Joint Deterioration Causes and Solutions

KU Asphalt Conference 2023

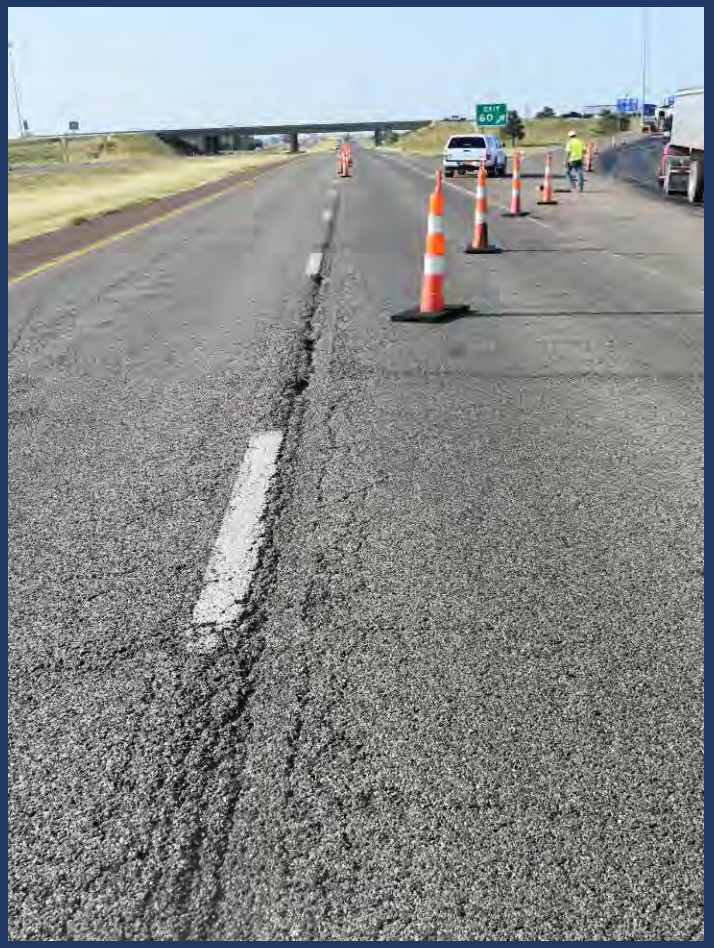
Ross Weber | KU Conference 2023

Presentation objectives

- Types of joint failure
- Primary or Secondary
- Causes of Initiation
- Causes of Propagation
- What will fix it?
- Questions

The majority of longitudinal cracks are caused by stripping.

