

DRAINAGE

413 PIPE STANDARDS

1) The proper drain size shall be calculated by using the rational formula, “ $Q = ACI$ ”, with a Manning’s “N” value of .012 for concrete and corrugated high density polyethylene pipe pipe. For culverts less than thirty (30) feet in length and all drains, the minimum size of pipe shall be twelve (12) inches diameter. Culverts and drains shall be large enough to pass the design storm without surcharge”.

2) TYPE OF PIPE

Storm drains shall be reinforced concrete or corrugated High density polyethylene pipe of adequate strength. All pipe shall conform to the state of Massachusetts standard specifications for highways and bridges, as amended

3) All pipes shall be laid on a slope so that the minimum velocity with the pipe flowing full shall be three (3.0) feet per second. All plans having drains with slopes which will produce pipe velocities less than three (3.0) feet per second, flowing full, shall be accompanied by a letter stating the reason for the flat slope. The letter shall have a space for approval by the Planning Board or its agent, and the drain shall not be constructed until the letter has been approved.

4) DROP INLETS

Drop inlets shall have an adequate water way opening to pass the design storm with not more than 0.2 feet for surcharge. Grates and frames shall be cast iron suitable for the loads which can occur either during the construction or afterward. Inlets shall be constructed either of brick or mortar with eight (8) inch thick walls, precast segmental concrete blocks not less than six (6) inches thick mortared in place, or of precast sections. Inlets shall be set on a base of either poured concrete eight (8) inches in thickness, or precast segmental base blocks not less than four (4) inches in thickness. Inlets shall be used in off-street locations and the grate frame shall be mortared in position with the top 0.2 feet below the grade of the finished ground surface. Side openings may be used in lieu of a grate if the quantity of run-off exceeds the capacity of a grate of reasonable size as approved by the Planning Board or its agent. Inlets shall be four (4.0) feet inside diameter below the corbelling, and shall not be used on drains greater than thirty (30) inches in diameter. A shaped invert is required. At inlets where the outlet pipe is larger than the inlet pipe, the crown of the outlet pipe shall be at the same elevation, or lower than the crown of the inlet pipe.

5) CATCH BASINS - - MANHOLES

Catch basins shall be installed on both sides of the roadway on continuous grades at intervals not to exceed three hundred (300) feet, at low points and sags in the roadway, near the corners of the roadway at intersecting streets, and at other such locations as required by the Board. Such catch basins shall be provided with inlets and transition stones. Each catch basin shall have a four (4) foot sump and be fitted with a gas and oil trap and granite headers with storm inlets. Drain pipes shall extend through a maximum of two (2) catch basins and thereafter through manholes to the point of discharge, manhole being required at every change in direction, slope, or diameter in the drain pipes. All catch basins except for the first two (2) shall discharge into the drain through a manhole, or in whatever manner the Planning Board shall direct.

414 CONSTRUCTION

1) Excavation

The trench for the pipe shall be excavated to the required line and grade, including earth, boulders, and ledge. Trenches for storm drains shall be no wider than the outside diameter of the pipe plus eighteen (18) inches for pipes through eighteen (18) inches nominal diameter, and the outside diameter plus twenty-four (24) inches for pipe larger than eighteen (18) inches. This trench width shall apply from the top of the pipe to the bottom of the trench. Above the top of the pipe the trench width may be as necessary to properly install the pipe. Trenches with side slopes steeper than the natural angle of repose of the soil shall be sheeted in an approved manner, as necessary, to avoid cave-ins and sloughing. All excavations shall be properly barricaded and lighted at night where they are close to pedestrian or vehicular traffic. Before any pipe is placed in a newly constructed fill, the contractor shall, as directed, place the filling two (2) feet above the top grade of the pipe, after which the pipe trench may be excavated. If cross pipes, conduits, drains or other unforeseen obstacles encountered in the excavation which cannot be relocated, the drain shall be redesigned to avoid the obstruction, if possible, in a manner suitable to the Planning Board or its agent. Possible obstructions to the line shall be investigated prior to the construction of the drain in its immediate vicinity.

