

## SECTION 5

### ROAD DESIGN STANDARDS

**5.0 General:** The County Engineer will approve all plans for construction or upgrading of streets or roads in the County Road System to include:

1. New construction
2. Staged development of roadways (overlays)
3. Roadway widening
4. Appurtenant roadway improvements such as storm drains and curb and gutter
5. Encroachments

To be eligible for acceptance into the County Road System, a street or road must be designed and constructed in accordance with these standards and approved by the County Engineer.

In general, roadways should be designed for the anticipated traffic density 20 years from the proposed date of construction. Special conditions such as long range planning studies, proposed zoning, industrial parks, proposed interstate facilities, etc. should be considered in the design.

**5.0.1 Road Designation:** Roadways in the County Road System are classified as one of the following:

1. Rural
2. Residential (Minor/Local)
3. Collector
4. Local Commercial
5. Industrial Service
6. Arterial

The determination of the appropriate classification should be made in consultation with the Planning Department.

**5.0.2 Drainage:** Storm sewer systems constructed to drain streets accepted into the County Road System are eligible for acceptance by the County if designed and constructed in accordance with the Richland County Stormwater Management Ordinance.

**5.0.3 Plans:** Complete construction plans and specifications together with all appropriate design calculations are to be submitted and approved prior to the commencement of construction. Plans are to be provided in digital format on computer disc as well as on 24" x 36" sheets. Plans are to be on state plane coordinates in accordance with Richland County's digital submission standard and to contain the following information:

1. Plan
2. Profile
3. Horizontal curve data
4. Vertical curve data
5. Grades
6. Stations of all PI's, PC's, PT's and intersections

7. Existing and proposed grades at half station
8. Typical cross section
9. Pavement design - to include supporting soil data (Grain Size, Attenberg limits, CBR's)
10. Drainage Structures
11. Utilities - all known or suspect (gas, phone, cable, electric, sewer and water)
12. Signing Plan
13. Pavement Marking Plan
14. Length of Proposed Roadways rounded to 0.01 Mile

**5.0.4 As-Builts:** As-built plans on computer disc are to be provided before final approval will be issued. As-built plans will also comply with the County's digital submission standard.

**5.0.5 Standard Sections:** Standard cross sections for the various road classifications and subgrade soil support values are available from the County Engineer's office.

**5.0.6 Dedication:** Roadways designed and constructed in accordance with these standards and approved by the County Engineer's office may be dedicated to Richland County for maintenance. This is accomplished through the submittal and acceptance of a deed for the right-of-way. Standard deed forms for this purpose are available from the County Engineer's office. The deed form, entitled Title to Real Estate, is reproduced at page 21. Executed deeds must be provided as a prerequisite for final approval.

**5.0.7 Guarantee:** As a condition for acceptance of a road into the County Road System, Richland County requires a one year warrantee accompanied by a bond in the amount of the construction cost. The warranty and bond will pertain to the design and construction of the streets and accompanying drainage system in accordance with these standards and their satisfactory performance during the warranty period.

All pavement failures and other structural defects that are detected during the warranty period are to be corrected by the grantor upon official notification by the County Engineer's office. A guarantee clause is contained in the easement and right-of-way deed itself. The guarantee period begins with the County's execution of the deed.

**5.0.8 Constructions Zones:** Within the County Easements/ROW's.

1. **Structural Zones** Any area that will or may receive an additional loading of weight or energy. To include all roads, road easements, detention or retention ponds.
2. **Non Structural Zones** Landscaped storm drain easements.

**Note:** Refer to section 5.0.12: Required Geotechnical Testing and County Inspections.

**5.0.9 Inspection:** All elements of roadway and storm drain system construction, in both Structural and Non Structural Zones must be inspected and approved by the County Engineer's office as a prerequisite for acceptance by Richland County. This will include:

1. Sub grade Surface
2. Storm Drain System and all related structures

3. Detention/Retention Ponds
4. Embankments
5. Utilities within the structural zone
6. Utilities in Landscaped zones
7. Sub grade for roads
8. Finished grade of road easements/ROW
9. Sub base
10. Base Course
11. Asphalt Paving

It is the contractor's responsibility to insure the County Engineer's office is notified upon completion of each phase of construction and has the opportunity to make their inspections before proceeding to the next phase. Instructions for coordination of the inspections with the contractor's activities are provided in Section 5.0.10 and 5.0.11.

It should be understood that the inspections conducted by the County Engineer's office are for the protection of Richland County only. They are not intended to certify the contractor's satisfactory discharge of his contractual obligation to the owner, nor do they relieve the project engineer from any of his responsibilities with regard to inspection and contract administration.

**5.0.10 General Instructions to Contractors:** The following procedures for implementation of the County's inspections and final approval shall be followed. It is recommended that these instructions be included in the contract documents for the construction contract.

**Applicability:** As a prerequisite to County approval and acceptance of new streets, all phases of construction must be inspected and approved by the County Engineer's office. This applies to all subdivision streets constructed under the jurisdiction of Richland County Land Development Regulation whether they are to be dedicated to Richland County or not.

**Specifications:** All construction and materials shall comply with the latest edition of the SCDOT Standard Specifications for Highway Construction unless specifically noted otherwise herein. These requirements and SCDOT specifications shall supersede the engineer's specifications in the event of a discrepancy.

**Testing:** The contractor is responsible for providing all geotechnical and materials testing and the accompanying documentation at no cost to the County. All testing is to be performed by a licensed certified agency and signed off on by the engineer. All testing is to be identified on forms as to the exact location (SD No.'s, Street name, Sta. No.'s, and elevation in regards to finished grade.) The County will be responsible for providing its own quality assurance testing. Unless otherwise stated herein, the proctor densities required under these procedures are standard proctor densities.

**Notification:** After receiving approval of street, storm drainage and sediment and erosion control plans, the contractor or engineer must contact the County Engineer's office with a start date for construction at least 48 hours in advance. Upon completion of site clearing and grubbing and erosion control installation a mandatory site meeting will be held. Meeting is to be arranged by the contractor or project engineer. Meeting shall be attended by project engineer, contractor, developer, geotechnical engineer, county engineer, and any utilities that will or may encroach on/into a Structural Zone. (Attendee must be a responsible

representative, meeting should be timely planned and the county notified at least 48 hours in advance.)

**Erosion Control:** Before starting any grading work, install sediment and erosion control measures per the approved plans to protect any downstream water bodies. The contractor is responsible for implementation and weekly or bi-weekly monitoring of the sediment and erosion control plan in accordance with SC DHEC Regulations, insuring inspection logs are available on site at all times, and for insuring that silt and sediment do not leave the site.

**Inspections:** Requests for any inspection must be arranged with the County Engineer's office 24 hours in advance.

**Other Regulations:** The developer and contractor are also responsible for compliance with all applicable regulations administered by other agencies such as:

- SCDHEC
- Corps of Engineers
- SCDOT
- Richland County Planning and Zoning

The County Engineer's office may withhold approval at any stage of construction, including final approval, for failure to comply with these regulations.

### **5.0.11 Required Geotechnical Testing and County Inspections:**

**Mandatory Initial Sub grade Surface Inspection:** After clearing and rough grading of streets but prior to placement of any storm drain or fill for road way embankments, a mandatory sub grade surface inspection is required.

The developer, contractor, project engineer, geotechnical engineer, any utilities that may be working within a structural zone and the County Engineer's office should be present. This inspection shall be set up by the contractor or the project engineer.

A rubber tired backhoe or motor grader are needed for this inspection in order to confirm that all stumps, roots and unacceptable soils have been removed. A proof-roll may be conducted during this inspection at the discretion of the County Engineer's office or geotechnical engineer. Underdrain requirements may also be identified at this point. All deficiencies identified during this inspection must be corrected by the contractor before the next inspection is requested. The consulting engineer or geotechnical engineer as well as the County Engineer's office and contractor should be represented. This inspection shall be set up by the contractor or the consulting engineer.

**Detention/Retention Ponds:** Such areas to be considered Structural Zones. Pond dikes are to be constructed with fill approved by and signed off on by the geotechnical engineer; absolutely No Organics are permitted in dikes. Fill material is to be tested every 1 ft. in elevation and every 100 l/ft., with a minimum of 2 tests per lift. Trenches through a pond dike are to be considered a Structural Zone and should be tested accordingly. All fill must be compacted to at least 95% of maximum proctor density. County Engineer is to be copied on all testing.

**Trenching and Backfilling:** Storm drain trench bedding and backfill must be a SCDOT approved material, be visually inspected, and signed off on by the geotechnical inspector and a copy of the inspection must be sent to Richland County.

The contractor shall notify the County Engineer's office when backfilling of storm drainage or utility excavations within a Structural Zone is to take place. Backfill in these excavations shall be compacted at the proper moisture content in lifts not exceeding 6 inches. The contractor shall provide geotechnical testing and documentation, at no cost to the County, confirming that all backfill has been compacted to at least 95% of maximum proctor density.

**Trenches in the Structural Zone:** Such trenches are to have density testing beginning at the pipe haunches, both sides, every 100 ft. or any portion of that, testing to be performed every 1 ft. of fill every 100 ft. until sub grade elevation is met.

**Trenches in a Non Structural Zone:** Such trenches are to have a density testing beginning at pipe haunches both sides every 200 ft., or any portion of that, testing to be performed every 2 ft. of fill every 200 ft. until sub grade elevation is achieved. Density Requirement in a Non Structural Zone to be 95% of maximum proctor density within the pipe zone and 85% from top of pipe zone to finished grade..

County Engineer is to be copied on all testing. If not properly notified, or if the test results are unsatisfactory, the County Engineer's office may require excavation and re-compaction of the backfill. No proof-roll of the sub grade will be scheduled until the backfill compaction has been documented. Flowable fill may be used in lieu of compaction in 6" lifts and geotechnical testing. Notification, however, is still required so that an inspection of the excavations can be accomplished prior to placement of flowable fill.

**Erosion Control:** Install sediment and erosion control measures around storm drain inlets as they constructed. Sediment basins and detention ponds must be in places at this time.

#### **Storm Drain Boxes:**

1. **Boxes inside a Structural Zone** - fill around boxes to have 1 density test for every 2 ft. of fill placed. Density test must meet 95% of maximum proctor density.
2. **Boxes inside a Non Structural Zone** - fill around boxes to have 1 density test for every 3 ft. of fill placed. Density test must meet 85% of maximum proctor density. County Engineer is to be copied on all testing.

**Embankments:** All stumps and large roots must be removed from the roadbed prior to placement of fill for embankments regardless of fill height. All roadway embankment and embankment fill must be approved by and signed off on by the geotechnical engineer. Roadway embankments fill to be placed and compacted in lifts not exceeding 8". The contractor is responsible for providing geotechnical testing and documentation that the embankment material has been compacted to 95% of maximum proctor density. Density testing of embankment fills to be performed every 1ft. of fill every 250 ft. alternating lanes with a minimum of 2 tests per road, per 1ft. of fill. County Engineer's office is to be copied on all testing. No proof-roll of the sub grade will be scheduled until the compaction has been documented.

**Embankment Modifications:** Any roadway embankment modifications (extra stone, soil cement, lime treatment, geo grid, etc) must be approved by the geotechnical engineer and the County Engineer notified of such modifications.

**Curb and Gutter Proof-Roll:** Curb and gutter must be placed on compacted and approved sub grade or base material. Prior to scheduling a curb and gutter proof-roll the County Engineer's office must be in receipt of all density testing data required to be completed at this stage of construction. The geotechnical inspector, contractor, project engineer and County Engineer shall be present for this proof-roll.

**NOTE:** Upon completion of a passing curb and gutter proof-roll, absolutely no excavation or trenching is to be done in a Structural Zone (Roadway or Roadway Easement) without the approval of the Richland County Engineer's office.

**Underdrains:** The need for and location of underdrains will be identified in conjunction with the proof-roll of the sub grade. Required underdrains will be clearly marked on the contractor's and County Engineer's plans and must be installed prior to requesting the next inspection. The location of underdrains must also be shown on the as-built plans.

**Sub Grade Proof-Roll:** Prior to scheduling a sub grade proof-roll, the County Engineer's office must be in receipt of all density testing data (sub grade should have been tested every 250 ft., alternating lanes testing to be completed on cut or fill), required to be completed at this stage of construction. It is the responsibility of the contractor to provide independent density verification prior to proof-rolling and at no cost to Richland County.

After fine grading of sub grade, but prior to placing base material, the sub grade must be proof-rolled with a loaded tandem axle dump truck or pan. The contractor shall schedule this inspection. The geotechnical engineer, County Engineer's office and contractor shall be represented. The County Engineer's office reserves the right to conduct or require additional testing at any time. The minimum acceptable sub grade density is 95% of maximum proctor density.

No base course material or curbs should be placed prior to written approval of the sub grade from the County Engineer's office.

**NOTE:** Any completed and approved sub grade left exposed for over two weeks or damaged by inclement weather must be re-inspected and approved by the County Engineer's office. This may include another proof-roll if necessary in the judgment of the County Engineer's office.

Any excavation within a tested and county approved sub grade shall be treated as new excavation and complete density testing and proof-rolling requirements must be met.

**Catch Basins:** The location and orientation of the catch basins relative to the curb and gutter, as well as the roadway width, should be confirmed at this time. Catch basins improperly placed must be relocated and/or reconstructed. All catch basins must have a temporary drain by which standing water can be drained from the surface of the sub grade and base during construction. These drains must be properly plugged before the final inspection is requested.

**Base Course:** Placement of base course material is only permitted on a County approved sub grade. Base course material other than graded aggregate base course must be approved by the County Engineer’s office (sand clay, cement, stabilized, geo grid etc.) All base course materials are to be density tested every 250 feet in alternating lanes with a minimum of 2 tests on any road no matter the length. Thickness of base course material must be verified at each density test location.

The following compaction requirements must be met:

- Graded Aggregate Base Course (98% of modified proctor density)
- Sand Clay Base Course (100% of maximum proctor density)
- Cement Modified Earth Base Course (95% of maximum proctor density)

It is the responsibility of the contractor to provide independent density verification at no cost to Richland County.

**Graded Aggregate Base Course:** If base course is thicker than 8 inches it shall be placed and compacted in equal lifts, if base course is less than 12 inches it can be tested as 1 lift. If base course is 12 inches or greater it must be placed compacted and density tested in equal lifts (12 inches, compact and test at 6 inches and 12 inches).

**Base Course Proof-roll:** Prior to scheduling a Base Course Proof-Roll the County must be in receipt of all base course density testing and thickness verification reports. If the average base course thickness is found to be deficient by more than ½ inch or any individual measurement deficient by more than 1 inch, the deficiency will be corrected by scarifying, adding base material, re-compacting and density testing. Upon completion of the curbing and base course, the contractor shall schedule an inspection to proof-roll the base with a loaded tandem axle dump truck or pan. The geotechnical engineer, County Engineer and contractor shall be represented. The contractor will provide proctor and gradation information on the base material from an independent testing firm as well as verification that all applicable compaction and depth requirements have been satisfied.

**NOTE:** Any completed and approved stone base left exposed for over one week or damage by inclement weather must be re-inspected and approved by the County Engineer’s office. This may include another proof-roll if necessary in the judgment of the County Engineer’s office.

**5.0.12 Paving:**

**Asphalt Requirements:** Unless another type has been approved in advance, by the County Engineer’s office for a specific project, hot mix asphalt pavements will be:

Binder Type 1 or 2 (Intermediate Type B or C)	for binder (Intermediate) courses
Surface Type 1 (Surface Type C)	for surfaces courses

All hot mix asphalt will contain hydrated lime as an anti-stripping agent. A roadway will not be approved and accepted by the County without this additive in the asphalt

**Coordination:** After approval of the base or sub grade, there must be coordination between the paving contractor and the County Engineer's office with regard to the schedule for paving. If possible, a County inspector will be present during paving operations but it is not mandatory unless so designate by the County Engineer.

1. Asphalt is only to be placed on a county approved base.
2. If more than one week passes or there is 1/4 in or more rain prior to paving an approved base, the base must be re-inspected by the County visually, and possibly proof-rolled.
3. Minimum Asphalt thickness for initial/ first lift is 2 in.
4. Asphalt concrete surface course may not be placed during the months of December, January and February except with the written permission of the County Engineer. Placement of hot mix Asphalt will not be authorized when surface temperatures are less than 45 degrees F.
5. Richland County Engineer's office to visually inspect pavement and review Asphalt core test data at all phases of paving, binder, intermediate and surface course.
6. Asphalt tack coat to be placed between all course no exceptions.

**Final Surface Course:** An existing asphalt concrete binder or base course must be inspected and approved prior to placement of the asphalt surface course. Verification of in-place density and thickness of the binder or base course must be provided as a prerequisite to this approval. Failure to obtain this approval will make the street ineligible for final approval and acceptance by the County.

