GEOTECHNICAL RESEARCH:
Safety Standard Operating Procedures

IOWA STATE UNIVERSITY
Department of Civil, Construction and Environmental Engineering

Standard Operating Procedure

Procedure Title: Moisture Content Determination using Oven Drying (ASTM D4959)

Dept: CCEE

Bldg/Rm: _____

Lab Supervisor: _____

Procedure Overview: (brief description of the procedure)

Health and safety information for materials used: (brief description of associated hazards)

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

□ Latex Gloves	□ Insulated Gloves	□ Face Shield	□ Respirator
□ Nitrile Gloves	□ Safety Glasses	□ Lab Coat	□ Fume Hood
□ Neoprene Gloves	□ Vented Goggles	□ Apron	□ Biosafety Cabinet
□ Heatproof Gloves	□ Splash Goggles	□ Dust Mask	□ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

Waste Disposal Measures:

Decontamination Procedures:

Spill/release Contaminant and Cleanup Procedures:

Written By: _____ **Date:**_____

Approved By: _____ **Date:**_____

Standard Operating Procedure

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Air-Jet Dispersion for Particle Size Analysis (ASTM D422)

Dept: CCEE

Bldg/Rm: _____

Lab Supervisor: _____

Procedure Overview:

The procedure involves dispersing soil (passing the #10 sieve) in a hydrometer jar using the air-jet dispersion tube. See manual for steps involved to perform the test.

Health and safety hazards:

- Possibility of material spillage as the dispersion tube is inserted in the hydrometer jar.
- Hydrometer glassware must be handled with care. If the hydrometer jar is dropped or broken, broken glassware must be carefully removed and placed in the glassware recycling bin.

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

□ Latex Gloves	□ Insulated Gloves	□ Face Shield	□ Respirator
□ Nitrile Gloves	**X Safety Glasses**	□ Lab Coat	□ Fume Hood
□ Neoprene Gloves	□ Vented Goggles	□ Apron	□ Biosafety Cabinet
□ Heatproof Gloves	□ Splash Goggles	□ Dust Mask	□ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Waste Disposal Measures:

Any broken glassware must be placed in the glassware recycling bin.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: Pavana Vennapusa **Date:** 12/30/2013

Approved By: David J. White **Date:** 12/30/2013

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Dynamic Cone Penetrometer Testing (ASTM D6951-03)

Dept: CCEE

Bldg/Rm: Geotechnical Mobile Lab (Field Test)

Lab Supervisor: David J. White or Pavana Vennapusa

Procedure Overview:

The ASTM D6951 procedure involves measuring the penetration of a 16 mm (5/8 in.) diameter rod under dynamic loading. Testing involves raising and dropping a 8 kg (17.6 lb) weight mounted on a guide rod up to the handle (height of about 575 mm (22.6 in.)) and releasing it to drop on to an anvil/coupler assembly. The total penetration for a given number of blows is measured and recorded.

Health and safety hazards:

- Catching fingers under drop weight.
- Noise (97 decibels) – Hearing protection is mandatory.
- Back pain due to lifting the weight.

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

☐ Latex Gloves	**X Work Gloves**	☐ Face Shield	☐ Respirator
☐ Nitrile Gloves	☐ **Safety Glasses**	☐ Lab Coat	☐ Fume Hood
☐ Neoprene Gloves	**X Ear Plugs**	☐ Apron	☐ Biosafety Cabinet
☐ Heatproof Gloves	**X Steel Toe Boots**	☐ Dust Mask	☐ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- DONOT put hand near the anvil when hammer is released.
- Keep one hand on the handle while operating the DCP.
- Always secure the hammer and/or the assembled DCP instrument when placing it on any flat elevated surface to prevent it from rolling off and causing personal injury or damage to the instrument.
- Keep back straight and lift with leg muscles when elevating and dropping the mass.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **7/18/2013**

Approved By: **David J. White** **Date:** **7/18/2013**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Drive Cylinder Testing (ASTM D2937-10)

Dept: CCEE

Bldg/Rm: Geotechnical Mobile Lab (Field Test)

Lab Supervisor: David J. White or Pavana Vennapusa

Procedure Overview:

The ASTM 2937 procedure involves measuring dry density and moisture content of soil in situ, by dropping a 10lb hammer on 3 in. or 4 in. diameter drive cylinders. Testing involves raising and dropping the hammer on a guide rod until the cylinder is fully penetrated into the soil and extracting the cylinder from the soil using shovels and hand tools.

