

THE FUTURE OF ASPHALT PAVING

2024 TEAM Conference
Chateau on the Lake
Branson, MO



***Back to the
Late 1800's***



Measuring Properties of Asphalt



- Chewing Asphalt
 - Determined how hard the asphalt was by chewing it by a certified chewer.
 - Great for dental care, so they said.

Asphalt Availability

- Natural Oil Pits
 - Often considered a nuisance
 - Little Value at the time

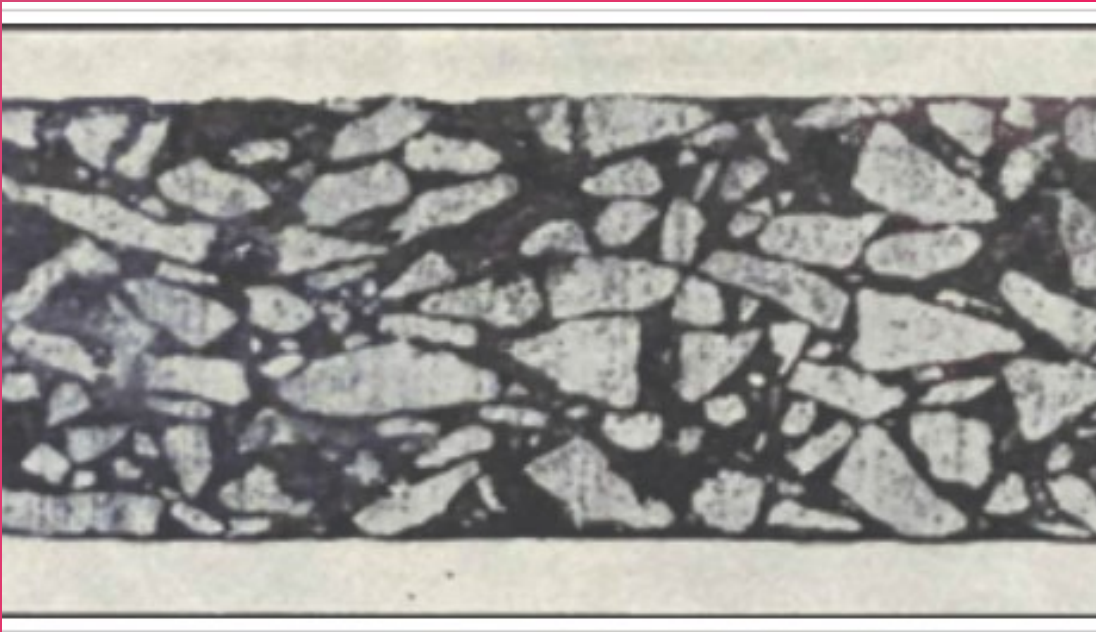




Properties of Aggregates

- Surface Mixes
 - Consisted of Sand

- Base Mixes
 - Consisted of larger aggregates



***Fast Forward
to the Early
1900's***



Measuring Resistance to Flow

- Penetration Test (1900's)
 - Measures how deep a needle drops into the asphalt binder.

Penetration Naming Convention

Depth of Needle (mm)	Viscosity	AC Pen Grade
4 - 5	Very Hard	40 - 50
6 - 7	Hard	60 - 70
8.5 - 10	Typical	85 - 100
12 - 15	Typical	120 - 150
20 - 30	Very Soft	200 - 300



Measuring Asphalt Mix Stability

- Marshall Mix Design (1940's)
 - Developed during WW-II
 - Later adopted by Asphalt Institute and still used today.



Figure 1: Marshall Hammer.



Figure 2: Marshall Stability and Flow device.




Figure 3: Marshall samples.

Measuring Resistance to Flow in Liquid Asphalt

- Viscosity Tests (1960's)
 - Kinematic (Gravity of Flow)
 - Absolute (Uses Pressure)
 - Saybolt Furol Viscosity



Viscosity Naming Convention Low Viscosity (Soft) - High Viscosity (Hard)		
Absolute Viscosity Pa-sec @ 140 F	Viscosity	AC Viscosity Grade Name
25	Very Soft	AC - 2.5
50		AC - 5
100		AC - 10
200		AC - 20
300		AC - 30
400	Very Hard	AC - 40



Pre-SuperPave Era

Before 1990's

What Is Superpave?

Understanding Performance-Based Asphalt



Traffic & Climate Considerations

- Focus on Aggregate Properties
- Focus on Asphalt Binder Properties
- Focus on Mixture Properties

Aggregate Properties

Aggregate Source Properties

- Hardness – Resistance to Abrasion
- Toughness – Soundness (Durability Tests)

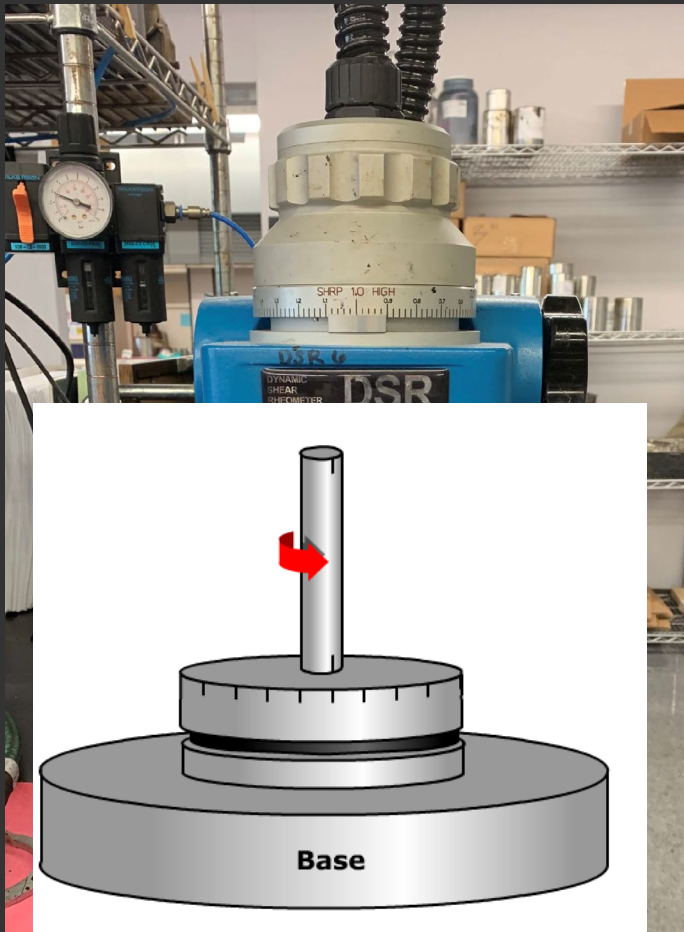
Aggregate Consensus Properties

- Coarse Aggregate Angularity
- Flat and Elongated
- Uncompacted Void Content of Fine Aggregate
- Sand Equivalent

Aggregate Gradation

Dynamic Shear Rheometer (DSR)

- DSR - Measures viscous and elastic properties of asphalt binder by two methods.