**Asphalt Requirements:** Asphalt verification testing will be conducted in accordance with Section 401.30 of the SCDOT Standard Specifications for Highway Construction, Newest Edition. The contractor shall be responsible for providing verification of the asphalt type, asphalt binder content, gradation and the average laboratory bulk specific gravity (BSG) for all asphalt mixes used on Richland County projects as well as the in-place asphalt density and thickness. The asphalt contractor must have an asphalt laboratory certified by the SCDOT for state highway projects.

For each day's production, the contractor's asphalt lab must provide:

- Average laboratory BSG
- Asphalt binder content
- Gradation
- Mix type

The in-place density and thickness determination of asphalt surface and binder courses will be based on the core data for each day's production. Cores will be obtained every 500 ft. in alternating lanes with a minimum of one core on any road no matter the length, immediately after completion and the holes patched with hot asphalt from the same day's production. The cores will be taken and evaluated by either the asphalt contractor or an independent materials testing firm certified by the SCDOT for state highway projects.

The pavement will be rejected, removed and replaced if the average in-place core density is less than 96% of the average laboratory BSG with all cores exceeding 95%.

The average pavement thickness must be equal to or greater than the plan thickness with no individual core thin by more than 0.25". Pavements that are deficient with regard to thickness will either be removed and replaced or overlaid at the discretion of the County Engineer. Each core will be tested for the presence of hydrated lime in the mix.

Documentation of the asphalt verification testing must be provided prior to requesting a final inspection. The Richland County Engineer's office reserves the right to conduct or require additional verification testing at any time.

**Proof-Roll of Road Easement:** Easements should be properly graded and compacted according to plans. Fill along curb line is to be a minimum of ½ inch above curb line and compacted. No water should be allowed to stand behind the curbing once it is completed. All water is either to drain away from or over the curb. In lieu of density testing in Roadway Easements, a proof-roll will be conducted by the County Engineer's office. Proof-Roll is to be scheduled by the contractor prior to grassing. A rubber tire backhoe pick-up truck, rubber tire skid loader is preferred for this proof-roll. A maximum of 1 inch deflection is permitted during this proof-roll.

**5.0.13 Signs:** Traffic control signs and name signs on new streets are to be installed by the developer in accordance with an approved signing plan as a prerequisite for acceptance by Richland County.

A standard detail for the name signs may be found on Page 29. For the sake of uniformity and ease of maintenance, this is the only acceptable name sign for County maintained streets unless and alternate design is submitted to and approved by the County Engineer's office.

Traffic control signs are to be fabricated and erected strictly in accordance with the S.C. Manual on Uniform Traffic Control Devices.

#### **5.0.14 Final Approval:**

**Final Inspection:** After the paving is completed and all utility, storm drainage and associated work is complete, a final inspection can be scheduled. The following items should all be completed before a final inspection is requested:

- Permanent grass on road shoulders; cut and fill slopes and easements
- Fence around detention ponds
- Street name signs (County Standard or an approved alternate)
- Traffic control signs (per SC MUTCD)
- Pavement marking (Thermoplastic)
- As-built Drawings

**Documentation:** As a prerequisite to conducting the final inspection, the following must be provided:

- Digital submission of as-built plans
- 12"x18" hard copy of as-built plans
- Right-of-way deeds for roads and drainage system
- One year warranty bond for road and drainage systems
- Documentation of asphalt verification testing

**Bond Estimate:** If approval of a bond in lieu of completion is sought, the engineer must provide an estimate of the quantities of the uncompleted items of work together with their contract values and total cost. When the uncompleted work includes the final surface course, the estimate must include remedial work on a minimum of 25% of the total pavement area.

**Punch List:** A written punch list of deficiencies found during the final inspection will be provided. All items should be completed before requesting a re-inspection.

**Final Approval:** Upon satisfactory completion of all punch list items, a final approval letter recommending County acceptance of the streets and drainage system will be issued by the County Engineer.

Failure to comply with any of the above listed requirements could render the streets and storm drainage systems ineligible for acceptance by Richland County.

**5.0.15 Encroachment Permits:** An encroachment permit, approved by the County Engineer's office, is required for all construction, undertaken by parties other than the Richland County Public Works Department or its authorized contractor, within or affecting the right-of-way of any County maintained road. This requirement applies, but is not be limited, to:

- Driveway connections involving a curb cut or pipe installation
- Curb cuts
- Utility taps
- Utility crossings
- Storm drainage installation
- Storm drainage discharge
- Subdivision entrance signs or gateways

The permittee is required to indemnify the County for any liability incurred or damages sustained as a result of the encroachment.

The permittee is responsible for:

- Notifying the County Engineer's office when construction begins on an encroachment
- Ensuring that a copy of the encroachment permit is on the construction site
- Ensuring that the construction and the restoration of the roadway have been approved by the County Engineer's office
- All construction

The encroachment permit application form may be obtained from the County Engineer's office.

Anyone who encroaches on the right-of-way of a County maintained road without securing an encroachment permit or who fails to adequately restore the road and right-of-way after an encroachment is subject to fines of up to \$500.00 per day in accordance with County ordinance.

## 5.1 Pavement Design Standards:

**5.1.1 General:** In determining the required pavement strengths, the following factors shall be considered:

1. Road designation
2. Traffic Data. DHV, ADT, Percent Trucks (T)
3. Soil characteristics and strength
4. Traffic growth rates
5. Pavement strengths
6. Structural number
7. Stage development
8. Parking
9. Drainage
10. Geometries

**5.1.2 Road Designation:** A road's designation as Rural, Residential, Collector, Local Commercial, Industrial Service or Arterial, should be determined in consultation with the Planning Department.

### 5.1.3 Reserved

**5.1.4 Traffic Data:** The following information shall be provided for each proposed road improvement:

- A. ADT, Average Daily Traffic, the daily traffic flow in both directions of travel, for a 24-hour period.
- B. DHV, Design Hour Volume, the 30th highest hourly volume of the year is designated the DHV. If this information is not readily available DHV may be calculated as 12% of the ADT.
- C. T, Percentage of Trucks, the quantity of trucks during the ADT or DHV, expressed as a percent of that total traffic. For the purpose here, light delivery trucks, such as panels and pick ups, are considered as passenger cars. In lieu of the actual field data, T can be considered 10% on Arterials, 5% on Collector and minor Residential. Special conditions must be discussed with the County Engineer for the Industrial Road Designations.
  - C.1 Trucks shall be further identified as follows, during the traffic counting.

2DT - Unit truck, two axles

3SU - Unit truck, three axles

2S1 - Semi truck, two axles on cab, one axle on tailer

2S2 - Semi truck, two axles on cab, two axles on tailer

2AX - Truck with five axles or more

C.2 In lieu of the actual traffic count to determine T, and utilizing the percentages provided in Section 5.1.4C the following road designations shall contain the respective road groups as follows:

- A. Residential (or Local) - Road Group B
- B. Collector - Road Group D
- C. Commercial - Road Group D
- D. Industrial - Road Group J

Road group loads and their effect on pavement design as related to these road groups is as shown on Data Sheet 1 of the design sheets.

- D. Lane Factor: In two lane roads the total one-way traffic is obvious. In four lane roads the most heavily traveled lane will be the right most lane and a factor of 0.8 will be applied to the total one-way traffic. In six lane roads, the most heavily traveled lane will be the right lane also, and a factor of 0.7 will be applied to the total one-way traffic.
- E. Average one-way ADT, or when the 20-year ADT is calculated based upon section shall be taken as the following: In or near City Suburbs - 55% - Rural Areas - 65%.

**5.1.5 Subgrade Soil Support Value:** In the case of proposed new construction, the soil support value of the Subgrade will be provided by the tri-axial shear test; modulus of deformation may be developed by laboratory testing and correlated with the accompanying soil support scale to provide these data. This value is requested also for staged road work (overlays) and road widening work. In lieu of an actual soils evaluation, a value of 1.50, 2.5 or 3.5 (as determined by the County Engineer) may be used for the value of S. Data Sheet 4 gives the estimated Soil Support Value and other related data for those soils occurring in Richland County as identified by the Soil Conservation Service.

The designer should be aware that the maximum soil support value that will be accepted without a laboratory analysis of the subgrade soil is 3.5.

**5.1.6 Traffic Growth Rate:** A figure of 4% per year has been identified as the growth rate characterizing traffic within the United States. This figure should be used for forecasting anticipated ADT with the pavement design life. Other figures from local expertise are acceptable, when qualified as acceptable by the County Engineer.

**5.1.7 Coefficients of Relative Strength of Pavement Component Layers:** The required thickness of a given layer or layers varies with their respective tensile strength. This strength is expressed in terms of relative coefficient. The estimated values of coefficients of the pavement components used in AASHTO Interim Guide for the Design of Flexible Pavement Structures and ASHTO Road Test Equations applied to the Design of Bituminous Pavements in Illinois are utilized in this standard. It is to be understood that these coefficients may change if and when future studies are made to more accurately evaluate their respective tensile strength. At that time the County Engineer will provide updated coefficients for incorporation with these standards.

**5.1.8 Structural Number:** An index number derived from an analysis of traffic and design features which may be converted to pavement thickness through the use of suitable factors related to the type of material being used in the pavement structure.

This dimensionless number reflects the product of the necessary thickness of the various road building components of pavement, i.e., sub-base, base-course, binder and/or leveling course, surface course and existing surface course, and their respective Coefficient of Relative Strength which when totaled together for the final pavement design must equal or exceed the Structural Number (SN).

The designer should be aware that the minimum structural number for the particular road designations are as follows:

Residential and Rural	1.56
Collector	2.00
Local Commercial	2.44
Industrial Service	2.44

These minimum structural numbers are applicable to roads constructed on subgrade soils with soil support values equal to or greater than 5.5. When constructed on poorer soils, the pavement must have a structural number appropriate to the road designation and soil support value for the subgrade soil on the particular site.

**5.1.9 Stage Construction:** Various items of road construction such as pavement courses, lane requirements for future traffic density, or other sequential work must have the approval of the County Engineer prior to consideration for acceptance by the County of Richland.

Pavements on which the total asphalt thickness equals 2.5" or greater will be placed in two stages. The base and asphalt concrete binder course will be placed as the first stage. At this stage, a surety bond may be posted and a bonded plat recorded for the subdivision in accordance with the provisions of the Land Development Regulations. After a minimum period of nine (9) months, all pavement failures and distresses will be repaired to the satisfaction of the County Engineer, or his representative, and a minimum of 1" of asphalt concrete surface course placed. At this stage, the road may be dedicated to the County through the execution and acceptance of a deed for the right-of-way.

The surety bond placed at the completion of the first stage will be in an amount equal to 125% of the estimated value of the remaining improvements. The estimated value will include, as a minimum, the cost of the surface course and repair of pavement failures on at least 25% of the pavement surface.

**5.1.10 Flexible Pavement Design Method:** The following explains the use of Data Sheets 1, 2 and 3 accompanying the Road Design Standards:

Data Sheet 1 is a summary of the traffic data, Data Sheet 2 is a nomograph relating the Soil Support Value and the Equivalent Daily 18 KIP Single Axle Load Application to the Structural Number, and Data Sheet 3 provides the Coefficients of Relative Strength for Flexible Pavement Components.

Most of the first two lines of Data Sheet 1 are obvious. The truck %, (T), Designation, and number of lanes are derived from the traffic count (ADT) and the design standards. In the event that this is to be a new road, this information will be obtained from the County Engineer. Section 5.1.4.C may be consulted for traffic information in lieu of an actual traffic count.

With the results of the traffic count (ADT) Columns 1 and 2 and the percent trucks, T can be inserted. The 20-year figure is obtained from the design criteria, or by the utilization of their growth rates acceptable to the County Engineer.

The average one-way ADT is derived from the design criteria, Section 5.1.4.E and is inserted in Column 3. Average one-way ADT factor is shown in Table IV. Average one-way trucks, are computed to be T multiplied by Column 3 with the result divided by 100 and then inserted in Column 4. The Truck weight, Column 5 represents either the design criteria road group equivalent 18 KIP applications per 100 trucks, or a computed equivalent 18 KIP applications per 100 trucks. The design criterion's road group is shown in Table I. The computed value is calculated by utilizing the traffic count, and the percent trucks T, with the actual quantity of each respective truck designation as described in the design criteria. The number of trucks of each respective designation when multiplied by its equivalent 18 KIP per 100 vehicles of a type (Table II), and then divided by 100 will be the equivalent truck weight figure based on the traffic count (ADT).

Column 6 is obtained by multiplying Column 5 by Column 4. Column 7 is obtained by going to Table III and selecting the appropriate lane factor, based upon the number of lanes in the project. Column 8 is obtained by multiplying Column 7 by Column 6. Column 8 becomes one point on the nomograph on Data Sheet 2, and is plotted on the Equivalent Daily 18 KIP single axle load applications.

The Soil Support Value, or the modulus of deformation is obtained through a soil test and is a measure of the bearing strength of the supporting subgrade under the pavement components. In lieu of a field test the values in the design criteria section 5.1.5 may be employed for S.

The tri-axial shear test is utilized for the field determination of the value of S. or the modulus of deformation, and becomes the second point on the nomograph shown on Data Sheet 2, under its appropriate scale shown. It is also to be shown on Data Sheet 1 to provide all information to the designer in a concise package.

The two points described in the preceding paragraphs describe a straight line, which is extended to intersect with the line segment designated as a total pavement strength measure, which is to be equaled or exceeded by the total of the respective pavement section strengths. This formula employed is  $SN = T_1a_1 + T_2a_2 + T_3a_3$  where:

- $T_1$  = thickness of bituminous surface courses, in inches
- $T_2$  = thickness of base course, in inches
- $T_3$  = thickness of subbase course, in inches

$a_1, a_2, a_3$  = Coefficients of Relative Strengths which are obtained from Data Sheet 3 accompanying this example.

When the aforementioned equation computes out to equal or exceed the SN obtained from nomograph, the design pavement is valid and may be proposed. The designer should verify that the minimum asphalt thickness, 1½", has been used in the surface courses and that the minimum pavement thickness for each component or its equivalent is in accord with that established for its respective road designation.

**5.1.11 Standard Design:** In lieu of a pavement design as prescribed above, the engineer may elect to use a pavement as shown on Richland County's Standard Street Cross Section, Alternate 1, 2, 3 or 4. The appropriate alternate is to be selected according to the estimated soils support value for the subgrade soil prevalent at the site as follows:

Soil Support Value	Alternate
1.5	1
2.5	2
3.5	3
5.5	4

Estimated soil support values for the various soil types identified on the Soil Survey of Richland County are provided in Data Sheet 4.

It should be noted that the standard pavement design may not be used in lieu of an individual pavement design based on subgrade or traffic conditions known or anticipated to be different from those on which the standard design is based.

