

ITEM 18

UTILITY CUT AND BACKFILL

18.1 DESCRIPTION OF WORK

This work shall consist of the excavation and rapid backfill of trenches for the accommodation of Utility substructures, and the replacement of paving surfaces. The work requires the use of removable, controlled low-strength materials (CLSM) for the backfill material, as an alternative to traditional compacted soil. This is specified herein for specialized backfill situations.

18.1.1 Description of Removable, Flowable, Backfill Materials or CLSM

The use of and requirements for CLSM is covered in detail in this Item due to the many time saving and engineering benefits of this type of material. This material does not need compacting from the Contractor, nor moisture density compaction testing. Only a few physical tests of the CLSM properties are needed to assure durability and future removability with light excavating equipment. A low strength is desired so that surrounding utilities or structures will not be damaged if the CLSM must be removed in the future. Air entrainment is required to prevent damage and displacement of trench patches due to freeze-thaw damage.

In addition, the CLSM may be used for other specialized applications apart from trench backfill. These include filling voids due to pipe abandonment or undercutting of excavation in caving or normal soils. CLSM offers quick restoration of the trench or improving other subgrade condition for roadway or structure support in a rapid time frame without need or traditional soil backfill testing requirements or when a quick strength is needed to support future layers. These benefits may outweigh the extra costs vs. using traditional compaction and testing methods.

Other specialized applications include: backfilling behind retaining walls and abutments, filling void areas including pipe abandonment, annular spaces, undercut areas and other approved void filling applications. Other suitable applications include structural support for utilities, replacement of unstable subgrade during pavement repairs.

Utility types that can utilize CLSM include: conduits or pipes for electrical, communications, fiber optic, traffic signal or other small utilities, gas and water lines, sanitary and storm sewer lines, and other types of utility under existing pavements or ground surfaces to be later improved.

18.1.2 Objectives for Required Use of CLSM

The objectives of requiring the use of the Flowable Backfill materials (vs. reusing excavated soils) specified below is to provide a self-leveling, frost heave-resistant, non-settling, controlled low-strength material (defined by American Concrete Institute ACI 229 as a CLSM), that does not require compactive effort and compaction testing. Traditional use of soil or aggregate materials for backfill will require **Agency** Approval and testing.

18.1.3 Requirements for CLSM – Flow-Fill or Flashfill

This ITEM further specifies two distinct material products: The Flashfill products will allow pavement repairs to occur more quickly than Flow-Fill, to open the streets back to traffic. 'Flowable Backfill' shall mean either or both.

A high slump is required to aid in the self leveling and void filling objective. The visual consistency may appear to range in appearance from thin batter or mud, to thick water. It must be foremost removable with light machinery in the future, and also quickly stable to support paving operations and traffic quickly.

Air contents at or above 15% are required in the top 4 feet of flowable fill to limit permanent frost heave. This air content requirement should be used for the entire depth, to aid in the ability to remove or excavate CLSM in the future. The air content spec may be forbidden for some utility agencies, such as for thrust blocks or as pipe bedding normally used for lateral support of pressurized pipes.

18.2 MATERIALS

18.2.1 Flow-Fill

Flow-Fill shall consist of a controlled low-strength, self-leveling concrete material composed of various combinations of cement, fly ash, aggregates, water, chemical admixtures and/or cellular foam for air-entrainment. It shall have an air content of 15%

to 25%, when tested in accordance with ASTM C231, to provide suitable resistance to frost-heave. Generally, a contractor may place Flow-Fill in approximate 3 feet thick layers, allow bleed water to rise and divert away from placement before another layer may be added. Refer to section 18.3.5 for more information.

Flow-Fill shall have typical design compressive strengths of 50 to 150 psi at 28 days, when tested in accordance with ASTM D4832. However, the Flow-Fill shall be limited to a maximum Removability Modulus (RE, as described in section 18.2.3) of 1.5, which may require the lower strengths towards the 50 psi minimum, and/or higher air contents over 15%.

The mix shall result in a product having a slump in the range of 7 to 10 inches, when tested in accordance with ASTM C143. Slumps of less than 7 inches will not be permitted for placement, since the flowability to avoid settlement is impaired, and strengths may increase.

The **CONTRACTOR** shall submit a mix design for approval by the **AGENCY**, prior to placement. The mix design shall be supported by laboratory test data verifying compliance with air content, slump, strength and removability (RE) requirements.