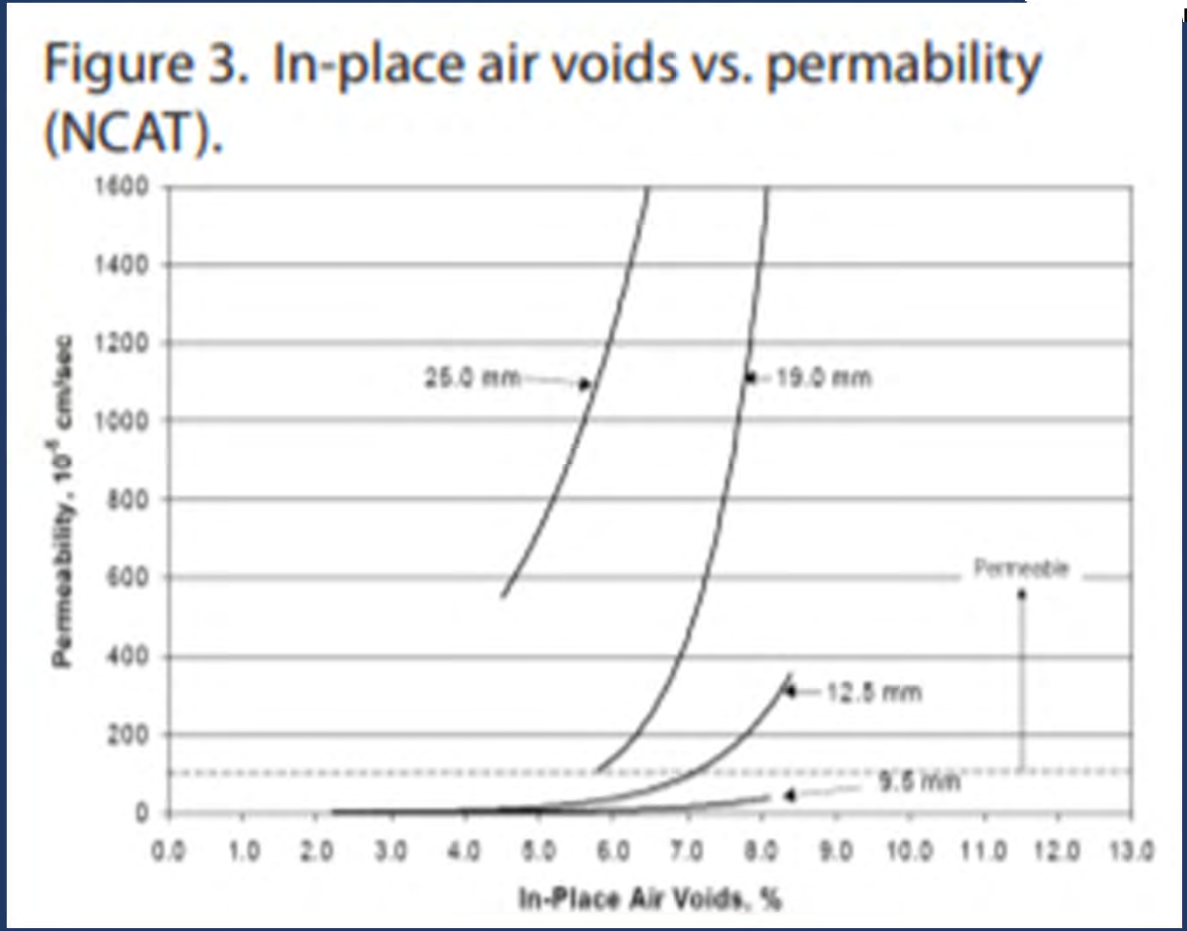
- Longitudinal joints deteriorate due to stripping.
- Top-Down Longitudinal Cracks are caused by stripping.
- Both commonly occur within a two-foot band.
- Both can be a source of water infiltration and can feed water between the two.



Phrases to remember:

- Water Pathways
- Density Dams
- Connecting Voids

NCAT research indicates 12.5 mm mixes are permeable at 7 to 8 % in place air voids



Most pavements look good in the beginning

With enough time most will look like this

The damage is already done

What is a primary joint crack?

Interface between first and second pass of paver

- Damage at the joint caused by roller
- Low Density
- Poor drainage
- Mix prone to stripping
- Matching to tight

Primary joint crack

Interface between first and second pass of paver

- Damage at the joint caused by roller
- Low Density
- **Poor drainage**
- Mix prone to stripping
- **Matching to tight**

Primary joint crack

Interface between first and second pass of paver

- **Damage at the joint caused by roller**
- **Low Density**
- **Poor drainage**
- **Mix prone to stripping**
- Matching to tight

Primary joint crack

Interface between first and second pass of paver

- Damage at the joint caused by roller
- **Low Density**
- **Poor drainage**
- Mix prone to stripping
- Matching to tight

Primary joint crack

Interface between first and second pass of paver

- **Damage at the joint caused by roller**
- **Low Density**
- Poor drainage
- Mix prone to stripping
- **Matching to tight**

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - Damage near joint caused by roller
  - **Low density**
  - **Poor drainage**
  - **Mix prone to stripping**
  - **Irregular density caused by screed set-up**
  - Edge of Stripe

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - Damage near joint caused by roller
  - Low density
  - Poor drainage
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - Damage near joint caused by roller
  - Low density
  - **Poor drainage**
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

