or other completed base course in such manner as will produce a surface conforming to the typical sections.

The stone shall be placed roughly by hand, the larger chinked with the smaller, and the whole thoroughly rolled with a three wheel roller weighing not less than ten (10) tons. The remaining voids in the stone shall be filled with gravel by alternately spreading and rolling, while dry, until the base is filled flush with the top. The base shall then be rolled until the stones are firmly bedded and compacted.

Care must be taken to protect the stone from being displaced by travel and whenever displaced, the stone shall be replaced, filled with gravel, and the surface rolled and brought to proper cross-section, before any surfacing material is applied.

The completed surface of the base shall conform to the typical cross-sections and to grades given by the Engineer.

Wherever stone base course is used, side outlets shall be built at least six (6) feet wide, having a depth and length and on such a grade as will drain into the side ditch or through the shoulder. Such outlets shall be built through the shoulders at points specified by the Engineer and especially at low points on vertical curves and on the inside of superelevated curves. These outlets shall be constructed of screened gravel from one (1) to three (3) inches in diameter or crushed stone of similar sizes.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Stone Base Course," measured in place after completion, in accordance with typical sec-

tions and plans, which price shall include all materials, tools, labor and all work incidental thereto, except:

(b) Gravel or crushed stone used in side outlets for stone base course shall be paid for at the contract unit price per cubic yard for "Base Outlets," Item 24-B.

(c) Excavation for stone base course shall be paid for at the contract unit price for "Excavation." Excavation for side outlets shall be paid for at the contract unit price for "Excavation for Structures."

Item 25--Stone Base Course

CRUSHED STONE BASE COURSE

SECTION 26

1. Description

Crushed Stone Base Course shall consist of a foundation course composed of crushed rock and shall be constructed upon the prepared subgrade or other completed base course in accordance with these specifications and in conformity with the lines, grades and typical cross-sections shown on the plans.

2. Materials

The stone used in this work shall consist of angular fragments of rock, newly broken, of uniform quality throughout and free from thin or elongated pieces, soft or disintegrated stone, dirt or other matter occurring either free or as a coating on the stone and shall be obtained from rock which when subjected to the Los Angeles abrasion test for stone described in the latest revised methods of the A.A.S.H.O. Designation T-96 shall show a per cent of wear of not over forty-five.

The following designations and sizes shall obtain and the crushed stone, when tested by laboratory methods, shall conform to the following requirements:

NAME	SIZES (Inches)	Per Cent Passing Sieves with Square Openings				
		3"	2"	$\frac{3}{4}$ "	$\frac{1}{2}$ "	No. 4
No. 1 Stone	2-3	95-100	0-15			
No. 2 Stone	$\frac{3}{4}$ -2		95-100	0-15		
Keystone	$\frac{1}{2}$ - $\frac{3}{4}$			95-100	0-15	
Chips	No. 4- $\frac{1}{2}$				95-100	0-15
Dnst						95-100

3. Construction Methods

Whenever the compacted depth of crushed stone base course, as shown on the plans, exceeds four and one-half ($4\frac{1}{2}$) inches, it shall be spread in two courses as directed by the Engineer. Tailings and No. 1 stone well mixed, may be used in the first course. The second course shall consist of No. 1 stone.

Whenever the compacted thickness of crushed stone base course, as shown on the plans, does not exceed four and one-half ($4\frac{1}{2}$) inches it shall be spread in one course; this course shall consist of No. 1 stone and tailings. The tailings shall be kept in the bottom of the course and shall be spread as evenly as possible over the subgrade or other completed base course; provided that when the compacted thickness of the base course does not exceed three and one-half ($3\frac{1}{2}$) inches, no tailings shall be used.

Each course shall be thoroughly rolled with a three wheel ten (10) ton roller unless a roller of different type and weight is ordered by the Engineer, and the surface of each course shall be parallel to and uniformly below the finished road surface.

The upper course of two course base, and one course base when only one course is required, shall, after compaction, be filled within one-half ($\frac{1}{2}$) inch of its surface, by alternately spreading, sweeping with brooms, and rolling, while dry, with stone dust. Coarse, clean sand may be used when approved by the Engineer. Care shall be taken not to form mats or bunches of sand or dust.

Tailings of a dimension greater than the compacted thickness of the course in which they are used shall be broken.

If there is a surplus of No. 2 stone, it may be used in the bottom course, when approved by the Engineer, if uniformly mixed with other specified sizes of stone.

If any of the stone becomes rutted or loosened by travel before the application of the next succeeding course, the Contractor, at his own expense, shall bring the surface to its proper cross-section with such material and in such manner as the Engineer shall direct.

The surface of the completed base shall be swept clean and firmly bound together before any surfacing material or pavement is applied. The completed crushed stone base course shall be of the required thickness and cross-section and its surface uniformly below the finished surface of the road by an amount equal to the compacted thickness of the surface course or pavement.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Crushed Stone Base Course," measured in place after completion, in accordance with the typical sections and plans, which price shall include all materials, equipment, tools, labor and all work incidental thereto, except:

(b) Excavation on account of Crushed Stone Base Course shall be paid for at the contract unit price per cubic yard for "Excavation."

Item 26--Crushed Stone Base Course

BITUMINOUS CONCRETE BASE COURSE

SECTION 27

1. Description

This item shall consist of a base or leveling course composed of a bituminous concrete mixture constructed

on the prepared base in accordance with these specifications and in conformity with the lines, grades and typical cross-sections shown on the plans or ordered by the Engineer.

The Bituminous Concrete Base Course shall be composed of a mixture of "Coarse Aggregate," "Fine Aggregate" and "Bituminous Material."

Composition of Mixture

The ingredients contained in the bituminous concrete mixture shall, when tested by means of square laboratory sieves, meet the following requirements:

Passing $1\frac{1}{4}$ " sieve	100%
Passing $\frac{3}{4}$ " sieve	50 - 85%
Passing No. 4 sieve	20 - 40%
Passing No. 10 sieve	16 - 30%
Passing No. 40 sieve	10 - 22%

Asphalt Cement

Bitumen (per cent of mineral aggregate) 4-6%

Job Mix

The composition limits given above are master ranges of tolerance to govern mixtures made from any raw materials or combinations thereof, proffered for use under these specifications and they are the maximum and minimum for all cases. A closer control within these ranges is intended for any specific project. No work shall be started on any specific project nor any mixture accepted therefor, until the Engineer has approved the job mix submitted by the Contractor in writing, indicating the percentage of each ingredient to be used in the mixture, and a resultant screen test and bitumen percentage from such combination. No change in this job mix shall be made without the approval of the Engineer.

Tolerances

Samples of the mixture will be taken as many times daily as necessary in the opinion of the Engineer. The

gradation of the aggregate and the bitumen content shall not vary from the fixed mean of formula by more than the following tolerances:

Aggregate passing sieve No. 4 and larger	7%
Aggregate passing sieve No. 4 and smaller	5%
Bitumen	0.5%
Temperature of mixture	25°F.

2. Materials

Coarse Aggregate

The coarse aggregate shall consist of either crushed stone or gravel which meets the following requirements:

(a) **Crushed Stone.** The crushed stone shall consist of fragments of clean, durable stone free from soft, thin, elongated pieces, disintegrated stone, vegetable, or other deleterious matter, and shall be obtained from rock having a per cent of wear of not more than thirty-five (35) as determined by the Los Angeles Method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96, except that in the case of native granite the per cent of wear obtained by the above method shall not exceed forty-five (45).

(b) **Gravel.** Gravel, when used, shall consist of clean, sound, tough, hard stone, free from dirt or foreign matter, and shall be washed if so directed.

Gravel which is fifty (50) per cent crushed shall be considered as crushed stone and shall meet the requirements therefor, otherwise it shall have a per cent of wear of not more than ten (10) after 100 revolutions and not more than thirty-five (35) after 500 revolutions as determined by the Los Angeles method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96.

Fine Aggregate

The fine aggregate shall be composed of sand or stone screenings or mixtures of the two. The sand shall consist of clean, hard durable grains free from clay, loam or other foreign matter. The stone screenings shall be free from weathered or soft particles and shall be produced from stone equal in quality to that specified for the coarse aggregate.

Bituminous Material

The bituminous material shall meet the requirements for asphalt cement specified for use in the "Bituminous Concrete Surface Course."

A tempering medium, approved by the Engineer, may be used, if necessary, to give workability to the Bituminous Concrete mixture.

3. Construction Methods

The construction methods to be used in mixing and placing the "Bituminous Concrete Base Course" shall conform to those methods specified for the construction of the "Bituminous Concrete Surface Course."

Where the depth of Bituminous Concrete Base Course to be laid is greater than $3\frac{1}{2}$ inches in thickness, the mixture shall be spread and compacted in layers of not more than $3\frac{1}{2}$ inches after compaction.

The surface after compression shall be smooth and true to the proposed grade and cross-section. Any portions of the completed surface which are found to be defective in smoothness, finish, compression, density, or composition, or that do not otherwise comply with the requirements of these specifications, shall be remedied by removal or the addition of fresh mixture which shall be immediately compacted as required herein.

4. Method of Measurement

The tonnage to be paid for under this item shall be the number of net tons of Bituminous Concrete Base Course laid in place completed and accepted.

5. Basis of Payment

The tonnage measured as provided shall be paid for at the contract unit price per ton bid for "Bituminous Concrete Base Course" complete in place which price shall be full compensation for furnishing, mixing, and placing all materials and for all labor, tools, and all incidental work.

Item 27--Bituminous Concrete Base Course

LEVELLING MIXTURE

SECTION 28

1. Description

This item shall consist of a mixture of sand and asphalt spread on the base course where the depth below the finished pavement surface is more than two inches and less than four inches.

2. Materials

Sand. The sand shall be clean and shall be graded from coarse to fine. It shall all pass a one-quarter ($\frac{1}{4}$) inch sieve.

Asphalt. The asphalt shall meet the requirements specified for use in the "Bituminous Concrete Surface Course."

3. Construction Methods

Free bituminous material on all areas, where patches or repairs have been made, sufficient to cause softening of hot bituminous mixture laid thereon, shall be removed. Before any levelling mixture is applied to the surface of the old roadway it shall be cleaned of all dirt, dust, sand, or loose material to the satisfaction of the Engineer.

The levelling mixture shall contain from $6\frac{1}{2}\%$ to 9% of asphalt cement and shall be delivered on the work in

a workable condition. Where so ordered by the Engineer for isolated holes or depressions the levelling mixture may contain coarser particles of stone up to $\frac{3}{4}$ " in size with an appropriate reduction in asphalt.

The levelling mixture shall be spread over all areas of the existing surface which are more than 2" and less than 4" below the finished pavement surface to such a depth that after compression the surface thus obtained shall be two inches below and parallel to the proposed new pavement surface.

Immediately after the levelling mixture has been spread it shall be compressed with a self-propelled roller weighing not less than five tons. If after the first rolling, areas appear porous or uneven, additional mixture shall be cast over the surface during the process of rolling until a uniformly compressed surface is obtained.

4. Basis of Payment

(a) The levelling mixture shall be paid for at the contract unit price per ton (of 2,000 lbs.) for "Levelling Mixture" which price shall include furnishing and applying all materials, labor, tools, equipment and all incidental work, except the removal of bituminous patches.

(b) The removal of bituminous patches shall be paid for at the contract unit price per square yard for "Removal of Bituminous Patches" which price shall include all labor, tools, equipment, and all incidental work.

Item 28-A--Levelling Mixture

Item 28-B--Removal of Bituminous Patches

CEMENT CONCRETE BASE

SECTION 29

1. Description

This base shall be a one course cement concrete base composed of Portland Cement, water and both fine and

coarse aggregate, all of which shall be of such quality and mixed in such proportions as hereinafter described and specified. The base shall be constructed on the subgrade or prepared base course in conformity with the plans and typical cross-sections and in accordance with these specifications.

2. Materials

All materials shall meet the requirements of the standard specifications for "Cement Concrete Pavement," Section 38. All materials including cement shall be furnished by the Contractor.

3. Construction Methods

The methods of constructing the cement concrete base shall be the same as specified in construction methods of cement concrete pavement, Section 38, except as herein-after described and specified.

Composition: The concrete shall be proportioned by weight and for this purpose one (1) bag of cement weighing ninety-four (94) pounds net shall be considered the equivalent of one (1) cubic foot.

The actual proportioning by weight shall be on a dry basis in accordance with the following table and shall correspond to the void content and specific gravity of the coarse aggregate and the specific gravity of the fine aggregate which are used in the work.

**Weights of Fine and Coarse Aggregates
per Bag of Cement**

Voids in Coarse Aggregate Per Cent	Weights of Fine Aggregate Pounds per Bag of Cement				Weights of Coarse Aggregate Pounds per Bag of Cement				
	Specific Gravity of Fine Aggregate				Specific Gravity of Coarse Aggregate				
	2.55	2.65	2.75	2.85	2.55	2.65	2.75	2.85	2.95
35	221	230	238	247	462	480	499	517	535
40	257	267	277	287	427	444	460	477	494
45	292	304	315	327	391	406	422	437	452
50	328	341	354	366	356	370	383	397	411

Note:—The figures in the above table are based on 1.21 barrels of cement per cubic yard of concrete. In no case shall the cement factor fall below 1.15 barrels per cubic yard of concrete.

The specific Gravity of sand and coarse aggregate proposed for use shall be ascertained by the Engineer in advance of the work and batch weights, calculated from the various amounts given in the table above, shall be used.

The relative weights of fine and coarse aggregate determined as above may be varied slightly by the Engineer during the progress of the work, in order to improve workability. However, the sum of the fine and coarse aggregate shall not be varied unless tests by the Engineer indicate that the specific gravity of either or both aggregates has changed.

Consistency. The consistency of the concrete base shall meet the specifications for consistency of concrete pavement except that the quantity of water inclusive of that contained in the aggregates shall not be more than six (6) gallons per bag of cement.

Finishing. As a final finish the surface of the base course shall be brushed with a steel broom to insure a rough texture for receiving the surface course. Joints shall not be sealed. The outside edges of the base need not be rounded.

4. Basis of Payment

The work shall be paid for at the contract unit price per cubic yard for "Cement Concrete Base" measured in place after completion in accordance with plans, which price shall include all materials (except steel reinforcement which shall be paid for under the item of "Steel Reinforcement for Concrete Base"), equipment, tools, labor and work incidental thereto.

Item 29--Cement Concrete Base

STEEL REINFORCEMENT FOR CONCRETE BASE

SECTION 30

1. Description

Under this item reinforcing steel shall be furnished and placed in concrete base as required by these specifications and as shown on the plans. This item shall include dowels or transverse joint assemblies, and tie-bars for longitudinal joints.

2. Materials

All materials shall meet the requirements of the standard specifications for "Steel Reinforcement for Concrete Pavement," Section 39. All materials shall be furnished by the Contractor.

3. Placing Reinforcement

The methods of placing the steel reinforcement, dowels, tie-bars, transverse joint assemblies, etc., shall meet the requirements of the standard specifications for "Steel Reinforcement for Concrete Pavement," Section 39.

4. Method of Measurement

The quantity to be paid for under this item shall be computed in the same manner as specified in the item of "Steel Reinforcement for Concrete Pavement," Section 39.

5. Basis of Payment

(a) The weight of steel reinforcement for concrete base thus determined shall be paid for at the contract unit price per pound for "Steel Reinforcement for Concrete Base," complete in place, which price shall include all materials, equipment, tools, labor, and work incidental thereto.

(b) The cost of all caps, chairs, supports, or other devices used to hold the reinforcement in correct position shall be included in the above prices and shall not be paid for directly.

(c) Transverse joint assemblies shall be paid for at the contract unit price each for "Transverse Joint Assemblies," complete in place, which price shall include all material, equipment, tools, labor, and work incidental thereto.

Item 30-A--Steel Reinforcement for Concrete Base

Item 30-B--Transverse Joint Assemblies

PART IV
CONSTRUCTION DETAILS
SURFACE COURSES AND PAVEMENTS

SURFACE COURSES AND PAVEMENTS

SECTION 31

1. Description

Surface courses or pavements shall consist of wearing surfaces or pavements constructed on the subgrade or completed base course. They shall be constructed to the width and cross-section shown on the plans and in accordance with these specifications.

2. Distributors

Distributors where required shall be equipped as follows:

- Manufacturer's tank capacity displayed
- Tachometer in working order, and chart
- Speedometer or odometer
- Measuring stick or gauge for tank
- Hand hose with nozzle
- Spray bars to 20 feet
- Plugs to block off bar nipples
- Pouring pot
- Thermometer to test tank temperature
- Auxiliary motor governed according to tachometer chart

GRAVEL SURFACE COURSE

SECTION 32

1. Description

This item shall consist of a wearing course of gravel constructed on the prepared subgrade or completed base course, in accordance with these specifications and in conformity with the lines, grades, number of component courses, and typical sections shown on the plans.

2. Materials

The gravel shall be furnished by the Contractor from sources approved by the Engineer, and shall be composed

of hard, sound, durable rock having uniform resistance to abrasion, together with fine material consisting of sand and suitable clay or other approved binding material. When required gravel pits shall be stripped to the satisfaction of the Engineer.

Gravel surface course shall be composed of screened gravel of the sizes specified herein.

The material shall be well graded and of such sizes that all will pass a screen having square openings of one and one-fourth ($1\frac{1}{4}$) inches, and shall contain not more than fifty (50) per cent of material passing a one-quarter ($\frac{1}{4}$) inch opening.

When, in the opinion of the Engineer better results can be obtained by the use of coarser gravel than above described, the maximum size of the screen opening may be increased to one and one-half ($1\frac{1}{2}$) inches.

If the binding material in an acceptable gravel is not sufficient to insure satisfactory bonding, and such gravel is used, the Contractor shall furnish sufficient additional binding material of quality approved by the Engineer, and by satisfactory manipulation incorporate it in the surface course material.

3. Construction Methods

The material for gravel surface course shall be spread in one course evenly upon the completed base course to such a depth as to insure the required thickness after being thoroughly compacted. No segregation of large or fine particles shall be allowed, but the gravel as spread shall be well graded with no pockets of fine or coarse material. The gravel shall be spread from trucks and thoroughly mixed and shaped with a blade grader.

If ordered by the Engineer, after the gravel has been uniformly spread, it shall be thoroughly harrowed with an approved type of harrow so regulated that the harrowing shall extend the full depth of the course and harrowing shall be continued until the different sized particles and binder material are evenly distributed through the

mass and a uniform density of material is obtained. Harrowing shall be done the same day the gravel is spread and before any compaction by traffic occurs.

After the material has been harrowed it shall be shaped to the required cross-section, sprinkled with water if and as directed, and thoroughly rolled with a three wheeled roller weighing at least ten (10) tons. All rolling shall begin at the sides and progress toward the center, overlapping at each succeeding passage, and shall be extended onto the shoulders as directed.

The bonding shall be produced by sprinkling with water when required, the addition of binding material if necessary, harrowing, and rolling until a smooth, hard surface has been produced conforming in every respect to the typical cross-sections and true to the lines and grades given by the Engineer. No irregularities or depressions shall be allowed to remain in any part of the completed course.

Until final acceptance the whole surface shall be bladed and dragged as often as necessary to maintain it smooth and true to grade and cross-section.

4. Basis of Payment

(a) Gravel surface course shall be paid for at the contract unit price per cubic yard for "Gravel Surface Course," measured in place after completion, in accordance with the typical cross-sections, which price shall include all materials, (except additional binding material), equipment, tools, labor and all work incidental thereto except overhaul and sprinkling which shall be paid for under the item of "Gravel Overhaul" and "Sprinkling" at the unit prices stipulated in this contract.

(b) Additional binding material ordered by the Engineer shall be paid for at twice the Contract unit price per cubic yard for "Earth Excavation," measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor and all work incidental thereto.

Item 32--Gravel Surface Course

SURFACE TREATED GRAVEL COURSE

CLASS A

SECTION 33

1. Description

This item shall consist of a wearing course of gravel with a bituminous surface treatment constructed on the prepared subgrade or completed base course, in accordance with these specifications and in conformity with the lines, grades, and typical sections shown on the plans.

2. Materials

Bituminous Material. The bituminous material shall be a tar conforming to the latest revised specifications of the A.A.S.H.O., Specification M-52, Grade RT-4 or RT-5 as ordered by the Engineer. It shall be sampled and tested by an experienced chemist selected by the Engineer who shall have the privilege of making any tests or inspections desired at the plant of the producer. No bituminous material shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

The specific viscosity of the material to be furnished will be subject to variation, within the limits designated in the foregoing specification, as may be directed as shipments of material are ordered; except that a range of two points each way from the stated specific viscosity will be allowed. Due notice of variation in viscosity will be given six days in advance of shipments.

Test of the physical and chemical properties of the tars shall be made in accordance with the methods described in the latest revised methods of the A.A.S.H.O.

Gravel. The gravel shall be furnished by the Contractor from sources approved by the Engineer, and shall be composed of hard, sound, durable rock having uniform resistance to abrasion, together with fine material consisting of sand and suitable clay or other approved bind-

ing material only in sufficient quantity to bind the lower half of the surface course. When required, gravel pits shall be stripped to the satisfaction of the Engineer.

Gravel surface course shall be composed of screened gravel of the sizes specified herein. The material shall be well graded and of such sizes that all will pass a screen having square openings of one and one-fourth ($1\frac{1}{4}$) inches, and shall contain not more than fifty (50) per cent of material passing a one-quarter ($\frac{1}{4}$) inch opening.

When, in the opinion of the Engineer, better results can be obtained by the use of coarser gravel than above described, the maximum size of the screen opening may be increased to one and one-half ($1\frac{1}{2}$) inches.

If the binding material in an acceptable gravel is not sufficient to insure satisfactory bonding of the lower half of the course, and such gravel is used, the Contractor shall furnish sufficient additional binding material of quality approved by the Engineer, and by satisfactory manipulation incorporate it in the surface course material.

Cover Material. The gravel shall consist of hard, durable stone particles which show uniform resistance to abrasion free from organic matter and shall when tested by laboratory methods fulfill the following requirements:

Passing a three-quarter ($\frac{3}{4}$) inch sieve, 100%.

Passing a one-quarter ($\frac{1}{4}$) inch sieve, not more than 50%.

3. Construction Methods

The material for gravel surface course shall be spread in one course evenly upon the completed base course to such a depth as to insure the required thickness after being thoroughly compacted. No segregation of large or fine particles shall be allowed, but the gravel as spread shall be well graded with no pockets of fine or coarse material. The gravel shall be spread from trucks and thoroughly mixed and shaped with a blade grader.

If ordered by the Engineer, after the gravel has been uniformly spread, it shall be thoroughly harrowed with an approved type of harrow so regulated that the harrowing shall extend the full depth of the course and harrowing shall be continued until the different sized particles and binder material are evenly distributed through the mass and a uniform density of material is obtained. Harrowing shall be done the same day the gravel is spread and before any compaction by traffic occurs.

After the material has been harrowed it shall be shaped to the required cross-section, sprinkled with water if and as directed, and thoroughly rolled with a three wheeled roller weighing at least ten (10) tons. All rolling shall begin at the sides and progress toward the center, overlapping at each succeeding passage, and shall be extended onto the shoulders as directed.

The bonding shall be produced by sprinkling with water when required, the addition of binding material if necessary, harrowing, and rolling until a smooth surface has been produced conforming in every respect to the typical cross-sections and true to the lines and grades given by the Engineer. No irregularities or depressions shall be allowed to remain in any part of the completed course.

To the clean, dry surface, bituminous material shall be applied with an approved type of pressure distributor at a uniform rate of approximately six-tenths (0.6) gallons per square yard. If the surface before treatment is compacted so that the bituminous material will not penetrate sufficiently it shall be loosened to a depth of approximately three-quarters ($\frac{3}{4}$) of an inch. The temperature of the bituminous material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. Two applications shall be made as ordered. After the first application of approximately four-tenths (0.4) gallons per square yard, the surface shall be mulched with a grader, or dragged, as directed by the Engineer. The

weight and type of drag must be approved by the Engineer. After mulching, cover material shall be spread uniformly in just sufficient quantity to prevent traffic from picking up the surface, and shall then be thoroughly rolled. After the second application of approximately two-tenths (0.2) gallons per square yard a uniform layer of cover material shall be spread in sufficient quantity to absorb any excess bituminous material. The surface shall then be dragged as directed by the Engineer with an approved broom drag and rolled.

The Contractor shall furnish sufficient watchmen to handle one way traffic whenever necessary until the surface treatment is completed.

4. Basis of Payment

(a) Gravel Surface Course shall be paid for at the contract unit price per cubic yard for "Surface Treated Gravel Course," measured in place after completion, in accordance with the typical cross-sections, which price shall include all materials, (except bituminous material and additional binding material), equipment, tools, labor and all work incidental thereto except overhaul and sprinkling which shall be paid for under the items of "Gravel Overhaul" and "Sprinkling" at the unit prices stipulated in this contract.

(b) Bituminous material shall be paid for at the contract unit price per gallon of 231 cubic inches measured at a temperature of 60°F. for "Bituminous Material," which price shall include furnishing and applying the bituminous material and all equipment, tools, labor and all incidental work.

(c) Additional binding material ordered by the Engineer shall be paid for at twice the contract unit price per cubic yard for "Earth Excavation," measured by cross-sections in the pit, which price shall include all materials, equipment, tools, labor and all work incidental thereto.

Item 33-A--Surface Treated Gravel Course

Item 33-B--Bituminous Material

BITUMINOUS GRAVEL SURFACE COURSE MIXED IN PLACE METHOD

CLASS C

SECTION 34

1. Description

This item shall consist of a wearing course of gravel mixed with bituminous material, constructed on the prepared subgrade or completed base course in accordance with these specifications and in conformity with the lines, grades, and typical sections shown on the plans.

The Contractor may, if he prefers, construct this surface course in accordance with the specifications for "Premixed Method," Section 35.

2. Materials

Bituminous Material. The bituminous material shall be a tar conforming to the latest revised specifications of the A.A.S.H.O., Specification M-52, grade RT-6 for the mixture and seal coat and grade RT-4 or RT-5 for surface treatment of the leveling course as ordered by the Engineer. It shall be sampled and tested by an experienced chemist selected by the Engineer who shall have the privilege of making any tests or inspections desired at the plant of the producer. No bituminous material shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

The specific viscosity of the material to be furnished will be subject to variation, within the limits designated in the foregoing specifications, as may be directed as shipments of material are ordered; except that a range of one and one-half ($1\frac{1}{2}$) points each way from the stated specific viscosity will be allowed. Due notice of variation in viscosity for any specification will be given six days in advance of shipments.

Test of the physical and chemical properties of the tars shall be made in accordance with the methods described in the latest revised methods of the A.A.S.H.O.

Gravel. Gravel shall be furnished by the Contractor from sources approved by the Engineer and shall be composed of clean hard, sound, durable rock having uniform resistance to abrasion together with fine material. When required, gravel pits shall be stripped to the satisfaction of the Engineer. The gravel surface course shall be composed of screened gravel of the sizes specified herein and shall when tested by means of square mesh sieves meet the following requirements:

Passing $1\frac{1}{4}$ " sieve	100%
Passing $\frac{1}{4}$ " sieve	30 - 45%

When in the opinion of the Engineer better results can be obtained by the use of coarser gravel than above described, the maximum size of the screen opening may be increased to one and one-half ($1\frac{1}{2}$) inches.

Testing. When tested, gravel shall have a per cent of wear of not more than thirty-five (35) after five hundred (500) revolutions as determined by the Los Angeles abrasion test for gravel made in accordance with the latest revised methods of the A.A.S.H.O., Designation T-96. When not meeting the above requirements gravel may be used upon written consent of the Engineer when the per cent of wear is not more than forty-five (45).

Cover Material. The cover material used for the surface treatment of the leveling course shall meet the same specification for gravel as the gravel of the leveling course itself. The cover material for the seal coat shall consist of stone chips or coarse clean sand free from organic matter and shall pass a one-quarter ($\frac{1}{4}$) inch square sieve.

3. Construction Methods

Leveling Course. Upon the completed base course shall be placed a one (1) inch compacted leveling course, conforming to the specifications for "Surface Treated Gravel Course" (Section 33), in accordance with typical

cross-sections shown on the plans and to the lines and grades given by the Engineer.

