

SECTION 719 Automated Machine Guidance - Concrete Paving

719.1 General

[Standard spec 650.3.1.2](#) allows the contractor to substitute automated machine guidance (AMG) for all or part of the concrete paving staking work under the contract. The extents of each AMG segment need to be described in the contractor's work plan. It is the contractor's option whether they will use AMG machine guidance or conventional methods.

Not all projects are suitable for AMG use. The AMG system for WisDOT projects should use Total Station technology to control paving operations. Projects can be challenged with a dense tree canopy, fog, sun light, large vertical cuts, or limited survey control which prove AMG is not suitable. On these projects, contractors would use conventional methods.

719.2 Initial Coordination

The contractor needs to provide the AMG work plan, as described in the specifications, to the project engineer before the preconstruction conference so the project engineer can evaluate the proposed plan.

An AMG work plan must document the items below:

- Portions proposed for AMG Concrete Paving
 - The plan should detail stationing or coordinates of paving sections that will be built using AMG technologies.
- Equipment and software of AMG equipment
 - Contractor should identify how many and types of robotic total stations to be used for guiding the paver when moving and the device to be used to perform quality control checks. Note: to achieve the best product possible, robotic total station with a 1" angular accuracy is required to for guiding the movement of paver. For static checks of the grade and top of pavement can be done with a robotic total station of 3" angular accuracy or lower.
 - The specifications for AMG equipment used on the paver.
- Key personnel, roles and responsibilities
 - Identify technical experts and who is responsible for monitoring paving operations. Who will be responsible for running AMG equipment on the paver. The plan should identify any consultants that will be on-site to assist the contractor to do AMG paving. Identify who is responsible to run the survey equipment for paving operations. Who is responsible for developing and revising contractor models used for AMG paving.
- Process for establishing project survey control and a map of the control points with their coordinates installed by the contractor.
- Contractor quality control for AMG, including the trimmed base and concrete final grade and position.

The design engineer, project engineer, region survey staff, appropriate management, and contractor survey personnel should be present at the pre-pour or a separate meeting before trimming/paving to discuss the AMG work plan. The project engineer should be in close contact with the region survey staff throughout the course of the project to assure the surveying aspects of the paving process are working properly.

719.3 3D Model Development and Exchange

Revise 719.3 to change wording from contractor to construction for data packet.

The contractor must develop and maintain the construction model for use with the AMG equipment, based on the initial survey information provided in the **construction** data packet, as discussed in [CMM 710.3](#). The department recognizes that the contractor will need time to develop the model.

The contractor is responsible for ensuring that the construction model agrees with the contract plans. If a plan error is discovered, the contractor must notify the project engineer. The project engineer will notify the designer of the errors so necessary plan revisions and updates to the existing surface can be made to the DTM. The contractor is still responsible for updating the construction model and sending the revised version back to the department in LandXML or another project engineer-approved format.

The project engineer and, if necessary the methods group in Bureau of Project Development should review the contractor's proposed model and perform spot checks by projecting known points generated from the plan cross sections onto the proposed model and generate an error report.

719.4 Site Control

The department is responsible for providing control from the initial survey. The contractor is responsible for verifying, supplementing, and maintaining the project control.

The project engineer should work with the region survey staff to develop a plan to perform construction checks. It is essential to provide some independent checks of the project control points before paving to assure the pavement is installed in the required location and elevation. These checks should be

performed using independent equipment and must meet the tolerances specified in the AMG work plan requirements of the contract special provision.

The project staff should do spot checks of pavement installed. Compare the x, y, and z coordinates of the pavement installed with the accepted cross section elevations.

Project staff should review paving plans with the contractor at adjacent pavement and bridges at centerline, edge of pavement, and other locations necessary to characterize existing profile and cross slope. The contractor must provide their plans in how the AMG paving is going to match into tapers and turn lanes before paving so locations of dowel joints are coordinated. The contractor must adjust design profile grade and cross slope to provide a smooth transition from the new pavement to the existing pavement or bridge. The contractor must notify the project engineer when a smooth profile cannot be provided. The contractor must submit final adjusted plan elevations to the project engineer.

The department reserves the right to do added checks as needed.