18.2.2 Flashfill

Flashfill shall consist of a controlled low-strength, self-leveling cementitious material composed of various combinations of fly ash, water, chemical admixtures and/or cellular foam for air-entrainment. No aggregate or sand is usually needed. It shall have an air content of 15% to 21%, when tested in accordance with ASTM C231, or by volumetric calculations shown below in section 18.2.4, to provide suitable resistance to frost-heave. Higher air limits may be allowed by the **AGENCY** for special circumstances.

Flashfill shall have typical design compressive strengths of 100 to 300 psi at 28 days, when tested in accordance with ASTM D4832. Higher strengths may be permitted, however the flashfill shall be limited to a maximum Removability Modulus (RE) of 1.5, which may require lower strengths and/or higher air contents.

The mix shall result in a product having a slump in the range of 8 to 11 inches, when tested in accordance with ASTM C143. Fluidity may also be measured by ASTM D6103, as described below, with typical spreads of 8 to 12 inches, or greater. Slumps of less than 8 inches or spreads of less than 8 inches will not be permitted for placement, since the flowability to avoid settlement is impaired and the strength may increase.

The **CONTRACTOR** shall submit a mix design for approval by the **AGENCY**, prior to placement. The mix design shall be supported by laboratory test data verifying compliance with air content, slump, strength and removability (RE) requirements.

18.2.3 Removability Modulus

The Removability Modulus* ,RE , is a value calculated by

$$RE = \frac{W^{1.5} \times 104 \times C^{0.5}}{10^6}$$

where : W = in-situ unit weight (pcf) and C = 28-day compressive strength

*RE was developed & is used by Hamilton County, Ohio; per the NCHRP #597 CLSM Report. A lower RE means easier to excavate or remove.

18.2.4 Air Content Volumetric Calculation

Air content can be calculated as follows (using wet unit weights before and after foaming or entraining air) :

$$\text{Air Content} = \frac{(\text{Unit Weight not Air-Entrained} - \text{Unit Weight Air-Entrained}) \times 100\%}{\text{Unit Weight not Air-Entrained}}$$

18.2.5, Flow Consistency of CLSMs, using ASTM D6103

ASTM D6103 utilizes a moistened 3" diameter, 6" high open-ended cylinder, filled with the flashfill. When the cone is lifted, the resulting "pancake" is measured at its longest and shortest dimensions and averaged.

18.2.6 Cement

Cement shall meet the standard chemical requirements of Type II or Type IP, ASTM C150 or ASTM C595, respectively.

18.2.7 Fly Ash

Fly ash shall meet the requirements of ASTM C618 Type C or Type F. Fly ash not meeting the requirements of ASTM C618 may be used if prior testing indicates acceptable, consistent results for strength and air content.

18.2.8 Water

Potable water or reasonably clean and free chemicals injurious to the final product are to be used.

18.2.9 Chemical Admixtures

Air-entraining admixtures shall conform to ASTM C260 requirements; other chemical admixtures shall conform to ASTM C494 requirements.

18.2.10 Foaming Agents

Foaming agents shall conform to ASTM C869 and C796, or as approved by the **AGENCY**.

18.2.11 Suitability of Flowable Backfill Constituents

Flowable Backfill materials may not contain any material deemed toxic or hazardous. Material Safety Data Sheets (MSDS) must be available for any cement, flyash or admixture component of the mixture upon request. Flowable Backfill shall be compatible with bedding materials, electrochemically and otherwise if used as a metal pipe backfill application.

18.2.12 Aggregates

Aggregates including rock, gravel or sand, shall conform to the following gradations:

TABLE 18.2.12

Sieve Size	% Passing
1 inch (25 mm)	100
No. 200	0 to 10

When coarse aggregate is used, 100 percent shall pass the 1-inch sieve, and it shall comprise not more than 40 percent of the total aggregate content. Other aggregate products such as aggregate base, crushed rock, pea gravel, or reject sand which has no more than 20 percent passing the No. 200 sieve and is free of organic material and other deleterious substances, may be accepted by the **AGENCY** if a flowable, workable mix can be produced without segregation of the aggregate.