Upon the completed leveling course bituminous material shall be applied by an approved type of pressure distributor at a uniform rate of approximately four-tenths (0.4) gallons per square yard. The bituminous material shall conform to the latest revised specifications of the A.A.S.H.O., Specification M-52, Grade RT-4 or RT-5. The temperature of the material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. After this application cover material shall be spread uniformly in a sufficient quantity to absorb any excess bituminous material. The leveling course shall then be dragged as directed by the Engineer with an approved brush or wire screen drag and rolled.

Surfacing Course. The gravel surface course shall be placed after the above described prime coat has had sufficient time to cure under the action of traffic. The time allowed for this curing shall be not less than three days and shall be longer if required by the Engineer.

To the clean, dry surface, bituminous material shall be applied with an approved type of pressure distributor at a uniform rate of approximately eighty-five hundredths (0.85) of a gallon per square yard divided into two or more applications if required. The temperature of the material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. After this application the surface gravel shall be bladed back and forth until it is thoroughly and uniformly coated with the bituminous material. During this blading process additional bituminous material shall be applied if required by the Engineer. After the gravel and bituminous material have been thoroughly mixed, it shall be deposited as directed by the Engineer in a windrow on the side of the road for a curing period of at least two days. During this period the mixture shall be worked back and forth with a grader as directed by the Engineer and windrowed over night.

After curing, the mixture shall be spread upon the prepared base, shaped to the required cross-section and thoroughly rolled. If in the opinion of the Engineer it is necessary, sufficient cover material as specified for the seal coat shall be uniformly applied to prevent traffic from picking up the surface.

A roller of a type and weight approved by the Engineer shall be used. Before rolling is started, the course shall be checked and any inequalities adjusted. All fat spots from any source shall be removed and replaced with satisfactory material. In all places inaccessible to a roller such as adjacent to curbs, headers and gutters, the required compression shall be secured by tamping. Depressions which may develop before the completion of the rolling shall be remedied by removing the mixture laid and adding new material to bring such depressions to the required surface. All inequalities such as depressions, high spots and honeycombs, shall be adjusted as directed by the Engineer. Care shall be taken not to damage the edge of the concrete pavement or any adjacent structures. If any such damage occurs it shall be repaired to the satisfaction of the Engineer by the Contractor without additional compensation.

Where there is traffic during construction, the Contractor will be required to perform the above operations on approximately one-half the width of the road at a time. Neither side of the road shall be treated beyond the opposite side more than the distance covered by two truck loads of the bituminous material and every effort shall be made to have the entire width completed to the same point at the end of each day's work.

A seal coat of bituminous material shall be applied with an approved type of pressure distributor at a uniform rate of approximately fifteen-hundredths (0.15) of a gallon per square yard. This seal coat shall not be applied until seven days after the road is opened to traffic unless a shorter time is approved by the Engineer.

The temperature of the material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. After this application cover material shall be uniformly spread in sufficient quantity to absorb any excess bituminous material. The surface shall then be dragged with an approved broom drag and rolled, as directed by the Engineer.

The Contractor shall furnish sufficient watchmen to handle one way traffic whenever required.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Bituminous Gravel Surface Course (Mixed in Place Method)", measured in place after completion in accordance with the typical cross-sections, which price shall include all materials (except the leveling course and the bituminous material), equipment, tools, labor and all work incidental thereto except overhaul, which shall be paid for under the item of "Gravel Overhaul."

(b) Furnishing and applying the bituminous material shall be paid for at the contract unit price per gallon of two hundred thirty-one (231) cubic inches measured at a temperature of 60°F. for "Bituminous Material."

(c) The furnishing and placing of the leveling course shall be paid for under Item 33-A, "Surface Treated Gravel Course."

**Item 34-A--Bituminous Gravel Surface Course
(Mixed in Place Method)**

Item 34-B--Bituminous Material

BITUMINOUS GRAVEL SURFACE COURSE PREMIXED METHOD

CLASS C

SECTION 35

1. Description

This item shall consist of a wearing course of gravel mixed with bituminous material, constructed on the prepared subgrade or completed base course in accordance with these specifications and in conformity with the lines, grades, and typical sections shown on the plans.

2. Materials

Bituminous Material. The bituminous material shall be a tar conforming to the latest revised specifications of the A.A.S.H.O., Specification M-52, grade RT-6 or RT-7 for the mixture and seal coat and grade RT-4 or RT-5 for surface treatment of the leveling course as ordered by the Engineer. It shall be sampled and tested by an experienced chemist selected by the Engineer who shall have the privilege of making any tests or inspections desired at the plant of the producer. No bituminous material shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

The specific viscosity of the material to be furnished will be subject to variation, within the limits designated in the foregoing specifications, as may be directed as shipments of material are ordered; except that a range of one and one-half ($1\frac{1}{2}$) points each way from the stated specific viscosity will be allowed. Due notice of variation in viscosity for any specification will be given six days in advance of shipments.

Test of the physical and chemical properties of the tars shall be made in accordance with the methods described in the latest revised methods of the A.A.S.H.O.

Gravel. Gravel shall be furnished by the Contractor

from sources approved by the Engineer and shall be composed of clean, hard, sound, durable rock having uniform resistance to abrasion together with fine material. When required, gravel pits shall be stripped to the satisfaction of the Engineer. The gravel surface course shall be composed of screened gravel of the sizes specified herein and shall when tested by means of square mesh sieves meet the following requirements:

Passing $1\frac{1}{4}$ " sieve	100%
Passing $\frac{1}{4}$ " sieve	30 - 45%

When in the opinion of the Engineer better results can be obtained by the use of coarser gravel than above described, the maximum size of the screen opening may be increased to one and one-half ($1\frac{1}{2}$) inches.

Testing. When tested, gravel shall have a per cent of wear of not more than thirty-five (35) after five hundred (500) revolutions as determined by the Los Angeles abrasion test for gravel made in accordance with the latest revised methods of the A.A.S.H.O., Designation T-96. When not meeting the above requirements, gravel may be used upon written consent of the Engineer when the per cent of wear is not more than forty-five (45).

Cover Material. The cover material used for the surface treatment of the leveling course shall meet the same specification for gravel as the gravel of the leveling course itself. The cover material for the seal coat shall consist of stone chips or coarse clean sand free from organic matter and shall pass a one-quarter ($\frac{1}{4}$) inch square sieve.

3. Construction Methods

Leveling Course. Upon the completed base course shall be placed a one (1) inch compacted leveling course, conforming to the specifications for "Surface Treated Gravel Course" (Section 33), in accordance with typical cross-sections shown on the plans and to the lines and grades given by the Engineer.

Upon the completed leveling course bituminous material shall be applied by an approved type of pressure distributor at a uniform rate of approximately four-tenths (0.4) gallons per square yard. The bituminous material shall conform to the latest revised specifications of the A.A.S.H.O., Specification M-52, grade RT-4 or RT-5. The temperature of the material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. After this application cover material shall be spread uniformly in a sufficient quantity to absorb any excess bituminous material. The leveling course shall then be dragged as directed by the Engineer with an approved brush or wire screen drag and rolled.

Surfacing Course. The gravel surface course shall be placed after the above described prime coat has had sufficient time to cure under the action of traffic. The time allowed for this curing shall be not less than three days and shall be longer if required by the Engineer.

Mixing. The gravel and bituminous material specified herein shall be mixed in an approved mixer until all particles are thoroughly coated with the bituminous material and no lean sandy streaks appear and no lumps containing an excessive amount of bituminous material remain. The mixer drum shall be heated by a blow torch or other approved method.

For incidental construction such as sidewalks, parking areas, shoulders, etc., where an approved mixer is not available, the tar and gravel may be mixed by building up a cone of gravel with a shovel and spraying the cone with tar by means of an approved distributor as the cone is built up. When the required amount of Mineral Aggregate and Tar has been combined, the shovel operator shall comb the shovel bucket through the conical pile with the bottom of the bucket open or by opening and shutting same in order to thoroughly mix the tar and Mineral Aggregate. This operation combined with the

complete removal of the first cone into two or more new cones within reach of the shovel shall continue until all particles are thoroughly coated with tar and no lean sandy streaks appear and no lumps containing an excessive amount of tar remain. This method of mixing may require a larger amount of tar.

Proportioning. Approximately ten (10) to twelve (12) gallons of the bituminous material shall be used to each cubic yard, loose measurement, of the gravel as determined by the Engineer.

Transportation of Mixture. The inside surfaces of trucks may be thinly coated with soapy water, or a mixture of water with not more than ten (10) per cent of lubricating oil. The use of kerosene, gasoline or similar products for this purpose will not be permitted. Trucks shall be covered with waterproof canvas when so ordered by the Engineer.

Curing. After the gravel and bituminous material have been thoroughly mixed, it shall be deposited as directed by the Engineer in a windrow on the side of the road for a curing period of at least two days. During this period the mixture shall be worked back and forth with a grader as directed by the Engineer and windrowed over night. After curing, the mixture shall be spread, shaped to the required cross-section and rolled.

When the material is mixed for incidental construction it shall be cured in a stock pile for at least seven days.

Rolling. A roller of a type and weight approved by the Engineer shall be used. When the surface is laid in more than one course, each course shall be rolled. Before rolling is started, the course shall be checked and any inequalities adjusted. All fat spots from any source shall be removed and replaced with satisfactory material. In all places inaccessible to a roller such as adjacent to curbs, headers and gutters, the required compression shall be secured by tamping. Depressions which may

develop before the completion of the rolling shall be remedied by removing the mixture laid and adding new material to bring such depressions to the required surface. All inequalities such as depressions, high spots and honeycombs, shall be adjusted as directed by the Engineer. Care shall be taken not to damage the edge of the concrete pavement or any adjacent structures. If any such damage occurs it shall be repaired to the satisfaction of the Engineer by the Contractor without additional compensation.

Seal Coat. A seal coat of bituminous material shall be applied with an approved type of pressure distributor at a uniform rate of approximately fifteen hundredths (0.15) of a gallon per square yard. This seal coat shall not be applied until ten days after the road is opened to traffic unless a shorter time is approved by the Engineer. The temperature of the material when applied shall be between 100°F. and 150°F. as the Engineer shall direct. After this application cover material shall be uniformly spread in sufficient quantity to absorb any excess bituminous material. The surface shall then be dragged with an approved broom drag and rolled, as ordered by the Engineer.

The Contractor shall furnish sufficient watchmen to handle one way traffic whenever required.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per cubic yard for "Bituminous Gravel Surface Course (Premixed Method)", measured in place after completion in accordance with the typical cross-sections, which price shall include all materials (except the leveling course and the bituminous material), equipment, tools, labor and all work incidental thereto except overhaul, which shall be paid for under the item of "Gravel Overhaul."

(b) Furnishing and applying the bituminous material shall be paid for at the contract unit price per gallon of two hundred thirty-one (231) cubic inches measured at a temperature of 60°F. for "Bituminous Material."

(c) The furnishing and placing of the leveling course shall be paid for under Item 33-A, "Surface Treated Gravel Course."

**Item 35-A--Bituminous Gravel Surface Course
(Premixed Method)**

Item 35-B--Bituminous Material

BITUMINOUS MACADAM SURFACE COURSE

CLASS E

SECTION 36

1. Description

This pavement shall consist of a surface course comprised of crushed stone and bituminous binder with a bituminous seal coat and stone chip covering, constructed on the prepared base course, in accordance with these specifications, and having the dimensions and cross-sections shown on the plans.

2. Materials

Bituminous Material. The bituminous material shall conform to the specification given below. It shall be sampled and tested by an experienced chemist selected by the Engineer. No bituminous material shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

**EMULSIFIED ASPHALT
QUICK SETTING TYPE**

The material desired under this specification is a water asphalt emulsion of the quick setting type for use in penetration work.

The asphalt emulsion shall be homogeneous and shall show no separation within thirty (30) days after delivery, provided that separation has not been caused by freezing after delivery. When tested as hereinafter specified, the emulsion shall conform to the following requirements:

Viscosity. Saybolt Furol—60 ml. at 25C (77F)

(Not less than 35 sec. and not more than 100 sec.)

Residue by distillation

(Not less than 55% and not more than 70%.)

Settlement, 5 days.....(Not more than 3.)

Demulsibility, a 35 ml. of 0.02 N CaCl₂

(Not less than 50%.)

Sieve Test.....(Not more than 0.10%.)

Residue. The residue obtained from distillation shall conform to the following requirements:

Penetration at 25C (77F) 100 g., 5 sec.....100 to 200.

Soluble in Carbon Disulphide.....Not less than 97.5%.

Ash.....Not more than 2%.

Ductility at 25C (77F).....Not less than 70 cm.

Specific Gravity at 25C (77F).....Not less than 1.00.

The demulsibility test shall be made within thirty (30) days from date of shipment.

At the option of the Engineer, the following test for determination of residue shall be carried out in lieu of the "Distillation by Weight":

Evaporation Residue. Three 100 gram samples shall be weighed into dishes or beakers of 3 to 4½ inches in diameter and of sufficient depth to prevent overflow when heated.

These shall be placed in an oven such as that described in A.S.T.M. Standard Method D6-30 (except that the revolving shelf shall be removed).

The heat shall be continued at 163 degrees C. until the residue presents a smooth appearance entirely free from bubbles or froth, after which the containers shall be removed, cooled, weighed, and the percentages of residue calculated. The percentages when averaged shall be 55 to 70%.

The residual material so obtained shall meet the requirements listed under "Residue from Distillation" above.

Sampling. Samples, as required by the Engineer, of not less than one gallon shall be taken and stored in clean air-tight glass containers until tested.

Methods of Testing. The properties enumerated in these specifications shall be determined in accordance with the latest revised Methods of Testing Emulsified Asphalts of the A.A.S.H.O. except for optional test for Evaporation Residue herein described.

Crushed Stone. The crushed stone shall consist of angular fragments of rock, newly crushed, of uniform quality and free from thin or elongated pieces, soft or disintegrated stone, dust or other matter occurring either free or as a coating on the stone, and shall be obtained from rock having a per cent of wear of not more than thirty-five (35) as determined by the Los Angeles abrasion test for stone described in the latest revised Methods of the A.A.S.H.O., Designation T-96, except that in the case of native granite the per cent of wear obtained by the above method shall not exceed forty-five (45).

Stone chips shall have a per cent of wear of not more than thirty-five (35) when tested by the above method.

(a) **Coarse Stone.** The coarse stone shall be well graded and when tested by means of square laboratory sieves shall meet the following requirements:

	Per Cent
Passing 2-inch sieve	95—100
Passing $\frac{3}{4}$ -inch sieve	0—15

(b) **Keystone.** The keystone used for filling the voids in the coarse stone when tested by means of square laboratory sieves shall meet the following requirements:

	Per Cent
Passing $\frac{3}{4}$ -inch sieve	95—100
Passing $\frac{1}{2}$ -inch sieve	0—40

(c) **Stone Chips.** The stone chips used for both seal coats, when tested by means of square laboratory sieves shall meet the following requirements:

	Per Cent
Passing $\frac{1}{2}$ -inch sieve	95—100
Passing No. 4 sieve	0—15

3. Construction Methods

Spreading and Rolling Stone. Upon the prepared base course, the coarse stone shall be spread with shovels from metal dumping boards or with spreading devices satisfactory to the Engineer. This stone shall be spread so that it will have the thickness and crown shown on the plans after being compacted and keyed together by rolling with a ten (10) ton three wheel roller. The rolling shall begin at the sides, overlapping the shoulders and progress to the center. It shall then form a fine, even surface, true to grades and cross-sections shown on the plans. If any irregularities appear during or after rolling of this course, they shall be remedied by loosening the surface and removing or adding stone, as may be required. The entire area, including the surrounding surface shall be rolled until it is compacted to the satisfaction of the Engineer and has a uniform surface.

First Application of Emulsified Asphalt. Any of the surface course stone which has become coated or mixed with dirt or foreign substances shall be removed

and replaced with clean stone, and all segregation of stone of the same size shall be remedied. The application must be made within a reasonable time after the stone has been spread and if the stone shall become dusty it must be thoroughly cleaned before the application of the bituminous material will be permitted.

If in extremely hot weather the emulsion tends to break too rapidly, the Contractor may be required to sprinkle the stone with water immediately prior to the first application of emulsified asphalt.

After the stone has been rolled and keyed as above, emulsified asphalt conforming to the requirements specified shall be uniformly applied at the rate of three-quarters to one gallon per square yard of surface area as directed. The emulsion shall be applied at air temperature and shall be evenly spread over the surface by means of an approved pressure distributor operating under a minimum pressure of twenty (20) pounds per square inch. The emulsified asphalt shall be screened through a screen not larger than $\frac{1}{4}$ -inch mesh between the tank car and the distributor. On widened areas, parking areas or such other areas as are not reached by the pressure distributor, the emulsion may be spread with pouring pots or by means of a hand spray nozzle.

Immediately after the emulsion has been applied and before it has had time to "break," clean keystone shall be uniformly spread over the surface, hand broomed and rolled. If necessary, the roller wheels shall be wet to assist in preventing displacement.

Second Application of Emulsified Asphalt. After in the opinion of the Engineer, the first application has set sufficiently, a second application of emulsified asphalt shall be uniformly applied at the rate of approximately one gallon per square yard. Before it has had time to "break" it shall be covered uniformly with clean keystone in such quantity as to fill all the voids, but not in excess of this. The surface shall then be thoroughly rolled.

During this rolling, the surface shall be broomed with a broom drag to evenly distribute the keystone and more keystone shall be added whenever necessary to give a uniform covering with out excess. The following day, the course shall be thoroughly and systematically rolled beginning at the shoulders and finishing at the crown. At least twenty-four (24) hours shall elapse after the second application of emulsified asphalt before traffic shall be allowed over the surface. At least one day shall elapse before applying the seal coat.

First Seal Coat. After the surface has been compacted as above it shall be swept clean and a seal coat of approximately $\frac{3}{10}$ ths of a gallon of emulsified asphalt per square yard of surface area shall be applied evenly. It shall then be uniformly covered with clean stone chips in a quantity sufficient to take up all excess bituminous material, after which it shall be well broomed with a broom drag and rolled. If the chips show excessive crushing under the roller, the Engineer may cause this rolling to be omitted.

Second Seal Coat. Before traffic is allowed over the first seal coat, a second seal coat of approximately $\frac{3}{10}$ ths of a gallon of emulsified asphalt per square yard of surface area shall be applied evenly. It shall then be uniformly covered with clean stone chips in a quantity sufficient to take up all excess bituminous material, after which it shall be well broomed with a broom drag and thoroughly rolled. The finished surface shall be uniform and shall conform to the grades and cross-sections given.

4. Basis of Payment

This work shall be paid for at the contract unit price per cubic yard for "Bituminous Macadam Surface Course," measured in place after completion, in accordance with typical sections and plans, which price shall include all materials, equipment, tools, labor and all work incidental thereto, except the emulsified asphalt, and the

application of the same, which will be paid for at the contract unit price for "Emulsified Asphalt" per gallon of 231 cubic inches, measured at a temperature of sixty degrees Fahrenheit (60°F.).

Item 36-A--Bituminous Macadam Surface Course

Item 36-B--Emulsified Asphalt

BITUMINOUS CONCRETE SURFACE COURSE

CLASS I

SECTION 37

1. Description

This item shall consist of a pavement composed of a graded bituminous concrete primary course with a fine graded wearing course, constructed on the prepared base in accordance with these specifications and in conformity with the lines, grades, thickness and typical cross-section shown on the plans and unless otherwise specified shall have a one (1) inch primary course and a one (1) inch wearing course after compression.

The bituminous mixture shall be composed of "Mineral Aggregate," "Mineral Filler" and "Bituminous Material."

General Composition of Mixtures

The blended mineral aggregate shall be combined with the asphalt cement by methods hereinafter described so that the resulting mixtures, when tested by laboratory methods, shall comply with the following composition limits in which the percentages are by weight:

Mineral Aggregate

Proportionate Amt. (Square mesh sieves)	Primary Course	Wearing Course
Passing $\frac{3}{4}$ inch	100%	—
Passing $\frac{3}{8}$ inch	—	100%
Passing No. 4 mesh	25 - 40	35 - 75
Passing No. 10 mesh	18 - 38	30 - 55
Passing No. 20 mesh	15 - 35	24 - 45
Passing No. 40 mesh	8 - 25	10 - 40
Passing No. 80 mesh	—	5 - 19
Passing No. 200 mesh	—	3 - 8

Asphalt Cement

Bitumen (% of min. agg.)	4 - 6.5	6 - 8
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The portion of the fine aggregate passing the No. 10 sieve with mineral filler added, if required, shall meet the following requirements:

	Passing	Retained on	Per Cent
Aggregate	10 mesh	40 mesh sieve	15 to 40
Aggregate	40 mesh	80 mesh sieve	22 to 53
Aggregate	80 mesh	200 mesh sieve	15 to 35
Aggregate and filler	200 mesh		7 to 14

Job Mix

The composition limits given above are master ranges of tolerance to govern mixtures made from any raw materials or combinations thereof, proffered for use under these specifications and they are the maximum and minimum for all cases. A closer control within these ranges is intended for any specific project. No work shall be started on any specific project nor any mixture accepted therefor, until the Engineer has approved the job mix submitted by the Contractor in writing, indicating the percentage of each ingredient to be used in the mixture, and a resultant screen test and bitumen percentage from such combination. No change in this job mix shall be made without the approval of the Engineer.

Tolerances

Samples of the mixture will be taken as many times daily as necessary in the opinion of the Engineer. The

gradation of the aggregate and the bitumen content shall not vary from the fixed mean of formula by more than the following tolerances:

Aggregate passing sieve No. 4 and larger	6%
Aggregate passing sieve No. 10, 20, 40 and 80	5%
Aggregate passing sieve No. 200	2%
Bitumen	0.5%
Temperature of mixture	25°F.

The mixture shall have a density when thoroughly compressed of not less than ninety-five (95) per cent nor more than ninety-nine (99) per cent of the calculated density of a voidless mixture composed of the same materials in like proportions. Density of the voidless mixture shall be calculated by the following formula:

$$\text{Density of Voidless Mix} = \frac{100}{\frac{\% \text{ Min. Agg. by Wt.}}{\text{Sp. Gr. Min. Agg.}} + \frac{\% \text{ Asphalt by Wt.}}{\text{Sp. Gr. Asphalt}}}$$

2. Materials

Coarse Aggregate

The coarse aggregate shall consist of crushed stone which meets the following requirements:

The crushed stone shall consist of fragments of clean, durable stone free from soft, thin, elongated pieces, disintegrated stone, vegetable or other deleterious matter, and shall be obtained from ledge rock having a per cent of wear of not more than twenty-five (25) as determined by the Los Angeles method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96.

When called for in the Special Provisions crushed gravel or crushed stone meeting the following requirements may be used. The gravel or stone shall consist of clean, sound, tough, hard particles, free from dirt or foreign matter, and shall be washed if so directed. The gravel or stone shall have a per cent of wear of not more than ten (10) after one hundred (100) revolutions and not more than thirty-five (35) after five hundred (500)

revolutions as determined by the Los Angeles test made in accordance with the latest revised Methods of the A.A.S.H.O., Designation T-96.

Fine Aggregate

The fine aggregate shall be composed of sand or stone screenings or mixtures of the two. The sand shall consist of clean, hard, durable grains free from clay, loam or other foreign matter. The stone screenings shall be free from weathered particles and shall be produced from stone equal in quality to that specified for the coarse aggregate.

Asphalt Cement

The asphalt cement shall meet the following standard tests:

1. It shall be homogeneous, free from water and shall not foam when heated to 347°F.
2. Specific Gravity at 77°F.—not less than 1.00.
3. Flash Point—not less than 450°F. (Cleveland Open Cup Method).
4. Melting Point—104° to 140°F.
5. Penetration at 77°F., 100 g., 5 sec.—85 to 100.
6. Loss at 325°F., 5 hours—not more than 1.0%.
Penetration of residue at 77°F.—not less than 50% of original.
7. Total bitumen soluble in carbon tetrachloride—at least 99.5%.
8. Ductility at 77°F.—not less than 100 cm.

Testing

Tests of Coarse Aggregate, Fine Aggregate and Asphalt Cement shall be made in accordance with the latest revised Methods of the A.A.S.H.O.

Mineral Filler

The mineral filler shall consist of limestone dust, dolomite or trap rock dust or Portland cement and shall meet the following grading requirements:

Passing 30 mesh sieve	100%
Passing 200 mesh sieve	65 - 100

3. Construction Methods

Plant and Machinery

The paving plant used by the Contractor in the preparation of the bituminous concrete shall comply with the following requirement:

The drier shall be of the rotating cylindrical type suitably designed to heat and dry the aggregate to specification requirements and to continuously agitate the aggregate during heating. The drier shall be capable of preparing aggregate to the full rated capacity of the paving plant.

All plant screens shall be designed, constructed and operated so as to screen all aggregates to their specified sizes and proportions and shall have a capacity when operated at normal speed, slightly in excess of the maximum capacity of the mixer.

Bins shall be divided into at least three compartments so proportioned as to insure adequate storage of appropriate fractions of the aggregate. To insure this provision, compartment spaces should be adjustable within reasonable limits. Each compartment shall be provided with an overflow pipe which shall be of such size and at such location to prevent all backing up of material into other bins.

The plant shall have a weigh box of sufficient capacity to hold the maximum amount of the aggregate material for one batch. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not be easily thrown out of alignment or adjustment. Said weighing hoppers must be free from contact on all edges, ends or sides with any supporting rods or columns or other equipment that will in any way affect proper functioning. In addition there must be sufficient clearance between the hopper and supporting devices so that foreign material will not accumulate. The discharge gate of the weigh box shall be so hung that the aggregates will not be segregated when dumped into the mixer. If

necessary to correct any such tendency, baffles shall be inserted or other means provided to discharge the materials in a blended condition.

Scales for the weigh box may be either of the beam or springless dial type and shall be of a standard make and design.

All mineral aggregate shall be stock piled at the plant or approved stock yard forty-eight hours before being used. If the mineral aggregate requires blending, the blended material shall be stock piled at least forty-eight hours before being used. The stock piles shall be of such size and shape that only a minimum amount of segregation of materials will take place.

Tack Coat

This coat shall consist of an application of R-C-O or R-C-1 cutback asphalt over such parts of the existing pavement as indicated on the plans or called for by the Engineer. Before any asphalt is applied, the roadway shall be cleaned of all dirt, sand and loose material. Over the surface shall then be spread the asphalt at the rate of one (1) gallon per six (6) or eight (8) square yards. Two applications shall be made if necessary. When only small amounts of the tack coat are required it may be made by cutting back the asphalt specified for the base course with gasoline as directed by the Engineer.

Preparation and Mixing

The following method shall be used in the preparation of the wearing surface: From each of the several compartments the proper amount shall be proportioned into the weigh box and introduced into the twin pug mixer. When limestone dust or other mineral filler is used same shall then be added and allowed to mix for at least 10 seconds. The asphalt cement shall be heated to a temperature between 250° and 325°F. in a suitable kettle or tank and conveyed to the mixing platform by such means that it be not chilled to below 250°F. There it shall be

weighed in a suitable vessel suspended from an approved standard weighing device. The asphalt cement shall then be added and mixed for at least 55 seconds, or until a uniform mass is secured. The temperature of the aggregate shall be such that when discharged the mixture shall have a temperature between 250°F. and 300°F.

On projects requiring less than two thousand (2000) tons of mixture, a plant of the batch type equipped with a rotary mixer may be used if approved by the Engineer. If a batch type plant is used, the several grades and sizes of the mineral aggregate as delivered at the mixing plant shall be kept in separate piles. The amount of mineral aggregate required for a batch shall then be accurately measured in the proper proportions of the several sizes to give the best results and same shall be fed into an elevator terminating in a hopper or bin which discharges into a rotary drier or heater, both hopper and heater being so designed as to keep each batch by itself until thoroughly dried and heated. From the rotary heater a batch of mineral aggregate shall pass into a rotary cylindrical mixer containing blades, spirals or other devices for producing a uniform mixture of the mineral aggregate with a predetermined quantity of the separately heated asphalt cement sufficient to coat all the particles of the aggregate. The asphalt cement shall be heated to a temperature between 250° and 325°F. in a suitable kettle or tank and conveyed to the mixing platform by such means that it be not chilled to below 250°F. There it shall be weighed in a suitable vessel suspended from an approved standard weighing device. After the asphalt cement has been added the whole batch shall be mixed for at least 55 seconds before discharging it from the mixer. The temperature of the mixture shall be within the limits described above.