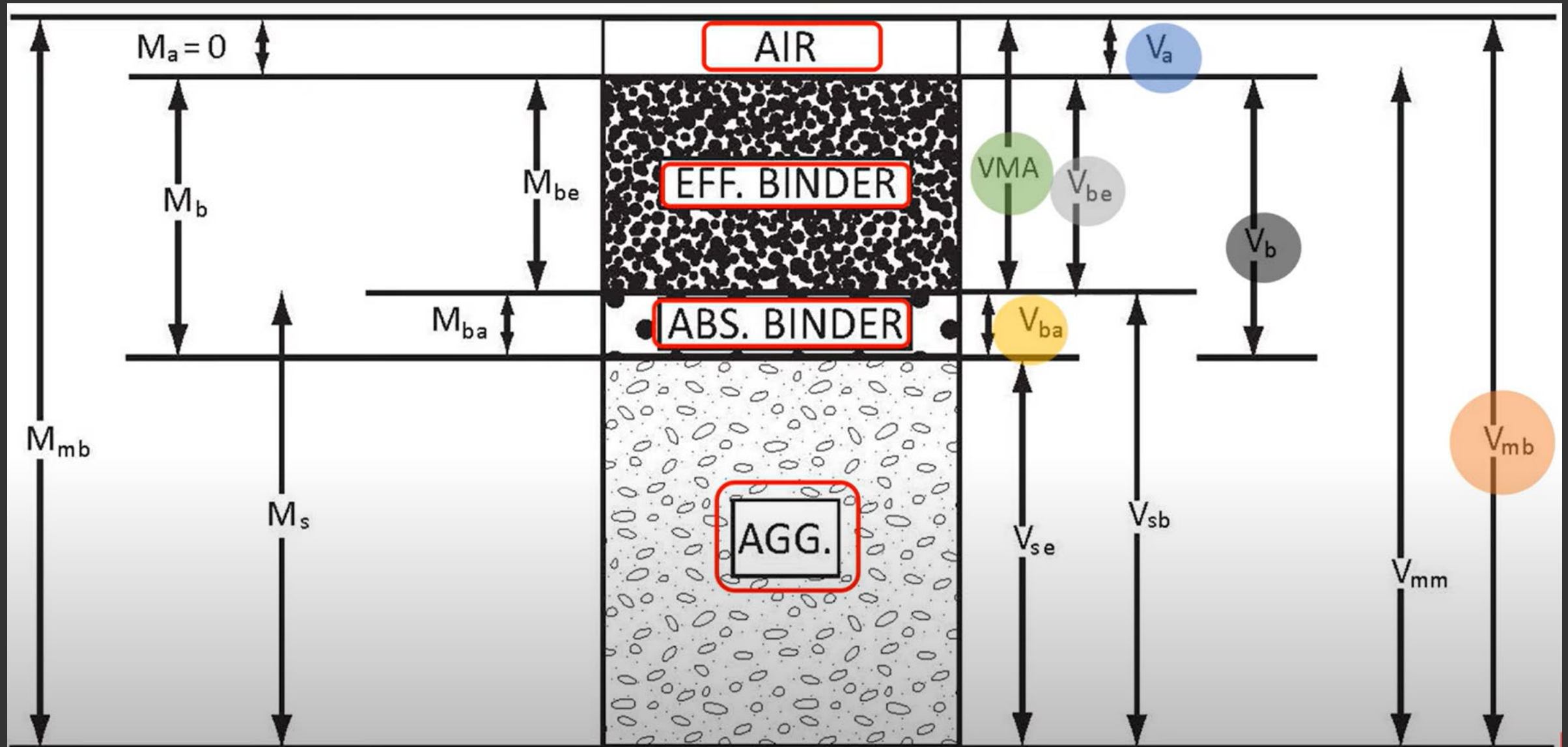


- Method 1 - Applies a torque and measures the resistance (G^*) and lag time of movement (δ).
 - $\uparrow G^*/\sin \delta \rightarrow$ Rut Resistant
 - $\downarrow G^* \times \sin \delta \rightarrow$ Cracking Resistant
- Method 2 – Applies a torque and measures the recovery effects (movement over time – J_{nr} value)
 - $\downarrow J_{nr}$ value \rightarrow Rut Resistant

Issues with the SuperPave Era

- Focuses on Material Properties; Not on End Result
 - A lot of laboratory and field testing required on individual mix components
- Greater Focus on mixture stiffness & stability
- Lacks True Performance Tests of the Asphalt Mixture
 - Introduction of Asphalt Recycling (RAP & RAS)
 - Rejuvenators & Additives
- Cost of Asphalt Binder Leads to Dry Mixes
- Changes in Binder Quality & Availability

Not going away from Volumetric Calculations!



To The Future of Asphalt Paving

- Performance Testing
 - Balanced Mix Design
- Paver Mounted Thermal Profiler
- Intelligent Compaction
- Intelligent Construction



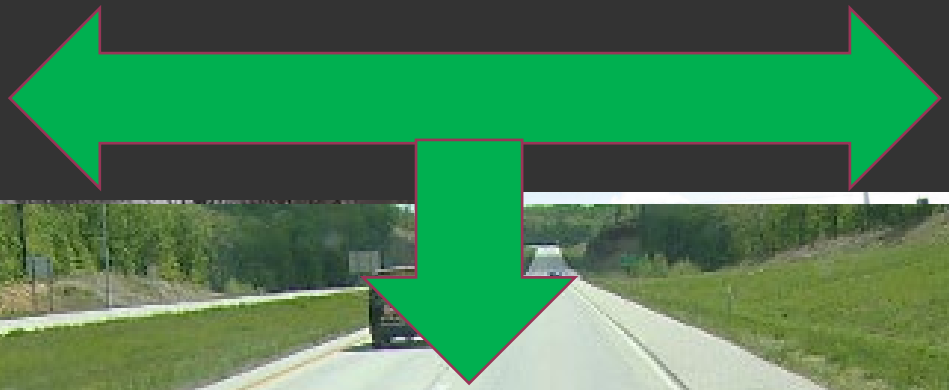
Tying BMD, PMTP, and IC all Together

- BMD Specifications – Using Performance Tests to ensure Crack and rut resistant and durable asphalt mixture without chasing individual mix components.
- PMTP Specifications – Uniform, properly handled asphalt mix is being delivered to the paver.
- IC Specifications – Consistent density of the entire mat
Roller Passes @ Compaction Temperature

What is Balanced Mix Design?

