INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 12-08
Technical Advisory

May 17, 2012

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/ Anthony L. Uremovich***
Anthony L. Uremovich
Manager, Office of Bridge Standards and Policy
Division of Bridges

SUBJECT: **Mechanically-Stabilized-Earth Retaining Wall Design**

REVISES: ***Indiana Design Manual*** **Section 410-5.01(06)**
ADDS: ***Indiana Design Manual*** **Section 410-5.01(07)**

EFFECTIVE: **September 12, 2012, Letting**

A. Design Criteria

For external stability, sliding eccentricity, *e*, at base, plus bearing capacity, deep-seated stability, and seismic stability shall be checked based on AASHTO *LRFD* 11.10.5.

The design height of the wall, *Z*, shall be measured from the theoretical top of the leveling pad to a point above the top of the wall as calculated from the formula as follows:

$$Z = H + L \tan \beta$$

Where:

H = height of the wall from the theoretical top of the leveling pad to the top of the coping,

L = width of the reinforced zone, and

β = surcharge slope angle as measured from the top of the coping.

See Figure 410-5(0)A, attached herewith.

B. Information to be Shown on Plans

The wall envelope should be determined from the plans' elevation view with three control lines. Control Line 1 defines the elevation of the top of coping, or wall, if no coping is used. It should be shown on the elevation view with stations and elevations in conjunction with cross-section locations. It should be located on the back face of the MSE wall or coping. Control Line 2 defines the elevation of the existing or proposed ground line in front of the wall. Control Line 3 defines the elevation of the top of the leveling pad. It is obtained by offsetting a minimum distance of 2 ft below the proposed ground line in front of the wall to the top of the leveling pad. All control lines should be shown and identified as such on the plans. Control Lines 1 and 3 should also be labeled as neat lines.

The minimum area required for the wall to be constructed should be defined by means of an envelope. The limits of the envelope are the beginning- and end-of-wall stations and the locations of Control Lines 1 and 3. From this information, a wall-elevation view along the front face of the wall showing leveling-pad and step locations should be prepared and shown on the plans as conceptual information for the contractor. The minimum area within the envelope described above should be the pay quantity for the wall. Figure 410-5(0)B, attached herewith, shows the difference between the minimum area required and an estimated amount of additional surface area required to construct the wall based on the wall-panel sizes and leveling-pad step increments described below. The area below Control Line 3 is conceptual information for the contractor and should not be included in the panels' pay quantity because it can vary depending on the wall system the contractor chooses. Pay quantities for each wall should be shown on the plans.

The plans should show the minimum height from the top of the leveling pad to the existing or proposed ground line, as required. The plans should also show all stations and offsets relative to the survey centerline on the back face of the wall for the beginning and ending points, and all such offsets for turn-point locations where the wall forms an angle. Details for drainage of the surface-water infiltration and reinforced-soil backfill should be included.

Panels of 10-ft length by 5-ft height should be assumed. Leveling-pad steps should be in 2.5-ft increments. The bottom of the pad should be level. The top of the wall or coping may be sloped. The standard-size-panel thickness should be taken as 6 in. The decorative-panel-size thickness should be taken as 9 in. Panel sizes and wall thickness should not be shown on the plans, as the wall-system manufacturer will show these values on the working drawings.

The elevation view should show and label all structure and appurtenance opening locations by station and elevation. The beginning and ending locations should be checked to determine where

the final grading elevations are equal both in front of and behind the wall, whereby the wall is no longer required.

C. Special Provision

Recurring Special Provision 731-R-597, attached herewith, should be called for beginning with the September 12, 2012, letting, if the project includes INDOT *Standard Specifications* Section 731 pay items.

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Attachments

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731-R-597 MSE PROVISIONS

(Adopted 03-15-12)

The Standard Specifications are revised as follows:

SECTION 211, BEGIN LINE 111, INSERT AS FOLLOWS:

(c) Type 3

Structure backfill in accordance with 904.05, except only nominal size aggregates 1 in., 1/2 in., No. 4 or No. 30, ~~or~~ *and* coarse aggregate No. 5, No. 8, No. 9, No. 11, or No. 12 shall be *stone or ACBF* ~~used. No slag other than ACBF will be permitted.~~

SECTION 731, BEGIN LINE 30, DELETE AND INSERT AS FOLLOWS:

~~The wall design shall follow the general dimensions of the wall envelope shown on the plans. The working drawings shall show the location of the concrete leveling pad to be at or below the theoretical leveling pad elevation shown on the plans. The top of each face panel shall be at or above the panel elevation shown on the plans.~~ *The Contractor shall determine the final leveling-pad layout and step elevations that provide the wall envelope shown on the plans. The Contractor shall use this information to provide a final horizontal plan and vertical elevation profile along the front face of the wall to account for the wall envelope shown on the plans. The final coping or top-of-wall elevations shall be at or above those shown on control line 1 on the plans. The final top-of-leveling-pad elevations shall be at or below those shown on control line 3 on the plans.*

Where a coping or barrier is utilized, the wall face panel shall extend up into the coping or barrier a minimum of 2 in. ~~(50 mm)~~. The top of the face panels may be level or sloped to meet the top of the face panel line shown. Cast-in-place concrete will not be an acceptable replacement for panel areas indicated by the wall envelope.

Where walls or wall sections intersect with an included angle of 130° or less, a vertical corner element separate from the standard panel face shall abut and interact with the opposing panels. The corner element shall have ground reinforcement connected specifically to that panel. *All turn-point locations where the wall forms an angle that are shown on the working drawings shall correspond to those shown on the plans unless otherwise approved in writing by the Engineer.*

SECTION 731, AFTER LINE 60, INSERT AS FOLLOWS:

An MSE wall shall be designed for a service life of 75 years. If a wall is supporting a spread footing for a bridge, the wall's design life shall be 100 years.

SECTION 731, BEGIN LINE 77, DELETE AND INSERT AS FOLLOWS:

(b) Height of Wall

The wall limits shall be defined by the wall envelope shown on the plans. For *internal stability* design purposes, the *design* height of wall~~, H,~~ shall be ~~measured from the theoretical top of the leveling pad to the top of the wall. For a wall with a level surcharge, the top of the wall shall be measured to the top of the coping or to the gutter line of the traffic barrier. The top of the wall shall be the theoretical top of the face panels only where a coping or barrier is not used. For a wall with a sloping surcharge, the top of the wall shall be measured at a point that is 0.3H back from the face where the design~~

~~height is H and the actual wall height is H. For an abutment face, H shall be defined as the height measured from the top of the leveling pad to the top of the roadway surface~~ *as follows*:

1. *For a wall with a level surcharge, the design height of the wall, H, shall be measured from the theoretical top of the leveling pad to the top of the coping or to the gutter line of the traffic barrier. The top of the wall shall be the theoretical top of the face panels only where a coping or barrier is not used.*

2. *For a wall with a sloping surcharge, the design height of the wall, Z, shall be measured from the theoretical top of the leveling pad to a point above the top of the wall as calculated from the formula as follows:*

$$Z = H + \frac{0.3H \tan\beta}{1\text{-}0.3 \tan\beta}$$

Where β = surcharge slope angle as measured from the top of the coping, and
H = height of the wall from the theoretical top of the leveling pad to the top of the coping.

3. *For an abutment face, the design height of the wall, H, shall be measured from the theoretical top of the leveling pad to the top of the roadway surface.*

SECTION 731, BEGIN LINE 112, DELETE AND INSERT AS FOLLOWS:

731.04 Submittals

The Contractor shall submit working drawings and design calculations in accordance with 105.02. Wall construction operations shall not begin until the Contractor receives written notice that the working drawings are approved.

(a) The working drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the wall. They shall include, but shall not be limited to, the following:

1. Plan and elevation ~~sheets.~~ *views along the front face of wall alignment, which shall include the following:*

   a. A final profile along the front face of the wall.

   b. A plan layout of the front face of the wall showing all alignment points with stations and offsets.

2. A plan view of the wall that indicates the offsets from the construction centerline to the face of the wall at all changes in horizontal alignment. A plan view and elevation view which detail the placing position and

connection of all ground reinforcement units in areas where piling, utility, or other structures are near the wall.

3. An elevation view *along the front face* of the wall *with respect to the wall alignment,* which shall include the following:

   a. The elevation at the top of the wall at all horizontal and vertical break points at least every 50 ft ~~(15 m)~~ along the face of the wall.

   b. All steps in the leveling pad.

   c. The designation as to the type of wall unit.

   d. The length of ground reinforcement units.

   e. A wall-elevation envelope that encompasses such envelope shown on the plans.