Transportation and Delivery of Mixture

The mixture shall be transported from the paving plant to the work in tight vehicles previously cleaned of

all foreign materials and when directed by the Engineer each load shall be covered with canvas or other suitable material of sufficient size and thickness to protect it from weather conditions.

Grade Control

The pavement shall be placed on a base which is parallel to the proposed finished surface of the course being laid and has been finished to the same surface tolerance as is required for such course. The finishing machine in use shall have a longitudinal wheel base of approximately ten (10) feet or more or the screed or strike-off action shall be controlled by a means of support of approximately ten (10) feet or more in length measured parallel to the direction of advance when in operation and such wheel-base or support, except as otherwise permitted below shall be in contact with the finished base surface and advance along it so as to provide continuous and positive mechanical control of the screed or strike-off assembly, and so as to strike off the mixture to the exact grade and elevation intended without the aid of manual adjustment during operation.

Machines otherwise meeting all requirements and having the forward supports riding on and in contact with the finished base surface may have the rear supports arranged to ride on the newly struck surface if in practice it is found that such method of support does not introduce or add any element of non-uniformity or inaccuracy and does not result in injury to the pavement due to sudden or severe application of power to such means of support riding on the newly struck course.

Spreading and Finishing

Prior to arrival of the bituminous mixture, the underlying course shall have been brought to exact line, grade and cross-section contour and shall be cleaned of all loose and foreign materials.

The mixture shall be delivered to the work in such condition that it is easily workable and can be efficiently laid by the methods prescribed below.

The mixture shall be laid only upon an approved underlying course which is dry and only when weather conditions are suitable. No mixture shall be placed when the air temperature in the shade and away from artificial heat is 40°F. or under. The engineer may, however, permit work of this character to continue when overtaken by sudden rains, up to the amount which may be in transit from the plant at the time.

Upon arrival at the work the mixture shall be spread and struck off exactly conforming to the profile grade or to a predetermined surface parallel thereto. It shall be handled by self-propelled mechanical spreading and finishing equipment approved by the Engineer and provided with a screed or strike-off assembly, either a combination machine or in multiple units, to distribute it into place either for the entire width or for such partial width lanes as may be practicable, and to strike it off to the transverse crown required. The screed assembly shall be adjustable to give the cross-section shape prescribed and shall be so designed and operated as to leave the pavement course of the weight per square yard required. Blade graders shall not be used.

If during the construction it is found that the spreading and finishing equipment in operation leaves in the new pavement, tracks or indented areas, which are not satisfactorily corrected by the scheduled operations or produces other permanent blemishes, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment provided by the Contractor.

The term "screed" includes any cutting, crowding or other practical action which is effective on the mixture at the workability specified and obtainable, without tearing, shoving or gouging, and which produces a finished surface of the evenness and texture specified.

The Primary Course shall be struck off to such a depth that after compression the thickness will be approximately 50% of the total surface course and will conform to the grade and surface contour required. The mixture shall then be compacted as required under the paragraph headed "Rolling." The Wearing Course shall then be spread in the same manner to such depth that after compression the thickness of this layer will be approximately 50% of the finished surface course and the two layers, having a combined thickness required by the plans, will conform to the grade and surface contour required.

In areas which, because of irregularity, inaccessibility, or other unavoidable obstacles, do not readily lend themselves to mechanical spreading and finishing, this may upon written approval of the Engineer, be accomplished by hand. When hand spreading is permitted, the mixture shall be dumped upon arrival on approved steel dump sheets outside the area on which it is to be spread and shall then be immediately distributed into place by means of shovels and spread with rakes in a uniformly loose layer the full width required and of such depth that when compacted the courses shall have at least the thickness above specified and will conform to the grade and surface contour required.

On relatively small projects such as bridge floors, approaches, etc., and where there is no mechanical spreading machine in the vicinity, the Contractor may, upon written approval of the Engineer, spread the mixtures by hand as above described and may be permitted to use only one roller for securing compression.

Rolling

After placing, the mixture shall be thoroughly and uniformly compressed by rolling. Two rollers shall be used for securing compression. One shall be an eight to ten ton tandem roller and the other shall be at least an eight ton roller of either the tandem or three wheel type.

All rollers shall be kept in good condition and shall weigh not less than two hundred and fifty (250) pounds to the inch width of tread. Each roller shall be in charge of a competent, experienced roller operator, and while the work is under way must be kept in continuous operation as nearly as practicable. The ashes from the roller must not be dumped upon the course. Rolling shall start longitudinally at the sides and proceed toward the center of the work, overlapping on successive trips by at least one-half of the width of the rear wheel of the roller. The work shall then be subjected to a diagonal rolling in two directions, the second diagonal rolling crossing the lines of the first. If the width of the work permits, it shall in addition be rolled at right angles to the centerline. Rolling shall be continued until all roller marks are eliminated. The motion of the roller at all times shall be slow enough to avoid displacement of the mixture, and any displacement occurring as a result of the reversing of the direction of the roller, or from any other cause shall at once be corrected by the use of rakes, and of fresh mixture when required. Rolling shall proceed at an average rate not to exceed two hundred (200) square yards per hour per roller. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water will not be permitted.

Along forms, curbs, headers, and similar structures and all places not accessible to the roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall weigh not less than twenty-five pounds and shall have a tamping face area of not more than fifty (50) square inches. The surface of the mixture after compression shall be smooth and true to the established crown and grade. Any mixture which becomes loose and broken, mixed with dirt, or in any way defective prior to the acceptance of the work, shall be removed and replaced with fresh mixture, which shall be immediately compacted to conform with the surrounding area. Areas of one

square foot or more showing an excess of asphalt cement shall be removed and replaced.

Joints

Placing of the course shall be as nearly continuous as possible; and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is to be discontinued for such length of time as to permit the mixture to become chilled. In all such cases, provision shall be made for proper bond with the new surface for the full specified depth of the course, by painting with the cut-back asphalt specified under Tack Coat.

Surface Test of the Course

No portion of the finished course shall be more than $\frac{1}{4}$ inch below a templet, cut to the crown shown on the cross-section drawings, placed on the course at right angles to the centerline of the road and no portion shall be more than $\frac{1}{4}$ inch below a straight edge ten (10) feet in length nor more than $\frac{1}{8}$ inch below a straight edge three (3) feet in length, laid on the course parallel with the centerline of the road. Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compression, and variations corrected by removing or adding material as needed. The rolling shall then be continued as specified.

Field Laboratory

The Contractor shall provide a field laboratory in which to house and use testing equipment. This laboratory is to be maintained for the exclusive use of the Engineer or inspectors, and shall be so located that details of the Contractor's plant are plainly visible from one window of the building.

4. Method of Measurement

The yardage to be paid for under this item shall be the number of square yards of Bituminous Concrete Surface Course in place, completed and accepted.

5. Basis of Payment

The yardage measured as provided above shall be paid for at the contract unit price per square yard bid for "Bituminous Concrete Surface Course" which price shall be full compensation for furnishing and placing all materials, and for all labor, equipment, tools and incidental work necessary to complete the item, except the tack coat which will be paid for at the contract unit price per gallon for "Tack Coat."

Item 37-A--Bituminous Concrete Surface Course

Item 37-B--Tack Coat

CEMENT CONCRETE PAVEMENT

SECTION 38

1. Description

This pavement shall be a one course cement concrete pavement composed of Portland cement, water and both fine and coarse aggregate, all of which shall be of such quality and mixed in such proportions as hereinafter particularly described and specified. It shall be reinforced with steel as shown on the plans or directed by the Engineer. The pavement shall be constructed on the subgrade or prepared base course in conformity with the plans and typical cross-sections and in accordance with these specifications.

2. Materials

Portland Cement. (a) The Portland cement used shall be a standard American brand which shall comply with the requirements and tests of the Standard Specifications and Tests for Portland Cement adopted by the A.A.S.H.O., Specification M-85-Type II, with any subsequent amendments and additions thereto adopted by the Association. Unless otherwise permitted by the

Engineer, the cement shall be of one brand and produced by a single mill.

(b) The cement shall be tested by an experienced cement tester selected by the Engineer. No cement shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

(c) The Contractor shall provide suitable buildings and means for storing and protecting the cement from dampness. Any shipment of cement received on the work which has been sampled, but not finally accepted, shall be stored not more than eight (8) bags high in a separate storage place from any other cement which has been accepted.

Cement which has become caked shall not be used, and when rejected by the Engineer, it shall be removed by the Contractor, at his expense, from the vicinity of the work without delay.

Aggregates. Aggregates shall consist of sand and gravel or crushed stone. All sand pits, gravel pits and quarries shall be thoroughly stripped of vegetation and overburden for a sufficient depth and area so that the underlying material to be used for aggregate will not be contaminated from this source. The depth of such stripping in the case of pits shall be determined by the Engineer by making tests for organic impurities throughout the depth of the pit face or of test holes. At quarries the entire overburden shall be removed exposing the rock surface. All aggregates shall be thoroughly washed if directed by the Engineer.

The aggregates shall be stockpiled at the plant or approved stock yard at least twenty-four (24) hours before being used. If the fine aggregate requires blending, the blended material shall be stockpiled at least twenty-four hours before being used. The stock piles shall be of such size and shape that only a minimum amount of segregation of materials will take place. Aggregates of

approved grading delivered by railway need not be stockpiled.

Fine Aggregate. The fine aggregate shall consist of sand or a combination of sand and stone screenings, free from frost or frozen lumps, conforming to the following requirements:

(a) **Sand.** The sand shall consist of clean, hard, durable, uncoated stone particles, preferably siliceous, free from lumps of clay, soft or flaky particles, loam, and all organic matter.

It shall be well graded from coarse to fine, and when tested by means of laboratory sieves shall meet the following requirements:

	Per Cent
Passing $\frac{3}{8}$ " sieve	100
Passing 4 mesh sieve	95 - 100
Passing 16 mesh sieve	45 - 80
Passing 50 mesh sieve	10 - 30
Passing 100 mesh sieve	4 - 8

Not more than 3 per cent by weight shall be removed by the elutriation test.

For the purpose of controlling uniformity on any one project, a tolerance of two-tenths in fineness modulus will be allowed.

(b) **Strength Tests.** When subjected to the structural strength test, mortar specimens containing the fine aggregate shall develop a compressive strength at the age of seven (7) days when using Type II cement of not less than eighty-five (85) per cent of the strength developed by a mortar prepared in the same manner with the same cement and graded Ottawa sand having a fineness modulus of 2.40 ± 0.10 . Type II cement is prescribed in the Standard Specifications for Portland Cement of the A.A.S.H.O., Designation M-85.

(c) **Absorption.** When subjected to the test for Absorption prescribed in the latest revised Standard Meth-

ods of the A.A.S.H.O., Designation T-84, the fine aggregate shall show a per cent of absorption of not more than 2.3.

(d) **Combination of Stone Screenings and Sand.** When approved by the Engineer, a combination of washed or dustless stone screenings and sand, containing not more than fifty (50) per cent by volume of screenings, may be used for fine aggregate. Screenings so used shall be obtained by crushing hard, durable rock having a per cent of wear as specified for crushed stone. Fine aggregate so combined shall meet all the requirements specified herein for the grading and strength of sand.

Coarse Aggregate. The coarse aggregate shall consist of either crushed stone or gravel which meets the following requirements:

(a) **Crushed Stone.** The crushed stone shall consist of fragments of clean, durable stone free from soft, thin, elongated pieces, disintegrated stone, vegetable, or other deleterious matter, and shall be obtained from rock having a per cent of wear of not more than thirty-five (35) as determined by the Los Angeles Method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96, except that in the case of native granite the per cent of wear obtained by the above method shall not exceed forty-five (45).

(b) **Gravel.** Gravel, when used, shall consist of clean, sound, tough, hard stone, free from dirt or foreign matter, and shall be washed if so directed.

Gravel which is 50 per cent crushed shall be considered as crushed stone and shall meet the requirements therefor.

Gravel which is less than 50 per cent crushed shall have a per cent of wear of not more than ten (10) after 100 revolutions and not more than thirty-five (35) after

500 revolutions as determined by the Los Angeles abrasion test for gravel, made in accordance with the latest revised Methods of the A.A.S.H.O., Designation T-96.

Unscreened gravel shall not be used.

(c) **Grading.** The coarse aggregate, crushed stone or gravel, shall be uniformly graded between the limits specified, and when tested by means of square laboratory sieves shall meet the following requirements:

	Per Cent
Passing $2\frac{1}{2}$ -inch sieve	100
Passing 2-inch sieve not less than	95
Passing 1-inch sieve	35 - 70
Passing $\frac{1}{2}$ -inch sieve	10 - 30
Passing No. 4 sieve	0 - 5

Coarse aggregate shall be delivered in two (2) sizes which shall be kept separate until the proportion of each size for each individual batch is separately weighed. The small size of coarse aggregate shall range between that retained on the No. 4 sieve and that passing the one (1) inch sieve; the coarser size shall range between that retained on the one (1) inch sieve and that passing the two and one-half ($2\frac{1}{2}$) inch sieve. The two sizes of coarse aggregate shall be used in approximately equal proportion by weight, however, the Engineer may adjust this ratio to improve density and workability as may be desirable.

Water. The water used in mixing concrete shall be clean, fresh, and free from oil or organic matter.

The water shall have a pH value of 4.5 to 8.5 when tested for acidity.

Mortar made with the water to be used shall not have a variation of more than ten (10) per cent in tensile strength when mixed in a standard 1:3 mortar with Ottawa sand from results obtained with the same mix in which distilled water is used.

Reinforcing Steel. All reinforcing steel shall be furnished and placed as shown on the plans, and as provided in these specifications under "Steel Reinforcement for Concrete Pavement."

Premoulded Expansion Joint Filler. The premoulded filler to be used in the transverse joints shall be one of the following types unless otherwise designated on the Plans or Special Provisions: Premoulded Bituminous Fiber, Premoulded Cork or Premoulded Cork Rubber. It shall have a thickness of one-half ($\frac{1}{2}$) inch, unless otherwise provided and a depth equal to one-half ($\frac{1}{2}$) inch less than the thickness of the pavement at the place where the joint is to be installed. The filler shall be cut to conform to the cross-section of the pavement and shall be furnished in strips having a length equal to the width of the pavement slab being constructed.

The transverse joint filler shall be installed with the use of a satisfactory removable metal cap, as directed by the Engineer.

The premoulded expansion joint filler shall meet the latest revised Standard Specifications of the A.A.S.H.O., M-58 or M-59.

Bituminous Material for Sealing Joints. This bituminous material shall be an approved asphaltic cold patch material and shall be furnished by the Contractor.

3. Construction Methods

Forms. Outside and center forms for this work shall be of metal, not less than ten (10) feet in length, except as hereinafter provided for the use of wood forms on curves having a radius of less than one hundred fifty (150) feet.

The depth of all forms shall equal the depth of the concrete and no horizontal joints shall be allowed. Forms shall be straight, free from warps, and of sufficient strength, when staked to resist the pressure of the concrete and finishing machine or finishing tools without

springing or settlement. The Engineer may require the Contractor to operate the finishing machine and subgrader over the forms prior to the placing of concrete to determine whether they will remain true to line and grade, and forms developing defects or weakness under this operation shall be rejected.

The width of the base of steel forms shall be at least five (5) inches for forms having a depth less than eight (8) inches, and the width of the base for forms of eight (8) inches and over shall be not less than six (6) inches.

Only approved steel forms shall be used, weighing not less than nine (9) pounds per lineal foot for seven (7) inch forms, not less than ten (10) pounds per lineal foot for eight (8) inch forms, and not less than eleven (11) pounds per lineal foot for nine (9) inch forms, exclusive of attachments, wedges and pins.

When a power-driven finishing machine is used the roadway forms shall be of metal with a minimum thickness of three-sixteenths ($3/16$) of an inch.

The use of wood or steel blocks to secure the required depth of section shall not be permitted.

Forms that become bent or deformed shall be condemned and immediately removed from the work until satisfactorily repaired and straightened. Forms so repaired shall be inspected and approved by the Engineer before being returned to the work.

The subgrade or base course shall be prepared, and forms shall at all times be set and kept true to line and grade, at least two hundred feet in advance of the mixer.

Whenever the subgrade or base course is incapable of bearing the weight of forms, finishing machine or finishing tools, without settlement, the Engineer may require suitable stakes driven to the grade of the bottom of the forms, sufficient in number to give the necessary support. The Engineer may, however, require additional bearing area under the forms by securely fastening them to planks secured to the subgrade by the required number of pins.

The planks shall be of such width and so fastened that no settlement or displacements occur.

The entire length of the form shall be set directly in contact with the finished subgrade or base course which shall be compacted by rolling for at least twelve (12) inches on each side of the roadway outside of the area required for the pavement. The building of pedestals of earth or other material upon which to rest the forms in order to bring them up to the required grade shall not be permitted.

In setting the forms joints shall be staggered. The length and number of pins for staking forms shall be increased, if necessary, to maintain the forms to correct line and grade, but in no case shall less than three (3) be used to each ten (10) foot section.

(a) **Wood Forms.** Wood forms shall be used for curves having a radius of less than one hundred fifty (150) feet. They shall be made of two (2) inch surfaced well seasoned planks of a width equal to the depth of the pavement. Wood forms shall be staked with at least five (5) steel pins eighteen inches in length and three-fourths ($3/4$) of an inch in diameter for each ten (10) feet of form.

Sufficient forms shall be provided so that it will not be necessary to remove them in less than twenty-four hours after the concrete has been placed.

Forms shall be cleaned and oiled before concrete is placed.

Handling Material. At no time shall aggregate be piled upon the subgrade or prepared base course or upon the sides of the road.

When stock piles are formed at loading plants or other distributing points, the materials shall be piled on space that has been properly prepared and the piles shall be of such shape and size that materials may be stored and handled without becoming dirty or mixed with foreign substances.

Cement shall be emptied directly from the shipping package into the charging skip of the mixer or shall be transported in its original package to the mixer in closed compartments, for each batch, supplied with a water-proof cover.

Bulk cement may be used if transported to the mixer in a separate waterproof compartment. All methods of handling and weighing bulk cement must meet with the approval of the Engineer.

Batching plants shall have at least three bins for separating the fine aggregate and the two sizes of coarse aggregate.

Weighing Equipment. Only weight batching apparatus approved by the Engineer will be allowed. The equipment shall be platform operated and the weighing beam or dial shall be in full view of the operator when he is in a position to operate the gate which delivers materials to the weighing hopper. Readings of the beam or dial of the scale shall agree, when tested with test weights, within four-tenths (0.4) of one per cent. The equipment shall be capable of weighing to five (5) pounds and at least that part of the total load of fine and coarse aggregate which is a fraction of one hundred (100) pounds shall be indicated on a graduated beam or dial. Bins must be equipped with an auxiliary volume control so arranged as to provide for the convenient removal of excess material in case of overloading in order that the beam or dial scale may be brought to the proper balance for each batch.

■ In case beam scales are used the normal position of the beam shall be horizontal and it shall have equal play above and below the horizontal position. To insure speed of operation, beam scales shall also be equipped with a beam balance indicator that will operate accurately when within one hundred fifty (150) pounds of the required weight. All parts of the scales shall be of steel or manganese bronze, so located that all knife edges of fulcrums,

clevises or shackles and exposed parts may be kept clean and protected as far as possible from dust and dirt. All levers exposed on the operating platform shall be inclosed to prevent injury.

Beam weights shall be provided with set screws so that they may be rigidly attached to the beam to avoid the possibility of accidental movement. The Contractor shall provide ten (10), fifty (50) pound weights, accurate to one-half ($\frac{1}{2}$) pound, for calibration purposes. The Contractor will be required to check with the weights the accuracy of the scales. The scales shall be checked for balances from two (2) to five (5) times daily. This may be done when the hopper is empty, by moving the sliding poise to the zero graduation on the scale beam and removing the weights from the weight pan. All fulcrums and clevises must be free from dirt and the hopper empty. If the beam does not balance in a horizontal position and no cause can be found for the inaccuracy, the counterpoise shall be moved until the beam balances in a horizontal position.

When dial scales are used, only the automatic, springless type will be allowed. The dial shall be of a diameter sufficiently great to be easily and accurately read by the operator without his leaving the hopper control levers. The dial shall be equipped with pointers that can be set at any desired position on the rim. The same care in maintaining the proper adjustment of the scales will be required as in the case of the beam scales.

Transporting Equipment. All aggregates including both coarse and fine shall be proportioned by weight at a central batching plant and transported to the mixer in pneumatic tired trucks with compartments of sufficient size to prevent spilling from one compartment to another, either in transit or when emptying the contents of the compartments into the skip of the mixer. The compartments shall be constructed of suitable material so as to insure, at all times, against any loss of fine or coarse aggregate.

Water Supply. The Contractor shall furnish pipe and pumps of sufficient size to furnish an adequate supply of water for the operations described in these specifications.

The concrete pavement in place for eight (8) days after laying, and the subgrade preparation shall have prior rights to the water supply. If it should develop that there is not sufficient water for all purposes, the cement mixer shall be shut down until the water needs of the curing and subgrading operations have been cared for.

Composition. The concrete shall be proportioned by weight and for this purpose one (1) bag of cement weighing ninety-four (94) pounds net shall be considered the equivalent of one (1) cubic foot.

The actual proportioning by weight shall be on a dry basis in accordance with the following table and shall correspond to the void content and specific gravity of the coarse aggregate and the specific gravity of the fine aggregate which are to be used in the work.

**Weights of Fine and Coarse Aggregate
per Bag of Cement**

Voids in Coarse Aggregate Per Cent	Weights of Fine Aggregate Pounds Per Bag of Cement					Weights of Coarse Aggregate Pounds Per Bag of Cement				
	Specific Gravity of Fine Aggregate					Specific Gravity of Coarse Aggregate				
	2.55	2.65	2.75	2.85		2.55	2.65	2.75	2.85	2.95
35	123	128	133	137		344	358	371	385	398
40	149	155	161	167		318	330	343	355	367
45	176	183	190	197		291	303	314	325	337
50	202	210	218	226		265	275	285	296	306

Note:—The figures in the above table are based on six and one-half ($6\frac{1}{2}$) bags of cement per cubic yard of concrete. In no case shall the cement factor fall below 1.55 barrels per cubic yard of concrete.

The specific Gravity of sand and coarse aggregate proposed for use shall be ascertained by the Engineer in

advance of the work and the batch weights calculated from the various amounts given in the table above shall be used.

The relative weights of fine and coarse aggregate determined as proposed above may be varied slightly by the Engineer during the progress of the work, in order to improve workability. However, the sum of the fine and coarse aggregate shall not be varied unless tests by the Engineer indicate that the specific gravity of either or both of the aggregates has changed.

Consistency. The amount of water used shall be such that the consistency of all batches will be uniform. The water shall be accurately measured and gauged and shall be discharged automatically into the mixer with the aggregate. A consistency in which there is any tendency towards segregation of the aggregates shall not be permitted. The concrete mix shall contain no more water than is necessary to produce a workable mass which can be brought to a satisfactory finish in the pavement.

The quantity of water inclusive of that contained in the aggregates shall be not more than five and one-half ($5\frac{1}{2}$) gallons per bag of cement, and if in the opinion of the Engineer the desired consistency and workability can be obtained with a less amount of water, the quantity shall be reduced until the minimum amount necessary for the desired consistency, plasticity and workability is obtained.

The consistency of the concrete under a visual examination shall conform to the following requirements:

The batch of concrete when deposited upon the subgrade shall tend to settle slowly. The concrete at the edges of the batch shall have a tendency to roll rather than to run. As the batch settles, the individual pieces of aggregate, which should be thoroughly coated with mortar, should crack or break away from adjoining pieces of aggregate. The concrete shall be of such consistency that there will be no glistening of the mortar from an excess of water.

When required by the Engineer, the consistency of the concrete shall be measured by a slump test. The test specimen shall be formed in a mold of No. 16 gauge galvanized metal in the form of the frustum of a cone with the base eight (8) inches in diameter, the upper surface four (4) inches in diameter, and the altitude twelve (12) inches. The base and top shall be open and parallel to each other and at right angles to the axis of the cone.

The sample shall be taken from the pile of concrete immediately after the entire batch has been discharged.

The mold shall be placed on a flat, non-absorbent surface, such as a smooth plank or a slab of concrete, and the operator shall hold the form firmly in place, while it is being filled. The mold shall be filled to about one-fourth of its height with the concrete which shall then be puddled, using 20 to 30 strokes of a $\frac{1}{2}$ -inch rod pointed at the lower end. The filling shall be completed in successive layers similar to the first and the top struck off so that the mold is exactly filled. The mold shall then be removed by being raised vertically, immediately after being filled. The molded concrete shall then be allowed to subside until quiescent and the height of the specimen measured. Twelve minus the measured height in inches shall be known as the slump and for concrete pavement should not be less than two (2) or more than three (3) inches.

Mixing Conditions. Concrete shall not be placed at any time when the temperature is below forty (40) degrees Fahrenheit, and whenever in the opinion of the Engineer, the temperature is liable to drop below that point within forty-eight (48) hours after the placing of any concrete, the Contractor shall take all necessary precautions to prevent damage to the pavement so placed. If the concrete should be appreciably affected by frost, it shall be removed by the Contractor, at once, at his expense, and rebuilt.

The concrete shall be mixed only in such quantities as are required for immediate use and any which has developed initial set, or has been mixed longer than thirty (30) minutes shall not be used.

Concrete shall not be placed upon a frozen subgrade. Chemical compounds to prevent damage by freezing shall not be allowed, except as ordered and approved by the Engineer.

Mixing. (a) **Operation of Mixer.** The concrete shall be mixed in a batch mixer with the "boom and bucket" type of delivery. The capacity of the mixer shall be such that only whole bags of cement are used in each batch and no mixer shall be used having a capacity of less than a two (2) bag batch. The mixer shall be of a type which will insure a uniform distribution of all the materials, including water, throughout the mass, until the mixture is uniform in color and smooth in appearance. No mixer shall be kept on the work which is not in condition to fulfill all its functions at all times. The volume of the mixed material in each batch shall not exceed the mixer manufacturer's rated capacity of the drum.

The mixer shall be equipped with a timing device which will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. During the progress of the work should the timing device become broken, or out of order, the Contractor will be permitted to operate while the same is being repaired provided each batch is mixed one and one-half ($1\frac{1}{2}$) minutes and providing repairs are made promptly.

The mixer shall also be equipped with a water measuring tank containing an adjustable overflow and with the necessary valves to prevent water flowing into the tank while the tank is discharging into the mixer. No mixing shall be permitted when valves are leaking or otherwise out of order.

All the materials, including the water for each batch of concrete, shall be discharged into the mixer at the same time, and shall be mixed at least one and one-quarter ($1\frac{1}{4}$) minutes after all the materials, including the water, are in the drum. During the time of mixing the drum shall revolve at a speed of not less than fourteen (14) nor more than twenty (20) revolutions per minute. The batch shall be immediately discharged from the mixer after it has been mixed, and shall not be allowed to stand in the drum more than five (5) minutes.

The entire contents shall be removed from the drum before the materials for the succeeding batch are deposited therein. The drum and hopper shall be kept clean at all times. At the direction of the Engineer, the time of mixing required for any particular type of mixer, after all the materials and water have been deposited in the drum, may be increased depending upon the plasticity of the mix turned out with a given amount of water, but the time in any case shall not exceed one and one-half ($1\frac{1}{2}$) minutes.

(b) **Truck Mixer.** Truck mixing shall not be used unless approved by the Engineer. The truck mixer shall be of a type approved by the Engineer, equipped with a belt conveyor or other approved means of placing the concrete. The concrete mixed by the truck mixer shall be mixed thoroughly for a period of not less than five (5) minutes after all materials are in the drum.

(c) **Retempering.** Retempering of concrete shall be prohibited, and all concrete which has become partially set shall immediately be removed from the vicinity of the work. Any batch of concrete which has begun to harden in the drum shall be rejected by the Engineer and removed from the work.

(d) **Hand Mixing.** Hand mixed batches will not be allowed except in an emergency, and if allowed, they shall not exceed one-half ($\frac{1}{2}$) cubic yard. In such cases, the batch shall be subject to the immediate direction and approval of the Engineer.

