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Uses and Benefits of 3D Milling

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Uses and Benefits of 3D Milling

Introduction

Automated Machine Guidance (AMG) uses data from 3D engineered models to guide construction equipment. The equipment utilizes the Global Navigation Satellite System (GNSS) or robotic total stations to accurately and efficiently complete construction activities such as excavating, grading, milling, and paving.

3D milling equipment can adjust elevation and slope based upon data sent from a total station, removing the need for extensive labor associated with surveyors placing stakes and equipment operators continually adjusting for variable mill depths.

Problem

To enhance the safety of Oregon's roadways, correcting substandard cross slopes has been a major part of highway rehabilitation projects. The typical approach to obtain proper cross slope has been to use leveling (feathered asphalt wedges). This method presents many issues related to pavement quality and durability. By placing a variable depth pavement layer that is feathered to 0 inches, it is difficult to achieve uniform density. This can reduce the pavement life due to insufficient strength or increased permeability leading to moisture damage. The wedge can also present issues for future pavement rehabilitation. Accurate as-built drawings are rarely produced for leveling work. Areas where an asphalt wedge is constructed often exhibit poor bonding to lower pavement layers, low density values, and reduced performance necessitating deeper milling that wasn't anticipated in the pavement design. All of these factors add to the operational and material costs associated with the long term use of the facility.

When constructing a project in an urban section that has grade constraints, increasing grade with an asphalt wedge is typically not an option. In the most extreme cases, a costly full rebuild of the section is required to obtain the required cross slope. This causes a major disruption to the community as the sections are closed to remove and construct the new roadway.

When profile milling is attempted without machine guidance, existing pavement generally serves as initial control for the operation. After the first milling pass, the previously milled surface serves as control. When traffic staging interrupts this sequence, accurate grade construction cannot be expected.

Intended Projects

Projects that should realize the greatest benefits include those with tight constraints or high cost materials. Tightly constrained projects include cross slope correction between points with fixed elevation, alignment shift of crowned sections, and pavement removal in

urban areas with ADA issues. ACP removal and replacement with PCC is an example requiring control of the quantity of high cost materials (PCC). 3D milling has been used successfully by contractors on ODOT projects for this purpose.

Benefits

There are many benefits to using 3D milling that impact pavement through the entire lifecycle of the section. ODOT is implementing 3D design throughout the state which will provide contractors the data necessary for 3D milling. This approach will allow constant grade control during milling operations to achieve high precision work. With the use of a GNSS rover or other positioning tools, the grade can be checked by the inspector to assure that it meets specifications.

A positive impact will be made on the staging of the project by removing staking tasks and automating the depth and slope of the milling machine. Less time will be spent marking locations and making adjustments. If a large amount of material is to be removed, traditional milling machines can remove the bulk of the material and the 3D milling machine can be used to grade the final surface. This will reduce the amount of time and effort required to operate the total stations.

Adjusting the grade through milling operations allows for placement of a uniform thickness of ACP. Efficiency gains can be realized from removing the need for multiple setbacks of the paver during wedge paving. 3D milling also removes the need to mark the pavement for transitions in pavement thickness. The uniform thickness will help control the quantity of material being placed along with aiding in uniform compaction that will increase the durability of the pavement structure.

Implementation Plan

Small scale projects (less than 1 mile centerline length) that will adjust cross slope will be identified as potential candidates to pilot this technology. A project specific special provision will be written for Section 00620 to address the necessary aspects for 3D milling. The effort will include representatives from multiple ODOT disciplines and the construction industry.