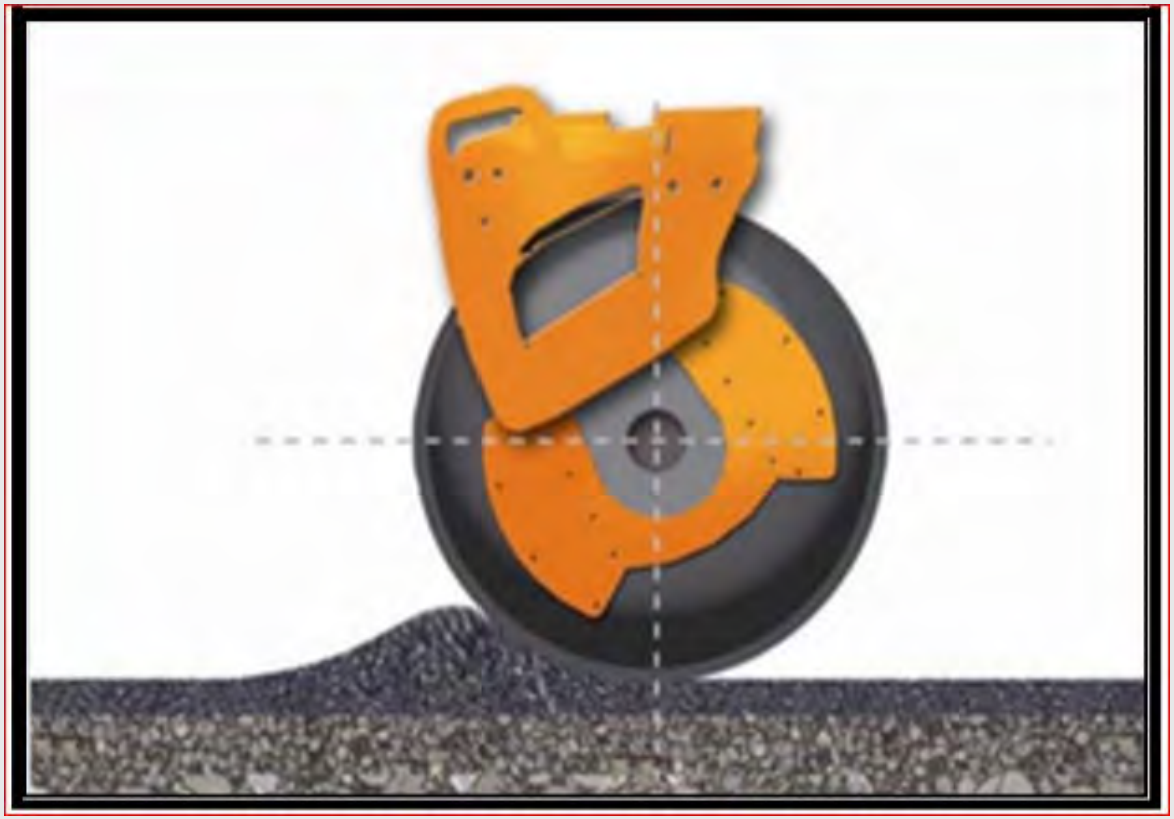
- Secondary Joint Crack (Near Joint)
  - **Damage near joint caused by roller**
  - **Low density**
  - **Poor drainage**
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - Damage near joint caused by roller
  - Low density
  - Poor drainage
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - **Damage near joint caused by roller**
  - Low density
  - Poor drainage
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe



Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - **Damage near joint caused by roller**
  - Low density
  - Poor drainage
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

- Secondary Joint Crack (Near Joint)
  - **Damage near joint caused by roller**
  - Low density
  - Poor drainage
  - Mix prone to stripping
  - Irregular density caused by screed set-up
  - Edge of Stripe

Secondary joint crack

Compacting Joint

Secondary joint crack


Becomes more obvious as binder ages

Stays wet longer than the roadway

Longitudinal and transverse – Note different look

Secondary joint crack

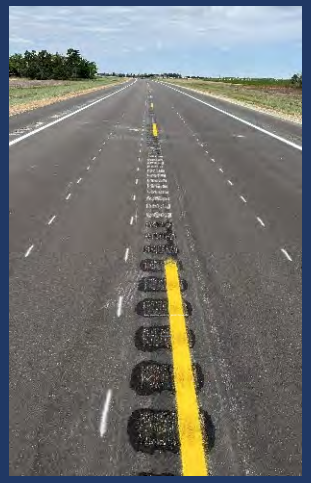
Roller turn damage in paved surface

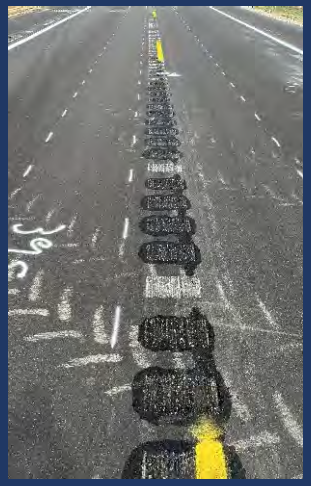
Roller turn damage in milled surface

Rumble strips make roads much safer

Are rumble strips a maintenance problem?

