Workflow Descriptions –

Conventional & Conventional Modified Retaining Wall

Contents

Workflow 1A: Geometric Modeling – Concrete Structure 1
Workflow 1B: Geometric Modeling – Piles 3
Workflow 2: Rebar Modeling 4
Workflow 3: Earthwork Modeling – Structure Excavation and Structure Backfill 5

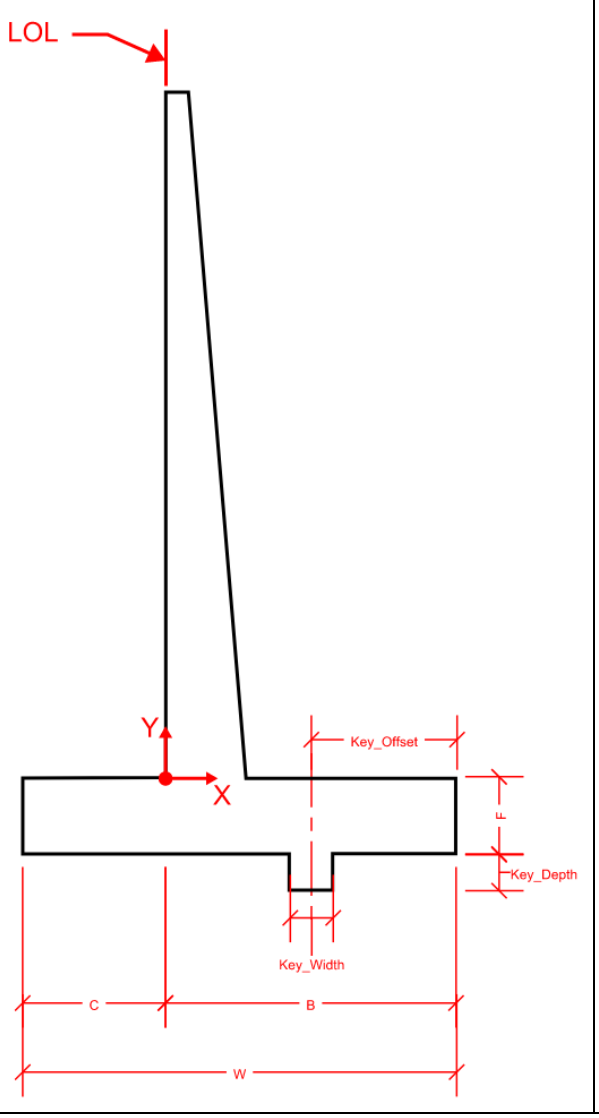
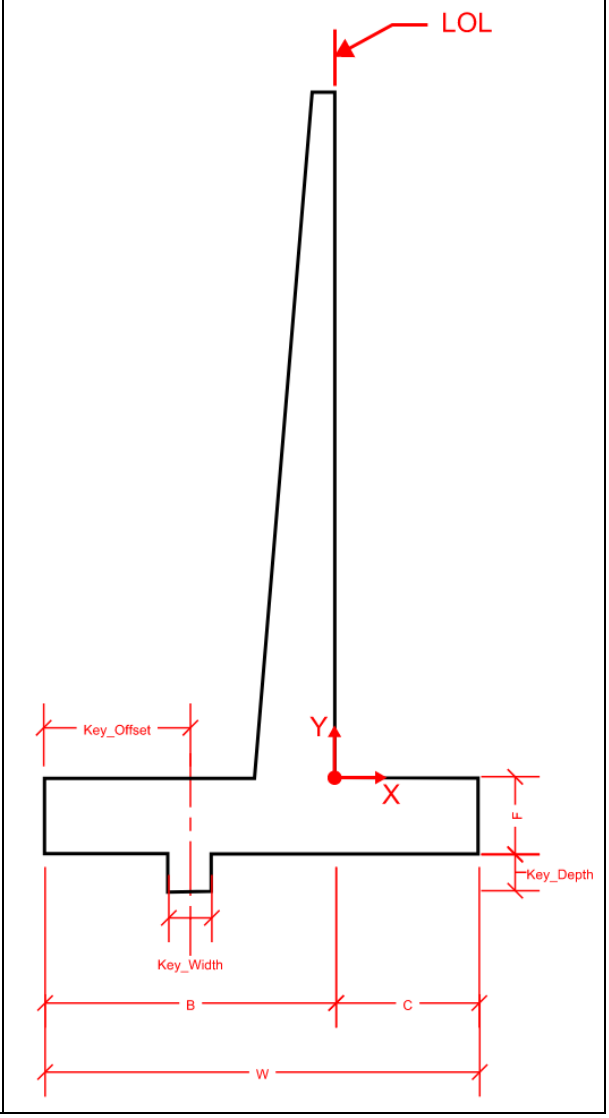
Workflow 1A: Geometric Modeling – Concrete Structure