TOO STIFF

TOO SOFT



Asphalt Performance Tests

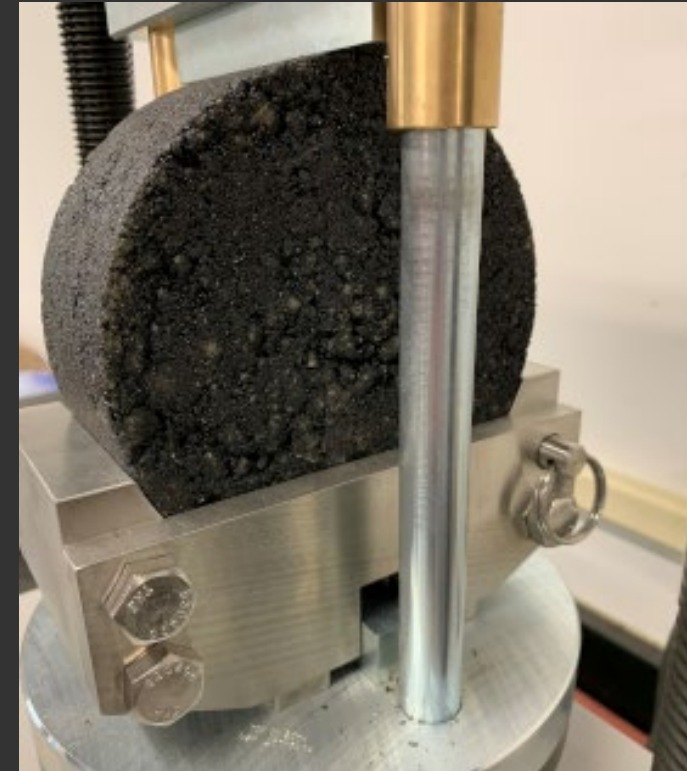
CRACKING

CT-Index



RUTTING

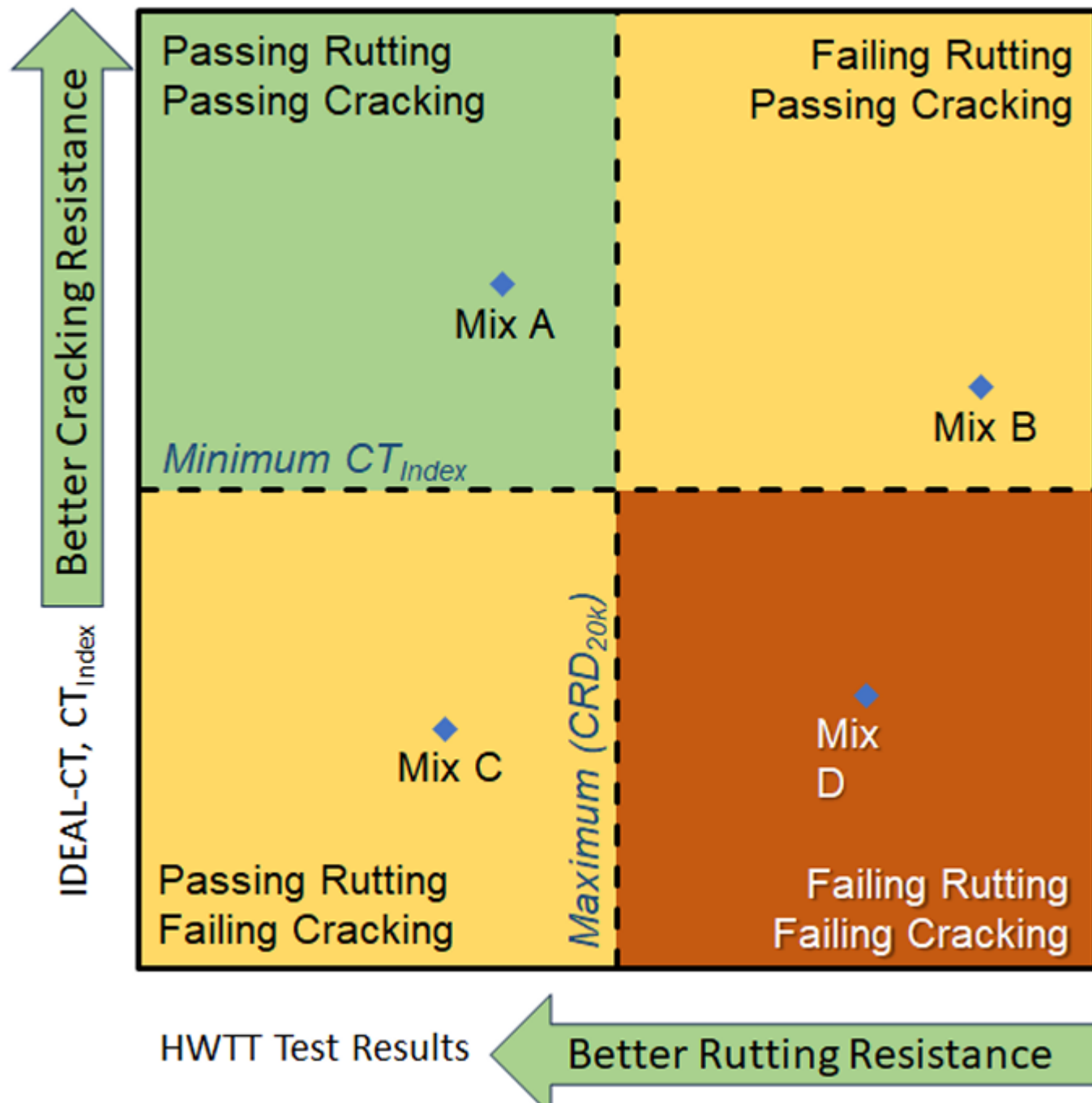
RT-Index



DURABILITY

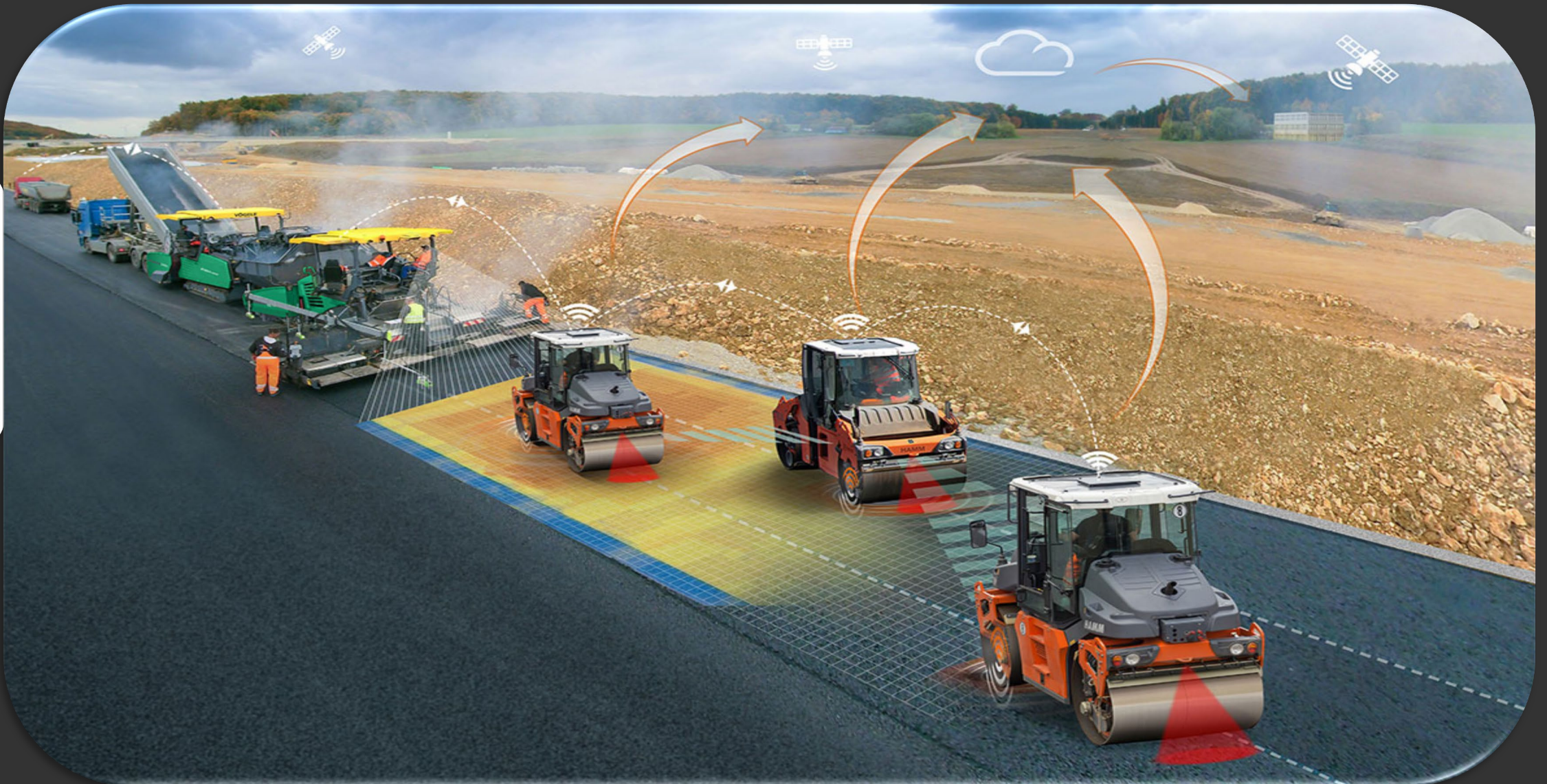
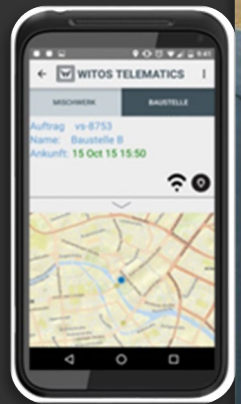
Tensile Strength Ratio (TSR)