**5.1.12 Rigid Pavement Design:** Rigid pavements are currently not approved for use on the County Road System.

DATA SHEET NO. 1

TRAFFIC DATA FOR PAVEMENT LOADING

ROAD \_\_\_\_\_ DESIGNATION \_\_\_\_\_ FROM \_\_\_\_\_ TO \_\_\_\_\_  
 T% TRUCKS \_\_\_\_\_ PAVEMENT TYPE \_\_\_\_\_ # OF LANES \_\_\_\_\_ DATE \_\_\_\_\_

1	2	3	4	5	6	7	8
ADT	DESIGN PERIOD	ONE-WAY ADT	ONE-WAY TRUCKS	TRUCK WEIGHT	ADJUSTED TRUCKS	LANE FACTOR	ONE-WAY EQUIV. DAILY 18 KIP SINGLE AXLE LOAD APPLICATION

TABLE I

ROAD GROUP	DISTRIBUTION BY TYPE				EQUIV. 18 KIP APP PER 100 TRUCKS	
	2DT	3SU	2SI	5AX	FLEXIBLE	RIGID
B	92.9	1.6	1.4	1.4	23.14	25.71
D	86.5	0.6	3.1	4.6	28.92	34.44
G	71.7	6.5	2.4	6.8	39.97	52.11
J	54.0	6.8	3.5	15.5	55.70	77.30

TABLE II

VEHICLE TYPE	EQUIV. 18 KIP APP PER 100 VEHICLES OF A TYPE	
	FLEXIBLE	RIGID
2DT	17.83	17.75
3SU	62.69	101.52
2SI	76.91	76.84
2S2	109.88	145.54
	109.14	185.32

SOIL SUPPORT VALUE \_\_\_\_\_

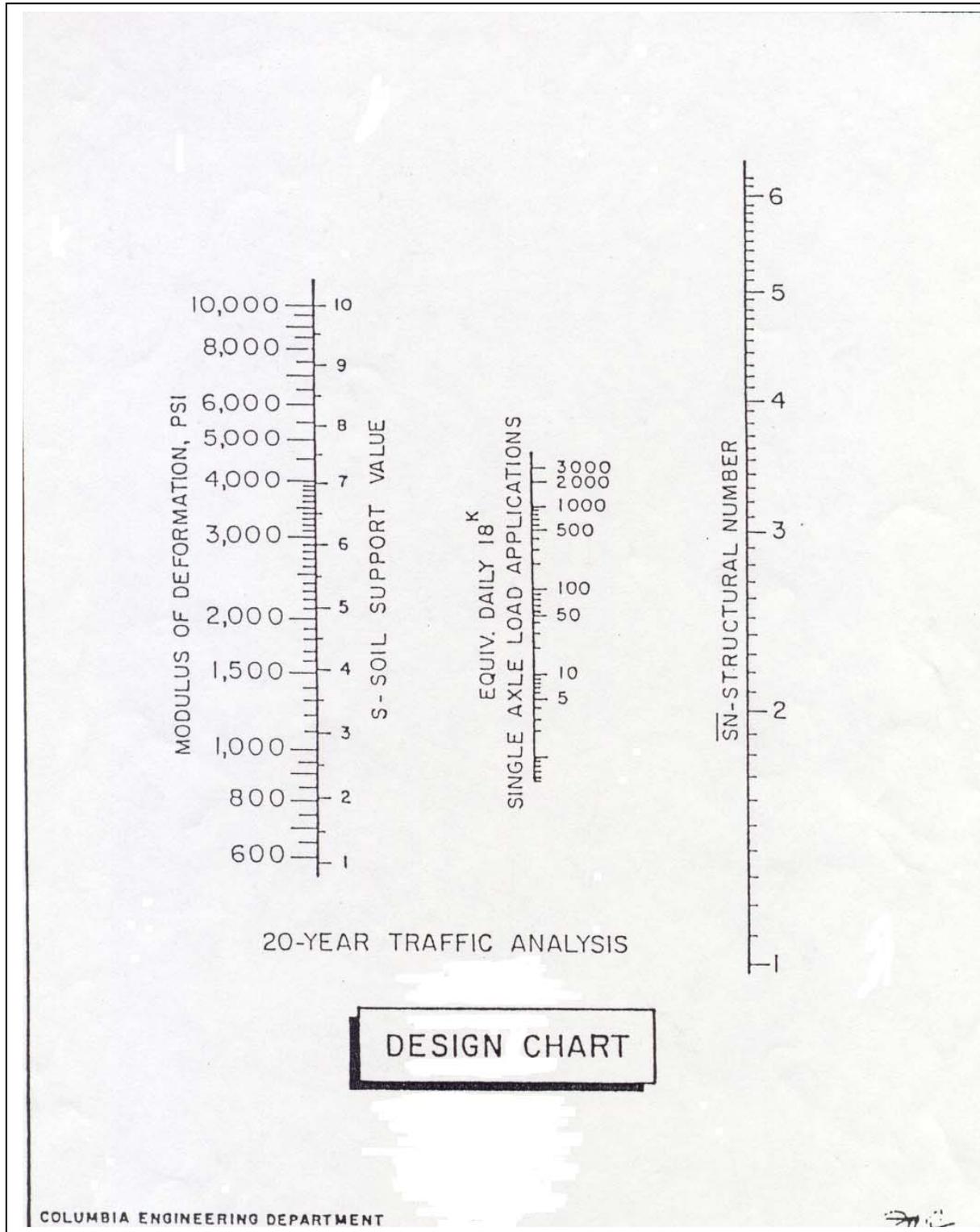
TABLE III

NO. OF LANES	LANE FACTOR
2	1
4	0.8
6	0.7

TABLE IV

AVERAGE ONE-WAY ADT FACTOR	
IN CITY	0.55
NEAR CITY (5~MI)	0.65

DATA SHEET NO. 2



**DATA SHEET NO. 3**  
**S.C. DEPARTMENT OF HIGHWAYS**  
**AND PUBLIC TRANSPORTATION**  
**COEFFICIENTS OF RELATIVE STRENGTH FOR**  
**FLEXIBLE PAVEMENT COMPONENTS**  
**July 1, 1979**

<u>Pavement Components</u>	<u>Coefficients</u>		
	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>
<u>Surface Course</u>			
Hot Laid Asphalt Concrete Surface	0.44		
Hot Laid Asphalt Concrete Binder	0.44		
Bituminous Surfacing	0.35		
<u>Old Surface</u>			
Old Asphalt Concrete Surface Course	0.26		
Old Asphalt Concrete Binder Course	0.26		
Old Sand Asphalt	0.16		
Bituminous Surfacing	0.21		
<u>Base</u>			
Earth Type Base Course (Sand Clay)		0.12-0.20*	
Coquina Shell Base Course		0.12	
Mcadam Base Course		0.15	
Cement Stabilized Earth Base Course			0.25
Hot Laid Sand Asphalt Base Course		0.20-0.25*	
Stabilized Aggregate Base Course (Fossil/Limestone)		0.22	
Stabilized Aggregate Base Course (Non-Fossil/Limestone)		0.15	
Hot Laid Asphalt Concrete Binder Course		0.34	
Hot Laid Asphalt Aggregate Base Course		0.34	
Cement Stabilized Aggregate Base Course		0.34	
Old PCC Pavement		0.40	
<u>Sub-base</u>			
Soil Aggregate Subbase Course			0.10
Cement-Modified Subgrade			0.15

(\*) Coefficient dependent on quality of material available.

**Note:** In general, it is recommended that, in computing SN for resurfaced flexible pavements, the coefficient for the former base be no greater than 0.7 of its original value, and that for the former subbase be no greater than 0.8 of its original value.

## Data Sheet No. 4

Soil Name & Map Symbol	% Passing 200 Sieve (F)	Liquid Limit (LL)	Plasticity Index (PI)	Group Index (GI)	Soil Support Value (S)
Ailey - AeC	40	40	16	2.5	3.5
Altavista - AtA	75	45	26	18.6	2.5
Blanton - BaB	12	--	--	0	3.5
Cantey - Ca	95	60	25	30.0	1.5
Chastain - Cd	98	75	40	48.5	1.5
Chewacla - Ce, CH	98	61	30	35.8	1.5
Clarendon - Cn	55	40	15	6.0	3.5
Congaree - Co	90	50	22	28.2	1.5
Coxville - Cx	80	55	35	28.6	1.5
Dorovan - Dn	NA	NA	NA	NA	NA
Dothan - DoA, DoB, DuB	45	40	25	3.5	3.5
Faceville - FaA, FaB	72	43	23	15.4	2.5
Fuguay - FuA, FuB	35	--	--	0	3.5
Georgeville - GeB, GeC	98	75	35	44.4	1.5
Goldsboro - GoA	55	35	16	5.9	3.5
Herndon - HeB, HeC, HnB	98	70	30	38.6	1.5
Johnston - Jo	75	35	10	7.0	3.5
Kershaw - KeC	--	--	--	0	3.5
Kirksey - Krb	95	40	15	16.0	2.5
Lakeland - LaB, LaD, LkB	--	--	--	0	3.5
Lucy - LuB	30	30	15	0	3.5
Marlboro - MaA, MaB	70	48	20	13.9	3.5
Nason - NaB, NaC, NaE	95	66	36	40.6	1.5

Soil Name & Map Symbol	% Passing 200 Sieve (F)	Liquid Limit (LL)	Plasticity Index (PI)	Group Index (GI)	Soil Support Value (S)
Norfolk - NoA, NoB	55	40	20	8.0	3.5
Orange - OaB	90	99	70	72.2	1.5
Orangeburg, Oba, ObB, ObC, Ogb, Ogd	35	30	4	0	3.5
Pelion - PeB, PeD, PnC	55	40	18	7.2	3.5
Persanti - Ps	95	60	30	34.0	1.5
Rains - Ra	70	40	18	11.8	3.5
Smithboro - Sm	95	60	30	34.0	1.5
State - StA	70	41	15	9.9	3.5
Tawcaw - Tc	98	65	33	39.6	1.5
Toccoa - To	55	30	4	0.6	3.5
Trooup - TrB	35	--	--	0	3.5
Vaocluse - VaC, VaD	50	40	18	5.8	3.5
Wedowee - WeB	70	58	25	18.4	2.5

**5.2 Geometric Design Criteria:** Unless specifically addressed in these regulations, all geometric elements of roadway design for streets and roads in the County Road System will be in accordance with the AASHTO Policy on Geometric Design of Highways and Streets.

**5.2.1 Right-of-Way:** The minimum right-of-way width acceptable under these standards is 50 feet. Required right-of-way widths for the several road classifications are shown in Table I. In all instances, the centerline of the road and the right-of-way are to be coincident.

**5.2.2 Pavement Width:** Minimum pavement widths are to be as shown in Table I. The pavement widths shown are as measured from face to face of curbs except for the rural road and industrial service road on which the width is measured edge to edge of pavement.

**5.2.3 Design Speed:** Stopping distances, sight distances, minimum curve radii, vertical curve lengths and other design criteria are based on the design speeds for the different road classifications shown in Table I.

**5.2.4 Stopping Sight Distance:** The distance that a vehicle travels during the time in which the driver perceives a hazard in the road, reacts and brings the vehicle to a halt is the stopping distance.

Stopping distance can be calculated using the equation:

$$d = 1.47Vt + 1.075 \frac{V^2}{a} \quad \text{where:}$$

d = Stopping distance, Ft.

t = brake reaction time, Sec.

V = Design Speed, mph

a = driver deceleration, Ft./Sec.<sup>2</sup>

When t = 2.5 Sec. and a = 11.2 Ft./Sec<sup>2</sup>, the above equation yields the following values for d at the design speeds shown:

V(mph)	d (Ft.)
10	46.3
20	111.9
25	151.9
30	196.6
35	246.2
40	300.6
45	359.7
50	423.7
55	492.5

The sight distance, measured along the road centerline from the eye at 3.75 feet above the road surface to an object, 0.5 feet high, is the stopping sight distance and at no point should it be less than the stopping distance. Minimum requirements for stopping sight distances are shown in Table II.

**5.2.5 Horizontal Curves:** Horizontal curves are to be introduced at all changes of direction on collector, local commercial and industrial service streets and at changes of direction on residential streets where the deflection angle exceeds 10°. The minimum radii of curvature are to be in accordance with Table II. Speed limits on each street will be determined according to the shortest curve radius on the street. For streets with 2% cross slopes (1/4 " per Ft. crown) the maximum acceptable speed limits are

Radius (Ft.)	Speed Limit (MPH)
150 to 179	20
180 to 299	25
300 to 459	30
460 to 674	35
675 to 939	40

**5.2.6 Vertical Curves:** Crest vertical curves are to be of sufficient length to provide the

minimum stopping sight distance at the design speed. The lengths required are as shown in Table III. The lengths are calculated using the formulas:

$$L = \frac{S^2 A}{1400} \quad \text{where } S < L$$

and

$$L = 2S - \frac{1400}{A} \quad \text{where } S > L$$

in which:

S = Stopping sight distance in ft.

L = Length of vertical curve in ft.

A = Algebraic difference in grades.

**5.2.7 Grades:** A minimum grade of 0.5% is to be maintained on all streets to insure proper drainage.

The maximum permissible grade on local and minor residential streets is 15%. Grades less than 12% are preferred.

The maximum permissible grade on collector, rural, local commercial and industrial service streets is 12%. Grades less than 8% are preferred.

**5.2.8 Crown:** All streets are to have a minimum cross slope of 1/4" per foot. Inverted crowns or center gutters are not acceptable.

**5.2.9 Curb and Gutter:** With the exception of rural and industrial service streets, all streets are to either have concrete curbs and gutters or asphalt valley gutters. Either rolled curb and gutter or barrier type curbs are acceptable except that the barrier type is required on some local commercial streets. Other types of curb and gutter may be approved by the County Engineer.

**5.2.10 Medians:** Natural or planted medians separating opposing traffic lanes are acceptable. The minimum width of pavement on either side of the median is to be in accordance with the minimum lane widths contained in Table I. Barrier type curbs or adequate lateral clearance, however, must be provided on the median. Painted medians are required on collectors, local commercial and industrial service streets.

**5.2.10.1 Median Openings:** The minimum number of median openings required to serve abutting property are to be provided. Care should be taken to locate openings only where there is adequate site distance.

**5.2.10.2 Left Turn Lanes:** On collector, local commercial and industrial service streets, left turn lanes are to be provided at all median openings and intersections. The length of the turn lane is to be such that adequate storage under the expected traffic loading is provided. The minimum length, however, is 100 feet.

**5.2.11 Cul-de-Sacs:** All permanent dead-end streets are to terminate in a paved turnaround with a minimum radius of 40 feet. The right-of-way shall have a minimum radius of 50 feet.

**5.2.12 Islands:** A natural or planted island may be used in the center of cul-de-sacs on residential and rural streets provided that a minimum pavement width of 18 feet is maintained around the island.

**5.2.13 Corner Sight Distance:** All roadways are to be designed so that adequate corner sight distance is provided at all intersections. Corner sight distance at an intersection is measured from a point on the intersecting street 15 feet from the edge of pavement on the through street and 3.75 feet above the street surface to an object 4.5 feet high on the through street. The minimum corner sight distance is equal to the stopping distance shown in section 5.2.4 at the design speed, or posted speed limit, on the through street.

**5.2.14 Intersections:** The centerlines of no more than two streets shall intersect at any one point. Whenever possible, the centerlines of intersecting streets are to be perpendicular but in no case is the angle of intersection to be less than 60 degrees. All angles and distances are measured relative to the intersection of a street centerline.

**5.2.14.1 Intersections in Curves:** Intersections within a horizontal curve are permitted provided that the intersecting street has a 100-foot minimum tangent at the intersection and the required corner sight distance is maintained. Whenever possible, the tangent of the intersecting street is to be radial to the curve but in no case will it be more than 30 degrees from radial.

**5.2.14.2 Curb Radius:** The minimum acceptable curb radius at intersections is 25 feet. Larger radii must be provided in accordance with the AASHTO Policy on Geometric Design of Highways and Streets when significant tractor-trailer, or other large vehicle, traffic is expected.

**5.2.14.3 Existing Streets:** The profile of existing streets on either side of a proposed intersection shall be provided to insure that adequate site distances are available.

**5.2.15 Reverse Curves:** Reverse curves are permissible provided that applicable sight distances are maintained.

**5.2.16 Lateral Clearance:** A minimum lateral clearance as shown below shall be maintained from the edge of pavement or from the back of curb or valley gutter:

Rolled curb and gutter.....	6.0'
Barrier type curb.....	4.0'
Valley gutter.....	6.0'
Flat pavement.....	10.0'

No trees, entrance gates or other obstructions, with the exception of traffic control and street name signs and mailboxes, are to be placed within these distances from the edge of the street.

It should be noted that the above setbacks are minimums based on the obstruction being located on a tangent. When an obstruction is located within a horizontal curve, the setback must be calculated using the equation:

$$R = \frac{S^2}{8M} \quad \text{where:}$$

- R = The radius of curvature at the centerline of the lane closest to the obstruction in ft.
- M = Distance from the centerline of the lane to the obstruction in ft.
- S = Stopping sight distance in ft.

Provided the above setbacks and sight distance requirements are met, trees may be retained or planted within the right-of-way for aesthetic or environmental purposes.

**5.2.17 Driveway Connections:** Driveway aprons that do not involve a curb cut are to abut the back of curb or valley gutter for no more than 25 feet, including the corner radius.

For all new construction, the builder or developer is to be responsible for construction of paved driveway aprons in accordance with an approved plan.

**5.2.18 Curb Cuts:** Curb cuts are to be made at all points of access for traffic generators such as shopping centers, apartment buildings and complexes, restaurants, warehouses and other commercial developments. Curb cuts are to be a maximum length of 25 feet plus twice the corner radius and shall not begin closer than one foot from the extension of a side property line.

**5.2.18.1 Encroachment Permits:** All curb cuts on existing County maintained streets require the submittal and approval of a Richland County encroachment permit application before construction begins. The application form may be obtained from the County Engineer's office.

All construction is the responsibility of the applicant.

**5.2.18.2 Sight Distance:** Entrances onto County maintained streets are to be made only at points where adequate corner sight distance is provided in accordance with Table II.

**5.2.19 Superelevation:** In general, superelevation is not required on streets in the County Road System. In situations involving rural or arterial roads where design speeds will exceed 45 MPH, however, superelevation may be required. In these cases, superelevation will be designed in accordance with the AASHTO Policy on Geometric Design of Highways and Streets.