They are likely a necessary problem

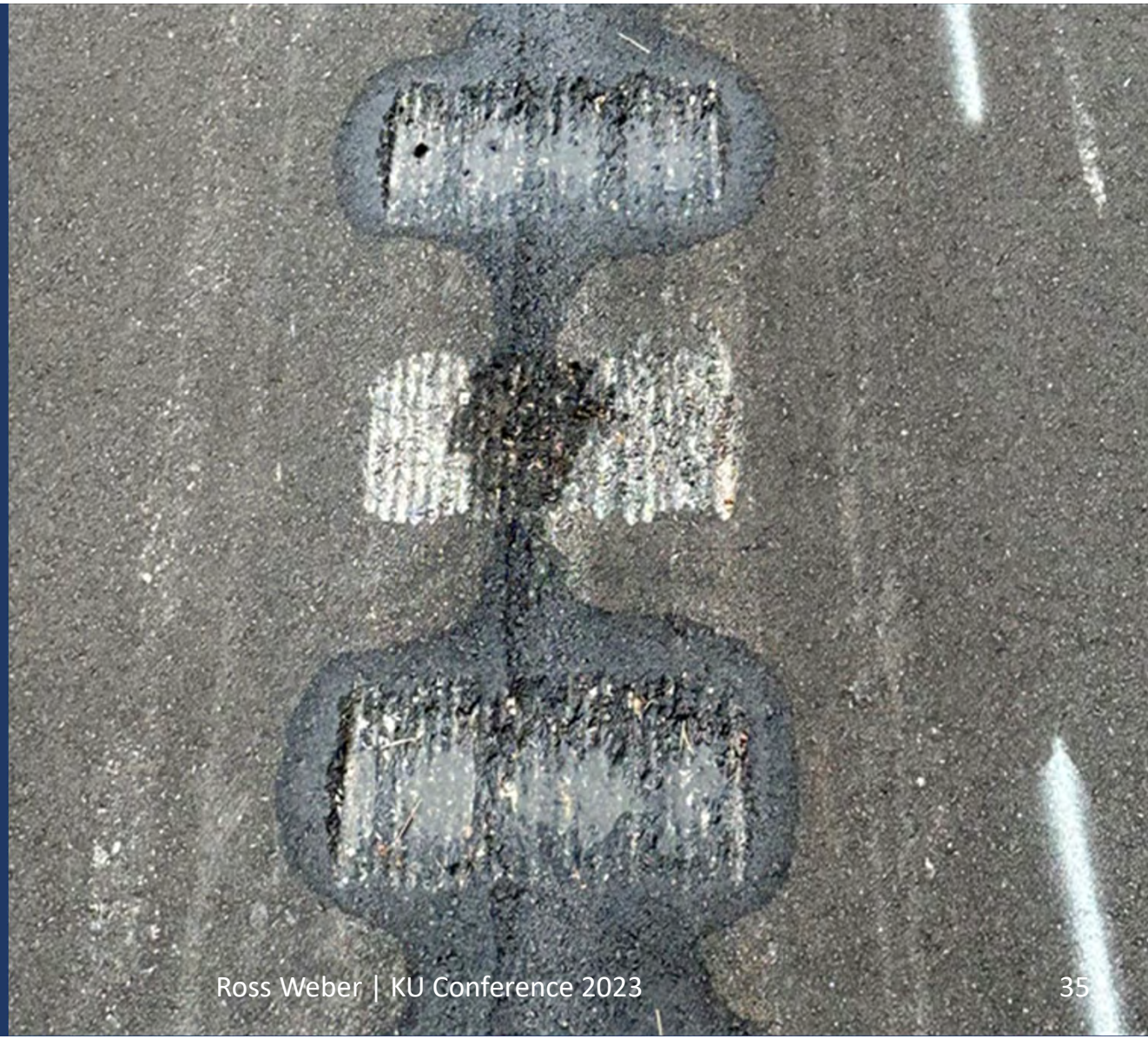




Stands water long after the roadway is dry

Why dry cut in middle of wet?