4. All general notes required for constructing the wall.

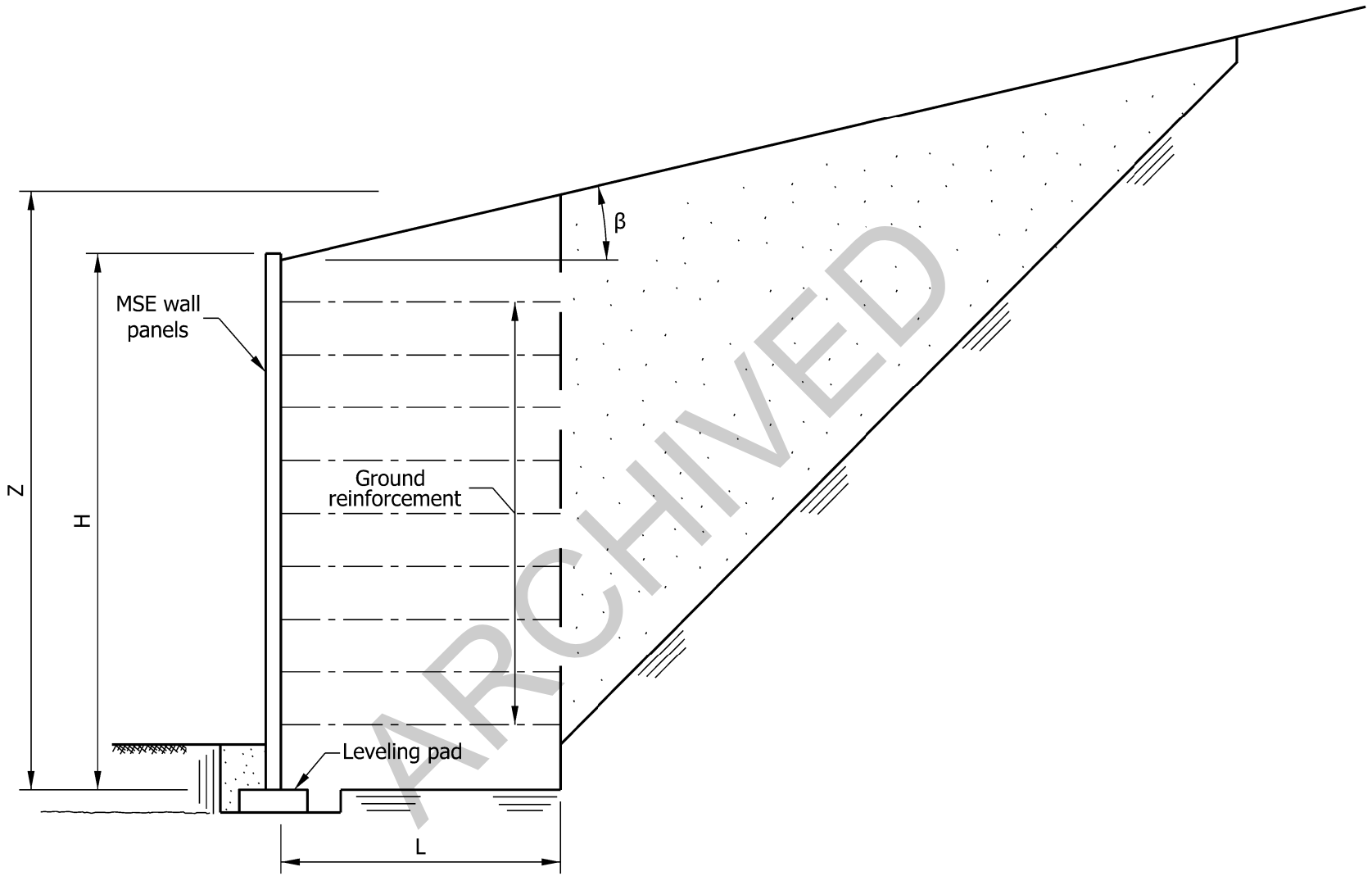
SECTION 731, BEGIN LINE 349, INSERT AS FOLLOWS:

731.12 Method of Measurement

The measurement of concrete face panels and wall erection will be based on the square foot ~~(square meter) of~~ area contained within the neat line limits of the wall envelope shown on the plans and not that of the wall system supplier.