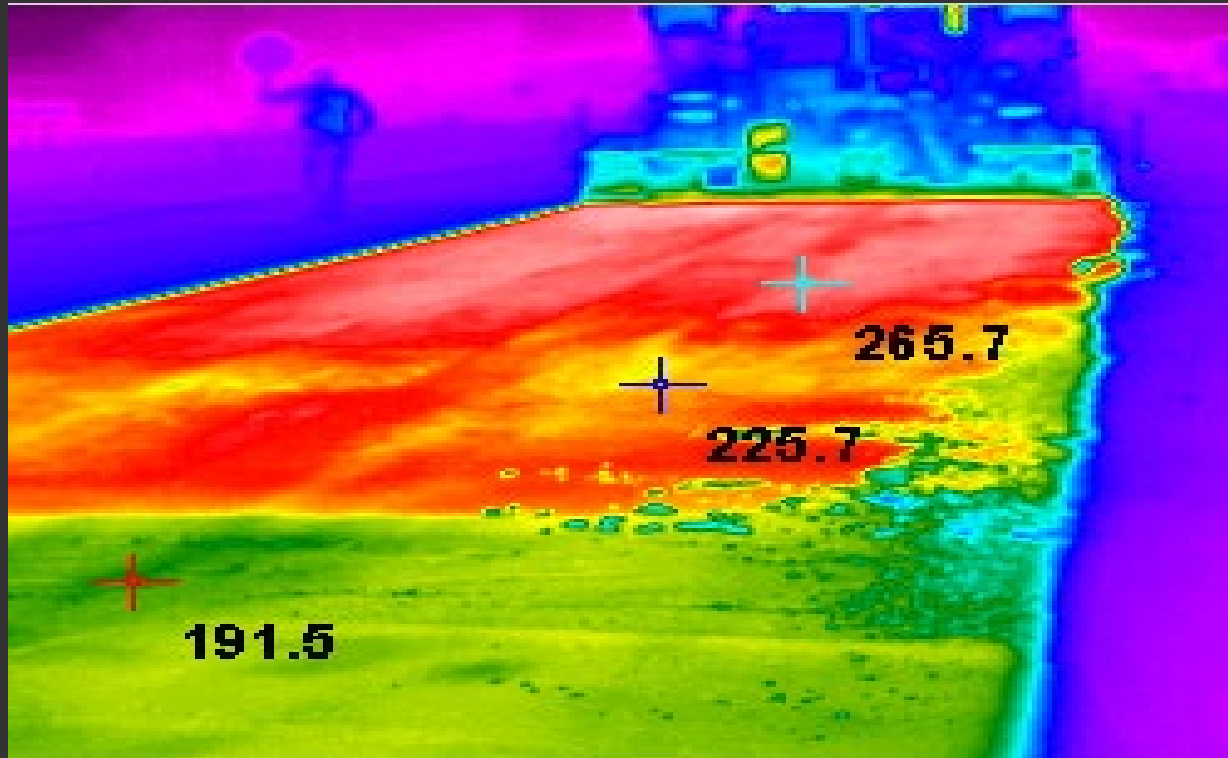


Intelligent Asphalt Construction

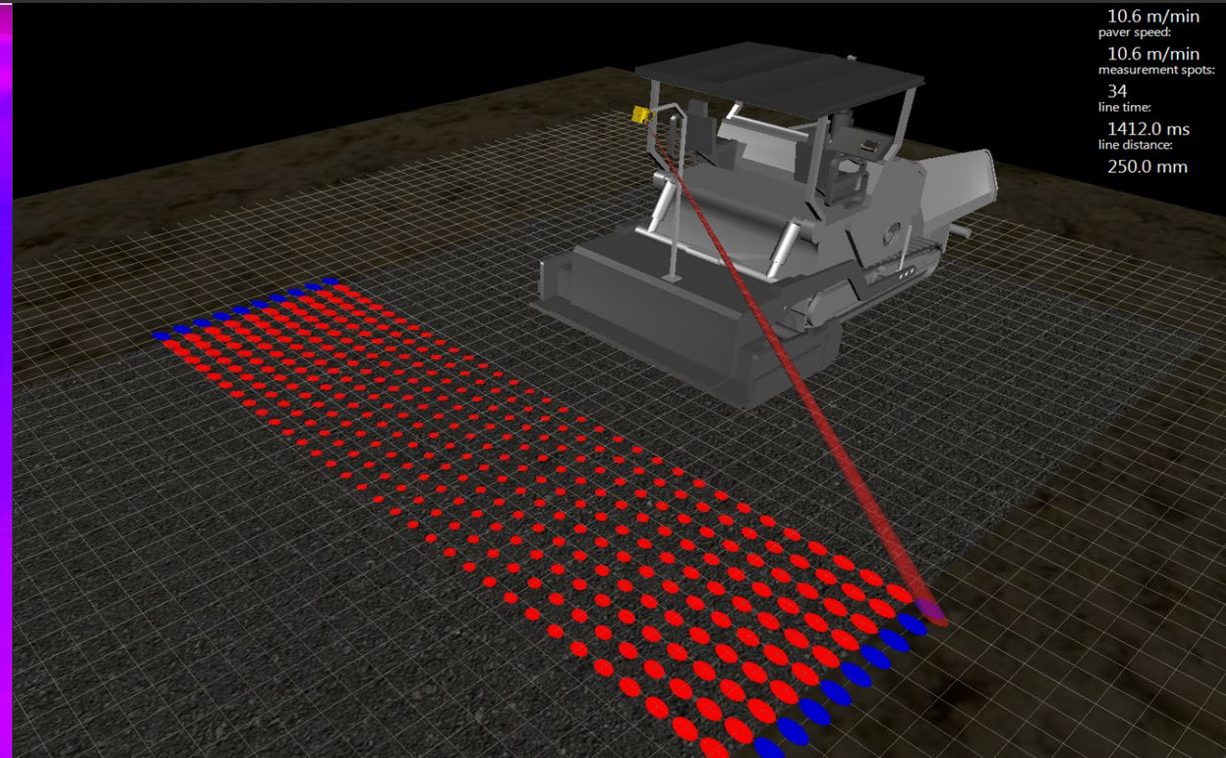
eTicket



Paver-Mounted Thermal Profiler (PMTP)