Pocket of segregation drained individual cut



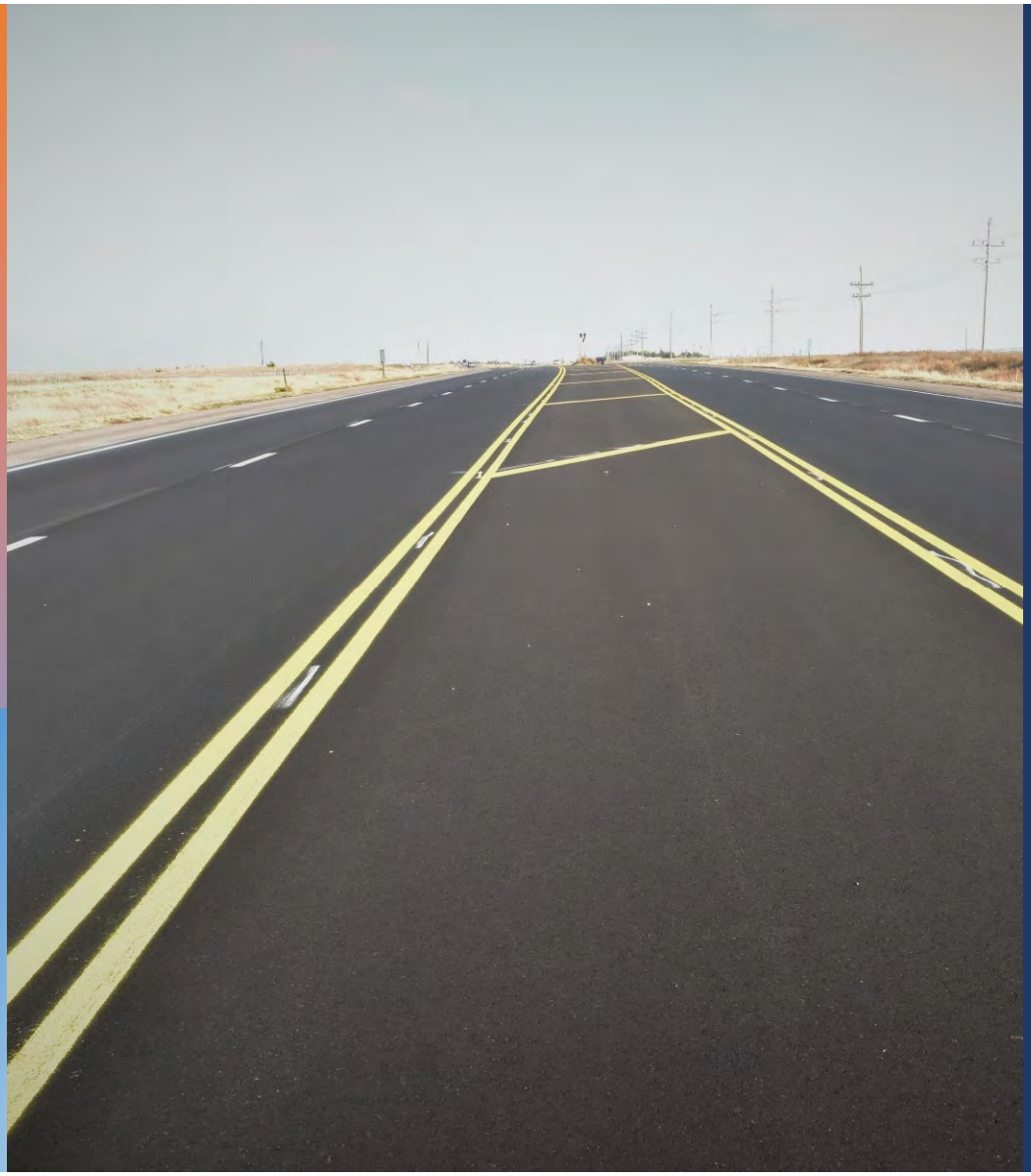
Extremely wet to extremely dry within same section

Wet beside stripe

- Dried quickly between stripes
- Rumbles with stripe stayed wet
- Stripe is directly over the joint
- I questioned if there was room, even in a poor joint, for the amount of water that disappeared.