Health and safety hazards:

- Catching fingers under drop weight.
- Noise – Hearing protection is mandatory.
- Back pain due to lifting the weight.
- Using shovels

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

☐ Latex Gloves	**X Work Gloves**	☐ Face Shield	☐ Respirator
☐ Nitrile Gloves	☐ **Safety Glasses**	☐ Lab Coat	☐ Fume Hood
☐ Neoprene Gloves	**X Ear Plugs**	☐ Apron	☐ Biosafety Cabinet
☐ Heatproof Gloves	**X Steel Toe Boots**	☐ Dust Mask	☐ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- DONOT put hand near the anvil when hammer is released.
- Keep one hand on the handle while operating the drive hammer.
- Always secure the hammer when placing it on any flat elevated surface to prevent it from rolling off and causing personal injury or damage to the instrument.
- Keep back straight when elevating and dropping the mass.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **5/30/2014**

Approved By: **David J. White** **Date:** **5/30/2014**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Light Weight Deflectometer Testing (ASTM E2835-11)

Dept: CCEE

Bldg/Rm: Geotechnical Mobile Lab (Field Test)

Lab Supervisor: David J. White or Pavana Vennapusa

Procedure Overview:

The ASTM E2835-11 procedure involves raising and dropping a weight mounted on a guide rod on a load plate to measure deflections. The drop weight weighs 10 to 15 kg.

Health and safety hazards:

- Catching fingers under drop weight.
- Back pain due to lifting the weight.
- Noise (80 to 83 decibels) – Hearing protection is suggested but it is not mandatory.

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

☐ Latex Gloves	**X Work Gloves**	☐ Face Shield	☐ Respirator
☐ Nitrile Gloves	☐ **Safety Glasses**	☐ Lab Coat	☐ Fume Hood
☐ Neoprene Gloves	**X Ear Plugs** (suggested)	☐ Apron	☐ Biosafety Cabinet
☐ Heatproof Gloves	**X Steel Toe Boots**	☐ Dust Mask	☐ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- Keep back straight and lift with leg muscles when elevating, dropping, and catching the mass.
- Make sure that hands are not positioned beneath the elevated mass.
- Secure load mass into the lower locked position prior to and during transportation between test locations.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **7/18/2013**

Approved By: **David J. White** **Date:** **7/18/2013**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Moisture Content Determination using Microwave (ASTM D4643)

Dept: CCEE

Bldg/Rm: Room 42 TEB

Lab Supervisor: David J. White

Procedure Overview:

The procedure involves determining moisture content of the soil by placing a soil sample in a nonmetallic nonabsorbent (e.g., ceramic or glass or plastic) containers in the microwave.

Health and safety hazards:

- Hot metal containers
- Heat retained in samples
- Particle shattering during heating, mixing, or mass determination
- Possibility of steam explosions or thermal stress shattering of porous or brittle aggregates
- Possibility of ignition when drying highly organic soils or soils containing oil

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

☐ Latex Gloves	☐ Insulated Gloves	☐ Face Shield	☐ Respirator
☐ Nitrile Gloves	**X Safety Glasses**	☐ Lab Coat	☐ Fume Hood
☐ Neoprene Gloves	☐ Vented Goggles	☐ Apron	☐ Biosafety Cabinet
X Heatproof Gloves	☐ Splash Goggles	☐ Dust Mask	☐ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- DO NOT use metallic containers. Use only glass or ceramic or plastic containers.
- The microwave MUST contain small plastic cups with water (about 100-200 ml).
- Cover sample containers with a vented cap to avoid possibility of steam explosions or thermal stress shattering of porous or brittle aggregates. DO NOT seal the container, only use vented cap.
- Be prepared to smother or extinguish flames to prevent operator injury or equipment damage if highly organic soils or soils containing oil are being dried. Smothering can be accomplished with a non-vented cap/cover.
- The microwave MUST be at least 6 inches from back of the countertop wall.
- DO NOT tamper with or adjust the door latch.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **11/26/2012**

