

CITY OF BRANSON

TECHNICAL

SPECIFICATIONS

FOR PUBLIC IMPROVEMENT

PROJECTS

June 2011

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City of Branson
TECHNICAL SPECIFICATIONS
for Public Improvement Projects

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GENERAL PROVISIONS

The provisions in this section shall be considered as applicable to all parts of these specifications including all revisions or supplements.

A. DEFINITIONS. Whenever the following words, phrases, or abbreviations appear in these specifications, they shall have the following meanings:

1. City shall mean the City of Branson, Missouri, a municipal corporation, acting by and through its duly elected governing body and its duly appointed officials.
2. Engineer shall mean the City Engineer of the City of Branson or his authorized representatives acting on behalf of the City.
3. Design Engineer shall mean a licensed engineer under contract to the developer or the City of Branson for the purpose of preparing and sealing engineering design drawings for a specific public improvement project.
4. Inspector shall mean an authorized representative of the City Engineer who has been assigned to assure conformance to the requirements of these specifications by the contractor.
5. Contractor shall mean the individual, firm, partnership, joint venture, corporation, or association contracting with the City, or private owner, to perform the work.
6. Permit shall mean the official document issued by the City, authorizing the construction of an improvement, subject to City inspection, control and approval.
7. Standard Specifications shall mean the official standard specifications, as adopted by the City.
8. Work or The Work shall mean the furnishing of all labor, materials, equipment and other incidentals necessary for the successful completion and the carrying out of all duties and obligations imposed by the contract or permit.
9. Surety shall mean the corporation, partnership or individual, duly licensed and authorized to do business in Missouri, who is bound with and for the Contractor to assume legal liability for the faithful performance of the contract.
10. Private Owner, or Developer shall mean the individual, corporation, partnership, joint venture, association or other legal entities paying all costs associated with the construction of an improvement under a permit granted by the City.
11. Sub-Contractor is any individual, firm, partnership, corporation, or association licensed or otherwise authorized by law to do business in Missouri, to whom the Contractor, with written consent of the City, sublets a part of the work.
12. Plans shall mean the official drawings, standard plans, profiles, and typical cross

sections all as specified in the Special Provisions and supplemental drawings or reproduction thereof, approved and furnished by the Engineer which show the location, character, dimensions and details of the work. All such plans are to be considered as a part of the contract whether attached or separate.

13. Performance Bond or Performance and Maintenance Bond shall mean the approved form of security furnished by the Contractor and his surety.
14. Extra Work is work over and above that called for in the Contract.
15. Calendar Day is every day shown on the calendar and shall mean a day of twenty-four (24) hours measured from midnight to the next midnight.
16. Or Equal. In order to establish a basis of quality for items of the work, certain processes, equipment, proprietary products or materials and their manufacturer may be mentioned by name. Such mention is not intended to exclude other processes, equipment, proprietary products or materials and their manufacturers, provided they are proven by the Contractor, to the satisfaction of the Engineer, to be equal in quality and performance to the same specified prior to their inclusion in the work.
17. Land, Right-of-Way or Easement shall mean the land provided by the City upon which to construct the work.
18. Construction Easement shall mean the land provided temporarily by the City for use by the Contractor during the construction of the work.

Whenever the words "as directed", "as required", "as permitted", or words of like meaning are utilized it shall be understood that the directions, requirements, or permission of the Engineer is intended. Similarly, the words, "approved", "acceptable", and "satisfactory" shall refer to approval of the Engineer.

B. REFERENCED STANDARDS. Whenever references are made to standard specifications, methods of testing, materials codes, practices, and requirements it shall be understood that the latest revisions of said references shall govern unless a specific revision is stated. Wherever any of the following abbreviations appear they shall have the following meaning:

A.A.S.H.T.O.	-	American Association of State Highway Transportation Officials
A.C.I.	-	American Concrete Institute
A.I.S.C.	-	American Institute of Steel Construction
A.W.S.	-	American Welding Society
A.P.W.A.	-	American Public Works Association
A.R.E.A.	-	American Railway Engineering Association
A.S.A.	-	American Standards Association
A.S.T.M.	-	American Society for Testing and Materials
A.N.S.I.	-	American National Standard Institute

- A.W.W.A. - American Water Works Association
- C.R.S.I. - Concrete Reinforcing Steel Institute
- M.C.I.B. - Mid-West Concrete Industry Board, Inc.
- W.P.C.F. - Water Pollution Control Federation
- M.U.T.C.D. - Manual of Uniform Traffic Control Devices

Where the words "these specifications" appear or words of similar connotation are used it shall be understood that such reference refers to the "Technical Specifications for Public Improvement Projects" of the City of Branson.

C. PERMIT FOR CONSTRUCTION. No construction of any public improvement project shall be undertaken until the following criteria and requirements have been fully met unless otherwise allowed by the City Engineer.

1. Contract plans and specifications have been submitted to and approved by the City Engineer.
2. A suitable performance and maintenance bond submitted and approved by the Engineer and placed on file with the City.
3. Payment to the City of an amount equal to the following for each type of public improvement project;

Water lines - Four (4) percent of the total estimated cost of the project.

Sewers - Two (2) percent of the total estimated cost of the project.

Streets - Three (3) percent of the total estimated cost of the project.

Such payment shall only be required in connection with private developer projects and shall be payable to the Director of Finance.

4. Advance notification of a minimum five (5) working days from the contractor prior to actual start of work.

Compliance with the above shall constitute a permit for construction activities. Work discovered underway not complying with these requirements shall be ordered to cease and shall not be allowed to commence until such requirements have been met.

D. AUTHORITY OF THE ENGINEER. The City Engineer is designated by the City of Branson to exercise all authority on behalf of the City to ascertain that all construction of facilities is equal to or better than the minimum construction requirements set forth in these specifications. The Engineer shall be represented by a project inspector to check any and all work performed, including all materials to be incorporated in the work, and all construction methods and practices. The Engineer shall have the sole authority to issue in writing, any deviations from the provisions of these specifications or changes to any previously approved drawing.

E. OBSERVATION OF THE WORK.

1. General:

- a. All materials and workmanship shall be subject to observation, examination, or test by the City of Branson and the Engineer or his representative at any and all times during construction and at any and all places where such construction is carried on. The City of Branson shall have the authority to reject defective material and workmanship or require its correction. Unacceptable workmanship shall be satisfactorily corrected. Rejected material shall be promptly segregated and removed from the project area and replaced with material of the specified quality to the satisfaction of the Engineer. If the contractor fails to proceed at once with correction of rejected workmanship or defective material, the City of Branson may contract or otherwise have the defects remedied or rejected materials removed from the project area and charge the cost of the same against the contractor, without prejudice to any other rights or remedies of the City of Branson.
- b. The contractor shall furnish promptly all materials reasonably necessary for any test which may be required. All tests by the City of Branson will be performed in such manner as not to delay the work unnecessarily and will be made in accordance with the provisions of the Technical Specifications.
- c. The contractor shall notify the City of Branson sufficiently in advance of backfilling or concealing any facilities to permit proper observation. If any facilities are concealed without approval or consent of the City of Branson, the contractor shall uncover for observation and recover such facilities all at his own expense, when so requested by the City of Branson.
- d. Neither observing, testing, approval nor acceptance of the work, in whole or in part, by the City of Branson or its agents shall relieve the contractor or his sureties of full responsibility for materials furnished or work performed not in strict accordance with the specifications.
- e. Any change or deviation from the approved plans and specifications approved by the Engineer must be received by the project manager in writing prior to implementing the change. The project managers are not authorized to alter any provisions or to issue instructions contrary to these specifications, or to make any revisions to any previously approved drawing.

2. Defective Work:

- a. The term "defective" is used in these documents to describe work that is

unsatisfactory, faulty, not in conformance with the requirements of the specifications, or not meeting the requirements of any observation, test, approval, or acceptance required by law or the specifications.

- b. Any defective work may be disapproved or rejected by the City at any time before final acceptance even though it may have been over-looked and/or included in a previous pay estimate.
- c. Contractor shall furnish samples of questionable equipment or materials from completed work for testing purposes when required by the Engineer. All costs in connection with the testing of equipment and materials which prove to be defective shall be paid by the contractor.

3. Uncovering Work:

- a. If any work is covered without concurrence of the inspector it must, if requested by the inspector, be uncovered for his observation. Such work will be at the contractor's expense unless the contractor has given the inspector timely notice and the inspector has not acted within a reasonable time.
- b. Should it be considered necessary or advisable by the City of Branson, at any time before final acceptance of the entire work to make an examination of work already completed by uncovering the same, the contractor shall on request promptly furnish all necessary facilities, labor, and material. If such work is found to be defective in any important or essential respect, due to fault of the contractor or his subcontractors, the contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the specifications, the actual cost of labor and materials necessarily involved in the examination and replacement, plus 15 percent of such cost to cover superintendence, general expenses and profit, shall be allowed the contractor and he shall, in addition, if completion of the work of the entire contract has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

F. WEEKEND OR HOLIDAY WORK. Work on Saturdays or legal holidays shall be as approved by the City Engineer. Such approval shall be granted only upon advance notification of a minimum five (5) working days prior to the anticipated date of the work to be performed. Sunday work will not be allowed under any circumstance. Legal holidays observed by the City of Branson are New Year's Day, Martin Luther King Day, President's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, and Christmas. The actual days off for these holidays may vary and in certain situations additional days may be a part of the amount of time granted as an official holiday by the City of Branson. It shall be the contractor's responsibility to obtain

these days prior to the actual request for inspection services.

- G. BONDS. A suitable performance and maintenance bond shall be furnished to the City of Branson guaranteeing the proper completion and maintenance of the construction involved in the public improvement project. The performance bond shall be in an amount equivalent to the full cost of the improvement. The maintenance bond shall remain in effect for a period of two (2) years for all public improvement projects and shall be in an amount of the full cost of the improvement.

No project shall be accepted by the City prior to the submittal and acceptance of the maintenance bond by the City Engineer.

- H. CHANGES IN THE WORK. Changes in the work from the approved project plans shall be made only upon the written consent of the City Engineer. All proposed changes must be submitted to the City Engineer (by the design engineer) to receive written approval by the City. Said written approval shall be received by the inspector prior to implementing the deviation. Any change in the work made without the consent of the City Engineer shall be subject to removal by the contractor at his expense.

- I. CORRELATION AND INTENT OF DOCUMENT. The plans and specifications are intended to supplement each other. Any work shown on the Plans and not mentioned in the Specifications (or vice versa) shall be as binding and shall be completed the same as if mentioned or shown on both. In case of conflict between the Plans and Specifications, the order of precedence shall be:

First	Special Provision
Second	Detail Plans
Third	Standard Plans
Fourth	Standard specifications

The general character of the detailed work is shown on the plans, but minor modifications may be made in the full size or scale details. Where the word "Similar" occurs on the plans, it shall be used in its general sense and not as meaning identical, and all details shall be worked out in relation to their location and their connection to the other parts of the work. Where on any plans, a portion of the work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other like portions of the work. Where ornaments or other details are indicated by starting only, such details shall be continued throughout the courses or parts in which they occur and shall also apply to all other similar parts in the work, unless otherwise indicated. In case of differences between small and large scale drawings, the larger scale drawings shall govern.

- J. ERRORS AND OMISSIONS. The contractor shall check over the plans before beginning construction work, and if errors or omissions are discovered, he shall call them to the attention of the Engineer before proceeding with the work. In no case will the Contractor make the corrections therefore without first consulting the Engineer. In case

revised plans of a supplementary or explanatory nature are necessary or desirable for clarification or to correct any errors or omissions, they will be furnished by the Engineer or Design Engineer as required.

- K. TRAFFIC CONTROL. The flow of traffic in street and access to private property shall be reasonably maintained at all times. The contractor shall provide a safe roadway, and shall erect and maintain warning signs, barricades and sufficient safeguards around all excavations, embankments, and obstructions. The contractor shall provide suitable warning lights or flares and shall keep them lighted from one-half hour prior to sunset until one-half hour after sunrise and all other times when visibility is limited. The contractor shall further provide such flagmen and watchmen as required by the Engineer or inspector for the protection of the public. The design, placement and maintenance of traffic control devices shall correlate with and so far as possible conform to the system set forth in the most recent edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The roadway shall be properly maintained and the contractor shall coordinate his operations with the City Engineer in order that suitable arrangements may be made for detours, parking, access to private property, etc. Whenever a street is closed or partially closed, the City of Branson Police Department shall be notified of the closing, and also when normal service is resumed. In the event it is determined that the contractor is not maintaining a safe roadway, the Engineer may improve the roadway conditions at the contractor's expense.
- L. MOVING OF PUBLIC AND PRIVATE UTILITIES. In general, the moving of utilities within the limits of established right-of-way or public easements, which conflict with the improvement, will be done by the respective controlling utility at its own expense and at no cost to the Contractor. The Contractor shall notify the owners of each utility identified on the plans, prior to the start of any construction. The work by these utilities may be completed before the Contractor progresses to the points affected. Under some circumstances, however, the work of the utilities may have to be performed during the Contractor's construction. It shall be the responsibility of the contractor to coordinate his work with that of the utility so as to cause the least possible delay in the work. No utility, public or private, shall be moved to accommodate the Contractor's equipment or his method of operation when such utility does not interfere with the improvement under construction, or, to be constructed, unless all costs of such removal and replacement, when permitted, will be paid for by the Contractor.
- M. PROTECTION OF PUBLIC AND PRIVATE UTILITIES. The Contractor shall be responsible for taking proper measures to support, sustain and protect existing pipes, conduits, poles, wires and other apparatus under, over, along, across or otherwise affected by the work. If such pipes, conduits, poles, wires or apparatus are damaged through carelessness or neglectful action of the Contractor, they will be repaired by the authorities having control of the same, but the cost of such repairs shall be paid by the Contractor.

The Contractor shall enlist the assistance of the affected agencies in the location of their utilities. The Contractor shall be responsible to any agency for the cost of such assistance

in the location of its utilities. If any underground facility not shown on the plans nor located by the utility agency is damaged by the Contractor, the Contractor shall be responsible for exercising good judgment and for taking such action as is reasonable and necessary to mitigate damages.

- N. USE OF PRIVATE PROPERTY. The Contractor shall confine his work to the City's premises, including construction easements and construction permit lines. He shall not enter upon or place materials on any private premises except by written consent of the individual owners, and he shall save the City harmless from all suits and actions of every kind and description that might result from his use of private property.
- O. DAMAGES. The Contractor hereby expressly binds himself or itself to indemnify and save harmless the City and its officers and employees against all suits or actions of every kind and nature brought or which may be brought, or sustained by any person, firm, or corporation, or persons, firms or corporations, in connection with or on account of the contractor's work or in consequence of any negligence in connection with same, or on account of any poor workmanship, or on account of any act of commission or omission of the contractor or his, its, or their agent or employees, or for any cause arising during the course of construction.
- P. CLEANING UP. The Contractor shall frequently clean up all refuse, rubbish scrap materials, and debris as a result of his operations, so that at all times the site of the work shall present a neat, orderly, and workmanlike appearance. As may be ordered by the Engineer, and immediately after completion of the work, the Contractor shall at his own expense clean-up and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within seventy-two (72) hours after such request by the Engineer, the work may be done by the City and cost thereof charged to the Contractor and deducted from his final payment (if applicable). Upon completion of the work, the Contractor shall remove all his equipment and put the area of the work in a neat and clean condition and do all other cleaning necessary to complete the work in a workmanlike manner satisfactory to the Engineer.
- Q. PROTESTS. If the Contractor considers any work demanded of him by the inspector to be outside the requirements of the specifications, he shall immediately ask for a written decision or instructions and shall proceed to perform the work to conform with the inspector's ruling. If the Contractor considers such instructions unsatisfactory, he shall, within twenty-four (24) hours after their receipt, file a written protest with the Engineer, stating his objections and the reasons therefore. Unless protests or objections are made in the manner specified and within the time limit stated herein, the contractor hereby waives all ground for protest.
- R. CONTRACTOR'S RESPONSIBILITY FOR WORK. Until work is accepted by the Engineer, it shall be in the custody and under the charge and care of the Contractor, who shall take every precaution against damage to the work, by action of the elements or any

other cause. The Contractor shall rebuild, repair, restore and make good, at his own expense, all damages to any portion of the work before its completion and acceptance.

- S. FINAL INSPECTION. As soon as practical after completion, the entire work will be examined thoroughly by the Engineer. The Contractor will be notified when the examination is to be made so that he, his representative or both may be present.

If the inspection reveals any defective or unsatisfactory work, it shall be replaced or repaired as the Engineer may order before final acceptance. The cost of all such repairs and replacements shall be borne by the Contractor.

T. ACCEPTANCE OF WORK.

1. Partial Acceptance. The City reserves the right to accept and make use of any completed section of the work without obligating the City to accept the remainder of the work or any portion thereof; however, the warranty period shall start when the project is complete and the City has issued the Project Completion Certificate.
2. Final Acceptance. When the final clean-up has been performed, the contractor shall notify the inspector in writing that all work has been completed. At the same time, the contractor shall notify the design engineer that the project has been completed and should forward to the design engineer all changes he has noted on his plans during the course of the work. Upon receiving such notification, the design engineer shall compute any changes in the original contract amount and send a letter to the City verifying the final contract amount. Within a reasonable time the inspector shall perform all necessary inspection procedures on the completed work. The contractor shall receive written notification of any defects in the project. The Project Completion Certificate will be issued after all defects have been corrected. Issuance of the Project Completion Certificate by the City will constitute formal acceptance of the project and the commencement of the maintenance period specified in the maintenance bond form.

- U. WARRANTY INSPECTION. Forty-five to sixty days prior to the expiration date of the maintenance bond a warranty inspection will be made. The Contractor and surety will be notified when the examination is to be made so that they or their representative may be present.

Within the time period prescribed by the bond the Contractor as ordered by the Engineer shall repair, replace, or rebuild such portions of the work which are found to be faulty because of materials or workmanship. The Contractor shall begin the remedial work not later than five (5) days after the order from the Engineer. In case the Contractor does not start the remedial work within the above time limit, or in case of an emergency condition caused by faulty work, the City may take remedial action and charge the cost thereof against the Contractor and his surety.

SECTION 1000 SITE PREPARATION

1001 SCOPE. This section governs the furnishing of all labor, equipment, tools and materials and the performance of all clearing, grubbing and demolition within the limits of work as defined in Section 1003(A) of this specification, in the Special Provisions or as shown on the plans.

1002 DEFINITIONS.

- A. Clearing. Clearing shall consist of removing all vegetable matter such as trees, brush, down timber and other objectionable materials found on or above the surface of the site. It shall include removing buildings, fences, lumber, waste dumps and trash and the salvaging of such materials as may be specified and disposing of the debris. The Contractor shall scalp all excavation and embankment areas. Scalping shall include the removal of material such as sod, grass, residue or agricultural crops and decayed vegetable matter from the surface of the ground without removing more earth than is necessary.
- B. Grubbing. Grubbing shall consist of removing and disposing of all vegetable matter such as stumps, roots, buried trees and brush encountered below the surface of the ground or sub-grade, whichever is lower, which have not been included in Section 1002(A) entitled "Clearing".

In all cases of grubbing, the vegetable matter shall be removed to a minimum depth of 12 inches below ground line or sub-grade, whichever is lower, except as provided in Section 1003(C).

When deleterious materials are encountered below ground line that may be detrimental to the proposed improvement, these shall be removed to a depth necessary to provide adequate support for the proposed improvement.

- C. Demolition and Removal. This work shall consist of demolishing, removing and disposing of all structures and improvements within the construction limits unless included in other items of work as shown on the plans or Special Provisions. This work shall apply to all structures and improvements, whether on, above or below the surface of the ground or sub-grade.

Demolition and removal shall include but not be limited to items such as buildings, drainage structures, pipes, pavements, fences, retaining walls, guardrails and signs.

Items such as fences and guardrails shall be salvaged and relinquished to the appropriate owner or relocated, where indicated on the plans.

Relocation of signs, fences, guardrails, etc. shall be considered incidental to removal work except where such relocation is listed separately in the itemized Proposal.

All pipes that are to be abandoned shall be removed unless otherwise shown on the plans

or approved by the Engineer.

In removing items such as Portland cement concrete pavement, base courses, curbs, curb and gutters, sidewalks, and similar objects where portions of said objects are to be left in place, they shall be removed to an existing joint or to a new joint sawed to a minimum depth of two (2) inches or 1/4 the slab thickness, whichever is greater, with a true line and vertical face. Sufficient portions of these objects shall be removed to provide for the proper grade and connection to the new work.

- D. Trees. Vegetable growth 6 inches in diameter, measured 3 feet above ground shall be classified as a tree.
- E. Brush. Vegetable growth less than 6 inches in diameter, measured 3 feet above ground shall be classified as brush.

1003 CONSTRUCTION DETAILS.

- A. Limits of Work. The limits for clearing, grubbing and demolition shall extend to the construction limits unless otherwise shown on the plans.

In the event construction limits have not been indicated on the plans, the limits for clearing, grubbing, and demolition shall not extend beyond the limits of the right-of-way, City property lines, or easements.

- B. Protection of Greenery, Existing Structures and Private Facilities. The plans will designate trees, shrubs or other plants that are to be saved and the Contractor will take necessary steps to protect this greenery. Trees may be pruned, upon prior approval of the Engineer, but only in accordance with the best practices of arboriculture in respect to the individual species with due regard to their natural form and growth characteristics.

Existing structures within or adjacent to the construction limits that are not to be removed or demolished shall be protected by the Contractor during his construction. Any private facilities such as house sewer laterals which are disturbed or damaged by the Contractor's work, shall be repaired by the contractor prior to the close of the work day. This repair shall be made in a manner sufficient to restore utility service to that property.

- C. Embankment Area. When undisturbed stumps and roots are encountered where the fill depth will exceed 3 feet the stumps and roots may be left in place provided they do not extend more than 3 inches above the original ground line.
- D. Borrow Areas. All stumps, roots and other objectionable matter shall be removed from the borrow material used for embankment or fill. The borrow area shall be left in a well drained and smooth condition.
- E. Backfilling the Site. All trenches, holes, pits and basement areas resulting from the operations of clearing, grubbing, demolition and removal on the site, shall be backfilled

with suitable material placed and compacted in conformance with Section 1106 entitled "Embankment".

- F. Disposal of Materials. All materials with the exception of those which are designated for salvage or which are used in the embankment in conformance with this specification, shall become the Contractor's property and shall be disposed of by him, outside the project limits unless otherwise indicated on the plans.

1004 PROGRESS OF CONSTRUCTION.

- A. Clearing. Clearing shall proceed well in advance of the construction operations so as not to delay the progress of the work. The refuse resulting from clearing may be hauled to a waste site secured by the Contractor or shall be burned or buried in such a manner as to meet all laws, regulations, and requirements of any governing authority regarding health, safety, and public welfare. When authorized by the Fire Department, the Contractor may dispose of such refuse by burning on the site of the project, provided all requirements as determined by the Fire Department are met. Under no circumstances will the authorization to burn on the site relieve the Contractor in any way from damages which may result from his operations. In no case shall any materials be left on the project site, shoved into abutting properties, or buried in embankments or trenches on the site.
- B. Grubbing. Grubbing shall parallel the clearing as nearly as the sequence of operations will permit.

Piling and butts of utility poles within the limits shall be removed to a minimum depth of two (2) feet below the subgrade or the original ground, whichever is lower.

All stumps, roots, and other objectionable matter found within borrow material to be used for embankment or fill material shall be removed.

- C. Demolition. Demolition work shall occur well in advance of the construction operations. Masonry and concrete walls, miscellaneous foundations, or other objects extending below ground shall be removed to a depth of at least twelve (12) inches below the original ground or subgrade, whichever is lower.

When explosives are used in demolition, the Contractor shall comply with the provisions of Specification Section entitled "Blasting".

1005 UTILITY COORDINATION.

The Contractor shall be responsible for protecting any improvement of any agency, public or private, in the vicinity of clearing, grubbing or demolition operations. When necessary, the Contractor shall enlist the assistance of the affected agencies in the location of their utilities. The Contractor will be responsible for the cost to any agency for assistance in utilities and for the cost of all damage to such facilities arising from his carelessness or negligence.

SECTION 1100 GRADING

1101 SCOPE. This section governs the performance of all work required to excavate, remove, dispose or compact all materials encountered within the limits of the project, at the locations shown on the contract documents.

1102 DEFINITIONS.

- A. Grading. Grading as used herein shall mean the performance of all excavation, embankment, and backfill in connection with the construction of all improvements.
- B. Excavation. Excavation is defined as the removal of materials from the construction area to the lines and grades shown on the plans.
1. Unclassified Excavation. Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless the Special Provisions specify Classified Materials.
 2. Rock Excavation. Rock excavation is defined as the removal of all rock ledges 6 inches or more in thickness, and detached rock or boulders having a volume of more than 1 1/2 cubic yards and shale occurring in its natural state, hard and unweathered.

A rock ledge is defined as a continuous body of rock which may include thin interbedded seams of shale or other soft materials less than 12 inches thick. The vertical limit of each ledge shall be defined by interbedded seams of soft materials 12 inches in thickness. The beds of soft interbedded material 12 inches in thickness shall not be included in the measurement of "Rock Excavation" but shall be included in the measurement for "Earth Excavation".
 3. Earth Excavation. Earth excavation is defined as the removal of all material not defined as rock.
- C. Embankment or Backfill. Embankment or backfill is defined as the placing and compacting of material in the construction area to the lines and grades shown on the plans.
1. Unsuitable Material. Unsuitable material is defined as muck, frozen material, organic material, top soil, rubbish, and rock with a maximum dimension greater than 24 inches.
 2. Suitable Material. Suitable material is defined as entirely imperishable with that portion passing the No. 40 Sieve having liquid limit not exceeding 40 and a plastic index not exceeding 25, when tested in accordance with ASTM D-4318-00.

- a. Rock Embankment. Material for rock embankment shall be free of unsuitable material and shall contain, by volume, greater than 10 percent rock or gravel having a maximum dimension greater than 3 inches but not greater than 24 inches.
 - b. Earth Embankment. Material for earth embankment shall be free of unsuitable material and shall, contain by volume, less than 10 percent rock or gravel having a maximum dimension greater than 3 inches.
- D. Borrow. Borrow is defined as approved material excavated from an area outside the project limits and required for the construction of the embankment.
- E. Waste. Waste is defined as excavation material not used in the embankment and disposed of outside the embankment areas.
- F. Structures. Structures as used herein refers to bridges, culverts, storm sewer and/or sanitary appurtenances, retaining walls and similar construction.

1103 CONSTRUCTION DETAILS - GENERAL. The contractor shall adhere to any and all statutes regarding the notification of utilities prior to beginning any work within public right-of-way. Relocation or protection of any existing utilities located in street right-of-way shall be governed by the applicable section of these Specifications. The relocation and/or protection of any utility that is shown on the plans, that lies within a utility easement and is endangered by this construction shall be the responsibility of the contractor.

The contractor shall make every reasonable effort to protect private facilities. These facilities may not be shown on the plans. When these facilities are disturbed or damaged by work, the contractor shall make necessary arrangements for repairs to the facilities for continuous service prior to the close of that work day.

It shall be the responsibility of the contractor to protect all property lot corners and control monumentation. Should it be necessary to disturb such monument, whether stake, pin, bar, disk, box, or other, it remains the responsibility of the contractor to reference such markers prior to removal, reset them, and file such relocations or monumentation documents as the law may require. Any such references, removal, replacement and certification of monuments shall be performed by a surveyor registered and licensed in the State of Missouri. A copy of all such certification documents shall be provided to the Engineer prior to completion to the project. Any monument destroyed or improperly reset by the contractor may be replaced by the Engineer to the standards required by law at the expense of the contractor.

Grading, excavation, and backfilling for all improvements, shall be made to the lines, grades, and cross section indicated by the plans. In addition, to any erosion control measures shown on the plans, the contractor shall schedule and conduct his operation in such a manner and shall provide any necessary control facilities to protect downstream and adjacent properties from

pollution, sedimentation or erosion caused by the grading operations. Any pollution or damage occurring as a result of the work shall be the responsibility of the contractor.

During construction the graded area shall be maintained by the contractor in such condition that it will be well drained at all times. Roadway ditches, channel changes, inlet and outlet ditches and other ditches in connection with the roadway shall be cut and maintained to the required cross section. All drainage work shall be performed in proper sequence with other operations. All ditches and channels shall be kept free of debris or obstructions.

1104 EXCAVATION. This section governs the excavation for all improvements.

All suitable material removed by excavation shall be used as far as practicable in the formation of embankment as required to complete the work. The contractor shall sort all excavating material and stockpile when necessary, so as to provide suitable materials for embankments.

After removal of the roadway excavation material to the required section, all material between lines 1 foot outside the curbs and within the top 6 inches of the subgrade shall be compacted to 95 percent of maximum density for the material as defined in Section 1106(E).

Rock encountered within the full width of the roadway, toe of slope to toe of slope, shall be undergraded to an elevation of 6 inches below the finished subgrade elevation. Care shall be taken to void overshooting when blasting. Rock shall be removed in such a manner as to leave no excessive water pockets in the surface.

Areas of undergrading or overbreak in rock between lines 1 foot outside of the curbs shall be backfilled with spalls, rock fragments or granular type material. Backfill materials shall have a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve.

1105 UNDERGRADING. Where materials are encountered which are deemed as unsuitable by the Engineer for use in the work, they shall be removed to the depth and limits as ordered by the Engineer. Areas undergraded shall be backfilled with one of the following materials:

- A. Rock fragments or spalls.
- B. A granular type material having a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve and no more than 40 percent will pass the No. 10 Sieve.
- C. A material meeting the requirements of Section 1102(C,2).

1106 EMBANKMENT. This section governs embankment for all improvements.

The embankments shall be constructed using suitable materials, as herein defined, procured from excavations made on the project site or from borrow areas as required to complete the grading work.

- A. Starting the Embankment. Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inches rises as the new fill is brought up in 12 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density. Material cut out, bladed into place and compacted shall not be measured and paid for directly but will be considered as incidental work. The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material removed before starting the embankment work.

Where embankments 2 feet or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted to the specified density. Where embankments greater than 2 feet in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than 24 inches maximum dimension, left in place and the embankment started thereon.

- B. Placing Earth Embankment. Earth shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of materials shall not exceed 12 inches maximum in thickness (loose state) and shall be compacted to not less than the required density before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading, or dozing will be required to level the surface and to insure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen or is snow covered.
- C. Placing Earth and Rock Embankment. When earth and stone or rock fragments are mixed in the embankment, all stones or rock fragments exceeding the thickness of the compacted lift shall be disposed of by being incorporated into the embankment outside the limits of the proposed surfaced areas. The thickness of the layer in these areas may be increased if necessary to accommodate the rocks, but shall not exceed 15 inches in thickness (loose state). The stones or rock fragments are to be placed so there will be no nesting.
- D. Consolidated Rock Embankment. When the excavated material consists predominantly of stone or rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, such material shall be placed in the embankment in layers having a thickness of approximate average size of the larger rocks but not to exceed 24 inches. Rock or boulders too large to permit placing in a 24 inch layer shall be reduced in size as necessary to permit placement. Rock shall not be dumped in place but shall be distributed by blading or dozing in a manner to insure proper placement in final position in the embankment. The spalls and smaller stone fragments shall be left on the surface of each layer as formed. Each layer shall be thoroughly consolidated before the next layer is placed.

- E. Compacting the Embankment. Before placing any embankment, the surface of the existing ground shall be prepared as heretofore specified, moistened as required, and the top 6 inches compacted to a density of 90 percent as prescribed by the following paragraph.

All embankment shall be compacted to a density of at least 90 percent of the maximum density for the material used as determined by ASTM D-698 and within a tolerance of minus 3 percent and plus 2 percent of the optimum moisture as maximum density as determined by the Moisture Density Curve obtained. In addition to the above required compaction, the subgrade between lines 1 foot outside of the curbs and within the top 6 inches of the subgrade shall be compacted to a density of at least 95 percent of the maximum density for material used as determined by ASTM D-698 and with a tolerance of minus 3 percent and plus 2 percent of the optimum moisture as maximum density as determined by the Moisture Density Curve obtained.

All work involved in either adding moisture to or removing moisture from embankment materials to within these moisture limits shall be considered incidental to the completion of the grading operation.

- F. Consolidated/Compacted. Consolidation and compaction will be placed not to exceed 24" layer and spread with equipment similar to Caterpillar D7G Bulldozer and Caterpillar CP433 weighing a minimum of 15,000 pounds and delivering a dynamic of 30,000 pounds during the vibratory operation as determined by Missouri Standard Specifications for Highway Construction Section 203.

- G. Moisture - Density Determination. In-place density and moisture content of the embankment will be determined by the Standard Method of Test for Density of Soil in Place by the Sand-Cone Method, ASTM D-1556-00; or the Rubber Balloon Method, ASTM D-2167-94; or by Nuclear Methods, ASTM D-2922-01.

- H. Backfilling Curb and Gutter. Backfilling behind curb or curb and gutter shall be done within seven (7) days after being laid unless otherwise approved by the Engineer. Unless otherwise shown on the contract drawings, the finish grading from the back of the curb to the right-of-way line and/or utility easement line or construction easement line shall be performed to provide a smooth transition between existing yard grades at the right-of-way line and/or easement line to the curb so that positive drainage will exist.

The top portion of the backfill within right-of-way areas shall be finished with topsoil corresponding to, or better than, underlying adjoining sodded areas. Top soil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

SECTION 1200 SUBGRADE PREPARATION

1201 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and performance of all work connected with subgrade preparation, prior to constructing pavements for streets, alleys, parking areas, sidewalks, drive approaches and the construction of concrete curb and curb and gutters. This section does not include the construction of any base courses.

1202 DEFINITIONS.

- A. Subgrade. Subgrade is defined as a well-graded and compacted surface, constructed as specified herein to the grades, lines and cross-section shown, bladed and compacted to the specified density, preparatory to constructing pavements, or other improvements thereon.
- B. Subgrade Preparation. Subgrade preparation is the repeated operation of fine grading and compacting the subgrade until the specified lines, grades, and cross-sections have been obtained and the materials are compacted to the specified depth and density.

1203 CONSTRUCTION REQUIREMENTS.

- A. General. All underground work contemplated, including clearing, grubbing, and demolition, shall be completed in accordance with the requirements of Section 1100 "Grading" prior to commencement of any subgrade preparation.

The subgrade surface shall be brought to the specified lines, grades, and cross-sections by repeatedly adding or removing material and compacting to the specified density with suitable equipment to perform these operations. Tolerance allowed on all lines, grades and cross-sections shall be a compensating maximum deviation of 1/4 inch.

- B. Foundation Treatment. Unless otherwise specified or shown on the contract drawings, the soil below grade line in cut sections shall be scarified, broken up, adjusted to a moisture content within the designated moisture range and compacted to the designated type of compaction.

The top 6 inches of subgrade for pavements shall be compacted to 95% of the maximum density for the material used as determined by ASTM D-698 and within a tolerance of plus 2% and minus 3% of the optimum moisture at maximum density as determined by the moisture density curve obtained.

- C. Moisture Control Requirements. The moisture content of the soil at the time of compaction shall be as necessary to obtain the density as designated on the contract drawings unless it is determined by the Engineer that the soil is unstable with that moisture content.

When the moisture content of the soil is not satisfactory to the Engineer, water shall be

added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. In no case, shall water be added without the consent of the Engineer.

- D. Compaction Control Requirements. Roadway embankment earth (fill) materials shall be placed in horizontal layers not exceeding twelve (12) inches unless otherwise approved by the Engineer and shall be compacted as specified in Section 1205 "Compaction Requirements" before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction. Water shall be added or removed on the approval of the Engineer, in order to obtain the required density.

1204 MOISTURE CONTENT REQUIREMENTS. The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction as designated on the contract drawings or as directed by the Engineer.

If Type B compaction is specified with this moisture control, the content shall be sufficient to produce an uniform mixture of the soil and moisture. It will be determined by the Engineer whether or not satisfactory compaction and moisture content is obtained.

1205 COMPACTION REQUIREMENTS.

- A. Pavements. The subgrade for pavements shall be compacted to a density of at least ninety-five (95) percent of the maximum density for the material used for a depth of at least six (6) inches below the finished subgrade elevation and within the tolerance of the moisture for the type of material at ninety-five (95) percent of maximum density, as determined by the standard proctor test (ASTM D698) for cohesive soils. Any further compacted layers shall be accomplished in the same manner as specified.

When Type B compaction is specified or shown on the contract drawings, the compacted density is to be such that the tamping or sheepsfoot roller, while rolling the layer or lift will walk out of the material and ride the top portion of the lift.

Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when additional passes of the roller do not bring the tamping feet closer to the surface of the lift, provided the entire weight of the roller is supported on the tamping feet and none by material directly in contact with the drum.

Sand and gravel which cannot be compacted satisfactorily with a sheepsfoot roller shall be rolled with a pneumatic-tired roller.

Each lift shall be rolled until no further consolidation is evident.

- B. Sidewalks. The subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil in areas not requiring fill. In areas where fill is required, the subgrade shall be compacted to ninety-five (95) percent of the maximum dry density as determined by ASTM D698 for cohesive soils or

seventy (70) percent relative density as determined by ASTM D2049 for non-cohesive soils.

- C Drive Approaches and Concrete Curb & Gutter. The subgrade for drive approaches and concrete curb and gutter shall be compacted to the same requirements as stated above in part A Pavements.

1206 PROTECTION AND MAINTENANCE OF SUBGRADE. The newly finished subgrade shall be repaired from action of the elements or others. Any settlement or erosion that occurs prior to placing the pavement thereon, shall be repaired and the specific lines, grades and cross-section reestablished.

Any subgrade that has become unacceptable shall be reworked as necessary to restore the subgrade to shape, tolerance, density, and moisture content range for such density, immediately prior to the placing of the pavement.

The Contractor shall protect all existing improvements from damage resulting from his subgrade operation. Any improvement damaged shall be repaired or replaced by the Contractor at his own expense.

1207 CLEAN-UP. Subgrade clean-up shall follow the work progressively. The Contractor shall remove from the project site all rubbish, equipment, tools, surplus or discarded material and temporary construction items.

1208 COMPACTION TESTING. At the option of the Engineer, compaction testing may be performed in the field using a nuclear density-moisture measuring device to determine the density of the subgrade. If as a result of this field testing the Engineer determines that further compaction is required, the Contractor shall revise his methods or procedures to obtain the specified density.

1209 PROOF ROLLING. Proof rolling with a heavy rubber-tired roller will be required when ordered by the City Engineer. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak (exhibit excessive pumping and those areas which fail shall be ripped, scarified, wetted or dried if necessary and re-compacted to the requirements for density and moisture at the contractor's expense. The operating weight of the roller shall be not less than 12-1/2 tons per wheel. Tires shall be inflated to a minimum pressure of 70 pounds per square inch and a maximum pressure of 90 pounds per square inch.

SECTION 1300 PRIME AND TACK COAT

1301 SCOPE. This section governs the requirements for all labor, equipment and materials for the application of liquid asphalt to a prepared pavement (concrete, asphaltic concrete), granular base or subbase. The type and grade of asphalt material to be used as prime or tack coat, is as specified in the special Provisions or as indicated by the plans.

1302 LIQUID ASPHALT MATERIAL. The liquid asphalt material to be used for surface preparation shall be as listed in the following table.

<u>Condition</u>	<u>Type</u>	<u>Gal./Sq.Yd.</u>	<u>Usage</u>	<u>Temperature</u>	<u>Cure Time</u>
Concrete	RC-70	.05-.10	Tack	150-225	1-6 hours
Asphalt	Emulsion	.05-.12	Tack	120-170	1-3 hours
	SS-CRS	.05-.12	Tack	120-170	1-4 hours
	RC-70	.05-.12	or prime	150-225	1-6 hours
Treated	CRS	.10-.20	Prime	120-170	1-3 hours
Base	MC-70	.10-.20	Prime	150-225	24-48 hours
	RC-800	.10-.20	Prime	150-225	1-6 hours
Rock	MC-70	.2-.5	Prime	150-225	24-48 hours

The asphalt material shall conform to the latest ASTM specifications for "Asphalt Cements and Liquid Asphalts." Sampling shall be in accordance with ASTM D-140.

1303 SAND COVER. Sand cover, if used, shall be any clean granular mineral meeting the following grading requirements. When tested with laboratory sieves 100 percent shall pass the No. 4 sieve and not more than 2 percent shall pass the No. 200 sieve. The moisture content of the sand shall not exceed 3 percent by weight.

1304 APPROVAL OF MATERIALS. Asphalt materials shall be approved by the Engineer prior to use in the work. The Engineer may accept a certified analysis by the refinery laboratory when a copy of the certified analysis accompanies each shipment of asphalt to the project. The Engineer will reserve the right to make check tests of the asphalt received on the job and, if the system of certified analysis proves to be unsatisfactory to the Engineer, he may discontinue this arrangement.

1305 PRESSURE DISTRIBUTOR. The distributor used in applying bituminous materials shall be of a self-propelled pressure type, equipped with suitable mechanical circulating appliances which will provide a uniform temperature in the entire mass of the material.

The distributor shall be so constructed and equipped as to meet the following requirements:

1. It shall be capable of applying bituminous material on the street at an accurately controlled uniform rate within the range of 0.01 to .050 gallons per square yard throughout the entire length of the spray bar, regardless of the load carried, gradient or change in direction of the street.
2. The spray bar shall be equipped with nozzles of such design and size that they can be adjusted to height and able to produce a uniform application, without streaks or ridges, throughout the entire width of application. The Contractor shall make tests and adjustments as necessary to insure that a uniform application is obtained. If nonuniform spraying occurs during priming operations, the Contractor shall correct the malfunction. If the malfunction cannot be corrected, a different distributor that functions properly shall be obtained, or operations will be terminated until corrections are made. The Contractor shall make a test application with the repaired or substituted distributor to insure proper operation of such equipment.
3. The pressure system on the spray bar shall be controlled to maintain a uniform pressure throughout the entire length of the spray bar at all times.
4. The distributor shall be equipped with a heating and circulating device to maintain the bituminous material within the bar at the specified temperature at all times.
5. The distributor or spray bar shall be equipped with a shutoff valve to be constructed and located as to provide instantaneous discharge of the bituminous material from the spray nozzles when the valve is opened, and instantaneous shutoff of the bituminous material discharge, without dripping, when the valve is closed.
6. The spray bar shall be so constructed that the width of application can be varied from 4 feet to 13 feet.
7. The circulating system shall be equipped with a readily accessible strainer in the discharge line.
8. The distributor tank shall be equipped with a thermometer so placed that it will accurately indicate the temperature of the contents of the distributor.
9. A calibrated measuring stick graduated in gallons shall be supplied to accurately determine the volume of the bituminous material in the distributor tank. If so directed by the Engineer, the measuring stick shall be recalibrated on the job, and the Contractor shall furnish all equipment, materials and labor for such calibration.
10. A meter shall be provided, operated by an independent wheel, to indicate the speed in feet per minute. It shall be located in such a position that is readily visible to the driver when the vehicle is in operation.

11. An auxiliary spraying hose equipped with a shutoff valve on the operating handle shall be provided for attachment to the pressurized system.

1306 PREPARATION OF EXISTING SURFACE. Immediately before applying the prime or tack coat, the area to receive asphalt shall be cleaned of all undesirable material.

1307 APPLICATION OF ASPHALT MATERIAL. Application of the asphalt material shall be made uniformly at the rate of gallons per square yard as specified in Section 1302 and shall be applied with a pressure distributor unless otherwise directed by the Engineer.

The spray bar shall be cut off instantaneously after each application to secure a straight line and full application of asphalt primer. If necessary, to prevent dripping and excess leakage, a drip pan shall be inserted under the nozzles when the application is stopped.

An auxiliary spraying hose shall be used to apply asphalt material to any and all locations that are unavoidably missed by the spray bar. The auxiliary spraying hose shall be used to apply material to small irregular areas not practical to apply with the spray bar. Hand spraying shall not be performed on any stretch of roadway in excess of 100 feet in length unless authorized.

1308 APPLICATION OF SAND COVER. If the asphalt material is not completely cured within the maximum specified curing time, sufficient sand shall be spread over the surface with a mechanical spreader to blot up the excess asphalt. The rate of application shall be specified or approved by the Engineer. Prior to placing an asphalt paving course, all loose sand shall be swept from the primed or tacked surface.

SECTION 1400 ASPHALTIC CONCRETE SURFACE AND BASE

1401 SCOPE. This section covers the requirements for all labor, equipment, materials and quality of work for the construction of asphalt concrete base and/or asphalt concrete surface.

The contractor shall cooperate with other contractors, public utility companies and other parties involved in arranging a schedule of operations. Such schedule shall be submitted to the Engineer for approval prior to commencing work when requested.

1402 GENERAL. Pavement shall be constructed to the lines, grades, dimensions and details contained herein or indicated on the plans.

Asphaltic concrete pavement shall conform to mix designs conforming to Section 1404 of these specifications and shall be as follows:

Surface Course MixType 3
Base Course MixType 1 or 2

Alternate mix designs may be used only where approved by the City Engineer.

1403 MATERIALS. No material shall be used until it has been checked or tested for compliance with specifications and approved by the Engineer. Representative samples of all materials proposed for use under these specifications shall be submitted at the Contractor's expense, for testing and the preparation of trial mixes to determine the job-mix formula. All tests necessary for determining conformance with the requirements specified herein will be performed at the expense of the Contractor.

A. Asphalt. Asphalt cement used in the manufacture of asphalt paving mixtures shall be of the penetration grade 50-60,60-70,70-85, or 85-100 or AC Designations 2.5,5,10, or 20 as designated by the Engineer. Such designation will be made at the time of the job-mix formula determination.

The asphalt cement shall conform to ASTM D-946. Sampling shall be in accordance with ASTM D-140.

If stripping of asphalt from the aggregate occurs in the mixing process, 1 percent of single strength anti-stripping agent shall be added to the liquid asphalt.

Asphalt materials shall be approved by the Engineer prior to use in the work. However, the Engineer may accept a certified analysis by the refinery laboratory when a copy of the certified analysis accompanies each shipment of asphalt to the project. The Engineer will reserve the right to make check tests of the asphalt received on the job, and if the system of certified analysis proves to be unsatisfactory to the Engineer, he may discontinue this arrangement.

The Contractor or asphalt supplier shall furnish the Engineer with data on the

temperature-viscosity relationship of each asphalt to be used on the project. This data shall cover the range of temperatures and viscosities within which the asphalt may be used.

Copies of all freight bills and weigh bills shall be furnished upon request to the Engineer as the work progresses.

- B. Aggregate. The quality of aggregates used in Asphaltic Concrete shall conform to the following sections of MCIB Section 4-Materials; Coarse Aggregate-Paragraph 2 (Quality) except that a total shale, clay, coal, and lignite content shall not exceed 0.5 percent by weight; and Fine Aggregate-Paragraph 3 (Deleterious Substances).

Sampling shall be in accordance with ASTM D-75. Gradation analysis shall be in accordance with Standard Method of Test for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing, ASTM C-117 and Standard Method Test for Sieve Analysis of Fine and Coarse Aggregate, ASTM C-136.

1404 MIXING AND PROPORTIONING.

- A. Composition of the Mix. Asphaltic concrete mixtures shall consist of Mineral Aggregate and Asphalt Cement within the following limits for the type specified.

	ASPHALTIC CONCRETE-TYPE			
	1	2	3	4
	<u>Percent by Weight of Total Mixture</u>			
Asphalt Cement	4-6	4-7	4-7	5-7.5
Aggregate-U.S. Standard				
Square Sieve Size	<u>Total Percent Passing by Weight</u>			
1 1/2"	100	---	---	---
1"	75-100	100	---	---
3/4"	60-85	80-100	100	---
1/2"	---	---	85-100	100
3/8"	40-65	60-80	70-90	85-100
No. 4	30-50	48-65	50-70	55-75
No. 10	17-33	32-43	34-43	36-46
No. 40	---	16-27	16-27	16-27
No. 80	5-12	7-15	7-16	7-18
No. 200	2-10	3-8	4-10	4-10

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25 for Type 1 Asphaltic Concrete or 20 for Type 2,3 and 4 Asphaltic Concrete.

That fraction of material retained on the No. 4 Sieve shall be composed of

particles with not less than 75 percent having two or more fractured faces, and not more than 20 percent by weight of that fraction shall be composed of flat or elongated particles (flat being a ratio of 1 to 3 between thickness and least width and a ratio of 1 to 3 between the least width and length).

That portion of the aggregate retained on the No. 10 Sieve shall be composed of at least 95 percent by weight of crushed aggregate.

The job-mix formula shall be within the limits specified above. The maximum permissible variation from the job-mix formula, within the specification limits, shall be as follows:

<u>U.S. Standard Sieve Size</u>	<u>Permissible Variation Percent by Weight of Total Mix</u>	
	<u>Type 1</u>	<u>Type 2,3,& 4</u>
No. 4 and larger	5.0	4.0
No. 10	4.0	3.0
No. 40	4.0	3.0
No. 200	2.0	1.0
Asphalt Cement	0.5	0.3

B Mix Design Criteria. Laboratory Test Specimen(s) of the Paving Mix, combined in proportions of the job-mix formula, shall be prepared and tested in accordance with ASTM D-1559.

Test requirements and criteria for the paving mixes under these specifications shall be as follows:

Marshall Stability, Types 2, 3, and 4 only	1500 lbs. minimum
No. of compaction blows	50
Flow, all mixtures	.08-16 inches
Air Voids: (Lab Specimen)	Percent
Base	1-8
Surface	1-5

<u>Voids in Mineral Aggregate (Max Size)</u>	<u>Percent (Minimum)</u>
1 1/2"	12
1"	13
3/4"	14
1/2"	15
3/8"	16

Mix designs for asphaltic concrete surface and base courses shall be submitted to the City Engineer for review and approval prior to placement. Work in progress without prior mix design approval by the City Engineer will be subject to removal at the expense of the

Contractor.

- C. Sampling and Testing of the Mixture. Mixes shall be sampled in accordance with ASTM D-979. The mixtures will be tested for Bitumen content in accordance with ASTM D-2172. The recovered aggregate will be sieved in accordance with Methods of Test for Mechanical Analysis of Extracted Aggregate, AASHTO T-30. When recovered Bitumen is required for further testing it will be obtained according to ASTM D-1856.
- D. Mixture Temperature Requirements. To aid in determining the proper temperature of the completed batch, current viscosity data shall be provided and shall be available at the plant at all times. With information relative to the viscosity of the particular asphalt being used, the temperature of the completed mix at the plant and at the paver shall be designated by the Engineer after discussing with the Contractor the hauling and placing conditions.

When the mix is produced in a batch-type plant, the aggregate shall be weighed accurately in the designated proportions to provide the specified batch weight. The temperature of the aggregate at the time of introduction into the mixed shall be as directed by the Engineer, with a tolerance of + or - 25 degrees F. In no case, however, shall the temperature of the mixture exceed 350 degrees F.

Continuous Mix or Drum Dryer Mixed plants shall, in general, be controlled in the same manner as batch-type plants. Details of control, differing because of the continuous mixing principle, shall be governed by instructions issued by the plant manufacturer, wherever these instructions are not contrary to these specifications.

- E. Control of Mixing Time. The dry mixing period is the interval of time between the opening of the weigh box gate and the application of the asphalt. The wet mixing period is the interval of time between the application of all asphalt and the opening of the mixer gate for discharge. When it is applied by spray system, the wet mixing time shall begin with the start of the asphalt spray.
 - 1. Batch-Type Plants. The length of time of both the dry and wet mixing periods shall be such to insure a uniformly and completely coated mix. Mixing period time shall not be altered unless so ordered by the Engineer. A dry mixing period of not less than five seconds shall precede the addition of asphalt to the mix. Excess wet mixing shall be avoided. Wet mixing shall continue as long as is necessary to obtain a thoroughly blended mix, but shall not exceed 75 seconds nor be less than 30 seconds.
 - 2. Continuous Type Plants. The determination of mixing time shall be by a weight method under the following formula, unless otherwise required:

$$\text{Mixing Time (sec)} = \frac{\text{Pugmill Dead Capacity (lbs)}}{\text{Pugmill Output (lbs per sec)}}$$

- F. Preparation of Asphalt Cement. The asphalt cement shall be heated at the paving plant to a temperature at which it can be uniformly distributed throughout the mix. It shall be delivered into the Contractor's tank at a temperature not exceeding 350 degrees F., and shall not be heated above this temperature for any operation of the paving plant.

The asphalt shall be heated so that it can be distributed uniformly throughout the batch. For mixing application, the specified temperature generally will be such that the asphalt viscosity is within the range of 75-150 seconds, Saybolt Furol. The material shall be sufficiently fluid to produce a complete coating on every particle of aggregate within the specified mixing time.

- G. Preparation and Handling of Aggregate. Coarse and fine aggregate shall be stored at the plant in such a manner that the separate sizes will not become intermixed. Cold aggregates shall be carefully fed to the plant in such proportions that surpluses and shortages in the hot bins will not cause breaks in the continuous operation. When loading aggregate into stockpiles, and into cars, barges, and trucks, the material shall be placed in such a manner as to prevent segregation of aggregate sizes. Stockpiles shall be built in uniform layers not exceeding 5 feet in depth.

Coarse and fine aggregate shall be sampled and tested upon arrival at the plant in accordance with the standard method specified in Section 1403(B). Samples of coarse and fine aggregate shall be submitted to an approved testing laboratory for testing, prior to the start of work, and as often thereafter as requested by the Engineer. When coarse aggregate grading is such that the material will tend to segregate during stockpiling or handling, it shall be supplied in two or more sizes. Each size of coarse aggregate required to produce the combined gradation specified shall be placed in individual stockpiles at the plant site and separated by bulkheads or other means approved by the Engineer. Likewise, when it is necessary to blend fine aggregates from one or more sources to produce the combined gradation, each source or size of fine aggregate shall also be placed in individual stockpiles. Aggregate from the individual stockpiles shall be fed through separate bins to the cold elevator feeders and they shall not be blended in the stockpile.

1. Drying. The aggregate shall be thoroughly dried and heated to provide a paving mix temperature within a tolerance of + or - 25 degree F., of that specified by the Engineer. The moisture content of the heated and dried aggregate shall not exceed 1.0 percent. The quantity of material fed through the dryer shall, in all cases, be held to an amount that can be thoroughly dried and heated.
2. Screening. Aggregates shall be screened into sizes such that they may be recombined into a gradation meeting the requirements of the job-mix formula.
3. Hot Aggregate Storage. Hot-screened aggregate storage shall be accomplished in such a manner as to minimize segregation and loss of temperature of the aggregate.

H. Inspection and Control of Asphalt Mixing Plant.

1. Job Mix Formula. The Engineer may make frequent gradation analysis of the hot aggregates and of the completed mix to be certain that the materials being used and produced are within the tolerances of the job mix formula, and the specifications of the mix number being used. If the mix is found to be outside of the job-mix formula tolerances, or outside of the specifications limits as specified in Section 1404, correction shall be made in quantities measured from the hot bins and adjustments made at the cold bin feeders.
2. Sampling and Testing. Stockpiles and bins may be sampled for gradation analysis and examined for dust coating and for other purposes, in compliance with state requirements.

Gradation analysis of each hot bin will be performed and a combined analysis computed at least once for every four hours of plant operation if requested by the Engineer. At least one sample shall be taken from each 300 tons of the mix being produced. Samples will be used to determine compliance with general and special requirements set forth in Section 1404.

When requested by the Engineer, the Contractor shall provide representative samples by taking aggregate from the discharge of the aggregate through each of the hot bin gates, or by drawing aggregate from each bin through the mixture chamber (without asphalt cement) into a truck or other receptacle.

1405 ASPHALT MIXING PLANT. Plants used by the Contractor for preparation of the asphalt paving mix shall conform to the following requirements:

A. Requirements for all Plants.

1. Consistency. The plants shall be designed, coordinated, and operated to produce a well-graded mixture within job mix tolerances as covered in Section 1404.
2. Equipment for Preparation of Asphalt. Tanks for storage of asphalt shall be provided with a device for controlled heating of the material to temperature requirements set forth in Section 1404 (F). Heating shall be accomplished so that no flame shall come in contact with the heating tank. A circulating system of adequate size to insure proper and continuous circulation of asphalt between storage tank and mixed during the entire operating period shall be provided. Storage tank capacity shall be sufficient to hold enough asphalt for at least one day's production.
3. Cold Aggregate Feeder. The plant shall be provided with an accurate mechanical means for feeding the mineral aggregate into the dryer to secure a uniform production and constant temperature. The feeder or feeders shall be capable of delivering, in preset conditions, the maximum number of aggregate sizes required.

When more than one cold elevator is used, each shall be fed as a separate unit and the individual controls shall be integrated with a master control.

4. Dryer. The plant shall include a rotary drum dryer that will continuously agitate the mineral aggregates during the heating and drying process. It shall be capable of continuously supplying aggregate to the mixing unit operating at capacity, to provide a mix at the temperatures specified in Section 1404, and at a moisture content not in excess of 1.0 percent.
5. Screens. Plant screens capable of separating all aggregates to the sizes required for proportioning, and by having normal capacity in excess of the full capacity of the mixer or the dryer, shall be provided. The Contractor shall expose the screens for inspection at the request of the Engineer. The plant screens shall have efficiency such that the undersize and oversize aggregate in the associated bins shall not exceed the following percentages:

<u>Bin Sequence from Hot Aggregate Discharge</u>	<u>Undersize Per Cent</u>	<u>Oversize Per Cent</u>
1	---	10
2	-10	10
3	-15	5
4	-15	0

The screen tolerances shall not invalidate the job-mix tolerances specified in Section 1404.

6. Bins. Bins shall be divided into compartments arranged to insure separate storage of the appropriate fractions of aggregates. Each compartment shall be provided with an overflow pipe that will prevent any backing up of material into other compartments or bins against the screens. The overflow material shall be wasted.

When mineral filler is required, additional dry storage shall be provided and the provision shall be made for proportioning it into the mix.

7. Asphalt Control Unit. Means shall be provided to obtain the required percentage of asphalt in the mix within tolerance specified, either by weighing, metering, or measuring volumetrically. Where metering controls the quantity of asphalt, provision shall be made for the amount of asphalt delivered through the meter to be readily checked by weight. Steam jacketing or other insulation shall be provided which will maintain the specified temperatures of asphalt in pipelines, meters, weigh buckets, spray bars or other containers.
8. Thermometric Equipment (Graduated in 10 degree Increments). An armored thermometer reading from 200 degrees F. to 400 degrees F. shall be fixed in the asphalt feed line at a location near the discharge valve at the mixer unit. A

pyrometric thermometer will be supplied in the sand bin and one in the intermediate aggregate bins. The plant shall be further equipped with an approved dial scale, mercury-actuated thermometer, a recording electric pyrometer, or other approved thermometric instrument having an accuracy of + or - 5 degrees F., placed at the discharge chute of the dryer to indicate the temperature of the heated aggregate. Any thermometric instrument used shall be sensitive to a rate of temperature change not less than 10 degrees F. per minute.

9. Dust Collector. The plant shall be provided with a dust collector, designed to waste, or return in a constant and uniform flow to the hot elevator by mechanical means, all or part of the material collected. Prior to permitting the return of such collected dust, the Engineer will examine the characteristics of the dust in relation to the mix requirements.

The plant shall have a mixer cover and such additional housing as may be necessary to insure proper control of dust. The plant shall operate in conformance with all applicable regulations concerning Air Quality Control.

10. Inspection Access. Adequate, safe and unobstructed access to all areas of the plant from which material samples are required shall be provided. These areas shall include, but not be limited to, Dryer, Screens, Storage Bins, Asphalt Control Unit, and Truck Loading Space. In addition, a ladder or platform shall be provided at the truck loading space to permit easy and safe inspection or sampling of the mix as it is delivered into the truck.
11. Screen By-Pass Operation. The producer of asphaltic concrete material may operate his asphalt plant by discharging the hot dry aggregate material from the dryer into one of the hot storage bins instead of separating the aggregate by screening.

The asphaltic concrete mixture discharged from the pugmill with the operating screen on by-pass shall comply with the specification and job-mix formula criteria.

12. Field Testing Laboratory. The Contractor shall provide a laboratory building or room at the plant site, for the exclusive use of the Engineer for performing tests, keeping records, and making reports when requested.

The Contractor shall also furnish necessary laboratory sieves and a powered shaker device for sieve analysis, scales, extractor and supplementary equipment to make aggregate sieve analysis, asphaltic concrete paving mixture analysis, and paving mixture density tests if requested by the Engineer.

B. Special requirements for Batch Type Plants.

1. Plant Scales. Scales for any weight box or hopper may be of either the springless

dial or beam type and shall be of an established make and design accurate to within 0.5 percent of the indicated load.

Dial scales shall be designed, constructed and installed in such manner as to be free from vibration. All dials shall be so located as to be plainly visible to the operator at all times. The numbers on the dial shall be large enough to be read at a distance of 25 feet. The end of the pointer shall be set close to the face of the dial to minimize parallax. The scale shall be provided with adjustable pointers for marking the weight of each material to be weighed into the batch.

When the scales are of the beam type, there shall be a tare beam for balancing the hopper and a separate beam for the aggregate from each hot bin. A telltale dial shall be provided that will start to function when the load being applied is within 100 pounds of the weight desired. Each beam shall have a locking device designed and so located that the beam can easily be suspended or put into action.

Scales for the weighing of asphalt cement shall conform to the requirements for aggregate scales, except that beam scales shall consist of a full capacity beam and tare beam. The minimum gradation shall not be greater than 1 pound and there shall be attached a telltale device which will start to function when the load being applied is within 25 pounds of the weight desired. Dial scales for weighing the asphalt cement shall read to the nearest pound. All scales for weighing the asphalt shall have a capacity of not more than 10 percent of the normal capacity of the mixer.

Scales shall be tested and sealed as often as the Engineer may deem it necessary to insure their accuracy. All weighing equipment shall be well constructed and designed to permit easy realignment and adjustment. Weighing equipment that gets out of adjustment shall be replaced or repaired when ordered by the Engineer. The Contractor shall provide and have available at least to 50-pound standard weights for frequent testing of all scales. For each scale, a suitable cradle, or platform, shall be provided for applying the test load so that the load is distributed uniformly. The test weights shall be kept clean and stored near the scales.

- 2 Weight Box or Hopper. Equipment shall include a weight box or hopper, large enough to hold a full batch without hand raking or running over, for accurately weighing each bin size aggregate. The weight box or fulcrums and knife-edges shall be so constructed that they will not readily be thrown out of alignment. Gates on both bins and hopper shall prevent leakage when they are closed. An interlocking device that prevents the opening of more than one gate at a time shall be provided. Proportioning of aggregates and charging of mixer shall be performed to blend the aggregates thoroughly and prevent segregation in the mixer.

Automatic plants may proportion all aggregates by simultaneous measuring if a weight hopper with a separate compartment for each bin size, calibrated by

weight, is used.

- 3 Asphalt Cement Measuring Equipment. Asphalt measuring equipment provided on the plant shall accurately measure into each batch the required amount of asphalt within a tolerance of plus or minus 2 pounds.

When an asphalt bucket is used, it shall be a no tilting type provided with a loose sheet-metal cover. The capacity of the asphalt bucket shall be a least 10 percent in excess of the weight of asphalt required for a one-batch mix. The plant shall have a steam-jacketed, quick closing, non-dripping, charging valve.

The length of the discharge opening or spray bar shall not be less than three-fourths of the length of the mixer and it shall discharge directly into the mixer. The discharge system shall be designed and arranged to deliver the asphalt the full length of the mixer in a thin, uniform sheet or in multiple streams or sprays.

When a volumetric meter is used, it shall automatically meter the asphalt into each batch. The dial to indicate the amount of asphalt shall have a capacity of at least 10 percent in excess of the weight or gallons of asphalt required in one batch. The meter shall be constructed so that it may be locked at any dial setting and will automatically reset to this reading after the addition of the flow of asphalt to each batch. The dial shall be in full view of the mixer operator. The flow of asphalt shall be controlled to begin automatically when the dry mixing period is over. All of the asphalt required for one batch shall be discharged in not more than 15 seconds after the flow has started. The section of the asphalt flow line located between the charging valve and the outlet shall be used for checking and testing the accuracy of the meter.

- 4 Mixer Unit for Batch Method. The plant shall include a batch mixer and a batch capacity of not less than 2000 pounds. It shall be capable of producing, uniformly, a mix within the job-mix tolerances established in Section 1404. Deviation in size of batches will be permitted to provide for mixing batches down to 20 percent below and up to 15 percent above the rated capacity in the mixer, provided the quality of the mix is not impaired.

The paddles shall be set to insure a completely uniform mixture. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The mixer shall be so constructed as to prevent leakage of contents.

5. Interlock, Time Control and Batch Counter. The Mixer shall have an interlocking control to lock the weight box gate until the material in the pugmill has been discharged and the pugmill has been closed. The interlock shall also lock the asphalt bucket throughout the dry and wet mixing periods. The timing control shall be flexible, permitting adjustments of cycles up to three minutes in five-second intervals. A batch counter, designed to register only completely mixed batches, shall be installed.

C. Special Requirements for Continuous Mixing Plants.

1. Feeder Signal Devices. The aggregate bins shall be provided with signal devices and controls which will warn of low levels and thereby lead to stopping the flow of all aggregate and asphalt to the mixer when the aggregate in any one bin is so low that the feeder will not operate at set capacity. The asphalt storage system shall be provided with signal devices and controls which will warn of low levels of asphalt and which will stop the entire plant operation when the asphalt storage lever is lowered to the point of exposing the feed end of the asphalt suction line.
2. Aggregate Feed Unit. The proportioning unit shall include a feeder mounted under the bins. Each bin compartment shall have an accurately controlled mechanically adjustable gate to form an opening for volumetrically measuring the material drawn from it. The opening shall be rectangular and provided with a lock. Indicators shall be provided on each gate to show the gate opening in inches. Mineral filler, if specified, shall be proportioned separately from a hopper equipped with an adjustable feed which may be accurately and conveniently calibrated and which shall be interlocked with the aggregate and asphalt feeds.
3. Calibration of Aggregate Feed. Samples shall be taken and weighed as a means of calibrating gate openings. Material shall be fed out of a bin through the individual opening and bypassed to a leakproof test box. The material from each compartment shall be taken separately. The plant shall be equipped to handle conveniently test samples weighing not less than 200 pounds. A platform scale shall be provided by the Contractor to weigh the test samples to an accuracy of + or - 0.5 percent of the indicated load.
4. Synchronization of Aggregate and Asphalt Feed. Positive interlocking control shall be assured between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning device. This shall be accomplished by a positive interlocking method.
5. Mixer Unit for Continuous Method. The plant shall include a continuous mixer capable of uniformly producing a mix within the job-mix tolerance specified in Section 1404(A). The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge.

- C. Special Requirements for Drum Dryer Mixing. Asphaltic concrete mixtures may be manufactured by the process of incorporating asphalt cement with aggregate as the material passes through the dryer. The drum dryer mixing operations shall be approved by the Engineer prior to the manufacture of asphaltic concrete mixes. The material so produced shall comply with specifications and job-mix formula criteria.

The aggregate bins and asphalt storage system shall be equipped with feeder control

devices in conformance with Section 1405(C,1). The Contractor shall provide and have available standard weights of sufficient sizes to calibrate the aggregate feed conveyor scales from their minimum to maximum readings in 1-pound increments.

1406 TRANSPORTATION OF MIX. The mix shall be transported to the job site in vehicles with tight metal bottoms, clean of all foreign material that may affect the mix. The inside of the truck beds shall be lubricated with a thin coating of volatile oil to prevent the mix from adhering to the bed, but an excess of lubricant will not be permitted. The dispatching of vehicles shall be so scheduled that all materials delivered may be placed in daylight unless the Engineer approves artificial light. Delivery of the material to the paver shall be at a uniform rate and in an amount within the capacity of the paving and compacting equipment.