**TABLE I**

Street Classification	Min. R/W Width (Ft.)	Min. Pave. Width (Ft.)	Min. Lane Width (Ft.)	Design Speed (MPH)
Rural	66(3)	22(2)	11	(1)
Minor Residential	50	20	10	25
Local Residential	50	24	12	25
Local Commercial	66	36	12	40
Collector	66	36	12	40
Industrial Service	66	36	12	40
Industrial Service	80	36(2)	12	40
Arterial	100	52	24	

(1) Determined in consultation with County Engineer

(2) Edge to Edge of Pavement

(3) May be reduced to 50' at the discretion of the County Engineer if the ground elevations at the 25' R/W line are no more than 0.85' above the proposed centerline elevation.

**TABLE II**

Street Classification	Stopping Site Dist. (Ft.)	Min. Curve Radius (Ft.)	Max. Grade (%)
Rural	*	*	12
Minor Residential	160	150	15
Local Residential	160	150	15
Local Commercial	275	350	12
Collector	275	350	12
Industrial Service	275	350	12
Industrial Service	275	350	12
Arterial	*	*	*

\* Dependent on design speed selected

**TABLE III: MINIMUM LENGTH OF CREST VERTICAL CURVES**

Algebraic Difference In Grades	For Stopping Sight Distances of:			
	160'	275'	300'	350'
4.0	---	200.0	250.0	350.0
5.0	40.0	270.0	321.4	437.5
6.0	86.7	324.1	385.7	525.0
7.0	120.0	378.1	450.0	612.5
8.0	145.0	432.1	514.3	700.0
9.0	164.6	486.2	578.6	787.5
10.0	182.9	540.2	642.9	875.0
11.0	201.1	594.2	707.1	962.5
12.0	219.1	648.2	771.4	1050.0
13.0	237.7	702.2	835.7	1137.5
14.0	256.0	756.3	900.0	1225.0
15.0	274.3	810.3	964.3	1312.5
16.0	292.6	864.3	1028.6	1400.0
17.0	310.9	918.3	1092.9	1487.5
18.0	329.1	972.3	1157.1	1575.0
19.0	347.4	1026.3	1221.4	1662.5
20.0	365.7	1080.4	1285.7	1750.0

THE STATE OF SOUTH CAROLINA )  
 )  
COUNTY OF RICHLAND )

TITLE TO REAL ESTATE  
*For Subdivision Streets*

KNOW ALL MEN BY THESE PRESENTS, That I (or we) \_\_\_\_\_ (the

“Grantor”) for and in consideration of the sum of One (\$1.00) Dollar to the Grantor paid by Richland County, South Carolina (the “Grantee”), the receipt whereof is hereby acknowledged, has granted, bargained, sold and released, and by these presents does grant, bargain, sell and release in fee simple absolute unto Richland County, South Carolina, its successors and assigns, all that certain real property comprising road rights-of-way, \_\_\_\_\_ feet in width, hereinafter described for the purpose of constructing, improving and/or maintaining streets or roads thereon:

**DESCRIPTION:**

**SPECIAL PROVISIONS:** The Grantor understands and acknowledges that said streets or roads were designed and constructed by the Grantor; that the streets or roads will tend to collect surface waters into artificial channels and cast same onto the lands adjoining said streets or roads in concentrated form; that the Grantee does not hold itself out to perform, nor does it have equipment and material or appropriations of money to adequately pipe and ditch the lands adjoining said streets or roads; and it is therefore agreed as one of the material considerations and inducements for acceptance of said streets or roads by the Grantee, that the Grantor does hereby assume all risks of loss, damage, destruction or claims, of every kind, present or future, suffered by the Grantor, his (her/their/its) heirs, assigns or successors in title resulting from the collection of surface water and casting of same onto said lands.

And the Grantor does hereby bind itself and its successors and assigns to save and hold harmless and release the Grantee, its successors and assigns, from all such losses, damages, destruction and claims hereinabove specified, and shall guarantee the herein described streets and roads and the accompanying drainage system for a period of three years from the date this Deed is recorded and shall make any and all repairs as become necessary in the sole judgment of the Grantee or its representative. The Grantee does hereby bind itself and its successors and assigns and agrees to maintain and repair said streets or roads in a reasonably good and workman like manner thereafter.

Together with all and singular the rights, members, hereditaments and appurtenances to the said premises belonging, or in anywise incident or appertaining.

**TO HAVE AND TO HOLD** in fee simple, absolute and singular, the said property and the rights hereinbefore granted, unto the Grantee, its successors and assigns forever.

And the Grantor does hereby bind itself and its successors and assigns, to warrant and forever defend all and singular the said premises unto the said Grantee, its successors and assigns, against it and its successors and assigns, and against every person whomsoever lawfully claiming or to claim the same, or any part thereof.

WITNESS the hand(s) and seal(s) of the Grantor(s) and Grantee this \_\_\_\_ day of

\_\_\_\_\_, 200\_\_.

IN THE PRESENCE OF:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

GRANTOR:

By: \_\_\_\_\_

GRANTEE:

By: \_\_\_\_\_

THE STATE OF SOUTH CAROLINA )  
 )  
COUNTY OF RICHLAND )

PROBATE  
(Grantor)

PERSONALLY appeared before me the undersigned witness, who, being duly sworn, says that (s)he saw the within-name Grantor by its officer(s) or partner(s) as its act and deed, sign, seal and deliver the within Deed; and that (s)he with the other witness whose signature appears above witnessed the execution thereof.

\_\_\_\_\_  
(Witness)

SWORN to before me this \_\_\_\_ day of \_\_\_\_\_, 200\_\_.

\_\_\_\_\_  
(Seal)  
Notary Public for South Carolina  
My Commission Expires: \_\_\_\_\_

THE STATE OF SOUTH CAROLINA )  
 )  
COUNTY OF RICHLAND )

PROBATE  
(Grantee)

PERSONALLY appeared before me the undersigned witness, who, being duly sworn, says that (s)he saw the County Administrator of Richland County, the County's duly authorized officer, sign, seal, and as the act and deed of the County of Richland, deliver the within written Instrument for the uses and purposes therein mentioned and that (s)he with the other above named witness witnessed the execution thereof.

\_\_\_\_\_  
(Witness)

SWORN to before me this \_\_\_\_ day of \_\_\_\_\_, 200\_\_.

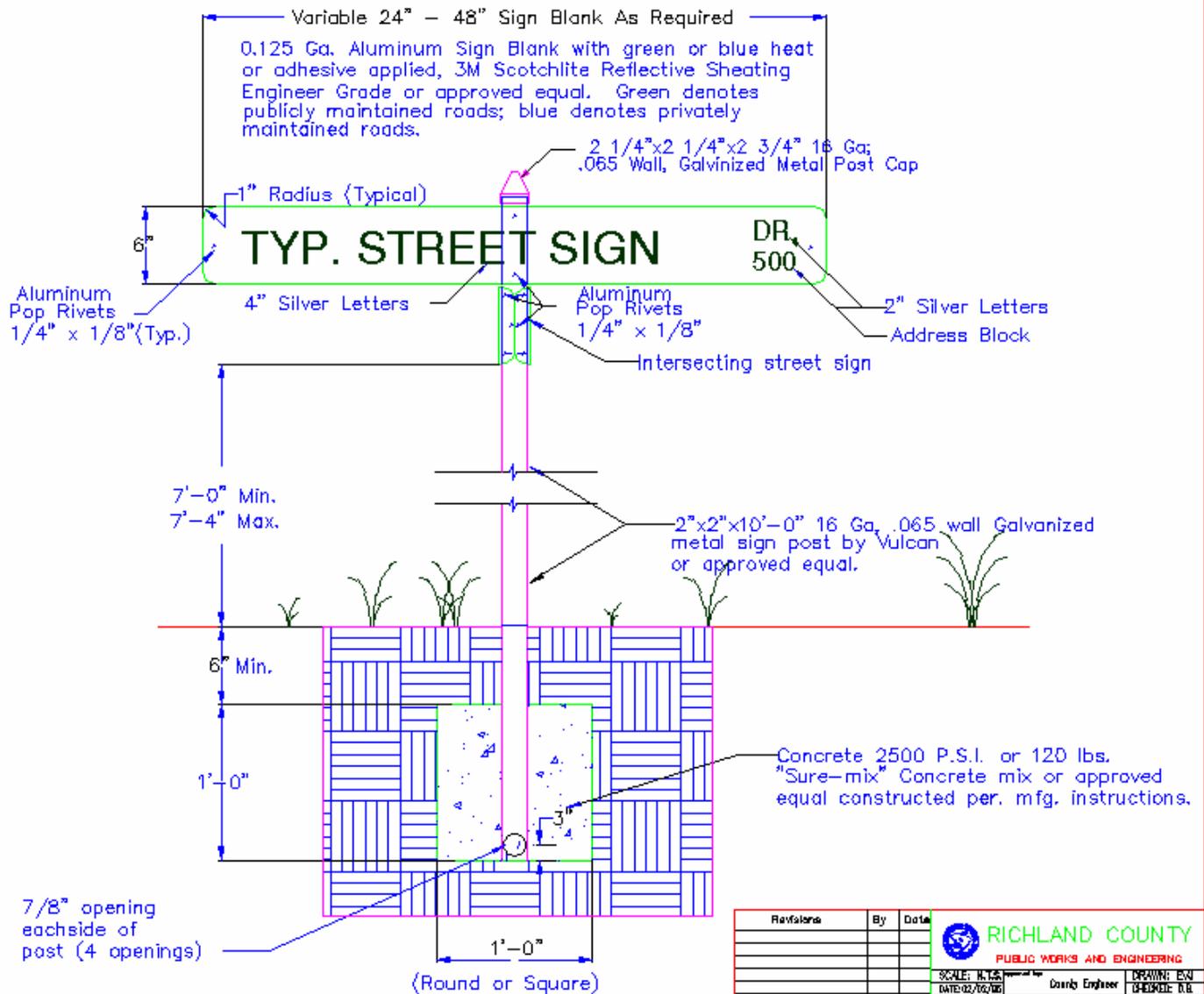
\_\_\_\_\_  
(Seal)  
Notary Public for South Carolina  
My Commission Expires: \_\_\_\_\_

# TYPICAL STREET SIGN DETAIL

Scale: 1 1/2" = 1'-0"

**General Notes:**

1. Submit sample of a completed sign (excluding concrete base) to the County Engineer's office for approval prior to installation.
2. All letters and numbers are to be silver 3M Scotchlite Reflective sheeting High Intensity Grade.



Revisions	By	Date

**RICHLAND COUNTY**  
PUBLIC WORKS AND ENGINEERING

SCALE: N.T.S. DATE: 02/06/06 County Engineer DRAWING: EW  
OF: B.R.E.

TYPICAL SUBMISSION ROAD SIGN DETAIL

DETAIL DRAWING: 1

## 5.3 Standard Details:

# Richland County Public Works Department

## 5.3.1 STANDARD STREET CROSS SECTIONS

DISCLAIMER: This is a product of the Richland County Department of Public Works. The standards depicted here have been developed with extensive cooperation from other county departments, as well as other federal, state and local government agencies. Reasonable efforts have been made to ensure the accuracy of these designs. Richland County expressly disclaims responsibility for damages or liability that may arise from the use of these designs.

PROPRIETARY INFORMATION: Any resale of this information is prohibited, except in accordance with a sublicensing agreement.

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Richland County Engineering  
400 Powell Rd.  
Columbia, SC 29203



# Richland County Public Works Department

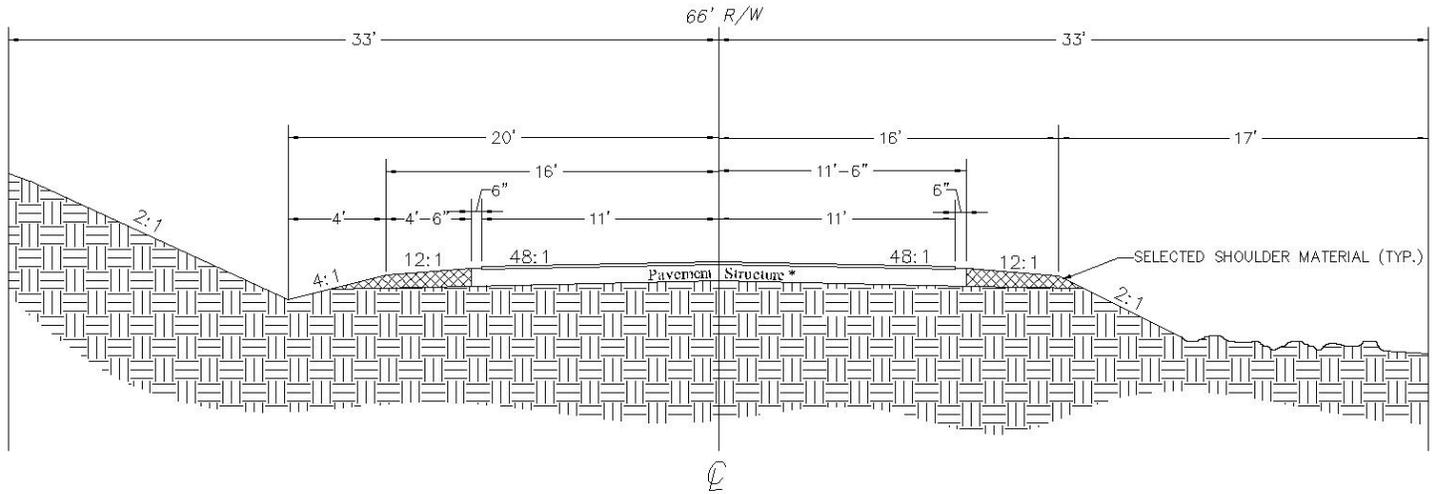
## Design Data for Standard Street Cross Sections

COEFFICIENTS OF RELATIVE STRENGTH					
PAVEMENT (UPPER 4" MAX)	COEFF	BASE COURSE	COEFF	SUBBASE	COEFF
Asphalt Concrete Surface Course	0.44	Earth Type Base Course (Top Soil)	0.12	Earth Type Subbase Course (top soil)	0.08
Asphalt Concrete Binder Course	0.44	Earth Type Base Course (Sand Clay)	0.15	Earth Type Subbase Course	0.10
		Macadam Base course	0.15	Soil Aggregate Subbase Course	0.10
		Cement Stabilized Earth Base Course	0.25	Cement Stabilized Earth Subbase	0.15
<b>OLD PAVEMENT</b>		Hot Laid Asphalt Base Course	0.24		
Asphalt Concrete Surface Course	0.26	Stabilized Aggregate Base Course	0.16	Old Base- 70% of original value	
Asphalt Concrete Binder Course	0.26	H.L. Asphalt Aggregate Base Course	0.34	Old Sub-Base 80% of original value	
Old Sand Asphalt	0.21	Cement Stabilized Aggregate Base Course	0.34		
Old Bituminous Surfacing	0.21	Old P.C.C. Pavement	0.40		

DESIGN DATA									
Types of Streets	Equiv. 18 <sup>K</sup> Load App's	Alternate 1		Alternate 2		Alternate 3		Alternate 4	
		S.S.V.	Min S.N.	S.S.V.	Min S.N.	S.S.V.	Min. S.N.	S.S.V.	Min. S.N.
Local Residential	6	1.5	2.80	2.5	2.50	3.5	2.12	5.5	1.56
Collector	24	1.5	3.55	2.5	3.08	3.5	2.69	5.5	2.00
Industrial Service	80	1.5	4.12	2.5	3.70	3.5	3.20	5.5	2.44
Local Commercial	80	1.5	4.12	2.5	3.70	3.5	3.20	5.5	2.44
Rural	6	1.5	2.80	2.5	2.50	3.5	2.12	5.5	1.56

Notes: (1) The minimum structural numbers (Min. S.N.) shown above are based on the soil support values (S.S.V.) and traffic loading (Equiv. 18<sup>K</sup> Load App's) shown. If these factors on a particular site differ significantly from the values shown, the pavement design must be adjusted accordingly.