Subgrade Conditions. Immediately before placing the concrete the subgrade or base course between the mixer and the concrete shall be checked with an approved template, provided by the Contractor, and shall be brought to a true grade conforming to the required cross-sections. All irregularities in the subgrade shall be removed prior to the placing of any concrete thereon. If loose material is thrown in to bring the surface to grade it shall be thoroughly tamped with an approved tamper.

Concrete shall be placed only on a moist subgrade, but there shall be no pools of standing water. If the subgrade or base course is dry, it shall be sprinkled with as much water as it will absorb readily.

Placing Concrete. The concrete shall be built in lanes of the width shown on the plans. An interval of at least seven days or a shorter period if permitted by the Engineer, shall elapse between placing adjacent lanes of pavement. All edges shall be protected by planking or other approved method when traffic is permitted prior to completion of the full pavement width.

The mixed concrete shall be deposited rapidly on the subgrade or base course to the required depth and for the entire width of the slab in successive batches, and in a continuous operation without the use of intermediate forms or bulkheads between joints. While being placed, the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honeycomb pockets. The concrete shall be especially well spaded and tamped along all joints and on the inside of forms. Rakes shall not be used for handling concrete.

Sufficient concrete shall be placed so that after being compacted by the screed or template used in finishing it will not be compressed below the required grade.

Whenever the placing of concrete is to be suspended for more than thirty (30) minutes, a transverse joint shall be formed as herein specified, at the point of stopping work, providing that the section on which work has been

suspended shall be not less than fourteen (14) feet in length.

In case of a breakdown or unavoidable interruption the concrete may be mixed by hand in order to complete the minimum length of slab. All hand mixing shall be done under the immediate direction and approval of the Engineer and batches so mixed shall not exceed one-half ($\frac{1}{2}$) cubic yard. Such work shall proceed within the period of thirty (30) minutes after the previous batch has been deposited, otherwise the concrete shall be removed at the Contractor's expense and rebuilt. Any concrete placed beyond a transverse joint and not completed as specified, shall be removed.

Joints. Joints shall be formed where shown on the plans or directed by the Engineer. They shall be perpendicular to the surface of the pavement and at right angles to the center line. Expansion joints shall be formed around all objects that project through the pavement, such as manholes, catch basins, etc.

(a) **Transverse Expansion Joints.** Transverse expansion joints shall be full length and full depth, straight, and perpendicular to the surface area axis of the pavement, and shall be constructed at intervals of eighty (80) feet unless otherwise shown on the plans. The transverse joints in the last half of the pavement shall be placed directly opposite the joints in the completed half.

The joints shall be not less than one-half ($\frac{1}{2}$) of an inch in thickness and shall be formed during the placing of the concrete, by securely staking an iron or steel bulkhead at right angles to the center line, and exactly perpendicular to the surface of the pavement, against which the premoulded joint filler shall be placed. The joint filler shall be held firmly in place, straight and to the required grade, by means of pins or other approved installing device. The bulkhead shall be at least three-eighths ($\frac{3}{8}$) of an inch in thickness, and of a width equal to the

depth of the pavement, and of a length not more than one-half ($\frac{1}{2}$) inch less than the width of the pavement slab. After the concrete has been placed on both sides of the joint, the bulkhead shall be removed carefully so that the transverse joint filler will not be disturbed. If, due to widened curves, the filler is in more than one piece the ends shall be carefully butted and stapled together with metal staples of suitable size and dimensions to fasten and hold the ends of the filler in place. At least two staples shall be used at each junction of joint filler. The filler shall be set and maintained on a straight line across the full width of the pavement and shall not become warped or disconnected.

The bulkhead plate shall be provided with suitable openings so that it may be withdrawn without disturbing the transverse dowels, and must be kept straight, free from mortar or rust, and oiled when ordered. After the side forms are removed the ends of the joints shall be cleaned of all concrete to the full depth of the pavement.

Transverse expansion joints shall be dowelled with three-quarter ($\frac{3}{4}$) inch plain round bars of the length and spacing shown on the plans. Dowels must be accurately held in place perpendicular to the plane of the cross-section of the pavement. One-half of the dowel shall be coated with bituminous material sufficient to break the bond and provided with a six (6) inch approved tight fitting metal cap which will allow an expansion of three-quarters ($\frac{3}{4}$) of an inch.

Transverse joint assemblies shall be used in place of dowels when called for on the plans. Such assemblies shall be of the type shown on the plans or approved by the Engineer.

(b) **Transverse Contraction Joints.** Transverse contraction joints shall be placed midway between expansion joints. Whenever the mixer is stopped for more than thirty (30) minutes a contraction joint shall be placed, but in no case shall the distance between joints

be less than fourteen (14) feet. These joints shall be provided with load transfer devices similar to those specified for transverse expansion joints, except that the use of metal caps will not be required. Directly over the center of the load transfer device a slot shall be formed in the slab as specified for dummy joints.

(c) **Transverse Dummy Joints.** Transverse dummy joints shall be constructed midway between contraction and expansion joints. They shall be constructed by forming in the surface of the slab a slot of the dimensions shown on the plans. The slot, formed in the soft concrete by a suitable tool or device, shall extend across the width of the slab in a straight line and shall extend vertically downward from the surface to the depth shown.

(d) **Longitudinal Joints.** Longitudinal joints between lanes shall be of the tongue and groove type of the dimensions shown on the plans. These joints shall be provided with tie-bars of the type, size, and spacing shown on the plans and complying with the Specifications for "Reinforcing Steel for Concrete Pavement," Section 39. Unless otherwise approved, tie-bars shall be installed in a right angle bent position. The half length resting against the side form shall be protected by an approved shield which also serves the purpose of providing the tongue and groove feature. The shield shall be straight and continuous in length and shall be securely held against the form. Tie-bars shall be bent out to a straight position before adjacent concrete is placed.

The face of the longitudinal joint shall be painted with bituminous material approved by the Engineer before an adjacent lane is constructed.

Finishing Concrete. Experienced concrete finishers must be employed at all times in finishing the surface of the pavement. At no time shall more concrete be laid than can be properly finished and covered during daylight, unless a lighting system, approved by the Engineer, is installed.

(a) **Machine Finishing.** Concrete surface finishing machines of a type approved by the Engineer shall be used, and an experienced operator, satisfactory to the Engineer, must at all times be in charge of the machine. A hand screeding template shall be kept on the work ready for use in case the finishing machine breaks down.

All mortar brought to the surface by the finishing machine shall be carried ahead and deposited on the subgrade. In no case shall this mortar be used to fill depressions in the surface of the concrete. Special care shall be taken to remove any accumulation of this mortar at transverse joints.

Unless otherwise ordered by the Engineer, the machine finisher shall be immediately followed by longitudinal floating as specified.

(b) **Longitudinal Floating.** The entire surface shall be floated longitudinally with an approved float board not less than sixteen (16) feet long and eight (8) inches wide. The float board shall have convenient plow-handles at each end. It shall be operated by two (2) men, one at each end, each man standing on a bridge spanning the pavement. The lower surface of the float board shall be placed upon the surface of the concrete with the long dimension parallel to the center line of the pavement. The float shall then be drawn back and forth in slow strokes about two (2) feet long, and advancing slowly from one side of the pavement to the other. The purpose of this operation is to produce a uniform even surface on the concrete, free from transverse waves. The two bridges on which the workmen stand should be placed about eighteen (18) feet apart when the length of the float is sixteen (16) feet. When the entire width of the pavement has been floated in this manner from one position of the bridges, they shall be moved ahead about twelve (12) feet so that the next section to be floated shall overlap the one previously so floated from three (3) to four (4) feet. After this floating has been completed,

and all transverse waves eliminated, the surface shall be finished by the belting process specified herein:

(c) **Belting.** The concrete shall be finished by using a belt of wood, canvas, or rubber, not less than six (6) inches nor more than twelve (12) inches wide, and at least two (2) feet longer than the width of the pavement. The belt shall be applied with a combined crosswise and longitudinal motion. For the first application vigorous strokes at least twelve (12) inches long shall be used, and the longitudinal movement along the pavement shall be very slight. The second application of the belt shall be immediately after the water sheen disappears, and the stroke of the belt shall be not more than four (4) inches, and the longitudinal movement shall be greater than for the first belting. Care shall be observed in the use of the belt not to permit the edges to dig into the surface of the concrete or to work the crown out of the surfacing. All belts shall be removed from the pavement surface between applications.

(d) **Testing and Correction of Irregularities.** The surface of the pavement shall be tested after the first belting with a ten (10) foot straight edge attached to a handle to detect waves and irregularities in the surface and such waves and irregularities must be corrected immediately. Should there appear on the concrete pavement surface any unevenness amounting to one-quarter ($\frac{1}{4}$) of an inch or over, then the Contractor shall at once take such means as will be effective to remove such unevenness and produce a true and uniform surface. Transverse joints shall show no unevenness greater than one-eighth ($\frac{1}{8}$) of an inch.

On steep grades and super-elevated curves, where there is a strong tendency for the concrete to flow, and the surface to become uneven after the concrete has apparently been finished, the Contractor shall continuously use the straight edge and shall use every means to keep the concrete smooth until it has hardened sufficiently to become stable.

If any part of the pavement surface appears defective or does not have the required finish, the Engineer may order such places finished by hand with a wood float from a suitable bridge, no part of which shall touch or come in contact with the concrete. The float shall be used in such manner as to produce a surface free from depressions or irregularities of any kind.

(e) **Brooming.** Before the concrete has taken its initial set the surface shall be lightly broomed uniformly with a steel or barn broom at right angles to the center line.

(f) **Testing Surface.** After the concrete has hardened, the surface of the pavement shall be again tested with a ten-foot straightedge. Any portion of the pavement which shows an unevenness of more than one-quarter ($\frac{1}{4}$) inch, or of more than one-eighth ($\frac{1}{8}$) inch at the transverse joints, shall, unless otherwise directed by the Engineer, be removed and replaced by and at the expense of the Contractor.

(g) **Finishing at Joints and Edges.** The upper edges of the pavement shall be rounded and tooled for a width of two (2) inches. At transverse expansion joints and at longitudinal joints the rounding shall have a radius of one-half ($\frac{1}{2}$) inch. At transverse contraction and dummy joints the rounding shall have a radius of one-quarter ($\frac{1}{4}$) inch. Final tooling shall be done after the surface has been broomed. The finishing of joints shall be done from a bridge which shall not rest on the concrete at any point.

(h) **Removal of Forms.** Forms shall not be removed for fifteen hours (or for a longer period if directed by the Engineer) after the concrete has been placed. Any honeycombs shall be pointed as soon as the forms are removed.

(i) **Hand Screeding.** Hand screeding, if permitted by the Engineer, shall be done in the following manner:

After the concrete has been placed it shall be struck off and brought to the specified contour by means of a steel template of approved section, having a bearing of at least six (6) inches on the surface of the concrete. The template shall weigh not less than twenty (20) pounds per linear foot, and shall be at least two (2) feet longer than the width of the pavement to provide a bearing on the side forms; it shall be shaped to the cross-section of the pavement, and have sufficient strength to retain its shape under all working conditions.

It shall be equipped with handles so constructed that the workmen can easily manipulate it in the manner required. The template shall be moved with a longitudinal and crosswise motion, moving on the side forms in the direction in which the work is progressing.

Care shall be taken in moving the template forward, during the screeding process, that it is not lifted from the side forms, but shall be held securely against the top of the forms and moved forward uniformly. A slight excess of material must be kept in front of the template at all times during the screeding. Concrete shall be added where required, and the surface restruck.

Immediately after the screeding has been completed, the entire surface shall be floated longitudinally as previously specified. After this floating has been completed, and all transverse waves eliminated, the surface shall be finished by the belting process previously specified.

(j) **Contractor to be Responsible.** The Contractor shall be held responsible for the trueness of surface of the pavement, and shall be required to make good any deviation from the alignment, grade and contour shown on the plans.

Curing and Protection. The pavement shall be cured by one of the following methods and protected in the manner hereinafter described.

(a) **Straw or Hay Curing.** The pavement shall be covered with wetted burlap. The burlap shall be new or burlap which has been used only for curing concrete. The burlap shall be furnished in strips not less than three (3) nor more than six (6) feet in width, and two and one-half ($2\frac{1}{2}$) feet longer than the width of the pavement to be covered. The strips of burlap shall be laid on the concrete surface as soon as it is sufficiently hardened. During warm weather the covering shall immediately follow the brooming of the surface. The strips of burlap must overlap and if the burlap weighs less than ten (10) ounces per square yard, two thicknesses will be required. The burlap shall be kept continuously saturated until removed. The burlap shall not be allowed to become displaced or be removed earlier than the morning of the day following its application. After the burlap covering is removed and the pavement wetted, the entire surface, including edges of the pavement, shall be covered immediately with hay or straw to a uniform depth of not less than six (6) inches.

The covering shall be kept wet by sprinkling with water for eight (8) days after which it may be removed.

(b) **Cotton Mat Curing.** Cotton mats to be used for curing shall meet the requirements of the latest revised methods of the A.A.S.H.O. Standard Specification for Cotton Mats for Curing Concrete Pavements, Designation M-73. The mats shall be kept saturated with water and shall be left on for not less than four (4) days.

(c) **Paper Curing.** Paper to be used for curing shall be waterproofed and of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on highway paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper shall be of such a width that, after shrinking, it will completely cover the surface and both sides of the pave-

ment. Paper not manufactured in the size specified above shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period.

As soon as the concrete surface has sufficiently hardened and the pavement wetted, the entire surface, including edges of the pavement, shall be covered immediately with units of the paper above specified which shall be lapped at least eighteen (18) inches. The paper shall be so placed and weighted with earth as to cause it to remain in close contact with the surface covered.

The covering shall be maintained in such condition for four (4) days.

(d) **Protection.** During threatening weather the concrete shall be protected with canvas or suitable paper covers as soon as it is finished. Sufficient canvas or paper to cover three hundred (300) lineal feet of pavement slab shall be provided and kept available for immediate use.

During cold weather, the concrete shall be protected by covering it with a canvas or paper cover, as specified above. When the concrete has hardened sufficiently, the canvas or paper cover shall be removed and the entire surface and sides of the pavement shall be covered with straw or other approved material to a depth of not less than nine (9) inches. It shall remain in place not less than three (3) days and traffic shall be excluded from the pavement for at least fifteen (15) days thereafter, or for a longer period if required by the Engineer.

In cold weather, or when required or approved, other methods of curing and protection may be used. Any concrete laid during cold weather is done at the Contractor's risk and damaged sections of concrete must be removed and replaced by him at his own expense.

(e) **Sealing Joints.** All concrete on the ends of the joint filler shall be dug out to the filler. All joints shall be sealed as required and directed, before the pavement

is opened to traffic, and just prior to discontinuing work when the work is suspended during the winter, and just previous to acceptance.

The joints shall be cleaned thoroughly, and when they are dry, approved bituminous material shall be poured into them. Care shall be taken to prevent the bituminous material from spreading over the surface of the pavement. The bituminous material shall then be covered with coarse, dry sand. The bituminous material shall meet the requirements heretofore specified for this purpose.

(f) **Opening Pavement to Traffic.** During the curing period traffic shall be excluded from the concrete by the erection and maintenance of suitable barricades.

The Contractor may be required to cast several beams of the dimensions specified by the Engineer from each day's run of concrete. The necessary forms for casting these beams will be furnished by the Commission and the number of beams required will be specified by the Engineer. These beams will be broken by a representative of the Commission at the laboratory or on the job, as may be most convenient, and the length of time that the concrete is closed to traffic will depend upon the modulus of rupture obtained from these tests, but in no case shall the concrete be opened to traffic in less than nine (9) days after laying.

If, in the opinion of the Engineer, the weather conditions make it advisable, the pavement shall be kept closed to traffic for a longer period of time. In no event, however, shall there be any hauling on the concrete surface until the pavement has been cleaned of all earth and other foreign material.

When in the opinion of the Engineer, it is necessary to provide for traffic across the concrete surfacing, the Contractor shall, at his own expense, construct suitable crossing to bridge over the concrete.

Machinery, Tools and Materials. All necessary machinery, tools, appliances and materials, including

canvas, burlap, cotton mats, paper, steel, transverse joint filler and rubber hose, shall be on the work sufficient for a day's work, before the work shall be allowed to proceed.

4. Basis of Payment

This work shall be paid for at the contract unit price per cubic yard for "Cement Concrete Pavement" measured in place after completion in accordance with the plans, which price shall include all materials (except steel reinforcement, which will be paid for under a separate item), all equipment, tools, labor and work incidental thereto.

Item 38--Cement Concrete Pavement

STEEL REINFORCEMENT FOR CONCRETE PAVEMENT

SECTION 39

1. Description

Under this item reinforcing steel shall be furnished and placed in concrete pavement as required by these specifications and as shown on the plans. This item shall include dowels or transverse joint assemblies, and tie-bars for longitudinal joints.

2. Materials

Reinforcing Steel. Reinforcement shall consist of plain round or approved deformed bars or steel mesh of the length, diameter and cross-sectional area shown on the plans. When embedded in the concrete all reinforcement shall be free from scale, grease, injurious rust, dirt, or other foreign substances.

All steel reinforcing bars for concrete pavement, including dowels and tie-bars, shall comply with the latest revision of the Standard Specifications of the A.A.S.H.O. for Billet Steel Concrete Reinforcing Bars, Specification M-31, Structural or Intermediate grade; for Rail-Steel

Concrete Reinforcement bars, Specification M-42; or for Axle-Steel Concrete Reinforcement Bars, Specification M-53, structural or intermediate grade. Any of the reinforcement which is to be bent shall comply with the above specification for Billet Steel Concrete Reinforcement Bars of Structural or Intermediate grade made by the open hearth process.

Steel mesh shall be furnished in flat sheets and shall conform to the latest revision of the Standard Specifications of the A.A.S.H.O., Specification M-55.

3. Placing Reinforcement

Bars shall be assembled on forms or templates in mats or sections of the size shown on the plans or ordered by the Engineer. The bars in each section shall be spaced as shown and shall be firmly wired together at each intersection before the section is placed in the pavement.

The sheets or mats of reinforcement shall be placed in position in the pavement as called for on the plans. Sections shall be lapped as shown on the plans and tied together at each longitudinal bar. The mats shall be placed by the strike-off method wherein a portion of the concrete is placed and struck off by an approved mechanical template at the required elevation of the reinforcing after which the mat is placed directly on the concrete and held securely in position while the balance of the concrete is placed.

Steel mesh reinforcing shall be placed as shown on the plans using the strike-off method described above.

4. Method of Measurement

The quantity to be paid for under this item shall be the number of pounds of steel in accordance with the theoretical weights furnished and placed as shown on the plans, or as ordered by the Engineer, and accepted. This shall be computed from the weights of the bar mats, steel mesh, tie-bars, and individual dowel bars shown on the plans but not including the weight of load transfer

devices or any dowels which are built into and are a part of the transverse joint assembly, or of any ties, clips, and welds, or of any chairs or other supporting devices.

5. Basis of Payment

(a) The weight of steel reinforcement for concrete pavement thus determined shall be paid for at the contract unit price per pound for "Steel Reinforcement for Concrete Pavement," complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

(b) The cost of all caps, chairs, supports, or other devices used to hold the reinforcement in correct position shall be included in the above prices and shall not be paid for directly.

(c) Transverse joint assemblies shall be paid for at the contract unit price each for "Transverse Joint Assemblies," complete in place, which price shall include all material, equipment, tools, labor, and work incidental thereto.

**Item 39-A--Steel Reinforcement for Concrete
Pavement**

Item 39-B--Transverse Joint Assemblies

PART V CONSTRUCTION DETAILS STRUCTURES

CONCRETE BRIDGES

SECTION 40

1. Description

All concrete bridges shall be built as indicated on the plans, conforming to lines, grades, dimensions and designs shown, and in accordance with the specifications for Piling, Concrete, Reinforcing Steel and other pay items which are to constitute the complete structure.

2. Materials

Materials used shall be those prescribed for the several items which constitute the structure.

3. Construction Methods

The construction methods used shall be those prescribed for the several items which are to constitute the structure.

All foundations shall be prepared as hereinbefore specified under "Excavation for Structures," and they shall be inspected and approved by the Engineer previous to placing any concrete.

4. Method of Measurement

The quantities of the various items which constitute the completed and accepted structure will be measured for payment according to the plans and specifications for the several pay items, and in terms of the prescribed units provided for the several pay items. Only accepted work will be included and the dimensions will be those shown on the plans, or ordered in writing.

5. Basis of Payment

The measured quantities, as provided above, shall be paid for at the contract unit prices bid for the several pay items, which prices shall be full compensation for furnishing, hauling, and placing all materials, and for all labor, equipment, tools, and necessary incidentals. Such payment shall constitute full payment for the completed structure, ready for use, and no additional allowance shall be made for coffer-dam construction, false work, form lumber, or other erection expenses.

CULVERTS AND RETAINING WALLS

SECTION 41

1. Description

All concrete and masonry culverts, all pipe culverts, headwalls and retaining walls shall be built as indicated on the plans, conforming to lines, grades, dimensions, and designs shown, and in accordance with the specifications for "Concrete," "Masonry," and "Pipe Culverts" of the several varieties, and other pay items which are to constitute the complete structure.

2. Materials

Materials and material requirements shall be those prescribed for the several pay items which constitute the complete structure.

3. Construction Methods

The construction methods used shall be those prescribed for the several items which are to constitute the structure.

All foundations, trenches and beds, shall be prepared as hereinbefore specified under "Excavation for Structures," and they shall be inspected and approved by the Engineer previous to placing any concrete, masonry material, or pipe culverts.

4. Method of Measurement

The quantities of the various pay items which constitute the completed and accepted structures will be measured for payment according to the plans and specifications for the several items. Only accepted work will be included and the dimensions used will be the neat dimensions shown on the plans or ordered in writing.

5. Basis of Payment

The measured quantities as provided above will be paid for at the contract unit prices bid for the several pay items, which prices shall be full compensation for furnishing all material, hauling and placing, all labor,

equipment, tools and necessary incidentals. Such payment shall constitute full payment for the completed structure ready for use, and no additional allowance shall be made for cofferdam construction, false work, form lumber, or other erection expenses.

CONCRETE

SECTION 42

1. Description

Concrete shall be composed of Portland cement, fine and coarse aggregate, and water, mixed as provided in the specifications, and shall be constructed where indicated and of the form and dimensions shown on the plans. It shall be reinforced with steel as shown on the plans or directed by the Engineer.

The class of concrete required for each part of the structure will generally be shown on the plans; but if it is not given the following requirements shall govern:

Class "A" concrete shall be used for reinforced concrete such as arches, beams, slabs, parapets, and all concrete measuring less than nine (9) inches in thickness, and for all concrete deposited in water, except as otherwise provided.

Class "B" concrete shall be used for walls, abutments and wing walls and all plain concrete not less than nine (9) inches in thickness, except footings and concrete deposited in water.

Class "C" concrete shall be used for plain concrete footings unless deposited in water.

Class "D" concrete shall be used for railings and concrete pipe.

2. Materials

Portland Cement. (a) The Portland cement used shall be a standard American brand which shall comply with the requirements and tests of the Standard Specifications and Tests for Portland Cement adopted by the A.A.S.H.O., Specification M-85, Type II, with any subsequent amendments and additions thereto adopted by the Association. Unless otherwise permitted by the Engineer, the cement shall be of one brand and produced by a single mill.

(b) The cement shall be tested by an experienced cement tester selected by the Engineer. No cement shall be used until it has been declared satisfactory after being sampled and tested according to the methods and requirements herein specified.

(c) The Contractor shall provide suitable buildings and means for storing and protecting the cement from dampness. Any shipment of cement received on the work which has been sampled, but not finally accepted, shall be stored not more than eight (8) bags high in a separate storage place from any other cement which has been accepted.

Cement which has become caked shall not be used, and when rejected by the Engineer, it shall be removed by the Contractor, at his expense, from the vicinity of the work without delay.

Aggregates. Aggregates shall consist of sand and gravel or crushed stone. All sand pits, gravel pits and quarries shall be thoroughly stripped of vegetation and overburden for a sufficient depth and area so that the underlying material to be used for aggregate will not be contaminated from this source. The depth of such stripping in the case of pits shall be determined by the Engineer by making tests for organic impurities throughout the depth of the pit face or of test holes. At quarries the entire overburden shall be removed exposing the rock surface. All aggregates shall be thoroughly washed if directed by the Engineer.

Fine Aggregate. The fine aggregate shall consist of sand or a combination of sand and stone screenings, free from frost or frozen lumps, conforming to the following requirements:

(a) **Sand.** The sand shall consist of clean, hard, durable, uncoated stone particles, preferably siliceous, free from lumps of clay, soft or flaky particles, loam, and all organic matter.

It shall be well graded from coarse to fine, and when tested by means of laboratory sieves shall meet the following requirements:

	Per Cent
Passing $\frac{3}{8}$ " sieve	100
Passing 4 mesh sieve	95 - 100
Passing 16 mesh sieve	45 - 80
Passing 50 mesh sieve	10 - 30
Passing 100 mesh sieve	4 - 8

Not more than 3 per cent by weight shall be removed by the elutriation test.

For the purpose of controlling uniformity on any one project, a tolerance of two-tenths in fineness modulus will be allowed.

(b) **Strength Tests.** When subjected to the structural strength test, mortar specimens containing the fine aggregate shall develop a compressive strength at the age of seven (7) days when using Type II cement of not less than eighty-five (85) per cent of the strength developed by a mortar prepared in the same manner with the same cement and graded Ottawa sand having a fineness modulus of 2.40 ± 0.10 . Type II cement is prescribed in the Standard Specifications for Portland Cement of the A.A.S.H.O., Designation M-85.

(c) **Absorption.** When subjected to the test for Absorption prescribed in the latest revised Standard Methods of the A.A.S.H.O., Designation T-84, the fine aggregate shall show a per cent of absorption of not more than 2.3.

(d) **Combination of Stone Screenings and Sand.** When approved by the Engineer, a combination of washed or dustless stone screenings and sand, containing not more than fifty (50) per cent by volume of screenings, may be used for fine aggregate. Screenings so used shall be obtained by crushing hard, durable rock having a per cent of wear as specified for crushed stone. Fine aggregate so combined shall meet all the requirements specified herein for the grading and strength of sand.

Coarse Aggregate. The coarse aggregate shall consist of either crushed stone or gravel which meets the following requirements:

(a) **Crushed Stone.** The crushed stone shall consist of fragments of clean, durable stone free from soft, thin, elongated pieces, disintegrated stone, vegetable, or other deleterious matter, and shall be obtained from rock having a per cent of wear of not more than thirty-five (35) as determined by the Los Angeles Method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96, except that in the case of native granite the per cent of wear obtained by the above method shall not exceed forty-five (45).

(b) **Gravel.** Gravel, when used, shall consist of clean, sound, tough, hard stone, free from dirt or foreign matter, and shall be washed if so directed.

Gravel which is 50 per cent crushed shall be considered as crushed stone and shall meet the requirements therefor.

Gravel which is less than 50 per cent crushed shall have a per cent of wear of not more than ten (10) after 100 revolutions and not more than thirty-five (35) after 500 revolutions as determined by the Los Angeles abrasion test for gravel, made in accordance with the latest revised Methods of the A.A.S.H.O., Specification T-96.

Unscreened gravel shall not be used.

(c) **Grading.** The coarse aggregate, crushed stone or gravel, shall be uniformly graded between the limits specified, and when tested by means of square laboratory sieves shall meet the following requirements:

Class A Concrete

	Per Cent
Passing $1\frac{1}{4}$ -inch sieve	100
Passing $\frac{3}{4}$ -inch sieve	40 - 75
Passing 4 mesh sieve	0 - 5

Class B Concrete

	Per Cent
Passing 2-inch sieve	100
Passing $1\frac{1}{4}$ -inch sieve	40 - 75
Passing 4 mesh sieve	0 - 5

Class C Concrete

	Per Cent
Passing $2\frac{1}{2}$ -inch sieve	100
Passing $1\frac{1}{4}$ -inch sieve	40 - 75
Passing 4 mesh sieve	0 - 5

Class D Concrete

	Per Cent
Passing $\frac{3}{4}$ -inch sieve	100
Passing $\frac{1}{2}$ -inch sieve	40 - 75
Passing 4 mesh sieve	0 - 10

Water. The water used in mixing concrete shall be clean, fresh and free from oil or organic matter.