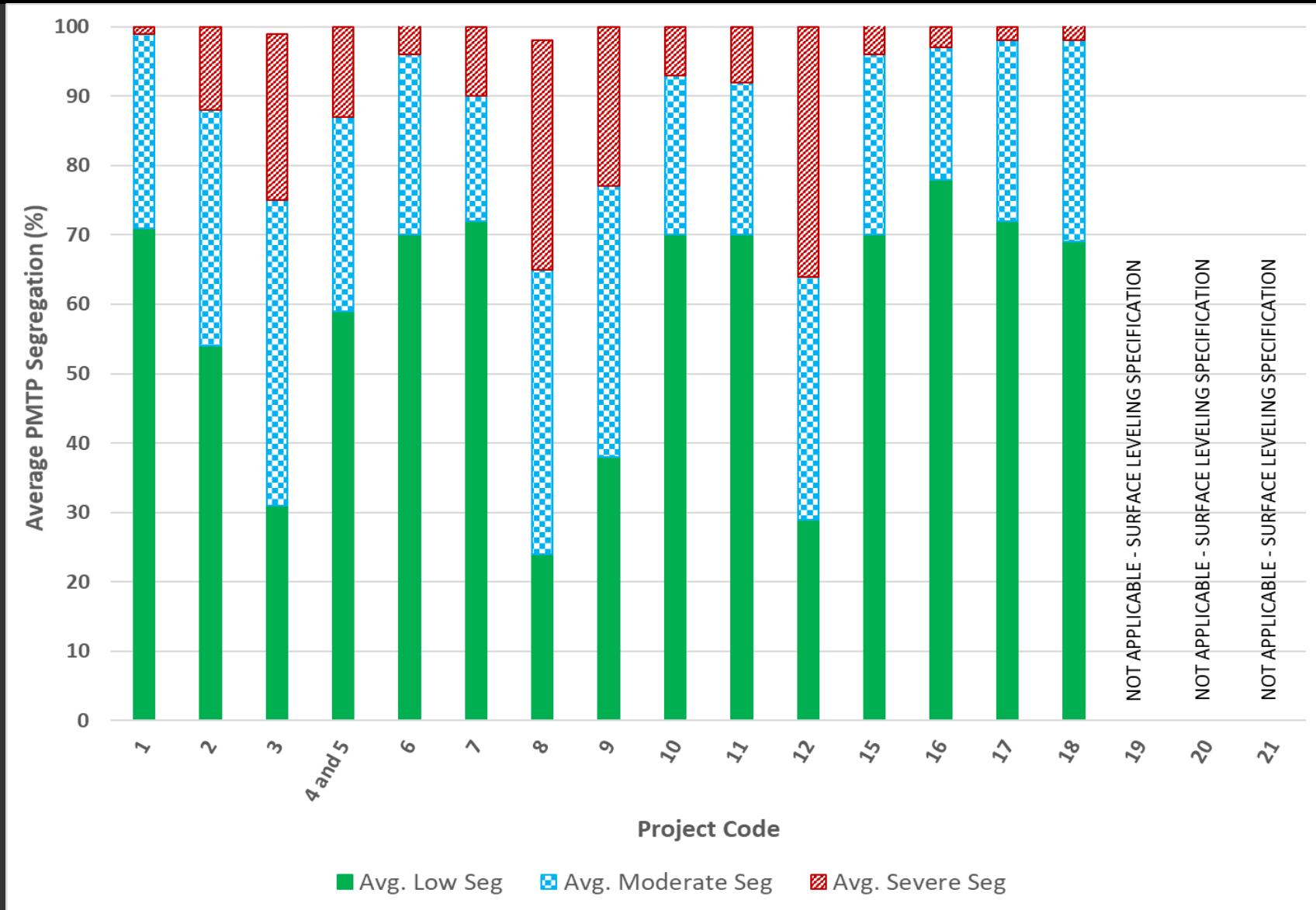
Conventional Thermal Camera



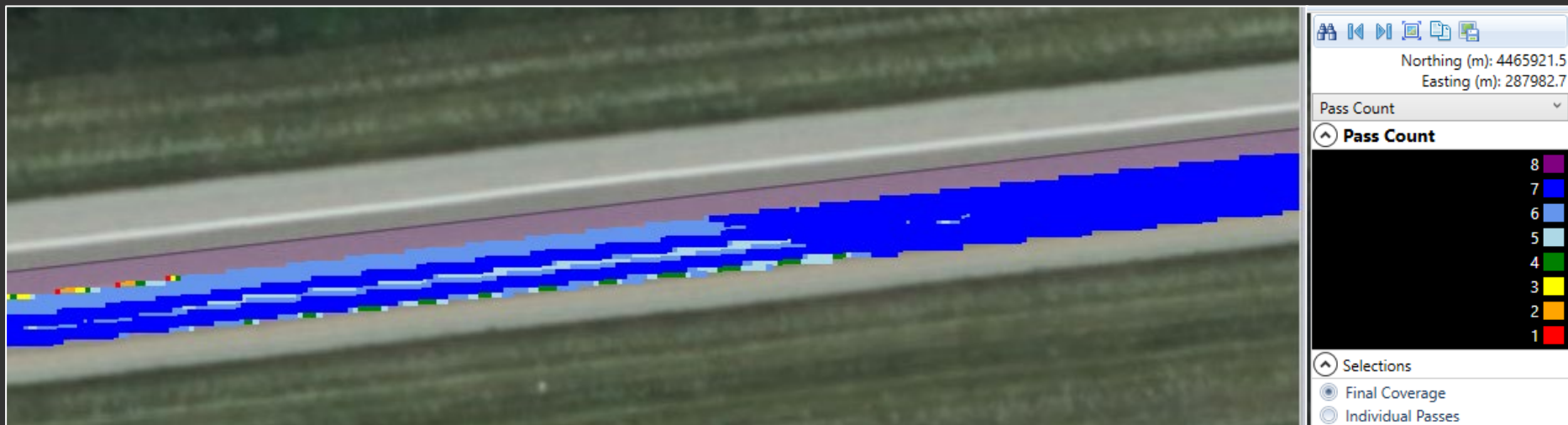
PMTP