Haul trucks shall be provided with covers of sufficient size and weight to completely cover the truck bed to protect the load and to prevent cooling of the upper surface. Failure to have the load completely covered shall be sufficient cause for rejection of the entire load. The load shall remain covered until the truck is next in line to be unloaded. In no case shall a load remain uncovered for more than 10 minutes before starting to use the load. If for any reason there is a delay in completely using a load, the remaining part of the load shall be re-covered until it can be used. It shall be the responsibility of the Contractor to inform all truck drivers of these provisions before starting work.

1407 SCALES AND WEIGHING OF VEHICLES. The vehicle's tare and gross weight shall be established by actually weighing the vehicle on a certified scale. The tare weight will be established at least twice each day. The vehicle, when establishing tare, shall be clean, bed empty, fuel tanks filled and shall have all side and back boards in place.

Scales used to determine the weight of vehicles shall be of the axle-load type. Certification of scales shall be accomplished by a scale company capable of testing the performance of axle-load for compliance with the National Bureau of Standards Handbook #44, "Specifications, Tolerance and other Technical Requirements for Commercial Weighing and Measuring Devices."

1408 REQUIREMENTS FOR ASPHALT PAVING EQUIPMENT. All asphalt paving equipment used by the Contractor shall meet the requirements of this section and shall be maintained in acceptable mechanical condition. Equipment shall be serviced and lubricated away from the paving site. Units that drip fuel, oil or grease shall be removed from the project until such leakage is corrected.

A. Pavers and Laydown Machines. Mechanical self-powered pavers shall be capable of spreading the mix, within the specified tolerances, true to the line, grade and crown indicated on the plans.

Pavers shall be equipped with quick and efficient steering devices and shall be capable of traveling both forward and in reverse. They shall be equipped with hoppers and distributing screws that place the mix evenly in front of the adjustable screeds. They shall be equipped with either a vibrating screed or a tamping bar immediately preceding a

static screed.

There shall be sufficient auxiliary attachments for the paving machine so that it may be operated to lay 8, 9, 10, 11 and 12-foot strips. The necessary width for laying shall be determined in the field by the Engineer. Vibrating screed or tamp bars shall be provided for the full width of all paving operations.

The screed shall include a strike-off device which is effective on mixes at workable temperatures without tearing, shoving or gouging them, and which produces a finished surface of an even and uniform texture. The screed shall be adjustable as to the height and crown and shall be equipped with a controlled heating device for use when required. For irregular width paving, hydraulic extensions, without tamping bars and vibrating screed, may be used only along the curb or outer edge of pavement.

1. Electronic Screed Controls. The paver shall be equipped with an approved system capable of automatically controlling the elevation and transverse slope of the paver screed. An erected string line, traveling string line or other approved device operating on the roadbed being paved or the surfaces of the previously placed lane shall be used to establish the grade reference. The grade reference device shall operate on either or both sides of the paver as required and shall be capable of maintaining the desired transverse slope regardless of changes in the screed elevation.

The traveling string line shall be constructed in such a manner that it does not vibrate or cause the sensor to make erroneous readings during the layout operation.

The length of the beam to be used shall be approved by the Engineer and shall be between 20 feet and 40 feet.

In the event of failure of the automatic screed control system, the Contractor will be permitted to continue placing the asphaltic concrete mix for the rest of the day in which the failure occurred. The Contractor will not be permitted to continue operations without using automatic screed controls unless permission has been granted by the Engineer on each succeeding day following the failure.

The use of the automatic screed control devices on asphalt pavers will not be required for paving small irregular areas, entrances, approaches, or side street connections.

Automatic screed control devices will be required for matching the joint with all previously laid strips, except for those areas noted above.

2. Beveled Joint. The paver shall be equipped with a shoe that will produce a joint between laying strips having its face inclined at an angle of thirty degrees from the vertical. This type joint shall be used with all asphaltic concrete mixes. The

shoe shall be designed in such manner that it will be capable of beveling depth up to 4 inches.

B Rollers. Compaction equipment may consist of vibratory steel wheel, static steel wheel or pneumatic-tired rollers. They shall be self-propelled and equipped with such controls that starting, stopping and reversing direction can be accomplished without displacing the hot asphaltic concrete pavement.

1. Steel-Wheeled Rollers. Steel-Wheeled Rollers may be as follows: three-wheeled rollers, vibratory rollers, tow-axle tandem rollers, or three-axle tandem rollers. These rollers shall develop contact pressure of 195 to 350 pounds per inch of width. Rollers shall be in good condition.

Rollers shall be equipped with adjustable scrapers to keep the wheel surfaces clean and with efficient means of keeping them wet to prevent mixes from sticking. These surfaces shall have no flat areas, openings or projections that will mar the surface of the pavement.

The three-axle tandem rollers shall be so constructed that, when locked in position with all treads in one plane, the roller wheels are held with such rigidity if either front or center wheel is unsupported, the other two wheels will not vary from the plane more than 1/4 inch.

2. Pneumatic-Tired Rollers. The rollers shall be equipped with pneumatic tires of equal size and diameter that are capable of exerting average contact pressures varying from 40 psi to 110 psi by adjusting the ballast and or tire inflating pressures. The wheels of the roller shall be so spaced than one pass will accomplish one complete coverage equal to the rolling width of the roller. There shall be a minimum of 1.4-inch overlay of the tracking wheel. The wheels shall oscillate but not wobble. The roller shall be so constructed that the contact pressure shall be uniform for all wheels, and the tire pressure of the several tires shall not vary more than 5 psi. Pneumatic-tired rollers shall be constructed with enough ballast space to provide uniform wheel loadings as may be varied by order of the Engineer to obtain contact pressures that will result in the required density.
3. Trench Rollers. Trench rollers shall have an auxiliary wheel that operates outside the area to be compacted at such a distance from the pavement edge as to cause no damage thereto. it shall be mounted upon an axle that is adjustable in height. The auxiliary wheel shall be kept in adjustment so that the compression wheels will develop a smooth, compacted surface true to crown and grade.

The contact pressure of the compression wheels shall be from 195 to 350 pounds per inch of width.

Trench rollers shall be equipped with adjustable scrapers to keep the rollers clean and with efficient means of wetting the compression wheels to prevent mixed

from sticking.

In lieu of the above requirements pertaining to non-vibratory compaction equipment, consideration will be given to use other types of equipment that are capable of producing equivalent results consistent with the requirements of the specifications.

- C. Pressure Distributor. The pressure distributor shall meet the requirements of Section 1305.
- D. Hand Tools. The Contractor shall provide sufficient lutes, rakes, shovels, tamping irons and other equipment as required to produce results consistent with the specifications.

1409 CONSTRUCTION REQUIREMENTS.

- A. Preparation of the Area to be Paved. The area to be paved shall be true to line and grade, and have properly prepared surface prior to the start of the paving operations. It shall be free from all loose or foreign material.

Where a base is rough or uneven, a leveling course shall be placed and properly compacted before the placing of subsequent courses.

When leveling course is not required, all depressions and other irregularities shall be patched or corrected, and the work approved by the Engineer before the paving operation begins.

The area to be paved shall be primed uniformly in accordance with the provisions of Section 1300. The asphalt emulsion may be diluted 1:1 to 1:3 parts emulsion to water.

The surfaces of curbs, gutters, vertical faces of existing pavements and all structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of asphaltic material to provide a closely bonded, watertight joint.

- B. Weather Limitations. When the moisture of the aggregate in the stockpile or from the dryer interferes with the quality of mix production, or with normal plant operations, or when pools of water are observed on the surface to be paved, the mixing and placing of hot-mix asphalt will not be permitted without the special permission of the Engineer.

Hot mix asphalt paving shall not be mixed or placed when the ambient temperature is below 40 degrees F., or when there is frost in the subgrade or any other time when weather conditions are unsuitable for the type of material being placed without expressed approval of the Engineer. The minimum temperature of the asphaltic concrete when placing at the construction site shall be 285 degrees F. when the ambient temperature is from 40 - 50 degrees F., 280 degrees F. when the ambient temperature is from 50 - 60 degrees F., and 275 degrees F when the ambient temperature is above 60 degrees F.

C. Spreading and Finishing. The spreading and finishing of each course shall be to the thickness and width indicated on the plans or Special Provisions. The thickness of individual layers shall not exceed the following for the respective type of mixture.

Type 1	Asphalt Concrete Base	8"
Type 2	Asphalt Concrete Base	4"
Type 3	Asphalt Concrete Surface	2"
Type 4	Asphalt Concrete Surface	3/4"

Spreading and finishing shall be conducted in the following manner:

- 1 Mechanical Pavers. The base and surface courses shall be spread and struck-off with a mechanical paving machine meeting the requirements of Section 1408 (A). The paving machine shall be operated so that the material does not accumulate and remain along the sides of the receiving hopper.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operation, or which produces other permanent blemishes or fails to produce a satisfactory surface, shall not be used.

Longitudinal joint and edges shall be constructed to true line markings. Lines for the paver to follow in placing individual lanes will be established parallel to the centerline of the proposed roadway. The paver shall be positioned and operated to follow closely the established line. When using pavers in echelon, the second paver shall follow the edge of the material placed by the first paver. The length of each laydown pass shall be limited, depending on weather conditions, to assure a hot joint and obtain proper compaction.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

Transverse joints in succeeding courses shall be offset at least 2 feet. Longitudinal joints shall be offset at least 6 inches.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Edges against which additional pavement is to be placed shall be beveled 30 degrees from the vertical plane. A lute or rake shall be used immediately behind the paver to obtain a true line and beveled edge. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed by a shovel or lute. Indented areas

shall be filled with hot mix and smoothed. Fanning of material shall not be permitted.

- 2 Hand Spreading. In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. Placing by hand shall be performed carefully; the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregate. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be rejected. Following placing and before rolling, the surface shall be checked with templates and straightedges and all irregularities corrected.

D. Compaction.

- 1 General. Rolling equipment for use in compacting mixes shall meet the requirements of Section 1408 (B). Unless otherwise approved by the Engineer, at least three (3) rollers shall be required at all times. Additional rollers shall be used as necessary to provide specified pavement density.

All rolling shall proceed as directed by the Engineer, but in general shall be longitudinal, starting near the edge of the pavement and proceeding toward the center of the roadway, overlapping on successive trips by not less than one-third (1/3) and no more than one-half (1/2) the width of the roller. Alternate trips of the roller shall be of slightly different lengths. The initial rolling shall take place as closely behind the laying machine as the temperature and condition of the mat will allow.

The motion of the roller shall be slow enough at all times to avoid displacement of the hot mixture. The initial compaction roll shall be accomplished with the roller drive wheel leading the tiller wheel. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required. To prevent adhesion of the mixture the wheels shall be kept properly moistened, but excess water will not be permitted.

Immediately after spreading, each course of the pavement mixture shall be compacted by rolling. The initial or "breakdown" rolling shall be accomplished with a smooth-wheeled roller. The pneumatic tired roller shall be used to knead and compact the pavement mixture following the initial rolling and preceding the final rolling. Care shall be exercised in the use of the pneumatic-tired roller to ensure that the pavement mixture is sufficiently cooled to avoid "picking-up" of the mixture on the tires of the roller, and also to ensure that the pneumatic-tired rolling is completed before the mixture becomes too cool to allow satisfactory finish rolling. Final, or finish rolling, shall be done with a smooth-wheeled roller.

The surface of the mixture after compaction shall be smooth and true to established section and grade. Any surface which shows an uneven mixture or which becomes loose, or is in any way defective, shall be removed and replaced with fresh hot mixture at the Contractor's expense, and be immediately compacted to conform with the surrounding area.

2 Rolling Procedure. When paving in single widths rolling shall proceed in the following order:

- a. Transverse Joint
- b. Outside Edge
- c. Initial or Breakdown rolling, beginning on the low side and progressing toward the high side
- d. Second rolling same procedure as 3
- e. Finish rolling

When paving in echelon, or abutting a previously placed lane the longitudinal joint rolling shall follow the transverse joint rolling.

When paving in echelon, 2-3 inches of the edge that the second paver is following shall be left unrolled, and rolled when the joint between the lanes is rolled. Edges shall not be exposed more than fifteen minutes without being rolled. Particular attention shall be given to the construction of transverse and longitudinal joints in all courses.

In laying a surface mix adjacent to any finished area, it shall be placed sufficiently high so that, when compacted, the finished surface will be true and uniform. Where the grade is slight, gutters will be checked with a straightedge to insure drainage to the desired outlet.

3 Transverse Joints. Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth riding surface. If the joint has been distorted, it shall be trimmed to a line. The joint face shall be painted with a thin coating of asphalt before the fresh material is placed against it. Transverse joints shall be held to a minimum. At the end of the paving day all lanes shall be completed to approximately the same station.

4 Longitudinal Joints. Longitudinal joints shall be rolled directly behind the paving operation. The first lane placed shall be true to line and grade. In spreading, the material shall overlap the edge of the lane previously placed by two (2) to four (4) inches. The width and depth of the overlapped material shall be kept uniform along the joint for alignment purposes. Before rolling, the coarse aggregate in the material overlapping the joint shall be carefully removed with a rake or lute and discarded.

5. Edges. The edges of the pavement shall be rolled concurrently with or immediately

after rolling the longitudinal joint.

Care shall be exercised in consolidating the material along the entire length of the edges. Before it is compacted, the material along the unsupported edges shall be slightly elevated with a tamping tool or lute. This will permit the full weight of the roller wheel to bear on the material to the extreme edges of the mat. In rolling pavement edges, roller wheels shall extend approximately one (1) inch beyond the pavement edge.

6. Breakdown Rolling. Breakdown rolling shall immediately follow the rolling of the longitudinal joint and edges. Rollers shall be operated as close to the paver as necessary to obtain adequate density without causing undue displacement. The breakdown roller shall be operated with the drive wheel nearest the finishing machine. Exceptions may be made by the Engineer when working on steep slopes or super-elevated curves.
7. Intermediate Rolling. Pneumatic-tired rollers as specified in Section 1408(B,2) shall be used for intermediate rolling. The intermediate rolling shall follow the breakdown rolling as closely as possible and while the paving mix is still of a temperature that will result in maximum density from the operation.

Pneumatic-tired rolling shall be continuous after the initial rolling until all of the mix placed has been compacted to the required density. Turning of pneumatic-tired rollers on the hot paving mix which causes displacement shall not be permitted.

8. Finish Rolling. The finish rolling shall be accomplished while the material is still warm enough for the removal of roller marks. All roller marks shall be removed by the finish rolling operation.

All rolling operations shall be conducted in close sequence. In places inaccessible for the operation of standard rollers as specified, compaction shall be performed by trench rollers or others meeting the requirements of Section 1408 (B.3). The trench roller shall be operated until the course is thoroughly compacted. Hand tamping, manual or mechanical, may be used in such areas, if such operations will give the required density.

- E Density and Surface Requirements. The completed asphalt concrete paving shall have a density equal to or greater than 95 percent for Type 1 and 2 Asphalt Concrete Base and 97 percent for Type 3 and 4 Asphalt Concrete Surface. Density is based on laboratory specimens prepared as specified in Section 1404 (B) and made from plant mix conforming to the job mix formula.

All unsatisfactory work shall be repaired, replaced or corrected at the direction of the Engineer. The surface of the final course shall be of a uniform texture and conform to line and grade shown on the plans.

Both density and thickness shall be carefully controlled during construction and shall be in full compliance with plans and specifications. During compaction, preliminary tests, as an aid for controlling thickness shall be made by means approved by the Engineer.

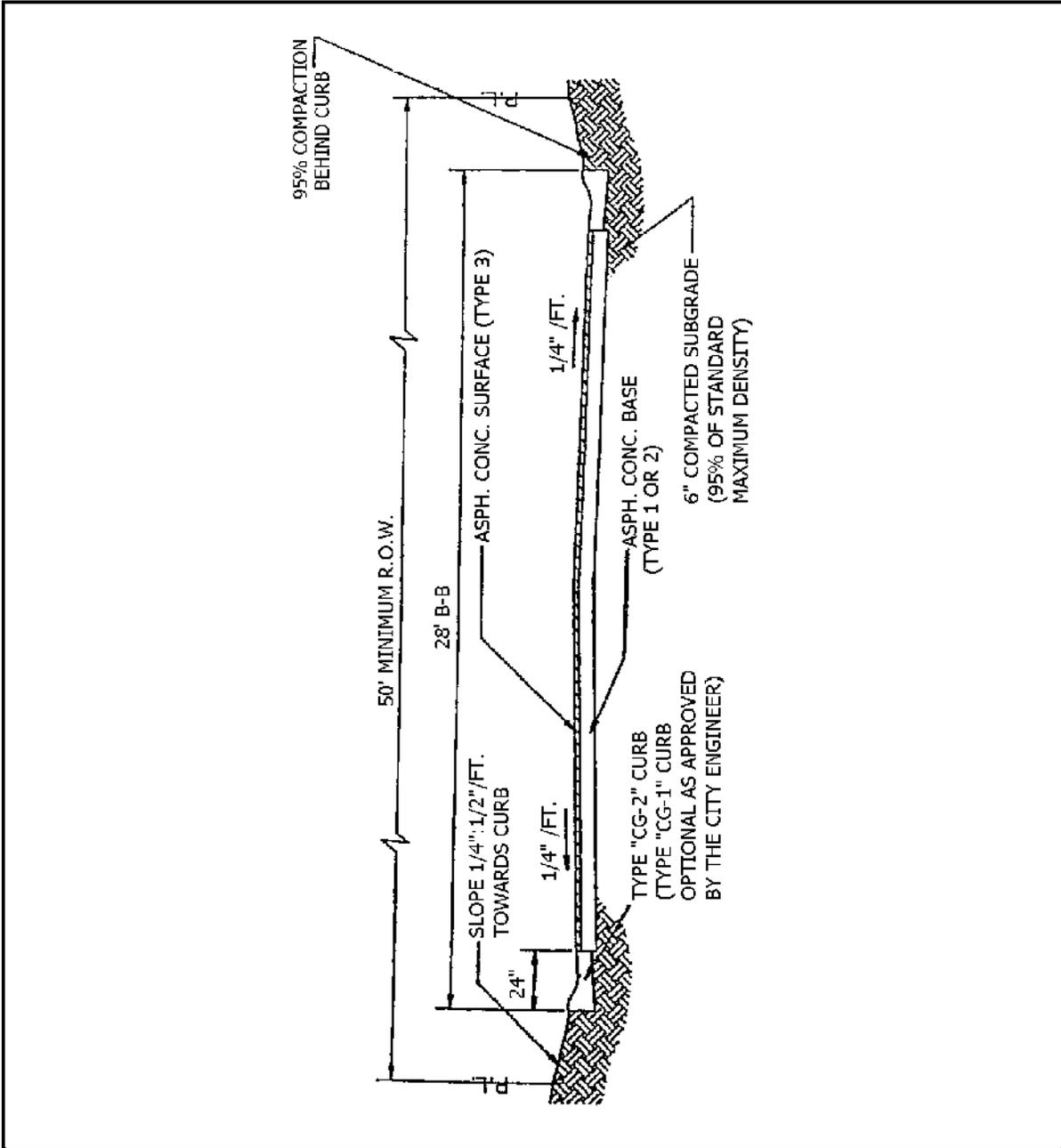
Upon request of the Engineer, representative samples of the compacted asphalt paving shall be obtained by the Contractor under the supervision of the Engineer and shall be tested by a suitable independent or municipal testing laboratory as necessary to verify compliance with respective density requirements.

Selection of the independent testing laboratory, the number, timing, location and testing procedures for the representative samples shall be approved by the Engineer. The testing laboratory shall submit to the Engineer four (4) copies of each report covering the details and results of the tests. All costs for the testing laboratory and all other costs of testing shall be borne by the Contractor, unless otherwise specified.

The surface of the final surface course shall not vary from a ten (10) foot straight edge, applied parallel to the centerline, by more than one-fourth (1/4) inch.

1410 PROTECTION OF PAVEMENT. The Contractor shall protect all sections of newly compacted base and surface courses from traffic until they have hardened properly, or as directed by the Engineer.

1411 COMPACTION TESTING. At the option of the Engineer, compaction testing may be performed in the field using a nuclear density-moisture measuring device to determine the density of the mixture as placed. If as a result of this field testing the Engineer determines that further compaction is required, the Contractor shall revise his rolling procedure to obtain the density as specified.

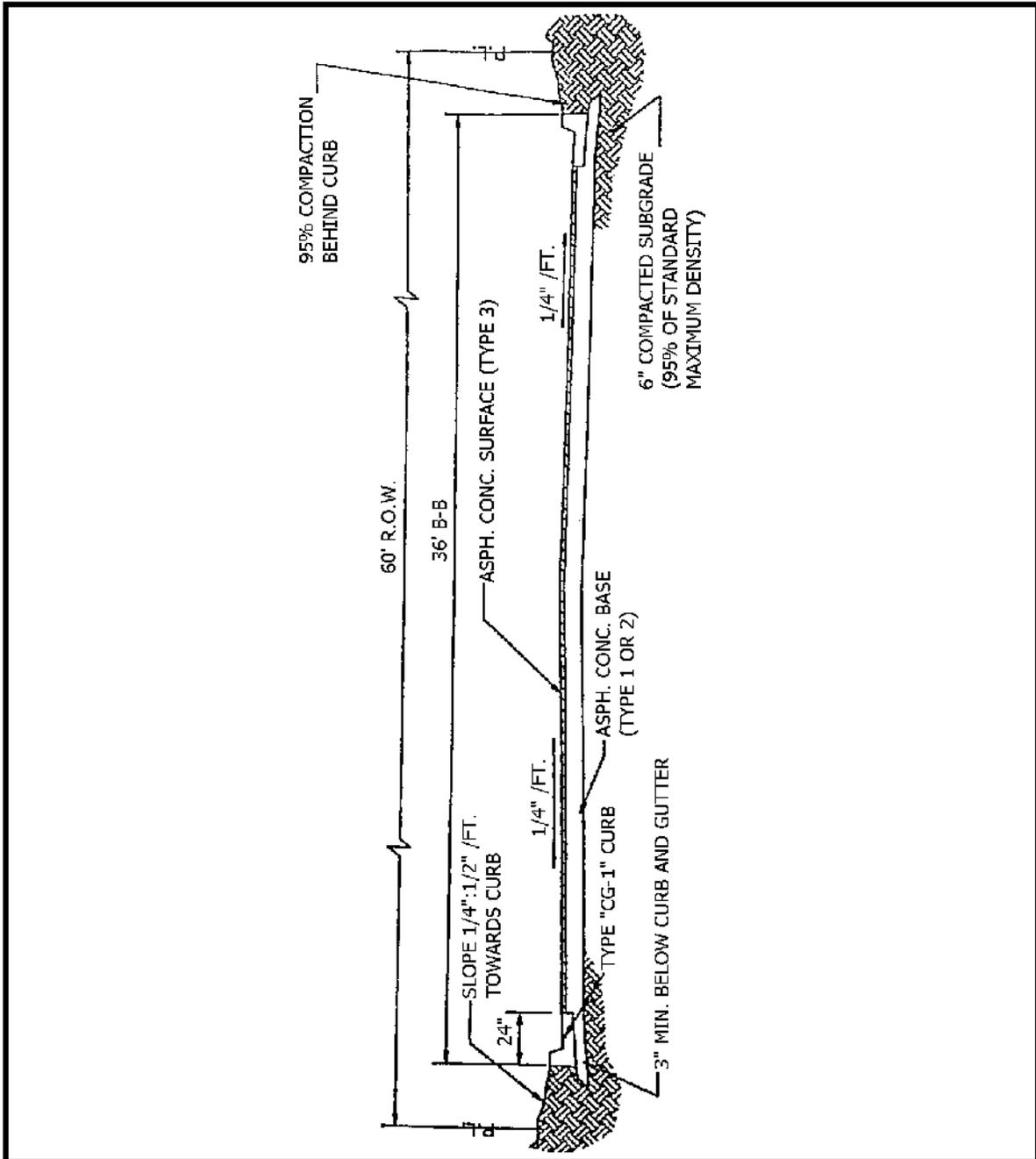


ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65618

**TOTAL ASPHALT
 LOCAL STREET
 DETAIL**

APPROVED
David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-1



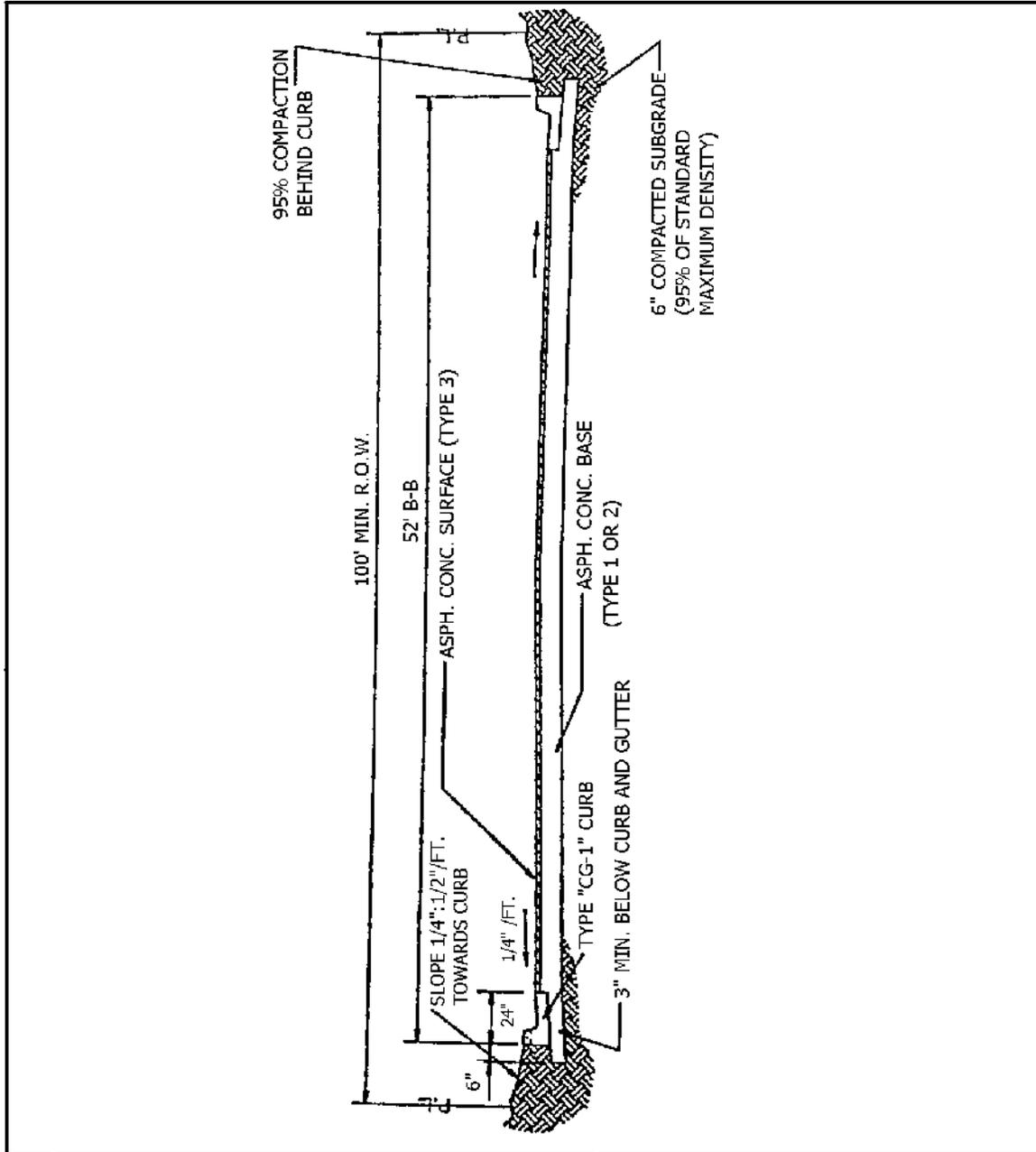
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

**TOTAL ASPHALT
 COLLECTOR/COMMERCIAL
 STREET DETAIL**

APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-2

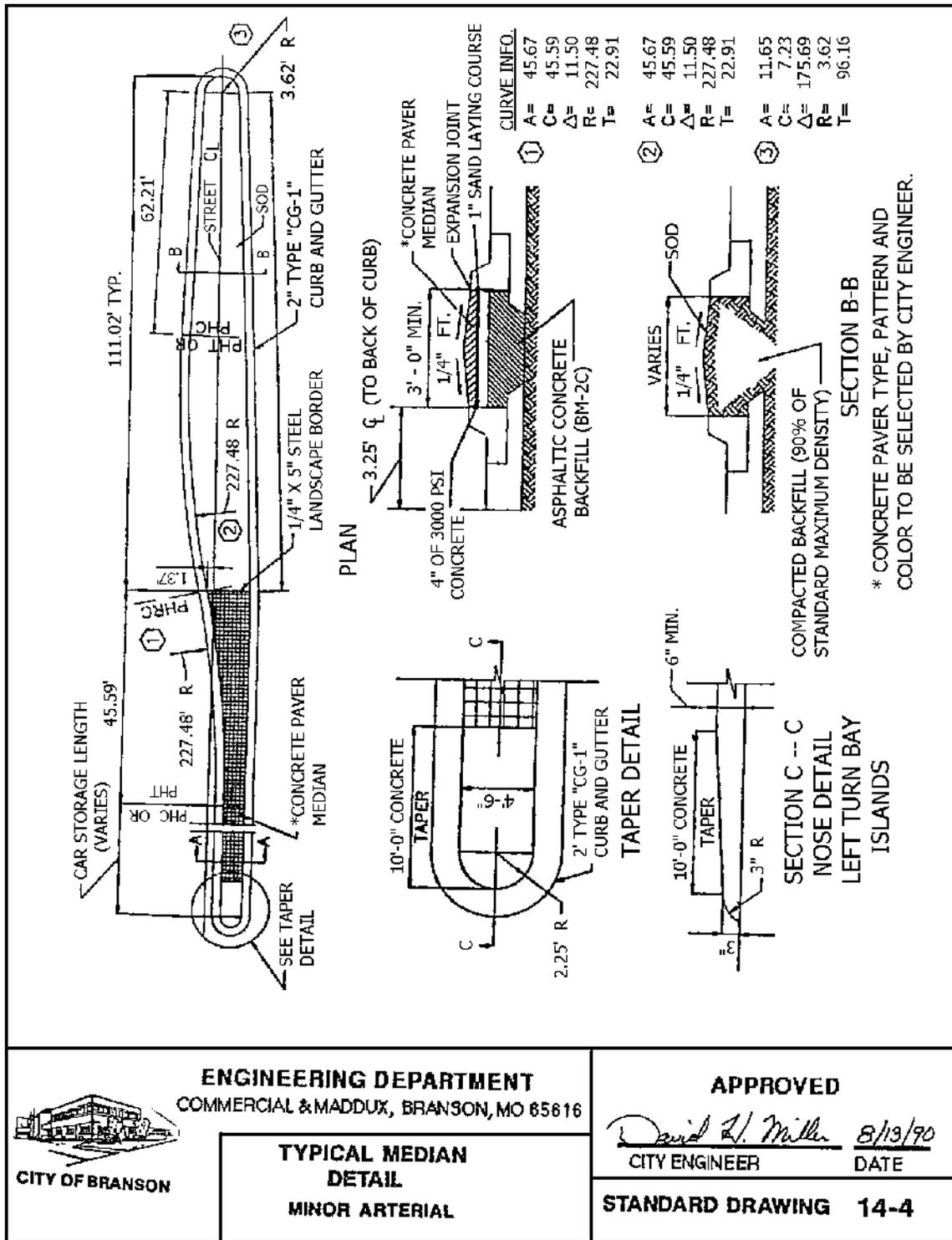


ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

**TOTAL ASPHALT
 MINOR ARTERIAL
 STREET DETAIL**

APPROVED
David A. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-3



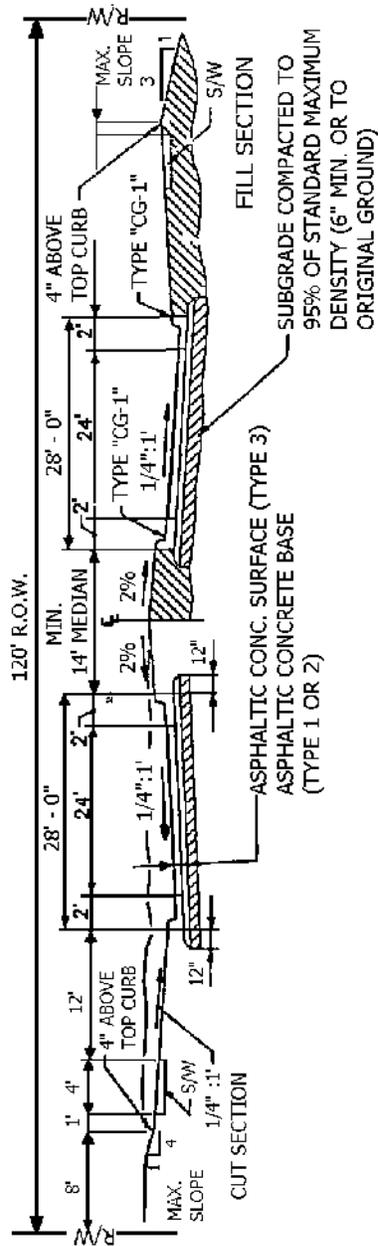
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

TYPICAL MEDIAN DETAIL
MINOR ARTERIAL

APPROVED

David Z. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 14-4



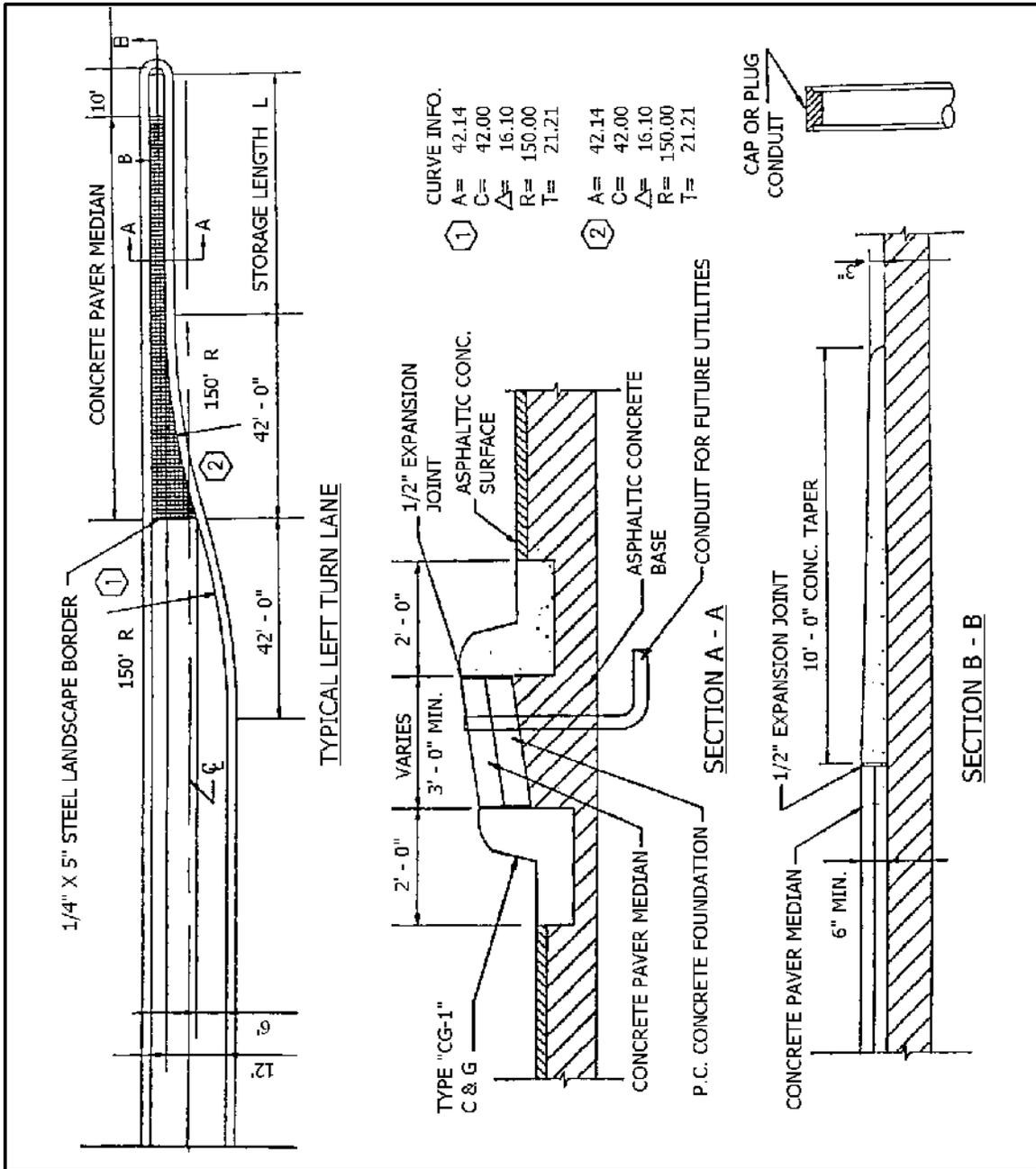
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

**TOTAL ASPHALT
 MAJOR ARTERIAL
 STREET DETAIL**

APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-5



 <p>CITY OF BRANSON</p>	<p>ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 658 16</p>	<p>APPROVED</p> <p><i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE</p>	
	<p>TYPICAL MEDIAN DETAIL MAJOR ARTERIAL</p>	<p>STANDARD DRAWING 14-6</p>	

NOTE:
 CAP FURNISHED BY CONTRACTOR.
 MARKER TO HAVE SECTION,
 TOWNSHIP AND RANGE STAMPED
 ON THE TOP WITH TRUE SECTION
 CORNER ETCHED ON THE SURFACE
 BY SURVEYOR LICENSED IN THE

NEENAH R-1968
 TYPE 36--3 OR APPROVED
 EQUAL

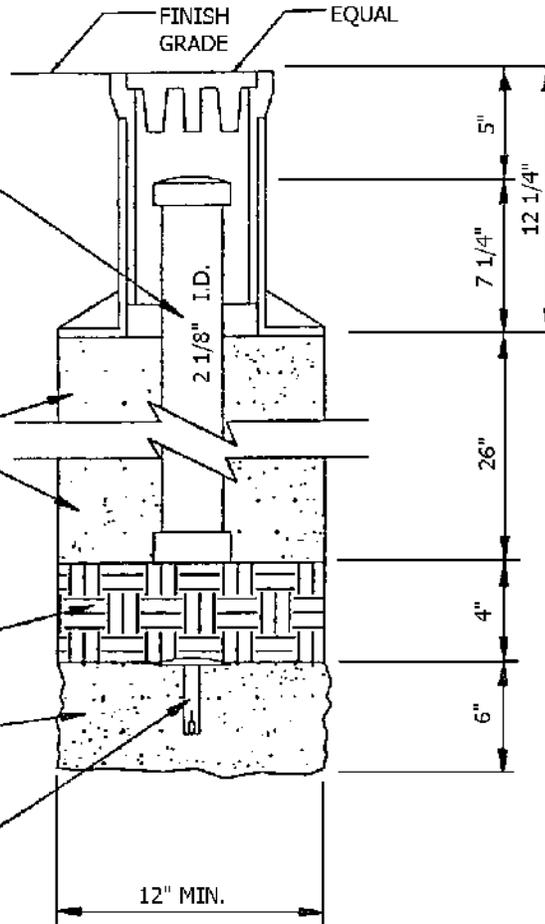
30" STANDARD ALUMINUM PIPE
 MONUMENT WITH MAGNETIC CAP
 BERNSTEN TYPE AU-1 OR
 APPROVED EQUAL. SET
 MONUMENT SO THAT THE CAP
 CAN BE READ FROM THE SOUTH

CAST - IN - PLACE
 CONCRETE

COMPACTED MOIST
 SOIL BACKFILL

CAST - IN - PLACE
 CONCRETE

STANDARD ALUMINUM DOME TOP
 DISK 3 1/4" DIAMETER WITH
 MAGNET ATTACHED TO UNDERSIDE,
 BERNSTEN OR EQUAL.



**STANDARD LAND
 CORNER MONUMENT**

(NO SCALE)



CITY OF BRANSON

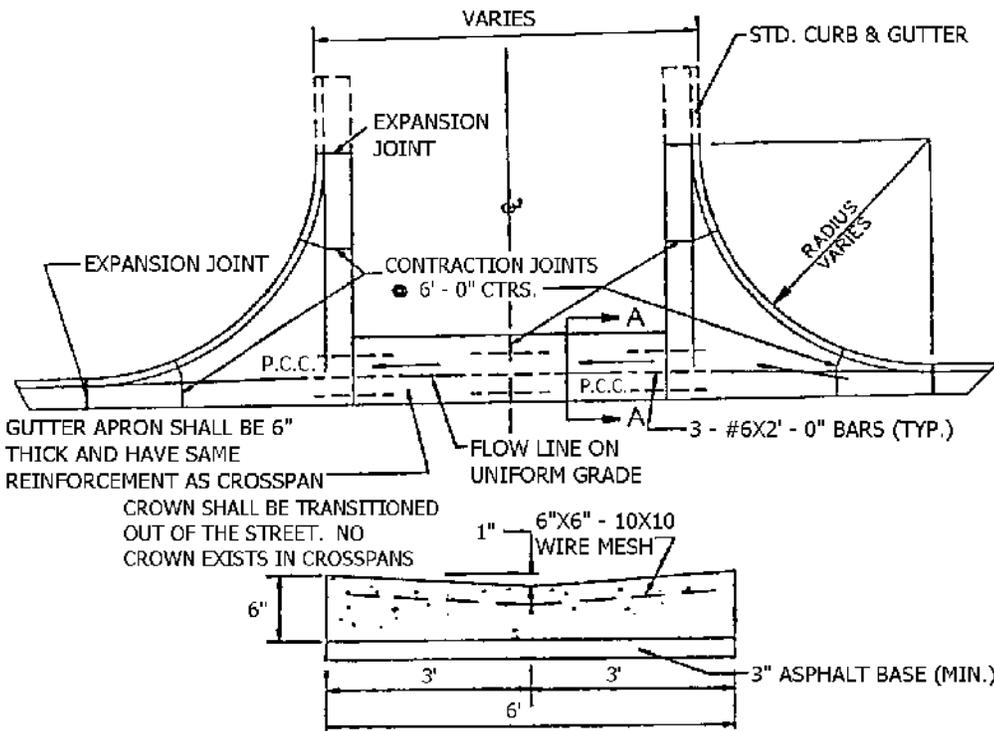
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65816

**MONUMENT BOX
 DETAIL**

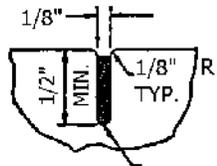
APPROVED

David L. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-7



SECTION A - A



CONTRACTION JOINT

NOTE:
 CROSSPAN DETAIL SHALL BE USED AT ALL LOCATIONS WHERE DRAINAGE IS TO BE TRANSPORTED ACROSS RETURN WITH LONGITUDINAL SLOPE OF ROADWAY BETWEEN 0.5% AND 1.0% UNLESS OTHERWISE DIRECTED BY THE CITY ENGINEER.



CITY OF BRANSON

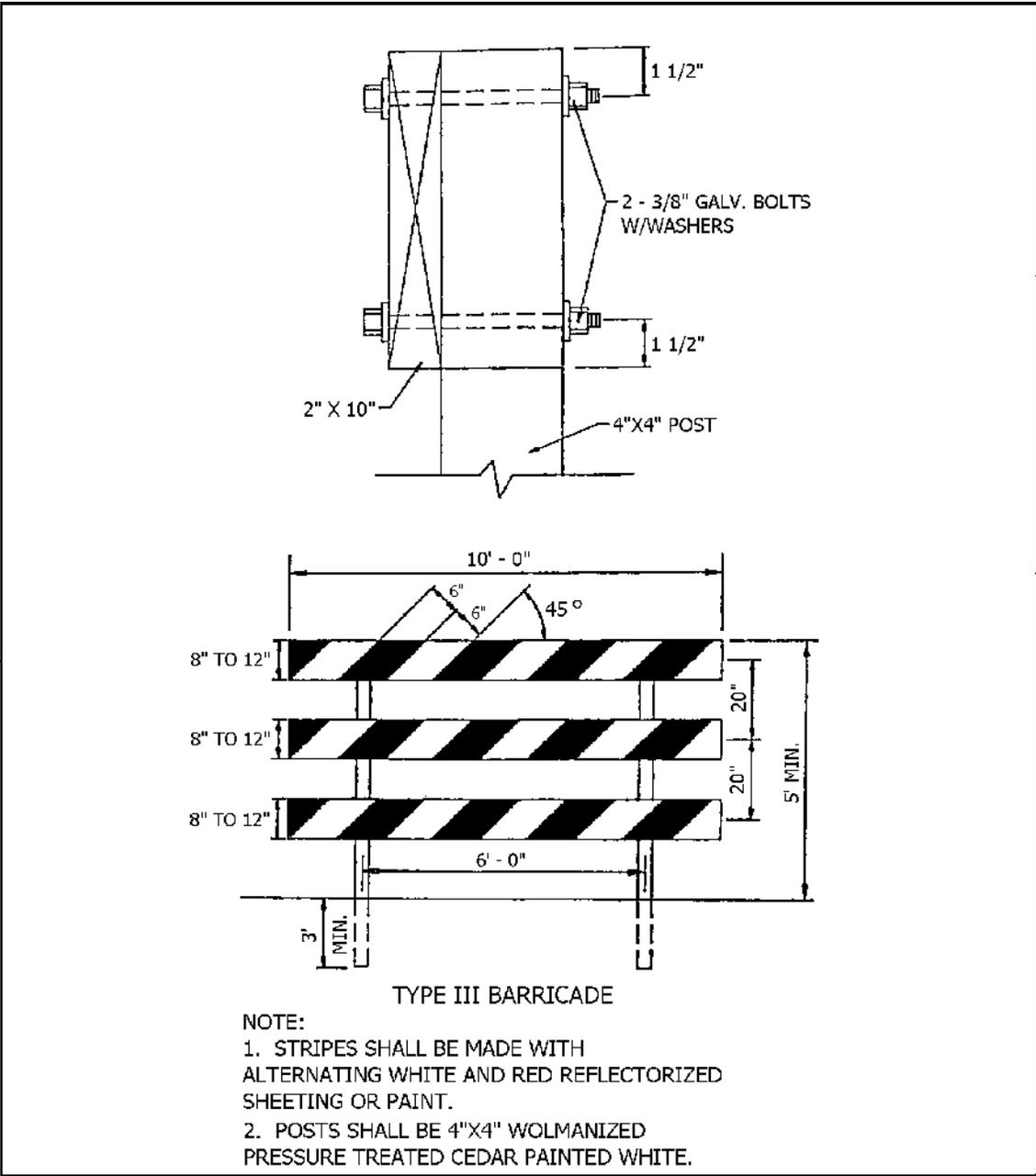
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

CROSS PAN DETAIL

APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 14-8



TYPE III BARRICADE

- NOTE:
1. STRIPES SHALL BE MADE WITH ALTERNATING WHITE AND RED REFLECTORIZED SHEETING OR PAINT.
 2. POSTS SHALL BE 4"X4" WOLMANIZED PRESSURE TREATED CEDAR PAINTED WHITE.

 <p>CITY OF BRANSON</p>	<p>ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65818</p>	<p>APPROVED</p>	
	<p>END OF PAVEMENT TYPE III BARRICADE</p>	<p><i>David H. Miller</i> CITY ENGINEER</p>	<p>8/13/10 DATE</p>

SECTION 1450 PAVEMENT STRIPING AND MARKING

1451 SCOPE. Permanent pavement striping and marking shall be applied to the final pavement surface as described on the Striping and Signing Plan included in the contract drawings.

1452 MATERIALS.

- A. Painted Striping. If painted striping is to be applied under the provisions of the contract, the paint and glass beads shall be of good commercial quality and shall be approved for use by the Engineer.
- B. Thermoplastic Pavement Marking. If thermoplastic marking material is to be applied under the provisions of the contract, the materials shall conform to Section 620 of the Missouri Highway and Transportation Department Standard Specifications. Thermoplastic pavement marking shall be used for all longitudinal and diagonal lines and striping and transverse markings such as arrows, stop bars and word messages.

1453 PREFORMED PAVEMENT MARKING TAPE.

- A. Description. This work shall consist of furnishing and placing preformed marking tape of the type and at the location as shown on the plans or as directed by the Engineer.

The contractor has the option to use thermoplastic pavement material in lieu of Type 1 or Type 2 preformed marking tape at the price bid for Type 1 or Type 2 marking tape.

1454 CONSTRUCTION REQUIREMENTS.

- A. Type 1 or Type 2 preformed marking tape shall be installed as shown on the plans, or as directed by the Engineer. The placement width of asphaltic concrete shall be adjusted such that the tape will not fall on a longitudinal joint.
- B. Lines shall be either white or yellow, continuous or intermittent and of the widths and configurations required.
- C. Arrows, words, and symbols shall be white and may be formed from one piece, multiple pieces, or strips of the tape material.
- D. Type 1 tape shall be embedded or inlaid in the asphalt surface by the final roller. Type 2 tape shall be placed on the asphalt surface after final rolling operations are complete.
- E. Any intermediate or previously existing markings, except edgelines, which are obliterated by the final wearing surface shall be replaced with the type of marking material as shown on the plans, no later than the end of the same day. The contractor shall begin centerline and lane line striping at the beginning of the last existing 10-foot stripe in order to maintain a 40-foot cycle along the entire pavement.

1455 METHOD OF MEASUREMENT.

- A. Measurement of lines will be made to the nearest 10 linear feet of marking tape used.
- B. Measurement of arrows, words, and symbols will be made per each.
- C. Accepted preformed pavement marking tape will be paid for at the unit price for each of the pay items included in the contract.

1456 THERMOPLASTIC PAVEMENT MARKING.

- A. Description. This work shall consist of furnishing materials and placing thermoplastic pavement marking at locations and of the dimensions shown on the plans or as directed by the Engineer.

1457 CONSTRUCTION REQUIREMENTS.

- A. Equipment. All equipment for application of thermoplastic marking material shall be of such design and maintained in such condition as to properly heat, mix, and apply the materials.
 - 1. Melting Kettle. The melting kettle shall be capable of heating the thermoplastic material to its recommended application temperature without scorching and shall be capable of maintaining that temperature. The heating kettle shall have a heat transfer medium and the flame shall not come in direct contact with the material container surface. A temperature gauge shall be visible on the outside of the kettle to indicate the temperature of the thermoplastic material. The melting kettle shall have a continuous mixer or agitator capable of thoroughly mixing the material at such a rate as to maintain homogeneity of material and uniformity of temperature throughout.
 - 2. Thermoplastic Dispensing Devices. The equipment may be mobile or portable and shall be capable of applying molten thermoplastic material at the temperature recommended by the manufacturer of the thermoplastic material in lines from 4 inches to 12 inches wide at a 125 mils thickness. Dispensing devices shall be of the extrusion type.
 - a. Extrusion dispensing devices shall be capable of depositing a mass of molten thermoplastic material on the pavement where it is immediately shaped to the specified width and thickness. The extrusion device shall have a visible temperature gauge to allow monitoring of the temperature of the thermoplastic material near the point of deposition.
 - 3. Glass Bead Dispenser. All thermoplastic dispensers shall be equipped with a drop-on type glass bead dispenser. The glass bead dispenser shall be located so as to drop the glass beads immediately after the molten thermoplastic material is

applied. The glass bead dispenser shall be adjustable to regulate flow of the beads and shall uniformly dispense the glass beads.

- B. Surface Preparation. The pavement surface on which the thermoplastic material is to be placed shall be clean and dry. Even if the pavement is visibly dry, subsurface moisture may be present in amounts sufficient to affect bonding. If excess pavement moisture exists, it will usually result in blisters appearing as bubbles in the hot thermoplastic material. If blisters appear, marking operations shall cease until the pavement dries.
1. Pavement surfaces shall be inspected for cleanliness and any dirt, debris, or other contaminants on the surface to be marked shall be removed. Existing painted pavement markings that would prevent a mechanical bond between the thermoplastic and the pavement shall be removed by methods approved by the Engineer. Any curing compound on new concrete pavements shall be removed by means acceptable to the Engineer.
- C. Temperature Limitations. The pavement surface where the thermoplastic material is to be placed shall have a minimum temperature of 60 F. The air temperature shall be at least 50 F during marking operations. The pavement surface temperature and air temperature shall be determined before the start of each day of marking operation and at any other time deemed necessary by the Engineer. Temperatures are to be obtained in accordance with MHTD Test Method T20.
- D. Primer Application. A primer shall be applied to bituminous surfaces over 2 months old and all concrete surfaces. Primer is not required on new bituminous surfaces unless recommended by the manufacturer of the thermoplastic material. A new bituminous surface is one less than 2 months old. Primer shall be applied and cured in accordance with the recommendations of the manufacturer of the thermoplastic material.
- E. Thermoplastic Application. The thermoplastic marking material shall be extruded onto the pavement surface.
1. Thermoplastic marking material for use on new bituminous surfaces shall be alkyd thermoplastic. Material for use on surfaces other than new bituminous surfaces may be alkyd, hydrocarbon or epoxy type thermoplastic.
 2. The temperature of the thermoplastic at the time of application shall be 400-425° F for alkyd or hydrocarbon materials, and 450-500 F for epoxy materials. The temperature of the thermoplastic material shall be checked at the point of deposition with a calibrated thermometer at the beginning of each day's marking, after material is added to the dispensing device, after delays in the marking operation, and any time deemed necessary by the Engineer.
 3. Alkyd thermoplastic material shall not be heated above 435F. Hydrocarbon thermoplastic material shall not be heated above 450F. Only the quantity of thermoplastic that can be used within 4 hours should be heated. In no case shall

any thermoplastic material be heated for more than 4 hours at the maximum application temperature, including initial heating. No material shall be reheated more than two times. Material subjected to these conditions will be rejected.

4. Pavement striping shall comply with the standard striping practices as shown on the plans. The contractor shall begin centerline and lane line striping at the beginning of the last existing 10-foot stripe in order to maintain a 40-foot cycle along the entire pavement.
 5. Alkyd type thermoplastic lane line marking or centerline marking of the surface of newly resurfaced bituminous surfaces shall be in place at the end of each day's resurfacing if pavement is open to traffic. If the roadway shoulders are to be resurfaced, application of edge lines may be delayed for a maximum of three days or until the shoulders are resurfaced whichever comes first.
 6. Furnished markings shall have well defined edges and be free of waviness. The minimum thickness of thermoplastic markings shall be 125 mils and the maximum shall be 188 mils. The thickness will be measured as a wet film except the Engineer may measure cured film by placing a tape or other bond breaker prior to placing the thermoplastic material and then removing a section of cured line and measuring thickness.
 7. Damage to pavement marking caused by the contractor's operation, including resurfacing of shoulders, shall be repaired or replaced at his expense.
- F. Glass Bead Application. The drop-on glass bead shall be mechanically deposited on the molten thermoplastic line immediately after placement of the thermoplastic at the rate of at least 8 pounds per 100 square feet of line. The glass beads shall not be dropped at the point of deposition of the thermoplastic or ahead of that point. The beads shall adhere to the cured thermoplastic or all marking operations shall cease until corrections are made.
- G. Workmanship. The applied markings should be inspected continually for overall workmanship. Markings shall have clean cut edges and the color shall be distinctive. The glass beads shall appear uniform on the entire marking surface. Adhesion to the pavement surface shall be checked with a stiff putty knife or similar instrument. The marking should not be removable from a concrete surface. The marking can be removed from a bituminous surface, however, residue of the bituminous substrate shall be stuck to the marking material.
1. If the thermoplastic line does not provide initial nighttime reflectivity or if the marking does not have the required minimum thickness, the contractor shall at his expense grind away the surface of the deficient portion of the marking to reduce the average thickness to 50 mils or less. The contractor shall then at his expense apply additional thermoplastic material to a total thickness of at least 125 mils and provide a uniformly reflective surface. If the markings do not comply with the specifications for any other reason, the engineer may require complete removal or correction at the contractor's expense.

H Method of Measurement.

1. Measurement of thermoplastic pavement marking will be made to the nearest 10 linear feet from point of beginning to point of ending for each line. Where intermittent lines are specified, deduction will be made for the gaps in the striping.
2. Measurement of arrows, words, symbols or markings other than lines will be made per each.
3. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity.
 - a Basis of Payment. The accepted quantity of thermoplastic pavement marking will be paid for at the contract unit price.

1458 REMOVABLE PAVEMENT MARKING

A. Description. This work shall consist of pavement striping, either by painting or by application of preformed removable tape, to delineate traffic lanes on bypasses, temporary connections, existing pavements, and new pavements used for handling traffic during construction. On new pavements and existing pavements that are to remain in place, preformed removable tape shall be used. This work shall also include all necessary operations for removal of existing pavement markings which might mislead traffic, and the removal of painted lines and preformed removable tape when no longer required.

1. If in the judgment of the engineer, the weather or pavement condition is unsuitable for the proper adhesion of removable tape, the contractor may use painted lane lines providing proper adhesion is attained. If painted lines are used or permitted, the paint and beads shall be of good commercial quality and shall be approved for use by the engineer.

B. Construction Requirements.

1. Removable pavement marking for edgelines, centerlines, stop lines, and lane lines shall be as shown on the plans or as directed by the engineer.
2. All removable pavement marking within the project limits shall be maintained by the contractor at his expense in a manner approved by the engineer.
3. Removal of all pavement markings within project limits will be shown on the plans. Preformed removable tape shall be removed by hand methods. Paint shall be removed from portland cement concrete pavement by a high pressure water blast method, or a low pressure water and sand blast method, or a steel shot blast method. Paint shall be removed from bituminous pavement by either a low pressure water and sand blast method or by a steel shot blast method. Paint shall be removed without damaging the surface or texture and without leaving an

image which might mislead traffic. High pressure water blast methods shall not exceed 10,000 pounds per square inch. Low pressure water and sand blast method shall not exceed 3,000 pounds per square inch.

C Method of Measurement

1. Measurement of removable pavement marking and the removal of pavement markings will be made to the nearest 10 feet as measured along the center line of the pavement from point of beginning to point of ending for each line and totaled to the nearest 100 feet. Where intermitten lines are specified or existing, deduction will be made for gaps in the striping and removal. Measurement will not be made for removal of stripes within the limits of a bypass roadway or other roadway to be obliterated at the completion of the project.
2. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

- D. Basis of Payment. The accepted quantity of removable pavement marking and the removal of pavement markings will be paid for at the unit price for each of the pay items included in the contract. When painted lines are used in lieu of preformed removable tape, due to weather or pavement conditions, payment will be made at 50 percent of the unit price for the pay items affected.

1459 SHORT TERM PAVEMENT MARKING

- A. Description. This work shall consist of furnishing, installing, and maintaining preformed short term pavement marking tape on bituminous resurfacing projects.
- B. Materials. At the option of the contractor, machine applied traffic paint and glass beads may be used in lieu of preformed short term marking tape provided satisfactory reflectivity is obtained.
- C. Construction Requirements.
1. When the contractor's work has obliterated the existing traffic striping on resurfacing projects open to through traffic, the contractor shall provide and maintain short term pavement marking. The center line and lane lines of all lanes subject to traffic during construction shall be marked. The short term pavement marking shall be in place at the end of each day's work between all lanes open to traffic.
 2. The center line marking shall be yellow for a two-lane road with opposing traffic and the lane lines shall be white for a two-lane road with one way traffic.

Preformed marking tape shall be applied in increments 4 feet long parallel to the direction of traffic flow at approximately 40-foot intervals.

3. The center line marking of pavement of sufficient width to accommodate four or more undivided lanes carrying opposing traffic shall be marked with two parallel lines of yellow preformed marking tape separated by a 4-inch space. Lane lines for these pavements shall be marked with white preformed marking tape in increments 4 feet long at approximately 40-foot intervals.

D Method of Measurement.

1. Measurement of short term pavement marking will made to the nearest 1/10 mile as measured along the center line of the pavement, or each pavement of a divided highway, regardless of the number of applications.
2. Final measurement will not be made except for authorized changes during construction or where applicable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.
3. Basis of Payment. The accepted quantity of short term pavement marking will be paid for at the contract unit price.

SECTION 1500 PORTLAND CEMENT CONCRETE PAVEMENT

1501 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary to construct Portland Cement Concrete Pavement.

1502 MATERIALS. Except as modified herein, all materials used for construction of Portland Cement Concrete pavement shall conform to the requirements stipulated in applicable sections of these Specifications.

A. Concrete. The concrete for the use in construction of Portland Cement Concrete pavement shall conform to the requirements established in Section 2000, "Concrete" with the following modifications.

Cement Portland Cement shall conform to ASTM C150, Type II. Type III cement may be used only upon written approval of the City Engineer.

B. Reinforcing Steel.

Bars Bars shall conform to ASTM A615, A616, and A617.

Welded Steel Wire Fabric ASTM A185

Supporting Elements Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.

C. Expansion Joint Fillers. Expansion joint fillers shall conform to ASTM D994, D1751 or D1752.

D. Joint Sealing Compounds. Joint sealing compounds shall conform to ASTM D1190.

E. Curing Membrane. All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C309.

1503 CONSTRUCTION DETAILS. The Portland Cement Concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the plans.

A. Grading and Subgrade Preparation. All excavation or embankment required shall be as defined in Sections 1100 and 1200 of these Technical Specifications entitled "Grading" and "Subgrade Preparation".

B. Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10

feet in length.

1. Material & Size. Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab.
2. Strength. Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.
3. Installation. Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.
4. Preparation. Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.
5. Paving Machine. A slip-form paving machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators, and be capable of placing the Portland Cement Concrete pavement to the correct cross-section, thickness, line and grade within the allowable tolerances.

1504 JOINTS. Generally joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the standard drawings or as modified by the plans and specifications.

A. Expansion Joints. Expansion joints shall be placed at all locations where shown on the plans and standard details or as directed by the Engineer.

1. General. Expansion joints shall extend the entire width of the pavement and from the sub-grade to one inch below the surface of the pavement or the material will have a suitable tear strip provided to allow for the application of the joint sealer.

Under no circumstances shall any concrete be left across the expansion joint at any point.

2. Material. Expansion joints shall be formed by a one piece, one inch thick preformed joint filler cut to the configuration of the correct pavement section.
3. Stability. Expansion joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.
4. Dowels. If expansion joints are to be equipped with dowels they shall be of the size and type specified, and shall be firmly supported in place, by means of a dowel basket which shall remain in place. One half of each dowel shall be pointed, greased or fitted with a dowel sleeve of the dimensions shown on the plans or standard drawings.

- B. Contraction Joints. Contraction joints shall be placed where indicated and to the depth indicated by the plans and specifications or standard drawings.
1. Templates. The templates shall be removed as soon as the concrete has attained its initial set and finished as outlined for tooling joints.
 2. Sawing. When transverse contraction joints are to be formed by sawing, care must be taken to saw the grooves soon after placing the concrete to prevent the formation of cracks due to contraction of the slab. All transverse joints shall be sawed at least 1/4 of the slab depth. Any procedures for sawing joints that result in premature and uncontrolled cracking shall be revised immediately by adjusting the time intervals between the placing of the concrete and the cutting of the joints.
 3. Tooling. Tooling or contraction joints will be permitted if completed to the width and depth specified on the construction plans or the standard drawings, and shall be true to line.
 4. Pre-molded Strip Joints. Pre-molded strip joints shall be of the proper dimensions as shown on the plans and standard drawings and shall be secured at the proper location so as not to be disturbed by the finishing of the concrete.
- C. Longitudinal and Construction Joints. Longitudinal joints or construction joints shall be placed as shown on the plans or where the Contractor's construction procedure may require them to be placed.
1. Center Joints. Longitudinal center joints shall be constructed using the methods specified in Section 1504(B) "Contraction Joints".
 2. Longitudinal Construction Joints. Longitudinal construction joints (joints between construction lanes) shall be keyed joints of the dimensions shown on the plans or standard drawings.
 3. Transverse Construction Joints. Transverse construction joints of the type shown on the plans or standard drawings shall be placed wherever concrete placement is suspended for more than 30 minutes.
 4. Tiebars. Tiebars shall be of deformed steel of the dimensions specified by the plans or standard drawings. Tiebars shall be installed at the specified spacing and firmly secured so as not to be disturbed by the construction procedure.

1505 PLACING, FINISHING, CURING, AND PROTECTION.

Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of Section 2000 of these Technical Specifications and as specified herein.

- A. Concrete Placement. Prior to placement of the concrete pavement, all debris and foreign material shall be removed from the inner surfaces of the forms and all forms and subgrade properly moistened. All required reinforcement and other special metal parts shall be properly and firmly set into position to preclude movement during placement of the concrete. The concrete shall be deposited on the prepared subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The concrete shall be placed as uniformly possible in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated and compacted with suitable tools so that the formation of voids or honeycomb pockets is prevented.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope. Concrete shall not be allowed to extrude below the forms.

- B. Concrete Finishing. The pavement shall be struck off and consolidated with a mechanical finishing machine or by hand-finishing methods.

When a mechanical finishing machine is used, the concrete shall be struck off at such a height that after consolidation and final finishing it shall be at the exact elevations as shown on the plans. A depth of at least 2 inches of concrete shall be carried in front of the strike-off screed for the full width of the slab, whenever the screed is being used to strike off the pavement. The finishing machine shall be provided with a screed which will consolidate the concrete by pressure. The concrete shall, through the use of this machine, be brought to a true and even surface, free from rock pockets, with the fewest possible number of passes of the machine. The edge of the screeds along the curb line may be notched out to allow for sufficient concrete to form the integral curb. Hand-finishing tools shall be kept available for use in case the finishing machine breaks down.

When hand finishing is used, the pavement shall be struck off and consolidated by a vibrating screed to the exact elevation as shown on the plans. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off; it shall not be allowed to idle on the concrete. Internal mechanical vibration shall be used along all formed surfaces.

- 1 Longitudinal Floating. After the concrete has been struck off and consolidated, it shall be further smoothed by means of a mechanical longitudinal float or float finishers using a longitudinal hand float. If a longitudinal hand float is used, it shall be operated from foot bridges spanning the pavement and shall be worked with a wiping motion parallel to the centerline, and passing from one side of the Pavement to the other. Movement ahead along the centerline of the pavement shall

be in successive advances of not more than 1/2 of the length of the float. The float shall not be less than 12 feet in length and 6 inches in width, and shall be properly stiffened and provided with handles at each end. This operation may be eliminated if specified tolerances can be attained by some other approved method.

In cases where the longitudinal floating operation has been eliminated, the pavement shall be scraped with a straight edge 10 feet long, equipped with a handle to permit it to be operated from the edge of the pavement. The longitudinal float and straight edge shall be operated so that any excess water and laitance are removed from the surface of the pavement. After the scraping operation, the surface of the pavement shall be within the specified tolerances.

2. Straight Edging. While the concrete is still plastic, the slab surface shall be tested for smoothness with a 10 foot straight edge swung from handles 3 feet longer than one-half the width of the slab. The straight edge shall be placed on the surface parallel to the centerline of the pavement and at not more than 5 foot intervals transversely. After each test the straight edge shall be moved forward one-half its length and the operation repeated. When irregularities are discovered, they shall be corrected by adding or removing concrete. All disturbed places shall be smoothed with a float not less than 3 feet long and not less than 6 inches wide, and again straight edged. The pavement surface shall have no depression in which water will stand.
3. Edging. Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be carefully finished with an edger of the radius shown on the plans or standard details.
4. Final Surface Finish. A burlap drag or a broom finish shall be used as the final finish method. When a drag is used it shall be at least 3 feet in width and long enough to cover the entire pavement width. It shall be kept clean and saturated while in use. It shall be laid on the surface of the pavement and dragged in the direction in which the pavement is being laid. When broom finishing, a hard bristle broom shall be used. The broom shall be kept clean and used in such a manner as to provide a uniform texture surface. The curb shall have the same final finish as the pavement.