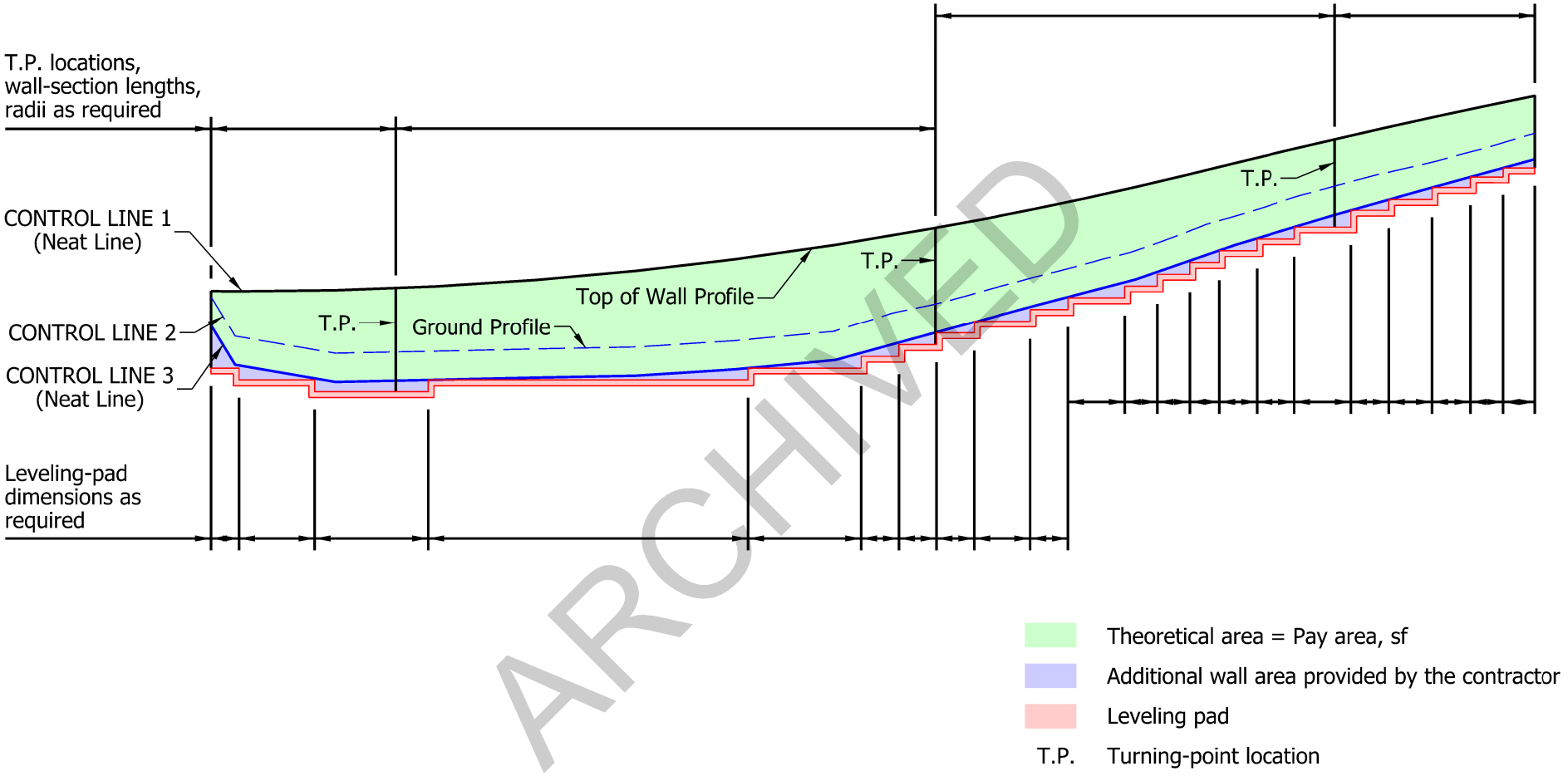
Concrete leveling pad will be measured by the liner foot ~~(meter)~~. Common excavation will be measured *by the cubic yard* in accordance with 203.27*(a) to the neat lines shown on the plans.* Structure backfill and B borrow will be measured in accordance with 211.09. Underdrains for MSE walls will be measured in accordance with 718.09. Unsuitable foundation materials, if found, will be measured in accordance with 211.09. Geotextile materials will not be measured.

Precast or cast-in-place concrete coping will not be measured. Drainage of the backfill including piping, aggregates, or geotextile materials will not be measured.



MSE RETAINING WALL SECTION SHOWING EXTERNAL-STABILITY VALUES

Figure 410-5(0)A



TYPICAL MSE WALL ELEVATION VIEW WITH WALL ENVELOPE

Figure 410-5(0)B