18.3 CONSTRUCTION METHODS

18.3.1 Cutting Streets

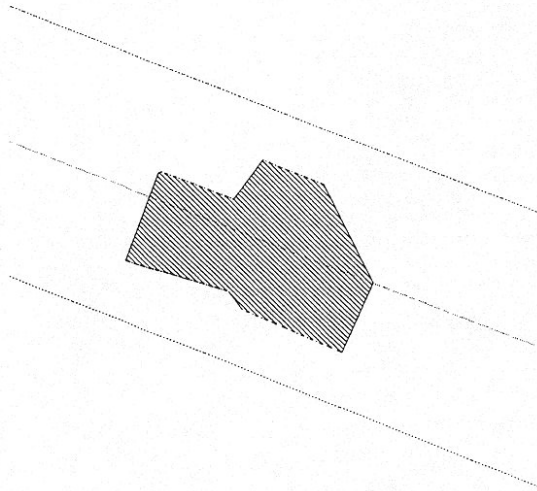
Prior to beginning work within any public right-of-way, or cutting any street surface, an encroachment permit and traffic control or barricade plan approval shall be obtained from the government entity or **AGENCY** having jurisdiction over that right-of-way.

Permit fees and construction restrictions shall be in accordance with the rules, regulations, and ordinances of the entity or **AGENCY** having jurisdiction.

While undergoing improvements, all streets upon or within which any work is being done shall be kept open to all traffic by the **CONTRACTOR** unless otherwise approved by the **AGENCY**.

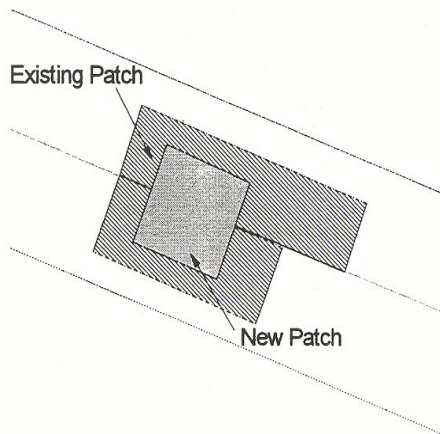
Prior to beginning the work, barricading and traffic control devices shall be in place, and shall be in compliance with the **AGENCY** approved traffic control and barricade plan.

Existing pavements shall be removed to clean, straight lines, parallel and perpendicular to the flow of traffic. Patches with angled sides and irregular shapes will not be accepted as depicted below.

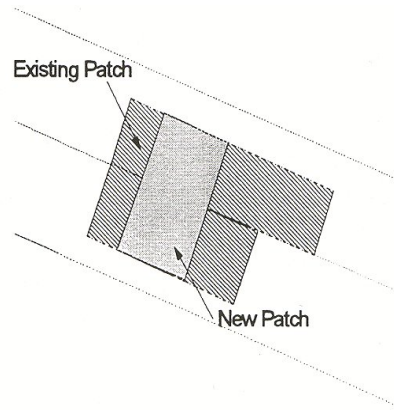


NOT ACCEPTABLE

Patches within existing patches will not be accepted. Boundaries of the patches shall coincide.

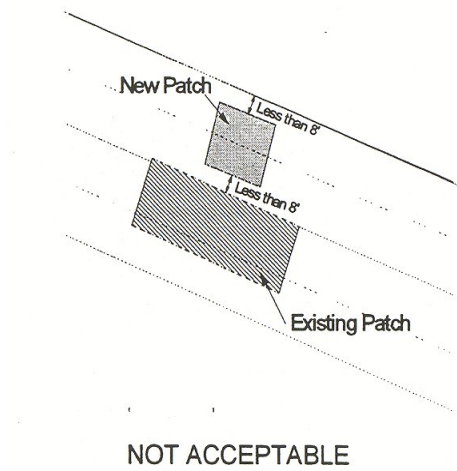


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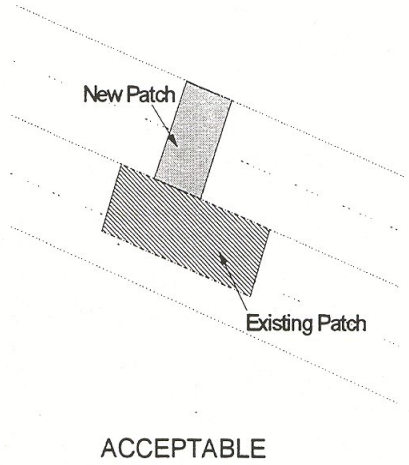