Approved By: **David J. White** **Date:** **11/26/2012**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Moisture Content Determination using Oven Drying (ASTM D4959/D2216)

Dept: CCEE

Bldg/Rm: _____

Lab Supervisor: _____

Procedure Overview:

The procedure involves determining moisture content of the soil by placing a soil sample in a metal container in the oven set at about 110^{o}C for a period of about 16-24 hrs. The oven temperature may be set at lower or higher than 110^{o}C for sample drying purposes.

Power: Power is controlled from a front panel mounted combination power switch and a circuit breaker. Press the **I** half of the rocker-type power switch to turn the oven on. Press the **O** half to turn the oven off. To reset the breaker, place the switch in the off position, then return it to the on position.

Controls: Temperature dial sets the oven operating temperature in degrees **Celsius**. Heat indicator lights when power is being supplied to the oven heater. Alarm indicator lights if the actual oven temperature exceeds the alarm temperature. The alarm temperature is factory-adjusted to be 5^{o} C above the set temperature. Power indicator lights when the power is on.

Operation: To achieve a set temperature, perform the following:

(1) Rotate the temperature dial full counterclockwise.

(2) Place the power switch in the ON position. The Power indicator will come on.

(3) Rotate the temperature dial to the desired temperature. The heat indicator will then come on.

(4) When the actual temperature reaches the target temperature, the heat indicator will cycle on and off to maintain the temperature at the target level.

Health and safety hazards:

- Hot metal containers
- Heat retained in samples
- Particle shattering during heating, mixing, or mass determination
- Possibility of steam explosions or thermal stress shattering of porous or brittle aggregates
- Possibility of ignition when drying highly organic soils or soils containing oil

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

□ Latex Gloves	□ Insulated Gloves	□ Face Shield	□ Respirator
□ Nitrile Gloves	**X Safety Glasses**	□ Lab Coat	□ Fume Hood
□ Neoprene Gloves	□ Vented Goggles	□ Apron	□ Biosafety Cabinet
X Heatproof Gloves	□ Splash Goggles	□ Dust Mask	□ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- Do not stand in front of an open oven.
- Cover sample containers with a vented cap or paper towel to avoid possibility of steam explosions or thermal stress shattering of porous or brittle aggregates
- Be prepared to smother or extinguish flames to prevent operator injury or equipment damage if highly organic soils or soils containing oil are being dried. Smothering can be accomplished with a non-vented cap/cover.
- Do not use in the presence flammable or combustible materials.
- The heater is in the bottom of the unit. Surface temperatures at the bottom cover of the unit may be higher than set point temperature. Do not place items on the heater cover.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa/Don Davidson** **Date:** **12/30/2013**

Approved By: **David J. White** **Date:** **12/30/2013**
Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Proctor Compaction Testing (ASTM D698/D1557)

Dept: CCEE

Bldg/Rm: Room 42 TEB

Lab Supervisor: David J. White

Procedure Overview:

The ASTM D698/D1557procedures involve compacting moist soils in a steel compaction mold (4 in. or 6 in. diameter) using a mechanical compactor or manual hammers, to determine the relationship between molding water content and dry unit weight at different compaction energies. ASTM D698 involves using a 5.5 lbf hammer with a drop height of 12 inches while ASTM D1557 involves using a 10 lbf hammer with a drop height of 18 inches. The procedure also involves determining moisture content in accordance with ASTM D2216 oven-drying procedure. Health and safety hazards associated with ASTM D2216 testing are addressed in a separate SOP.