The water shall have a pH value of 4.5 to 8.5 when tested for acidity.

Mortar made with the water to be used shall not have a variation of more than ten (10) per cent in tensile strength when mixed in a standard 1:3 mortar with Ottawa sand from results obtained with the same mix in which distilled water is used.

Steel Reinforcement. When steel reinforcement is called for on the plans, or is ordered by the Engineer, it

shall conform with the specifications for "Steel Reinforcement for Concrete Structures."

3. Construction Methods

Falsework. Falsework shall be built on good, firm foundation and be of sufficient strength to carry the loads without appreciable deformation. It shall be supported by piling if it cannot be otherwise placed on a solid footing. No extra compensation for such piling shall be allowed.

Forms. The material to be used in forms for exposed surfaces shall be sized and dressed lumher or metal in which all bolt and rivet heads are countersunk, so that in either case a plain, smooth surface of the desired contour is obtained. Lumber used for box culverts, with an iuside height of less than four (4) feet, pipe culvert eudwalls, catch-basins aud drop inlets shall have a minimum thickness of three-quarters ($\frac{3}{4}$) of an inch after dressing. Lumber used for other forms shall have a minimum thickness of one and one-quarter ($1\frac{1}{4}$) inches after dressing. Plywood of less thickness may be used if properly supported. Undressed lumber may be used for backing or for surfaces which will not be exposed in the finished structure. The forms shall be built true to line, and braced in a substantial and unyielding manner. They shall be mortar-tight and shall be thoroughly soaked with water before and throughout the placing of the concrete. Forms for re-entrant angles shall be chamfered and for edges shall be filleted. Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected, and before any concrete is placed. The interior snrfaces of the forms shall be adequately oiled or greased to insure the non-adhesion of mortar. Form lumber if used a second time shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete, any bulging or warping shall be reme-

died, and all dirt, sawdust, shavings, or other debris within the forms shall be removed.

Unwatering Forms. Unless otherwise provided all forms shall be unwatered before concrete is placed in them. Pumping will not be permitted from inside the forms while concrete is being placed.

Composition. For structures containing over one hundred (100) cubic yards the concrete shall be proportioned by weight. For structures containing less than one hundred (100) cubic yards the concrete may be proportioned by volume.

The various classes of concrete shall be proportioned in accordance with the following tables:

Class	Proportions by Weight			Proportions by Volume		
	Portland Cement	Fine Aggregate	Coarse Aggregate	Portland Cement	Fine Aggregate	Coarse Aggregate
A	94	190	380	1	2	4
B	94	240	470	1	2½	5
C	94	285	560	1	3	6
D	94	190	280	1	2	3

The proportions of fine and coarse aggregate specified may be varied slightly by the Engineer to obtain concrete of maximum density, but the proportion of cement to the sum of the aggregates, measured separately, shall not be reduced.

In determining the quantities of aggregates to be incorporated in the mixture, consideration shall be given to the bulking effect of moisture contained in the fine aggregate.

When weighing equipment is used it shall be of a type approved by the Engineer. The equipment shall, when tested with test weights, be accurate within four-tenths (0.4) of one per cent. The equipment shall be capable of weighing to five (5) pounds and at least that part of the total load of sand and stone aggregate which is a

fraction of one hundred (100) pounds shall be indicated on a graduated beam or dial. Convenient means shall be provided for removal of excess material in case of overloading in order that the beam or dial scale may be brought to the proper balance.

The Contractor shall provide four, fifty (50) pound weights, accurate to one-half pound, for calibration purposes, and shall check the accuracy of the scales. The scales shall be checked for balance, when empty, daily before use and at any other times directed by the Inspector. All parts of the equipment shall be kept clean, protected from injury and in proper adjustment.

When the concrete is proportioned by volumes, these volumes shall be measured separately in an approved manner. The Contractor shall furnish and use approved wheelbarrows, boxes, or pans of such dimensions as will give, when filled and struck, the exact volume of aggregate required for the class of concrete specified. Water shall be accurately measured with a device approved by the Engineer.

The cement shall be measured as packed by the manufacturer, a sack containing not less than ninety-four (94) pounds net being considered one (1) cubic foot.

Consistency. The quantity of water to be used shall be determined by the Engineer and no changes shall be made without his consent. In general, a mixture shall be used which contains the minimum amount of water consistent with the required workability.

Sufficient water shall be used in mixing concrete to produce a mixture which will flatten and quake when deposited in place, but not enough to cause free flow, and which can be conveyed from the mixer to the forms without separation of the coarse aggregate or water from the mortar. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms. When required by the Engineer the consistency of the concrete shall be measured by the slump test in accord-

ance with the methods described in the specifications for "Cement Concrete Pavement."

The slump for the different types of concrete shall not be greater than as follows:

For mass concrete and reinforced concrete, where tamping and spading can be readily done, not more than three (3) inches.

For reinforced concrete, where tamping and spading are difficult, not more than five (5) inches.

These values may be modified slightly at the discretion of the Engineer on account of difficulties in tamping and spading, or concentration of reinforcing steel.

Mixing Concrete. The concrete shall be mixed in the quantities required for immediate use, and any which has developed initial set, or which is not in place in the forms within thirty (30) minutes after the water has been added, shall not be used. No retempering will be allowed.

(a) **Machine Mixing.** Concrete shall be mixed in a batch mixer of approved type which will insure the uniform distribution of the materials throughout the mass so that the mixture is uniform in color and smooth in appearance. No mixer shall be used which has a capacity of less than a one (1) bag batch, and no mixer shall be operated above the manufacturer's rated capacity. Fractional bags of cement shall not be allowed except in an emergency and then only under the direction of the Engineer.

The mixing shall continue for a minimum time of one and one-quarter ($1\frac{1}{4}$) minutes after all the ingredients, including water, are assembled in the drum, during which time the drum shall revolve at the speed for which it was designed, but shall make not less than fourteen (14) nor more than twenty (20) revolutions per minute. If required by the Engineer the mixer shall be equipped with adequate water storage and a device for accurately measuring the amount of water used in each batch, and an

attachment for automatically locking the discharging device so as to prevent the emptying of the mixer until the materials have been mixed for the minimum specified time. The entire contents of the drum shall be discharged before any materials are placed therein for the succeeding batch.

(b) **Hand Mixing.** Concrete shall not be mixed by hand except with the approval of the Engineer. When hand mixing is permitted, it shall be done on a watertight platform. The sand aggregate shall be evenly spread upon the platform and the cement spread upon it. The sand aggregate and cement shall then be mixed dry with shovels until a uniform color is attained, after which the mixture shall be formed into a "crater" and the quantity of water necessary to produce a mortar of desired consistency poured thereon. The material upon the outer portion of the "crater" ring shall then be shoveled to the center and the entire mass sliced and turned until a uniform wet mortar is produced. The stone aggregate which shall have been previously wetted shall then be deposited upon the mortar and the entire mass turned and returned with shovels until all the stone particles have become thoroughly coated with mortar, and until the mixture is uniform in color and smooth in appearance. Hand mixed batches shall not exceed one-half ($\frac{1}{2}$) cubic yard in volume.

Placing Concrete. No concrete shall be placed until the depth and character of the foundation, the adequacy of the falsework and forms, and the placing of steel reinforcement, have been approved by the Engineer.

Concrete shall be placed in the forms immediately after mixing, in horizontal layers not over twelve (12) inches in depth. It shall be so deposited that the aggregates are not separated. Dropping the concrete more than six (6) feet, depositing large quantities at a point and running or working it along the forms, or any other

practice tending to cause segregation of the ingredients will not be allowed. It shall be compacted by tamping, spading or slicing. Care shall be taken to fill every part of the forms, to work the coarse aggregate back from the face, and to force the concrete under and around the reinforcement without displacing it. Mass concrete shall be deposited in continuous horizontal layers and any incomplete layer shall be left with a vertical joint. Whenever practical all concrete shall be deposited continuously for each monolithic section of the work. All floor slabs and similar thin sections shall be placed full thickness.

In general, no concrete shall be placed in pier, abutment, or other excavations without forms. When placing without forms is permitted by the Engineer, especial care shall be taken that lumps of earth or other foreign matter falling from the sides of the excavation do not become buried in the concrete.

Horizontal layers so located as to produce a construction joint at a location wherein a "feather edge" will normally be produced in the succeeding layer shall be so formed by insert form work that the succeeding layer will end in a body of concrete having a thickness of not less than six (6) inches.

Each layer of concrete shall generally be left somewhat rough to secure an efficient bonding with the next layer above. A succeeding layer placed before the underlying layer has become set shall be compacted in a manner that will entirely break up and obliterate the tendency to produce a construction joint between the layers.

All wooden spacer bars and braces within the forms shall be removed when the placing of concrete has reached their height. These pieces of form material must not be buried within the concrete mass.

Layers completing a day's work or placed just prior to temporarily discontinuing concrete operations shall be cleaned of all "laitance" or other objectionable material as soon as the concrete has become sufficiently firm to

retain its form. To avoid visible joints so far as possible upon the face surface, the top surface of the concrete adjacent to the forms shall be finished by being smoothed with a plaster mason's trowel.

The top surfaces of bridge seats, backwalls, floor slabs, parapet walls, curbs, end walls, retaining walls, etc., shall be "struck" with a straight edge or "floated" after the stone aggregate has been forced below the finished elevation of the concrete. The use of a layer of mortar to produce the final finished surface shall not be permitted.

Care shall be taken that face surfaces of forms and the surfaces of reinforcement do not become splashed with concrete which will take its initial set before becoming covered by the concrete being placed in the work. Splashes that have taken such initial set shall be carefully removed and the surface of the forms again wetted or oiled.

In no case shall the work on any section or layer be stopped or temporarily discontinued within eighteen (18) inches below the top of any face, unless the details of the work provide for a coping having a thickness less than eighteen (18) inches, in which case the construction joint may be made at the under side of the coping.

Construction Joints. Whenever the work of placing concrete is delayed until the concrete shall have taken its initial set, the point of stopping shall be deemed a construction joint. So far as possible the location of construction joints shall be planned in advance and the placing of concrete carried continuously from joint to joint. These joints shall be perpendicular to the principal lines of stress and in general be located at points of minimum shear. Bulkheads shall be provided and placed as directed by the Engineer.

In joining fresh concrete to concrete that has already set, the work already in place shall have its surface cut over thoroughly with a suitable tool, approved by the Engineer, to remove all "laitance," loose and foreign

material. The surface shall then be washed and scrubbed with wire brooms, thoroughly drenched with water until saturated, and shall remain saturated until the new concrete is placed. Immediately prior to the placing of the new concrete, the old surface shall be thoroughly coated with a thin coating of neat cement mortar and all forms drawn tight against the face of the concrete.

In order to bond successive courses, suitable keys shall be formed at the top of the upper layer of each day's work by the insertion and subsequent removal of beveled wood strips, which shall be thoroughly saturated with water prior to insertion. Rough stone or steel dowels may, at the discretion of the Engineer, be used in lieu of keys. The size and spacing of keys and dowels shall be as determined by the Engineer.

Expansion Joints. Expansion and contraction of concrete shall be provided for by expansion joints as shown on the plans. Care should be taken in construction that these joints are so made as to permit a free movement at the joint when the concrete expands and contracts.

Placing Concrete in Cold Weather. No concrete shall be placed when the atmospheric temperature is below 35°F. without written permission of the Engineer. When directed by the Engineer, the Contractor shall enclose the structure in such a way that the air within the enclosure or the concrete aggregates can be kept above 50°F. for a period of 5 days after placing the concrete, and above 32° for an additional 5 days; then the temperature shall be gradually reduced to that of the surrounding atmosphere.

The Contractor shall supply such heating apparatus as stoves, salamanders or steam equipment and the necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. All aggregates and mixing water shall be heated to a temper-

ature of at least 70 degrees but not more than 150°F.; the aggregates may be heated by either steam or dry heat. If permitted by the Engineer the torch method of heating mixed concrete may be used. The heating apparatus shall be such as to heat the mass uniformly and avoid hot spots which will burn the materials. The temperature of the concrete shall be not less than 60 degrees at the time of placing in the forms. In cases of extremely low temperatures, the Engineer may, at his discretion, raise the lower limiting temperatures for water, aggregates and mixed concrete.

Placing Concrete under Water. Concrete shall be deposited in water only with the permission of the Engineer and under his supervision. When depositing in water is allowed, the concrete shall be carefully placed in the space in which it is to remain, in a compact mass by means of a tremie, bottom-dumping bucket, or other approved method that does not permit the concrete to fall through the water without adequate protection. The concrete shall not be disturbed after being deposited. No concrete shall be placed in running water, and forms which are not reasonably water-tight shall not be used for holding concrete deposited under water.

Curing Concrete. In order to develop the desired strength, careful attention shall be given to the proper curing of the concrete. In hot weather all concrete surfaces exposed to premature drying shall be protected from the direct rays of the sun by means of canvas, straw, sand, or other satisfactory covering, and shall be kept continually moist by sprinkling with water or otherwise for a period of at least ten (10) days after placing. Other precautions to insure proper curing of concrete shall be taken by the Contractor as directed by the Engineer.

Removal of Forms. Location, weather conditions, materials used, and the character of the structure involved shall be considered in determining the time for

the removal of forms. In general, supporting forms for arches, beams and floor slabs shall not be removed within twenty-one (21) days after all concrete has been placed. Forms for vertical surfaces such as walls, and sides of beams shall not be removed within seven (7) days, after all concrete has been placed. Forms shall be removed in such a manner that shocks, jars and fracturing of the concrete will not occur.

Forms shall not be removed at any time without the consent of the Engineer. However, such consent shall not in any way relieve the Contractor of his responsibility for the work.

No backfilling shall be placed over the concrete structure and no hauling over it shall be permitted for at least fourteen (14) days after the concrete has been placed.

Surface Finish. In general, all face surfaces of concrete whether produced by contact with the forms or by screeding, floating, troweling, or other means, shall be true and even, free from depressions or projections not shown on the plans, and from "honeycomb," stone pockets, and other defects resulting from defective forms and improper placing; nor shall these surfaces show layers of accumulated "laitance" or other foreign materials. These surfaces shall be free from injurious seams, flaws, cracks, broken edges, or other defects.

As soon as the forms are removed all lips of mortar, all stone pockets, "laitance" layers, chips, shavings, or other foreign matter shall be removed by the use of chisels or other means satisfactory to the Engineer, and the cavities so produced shall be filled as he may direct. All bolts, wires, or other appliances which hold the forms and which pass through the concrete shall be cut off or set back one-half ($\frac{1}{2}$) inch below the surface in such a manner as not to disturb the concrete more than one-quarter ($\frac{1}{4}$) inch around the holes. Such bolt or wire holes and all water cavities, air voids, pits and other defects, not detrimental to the strength of the structure, shall be filled

with mortar of the same mix as that used in the concrete containing the defects. This mortar shall be applied with a wooden float and shall be thoroughly forced into the holes to completely fill them. All excess mortar shall be removed by cutting it away with the edge of the float. Cavities, pits and other defects upon vertical surfaces shall be filled by floating upward to force the mortar into contact with the uppermost surfaces of the holes. The cavities shall be freed from loose dust and the surrounding concrete shall, if dried, be thoroughly saturated with water before the cavities are filled.

Under no circumstances shall mortar be used for the purpose of producing a plaster coating to cover irregularities of surface resulting from warps, buckles, mismatches of lagging, or other defects in forms.

Surfaces not exposed to general view shall be subject to the general conditions described above. Form marks shall not be removed, but all surfaces, which in the opinion of the Engineer, are of this class shall present a clean cut, workmanlike appearance.

Surfaces exposed to general view, sides and bottoms of exterior girders and stringers, spandrel arches, roadway curbs, hand rails, and all exposed surfaces of abutment breast and wing walls, end walls, piers and retaining walls down to a depth of two (2) feet below extreme low water, and any other surfaces as the Engineer may decide shall be so considered, shall be "rubbed mortar" finish. A "rubbed mortar" finish shall be produced as follows:

As soon as the mortar used in filling surface defects has taken a firm set, the surface to be finished shall be moistened and thoroughly rubbed or ground with a carborundum brick or similar tool to remove from such surfaces all inert sand and cement materials and to eradicate all impressions of form work. When the surface under treatment has been rubbed to a smooth and even surface, the pasty material adhering to the surface shall be en-

tirely washed off and the surface shall be again wet rubbed until a small accumulation of fine grained paste is produced. This paste shall not be removed but shall be carefully spread with a moist whitewash brush to form a uniform, very thin coating upon the surface of the concrete. This coating shall remain undisturbed until it has attained a firm set.

Final surface finishing shall not be done in freezing weather or when the concrete contains frost. In cold weather the preliminary rubbing necessary to remove the inert sand and cement materials and surface inequalities may be done without the application of water to the concrete surfaces.

4. Method of Measurement

All concrete conforming to the specifications and plans and placed as directed shall be measured by the cubic yard. In computing the concrete yardage for payment the dimensions used shall be those shown on the plans or ordered in writing by the Engineer. No measurements or other allowances will be made for work or materials for forms, falsework, cofferdams, pumping, bracing, etc.

5. Basis of Payment

(a) Payment for this work shall be made for the yardage of concrete measured as prescribed above at the respective contract unit price per cubic yard for "Class A," "Class B," "Class C," or "Class D" concrete. Such payment shall be full compensation for all materials, forms, falsework, equipment, tools, labor and incidentals necessary to complete the work, except that steel reinforcement will be paid for as a separate item.

(b) Excavation on account of this work shall be paid for at the contract unit price for "Excavation for Structures."

Item 42-A--Class A Concrete

Item 42-B--Class B Concrete

Item 42-C--Class C Concrete

Item 42-D--Class D Concrete

STEEL REINFORCEMENT FOR CONCRETE STRUCTURES

SECTION 43

1. Description

Under this item reinforcing steel, consisting of plain round or approved deformed bars, shall be furnished and placed as called for on the plans, or as ordered by the Engineer.

2. Materials

Reinforcing bars for concrete structures shall conform to the requirements of the latest revision of the Standard Specifications for Billet Steel Concrete Reinforcement Bars, Specification M-31, of the A.A.S.H.O., and unless otherwise provided, all bars shall be of structural or intermediate grade made by the open hearth process. No rerolled material will be accepted.

3. Construction Methods

Steel reinforcement shall be stored under a water-proof shelter above the surface of the ground upon platforms, skids or other supports, and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, it shall be free from dirt, scale, paint, oil or other foreign matter, and, if ordered by the Engineer, shall be scraped and cleaned by the use of scrapers, wire brushes or other satisfactory means.

The reinforcement shall be bent cold to the shapes indicated on the plans, and bending shall be done in the shop before shipment, except as called for on the plans or ordered by the Engineer.

All reinforcement shall be accurately placed in the locations shown on the plans and adequate means provided for securely holding it in correct position during the placing of concrete in the forms. Whenever the reinforcement is to be held out of contact with the forms by supporting it upon blocks, precast mortar blocks of

approved dimensions shall be used. Likewise tiers of bars in girders, T-beam stem, etc., shall be separated by the use of precast blocks. The use of pebbles, flat pieces of broken stone, bricks, metal pipe or wooden blocks shall not be permitted. The locations of reinforcement are, with few exceptions, mathematically determined to conform with the loadings assumed in the design and variations therefrom, produced by careless placing of the metal, radically affect the strength. The placing of the reinforcement as the placing of concrete progresses without definite means for holding it in its correct location shall not be permitted. Reinforcement shall be placed well in advance of the placing of concrete and shall be inspected and approved by the Engineer before any concrete is placed in contact with it. Before any concrete is placed all mortar shall be cleaned from the reinforcement.

All reinforcement shall be furnished in the full lengths indicated on the plans. No splicing of bars, except where shown on the plans, will be permitted without the approval of the Engineer. Splices shall be avoided at points of maximum stress and shall be staggered where possible. No splices will be permitted in the main reinforcement of beams and girders. Splices shall be designed to develop the strength of the bar without exceeding the allowable load stress, but in the absence of an actual design a minimum lap of forty (40) diameters shall be used. All splices shall be firmly seized with not less than four (4) turns of wire at intervals of six to ten (6 to 10) inches depending upon the size of bars, the shorter spacing being used upon the larger sizes of bars. Splicing by means of welds shall not be permitted.

4. Determination of Weight

The weight of steel to be paid for shall be the theoretical weight of the steel furnished and placed as shown on the plans, or as ordered by the Engineer, and accepted.

5. Basis of Payment

The weight of steel thus determined shall be paid for at the contract unit price per pound for "Steel Reinforcement for Concrete Structures," which price shall be full compensation for furnishing the material, all equipment, tools, labor, and incidentals necessary to complete the item. No allowance shall be made for clips, wire, separators, or other materials used for fastening the reinforcement in place.

Item 43--Steel Reinforcement for Concrete Structures

CEMENT STONE MASONRY

SECTION 44

1. Description

Cement Stone Masoury shall consist of approved stones laid up in Portland cement mortar, and shall be constructed in accordance with these specifications and in conformity with the dimensionous and designs shown on the plans, or as directed by the Engineer.

2. Materials

Cement and Sand. The Portland cement, sand and water for the mortar shall be such as to conform with the respective requirements for these materials as contained in the specifications hereinbefore given for "Concrete."

Stone. The stone shall be clean, sound, split granite quarry stone or other stone of equal quality. Weathered stone will not be acceptable.

Mortar. The mortar shall be composed of one part Portland cement as specified and two (2) parts of sand as specified. Hydrated lime, conforming to the A.S.T.M. latest revised Standard Specifications C-6, to the extent

of ten (10) per cent, by volume, of the cement, may be added to the mortar if directed. When used, hydrated lime shall be treated as an addition and not as replacing any of the cement. Mortar for pointing shall be composed of one (1) part of Portland cement, ten (10) per cent hydrated lime, and one (1) part sand. Mortar which has been mixed for more than thirty (30) minutes shall not be used. Retempering of mortar will not be permitted. The sand, cement and lime shall be mixed dry in a tight box until the mixture assumes a uniform color, after which water shall be added as the mixing continues until the mortar obtains a consistency that can be easily haudled and spread with a trowel.

3. Construction Methods

The stones shall be laid on their natural beds in courses of uniform rise throughout the length and height of the structure, horizontal joints being level and vertical joints truly plumb. Joints shall not exceed three-quarters ($\frac{3}{4}$) of an inch in thickness. Care shall be exercised in bringing up the masonry so that all stone shall break joints with the courses next above and below by at least nine (9) inches. All stone shall be cleaned and wetted just before being set. They shall be laid in full beds of mortar and vertical joints shall be completely filled with mortar at the time the stone is set.

The height or rise of all stones shall be at least twelve (12) inches.

The face length of all stones, except headers, shall be not less than twice the height or rise, and the width of the bed, back from the face of the masonry, shall be not less than one and one-half ($1\frac{1}{2}$) times the rise.

One-fourth ($\frac{1}{4}$) the area of the face stone shall be headers uniformly distributed, of face width not less than the rise, and length not less than two and one-half ($2\frac{1}{2}$) times the rise, to bond into the backing.

The stones shall be rock face having a projection not greater than two (2) inches with edges pitched to proper

batter or plumb as required. All stones shall hold their face dimensions for a distance of at least twelve (12) inches back from the face and no spalls will be permitted in the face.

Backing for this class of masonry shall be Class B Concrete and shall be carried up level with the face stone before the next course of stone is laid.

No stones shall be cut or otherwise worked on the wall, and no stone once bedded shall be moved except by order of the Engineer.

All face joints in the masonry shall be raked out to a depth of one and one-half ($1\frac{1}{2}$) inches, thoroughly wetted, and then filled flush to the surface with mortar specified for pointing, tightly pressed into place and neatly smoothed.

Copings, bridge seats and back walls shall be of the material and dimensions shown on the plans and when not otherwise specified shall be of Class A concrete. Concrete copings shall be made in sections extending the full width of the wall, not less than eight (8) inches in thickness, and from five (5) to ten (10) feet long. The sections may be cast in place or precast and set in full mortar beds. If a stone coping is specified, the stones shall be not less than eight (8) inches thick, from one and one-half ($1\frac{1}{2}$) to five (5) feet long and wide enough to cover the full width of the wall. They shall be set in full mortar beds.

No masonry shall be laid in freezing weather without permission of the Engineer and the use of such precautions as he may direct. In hot or dry weather the masonry shall be protected from the sun and kept moist for at least three (3) days after laying.

4. Basis of Payment

(a) This work shall be measured in accordance with the dimensions shown on the plans, except where changes are ordered by the Engineer, and shall be paid for at the contract unit price per cubic yard for "Cement Stone

Masonry" complete in place, which price shall be full compensation for the concrete coping or stone coping, whichever is required, concrete backing, and for all materials, equipment, tools, labor and incidentals necessary to complete the item.

(b) Excavation on account of this work shall be paid for at the contract unit price per cubic yard for "Excavation for Structures."

Item 44--Cement Stone Masonry

CEMENT RUBBLE MASONRY

SECTION 45

1. Description

Cement Rubble Masonry shall be composed of approved stones laid up in Portland cement mortar, and shall be constructed in accordance with these specifications and in conformity with the dimensions and designs shown on the plans or as directed by the Engineer.

2. Materials

Portland Cement and Sand. The Portland cement, sand and water for the mortar shall be such as to conform with the respective requirements for these materials as contained in the specifications given hereinbefore for "Concrete."

Stone. The stone shall be clean, hard and of a kind known to be durable. All weathered stone shall be rejected. The individual stones, except for filling joints, shall have a thickness not less than six (6) inches, and a width not less than one and one-half ($1\frac{1}{2}$) times the thickness nor less than twelve (12) inches. No stone, except headers, shall have a length less than one and one-half ($1\frac{1}{2}$) times its width.

Mortar. Mortar shall conform to the requirements for mortar specified for "Cement Stone Masonry."

3. Construction Methods

The stones shall be roughly squared on joints, beds and faces. Selected stones, roughly squared and pitched to a line shall be used at all angles and ends of walls. All stones shall be thoroughly cleaned and wetted prior to laying and shall be laid with horizontal beds. Large flat stones shall be selected for the bottom course. Headers shall be arranged to interlock and shall occupy at least one-fifth (1-5) of the area of the face and of the back of the wall and shall be evenly distributed. Headers in walls two (2) feet thick or less shall extend entirely through the walls. For thicker walls, front, back and intermediate headers shall be arranged to lap at least twelve (12) inches.

Each stone shall be settled into place in a full bed of mortar throughout the wall. The wall shall be compactly laid having all vertical joints in the interior of the wall filled with suitable stones or spalls thoroughly bedded in mortar. No voids will be permitted. No spalls will be allowed in the face of the wall.

Horizontal joints shall not exceed one (1) inch in thickness, and vertical joints shall not exceed two (2) inches in width; joints shall be broken at least six (6) inches. No hammering shall be done of any kind that loosens the stones. If a stone is loosened after the mortar has set it shall be removed, the mortar cleaned off and the stone relaid with fresh mortar.

All joints in the face of the masonry shall be raked out to a depth of one and one-half ($1\frac{1}{2}$) inches, thoroughly wetted and then filled flush to the surface, with the mortar specified for pointing, tightly pressed into place and neatly smoothed.

Copings, bridge seats and backwalls, shall be made of the dimensions and materials as shown on the plans and

when not otherwise specified shall be of Class "A" concrete, and fulfill the following requirements:

Copings shall be made in sections, extending the full width of the wall, not less than eight (8) inches thick, and from five (5) to ten (10) feet long. The sections may be cast in place or moulded and set in place in full mortar beds. If a stone coping is specified, the stones shall be not less than eight (8) inches thick, from one and one-half to five ($1\frac{1}{2}$ to 5) feet long and wide enough to cover the full width of the wall, and shall be set in full mortar beds.

No masonry shall be laid in freezing weather without the permission of the Engineer and the use of such precautions as he may direct. In hot or dry weather the masonry shall be protected from the sun and kept moist for at least three (3) days after laying.

4. Basis of Payment

(a) This work will be measured in accordance with the dimensions shown on the plans, except where changes are ordered by the Engineer, and shall be paid for at the contract unit price per cubic yard for "Cement Rubble Masonry," complete in place, which price shall be full compensation for the concrete coping or stone top course, whichever is required, and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(b) Excavation on account of this work shall be paid for at the contract unit price per cubic yard for "Excavation for Structures."