The final surface of the concrete pavement and curb shall have a uniform gritty texture free from excessive harshness and true to the grades and cross section shown on the plans. The Engineer may require changes in the final finishing procedure as required to produce the desired final surface texture.

- C. Curing. Curing shall conform to the requirements set forth in Section 2000, "Concrete" with the exception that water proof paper, or polyethylene sheeting, shall not be acceptable as curing methods for concrete pavement. The use of straw or burlap for

curing shall be as approved by the Engineer.

As soon as practical after the concrete is finished it shall be cured with one of the acceptable methods. If a liquid curing membrane is used, it shall be according to the manufacturer's directions.

A nozzle producing a uniform mist pattern will be used on all spray equipment when applying the liquid curing membrane. Rate of application to the pavement shall be (1 gallon/175 ft) with a wet thickness of 6 to 10 mils. If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip form paving machine has been used, these surfaces shall also be cured.

- D. Protection. The Contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until it has been accepted by the City.

All vehicular traffic shall be prohibited from using the new concrete pavement until it has attained 70 percent of the 28 day compressive design strength.

Concrete pavement which is not acceptable to the Engineer because of damage or defacement, shall be removed and replaced, or repaired to the satisfaction of the Engineer, at the expense of the Contractor.

- E. Temperature Limitation. Concrete work shall proceed in accordance with the requirements established in Section 2000, "Concrete".

1506 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and 5 days shall lapse before pavement shall be backfilled unless otherwise approved by the Engineer.

Backfill shall be accomplished in accordance with Section 1100 and 1200 entitled "Grading" and "Subgrade Preparation".

The Contractor shall be responsible for the repair of any existing street pavement disturbed by the construction to the satisfaction of the Engineer.

1507 JOINT SEALING AND CLEAN-UP. All joints shall be sealed with an approved joint sealer applied in accordance with the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of the construction.

1508 INTEGRAL CURB. Integral curbs shall be required along the edges of all street pavement as indicated on the plans or standard drawings except at such locations as the Engineer may direct.

The integral curb shall be constructed immediately following the finishing operation unless

otherwise shown on the plans. Special care shall be taken so that the curb construction does not lag the pavement construction and form a "cold joint".

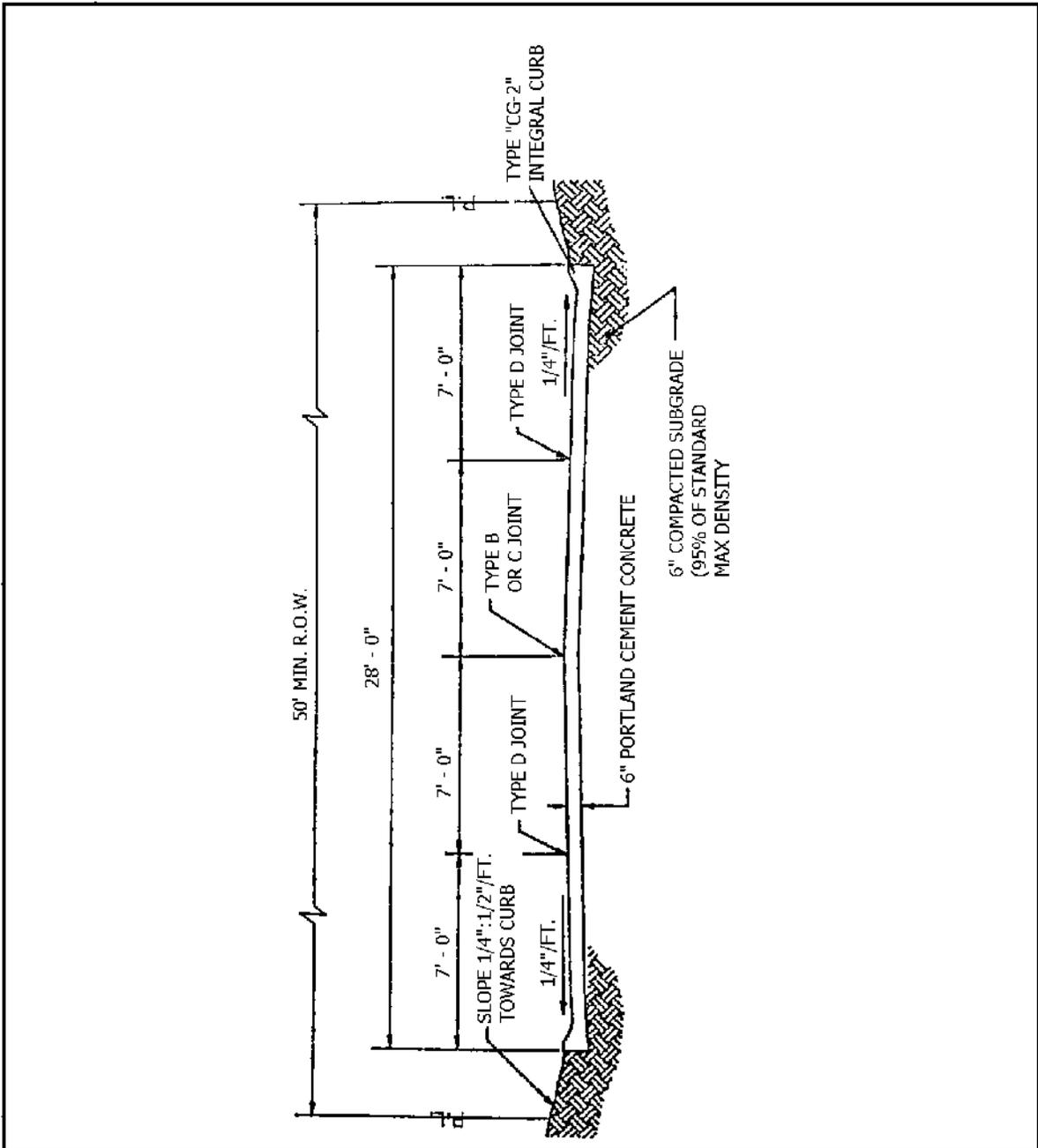
Steel curb forms shall be required to form the backs of all curbs except where impractical because of small radii street returns or other special sections.

In placing curb concrete, sufficient spading shall be done to secure adequate bond with the paving slab and eliminate all voids in the curb.

Curbs shall be formed to the cross section as shown on the drawings with a mule or templates supported on the side forms and with a float not less than 4 feet in length.

The finished surface of the curb and gutter shall be checked by the use of a 10 foot straight edge and corrected if necessary. Where grades are flat and while the concrete is still plastic, the drainage of the gutter should be checked by pouring water at the gutter summit and observing its flow to the inlet.

1509 SURFACE TOLERANCES. Concrete pavement shall have a surface tolerance in all directions of 1/4 inch in 10 feet when checked with a 10 foot straight edge.



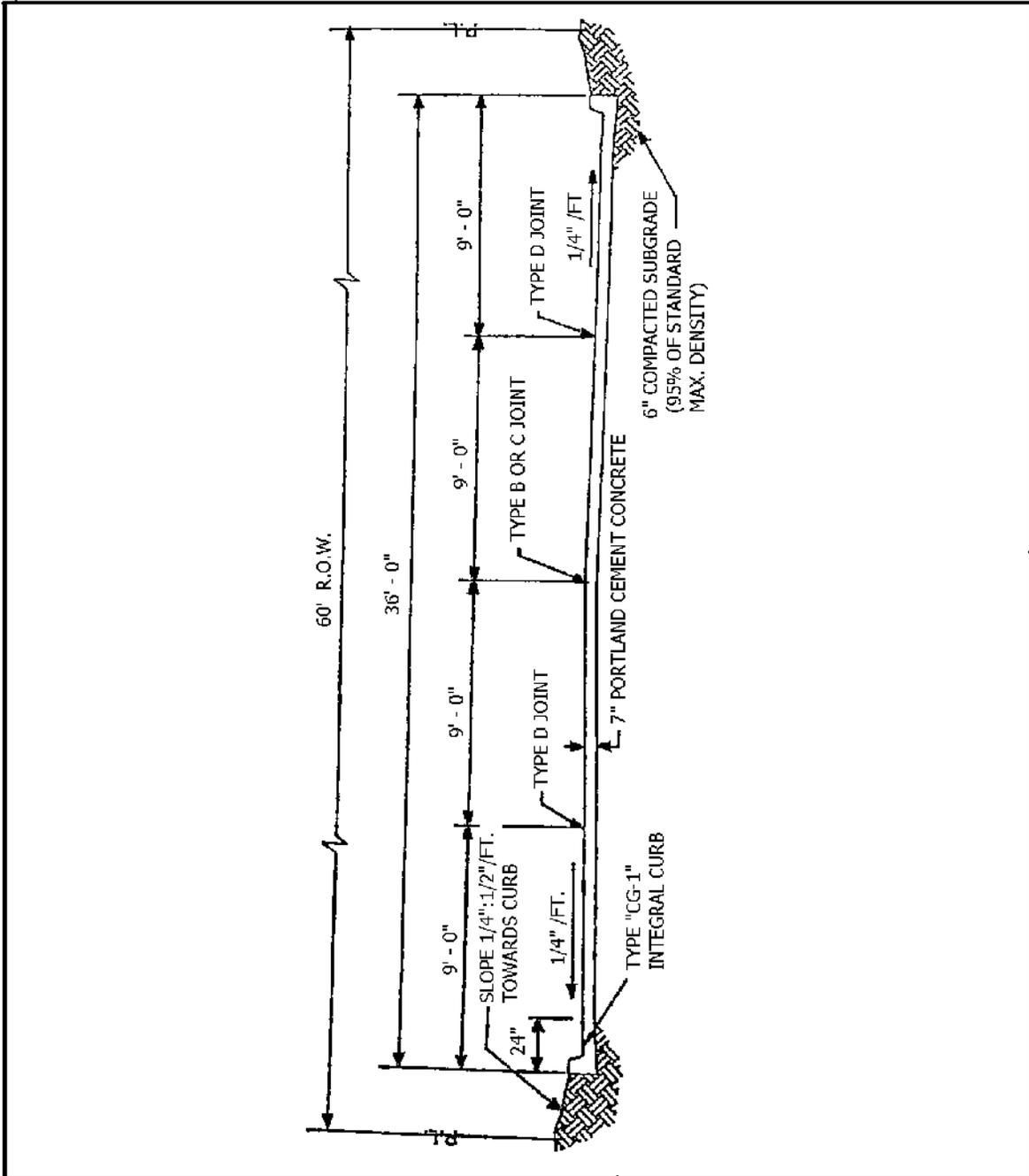
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

**CONCRETE PAVEMENT
 CROSS SECTION
 AND JOINT LOCATIONS
 (LOCAL STREET DETAIL)**

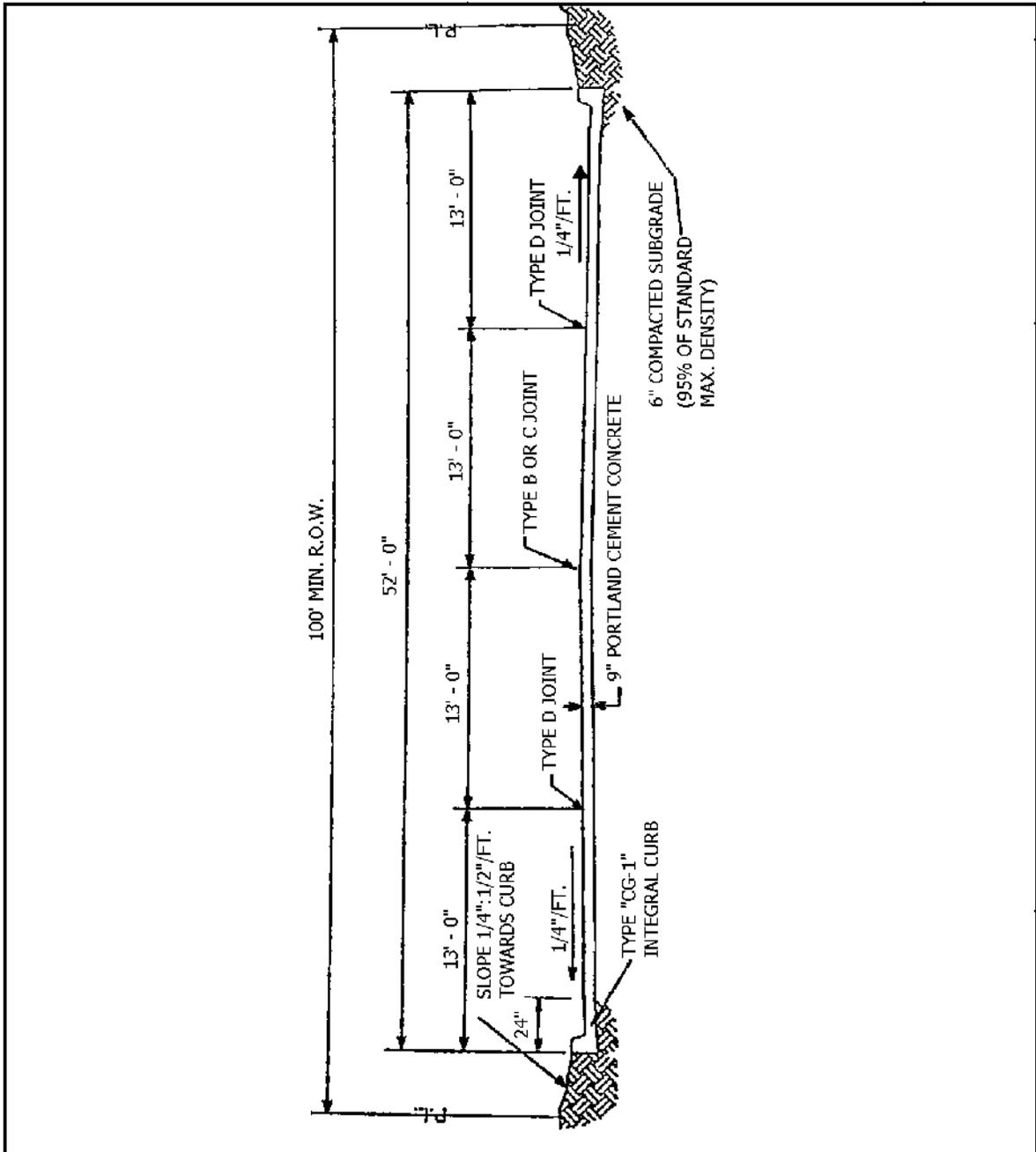
APPROVED

David L. Miller 8/13/90
 CITY ENGINEER DATE

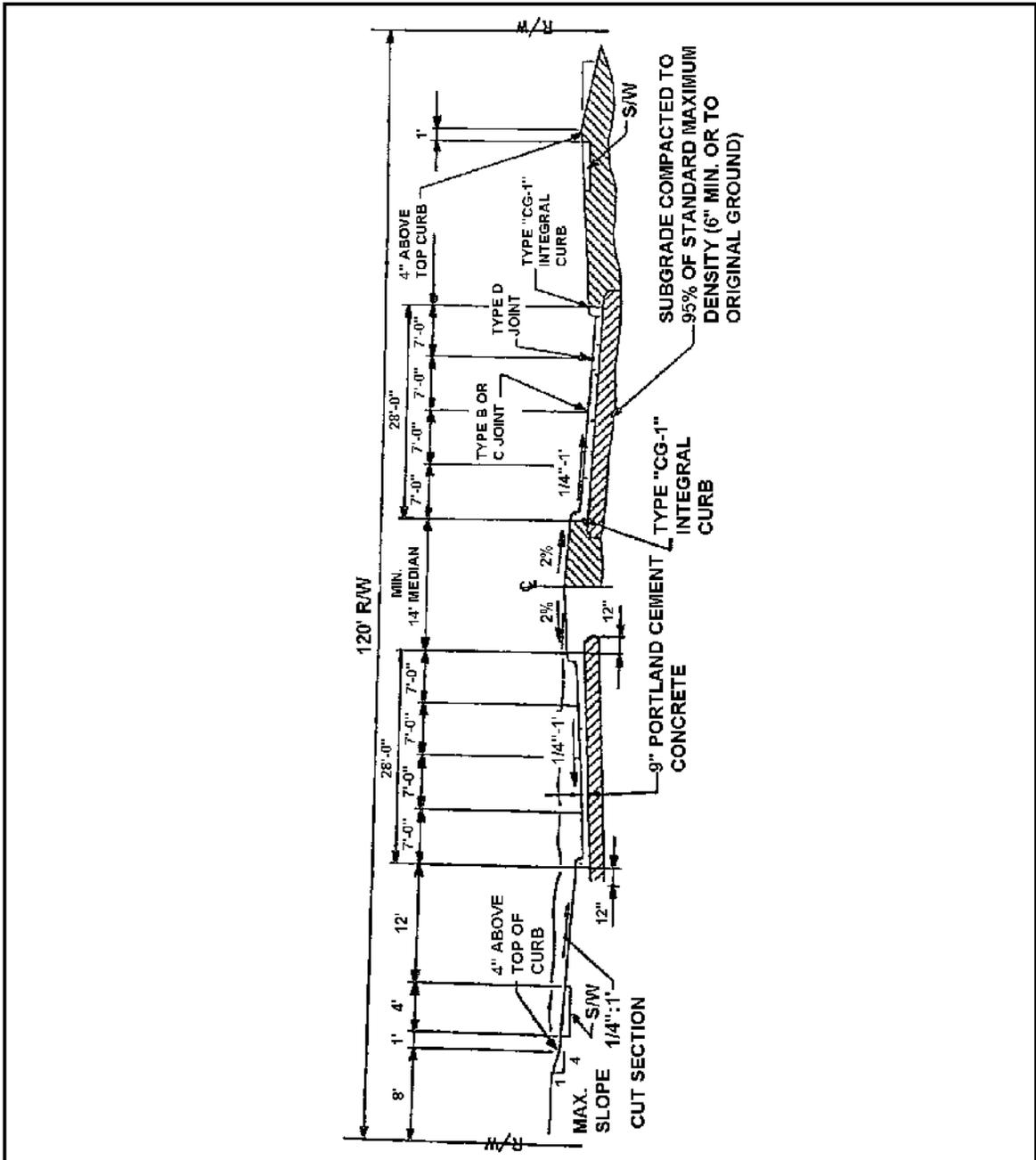
STANDARD DRAWING 15-1



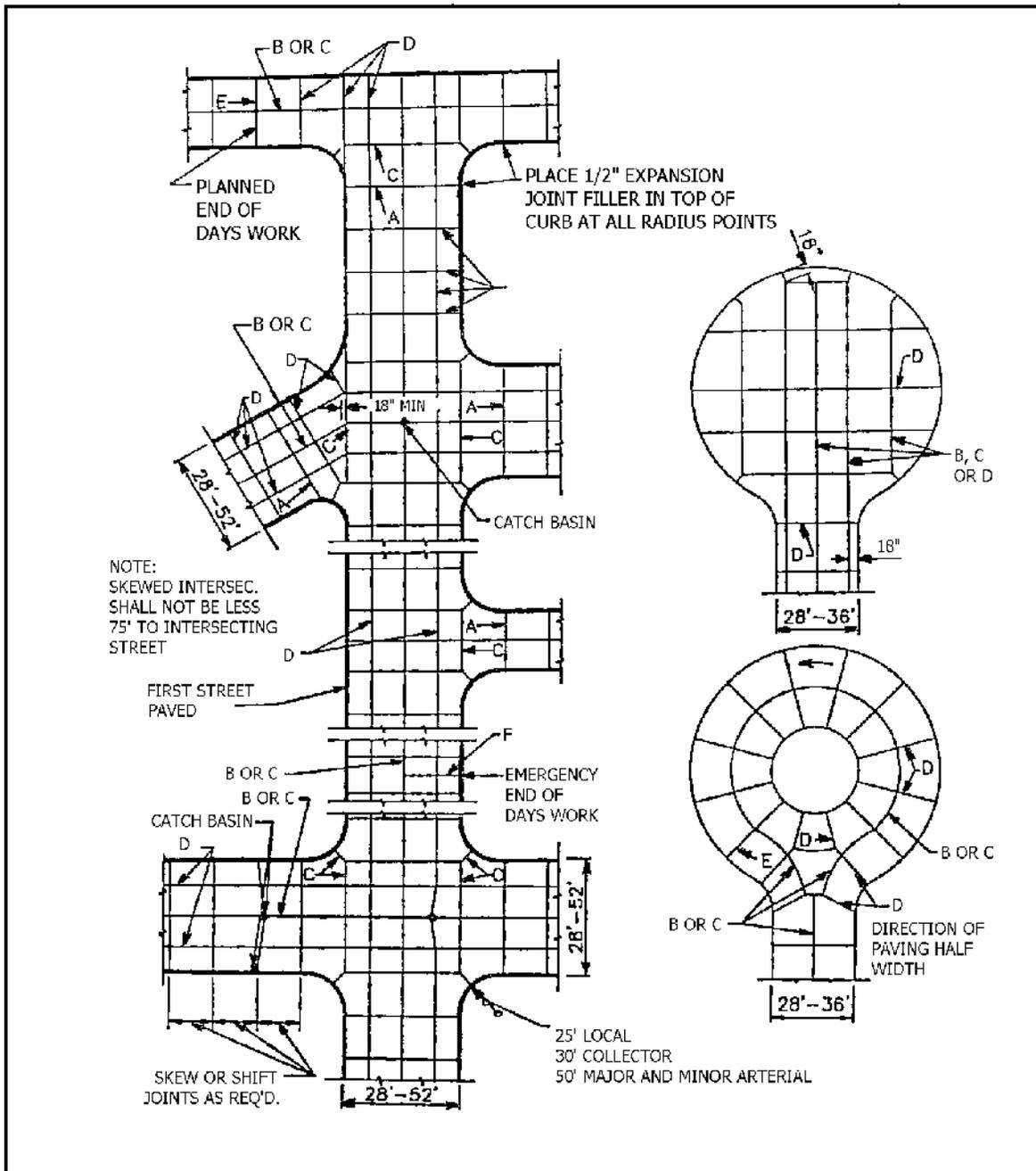
 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65618	APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE
	CONCRETE PAVEMENT CROSS SECTION AND JOINT LOCATIONS (COLLECTOR/COMMERCIAL STREET DETAIL)	STANDARD DRAWING 15-2



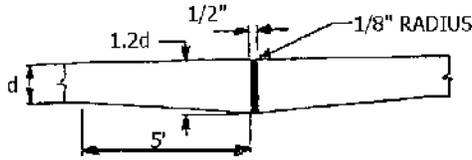
 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65818	APPROVED <i>David R. Miller</i> 8/13/90 CITY ENGINEER DATE
	CONCRETE PAVEMENT CROSS SECTION AND JOINT LOCATIONS (MINOR ARTERIAL STREET DETAIL)	STANDARD DRAWING 15-3



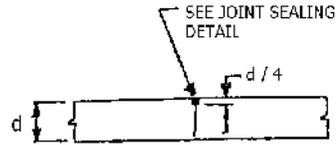
 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616		APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE	
	CONCRETE PAVEMENT CROSS SECTION AND JOINT LOCATIONS (MAJOR ARTERIAL STREET DETAIL)		STANDARD DRAWING 15-4	



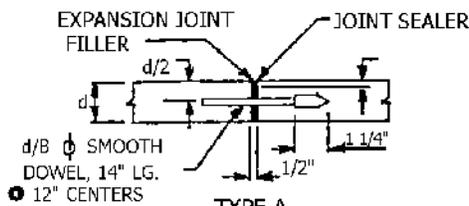
 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65818	APPROVED <i>David B. Miller</i> 8/13/90 CITY ENGINEER DATE
	CONCRETE PAVING JOINT LOCATIONS	
	STANDARD DRAWING 15-5	



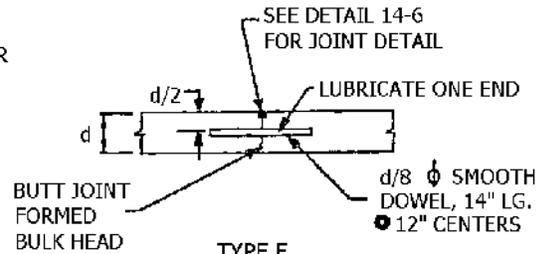
TYPE A
EXPANSION JOINT



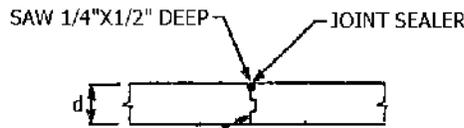
TYPE D
SAWED LONGITUDINAL OR TRANSVERSE



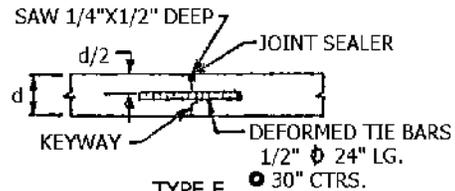
TYPE A
ALTERNATE EXPANSION JOINT



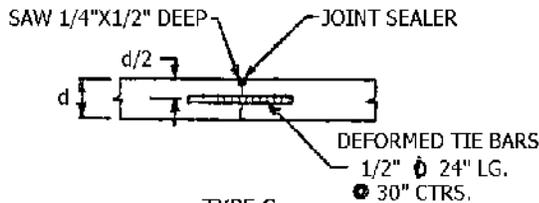
TYPE E
PLANNED TRANSVERSE CONSTRUCTION JOINT
(USED AT NORMAL JOINT SPACING)



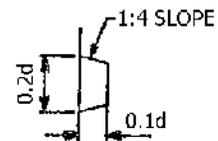
TYPE B
LONGITUDINAL CONSTRUCTION JOINT



TYPE F
EMERGENCY TIED TRANSVERSE
CONSTRUCTION JOINT
(USED AT MIDDLE THIRD NORMAL
JOINT SPACING)



TYPE C
TIED BUTT LONGITUDINAL CONSTRUCTION JOINT



KEYWAYS FOR TYPE B AND F
CONSTRUCTION JOINT



ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

**CONCRETE PAVING
JOINT DETAILS**

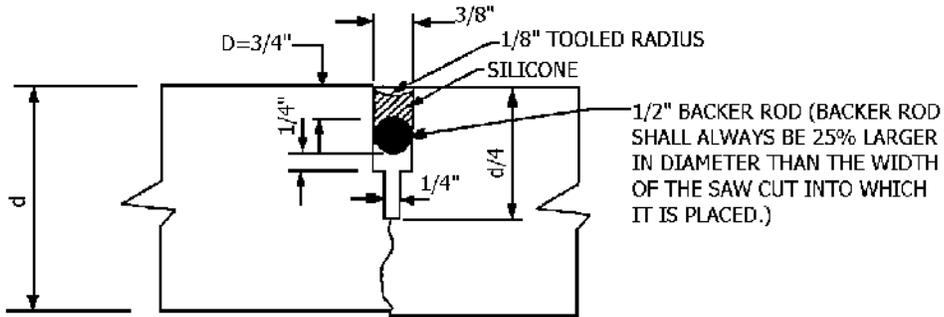
APPROVED

David H. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 15-6

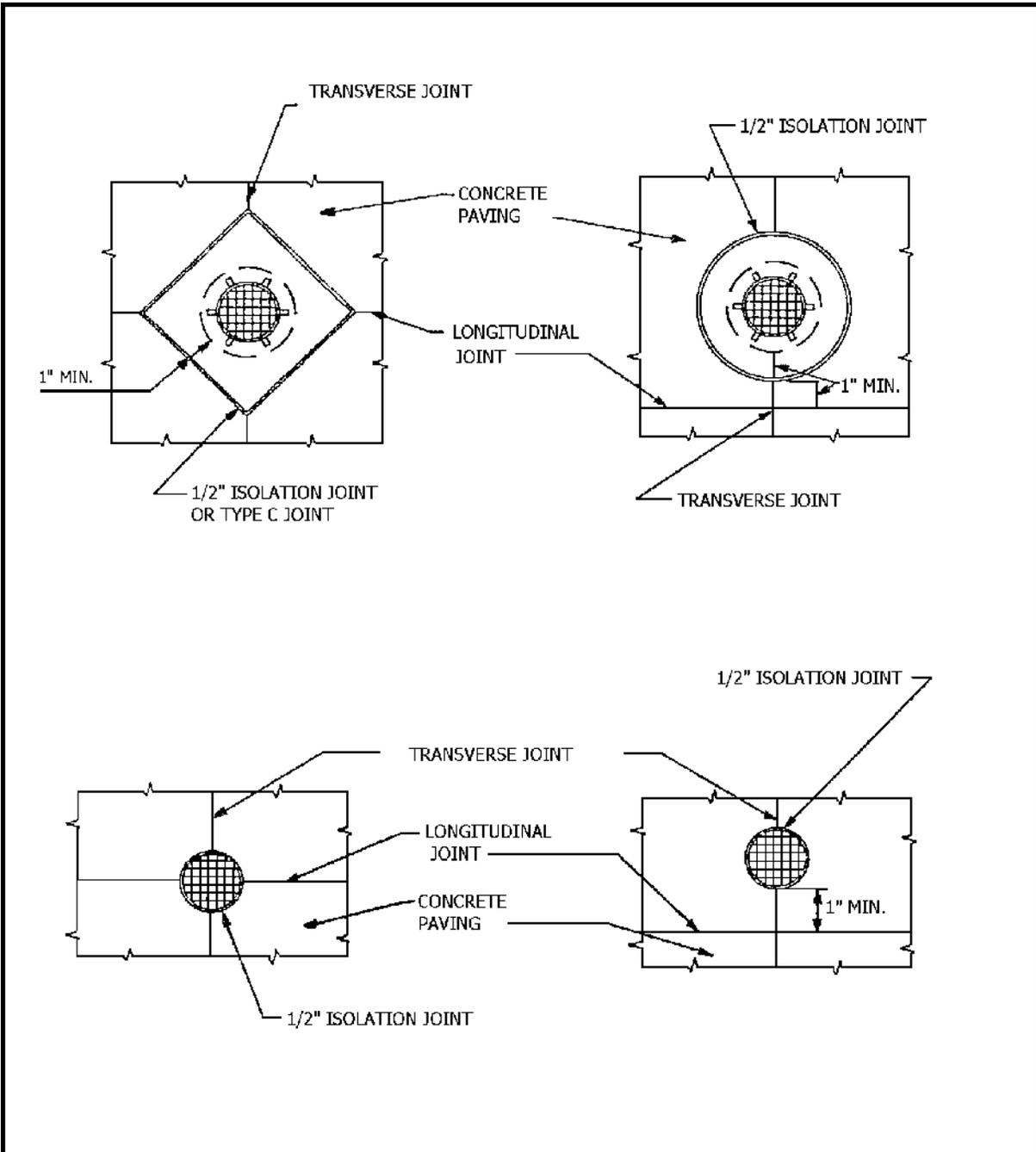
NOTES:

1. SILICONE JOINT SEALING MATERIAL SHALL BE COLD-APPLIED, SINGLE COMPONENT TYPE CONFORMING TO REQUIREMENTS OF FED. SPEC. TT-S-1543, DOW CORNING "888 SILICONE HIGHWAY JOINT SEALANT". SEALING MATERIAL SHALL BE PRESSURE MACHINE APPLIED IN ACCORDANCE WITH THE SEALING MATERIAL MANUFACTURER'S RECOMMENDATIONS. THE MATERIAL FURNISHED FOR THE BACKER ROD SHALL BE A RESILIENT, CLOSED CELL POLYETHYLENE FOAM ROD AS RECOMMENDED BY THE MANUFACTURER OF THE SEALANT.
2. d = DEPTH OF SLAB
3. D = DEPTH TO TOP OF BACKER ROD. DEPTH "D" SHALL ALWAYS BE TWICE THE WIDTH OF THE JOINT.



TYPICAL SECTION

 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE
	CONCRETE PAVING JOINT SEALING DETAILS	STANDARD DRAWING 15-7



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Muller</i> 5/13/90	
	CONCRETE PAVING ISOLATION JOINT DETAILS	CITY ENGINEER	DATE
		STANDARD DRAWING 15-8	

SECTION 2000 CONCRETE

2001 SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work.

2002 GENERAL. All cast-in-place concrete shall be accurately formed, and properly placed and finished as shown on the drawings and specified herein.

The Contractor shall inform the Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.

2003 MATERIALS. All material used in the manufacture of concrete shall conform to the following:

- A. Concrete Control and Quality. The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of such "Bulletins" and "Sections" differ from these specifications, the provisions of this Specification shall govern.
- B. Concrete. Concrete for use in construction shall conform to the requirements of Sections 2005 and 2006.
 - 1. Cement. Portland Cement shall conform to ASTM C-150, Type I, II or III.
 - 2. Coarse Aggregate. Coarse Aggregate shall conform to MCIB Section 4.
 - 3. Fine Aggregate and Mixing Water. Fine aggregate and mixing water shall conform to MCIB Section 4.
 - 4. Admixtures. Admixtures shall conform to MCIB Section 5 and ASTM 494.
- C. Reinforcing Steel.
 - 1. Bars. Bars shall conform to ASTM A-615, A-616, and A-617.
 - 2. Welded Steel Wire. Welded steel wire fabric shall conform to ASTM A-185.
 - 3. Supporting Elements. Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.
- D. Expansion Joint Fillers. Expansion joint fillers shall conform to ASTM D-1752.
- E. Joint Sealing Compounds. Joint sealing compounds shall be one or two component rubberized polysulfide urethanes conforming to Federal Specification Numbers TT-00227 or TT-00230-C.

F. Curing Membrane. All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to one of the following:

1. A white pigmented two component water insensitive epoxy with a solid epoxy content of 40 to 60 percent. Application rate is 5 to 8 mils wet.
2. A white pigmented liquid system of styrene acrylate Type I Class 2 or liquid chlorinated rubber Type II Class 2, complying with Federal Specification No. TTC-800A. Application rate 6 to 10 mils wet.

Method of Applying Curing Membrane. A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane.

2004 PRELIMINARY REVIEW. A report shall be submitted to the Engineer prior to the placement of concrete and shall include data on proposed concrete mix proportions and the fine and coarse aggregate gradation. Mix proportions shall be selected preferably on the basis of field experience and may be adjusted upon approval of the Engineer where required to produce concrete of proper workability, uniform consistency, and acceptable density and strength.

A tentative concrete mix shall be designed and tested for each size and gradation of aggregate and for each slump intended to be used on the work. Design quantities and test results of each mix shall be submitted to the Engineer for review and approval.

2005 CONCRETE MIX DESIGNATIONS. The following tabulation indicates minimum strengths for the various types of concrete which will be accepted.

<u>Class</u>	<u>Min. Compressive Strength</u>		<u>Slump</u>
	<u>7-days</u>	<u>28-days</u>	
I	2000 psi	3000 psi	4 inches max.
II	2650 psi	4000 psi	2-4 inches max.

All cast-in-place or precast construction for pavements, curbs, curb and gutter, sidewalks, drive approaches, inlets, manholes, reinforced concrete boxes, bridges and as otherwise required by the Engineer shall be of Class II concrete. The use of Class I concrete shall be confined to non-structural elements such as manhole or inlet inverts and pipe encasements. When high-early strength cement is to be used for concrete, the mix shall obtain a 7-day strength not less than the minimum 28-day strength specified for concrete of the same class.

2006 LIMITING REQUIREMENTS. Each concrete mix shall be designed and concrete shall be controlled within the following limits.

	<u>Slump</u>	<u>Max. Size Course Aggregate</u>	<u>Cement Content Lbs./C.Y.</u>	<u>Max. Water Cement Weight Ratio</u>	<u>Max. Gals Water per Sack of Cement</u>
Class I (3000 psi)	4"	1"	480	.542	6.12
Class II (4000 psi)	2"	1"	558	.421	4.75
	3"	1"	588	.421	4.75
	4"	1"	618	.421	4.75

The quantity of portland cement shall be not less than that shown in the preceding table. The use of plasticizers in concrete mixes shall only be as approved by the Engineer. If an approved plasticizer is utilized in the concrete mix, the cement factor shown shall be decreased ten (10) percent, or as approved by the Engineer.

Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Maximum slump for portland cement concrete pavement shall be two inches. Slumps for concrete work other than pavement construction shall not exceed four inches. Use of slumps in excess of those specified shall be only when authorized by the Engineer. The use of water to obtain so-called "improved workability" shall not be permitted.

The initial set as determined by ASTM C403 shall be attained 5-1/2 hours, plus or minus one hour, after the water and cement are added to the aggregates. If such use has been approved by the Engineer, the quantity of retarding or accelerating admixture shall be adjusted to compensate for variations in temperature and job conditions. The admixture content shall be in accordance with the recommendations of the manufacturer for compliance with these specifications.

The total volumetric air content of concrete after placement shall be six (6) percent, plus or minus one (1) percent.

The minimum acceptable compressive strengths shall be as determined by ASTM C39.

As the work progresses, the Engineer reserves the right to change the proportions from time to time if conditions warrant such changes to produce a satisfactory job. Any such changes may be made within the limits of the specifications at no additional compensation to the Contractor.

2007 BATCHING AND MIXING. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

The consistency of concrete shall be suitable for placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2008 PLACEMENT. The limits of each concrete pour shall be predetermined by the Contractor and shall be acceptable to the Engineer. All concrete within such limits shall be placed in one continuous operation.

Before concrete is placed, forms, reinforcements, and embedments shall be rigidly secured in proper position and all dirt, mud, water and debris shall be removed from the space to be occupied by the concrete. Bonding surfaces shall be cleaned of all foreign material and shall be free from laitance. Concrete shall not be placed on frozen subgrade or in excavations which have been dewatered.

Placement of concrete shall conform to requirements of ACI 304. Concrete shall be placed within forty-five (45) minutes of mixing operations, with the exception that the Engineer may extend the period to ninety (90) minutes (maximum) dependent upon weather conditions. Concrete shall not be placed in horizontal layers exceeding eighteen (18) inches. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. The concrete shall be vibrated or spaded to produce a solid mass without honeycomb or surface air bubbles.

2009 COLD WEATHER CONCRETING. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when the descending air temperature in the shade and away from artificial heat reaches 40 degrees F or when forecast to drop below 40 degrees F within 24 hours of placement, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees F.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the Engineer prior to being placed in the mixer. No ingredient that is frozen or contains ice shall be placed in the mixer. The temperature of the concrete shall be not less than 60 degrees F and not more than 80 degrees F at the time of placement in the forms. Under no circumstances shall concreting operations continue when the air temperature is less than 20 degrees F. No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete injured by frost action or freezing weather shall be removed and replaced at the Contractor's expense.

2010 HOT WEATHER CONCRETING. The provisions of this section shall apply to all concrete work which is done when the air temperature is above 80 degrees F at the time of placement.

The temperature of the concrete, when placed, shall not be high enough to cause excessive loss of slump, flash set or cold joints. In no case shall the temperature of the concrete, when placed, exceed 90 degrees F. Forms, reinforcing and subgrade surfaces against which the concrete is to be placed shall be wetted down immediately before placement.

When the air temperature exceeds 90 degrees F and as soon as practicable without causing damage to the surface finish, all exposed concrete shall be kept continuously moist by means of fog sprays, wet burlap, cotton mats, or other means acceptable to the Engineer. This cooling with water shall be in addition to the initial sealing by membrane curing compound.

2011 CURING AND PROTECTION. Concrete shall be cured by protecting it against loss of moisture, rapid temperature changes and mechanical injury for at least 4 days after placement. Acceptable methods shall be moist curing, waterproof paper, white polyethylene sheeting, liquid

membrane-forming compounds, or a combination thereof. After concrete finishing operations have been completed, the entire surface of the newly-placed concrete shall be covered by the curing medium applicable to local conditions and acceptable to the Engineer. The Contractor shall have the necessary equipment for adequate curing on hand and be ready to install prior to concrete placement.

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the surface for the duration of the moist-curing period. Burlap or fabric mats shall be long enough to cover the entire surface of the work and lapped at joints to prevent drying between adjacent sheets.

Waterproof paper or white polyethylene sheets shall be large enough to cover the entire surface of the work and shall be lapped not less than eighteen (18) inches. The sheets shall be adequately weighted to prevent displacement or billowing due to wind. Tear holes appearing in the material during the curing period shall be immediately repaired or replaced with material in acceptable condition.

White membrane curing compound shall be applied after finishing operations have been completed and immediately after the free water has left the surface. The surface of the work shall be completely coated and sealed with a uniform layer of the curing compound at a rate of not less than one gallon per 150 square feet. The compound shall not be thinned and shall be kept agitated to prevent settlement of pigment. On surfaces where forms are removed prior to the end of the specified curing period, the entire exposed surface shall be coated at the specified rate of coverage. If rain falls on the newly-coated surface before the film dries sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of compound to the affected area.

During cold weather concreting when the ambient air temperature is expected to drop below 40 degrees F, sufficient supply of burlap, straw, hay, or other blanketing material shall be provided along the work to protect the concrete and maintain a minimum temperature of 40 degrees F in the concrete as measured on the surface. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material. This type of curing shall be maintained for a period of six (6) days as the initial cure.

Sidewalks, curb and gutter, and miscellaneous concrete shall be protected and cured for a period of not less than seventy-two (72) hours after the placing of the concrete by covering with wet burlap or by the application of a membrane curing compound as specified above.

2012 FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings. They shall be sufficiently tight to prevent leakage of mortar and shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Forms may be of wood or metal and shall be designed to permit easy removal without injury to the concrete. Forms for all exterior exposed surfaces which will be visible after backfilling shall

be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. Forms shall be coated with an approved light oil to prevent concrete from adhering and shall be thoroughly cleaned and re-oiled before re-use.

Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete. The following table gives the approximate minimum time that forms shall be left in place.

<u>Average Air Temperature Greater Than</u> Structural Member	<u>70 Deg</u>	<u>60 Deg</u>	<u>50 Deg</u>	<u>40 Deg</u>
	Time in Place (24 Hour Days)			
Slab Shoring	10	12	14	21
Slab Forms	7	7	7	7
Beams Soffits and Shoring	10	12	14	21
Beam Side Forms	1	1	2	3
Wall Side Forms	2	2	3	4

2013 FINISHING FORMED SURFACES. Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with backfill. A power grinder shall be used, if necessary, to remove projections and provide a flush surface. Surfaces to be dampproofed shall have fins removed and tie holes filled, but no additional finishing will be required.

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with patching mortar. Tie hole patches shall be finished flush and shall match the texture of the adjacent concrete.

2014 REPAIRING DEFECTIVE AND DAMAGED CONCRETE. Any concrete found not to be formed as indicated on the plans, or out of alignment or level, or having a defective surface, or damaged prior to acceptance of the project by the City, shall be considered as not conforming to the intent of these specifications and may be ordered removed and replaced by the contractor at his expense unless the Engineer authorizes patching of the defective or damaged area. Surface defects such as ridges and bulges shall be removed by grinding. Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and the vacated area shall be filled. The methods used in this type of repair shall be approved by the Engineer. Material used for patching shall be a non-shrink, non-metallic grout with a minimum 28-day compressive strength of 5000 psi or a similar material approved by the Engineer. Prior to placement of the repair filling, the contact surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy bonding agent.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing or surrounding concrete. Repair work shall be adequately cured and protected from further damage.

2015 REINFORCEMENTS. The metal reinforcement shall be protected by the thickness of

concrete indicated on the construction drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

<u>Location of Reinforcement</u>	<u>Cover in Inches</u>
Surfaces where concrete is deposited directly against the ground.	3
Formed surfaces exposed to the ground, to water, or to weathering.	2
Beams, girder, and columns not exposed to ground, water, or weathering.	1-1/2
All surfaces other than those above.	1

Reinforcing steel shall be accurately placed and positioned on supports, spacers, hangers, or other reinforcing steel as approved by the Engineer and shall be secured in place with wire ties or suitable clips. The minimum clear distance between parallel bars shall not be less than 1-1/2 times the diameter of round bars, except that in no case shall clear spacing between parallel bars be less than 2 inches or less than 1-1/2 times the nominal size of the coarse aggregate.

Splices in reinforcing steel will not be permitted at points of maximum stress. When it becomes necessary to splice reinforcing steel at points other than those shown on the contract drawings, the character and location of the splice shall be approved by the Engineer. Welding or tack welding of reinforcement will not be permitted. Reinforcements upon which unauthorized welding has been done shall be removed and replaced as directed by the Engineer. Spliced bars shall be placed in contact and securely tied together.

Metal reinforcement at the time concrete is placed shall be free from rust, scale, or other contaminants that will destroy or reduce the bond.

2016 CONSTRUCTION JOINTS. Construction joints shall be made at locations indicated on the drawings or specified, and shall conform to the requirements of ACI 318. When the Contractor desires to make construction joints at other locations, he shall anticipate such changes far enough in advance of the construction operations to allow the Engineer to investigate such changes and approve additional construction joints.

2017 EXPANSION AND CONTRACTION JOINTS. Expansion and contraction joints shall be at locations indicated on the drawings or as specified.

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the concrete. Formed grooves shall be made by depressing an approved tool or devise into the plastic concrete. Sawed joints shall be constructed by sawing through the surface of the concrete with an approved concrete saw. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to prevent excessive raveling.

Expansion joints shall be formed with pre-formed expansion joint filler of the non-extruding and resilient types which shall include the following; Cork, self-expanding cork, sponge rubber, cork rubber, and bituminous fiber. These materials shall meet the requirements of ASTM D994, D1751 and D1752.

2018 REINFORCED CONCRETE BOX FORMING SEQUENCE. Wall forms may be placed the day following the placement of the bottom slab, as long as care is taken to protect the slab against rough or abusive handling of forms and or placing equipment. The actual placement of concrete shall not occur prior to the fifth day after placing the bottom slab. Top forms may be placed with wall forms if the walls and top are to be monolithic construction, otherwise top forms are not to be placed until the third day after placing the walls. The actual placement of concrete for the top shall not occur prior to the fifth day after placing the walls (for base to top shoring) or until the walls have reached their design minimum of two days after the walls are poured. Wall forms shall remain in place a minimum of two days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown on page 20-5, Section 2012, Forms.

The above guidelines for placing forms for reinforced concrete boxes are based on the use of standard forming procedures and with the use of concrete containing no admixtures to achieve high early strength. Variations in forming techniques and/or the use of high early strength concrete shall only be allowed after the contractor obtains the written approval of the City Engineer.

SECTION 2100 CONCRETE CURB AND CURB AND GUTTER

2101 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary to construct or reconstruct curbing and/or curb and gutter.

2102 MATERIALS. All items of material included in this section shall conform to Section 2000 except as follows:

- A. Concrete Mix. Concrete shall conform to the requirements set forth for Class II mix design. Slump shall be approved by the Engineer.
- B. Expansion Material. Expansion material shall be a preformed, one-piece, non-extruding material such as "Bondex" No. 941 pre-formed rubber joint, "Rubatex" both manufactured by Rubatex Co., or "Homex" as manufactured by Homasote Co. or equal. Any substitute material requires the approval of the Engineer.
- C. Joint Sealer. Joint sealer shall be a one component, gun-grade, moisture cured epoxy or urethane such as "Vulcum 45" as manufactured by Maneco International, "Sidaflex 1-A" by Sika Chemical Corporation or "Pecora CG-9" by Pecora Co., or equal as approved by the Engineer.
- D. Curing Membrane. Curing membrane shall be as specified in Section 2003 (F).

2103 CONSTRUCTION DETAILS. The curbing shall be constructed or reconstructed to the configuration and to the lines and grades shown on the plans. Generally the curbing shall be placed prior to the placement of pavement or sidewalk sections, except when curb and gutter is integral with the pavement, and as directed by the Engineer.

- A. Removal of Existing Curbing for Reconstruction. Existing curbing shall be totally removed to the nearest contraction or expansion joint or with the approval of the Engineer it may be sawed provided no free section is left that is less than 5 lineal feet in length, and provided the entire curbing section is sawed a minimum of 2 inches below top of pavement elevation.
- B. Grading and Subgrade Preparation. All excavation or embankment shall conform to Section 1000, Site Preparation and 1200, Subgrade Preparation; and as follows:

The top 6 inches of the subgrade shall be compacted to obtain a density of 95 percent of the maximum in conformance with Section 1205(A). If during reconstruction operations, additional fill material is needed beneath the curb, it shall be of crushed limestone, placed in lifts of 4 inches not to exceed 12 inches maximum thickness, moistened if necessary, and compacted by mechanical tampers to a density of 95 percent of the maximum.

- C. Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet in length.

1. General. Face forms will be used with all curb standards as applicable. Forms shall have a height equal to or greater than the height of the curb section.

The forms shall be set true to line and grade and shall be supported to stay in position while depositing and consolidating the concrete. The forms shall be designed to permit their removal without damage to the concrete. The forms shall be lubricated.

2. Curb Machine. A slip-form curb machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators and be capable of placing curb to the correct cross section, line and grade within the allowable tolerances.

2104 JOINTS. The joints shall be formed at right angles to the alignment of the curbing and to the depth specified by the appropriate standard or as modified by the plans.

- A. Expansion Joints. Expansion joints shall be placed at all radius points, driveways, curb inlets, or where directed by the plans or Engineer.

1. Material. Expansion joints shall be formed by a one piece 3/4 inch thick preformed joint filler cut to the configuration of the correct curb section.
2. Stability. Expansion joints shall be secured in a manner so they will not be disturbed by depositing and consolidation of concrete.
3. Edging. The edges of the joints shall be rounded with an edging tool of 1/4 inch radius.

- B. Contraction Joints. Curbing shall have contraction joints formed at intervals of not less than 10 feet or more than 20 feet. They shall extend through the entire curb section from the top of the curb to a depth 1 inch below pavement surface.

1. Method. Contraction joints may be formed by a template, tooling, or sawing.
 - a. Templates. Templates shall be 1/8 inch metal cut to the configuration of the curbing section. The templates shall be secured at the proper locations so that they will not be disturbed by the depositing of concrete. The templates shall be removed as soon as the concrete has attained its initial set and finished as outlined below.
 - b. Tooling. Tooling of contraction joints will be permitted if done to the depths specified on the appropriate standard. Tooled contraction joints shall be constructed with a 1/4 inch radius on all exposed edges.
 - c. Sawing. Sawing of contraction joints is permitted when a curb machine has been used. The sawing of joints must be completed within 24 hours of the placing of concrete.

2. Joint Sealer. Joint sealer is not required on contraction joints.

2105 CONCRETE WORK. Concrete for curbing shall be placed in accordance with the requirements of MCIB Standard Concrete Specifications. Expansion and contraction joints shall be constructed as shown on the plans, standards, or where directed by the Engineer.

- A. Concrete Placement. Concrete shall be mechanically vibrated when directed by the Engineer and shall not be allowed to extrude below the forms to cause an irregular alignment of the abutting street pavement.
- B. Finishing. After placing and initial strike-off the curb shall be tooled to the required radii. If the surface of the concrete is sufficiently wet that a ridge is formed at the inside of the radius tool, finishing will cease until the excessive moisture has evaporated.

After initial set, the face forms and templates, if used, shall be removed and the surface finished to the required dimensions. No water, dryer, or additional mortar shall be applied to the free surface of the concrete.

The finished surface of the concrete shall be broomed with a clean broom to provide an antiskid surface.

In all cases the finished curb shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.

- C. Curing. As soon as practical after the concrete is finished it shall be cured with one of the acceptable liquid curing membranes applied according to the manufacturer's directions.

If front and/or back forms are removed from finished curbing within a period of 72 hours of placement these surfaces shall also be cured.

Wet burlap, cotton mat, waterproof paper, polyethylene sheeting or earth backfill is not an acceptable curing method for curbing.

- D. Protection. The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the City. Concrete which is damaged or defaced, shall be removed and replaced, or repaired to the satisfaction of the Engineer, at the expense of the Contractor.
- E. Temperature Limitations. Concrete work shall be placed in accordance with requirements of Section 2009 and 2010.

2106 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and curb sections are backfilled unless otherwise approved by the Engineer. Backfill shall be accomplished in accordance with Sections 1100 and 1200 entitled "Site Preparation" and "Subgrade Preparation".

The Contractor shall be responsible for the repair of any street pavement disturbed by the construction to the satisfaction of the Engineer.

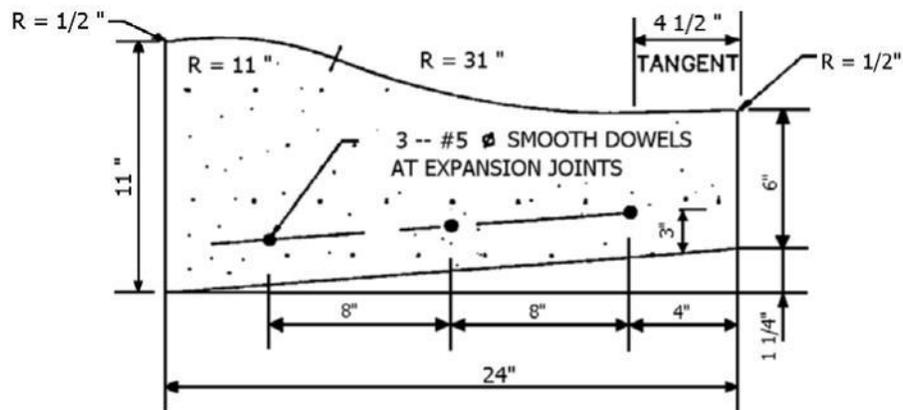
2107 JOINT SEALING AND CLEAN-UP. Only the sidewalk portion of the curbing will require joint sealing. An approved joint sealer shall be applied in accordance with the manufacturer's directions within 7 days of the placement of the concrete.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of construction.

2108 SURFACE TOLERANCES. Curbing shall have a surface tolerance of 1/4 inch in 10 feet when checked with a ten foot straightedge.

2109 REINFORCEMENT (CURB AND GUTTER). Reinforcement for concrete curb and gutter shall be as designated on the Standard Details. The exception to this shall be when the curb and gutter is to be constructed on an asphaltic concrete base with a minimum depth of three (3) inches. In this case, no reinforcement shall be required unless otherwise determined by the City Engineer.

2110 REINFORCEMENT (OTHER). Reinforcement for all other work shall be as shown on the contract drawings or as depicted on details contained in this specification.



NOTE: 1. EXPANSION, CONTRACTION,
OR CONSTRUCTION JOINTS ARE TO BE
SAME AS NOTED ON TYPE "CG-1" CURB
AND GUTTER DETAIL



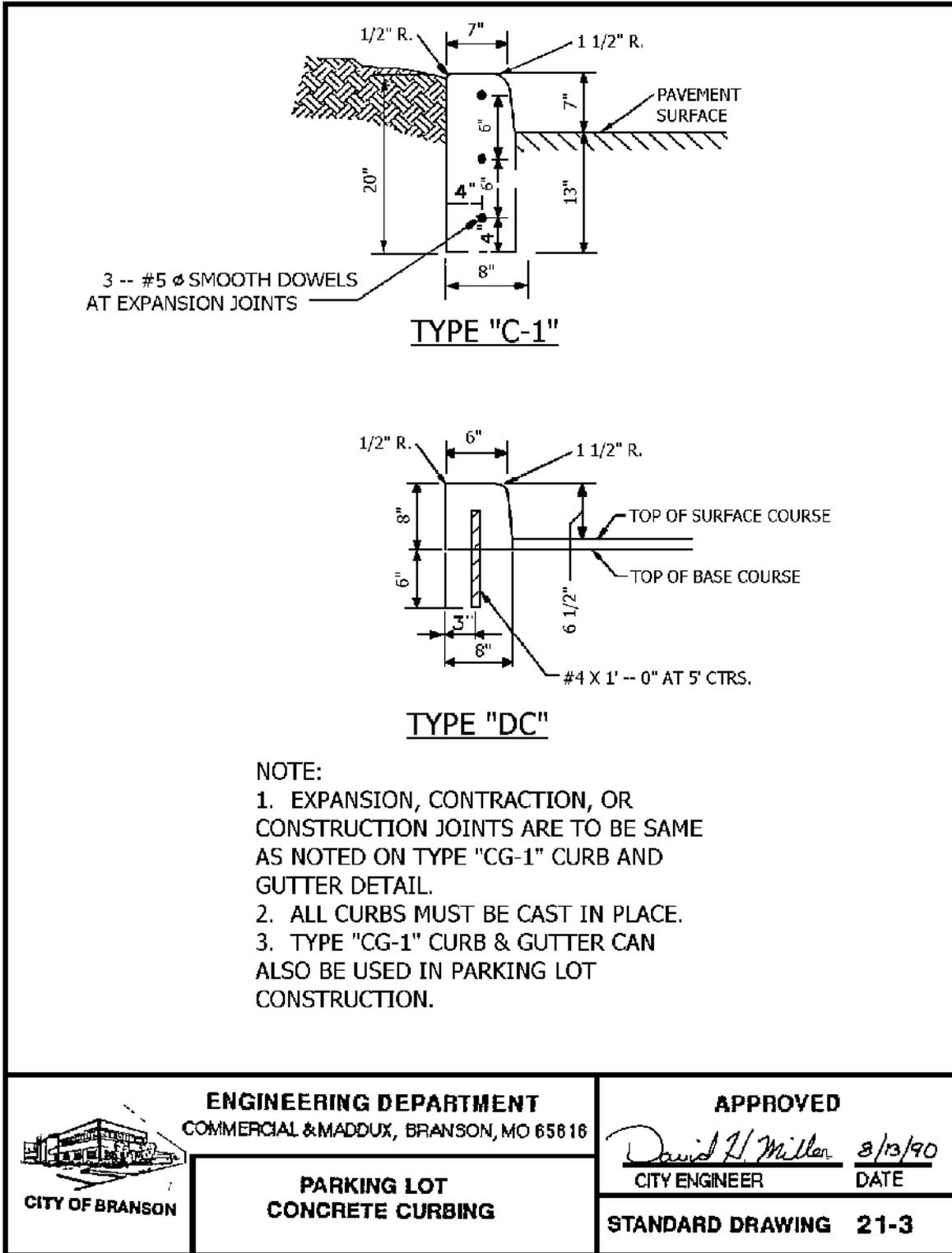
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65618

**ROLL-BACK
TYPE "CG-2" CURB
AND GUTTER DETAIL**

APPROVED

David H. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 21-2



SECTION 2200 STANDARD SIDEWALKS AND DRIVEWAYS

2201 SCOPE. This section governs the furnishing of all labor, equipment, tools, material, and the performance of all work necessary to construct or reconstruct sidewalks and driveways.

2202 MATERIALS. All items of material included in this section shall conform in general to the requirements of Section 2000, "Concrete" for Class II concrete.

- A. Concrete Mix. Concrete shall conform to the requirements. When the ambient air temperature is 90 deg F. or higher, a retarder will be used in all concrete mixes.
- B. Reinforcement. Reinforcement shall be 6x6-W2.9 x W2.9, welded steel wire fabric or as shown by the plans and specifications.

2203 CONSTRUCTION DETAILS. The sidewalks or driveways shall be constructed or reconstructed to the configuration, and to the lines and grades indicated by the plans. Generally sidewalks and driveways should be constructed after the curbing if applicable.

- A. Removal. Existing sidewalks or driveways shall be totally removed to the nearest contraction or expansion joint. With the approval of the Engineer, the sidewalk or driveway may be sawed provided no "free section" is left of less than 15 square feet. It is preferred that the section be sawed full depth; however, as a minimum the section shall be sawed 1/2 the depth of the concrete.
- B. Grading and Subgrade Preparation. All excavation or embankment required in the grading or subgrade preparation shall be defined in the Sections 1000 and 1200, except as follows:

The top 6 inches of the subgrade shall be compacted to obtain a density of 95 percent of maximum in conformance with Section 1205(A).

If during reconstruction operations additional fill material is needed beneath sidewalks or driveways it shall be of crushed limestone, placed in maximum lifts of 4 inches, moistened if necessary, and compacted by mechanical tampers to a density of 95 percent of the maximum.

- C. Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal or vertical alignment for each 10 feet in length.
 - 1. Size. Forms shall have a height equal to or greater than the depth of the sidewalk or driveway section.
 - 2. Installation. The forms shall be set true to line and grade, and shall be supported to remain in position while depositing and consolidating the concrete.

- 3 Preparation. The forms shall be lubricated and shall be designed to permit their removal without damage to the concrete.

2204 JOINTS. Unless directed by the Engineer the joints shall be formed at right angles to the alignment of the sidewalk or driveway, and to the configuration specified by the plans or standards.

A. Joint Patterns.

1. Sidewalks. Sidewalk surfaces shall be marked with a transverse joint spaced at a distance equal to the width of the sidewalk. Sidewalks greater than 6 feet in width shall be divided by longitudinal joints spaced not less than 30 inches nor more than 48 inches with transverse joints spaced to form a square pattern. Edger tool marks shall remain showing.
2. Wide driveways. Driveways in excess of 20 feet in width shall have a transverse joint located in the center.

B. Expansion Joints. Expansion joints shall be placed where directed by the plans or Engineer. The expansion joints shall be located to give the sidewalk or driveway an appearance of continuity.

1. General. The preformed expansion joint material shall either be left 1/2 inch below the surface, or a suitable tear strip will be provided to allow for the application of the joint sealer.
2. Material. Expansion joints shall be formed by a 1 piece, 1/2 inch preformed joint filler cut to the configuration of the correct section. The filler material shall be as specified in Section 2003 (D).
3. Stability. Expansion joints shall be secured in a manner so they will not be disturbed by depositing and consolidating the concrete.
4. Edging. The edges of these joints shall be rounded with an edging tool of 1/4 inch radius.

C. Contraction Joints. Contraction joints or false joints shall be one inch deep by 1/8 inch wide with 1/4 inch radii edging.

1. Edging. Edger marks or "Ribbons" shall be left on sidewalks and driveways.
2. Contraction Joints. Contraction joints may be sawed with the approval of the Engineer.
3. Joint Sealer. Joint Sealer is not required on contraction joints.

2205 CONCRETE WORK. Concrete work for sidewalks and driveways shall be placed in accordance with the requirements of MCIB Standard Concrete Specifications. Joints shall be constructed as in Section 2204 or as modified by the plans or special provisions.

- A. Concrete Placement. Concrete shall not be allowed to extrude from below the forms. Vibration is not required for sidewalks or driveways.
- B. Finishing. After placing and the initial strike off, if the surface of the concrete is sufficiently wet that a ridge is formed at the inside of the edging tool, finishing will cease until the excessive moisture has evaporated. No water, dryer or additional mortar shall be applied to the free surface of the concrete.

After finishing, the surface of the concrete shall be broomed with a fine clean broom to provide an antiskid surface, and the edges and joints retooled.

In all cases the finished sidewalk or driveway shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.

- C. Curing. As soon as practical after the concrete is finished it shall be cured with one of the acceptable liquid curing membranes applied according to manufacturers directions.

If forms are removed from sidewalks or driveways within a period of 72 hours of placement those surfaces shall also be cured.

Wet burlap, cotton mats, waterproof paper, polyethylene sheeting or earth backfill shall not be acceptable as curing methods for sidewalks or driveways.

- D. Protection. The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the City. Concrete which is damaged or defaced, shall be removed and replaced or repaired to the satisfaction of the Engineer, at the expense of the Contractor.
- E. Temperature Limitations. Concrete shall be placed in accordance with requirements of Section 2009 and 2010.

2206 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and sidewalks or driveways are backfilled unless otherwise approved by the Engineer.

Backfill shall be accomplished in accordance with Sections 1100 and 1200.

The Contractor shall be responsible for the repair of any street pavement disturbed by the construction.

2207 JOINT SEALING AND CLEAN-UP. All expansion joints shall be sealed with an approved joint sealer applied in accordance with Section 2003 within 7 days of the placement of the concrete.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, splatters and overspray from the area of the construction within 10 days of the date of placement.

2208 SURFACE TOLERANCES. Sidewalks or driveways shall have a surface tolerance of 1/4 inch in 10 feet when checked with a 10 foot straightedge.

2209 PAVEMENT. It is anticipated that parking lots and entrance drives will be constructed of asphaltic concrete wearing surface placed over a base. The base may be either a "black" base or a crushed limestone granular base. The minimum recommended thickness of asphaltic concrete wearing surface is 2.5 inches. The mix should meet the requirements of the Missouri State Highway Department, Standard Specifications for a BP-1 asphaltic concrete pavement as described in Section 401.3.1. The base can be constructed of crushed limestone rolled stone meeting the requirement of State specification 1007.1 for Type 1 or Type 2 aggregate. This material should be placed in two (2) lifts with each lift compacted to 100% of maximum Standard Proctor Compaction (ASTM D 698). Crushed stone base course may be replaced by asphaltic course using a substitution ratio of 1 inch of asphaltic base for each 2 inches of crushed stone.

2210 DETECTABLE WARNING (TRUNCATED DOME). Truncated domes and all related installed surfaces to be installed according to manufacturers specifications. **All detectable warning surface installations shall be at minimum, at least as non skid as the surrounding pedestrian surfaces.**

Truncated dome material specifications:

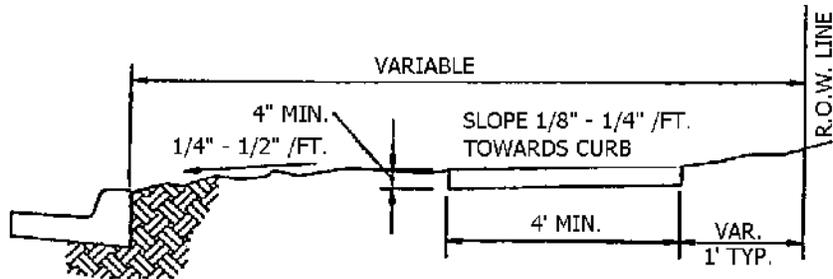
- A. Chemical Resistance -- Seven (7) day immersion test:

Motor oil.....no effect	Transmission fluid.....no effect	Diesel fuel..... no effect
Anti-freeze.....no effect	Gasoline.....no effect	Road salts..... no effect
- B. Skid Resistance – Minimum 45 (ASTM E303) in units (British pendulum)
- C. Reflectivity – 200 millicandella minimum initial reading.
- D. Composition – Comprised of resins, reactive monomers, pigments, glass beads, and fillers. Exact composition is as the manufacturer’s discretion. The material must be resistant to ultra-violet light.
- E. Substrate Requirements:
 - 1 Asphalt: Asphalt surfaces shall be composed of oil based bitumen. Asphalt must cure minimum 20 days prior to truncated dome installation to insure proper bonding of all surfaces. Any asphalt areas requiring detectable warning installations shall be compacted with vibratory rollers or approved compaction equipment to provide maximum compaction of asphalt allowing the greatest adhesion.

2. Seal Coat: Truncated dome products shall not be placed on asphalt or coal tar sealers. If surface has been sealed, grind entire area to be installed to remove all sealers.
 3. Concrete: Minimum compressive strength 3000 PSI. Concrete must cure for 15 days prior to truncated dome installation to insure proper bonding. All concrete coloring/additives shall be integral, not surface applied. All "surface curing" compounds or sealers shall be removed by method of grinding on any concrete that is less than 6 months old before truncated dome products are installed. Surface finish should be medium broom finish for maximum adhesion.
 4. Surfaces: All surfaces to be clean and dry.
 5. Temperatures: Surface temperatures should not exceed 88 deg F, or be below 35 deg F.
- F Detectable warning surfaces must be "black" in color unless otherwise approved by the City Engineer.

NOTES:

1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE-EIGHTH (1/8) INCH WIDE BY ONE (1) INCH DEEP AND SHALL BE FORMED BY TOOLING.
3. EXPANSION JOINTS SHALL BE FORMED BY A ONE-HALF (1/2) INCH THICK PREFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. EXPANSION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.



ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

**4' CONCRETE
SIDEWALK DETAIL**

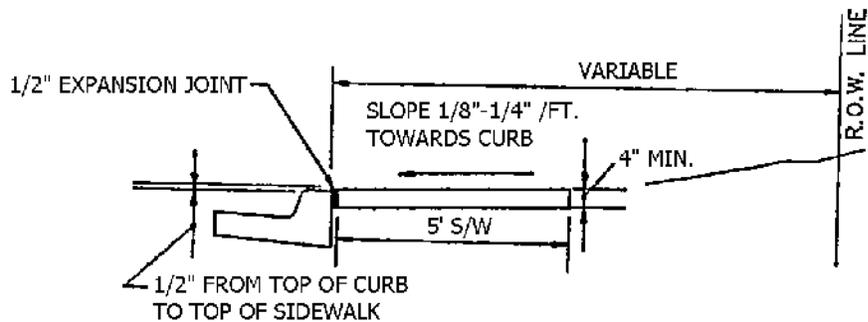
APPROVED

David L. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 22-1

NOTES:

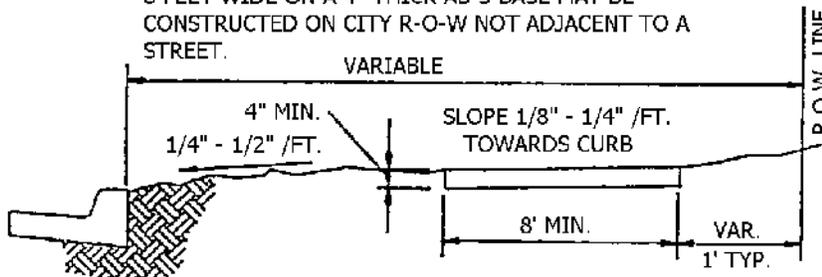
1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE-EIGHTH (1/8) INCH WIDE BY ONE (1) INCH DEEP AND MAY BE FORMED BY TOOLING OR BY USE OF A CONCRETE SAW.
3. EXPANSION JOINTS SHALL BE FORMED BY A ONE-HALF (1/2) INCH THICK PREFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. EXPANSION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 5/13/90 CITY ENGINEER DATE
	5' CONCRETE SIDEWALK DETAIL	STANDARD DRAWING 22-2

NOTES:

1. JOINTS SHALL BE SAWED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE-EIGHTH (1/8) INCH WIDE BY ONE (1) INCH DEEP AND MAY BE MADE BY THE USE OF A CONCRETE SAW ONLY.
3. EXPANSION JOINTS SHALL BE FORMED BY A ONE-HALF (1/2) INCH THICK PREFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. EXPANSION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAKE SIDEWALKS.
5. CONCRETE SHALL BE USED FOR THE CONSTRUCTION OF THE BICYCLE TRAILS LOCATED WITHIN CITY STREET R-O-W AT THE DISCRETION OF THE CITY ENGINEER. A 4" THICK ASPHALT SIDEWALK 8 FEET WIDE ON A 4" THICK AB-3 BASE MAY BE CONSTRUCTED ON CITY R-O-W NOT ADJACENT TO A STREET.



CITY OF BRANSON

ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

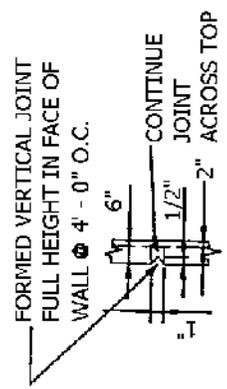
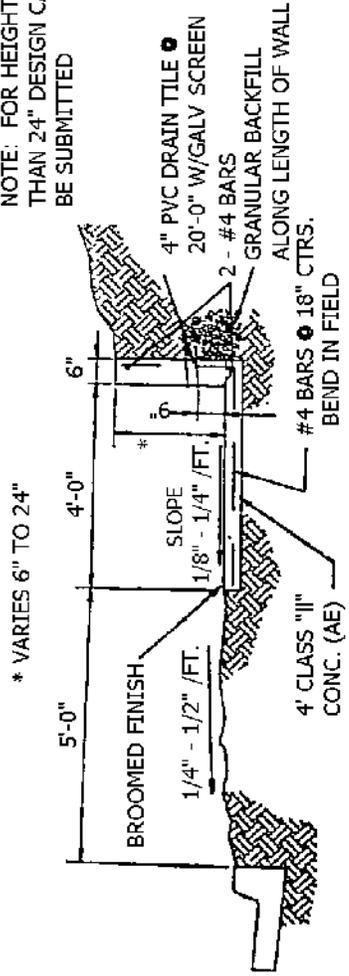
**8' BICYCLE
TRAIL DETAIL**

APPROVED

David R. Miller 8/13/10
CITY ENGINEER DATE

STANDARD DRAWING 22-3

NOTE: FOR HEIGHTS GREATER THAN 24" DESIGN CALCS MUST BE SUBMITTED



- NOTES:
1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW. SIDEWALK JOINTS SHALL MATCH RETAINING WALL JOINTS.
 2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE-EIGHTH (1/8) INCH WIDE BY ONE (1) INCH DEEP AND MAY BE FORMED BY TOOLING OR BY USE OF A CONCRETE SAW.
 3. EXPANSION JOINTS SHALL BE FORMED BY A ONE-HALF (1/2) INCH THICK PREFORMED JOINT FILLER EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
 4. EXPANSION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.
 5. PROVIDE 4" DIA. PVC DRAIN TILE AT 20'-0" INTERVALS ALONG LENGTH OF RETAINING WALL WITH GALVANIZED SCREEN AND GRANULAR BACKFILL WHEN WALL HEIGHT IS GREATER THAN OR EQUAL TO 1'-6" FROM TOP SURFACE OF SIDEWALK.
 6. ALL EXPOSED CORNERS OF WALL SHALL BE CHAMFERED.



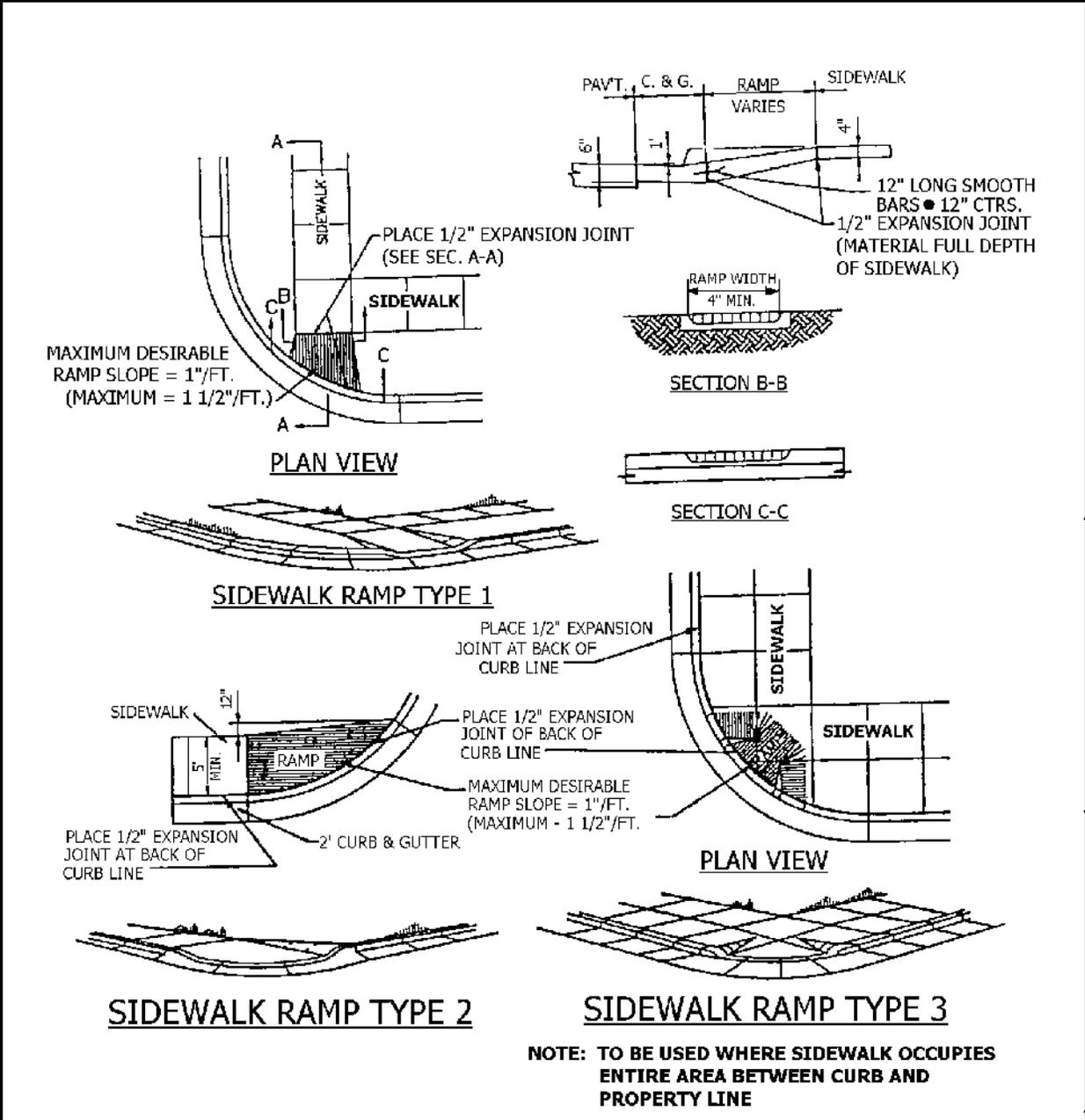
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616

**SIDEWALK DETAIL
 W/ABUTTING
 RETAINING WALL**

APPROVED

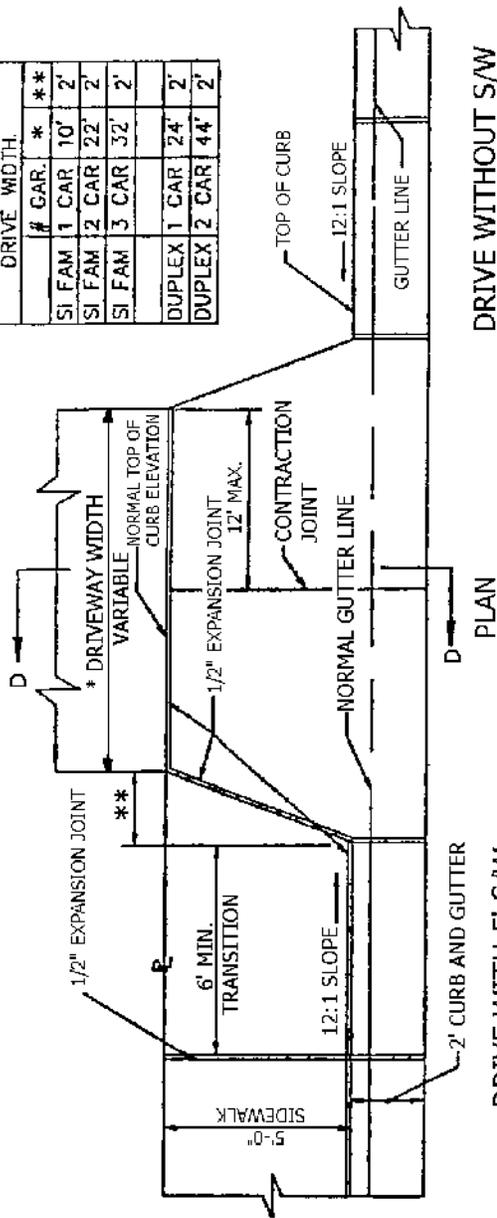
David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 22-4



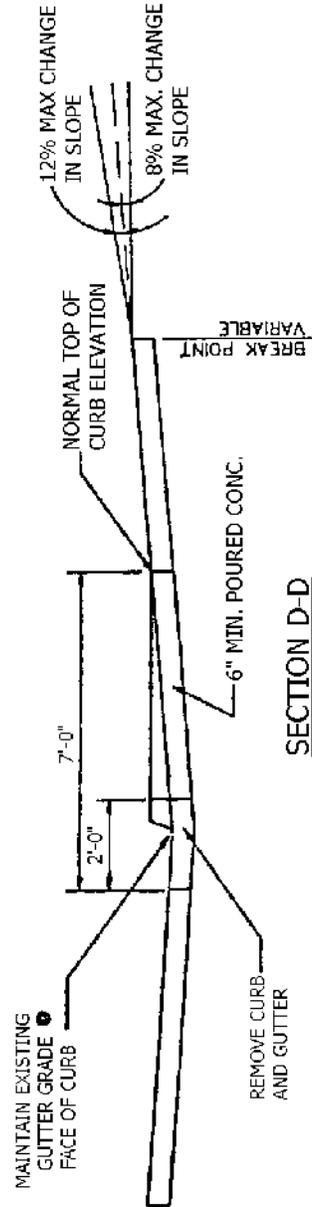
 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65818	APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE
	SIDEWALK RAMP DETAILS	STANDARD DRAWING 22-5

DRIVE WIDTH.		
# GAR.	*	**
SI FAM 1 CAR	10'	2'
SI FAM 2 CAR	22'	2'
SI FAM 3 CAR	32'	2'
DUPLEX 1 CAR	24'	2'
DUPLEX 2 CAR	44'	2'



DRIVE WITHOUT S/W

DRIVE WITH 5' S/W
ADJACENT TO CURB



CITY OF BRANSON

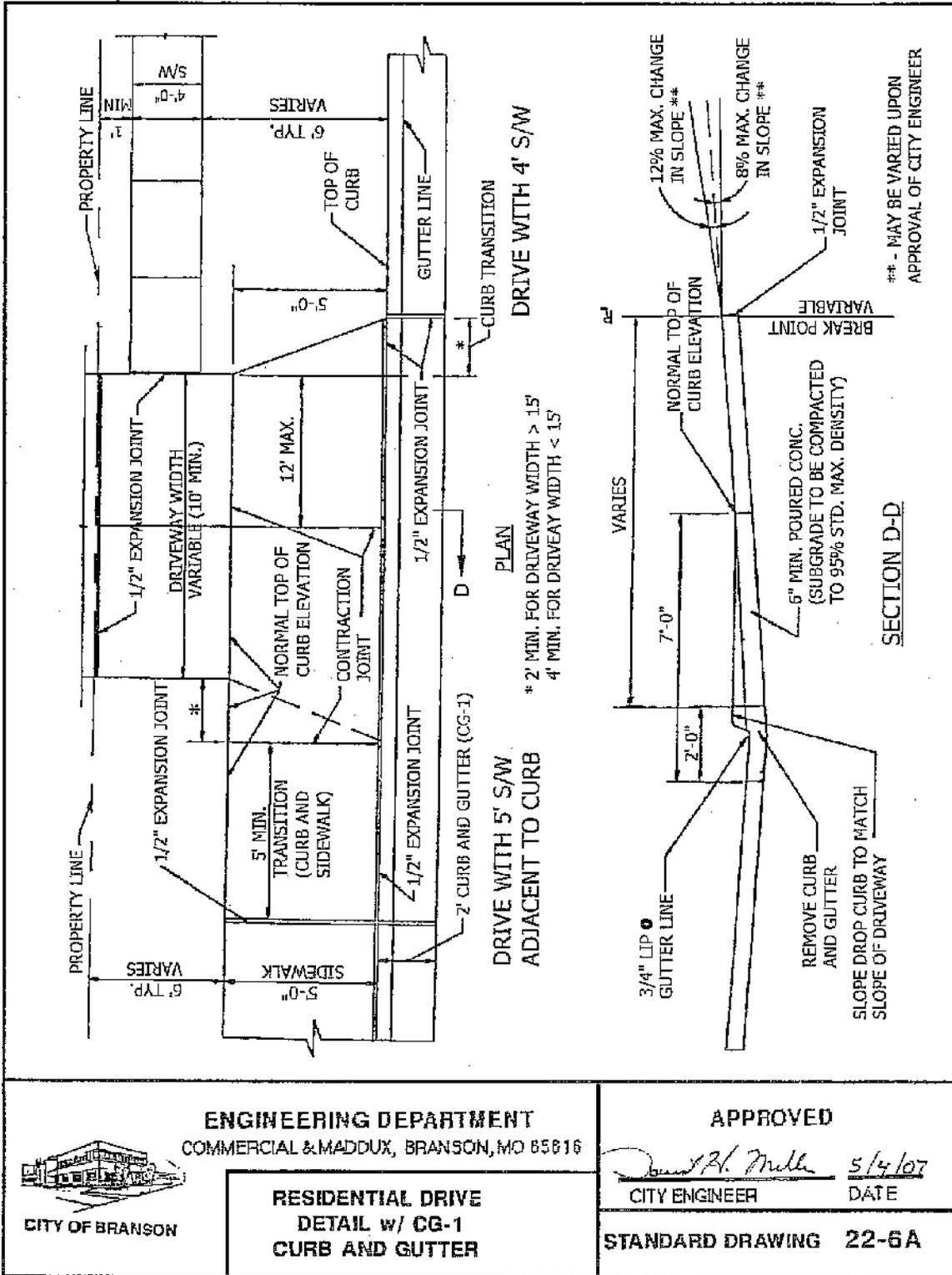
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

**RESIDENTIAL
DRIVE DETAIL**

APPROVED

David H. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 22-6



CITY OF BRANSON

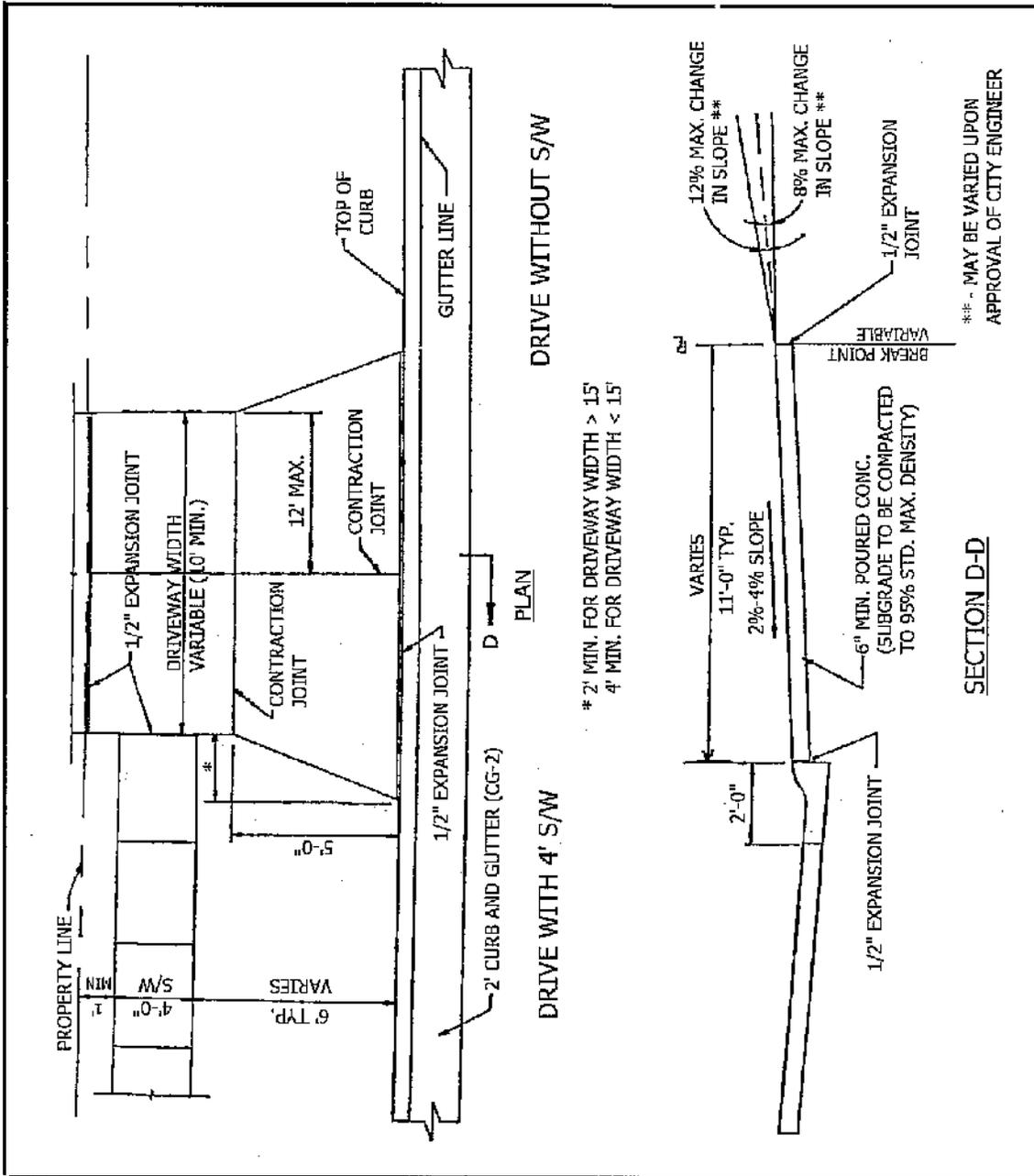
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65816

**RESIDENTIAL DRIVE
 DETAIL w/ CG-1
 CURB AND GUTTER**

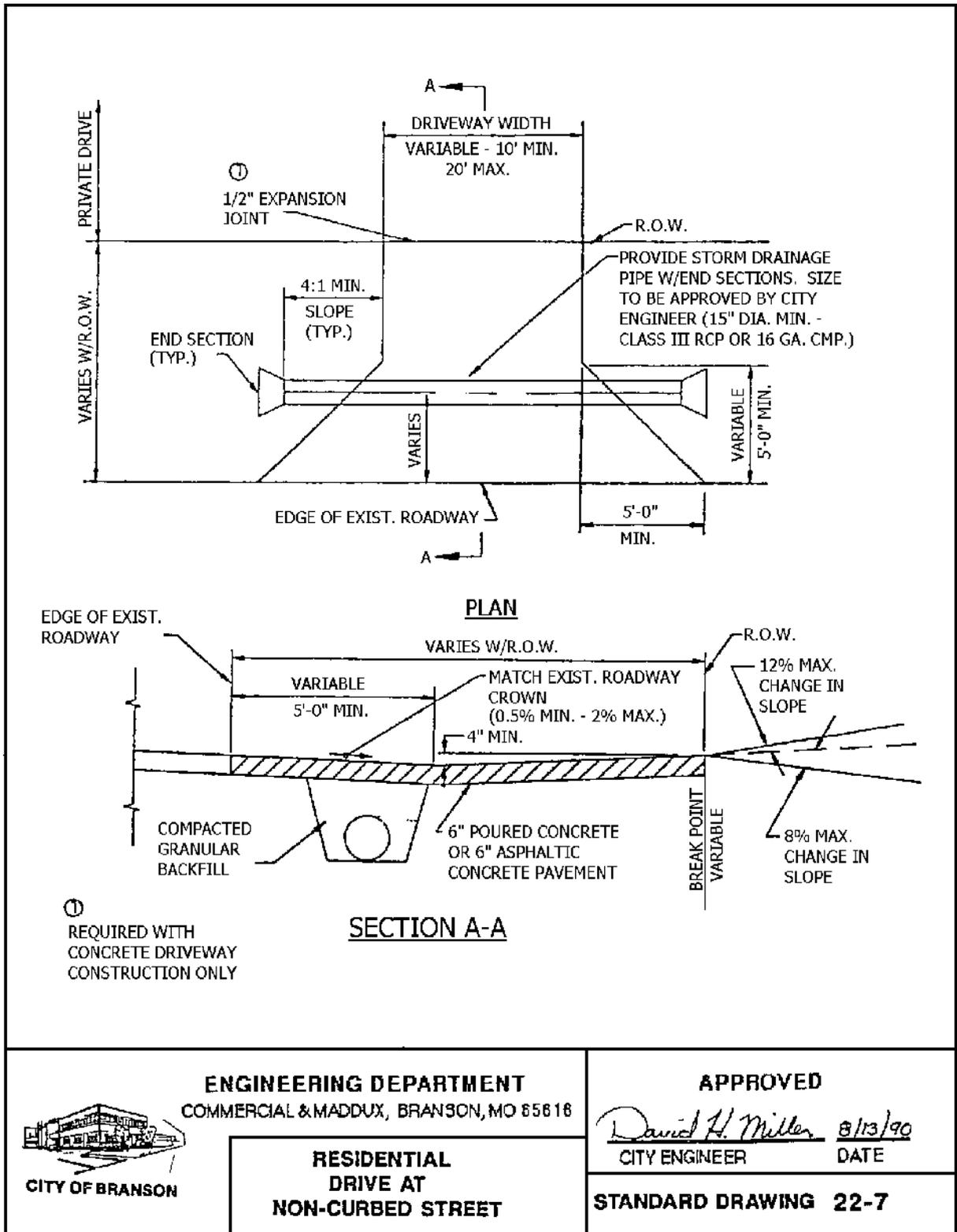
APPROVED

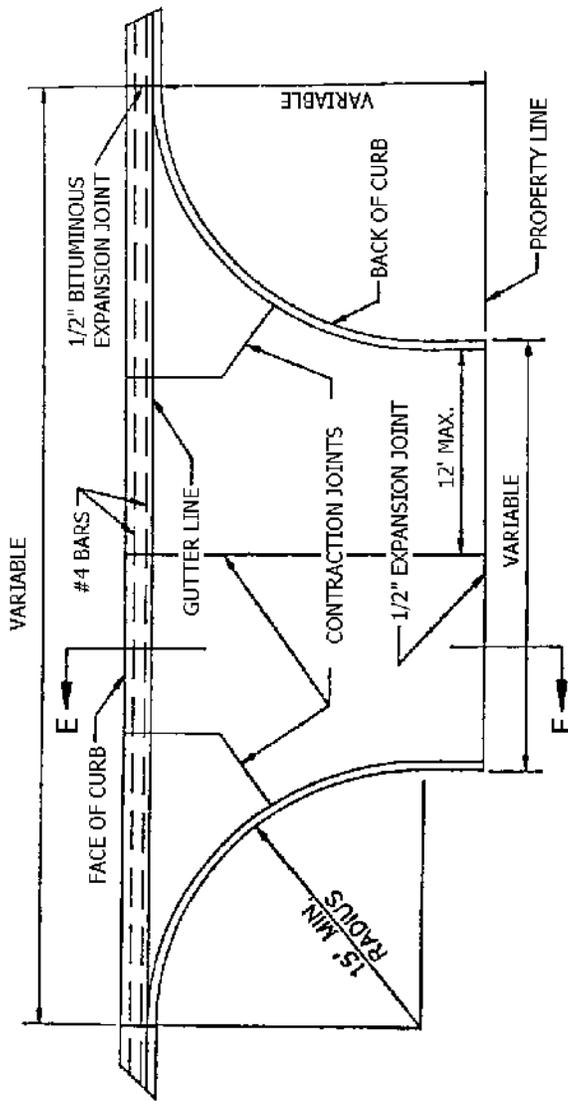
James R. Miller 5/4/07
 CITY ENGINEER DATE

STANDARD DRAWING 22-6A



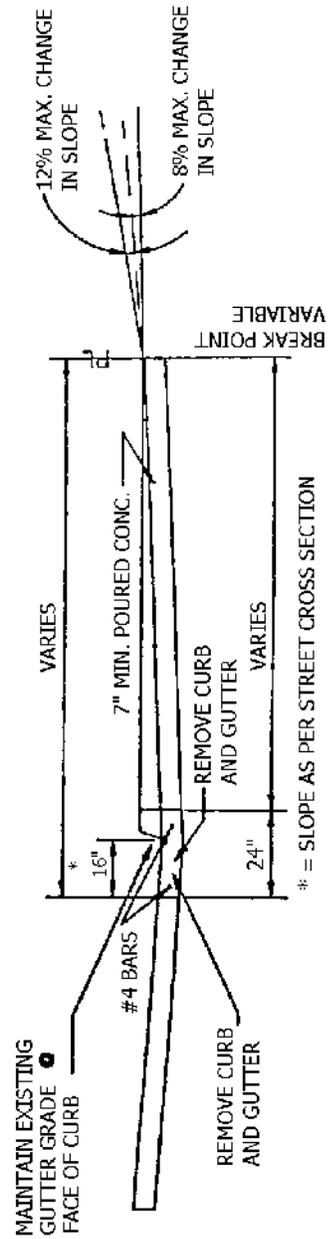
 <p>CITY OF BRANSON</p>	<p>ENGINEERING DEPARTMENT</p> <p>COMMERCIAL & MADDUX, BRANSON, MO 65616</p>	<p>APPROVED</p> <p><i>David P. Miller</i> 5/14/07 CITY ENGINEER DATE</p>
	<p>RESIDENTIAL DRIVE DETAIL w/ CG-2 CURB AND GUTTER</p>	<p>STANDARD DRAWING 22-6B</p>





NOTE: ENTRANCE TO DRIVE TO BE POURED MONOLITHICALLY

PLAN



SECTION E-E



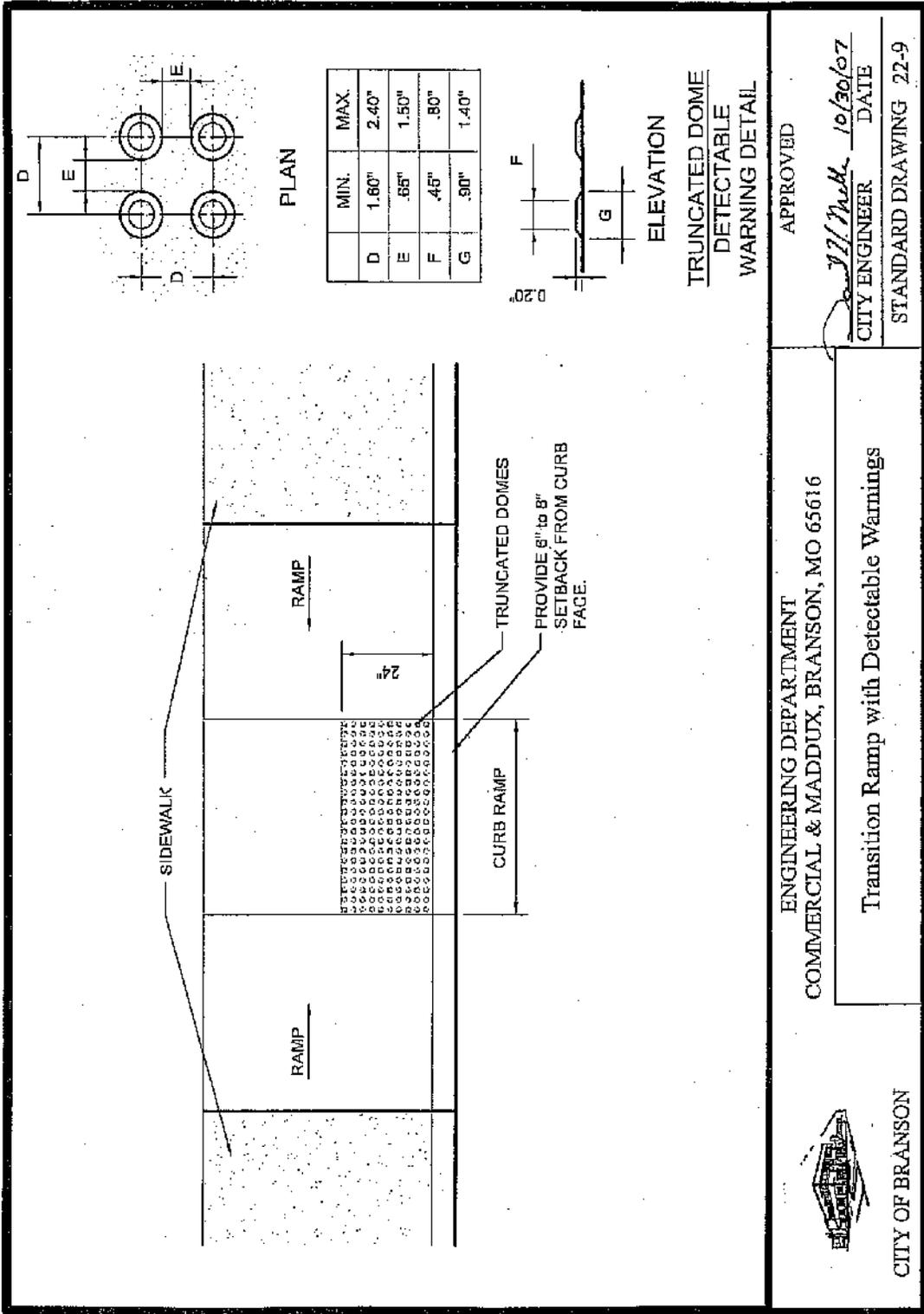
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65818

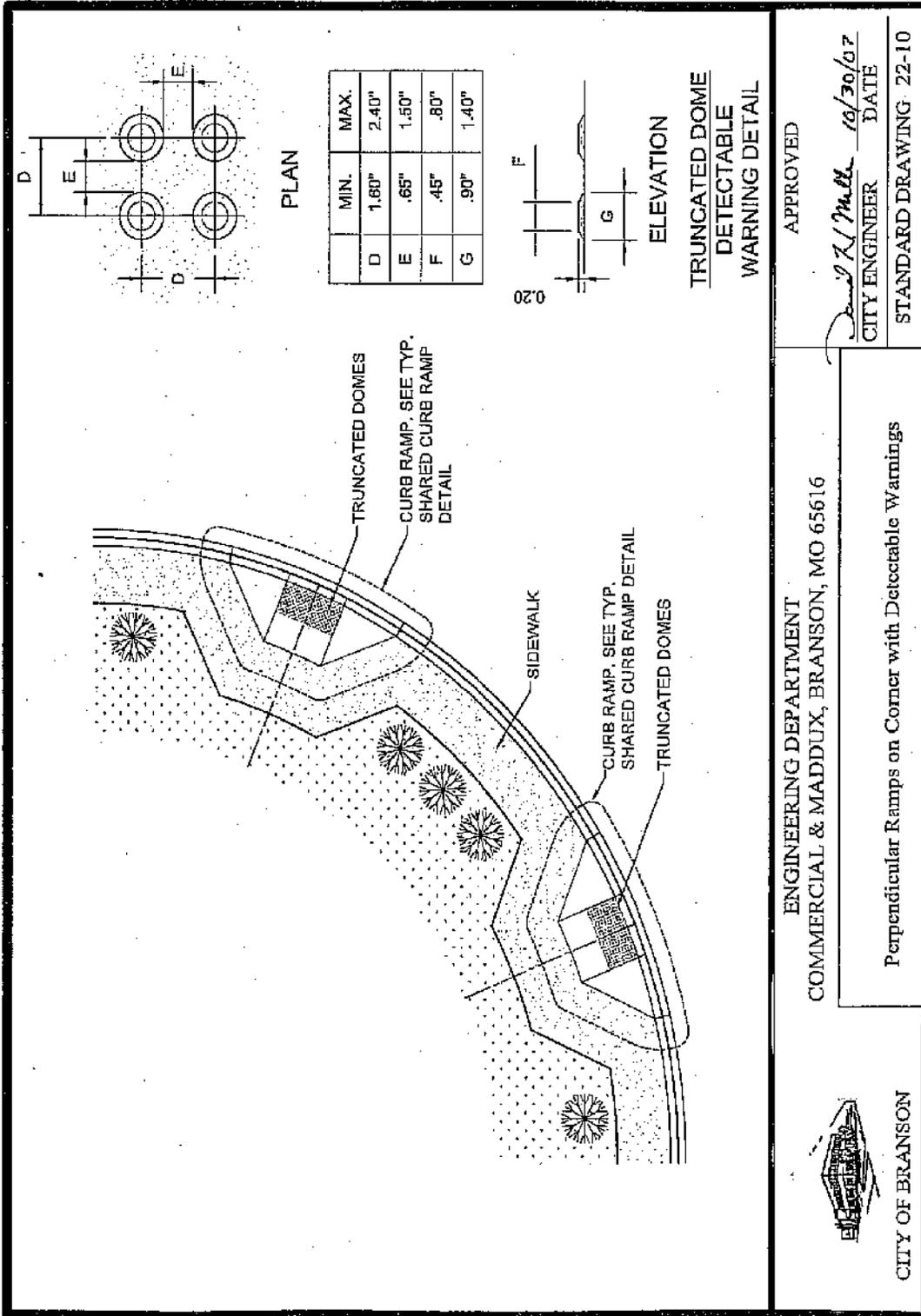
COMMERCIAL & INDUSTRIAL
ENTRANCE DRIVE
DETAIL

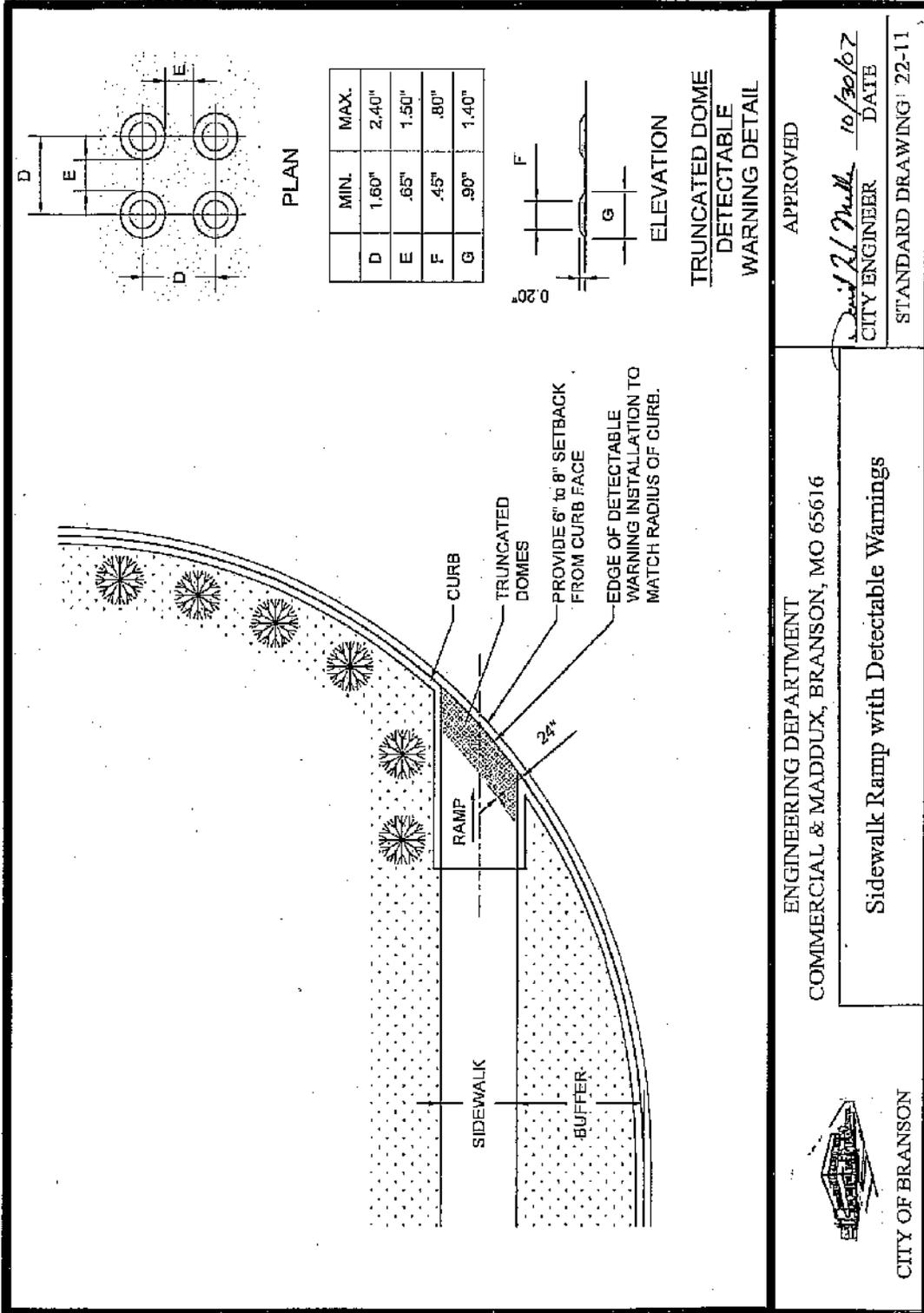
APPROVED

David H. Miller 8/13/70
 CITY ENGINEER DATE

STANDARD DRAWING 22-8





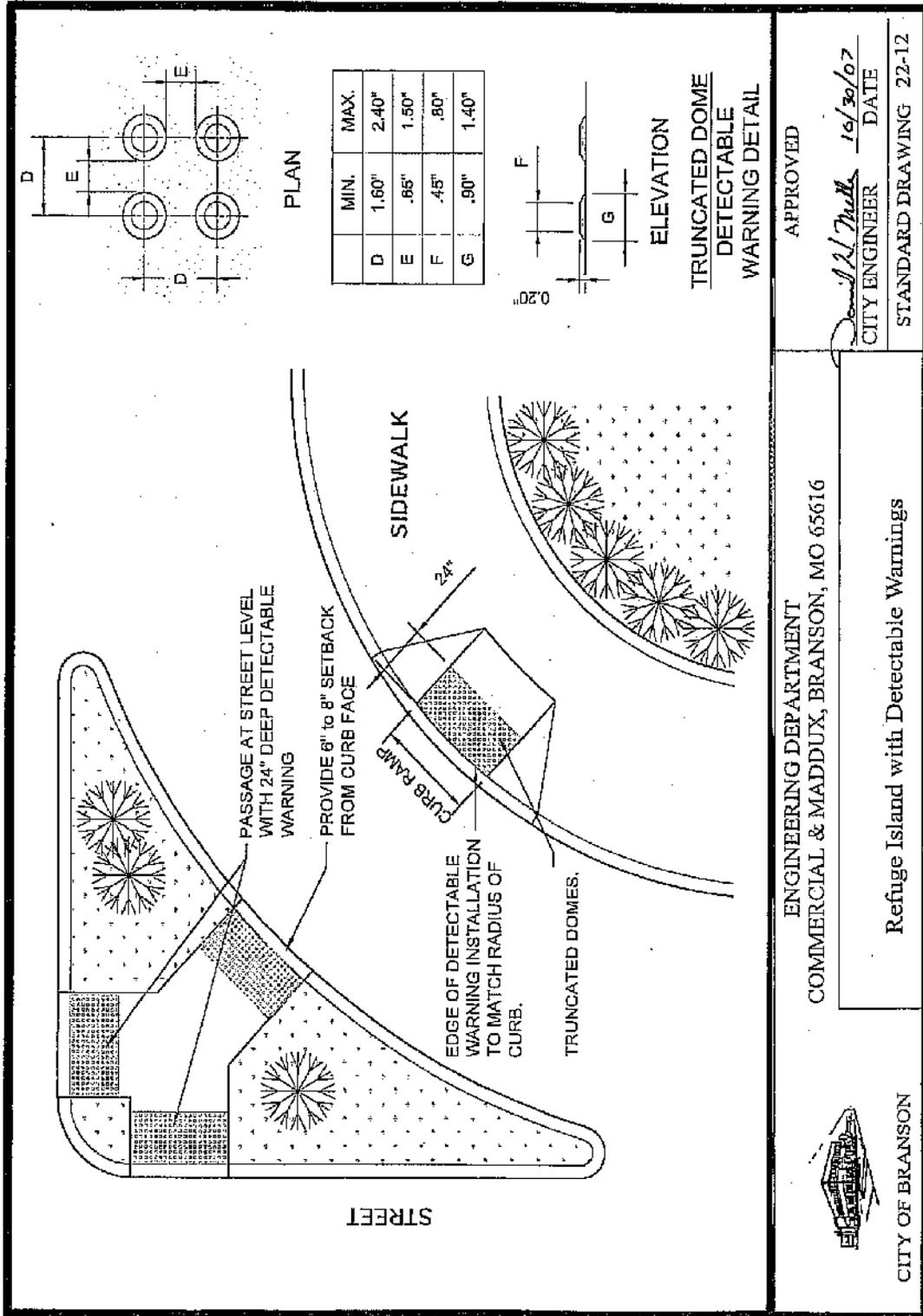


	MIN.	MAX.
D	1.60"	2.40"
E	.65"	1.50"
F	.45"	.80"
G	.90"	1.40"

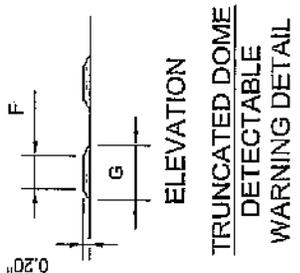
TRUNCATED DOME
DETECTABLE
WARNING DETAIL

APPROVED
David R. Mull 10/30/07
 CITY ENGINEER DATE
 STANDARD DRAWING: 22-11

ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65616
 Sidewalk Ramp with Detectable Warnings
 CITY OF BRANSON



	MIN.	MAX.
D	1.60"	2.40"
E	.65"	1.50"
F	.45"	.80"
G	.90"	1.40"



ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

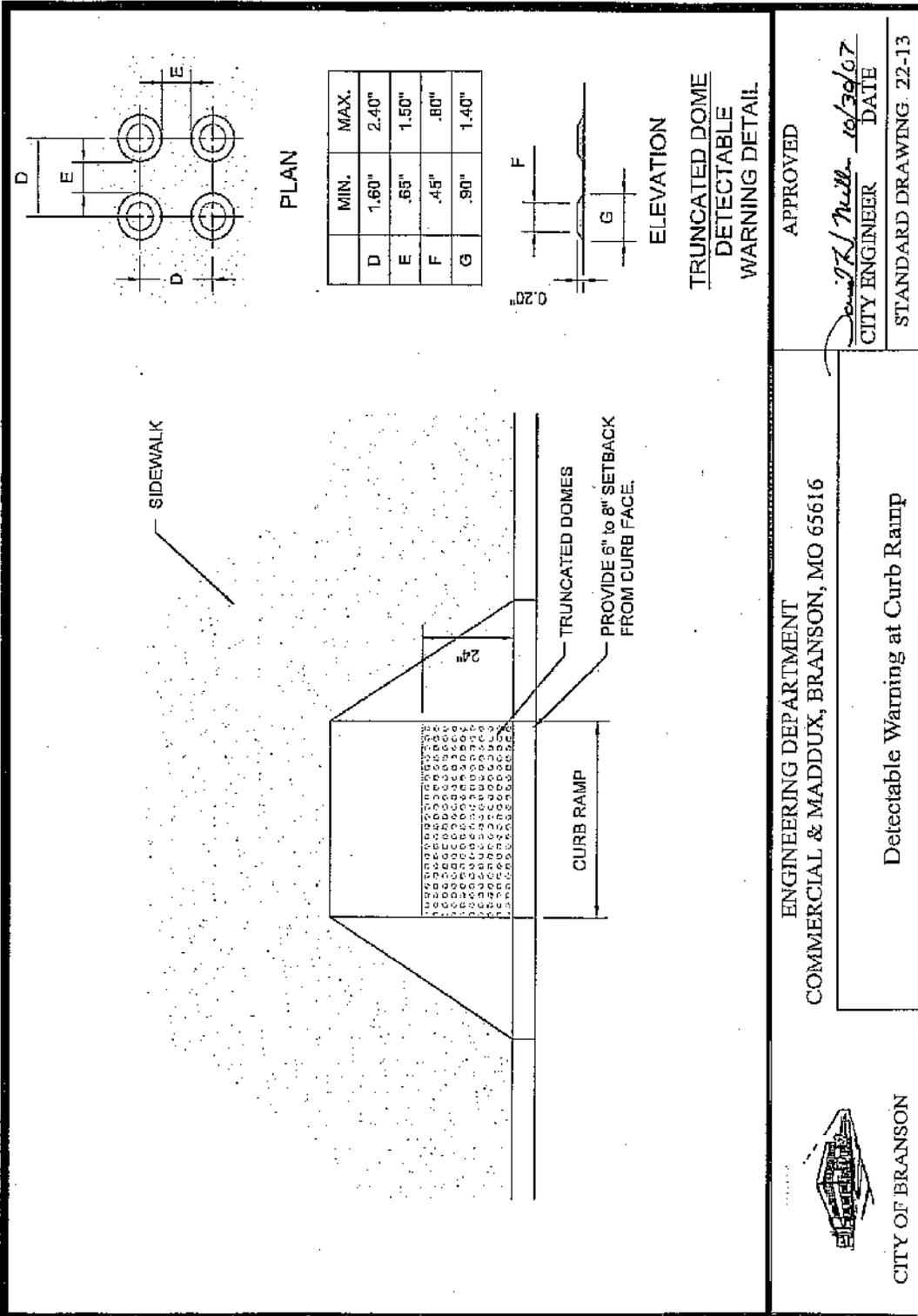
Refuge Island with Detectable Warnings

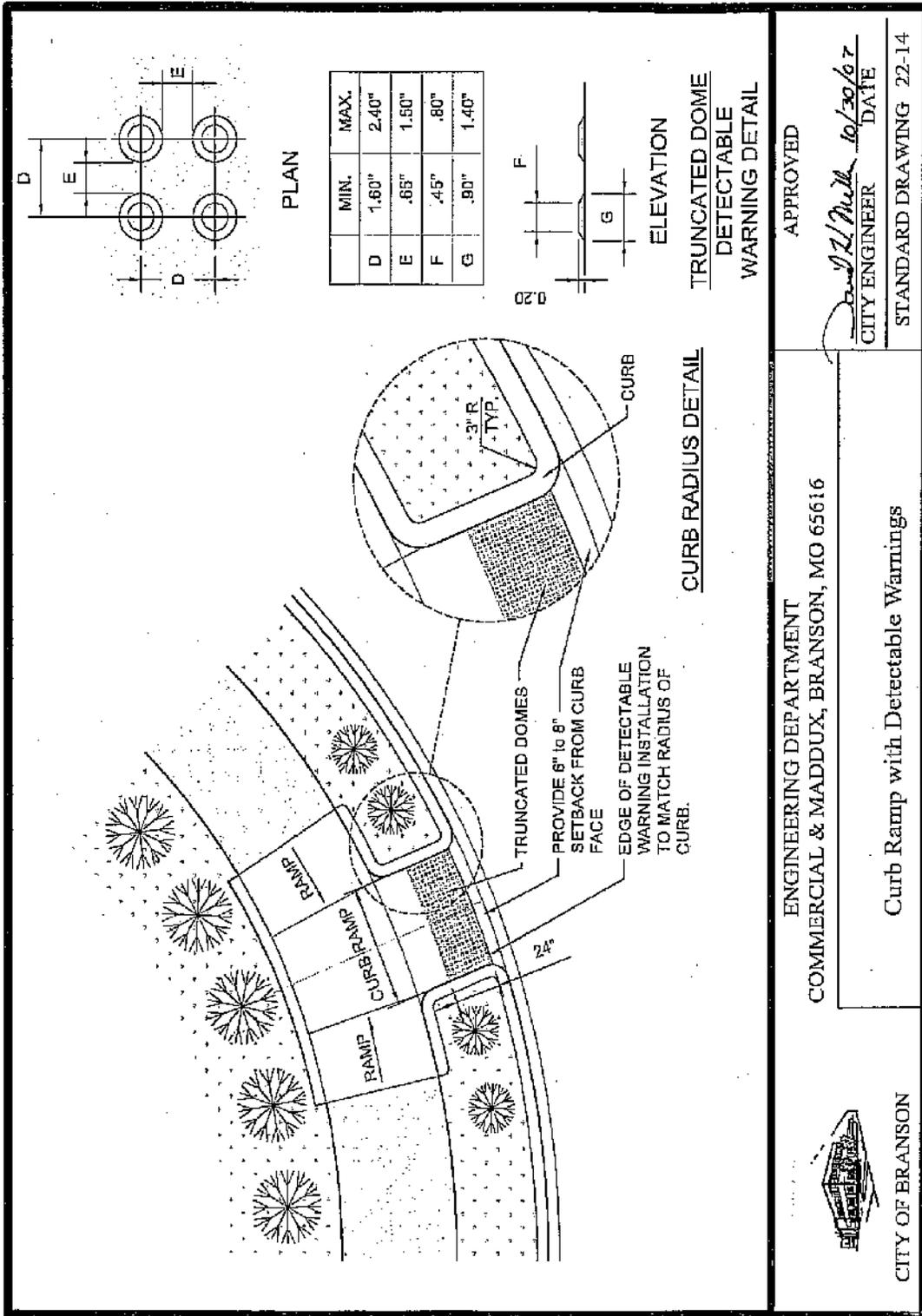
CITY OF BRANSON

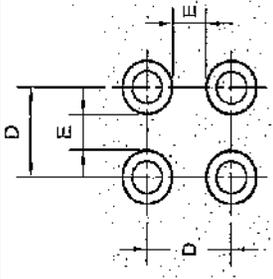
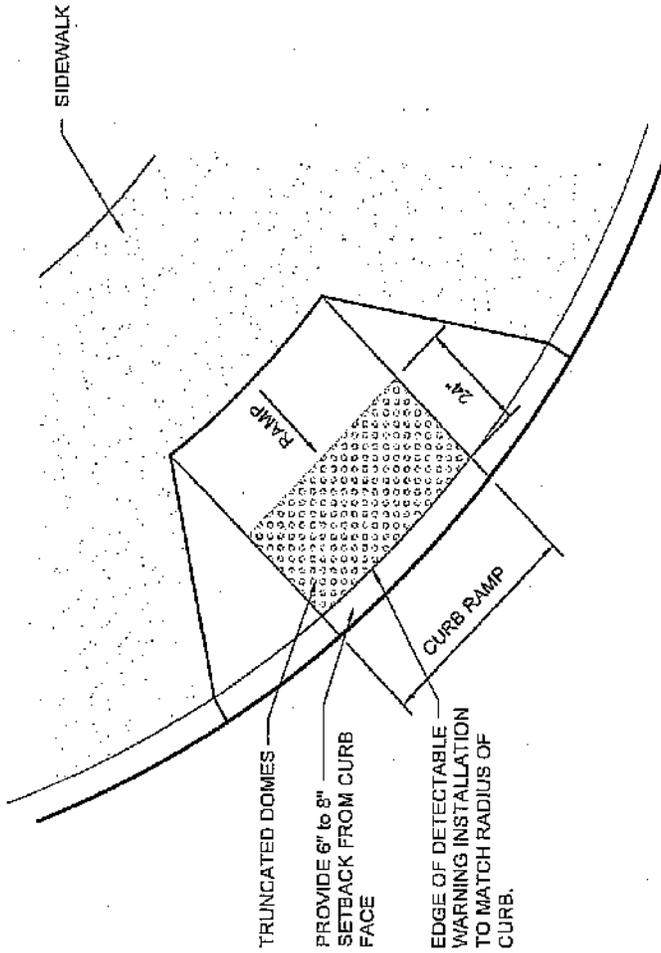
APPROVED

Donna M. Maddux
CITY ENGINEER 10/30/07 DATE

STANDARD DRAWING 22-12

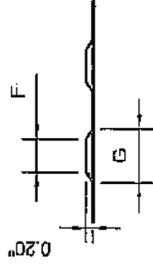






PLAN

	MIN.	MAX.
D	1.60"	2.40"
E	.65"	1.50"
F	.45"	.80"
G	.90"	1.40"



ELEVATION

TRUNCATED DOME
DETECTABLE
WARNING DETAIL

ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616



CITY OF BRANSON

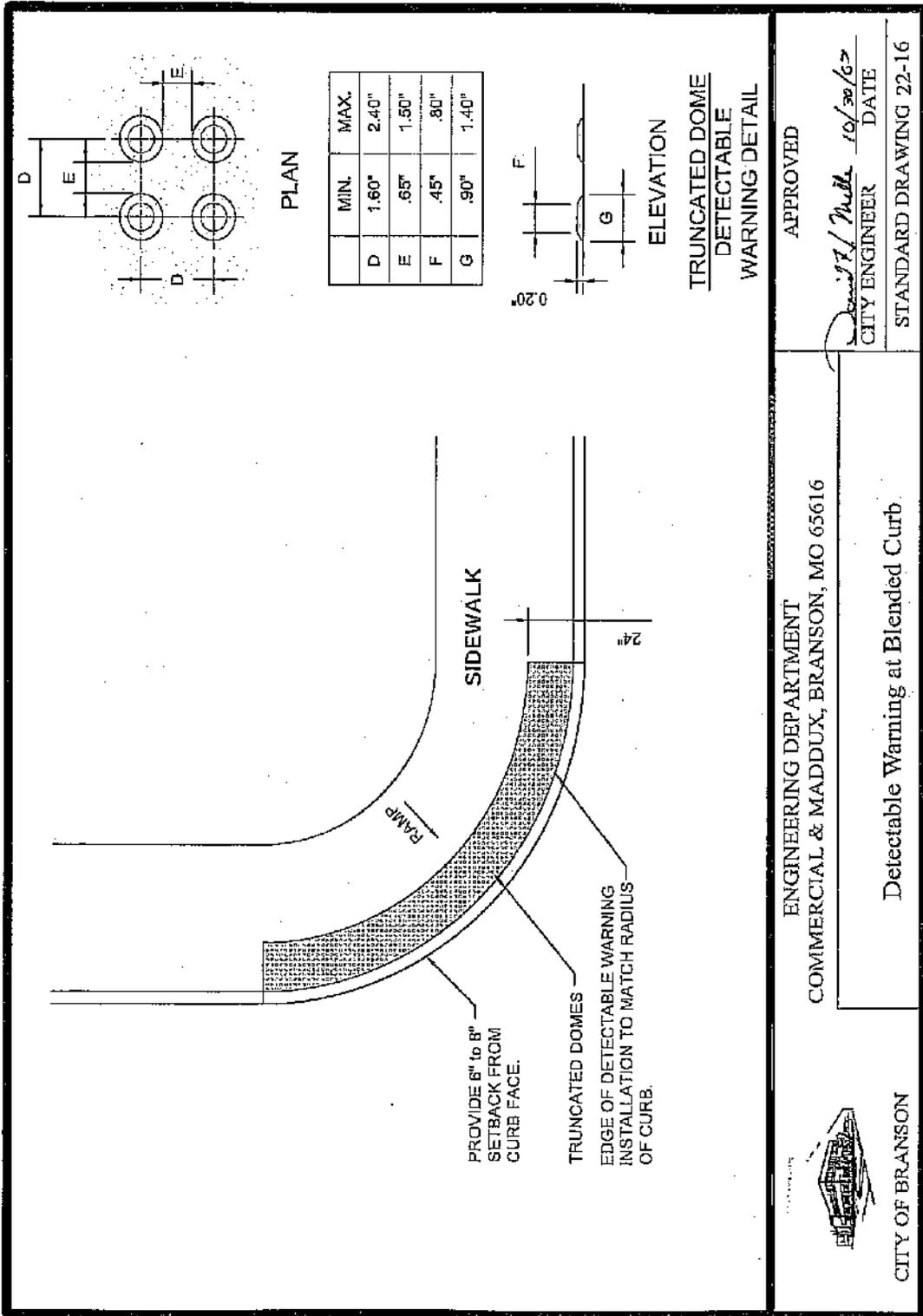
Shared Curb Ramp with Detectable Warnings

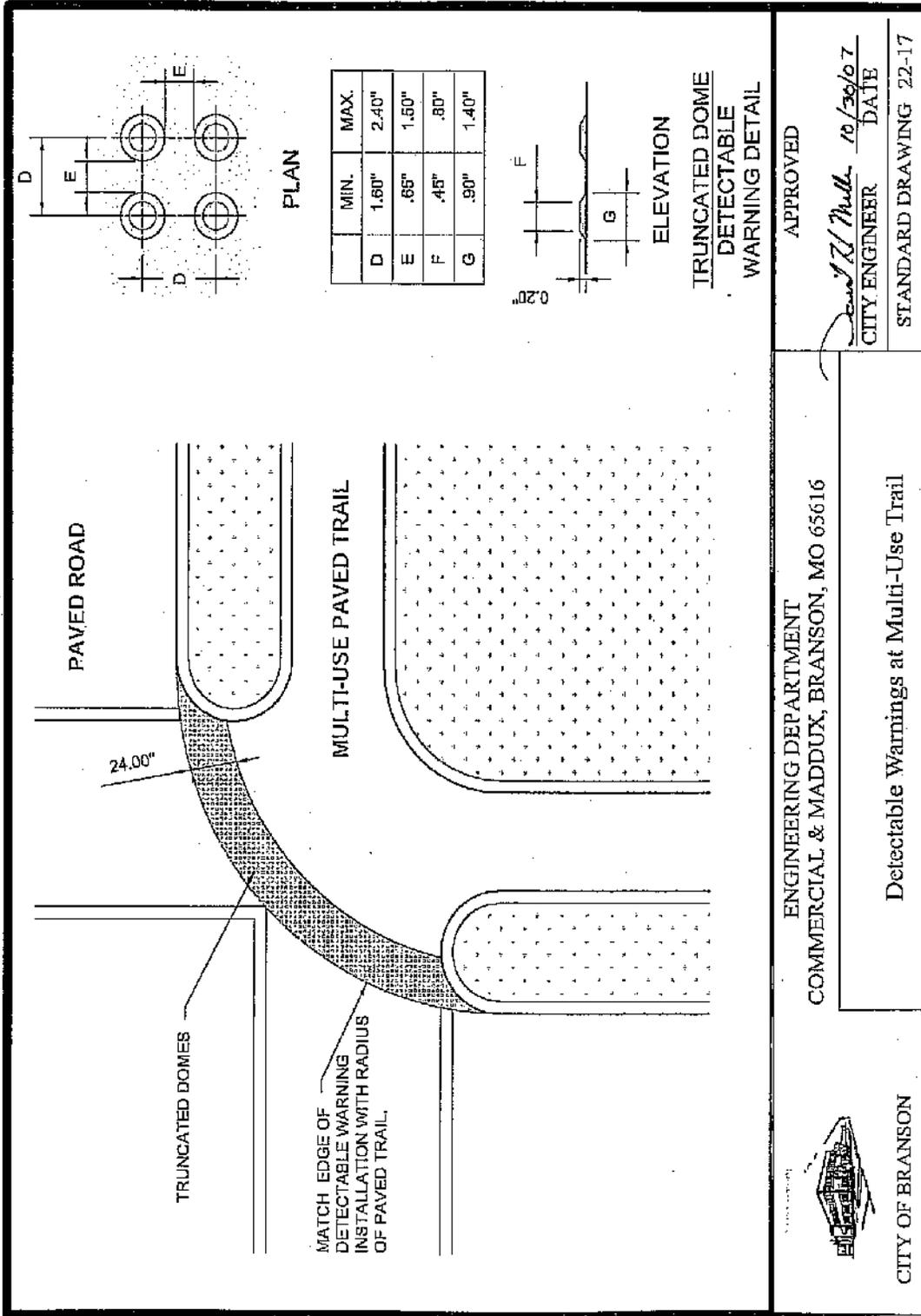
APPROVED

Daniel Maddux
CITY ENGINEER

10/22/07
DATE

STANDARD DRAWING 22-15





SECTION 2300 STEEL BEAM GUARDRAIL

2301 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary for the installation of steel beam guardrail as shown on the construction plans or standard drawings.

2302 MATERIALS.

- A. Steel Posts. All posts, terminal posts connectors, and steel blocks for guardrail shall be formed from a structural steel meeting the requirements of ASTM A-36.
- B. Guardrail and Hardware. All guardrail and hardware shall conform to the requirements of AASHTO M-180 Class A, Type I.

2303 ERECTION.

- A. Setting Posts. Posts shall be set to the depth and spaced at the intervals shown on the construction plans or standard drawings. They shall be set vertical and true to line and grade. Steel posts may be driven by a power hammer or may be set in, dug or bored holes of a size sufficient to permit thorough compacting of the backfill around the post. The backfill material shall be dry sand, placed in layers not exceeding 12 inches in thickness to a height 12 inches below the finished grade. After erecting and adjusting the rail to true line and grade, the sand backfill shall be compacted by flooding. The final 12 inches of backfill consisting of suitable earth material shall then be compacted in six inch lifts. Any "mushrooming" of the top of the post shall be removed and damaged spelter coating on posts shall be repaired by the Zinc alloy stick method while the surface is heated to approximately 600 deg F. Other methods of repairing the spelter coating shall receive prior approval of the Engineer.
- B. Placing Guardrail. Bolt holes shall be shop punched. Field punching, reaming and drilling will not be permitted. Guardrail beams shall be spliced, only at posts by lapping in the direction of traffic, using the required number of splice bolts. Beams for twisted turned down terminal sections may be either field or shop twisted. Sufficient twist shall be introduced such that the beam shall retain the required shape in a relaxed condition. Beams to be erected on a radius of 150 feet or less shall be shop-curved as shown on the plans.

Each end of every installation of guardrail shall have an end, bridge anchor, or terminal section of the design and type shown on the construction plans or standard drawings. They shall be of the same material and shall be galvanized in accordance with the requirements for the guardrail beam.

Galvanized rail shall be handled in a manner to avoid damage to the galvanized coating. Any sections of rail, end sections or terminal sections on which the spelter coating has been bruised or broken shall be rejected, or may, with the prior approval of the Engineer, be repaired by the method described for repairing damaged spelter coating of steel posts.

SECTION 2400 TRAFFIC

2401 GENERAL. The Contractor shall be responsible for maintenance, control, and the safeguarding of traffic within and immediately abutting the project as further outlined herein, and as may otherwise be provided for in the Special Provisions. The City will be responsible for maintenance, control, and safeguarding of traffic on all detours which do not lie within the project limits, unless otherwise required in the Special Provisions or contract drawings.

2402 STREET CLOSURES. Streets may not be closed to through traffic unless otherwise provided for in the Special Provisions. Streets shall not be closed to traffic until such closure has been approved by the Engineer. Street closures shall be made in such a manner as to provide for maximum public safety and public convenience, and if closed, shall be opened to through traffic at such time as the work has been completed, or as the Engineer may direct.

2403 EXISTING TRAFFIC SIGNS AND FACILITIES. The City, unless otherwise indicated, will make all necessary adjustments to traffic signals and traffic signal activators at no cost to the Contractor. Existing traffic and street name signs which will interfere with construction shall be removed by the Contractor and stored in a safe place. These signs shall not be removed until the Engineer has so directed and until the necessary measures have been taken to safeguard traffic after the signs have been removed. Preservation and maintenance of the signs shall be the sole responsibility of the Contractor. Upon completion of the project, the Contractor shall reset all such signs.

2404 DETOURS. Detours outside the limits of the project shall be the sole responsibility of the Contractor unless otherwise provided in the Special Provisions. Detours within the limits of the project such as side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction are for maintenance of traffic, and such related facilities for the maintenance of traffic shall be the responsibility of the Contractor, the costs which shall be included in the unit contract prices unless otherwise provided for in the Special Provisions. All detour signage shall conform to the standards set forth in MUTCD.

2405 LOCAL AND EMERGENCY TRAFFIC. Local traffic shall be provided access to private properties at all time, except during some urgent states of construction when it is impracticable to carry on the construction and maintain traffic simultaneously, such as for the placing of asphalt concrete pavement, placing and curing of portland cement concrete pavement, and deep sewer excavations which prohibit safe travel of vehicular traffic. No private driveway may be closed without the approval of the Engineer, unless written permission has been given the Contractor by the owner of the property affected.

Emergency traffic such as police, fire and disaster units shall be provided reasonable access at all times. The Contractor shall be liable for any damages which may result from his failure to provide such reasonable access.

2406 PROTECTION OF PEDESTRIAN AND VEHICULAR TRAFFIC. The Contractor shall take every precaution to protect pedestrian and vehicular traffic. Whenever, in the opinion of the

Engineer, the Contractor has not provided sufficient or proper safety precautions and safeguards, he shall do so immediately and to whatever extent the Engineer deems advisable.