Health and safety hazards:

- Excessive noise
- Particles shattering during compaction
- Catching fingers under dropping hammer

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

☐ Latex Gloves	**X Work Gloves**	☐ Face Shield	☐ Respirator
☐ Nitrile Gloves	**X Safety Glasses**	☐ Lab Coat	☐ Fume Hood
☐ Neoprene Gloves	**X Ear Plugs**	☐ Apron	☐ Biosafety Cabinet
☐ Heatproof Gloves	☐ Splash Goggles	☐ Dust Mask	☐ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Other Control Measures:

- Keep hands clear off of the mechanical compactor, when compaction blows are being applied. Ensure that the protective cover is placed around the mechanical compactor, prior to starting the test.
- Prior to adjusting or removing the collar/mold, ensure that the hammer catching guard is placed under the automatic hammer.

Waste Disposal Measures:

Not applicable.

Decontamination Procedures:

Not applicable.

Spill/release Contaminant and Cleanup Procedures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **2/22/2012**

Approved By: **David J. White** **Date:** **2/22/2012**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Rapid Soil Processor

Dept: CCEE

Bldg/Rm: _____

Lab Supervisor: _____

Procedure Overview:

The procedure involves processing soils, i.e., breaking lumps of clay soils to help pass through the #4 sieve for moisture-conditioning and compaction testing. See manual for operating instructions, cleaning, and maintenance.

Health and safety hazards:

- CAUTION: The machine has 2,323 ft-lbs of torque on drum shaft. Follow hazard/safety control measures provided below to avoid injuries.
- Material shattering as large lumps break during the grinding process

Hazard Control Measures: (Lab coat, eye protection and hand protection must be selected as required by Section D of the Laboratory Safety Manual.)

□ Latex Gloves	□ Insulated Gloves	□ Face Shield	□ Respirator
□ Nitrile Gloves	**X Safety Glasses**	□ Lab Coat	□ Fume Hood
□ Neoprene Gloves	□ Vented Goggles	□ Apron	□ Biosafety Cabinet
X Work Gloves	□ Splash Goggles	□ Dust Mask	□ Glove Box

Note: Open-toed and heeled shoes are NOT allowed

Additional Control Measures**:**

- The guard over the drum gear and chain should be in a closed position when the machine is in operation. It is easily raised for cleaning and loading the machine.
- The machine is equipped with three switches. Switch #1 on the arm of the pressure plate automatically shuts the switch off before pressure damages the screen or drum. Switch #2 is manually operated to control the machine at any time and position. Switch #3 on the safety guard must be closed for the processor to operate.
- **Dry material or material containing aggregate over 3/4 inch, should not be processed.**
- The **Spring tension on the pressure plate,** which releases gravel without damaging the screen is **Pre-Set** and should not be changed.
- The weight of the Pressure Plate Arm has been pre-determined and should be sufficient to move material into the screen.

Waste Disposal/Decontamination/Spill/Release Contaminant and Cleanup Measures:

Not applicable.

Written By: **Pavana Vennapusa** **Date:** **12/30/2013**

Approved By: **David J. White** **Date:** **12/30/2013**

Lab PI or Supervisor

Standard Operating Procedure

Procedure Title: Work Zone Safety – Field Testing on Low-Volume Unpaved Roads (Shoulder/Minor Lane Encroachment)

Dept: CCEE

Bldg/Rm: N/A – Field Testing

Supervisor: David J. White

Procedure Overview:

This procedure involves setting up traffic control devices when working in field on low-volume unpaved roads with work on shoulder and/or minor lane encroachment. MUTCD guidelines for work on shoulders with and without encroachment on travel lanes (on high-volume roads), and lane closure (on low-volume roads) are attached to this SOP for reference. A modified traffic control procedure has been developed based on this, and is intended only for **short-term work on low-volume unpaved roads** with high visibility conditions (NO FOG, RAIN, or SNOW).

