ESCSI Expanded Shale Clay & Slate Institute

Information Sheet 6650

ROTARY KILN EXPANDED SHALE, CLAY OR SLATE LIGHTWEIGHT AGGREGATE FOR SEWER BEDDING AND FILL

RECOMMENDED SPECIFICATION

Lightweight aggregate to be used as fill or pipe bedding in unstable foundation areas shall be Rotary Kiln Expanded Shale, Clay or Slate, or approved equal. The loose volume unit weight shall not exceed 55 pounds per cubic foot. The aggregate shall be graded in accordance with ASTM Specification C-330 for 3/4 inch to No. 4.

LIGHTWEIGHT AGGREGATE
... for better and less costly sewer construction

By WILLIAM H. McCOMBS
McCombs-Knutson Associates, Inc.
Consulting Engineers
Plymouth, Minnesota

Revised and reprinted from the August 1972 issue of THE AMERICAN CITY Magazine.

Unfavorable soils make the construction of sewers, forcemain, and other underground utilities expensive and risky. If firm soil underlays unstable soil within five to six feet below the pipe, the unstable soil can be removed and replaced with washed rock in sizes from 3/4 to 2 inches. But this method becomes too costly and ineffective when the unstable soil extends beyond the five to six foot depth. Also, the use of rock can result in a "sloughing off" since it is appreciably heavier that the surrounding soil, permitting the pipe to settle and crack.

Pipe foundation may also be used, but increases the cost approximately four to six times that of pipe laid in good soils. Also the piling must be constructed and located where a subsequent load placed on the pipe by traffic or other changes in surface conditions will not result in the vertical failure of the pipe or the shifting of soils which could produce lateral movement of the pipe.

A third method employs lightweight pipe such as corrugated metal and plastic that floats on the unstable soil bedding. The theory here is that the lightweight pipe would stay in place making removal of the unstable soil unnecessary. However, construction of this type has generally resulted in failure of the pipe and subsequent replacement.

Minnesota is particularly plagued with areas of unfavorable soil conditions, especially adjacent to our numerous lakes and low swamp areas, where it is most often necessary to construct the sanitary and storm sewers. Our office has encountered several projects where the soils made the construction so expensive that it was not economically feasible to construct the facilities. Thus we had to find a better method of construction.

Our investigation centered around finding a material that could be placed under the pipe similar to the rock method of construction, and yet would be lighter than the existing soil. It would not experience the sloughing problems and in some cases could serve as a bridge across some marginal soils. On the job in question, located in the city of Medicine Lake, the major type of soil in the construction area was peat having a weight of 55 to 65 pounds per cubic foot. Thus we needed a material that would be less than this weight, yet would be strong, inert, insoluble, and non-corrosive to the pipe.

A lightweight aggregate similar to that used in the manufacture of lightweight concrete and concrete block seemed promising. Tests showed the lightweight aggregate to be light in weight, hard, durable, inert, and insoluble - all the properties needed for a good foundation material for underground piping.

To find out the bridging ability of the material we dug a trench and placed and compacted the lightweight aggregate. We then exposed the material by cutting away the side of the trench and finally dug a hole underneath the aggregate to observe its ability to carry a load.

Satisfied with test results, we used the material for the sewer foundations under PVC in the city of Medicine Lake. The unstable soils were removed (Figure 1) to a good foundation material and lightweight aggregate placed to the approximate centerline of the pipe. In some cases we placed the lightweight aggregate above the pipe to decrease the overall weight. Heavy compaction equipment was employed to thoroughly compact the material without adverse effect. Experience showed that the light material compacted well and provided a tighter, firmer, drier base on which to work than would have been obtained had a rock material been used.

FIGURE 1: Tested in the field under difficult conditions, the use of lightweight aggregate as bedding for a sewer line proved successful.

The material was also much lighter and easier to handle, resulting in savings in labor cost because of the ease and speed in constructing the pipe bed. Television inspection of the lines conducted four years after the original construction showed that the line and grade of the pipe was still to the true grade and no settling or damage had taken place.