Source: MOBA

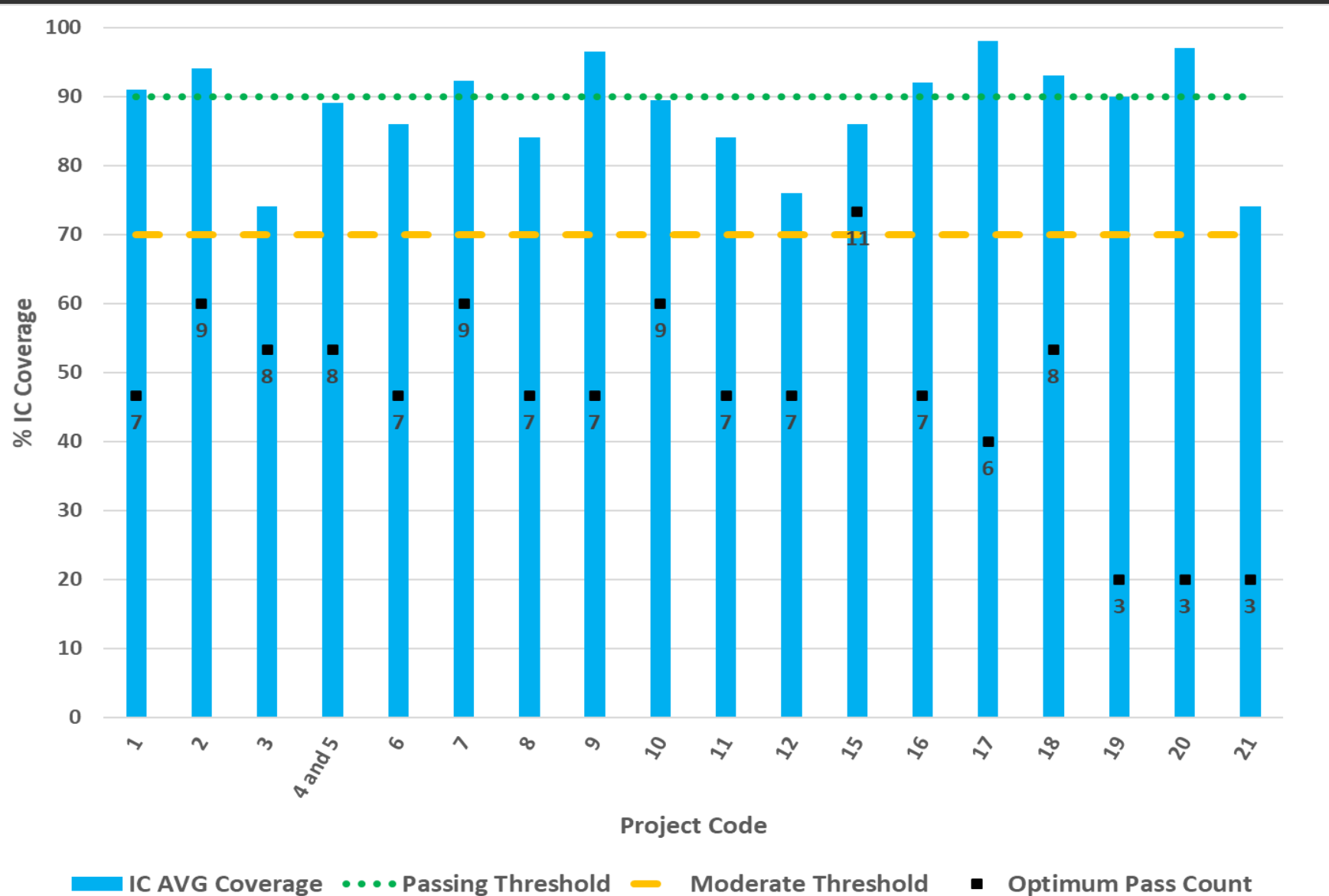
2022 PMTP DRS Thermal Segregation by Project (Average of all Paving Days)



