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Smart Infrastructure
Presented By
John Wallace
Director Intelligent Systems
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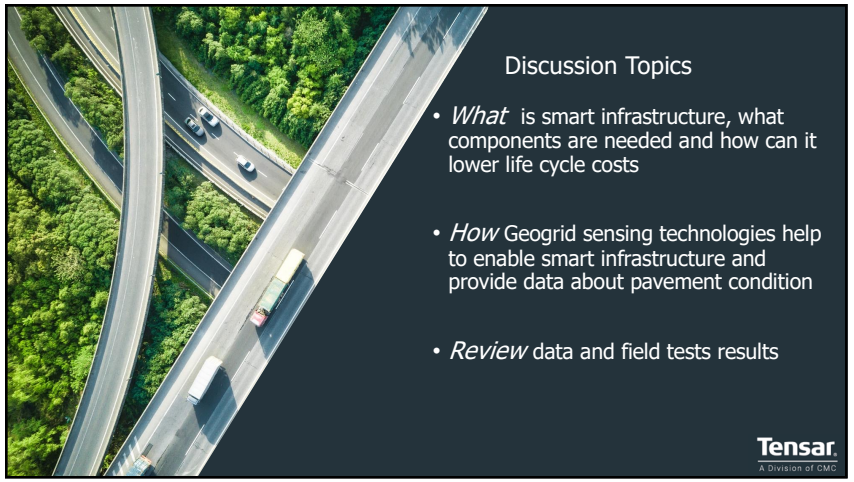
Discussion Topics
• What is smart infrastructure, what components are needed and how can it lower life cycle costs
• How Geogrid sensing technologies help to enable smart infrastructure and provide data about pavement condition
• Review data and field tests results
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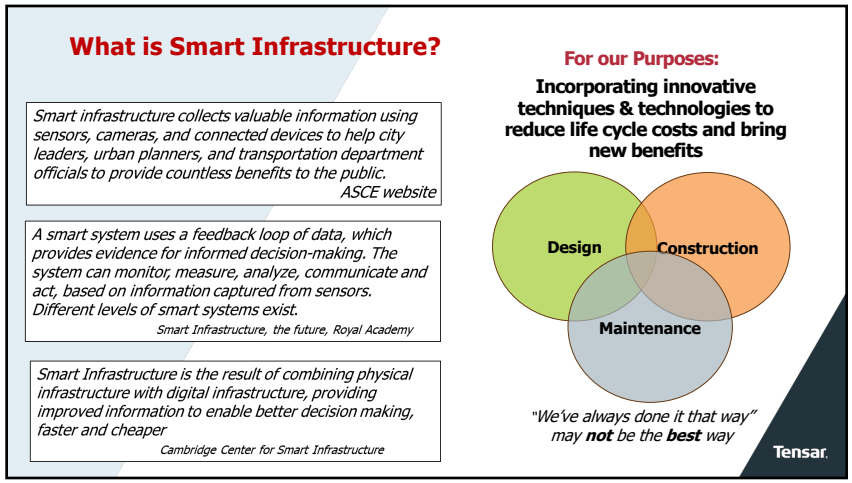
What is Smart Infrastructure?
Smart infrastructure collects valuable information using sensors, cameras, and connected devices to help city leaders, urban planners, and transportation department officials to provide countless benefits to the public.
ASCE website
A smart system uses a feedback loop of data, which provides evidence for informed decision-making. The system can monitor, measure, analyze, communicate and act, based on information captured from sensors. Different levels of smart systems exist.
Smart Infrastructure, the future, Royal Academy
Smart Infrastructure is the result of combining physical infrastructure with digital infrastructure, providing improved information to enable better decision making, faster and cheaper
Cambridge Center for Smart Infrastructure
For our Purposes:
Incorporating innovative techniques & technologies to reduce life cycle costs and bring new benefits
Design
Construction
Maintenance
"We've always done it that way" may not be the best way
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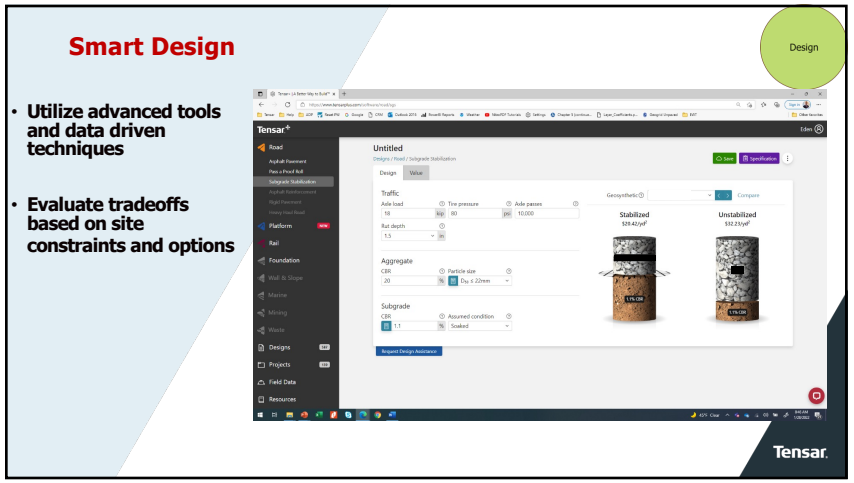
Smart Design
Design
• Utilize advanced tools and data driven techniques
• Evaluate tradeoffs based on site constraints and options
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Untitled
Traffic
Aggregate
Subgrade
Stabilized
Unstabilized
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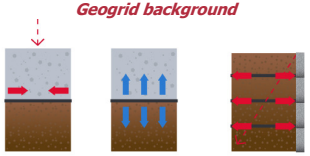
Smart Construction- Introduction To Geogrid's

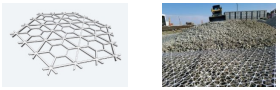
Supporting Sustainable Construction

Construction

Geogrid background

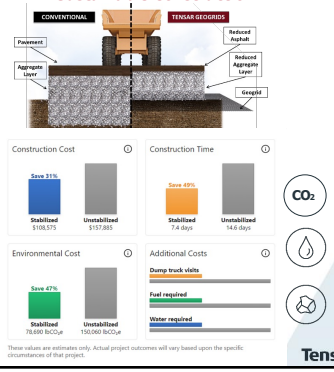


- Biaxial and multi-axial geogrids provide stabilization and filtration
- Uniaxial geogrids provide reinforcement



Tensar's Multi-Axial InterAx geogrid

Sustainable Construction



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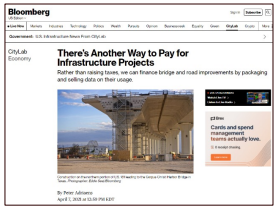
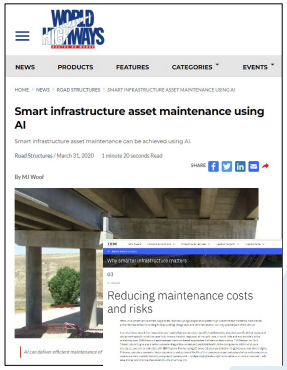
Smart Infrastructure Uses Data to Realize "Non-Traditional" Benefits

What if my roads could talk?



Alternative Financing

Increased Resiliency



Asset Management/Cost Savings

www.worldhighways.com/wh10/news/smart-infrastructure-asset-maintenance-using-ai
www.bloomberg.com/news/articles/2021-04-07/use-data-not-taxes-to-pay-for-infrastructure
www.ibm.com/internet-of-things/learn/smart-infrastructure-management/#maintenance

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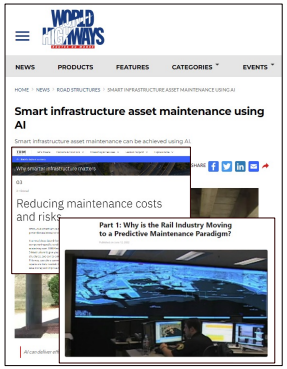
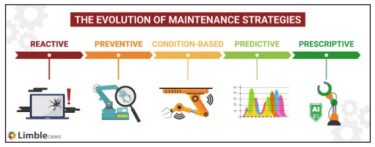
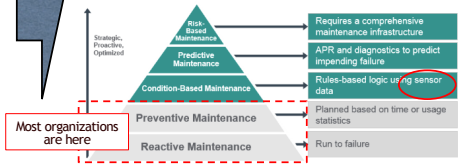
Smart Maintenance- Strategies are Evolving with New Technologies

Maintenance





It's a Journey



Smart sensing technologies enable a shift in maintenance strategy and better asset management

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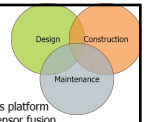
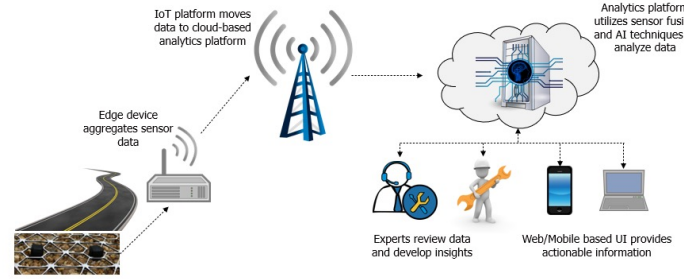
Intelligent Solutions Infrastructure Monitoring Platform

Geogrid based monitoring





Sensors provide data about hidden conditions → IoT and Analytic platform mines data for patterns → Experts & AI deliver Insights

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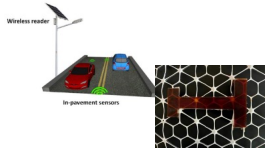
Smart Maintenance

Sensors provide insight into what's below the surface

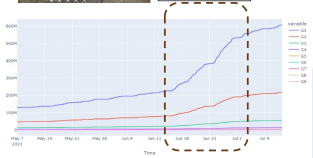
Maintenance



- **Utilizes Geogrid as base**
- **Purpose built technology provides insight into conditions "under the pavement"**
- **"No wires" system uses wireless communication and energy harvesting technology**
- **Wireless reader installed roadside to collect data and send to cloud based IoT platform**

Installation at FAA Blvd in Ft Worth

"With continuous monitoring, cities and municipalities can make information decisions for M&R activities, improve safety and prolong the service life of roadway infrastructure"-
Omar Elbagalati, Pavement Manager, City of Ft. Worth



Sensor Analytics detect & predict issues

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Sensor Installation- Unpaved Road Buchanan County IA

Sensors

Sensors placed in control and geogrid test sections

Final Installation

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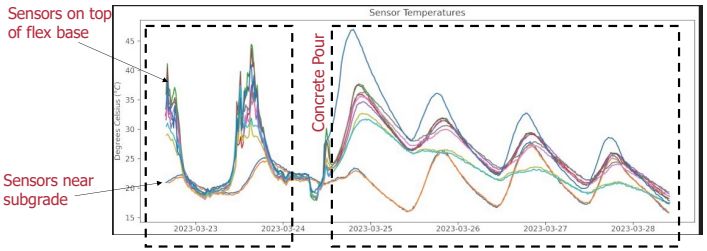
Smart Construction

Temperature Sensors Show Concrete Curing Cycle (FAA Blvd)

Construction



- Before concrete pour, sensors roughly followed ambient
- Note damped response of sensors closer to subgrade
- Sensor temperatures show slowly changing response as concrete cures and effects of ambient are damped
- All sensors eventually converge to similar value

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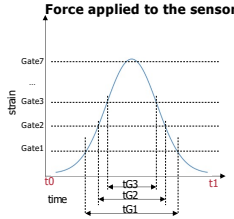
"Purpose Built" Technology For Geotechnical Needs

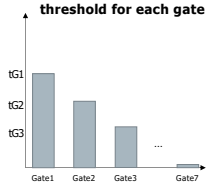
Energy Harvesting/Wireless capture & record strain with reduced complexity

Force applied to the sensor



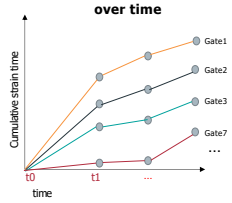
- Energy harvesting technology
- Sensor "Gates" capture time dynamic strain above corresponding threshold level
- **"Automatic" data compression (Terabytes to kilobytes)**

Records time above threshold for each gate



- Gate value represents total time above strain threshold
- Cummulative time stored for each gate and reported periodically

Graphs show performance over time



- Overlay graph provide cummulative strain time for all gates
- Gate 1 (lowest strain) always highest
- **Increasing levels in higher gates indicate damage starting to occur long before visible on surface**

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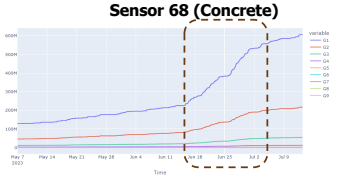
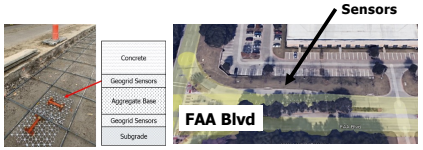
Sensor Data- Understand Conditions Beneath The Surface

Anomalies detected near concrete "cut line"

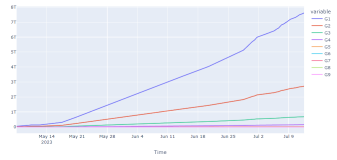
Maintenance

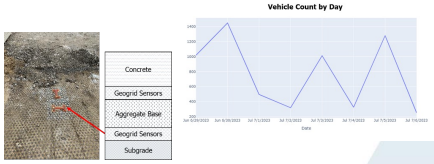
Sensor 68 (Concrete)





Sensor 60 (Subgrade)





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Smart Maintenance

Using Technology to Determine Surface Conditions

Maintenance

The "Old" Way

Upload

Image Collection:
- Condition Assessment
- Collection of Tasks and Inventory

Workflows in the web system:
- real-time image data
- task management
- digital report & planning tool

The "New" Way

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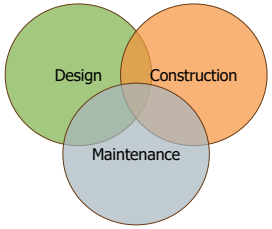
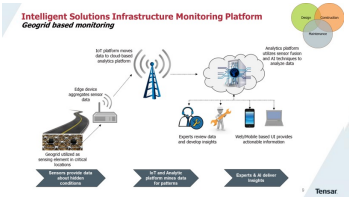
Smart Infrastruture Summary

- New, innovative technologies benefit entire life cycle of roads and other infrastructure
- Consider life cycle benefits early in the design cycle
- Sustainability & Resiliency important considerations
- Think short term… and long term!





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