ACCEPTABLE

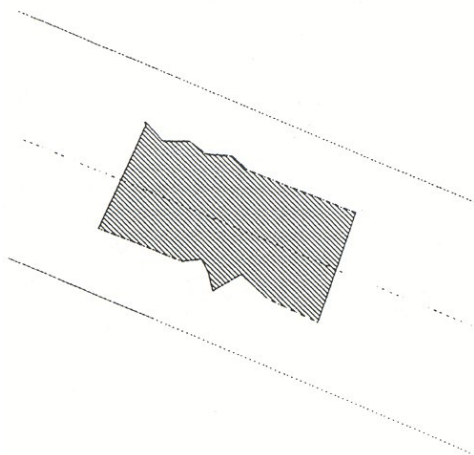
Existing pavement shall not leave strips of pavement less than one-half lane in width from the edge of the new patch or the lip of the gutter for commercial, industrial and residential streets. In the case of residential streets, strips shall not be less than 8 feet in width from the existing patches or the lip of the gutter.



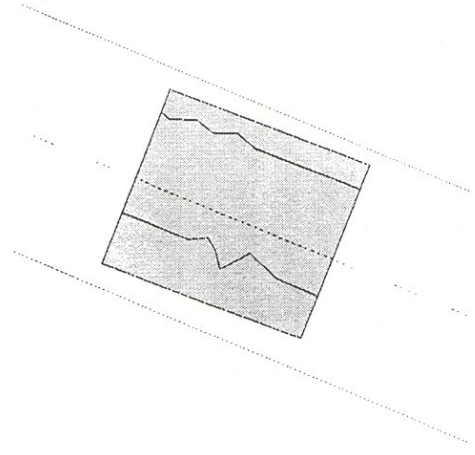
NOT ACCEPTABLE



ACCEPTABLE



NOT ACCEPTABLE



ACCEPTABLE

Asphalt and concrete pavements shall be removed by saw cutting. Avoid breaking away the edges of the existing pavement or damaging the remaining pavement with heavy construction equipment.

18.3.2 Trench Excavation. General

Excavation including the manner of supporting excavation and provisions for access to trenches shall comply with the current regulations as determined by OSHA for bracing and safe conditions. Excavation shall include, without classifications, the removal of all materials of whatever nature encountered, including all obstruction of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grade shown. Excavation for pipe, wire, or

conduits shall be by open trench unless otherwise specified or shown on the plans. However, should the **CONTRACTOR** elect to tunnel or jack any portion not so specified, he shall first obtain approval from the **AGENCY**.

The **CONTRACTOR** shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavation, and all pumping, ditching, or other approved measures for the removal or exclusion of water, including storm water and waste water reaching the site of the work from any source as to prevent damage to the work or adjoining property. The **CONTRACTOR** shall be responsible for any damage to persons or property due to interruption or diversion of potable, storm or wastewater on account of his operations. If due to delays in delivery of materials or for other reasons, and the **CONTRACTOR** is not expected to fully complete the work within any excavated area in a reasonable length of time as determined by the **AGENCY**, the **AGENCY** may require the **CONTRACTOR** to backfill the excavation and re-excavate when the work can be completed expeditiously, with no additional payment.

Except as otherwise shown or provided herein, excavation shall be open cut trenches with vertical sides up to the top of the pipe, and from the top of the pipe to the ground surface. The bottom of the trench shall have a maximum width equal to the outside diameter of the pipe plus 24 inches (600 millimeters) or as shown on the plans. If the maximum trench width is exceeded, the **CONTRACTOR** shall provide either; additional bedding, another type of bedding, or a higher strength of pipe if required by the **AGENCY**, with no additional payment thereof. Trench widths greater than the outside diameter of the pipe plus 24 inches (600 mm) may be required by the **AGENCY** for flexible pipe to compensate for low stability soils.

Except when otherwise specified or ordered by the **AGENCY**, the bottom of the trench shall be excavated uniformly to the grade or depth indicated on the drawings. The maximum amount of open trench permitted in any one location shall be 500 feet (152 m), or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater, unless otherwise approved by the **AGENCY**. Trench shall be considered open until backfilled to finish surface. Trenches across streets shall be completely backfilled as soon as possible after pipe, wire, or conduit installation.