2) Bedding

Trenches may be excavated with a flat bottom, but the full length of the pipe, except the bell, must rest upon undisturbed soil except as hereinafter specified. Where trenches have been over excavated, a selected earth or gravel foundation, thoroughly compacted, shall be provided for proper pipe bedding. Soil, which is considered to be unsuitable by the Department of Public Works, shall be removed to a depth of not less than two (2) feet below the bottom of the pipe and replaced with compacted sand and gravel to the bottom of the pipe. Unsuitable soil or other excavated material shall be disposed of as directed by the Planning Board, or its Agent.

3) Pipe Laying

Pipe shall be laid starting with the down stream end. Grade boards or other approved devices, including the laser beam, shall be provided to insure that the pipe is laid true to line and grade. Reference bench marks shall be clearly marked to enable the inspector to quickly check the grade and invert elevations. The downstream pipe shall be laid with groove or bell and facing upstream in the proper position. The spigot or tongue end shall be placed in the bell or groove, such that the inverts match.

4) Backfilling

After the pipe has been laid and inspected, the trench shall be backfilled. The space under the pipe haunches shall be carefully filled with selected material. Free from stones or frozen earth, and compacted carefully to prevent the pipe from moving. The layer of backfill up to twelve (12) inches over the top of the pipe shall also be of selected material free from stones and frozen earth, well compacted. The remainder of the trench shall be backfilled in twelve (12) inches layers except as noted below, and each layer shall be fully compacted in the approved manner. Under roads or other traffic areas, the trench shall be backfilled in six (6) inch layers, with each layer compacted to the density of the surrounding soil. Pavement and base course materials removed during the excavation process shall be replaced with pavement and base course to match those removed. When, in the opinion of the Department of Public Works, the excavation is deep enough to warrant it, temporary pavement shall be provided as directed. Trenches not in pavement shall be left in a mounded condition as directed by the Department of Public Works.

415 GRATES AND HEADWALLS

1) Security Bars

Security bars shall be provided at the entrance to all culverts or open pipe drains over eighteen (18) inches in diameter. The grate shall be constructed of steel bars not less than one-half (1/2) inch diameter welded together to provide a grate not smaller than the pipe opening.

The vertical bars shall be placed with two (2) inch clear openings between them, and the horizontal bars shall be placed twelve (12) inches on center. The grate shall be installed not closer than one pipe diameter upstream from the entrance in a manner approved by the Planning Board or its Agent. A suitable sketch of the grate and method of installation shall be submitted for approval with the plans for the drains and appurtenances.

2) Headwalls or Flared End Sections

Concrete or field stone masonry headwalls or flared ends shall be installed at outlet ends of storm drains. They shall conform to the tables on plates 13 and 14, and be placed a distance of not less than sixty-five (65) feet from the way line.

3) Scour Protection

The discharge ends of all drains with flowing full velocities of four (4) feet per second or more shall be protected with a rip-rap apron of a width not less than three (3) times the normal diameter of the pipe. The rip-rap apron shall extend for a distance of not less than ten (10) times the nominal pipe diameter from the end of the discharge pipe. The rip-rap for exit velocities of them (10) feet per second or less shall be composed of a layer of stones twelve (12) inches in thickness or more, placed upon a bed of sand and gravel six (6) inches in thickness. The stones shall be sized so that not less than sixty (60) per cent shall have one dimension twelve (12) inches or more. The stones, after being laid shall be carefully chinked by hand to make a reasonably smooth and shaped surface. Where exit velocities are greater than ten (10) feet per second, the thickness of stones and the dimensions of the individual pieces shall be sized to prevent displacement by the flow. In this case, details shall be submitted to the Board's Engineer for approval.