719.5 Training for AMG

An overview of AMG concrete paving uses and best practices, called "Proper Use of Stringless Paving Technology", is available from industry.

<http://www.wisconcrete.org/>

719.6 Best Practices for AMG for concrete paving

Best Practices:

1. The contractor should employ the services of a professional engineer or professional surveyor, licensed by the state of Wisconsin to provide the contractor the model used by the paver and operation of total station or GPS control equipment.
2. The model being used has been verified by the department and error checking was performed on the model. Error checking should include a comparison between the design and model to be used by the paver. Check model alignments and elevations to assure the contractor's model meets the design.
3. Control points used meet the 250' spacing requirements and are located where they will not be disturbed, instruments and paver should have line of site to three points.
4. Contractor is using approved AMG work plan.
5. Line of sight to instrument must be maintained, care must be taken in foggy situations and interferences with the exhaust from the paving equipment.
6. Control instruments should have line of site with at least 3 control points to maintain accuracy.
7. Radios should be checked periodically.
8. There should be a constant head of concrete in front of paver. Maintain a uniform delivery schedule. Consistent batch to batch properties is important. Operate paver vibrators per recommended machine specifications, typically 5000-8000 rpm and the paver speed should be constant without stops.

719.7 Checklist for AMG for concrete paving

Stringless Paving Checklist

Date Prepared: _____ By: _____

Project Name/No: _____ Location: _____

Check if the statement is true.

DATA CHECK AND MODELLING

- The CAD data is checked against plan sheets for errors in alignment, elevations, and cross- sections.
- Any discrepancies in the CAD data are confirmed with the owner/engineer.
- Surface mapping is conducted for use in 3-D modeling.
- The 3-D model is checked for segment to segment alignment.
- The profile is completed to characterize the surface on at least 25-foot intervals.
- For modeling the profile of an existing pavement: data was taken at lane edges, wheel paths, lane quarters, and centerline positions.
- The 3-D model is checked for constructability & compatibility with the equipment for paving tight turning radii.

SURVEYING

- The survey control network has been established and is tied into known benchmark(s).
- Control point locations are identified and are assessable throughout the project length.
- A plan for total station locations (or other instruments) is completed.
- Instruments are positioned adequately on both sides of pavement (if possible) and within recommended range of the instruments.
- Sandbags or anchors are in place to secure tripods in windy conditions.

EQUIPMENT CONFIGURATIONS

- Appropriate instrument types are selected for the application (total stations, GPS with total stations, GPS augmented with Lasers).
- The instruments selected with tolerances compatible with paving specifications and smoothness requirements.
- The placement of instruments is correct for the type of paving, tolerances, and specifications.
- The software, sensors, instruments and other components are compatible with paver and checked for proper operation before the start of production paving.
- Spare sensors, instruments and other components are available on the job site. Radios are properly powered, connected and signals are verified on the paving machine.
- Antennae are positioned vertically and checked for signal interference with metal components of the paving machine.
- Antenna positioned away from other metal (or object that may interfere with signal).
- Antenna for each radio is spaced at 1 1/2 feet or more.
- Batteries (including spares) are charged for all instruments and radios.
- The four corners of profile pan and mast elevations checked. (These should be checked after setting up machine for a new project, moving to a new location on site, after changing paver width, or if mast heights, prism swaps, or other instruments have been changed.)
- A plan is in place to configure the equipment for paving against existing pavement sections.

PERSONNEL

- Personnel assigned to project are trained and dedicated to the stringless equipment.
- Personnel assigned to project are capable to create, interpret and correct 3D data.
- Personnel assigned to project are familiar with using and maintaining the equipment/components of the stringless paver.

DAILY CHECKS AND SPECIAL CONSIDERATIONS DURING PAVING

- Battery life is assessed for weather conditions (particularly cool weather) and charged spare batteries are available for all equipment.
- Prisms are checked and cleaned of dust and moisture (dew) before starting paving.
- A plan is in place for receiving GPS signals (if GPS is used) when paving in wooded terrain, in urban environment, or under bridges where signals may be lost temporarily.
- A rover is assigned to check results behind paver or other equipment and to communicate results to the paver operator or ground crew foreman.
- The paver operator or ground crew foreman is trained to make compensating manual adjustments to the on-board computer to meet project specifications and tolerances.