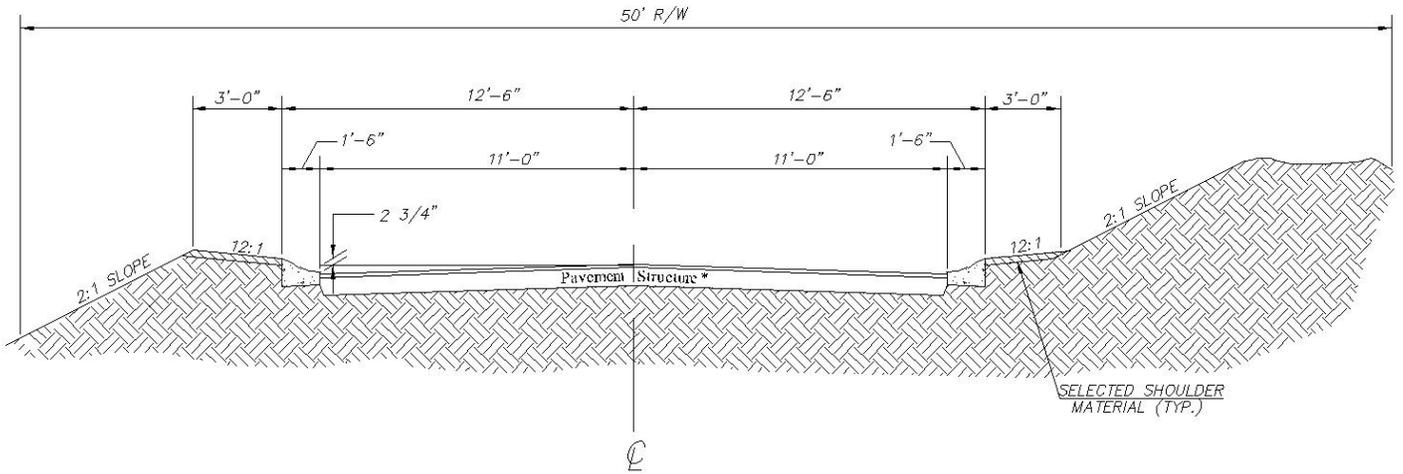
# 22' Farm-To-Market



## **RURAL (FARM-TO-MARKET)**

\* STRUCTURAL NUMBER AS PER DESIGN DATA TABLE

### 24' OG Curb

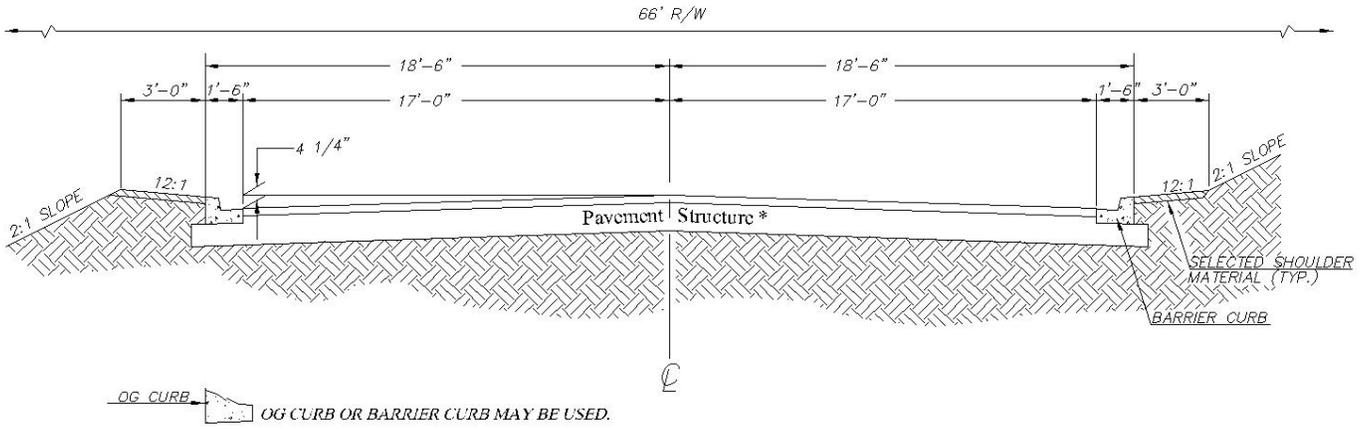


### LOCAL RESIDENTIAL STREET

\* STRUCTURAL NUMBER AS PER DESIGN DATA TABLE



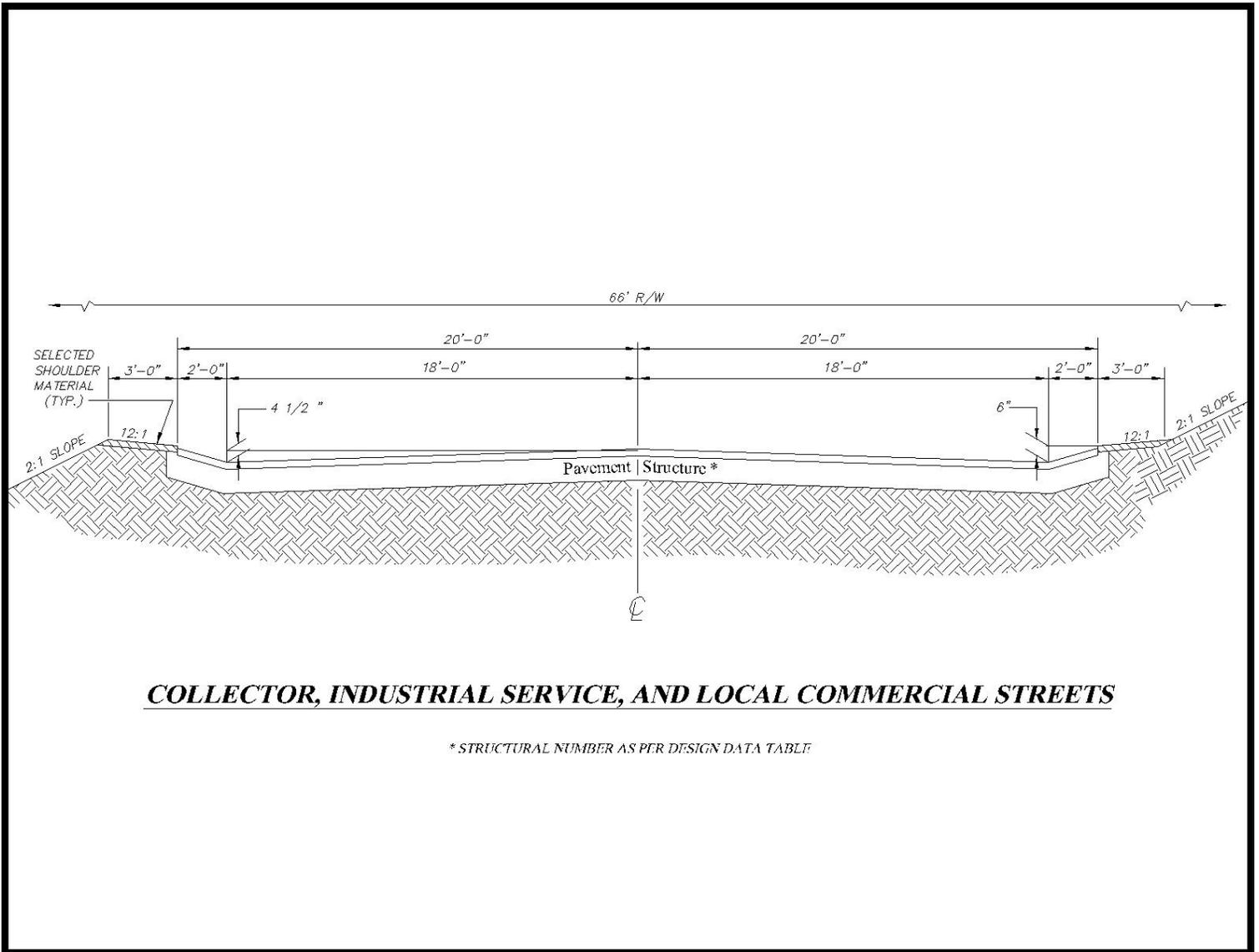
### 36' Curb Section



### COLLECTOR, INDUSTRIAL SERVICE, AND LOCAL COMMERCIAL STREETS

\* STRUCTURAL NUMBER AS PER DESIGN DATA TABLE

### 36' Valley Gutter



## **5.3.2 STANDARD CATCH BASIN DETAILS**

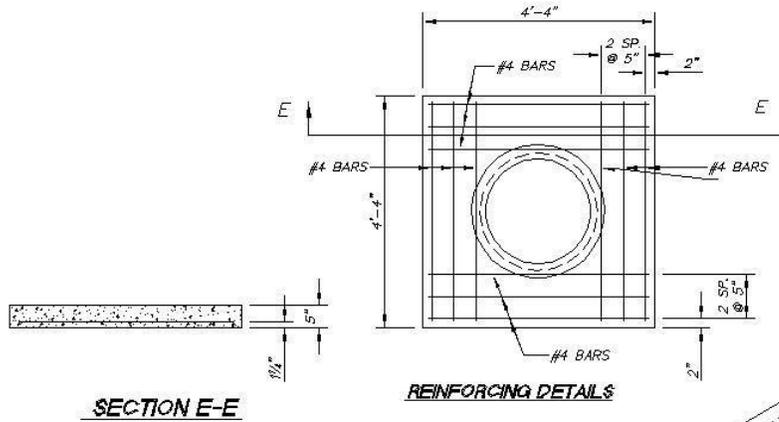
DISCLAIMER: This is a product of the Richland County Department of Public Works. The standards depicted here have been developed with extensive cooperation from other county departments, as well as other federal, state and local government agencies. Reasonable efforts have been made to ensure the accuracy of these designs. Richland County expressly disclaims responsibility for damages or liability that may arise from the use of these designs.

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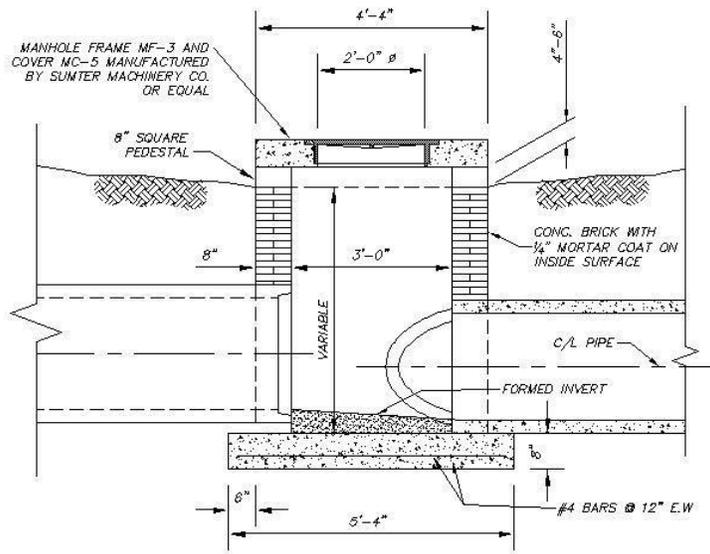
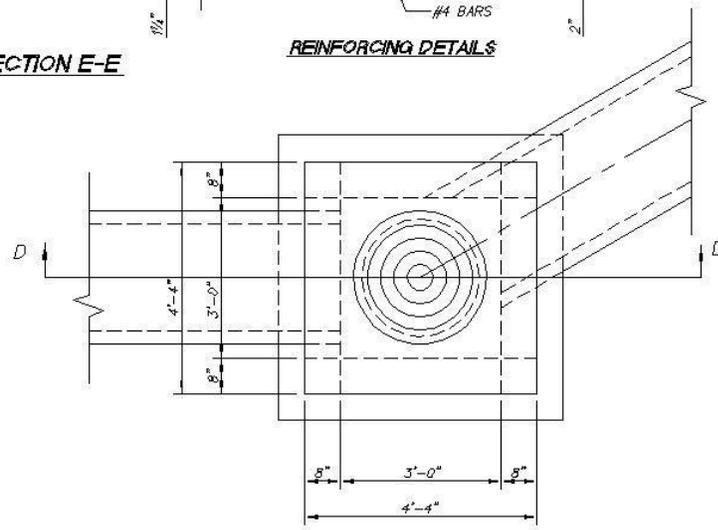
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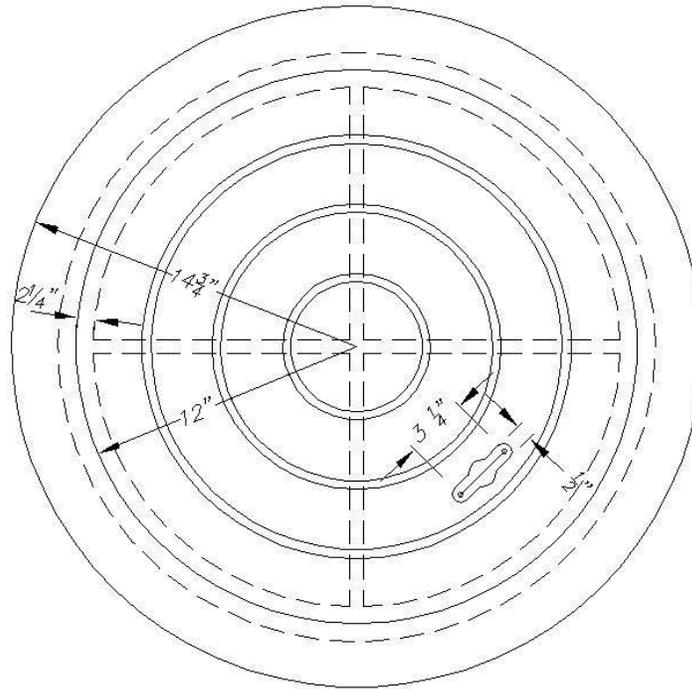


