

Session 4.4.1 Using 3D Stereo Data in the Estimation of Construction Quantities and Costs

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The Paving Operations office of the Metro Nashville Public Works Department employs a variety of GIS-centric methods to help manage its roadway resurfacing and pavement preservation programs. Metro Nashville tests and deploys a variety of pavement preservation techniques, and Paving Operations can use the GIS to easily filter data and visualize information about any of its 37,000+ roadway and alley segments. While GIS is of increasing usefulness within the Paving Operations office, our street centerline data and traditional orthophotography have proven for various reasons to be less than satisfactory tools for the accurate estimation of construction quantities required for a given section of roadway. Among other factors, the use of traditional GIS layers to estimate slightly irregular areas such as as-built pavement geometry does not readily accommodate shifts in the Z axis (elevation) over the course of any particular area or surface. Using traditional GIS to measure the area of a paved surface will not consider factors such as banked curves, hills, valleys, dips, intersection radius, etc., and is thus unreliable for estimation of construction-related quantities.

Currently, the best way for Metro Nashville Public Works to derive the actual dimensions of a roadway section to be paved is to send out a pair of inspectors in a vehicle with a distance measuring device installed onto the truck and ride the extents of the project, measuring all the dimensions with a wheel and logging the location of each shift in roadway width. Then the dimensions must be returned to the office for the area calculation to begin. This process, while extremely accurate, requires a significant investment in manpower and elapsed time – and the result is a piece of paper or a spreadsheet that has not traditionally been used to feed any of the data layers that are in use within the Metro Nashville GIS libraries.

With access to recent high-resolution aerial imagery (1 pixel = 6 inches) of the Metro Nashville – Davidson County service area, the Paving Operations office chose to investigate the use of 3D stereo imagery and analysis tools toward the collection of roadway geometry for construction quantity estimation. A high-accuracy 3D toolset is used to measure the roadway surface along the X, Y, and Z planes and to calculate the dimensions of each segment -- and the area calculation processes have been established to accommodate roadway width transitions that may occur within any specific segment.

This process is being tested as a means to calculate geometry data on an as-needed basis for the estimation of construction quantities associated with the roadway projects being bid for next fiscal year, and Paving Operations is planning to use the same methodology to eventually calculate as-built areas of the entire Metro Nashville service area to accuracies within 6" along the X and Y axes, and within 9" along Z axis. While the current use of this 3D data and the accompanying toolset is focused solely on the calculation of pavement geometry, Metro Nashville expects that this 3D imagery will soon prove just as useful in the creation of GIS layers for use in the maintenance of additional infrastructure assets such as sidewalks, signage, striping and pavement markings, traffic control hardware, etc.