Item 45--Cement Rubble Masonry

DRY RUBBLE MASONRY

SECTION 46

1. Description

Dry rubble masonry shall be composed of stone laid without mortar, and shall be constructed in accordance with these specifications and in conformity with the dimensions and designs shown on the plans or as directed by the Engineer.

2. Materials

(a) **Size of Stone.** Individual stones shall have a thickness of not less than twelve (12) inches nor greater than twenty-four (24) inches. When courses of different thickness are used the thicker courses shall be at the base of the wall. All stones shall extend into the wall not less than twelve (12) inches. Headers shall show a minimum face width equal to the thickness of the course.

(b) **Dressing Stone.** Stones shall be roughly squared on joints, beds and faces. Headers shall show in the heart of the wall the general shape shown in the face and shall extend not less than twelve (12) inches into the backing. The headers shall occupy not less than one-fourth ($\frac{1}{4}$) the face area of the wall and shall be uniformly distributed.

All shaping of stone shall be done before the stone is laid in the wall and no dressing or hammering which will loosen the stone shall be permitted after it is placed in position.

3. Construction Methods

(a) **Laying Stone.** Stone shall be laid on their natural beds, in courses, and shall conform to the lines indicated on the plans.

All joints, either horizontal or vertical, shall not exceed three (3) inches in thickness or width. Joints shall be broken by at least six (6) inches, measured edge to edge of stone, but no vertical joint shall be located directly above or below a header.

Care shall be taken that each stone takes a firm bearing in at least one point upon the underlying stone and upon two or more fitted spalls so placed that the stone takes a well distributed bearing on the wall. Open horizontal joints, both front and rear, shall be "chinked" with spalls fitted to take firm bearing upon their top and bottom surfaces, for the purpose of securing firm bearing throughout the length of the stone. Vertical joints shall be "chinked" with spalls. All spalls shall be from stone similar to that being used in the wall or other material approved by the Engineer.

(b) **Stone Backing.** Stone backing shall be laid in the same manner as specified above, with headers interlocking with face headers when the thickness of the wall permits and breaking joints with the face stone. Joints shall conform to those specified for face stone. Sizes of stone may vary, providing the backing levels up with each course of face stone and providing all stones have good bearing and interlock with each other in a manner which does not detract from the strength of the wall and is satisfactory to the Engineer.

4. Basis of Payment

(a) The quantity of stone masonry to be paid for under this item shall be the number of cubic yards measured in the completed work and the limiting dimensions shall not exceed those shown upon the plans or fixed by the Engineer. The contract price shall include all labor, tools, materials and other expense incidental to the satisfactory completion of the work. *

(b) Excavation on account of this work shall be paid for at the contract unit price per cubic yard for "Excavation for Structures."

Item 46--Dry Rubble Masonry

CORRUGATED METAL PIPE

SECTION 47

1. Description

This item shall consist of furnishing corrugated metal pipe, conforming to these specifications and of the sizes and dimensions required, and installing such pipe at such places as are designated on the plans or by the Engineer and in conformity with the lines and grades given.

2. Materials

Corrugated metal pipe culverts shall conform to the latest revised specification of the American Association of State Highway Officials, Specification M-36.

3. Laying Pipe

All trenches and beds shall be prepared as specified under "Excavation for Structures."

The pipe shall be laid in the trench or on the prepared bed with the separate sections firmly joined together with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints which is not thoroughly protected by galvanizing shall be coated with a suitable asphaltic paint.

No pipe culvert shall be placed until the location has been approved by the Engineer. The pipe shall be laid carefully true to line and grade. Any pipe which is not true to alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

The filling around the pipe shall be made in nine (9) inch layers with approved materials free from large stones, sods, or other material which would prevent the backfill from being thoroughly compacted, and each layer shall be tamped thoroughly around and over the pipe. No pavement or surfacing material shall be laid over the pipe until the backfill has been thoroughly compacted and settled satisfactorily to the Engineer.

4. Method of Measurement

The footage to be paid for shall be the actual length of pipe laid in place and accepted.

5. Basis of Payment

(a) Corrugated metal pipe, placed and accepted, shall be paid for at the contract unit prices per linear foot for "Corrugated Metal Pipe" of the several sizes, measured as provided above, which prices shall be full compensation for furnishing all materials (including coupling bands), unloading from cars, handling and installing the pipe, and all equipment, tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry headwalls.

(b) Relaying corrugated metal pipe shall be paid for at the contract unit prices per linear foot for "Relaying Corrugated Metal Pipe" of the several sizes, measured as provided above, which prices shall be full compensation for loading, hauling and installing the pipe, and all equipment, tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry headwalls.

(c) Excavation, including backfill, shall be paid for under the item of "Excavation for Structures."

Item 47-A-- 8 Inch Corrugated Metal Pipe
Item 47-B--10 Inch Corrugated Metal Pipe
Item 47-C--12 Inch Corrugated Metal Pipe
Item 47-D--15 Inch Corrugated Metal Pipe
Item 47-E--18 Inch Corrugated Metal Pipe
Item 47-F--21 Inch Corrugated Metal Pipe
Item 47-G--24 Inch Corrugated Metal Pipe
Item 47-H--30 Inch Corrugated Metal Pipe
Item 47-I--36 Inch Corrugated Metal Pipe
Item 47-J--42 Inch Corrugated Metal Pipe
Item 47-K--48 Inch Corrugated Metal Pipe
Item 47-L--54 Inch Corrugated Metal Pipe
Item 47-M--60 Inch Corrugated Metal Pipe

ASPHALT COATED CORRUGATED METAL PIPE

SECTION 48

GENERAL REQUIREMENTS

1. **Description:** Asphalt coated corrugated metal pipe shall conform to the requirements of the A.A.S.H.O., M-36, Standard Specification for Corrugated Metal Pipe Culvert in its entirety, and in addition shall be completely coated inside and out with an asphalt cement, which will meet the performance requirements set forth herein.

(a) The asphalt cement shall be 99.5% soluble in Carbon Bisulphide.

(b) **Thickness of Coating.** The inside of the pipe shall be uniformly coated for three-fourths of the circumference (top of pipe when installed) to a minimum thickness of .03 inches. The thickness shall be measured on the crests of the corrugations. The bottom quarter of the circumference shall be of such thickness as to comply with the Erosion Test hereinafter described.

PERFORMANCE REQUIREMENTS

2. The asphalt cement shall adhere to the metal tenaciously; shall not chip off in handling; and shall protect the pipe from deterioration, as evidenced by successfully meeting the following test:

(a) **Stability Test:** The asphalt cement shall not lose its stability when subjected to the highest summer temperature, as indicated by successfully withstanding the following test:

Parallel lines shall be drawn along the valleys of the corrugations of a representative sample of coated pipe and the specimen placed on end in a constant temperature oven, with the parallel lines in a horizontal position. The temperature of the specimen shall be maintained

within 2°F. of 150°F. for a period of four hours. At the end of this time no part of any line shall have dropped more than $\frac{1}{4}$ ".

(b) **Imperviousness Test:** The asphalt cement shall be impervious to liquids as indicated by the following test:

A 25% solution of sulphuric acid, or a 25% solution of sodium hydroxide or a saturated salt solution (such as sodium chloride) shall be held in the valley of a corrugation for a period of 48 hours, during which time no loosening or separation of the bituminous material from the galvanizing shall have taken place.

(c) **Erosion Test:** A representative sample consisting of a two foot length of a fully coated pipe (with ends closed by suitable bulkheads) shall be revolved end over end about its transverse axis at a speed of 3.7 revolutions per minute and in such a manner that the erosive charge shall alternately roll along the inner surface of opposite sides of the pipe (inside top and bottom, as when installed in service). At least 75% of the sample shall be immersed, as it revolves, in a bath of water maintained at a temperature of 50°-55°F. The top three-quarters of the pipe shall not show areas of bare metal more than two inches in length on four of the seven central corrugations after 5 hours of continuous testing (called a test period), and the bottom one-quarter shall not show a similar failure in 9 additional periods of testing. A new erosive charge shall be used for each period of test. The erosive charge shall be 50 pounds of grade B building brick, conforming to the requirements of the A.S.T.M. Specification, Serial Designation C62-30, broken up into pieces 2 to 3 inches in diameter and 3 gallons of water.

3. Laying Pipe

All trenches and beds shall be prepared as specified under "Excavation for Structures."

The pipe shall be laid in the trench or on the prepared bed with the separate sections firmly joined together with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints which is not thoroughly protected by galvanizing shall be coated with a suitable asphaltic paint.

Care shall be taken in unloading and hauling the pipe not to damage the asphalt coating. The pipe shall not be dragged, or rolled over rocky ground.

No pipe culvert shall be placed until the location has been approved by the Engineer. The pipe shall be laid carefully, true to line and grade. Any pipe which is not true to alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

The filling around the pipe shall be made in nine (9) inch layers with approved materials free from large stones, sods, or other material which would prevent the back fill from being thoroughly compacted, and each layer shall be tamped thoroughly around and over the pipe. No pavement or surfacing material shall be laid over the pipe until the backfill has been thoroughly compacted and settled satisfactorily to the Engineer.

4. Method of Measurement

The footage to be paid for shall be the actual length of pipe laid in place and accepted.

5. Basis of Payment

(a) Asphalt coated corrugated metal pipe, placed and accepted shall be paid for at the contract unit prices per linear foot for "Asphalt Coated Corrugated Metal Pipe" of the several sizes measured as provided above, which prices shall be full compensation for furnishing all materials (including coupling bands), unloading from cars, hauling and installing the pipe and all equipment, tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry headwalls.

(b) Excavation, including backfill, shall be paid for under the item of "Excavation for Structures."

Item 48-A-- 8 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-B--10 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-C--12 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-D--15 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-E--18 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-F--21 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-G--24 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-H--30 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-I--36 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-J--42 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-K--48 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-L--54 Inch Asphalt Coated Corrugated Metal Pipe

Item 48-M--60 Inch Asphalt Coated Corrugated Metal Pipe

CAST IRON PIPE

SECTION 49

1. Description

This item shall consist of furnishing cast iron pipe, conforming to these specifications and of the sizes and

dimensions required and installing such pipe at such places as are designated on the plans or by the Engineer and in conformity with the lines and grade given.

2. Materials

Cast Iron Pipe shall comply with the latest revision of the Standard Specifications for Heavy Cast Iron Culvert Pipe of the American Association of State Highway Officials, Specification M-64.

3. Laying Pipe

All trenches and beds shall be prepared as specified under "Excavation for Structures."

When pipe is of the bell and spigot type, the bell end of the pipe shall be laid up grade and all joints shall be filled with one to two (1 to 2) Portland cement mortar. Portland cement and sand for mortar shall fulfill the requirements specified under "Concrete." Before succeeding sections of pipe are laid, the lower portion of the hub of the preceding pipe shall be plastered on the inside with mortar of sufficient thickness to bring the inner surfaces of abutting pipes even. After the pipe is laid the remainder of the joint shall be filled with mortar, and sufficient additional mortar shall be used to form a bead around the joint. The inside of the joint shall be wiped clean and finished smooth. The cement mortar on the outside shall be protected from the sun with an adequate covering. Joints in pipe having approved interlocking joints shall be carefully laid and securely interlocked. No pipe shall be laid until the location has been approved by the Engineer. The pipe shall be carefully laid true to line and grade. Any pipe which is not true in alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

The filling around the pipe shall be made in nine (9) inch layers with approved material free from large stones, sods, or other material which would prevent the backfill

from being thoroughly compacted, and each layer shall be tamped thoroughly around and over the pipe.

No pavement or surfacing material shall be laid over any pipe until the backfill has been thoroughly compacted satisfactory to the Engineer.

4. Method of Measurement

The footage to be paid for shall be the actual length of pipe laid in place and accepted.

5. Basis of Payment

(a) Cast Iron Pipe placed and accepted, shall be paid for at the contract unit prices per linear foot for "Cast Iron Pipe" of the several sizes, measured as provided above, which prices shall be full compensation for furnishing all materials, unloading from cars, hauling and installing the pipe, and all equipment tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry end walls.

(b) Excavation, including backfilling, on account of this work shall be paid for under the item of "Excavation for Structures."

Item 49-A--12 Inch Cast Iron Pipe
Item 49-B--15 Inch Cast Iron Pipe
Item 49-C--18 Inch Cast Iron Pipe
Item 49-D--24 Inch Cast Iron Pipe
Item 49-E--30 Inch Cast Iron Pipe
Item 49-F--36 Inch Cast Iron Pipe
Item 49-G--42 Inch Cast Iron Pipe
Item 49-H--48 Inch Cast Iron Pipe

REINFORCED CONCRETE PIPE

SECTION 50

1. Description

This item shall consist of furnishing reinforced concrete pipe, conforming to these specifications and of the

sizes and dimensions required, and installing such pipe at the places designated on the plans or directed by the Engineer, and in conformity with the lines and grades given.

Reinforced concrete pipe may be either cast or machine made. Each type shall conform in size, shape and reinforcement to the standards as shown in the table forming a part of these specifications. The letter C or M shall be plainly stamped upon the outside surface of each length of pipe to designate whether it is cast or machine made respectively. Each length of pipe shall also be clearly marked with the date of manufacture and the name or trademark of the manufacturer.

2. Materials and Manufacture

Shape. All concrete pipe twelve (12) inches or over in diameter shall be reinforced as herein specified and shall be either of the projecting bell and spigot type or a modified type where the bell does not project from the body of the pipe. Each section shall have square ends, be circular in cross-section, unless otherwise specified, and have walls of uniform thickness throughout except the bell end, which in the case of the projecting bell type shall have a thickness of not less than three-fourths ($\frac{3}{4}$) of the wall thickness at a point one-quarter ($\frac{1}{4}$) inch from the end of the bell.

Size. It shall be made in sections, the length of which shall be as herein specified, or shown on the plans. When no particular length is specified, the pipes shall be manufactured in standard lengths of not less than thirty (30) inches nor more than six (6) feet.

Joints. The bell end shall be so constructed that the spigot end will enter to full depth. The distance the spigot end must enter freely shall be as follows: 12 to 18-inch pipe, not less than two and one-half ($2\frac{1}{2}$) inches; 24 to 30-inch pipe, not less than three (3) inches; and 36 to 72-inch pipe, not less than three and one-half ($3\frac{1}{2}$)

inches. On the modified type the spigot end must enter freely and not less than one-half ($\frac{1}{2}$) the shell thickness of the pipe.

Finish. The surface of all pipe, both interior and exterior, shall be smooth and even, of uniform texture, free from surface checks, cracks, blisters, fractures, laminations, lean or porous spots. The pipe shall be true to dimensions intended in the design with a permissible variation from the true form of not more than one and one-half ($1\frac{1}{2}$) per cent. The shell of the pipe may be thicker than called for in the design, but it shall be not less than the designated shell thickness by more than five (5) per cent.

Composition. The concrete shall be a mixture composed of not less than one (1) part Portland cement, two (2) parts fine aggregate and three (3) parts coarse aggregate, all measured by volume, with water measured in such proportions as may be necessary to fully meet the requirements hereinafter provided.

Materials. The materials used in the manufacture of the pipe shall comply with the following requirements:

(a) **Portland Cement.** The Portland cement shall be a standard American brand which shall comply with the requirements and tests of the latest revised Standard Specifications and Tests for Portland Cement adopted by the A.A.S.H.O., Specification M-85, Type II.

(b) **Fine Aggregate. Sand.** The sand shall consist of clean, hard, durable, uncoated particles, preferably siliceous, free from lumps of clay, soft or flaky particles, loam and all organic matter, and shall be washed if so directed. It shall be well graded from coarse to fine, and when tested by laboratory methods shall meet the following requirements:

	Per Cent
Passing $\frac{3}{8}$ " sieve	100
Passing 4-mesh sieve	95 - 100
Passing 16-mesh sieve	45 - 80
Passing 50-mesh sieve	10 - 30
Passing 100-mesh sieve	4 - 8

Not more than three (3) per cent by weight shall be removed by the elutriation test.

The sand shall fulfill the strength tests prescribed under "Concrete."

(c) **Coarse Aggregate.** The coarse aggregate shall consist of either crushed stone or gravel which meets the following requirements:

(1) **Crushed Stone.** The crushed stone shall consist of fragments of clean, durable stone free from soft, thin, elongated pieces, disintegrated stone, vegetable, or other deleterious matter, and shall be obtained from rock having a per cent of wear of not more than thirty-five (35) as determined by the Los Angeles Method made in accordance with the latest revision of the Standard Specifications of the A.A.S.H.O., Designation T-96.

(2) **Gravel.** Gravel, when used, shall consist of clean, sound, tough, hard stone, free from dirt or foreign matter, and shall be washed if so directed.

Gravel which is 50 per cent crushed shall be considered as crushed stone and shall meet the requirements therefor.

Gravel which is less than 50 per cent crushed shall have a per cent of wear of not more than ten (10) after 100 revolutions and not more than thirty-five (35) after 500 revolutions as determined by the Los Angeles abrasion test for gravel, made in accordance with the latest revised Methods of the A.A.S.H.O., Designation T-96.

Unscreened gravel shall not be used.

(3) **Grading.** The coarse aggregate, crushed stone or gravel, shall be uniformly graded between the limits specified, and when tested by means of square laboratory sieves shall meet the following requirements:

	Per Cent
Passing $\frac{3}{4}$ -inch sieve	100
Passing $\frac{1}{2}$ -inch sieve	30 - 75
Passing 4-mesh sieve	0 - 5

Reinforcement. Reinforcement shall consist of wire mesh, bars, hoops, or spirals, and shall be manufactured from material that conforms to the requirements of the latest revised Standard Specifications of the A.A.S.H.O., M-31, for Billet Steel Concrete Reinforcement Bars, Structural or Intermediate grade, or M-32, for cold drawn steel wire for concrete reinforcement.

All pipe shall be reinforced as herein specified. Pipe under thirty (30) inches in diameter shall have a single line of reinforcement, thirty (30) inches and over, two lines of reinforcement, as shown in the following table, or an approved method of reinforcement developing equivalent strength.

Single lines of reinforcement shall be placed at equal distances from the inside and outside surfaces of the pipe.

Double lines of reinforcement shall be placed parallel to each other and one (1) inch from the inside and outside surface walls of the pipe, other requirements to be as above defined for single line reinforcement.

Longitudinal reinforcement shall extend full length of each section, and shall be wired or otherwise securely fastened to the body and bell reinforcement.

Circular reinforcement shall extend completely around the pipe and have adjacent ends lap not less than forty (40) diameters of the circular reinforcement and be firmly fastened together.

In all sizes of bell-and-spigot pipe there shall be a line of circumferential reinforcement in the bell equal in area to that of a single line within the barrel of the pipe. In tongue-and-groove pipe 36 inches in diameter and larger there shall be a line of circumferential reinforcement in the groove equal in area to that of a single line within the barrel of the pipe.

The reinforcing metal must be so held in the required position that it will not be displaced during manufacture of the pipe.

Each length of pipe shall be cast in a single operation.

The moulds must be properly assembled, cleaned and oiled when so ordered before any concrete mortar is placed therein.

Curing. Unless steam cured, the pipe must be covered and kept wet at least ten (10) days. Pipe manufactured when the atmospheric temperature may drop below 35° Fahrenheit must be so protected that the concrete therein will not at any time have a temperature below 35° Fahrenheit, until the concrete is at least seven (7) days old.

Pipe shall not be shipped for use that is less than fourteen (14) days old, except in the case of pipe which has been steam cured for at least twelve (12) hours, which may be shipped when seven (7) days old.

The thickness of the pipe walls and total cross sectional area of circular and longitudinal reinforcement for the different sizes of the pipe shall be not less than those shown in the table given below.

Cast Pipe			Machine-Made Pipe		Longitudinal Reinforcing	
Diameter of Pipe	Shell Thickness	Min. Area of Circular Reinforcing per Ft. of Pipe Sq. In.	Shell Thickness	Min. Area of Circular Reinforcing per ft. of Pipe Sq. In.	Minimum No. of Longitudinal Rods	Minimum Tot. Area Longitudinal Rods Sq. In.
12"	2"	.070	1½"	.08	4	.150
15"	2¼"	.09	1½"	.11	4	.150
18"	2½"	.12	2"	.14	4	.150
24"	3"	.17	2½"	.21	4	.196
30"	3½"	2x.16	2½"	2x.210	8	.392
36"	4"	2x.18	3"	2x.26	8	.614
42"	4½"	2x.21	3½"	2x.30	8	.614
48"	5"	2x.25	4"	2x.34	8	1.200
54"	5½"	2x.30	4½"	2x.38	12	1.326
60"	6"	2x.33	5"	2x.42	12	1.326

Strength. When tested by the three-point method of applying load in the crushing test as presented in the latest revised A.A.S.H.O. Standard Method T-33, the pipe must show no crack under a load of 1000-D, where D is the inside diameter of the barrel in feet, and shall develop an ultimate strength of 2000-D.

Absorption. The maximum average absorption as obtained by the A.A.S.H.O. Standard Method T-33 shall not exceed eight (8) per cent by weight.

Testing. Each manufacturer furnishing pipe under these specifications shall be fully equipped to carry out the tests herein designated. Upon the demand of the Engineer and under his supervision, the manufacturer shall perform such number of tests as the Engineer may deem necessary to establish the quality of the pipe offered for use. Failure of any size of pipe to meet the test requirements shall be sufficient cause for rejection of all pipes of that size, which the test specimen represents.

Inspection. All pipes shall be subject to inspection at the factory, or point of delivery, by a competent inspector employed by the Engineer. The purposes of the inspection shall be to cull and reject pipes which, independent of the physical tests herein specified, fail to meet the requirements of these specifications, and rejection through inspection may be made on account of any of the following:

(a) Porous spots on either inside or outside surface of pipe having an area of more than ten (10) square inches and a depth of more than one-half (½) inch.

(b) Pipes which have been patched to repair porous spots, cracks or other defects.

(c) Variations in any dimensions exceeding the permissible variations.

(d) Fractures or cracks passing through the body or bell, except that a single crack at either end of the pipe

not exceeding three (3) inches in length or a single fracture in the bell not exceeding two (2) inches in depth nor extending more than ten (10) per cent around the circumference of the bell will not be considered cause for rejection.

(e) Failure to give a clear ringing sound when tapped with a light hammer.

(f) Exposure of the reinforcement when such exposure would indicate that the reinforcement was misplaced.

3. Laying Pipe

All trenches and beds shall be prepared as specified under "Excavation for Structures."

When pipe is of the bell and spigot type, the bell end of the pipe shall be laid up grade and all joints shall be filled with one (1) to two (2) Portland cement mortar. Portland cement and sand for mortar shall fulfill the requirements specified under "Concrete." Before succeeding sections of pipe are laid, the lower portion of the hub of the preceding pipe shall be plastered on the inside with mortar of sufficient thickness to bring the inner surfaces of abutting pipes even. After the pipe is laid the remainder of the joint shall be filled with mortar, and sufficient additional mortar shall be used to form a bead around the joint. The inside of the joint shall be wiped clean and finished smooth. The cement mortar on the outside shall be protected from the sun with an adequate covering.

When pipe is of the modified bell type, the lower half of the bell and the top half of the spigot shall be coated with mortar and the pipe shoved into place. After the pipe is laid the joints shall be pointed up on the outside. The joints on the inside shall be pointed where pipe is large enough to allow access to joint. Sufficient additional mortar shall be used to form a bead around the outside of the joint.

No pipe shall be laid until the location has been approved by the Engineer. The pipe shall be carefully

laid true to line and grade. Any pipe which is not true in alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

The filling around the pipe shall be made in nine (9) inch layers with approved material free from large stones, sods, or other material which would prevent the backfilling from being thoroughly compacted, and each layer shall be tamped thoroughly around and over the pipe.

No pavement or surfacing material shall be laid over any pipe until the backfill has been thoroughly compacted satisfactory to the Engineer.

4. Method of Measurement

The footage to be paid for shall be the actual length of pipe laid in place and accepted.

5. Basis of Payment

(a) Reinforced concrete pipe, placed and accepted, shall be paid for at the contract unit prices per linear foot for "Reinforced Concrete Pipe" of the several sizes, measured as provided above, which prices shall be full compensation for furnishing all materials, unloading from cars, hauling and installing the pipe, and all equipment, tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry end walls.

(b) Excavation including backfilling, on account of this work shall be paid for under the item of "Excavation for Structures."

Item 50-A--12 Inch Reinforced Concrete Pipe
Item 50-B--15 Inch Reinforced Concrete Pipe
Item 50-C--18 Inch Reinforced Concrete Pipe
Item 50-D--24 Inch Reinforced Concrete Pipe
Item 50-E--30 Inch Reinforced Concrete Pipe
Item 50-F--36 Inch Reinforced Concrete Pipe
Item 50-G--42 Inch Reinforced Concrete Pipe
Item 50-H--48 Inch Reinforced Concrete Pipe
Item 50-I--54 Inch Reinforced Concrete Pipe
Item 50-J--60 Inch Reinforced Concrete Pipe

VITRIFIED CLAY PIPE

SECTION 51

1. Description

This item shall consist of furnishing vitrified pipe, conforming to these specifications and of the sizes and dimensions required, and installing such pipe at such places as are designated on the plans or by the Engineer and in conformity with the lines and grades given.

2. Materials and Manufacture

Vitrified clay pipe shall be of the bell and spigot type of first quality, sound and thoroughly and perfectly burned, and shall be fully and smoothly glazed over the entire inner and outer surface, except that the inside of the hub, and the outside of the spigot may be unglazed for the full depth of the bell.

The minimum length of sections, thickness and the depth of bell shall be as follows:

Size Inches	Minimum Length Feet	Permissible Variation In. (—)	Minimum Thickness Inches	Permissible Variation In. (—)	Minimum Depth of Bell Inches
6	2	$\frac{1}{4}$	$\frac{3}{8}$	1/16	2
8	2	$\frac{1}{4}$	$\frac{3}{4}$	1/16	2
10	2	$\frac{1}{4}$	$\frac{7}{8}$	1/16	2 $\frac{1}{2}$
12	2	$\frac{1}{4}$	1	1/16	2 $\frac{1}{2}$
15	2	$\frac{1}{4}$	1 $\frac{1}{2}$	$\frac{1}{8}$	2 $\frac{1}{2}$
18	2	$\frac{1}{4}$	1 $\frac{3}{4}$	$\frac{1}{8}$	2 $\frac{1}{2}$
21	2	$\frac{1}{4}$	1 $\frac{1}{2}$	$\frac{1}{8}$	2 $\frac{1}{2}$
24	2	$\frac{1}{4}$	2	$\frac{1}{8}$	2 $\frac{1}{2}$
30	2 $\frac{1}{2}$	$\frac{3}{8}$	2 $\frac{1}{2}$	$\frac{1}{8}$	3 $\frac{1}{2}$
36	2 $\frac{1}{2}$	$\frac{3}{8}$	2 $\frac{3}{4}$	3/16	3 $\frac{1}{2}$

All pipe shall have sufficient strength that when tested by the three-point method of applying load in the crushing test as prescribed in the latest revised A.A.S.H.O. Standard Method T-33, the pipe shall develop an ultimate strength of 1000-D where D is the inside diameter of the barrel in feet.

If vitrified clay pipe is used under the surfaced portion of the road, it shall develop an ultimate strength of 2000 D under the test prescribed above.

3. Laying Pipe

All trenches and beds shall be prepared as specified under "Excavation for Structures."

The bell end of the pipe shall be laid upgrade, and all joints shall be filled with one to two (1 to 2) Portland cement mortar. The Portland cement and sand shall fulfill the requirements specified under "Concrete." Before the succeeding sections of pipe are laid, the lower portion of the hub of the preceding pipe shall be plastered on the inside with cement mortar of sufficient thickness to bring the inner surfaces of the abutting pipes even. After the pipe is laid, the remainder of the joint shall be filled with mortar, and sufficient additional mortar shall be used to form a bead around the joint. The inside of the joint shall be wiped clean and finished smooth. The cement mortar on the outside shall be protected from the air and sun with an adequate covering.

No pipe shall be laid until the location has been approved by the Engineer. The pipe shall be carefully laid true to line and grade. Any pipe which is not true in alignment or which shows any settlement after laying shall be taken up and relaid without extra compensation.