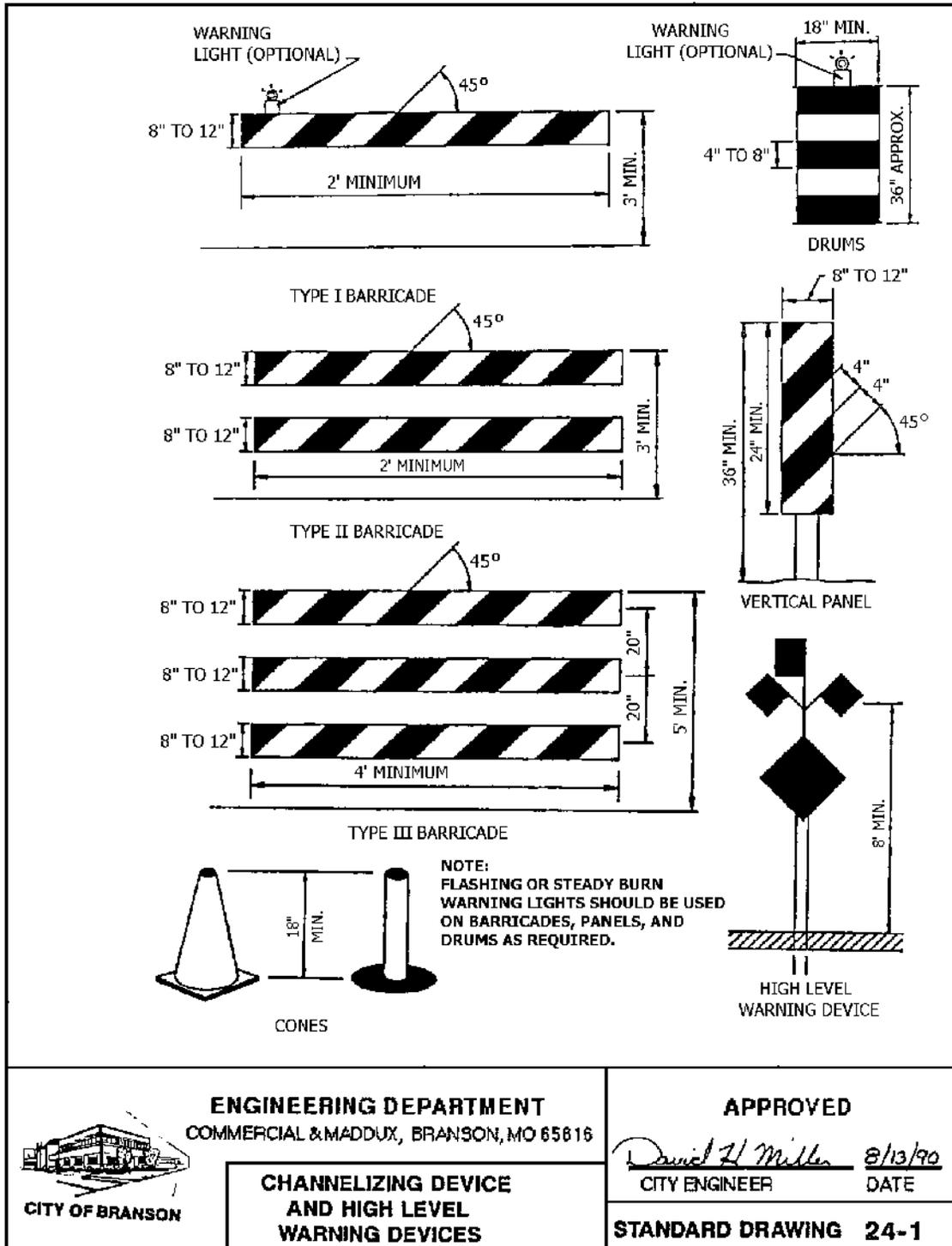
2407 RESTRICTION OF PARKING. Where parking is a hazard to through traffic or to the construction work, it shall be restricted either entirely or during the time when it creates a hazard. Signs for this purpose will be initially furnished and placed by the City unless indicated otherwise. The Contractor shall be responsible for and shall maintain the signs if they are used on any street which is directly involved in the construction work. If the parking signs are to be used beyond the confines of the work area, such as another street being used as a detour, the signs will be the responsibility of the Contractor.

2408 FLAGMEN. The Contractor shall furnish at his own expense all flagmen who may be needed unless otherwise provided for in the Special Provisions.

2409 TRAFFIC CONTROL WITHIN AND ABUTTING THE PROJECT. The contractor shall place and maintain all signs, barricades and warning lights within the limits of the project on all streets, alleys, and driveways entering the project so that approaching traffic will turn right or left on existing and undisturbed streets before reaching the warning signs and barriers immediately abutting the project. Unless otherwise provided for in the Special Provisions, all required signs will be furnished by the Contractor.

Barricades shall be furnished by the Contractor. The barricades shall be of a conventional design normally used in street construction work, and painted a current traffic yellow with black stripes as shown in Part VI of the Manual on Uniform Traffic Control Devices, latest edition.

2410 FLASHERS. Flashers used shall be a type approved by the Engineer with a 7 inch lens, amber in color, and reflectorized rim. The rate of flashes shall be regular and shall be between 50 and 60 flashes per minute + or - 5 percent; the "on" time shall be at least 25 percent of the cycle + or - 5 percent. Batteries shall be replaced in flasher units when the voltage is less than 4.6 volts for a 6-volt unit and 9.2 volts for a 12-volt unit.



SECTION 2500 PLANING

2501 SCOPE. This section governs the furnishing of all labor, equipment, tools and materials and the performance of all work required for planing pavement surfaces.

2502 EQUIPMENT. Planing the surface of pavements shall be completed by the use of a planer conforming to one of the two following types:

A. Heater Planing.

1. Machine. The heater planing machine shall be designed and built for planing work, be self propelled and shall have the means of heating, planing and cutting the old surface and blading the cuttings into a single windrow.
2. Heater. The machine shall be equipped with an adequate pavement surface heater to heat the surface to the optimum temperature for planing.
3. Operating Width. The heating and cutting width of the machine shall be the same and shall not be less than 8 feet.
4. Drive Wheels. The rear driving wheels shall be tandem to protect the softened surface of the pavement.
5. Speed. The machine shall be capable of operating at a speed compatible with the heating capacity of the burner.
6. Power. The planer shall have adequate power to force the cutting edge to the proper depth below the surface of the heated pavement without chattering or causing irregularities in the surface of the planed pavement. This machine shall have enough power to operate all auxiliary equipment without interfering with the performance of the machine as a planer.
7. Air Pollution. The machine shall comply with current air pollution standards.
8. Warning Lights. The planing machine shall be equipped with a flashing warning light visible from 360 degrees. The light shall be mounted near the rear of the machine, at least 2 feet above the highest part of the planing machine, and shall be used whenever the machine is being used or moved upon City streets.

B. Cold Planing.

1. Machine. The cold planing machine shall be self-propelled and shall have in combination the means of planing and cutting, without softening, the old surface and blading the cuttings into a single windrow.
2. Air pollution. The machine shall be equipped with a dust suppression system

including water storage tanks and high pressure spray bars.

3. Operating Width. It is desirable that the cutting width be greater than 5 feet. In the event the cutting width is less than 5 feet a system of electronic grade control for consecutive passes will be required.
4. Cutting Drum. The cutting drum shall be totally enclosed to prevent discharge of any loosened material on adjacent work areas.
5. Warning Lights. The planing machine shall be equipped with a flashing warning light visible from 360 degrees. The light shall be mounted near the rear of the machine, at least 2 feet above the highest part of the planing machine, and shall be used whenever the machine is being used or moved upon the City streets.

2503 CONSTRUCTION DETAILS.

A Methods of operations for Planing:

1. Operator. The planing machine shall be operated by an experienced and capable operator.
2. Utilities. Street surfaces adjacent to manholes, water valves and other utility extensions, shall be completely removed to the full depth of cut specified for the street unless otherwise specified by the Engineer.
3. Material Disposal. The material left windrowed by the machine, or removed by hand labor methods, shall be removed immediately from the surface of the pavement and disposed by the Contractor at a disposal area designated or as directed by the Engineer.
4. Surface Conditions:
 - a. Heater Planing. The temperatures at which the work is performed, the nature and condition of the equipment and the manner of performance of the work shall be such that the pavement is not torn, gouged, broken or otherwise damaged by the planing operation.
 - b. Cold Planing. The drum lacing patterns shall produce a smooth surface finish after planing, with groove depths not to exceed 1/4 inch unless otherwise approved by the Engineer.

B. Types of Cuts to be made by Planing:

- 1 Leveling. Sufficient passes, shall be made such that all irregularities or high spots are eliminated, and that 100 percent of the surface is planed.

2. Average Depth. Sufficient passes, or cuts, shall be made in order to remove a specified depth over the entire street section. These depths will be designated in the Special Provisions or as directed by the Engineer.
 3. Bridge Deck Planing. Sufficient passes, or cuts, shall be made in order to remove the material as specified on the plans or in the Special Provisions.
- C. Clean-up. All loose asphalt and debris shall be removed from the street surface and curb and gutter. Any material and debris that adheres to the curb and gutter shall be removed.

SECTION 2600 PAVEMENT CRACK SEALING, STREET CHIP SEAL, AND STREET SLURRY SEAL

2601 SCOPE. This section governs the furnishing of all labor, equipment, tools and material, and the performance of all work necessary for minor pavement patching and crack cleaning and sealing, construction of asphalt seal-coat and slurry seal, complete, in place, at the locations specified in the Special Provisions and as directed by the Engineer.

2602 CRACK SEALING.

A. Crack Sealing Material. Asphalt Material used for crack sealing shall be RC-250, 800 or 3000 with 1 per cent anti-stripping agent added as specified in the contract or as directed by the Engineer. The temperature range for these RC's shall be 240-290 deg F when applied.

When the ambient temperature exceeds 60 deg F the material used for crack sealing may be emulsified asphalt Designation CRS-1 or CRS-2.

B. Weather Limitations. Crack sealing shall be performed only on days when the ambient temperature is greater than 25 deg F and rising at the time work is to begin. Crack sealing shall not be done on days when ice or other conditions prevent proper cleaning of the cracks.

C. Distributor. A distributor as listed in Section 1305 is required for handling the liquid asphalt for crack sealing.

D. Aggregate for Blotting. "Buckshot Aggregate" shall be clean and dry and conform to the following gradation:

Sieve Size	Percent Passing
No. 4	90-100
No. 10	0-15

E. Cleaning. All cracks shall be thoroughly cleaned of undesirable material by the use of an 85 to 90 C.F.M. compressor with air hoses and attachments.

F. Filling Procedure. After all cracks have been thoroughly cleaned, the operator of the hand hose shall apply hot liquid asphalt to the cleaned cracks. Application of the liquid asphalt shall be done in such a manner to avoid an accumulation of excess material on areas adjacent to the cracks. Excess material on the cracked areas shall be redistributed by means of a U-shaped squeegee.

2603 CHIP SEAL.

A. Description. This work shall consist of the application of asphaltic cements and cover aggregate to an existing improved street surface.

B. Requirements for Materials to be used for Street Sealing.

1 Asphalt Cement.

- a. The asphalt cement for sealing shall be 85-100 penetration grade, complying with ASTM D-946.

The material shall be sampled and tested as set forth by Section 4 of ASTM D-946.

- b. A sample of the liquid bituminous materials may be taken from each distributor or relay on the job site. If the liquid bituminous materials do not meet the specifications as set out in the contract after applying, the Contractor shall correct, at his own expense, all unsatisfactory areas. No additional areas shall be sealed until corrections have been accomplished

2 Cover Aggregates.

a Precoated Limestone.

- (1) Aggregate. This material shall be precoated limestone chips that meet current edition of the Missouri Department of Transportation specifications, or other materials approved by the Engineer. Stone chips for seal coating shall be precoated with 3/4 to 1 percent by weight of MC-70, as specified in Paragraph 4. All material shall be free of moisture, dust and lumps and shall be approved by the Engineer prior to use.

The chips shall be uniformly heated in a dryer until surface dry. The asphaltic material and hot aggregate shall be measured separately and accurately immediately before introduction into the mixer. Mixing shall be at a suitable temperature and sufficient to produce a thoroughly and uniformly coated aggregate. Precoated seal coat chips shall be stockpiled at least 3 days before using.

- (2) Gradation. Limestone chips to be used for sealing shall, when graded through sieves with square openings, conform to the following percentages:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2"	100
3/8"	95-100
No. 4	18 Max.
No. 10	0-2

- (3) Physical Properties. The chips, when tested by Los Angeles Abrasion test shall have a percentage of wear not to exceed 35 percent after 500 revolutions as determined by ASTM C-131. The shale content of the material shall not exceed 0.5 percent by

weight. The materials shall be free of acid or other deleterious substances.

- (4) Asphalt Coating. Asphalt for the coating of limestone cover aggregate shall be MC-70 conforming to ASTM D-2027, Liquid Asphalt, Medium Cure.

b Lightweight Cover Aggregate.

- (1) Aggregate. Lightweight cover aggregate consists of expanded shale produced by the rotary kiln method and shall comply with the quality and gradation requirements as set forth in these specifications.

- (2) Unit Weight. The dry loose weight of Lightweight Cover Aggregate shall not be less than 39 nor more than 48 lbs per cubic foot.

- (3) Quality Requirements.

- (a) Soundness. The loss ration for Lightweight Cover Aggregate shall not be less than 0.90 when subjected to 25 cycles of the freezing and thawing test as set forth in Section 4, MCIB Specification.

- (b) Wear. The percent loss shall not exceed 25 percent when tested by the Los Angeles Abrasion Test Method (ASTM C-131).

- (c) Deleterious Substances. The deleterious substances in each individual aggregate shall not exceed the following percentages by weight:

Sticks (wet weight)	0.5
Coal	0.5
Soft Friable Materials	2.5
Unburned or Underburned Shale	0.5

The above percentages are when taken separately. In addition, any combination of the above shall not exceed 3.0 percent.

- (d) Absorption. The water absorption of the expanded shale aggregate shall not exceed 18 percent when soaked for 24 hours.

- (4) Gradation. Lightweight cover aggregate shall conform to the grading requirements as follows:

Sieve Size	Percent Passing
3/8	100
No. 4	0-15
No. 8	0-2
No. 100	0-0.5

c Weighing of Cover Aggregate.

The Contractor shall furnish scales for weighing cover aggregate as required in Section 1407 entitled "Scales and Weighing of Vehicles." All loads of cover aggregate will be weighed and evidenced by approved delivery tickets showing the net weight in pounds for each load. Two copies of each ticket shall accompany the load to the work site. Upon the load being incorporated in the work, both copies will be signed by the inspector and one of these copies will be returned to the Contractor.

C. Spot Patching.

Holes, where the surface is broken out, shall be cleaned of any loose material. Holes shall be tacked with a light coating of emulsified asphalt. The tack coat shall extend beyond the limits of the patch.

The emulsified asphalt used for the tack coat shall be either CRS-1, RS-1, MS-1 or SS-1h conforming to ASTM D-977. Patches shall be made in holes or depressions where the surface is in good condition. The Engineer will indicate the extent to which patches shall be made.

The prepared hole shall be patched with hot-mix asphaltic patching material by placing in layers not to exceed 2 inches; each layer being thoroughly compacted before the next layer is placed. After the patching material is placed and raked to a uniform surface, it shall be thoroughly compacted by rolling with a tandem or three-wheeled roller with a minimum weight of 180 pounds per lineal inch of roller. The edges shall be will bonded with the old surface. The completed patch shall be in the same plane as the existing pavement.

The asphaltic concrete used for patching at the different locations shall be as directed by the Engineer and shall conform to one of the mixes as set out in Section 1404, for Types 3 and 4 Asphaltic Concrete Surface. Generally the Type 4 mix shall be used for patching.

D. Sealing.

- 1 Cleaning. After all holes and cracks have been repaired to the satisfaction of the Engineer, and immediately before sealing the Contractor shall thoroughly clean

the area to be sealed. The street shall be dry before applying the seal coat.

- 2 Sealing. After the street has been prepared as set forth above the Contractor shall apply the liquid asphalt by means of an approved distributor meeting the requirements of Section 1305. Provisions shall be made by the Contractor to properly protect the curbs and gutters from the asphaltic spray. Liquid bituminous material shall be applied at a rate between 0.16 and 0.22 gallons per square yard. The specific rate for each job will be determined by the Engineer in the field.

To insure uniform application of the bituminous material to the street surface at the beginning of each distributor load or portion thereof, the Contractor will be required to cover a portion of the street surface with building paper. The area covered by the building paper shall be used as the starting point for each distributor load or each part of a distributor load after a temporary delay, and the spray bars shall be discharged on this paper until all nozzles are working properly. After use, the building paper shall be removed and disposed of by the Contractor.

Immediately after the application of the asphalt, the Contractor shall by means of a self-propelled mechanical spreader, apply a uniform layer of cover aggregate. This material shall be spread at the rate specified by the Engineer. This rate shall be between 10 and 20 pounds per square yard for pre-coated limestone chips and between 8 and 10 pounds per square yard for lightweight aggregate. If material is spread on any area in excess of the amount specified by the Engineer, the surplus shall be immediately removed and placed elsewhere as directed. No payments will be made to the Contractor for the picking up and redistribution of each excess. Hand spreading will be permitted only in those areas not accessible to the mechanical spreader.

Immediately after spreading the cover aggregate, the entire surface shall be rolled with multiple wheel, pneumatic-type rollers. Rolling shall be continued until a thoroughly compacted surface with a uniform aggregate coverage has been obtained. The Engineer may require additional rollers if one roller cannot keep up with the operations. The first pass of the rollers over the cover aggregate shall not exceed 5 miles per hour. The rollers shall not exceed 10 miles per hour during any rolling operation.

Where double sealing is specified or directed by the Engineer, the area shall be treated with two coats. The top seal coat shall be applied the same day as the first seal coat. Double sealing will be performed in the same manner as set out for sealing.

The Contractor shall seal all roadway areas within the street right-of-way, except private driveways, including sealing of intersections, alleys, etc, to the property line.

During the sealing operation as described above, the Contractor shall cooperate with the Engineer in arranging a program and schedule of work so traffic may be handled or routed around or thorough the section being sealed. Whenever possible, the street will be closed; but when this is not possible, the sealing will be done in strips while traffic is diverted to the balance of the street. No traffic will be permitted on the sealed portion of the roadway until rolling is completed.

When bleeding occurs or more material is required, additional cover aggregate shall be spread as directed. As soon as the cover material has adhered to the surface, all excess cover aggregate shall be immediately removed.

2604 SLURRY SEAL.

A. Description. This work shall consist of the application of Slurry Seal Material to an existing surface. The Slurry Seal shall consist of a mixture of emulsified asphalt, mineral aggregate and water, properly proportioned, mixed and spread on the surface in accordance with this specification and as directed by the Engineer.

B. Materials.

1. Emulsified Asphalt. The Emulsified Asphalt to be used for this work shall be CRS-1h unless otherwise specified.
2. Aggregate for Slurry Seal. The mineral aggregate used for this work shall be chat aggregate which is a by-product of the milling of lead and zinc ores and shall conform to the following grading requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
No. 4	82-94
No. 8	45-65
No. 16	25-46
No. 30	15-35
No. 50	10-25
No. 200 *	5-15

* The percent passing the No. 200 Sieve shall be determined by ASTM C-117.

3. Mineral Filler. Mineral Filler shall be any recognized brand of Portland Cement that is free from lumps.
4. Water. Water shall be potable and shall be free of harmful soluble salts.

C. Equipment.

1. Slurry Mixing Equipment. The slurry mixing machine shall be self-propelled.

Sufficient storage capacity for aggregate, emulsified asphalt, cement and water shall be provided to properly mix and apply a minimum of 8 tons of aggregate without the use of auxiliary tracks and tanks. The mixed unit shall be capable of delivering to the spreader unit a properly proportioned and thoroughly mixed slurry on a continuous flow basis.

The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler at the same time and location that the aggregate is fed.

2. Slurry Spreading Equipment. Attached to the slurry mixing machine shall be a squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor box. The rear flexible seal shall act as a strike off and be adjustable in width. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. A burlap drag will be required to obtain the desired texture. The box shall be equipped with a steering device and shall be kept clean and free of any build up of asphalt and aggregate.

- D. Proportioning. The Engineer shall approve all Slurry Seal Materials and methods prior to mixing and application. The proportions of the mixture to be used shall be as follows unless variations are approved by the Engineer:

Aggregate for Slurry Seal	13.5 to 16.5 lbs per sq. yd. (dry basis)
Emulsified Asphalt	9.5 to 10.5 percent by weight of dry aggregate.
Mineral Filler (added)	1.5 to 3.0 percent by weight of dry aggregate.
Water	Quantity to produce proper consistency.

Once the proper consistency is obtained changes in proportioning of the various components of the mixture shall be held to a minimum.

- E. Construction Requirements.

1. Surface Preparation. Immediately prior to applying the Slurry Seal the surface shall be thoroughly cleaned of all objectionable materials and pre-wetted, leaving no standing water.
2. Application. The mixture shall be spread to leave a uniform non-skid film of fine aggregate and asphalt on the surface. Squeegees shall be used to spread the

Slurry Seal mixture in areas inaccessible to the spreader box and other areas where hand spreading may be required. A hand drag shall be used at these locations to give the same texture as the machine-layed surface.

A sufficient amount of slurry shall be carried in all parts of the spreader box at all time so that complete coverage is obtained. No lumping, balling, or unmixed aggregate shall be permitted. Any oversized aggregates or foreign materials shall be removed from the aggregate prior to delivery to the mixing machine. No streaks or slick spots shall be left in the unfinished surface.

3 Weather Limitations. Slurry Seal shall be placed only when the surface temperature is 60 deg. F or above, the relative humidity is below 80 percent and no precipitation.

F. Property Owner Notification. The Contractor shall supply and place door tags on the doors of all involved property owners. The door tag shall comply with the following sample or an approved equal.

TOMORROW YOUR STREET WILL BE CLOSED

SORRY	to inconvenience you but your street must be seal coated. <u>All cars must be off the street.</u>
SEAL COATING	is necessary to prevent weathering and deterioration of the pavement surface.
TOMORROW	weather permitting we will be blocking off your street at <u>8 a.m.</u> for as long as it takes to apply the seal coat and allow ample curing time. When barricades are taken down later in the day you can again use the street.
WITH THIS PROCESS	we will eliminate all dust and loose stone usually associated with seal coating. The new surface will be jet black and improve the appearance of your street and neighborhood.
IN CASE OF RAIN	the street will be open but will be closed without further notice when weather improves. If unable to complete seal coating in one day, the street will be open overnight but closed the next morning. To prevent tracking, caution children to stay off the seal coat until it is dry.

2605 PROVISIONS FOR PUBLIC CONVENIENCE DURING SEALING OPERATION. The Contractor shall provide and maintain sufficient signs, barricades, warning lights, flag persons and watch persons to protect the work and public in a manner satisfactory to the Engineer. Any areas damaged prior to acceptance by the City shall be repaired at the Contractor's expense.

Signs for "No Parking" to be used will be furnished by the Contractor. These signs shall comply with the standards established by the MUTCD with regard to size, color, wording, height and placement. When "No Parking" signs are posted on the streets with parking meters, the Contractor shall cover the parking meter heads with cloth or paper bags.

The Contractor shall take all necessary precautions to protect the public (pedestrian and vehicular) from flying debris. The Contractor shall use warning signs and devices to warn motorists of work ahead and shall use traffic cones where necessary to guide traffic.

SECTION 3000 MATERIALS AND CONSTRUCTION - SANITARY SEWERS

3001 GENERAL. Sanitary sewer construction shall consist of furnishing all labor, materials and equipment for the complete installation of sewers and appurtenances.

3002 SPECIFICATION MODIFICATIONS. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the contract drawings.

3003 MATERIALS AND TESTING. Furnish pipe of materials, joint types, sizes, and strength classes indicated and specified. Higher strengths may be furnished at the Contractor's option and at no additional cost to the Owner.

The manufacturer shall be experienced in the design, manufacture and commercial supplying of the specific material.

Testing is to be performed by the manufacturer's quality control personnel in conformance with applicable standards.

Testing may be witnessed by Owner, Engineer, or approved independent testing laboratory. Upon request of the Owner, and prior to delivery, the Contractor shall provide three (3) copies of certified test reports indicating that material does conform to the specifications.

No pipe or fitting shall be delivered until approved by the Materials Laboratory and are so marked. The manufacturer and contractor shall use equipment and methods adequate to protect pipe, joint elements and prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or watertightness will be rejected.

3004 REINFORCED CONCRETE PIPE. Conform to ASTM C76, C 497, C 506, and C 507, except as otherwise noted herein.

- A. Materials. Cement shall not contain tricalcium aluminate in excess of 5.0 percent. Fine aggregate shall be natural sand conforming to the requirements of MCIB Bulletin No. 1.
- B. General. Furnish maximum lengths manufactured by supplier, except for fittings, closures and specials. Moisture absorption by boiling test shall not exceed 5.0 percent. Concrete pipe sections shall be cut while still green, reinforcing shall be exposed and welded together at junctions and miters. Splice shall be built up to nominal wall thickness with mortar or concrete.
- C. Circular Pipe. Furnish ASTM C 76, Class III minimum, with either Wall B or Wall C. Reinforcement shall be circular or elliptical. Elliptically reinforced pipe shall be marked in accordance with Section 15.2, ASTM C 76, for correct installation.
- D. Arch Pipe. Furnish ASTM C 506, Class A-III minimum. Reinforcement shall be single line or double line.

- E. Elliptical Pipe. Furnish ASTM C 507, Class HE-III or Class VE-III minimum. Reinforcement shall be double cage.
- F. Low-Head Pressure Pipe. Furnish ASTM C 361. Reinforcement shall be circular or elliptical. Elliptically reinforced pipe shall be marked in accordance with Section 15.1.4, ASTM C 361, for correct installation.
- G. Joints. Flexible gasketed joints in concrete pipe shall be made with continuous ring, compression type rubber gaskets. Design of joints and physical requirements of rubber type gaskets shall conform to ASTM C 361 and C 443. Natural rubber will not be acceptable.

3005 DUCTILE-IRON PIPE. Conform to ANSI A21.51; ASTM A536, Grade 60-42-10, except as otherwise specified herein.

- A. Design. Design of pipe shall be in accordance with ANSI A21.50 laying conditions S, Type 2 or 3. Minimum wall thickness shall be Class 50.
- B. Joints. Mechanical and push-on joints for ductile-iron pipe and fittings shall conform to the requirements of ANSI A21.11. Gaskets shall be neoprene or other synthetic rubber material. Natural rubber gaskets will not be acceptable.
- C. Fittings. Fittings shall be in accordance with ANSI A21.10 and shall have a pressure rating of not less than that specified for pipe. Fittings used with ductile-iron pipe shall be ductile-iron or cast iron. Fittings for pipe with mechanical joints shall have mechanical joints. Fittings for pipe with push-on joints shall be either mechanical joint or push-on joint.
- D. Lining & Coating. All ductile-iron pipe, fittings and specials shall be cement mortar lined in accordance with ANSI A21.4. Coat all pipe, fittings and specials with manufacturers standard coal tar coating.

3006 POLY VINYL CHLORIDE (PVC) SEWER PIPE. Conform to ASTM D3034, except as otherwise specified herein.

- A. General. Furnish maximum pipe lengths manufactured by the supplier, except for fitting, closures and specials.
- B. Design. The minimum wall thickness for PVC Pipe shall conform to SDR-35 (Schedule 40 Solid PVC for service). PVC pipe having a cover to finish grade of fifteen (15) feet or more shall conform to AWWA C900. Pipe bedding shall conform to ASTM D2321 for Class I materials.
- C. Joints. Flexible gasketed joints shall be compression type with a gasket confined in a machined groove in the spigot end of the pipe. Oil resistant rubber gasket rings shall

conform to the requirements of ASTM D 1869. Gaskets shall be neoprene or other synthetic material. Natural rubber gaskets will not be acceptable.

- D. Fittings. Fittings defined as tee or wye connections suitable for assembly to 4-inch or 6-inch house or building sewers shall be saddle-type fittings molded of PVC plastic.

3007 CONCRETE. Concrete, whether reinforced or non-reinforced, shall conform to MCIB Specifications and to the requirements set forth in Section 2000 "Concrete".

3008 REINFORCING STEEL. Reinforcing steel shall be placed as shown on the plans and shall conform to ASTM Specifications as follows:

- A. Bars and rods shall be deformed billet-steel conforming to ASTM A 615, Grade 40.
- B. Welded wire fabric shall conform to ASTM A 185, Grade 40.
- C. Fabricated steel bar and rod mats shall conform to ASTM A 184. Bar material shall conform to ASTM A 615, Grade 40.
- D. Smooth bars shall be round carbon steel bars conforming to ASTM A 306, Grade 60.

3009 MANHOLE MATERIALS.

- A. General. Manholes shall conform to the Standard Drawings.
- B. Precast Concrete. Precast concrete manholes shall conform to ASTM C 478. Joints shall be of material as specified for reinforced concrete pipe joints or a bitumastic material or preformed flexible joint sealants applied in accordance with manufacturer's recommendations.
- C. Cast in Place Concrete. Concrete used shall conform to requirements set forth in Section 2000, "Concrete".
- D. Waterproofing. Waterproofing will be required on all manholes. The bitumen shall consist of two coats of asphalt or coal-tar pitch. Asphalt shall conform to the requirements of ASTM D 449. Coal-tar pitch shall conform to the requirements of ASTM D 450.

3010 MANHOLE CASTINGS.

- A. General: Cast-iron rings, covers, and steps shall conform to City Standard Drawing. Manhole rings and covers shall be Clay and Bailey No. 2008BV, Deeter No. 1315, or approved equal. The exception shall be for use on shallow manholes where manhole covers shall be Clay & Bailey No. 2020, Deeter No. 2016 or approved equal.

When bolt-down type manhole rings and covers are required and specified, Clay and

Bailey No. 2014, or approved equal, with rubber gaskets and stainless steel cover bolts 5/8-inch diameter with hexagonal-head bolts shall be furnished. Bolt-down type manhole rings shall be anchored to the manhole with not less than four (4) 3/4-inch diameter anchor bolts having a minimum of fourteen (14) inches of embedment, except in concrete manholes in which the ring is embedded in concrete.

Cast iron manhole steps shall be Clay and Bailey, or approved equal, No. 2102 for precast concrete manholes and No. 2104 for concrete manholes.

Polypropylene coated steel reinforced "plastic steps" shall be M.A. Industries, Inc. model PS-2-PF or approved equal manhole step for precast concrete manholes.

The castings shall meet or exceed the following minimum requirements.

1. Iron castings shall conform to the requirements of ASTM A 48, Class 25.
2. Castings shall be clean and whole, and without blow or sand holes or any other surface defects which would impair serviceability. Plugging or filling of holes or other defects will not be permitted.
3. Parting fins and pouring gates shall be removed.
4. Castings shall be cleaned and painted with one coat of coal tar before being delivered to the site.

3011 BEDDING AGGREGATE. All materials used for crushed stone pipe bedding shall conform to the requirements of MCIB Specification Sec. 4 Materials for coarse aggregate and shall meet the gradation specified therein under Column III, Table 2, for three quarters (3/4) inch maximum size aggregate with the following modifications.

Sieve Size	Percentage Passing
No. 4	0-5
No. 8	0-2

3012 CONSTRUCTION REQUIREMENTS.

A. Grading and Excavation.

1. Scope. Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.
2. General. Excavation and trenching work shall be performed in a safe and proper

manner with suitable precautions being taken against all hazards.

The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

In paralleling present water and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

3 Classification of Excavated Material. When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:

a. Rock. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the Engineer, requires drilling or blasting or remove the material.

b. Earth. All material not classified as rock.

4 Clearing. The Contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

5. Unauthorized Excavation. Any part of the trench excavated below grade shall be corrected with material approved by the Engineer placed and compacted by the Contractor.

6 Dewatering. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit

which he may use for drainage purposes, and all such pipes or conduit shall be left clean and free of sediment.

7. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement of pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling. When ordered by the Engineer, wood sheeting shall be left permanently in the trench.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

8. Stabilization. Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of crushed stone or gravel. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

9. Trench Excavation. the Contractor shall not open more trenching advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer.

Except where tunneling or boring and jacking is specified and shown on the plan by the Engineer, all trench excavations shall be open cut.

10. Alignment and Grade. The alignment and grade or elevation of the pipeline shall be as shown on the plans.

The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations therefrom.

11. Limiting Trench Width. Trenches shall be excavated to a width which will

provide adequate working space and pipe clearances for proper pipe installation,

jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six (6) inches below and on each side of all pipe. These distances are minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one (1) foot above the top of the pipe.

Limiting trench widths below an elevation of one (1) foot above the exterior top of the installed pipe shall be not less than fifteen (15) inches nor more than twenty-four (24) inches greater than the nominal outside diameter of the pipe.

12. Unauthorized Trench Widths. When, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the Contractor's expense.
13. Trench Bottom in Earth. The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the pipe is to be laid. The surface shall be graded to provide a uniform bearing and continuous support for each pipe at every point along its entire length.
14. Rock Exploration. Unless shown otherwise on the plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.
15. Trench Bottoms in Rock. All rock excavation shall be carried to a minimum of inches below the bottom of the pipe. Granular pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide an uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.
16. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of the type, design and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

17. Stream Crossings. Stream crossings shall be made in accordance with these specifications and as shown on the plans.

The trench width shall be as required for proper pipe installation and the trench depth shall be as required to give minimum cover shown on the plans, Pipe encasement, where required, shall be in accordance with the specifications and placed as indicated on the plans.

18. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossing in accordance with these specifications, the Special Provisions and as shown on the plans.

All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad right-of-ways shall be in conformity with all the requirements, regulations and be under the control (through the Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

The Contractor shall pay fees and obtain permits to make the crossings unless otherwise directed.

3013 HANDLING. Handle pipe materials and fittings in a manner to insure installation in sound and undamaged condition. Do not drop or bump. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements and coatings. In handling plastic pipe of ten (10) feet in length or greater, a double sling will be required unless otherwise approved by the Engineer.

Materials shall be shipped, moved and stored with provisions to prevent movement or shock contact with adjacent units.

3014 INSTALLATION.

- A. All work shall be in accordance with the following standards:

Flexible Thermoplastic Pipe; ASTM C600
Ductile Iron Water Mains; AWWA C600
Reinforced Concrete Pipe;

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361, except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Core holes and handling holes in concrete pipe shall be repaired by cementing a properly-shaped concrete plug in place with epoxy cement or by other methods acceptable to the Engineer.

B Utilize equipment, methods and materials insuring installation to lines and grades indicated.

1. Maintain the following tolerances from true alignment and grade:

Alignment	3 inches
Grade	+/- 1 inch

Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM C 425, ASTM C 594 and AWWA C 600. Only one correction for alignment and/or grade shall be made between adjacent manholes.

2. Except where pipe sections are being encased in concrete, no pipe is to be supported by blocks.

3. Accomplish curve alignments with bends, bevels, and open joints. Limit joint opening in concrete pipe to 3/8 inch in laying schedule and 1/2 inch in actual installation. Limit joint deflection with cast iron or ductile iron pipe not to exceed the maximum allowable deflection per joint according to ASTM C 425, ASTM C 594, and AWWA C 600.

C. Install pipe of size, material, strength class, and joint type with embedment as shown on the Plans.

Reinforced concrete pipe with elliptical reinforcement shall be installed and positioned in accordance with the pipe manufacturer's pipe markings indicating top and bottom of pipe.

D. Insofar as possible, commence laying at downstream end of line and install pipe with spigot or tongue end downstream. Connection to downstream manhole shall not be made until newly installed piping has passed all tests.

E Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation. Close open ends of pipe with snug fitting closures. Do not let water fill trench. Include provisions to prevent

flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.

- F. Install pipe only when weather and trench conditions are suitable. Do not lay in water. Brace or anchor pipe as required to prevent displacement after establishing final position.
- G. Where pipe is laid at a slope of 20% or greater, concrete slope anchors shall be installed.

3015 PIPE BEDDING. The sewer trench shall be carried to a point not less than two (2) inches below bottom of pipe bell, or less than four (4) inches below bottom of pipe barrel, whichever is greater. Crushed stone pipe bedding, compacted to full width of trench, shall then be placed and compacted to bottom of pipe with proper allowance for bell joints or couplings. After each length of pipe being laid has been shoved "home" and placed in proper alignment, it shall be securely anchored and held in position by crushed stone backfill extending to a point not less than six (6) inches above the top of the pipe bell or coupling. If unstable subgrade conditions are encountered and it is determined by the Engineer that the bedding specified will not provide suitable support for the pipe, additional excavation to the limits determined by the Engineer will be required. This additional excavation shall be backfilled with crushed stone material approved by the Engineer.

3016 JOINTING.

A. General Requirements.

1. Locate joints to provide for differential movement at changes in type of pipe embedment, concrete collars, and structures. Support pipe from wall of manhole at first joint in normal sewer trench with concrete cradle structurally continuous with base slab or footing.
2. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
3. Utilize methods and equipment capable of fully homing or making up joints without damage.
4. Check joint opening and deflection for specification limits.
5. Examine each piece of pipe prior to installation for soundness and specification compliance.

B. Provisions for Jointing Clay Pipe.

1. Conform with ASTM C 12, Section 8.
2. Handle pipe having premolded joint rings or attached couplings so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing

material.

- C. Provisions for Jointing Concrete Pipe. Check gasket position and condition after assembly with feeler gauge prior to installation of next section.
- D. Provisions for Jointing Ductile Iron Pipe.
 - 1. Conform with AWWA C 600.
 - 2. Paint suspected damaged portions with turpentine and dust with cement to check for cracks. Remove turpentine and cement by washing when crack test is satisfactorily completed. If cracks are found, the pipe shall be rejected.
 - 3. Check gasket position and condition after assembly prior to installation of next pipe section.
- E. Provisions for Jointing PVC Pipe. Check gasket for position and condition after assembly prior to installation of next pipe section.

3017 CUTTING. Cut in neat workmanlike manner without damage to pipe. Observe specification regarding joint locations. Smooth cut by power grinding to remove burrs and sharp edges. Repair lining as required and approved.

3018 TEMPORARY PLUGS.

- A. Plugs. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be water-tight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.
- B. Location. Plugs shall be installed as specified or where shown on Plans. Also the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

3019 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES.

- A. Connections shall not be made to existing facility until all of the new system has been tested.
- B. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.
- C. Connections to existing structures shall be made by coring and installation of a flexible watertight seal per Standard Drawing 31-4.
- D. Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls and invert shall be

completed and all testing of new line passed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced at no expense to the City.

- E Connections between different pipe materials shall be made using proprietary transition coupling, unless otherwise specified on the Plans.

3020 LOCATION WIRE AND MARKING TAPE. Location wire and warning marking tape shall be installed with all sanitary sewer force mains.

Location wire shall be #12 insulated solid copper wire and shall be placed at the top of the force main pipe. Six feet of the ends of the location wire shall be coiled inside valve boxes and the discharge manhole.

Warning Marking Tape shall be 6” wide polyethylene plastic green in color and have “Buried Sewer Main Below” printed on the tape at 20 to 30 inch intervals. The marking tape shall be installed directly above the centerline of the pipe and 18 to 24 inches below finished grade.

3021 TRENCH BACKFILL. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings shall be backfilled with graded gravel, four (4) feet back of curb to four (4) feet back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three (3) inches in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to ninety-five (95) percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to seventy (70) percent relative density as determined by ASTM D2049 when that test is appropriate.

Gravel for compacted backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85-100
3/8 inch	50-80
No. 4	35-60
No. 40	15-30
No. 200	5-10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than seventy (70) percent relative density as determined by ASTM D2049.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket or snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to ninety (90) percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the Engineer.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots, more than two (2) inches in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least two (2) feet of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen (18) inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed

within three (3) feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3022 STRUCTURE BACKFILL. Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the Engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 psi and can sufficiently support the loads imposed by the backfill without damage.

The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.

Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is approximately the same elevation on all sides of the structure.

No excavated rock larger than four (4) inches maximum dimension shall be placed within one (1) foot of the exterior surface of any structure.

3023 DENSITY TESTING. At the option of the Engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the Contractor shall revise his compaction procedures to obtain the results specified.

3024 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3025 PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion.

When the grade of the ditch exceeds one (1) percent, ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the Engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two (2) feet below the original ditch or water course bottom for the full bottom width and at least eighteen (18) inches into the side slopes and shall be at least twelve (12) inches thick.

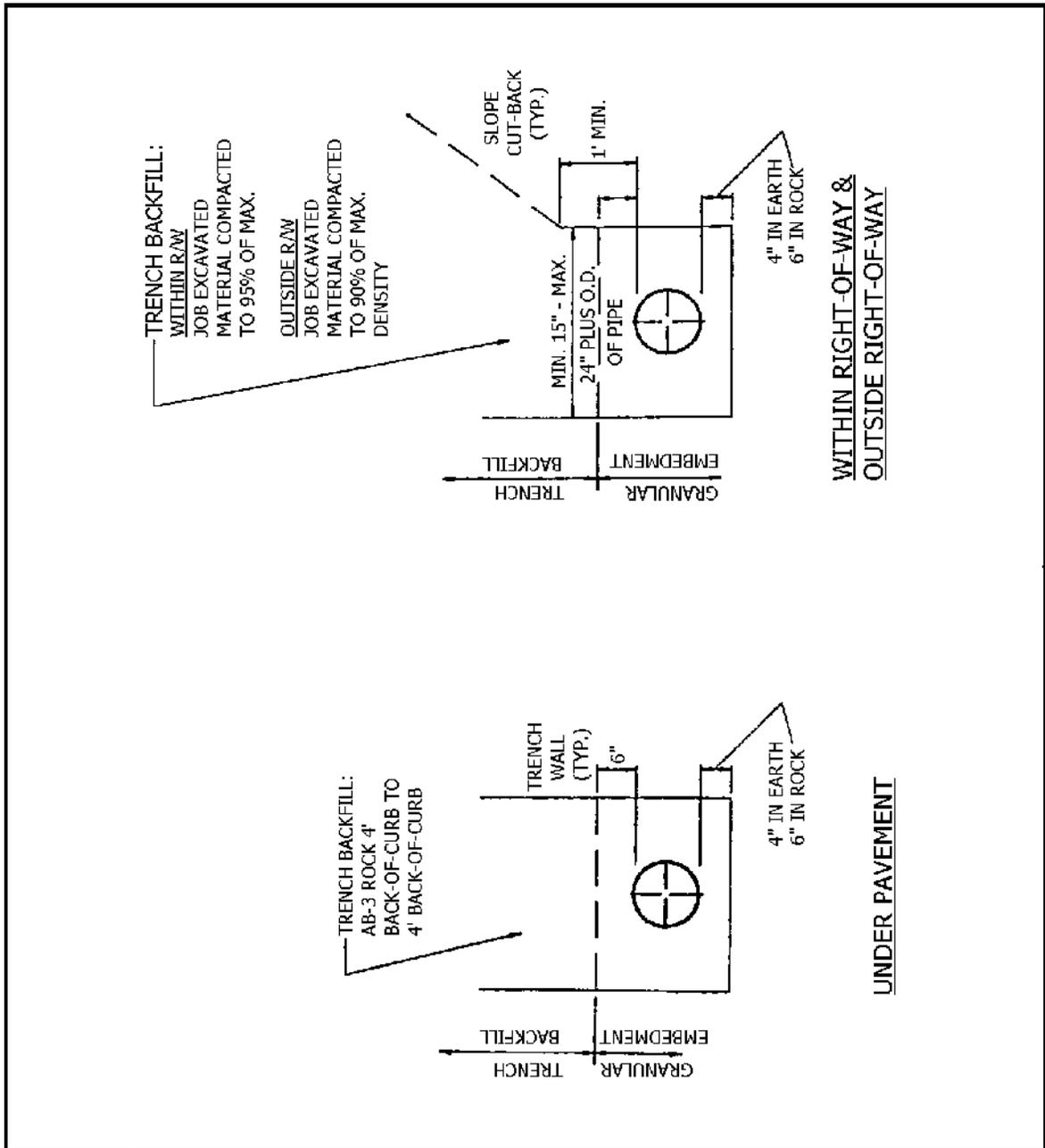
3026 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site or work. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavation located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six (6) inches above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

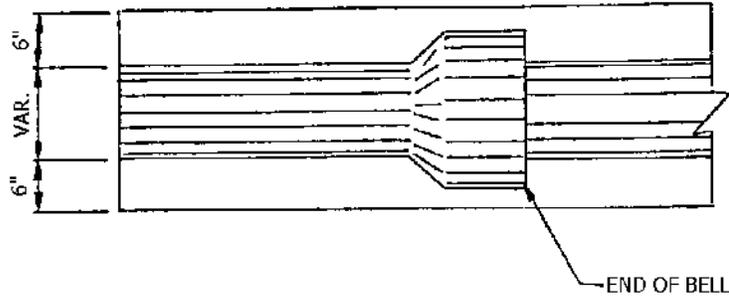
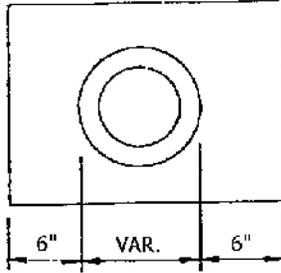
3027 SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the City Engineer shall be furnished to the City of Branson by the Contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the City.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer.



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED	
		<i>David H. Miller</i> CITY ENGINEER	8/13/90 DATE
EMBEDMENT AND BACKFILL FOR SANITARY SEWERS		STANDARD DRAWING 30-1	



FOR USE ONLY WHERE INDICATED ON PLANS THE CONCRETE ENCASEMENT SHALL BE OF 3000 PSI CONCRETE WITH A MINIMUM THICKNESS ON ALL SIDES OF 6"

1. 8" DIA. = .11 C.Y. OF CONCRETE PER LINEAL FT.
2. 10" DIA. = .12 C.Y. OF CONCRETE PER LINEAL FT.
3. 12" DIA. = .14 C.Y. OF CONCRETE PER LINEAL FT.
4. 15" DIA. = .15 C.Y. OF CONCRETE PER LINEAL FT.



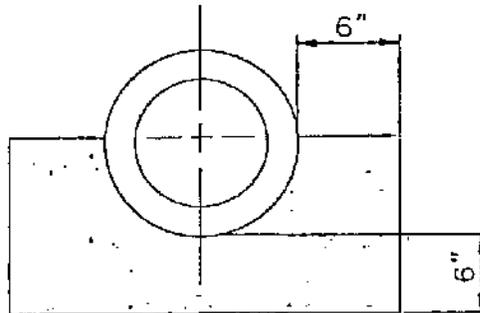
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65816

**CONCRETE ENCASEMENT
DETAIL**

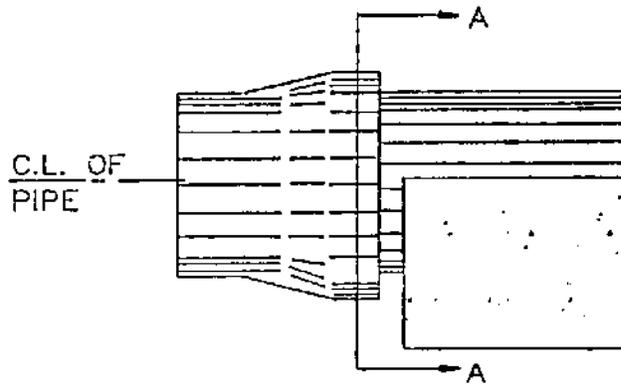
APPROVED

David R. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 30-2



SEC. A-A



FOR USE ONLY WHERE INDICATED ON PLANS.
 THE CONCRETE SHALL BE 3000 PSI CONCRETE.
 THE MINIMUM THICKNESS, ON THE SIDES AND BOTTOM
 SHALL BE 6". THE TOP OF THE CONCRETE SHALL BE
 AT LEAST TO THE CENTER OF THE PIPE.



CITY OF BRANSON

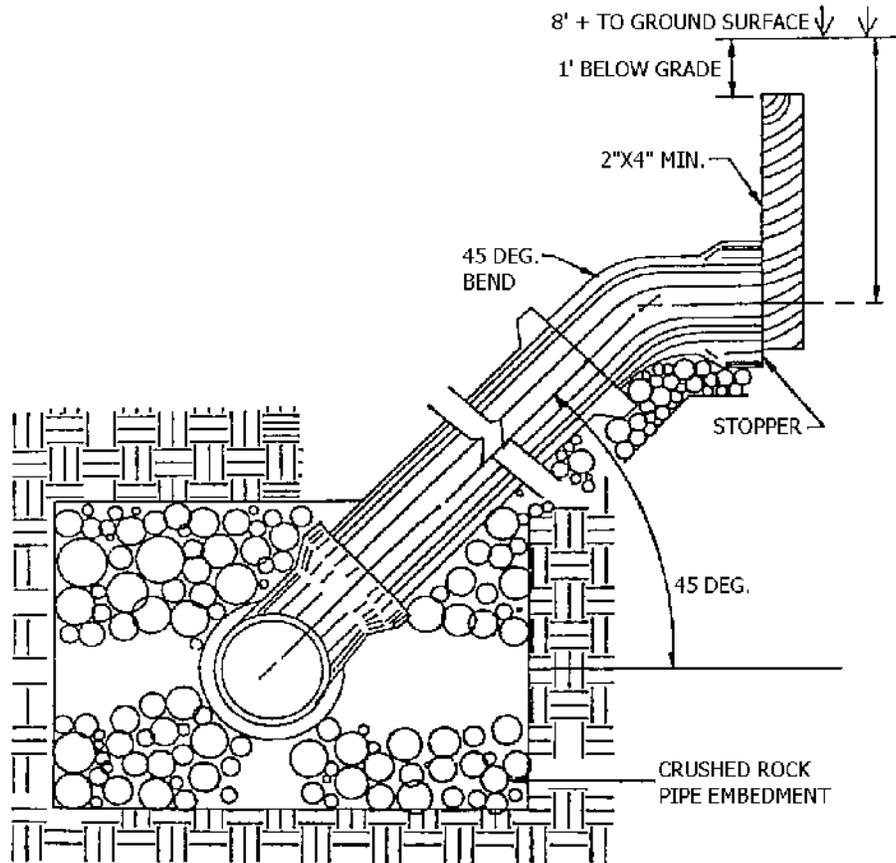
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65818

**CONCRETE CRADLE
 DETAIL**

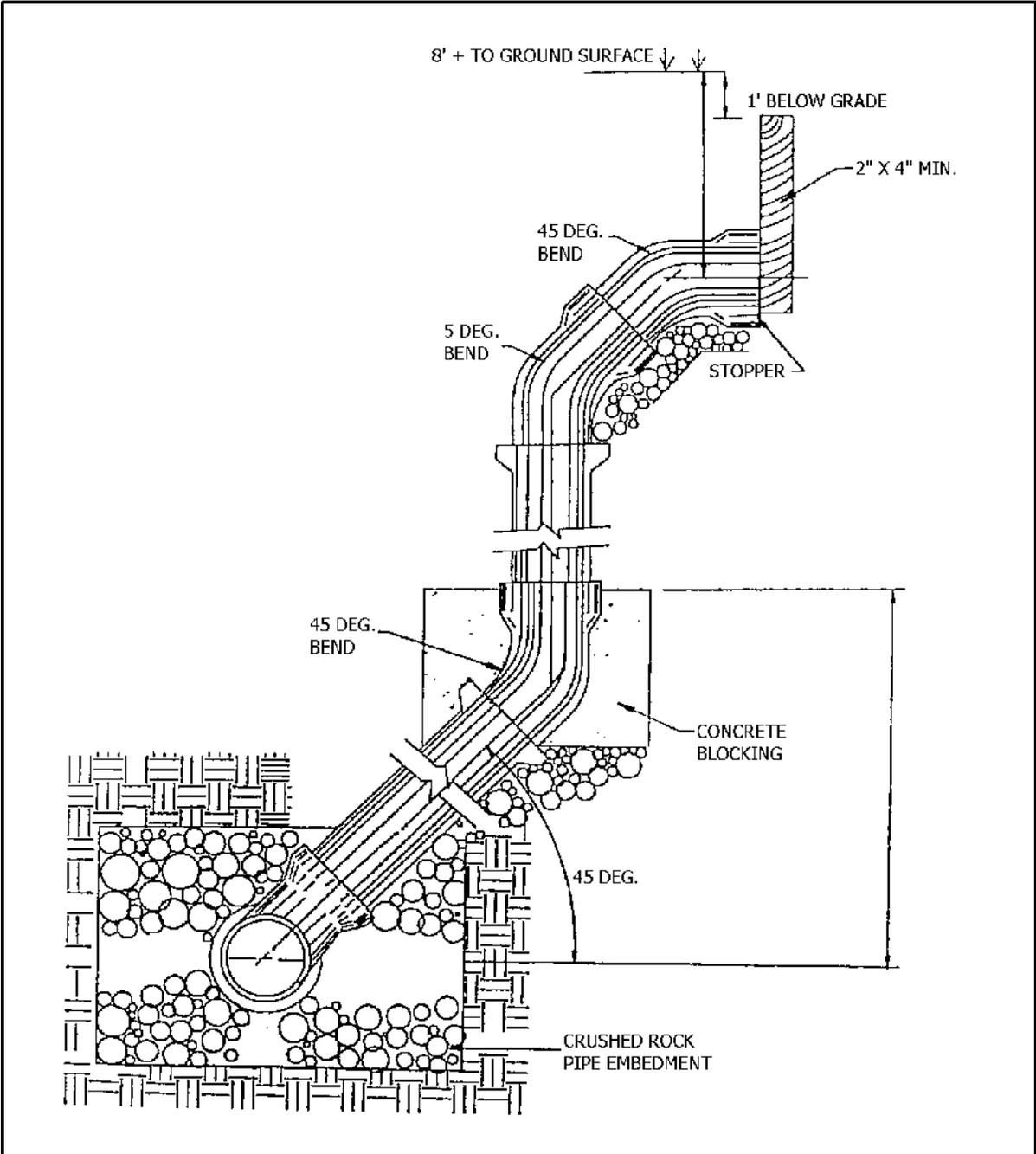
APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 30-3



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65816	APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE
	STANDARD DEEP TRENCH SERVICE RISER	STANDARD DRAWING 30-4



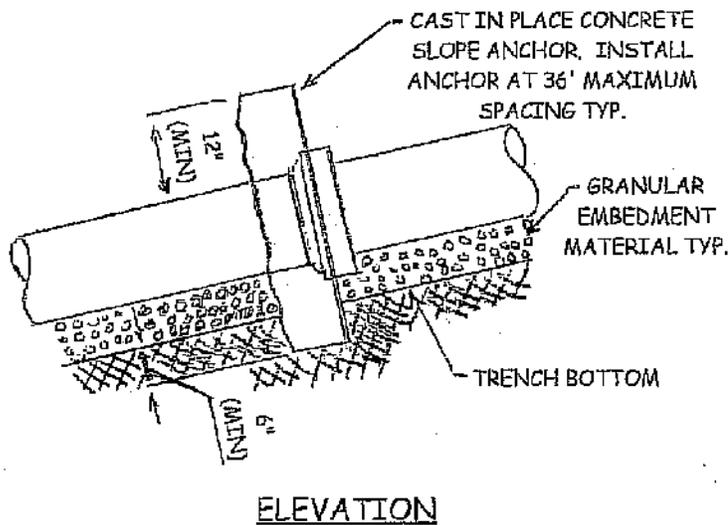
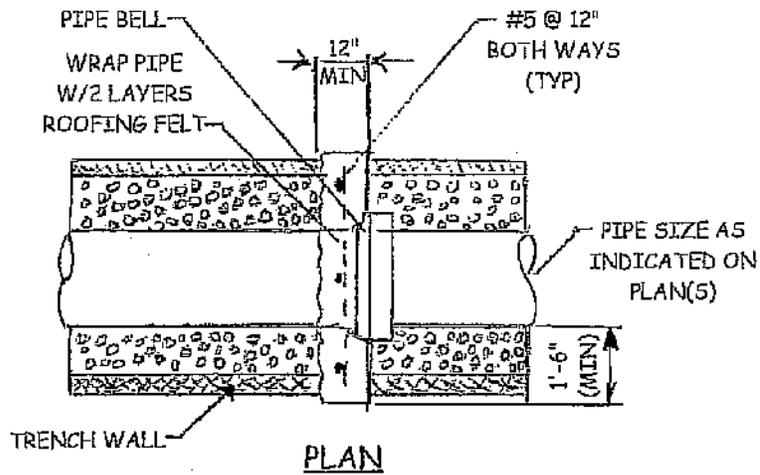
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65818

**STANDARD DEEP
 TRENCH SERVICE RISER
 (IN ROCK)**

APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

STANDARD DRAWING 30-5



NOTE: EXTENSION OF ANCHORS BEYOND TRENCH WALL NOT REQUIRED IN ROCK TRENCH

 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED  CITY ENGINEER	5/4/07 DATE
	SLOPE ANCHOR	STANDARD DRAWING 30-6	

SECTION 3100 MANHOLE AND SPECIAL STRUCTURES - SANITARY SEWERS

3101 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work incidental to the construction of manholes, drop manholes and special sewer structures complete with covers, steps, fittings and appurtenances as required for sanitary sewer construction.

3102 GENERAL. As used herein special structures refers to manholes on large sewers, special junction structures, metering stations, siphons and similar structures constructed on the pipeline.

Manholes and special structures may be constructed of precast concrete sections or cast-in-place concrete. Construction of brick masonry will not be allowed.

3103 CONSTRUCTION.

- A. General. Manholes and special structures shall be constructed at locations indicated and in accordance with details as shown on the plans or City Standard Drawings. Manholes will be constructed with eccentric cones unless otherwise approved by the City Engineer.
- B. Precast Wall and Reducing Cone Sections. Handle with care to avoid damage to joint ends of each section. Damaged sections may be subject to rejection at the discretion of the Engineer.

When using O-ring joint care shall be exercised in placing the O-ring on the spigot end, and lowering the bell section on the spigot end so that a watertight seal is obtained.

When using bitumastic joints, both spigot and bell end shall be primed with solvent material compatible to the adhesive in the mastic. Approved bitumastic material shall completely fill the joints so that a minimum of one-fourth (1/4) inch bead of material is visible after jointing, to be smoothed off after completion of the jointing operation.

When a flexible preformed butyl rubber or bituminous polymer compounded with modifiers is used to seal jointed sections of manholes, the extrusion of sealant from the joint is not required. The vertical spacing between manhole section shall not exceed one-fourth (1/4) inch. Preformed joint sealers shall remain flexible at temperatures as low as 0 deg. F.

All bitumastic materials or preformed flexible joint sealants shall not be applied to wet or damp surfaces.

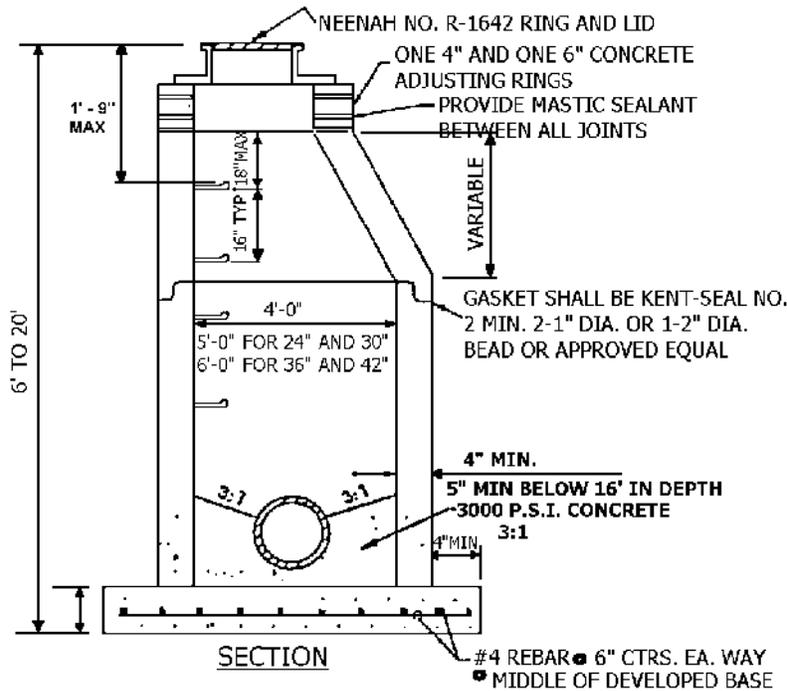
- C. Cast-in-Place. Consolidate concrete with mechanical vibrators to eliminate entrapped air voids and rock pockets. Forms shall be supported in such a manner as to prevent any movement of the forms while concrete is being cured. Any movement of the forms may be cause for rejection.

- D. Invert Channels. Alignment of the invert channels shall be as shown on the Contract Drawings. When no specific details and dimensions are given, changes in flow direction shall be smooth, uniform and made with the longest radius possible. The cross sectional shape of invert channels shall match the lower halves of the entering and existing pipes. The surfaces of the channels shall be steel-trowelled to produce a dense, smooth surface.
- E. All new sewer line construction shall use flexible gaskets to provide a watertight connection such as the “A-LOK” brand product. Because of the A-LOK connector’s (or equivalent) ability to insure a flexible, watertight joint, NO mortar shall be placed around the connector at all on the outside of the structure and NO mortar shall be placed around the top half of the connector on the inside when completing the invert work. The use of mortar in either of these areas would eliminate the flexibility for which the connector is designed, and cause problems of shear. When installing an invert in the field, mortar only the bottom half of the pipe to complete a smooth transition into the pipe.

3104 CURING. All masonry, plaster coating and cast-in-place concrete shall be adequately protected from freezing and loss of moisture for the first 24 hours. The curing methods and materials to be used shall be approved by the Engineer.

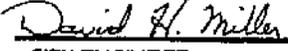
3105 MANHOLE RINGS. All rings for manhole covers shall be set to match elevations indicated on the City approved plans. Each ring shall be set on one 4-inch and one 6-inch adjusting ring as indicated on the Standard Details. Mastic sealant shall be provided between all joints.

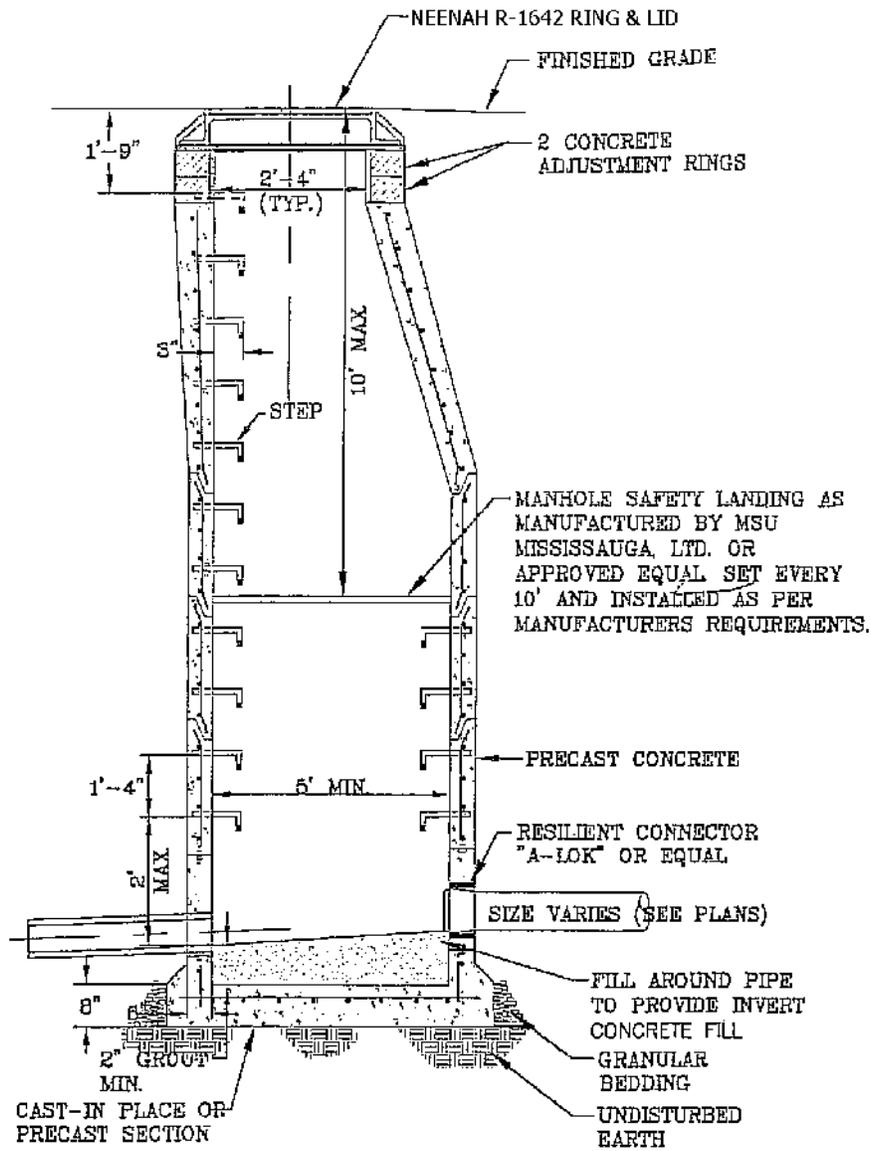
3106 WATER-PROOFING. Two coats of an asphalt or coal-tar pitch waterproof coating shall be applied to the exterior of all manhole structures from base to manhole ring. The coating shall be applied in sufficient quantity so that no bare or thin spots show. The coating shall be applied in sufficient time to permit proper curing prior to backfilling the excavation. Proper methods and material shall be used during backfilling to prevent damage to the coating. Any damage to the coating which does occur shall be immediately repaired.



NOTE:

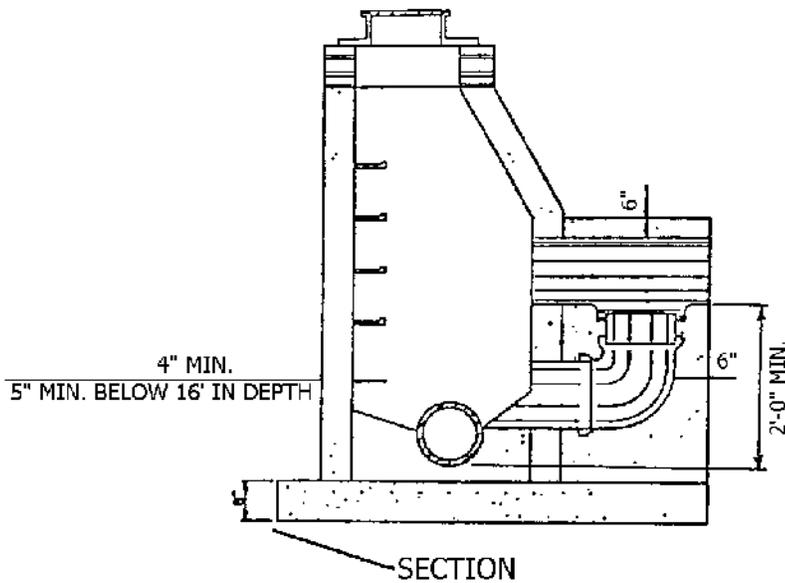
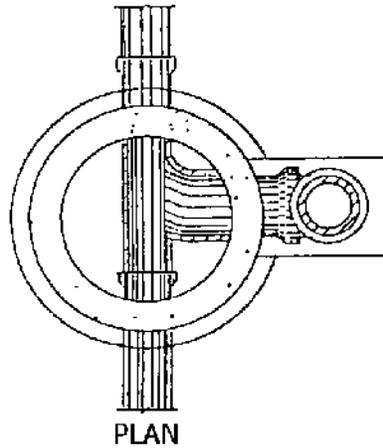
1. PRECAST CONCRETE MANHOLES SHALL CONFORM TO ASTM C478 EXCEPT AS MODIFIED BY THE SPECIFICATIONS.
2. BASES NOT BUILT MONOLITHIC WITH BOTTOM SECTION SHALL BE POURED OF 3000 PSI CONCRETE.
3. MANHOLE MAY BE TRANSITIONED TO 4'-0" DIA. 8" ABOVE F.L. OF OUTFALL FOR 5'-0" AND 6'-0" MANHOLES.
4. THE BOTTOM SECTION OF ALL PRECAST MANHOLES NOT BUILT MONOLITHIC WITH THE BASE SHALL BE SET INTO A STEEL REINFORCED POURED CONCRETE BASE A MINIMUM OF 4" (#4 @ 6" E.W.)
5. WATERPROOFING: WILL BE REQUIRED ON THE OUTSIDE OF MANHOLES. THE BITUMEN SHALL CONSIST OF TWO (2) EIGHT (8) MIL COATS OF ASPHALT, COAL TAR PITCH, OR A COATING MEETING AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM) D-41. ASPHALT SHALL CONFORM TO THE REQUIREMENTS OF ASTM D449 COAL-TAR PITCH SHALL CONFORM TO THE REQUIREMENT OF ASTM C450.
6. THE COMPRESSIVE STRENGTH OF CONCRETE USED IN THE CONSTRUCTION OR PRECAST REINFORCED CONCRETE MANHOLES SHALL NOT BE LESS THAN 4000 PSI.
7. ONLY ECCENTRIC MANHOLE CONES WILL BE ALLOWED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
8. ADDITIONAL BASE THICKNESS FOR MANHOLES GREATER THAN 20' DEEP SHALL BE APPROVED BY CITY ENGINEER WITH SUBMITTAL OR APPROPRIATE CALCULATIONS.