**SECTION E-E**

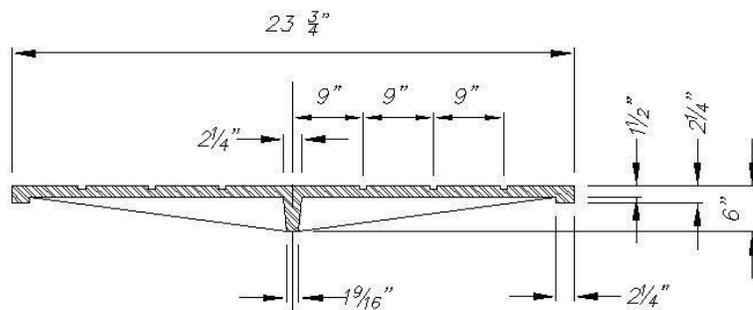


**TYPE B**

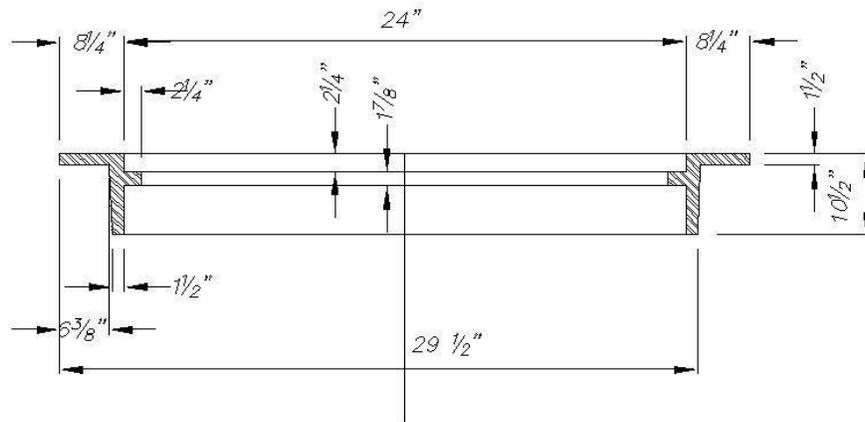
MAXIMUM Q = 10.6 CFS



**PLAN OF MANHOLE  
FRAME AND COVER**

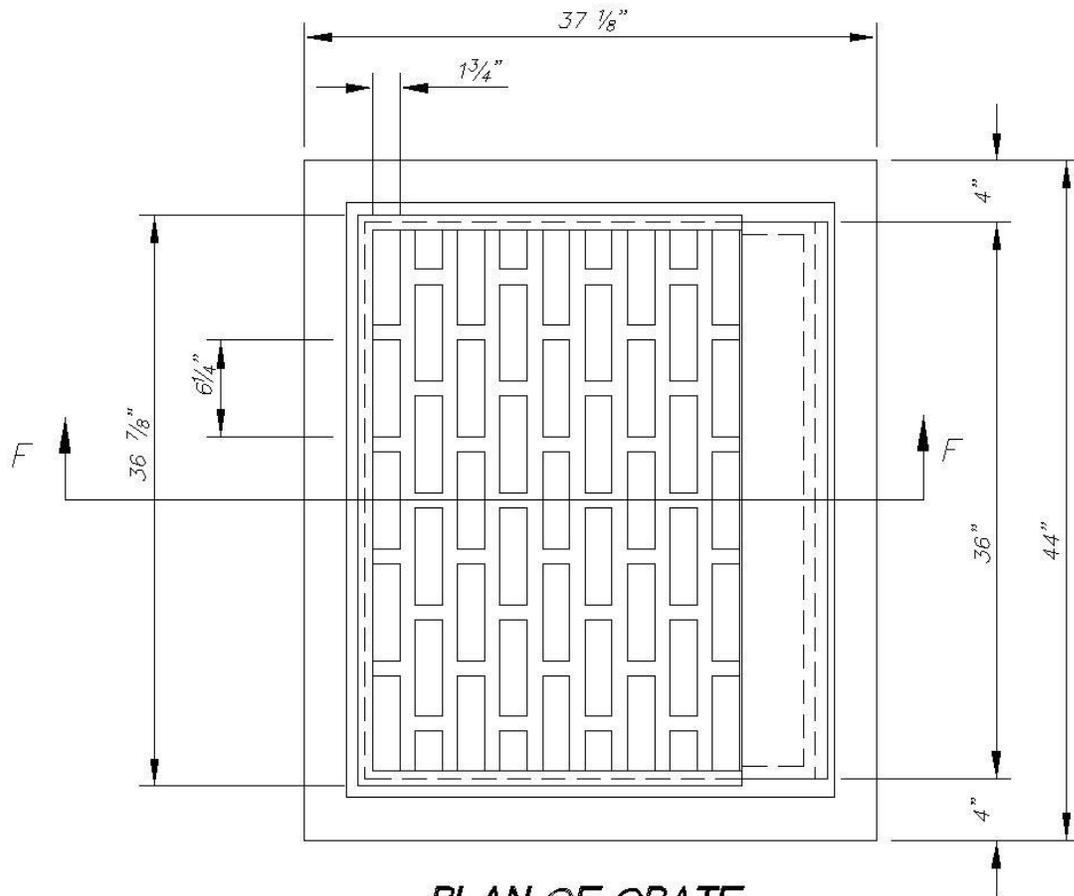


**SECTION THRU COVER**



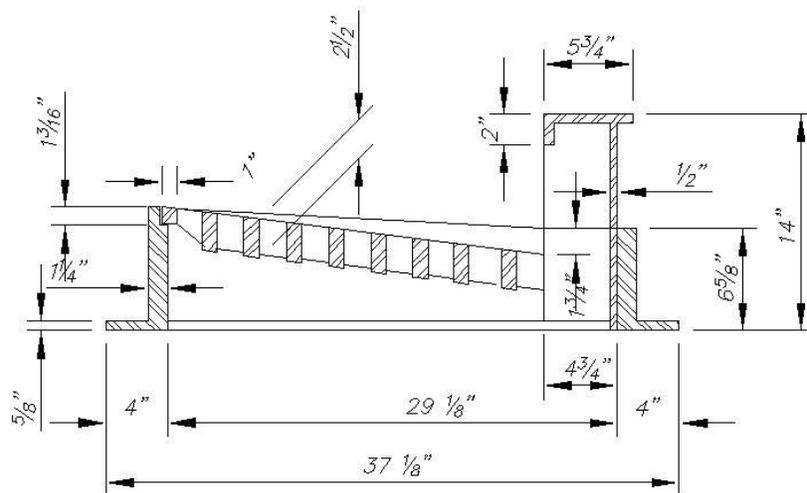
**SECTION THRU FRAME**

SCALE: 1/8" = 1'

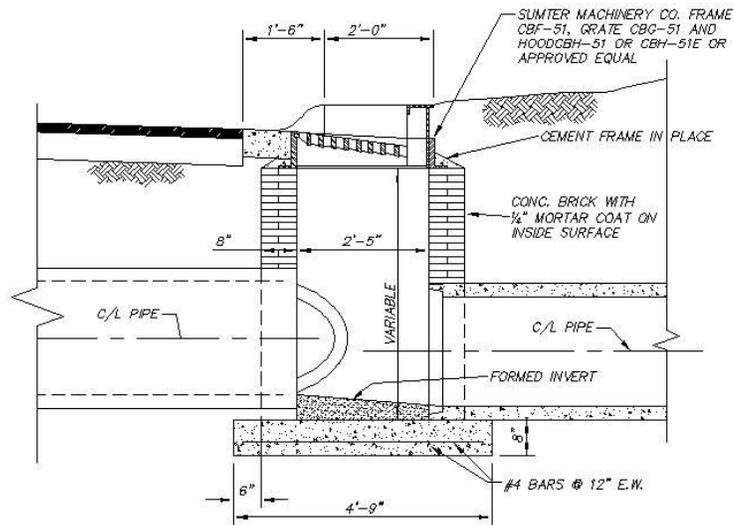
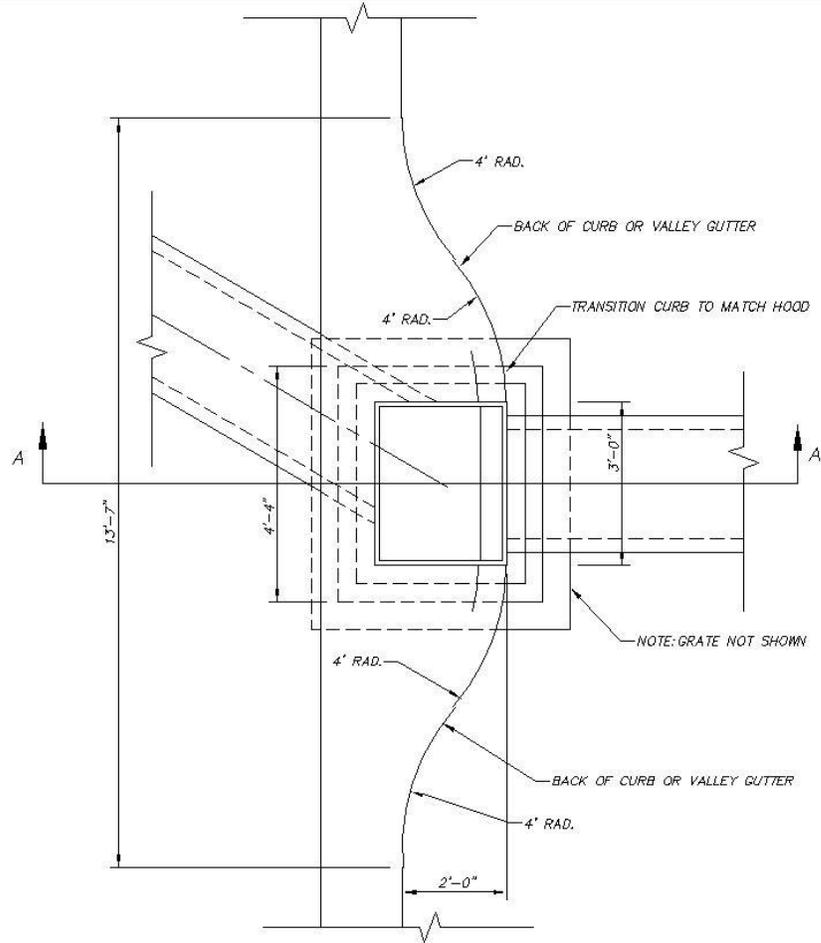


**PLAN OF GRATE,  
FRAME AND HOOD**

SCALE: 1/4" = 1'



**SECTION F-F**



**SECTION A-A**

**TYPE C**

**MAXIMUM Q = 9.4 CFS**

### **5.3.3 STANDARD HEAD WALL DETAILS**

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# 66" & 72" PIPE HEADWALLS

## SCHEDULE

### BARS IN ONE HEADWALL

66" PIPE						72" PIPE			
1 1/2:1 SLOPE		2:1 SLOPE		4:1 SLOPE		1 1/2:1 SLOPE		2:1 SLOPE	
MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.
A	21	A	24	A	44	A	20	A	26
B	2	B3	2	B6	2	B9	2	B12	2
B1	2	B4	2	B7	2	B10	2	B13	2
B2	1	B5	1	B8	1	B11	1	B14	1
C	2	C1	2	C6	2	C2	2	C3	2
C4	2	C6	2	C15	2	C5	2	C7	2
C8	2	C10	2	C17	2	C9	2	C12	2
C11	8	C14	8	C18	8	C13	8	C16	8
H	1	H2	1	H4	1	H6	1	H8	1
H1	1	H3	1	H5	1	H7	1	H9	1
P	4	P	4	P	4	P	4	P	4
V	4	V	6	V	10	V1	4	V1	6
V3	4	V4	4	V2	10	V4	4	V5	4
V7	4	V7	4	V6	10	V9	4	V8	6
V11	4	V10	6	V10	10	V12	6	V12	6

### SIZES OF STRAIGHT BARS

MARK	SIZE	LENGTH
A	1/2"φ	3'-3"
C	1/2"φ	1'-8"
C1	"	2'-2"
C2	"	2'-6"
C3	"	2'-9"
C4	"	3'-6"
C5	"	4'-4"
C6	"	4'-5"
C7	"	5'-2"
C8	"	5'-4"
C9	"	6'-2"
C10	"	6'-10"
C11	"	7'-3"
C12	"	7'-7"
C13	"	8'-2"
C14	"	9'-2"
C15	"	9'-3"
C16	"	10'-2"
C17	"	14'-2"
C18	"	19'-2"
P	1/2"φ	2'-1"

### DIMENSIONS AND QUANTITIES

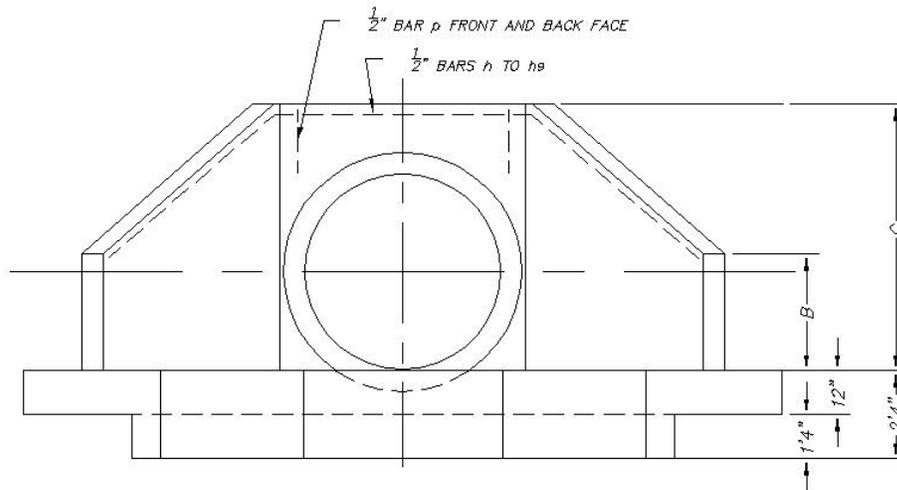
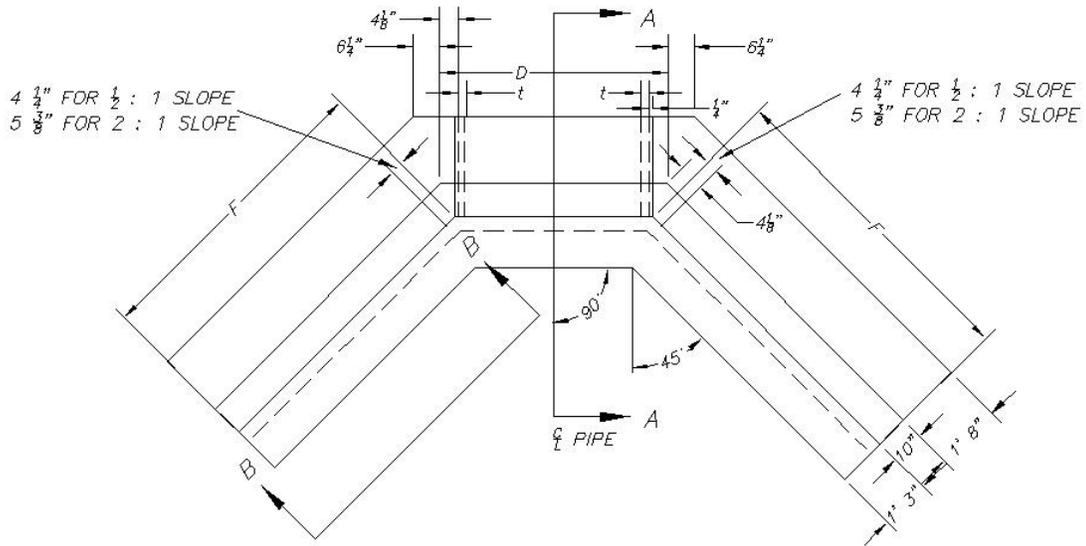
INSIDE DIAMETER OF PIPE	SLOPE OF FILL	DIMENSIONS					2 HEADWALLS	
		B	C	D	F	T	CLASS "A" CONCRETE	STEEL REINFORCEMENT
							CUBIC YDS.	LBS.
66"	1 1/2:1	3'-2"	7'-0 1/2"	7'-3 3/4"	7'-5 1/8"	6 1/2"	14.58	574
	2:1	3'-2"	7'-0 1/2"	7'-3 3/4"	9'-9 3/4"	6 1/2"	17.76	700
	4:1	3'-2"	7'-0 1/2"	7'-3 3/4"	19'-4 3/8"	6 1/2"	31.12	1308
72"	1 1/2:1	3'-5"	7'-7"	7'-10 3/4"	8'-0 5/8"	7"	16.34	620
	2:1	3'-5"	7'-7"	7'-10 3/4"	10'-7 3/4"	7"	20.06	788

### DIMENSIONS OF BENT BARS

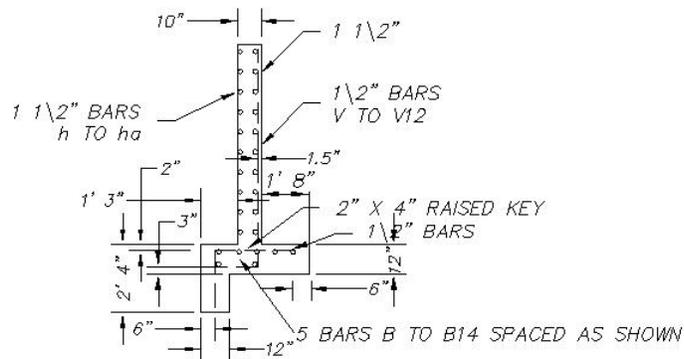
MARK	A	B	TOTAL LENGTH
B	6'-0 1/2"	7'-5 1/8"	20'-10 3/4"
B1	7'-1 3/4"	7'-11 3/4"	23'-1 3/4"
B2	8'-3 3/4"	8'-6 3/4"	25'-5 1/4"
B3	6'-0 1/2"	9'-9 3/4"	25'-8"
B4	7'-1 3/4"	10'-4 3/8"	27'-10 1/2"
B5	8'-3 3/4"	10'-11 3/8"	30'-2 1/2"
B6	6'-0 1/2"	19'-4 3/8"	44'-9 1/4"
B7	7'-1 3/4"	19'-11 1/4"	46'-11 3/4"
B8	8'-3 3/4"	20'-6"	49'-3 3/4"
B9	6'-2 3/4"	7'-5 7/8"	21'-2 1/2"
B10	7'-3 3/4"	8'-0 3/8"	23'-4"
B11	8'-5 3/4"	8'-7 3/8"	25'-8"
B12	6'-2 3/4"	10'-1"	26'-4 3/4"
B13	7'-3 3/4"	10'-7 1/2"	28'-4 3/4"
B14	8'-5 3/4"	11'-2 1/2"	30'-10 3/4"

MARK	C	TOTAL LENGTH
V	3'-8"	5'-6"
V1	4'-11"	5'-9"
V2	4'-8"	6'-6"
V3	4'-8"	6'-7"
V4	5'-0"	6'-10"
V5	5'-2"	7'-0"
V6	5'-4"	7'-6"
V7	5'-10"	7'-8"
V8	6'-0"	7'-10"
V9	6'-1"	7'-11"
V10	6'-8"	8'-6"
V11	7'-0"	8'-10"
V12	7'-2"	9'-0"

MARK	A	B	TOTAL LENGTH
H	7'-0 1/2"	8'-3"	23'-6 1/2"
H1	7'-5 1/2"	8'-5 1/2"	24'-4 1/2"
H2	7'-0 1/2"	10'-0"	27'-0 1/2"
H3	7'-5 1/2"	10'-2 1/2"	27'-10 1/2"
H4	7'-0 1/2"	19'-6"	46'-0 1/2"
H5	7'-5 1/2"	19'-8 1/2"	46'-10 1/2"
H6	7'-7 1/2"	8'-6"	24'-7 1/2"
H7	8'-0 1/2"	8'-8 1/2"	25'-5 1/2"
H8	7'-7 1/2"	10'-10"	29'-3 1/2"
H9	8'-0 1/2"	11'-0 1/2"	30'-1 1/2"