Substantial bridging, properly anchored, capable of carrying the legal limit loading, in addition to adequate trench bracing, shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular working hours. Safe and convenient passage for pedestrians and access to all properties shall be provided.

18.3.3 Trench Over-Excavation

Wherever the excavation is made below the grade shown on the drawings, or below the grade ordered by the **AGENCY**, it shall be refilled to the required grade with Flowable Backfill, or using **Agency** approved methods and specifications and verified with materials and compaction testing.

18.3.4 Disposal of Unsuitable and Excess Excavated Materials

Excess material and excavated material unsuitable for backfill, shall be removed from the site of the work by the end of each working day unless otherwise approved by the **AGENCY** and disposed of by the **CONTRACTOR**.

18.3.5 Trench Backfill

Except as otherwise provided or approved by the **AGENCY**, after the pipe or conduit is laid, trenches shall be backfilled with Flowable Backfill in the pipe zone as defined in the following table:

TABLE 18.3.5

Pipe or Conduit	Pipe Zone
2-inch (50 mm) or less diameter	6 inches (150 mm) above the top of the pipe up to subgrade
Greater than 2-inch (50 mm) diameter, except vitrified clay pipe	12 inches (300 mm) above the top of the pipe up to subgrade
Vitrified clay pipe	24 inches (600 mm) above the top of the pipe up to subgrade

Flowable backfill should be discharged directly from the truck into the space to be filled, or by other methods approved by the **AGENCY**. The mix may be placed part depth or

full depth as conditions at the site dictate. When used as backfill in the pipe zone, care should be taken to prevent flotation or misalignment of the pipe by means of straps, soil anchors or other approved means of restraint. Material may be placed in stages with initially lesser flowability, to prevent movement or flotation of pipe.

Compaction of flowable backfill will not be required. The maximum layer thickness shall be 3 feet at one time. Additional layers shall not be placed until the backfill has lost sufficient moisture to be walked on without indenting more than 2 inches. Any damage resulting from placing flow fill in layers that are too thick or from not allowing sufficient time between placement of layers shall be repaired at the **CONTRACTOR's** expense.

Placement of pavement materials or vehicle traffic shall not be allowed until the flowable backfill has achieved a penetration resistance of at least 600 psi using a hand-held penetrometer, in accordance with ASTM C 403. This penetration resistance shall be considered achieved when a person weighing at least 150 pounds, by use of their body weight as an axial load, cannot penetrate the flowable backfill with the square cut end of a No. 4 steel reinforcing bar (764 psi equivalent).

18.3.6 Temporary Patch

Whenever permanent pavement patches are not constructed immediately following trench backfilling operations, temporary pavement patches consisting of a minimum of 3 inches of hot or cold plant mix or steel plates must be utilized to provide the required number of paved travel lanes. Plates may be left in place for the short duration as approved by the **AGENCY**. Temporary pavement patches may be left in place for a maximum of 30 working days following completion of backfilling operations unless otherwise approved by the **AGENCY**.

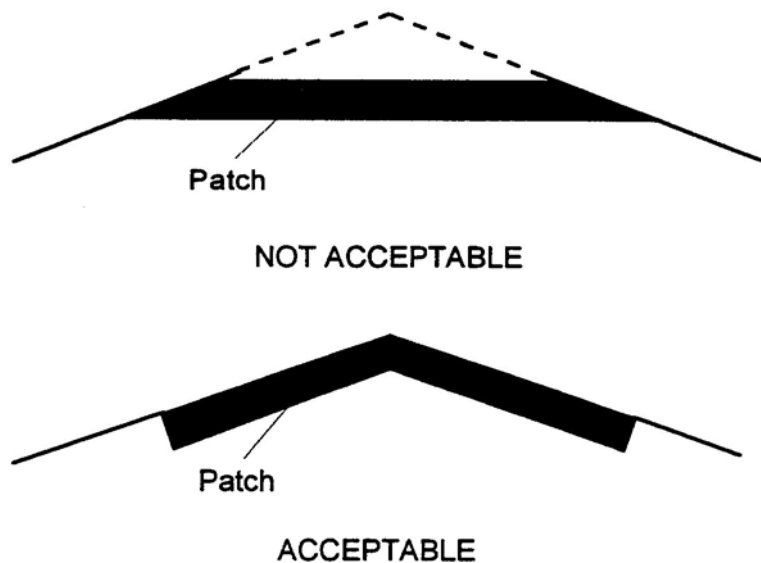
The following surface tolerance for temporary patches shall be observed. When a 12 foot straight edge is laid across the temporary patch parallel to the centerline of the street and in the direction transverse to the centerline, there shall be no more than a $\frac{3}{4}$ inch rut, hump, or depression evident. Deteriorated temporary patches exhibiting ruts, humps, or depressions shall be repaired or replaced immediately upon notification of the **AGENCY**. If the existing street exceeds the above tolerances prior to patching, then the