 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65816	APPROVED  CITY ENGINEER	8/13/90 DATE
	STANDARD PRECAST MANHOLE DETAIL	STANDARD DRAWING 31-1	



**DETAIL FOR MANHOLES
OVER 20' DEEP**

 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65816	APPROVED <i>David L. Miller</i> 10/21/04 CITY ENGINEER DATE
	CHANNELIZING DEVICE AND HIGH LEVEL WARNING DEVICES	STANDARD DRAWING 31-1A



1. FOR ALL DIMENSIONS NOT SHOWN, SEE STANDARD MANHOLE DETAIL.
2. WATERPROOFING: WATERPROOFING WILL BE REQUIRED ON THE OUTSIDE OF MANHOLES. THE BITUMEN SHALL CONSIST OF TWO (2) EIGHT (8) MIL COATS OF ASPHALT, COAL TAR PITCH, OR A COATING MEETING (ASTM) D-41. ASPHALT SHALL CONFORM TO THE REQUIREMENTS OF ASTM D 449. COAL-TAR PITCH SHALL CONFORM TO THE REQUIREMENTS OF ASTM C 450



CITY OF BRANSON

ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

**STANDARD
DROP MANHOLE
DETAIL**

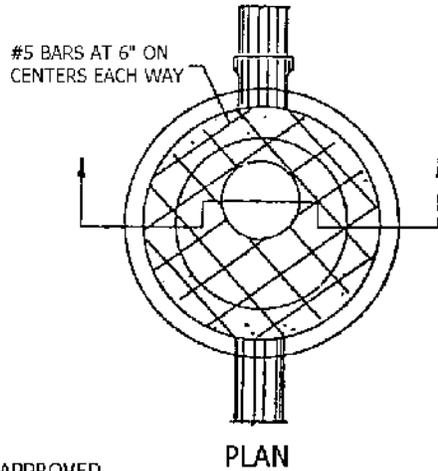
APPROVED

David L. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 31-2

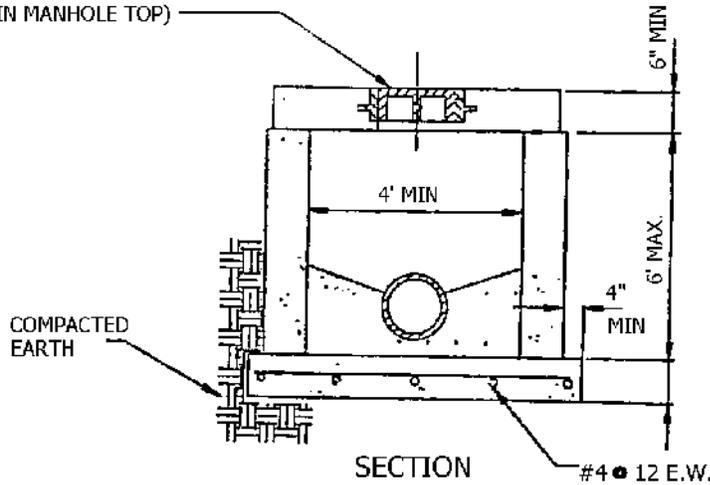
NOTE:

1. WATERPROOFING: WATERPROOFING WILL BE REQUIRED ON THE OUTSIDE OF MANHOLES. THE BITUMEN SHALL CONSIST OF TWO (20 EIGHT (8) MILL COATS OF ASPHALT, COAL TAR PITCH, OR A COATING MEETING (ASTM) D-41. ASPHALT SHALL CONFORM TO THE REQUIREMENTS OF ASTM D449. COAL-TAR PITCH SHALL CONFORM TO THE REQUIREMENTS OF ASTM C 450.
2. FOR ALL DIMENSIONS NOT SHOWN, SEE



USE OF A STANDARD LID AND RING WILL BE ALLOWED WHERE GRADE PERMITS (SEE SPEC. FOR APPROVED TYPES)

NEENAH NO. R-1642 OR APPROVED EQUAL RING AND LID (CAST IN MANHOLE TOP)



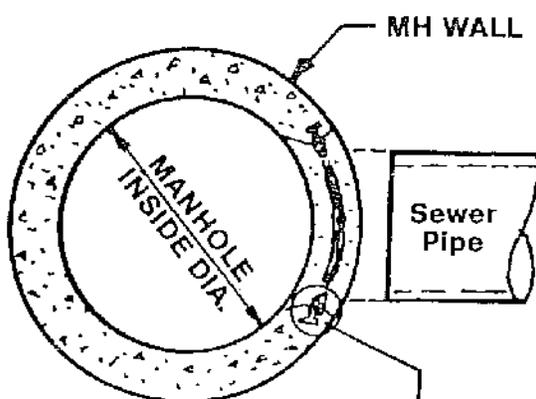
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

**STANDARD
SHALLOW MANHOLE
DETAIL**

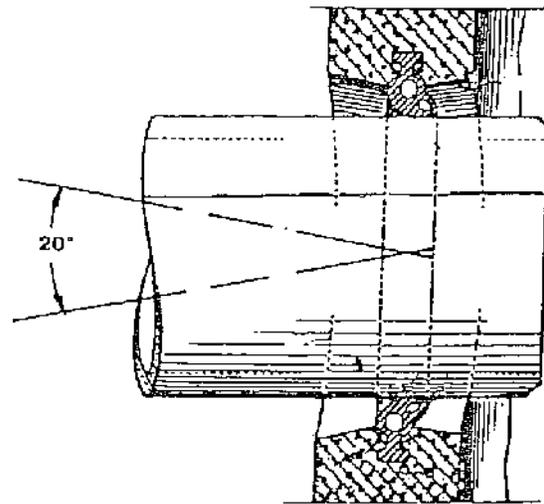
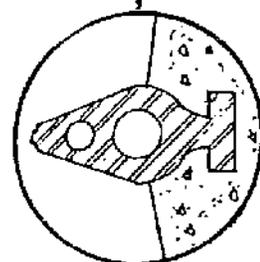
APPROVED

David A. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 31-3



**CROSS SECTION
OF A-LOK BEFORE
INSTALLATION**



**CROSS SECTION
OF A-LOK AFTER
INSTALLATION**

THE A-LOK IS A HIGH PERFORMANCE FLEXIBLE CONNECTOR DESIGNED TO PRODUCE A POSITIVE WATERTIGHT CONNECTION FOR PIPES ENTERING PRECAST MANHOLES AND OTHER CONCRETE SURFACES. THE RUBBER CONNECTOR IS COMPOUNDED FROM A POLYISOPRENE BLEND WHOSE PERFORMANCE HAS BEEN PROVED TO BE EXCELLENT FOR USE IN SANITARY SYSTEMS.

INTEGRAL PLACEMENT OF THE CONNECTOR IN THE CONCRETE WALL IS ACHIEVED BY USE OF A TWO PART PRECISION MANDREL WITH A POSITIVE SECURING SYSTEM TO "LOCK IN" CONNECTORS ON THE CORRECT LINE AND GRADE.



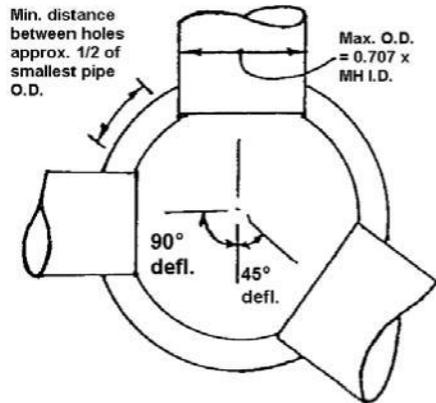
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

**MANHOLE CONNECTIONS
w/ P.V.C. SEWER PIPE**

APPROVED

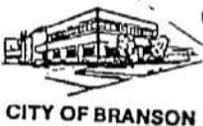
David H. Miller 6/27/02
CITY ENGINEER DATE

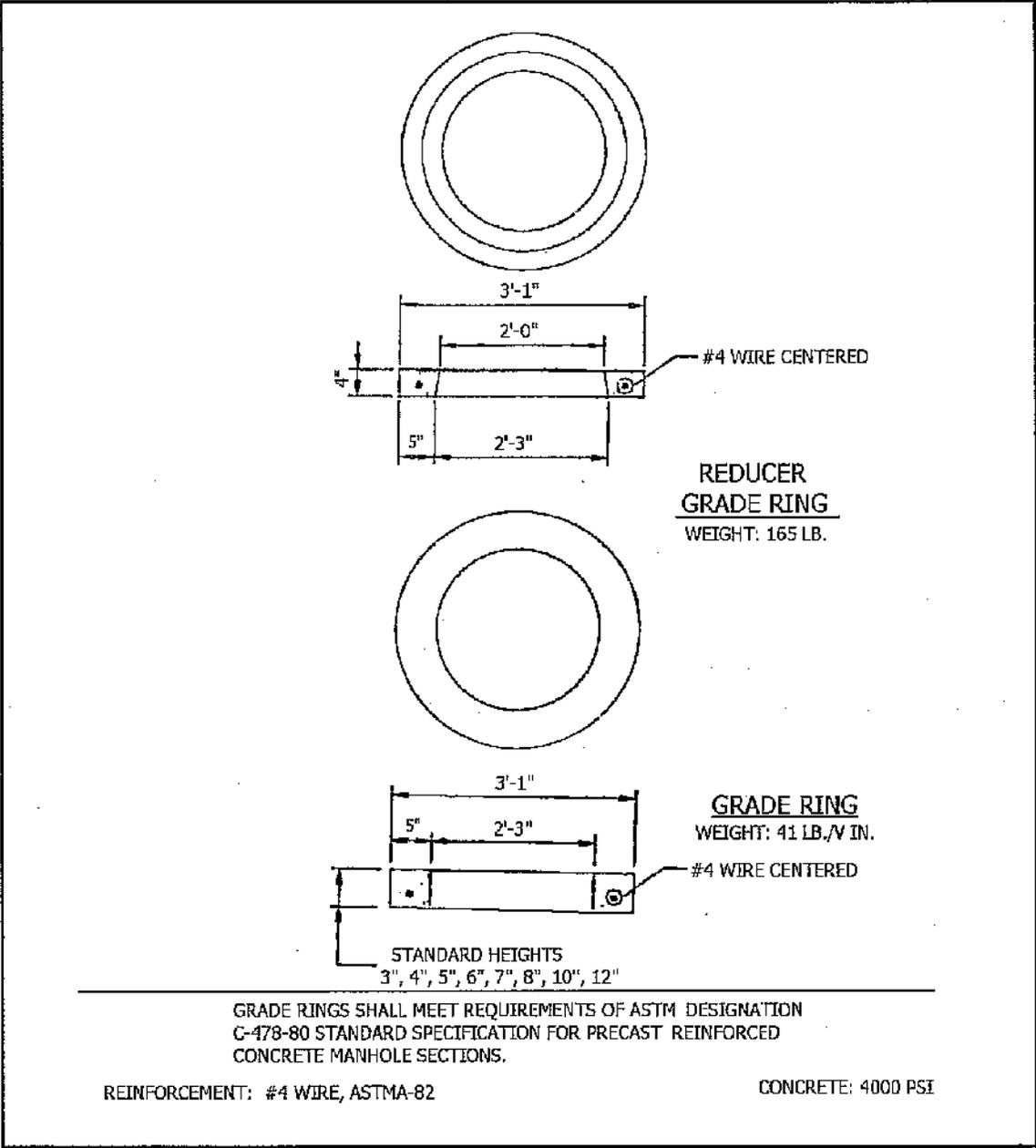
STANDARD DRAWING 31-4



PLAN VIEW OF MH

MANHOLE DIA.	MAX. PIPE SIZE O.D.	
	From Straight thru to 45° Defl.	If 90° Defl.
4 ft.	31 1/2 in.	25 in.
5 ft.	42 in.	32 in.
6 ft.	51 in.	38 in.
7 ft.	59 in.	44 in.
8 ft.	73 1/2 in.	50 in.

	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65618	APPROVED <i>David H. Miller</i> 6/27/02 CITY ENGINEER DATE	
	MANHOLE CONNECTIONS w/ P.V.C. SEWER PIPE	STANDARD DRAWING 31-4A	



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 5/3/07 CITY ENGINEER DATE
	GRADE RINGS	STANDARD DRAWING 31-5

SECTION 3200 ACCEPTANCE TESTS FOR SANITARY SEWERS

3201 SCOPE. This section governs the furnishing of all labor, equipment, tools and materials, and the performance of any or all acceptance tests as required by the Plans, Special Provisions, and these specifications.

3202 ACCEPTANCE TESTS FOR GRAVITY SEWERS.

A. Visual Inspection

1. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.
2. Correct defects as required prior to conducting leakage tests.

B. Leakage Tests. A leakage test shall be performed on the full length of all sewer lines prior to acceptance.

1. Exfiltration Leakage Test.

- a. Contractor may perform leakage testing by exfiltration on sewer pipe larger than eighteen (18) inches I.D.
- b. Furnish all labor, equipment, tools and materials required including bulkheads, water and all miscellaneous items required to perform the tests.
- c. Test all sewer pipe over eighteen (18) inches I.D. after either the completed backfill or partial backfill sufficient to stabilize the position of the pipe in both alignment and grade is accomplished. Contractor may select section of the project for testing at any time by notifying the Engineer 24 hours in advance.
- d. Perform at depths of water as measured above center line of pipe of not less than two (2) feet nor more than ten (10) feet (consideration shall be given for water table above said centerline).
- e. Maintain test as necessary to locate all leaks but not less than two hours.
- f. Repeat as necessary after repair of leaks and defects until leakage, as measured, does not exceed 0.15 gallons per inch of internal diameter per hour per 1000 feet of pipe length (200 gal/inch of I.D./day/mile).
- g. Protect manholes and other structures by means of bulkheads to prevent bursting pressures from being applied inside the structure.
- h. De-water pipe upon completion of testing.

2 Air Leakage Testing.

- a Contractor may perform air tests for all pipe sizes.
- b. Furnish all facilities required including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator to avoid over pressurization, and all miscellaneous items required.

- (1) The pipe plug for introducing air to the sewer line shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valve and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.
- (2) The pressure test gauge shall meet the following minimum specifications:

Size (diameter)	4-1/2 inches
Pressure Range	0-15 P.S.I.
Figure Intervals	1 P.S.I. Increments
Minor Subdivisions	0.05 P.S.I.
Pressure Tube	Bourdon Tube or Diaphragm
Accuracy	+/- 0.25% of maximum scale reading
Dial	White coated aluminum with black lettering, 270 deg. Arc and mirror edge.
Pipe Connection	Low Male 1.2" N.P.T.

Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed.

- c Test each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trench.
- d Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose,

monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressured is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop from 3.5 psig to 2.5 psig. If the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below, the pipe shall be presumed free of defects.

<u>Pipe Size</u>	<u>Required Time per 100 LF</u>	<u>Minimum Required Time</u>
8"	70 sec	227 sec
10"	110 sec	283 sec
12"	158 sec	340 sec
15"	248 sec	425 sec
18"	356 sec	510 sec
21"	485 sec	595 sec
24"	634 sec	680 sec
27"	765 sec	765 sec
30"	851 sec	851 sec
33"	935 sec	935 sec

Sanitary sewer mains with service stubouts shall be tested with a pressure at 5 psi for a duration of 15 minutes with no drop in test pressure.

If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance all constructed sewer lines shall satisfactorily pass the low pressure air test.

- e. In areas where ground water is known to exist, install a one-half inch diameter capped pipe nipple, approximately 10" long, through manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, ground water level shall be determined by removing pipe cap, blowing air through pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

C Deflection Tests.A deflection test shall be required on all installations involving flexible

or semi-rigid pipe after said pipe has been laid and backfilled. *The tests shall be run not less than thirty (30) days after final backfill has been placed.* The maximum allowable deflection shall not exceed 5.0% of the pipe's internal diameter. The deflection test shall consist of guiding a device of the appropriate size for the pipe involved to accurately measure any deflection in the pipe. The device to be used shall be approved by the City Engineer prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping or other visual testing will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than 5.0% shall be excavated, replaced, backfilled, and retested to the satisfaction of the Engineer.

3203 ACCEPTANCE TESTS FOR PRESSURE SEWAGE FORCE MAINS.

- A. Perform hydrostatic pressure and leakage tests. Conform to AWWA C 600 procedures as modified herein. Test shall apply to all pressure sewers. Perform after backfilling.
- B. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Select test segments such that adjustable seated valves are isolated for individual checking. Contractor shall furnish and install test plugs at no additional cost to the Owner, including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs. Contractor shall be responsible for any damage to public or private property caused by failure of plugs. Limit fill rate of line to available venting capacity.

Conduct test at a pressure of 150 psi measured at the highest point of the main. Duration of the test shall not be less than two (2) hours with no loss in pressure.

- 1 All joints shall be watertight and free from leaks.

3204 ACCEPTANCE TESTS FOR SANITARY SEWER MANHOLES.

Test all manholes after completion but prior to backfilling of structure. Interior of manhole shall be dry with no standing water. All pipes entering and exiting the manhole shall be adequately plugged for the purposes of the vacuum testing. A vacuum of 10" Hg shall be drawn and the time recorded for the vacuum to drop to 9" Hg. The time to drop shall meet or exceed the values as follows:

- A. 48" Manhole Diameter : Up to 10 feet depth – 60 seconds, 10-15 feet depth – 75 seconds, 15-25 feet depth – 90 seconds
- B. 60" Manhole Diameter : Up to 10 feet depth – 75 seconds, 10-15 feet depth – 90 seconds, 15-25 feet depth – 105 seconds

If the test fails or the manhole joint mastic or gasket is displaced, the manhole structure shall be repaired and re-tested.

SECTION 4000 MATERIALS AND CONSTRUCTION - STORM SEWERS

4001 SCOPE. Storm sewer construction shall consist of furnishing all labor, materials, and equipment necessary for the complete installation of storm sewers and appurtenances. Unless otherwise noted within these specifications, the word "sewers" shall refer to pipe sewers, or open channels.

4002 SPECIFICATION MODIFICATION. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the Special Provisions or notes on the contract drawings.

4003 REVISIONS OF STANDARDS. When reference is made to a standard specification (ASTM, AWWA, MCIB, etc.), the specification referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders, except as noted on the contract drawings or as provided for in the Special Provisions.

4004 MATERIALS.

A. Reinforced Concrete Pipe:

1. Pipe. Reinforced concrete pipe shall conform to the following ASTM Standards and be of the minimum strength designated herein or such higher strength as may be required by the Plans or Special Provisions:
 - a. Round Pipe: ASTM C-76, Class III, Wall B.
 - b. Elliptical Pipe: ASTM C-507, Class HE-III.
 - c. Arch Culvert Pipe: ASTM C-506, Class A-III.

2. Joints:
 - a. Flexible Gasket: Flexible gaskets may be either flat gaskets cemented to the pipe tongue or spigot, O-ring gaskets, or roll-on gaskets. All gaskets shall conform to ASTM C-433.
 - b. Cement Mortar: Cement mortar shall consist of one part Type I portland cement by volume to three parts sand conforming to ASTM C-144 by volume mixed with sufficient water to form a workable stiff mortar paste.
 - c. Plastic Compound: This compound shall be a homogeneous blend of bituminous material, inert filler and suitable solvents or plasticizing compounds thoroughly mixed at the factory to a uniform consistency suitable for sealing joints of concrete pipe. The compound shall conform to the following requirements:

Bitumin, soluble in CS , percent
 by weight, minimum45%
 Ash, percent by weight 15-50%
 Penetration, standard cone, 150g,
 5 seconds, 25 C
 Trowel grade, bulk type 110-250mm
 Extruded rope or flat tape type50-120mm

The above penetration ranges include test tolerances.

d Preformed Plastic Compound: This compound shall be either rope form or flat tape form conforming to Federal Specification SS-S-210A. Primer, as recommended by the manufacturer, shall be used to maintain the material in position while pipe sections are being joined.

B. Corrugated Steel Pipe: Pipe and couplings bands shall conform to the requirements of AASHTO M-36. Bituminous and/or other coatings shall be provided when required by the Special Provisions. Bituminous coating shall conform to AASHTO M-190. Minimum thickness of the metal after galvanizing shall be as follows:

Circular Culvert Pipe
 (2-2/3" x 1/2" corrugations)

<u>Under Roadways or In Street Right-of-Way</u>		<u>Under Railroads</u>		<u>Not Under Roadways</u>	
<u>Diameter</u>	<u>Minimum Thickness</u>	<u>Diameter</u>	<u>Minimum Thickness</u>	<u>Diameter</u>	<u>Minimum Thickness</u>
15-21"	.064"	12-18"	.079"	12-30"	.064"
24-30"	.079"	21-24"	.109"	36-54"	.079"
36-54"	.109"	30-36"	.138"	60-84"	.109"
60-72"	.138"	42-84"	.168"	84"	.168"

Circular Culvert Pipe
 (3" x 1" corrugations)

<u>Under Roadways or In Street Right-of-Way</u>		<u>Not Under Roadways</u>	
<u>Diameter</u>	<u>Minimum Thickness</u>	<u>Diameter</u>	<u>Minimum Thickness</u>
36-54"	.079"	36-54"	.064"
60-84"	.109"	60-84"	.079"

Arch Culvert Pipe
(2-2/3" x 1/2" corrugations)

<u>Equivalent Diameter</u>	<u>Minimum Thickness</u>	<u>Span*</u>	<u>Rise*</u>
15"	.064"	17"	13"
18"	.064"	21"	15"
21"	.064"	24"	18"
24"	.079"	28"	20"
30"	.079"	35"	24"
36"	.109"	42"	29"
42"	.109"	49"	33"
48"	.109"	57"	38"
54"	.109"	64"	43"
60"	.138"	71"	47"

* Subject to manufacturing tolerances.

Arch Culvert Pipe
(3" x 1" corrugations)

<u>Equivalent Diameter</u>	<u>Minimum Thickness</u>	<u>Span*</u>	<u>Rise*</u>
36"	.046"	40"	31"
42"	.064"	46"	36"
48"	.064"	53"	41"
54"	.079"	60"	46"
60"	.079"	66"	51"
66"	.079"	73"	55"
72"	.079"	81"	59"
78"	.109"	87"	63"
84"	.109"	95"	67"
90"	.109"	103"	71"

*Subject to manufacturing tolerances.

<u>Minimum Thickness</u>	<u>Equivalent Nominal Gage</u>
.064	16
.079	14
.109	12
.138	10

The thickness of metal or size of corrugation shall not be changed throughout the length of any individual pipe culvert.

Adding to existing corrugated steel pipe the size of corrugation and thickness of pipe shall be the same as existing pipe.

C. Structural Plate Pipe and Pipe Arches. Structural plate shall conform to the requirements of AASHTO M-167. Corrugations shall have a depth of 2 inches and a pitch of 6 inches, and be galvanized with a zinc coating of 2.0 ounces per square foot for plates 0.168 inch and lesser thickness, and 3.0 ounces per square foot for plates greater than 0.168 inches in thickness. Bolts, nuts, and washers for connecting plates shall be galvanized in accordance with AASHTO M-232. Bolts shall be not less than 3/4 inch diameter and conform to ASTM A-449. Nuts shall conform to ASTM A-563, Grade C.

D. High Density Polyethylene Pipe (HDPE).

Pipe: Pipe shall be highly density smooth interior corrugated polyethylene (HDPE) that complies with ASTM F2306 and AASHTO M294 Type S. The manufacturer of the pipe must participate in the AASHTO/National Transportation Produce Evaluation Program (NTPEP). Nominal sizes include 12" to 60" diameters. Pipe corrugations shall be annular.

Joints: Joints may be bell and spigot, gasketed joints or external coupling bands. Joint integrity shall be soil tight as defined in ASTM F2306 and AASHTO M294. Bells shall span over three corrugations. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.

Fittings: Fittings and coupling bands shall be fabricated from the same material and conform to ASTM F2306 and AASHTO M294.

4005 CONSTRUCTION DETAILS.

A. Trench Excavation: Trenches shall be excavated to the width and depth as necessary to lay the sewer pipe to the grade line as indicated on the plans. Deviation from plan line and grade will not be permitted except under special circumstances subject to approval of the Engineer. The materials to be excavated are to be deposited on the sides of trenches and excavations, and beyond the reach of slides, or transported to the spoil banks, or used for backfilling. The length of trench excavation opened at one time shall be limited depending on the nature of the soil or other safety considerations.

Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths must comply with bedding class requirements as shown on the plans. Over-excavation shall be replaced with granular bedding material.

1. Unclassified Excavation. Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless the Special Provisions specify Classified Materials.

2. Rock Excavation. Rock excavation is defined as the removal of all rock ledges 6 inches or more in thickness, and detached rock or boulders having a volume of more than 1-1/2 cubic yards and shale occurring in its natural state, hard and unweathered.

A rock ledge is defined as a continuous body of rock, which may include interbedded seams of shale or other soft materials. Such interbedded soft material seams less than 12 inches in thickness will be included in the measurement of rock excavation. Such seams 12 inches or greater in thickness will be included only in the measurement of earth excavation. No soft or disintegrated rock which can be removed with a pick or digging machine, no loose, shaken or previously blasted rock, no broken stones, and no rock which may fall into the trench from outside the limits of excavation will be included. When solid rock is encountered in the trench, it shall be stripped of earth, and the Engineer notified. When blasting is permitted by the Engineer, the Contractor shall use the utmost care to protect life and property. The Contractor shall comply with all laws, ordinances, and applicable safety code requirements and regulations relative to the handling, storage and use of explosives and protection of life and property, and he shall be responsible for all damage thereto caused by his or his subcontractor's operations.

When blasting is required for rock excavation, all such operations shall conform to the requirements set forth in Section 7000 entitled "Blasting".

3. Earth Excavation. Earth excavation is defined as the removal of all material not defined as rock.
4. De-watering. The Contractor shall remove any water which may accumulate, or be found in the trenches and other excavations made under the Contract. The Contractor shall form all dams, flumes or other works necessary to keep them clear of water while the sewers and their foundation, and other foundations works, are being constructed. All water shall be removed from such excavation in a manner to not damage property.
5. Cribbing and Sheeting. The Contractor shall furnish, install, and maintain such sheeting, bracing, etc., as may be required to support any excavation and to prevent any movement which could in any way injure or delay the work or endanger adjacent pavement, building or other structures. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and consolidated.

For the purpose of preventing injury or property damage, contractor may leave in place all sheeting or bracing, etc., to be embedded in the backfill of the trench. No sheeting or bracing, however, shall be left in place within 5 feet of the surface without the written permission of the Engineer.

Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, or whenever any sheeting is driven for protection of trench walls in water bearing soil, the Engineer shall determine whether or not this section of the sheeting may be removed. Should he determine that any portion of this sheeting must be left in place, it shall be considered as "Extra Work" and will be compensated for on such a basis.

6. Unstable Foundation. Where materials are encountered in the bottom of the trench which are deemed as unsuitable by the Engineer to afford a sufficiently stable pipe foundation, the materials shall be removed to the depth and limits as ordered by the Engineer. Areas undergraded shall be backfilled with approved granular material or materials meeting the approval of the Engineer.
7. Protection of Property. The Contractor shall satisfactorily shore, support, and protect any and all structures and all pipes, sewers, drains, conduits, and other facilities, and shall be responsible for any damage resulting thereto. The Contractor shall not be entitled to any damages or extra pay on account of any postponement, interference, or delay caused by any such structures and facilities being on the line of work, whether they are shown on the plans or not; specifically, but not limited to damage due to delay in utility relocation.

B. Laying and Jointing:

1. Handling and Protection. All pipe shall be protected during installation against shock and free fall, and be installed without cracking, chipping, breaking, bending, or damage to coating materials. Damaged pipe materials shall be replaced with new materials except as repair may be permitted by the Engineer.
2. Grade Control. Maximum deviation from plan line or grade of any pipe after installation and backfilling shall not be greater than 0.1 foot. All pipe shall have a continuous slope free from depressions that will not drain. The Contractor shall establish such grade control devices as are necessary to maintain the above tolerances.
3. Laying. The laying of pipe in finished trenches shall be commenced at the lowest point and installed with the bell end forward or upgrade. All pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered so that when laid they will form a sewer with a uniform invert.
4. Bedding. The class of bedding required shall be as indicated on the plans or standard details. Bedding shall be rodded, spaded, and compacted as necessary to provide firm uniform support for the pipe; and not subject it to settlement or displacement.

5. Jointing. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed shall be clean and dry. Lubricants, primers, adhesives, etc. that are used shall be compatible with the jointing material recommended or specified.

All bell and spigot ends of concrete pipe shall be primed prior to application of a trowelable bitumastic plastic compound. No pipes may be trimmed unless ordered or approved by the Engineer. Pipes having defects that do not cause their rejection shall be so laid as to place these defects where they will be of least consequence.

Trenches shall be kept water-free and as dry as possible during bedding, laying and jointing, and for as long a period as required to protect the pipe joints and concrete in structures.

As soon as possible after the joint is made, sufficient material shall be placed alongside each side of the pipe to offset conditions that might tend to move the pipe off line and grade.

a Concrete Pipe:

- (1) Plastic joint sealant shall be applied to the tongue or spigot prior to the insertion into the bell or groove. A sufficient amount of sealant shall be used to fill the annular joint space with some squeeze out. Wipe the outside surface of the joint with additional material to assure a complete seal.
- (2) Mortar. When cement mortar is used the joint surface shall be clean and soaked with water immediately before the joint is made. A layer of mortar shall be placed in the lower portion of the bell or groove of the installed pipe and on the upper portion of the tongue or spigot of the pipe section to be installed. The tongue or spigot shall then be inserted into the bell or groove of the installed pipe until the mortar is squeezed out on both the interior and exterior surfaces. The annular joint space shall be completely filled and the abutting joint sections flush and even, with excess mortar struck off.
- (3) Flexible Gaskets. Flat gaskets may be cemented to the pipe tongue or spigot. O-ring gaskets shall be recessed in the groove of the pipe tongue or spigot and confined by the bell or groove after the joint is completed. Roll-on gaskets shall be placed around the tongue or spigot and rolled into position as the joint is assembled. Flat gaskets and O-ring gaskets shall be lubricated as recommended by the manufacturer.

- b Corrugated Steel Pipe. Corrugated steel pipes shall be joined with a band type of coupling. The band shall be drawn and secured on the pipe by connecting devices as furnished by the manufacturer. Pipe ends for annular corrugations shall be identical to the rest of the pipe barrel (plain ends), or in the case of helical pipe, the pipe ends at the joint shall be reformed to an annular corrugation or flange (reformed end). Gaskets, if required, shall be furnished in accordance with the plans and Special Provisions.

- c High Density Polyethylene (HDPE) Pipe. Gasketed integral bell and spigot pipe shall be utilized whenever possible. The mating bell and spigot shall be clean and properly lubricated. Care shall be taken to prevent damage to the pipe ends or exterior during assembly process. Insure joint is pushed “home” before beginning backfill or assembly of next pipe section.

C. Trench Backfill.

1. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

2. The top portion of the backfill beneath established sodded areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

3. At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings with pipe diameters less than 4' 0" shall be backfilled with graded gravel, four (4) feet back of curb to four (4) feet back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three (3) inches in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to ninety-five (95) percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to seventy (70) percent relative density as determined by ASTM D2049 when that test is appropriate.

Gravel for compacted backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than seventy (70) percent relative density as determined by ASTM D2049.

4. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.
5. Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.
6. Trench backfill above pipe embedment in locations other than those specified shall be compacted to ninety (90) percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the City Engineer.
7. Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two (2) inches in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.
8. Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least two (2) feet of loose backfill above pipe embedment.

9. No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen (18) inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed within three (3) feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

- C. Structural Plate Erection. Structural plate pipe, fabricated from hot-dip galvanized steel plates, shall be assembled by bolting individual plates together to erect the pipes or structures as shown on the plans. Bolts, fittings, and other appurtenances shall be furnished by the plate manufacturer. All materials shall be handled in such a manner that they are not chipped, dented, or bent. If the base metal is exposed in any way it shall be rejected, or repaired to the satisfaction of the Engineer.

4006 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

4007 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work.

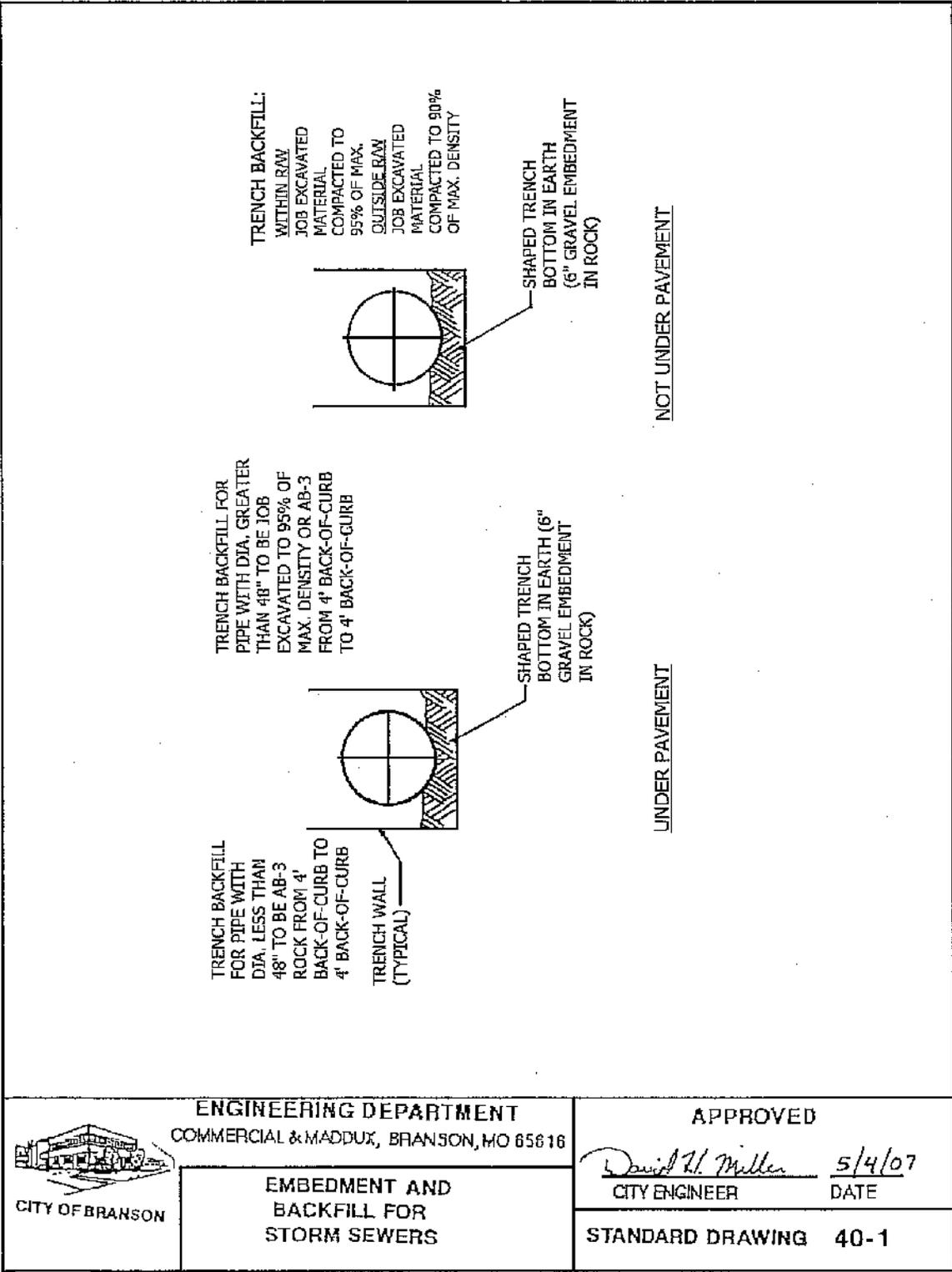
Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six (6) inches above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

4008 SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the City Engineer shall be furnished to the City of Branson by the Contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the City.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer.



 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65616	APPROVED	
	EMBEDMENT AND BACKFILL FOR STORM SEWERS	<i>David H. Miller</i> CITY ENGINEER	5/4/07 DATE
		STANDARD DRAWING 40-1	

SECTION 4100 STRUCTURES - STORM SEWERS

4101 SCOPE. This section governs the performance of all work necessary for construction of cast-in-place and precast concrete and masonry structures for inlets, manholes, junction boxes, box culverts, headwalls, and incidental structures.

4102 MATERIALS.

- A. Concrete Mixes. Concrete shall conform to requirements set forth in Section 2000, "Concrete".
- B. Reinforcing Steel. Reinforcing bars shall conform to ASTM A-615, Grade 60 Welded steel wire fabric shall conform to ASTM A-185.
- C. Precast Concrete Structures.
 - 1. Manholes. Precast manholes shall conform to ASTM C-478. Joints between concrete manhole sections shall be made with plastic joint compound or preformed plastic compound as specified in Section 4004. Minimum cross sectional area of preformed compound shall be 1 inch square or 1.25 inches diameter.
 - 2. End Sections for Concrete Pipe. Shall be flared end sections of the pipe manufacturer's standard design, and shall meet all applicable requirements of ASTM C-76 for Class II or higher classes of pipe.
 - 3. Rectangular Structures. Shall conform to the inside dimension indicated on the drawings and be designed for the following loads:
 - a. H-20 live load for all structures in/or under pavement, shoulders, driveways, and other traffic areas.
 - b. 2,000-lb wheel live load for curb opening inlets and junction boxes in non-traffic areas.
 - c. 50 pcf, equivalent fluid pressure for soil pressure on vertical walls.
 - d. 120 pcf for unit weight of soil cover on top slabs.
- D. Brick. Brick shall conform to ASTM C-32, Grade SM: and be free from cracks and checks, and emit a metallic ring when struck with a hammer.
- E. Masonry Mortar. Mortar for brick construction shall be one part portland cement plus 10 percent of portland cement by volume of hydrated lime conforming to ASTM C-207, Type N; and two parts sand conforming to ASTM C-144 by volume. Mortar shall not be mixed more than 30 minutes prior to use, and retempering will not be allowed. Water

content shall be controlled to produce a stiff mortar.

- F. Cement Mortar. Pre-mix mortar non-shrink or expansive grout in mortar for packing pipe in openings of precast structures, setting castings, and other incidental work shall consist of one part portland cement and two parts sand by volume mixed with sufficient water to form a workable stiff grout.
- G. Metal Castings. Castings shall be gray iron conforming to ASTM A-48, Class 30. Castings shall be of the shape, dimension and minimum weight indicated on the drawings, and be free from manufacturing defects. Castings shall be cleaned and painted with one coat coal tar before delivery. Bearing surfaces between frames and covers for installation in traffic areas shall be machined to provide even seating. Manhole rings and covers shall be Clay and Bailey No. 2008BV, Deeter No. 1315 or approved equal. Inlet rings and covers shall be Clay and Bailey No. 2020, Deeter No. 2016 or approved equal.
- H. Metal End Sections. Metal end sections shall be fabricated from galvanized base metal as specified in Section 4004, and shall be flared end sections of the metal pipe manufacturer's standard design. End sections shall be furnished with a metal toe plate. Bituminous coating is not required.
- I. Toe Walls. Flared end sections for concrete and metal pipe shall be set on a concrete toe wall centered on the end of the section. Toe walls shall be 8 inches thick by 24 inches deep by the width of the end section.

4103 CONSTRUCTION DETAILS.

- A. Concrete Structures. Concrete construction shall conform to the requirements set forth in Section 2000, "Concrete".
 - 1. Precast Structures. The Contractor may, at his option, construct precast concrete inlets, junction boxes, and box culverts, in lieu of the cast-in-place structures indicated on the drawings; except that all concrete base slabs for pre-cast inlets, manholes, and junctions boxes may be cast-in-place. Solid concrete brick or block shall be used to block inlets and similar structures to grade during placement of base slab concrete.

Precast concrete box culvert sections shall be installed on a 4 inch leveling course of untreated compacted aggregate conforming to the following:

<u>U.S. Standard Square Mesh Sieve</u>	<u>Percent Passing Square Mesh Sieve</u>
1 1/4"	100
1"	72-100
3/4"	60-90
3/8"	43-74

No. 4	28-60
No. 10	16-40
No. 40	3-22
No. 200	0-15

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25. That fraction of the material passing the No. 40 Sieve shall have a plasticity index not to exceed 8 when tested in accordance with ASTM D-423, and D-424.

Leveling courses shall extend one foot past the line of the box section, and be finished to a true plane surface to provide uniform bearing for the precast section.

2 Finishing.

- a. Formed Surfaces. Immediately following removal of the form, fins and irregular projections shall be removed. Form tie connections, holes, honeycomb spots, and other defects shall be thoroughly cleaned, saturated with water, and pointed with grout. The repaired surfaces shall be cured in accordance with Section 2000, "Concrete".
- b. Exposed Slabs. Finish for exposed slabs shall be wood float texture in accordance with MCIB Specification Section 24. Exposed edges shall be beveled or edged with a radial tool.

3 Form Removal. Forms shall remain in place until the concrete has attained sufficient strength to support loads imposed by backfilling, construction, and traffic, but not less than:

- a. Walls. Forms shall remain in place for a minimum of 3 days or until the concrete reaches a minimum strength of 2000 p.s.i.
- b. Slabs. Form shall remain in place for a minimum of 7 days or until the concrete reaches a minimum strength of 3000 p.s.i.

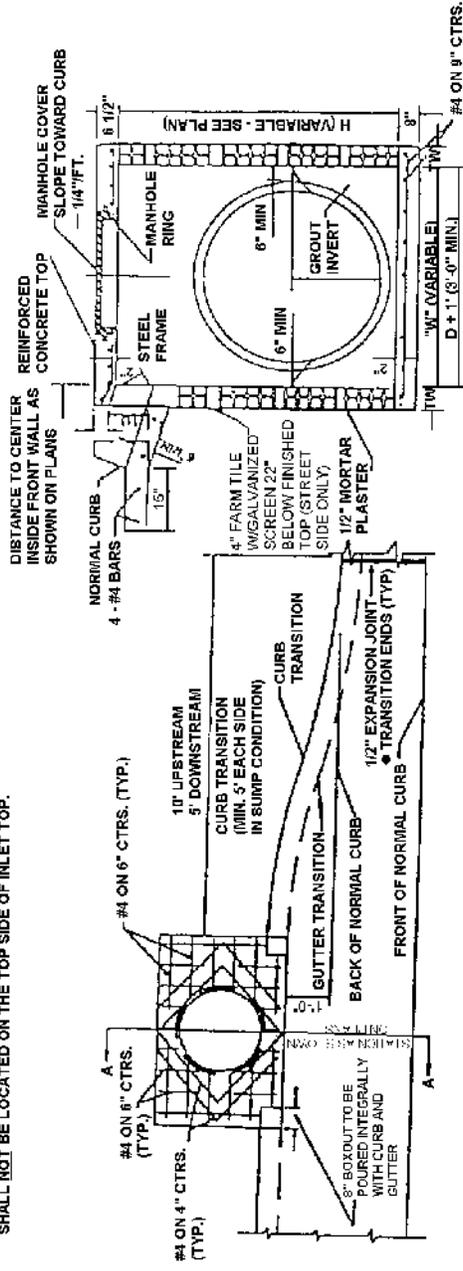
B. Brick and Masonry Structures.

1. Wet brick units thoroughly before laying. Each brick shall be laid with push joints in a full bed of mortar. The mortar shall fully cover the bottom and ends of the brick and surplus mortar on the inside face shall be removed and mortar joints on the inside face shall be well filled with a suitable pointing iron before initial set and be left with a smooth hard finish.
2. Lay brick in a stretcher course with every sixth course a header.
3. Plaster outside surfaces of brick structures with 1/2 inch thick mortar troweled to

a smooth hard finish. Cure with liquid membrane curing compound.

4. Protect new masonry work from loss of moisture while curing and protect from frost damage during freezing weather.
- C. Invert Channels. Form concrete invert channels in manholes, inlets, and junction boxes to make changes in direction of flow with smooth curves of as large a radius as permitted by the inside dimension of the structure. Grade changes and transitions shall be smooth and uniform and all parts of the invert channel and adjacent floor shall slope to drain. Channel bottom shall be finished smooth without roughness or irregularity. Invert channels for precast concrete structures may be cast integrally with the structure base slabs at the Contractor's option.
- D. Excavation and Backfill. All excavation and backfill shall be in conformance with Section 1100 entitled "Grading" and as specified herein.
1. Excavation. Excavation for structures shall be carried a sufficient distance, but not less than 18 inches outside the limits of the structure to permit efficient erection and removal of forms and laying of masonry units, and shall be sloped, stepped, or braced as required for stability. When unsuitable soils are encountered at the bearing elevation of the structure, they shall be removed and replaced with either fill concrete or compacted granular material at the Contractor's option. Over excavation shall be corrected in like manner. The Contractor shall maintain the excavation free of standing water until backfilling is complete.
 2. Backfilling. Backfilling shall conform to the requirements of Section 4005(C) and as follows:
 - a. No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 p.s.i. and can sufficiently support the loads imposed by the backfill without damage.
 - b. The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and the structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.
 - c. Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is always at approximately the same elevation on all sides of the structure.
 - d. No excavated rock larger than four (4) inches maximum dimension shall be placed within one (1) foot of the exterior surface of any structure.

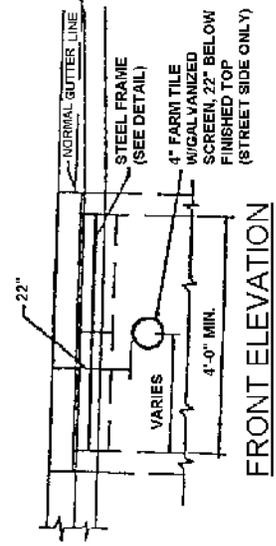
NOTE: POINTS OF ATTACHMENT PROVIDED FOR LIFTING PRECAST TOPS SHALL NOT BE LOCATED ON THE TOP SIDE OF INLET TOP.



PLAN VIEW

SECTION A-A

- NOTES:
1. CONTRACTOR SHALL PROVIDE STEPS SPACED AT 1'-4" O.C. WHERE INLET OR MANHOLE DEPTH IS GREATER THAN 4'-0". STEPS SHALL BE M.I.A. INDUSTRIES, INC. MODEL PS-2-PF OR APPROVED EQUAL.
 2. USE OF PRECAST CONCRETE REQUIRES CITY ENGINEER'S APPROVAL OF SHOP DRAWINGS.
 3. MASONRY WILL BE CONSTRUCTED TO 12" THICKNESS WHERE INLET OR MANHOLE IS GREATER THAN 8'-0". WHERE DEPTH IS GREATER THAN 6'-0" WALL IS TO BE CONSTRUCTED AS A DOUBLE WALL.
 4. MANHOLE RING AND LID SHALL BE NEENAH NO. R-1642-15 OR AN APPROVED EQUAL.
 5. SPACER SHALL BE PLACED AT EQUAL INTERVALS ACCORDING TO THE FOLLOWING: L=4'-0", 2 SPACES; L=6'-0", 2 SPACES; L=8'-0", 2 SPACES; L=10'-0", 3 SPACES.
 6. THE FIRST DIMENSION IN THE PLAN NOTATIONS REFERS TO "L" DIMENSION I.E. TYPE VI DENOTES L=8'-0".
 7. THE SECOND DIMENSION IN THE PLAN NOTATIONS REFERS TO THE "W" DIMENSION.
 8. "JUNCTION BOX" AS CALLED FOR IN THE PLANS, SHALL BE CONSTRUCTED TO CONFORM APPLICABLE WITH THE DIMENSIONS, THICKNESS AND DETAILS SHOWN.
 9. ALL METAL SURFACES, AFTER BEING CLEANED OF ALL DUST, WILL SCALE AND WELD SCALE SHALL BE COATED UNIFORMLY WITH ONE COAT OF RED EPOXY PRIMER NO. 68-1211 AS MANUFACTURED BY TRINEX CO. INC. THE PRIMER SHALL BE APPLIED TO A DRY FILM THICKNESS OF 4-8 MILS APPLIED AT THE RATE RECOMMENDED BY THE MANUFACTURER (APPROX. 290 SQ. FT. PER GALLON)
 10. CURB CONTRACTOR SHALL HAND FORM AND FINISH GUTTER WITHIN THE INLET THROAT TO THE REAR OF FRONT INLET WALL AT THE TIME THE FINISHING OF NORMAL CURB IS ACCOMPLISHED.
 11. USE CLASS 13000 PSI CONCRETE FOR ALL STANDARD CATCH BASIN AND INLET INVERTS.
 12. THE INVERT SHALL HAVE A TROWEL FINISH TO SECURE SMOOTH INVERT SLOPING TO OUTLET PIPE.
 13. OUTLET OR INLET PIPE SHALL BE PLACED AS SPECIFIED OR AS DIRECTED BY THE ENGINEER. REINFORCING STEEL SHALL BE BENT AROUND PIPE.
 14. USE CLASS III 4000 PSI CONCRETE FOR ALL STANDARD CATCH BASINS AND INLETS.



FRONT ELEVATION



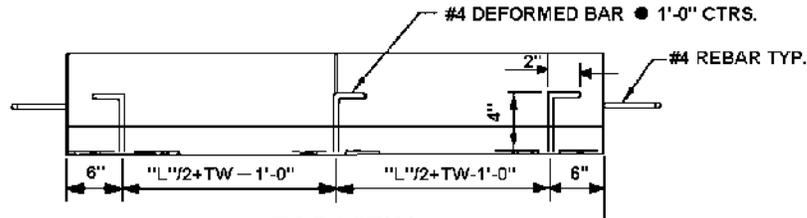
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

STANDARD CURB
INLET

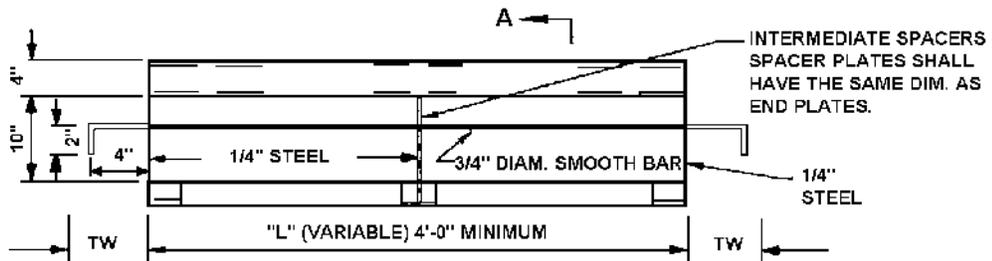
APPROVED

David H. Miller 8/13/90
CITY ENGINEER DATE

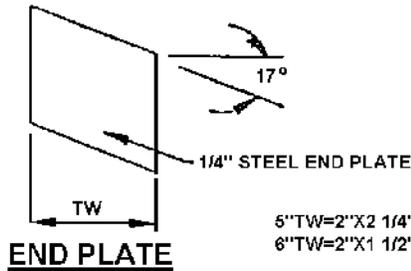
STANDARD DRAWING 41-1



TOP VIEW

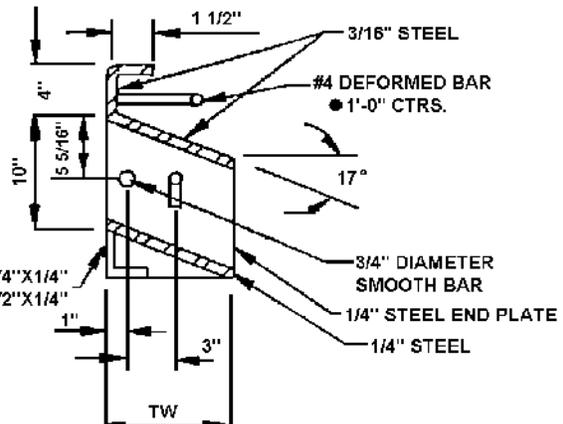


FRONT VIEW



END PLATE

5"TW=2"X2 1/4"X2 1/4"X1/4"
6"TW=2"X1 1/2"X1 1/2"X1/4"



SECTION A-A

NOTE: SEE NOTES STANDARD CURB
INLET DETAIL SHEET



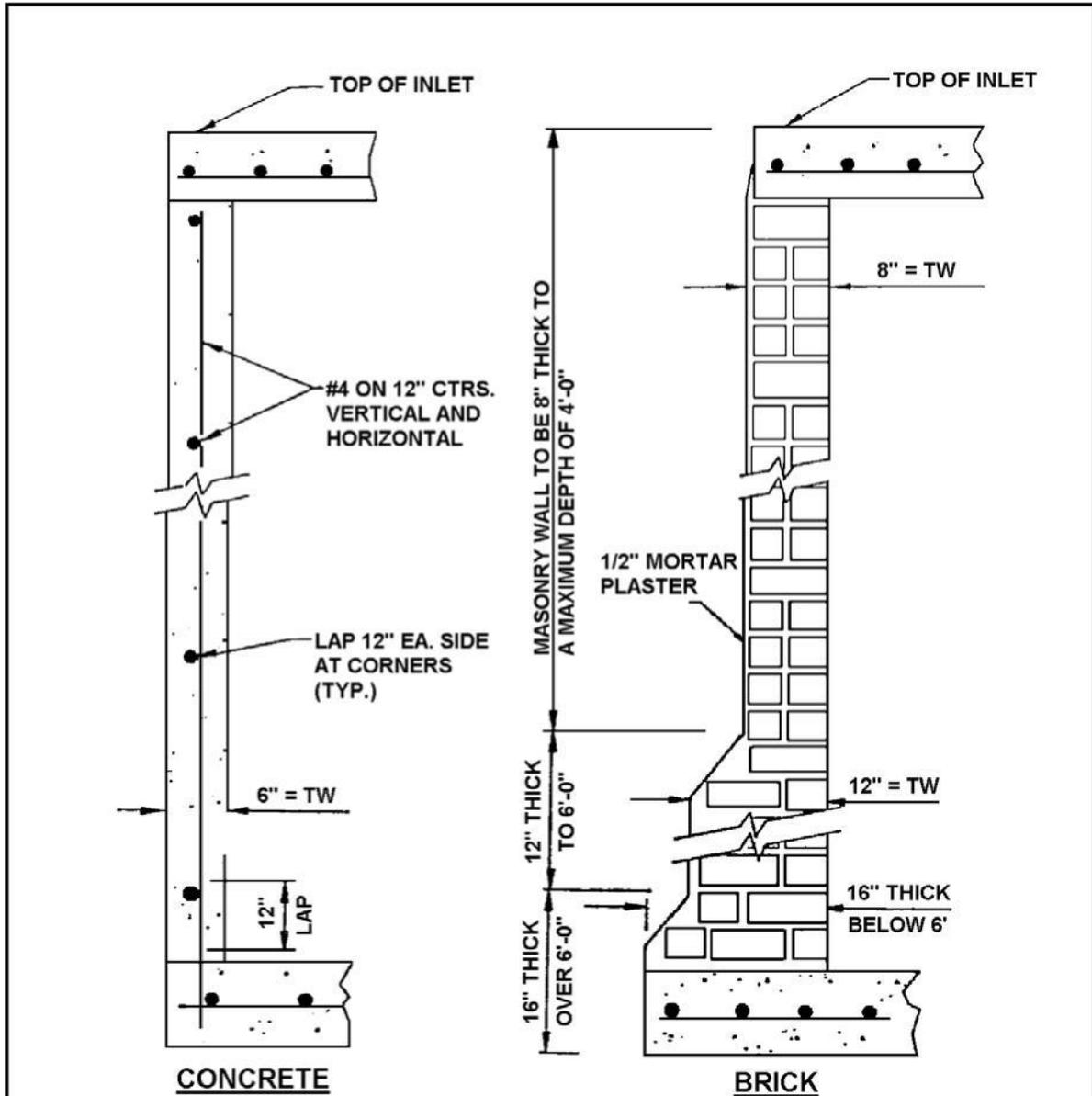
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

STEEL FRAME
DETAIL

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STANDARD DRAWING 41-2



NOTE: SEE NOTES STANDARD CURB INLET
DETAIL SHEET



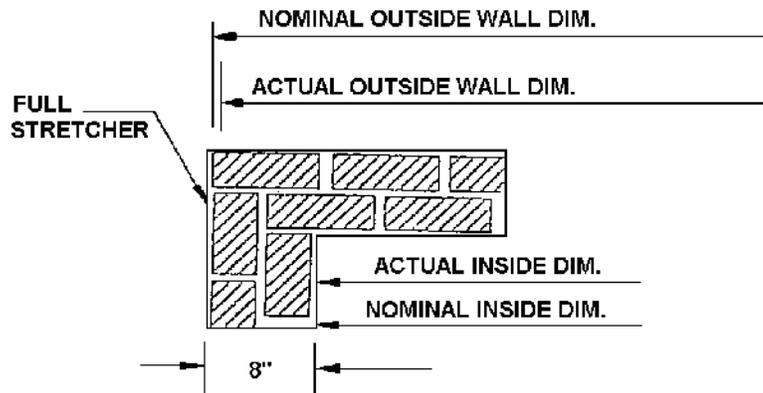
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65818

WALL SECTIONS
(FOR BRICK AND CONCRETE CONSTRUCTION)

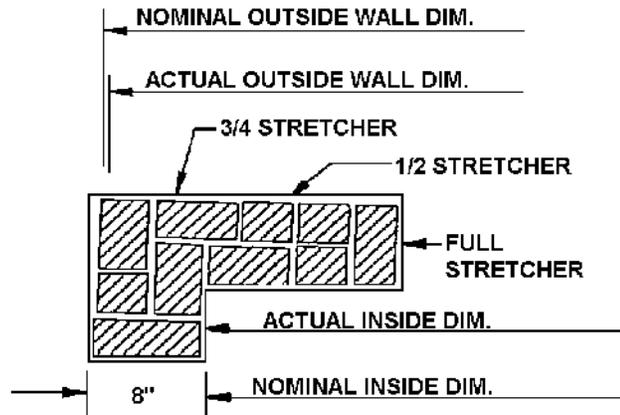
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CITY ENGINEER DATE

STANDARD DRAWING 41-3



STRETCHER COURSE



BONDING COURSE

NOTE: SEE NOTES STANDARD CURB INLET
DETAIL SHEET.



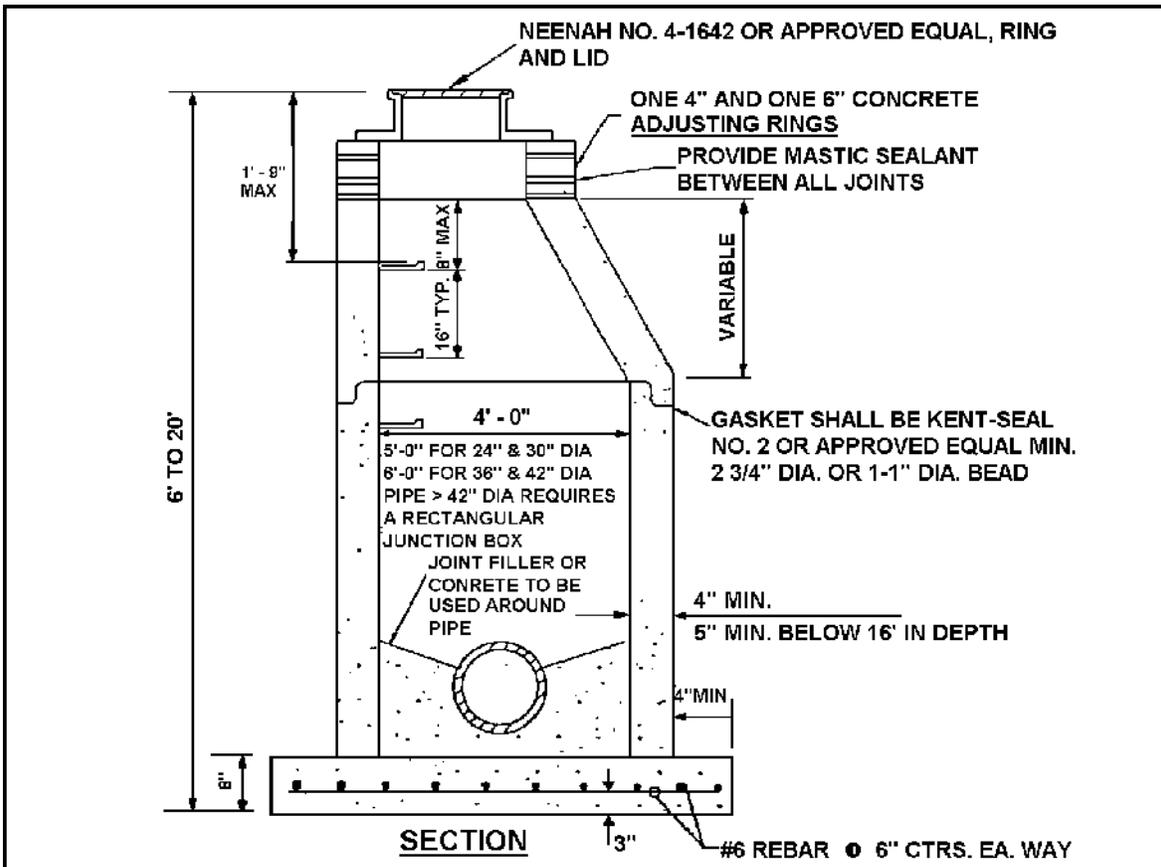
ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

**MASONRY CURB
INLET**
(BRICK WALL AT CORNER)

APPROVED

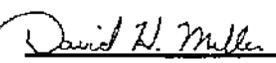
David L. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 41-4



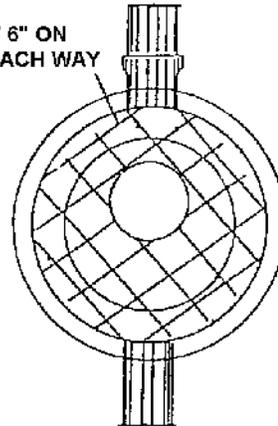
NOTE:

1. PRECAST CONCRETE MANHOLES SHALL CONFORM TO ASTM C478 EXCEPT AS MODIFIED BY THE SPECIFICATIONS.
2. BASES NOT BUILT MONOLITHIC WITH BOTTOM SECTION SHALL BE POURED OF CLASS I 3000 PSI CONCRETE.
3. MANHOLE MAY BE TRANSITIONED TO 4'-0" DIA., 8' ABOVE F.L. OF OUTFALL FOR 5'-0" AND 6'-0" MANHOLES.
4. THE BOTTOM SECTION OF ALL PRECAST MANHOLES NOT BUILT MONOLITHIC WITH THE BASE SHALL BE SET INTO A STEEL REINFORCED POURED CONCRETE BASE A MINIMUM OF 4". (#4 @ 6" E.W.)
5. THE COMPRESSIVE STRENGTH OF CONCRETE USE IN THE CONSTRUCTION OR PRECAST REINFORCED CONCRETE MANHOLES SHALL NOT BE LESS THAN 4000 PSI.
6. ONLY ECCENTRIC MANHOLE CONES WILL BE ALLOWED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.

 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65816	APPROVED  8/13/90 CITY ENGINEER DATE
	STANDARD STORM SEWER MANHOLE	STANDARD DRAWING 41-5

NOTE:
 MANHOLE BASE THICKNESS WILL BE 8"
 ON MANHOLES LESS THAN 20 FEET.
 FOR MANHOLES GREATER THAN 20 FEET
 IN DEPTH, THE BASE THICKNESS WILL
 HAVE TO BE CALCULATED. COPIES OF
 THE CALCULATIONS WILL BE REVIEWED
 BY THE CITY FOR APPROVAL.