END ELEVATION



TYPICAL WING SECTION

66" & 72" PIPE HEADWALLS



# 48", 54" & 60" PIPE HEADWALLS

## DIMENSIONS OF BENT BARS

5/8"Ø BARS V TO V42		
MARK	C	TOTAL LENGTH
V	2'-10"	4'-9"
V1	3'-1"	5'-0"
V2	3'-3"	5'-2"
V3	3'-4"	5'-3"
V4	3'-5"	5'-4"
V5	3'-6"	5'-5"
V6	3'-7"	5'-6"
V7	3'-8"	5'-7"
V8	3'-9"	5'-8"
V9	3'-10"	5'-9"
V10	3'-11"	5'-10"
V11	4'-0"	5'-11"
V12	4'-1"	6'-0"
V13	4'-2"	6'-1"
V14	4'-3"	6'-2"
V15	4'-4"	6'-3"
V16	4'-5"	6'-4"
V17	4'-6"	6'-5"
V18	4'-7"	6'-6"
V19	4'-8"	6'-8"
V20	4'-10"	6'-9"
V21	5'-0"	6'-11"
V22	5'-1"	7'-0"
V23	5'-2"	7'-1"
V24	5'-3"	7'-2"
V25	5'-4"	7'-3"
V26	5'-5"	7'-4"
V27	5'-6"	7'-5"
V28	5'-7"	7'-6"
V29	5'-8"	7'-7"
V30	5'-9"	7'-8"
V31	5'-10"	7'-9"
V32	5'-11"	7'-10"
V33	6'-0"	7'-11"
V34	6'-1"	8'-0"
V35	6'-2"	8'-1"
V36	6'-3"	8'-2"
V37	6'-4"	8'-3"
V38	6'-5"	8'-4"
V39	6'-6"	8'-5"
V40	6'-8"	8'-7"
V41	6'-9"	8'-8"
V42	6'-10"	8'-9"

5/8"Ø BARS H TO H8			
MARK	A	B	TOTAL LENGTH
H	5'-3"	5'-8"	16'-7"
H1	5'-3"	7'-2"	19'-7"
H2	5'-3"	13'-6"	32'-3"
H3	5'-11"	6'-5"	8'-9"
H4	5'-11"	8'-2"	22'-3"
H5	5'-11"	15'-9"	37'-5"
H6	6'-5"	7'-3"	20'-11"
H7	6'-5"	13'-7"	33'-7"
H8	6'-5"	26'-5"	59'-3"

## DIMENSIONS AND QUANTITIES

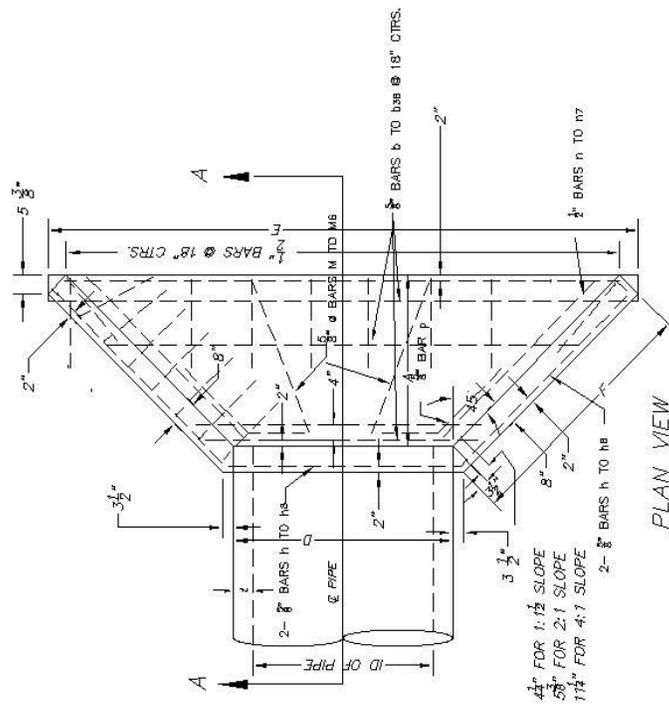
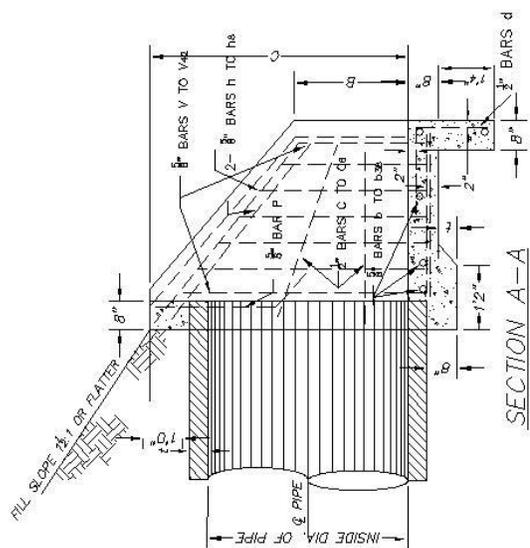
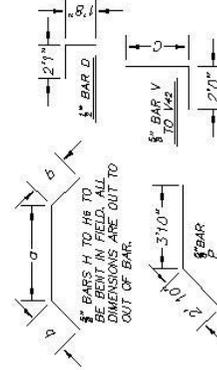
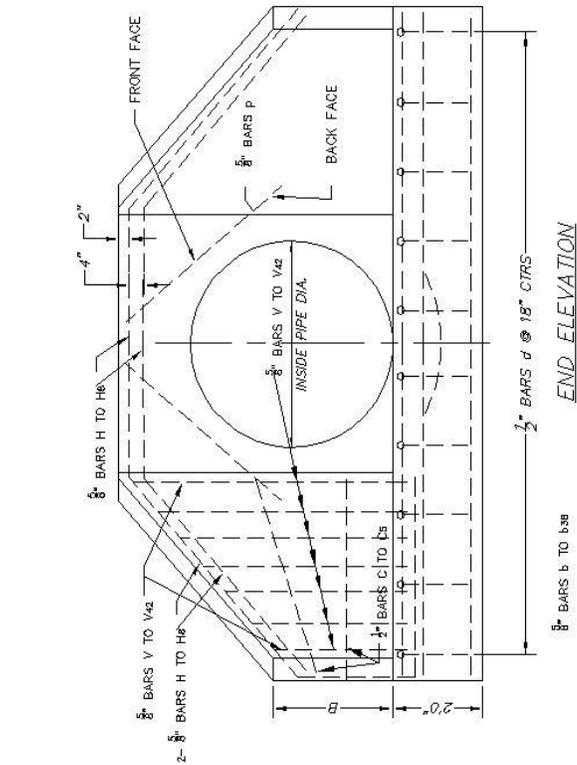
INSIDE DIAMETER OF PIPE	SLOPE OF FILL	DIMENSIONS							CLASS "A" CONCRETE HEADWALLS	STEEL REINFORCEMENT HEADWALLS
		A	B	C	D	E	F	T		
48"	1 1/2:1	3'-9"	2'-5"	5'-5"	4'-10"	13'-3"	5'-3 1/2"	5"	5.86	414
	2:1	4'-11 3/4"	2'-5"	5'-5"	4'-10"	15'-8 3/4"	7'-0 1/2"	5"	7.84	522
	4:1	6'-11 1/2"	2'-5"	5'-5"	4'-10"	25'-8 1/2"	14'-1"	5"	16.50	1042
54"	1 1/2:1	4'-2 1/4"	2'-8"	5'-11 1/2"	5'-5"	14'-10"	5'-11 1/4"	5 1/2"	7.28	516
	2:1	5'-7"	2'-8"	5'-11 1/2"	5'-5"	17'-7 1/4"	7'-10 3/4"	5 1/2"	9.60	660
	4:1	11'-2"	2'-8"	5'-11 1/2"	5'-5"	28'-8 1/4"	15'-6 1/2"	5 1/2"	20.86	1272
60"	1 1/2:1	4'-7 1/8"	2'-11"	6'-8"	6'-0"	16'-2 1/4"	6'-6 1/2"	6"	7.70	582
	2:1	6'-1 7/8"	2'-11"	6'-8"	6'-0"	19'-3 1/8"	8'-8 3/4"	6"	10.30	1020
	4:1	12'-3 3/4"	2'-11"	6'-8"	6'-0"	31'-6 7/8"	17'-5 1/8"	6"	22.85	2108

## SIZES OF STRAIGHT BARS

MARK	SIZE	LENGTH
B	5/8"	6'-7"
B1	"	7'-3"
B2	"	7'-10"
B3	"	8'-0"
B4	"	8'-8"
B5	"	9'-2"
B6	"	9'-9"
B7	"	10'-4"
B8	"	10'-10"
B9	"	11'-3"
B10	"	12'-0"
B11	"	12'-2"
B12	"	12'-4"
B13	"	12'-10"
B14	"	13'-5"
B15	"	13'-10"
B16	"	14'-3"
B17	"	14'-7"
B18	"	15'-0"
B19	"	15'-9"
B20	"	16'-0"
B21	"	16'-10"
B22	"	17'-3"
B23	"	17'-6"
B24	"	19'-10"
B25	"	20'-0"
B26	"	20'-3"
B27	"	20'-9"
B28	"	22'-4"
B29	"	22'-11"
B30	"	24'-0"
B31	"	25'-3"
B32	"	26'-5"
B33	"	26'-0"
B34	"	26'-11"
B35	"	32'-0"
B36	"	36'-0"
B37	"	40'-0"
B38	"	43'-8"
C	1/2"	5'-3"
C1	"	6'-3"
C2	"	7'-9"
C3	"	13'-2"
C4	"	15'-1"
C5	"	26'-2"
M	5/8"	4'-6"
M1	"	5'-0"
M2	"	5'-6"
M3	"	8'-0"
M4	"	10'-0"
M5	"	11'-0"
M6	"	19'-6"
N	1/2"	4'-0"
N1	"	4'-9"
N2	"	5'-9"
N3	"	8'-9"
N4	"	11'-8"
N5	"	12'-8"
N6	"	14'-9"
N7	"	24'-6"

## BARS IN ONE HEADWALL

48" PIPE						54" PIPE						60" PIPE					
1 1/2:1 SLOPE		2:1 SLOPE		4:1 SLOPE		1 1/2:1 SLOPE		2:1 SLOPE		4:1 SLOPE		1 1/2:1 SLOPE		2:1 SLOPE		4:1 SLOPE	
MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.
B	1	B	1	B	1	B1	1	B1	1	B3	1	B2	1	B2	1	B2	1
B1	1	B1	1	B1	1	B3	1	B3	1	B3	1	B4	1	B4	1	B4	1
B7	1	B8	1	B8	1	B5	1	B5	1	B9	1	B12	1	B14	1	B10	1
B13	2	B13	1	B15	1	B11	1	B11	1	B16	1	B19	2	B23	1	B20	1
		B19	2	B21	1	B17	2	B19	1	B22	1			B27	1	B25	1
				B24	1			B26	1					B31	2	B30	1
				B29	1			B28	1					B32	1	B33	1
				B31	2			B32	1					B34	2	B35	1
								B34	2							B36	1
																B37	1
																B38	2
C	4	C1	4	C3	4	C	4	C2	4	C4	4	C1	4	C3	4	C5	4
D	8	D	10	D	17	D	11	D	12	D	19	D	11	D	13	D	21
H	2	H1	2	H2	2	H3	2	H4	2	H5	2	H6	2	H7	2	H8	2
		M1	2	M4	2	M	2	M2	2	M5	2	M	2	M3	2	M8	2
N	2	N2	2	N5	2	N1	2	N3	2	N6	2	N2	2	N4	2	N7	2
						P	2	P	2	P	2	P	2	P	2	P	2
V	2	V	2	V	2	V7	2	V7	2	V7	2	V3	2	V3	2	V2	2
V5	2	V3	2	V7	2	V8	2	V8	2	V2	2	V10	2	V6	2	V4	2
V13	2	V9	2	V3	2	V18	2	V12	2	V5	2	V17	2	V9	2	V8	2
V20	2	V15	2	V8	2	V21	2	V17	2	V8	2	V22	2	V13	2	V7	2
V27	2	V20	2	V9	2	V29	2	V21	2	V11	2	V29	2	V16	2	V9	2
V30	2	V25	2	V12	2	V36	2	V27	2	V14	2	V36	2	V19	2	V17	2
		V31	2	V15	2			V32	2	V17	2	V42	2	V21	2	V13	2
				V18	2			V19	2					V25	2	V15	2
				V20	2			V21	2					V28	2	V16	2
				V22	2			V23	2					V31	2	V18	2
				V25	2			V26	2					V35	2	V19	2
				V28	2			V29	2					V39	2	V20	2
				V30	4			V31	2					V41	4	V21	2
								V35	2							V23	2
								V37	4							V24	2
																V26	2
																V28	2
																V29	2
																V31	2
																V33	2
																V34	2
																V36	2
																V39	2
																V39	2
																V40	2
																V42	4



4 1/4" FOR 1:1 1/2 SLOPE  
 5 3/8" FOR 2:1 SLOPE  
 1 1/4" FOR 4:1 SLOPE

48", 54" & 60" PIPE HEADWALLS

## 30", 36" & 42" PIPE HEADWALLS

### DIMENSIONS AND QUANTITIES

INSIDE DIAMETER OF PIPE	SLOPE OF FILL	DIMENSIONS							CLASS "A" CONCRETE 2 HEADWALLS	STEEL REINFORCEMENT 2 HEADWALLS
		A	B	C	D	E	F	T		
30"	1 1/2 : 1	2'-5 3/4"	1'-8"	3'-9 1/2"	3'-1"	8'-10 1/2"	3'-5 1/2"	3 1/2"	3.02	254
	2 : 1	3'-3"	1'-8"	3'-9 1/2"	3'-1"	10'-6"	4'-7"	3 1/2"	3.98	306
	4 : 1	6'-5 3/4"	1'-8"	3'-9 1/2"	3'-1"	16'-11 1/2"	9'-2"	3 1/2"	7.78	634
36"	1 1/2 : 1	2'-10 1/2"	1'-11"	4'-4"	3'-8"	10'-4 1/2"	4'-0 1/2"	4"	3.76	318
	2 : 1	3'-9 3/4"	1'-11"	4'-4"	3'-8"	12'-3"	5'-4 1/2"	4"	4.98	372
	4 : 1	7'-7 3/4"	1'-11"	4'-4"	3'-8"	19'-10 1/2"	10'-9 3/4"	4"	10.48	738
42"	1 1/2 : 1	3'-3"	2'-2"	4'-10 1/2"	4'-3"	11'-8"	4'-8 1/2"	4 1/2"	4.76	348
	2 : 1	4'-4"	2'-2"	4'-10 1/2"	4'-3"	13'-10"	6'-1 1/2"	4 1/2"	6.14	466
	4 : 1	8'-8"	2'-2"	4'-10 1/2"	4'-3"	23'-1"	12'-2 1/2"	4 1/2"	13.10	934

### SIZES OF STRAIGHT BARS

MARK	SIZE	LENGTH
B	5/8"φ	4'-9"
B1	"	5'-5"
B2	"	6'-0"
B3	"	6'-7"
B4	"	6'-11"
B5	"	7'-8"
B6	"	8'-1"
B7	"	8'-3"
B8	"	8'-5"
B9	"	8'-8"
B10	"	8'-11"
B11	"	9'-3"
B12	"	9'-10"
B13	"	10'-0"
B14	"	10'-6"
B15	"	11'-1"
B16	"	11'-4"
B17	"	11'-9"
B18	"	13'-5"
B19	"	13'-7"
B20	"	14'-2"
B21	"	15'-2"
B22	"	16'-1"
B23	"	16'-6"
B24	"	18'-5"
B25	"	19'-8"
B26	"	22'-0"
C	1/2"φ	3'-2"
C1	"	4'-3"
C2	"	5'-2"
C3	"	6'-3"
C4	"	8'-1"
C5	"	10'-2"
C6	"	12'-2"
N	5/8"φ	9'-6"
N1	"	11'-0"
N2	"	12'-6"
N	1/2"φ	2'-0"
N1	"	3'-0"
N2	"	4'-0"
N3	"	5'-0"
N4	"	6'-0"
N5	"	9'-0"
N6	"	11'-0"

### BARS IN ONE HEADWALL

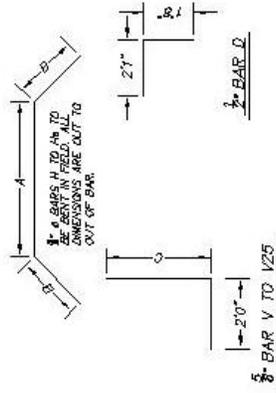
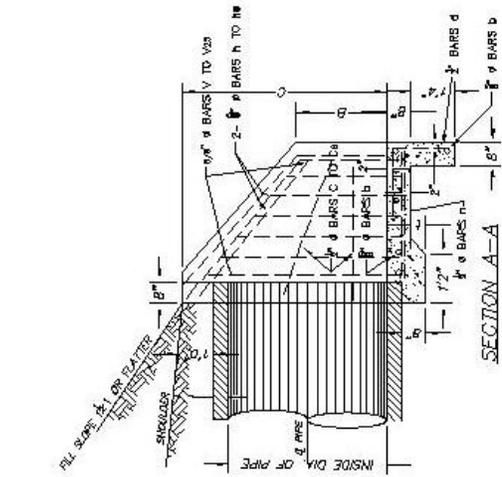
30" PIPE						36" PIPE						42" PIPE					
1 1/2:1		2:1		4:1		1 1/2:1		2:1		4:1		1 1/2:1		2:1		4:1	
MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.	MARK	NO.
B	1	B	1	B	1	B1	1	B1	1	B1	1	B2	1	B2	1	B2	1
B1	1	B1	1	B6	1	B2	1	B2	1	B2	1	B3	1	B3	1	B3	1
B4	1	B5	1	B15	1	B6	1	B10	1	B7	1	B10	1	B9	1	B7	1
B8	2	B13	2	B20		B12	2	B17	2	B9	1	B16	2	B17	1	B14	1
				B23	2					B20	1		B18	2	B19	1	
										B22	1				B23	1	
										B24	2				B25	1	
															B26	2	
C	4	C1	4	C4	4	C1	4	C2	4	C5	4	C1	4	C3	4	C6	4
D	6	D	7	D	11	D	7	D	8	D	13	D	8	D	9	D	15
H	2	H1	2	H2	2	H3	2	H4	2	H5	2	H6	2	H7	2	H8	2
				M	2					M1	2					M2	2
N	2	N1	2	N4	2	N1	2	N2	2	N5	2	N1	2	N3	2	N6	2
V	2	V	2	V	2	V1	2	V1	2	V1	2	V3	2	V3	2	V3	2
V4	2	V3	2	V1	2	V6	2	V5	2	V2	2	V6	2	V7	2	V4	2
V10	2	V7	2	V3	2	V13	2	V9	2	V4	2	V15	2	V12	2	V6	2
V17	2	V12	2	V5	2	V19	2	V14	2	V6	2	V20	2	V16	2	V6	2
						V21	2	V19	2	V6	2	V24	2	V20	2	V11	2
				V3	2			V22	2	V11	2			V23	2	V13	2
				V12	2			V13	2	V13	2			V25	2	V16	2
				V14	2			V16	2							V18	2
				V17	4			V18	2							V20	2
								V20	2							V22	2
								V22	2							V23	2
																V25	4

### DIMENSIONS OF BENT BARS

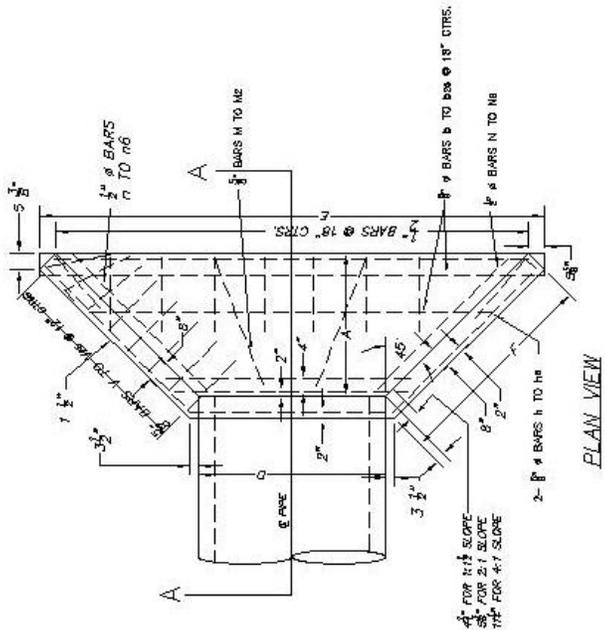
5/8"φ BARS H TO H8			
MARK	A	B	TOTAL LENGTH
H	3'-6"	4'-0"	11'-6"
H1	3'-6"	5'-1"	13'-8"
H2	3'-6"	10'-0"	23'-6"
H3	4'-1"	4'-8"	13'-5"
H4	4'-1"	5'-11"	15'-11"
H5	4'-1"	11'-8"	27'-5"
H6	4'-8"	5'-4"	15'-4"
H7	4'-8"	6'-10"	18'-4"
H8	4'-8"	13'-6"	31'-8"

5/8"φ BARS V TO V16		
MARK	C	TOTAL LENGTH
V	2'-1"	4'-0"
V1	2'-4"	4'-3"
V2	2'-6"	4'-5"
V3	2'-7"	4'-6"
V4	4'-9"	4'-8"
V5	2'-10"	4'-9"
V6	3'-0"	4'-11"
V7	3'-1"	5'-0"
V8	3'-3"	5'-2"
V9	3'-4"	5'-3"
V10	3'-5"	5'-4"
V11	3'-6"	5'-5"
V12	3'-7"	5'-6"
V13	3'-8"	5'-8"
V14	3'-10"	5'-9"
V15	3'-11"	5'-10"
V16	4'-0"	5'-11"

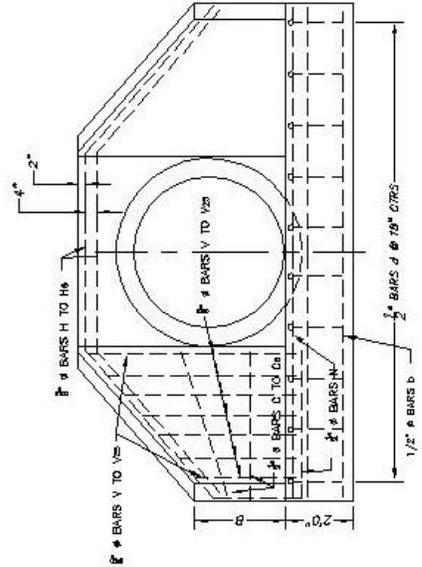
5/8"φ BARS V17 TO V25		
MARK	C	TOTAL LENGTH
V17	4'-1"	6'-0"
V18	4'-3"	6'-2"
V19	4'-4"	6'-3"
V20	4'-6"	6'-5"
V21	4'-8"	6'-7"
V22	4'-9"	6'-8"
V23	5'-0"	6'-11"
V24	5'-2"	7'-1"
V25	5'-3"	7'-2"



BENT BAR DETAIL



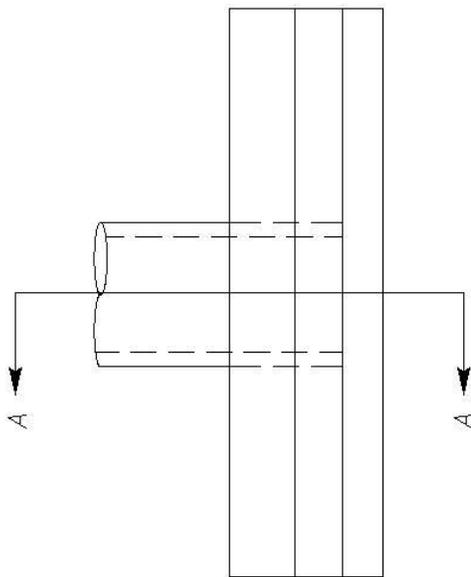
PLAN VIEW



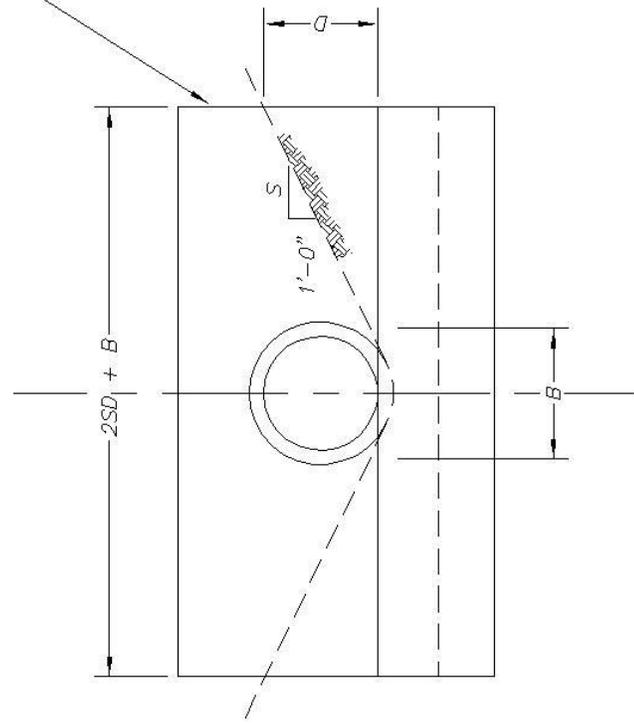
30", 36" & 42" PIPE HEADWALLS

NOTES:

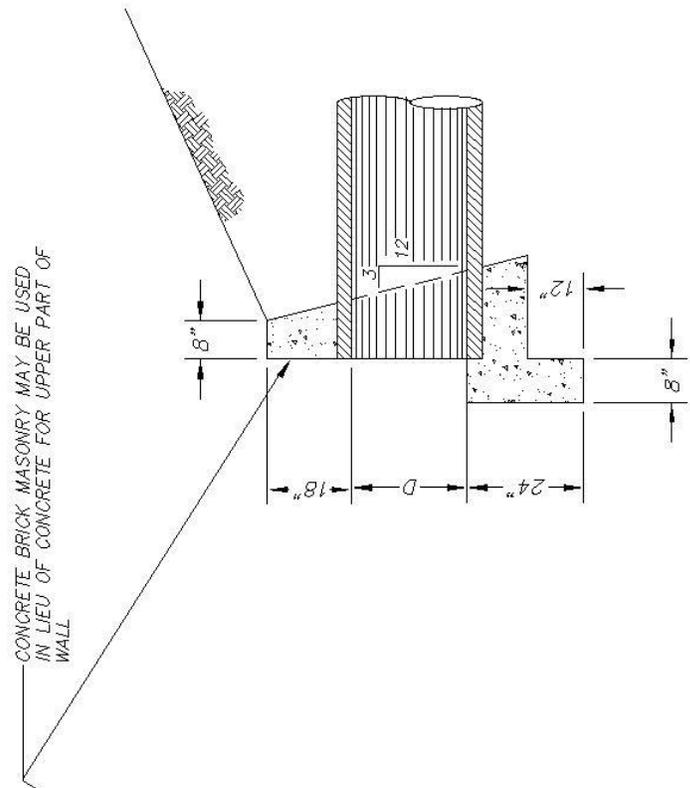
- (1) CONCRETE FOR HEADWALLS TO BE CLASS "A" ( $F'c=3000$  PSI).
- (2) REINFORCING STEEL SHALL COMPLY WITH ASTM A 615.
- (3) PRECAST CONCRETE HEADWALLS MAY BE USED IN LIEU OF CAST IN PLACE OF CONCRETE. SHOP DRAWINGS TO BE SUBMITTED TO THE ENGINEER AND APPROVED BEFORE USE.
- (4) CAST IN PLACE CONCRETE TO BE CONSTRUCTED IN ACCORDANCE WITH SECTION 702 OF THE S.C. DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION STANDARD SPECIFICATIONS (LATEST EDITION).
- (5) ALL EXPOSED CONCRETE EDGES TO BE CHAMFERED  $3/4$  INCH EXCEPT WHERE NOTED.



PLAN



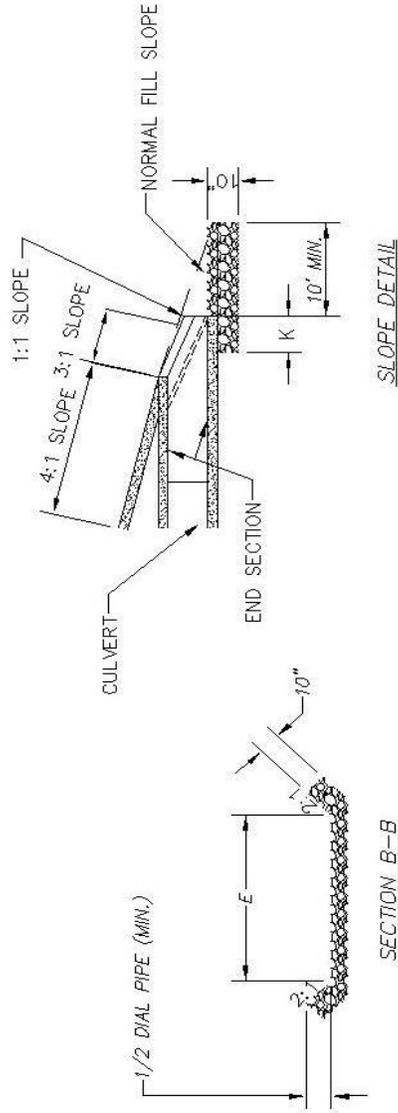
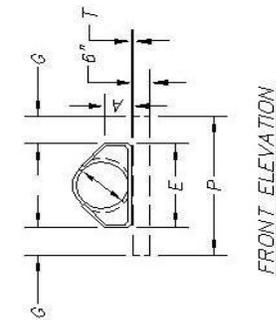
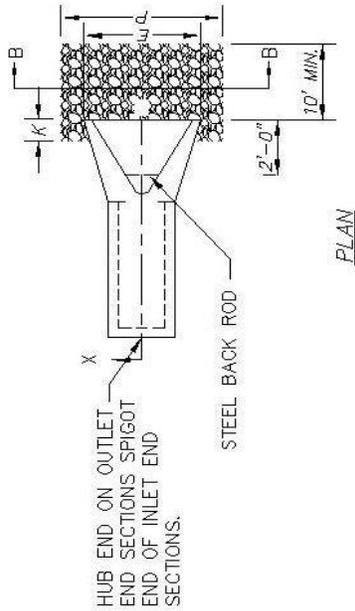
END ELEVATION



SECTION A-A

15", 18" & 24" PIPE HEADWALL

RIP RAP (6"-10" STONES)  
 BROKEN CONCRETE USED ONLY AS APPROVED BY THE ENGINEER.  
 STONES SHALL VARY IN WEIGHT FROM 5 TO 200LBS.  
 AT LEAST 30% OF THE TOTAL WEIGHT OF THE RIP RAP SHALL BE  
 IN INDIVIDUAL PIECES WEIGHING A MINIMUM OF 60LBS. EACH.  
 NOT MORE THAN 10% OF THE TOTAL WEIGHT OF THE RIP RAP MAY  
 BE IN INDIVIDUAL PIECES WEIGHING LESS THAN 15 LBS. EACH OR  
 AS SPECIFIED.  
 REFER TO STANDARD NO. 20.17 FOR CONCRETE SPLASH PAD.  
 ALL SUBGRADE FOR STRUCTURE TO BE COMPACTED TO 95% OR  
 GREATER.



PIPE DIA.	NO. & DIM OF RODS	PERF. LBS.	FABRIC
15"	2-#3x4'-0" SIDE RODS	3,008	18"-2x8-W2.1xW1.7
18"	2-#3x4'-0" SIDE RODS	3,008	16"-2x8-W2.1xW1.7
24"	2-#3x6'-0" SIDE RODS	4,512	24"-2x8-W2.9xW2.9
30"	2-#4x6'-0" SIDE RODS	8,016	30"-2x8-W4xW2.9
36"	2-#4x8'-0" SIDE RODS	10,668	42"-2x8-W4xW2.9
36"	2-#4x8'-0" BACK RODS	8,016	

END SECTIONS DIMENSIONS										
PIPE DIA.	A	B	C	E	F	T	G	K	P	
15"	6"	2'-3"	3'-10"	2'-6"	6'-1"	1 7/8"	1'-2"	9"	4'-10"	
18"	9"	2'-3"	3'-10"	3'-0"	6'-1"	2"	1'-5"	11"	5'-10"	
24"	9 1/2"	3'-7 1/2"	2'-6"	4'-0"	6'-1 1/2"	2 1/2"	1'-8"	11"	7'-4"	
30"	1'-0"	4'-6"	1'-7 3/4"	5'-0"	6'-1 1/2"	2 3/4"	1'-11"	1'-1"	8'-10"	
36"	1'-3"	5'-3"	2'-10 1/4"	6'-0"	8'-1 1/2"	3"	2'-3"	1'-3"	10'-6"	
42"	1'-10"	5'-3"	2'-11"	6'-6"	8'-2"	3 1/2"	2'-9"	1'-6"	12'-0"	
48"	2'-1"	6'-0"	2'-2"	7'-0"	8'-2"	4"	3'-4"	1'-8"	13'-6"	

RIP RAP APRON  
 FOR FLARED END SECTION

N.T.S.