Short-term work is defined in MUTCD as follows: *"Short-term stationary is daytime work that occupies a location for more than 1 hour within a single daylight period."*

Health and safety hazards:

- Traffic
- Low visibility conditions (due to fog)
- Wind and dust

Hazard Control Measures:

x Work Gloves	x First Aid Kit (optional)
x Steel Toe Shoes	x Ear Plugs (may be needed when conducting field tests)
☐ Hard Hat	x Traffic signs
x Safety Vest	x Orange Cones
x Safety Glasses (when windy)	x Beacon Light

Other Control Measures:

- Setup beacon light on the truck and have it ON at all times during the field work.
- Hazard lights on the truck should be ON at all times during the field work.
- Setup "Road Work Ahead" Sign as indicated in the attached diagram.
- Park the truck in the shoulder with as minimum encroachment as possible in to the travel lane.
- Determine your work area and place orange cones as indicated in the attached diagram.

Written By: **Pavana Vennapusa** **Date:** **6/22/2015**

Approved By: **David J. White** **Date:** _____
Lab PI or Supervisor

Standard Operating Procedure

Traffic Control on Low-Volume Unpaved Roads with Shoulder Work or Minor Lane Encroachment

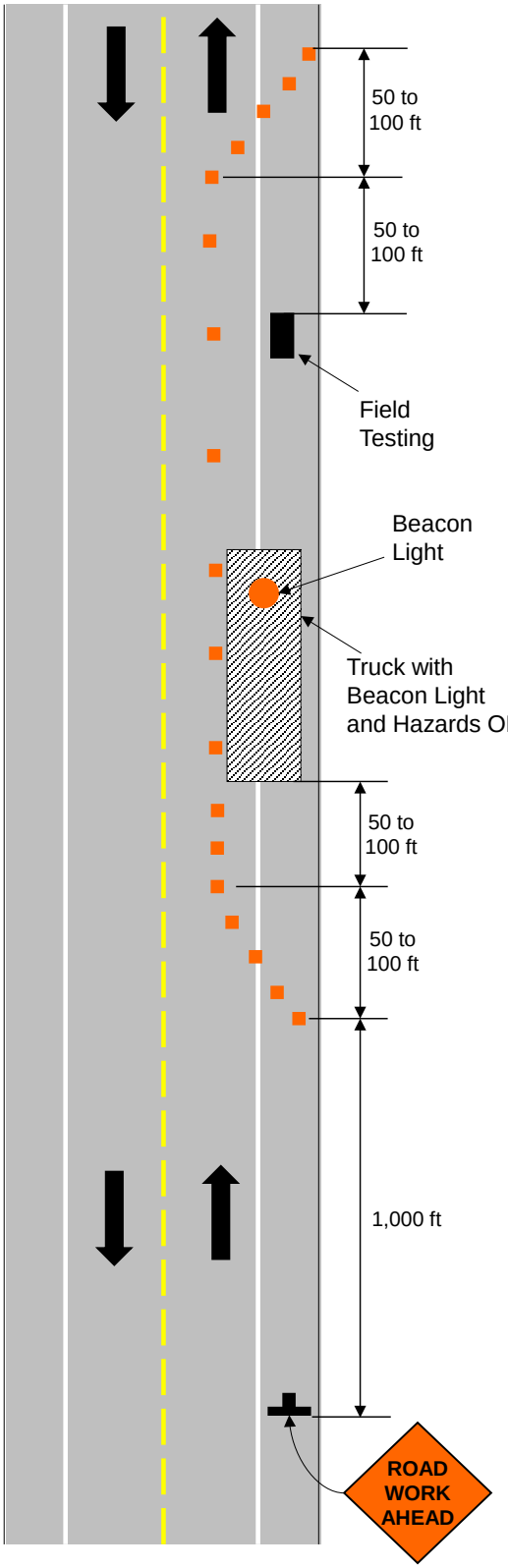
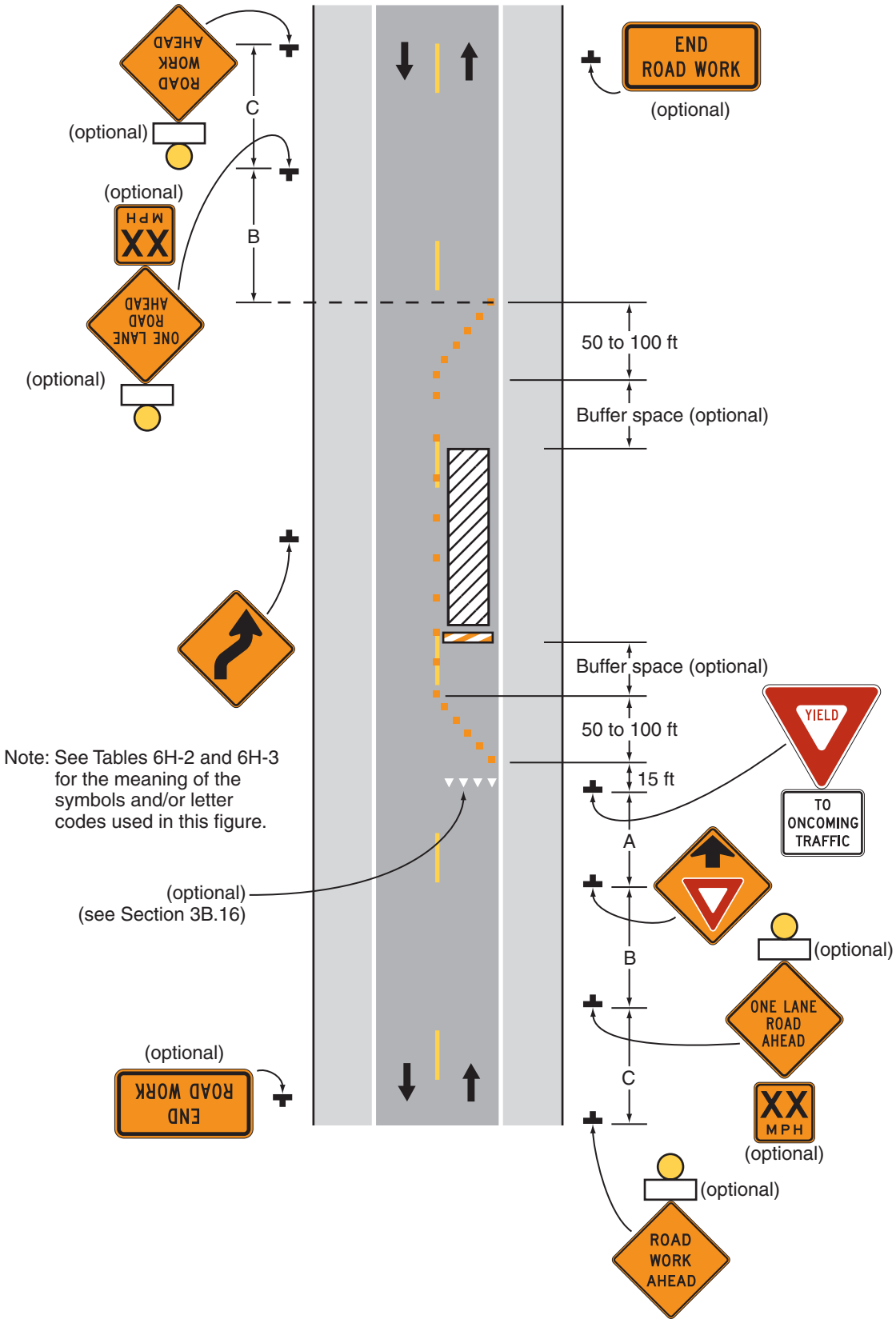
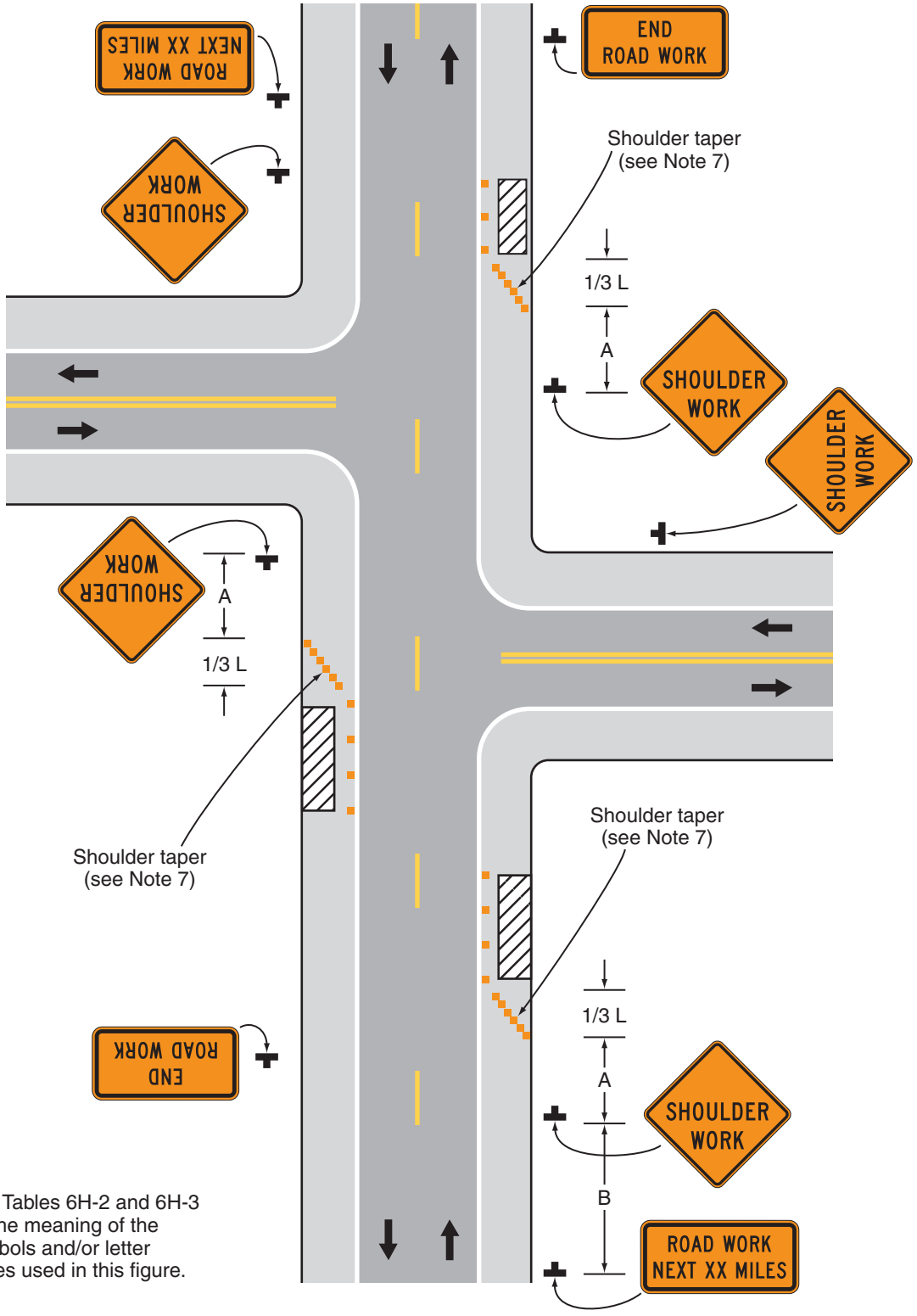