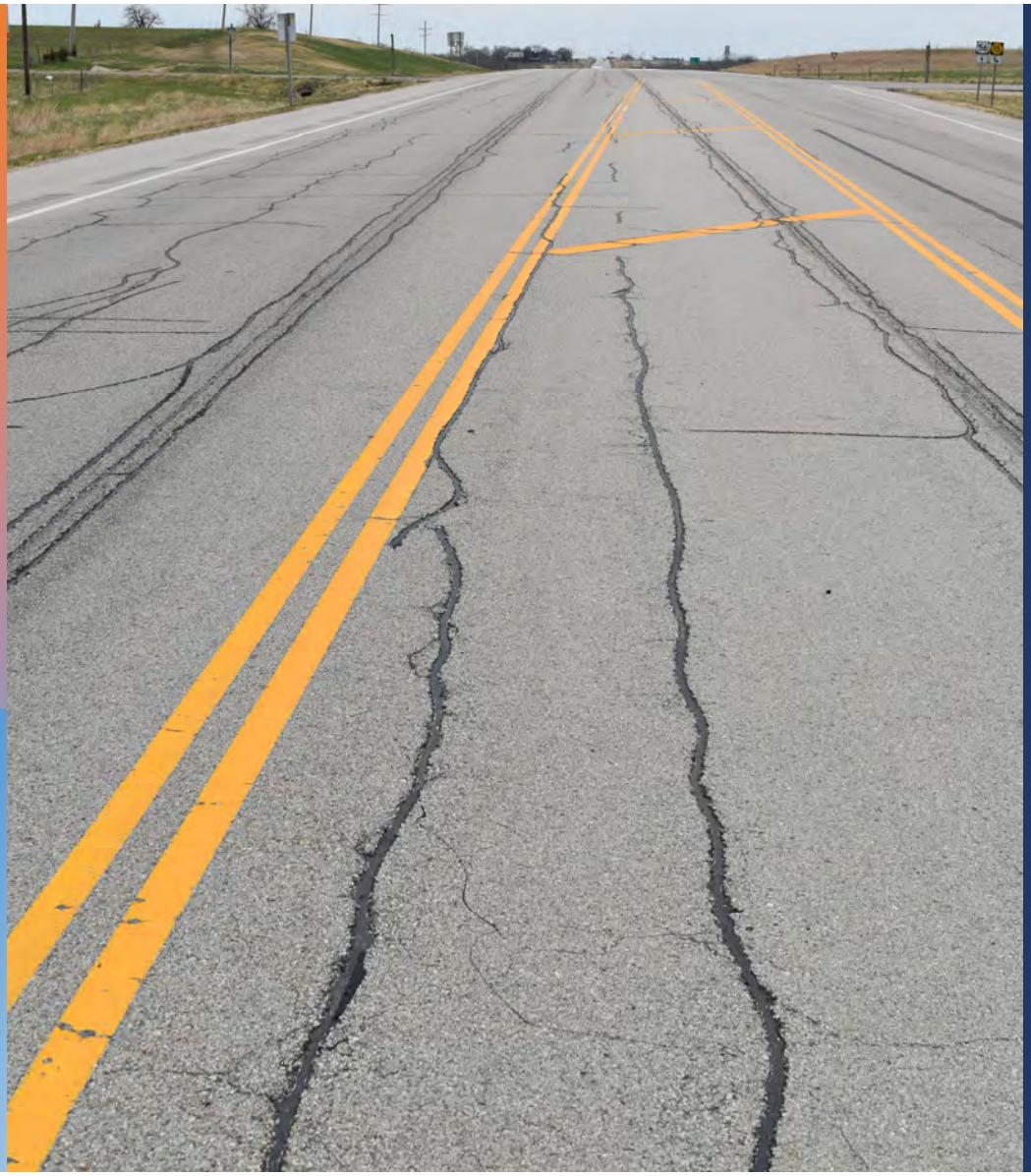
Top & bottom of core over roller mark.