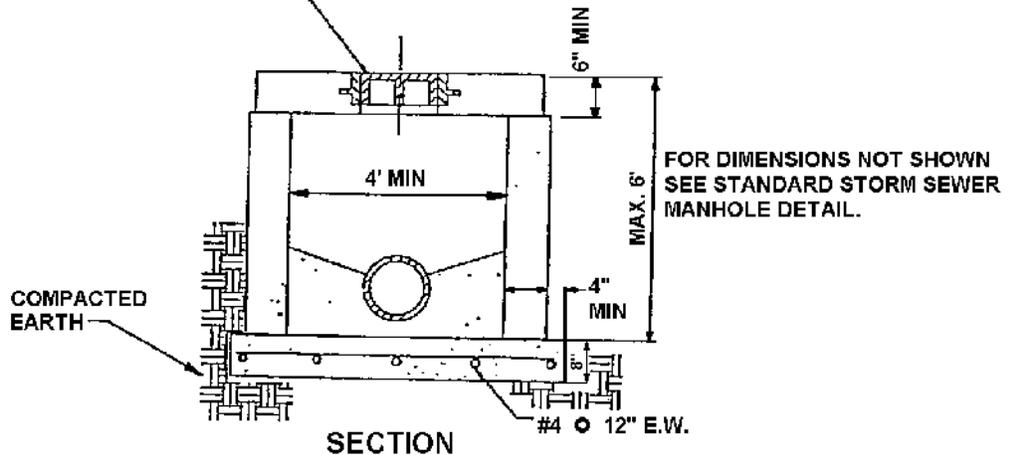
#5 BARS AT 6" ON
 CENTERS EACH WAY



PLAN

USE OF A STANDARD LID
 AND RING WILL BE
 ALLOWED WHERE GRADE
 PERMITS (SEE SPEC. FOR
 APPROVED TYPES)

NEENAH NO. 4-1642-15 OR APPROVED EQUAL RING
 AND LID (CAST IN MANHOLE TOP)



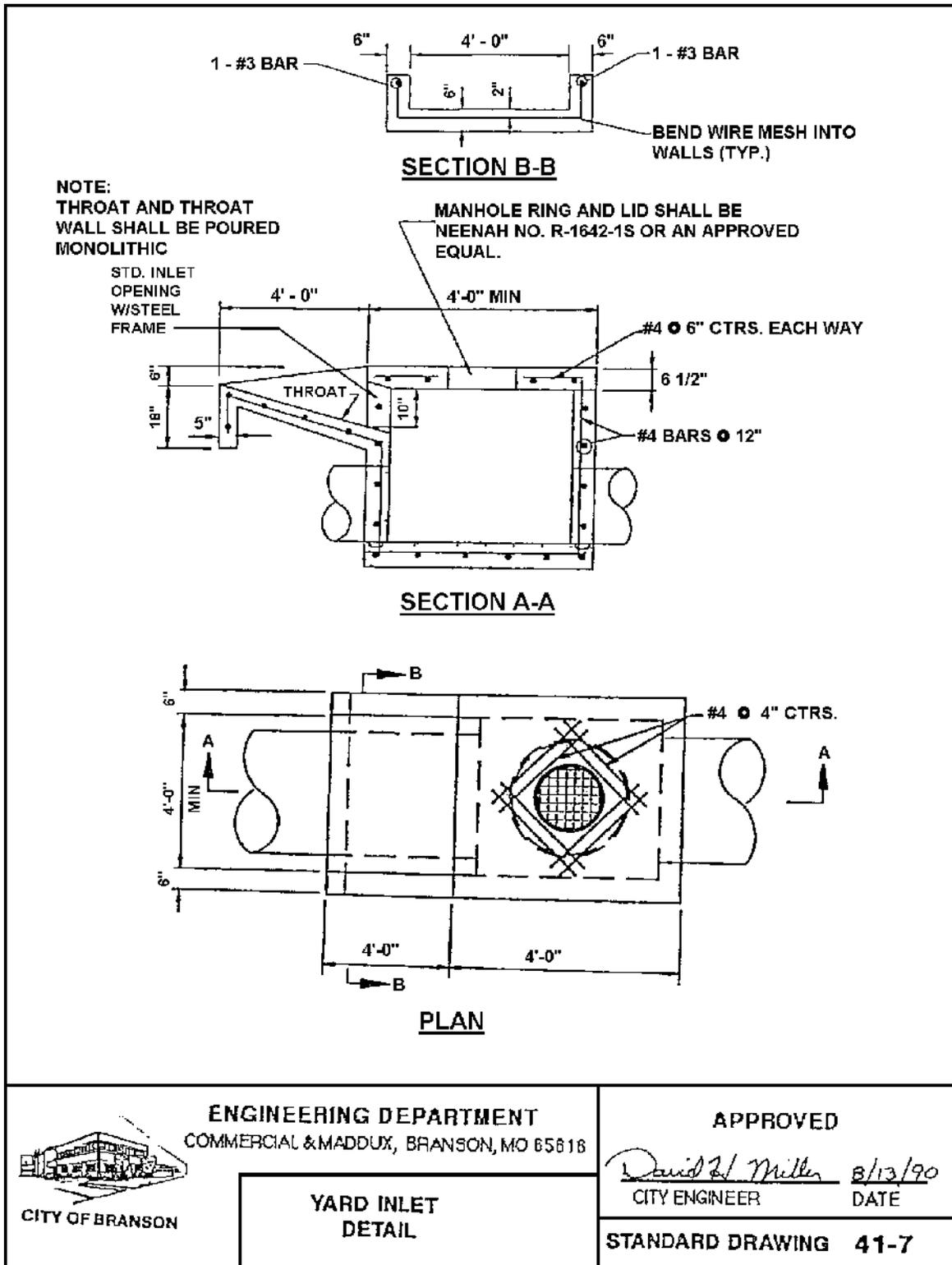
ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65818

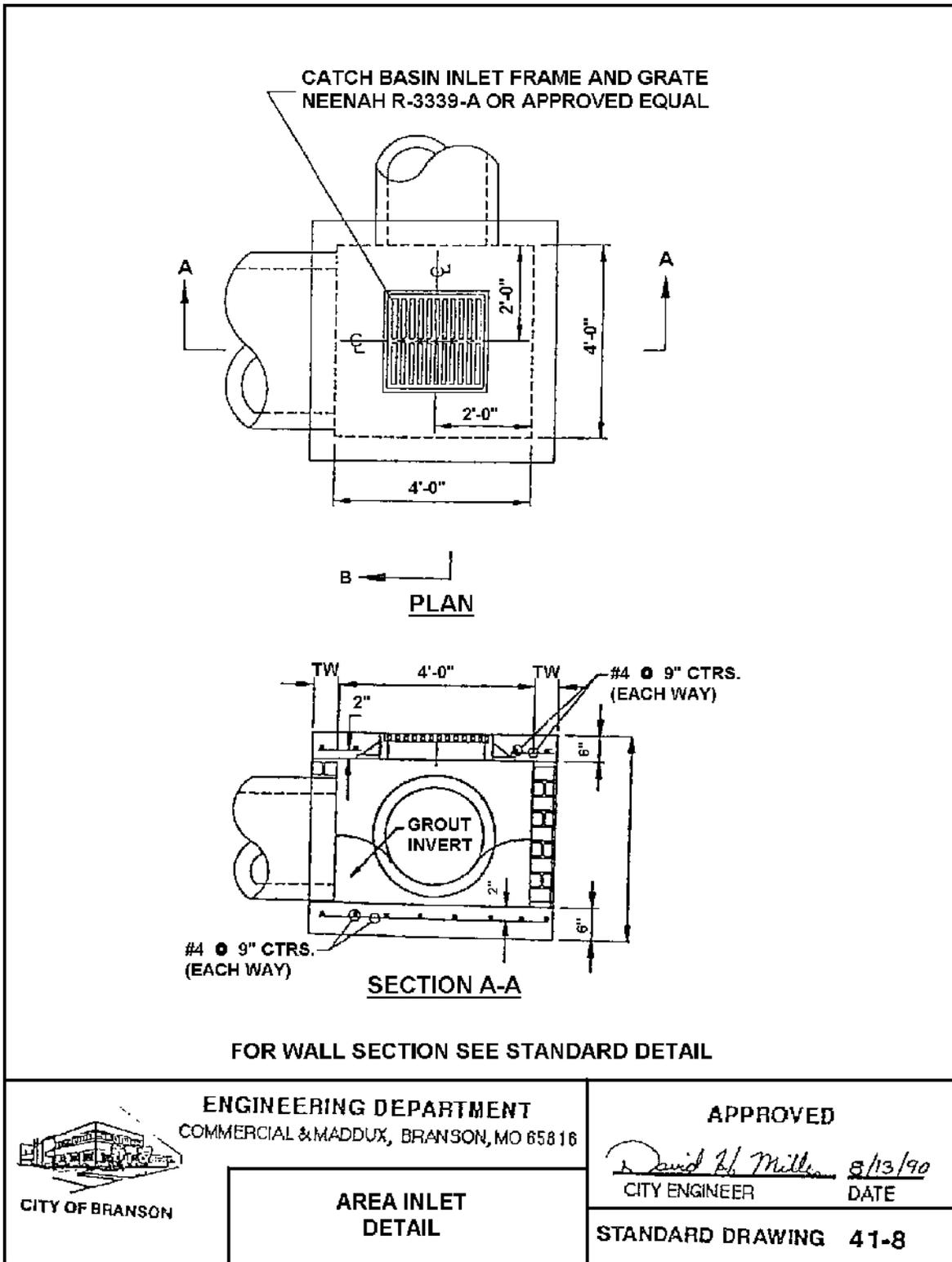
**SHALLOW
 JUNCTION BOX
 DETAIL**

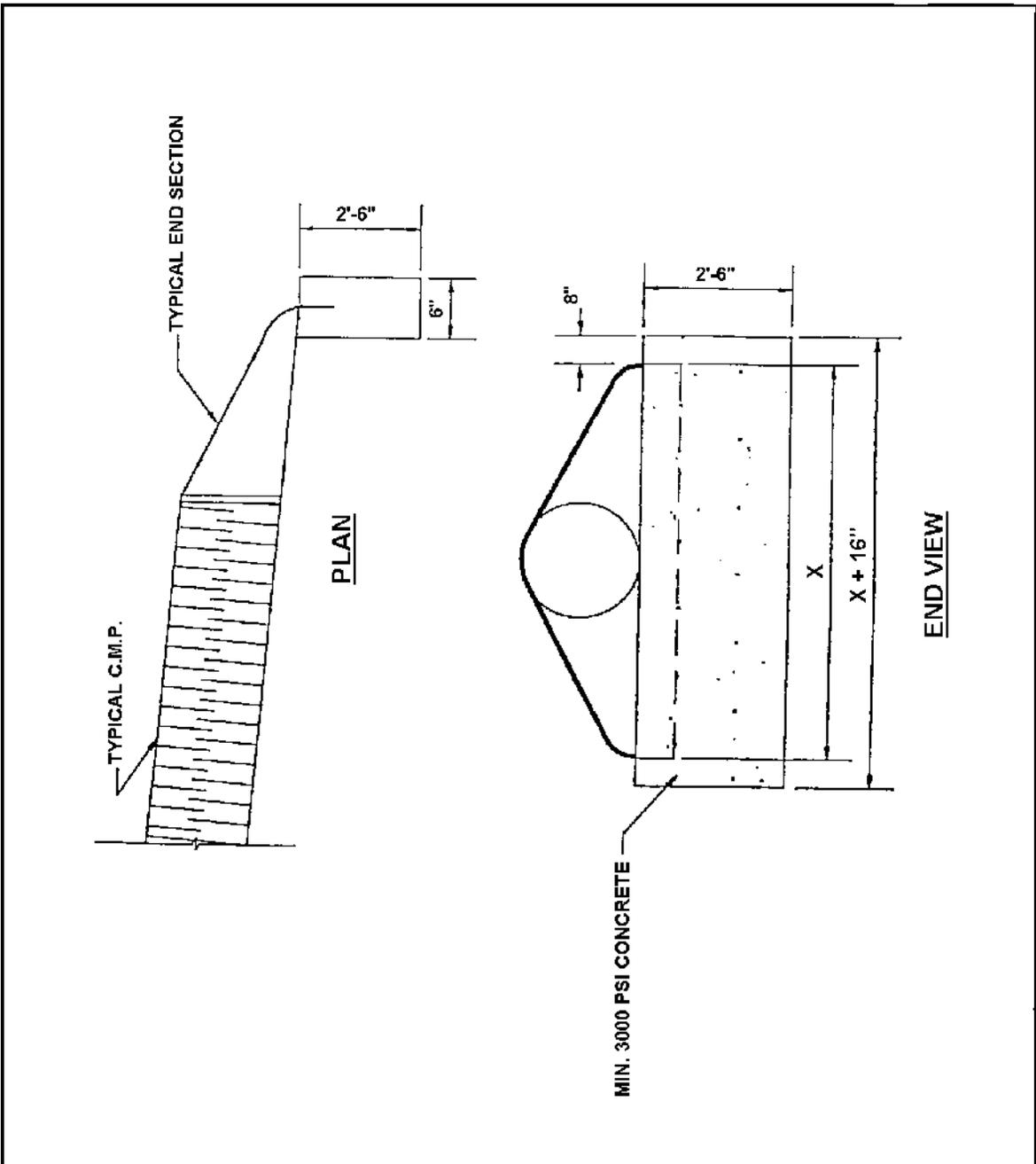
APPROVED

David L. Miller 8/13/90
 CITY ENGINEER DATE

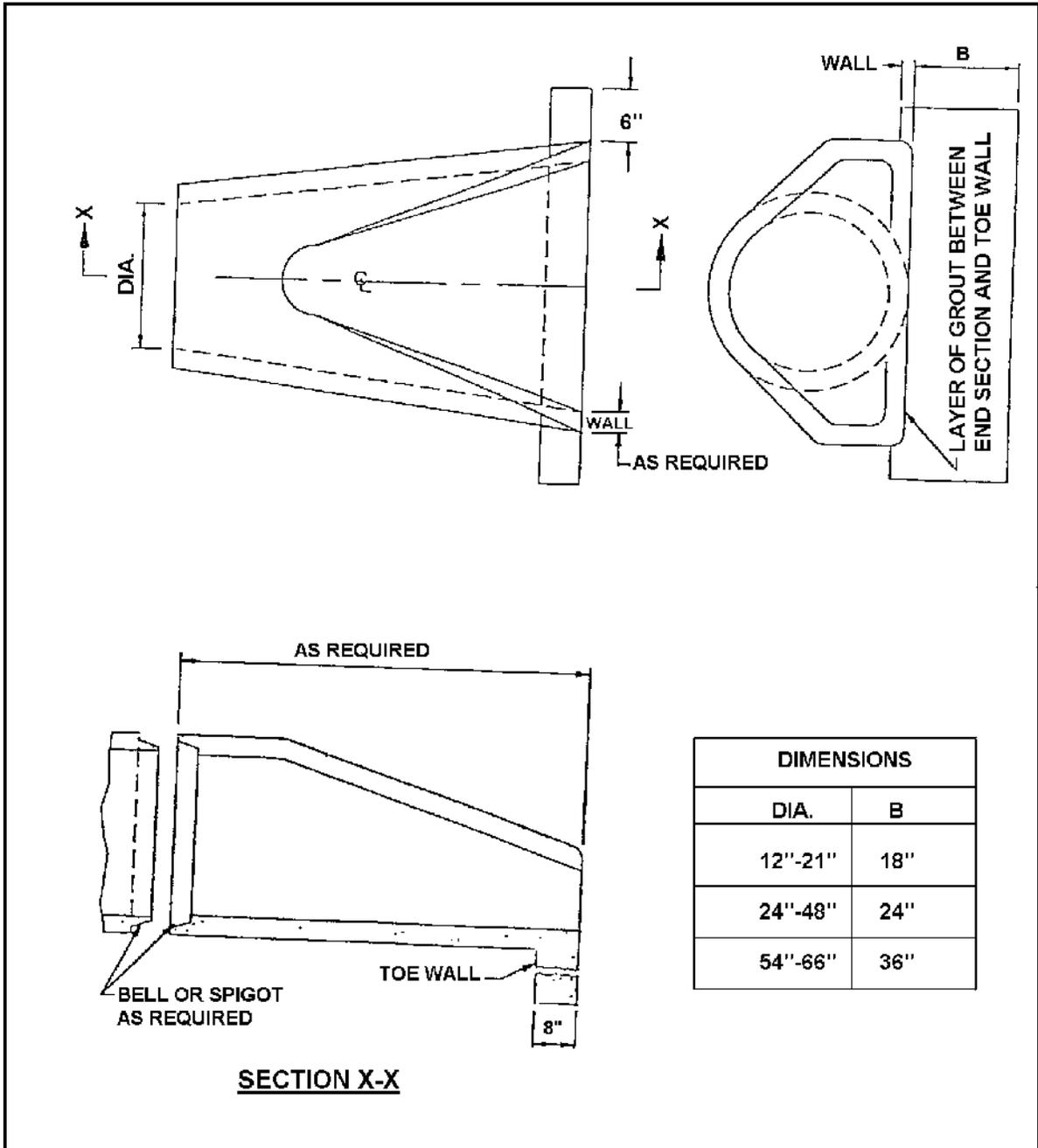
STANDARD DRAWING 41-6







 CITY OF BRANSON	ENGINEERING DEPARTMENT COMMERCIAL & MADDUX, BRANSON, MO 65818	APPROVED <i>David H. Miller</i> 8/13/90 CITY ENGINEER DATE	
	TYPICAL METAL END SECTION DETAIL	STANDARD DRAWING 41-9	



SECTION X-X



ENGINEERING DEPARTMENT
 COMMERCIAL & MADDUX, BRANSON, MO 65618

**TYPICAL PRECAST
 END SECTION
 DETAIL**

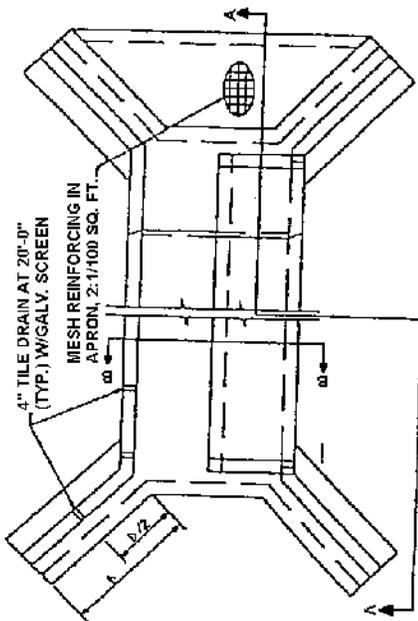
APPROVED

David H. Miller 8/13/90
 CITY ENGINEER DATE

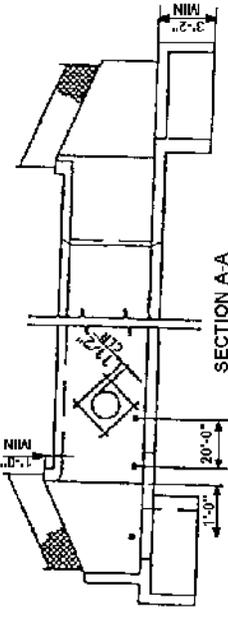
STANDARD DRAWING 41-10

GENERAL NOTES:

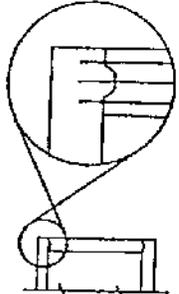
1. RCB'S SHALL BE DESIGNED TO CARRY AASHTO HS20-44 LOADING AS OUTLINED IN THE STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, 1977 EDITION.
2. ALL CONCRETE SHALL DEVELOP A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000 PSI.
3. REINFORCING STEEL SHALL BE ASTM A-615 GRADE 60, EXCEPT TIES AND STIRRUPS WHICH SHALL BE GRADE 40.
4. AT ALL HOLES IN CONCRETE WALLS, ADD 4 #5 BARS (OPENING DIMENSION PLUS 60 BAR DIAMETERS LONG) DIAGONALLY TO THE MAIN WALL REINFORCEMENT. SPREAD MAIN REINFORCEMENT AT ALL PENETRATIONS. DO NOT CUT OR ELIMINATE.
5. A CONCRETE SEAL COURSE SHALL BE CONSTRUCTED WHERE SPECIFIED ON THE PLANS OR BY THE CITY ENGINEER. ALL RCB BASE SLABS SHALL BE CONSTRUCTED ON STABLE SUBGRADE.
6. KEYED JOINTS SHALL BE PROVIDED AS SHOWN IN ALL CULVERTS WHERE THE LENGTH IS 40' OR MORE. THESE JOINTS SHALL BE SPACED SO AS TO DIVIDE THE BOX INTO SECTIONS OF EQUAL LENGTH. THE REINFORCING STEEL SHALL BE CARRIED THROUGH EACH KEYED JOINT AND STEEL LAPS SHALL BE 24 TIMES THE BAR DIAMETER OR A MINIMUM OF 12".
7. STANDARD CONCRETE COVER OF BARS UNLESS OTHERWISE NOTED SHALL BE:
 - WHERE DIRT FORMED... 3"
 - CONCRETE EXPOSED TO EARTH OR WEATHER 1 1/2"
 - #6 BARS OR SMALLER... 2"
 - #8 THROUGH #18 BARS... 3"
8. BACKFILLING MAY NOT BEGIN UNTIL THE CONCRETE REACHES A STRENGTH EQUAL TO 75% OF THE DESIGN STRENGTH OF THE CONCRETE (4000 PSI) IS ATTAINED PRIOR TO THE 14 DAY PERIOD.
9. A STANDARD 42" HIGH CHAIN LINK FENCE SHALL BE REQUIRED AT EACH END OF ALL RCB'S UNLESS APPROVED OTHERWISE BY THE CITY ENGINEER. FENCING SHALL EXTEND CONTINUOUSLY ALONG THE HUB GUARD AND DOWN EACH WING WALL.
10. HUB GUARDS SHALL BE DESIGNED TO ACCOMMODATE GRADING WITH A 6:1 MAXIMUM SLOPE BETWEEN BACK OF CURB AND THE HUB GUARD (OR EDGE OF SIDEWALK AND THE HUB GUARD IF APPLICABLE).
11. CONTRACTOR TO SUPPLY AN EXTRA AMOUNT OF REINFORCEMENT, 1% OF LENGTHS AND SIZED, TO BE USED AT THE DISCRETION OF THE CITY ENGINEER.
12. FLOATING APRON SHALL BE REQUIRED AT DOWNSTREAM END OF RCB.
13. UNLESS BOTTOM OF CHANNEL RESTS ON SOUND BEDROCK. TOE WALL TO BE 32" MINIMUM BELOW FLOW LINE OF RCB OR 6" INTO BEDROCK IF APPLICABLE.



PLAN

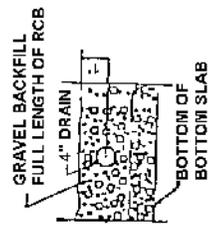


SECTION A-A

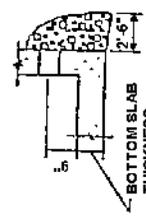


SECTION B-B

NOTE: IF TOP AND WALLS ARE MONOLITHICALLY POURED THEN UPPER KEYWAY CAN BE DELETED. REBAR MUST CONTINUE THROUGH KEYWAY AS SHOWN.



GRAVEL BACKFILL FULL LENGTH OF RCB
4" DRAIN
BOTTOM OF BOTTOM SLAB



DETAIL OF COURSE AGG. AROUND TILE DRAINS
BOTTOM SLAB THICKNESS (VARIES)



CITY OF BRANSON

ENGINEERING DEPARTMENT
COMMERCIAL & MADDUX, BRANSON, MO 65616

REINFORCED
CONCRETE BOX

APPROVED

David H. Miller 8/13/90
CITY ENGINEER DATE

STANDARD DRAWING 41-11

SECTION 4200 OPEN CHANNELS

4201 SCOPE. This section includes all work for construction of open channel lining at the location, and to the lines, grades and dimension indicated on the drawings. Grading shall have been previously completed in accordance with Sections 1000 and 1100 "Site Preparation" and "Grading".

4202 MATERIALS.

- A. Concrete. Concrete and materials shall conform to the requirements set forth in Section 2000, "Concrete".

- B. Stone. Stone for riprap, grouted riprap, and gabion linings shall consist of quarried rock and be sound, durable, and angular in shape. No more than 10 percent shall have an elongation greater than 3:1, and no stone shall have an elongation greater than 4:1. Material shall be free from cracks, seams, or other defects. Shale and stone with shale seams are not acceptable.
 - 1. The minimum weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity times 62.4 pounds per cubic foot.
 - 2. Not more than 10 percent of the stone shall exhibit splitting, crumbling, or spalling when subject to 5 cycles of the sodium sulfate soundness test in accordance with AASHTO T104.
 - 3. Stone shall be of the following gradations:
Riprap (15" Minimum Thickness)

<u>Weight of stone in lbs.</u>	<u>Percent Lighter by Weight</u>
180	100 (minimum)
120	80 (maximum)
60	50 (maximum)
6	10 (maximum)

Grouted Stone Lining (12" Minimum Thickness)

<u>Weight of stone in lbs.</u>	<u>Percent Lighter by Weight</u>
90	100 (minimum)
60	80 (maximum)
30	50 (maximum)
3	10 (maximum)

Gabion Fill Stone

<u>Stone Size Inches</u>	<u>Percent Smaller by Weight</u>
*	100
2 1/2	0

* one half of least dimension of gabion basket.

Stone shall be graded within the above limits as required to provide a unit weight in-place of 100 pounds per cubic foot or greater.

C. Filter Blanket. Filter blanket may be either of the following types at the Contractor's option:

1. Granular Filter. Granular filter material shall consist of sound, durable rock particles conforming to the following gradation.

<u>Sieve Size</u>	<u>Cumulative Percent Passing By Weight</u>
1"	100
1/2"	70-100
No. 4	50-85
No.10	35-70
No.40	20-50
No.100	15-40

2. Filter Fabric. Filter fabric shall consist of woven or nonwoven fabric. The synthetic fiber of either the woven or nonwoven fabric shall consist of polypropylene, nylon, or polyester filaments. The percent open area shall be not less than 4 percent nor more than 10 percent. The cloth shall provide an Equivalent Opening Size (EOS) no finer than the U.S. Standard Sieve No. 70. In addition, filter fabric shall meet the following physical requirements:

- a. Tensile Strength. Minimum grab tensile strength, both warpwise and fillingwise, shall be 200 pounds when tested in accordance with ASTM D 1682, using a 4 inch by 6 inch specimen and a jaw speed of 12 inches per minute.
- b. Elongation. Grab elongation shall be not less than 15 percent nor more than 60 percent, both warpwise and fillingwise, when tested in accordance with ASTM D 1682.
- c. Tear Strength. Minimum trapezoid tear strength shall be 100 pounds, both warpwise and fillingwise. Method of test for woven fabrics shall be in

accordance with ASTM D 1117.

- d. Bursting Strength. Minimum bursting strength shall be 200 psi when tested in accordance with ASTM D 3887.
- e. Seam Strength. Woven fabric shall have a minimum seam-breaking strength of 180 pounds when tested in accordance with ASTM D 1683, using a jaw speed of 12 inches per minute.
- f. Width. Filter fabrics shall be furnished in widths of not less than 6 feet.

D. Gabion Baskets. Baskets shall be of the dimensions indicated on the drawings and be fabricated using hexagonal triple-twist wire mesh.

- 1. Wire. Wire shall be galvanized-steel having a minimum tensile strength of 60,000 psi, and be zinc coated with a minimum coating weight of 0.80 oz. psf.
- 2. Wire Mesh. Maximum dimension of the mesh opening shall be 4 1/2 inches or less, and the maximum area of the mesh opening shall not exceed 12 square inches. Wire shall be 0.115 inch (minimum) diameter.
- 3. Selvedge Wire. Selvedge wire shall be 0.150 inch (minimum) diameter. All perimeter edges of the mesh forming the gabion selvedges have a strength equal to or greater than the body of the basket.
- 4. Lacing and Stay Wire. Wire shall be 0.091 inch diameter or larger.
- 5. Diaphragms. Gabions shall be divided into cells not greater than 4 feet in width by wire mesh diaphragms. Diaphragms shall be factory secured to the base of the basket by continuous spiral wire.

E Grout. Grout shall consist of one part portland cement and five parts aggregate by volume. The aggregate shall be a mixture of crushed stone and clean sand. Uniformly graded from coarse to fine, and meet the following gradation:

<u>Sieve Size</u>	<u>Cumulative % Passing</u>
1/2"	100
No.4	40-60

Water shall be proportioned to provide a grout having a consistency to permit thorough penetration of the grout into the joints and voids between the stones, but shall not exceed 5.0 gallons per sack of cement. The Contractor may use concrete conforming to MCIB Mix Number A 384- 1/2-2 or A 420 1/2-4 in lieu of the grout here-in-before specified.

4203 CONSTRUCTION DETAILS.

- A. Foundation Preparation. After completion of grading in accordance with Section 1100, the area to receive channel lining shall be trimmed and dressed to conform to the cross sections indicated on the drawings within a tolerance of plus or minus 2 inches from the theoretical slope lines and grades. All deleterious materials shall be removed from the foundation area.
- B. Concrete Lining.
1. Preparation. Earth foundation subgrade shall be moistened by sprinkling. Forms shall be securely staked, braced, and set to line and grade. Reinforcement and tie bars shall be held in position by bar chairs, concrete brick, or other approved devices.
 2. Placing and Finishing. Place, consolidate, and strike off concrete to the thickness indicated on the drawings. Concrete shall be tamped or vibrated to eliminate all voids and bring sufficient mortar to the top for finishing. Surface finish shall be a wood-float finish. Round all edges and joints with a 1/4 inch radius edging tool, except contraction joints may be sawed to a depth of 30 percent of the thickness of the concrete lining after concrete has hardened but before uncontrolled cracking occurs. Apply curing membrane as specified in Section 2000.
- C. Filter Blanket.
1. Granular Filter. Place granular filter to its full thickness in a single operation. Construction methods shall be such that the material is placed without segregation. Compaction of granular filter material is not required.
 2. Filter Fabric. Place filter fabric with its long dimension horizontal and lay free of tension, stress, folds, wrinkles, or creases.
 - a. Place to provide 18 inches minimum overlap at each joint and anchor to prevent dislocation during construction of overlaying material.
 - b. Fabric shall not be left exposed more than two weeks prior to placement of overlaying material. Tracked or wheeled equipment or vehicles shall not be operated on the fabric.
- D. Riprap Placement. Riprap shall be placed on the prepared foundation in a manner which will provide a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thicknesses indicated. Riprap shall be placed to full-course thickness in one operation and in such a manner as to avoid displacing the underlying material. If the underlying layer consists of filter fabric, the Contractor shall place the riprap in such a way as to not tear, puncture, or shift the fabric. Riprap shall not be

dropped more than 3 feet when being placed directly on the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.

1. Placing. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.
 2. Distributing. The larger stones shall be well distributed and the entire mass of stone shall conform to the specified gradation. All material shall be so placed and distributed that there will be no objectionable accumulations of either the larger or smaller sizes of stone.
 3. Hand Placing. It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the specified results.
- E. Grouted Stone Lining. Place stone and grout in a manner to produce a securely bound solid mass with the stone interstices completely filled. Sweep the surface clean of all surplus grout with a stiff broom. Apply curing membrane as specified in Section 2000.
- F. Gabion Lining.
1. Assembly. Assemble each gabion unit by binding all vertical edges together with a continuous piece of connecting wire stitched around the vertical edge with coils spaced at 3 inches or less. Set empty units to line and grade and join units by stitching with connecting wire along adjoining edges. Install and securely fasten internal tie wires in each cell if necessary to retain the shape of the cell during filling operations.
 2. Filling. Fill gabion cells with stone carefully by hand or machine to provide a minimum of voids and avoid bulges and distortions of the gabion. After filling, secure the lid to the sides, ends, and diaphragm by stitching with connecting wire.

SECTION 4300 STORMWATER DETENTION REQUIREMENTS

4301 GENERAL

Detention may be accomplished in nearly any method viable on the project site. This can include detention ponds, tanks, below ground systems or even parking lot or landscape island detention.

- A. Discharge may be by use of V-notch walls or small pipe. Innovative solutions are usually acceptable depending upon City staff review.
- B. Open basins must be soil lined and have soil placed on interior and exterior side slopes. Soil must be seeded and mulched.
- C. Rip rap or rock lined basins and berms will only be allowable under unusual circumstances and with special permission from the City.

4302 RATE OF RUN-OFF

- A. Stormwater shall be retained such that the rate of run-off leaving the post-developed site is no greater than the pre-development run-off rate. The difference between the two runoff rates is the amount that should be detained.
- B. Detention facilities shall be designed in accordance with the City of Branson Design Criteria for Public Improvement Projects.
- C. Discharge velocities must not be erosive. The following channel linings are required:

<u>VELOCITY</u>	<u>LINING TYPE</u>
< 3 fps	Seeded
3 to 5 fps	Staked sod
5 to 10 fps	15" thick stone rip-rap
10 to 15 fps	Grouted stone rip-rap, gabion revetment or concrete paved
Over 15 fps	Concrete paved or bedrock

Velocities must be reduced prior to exiting the appropriate lining.

4303 REQUIREMENTS

All storm sewers under street pavement must be concrete unless a specific waiver is granted from the City Engineer. Flared end-sections are required on all CMP and RCP and concrete aprons and wing walls are required on all concrete box culverts.

Any disturbance of land over 1 acre in size requires a permit from the Missouri Department of Natural Resources.

An erosion control plan must be developed and implemented prior to beginning any land disturbance. The plan can include such items as silt logs, silt fencing, staked straw bales or silt retention ponds to control the run-off during the construction.

Drainage easements must be dedicated to the City where appropriate.

4304 MAINTENANCE OF DETENTION FACILITIES

The maintenance of the detention facilities shall be the responsibility of the property owner. Maintenance shall include the removal of silt and debris from the basin and control structure in order to maintain full operational capacity.

Where a basin serves more than one property owner, such as a subdivision, the maintenance requirement shall be vested with a property owners association.

SECTION 5000 MATERIALS, CONSTRUCTION AND TESTING - WATER LINES

5001 GENERAL. The purpose of this specification is to govern the furnishing of all materials, labor, equipment, tools, superintendence, and other services necessary to construct water mains, complete with appurtenances including extensions and relocations at the locations shown on the plans. These specifications have been approved by the Department of Natural Resources for use of water distribution system construction under Review No. 54516-09. All water system materials and installation shall conform to current AWWA standards.

5002 MATERIALS.

A. Scope. This section governs materials for water mains having diameter of two inches and larger.

B. Pipe and Fittings.

1. Ductile-Iron Pipe. Unless indicated otherwise on the construction plans or directed by the Engineer, all 6 inch pipe and larger shall be Class 50 ductile iron, all 4 inch pipe shall be Class 51 Ductile iron complete with all accessories and conforming to ANSI A21.51, AWWA C151, ASTM A536, and Grade 60-42-10. (2 inch pipe shall be PVC.)

Joints, unless otherwise specified, shall be of the push-on type conforming to ANSI A21.11/AWWA C111, except gaskets shall be synthetic rubber. Natural rubber will not be acceptable. The pipe shall be cement mortar lined, conforming to ANSI A21.4/AWWA C104 and shall be coated inside and out with a bituminous coating.

2. Ductile-Iron Fittings. Ductile-iron fittings shall be complete with all accessories and shall be ASTM A536, Grade 70-50-05, conforming to ANSI A21.10/AWWA C110, 350 psi pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.11/AWWA C104 and shall be coated inside and out with a bituminous coating. Fittings shall have distinctly cast upon them the pressure rating and letters "DI" or "DUCTILE".
3. Cast-Iron Fittings. Cast-iron fittings in sizes 4 inches through 12 inches shall be complete with all accessories and shall conform to ANSI A21.10, 250 psi pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.10/AWWA C110. All fittings shall be cement mortar lined conforming to ANSI A21.4/AWWA C104, and shall be coated inside and out with a bituminous coating.
4. Poly (vinyl chloride) Pipe. PVC pressure pipe shall be designed to carry potable water at pressures (including surge) up to the maximum class rating. Materials from which the pipe, couplings, and fitting are manufactured shall conform to ASTM D1784, Type 1, Grade 1, 2,000 psi design stress. The minimum wall thickness for the pipe shall be SDR 21 (Class 200). 2" PVC pressure pipe shall

have a minimum wall thickness of 17 (Class 250) or Schedule 40 (Class 270).

All PVC pipe shall conform to the latest revisions of ASTM D2241, Department of Commerce PS22-70 (SDR-PR) pressure rated pipe, and National Sanitation Foundation Testing Laboratories (NSF). Pipe end gaskets, meeting the requirements of ASTM F477, shall be synthetic rubber. Natural rubber will not be acceptable. Gaskets shall be held in place with glue or other adhesive sufficient to hold gasket in place during the insertion of the adjoining pipe.

The couplings and fittings shall accommodate the pipe for which they are used. The minimum pressure ratings shall be 235 psi for couplings and 250 psi for the fittings. The insertion depth of the pipe in the coupling shall be controlled by an internal PVC mechanical stop in the coupling. Each pipe and fitting shall be plainly and permanently marked thereon:

- a. Manufacturer's name and trademark
- b. Nominal pipe size
- c. ASTM Designation D 2241
- d. SDR Number
- e. Material designation

C Valves and valve Boxes.

1. Gate Valves. Generally, and unless otherwise directed by the Engineer, gate valves shall be used on all water mains, up to and including, 12 inches nominal diameter. The type, size and location of valves shall be as shown on the Plans. Except as modified or provided herein all gate valves in pipe lines shall be 200 psi, iron body, gate valves with non-rising stems. Gate valves shall be resilient-seated conforming with all applicable requirements of ANSI/AWWA C509 and shall be Mueller A2370-20, American-80 "CRS" or approved equal.
2. Butterfly Valves. Butterfly valves shall be used for water lines larger than 12 inches in diameter unless otherwise directed by the City Engineer. Butterfly valves shall be of the rubber-seat, tight-closing type. Valve discs shall seat at 90 deg. with the pipe axis. Flanged end valves shall be of the short body type. For buried service, shaft shall be O-ring type.

All butterfly valves and operators shall conform to AWWA C504. Metal mating seat surfaces shall be 18-8 stainless steel or monel. Each valve shall be provided with an operator with a torque rating at least equal to the torques listed in AWWA C504, Table 1.

Butterfly valve shall be Kennedy 50C, American Class 150-B, Mueller "Line Seal III" or approved equal.

3. Valve Ends. Valve ends shall be of the mechanical joint type, conforming to ANSI A21.11/AWWA C111 except where flange ends are required on the plans.

The end flanges of flange gate valves shall conform in dimensions and drilling to ANSI B16.1 for cast-iron flanges and flange fittings, Class 125, unless explicitly provided otherwise on the plans and Special Provisions. The laying lengths of the flange valves shall conform to the dimensions of ANSI B16.10.

Valves connecting to tees shall have restrained joints.

- 4 Bonnet Thrust Plates. The bonnet shall have a removable thrust plate to permit the removal and replacement of the valve stem and "O" ring seal while the valve is in service.
- 5 Tapping Valves and Sleeves. The size and location of the tapping valves, shall be as shown on the plans. The valves shall be 200 psi, iron body, resilient-seated gate valves with non-rising stems conforming with all applicable requirements of ANSI/AWWA C509, except that the outlet end shall be standard mechanical joint end conforming to ANSI A21.11/AWWA C111 and the inlet end shall have an inlet flange conforming to ANSI B16.1 for cast iron flanges, Class 125.

Tapping sleeves shall be of the flanged-outlet type designed for attachment to the flanged inlet end of the tapping valve, and shall be provided with mechanical joint ends at each end of the run and shall be Mueller "No. H-615" for ductile iron pipe or approved equal.

- 6 Stem Seals and Coatings.
 - a. All valves shall be provided with stem seals of the "O" ring type. Two "O" rings shall be used with at least one "O" ring inserted above the thrust collar. The packing plate shall be attached to the valve bonnet by not less than three (3) bolts and one "O" ring below the thrust collar.
 - b. All exterior surfaces of each valve shall be cleaned and painted in the shop with two (2) coats of asphalt varnish conforming to Federal Specifications TT-V-51-E or be epoxy coated. The interior surfaces of resilient-seated gate valves shall have a protective coating of fusion-bonded, nontoxic epoxy which is safe for potable water.
- 7 Valve Operation. All valves shall be equipped with a 2 inch square wrench nut and the direction of rotation to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word "Open" and an arrow indicating the direction to open.
- 8 Extension Stems. Extension stems and stem guides shall be provided where shown, specified, or required for proper operation. Extension stems shall be fabricated from solid steel shafting not smaller in diameter than the stem of the valve or from galvanized steel piping having an ID not smaller than the OD of the

valve stem. Extension stems shall be connected to the valve by a flexible, socket-type coupling. All connections shall be pinned, keyed, or socket type. Pipe couplings will not be acceptable.

Extension stems shall be provided for buried valves when the operating nut is more than three feet below finished grade. Each extension stem for a buried valve shall extend to within three feet of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

9 Valve boxes, Bases, Lids and Covers.

- a. All buried valves shall be provided with valve boxes. Valve boxes shall be of cast iron, extension sleeve screw type (5 1/4" diameter), suitable for the depth of cover required by the drawings. Valve boxes shall be Clay & Bailey No. P-1108 or approved equal.
- b. All parts of valve boxes, bases, and covers shall be coated by dipping in bituminous varnish.

Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped on each side of the box.

- c. Fire Hydrants. Fire hydrants shall be Mueller A-423 Super Centurion 250 or Clow Model #2545 Medallion and shall be furnished with a six (6)-inch auxiliary gate valve. The fire hydrants shall be pressure rated at 150 psi working pressure and 300 psi test pressure. Hydrants shall be traffic model with breakaway flange or coupling. Fire hydrants shall conform to AWWA C502 with information required by Section 2 as follows:

<u>Type of Shutoff</u>	<u>Compression</u>
Size of Hydrant	5 1/4 inches
Inlet Connection	6 inches
Outlet Nozzles	2-2 1/2 inch hose and 1-4 1/2 inch pumper
Outlet Nozzle Threads	ANSI B-26
Direction to Open	Counterclockwise
Stem Seals	O-ring
Outlet Nozzle Cap Chains	Required
Drain Outlet	Required
Finish Paint	Factory painted above the ground line with red reflective enameled paint.

Weather Cap on Operating Nut
Oil Reservoir

Required
Required

Hydrants shall be furnished with all joint glands, gaskets, bolts, and nuts required for installation. Hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply line. Each hydrant shall be set on a concrete foundation at least eighteen (18) inches square and (6) inches thick. Each hydrant shall be suitably anchored.

Hydrant drainage shall be provided by installing around the hydrant, and below the top of the hydrant supply pipe, at least one-half (1/2) cubic yard of three-fourths (3/4)-inch rock.

Fire hydrant installations shall conform to the Standard Detail. All hydrants shall stand plumb. The exact direction the nozzles will be facing shall be determined by the Engineer.

D. Specials.

1. General. Air release, meter, and pressure-reducing valve vaults shall be precast concrete conforming to ASTM C478. Access lid castings shall be as noted in the Special Provisions or as shown on the plans.

Vaults which, by their special nature, must be cast in place shall conform to the plans and concrete specifications in Section 2000 "Concrete".

2. Pressure-Reducing Valves. Pressure-reducing valves shall be designed to provide tight shutoff under conditions of no flow and shall not "hunt" under ordinary flow conditions. Pressure-reducing valves shall be as noted in the Special Provisions, selected and sized as recommended by the valve manufacturer. Pressure-reducing valves shall be suitable for operation under the pressure and flow conditions as shown on the plans.
3. Combination Air Valves. Combination air-release and vacuum-relief valves shall be installed at the locations indicated on the plans. Each valve assembly shall be installed complete with appropriate piping and valves as shown on the plans. All piping and isolation valves shall be brass except for the air outlet from the valve which shall be brass or copper tubing.

Air releases for mains 12 inches in diameter or smaller shall have 1 inch combination air-release valves, APCO No. 143C or approved equal.

4. Tapping Sleeves. Tapping sleeves shall be standard mechanical joint type for iron pipe and shall comply with all applicable requirements of ANSI A21.10/AWWA C110 for iron fittings. Tapping sleeves shall be furnished with a flange outlet

conforming in dimensions and drilling to ANSI B16.1, Class 125.

E. Location Wire and Tape. Location wire and warning marking tape shall be buried above all water mains and water services 4" diameter and greater.

1. Location Wire. Location wire shall be No. 12 solid insulated copper wire laid directly on top of pipe and connected to valve boxes and existing iron piping as shown on the Standard Drawing.

2. Warning Marking Tape Warning marking tape shall be 6" wide polyethylene blue in color and have "BURIED WATER LINE BELOW" printed on the tape at 20 to 30 inch intervals. The detection and marking tape shall be installed directly above the centerline of the pipe and 18 to 24 inches below finish grade.

F. Bedding Aggregate. All materials used for crushed stone pipe bedding shall conform to the requirements of MCIB Specification Sec. 4 Materials for coarse aggregate and shall meet the gradation specified therein under Column III, Table 2, for three quarters (3/4) inch maximum size aggregate with the following modifications.

<u>Sieve Size</u>	<u>Percentage Passing</u>
No. 4	0-5
No. 8	0-2

5003 CONSTRUCTION REQUIREMENTS.

A. Grading and Excavation.

1. Scope. Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.

2. General. Excavation and trenching work shall be performed in a safe and proper manner with suitable precautions being taken against all hazards.

The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

In paralleling existing water, sewer, and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept

clear or other satisfactory provisions made for street drainage.

3. Classification of Excavated Material. No classification of excavated materials will be made unless otherwise indicated on the contract drawings. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work regardless of the type, character, composition, or condition thereof.
4. Unauthorized Excavation. Any part of the trench excavated below grade shall be corrected with material approved by the Engineer placed and compacted by the Contractor.
5. Removal of Water. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during sub-grade preparation and continually thereafter until the structure to be built or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

6. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling. When ordered by the Engineer, wood sheeting shall be left permanently in the trench.

Where trench sheeting is left in place, such sheeting shall not be braced against

the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

7. Stabilization. Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of crushed stone or gravel. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

8. Trench Excavation. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer.

Except where tunneling or boring and jacking is specified and shown on the plan by the Engineer, all trench excavations shall be open cut.

9. Alignment and Grade. The alignment and grade or elevation of the pipeline shall be as shown on the plans.

The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations therefrom.

Unless otherwise shown or indicated on the plans or unless otherwise set forth by the Engineer, the horizontal and vertical alignment of the water main shall be maintained to within the following tolerances:

<u>Horizontal</u>	<u>Vertical</u>
3"	42" to 48"
	Depth of Cover

10. Minimum Cover. Except where otherwise shown, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe as indicated above. Greater pipe cover depths may be necessary on existing pipe, conduits, drains, drainage structures, or other obstruction encountered at normal pipe grades.

Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finish grade or pavement surface elevations. Maximum cover shall not exceed 60".

11. Limiting Trench Width. Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment. However, the limiting trench width below an elevation 6 inches above the top of the installed pipe shall be as follows:

Ductile-Iron Pipe

Clearance	<u>Maximum Trench width</u>		<u>Minimum Trench width</u>	
	<u>Pipe Size</u>	<u>in Earth</u>	<u>in Earth</u>	<u>in Rock</u>
	4"	18"	30"	6"
	6"	24"	30"	6"
	8"	26"	32"	6"
	10"	28"	34"	6"
	12"	28"	34"	6"

When PVC pipe is used, the minimum trench width shall be equal to the outside diameter of the pipe plus 6 inches on each side of the pipe.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than 1 foot above the top of the pipe.

12. Unauthorized Trench Widths. When, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the Contractor's expense.
13. Trench Bottom in Earth. The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the pipe is to be laid. The surface shall be graded to provide a uniform bearing and continuous support for each pipe at every point along its entire length.
14. Bell Holes. Bell holes for the pipe shall be dug after the trench has been cut to proper grade and immediately prior to the laying of the pipe length. No part of the bell shall be in contact with the trench bottom.
15. Bell Hole Option. The Contractor, at his option, may use granular material in the trench bottom in lieu of bell holes. The granular fill material shall be spread and the surface graded to provide a uniform bearing with continuous support along each section of pipe.
16. Rock Exploration. Unless shown otherwise on the plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock

exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.

The Contractor must form his own opinion as to the character of materials which will be encountered from an inspection in the ground, from his own investigation of the test hole information, or from such other investigations as he may desire.

17. Trench Bottoms in Rock. All rock excavation shall be carried to a minimum of 6 inches below the bottom of the pipe. Granular pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.
18. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities or structures above or below ground, In all such locations, hand-excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of the type, design and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

19. Stream Crossings. Stream crossings shall be made in accordance with these specifications and as shown on the plans.
 - a. Flowing Streams.

A minimum cover of four (4) feet shall be provided over the pipe. When crossing water courses are greater than fifteen (15) feet in width, the following shall be provided:

 - (1) The pipe shall be special construction, having flexible water tight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing.

Restrained joint or fusion weld pipe shall be used for bored crossings.

- (2) Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding; and the valve closest to the supply source shall be in an accessible location.
- (3) Permanent taps shall be provided one each side of the valve within the manhole to allow insertion of a small meter to determine leakage and for sampling purposes.
- (4) The stream crossing pipe or casing shall extend at least fifteen (15) feet beyond the upper edge of the stream channel on each side of the stream.

b. Intermittent Flowing Streams.

- (1) Restrained joint pipe shall be used for all stream crossings.
- (2) The pipe shall extend at least fifteen (15) feet beyond the upper edge of the stream channel on each side of the stream.

20. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossings in accordance with these specifications, the Special Provisions and as shown on the plans.

All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad right-of-ways shall be in conformity with all the requirements, regulations and be under the control (through the Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

The Contractor shall pay fees and obtain permits to make the crossings unless otherwise directed.

5004 INSTALLATION.

- A. General. Laying of ductile-iron pipe, and poly(vinyl chloride) pipe; installation of valves, and hydrants; and embedment and backfill shall conform to the following specifications and the details as shown on the plans.

1. Unless otherwise specified or shown on the plans, the water mains shall be laid to have a minimum cover of 42 inches, measured from the finished grade or from established street grades shown on the plans.

2. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.
3. Where the pipe is to be installed inside a casing pipe or tunnel liner, creosote timber skids or approved equal shall be strapped to each pipe before it is placed in the casing pipe or tunnel liner in accordance with these specifications and as shown on the plans, Sand fill shall be used when shown on the plans or required by the Special Provisions. The ends of each casing pipe or tunnel liner shall be closed with a dry brick wall or as shown on the plans. The closures for each casing pipe or tunnel line shall not be constructed until all testing of the line has been completed and accepted.
4. Where pipe is laid at a slope of 20% or greater, slope anchors shall be installed.

B. Poly (vinyl chloride) Pipe.

1. Handling. Pipe, fitting, and other accessories shall at all times be handled with care to avoid damage. Under no circumstances shall they be dropped. Pipe fittings shall be handled as specified for ductile-iron pipe. Any damaged pipe shall be rejected.
2. Cutting Pipe. All pipe shall be cut with a saw or special cutting tool. Cutting shall be done in a neat manner without damage to the pipe. Cuts shall be smooth, straight and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed and beveled. Beveling shall be done with specifically designed beveling tool. Hand beveling will not be allowed. When cutting pipe with couplings, mark the field cut pipe end the same distance in as the mark appeared on the original full-length section.
3. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted.
4. Pipe Laying. PVC pipe shall be installed in strict accordance with the requirements and instructions of the pipe manufacturer. It shall be protected from lateral displacement and deflection by pipe embedment material installed as specified for pipe embedment and as shown on the Standard Drawings. No pipe shall be laid under unsuitable trench conditions. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

C. Ductile-Iron Pipe.

1. Handling. Pipe, fittings and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall

be such that the pipe, pipe coating, and fittings are not damaged. Hooks shall not be used. Under no circumstances shall pipe or accessories be dropped or dumped. Pipe and fittings on which the cement lining has been broken or loosened shall be replaced by the Contractor. Where the damaged areas are small and readily accessible, the Contractor may be permitted to repair the lining.

All pipe coating which has been damaged shall be repaired by the Contractor before installing the pipe.

2. Cutting Pipe. Ductile-iron pipe shall be cut with either a saw or an abrasive wheel. Cutting of existing cast-iron pipe shall be done with mechanical pipe cutters. The cutting of pipe with a torch will not be permitted.

Cutting shall be done in a neat manner without damage to the pipe, or the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

3. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted. Such surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.
4. Inspection. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective, damaged, or unsound pipe and fittings shall be rejected and marked as such and removed from the site of the work.
5. Alignment of Bell-and-Spigot Pipe. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Tables 4 and 5 of ANSI/AWWA C600.
6. Laying Pipe. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

5005 JOINTING.

- A. Push-on Joints. The gasket seat in the bell shall be wiped clean after which the gasket should be placed. A thick film of lubricant should be applied to all of the inner surface of the gasket and on the spigot end of the pipe.

The lubricant and the gaskets shall be as recommended and supplied by the manufacturer of the pipe being used. The lubricant shall be odorless, tasteless, nontoxic, and suitable for use in potable water.

Field-cut pipe shall be bevel filed to remove any sharp or rough edges which might otherwise damage the gasket.

- B. Mechanical Joints. The mechanical joint shall be used only when shown on the plans and shall be installed in strict accordance with the manufacturer's recommendations.
- C. Flanged Joints. When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell-and-spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate so that gasket compression is uniform.
- D. Restrained Joints. Restrained joints and anchoring joints shall be installed in strict accordance with the pipe manufacturer's recommendations.

5006 CONNECTION TO EXISTING MAINS. The Contractor shall furnish and install all fittings necessary to join the existing and new water mains as shown on the plans.

The City of Branson shall be given at least 24 hours notice prior to turning off any water supply mains. The Contractor shall coordinate tie-ins with the City of Branson to minimize down time.

5007 POLYETHYLENE ENCASEMENT.

- A. General. Polyethylene encasement shall be installed on ductile-iron pipe and fittings when indicated on the plans.
- B. Installation. The polyethylene encasement shall be installed as specified in "Method A" or "Method B" below.
 - 1. Method A: Polyethylene tubing shall be approximately 2 feet longer than the length of the pipe section to provide a 1 foot overlap on each adjacent pipe section. Tube ends need not be taped in place unless Contractor is directed to do so by the Engineer.
 - 2. Method B. Polyethylene tubing shall be 1 foot shorter than the length of the pipe section with a 3 foot length of polyethylene tube center over pipe joint and lapped over pipe section and its tubing. Tube ends need not be taped in place unless the Contractor is directed to do so by the Engineer.
 - 3. Repairs. Any rips, punctures, or other damages to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured with adhesive tape.

5008 SETTING VALVES, FITTINGS AND HYDRANTS.

- A. Valves and Fittings. All valves, fittings, plugs and caps shall be set and joined to the pipe in the manner heretofore specified for cleaning, laying and joining pipe, except that large valves may require special support so that the pipe will not be required to support the valve weight. Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition. Gate valves shall be set vertical in the horizontal pipeline. Valves and pipe shall be supported in such a manner as to prevent stress in either with no deflection in the valve/pipe joint.

Valve boxes and lids shall be installed at each valve and shall be supported and maintained centered and plumb over the operating nut of the valve. The valve box shaft shall not transmit shock or stress to the valve. Install valve box covers flush with the surface of the finished area or as directed by the Engineer.

All bends and tees shall be provided with thrust blocks of plain concrete, as specified. All dead ends on new mains shall be closed with plugs or caps suitably restrained to prevent blowing off under test pressure.

- B. Hydrants. All new hydrant installations shall be as shown on the plans or Standard Drawings and shall include all necessary excavation and backfill to make the installation complete.

Each hydrant shall be inspected before installation for direction of opening, nozzle size and threading, nozzle caps and chains, operating nut, and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow and weep hole openings, and handling damage and cracks. Defective hydrants shall be corrected or replaced.

All hydrants shall stand plumb. The weep holes of the hydrant shall be kept clear and free to drain. The areas around each hydrant and hydrant valve shall be thoroughly compacted to prevent settlement of these areas.

Hydrants shall be set to a grade that allows their proper operation. Traffic hydrants with breakaway joint must be set with the joint above the ground line. Hydrants behind curbs shall be placed with the hydrant centerline at least 24 inches from the back of curb. Hydrants shall be rotated so as to have the pumper nozzle facing the street or rotated to face any direction as required by the Engineer.

5009 THRUST RESTRAINTS.

- A. Hydrants. The back of the base elbow of each hydrant shall be braced against a sufficient area of unexcavated earth or rock with a concrete thrust block or be restrained by suitable restrained joints as shown on the plans or the Standard Drawings.
- B. Fittings. All plugs, caps, tees, bends and other fittings, unless otherwise specified, shall be provided with reaction blocking or suitable restrained joints as shown on the plans or Standard Drawings.

- C. Thrust Blocks. Vertical and horizontal reaction blocking shall be concrete as specified herein. Thrust blocks shall be installed between solid ground and the fitting to be restrained. Concrete shall be located to contain the resultant thrust force and permit access to pipe and fitting joint for repairs.
- D. Restrained Joints. Restrained push-on or mechanical joints, mechanical joint anchoring fittings, and mechanical joints utilizing set screw ductile-iron retainer glands may be used in lieu of concrete thrust blocking if so indicated on the plans or approved by the Engineer.

5010 TRENCH BACKFILLING.

Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings shall be backfilled with graded gravel four (4) feet back of curb to four (4) feet back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three (3) inches in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to ninety-five (95) percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to seventy (70) percent relative density as determined by ASTM D2049 when that test is appropriate.

Gravel for compacted backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than seventy (70) percent relative density as determined by ASTM D2049.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind. Trench backfill above pipe embedment in locations other than those specified shall be compacted to ninety (90) percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the City Engineer.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two (2) inches in diameter, debris, cinders, or other corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least two (2) feet of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen (18) inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed within three (3) feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

5011 DENSITY TESTING. At the option of the Engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the Contractor shall revise his compaction procedures to obtain the results specified.

5012 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required

to maintain traffic across such unfilled trenches shall be constructed and maintained by the contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

5013 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six (6) inches above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

5014 SETTLEMENT. The contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the City Engineer shall be furnished to the City of Branson by the contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the City.

5015 DISINFECTION AND TESTING.

A. Disinfection. After installation, the entire main shall be flushed and disinfected by chlorination. Flushing shall be carried out until a turbidity-free water is obtained from all points along the main.

Immediately prior to disinfection, the main to be disinfected shall be flushed at the maximum velocity which can be developed. The flushing velocity shall be at least 2.5 feet per second.

All flushing work shall be done in the presence of the Engineer. The contractor shall notify the Engineer at least 24 hours in advance of the times and places at which flushing work is to be done.

- 1 Chlorination by the Contractor shall conform to AWWA C601 and be performed using a 1 percent chlorine solution prepared from granular calcium hypochlorite (1 pound of HTH per 8 gallons of water). Water entering the new main shall receive a dose of the chlorine solution fed at a constant rate such that the water will have not less than 25 mg/l free chlorine.

Chlorine Required to Produce 25 mg/l
Concentration in 100 feet or Pipe

<u>Pipe Diameter</u>	<u>1 Percent Chlorine Solution</u>
<u>in.</u>	<u>Gal.</u>
4	0.16
6	0.36
8	0.65
10	1.02
12	1.44

2. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances.
 3. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.
 4. Mains shall be flushed prior to placing in service. The water shall be disposed of without damage to public or private property.
 5. Following the flushing of the mains, a water sample shall be taken from the new main and tested by the City for bacteria. No less than three (3) sample points shall be installed on any water main. Locations shall be as follows:
 - a. Within fifty (50) feet of the beginning of the pipeline, mid-way in the pipeline, and within fifty (50) feet of the end of the Pipeline.
 - b. For line length longer than two thousand five hundred (2,500) feet, sample points shall be located every one thousand (1,000) feet in addition to the locations at the beginning and end of the line.
 6. The contractor shall repeat disinfection procedure should initial treatment fail to yield satisfactory results.
- B** Hydrostatic Testing. The Contractor shall perform hydrostatic pressure and leakage tests in accordance with AWWA C600 procedures. Where practicable, mains shall be tested in lengths between line valves or plugs of no more than 1,500 feet in length.

Conduct test at a pressure of 150 psi measured at the highest point of the main. Duration of the test shall be not less than 2 hours. Maintain pressure throughout test ± 5 psi of test pressure.

Leakage test shall be conducted concurrently with the pressure test. Acceptable when leakage does not exceed that determined by the following formula:

English Units

$L = 0.0000075SD(P)^{1/2}$, in which

L = maximum allowable leakage in gallons per hour

S = length of pipe tested in feet

D = nominal internal diameter of pipe being tested in inches

P = average actual leakage test pressure in psi

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant.

All visible leaks at exposed joints and all leaks evident on the surface where joints are covered shall be repaired regardless of total leakage as shown by test. All pipe, fittings, valves and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.

Lines which fail to meet test shall be repaired and retested as necessary until the test requirements are met.

5016 SEPARATION OF WATER MAINS AND SANITARY SEWERS.

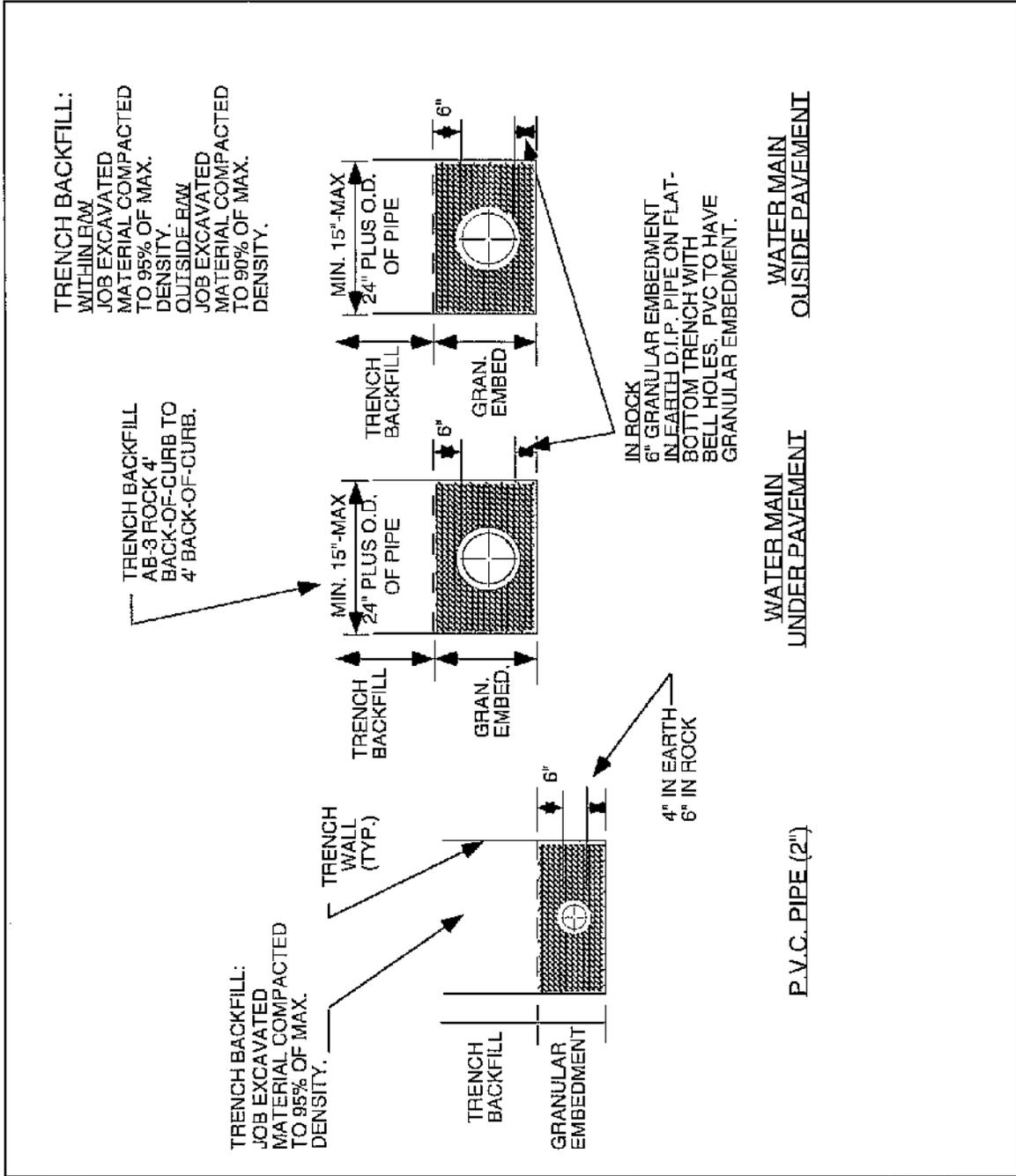
A. General. The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes.
2. Soil conditions.
3. Service and branch connections into the water main and sewer line.
4. Compensating variations in the horizontal and vertical separations.
5. Space for repair and alterations of water and sewer pipes.
6. Off-setting of water mains around manholes.

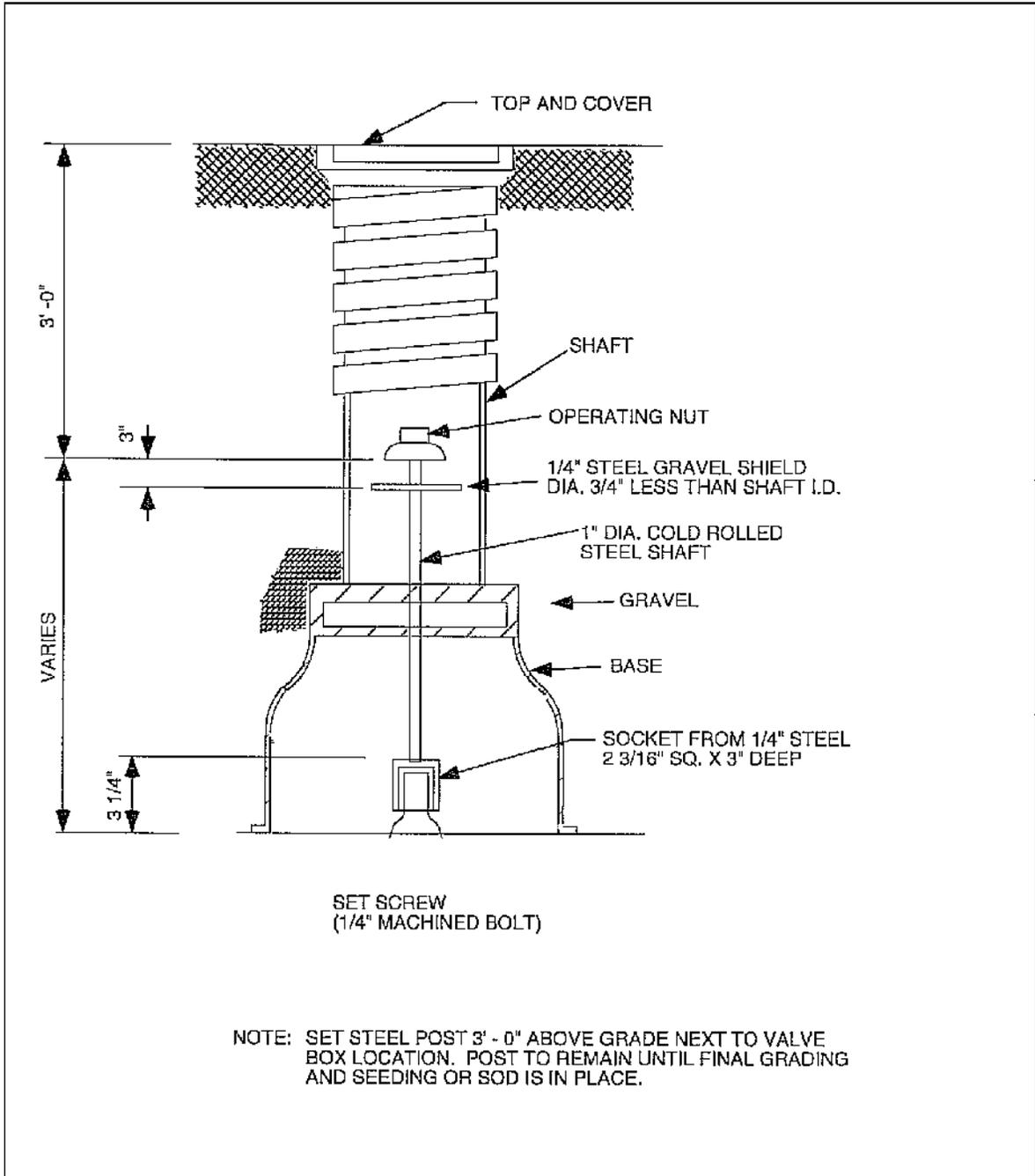
B. Parallel Installation. Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and, at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the water line or the sewer line shall be constructed

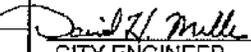
of mechanical joint pipe or cased in a continuous casing.

