AIM Innovation Showcase Application

Sponsor

Nominations must be submitted by an AASHTO member DOT willing to help promote the innovation. If selected, the sponsoring DOT will be asked to present the innovation at the Innovation Showcase during the AASHTO Spring Meeting.

1. Sponsoring DOT (State): Minnesota Department of Transportation

2. Name and Title: Adam Ahrndt, District 8 Resident Engineer

Organization: Minnesota Department of Transportation

Street Address: 2505 Transportation Road

City: Willmar

State: Minnesota

Zip Code: 56201

Email: adam.ahrndt@state.mn.us Click or tap here to enter text.

Phone: 320-905-0163

Innovation Description (30 points)

The term "innovation" may include processes, products, techniques, procedures, and practices.

3. Name of the innovation:

"Controlled Modulus Columns" Automated Roadway Support Method Delivers Construction Savings Click or tap here to enter text.

4. Please describe the innovation.

Stabilization is an important part of roadway construction projects, to ensure roadways can support pavement loads and minimize disruptions to the surrounding environment. Reinforcement is often needed when there are peaty or mucky soils, or the roadway is located near a waterbody. Traditionally, surcharges have been used to compress and stabilize mucky soils, but this often takes 6 months or longer of settlement time. Timber and concrete piles have been used to support the roadbed embankment as well. In MnDOT's Hwy 23 South Gap project, MnDOT is utilizing a new, innovative

solution called Controlled Modulus Columns (CMC). Developed in the 1990s, CMC, also called rigid inclusions, are a ground improvement technique executed through a simple procedure that involves injecting grout or concrete through the hollow core of the drilling tool. The CMC machines can place up to 11 concrete shafts per hour and are much quieter than a pile driving rig, reducing the impact to nearby communities. 430 columns were used in the Hwy 23 South Gap project; a time lapse video shows the installation process. “This innovative technique resulted in major time and cost savings—it took 2.5 weeks to drill the CMC columns, compared to 2.5 months for the original timber design plan. The CMC design saved the project $1.4 million,” said Alan Setrum, Hwy 23 South Gap project engineer. While CMCs are commonly used in construction projects, creating foundations for buildings and agricultures, they are still new to the transportation sector. MnDOT has utilized CMCs on two other projects, Hwy 169 at Nine Mile Creek and the Twin Ports Interchange, and is exploring expanded use in the future. “This method stabilized the ground, providing the strength needed to carry the roadway far into the future, without adverse effects to our surrounding environment,” said Adam Ahrndt, District 8 resident engineer.

5. What is the existing baseline practice that the innovation intends to replace/improve?

Surcharging mucky soils and allowing it to compress over months of time. Driving wood piles is another method but is slow and loud due to pile driving equipment. Driving piles may also shake adjacent buildings.

6. What problems associated with the baseline practice does the innovation propose to solve?

Installing controlled modulus columns does not take months of settlement time that surcharging requires. It is also much less expensive than driving timber piles. Computers also provide a permanent record of each controlled modulus column to show that it has indeed reached all bearing parameters.

7. Briefly describe the history of its development.

Driving wood piles as old as 1200 years are used to hold up houses and structures in Venice, Italy. Some believe using wood piles to support houses has been happening since early human civilization. Controlled modulus columns automate this support method but are done thru automated drilling and filling the borehole with concrete grout. CMCs were developed by Menard's French affiliate, Menard Soltraitement, in 1994, and were patented in the US in 1999. Menard's first CMC project in the USA was for the support of a Lowes Home Improvement Store in South Burlington, Vermont. The company has recently been transitioning to the highway industry. Instead of supporting architectural structures, the concrete inclusions support the roadway.

8. What resources—such as technical specifications, training materials, and user guides—have you developed to assist with the deployment effort? If appropriate, please attach or provide weblinks to reports, videos, photographs, diagrams, or other images illustrating the appearance or functionality of the innovation below (if electronic, please provide a separate file). Please list your attachments or weblinks here.

MnDOT has presently drafted and routed new technical specifications for this type of embankment support. The new specification was drafted due to demand by other MnDOT districts seeking to

purposefully design this type of foundation treatment ahead of time. In the future, they will be listed as (2452) Column Supported Embankment. In District 8's case we treated this poor soil area as a mini-design build area. The contractor and MnDOT in D8 were able to employ trying this for the first time in D8 by using the MnDOT Value Engineering spec. 1408 – Value Engineering Incentive and use proprietary information from the contractor Menard that was approved by our foundations office on the condition they supply a geotechnical engineer and perform as the engineer of record for this one time use. The company did a wonderful job both in preliminary analysis of the site and being available on site during the installation of 736 columns. Attached is a video to show how efficient this method is, again it eliminates months settling time used by other methods. It also eliminates the slow and laborious process of driving wood pilings https://www.youtube.com/watch?v=2GXDK24rbck

AASHTO INNOVATION MANAGEMENT

State of Development (10 points)

Innovations must be successfully deployed in at least one State DOT. The AIM selection process will favor innovations that have advanced beyond the research stage, at least to the pilot deployment stage, and preferably into routine use.

9. How ready is this innovation for implementation in an operational environment? Please select from the following options. Please describe.

☐ Innovation is fully functional and yet to be piloted.

☐ Innovation has been piloted successfully in an operational environment.

☒ Innovation has been deployed multiple times in an operational environment.

☐ Innovation is ready for full-scale implementation.

Click or tap here to enter text.

10. What additional development is necessary to enable implementation of the innovation for routine use?

As mentioned in #8 above, MnDOT designers need fully vetted specs to be confident enough to routinely insert this into standard highway plans. The MnDOT foundations office worked with the district offices to draft new acceptable specs. and are almost ready to use more broadly now.

11. Do you have knowledge of other organizations using, currently developing, or showing interest in this innovation? ☒ Yes ☐ No

If so, please list organization names and contacts.

(Pennsylvania DOT, Illinois DOT, and Amazon. Names given are of prime contractors)

Organization	Name	Phone	Email
PENNDOT	Eric Klimas, P.E.	(724)-828-2800	Eklimas@gtcpgh.com
IDOT - (Illinois DOT)	Scott Marquart	(815)-338-5900	Smarquart@alliancecontractors.com
Amazon	Daryn Benedict Lariego	(913) -386-2015	Daryn.lariego@laytonconstruction.com

Potential Payoff (30 points)

Payoff is defined as the combination of broad applicability and significant benefit or advantage over baseline practice.

12. Identify the top three benefits your DOT has realized from using this innovation. Describe the type and scale of benefits of using this innovation over baseline practice. Provide additional information, if available, using quantitative metrics, to describe the benefits.

Benefit Types	Please describe:
Cost Savings	This method was 56% the cost of wood pilings
Environmental Benefits	No pounding or vibrations were needed to install CMC's
Shorter Schedule	This method shaved 1.5 months from our project schedule.

Provide any additional details below:

All columns were drilled 3 feet into the hard pan. The contractor showed this method is all computer controlled and printouts were provided to MnDOT showing each column's live performance requirements as they were drilled and grouted.

Deployability (30 points)

The AIM selection process will favor innovations that can be adopted with a reasonable amount of effort and cost, commensurate with the payoff potential.

13. What challenges and/or lessons learned should other organizations be aware of before adopting this innovation?

MnDOT has Value Engineering Incentive specifications, which empowered both MnDOT and the contractor to be innovative and introduce this new method. It saved us money, time, noise, and improved the quality of our finished roadway, with that spec. There would have been no incentive for the prime or MnDOT to even consider such a fix. MnDOT is also aware that designers are reluctant to use specifications that are not standard. So, a group here (District 3 and Foundations unit) took charge and created brand new specifications available for all designers to implement with confidence. This new specification will ensure MnDOT and other state agencies continue to use this money and time saving innovation.

14. Please provide details of cost, effort, and length of time expended to deploy the innovation in your organization.

Cost: The total cost as bid for wood pilings was $3.354 million. The total cost of the controlled modulus columns was $1.904 million, for a total project cost savings of $1,450,367.08

Level of Effort: The machinery and electronic computer gauges did all of the automatic grout injection very fluidly. Since there were no large timber piles to load into the piling rig, a large amount of human effort was eliminated – it also eliminated a significant amount of safety risks to the jobsite. Some CMC's were placed in less than a minute - IMPRESSIVE!

Time: The wood piles matrix was supposed to be done in a few months. The CMC's job that replaced them took only 2 weeks. An interesting note here is that the contractor usually shut down by 3:30, so their crews only worked a 8-hour workday, very professional operation.

15. To what extent might implementation of this innovation require the involvement of third parties, including vendors, contractors, and consultants? If so, please describe. List the type of expertise required for implementation.

Since this innovation is used in highway heavy construction – it will always be performed by a contractor or subcontractors - that bid on MnDOT road projects - at least under current circumstances. Once MnDOT finalizes its new spec. consultants and MnDOT designers should be able to easily insert it into plans with significant confidence. Presently companies that use this technology employ local vendors to source their grout (concrete grout) and rebar. They typically also employ the prime contractor to produce a locally source gravel working platform. The company then supplies its own onsite workers, machinery, and testing equipment. MnDOT also requires several onsite tests to be done by the contractor or our own construction inspectors. Some or all of this testing equipment may be supplied by the CMC contractor. An impressive output of this innovation is a detailed electronic file of data on each and every CMC column that was installed-that is stored in the MnDOT project file.