Figure 6H-11. Lane Closure on a Two-Lane Road with Low Traffic Volumes (TA-11)



Typical Application 11

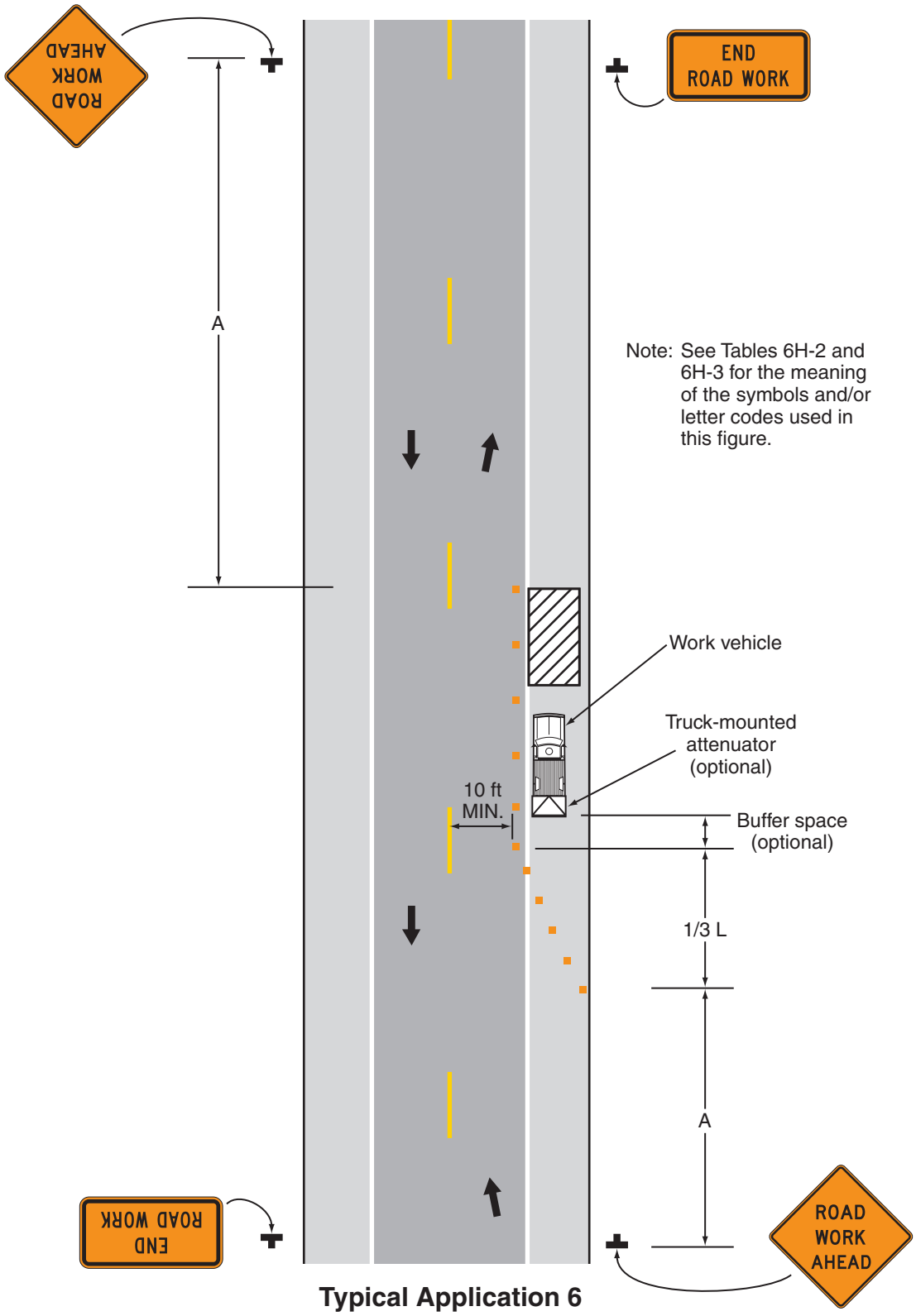
Figure 6H-3. Work on the Shoulders (TA-3)



Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.

Typical Application 3

Figure 6H-6. Shoulder Work with Minor Encroachment (TA-6)



Typical Application 6