The filling around the pipe shall be made in nine (9) inch layers with approved material free from large stones, sods, or other material which would prevent the backfill from being thoroughly compacted, and each layer shall be tamped thoroughly around and over the pipe.

4. Method of Measurement

The footage to be paid for shall be the actual length of pipe laid in place and accepted.

5. Basis of Payment

(a) Vitrified clay pipe, placed and accepted, shall be paid for at the contract unit prices per linear foot for

"Vitrified Clay Pipe" of the several sizes, measured as provided above, which prices shall be full compensation for furnishing all materials, unloading from cars, hauling and installing the pipe and all equipment, tools, labor and incidentals necessary to complete the work, but shall not be payment for concrete or masonry end walls.

(b) Excavation, including backfilling, on account of this work shall be paid for under the item of "Excavation for Structures."

Item 51-A-- 6 Inch Vitrified Clay Pipe

Item 51-B-- 8 Inch Vitrified Clay Pipe

Item 51-C--10 Inch Vitrified Clay Pipe

Item 51-D--12 Inch Vitrified Clay Pipe

Item 51-E--15 Inch Vitrified Clay Pipe

Item 51-F--18 Inch Vitrified Clay Pipe

Item 51-G--21 Inch Vitrified Clay Pipe

Item 51-H--24 Inch Vitrified Clay Pipe

Item 51-I--30 Inch Vitrified Clay Pipe

Item 51-J--36 Inch Vitrified Clay Pipe

DROP INLETS, CATCH BASINS AND MANHOLES

SECTION 52

1. Description

Drop inlets, catch basins and manholes shall be built where called for on the plans or directed by the Engineer. They shall be built to the lines, grades, dimensions and designs shown on the plans with the necessary frames, gratings, covers, etc., and in accordance with these specifications.

2. Materials

Catch basins and manholes shall be constructed of concrete, brick or stone masonry. Drop inlets shall be constructed of concrete. Unless otherwise shown on the

plans, or ordered by the Engineer, all concrete shall be "Class A" as described under "Concrete."

Concrete and Mortar Materials. Portland cement, fine aggregate, coarse aggregate and water shall conform to the requirements specified for these materials under "Concrete."

Brick. The brick shall be new, well formed whole brick of the best quality, burned hard entirely through, free from injurious cracks and flaws, tough and strong, and shall have a clear ring when struck together.

Stone. Stone shall consist of sound hard granite blocks, rectangular in shape, six (6) inches to twelve (12) inches long, three and one-half ($3\frac{1}{2}$) inches to six (6) inches wide and three and one-half ($3\frac{1}{2}$) inches to six (6) inches thick. The face of the block shall have no depression or point over one-half ($\frac{1}{2}$) inch.

Curb-stone Inlets. Curb-stone inlets shall be composed of sound, durable granite free from seams. The stone shall meet the requirements for granite curb hereinbefore specified except that it shall have a thickness at the top of not less than seven (7) inches. The stone shall be shaped so as to provide an inlet to the catchbasin as shown on the plans. The surface of the inlet opening shall be bush-hammered.

Castings. Castings from frames, covers, gratings, traps, etc., shall be composed of the best quality tough, gray iron free from cold shuts, blowholes and other imperfections. The casting shall be sound, true to form and size, clean and neatly finished, and coated with coal tar pitch varnish.

3. Construction Methods

Masonry. All brick and stone masonry shall be laid by a competent mason and in a workmanlike manner. The bricks shall be well soaked in water before laying.

Every fourth course shall consist of headers. The dome shall be wholly composed of headers. The joints shall be thoroughly flushed full of mortar, consisting of one (1) part of Portland cement and two (2) parts sand. No joint on the face shall be greater than one-quarter ($\frac{1}{4}$) inch for brick or one-half ($\frac{1}{2}$) inch for stone. The joints shall be neatly pointed on the inside. As the walls are laid up they shall be well plastered with mortar on the outside. The mortar shall be mixed as specified under "Cement Stone Masonry."

Concrete. Concrete shall be proportioned, mixed and placed in accordance with the requirements hereinbefore specified for "Concrete."

All frame castings shall be set in full mortar beds, or otherwise secured as shown on the plans.

4. Basis of Payment

(a) Drop Inlets, Catch Basins and Manholes shall be paid for at the contract unit price each respectively for "Catch Basins," "Drop Inlets," or "Manholes" complete in place, which price shall include frames and gratings, curb-stone inlets, and all other material except traps, and all equipment, tools, labor and work incidental thereto.

(b) Traps shall be paid for at the contract unit price each for "Traps," complete in place, which price shall include all material, labor and all incidental work.

(c) Excavation on account of drop inlets, catch basins and manholes shall be paid for under the item of "Excavation for Structures."

Item 52-A--Drop Inlets--Type A

Item 52-B--Drop Inlets--Type B

Item 52-C--Catch Basins--Type A

Item 52-D--Catch Basins--Type B

Item 52-E--Catch Basins--Type C

Item 52-F--Manholes

Item 52-G--Traps

PART VI

INCIDENTAL CONSTRUCTION

PLAIN RIPRAP

SECTION 53

1. Description

Plain riprap shall consist of heavy stone used to protect slopes and foundations of piers, abutments and walls from scour. It shall be placed as shown on the plans or directed by the Engineer.

2. Material

The material to be used shall consist of sound and durable field or rough quarry stone which will not become disintegrated by action of water or exposure to the atmospheric elements. From sixty (60) to seventy-five (75) per cent of the stone shall be "two-man stone" or larger and the remainder shall be graded in size from "two-man stone" to pieces weighing ten (10) pounds each

3. Construction Methods

The riprap stone, graded so that the smaller stone is uniformly distributed throughout the mass, shall be dumped over the area designated and roughly spread until the required depth is obtained.

4. Method of Measurement

Plain riprap shall be measured in accordance with the depth shown on the plans or ordered by the Engineer.

5. Basis of Payment

This work shall be paid for at the contract unit price per cubic yard for "Plain Riprap," complete in place, which price shall include all materials, tools, equipment, labor, and all work incidental thereto.

Item 53--Plain Riprap

HAND-LAID RIPRAP

SECTION 54

1. Description

Hand-laid riprap shall be used for bank protection, and shall be placed where shown on the plans or directed by the Engineer.

2. Materials

The material to be used shall consist of sound and durable field or rough quarry stone which will not become disintegrated by the action of water or by exposure to the atmospheric elements.

Unless otherwise specified, all stones used in this class of riprap shall weigh at least fifty (50) pounds each and at least sixty (60) per cent of them shall weigh more than one hundred (100) pounds.

3. Construction Methods

The stones shall be placed upon a slope not steeper than the angle of repose of the embankment material, and no riprap shall be placed until the slopes of the embankment have been trimmed to the slope indicated on the plans, or in accordance with the lines given by the Engineer. The stones shall be placed with their beds at right angles to the slope, the larger stones being used in the bottom courses and the smaller stones at the top. They shall be laid in close contact so as to break joints, and in such manner that the weight of the stone is carried by the earth and not by adjacent stones. The spaces between the larger stones shall be filled with spalls securely rammed into place. The finished work shall present an even, tight, and reasonably smooth surface conforming to the required contour. When directed by the Engineer, the Contractor shall excavate sufficiently at the toe of slopes for the satisfactory placing and toeing in of the bottom stones.

4. Method of Measurement

Hand-laid riprap shall be measured in accordance with the depth shown on the plans or ordered by the Engineer.

5. Basis of Payment

(a) This work shall be paid for at the unit price per cubic yard for "Hand-Laid Riprap," complete in place, which price shall include all materials, equipment, tools, labor, and all work incidental thereto, except excavation at the toe of the slope.

(b) Necessary excavation at the toe of slopes for hand-laid riprap shall be paid for under the item of "Excavation for Structures."

Item 54--Hand-Laid Riprap

UNDERDRAIN

SECTION 55

1. Description

This item shall consist of either a trench filled with crushed stone or screened gravel, (TYPE A); or perforated asphalt coated metal pipe (TYPE B), laid on a course of crushed stone or screened gravel and with the trench filled with crushed stone or screened gravel to the required height. Underdrains shall be constructed at such places as shown on the plans, or as designated by the Engineer. They shall be built to the lines and grades given by the Engineer and in accordance with the plans and these specifications.

2. Materials

Perforated asphalt coated metal pipe shall conform to the requirements for "Asphalt Coated Corrugated Metal Pipe, Section 48," except as revised by the following:

Corrugations: Corrugations shall be not less than $1\frac{1}{2}$ inches nor more than $2\frac{3}{4}$ inches center to center, measured at right angles to the corrugations. The corrugations shall have a depth of not less than one-quarter ($\frac{1}{4}$) inch.

Perforations: Perforations shall be approximately three-eighths ($\frac{3}{8}$) inch in diameter after galvanizing. The number and location of perforations shall meet the requirements of the A.A.S.H.O., M-36, Standard Specifications for Corrugated Petal Pipe. In the case of six (6) inch pipe, there shall be not less than four (4) nor more than six (6) rows of perforations.

Shape: The pipe shall be of the full circle type. It may be of either the riveted, spiral seam, or other approved type of construction.

Dimensions and Weights: Unless otherwise shown on the plans or called for by the Engineer, the pipe shall have an inside diameter of six (6) inches. If riveted corrugated metal pipe is furnished, the sheets shall be of not lighter than 16 gauge (U. S. Standard). If spiral seam metal pipe is furnished, the pipe shall be of not lighter than 18 gauge (U. S. Standard). Larger size pipe shall conform to the requirements of the A.A.S.H.O., M-36 Standard Specifications.

End Connections: Field joints shall be made either by means of bands or other approved devices which hold the abutting sections firmly and accurately in the required position.

Workmanship: If riveted corrugated metal pipe is furnished, the provisions of A.A.S.H.O., M-36, Standard Specifications relating to rivets and riveting shall apply. If spiral seam metal pipe is furnished, the lapped edges shall be turned under and pressed down smoothly so as not to affect the shape and nominal diameter of the pipe. The lapped joint shall develop a strength at least equal

to that of the balance of the pipe. If other approved types of metal pipe are furnished the longitudinal joint shall develop a strength at least equal to that of the balance of the pipe.

Thickness of Coating: The inside of the pipe shall be uniformly coated to a minimum thickness of .03 inches.

Erosion Test: The erosion test specified shall not be made on pipe intended for use under this item.

Stone. All crushed stone or gravel for preparing the bed or bottom course and for backfilling shall be composed of clean, tough, durable stone of the sizes herein after specified.

3. Construction Methods

Type "A" Underdrain. The trench shall be excavated to the required width and depth. Unless otherwise shown on the plans, the trench shall be filled with crushed stone or screened gravel, uniformly graded, which will pass a two (2) inch sieve and be retained on a one-quarter ($\frac{1}{4}$) inch sieve. All stone filling shall be tamped firmly in layers of not more than nine (9) inches.

Type "B" Underdrain. The trench shall be excavated to the required width and depth. Stone for the bed or bottom course shall consist of crushed stone or screened gravel, uniformly graded, which will pass a one and one-quarter ($1\frac{1}{4}$) inch sieve and be retained on a one-quarter ($\frac{1}{4}$) inch sieve; it shall be placed and tamped to a uniform depth of three (3) inches and shall be true to grade. The pipes shall then be bedded firmly on the bottom course of stone with perforations up. After the pipes have been laid crushed stone or gravel of the sizes above specified shall be filled about the pipe and over it for a depth of six (6) inches, and carefully tamped. Unless otherwise shown on the plans, the remainder of the trench shall be filled with crushed stone or screened gravel, uniformly graded, which will pass a two (2) inch

sieve and be retained on a one-quarter ($\frac{1}{4}$) inch sieve. All stone filling shall be tamped firmly in layers of not more than nine (9) inches.

Type "C" Underdrain. The trench shall be excavated to the required width and depth. The bottom of the trench shall be shaped to fit the lower part of the pipe which shall be placed with the perforations uppermost. The trench shall be backfilled with clay or other impermeable material up to the elevation of the perforations and thoroughly tamped. Crushed stone or gravel, uniformly graded, which will pass a one and one-quarter ($1\frac{1}{4}$) inch sieve and be retained on a one-quarter ($\frac{1}{4}$) inch sieve, shall be placed about the pipe and over it for a depth of six (6) inches and carefully tamped. Unless otherwise shown on the plans, the remainder of the trench shall be filled with crushed stone or screened gravel, uniformly graded, which will pass a two (2) inch sieve and be retained on a one-quarter ($\frac{1}{4}$) inch sieve. All stone filling shall be tamped firmly in layers of not more than nine (9) inches.

Outlets. Underdrain shall have suitable outlets in culverts, or such other outlets as to drain water entirely away from the road.

When outlets requiring pipe only are called for on the plans or ordered by the Engineer they shall be constructed of the same pipe used in the underdrain except that perforations need not necessarily be required. Suitable bends shall be used to enable the pipe to be located where directed by the Engineer.

When called for on the plans, or ordered by the Engineer, outlets shall be protected by Class B Concrete or Cement Rubble Masonry headwalls.

4. Basis of Payment

(a) Underdrain shall be paid for at the contract unit price per linear foot complete in place for the type of underdrain used, which price shall include all pipe, fit-

tings, and other materials, laying pipe and backfilling, equipment, tools, labor and all work incidental thereto, including connections with culverts, catch basins and drop inlets, except pipe outlets, excavation and headwalls.

(b) Pipe outlets for underdrain shall be paid for at the contract unit price per linear foot for "Underdrain outlets," complete in place, which price shall include all pipe, fittings, and other materials, laying pipe, equipment, tools, labor and all work incidental thereto except excavation and headwalls.

If the outlets require pipe larger than six (6) inches payment will be made at the contract unit price for the type and size of pipe used.

(c) Excavation shall be paid for at the contract unit price per cubic yard for "Excavation for Structures" or at the price allowed for "Rock Excavation for Structures" and no allowance shall be made for pumps, pumping or bailing, or for any materials, equipment, or labor necessary on account of water or unsuitable material. Excavation shall be measured to the neat lines shown on the plans or as ordered by the Engineer except, in case "Rock Excavation" is encountered, payment will be made for material actually removed if within planes not over six (6) inches from the neat lines shown or ordered.

(d) Headwalls shall be paid for at the contract unit price for "Class B Concrete" or "Cement Rubble Masonry" as the case may be.

Item 55-A--Underdrain--Type A

Item 55-B--Underdrain--Type B

Item 55-C--12 Inch Underdrain--Type C

Item 55-D--15 Inch Underdrain--Type C

Item 55-E--18 Inch Underdrain--Type C

Item 55-F--24 Inch Underdrain--Type C

Item 55-G--Underdrain Outlets

STONE GUTTER

SECTION 56

1. Description

This item shall consist of a gutter of stones with the interstices filled with fine sand or grouted with Portland cement mortar and shall be constructed on the prepared bed in conformity with the dimensions shown on the plans and in accordance with these specifications.

2. Materials

Stone. The stones shall be selected with due regard for sizes and soundness. All stones shall be of such a size that when laid they shall have a depth of approximately nine (9) inches.

Filler. The filler material shall consist of fine sand, dry and free from stones.

Mortar. The mortar for grouting the stones shall consist of one (1) part cement, three (3) parts fine aggregate, and water. The cement, fine aggregate and water shall meet the requirements specified for these materials under "Concrete."

3. Construction Methods

Where Grouted Stone Gutter is used, a bed of fine gravel shall be prepared having a depth of six (6) inches for the entire width of gutter. The bed of the Dry Stone Gutter shall be loosened to facilitate the placing and ramming of stones.

Stones of the required sizes shall be laid by hand with broken joints. After the stones are laid they shall be tamped with a tamper weighing not less than twenty-five (25) pounds. The area adjacent to both sides of the gutter for a width of approximately twelve (12) inches shall be thoroughly tamped.

After the stones have been placed and tamped, the interstices between the stones shall be filled by that one of the following methods which pertains to the type of gutter specified.

Filling Interstices

(a) **Dry Stone Gutter.** After the stones are thoroughly tamped the interstices between the stones shall be swept full of fine sand. When completed the surface of the gutter shall be true to the line, cross-section and grade as shown on the plans or ordered by the Engineer.

(b) **Grouted Stone Gutter.** After the stones are thoroughly tamped the interstices between the stones shall be swept full of cement mortar. When completed the surface of the gutter shall be true to the line, cross-section and grade as shown on the plans or ordered by the Engineer.

Cut-Off Walls

A cut-off wall shall be constructed at the inlet end of each section of gutter. These walls shall extend the full width of the gutter and shall be not less than nine (9) inches thick and shall extend to a depth approximately twenty-one (21) inches below the finish grade of the gutter. The stones composing these walls shall extend entirely through the wall.

The walls for a dry stone gutter shall be laid with the smallest and fewest practical number of joints and each stone shall be so placed as to have a firm bearing on the supporting stones.

Marl or other clayey material shall be used in backfilling nine (9) inches around the walls and special care shall be taken in tamping this backfill.

The walls for a grouted stone gutter shall be laid in cement mortar as specified for the gutter.

4. Basis of Payment

Payment for these items shall be made at the contract unit price per square yard for "Dry Stone Gutter" or "Grouted Stone Gutter," complete in place, which price shall include the construction of the cut-off walls and all

materials, equipment, tools, labor and all incidental work except excavation, which will be paid for at the contract unit price for "Earth Excavation."

Item 56-A--Dry Stone Gutter

Item 56-B--Grouted Stone Gutter

SLOPE CHECKS

SECTION 57

1. Description

This item shall consist of boards staked on slopes to temporarily hold loam and sod from sliding until a grass sod is established and shall be installed at such places as are designated on the plans or as directed by the Engineer in accordance with these specifications and in conformity with the plans.

2. Materials and Construction Methods

One (1) inch by six (6) inch undressed boards of acceptable quality shall be placed on edge at right angles to the slope. Each board shall be supported by two (2) inch by two (2) inch by twenty-four (24) inch stakes along the lower side of the board beginning at the ends and spaced at intervals of not more than four (4) feet apart. Each stake shall be driven flush with the top of the board and shall fit closely against it.

Loam and sod shall be placed firmly against the slope checks to keep the boards in position.

3. Measurement and Payment

This item shall be paid for at the contract unit price per linear foot of boards for "Slope Checks," complete in place, which price shall include all materials, equipment, tools, and all incidentals necessary to the completion of the work.

Item No. 57--Slope Checks

PLANK CURB

SECTION 58

1. Description

This item shall consist of a plank curb, with suitable outlets, along guard rail sections on the inside of super-elevated curves, high fills and at other necessary places in accordance with these specifications and in conformity with the plans or as directed by the Engineer.

2. Materials

The curb shall be composed of plank two (2) inches thick by ten (10) inches wide, unless otherwise noted on the plans. All plank shall be of sound seasoned hemlock and shall be treated with the same material and in the same manner as specified for wood guard rail posts.

3. Construction Methods

Curb. Plank shall be placed on the inside of the guard rail posts in accordance with the design shown on the plans or as directed by the Engineer. The planks shall be fastened together at the ends with splices ten (10) inches wide by two (2) inches thick by eighteen (18) inches long. The splice shall be placed on the back side of the curb and shall be secured to each curb plank by five (5) spikes sufficiently long to extend through both plank and splice and be clinched on the back. The plank shall bear on the posts but shall not be fastened to them.

Baffle Wall. At curb outlets a baffle wall shall be constructed of plank of the dimensions and designs shown on the plans. This wall shall be securely fastened to the curb by splices as specified for the plank curb. There shall be no space between the curb and the baffle wall.

Shoulder. After the plank curb is installed and the gravel base is satisfactorily compacted, the mixed bituminous gravel surface may be placed. All areas which cannot be compacted with a roller shall be tamped by hand with a tamp weighing not less than twenty-five

(25) pounds. The finished shoulder grade shall be depressed at the outlets to match the cut section in the curb.

Apron. Where sodded outlets are used the apron shall be of sod and where plank sluices are used the apron shall be constructed of plank.

Aprons shall be warped in construction to meet the inlet of the sluice or sod outlet.

4. Measurement and Payment

This item shall be paid for at the contract unit price per linear foot for "Plank Curb," which price shall include full compensation for furnishing and placing plank, labor, tools and all incidentals necessary to satisfactorily complete the work except as hereinafter specified.

The linear feet paid for under this item shall include the overall length of the curb plus the actual length of each baffle wall.

Gravel Base Course, Mixed Bituminous Gravel Surface, Loam, Sod and Sluices shall be paid for at the contract unit prices bid for their respective items.

Item 58--Plank Curb

PLANK SLUICE

SECTION 59

1. Description

This item shall consist of a plank sluice for the outlets to plank curb and shall be constructed in accordance with these specifications and in conformity with the design, dimensions and sizes shown on the plans or as directed by the Engineer.

2. Materials

All plank and posts shall be of sound, seasoned undressed hemlock or spruce.

3. Preservative Treatment

All plank, posts, and boards shall be treated with two coats of creosote oil thoroughly and uniformly applied with a paint brush. The second coat shall not be applied until the first coat has become thoroughly dry.

The Preservative material to be used in this method shall be a liquid grade of pure coal-tar creosote oil, specially refined for non-pressure treatments, and when tested shall conform to the following requirements:

*(a) The oil must be a pure distillate from coal-tar.

(b) The specific gravity at 38°C. compared with water at 15.5°C. shall be not less than 1.03.

(c) Water must not exceed two (2) per cent.

(d) The matter insoluble in hot benzol shall not exceed five-tenths (0.5) per cent.

The distillates based on a dry oil shall meet the following requirements by weight:

(a) Up to 210°C., not more than one (1) per cent.

(b) Up to 235°C., not more than ten (10) per cent.

*This shall be checked by A.W.P.A. Standard Specifications 4F(1936) Footnote 1.

4. Construction Methods

Sluice

No section shall be less than eight feet in length. Where total length of sluice is fifteen feet or less, it shall be constructed in one piece. Matched lumber shall be used on bottom of apron and sluice.

All plank shall be fastened with 20 penny nails.

The baffle wall at the inlet end of the sluice shall be of two (2) inch plank ten (10) inches wide and shall extend the full length of the horizontal floor brace.

The sluice shall rest on suitable sized pieces of lumber or timber so that there will be an air space under it of at least two (2) inches.

All posts shall be driven snug to the sides of the sluice and the overhanging horizontal floor braces and shall not be attached to the sluice in any way.

Where a section of sluice is constructed with plank shorter than the length of the section, joints in the floor of the sluice shall be staggered and the ends of each plank shall be supported by a horizontal floor brace. The side plank shall overlap the adjacent floor joint by at least two (2) feet and shall be joined with a splice one (1) inch by eight (8) inches by thirty (30) inches.

Where the sluice is made up of two or more sections the joint between sections shall be supported by an overlapping horizontal floor brace at least ten (10) inches wide. The side walls of each section shall be spliced to the adjoining section as shown.

One (1) inch boards at least six (6) inches wide shall be used as top horizontal braces at all vertical joints and at such other places as may be directed by the Engineer.

Sluices shall be staked at all overhanging floor braces.

Apron

Vertical and horizontal braces attached to the baffle wall of the curb and sluice and plank floor and sides shall be of the dimensions shown on the plans.

The flow line of the apron at the curb end shall be at least one-half ($\frac{1}{2}$) inch lower than the cut section through the curb and at the sluice end shall be at least one-half ($\frac{1}{2}$) inch higher than the flow line of the sluice.

Both ends of the apron shall be securely fastened to the horizontal and vertical braces with 20 penny nails through the sides and floor of the apron.

The sides of the apron shall extend into the sluice as shown on the plans.

A strip of number 28 galvanized iron eight (8) inches wide by twenty-four (24) inches long shall be nailed to the floor of the apron at the junction of the apron and sluice with galvanized roofing nails in such a manner that six (6) inches extends over the floor of the sluice, and a strip of the same material sixteen (16) inches wide by four feet ten inches (4'-10'') long shall be bent over the upper side of the curb baffle wall 6'' and extended over the apron 8''.

5. Measurement and Payment

This item shall be paid for at the contract unit price per linear foot for "Plank Sluice," which price shall include all materials, tools, labor, and all work incidental thereto.

The length of the plank sluice to be paid for under this item shall include the length of the plank apron.

Item 59--Plank Sluice

METAL SLUICE

SECTION 60

1. Description

This item shall consist of furnishing and laying half circle bituminous coated metal sluice constructed in conformity with the plans and these specifications and located where shown on the plans or ordered by the Engineer.

2. Materials

Sluice. The sluice shall be composed of 16 gauge corrugated metal shaped to a half circle having a diameter of eighteen (18) inches. The corrugated metal and bituminous coating shall comply with the foregoing specification for "Asphalt Coated Corrugated Metal Pipe." Two (2) inch flanges at the sides of the sluice shall be made either from the sluice material or of 2''x2''x $\frac{1}{8}$ '' steel angles bolted to the sluice with three-eighths ($\frac{3}{8}$) inch bolts spaced approximately twelve (12) inches. Both flanges shall be punched with two three-eighths ($\frac{3}{8}$) inch holes, three (3) inches center to center in the center of each two foot length of sluice.

Stakes. The stakes shall be of spruce or hemlock 2''x6''x2'-6'' and pointed on one end. They shall receive the same preservative treatment as specified for wood posts for guard rail.

3. Construction Methods

A trench shall be excavated to provide a uniform firm bed, shaped to conform to the bottom of the sluice. Stakes shall be driven, on each side, approximately six (6) feet apart measured on the axis of the sluice. The sluice shall be fastened to each stake with two five (5) inch spikes. The upper end of the sluice shall be fitted to the plank curb and the joint shall be thoroughly caulked with oakum. Excavated material shall be tamped firmly around the sluice and any excess shall be disposed of as directed.

4. Basis of Payment

This work shall be paid for at the contract unit price per linear foot, measured along the axis of the sluice, for "Metal Sluice," complete in place, which price shall include all excavation, labor, materials, and all incidental work.

Item 60--Metal Sluice

GRANITE CURB

SECTION 61

1. Description

This item shall consist of furnishing and placing granite curb, wherever designated on the plans or ordered by the Engineer, in conformity with these specifications.

2. Material

The curb stone shall be sound, durable and free from seams: they shall be straight lined and without wind. The stone shall be not less than four feet in length and shall have a uniform thickness of not less than six inches on top, and in no place shall the thickness be less than the top thickness. The stone shall have a depth of at least seventeen inches. The top of the stone shall be

square with the face or have a slope down towards the face of not over one inch. The surface of top, eight inches in depth of face, and two inches in depth of back shall be pointed. The top edges and surface shall be true to line and straight edge. The ends for the depth of eight inches from the top shall be truly squared and dressed so that when laid they shall abut one against the other, making a joint not exceeding one-half of an inch.

Circular curb stone shall be cut to the radius shown on the plans or ordered by the Engineer. The ends shall be cut on radial lines so that when laid they shall abut one against the other, making a joint not exceeding one-half of an inch.

3. Construction Methods

All curb stone shall be laid to conform with the line and grade called for on the plans or given by the Engineer. It shall be set throughout its entire length on a tamped gravel base so that its outer face shall be vertical. Each stone shall be set not exceeding one-quarter inch above grade and rammed to grade with a paving rammer so as to secure an even bearing of the stone. The gravel base for the sidewalk and road which is to be placed on each side of the curb shall be thoroughly tamped for a distance of twelve inches from the curb.

4. Basis of Payment

(a) This work shall be paid for at the contract unit price per linear foot for "Granite Curb," complete in place, which price shall include all materials, tools, labor and all incidental work, except as follows:

(b) Circular granite curb shall be paid for at the contract unit price per linear foot for "Circular Granite Curb," complete in place, including all materials, tools, labor and all incidental work.

(c) Excavation for curb shall be paid for under the pertinent item of "Excavation," "Rock Excavation," or "Unclassified Excavation."

(d) Gravel base shall be paid for under the item of Gravel Base.

Item 61-A--Granite Curb

Item 61-B--Circular Granite Curb

CONCRETE CURB, INTEGRAL CONCRETE CURB, CURB AND GUTTER

SECTION 62

1. Description

This item shall consist of constructing concrete curb, integral concrete curb, or concrete curb and gutter, wherever designated on the plans or ordered by the Engineer. It shall be built in accordance with the plans and in conformity with these specifications.

2. Materials

Cement. The cement used shall be a standard American brand which shall comply with the latest revised Specifications of the A.A.S.H.O., Specification M-85, Type II. It shall be interground at the mill with approximately three-hundredths (0.03) per cent of Vinsol Resin.