1. Import Retaining Wall Alignment including the Top of Wall Profile from LandXML file.
2. Import Existing Ground and Finished Grade Surfaces from LandXML file.
    a. Note that these input files will also be used for the earthwork modeling workflow described in a separate document (see *G-06_CT_Workflow_General / Workflow 2*)
3. Specify the total length of the Retaining Wall and the length of each individual wall segment considering changes in Design Height, location of Expansion Joints, and other design details or requirements.
4. Specify Retaining Wall Geometric Parameters for each wall segment:
    a. Retaining Wall Type
        i. Retaining Wall Type 1 per Standard Plans B3-1A, B3-1B and B3-1C
        ii. Retaining Wall Type 1A per Standard Plans B3-3A and B3-3B
        iii. Retaining Wall Type 5 per Standard Plans B3-4A, B3-4B and B3-4C
        iv. Custom Retaining Wall Type with user input parameters
    b. Design Height
        i. Note that the Stem and Footing Parameters below should be automatically populated with values from the Standard Plans if a Standard Wall Type is selected.
    c. Stem Parameters
        i. Stem Orientation (Is the battered face on the left or right when looking at the cross section up station?)
        ii. Top of Wall Thickness 'T'
        iii. Batter Ratio

   d. Footing Parameters
      i. Parameter 'C' (distance from exterior face to closest edge of footing)
      ii. Parameter 'B' (distance from exterior face to opposite edge of footing)
      iii. Parameter 'F' (footing thickness)
      iv. Footing Key Depth
      v. Footing Key Width
      vi. Footing Key Location/Offset with respect to closest edge
      vii. Bottom of Footing Elevation
   e. Barrier or Barrier Slab Type
      i. Type 836 Barrier per Standard Plan B11-79 & B11-80
      ii. Type 842 Barrier per Standard Plan B11-81 & B11-82
      iii. Type 732SW Barrier Slab per Standard Plan B11-58 & B11-59
      iv. Custom Cross-Section
5. Extrude Wall Stem along the Top of Wall Profile. The bottom of the wall elevation is found by adding parameter 'F' to the Bottom of Footing Elevation.
6. Extrude Footing given the geometric parameters above.
7. Place footing steps where the difference in bottom of footing elevations of adjacent wall segments exceeds a specified tolerance.
8. Compute Footing Step Width based on Design Height per Standard Plan B3-5
   a. Footing step thickness = 1'-0" for H=4' to H=22'
   b. Footing step thickness = 1'-6" for H=24' to H=36'
9. Extrude Barrier or Barrier Slab above top of wall profile with specified distance requirements.
10. Add a haunch detail to the top of wall to properly support the base of the barrier or barrier slab (if applicable)
11. Place Expansion Joints and Weakened Planes at specified locations along the Retaining Wall span.
12. Place Utility openings given shape, size, location, and elevation of openings

Assign "Object ID" attribute to each wall stem, footing, step footing, and barrier or barrier slab. (See *E-01_CT_Object-ID_Reqs.pdf*)

Diagram below for reference only:

Footing Heel/Batter Side = Right	Footing Heel/Batter Side = Left
	

Workflow 1B: Geometric Modeling – Piles

1. Import Retaining Wall Alignment from LandXML file.
2. Define Pile Type, including Material and Installation Method
3. Define the Pile Rows along each Retaining Wall Footing. The Pile Rows are offset in the transverse direction of the wall, parallel to the Retaining Wall Alignment.
4. Define Pile Spacing along each Pile Row definition
    a. Allow option to define unique Pile Spacing per Pile Row
5. Define the Pile Cutoff Elevation and Tip Elevation

Workflow 2: Rebar Modeling

1. See Workflow 1 above:
    a. Note that Retaining Wall objects are already modeled (Stem, Footings, and Footing Steps).
    b. Note that the stem and footing parameters have been specified in Retaining Wall Geometric Modeling Workflow Section 4
2. Specify additional Rebar Parameters based on the Retaining Wall Type from the corresponding Standard Plan. The following parameters vary given the wall's Design Height 'H' value.
    - Spacing 'S'
    - a Bar Size
    - b Bar Size
    - c Bar Size
    - d Bar Size
    - h1 Dimension
    - h2 Dimension
    - h3 Dimension
    - Zone 1 s Bar Size
    - Zone 1 s Bar Spacing
    - Zone 2 s Bar Size
    - Zone 2 s Bar Spacing
3. Create sets of polylines to represent the centerlines of rebars in the following sets as applicable as per the Standard Plans. The sets are shown below and can be modeled in any order:
    a. Footing Rebar Sets
    - Top Longitudinal Bar @ Footing Toe
    - Bottom Longitudinal Bar @ Footing Toe
    - Top Transverse Bar @ Footing Toe
    - Top Longitudinal Bar @ Footing Heel
    - Bottom Longitudinal Bar @ Footing Heel
    - Bottom Transverse Bar @ Footing Heel
    - d Bar @ Footing Heel
    - Top Corner Bar @ Footing Toe
    - Bottom Corner Bar @ Footing Toe
    - Top Corner Bar @ Footing Heel
    - Bottom Corner Bar @ Footing Heel

    b. Stem Rebar Sets
    - Transverse s Bar @ Stem Exterior Face

- Longitudinal s Bars @ Stem Exterior Face
- Longitudinal s Bars @ Stem Battered Face
- c Bars @ Stem Battered Face
- Short c Bars @ Stem Battered Face
- b Bars @ Stem Battered Face
- a Bars @ Stem Battered Face
- e Bars @ Stem Battered Face

4. Extrude rebar along the Polylines from step 3 given the different rebar parameters in Step 2 and according to the corresponding Standard Plans.
    a. Assign additional user defined attributes to each bar as applicable using the Object ID (See *E-01_CT_Object-ID_Reqs.pdf*)
    b. Also, see Attribute Workflow described in a separate document (see *G-06_CT_Workflow_General.pdf / Workflow 2*)

Workflow 3: Earthwork Modeling – Structure Excavation and Structure Backfill

1. See Workflow 1 above
    a. Note that alignment, Existing Ground, and Finished Grade surfaces are already imported. Bridge objects are already modeled (retaining wall used here as an example).
2. Specify the total length of earthwork operations and the length of each individual earthwork segment considering changes in structural geometry, steps, and any plan or spec driven requirements.
3. Specify Earthwork Geometric Requirements for each segment using project plans and Standard Plans (and any structure specific notes):
    a. Structural Excavation Requirements
        i. Offset limits from structure faces (example: 1'-0" offset from footing side faces)
        ii. Bottom definition (bottom elevation, bottom profile, over excavation if required)
        iii. Side limits definition (vertical cut or slope, benches or shoring limits if applicable)
        iv. Any special geometric constraints at steps or transitions (segment breaks at step locations)
    b. Structural Backfill Requirements
        i. Backfill zone limits relative to the structure (example: within a specified offset behind the wall and around the footing)

ii. Top of backfill definition (trim to Finished Grade surface, or to a specified cap elevation if required)

4. Create earthwork solids that represent the plan and spec requirements:
    a. Create Structural Excavation Solid
        i. Create a solid representing the structural excavation envelope for the segment.
        ii. The solid limitation follows the shape of the retaining wall (extrude or loft along the wall alignment or wall path), using the modeled wall geometry as the controlling reference.
        iii. Trim or cut the excavation solid by the Existing Ground surface so excavation is limited to material below existing ground.
    b. Create Structural Backfill Solid
        i. Create a solid representing the structural backfill envelope for the segment (bounded by structure limits and excavation limits).
        ii. Trim or cut the backfill solid by the Finished Grade surface so backfill is limited to the finished condition.

Note: If steps or changing requirements exist along the wall length, generate multiple solids (one per segment) to match the geometric requirements and keep quantities clean per segment.

5. Assign tracking attributes. Assign "Object ID" (see *E-01_CT_Object-ID_Reqs.pdf*) to each excavation solid and each backfill solid for reporting and takeoff grouping.
6. Extract quantities
    a. Extract the volume of each excavation and backfill solid (by Object ID and by segment) as the earthwork quantity.
    b. Sum segment quantities for total structural excavation and total structural backfill.