temporary patch shall be equal to or better than the condition of the surrounding pavements.

18.3.7 Permanent Patch

Prior to placing the permanent patch, the existing HMA pavement shall be saw cut to a neat line and to a minimum 9 inches outside of the trench area. The edges of the resulting "T patch" shall not fall within existing wheel paths. Patches parallel to the direction of traffic and encompassing the wheel path shall extend to lane lines.

For patches in a HMA pavement, a tack coat shall be applied to all edges to the existing freshly cut and/or well cleaned edges of HMA prior to placing new pavement. Existing HMA shall be replaced with the thicker of: the depth that is shown on the plans, or the **AGENCY** standards, except that the minimum depth shall be at least 4 inches. HMA shall meet the material requirements in Item 9 for Grading S or SX with PG 64-22 binder unless specified otherwise. Compaction shall be between 92 and 96 percent of T 209. Average compaction of less than 92 percent of T 209 will be cause for rejection. Completion of the permanent patch in areas where an open-graded surface course exists shall include placement of a surface course to match the existing surface texture.



In areas where lime treated sub-base, cement modified sub-base, soil cement, or similar materials have been used, the **CONTRACTOR** shall provide flow fill to the HMAP or PCCP level.

Upon completion of the permanent patch, including the surface treatment, the surface shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge 12 feet (4 m) long is laid across the permanent patch parallel to the centerline of the street and in a direction transverse to the centerline, the surface shall not vary more than 1/4 inch from the lower edge of the straight edge. Patches exhibiting deviations greater than 1/4 inch shall be replaced prior to acceptance of the patch. If the existing street exceeds the above tolerances, then the patch shall be equal or better than the condition of the surrounding pavement. Patches shall also have a cross slope or cross section consistent with the design of the existing roadway.

Any improvements in the right-of-way or on private property disturbed or damaged during construction shall be replaced prior to placement of the permanent pavement patch. Damaged sections of concrete sidewalk shall be removed and replaced to the nearest expansion joint or score line. Damaged concrete curb and gutter shall be removed and replaced to the nearest expansion joint. Replacement of less than a 10-foot length of curb and gutter will not be permitted. Integral curb, gutters, and/or sidewalk shall be replaced in their entirety.

For patches in a PCCP street, only full panels shall be replaced, with tie bars on longitudinal joints, and dowels in transverse regardless if the existing PCCP had or has them. Refer to Item 11 for more construction details.

18.3.8 Traffic Control Devices

All traffic control devices removed or disturbed during construction must be replaced upon completion of the permanent patch including but not limited to delineation, paint, thermoplastic pavement markings, and traffic signal detector loops. Temporary lane lines and other markings used during construction shall be permanently removed, to the satisfaction of the **AGENCY**, prior to placing the new traffic stripes of markings.

18.4 PAYMENT

Unless otherwise provided, no payment will be made for trench excavation or backfill as such; the cost thereof under normal circumstances being considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant.

Any trench over-excavation below the specified level of bedding material and additional backfill material, when ordered or approved by the **AGENCY** because unsuitable materials are encountered, shall be paid separately by the appropriate contract item.

In the event that changes in elevation of the trench of less than 6 inches (150 mm) are ordered by the **AGENCY**, no changes in the contract amount will be allowed. When such changes in elevation are more than 6 inches (150 mm) or changes in alignment are made that change the character of the work required, the work shall be performed as specified.

<u>Item</u>	<u>Description</u>	<u>Payment</u>
18.1	Utility Cut and Backfill	unit price
18.2	Flowable (CLSM) Backfill	cubic yards (yd ³)