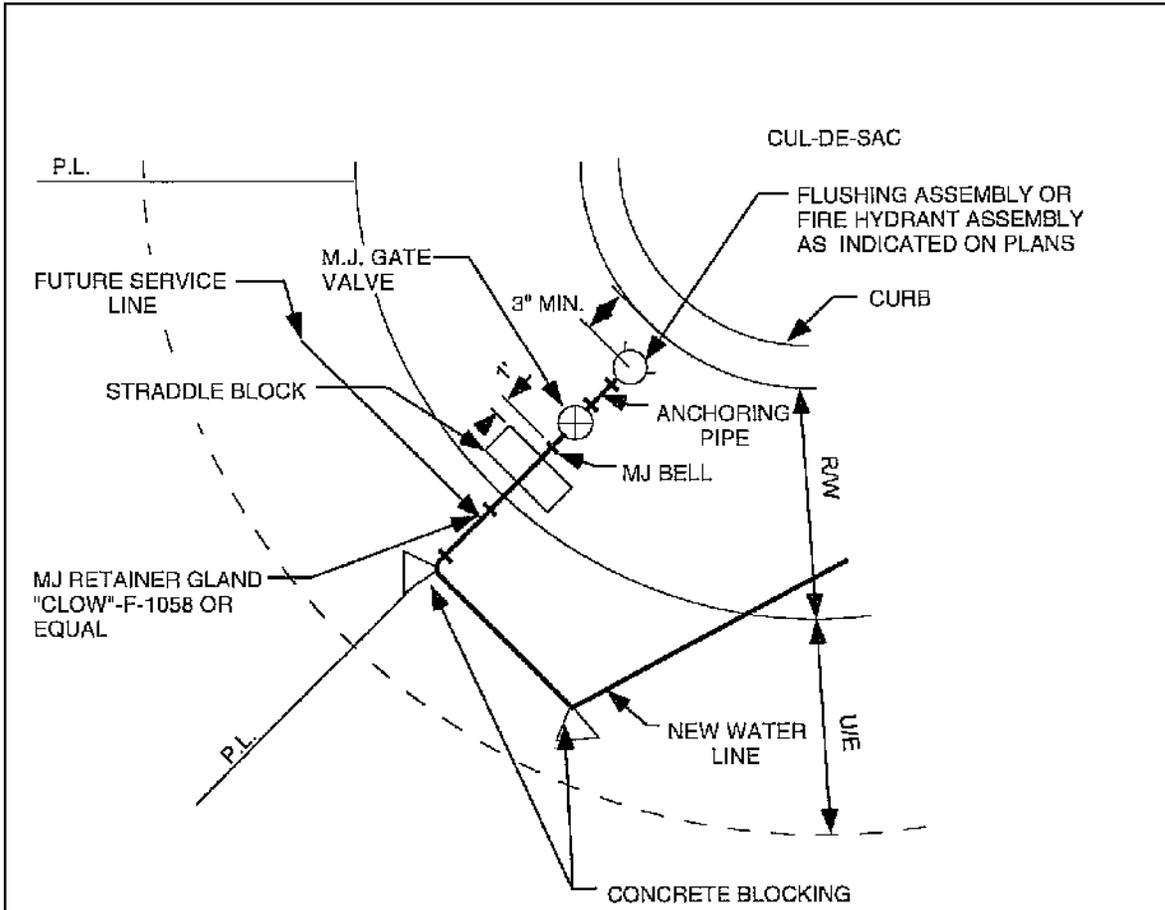
- C. Crossings. Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of eighteen (18) inches between the outside of the water main and the outside of the sewer line. This shall be the case where the water main is either above or below the sewer line. At the crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten (10) feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained, either the water line or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten (10) feet on both sides of the crossing.
- D. Exception. Any variance from the specified separation distances in paragraphs 5016B & C must be submitted to the engineering department for approval.
- E. Force Mains. There shall be at least a ten (10) foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the water line or the sewer line shall be cased in a continuous casing.
- F. Sewer Manholes. No water line shall be located closer than ten (10) feet to any part of a sanitary or combined sewer manhole.
- G. Disposal Facilities. No water line shall be located closer than twenty-five (25) feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.



 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David R. Mills</i> 8/17/98 CITY ENGINEER DATE
	EMBEDMENT AND BACKFILL FOR WATER MAINS	STANDARD DRAWING 50-1



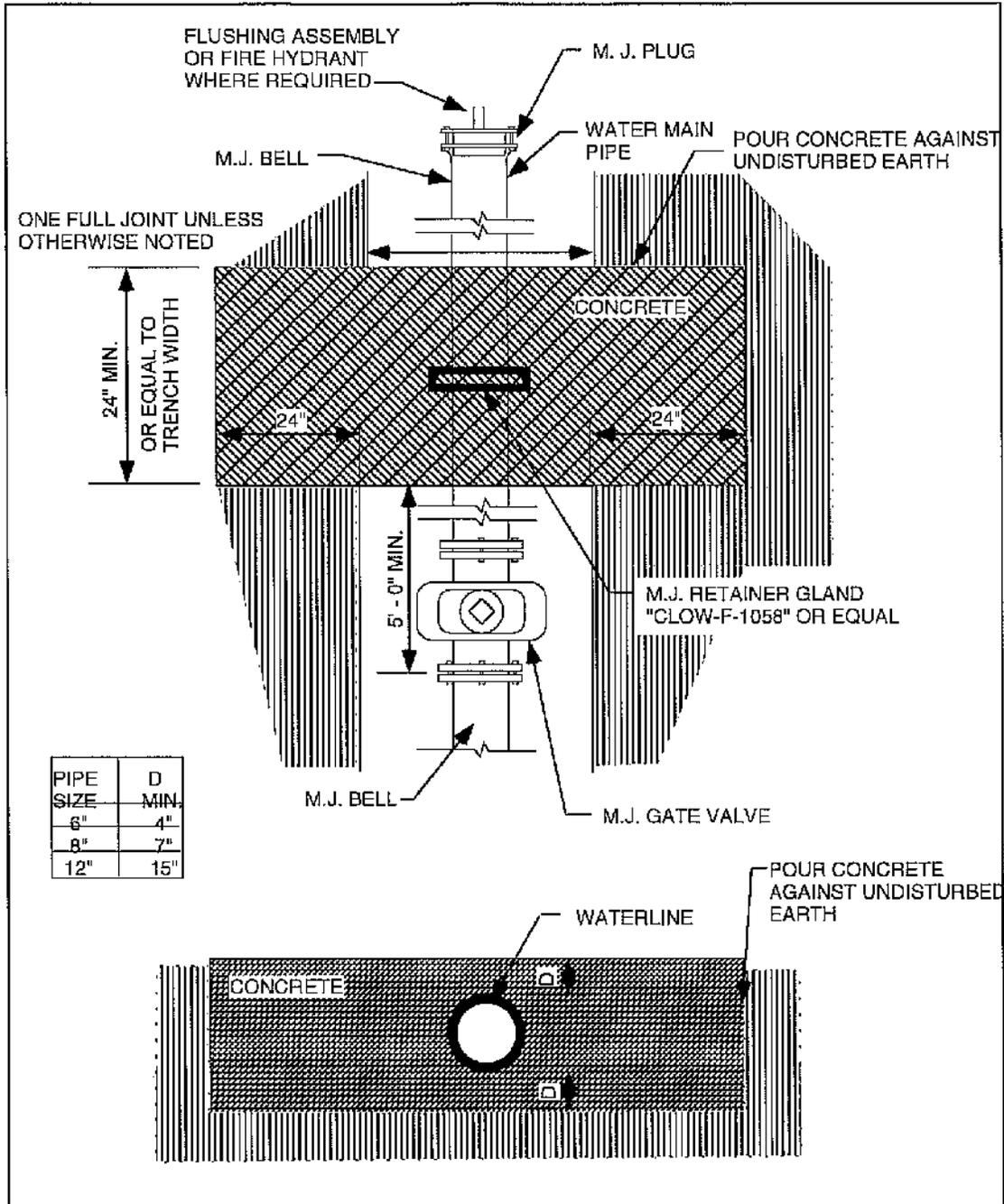
 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED  CITY ENGINEER	8/17/98 DATE
	SCREW SHAFT TYPE VALVE BOX DETAIL	STANDARD DRAWING 50-2	



NOTES:

1. USE MJ ANCHOR PIPE AND FITTINGS BEYOND THE STRADDLE BLOCK.
2. ALIGNMENT OF NEW WATER LINE AROUND CUL-DE-SAC VARIES TO MAINTAIN CLEARANCE FROM SANITARY SEWER.
3. MAIN TO BE EXTENDED TO INSURE NEW WATER LINE IS LOCATED ON PROPERTY LINE FOR FUTURE TAPPING PURPOSES.

 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/17/98 CITY ENGINEER DATE
	END OF LINE ON CUL-DE-SAC	STANDARD DRAWING 50-3

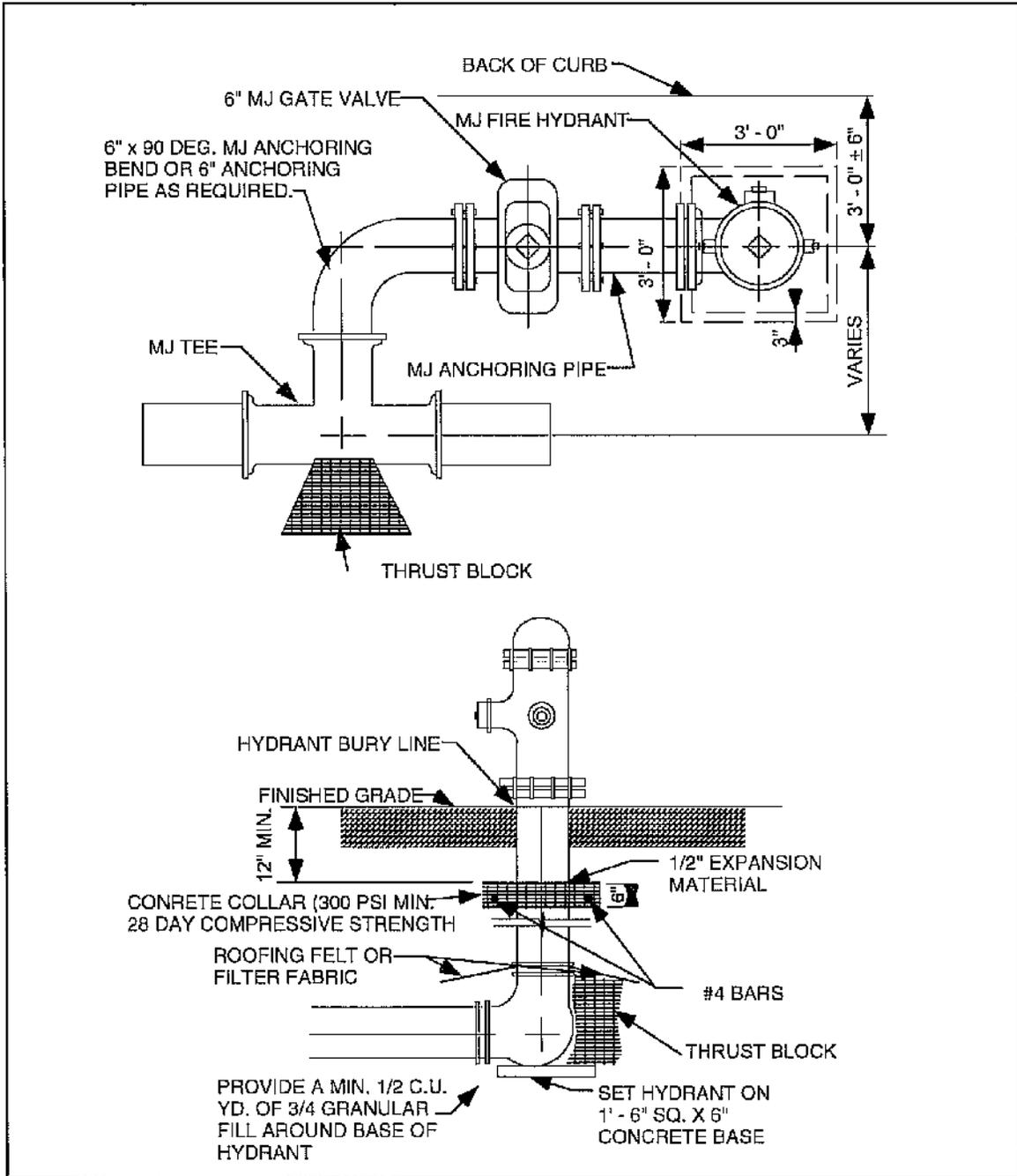


ENGINEERING DEPARTMENT
 110 WEST MADDUX, BRANSON, MO 65616

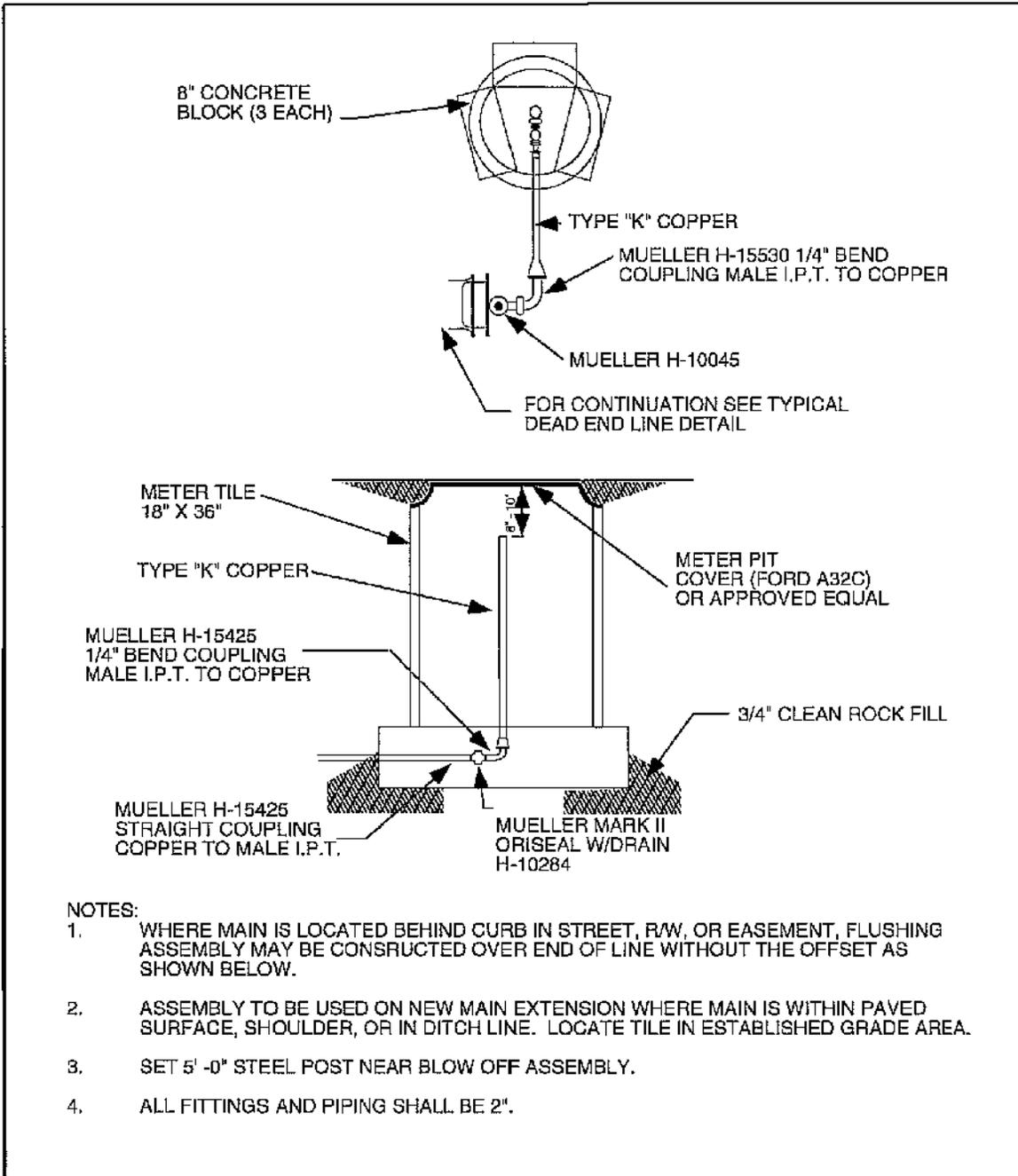
DEAD END LINE ASSEMBLY

APPROVED
David H. Miller 8/17/98
 CITY ENGINEER DATE

STANDARD DRAWING 50-4



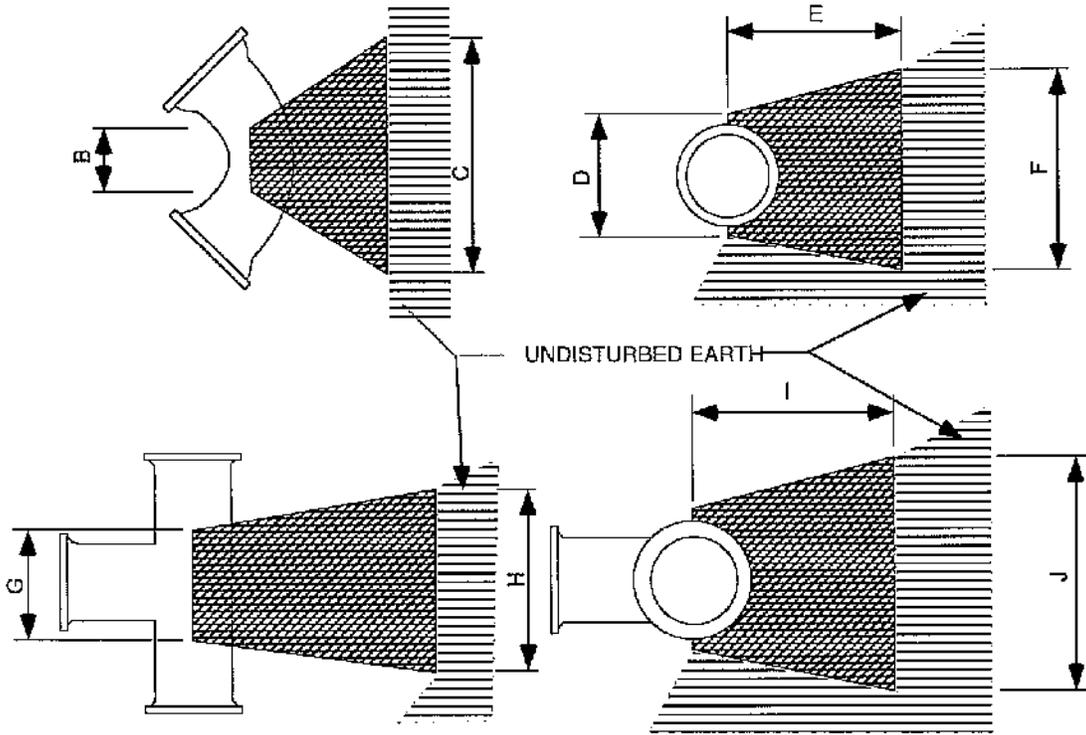
 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/17/98 CITY ENGINEER DATE
	TYPICAL FIRE HYDRANT INSTALLATION DETAIL	
	STANDARD DRAWING50-5	



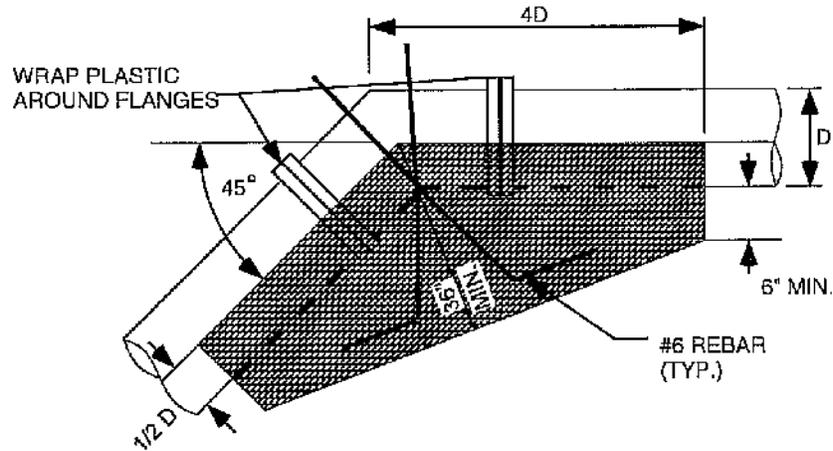
 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/17/98 CITY ENGINEER DATE
	FLUSHING ASSEMBLY	STANDARD DRAWING 50-6

BENDS	B	C	D	E	F	BENDS	B	C	D	E	F
6" 11 1/4 DEG	8"	15"	12"	24"	12"	6" 45 DEG	8"	30"	12"	24"	14"
6" 22 1/2 DEG	8"	19"	12"	24"	24"	6" 90 DEG	8"	30"	12"	24"	27"
8" 11 1/4 DEG	8"	20"	12"	24"	12"	8" 45 DEG	8"	30"	12"	24"	24"
8" 22 1/2 DEG	8"	22"	12"	24"	17"	8" 90 DEG	8"	38"	12"	24"	36"
12" 11 1/4 DEG	8"	30"	12"	24"	15"	12" 45 DEG	8"	40"	12"	24"	40"
12" 22 1/2 DEG	8"	35"	12"	24"	25"	12" 90 DEG	8"	60"	12"	24"	52"

TEES	C	H	I	J	TEES	G	H	I	J
6" X 6" X 6"	12"	24"	24"	18"	12"x12"x6"	12"	24"	24"	18"
8" X 8" X 6"	12"	24"	24"	18"	12"x12"x8"	12"	24"	24"	24"
8" X 8" X 8"	12"	24"	24"	24"	12"x12"x12"	12"	36"	24"	36"

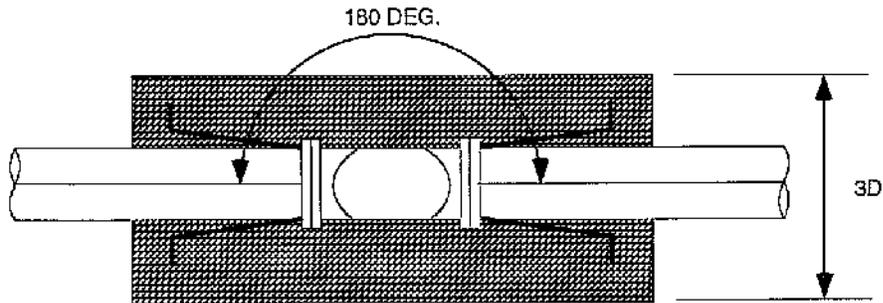


 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/17/98 CITY ENGINEER DATE
	CONCRETE BLOCKING DETAIL	STANDARD DRAWING 50-7



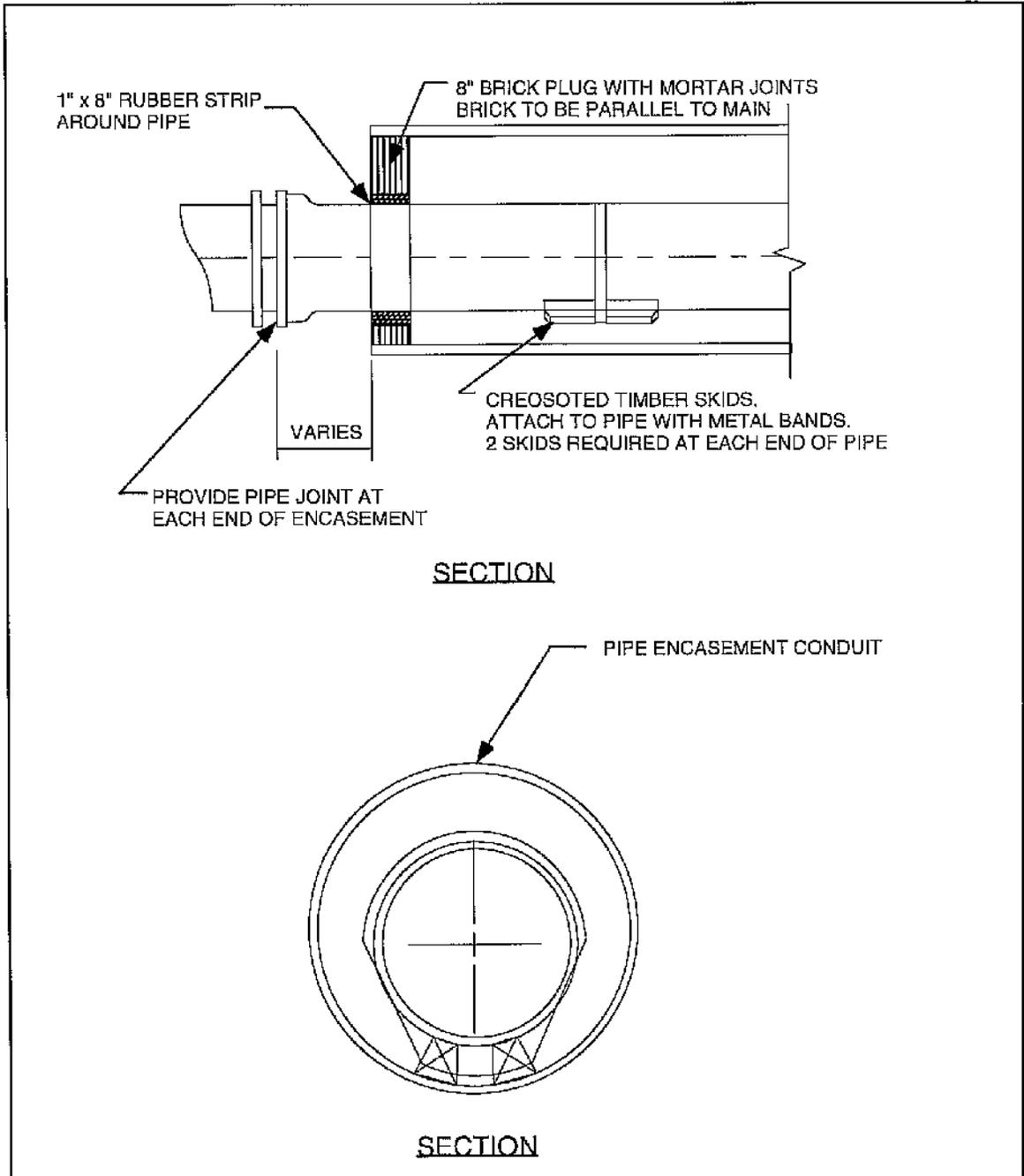
SIDE VIEW

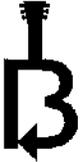
NOTE: RETAINER GLANDS WILL BE USED ON ALL VERTICAL BENDS



TOP VIEW

 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David H. Miller</i> 8/17/98 CITY ENGINEER DATE
	VERTICAL BEND BLOCKING DETAIL	STANDARD DRAWING 50-8



 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>David K. Miller</i> 8/17/98 CITY ENGINEER DATE
	PIPE ENCASEMENT DETAIL	STANDARD DRAWING 50-9

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE * - gph

NOMINAL PIPE DIAMETER (INCHES)

AVERAGE TEST PRESSURE (psi)	4	6	8	10	12	14	16	18	20	24
300	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12
275	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99
250	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85
225	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70
200	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55
175	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01
100	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80

*FOR PIPE WITH 18-FOOT NOMINAL LENGTHS. TO OBTAIN THE RECOMMENDED ALLOWABLE LEAKAGE FOR PIPE WITH 20-FOOT LENGTHS, MULTIPLY THE LEAKAGE CALCULATED FROM THE TABLE BY 0.9. IF THE PIPELINE UNDER TEST CONTAINS SECTIONS OF VARIOUS DIAMETERS, THE ALLOWABLE LEAKAGE WILL BE THE SUM OF THE COMPUTED LEAKAGE FOR EACH SIZE.



CITY OF BRANSON

ENGINEERING DEPARTMENT
110 WEST MADDUX, BRANSON, MO 65616

ALLOWABLE LEAKAGE
FOR WATER LINES

APPROVED

David L. Miller 8/17/08
CITY ENGINEER DATE

STANDARD DRAWING 50-10

SECTION 6000 TUNNELING, BORING AND JACKING (PIPELINES)

6001 SCOPE. This section governs construction of steel casings, complete with bulkheads and sand fill, by boring and/or jacking at the locations and to the lines and grades indicated on the drawings directed by the Engineer, or where constructed at the contractor's option, when approved, to bypass obstructions without open cutting.

6002 MATERIALS.

A. Steel Liner Plate. Steel tunnel liner plates shall be Armco "Standard", Commercial Shearing and Stamping Company "Commercial", Republic "Truscon Paneled Out", or equal and shall be galvanized in accordance with ASTM A 123. The design and shape of the liner plates shall be such that assembly can take place entirely from within the tunnel liner. Sufficient sections shall be provided with one and one-half (1 1/2) inch or larger grouting holes, located near the centers, so that when the plates are installed there will be one line of holes on either side of the tunnel and one at the crown. The holes in each line shall not be more than nine (9) feet apart and, unless otherwise approved, shall be staggered. Bolts and nuts shall conform to ASTM A 153, A 307, A 325 and A 449 as applicable.

B. Steel Casing.

1. Steel casing for bored or jacked construction shall conform to ASTM A-139.
2. Steel shall be grade B under railroads and grade A for all other uses.
3. Minimum wall thickness for steel casing shall be in accordance with the following table:

<u>Diameter of Casing</u>	<u>Under Railroads</u>	<u>All Other Uses</u>
24"	0.406"	0.281"
26"	0.438"	0.281"
28"	0.469"	0.312"
30"	0.469"	0.312"
32"	0.500"	0.312"
34"	0.500"	0.312"
36"	0.500"	0.312"

4. Casing joints shall be welded by a certified welder in accordance with AWWA C-206.

C. End Seals. End seals shall be brick conforming with Section 4102(D) of these specifications. Mortar shall comply with Section 4102(E) of these specifications.

D. Sand Fill. Sand fill shall comply with ASTM C-33 or MCIB Section 4, Fine Aggregate. Moisture content of the sand shall not exceed 0.5%.

6003 CONSTRUCTION DETAILS.

A. General.

1. Prior to starting work, complete details of the method of operation and liner materials to be used shall be submitted to the Engineer. The pipe line, in the area to be tunneled, bored or jacked, shall be completed before the construction of adjacent portions of the same pipe line. The purpose of this requirement is to allow for slight discrepancies in alignment and grade which may occur in the tunneled, bored or jacked installation, so minor adjustments in the adjacent pipe can be made.
2. The maximum allowable deviation from plan alignment and grade shall be as follows except when altered by the Plans or Special Provisions:
 - a. Alignment 1.0%
 - b. Grade 1.0%

B. Casing Installation.

1. The steel casing shall be advanced in a continuous operation without interruption. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing in its final position shall be within alignment and grade tolerances specified in Section 6003 (A2). There shall be no space between the earth and the outside of the casing. Any voids which do occur shall be filled by pressure grouting.
2. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. Boring shall be performed in a manner to prevent disturbing the overlying and adjacent materials.
3. Jacking.
 - a. Jacking frame, guides, blocking, head and reaction devices shall be arranged to apply uniform pressure about the casing circumference without damage to the casing material, and to maintain alignment within specified tolerances.
 - b. Jacking reaction device shall provide adequate resistance to withstand 200 percent of the maximum jacking pressure.
 - c. Provide jacks of adequate number and size for the required jacking pressure; but not less than two jacks.
 - d. Maintain jacking pit and pipe installation in such condition that drainage does not accumulate. Control and disposition of surface and subsurface

water at the site of jacking operations shall be the Contractor's responsibility subject to the approval of the Engineer.

- e. Excavation of the heading shall not be extended more than 1 inch outside the top and sides (upper 300-degree sector) of the casing and shall be true to grade at the invert (lower 60-degree sector).
 - f. Once jacking begins, it shall proceed without interruption until installation of the entire length of the jacked line is complete.
4. Excavation in Jacked Casings. Perform excavation within jacked casings by hand or machine methods as necessary to remove the materials encountered without disturbing the overlying material. The jacked casing shall be advanced a sufficient distance ahead of the excavation face and/or shield used as necessary to protect the workman and the work, and to prevent the uncontrolled entry of unstable materials into the casing.
 5. Unstable Materials. If materials are encountered during casing installation that cannot be excavated safely or without creating voids around the exterior of the casing, the Contractor shall discontinue casing installation and stabilize such materials by dewatering, chemical soil stabilization, grouting, or other methods, and/or modify equipment and procedures as necessary to complete the casing installation.

C. Lining Installation.

1. Excavation. Excavate by approved methods applicable to materials encountered. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. Include dewatering and chemical soil stabilization or grouting when necessary due to existing field conditions. Conduct excavation in a manner to prevent disturbing the overlaying and adjacent material.
2. Lining. Assemble liner plates immediately following the excavation. Advance casing continuously with excavation. When liner plates are being installed, care shall be taken to maintain alignment, grade and circular shape of the tunnel. All voids between liner and surrounding earth shall be filled with grout forced in under pressure. The grout shall consist of two parts of sand to one part of Portland Cement, mixed with sufficient water to maintain a freely pouring consistency. As the pumping through any hole is stopped, it shall be plugged to prevent the backflow of grout. After lining installation is complete it shall be cleaned of all debris and all leaks which allow flowing or seeping water into tunnel, shall be stopped.

D. Pipe Installation.

1. Pipe shall be placed inside the casing to the plan line and grade by the use of wood skids or other equivalent methods. The wood shall be pressure treated with creosote, pentachlorophenol, or salt-type preservative in accordance with AWWA C2. Cut surfaces shall be given 2 heavy brush coats of the same preservative. The wood skids shall be securely fastened to the pipe with steel straps.
2. End seals shall be constructed after the pipe is installed and approved.
3. In sanitary sewer construction, the annular space between the casing and pipe shall be filled with stabilized sand blown in so that all space is filled without disturbing the alignment and grade of the pipe.
4. No interruption of traffic will be permitted at any location where a tunnel or casing is required.

SECTION 7000 BLASTING

7001 GENERAL. All federal, state and local laws and regulations applicable to obtaining, owning, transporting, storing, handling, and using explosive materials shall be followed. The Contractor shall be responsible for all blasting operations and shall be responsible for responding to all complaints.

7002 PERMITS. The Contractor shall not blast any rock or other materials or allow the same to be done in prosecution of the work until he secures a blasting permit from the Fire Chief.

7003 NOTIFICATION. Before beginning work, the contractor shall furnish the engineer letters of approval for the proposed operation from the appropriate regulating agencies. Whenever a new explosive materials storage location is established, including a temporary job site, the local law enforcement agency, fire department and local emergency planning committee shall be notified 48 hours in advance, not including Saturdays, Sundays and holidays, of the type, quantity and location of explosive materials at the site and shall provide proof of notice to the engineer. The contractor shall retain copies of all permits, blasting logs and seismic monitoring data.

7004 BLASTING REQUIREMENTS. All blasting operations shall be conducted under the direct supervision of a blaster certified by the Missouri Limestone Producers Association or equal. When explosives are used in the prosecution of the work, the contractor shall use the utmost care to prevent personal injury and property damage. The contractor shall be responsible for damage resulting from the use of explosives. The engineer has the authority to suspend any unsafe blasting operation. The contractor shall be familiar and comply with the rules and regulations of any city, county, state or federal agency or any other agency which may have jurisdiction in the handling, loading, transporting, storage and use of explosives. All places used for explosives storage shall be marked clearly "DANGEROUS EXPLOSIVES".

7005 BLASTING PLAN

- A. The Contractor shall submit a rock excavation-blasting plan to the engineer at least fourteen (14) days before drilling operations begin. The blasting plan shall address all trenching, presplitting and production shots and shall include, but not be limited to the following information: powder factor per cubic yard, hole size, subdrill, stemming depth, drill pattern, type of explosives and detonators, and safety precautions. Any changes to blasting plans shall be provided to the engineer for review prior to performing the work.
- B. The plan, as a minimum, shall include statements that the following procedures, rules and materials will be followed or used.
 - 1. The Contractor shall provide all blasting work as required to allow rock fragmentation for excavation of all rock and earth materials to the indicated sub-grade elevation.
 - 2. The Contractor shall perform the excavation of rock cuts by the technique of presplitting, cushion blasting or air decking to produce a neat line of the proposed

excavation, with the results subject to the approval of the engineer. Holes for presplitting shall be drilled to the full depth of the cut or to a pre-selected bench elevation as shown on the plans. Presplitting shall be done according to accepted practice to produce a clean face on the excavated cut. Presplit shots shall be made prior to production shots.

- 3 Removal of any item or material of any nature by blasting shall be done in such a manner and at such time as to avoid damage affecting the integrity of the design of the project and to avoid damage to any new or existing structures whether on right-of-way or private property, included in or adjacent to, the work. It shall be the Contractors responsibility to determine a method of operation to insure the desired results and the integrity of the completed work.

C. Storage and Transport

- 1 All local, state or federal regulations pertaining to the storage or transportation of explosives and detonators shall be strictly obeyed.
- 2 Types of Explosives:
 - a. Accuracy in placement of explosive charges within each borehole and accuracy in determination of charge weights dictate the use of cartridge explosives on the project. The use of pourable powders or slurries may be permitted if placed in properly designed casings when water is encountered and if in the opinion of the blasting expert, satisfactory control of the blast will be obtained as specified herein.
 - b. Primacord down lines, placed below surface level, shall be permitted, provided special provisions are made to assure the sound pressure levels shall be no greater than any produced by standard electric blasting. No primacord trunk lines or surface connections may be used in the detonation process.

D. General Rules for Blasting

1. Prior to any delivery of any explosives to the jobsite, Contractor must have obtained blasting endorsement on his public liability and property damage insurance policy.
2. No blasting operation shall be performed in a manner contrary to the instructions of the manufacturer of the explosive materials being used.
3. No smoking shall be permitted within fifty (50) feet of any location where explosives are being handled or utilized, and any person located within fifty (50) feet of said location shall not carry any matches, open light or other type of fire or

flame, except suitable devices for lighting safety fuses.

4. Mobile radio transmitters, if used for the project, must strictly adhere to the minimum safe distances for transmitters published by the Institute of Manufacturers of Explosives.
5. Persons authorized to prepare explosive charges or to conduct blasting operations shall use every reasonable precaution including, but not limited to, warning signals, flags, barricades, mats or other equally effective means to ensure the safety of the general public and workers.
6. It shall be the responsibility of the Contractor to ascertain the locations of any powerful fixed transmitters in the vicinity of any blasting site and coordinate blast loading with times of transmission silence.
7. Special precautions shall be taken to protect from local electrical hazards and from possible build-up of static charges. These precautions shall include stopping loading operations during the approach of thunderstorms or other naturally occurring phenomena that may endanger workers or the project.
8. Adequate notice shall be given to all local residents and construction personnel on or near the job site prior to the initiation of a blast. Blasting shall not be conducted until the blaster in charge has confirmed that all surplus explosive materials are in a safe place, all persons and equipment, including vehicles, are at a safe distance or under sufficient cover and an adequate warning signal has been given.
9. Where blasting is done in a congested area or in close proximity to a structure, railway, or highway or any other installation that could be affected, special precautions shall be taken to prevent damage and to minimize earth vibrations and air blast effects. Blasting mats of acceptable design shall be used to prevent any occurrence of fly rock. Fly rock is not acceptable.
10. Blasting operations shall be conducted during daylight hours. Except by special approval by the Engineer, these hours shall be limited to between 9:00 a.m. and 5:00 p.m. each working day.
11. No blasting shall be allowed within a thirty-five (35) foot radius of utility poles without a written special exception from the affected utility companies. Extra care in placing blasting mats shall be taken when blasting near utility poles and under utility lines. All utility companies involved must approve any deviation from this. This requirement in no way shall reduce the contractors' liability for damage during blasting.
12. When blasting is to occur near existing in ground structures, (manholes, lift stations, pipe, etc.), the Contractor shall blast no closer than 50 feet from the structure unless special written permission is obtained from the City Engineer prior to blasting in which case, ground monitoring equipment shall be placed

adjacent to the existing structure and no blasting may be conducted closer than 20 feet or the maximum particle velocity allowed on the existing structure shall be no greater than 2.0 inches per second whichever occurs first.

E. Procedures after Blasting

1. The blaster shall allow sufficient time for smoke and fumes to dissipate and for dust to settle before returning to the blast site.
2. The blaster shall inspect the entire blast site for misfires before allowing other personnel to return to the blast site.
3. No person shall return to the blast area until permitted to do so by the blaster.

F. Misfires

1. Misfires shall be the responsibility of the person in charge of the blasting operation.
2. Where a misfire is found, the blaster shall provide the proper safeguards for excluding all personnel from the blast area. Misfires shall be reported to the supervisor immediately.
3. No additional work, other than that necessary to remove the hazard, shall be performed. Only those persons needed to do such work shall remain at the blast site.
4. No drilling, digging, or picking shall be permitted until all misfires have been detonated or until the authority having jurisdiction approves the resumption of work.

G. On-Going Seismic and Acoustic Investigations

1. The contractor shall provide instruments for all blasting operations. All instruments provided must be seismographs with full waveform capability that exhibit a flat frequency response from two (2) thru two hundred (200) cycles per second. Each instrument must also simultaneously record three (3) components of ground motion and the sound pressure levels emanating from all blasts. Each instrument must be equipped with an internal dynamic calibration system in order that all components of the system can be determined to be operating properly prior to any blast.
2. The contractor shall furnish, as a minimum, at least one (1) seismograph of a type to secure measurements of all blasts at a distance of one hundred (100) feet. At all blasting operations, the maximum ground vibration at any dwelling, public

building, school, church, or commercial or institutional building adjacent to the blasting site shall not exceed the following Peak Particle Velocity Limits as outlined in Chapter 8 Table 8-1.1 of the NFPA 495 Explosive Materials Code.

Distance from Blasting Site	Maximum Allowable Peak Particle Velocity
0 ft. to 300 ft.	1.25 in./ sec.
301 ft to 5000 ft.	1.00 in./sec.
5000 ft. and over	.75 in./ sec

3. Recordings or measurements from each blast made daily shall be recorded on the daily blasters record and shall be certified as to the accuracy thereof by the contractor. If a direct writing seismograph is used, a copy of the seismogram obtained for each blast shall be furnished with the blasters daily record.
4. The City may retain the services of an additional independent blasting expert to review and consult regarding all aspects of the blasting work.

H. Pre-Blast and Post-Blast Surveys

1. Prior to the initiation of blasting on site, the contractor shall conduct a pre-blast survey of all houses and all other human cultural conditions (interior and exterior). This survey shall be done, at a minimum, to those structures within three hundred (300) feet of those areas that require blasting. It will be the right of the property owner to accept or reject these inspections. These inspections shall include public facilities such as bridges and natural geologic features including caves, arches and springs that fall within the specified distance.
2. These pre-blast surveys shall consist of professional photographic and written description of existing cracks in walls, chimneys, pools, foundations and other structural components of the structures surveyed. The objective is to document pertinent conditions that may potentially be affected by, or erroneously attributed to, blasting on site. The written descriptions may be transcribed from oral notes taken by tape recorder by the pre-blast inspector. All photographs must be identified by number and keyed to the written description of the pertinent structural conditions.
3. If during the course of the blasting program a complaint is lodged, or a claim for damage stated, the contractor shall conduct a post-blast inspection on the property in question. The post-blast inspector should investigate each complaint or claim thoroughly, and using, where appropriate, the pre-blast inspector's report to compare pre-existing damages with those being claimed.
4. Companies or individuals experienced in the conduct of such work and knowledgeable in the use and application of explosives shall perform all pre-blast surveys and inspections. The person performing the work shall sign each written

report. An independent company approved by the City shall perform all pre-blast and post-blast surveys and inspections.

SECTION 8000 RESTORATION OF SURFACE CONSTRUCTION

8001 SCOPE This section covers restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during construction.

8002 GENERAL. All pavement or other surface construction which is removed or damaged during the progress of the work shall be restored to its original or better condition by the Contractor. All restoration work shall be subject to acceptance by the Engineer and the Owner or the agency having jurisdiction thereof. All materials used for restoration work shall be new.

8003 REFERENCE STANDARD. Materials and construction methods, as referred to herein, shall conform to all applicable sections of these technical specifications.

8004 PAVEMENT REPLACEMENT. The replacement of all street surfacing shall be in accordance with the pavement replacement detail shown on the Standard Detail. The replacement concrete and asphalt pavement shall be composed of a concrete base course at least seven (7) inches thick and an asphaltic concrete overlay at least two (2) inches thick. Materials and workmanship shall conform to the following:

Concrete	As specified in Section 2000
Asphaltic Concrete	As specified in Section 1400
Trench Backfill	Graded gravel

All drives, parking areas, and other pavement or asphalt surfaces which are removed or damaged shall be replaced to at least their original thickness. Materials used shall be new and shall match the existing surfacing as closely as possible in type, kind and quality.

8005 CONCRETE WALKS. Concrete walks removed in connection with, or damaged as a result of, construction operations shall be replaced with new construction. Such walks shall be constructed of concrete on a thoroughly compacted subgrade, shall have a vertical thickness at least as thick as the existing walks, but not less than four (4) inches thick, shall be constructed with expansion joints spaced not exceeding fifty (50) feet apart, and shall be sloped for drainage at right angles to the longitudinal centerline in the amount of approximately one-fourth (1/4) inch per foot of walk width.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2000, "Concrete" of these specifications.

Surface finish of concrete walks replaced shall conform to, and shall match as closely as possible, that of existing concrete walk surfaces.

8006 CONCRETE CURBS AND GUTTERS. Concrete curbs and gutters which have been removed or damaged by reason of construction operations or any other cause shall be replaced with new concrete construction. New curb and gutter sections shall be as designated on the

drawings and as detailed on the Standard Details.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2000.

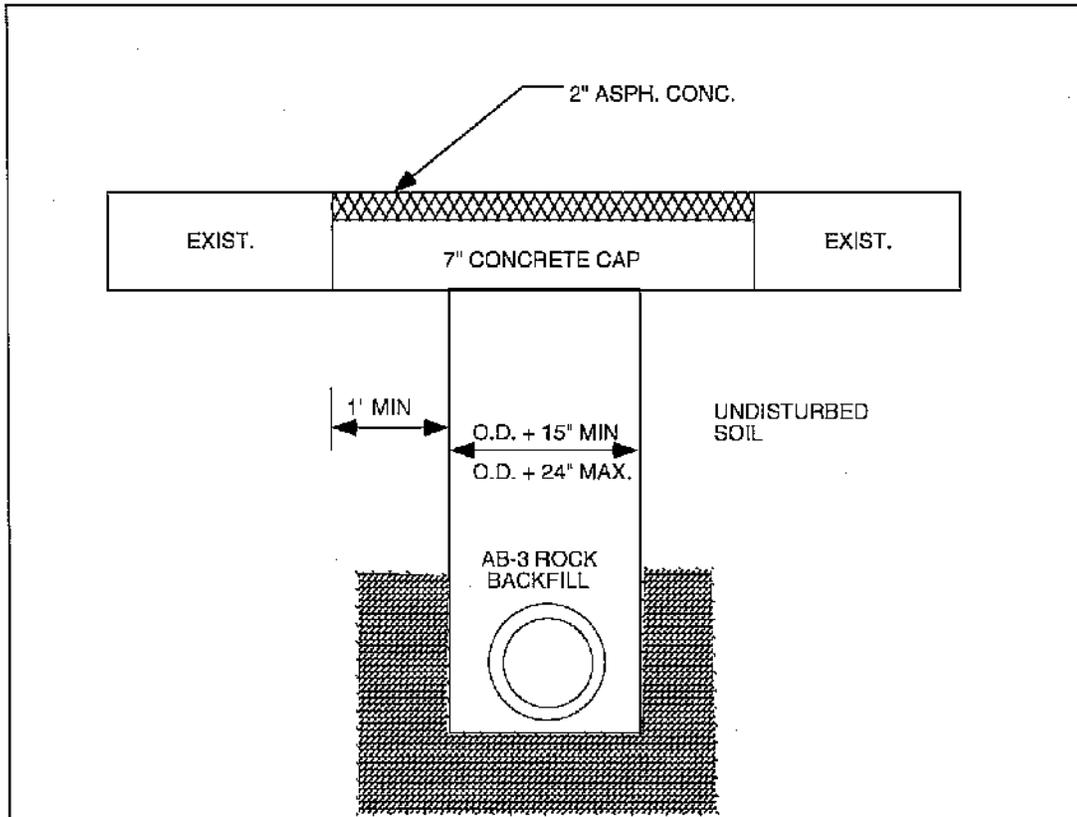
Construction and expansion joints, dimensions, elevations and surface finish of curb and gutter replacements shall conform to, and shall match as closely as possible, that of adjacent existing concrete curbs and gutters.

8007 GRAVEL SURFACING. Existing gravel drives, parking and surfacing which is removed or damaged during the progress of the work shall be replaced with an aggregate surfacing at least as thick as that removed, but in no case less than four (4) inches.

New aggregate surfacing shall match existing surfacing as nearly as possible in size, gradation, color, and compaction.

8008 MISCELLANEOUS REPAIR WORK. All existing items and construction, whether or not indicated by the drawings but which are removed or damaged as a result of construction operations, shall be repaired or replaced unless otherwise required by the drawings.

Repair or replacement shall be with materials similar to those existing, and shall in each case restore the item to its original or better condition as acceptable to the Engineer and the Owner thereof.



NOTE:

1. THE 1 FT. ON EITHER SIDE OF ACTUAL TRENCH WIDTH SHALL NOT BE REMOVED UNTIL THE TRENCH HAS BEEN FILLED AND COMPACTED.

 CITY OF BRANSON	ENGINEERING DEPARTMENT 110 WEST MADDUX, BRANSON, MO 65616	APPROVED <i>Daniel H. Miller</i> 8/17/98 CITY ENGINEER DATE
	STREET PATCH DETAIL	STANDARD DRAWING 80-1

SECTION 8100 CHAIN LINK FENCING

8101 SCOPE. This specification covers chain link fencing and gates.

8102 FENCE TYPE. Fencing shall conform to the alignment and details shown on the drawings and shall consist of galvanized or aluminum-coated steel fabric, steel posts, top rail, and bottom rail or tension wire. Posts shall be set in concrete.

8103 MATERIALS. All steel or malleable iron parts and accessories shall be hot-dip galvanized or aluminum coated after fabrication.

Fabric	9 gauge, 2-inch mesh; galvanized ASTM A392, Class II or aluminum-coated ASTM A491, Class II.
Posts	Steel H-Section , 0.35 percent carbon; steel pipe, ASTM A120, standard weight (Schedule 40); or steel hollow structural tubing, ASTM A500 or A501.
Line Posts	
For 6-foot Fencing	H-Section 4.10 pounds per foot; 2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.
For 42-inch Fencing	H-Section, 2.70 pounds per foot; or 1 7/8 inch OD pipe, 2.72 pounds per foot.
Terminal Posts	End, corner, and pull posts.
For 6-foot Fencing	2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot.
For 42-inch Fencing	2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.
Gate Posts	Gate or leaf 6 foot or less, 2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot; gate or leaf over 6 foot, 4 inch OD pipe, 9.10 pounds per foot; or 3 inch square, 9.10 pounds per foot.
Top Rail	1 5/8 inch OD steel tubing, 1.40 pounds per foot.
Rail Couplings	Sleeve type, 6 inches long.
Post Tops (when barbed wires are required at the top of the fence)	Pressed steel, malleable iron, with pressed steel extension arm, or one-piece aluminum casting; with hole for top rail, designed to prevent entry of

	moisture into tubular posts.
Post Tops	Pressed steel, malleable iron, or cast aluminum; designed to prevent entry of moisture into tubular posts.
Barbed Wire	Galvanized, ASTM A121, Class 2 or aluminum coated ASTM A585, Class II; two 12 1/2 gauge steel wires with 4 point barbs.
Stretcher Bars	Steel, 3/16 inch by 3/4 inch, or equivalent area.
Fabric Ties	Aluminum bands or wires.
Gate Frames	Steel tubing, 1 7/8 inch OD, 2.09 pounds per foot; or 2 inch square, 2.10 pounds per foot.
Tension Wire	Galvanized or aluminum coated coil spring wire, 7 gauge.
Handrail-Setting Cement	Hallemitte "Por-rok Cement".

8104 GATES. Gates shall be swing type, hinged to swing 90 deg. from closed to open, complete with frames, latches, stops, keepers, hinges, and fabric. Gate leaves shall have intermediate members and diagonal truss rods as required for rigid construction. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and water tight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than ten (10) feet wide may be provided with a forked latch. Latches shall be arranged for padlocking with the padlock accessible from both sides of the gate. Stops shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end of gates when in the full-open position.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

8105 FENCE CONSTRUCTION. The installed fence shall conform to the alignment and finish grade indicated. All posts shall be plumb unless otherwise shown or required shall be spaced ten (10) feet apart for 6-foot fencing and six (6) feet apart for 42-inch fencing. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Found surface irregularities shall be graded as required to maintain not more than a two (2) inch clearance below the bottom of the fence fabric.

Where posts are set in earth, concrete foundations thirty-six (36) inches deep shall be provided. If bedrock is encountered, post excavation shall be continued to the thirty-six (36) inch depth or eighteen (18) inches into the rock, whichever is less. Concrete foundation shall be circular in horizontal section, not less than ten (10) inches in diameter for line posts, and with a diameter not less than the post OD plus nine (9) inches for terminal and gate posts, except that foundations in bedrock shall be a minimum of six (6) inches larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately one (1) inch. Concrete for foundations shall conform to the requirements of Section 2000 "Concrete". Each foundation shall be cured for at least seventy-two (72) hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least eighteen (18) foot lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately six (6) inches above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1,500 feet. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail, bottom rail, and bottom tension wire at twenty-four (24) inch centers and to the line posts at fifteen (15) inch centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties. Each stretcher bar shall be threaded through the fabric and anchored to the post at fifteen (15) inch center by positive mechanical means.

Each gate and terminal post shall be braced by horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabrics shall be stretched taut and anchored so that a pull of 150 pounds at the middle of a panel will not lift the bottom of the fabric more than six (6) inches.

SECTION 8200 SEEDING AND SODDING

8201 SEEDING.

A. Scope. This section governs the furnishing of all labor, equipment, tools, materials and performance of all work for seeding and sodding.

B. Materials, Definitions and Equipment.

1. Seeds. Seeds for cover crops shall comply with the requirements of the applicable state seed laws and shall be the mixture of seeds specified in the Special Provisions. Seeds shall be free of prohibited weed seeds and shall not have more than 1 percent (1%) noxious weed seeds. Seeds shall be delivered to the site in convenient containers, each fully labeled, bearing the name, trade name, or trade mark, and a warranty of the producer and a certificate of the percentage of the purity and germination of each kind of seed specified.

2. Pure Live Seed. The following formula shall be used to determine the amount of commercial seed required to provide each kind of seed for the specified quantities of pure live seeds:

$$\text{Pounds of Commercial Seed Required} = \frac{10,000 \times \text{Pure Live Seed (lbs per acre)}}{\text{Purity (percent)} \times \text{Germination (percent)}}$$

3. Fertilizer. Fertilized shall be inorganic 12-12-12 or 13-13-13 grade, uniform in composition free flowing and suitable for application with approved equipment, deliver to the site in convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, bearing the name, trade mark, or trade name, and a warranty of the producer.

4. Mulch. Mulch shall be either the vegetative type, wood cellulose fiber type, whichever is specified in the Special Provisions, or as approved by the Engineer.

a. Vegetative Type. The vegetative type shall be the cereal straw from stalks of oaks, rye, wheat or barley and shall be free of prohibited and noxious weed seeds.

b. Wood Cellulose Fiber Mulch. Wood cellulose fiber shall contain no germination or growth inhibiting ingredients, and shall be dyed an appropriate color to aid in visual metering in its application. It shall be easily and evenly dispersed and suspended when agitated in water, and when sprayed uniformly on the soil surface, shall form a blotter like cover, which readily absorbs the water and allows infiltration to the underlying soil. The mulch material shall be supplied in packages of not more than 100 pounds gross weight, and shall be marked by the manufacturer to show the air dry weight content. (Air dry weight shall contain not more

than 10 per cent moisture).

5. Equipment. The seeding operation shall be accomplished with equipment suitable for preparing the seed bed, sowing the seed, fertilizing, spreading the vegetative type mulch, spreading the emulsion type mulch, or spreading the wood cellulose fiber mulch in accordance with the applicable requirements of the following subsection entitled "Construction Details".

C. Construction Details. All equipment used in the project and all workmanship shall meet the approval of the engineer.

1. Application of Fertilizer. Before tilling the soil the fertilizer shall be distributed uniformly at the rate of 600 pounds per acre and incorporated into the soil to a depth of at least 2 inches by discing or harrowing methods. Fertilizing rate is equivalent to 7 pounds per 500 square feet.
2. Tilling the Seed Bed. Areas shown on the plans or specified to be seeded shall be cleared and graded as required preparatory to tilling the surface for seeding. The surface shall be tilled to a depth of at least 2 inches by discing or other approved methods until the soil is suitable for seeding. Areas tilled shall be maintained until seeding and mulching is complete to insure a smooth area with no gullies or depressions.
3. Planting Seeds. The kinds of seeds and the rate of sowing pure live seed shall be as specified on the Plans or in the Special Provisions, but shall be one of the following mixtures:
 - a. Type "A" Seed. This seeding mixture will normally be used where seeding is required in areas of established yards, shoulders and slopes in street right of way, and any other areas where a high-type seeding is deemed necessary. The seed mixture will be as follows:

<u>Kind of Seed</u>	<u>Minimum Pure Live Seed %</u>	<u>Rate of Pure Live Seed</u>
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundines	75	25
Rye Grass (Lolium Perenne or L. Multiflorum)	80	25

Kentucky Blue Grass (Pac. Pratensis)	75	20
Creeping Red Fescue (Festuca Rubra)	85	<u>10</u>
TOTAL		80

- b Type "B" Seed. This seeding mixture will normally be used to seed areas off street rights-of-way that are not maintained.

<u>Kind of Seed</u>	<u>Minimum Pure Live Seed %</u>	<u>Rate of Pure Live Seed</u>
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundines	75	90
Rye Grass (Lolium Perenne or L. Multiflorum)	80	<u>50</u>
TOTAL		140

All seeding work shall be done between the dates of February 1 and April 15 for spring planting or August 15 and October 15 for fall planting. Sowing shall be accomplished by use of an approved mechanical seeder or drill (hand spreader can be used in small areas), making sure that successive seed strips overlap to provide uniform coverage. Seed should be drilled to a depth of 1/2 inch.

4. Compaction. Immediately following the completion of seeding operation, the entire area shall be compacted by means of a roller weighing at least 60 but not more than 90 pounds per linear foot of roller.
5. Mulching. Mulching shall be done within 24 hours following the seeding operation except in the case of wood cellulose fiber type mulch.
 - a Vegetative Type Mulch. After compacting the surface, mulch shall be uniformly spread at the rate of 1-1/2 tons per acre by means of a mechanical spreader or other approved means.

As soon as the mulch is spread it shall be anchored to the soil a minimum depth of 3 inches by use of a heavy disc harrow, set nearly straight, or similar approved tool. Discs of the anchoring tool shall be set approximately 9 inches.

Anchoring shall be accomplished by not more than two passes of the tool.

- b Wood Cellulose Fiber Type. Wood cellulose fiber mulch shall be added to the hydraulic seeder after the proportionate amounts of seed, fertilizer and water, and other approved materials are added. These ingredients shall be mixed to form a slurry which shall be applied at the rate of 1,000 pounds per acre. The mulch shall make a uniform coverage of the soil surface that will be satisfactory to the Engineer.

- D. Protection and Repair. The seeded area shall be kept free of traffic until accepted. If at any time before acceptance of the completed contract, any portion of seeded surface becomes gullied or otherwise damaged, or the seeding has been damaged or destroyed, the affected portion shall be repaired to re-establish the specified condition prior to the acceptance of the work.

8202 SODDING.

- A. Scope. This section governs the furnishing of all labor, equipment, tools and materials, and the performance of all work for sodding.

- B Materials and Definitions.

- 1. Sod. The sod shall be densely rooted nursery grown Kentucky Blue Grass. The sod shall contain a growth of not more than 10 percent of other grasses and clovers, shall be free from all prohibited and noxious weeds, and shall be cut in strips of uniform thickness, the range of acceptable thickness shall be 3/4 to 1-1/4 inch; each strip containing at least one (1) square yard. Sod shall be cut in strips not less than 12 inches wide.
- 2. Fertilizer. Fertilizer shall be inorganic 12-12-12 or 13-13-13 grade, uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in convenient containers, each fully labeled, conforming to applicable state fertilizer laws, bearing the name, trade name, or trademark and warranty of the producer.

- C. Construction Details.

- 1. Fertilizing. Before tilling operations, fertilizer shall be spread uniformly at the rate of 300 pounds per acre. Fertilizing rate is equivalent to 3.5 pounds per 500 square feet.
- 2. Tilling the Sod Bed. The sod bed shall have a uniform surface free from washes and depressions; and shall conform to the finished grade profile and cross-section shown on the plans. The soil except where fresh top soil has just been applied and compacted, shall be thoroughly tilled to a depth of 2 inches.

Freshly graded areas, which have set long enough to become dry and crusted over shall be tilled as specified above, preparatory to placing the sod.

3. Placing Sod. Sod shall not be placed during a drought nor during the period from June 1 to September 1, unless authorized by the Engineer, and shall not be placed on frozen ground.

Sod shall be moist when it is placed. Sod strips shall be laid along contour lines, commencing at the lowest point of the area and working upward. The transverse joints of sod strips shall be staggered and the sod carefully placed to produce tight joints. The sod shall be firmed and watered immediately after it is placed. The "firming" shall be accomplished by application of a roller weighing not less than 60 nor more than 90 pounds per lineal foot of roller.

4. Anchoring Sod. On 2:1 slopes, or steeper, the sod shall be anchored with 1/2 inch square by 8 inch long wooden pegs driven into the grounds, 3 pegs to the square yard or other approved methods. Pegging shall be done immediately after sod is firmed. The area shall then be cleared of loose sod, excess or broken anchors, excessive soil, or other foreign materials.
5. Maintenance. The sodded area shall be thoroughly watered daily for a period of fifteen days after placing except when thoroughly wetted by rain. Any portion of the sod that is not in good growing condition following the first full growing season (Spring to Fall) shall be replaced with fresh live sod.

8203 GUARANTEE. The contractor shall guarantee all work and materials for a period of one full growing season (Spring to Fall) after the date of final acceptance of the project. During the guarantee period, all turf which dies shall be replaced, by and at the expense of the contractor, with like material.

SECTION 9000 MATERIALS TESTING

9001 SCOPE. This section shall apply to all required testing services for soils, asphalt and concrete.

9002 GENERAL. All materials testing shall be conducted by a testing laboratory qualified and approved by the City to perform the required sampling, analysis, testing and report writing services. Reports shall be prepared by or under the supervision of and bear the seal and signature of a professional engineer licensed in the State of Missouri. Improperly completed or certified reports will not be accepted.

9003 RESPONSIBILITIES OF THE CONTRACTOR OR DEVELOPER. When required by the Engineer, the contractor or developer shall provide all the required tests as herein specified at his expense. The contractor shall allow the testing agency access to the job site as may be required and shall furnish any labor as may be required by the testing agency to obtain and handle samples at the source of the material and at the site of the work. Adequate facilities shall be provided at the project site for the safe storage and proper curing of specimens requiring such facilities. The use of a testing agency's service does not relieve the contractor of the responsibility to furnish the required materials and to perform the required construction in full compliance with the City of Branson Technical Specifications. The successful passing of a test does not constitute acceptance of the work or materials represented by the test or any portion of the work or materials. Final acceptance of the project shall be granted only through the issuance of a Project Completion Certificate by the City of Branson and the expiration of the two (2) year maintenance period as established in these specifications.

9004 RESPONSIBILITIES OF THE TESTING AGENCY. All testing agencies shall meet the requirements of ASTM E329. A representative shall inspect, sample and test the materials and work as required by the City Engineer. Any material furnished or work performed by the contractor failing to conform to the specification requirements shall be immediately brought to the attention of the City Engineer and the contractor. Preliminary written field reports of all tests and inspection results shall be given to the contractor immediately after they are performed. A copy of all reports shall be forwarded to the City Engineer as they are made available. Results of all tests taken, including failing tests, shall be reported. The testing agency and its representative are not authorized to revoke, alter, relax, enlarge or release any requirement of the specifications, nor to approve or accept any portion of the work.

9005 ASPHALT TESTING. Sampling and testing of the asphalt mix shall be required on all asphalt paving projects constructed in the City of Branson.

Samples of the actual asphalt mix being used on a paving project shall be acquired by a qualified testing laboratory technician at either the construction site or the batching plant in accordance with ASTM Standards D979 and D3665. These samples shall be used to perform an aggregate gradation test (ASTM C136), asphalt extraction test (ASTM D2172), stability and flow test (ASTM D1559) and bulk specific gravity test (ASTM D2726). One complete group of tests shall be conducted on both the base material and the surface material for each paving project.

In-place density tests shall be conducted with a nuclear testing device during the course of the work. Density tests may be performed by City inspectors to verify that the performance specifications in Section 1409(E) (Density and Surface Requirements) of this specifications manual have been achieved. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the paving process. A minimum of two (2) tests per 1500 feet of street improvement shall be taken unless otherwise directed by the City Engineer. Tests performed with a nuclear device shall be conducted in accordance with the requirements of ASTM D2950.

9006 CONCRETE TESTING. Sampling and testing shall be required on all concrete work including curb and gutter, sidewalk, slope paving, retaining walls, inlets, manholes or any other structures as directed by the Engineer.

During the progress of the work, compression tests of the concrete used shall be made as directed by the engineer in accordance with the requirements of ASTM C31, C143, and C172. At least one sample, consisting of four (4) cylinders minimum, shall be taken from each 100 cubic yards of concrete placed or fraction thereof. In the event that the total amount of concrete on a project does not exceed 200 cubic yards, a minimum of four (4) specimens (consisting of four (4) cylinders each) shall be submitted for the project. In the case of a reinforced concrete box, a minimum of one sample shall be taken for each days pour. The cylinders shall be cast in the field and transported to the laboratory 24 hours after the concrete was placed. Each set of compression test cylinders shall be marked and tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders taken was placed, the delivery truck or batch number, the air content, and the slump. From each sample consisting of four cylinders, one (1) shall be broken at seven (7) days, one (1) at fourteen (14) days and two (2) at twenty-eight (28) days noting the compressive strength of each break.

Slump tests (ASTM C143) and air tests (ASTM C321) shall be made for each 25 cubic yards of concrete placed or fraction thereof. A minimum of two (2) slump and air tests shall be taken per day. Slump and air tests shall be taken with each cylinder series.

If samples of fresh concrete have not been obtained and tested, a minimum of three (3) cores shall be taken per ASTM C42 and broken as directed by the Engineer. Air content (ASTM D457) and cement content (ASTM C85) shall also be determined. Concrete in the portion of the structure from which the core was taken will be considered adequate if the average strength of the cores is equal to a minimum of 95% of the specified strength (f_c) and if the strength of any single core is not less than 80% of f_c . All core holes shall be completely filled with a low-slump, high strength concrete at the expense of the contractor.

All reports by testing laboratories shall include the type of structure and information on obtaining, transporting, storing, curing, time between obtaining and casting cylinders (when applicable), supplier, finisher and batch as well as the specific test data.

9007 SOIL TESTING. Sampling and testing shall be required on all subgrade preparation for street construction and all trench backfilling operations within the City of Branson. Prior to the contractor commencing subgrade compaction for any street improvement project, the

City Engineer shall designate the locations and depths at which a qualified technician shall acquire samples of soil for performing a moisture density test (ASTM D698 for cohesive soils and ASTM D2049 for noncohesive soils). A minimum of one (1) density test and maximum of two (2) density tests shall be performed for every 1000 feet of street construction.

Reports for moisture-density tests shall include the date, the location of the tests, the elevation or depth at which the test was taken, the maximum dry density, and the optimum moisture content as well as properly constructed moisture density curves for each sample. Also included shall be a determination of the soils plastic index (PI) and classification in accordance with ASTM D2487.

During the progress of the subgrade preparation, in-place density tests shall be performed with a nuclear density tester by a qualified technician approved by the City of Branson. The number of tests to be taken and the location thereof shall be determined by the inspector based upon his observation of the subgrade preparation. A minimum of two (2) tests per lift per 1500 feet of street improvement shall be taken unless otherwise directed by the City Engineer. Results of these tests shall indicate whether or not the performance specifications stated in Section 1205 (Compaction Requirements) of this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas. Tests performed with a nuclear device shall be conducted in accordance with the requirements of ASTM D2922.

During the progress of the work of trench backfilling, in-place density tests shall be performed with a nuclear density tester by a City of Branson inspector or qualified laboratory technician. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the backfilling process. A minimum of two (2) tests per 1000 feet of trench shall be taken unless otherwise directed by the City Engineer. Results of these tests shall indicate whether or not the performance specifications stated in this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas.