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## Surface Models

### 2011 Construction Surveying – Automated Machine Guidance Muck Excavation

Create the following surface models for projects requiring automated machine guidance (AMG) for muck excavation:

- (1) In-place surface model  
The in-place surface is the surface immediately below bottom of in-place pavement (i.e., concrete, bituminous stabilized materials, cement stabilized materials), or topsoil, in areas requiring muck excavation.
- (2) Bottom of muck excavation surface model  
Muck excavation, removed using AMG, is all excavated materials immediately below the in-place surface, exclusive of rock or rock channel excavation. Soil borings, and other in-situ information, should be used to develop this model.

Ensure that the in-place surface model(s) extend to the limits, or slightly beyond, those needed for the bottom of muck excavation surface model to allow tying of models together for calculation of quantities.

Provide the following files to the Contractor as part of the award package:

- (1) Background files in DGN format
- (2) Alignment files in LandXML format
- (3) In-place surface model in LandXML format
- (4) Bottom of muck excavation surface model in LandXML format

See **Design Scene Part 1 Pay Item Guidance**, for information detailing when the AMG muck excavation pay item is required on a given project.

2011.601 CONSTRUCTION SURVEYING by LUMP SUM

### 2232 Mill Pavement Surface – Automated Machine Guidance Milling Using Relative Surface or Robotic Total Stations

#### *3D surface models*

Create the 3D surface models for both existing and milled surfaces.

The following design constraints require consideration for development of the relative milled surface model:

- (1) Minimum milling depth
- (2) Maximum milling depth
- (3) Cross-slope corrections, if any

- (4) Determination of critical project constraints (e.g., no shoulder PI impact, minimal profile change, etc.).

*Model extent requirements*

- (1) Extend milling depth and existing surface models a minimum of 1 to 2 feet beyond the width of asphalt surface requiring AMG milling. (This allows for positioning of milling machine end gates to be placed outside of the milling areas as the milling drum is approximately 6 inches inset from the outside edge of these gates.) Ensure that the 1- and 2-foot model extension is reflective of the existing slope in that region should a breakline exist.
- (2) Ensure milling depth and existing surface model extents overlap by a minimum of 300 feet for instances where the models are split into multiple segments (files). See Figure 2232-1 for an example of a model split into 3 segments (files).
- (3) Mill depths must match on all model extent overlaps.

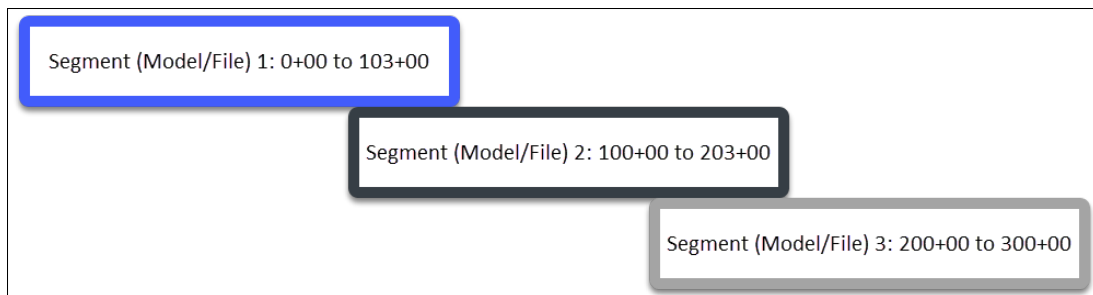


Figure 2232-1: Example of the overlap in model extents when overall project split into 3 segments.

*Milled surface model smoothness*

High levels of initial smoothness have been shown to have a significant effect on the future smoothness of pavements and have been linked to increases in pavement life. The design shall provide adequate theoretical lane profile smoothness in order to achieve high levels of initial smoothness in construction. The pavement profiles will be designed to meet smoothness criteria when analyzing using the add-on smoothness application that is available with some design software platforms. Should this application not be available within the design software version being used, review smoothness using ProVAL. [Instructions for review of smoothness](#), using ProVAL, are available on the resources page of the Advanced Materials and Technology website.

Generate a smoothness report using short continuous analysis. See table 2232-1 for values that require designer to further investigate cause, and if possible, modify design to remove roughness (e.g., additional template drops, insert of parabolic vertical curves, etc.).

Table 2232-1 IRI smoothness values requiring further model review

Description	IRI (inches per mile)
Mainline, Auxiliary Lanes, Collectors-Distributors (C-D)	Less than or equal to 30 inches per mile
Ramps, Shoulders	Less than or equal to 50 inches per mile

### Miscellaneous

- (1) Verify that the models match any tie-ins.
- (1) Be prepared to review exports from surface model to determine if any further modifications are needed. Involvement from Materials may be needed should select areas require milling outside of milling depth constraints for cross-slope corrections and/or adjustments for smoothness.
- (2) For micromilling applications, use minimum and maximum milling depths of 1/8 and 3/4 inch, respectively. This minimum mill depth ensures that the surface is at least scratched for better bonding of materials. Milling depths up to 1 inch are allowed within the model to assist with profile corrections and smoothness, however, these areas (i.e., areas with milling depths between 3/4 and 1 inch) should be limited due to the significant increase in teeth wear and reduction in production rates that occur with these deeper milling depths. Typically, conventional milling is completed in regions where milling depths exceed 1 inch.
- (3) Ground Penetrating Radar (GPR) data (with associated x-y coordinates collected) can be imported into the design software as a surface for assistance when creating the milling depth model.

### Award package

Provide the following files to the Contractor as part of the award package:

- (1) LandXML file with centerline and final profile.
- (2) The following surfaces models files from shoulder PI to shoulder PI:
  - (a) LandXML Relative Surface Models and 3D breaklines for: existing pavement and milled surface
  - (b) 2D Line-Work
- (3) Milling depths (within plus or minus a minimum of 0.01 feet) at 50-foot linear intervals, exported in \*.csv or \*.xlsm format, for the following nodes (include fill areas [pre-fill areas]): edges of pavement and centerlines, edge of shoulder (when AMG milling is required on shoulders), and at all breaklines
- (4) Control Points
- (5) Cross slopes/supers report at 50-foot linear intervals for the following nodes: all breaklines and grade breaks.

### Pay items

See **Design Scene Part 1 Pay Item Guidance**, for *information* detailing when the AMG milling using relative surface or robotic total stations pay item is required on a given project.

2232.604 MILL BITUMINOUS PAVEMENT (SPECIAL) by SQUARE YARD