Expansion Joint Filler. The expansion joint filler shall comply with the specifications for Premoulded Expansion Joint Filler as specified for use in Cement Concrete Pavement.

Aggregate. The fine and coarse aggregates shall comply with the specifications for fine and coarse aggregates for Class "A" Concrete.

Steel Reinforcement. The steel reinforcement shall comply with the specifications for Steel Reinforcement for Concrete Pavement.

3. Construction Methods

All concrete curb, integral concrete curb, and concrete curb and gutter shall be constructed in accordance with the design and dimensions shown on the plans and to the line and grade designated on the plans or ordered by the Engineer. The concrete shall be proportioned, mixed and placed as specified for Class "A" Concrete and reinforced as shown on the plans. It shall set throughout its entire length on a tamped gravel base.

The curb shall be constructed in twenty foot sections unless otherwise shown on the plans. Every forty feet there shall be a one-half inch expansion joint. Intermediate joints shall be painted with a cold bituminous material approved by the Engineer.

The gravel base for the sidewalk and road which is to be placed on each side of the curb shall be thoroughly tamped for a distance of twelve inches from the curb.

4. Basis of Payment

(a) Concrete curb shall be paid for at the contract unit price per linear foot for "Concrete Curb," complete in place, which price shall include all materials, tools, labor and all incidental work, except excavation and gravel base.

(b) Integral concrete curb shall be paid for at the contract unit price per linear foot for "Integral Concrete Curb," complete in place, which price shall include all materials, tools, labor and all incidental work, except excavation and gravel base.

(c) Concrete curb and gutter shall be paid for at the contract unit price per linear foot for "Concrete Curb and Gutter," complete in place, which price shall include all materials, tools, labor and all incidental work, except excavation and gravel base.

(d) Excavation for curb shall be paid for under the pertinent item of "Excavation," "Rock Excavation," or "Unclassified Excavation."

(e) Gravel base shall be paid for under the item of "Gravel Base."

Item 62-A--Concrete Curb

Item 62-B--Integral Concrete Curb

Item 62-C--Concrete Curb and Gutter

FIELD STONE CURB

SECTION 63

1. Description

This item consists of furnishing and placing a curb composed of field stone or other stone meeting the approval of the Engineer, wherever called for on the plans or ordered by the Engineer in conformity with these specifications.

2. Material

The stone shall be sound and durable from five (5) to seven (7) inches thick at least six (6) inches wide and have a length of at least twelve (12) inches.

3. Construction Methods

The stones shall be placed with the twelve (12) inch dimension vertical and the largest end down and shall fit snugly together. If the stones are weathered, the weathered side shall be visible. After the stones are placed they, and the loose dirt around them, shall be tamped with a tamper weighing not less than twenty-five (25) pounds. When thoroughly tamped the curb shall be true to the line and grade shown on the plans or ordered by the Engineer.

4. Basis of Payment

This item shall be paid for at the contract unit price per linear foot for "Field Stone Curb," which price shall include all material, labor, equipment, tools, and incidental work.

Item 63--Field Stone Curb

WOOD PILING

SECTION 64

1. Description

Piling shall consist of timber of the kind and dimensions specified, placed in the location and to the elevation shown on the plans or as directed by the Engineer, and in accordance with these specifications.

2. Materials

In general, wooden piles shall consist of white and red oak, rock elm, hackmatack, spruce, red pine or other species of wood which will satisfactorily resist the action of the hammer during the process of driving. However, the specie to be used must be approved by the Engineer.

Piles shall be cut from straight, live timber, close grained and free from injurious cracks, shakes, large and rotten knots, decay, short bends and other defects impairing their strength; they shall be so straight that a line passing through the center of butt and point will be wholly within the body of the pile. Whenever conditions will permit they shall be cut when the sap is down. All knots shall be trimmed close to the body of the pile and unless otherwise provided the bark shall be removed.

Piles shall show an even, gradual taper from end to end and must be not less than eight (8) inches in diameter, not including the bark, at the point or small end, and not less than the following minimum diameter under the bark at the butt or large end.

Length	Butt Diameter
20 feet and under	10 inches
21 feet to 30 feet	12 inches
31 feet to 50 feet	14 inches
51 feet and over	16 inches

Piles shall be sharpened or spliced only when authorized by the Engineer. Metal points and rings shall be used when required by the Engineer.

The Contractor shall be responsible for determining the length of piles required by driving test piles or otherwise. All piles shall be of such length that the tops, after all damaged wood has been cut off, will be at the required elevations.

3. Construction Methods

Piles shall be driven plumb, or to the batter indicated and spaced as shown on the plans, or as directed by the Engineer. Either a gravity or steam hammer of approved type and weight may be used. Each pile shall be considered as having a safe supporting capacity found by the following formulae:

$$P = \frac{2WH}{S+1} \text{ for gravity hammer}$$

$$P = \frac{2WH}{S+0.1} \text{ for steam hammer}$$

In these formulae:

P = Safe load per pile in pounds.

W = Weight of hammer in pounds.

H = The fall of the hammer in feet.

S = Average penetration per blow for last five blows in inches.

In applying the above formulae, the following conditions must maintain:

The head of the pile must be free from "broomed" or crushed wood in determining all factors of the formulae. The value of S can only be determined by taking the mean of the penetrations per blow for a number of blows when the penetration has been at a reasonably uniform or uniformly decreasing rate and there is reasonable assurance that the penetration will continue uniform if the pile be driven further. In determining the value of "H," the full fall must be counted only where there is no perceptible bounce after the blow. If the value of "H" is determined from a blow which produces a bounce, at least twice the height of the bounce should be deducted from the total fall to determine its true value for use in the formulae.

Unless otherwise indicated on the plans or permitted by the Engineer, each pile shall be driven until it will support a load of fifteen (15) tons as determined by the above formulae. In every case the piles shall be driven until the total penetration is satisfactory to the Engineer, regardless of the fact that the required bearing capacity as determined by the formulae may be obtained at a lesser penetration.

Any pile broken or driven out of its proper location shall be removed, or at the option of the Engineer, a second pile shall be driven adjacent thereto at the expense of the Contractor. If any piles are raised by subsequent driving of others they shall be redriven.

All foundation piles shall be cut off at elevations below that of low water in the stream or well below the elevation of permanent moisture in cases where no stream is involved, or at the elevation shown on the plans or directed by the Engineer.

4. Basis of Payment

Payment for piles shall be made at the contract unit price per linear foot of pile complete in place, which price shall include furnishing, driving, cutting off, equipment, tools, labor and all work incidental thereto.

In addition, an allowance shall be made on the basis of actual cost of material delivered at the job for all cut-off lengths in excess of three (3) feet.

Item 64--Wood Piling

WIRE CABLE GUARD RAIL

SECTION 65

1. Description

Wire Cable Guard Rail shall consist of cables supported by posts erected as indicated on the plans or as directed by the Engineer, in accordance with these specifications and in conformity with the plans. Type A guard rail shall consist of two cables supported by wood posts. Type B guard rail shall consist of three cables supported by offset brackets on steel posts.

2. Materials

Wood Posts. Wood posts shall be of the length shown on the plans and shall be of sound seasoned cedar, oak or hackmatack and either round or square. The bark shall be removed from all posts, and all knots hewn flush with the face. All round posts shall be shaved so as to take treatment and paint properly. The bottom shall be pointed. Round posts shall be not less than six (6) inches in diameter at the smaller end after the bark has been removed, and the posts shaved. Square posts shall be not less than six (6) inches square. Round and square posts shall not be used on the same contract. Anchor posts shall be of oak not less than ten (10) inches in diameter at the small end after the bark has been removed or nine (9) inches square. The lower part of all wood guard rail posts to a point which will be six (6) inches above the ground surface, when in place, shall be treated by dipping in emulsified asphalt similar to that specified for Bituminous Macadam Surface Course or in bituminous material similar to that specified for either of the Gravel Surface Courses specified herein. This treatment shall be allowed to dry before the posts are used.

Guard Posts. Guard posts shall be wood posts conforming to the above requirements.

Steel Posts. Steel posts shall be fabricated from new structural steel 6" x 4" x 8.5L H sections in accordance with the dimensions and design shown on the plans. After fabrication the posts shall be cleaned to a steely brightness and painted with a shop coat of red lead paint complying with the requirements of the latest revision of the A.A.S.H.O. Standard Specification M-71.

Cable. The cable shall be manufactured of standard durable galvanized steel wire and shall be not less than three-quarters ($\frac{3}{4}$) of an inch in diameter. The cable shall consist of three (3) strands with seven (7) wires to the strand. Individual wires shall be not less than 0.117 inch diameter. The cable shall have a tensile strength of not less than 25,000 pounds.

All wire rope shall be shipped upon substantial wooden reels. Each reel shall have the length and weight of the rope plainly and indelibly marked on a strong tag, firmly attached. The wooden reel shall be mounted so that it will revolve and the rope run off by pulling straight ahead.

Offset Brackets. Offset brackets shall be fabricated from spring steel conforming to the requirements of the latest revised A.S.T.M. Specification A-14. The brackets shall be machined and formed as shown on the plan with one-eighth ($\frac{1}{8}$) inch tolerance in height and width and shall be tempered, drawn and galvanized after forming. The completed bracket shall meet strength requirements as follows. The load shall be applied through $\frac{3}{4}$ " cables laid in the slots. Measured out to out front to back, a load of 15,000 pounds shall cause a minimum deflection of one inch. After the load has been held for one minute and released, the bracket shall show a permanent set of not greater than one-half ($\frac{1}{2}$) inch.

Fittings. All fittings and fastenings shall be of the design and dimensions shown on the plan or approved by the Engineer. Drop forged steel weldless or malleable iron fittings approved by the Engineer shall be used.

Where wedge type fittings are used, large wedges, which may be of cast iron, will be required. All fittings to which the cable is fastened shall be of sufficient strength to withstand a strain on the cable of at least 25,000 pounds.

Plate washers shall be steel and of the design and dimensions shown on the plan. Plate washer "A" shall be galvanized and plate washers "B" and "C" shall be painted as specified for steel posts.

Hook bolts shall be of steel not less than five-eighths ($\frac{5}{8}$) of an inch in diameter and have a minimum length of eight and one-half ($8\frac{1}{2}$) inches with three (3) inch thread and fitted with standard round washer and nut. When hook bolts are bent by the cold process, they shall be annealed before galvanizing.

Anchors. The anchor block used shall be of the design and dimensions shown on the plans. The anchor rod assembly shall be of the length and design shown on the plans and shall be at least one (1) inch in diameter for Type A guard rail and one and one-quarter ($1\frac{1}{4}$) inches in diameter for Type B guard rail. It shall have a tensile strength of at least 40,000 pounds for Type A guard rail and of at least 60,000 pounds for Type B guard rail.

Galvanizing. Each wire of the cable and all fittings and fastenings shall be galvanized by the Hot Dip Method and shall have a continuous coating of pure zinc of a uniform thickness, so applied that it will adhere firmly to the surface of the wire and fittings and it shall be capable of withstanding four (4) immersions in a standard testing solution of copper sulphate without showing appreciable trace of metallic copper on the steel. The first three (3) immersions shall be for a period of one (1) minute each and the fourth immersion for a period of one-half ($\frac{1}{2}$) minute, except the threaded portions which shall be capable of withstanding two (2) immersions of one (1) minute each in a standard testing

solution of copper sulphate without showing any trace of metallic copper on the steel. All burrs and ragged edges shall be removed from fittings before galvanizing.

3. Construction Methods

The posts shall be set vertically to full depth and spaced as shown on the plans, and accurately lined. Post holes shall be backfilled with suitable material and thoroughly tamped in layers of not more than six inches, care being taken to preserve the alignment of the posts. The tops of wood posts shall be sawed off to the exact grade after the backfilling and tamping is finished. A one-inch bevel shall be provided around the tops of wood posts. Steel posts may be driven and suitable driving caps and equipment shall be provided to prevent battering or injury to the posts. Before driving these posts, holes about eight (8) inches deep and one (1) foot in diameter shall be dug at post locations to facilitate painting. Posts shall then be driven to the proper depth. An underground steel channel shall be bolted to each anchor post after driving as shown on the plans. The posts shall be painted below the bottom of the bracket to six (6) inches below the ground with one coat of black asphalt varnish of such quality as to give a tough flexible film, free from tackiness, and which will not chip off or flake off in handling. After the varnish has thoroughly dried the space around the posts shall be filled with suitable material thoroughly tamped.

The cables shall be drawn to take up all sag between the posts and both ends of each section of cable shall be anchored as shown on the plan. At all cable ends the rods shall be screwed against the wedges so as to hold them tightly in place. For Type A guard rail the cable shall be attached to the posts by means of hook bolts and for Type B guard rail the cable shall be positioned and confined by stay pins into the offset brackets and the stay pins shall be held in place so that they cannot be removed without the use of tools. The cables shall

be stretched to such magnitude as the Engineer may direct and tension in each cable shall be the same. Splicing of the cable will be permitted but no single piece of cable shall be less than fifty (50) feet long and not more than one splice shall occur in any one space between posts. Continuous stretches of cable more than five hundred (500) feet long shall have intermediate turn-buckles. The anchor rods shall be adjusted to equalize the strain on the cable and anchors.

4. Basis of Payment

(a) This item shall be paid for at the contract unit price per linear foot for "Wire Cable Guard Rail," of the type indicated in the proposal, complete in place, which price shall include all materials, equipment, tools, posts, excavation (except solid ledge), backfilling and all work incidental thereto, except the construction of anchorages.

The quantity to be paid for under this item shall be the number of linear feet as measured from outer post to outer post and will not include the distance between the end post and the "dead man."

(b) Anchorages shall be paid for at the contract unit price each for "Anchorages," complete in place, which price shall include all materials, equipment, tools, excavation (except solid ledge), backfilling and all work incidental thereto.

(c) Guard posts shall be paid for at the contract unit price each for "Guard Posts," complete in place, which price shall include all materials, tools, labor and all incidental work except solid ledge excavation.

(d) Allowance for solid ledge rock will be made for holes two (2) feet in diameter and of the required depth. Payment for the same will be made under the item of "Rock Excavation for Structures."

Item 65-A--Wire Cable Guard Rail--Type A

Item 65-B--Wire Cable Guard Rail--Type B

Item 65-C--Anchorages

Item 65-D--Guard Posts

WOOD GUARD RAIL

SECTION 66

1. Description

Wood Guard Rail shall consist of wood rails supported by wood posts erected as indicated on the plans or as directed by the Engineer, in accordance with these specifications and in conformity with the plans.

2. Materials

The posts shall comply with the requirements for wood posts in accordance with the specifications for "Wire Cable Guard Rail," except round posts shall be not less than eight (8) inches in diameter at the smaller end after the bark has been removed, and the posts shaved and square posts shall not be less than eight (8) inches square.

Wood rails shall be well seasoned, straight and sound spruce, southern yellow pine, or Douglas fir, cut from live growing timber, free from loose knots or other defects, and shall be surfaced on all sides. The dimensions of the rail shall be six (6) inches by eight (8) inches before being dressed by sixteen feet long.

3. Preservative Treatment of Posts

Preservative treatment of posts shall be in compliance with the requirements of the specifications for "Wire Cable Guard Rail."

4. Construction Methods

The Posts shall be set in compliance with the requirements of the specifications for "Wire Cable Guard Rail."

The wood rails shall be placed as shown on the plans and the rails shall be secured to the posts with two ten (10) inch spikes at each end and two at intermediate posts as shown on plans. The rails shall be drilled for the spikes to prevent splitting.

5. Basis of Payment

This item shall be paid for at the contract unit price per linear foot for "Wood Guard Rail," complete in place,

which price shall include all materials, equipment, tools, posts, rails, excavation (except solid ledge), backfilling and all work incidental thereto.

Allowance for solid ledge rock will be made for holes two (2) feet in diameter and of the required depth. Payment for the same will be made under the item of "Rock Excavation for Structures."

The quantity to be paid for under this item shall be the number of linear feet as measured from outer end to outer end of rails.

Item 66--Wood Guard Rail

LOAM

SECTION 67

1. Description

This item shall consist of furnishing and placing loam wherever called for on the plans or ordered by the Engineer in conformity with these specifications. Loam Excavation shall consist of material taken from within the lines of improvement. Loam Borrow shall consist of material obtained outside the right of way.

2. Material

The loam shall be of a quality approved by the Engineer and shall be comparatively free from stones, gravel, roots, or other material which would tend to form large air pockets in the soil. The use of sour loam or muck will not be permitted. Prior to stripping the loam, the Contractor shall remove any briars, stumps, or roots, by mowing, grubbing, or other satisfactory means.

3. Construction Methods

As much of the required amount of loam as is suitable shall be taken from within the lines of improvement.

Loam shall be spread on the prepared subgrade to the depth shown on the plans or required by the Engineer. It shall then be thoroughly raked and all stones and unsatisfactory material shall be removed. No loam shall be taken from locations where in the opinion of the Engineer, it would leave unsightly conditions as viewed from the main highway.

Loam shall be left in a loose condition suitable for seeding.

4. Method of Measurement

Measurements to determine the amount of loam shall be made in position by cross-sections made before and after removal and the volume shall be computed by the average end area method. Material paid for under the item of "Loam Excavation" shall not be paid for under the item of "Earth Excavation."

5. Basis of Payment

(a) Loam Excavation shall be paid for at the contract unit price per cubic yard for "Loam Excavation" which price shall include full compensation for excavating, stockpiling and placing the loam and for all equipment, tools, labor and all incidental work.

(b) Loam Borrow shall be paid for at the contract unit price per cubic yard for "Loam Borrow" which price shall include full compensation for furnishing and placing the loam and all equipment, labor, tools, and all incidental work.

Item 67-A--Loam Excavation

Item 67-B--Loam Borrow

SODDING

SECTION 68

1. Description

Sods shall be placed and located as indicated on the plans, or as directed by the Engineer, in accordance with these specifications and in conformity with the plans.

2. Materials

Sod shall be from a loam soil of such character that the sod will not break up or crumble during the operation of cutting, transporting or laying. The sod shall be freshly cut and transported to the job in an unbroken condition. It shall be rolled or piled in transit with the grass portions together, laying alternate rows of sod and soil against each other. Storage of sod will not be permitted and it shall be placed in final position immediately after cutting.

Grass sod free from noxious weeds and acceptable to the Engineer shall be used. Pasture sods are to be preferred. All sods shall have a minimum thickness of two (2) inches and shall be cut in blocks of convenient size for transporting to the place where used. Broken or damaged sods shall not be used.

Wooden pegs shall have a minimum cross-section area of at least one (1) inch and a minimum length of twelve (12) inches.

3. Construction Methods

All sod shall be cut with an acceptable sod cutter or sharp flat spade.

After the subgrade has been prepared and shaped and loam where required has been spread to conform with the lines and grades given by the Engineer, sods may be laid. All sods must be tamped to insure tight joints and a smooth uniform surface. On sodded slopes every other line of sods shall be fastened with acceptable sized wooden pegs, driven flush with the surface of the sod and three (3) feet apart. Single lines of sods for anchoring loam shall be fastened with pegs spaced three (3) feet apart.

A sufficient quantity of water shall be applied to all sods after laying to insure immediate growth.

4. Method of Measurement

Sodding shall be measured by the square yard computed by multiplying the average width measured on the

slope by the length of the area sodded. Sod strips shall be measured in the same manner.

5. Basis of Payment

This item shall be paid for at the contract unit price per square yard for "Sodding," which price shall include all materials, equipment, tools, labor and all incidental work.

Item 68--Sodding

PROJECT MARKERS

SECTION 69

1. Description

This item shall consist of constructing and placing project markers where called for by the Engineer and in conformity with these specifications.

2. Materials

The project markers shall be made of Class "D" Concrete as specified in Section 42 except that the cement used shall be a White Portland Cement and the sand used shall be of light color meeting the approval of the Engineer. The steel used shall comply with the specifications for Steel Reinforcement for Concrete Structures, Section 43.

3. Construction Methods

The project markers shall be six (6) feet long and shall have a modified triangular cross-section. The narrow face of the section shall have a width of one and one-half ($1\frac{1}{2}$) inches, the opposite face shall have a width of seven (7) inches, and the distance between faces shall be six and one-half ($6\frac{1}{2}$) inches. The acute angles shall be chamfered one-half ($\frac{1}{2}$) inch or rounded to a similar radius. The reinforcement shall consist of three (3) one-quarter ($\frac{1}{4}$) inch round rods, one in each corner, connected with

loops or spirals of No. 14 wire spaced not more than twelve (12) inches apart. The faces of the posts shall have painted on them with black paint the inscription ordered by the Engineer. The letters and numerals shall be one and one-half ($1\frac{1}{2}$) inches high and lines shall be spaced one (1) inch apart. The top line of letters shall be three (3) inches from the top of the post. The letters and numerals shall have a width of stroke of three-sixteenths ($\frac{3}{16}$) of an inch. The project markers shall be set with the narrow face facing the highway in the location designated by the Engineer at each end of the project. They shall be set in a vertical position extending four (4) feet into the ground and shall be securely tamped in place.

4. Basis of Payment

This work shall be paid for at the contract unit price each for "Project Markers," complete in place, which price shall include all materials, equipment, tools, excavation, backfilling and all work incidental thereto.

Item 69--Project Markers

RIGHT OF WAY MONUMENTS

SECTION 70

1. Description

This item shall consist of furnishing, erecting and placing Right of Way Monuments, where shown on the plans or ordered by the Engineer, in accordance with these specifications and in conformity with the plans.

2. Materials

Either granite or concrete monuments may be used, unless a particular type is required. When granite monuments are used they shall be clean, sound, split granite quarry stone. Granite monuments shall be not less than

five and one-half ($5\frac{1}{2}$) inches square, and shall be approximately four (4) feet in length. Concrete monuments shall be six (6) inches square on the top with a three-eighths ($\frac{3}{8}$) of an inch batter to the foot on all sides and shall be four (4) feet in length. The monument shall be composed of Class "D" Concrete, specified in Section 42. The reinforcing steel shall meet the requirements specified in Section 43.

3. Construction Methods

These monuments shall be set in a vertical position and the backfill shall be thoroughly tamped around the monument in not more than one (1) foot layers.

The part of the monument showing above the ground shall be left to the discretion of the Engineer.

When the monuments are to be set in solid ledge a hole shall be excavated to a depth of approximately one foot, and the area around the monument set in the ledge shall be grouted with cement mortar, consisting of one (1) part Portland Cement and two (2) parts sand. When monuments are set in ledge the monuments may be shortened as ordered by the Engineer.

4. Basis of Payment

Right of Way Monuments shall be paid for at the contract unit price each complete in place, which price shall include materials, equipment, tools, excavation, backfilling and all work incidental thereto.

Item 70--Right of Way Monuments

SPRINKLING

SECTION 71

1. Description

This item shall consist of sprinkling the sub-grade, gravel base and sand base and gravel surface with water.

2. Methods

The Contractor shall provide the necessary equipment, labor, and water and shall sprinkle the road whenever ordered by the Engineer and to the extent that the Engineer shall direct.

3. Method of Measurement

The time to be paid for shall include that necessary to go from the project to the water source, fill the tank, return to the project and apply the water.

4. Basis of Payment

This work shall be paid for at the contract unit price per hour for "Sprinkling," which price shall include furnishing the water and all equipment, labor, and incidental work.

Item 71--Sprinkling

UNDERDRAIN OUTLET MARKERS

SECTION 72

1. Description

This item shall consist of furnishing and placing wood posts at underdrain outlets and at such other places as ordered by the Engineer.

2. Materials

The posts shall be five (5) feet long and four (4) inches square, surfaced on four sides. They shall be of seasoned pine or spruce and treated with bituminous material for one-half their length in the same manner as specified for guard rail posts. The other half of the post shall be painted with two coats of white lead paint approved by the Engineer.

3. Construction Methods

The posts shall be set to a depth of two feet into the ground at the locations ordered by the Engineer.

4. Basis of Payment

This item shall be paid for at the contract unit price each for "Underdrain Outlet Markers," complete in place, which price shall include all materials, labor, and all incidental work.

Item 72--Underdrain Outlet Markers

TRAFFIC OFFICERS

SECTION 73

1. Description

This item consists of furnishing traffic officers wherever one way traffic is required during the construction of the items of crushed stone base, bituminous concrete base, cement concrete base, bituminous macadam surface, bituminous concrete surface or cement concrete surface.

All traffic officers working under this section shall have police powers granted by the proper authorities.

Where cement concrete base or cement concrete pavement is being constructed, officers shall control traffic with the aid of a telephone system furnished by the Contractor.

2. Basis of Payment

This item shall be paid for at the contract unit price per man-hour for "Traffic Officers" for the number of hours during which traffic is actually controlled, which price shall include furnishing telephones and all incidentals.

Item 73--Traffic Officers

FENCING

SECTION 74

1. Description

This item shall consist of galvanized wire fence supported by posts together with the necessary barways constructed in accordance with the plans and located where designated on the plans or ordered by the Engineer and in conformity with these specifications.

2. Materials

Posts. The posts shall be of seasoned cedar, oak or hackmatack. They shall be not less than four (4) inches in diameter at the smaller end after the bark has been removed and at least eight (8) feet long. The bark shall be removed from all posts and all knots shall be hewn flush with the face and the bottom end shall be pointed.

Fence. The fence shall be galvanized rectangular mesh forty-five (45) inches in height with eight (8) horizontal wires and with vertical wires spaced twelve (12) inches apart. The top and bottom wires shall be not less than number nine (9) gauge and all other wires not less than number eleven (11) gauge.

Staples. Staples shall be not less than one and one-half ($1\frac{1}{2}$) inches in length and shall be made of galvanized wire of not less than number nine (9) gauge.

Bars. Bars shall be of cedar or spruce with the bark removed and all knots hewn flush with the face. They shall be at least three (3) inches in diameter and fourteen feet long unless a shorter length is ordered by the Engineer.

Braces. Braces shall be spruce or hemlock four (4) inches by six (6) inches in size and of sufficient length to brace between adjacent posts.

3. Construction Methods

The posts shall have a preservative treatment complying with the foregoing specifications for preservative treatment of posts for "Wire Cable Guard Rail."

The posts shall be set to a depth of at least three (3) feet. They shall be spaced ten (10) feet on centers set vertically and accurately lined. The post holes shall be backfilled with suitable material and thoroughly tamped in layers of not over six (6) inches, care being taken to preserve the alignment of the posts. The tops of the posts shall be sawed off square at a uniform height above the wire after the wire has been placed. All corner, end, and barway posts shall be securely braced by diagonal struts bearing on the preceding posts. Intermediate posts shall be braced where directed by the Engineer.

The fencing shall be stretched tightly and fastened securely to the posts by staples at each horizontal wire. The ends of the fencing shall encircle half the post and be secured by double staples on front and rear of posts. Sections less than three hundred and thirty (330) feet in length shall be erected without splicing the wire. Sections of greater length shall have overlapping splices made at fence posts.

Barways shall be located where ordered by the Engineer. The clear width of the barway shall be twelve feet unless a shorter length is ordered by the Engineer. Two posts shall be set at each end of the barway location properly braced and constructed to hold four (4) bars.

4. Basis of Payment

(a) This item shall be paid for at the contract unit price per linear foot for "Fencing," complete in place, measured from outer post to outer post including barways, which price shall include all material, labor, equipment, tools, and all incidental work except solid ledge excavation.

(b) Allowance for solid ledge rock will be made for holes two (2) feet in diameter and of the required depth.

Payment for the same will be made under the item of "Rock Excavation for Structures."

Item 74--Fencing

GRAVEL OVERHAUL

SECTION 75

1. Description

Payment for overhaul will be made if, in the opinion of the Engineer, it is necessary to haul gravel for gravel borrow, gravel sub-base, gravel base, or gravel surface and sand for sand base for a greater distance than two miles as measured from the pit to the nearest point on the project.

2. Basis of Payment

The sum of ten (10) cents per cubic yard for each mile of haul in excess of two miles as measured along the shortest practicable line of haul from the pit to the nearest point on the project, will be paid for overhaul based on the pay quantities for gravel borrow, gravel sub-base, sand base, gravel base, and gravel surface. The length of overhaul shall be measured to the nearest one-tenth (1/10) of a mile.

Item 75--Gravel Overhaul

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