Intelligent Compaction

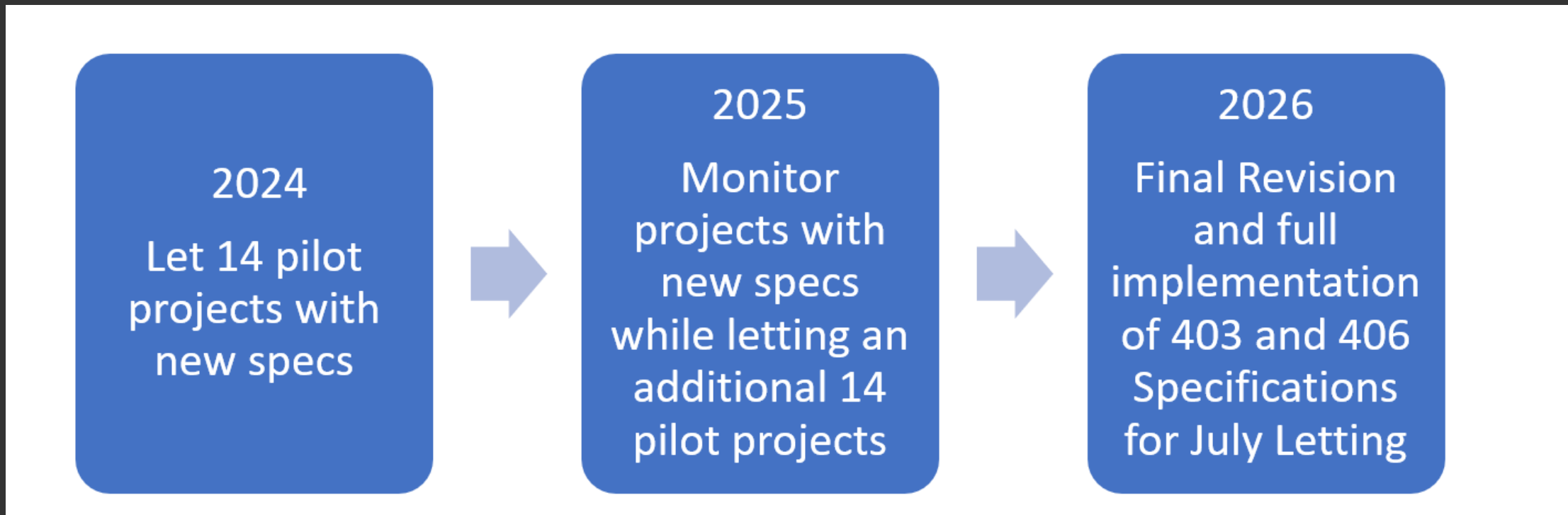


2022 IC Roller Coverage by Project

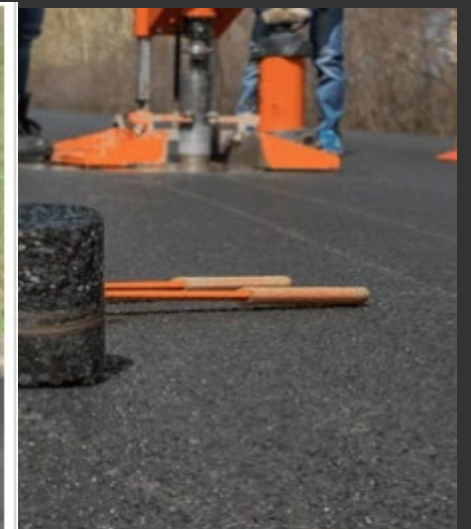
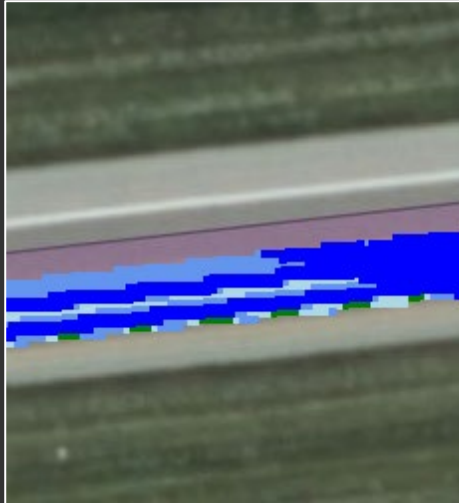


Work Continues...

- Balanced Mix Design & Paver Mounted Thermal Profiler



Intelligent Compaction & Removal of Coring



Before We Fly

- Intelligent Construction
 - Automated Technology



Automated Machine Control (AMG)

- Common Use
 - Earthwork
- Moderate Use
 - Concrete Paving
 - Pipe Trench Excavation
- Limited Use
 - Milling & Paving - Pilot Projects



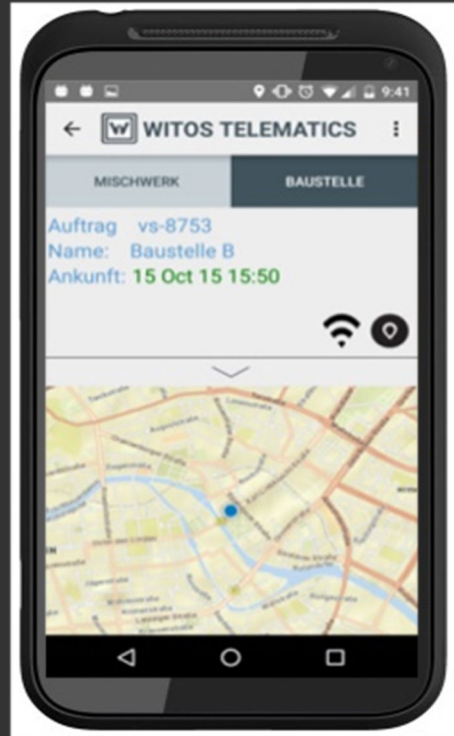
AMG 3D Milling



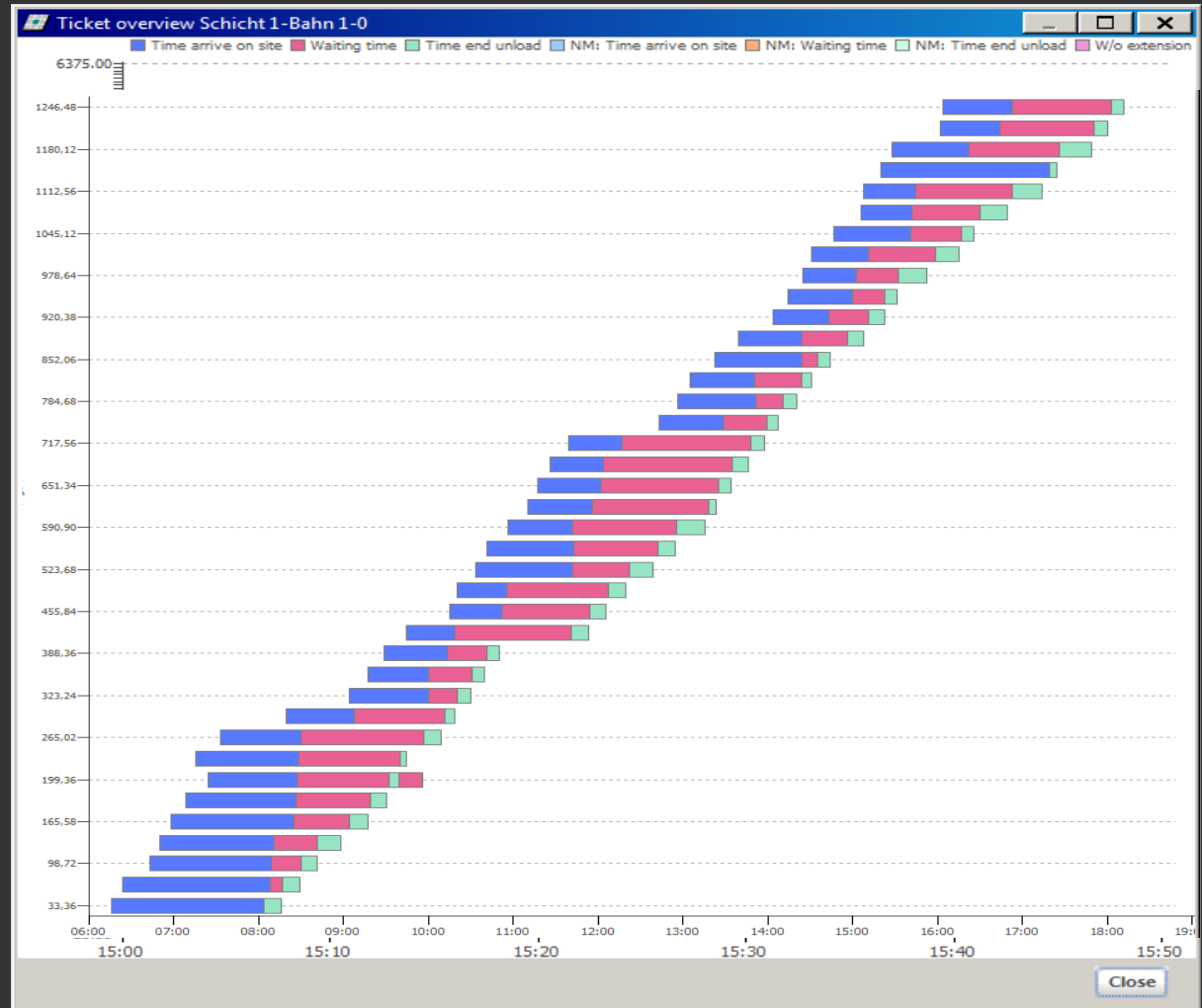
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Courtesy: Caterpillar



Courtesy: Vogele



Courtesy of Vogele



AMG Paving



Remote Control Command Station



Courtesy: BOMAG



Courtesy: Caterpillar

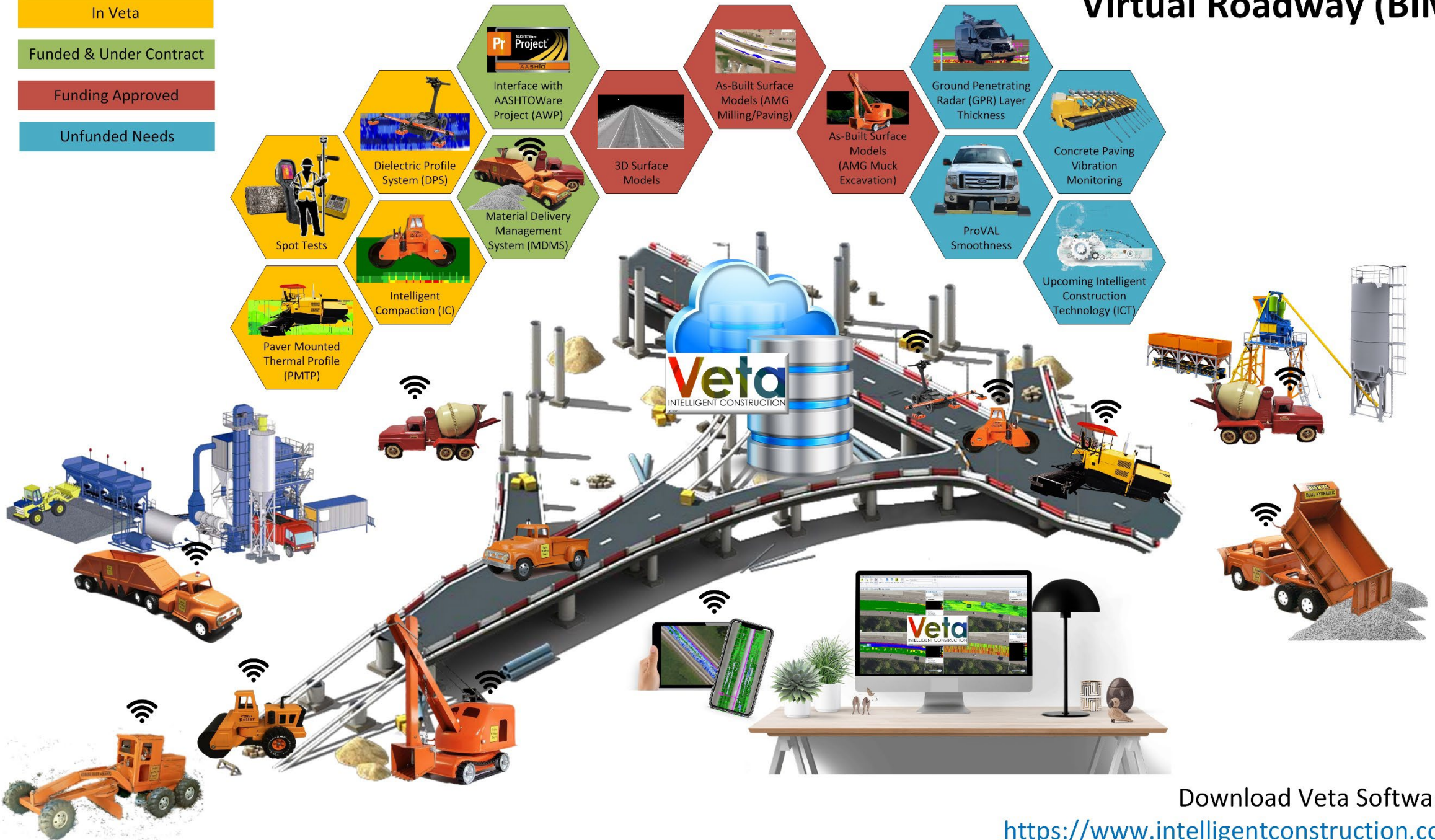
Virtual Roadway (BIM)

In Veta

Funded & Under Contract

Funding Approved

Unfunded Needs



Download Veta Software:

<https://www.intelligentconstruction.com>

QUESTIONS?