As a result of this construction, the weight of the lightweight aggregate including the pipe construction was less than the weight of the soil removed. The successful experience on this first application led to a subsequent test area on a storm sewer. However, instead of removing all of the unstable subsoils we removed only sufficient material so that the combined weight of the pipe, the water inside the pipe, and the foundation material was less than that of the soil removed. Figure 2 gives an example of different bedding conditions utilized. Subsequent checks of this storm sewer showed that this pipe also stayed true to line and grade.

We have employed similar methods in other areas with equally satisfying results and found that they result in lower construction costs. The cost of the material is about the same as rock when considered on a volume basis, but it is much easier to handle. Also, the dollar savings by the elimination of the need for piling, and/or possible replacement where heavier materials settle and the pipe fails could be substantial.

We feel that lightweight aggregate when used in conjunction with unstable subsoils has a very wide application. However, the engineer must use caution in its application to insure that the underlying soil is stable enough to carry the lightweight material, and that it will not settle into the subsoil. Thus it should not be used in "soupy" soils.

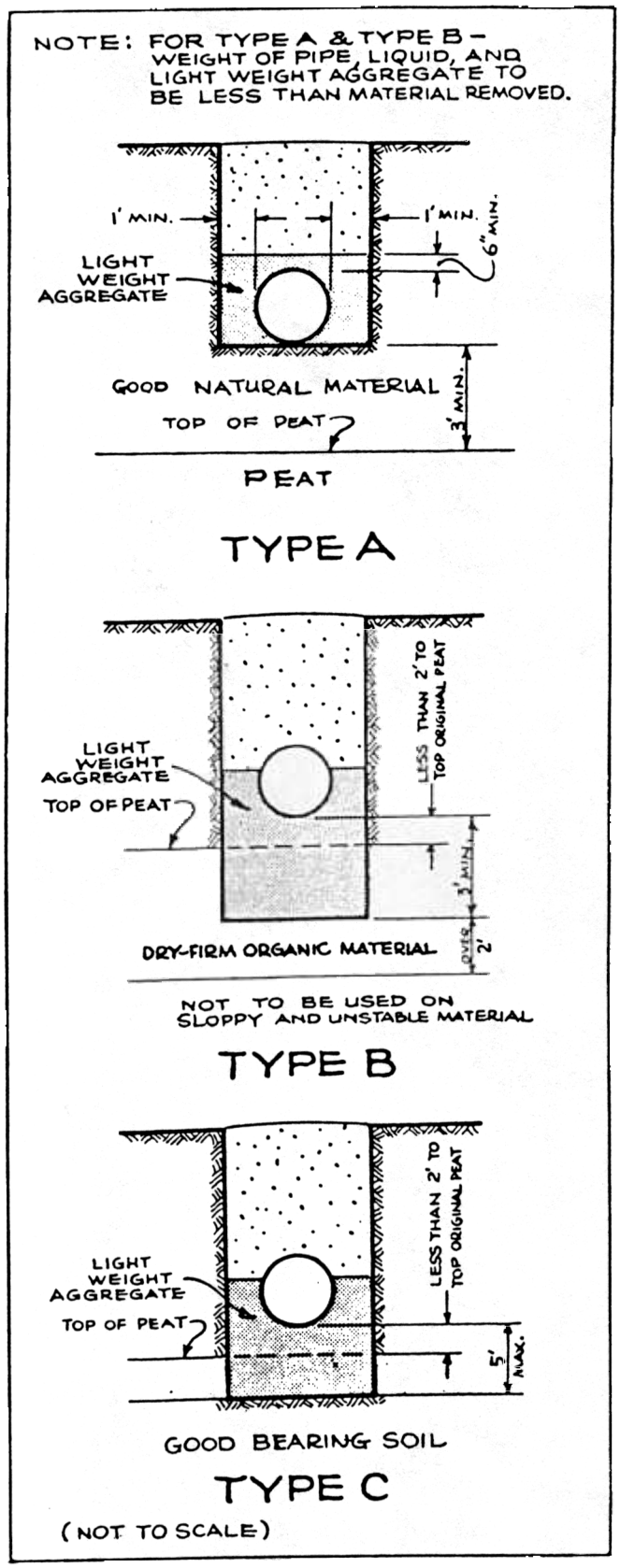

FIGURE 2: Typical application lightweight aggregate bedding.