- There are a lot of voids in the bottom of most cores.
- There is potential to store and move water from the substrate.
- The bottom surface of this core easily absorbed 8 ml of water (13 oz/sqy)



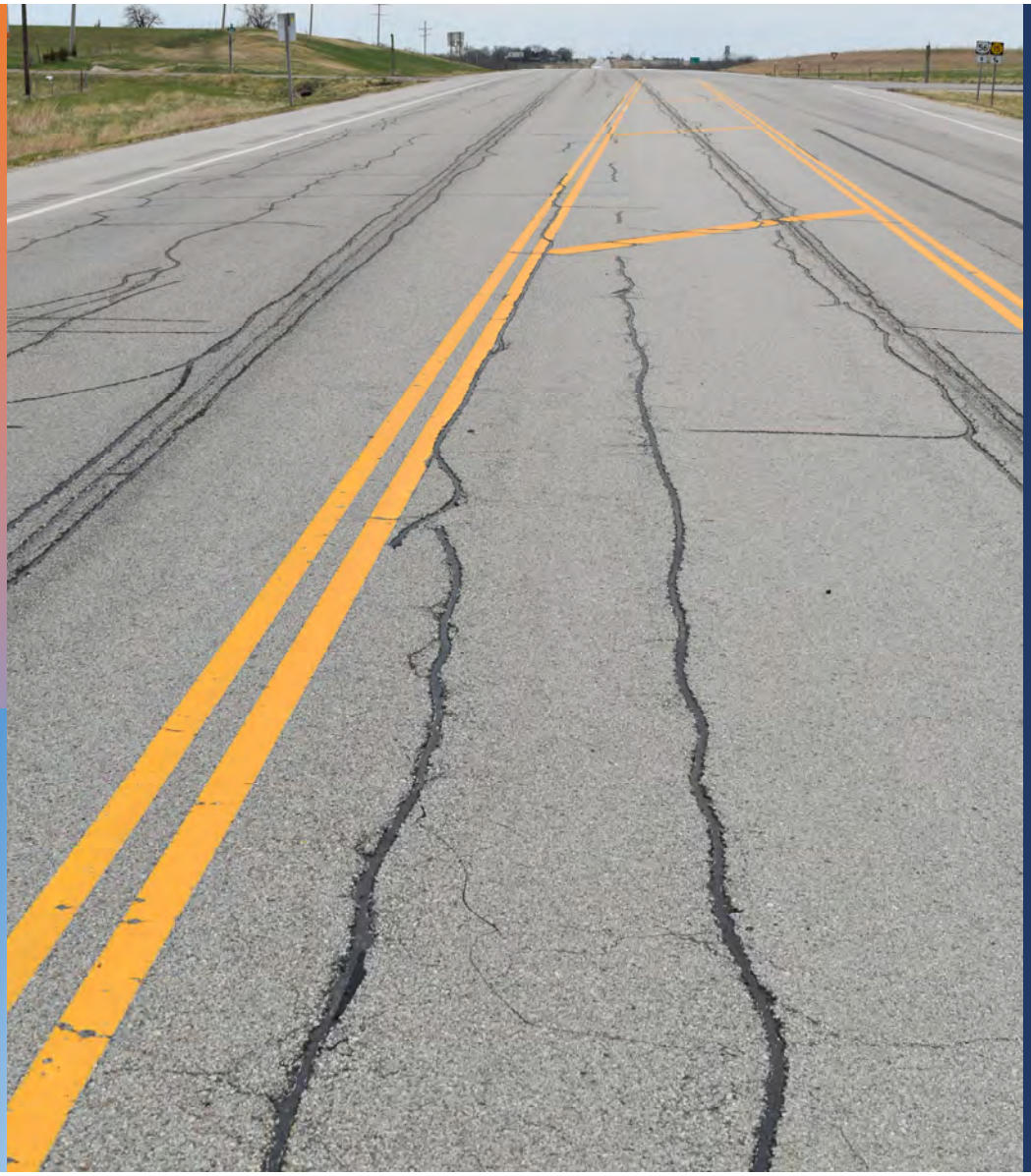
Is loading fatigue a problem?

- In my opinion it is not normally an issue
- Cracks occur in the absence of traffic.



How do we know fatigue isn't the problem?

- If fatigue were the issue, we should not find cracks in areas with little loading, such as gore areas and dead lanes.



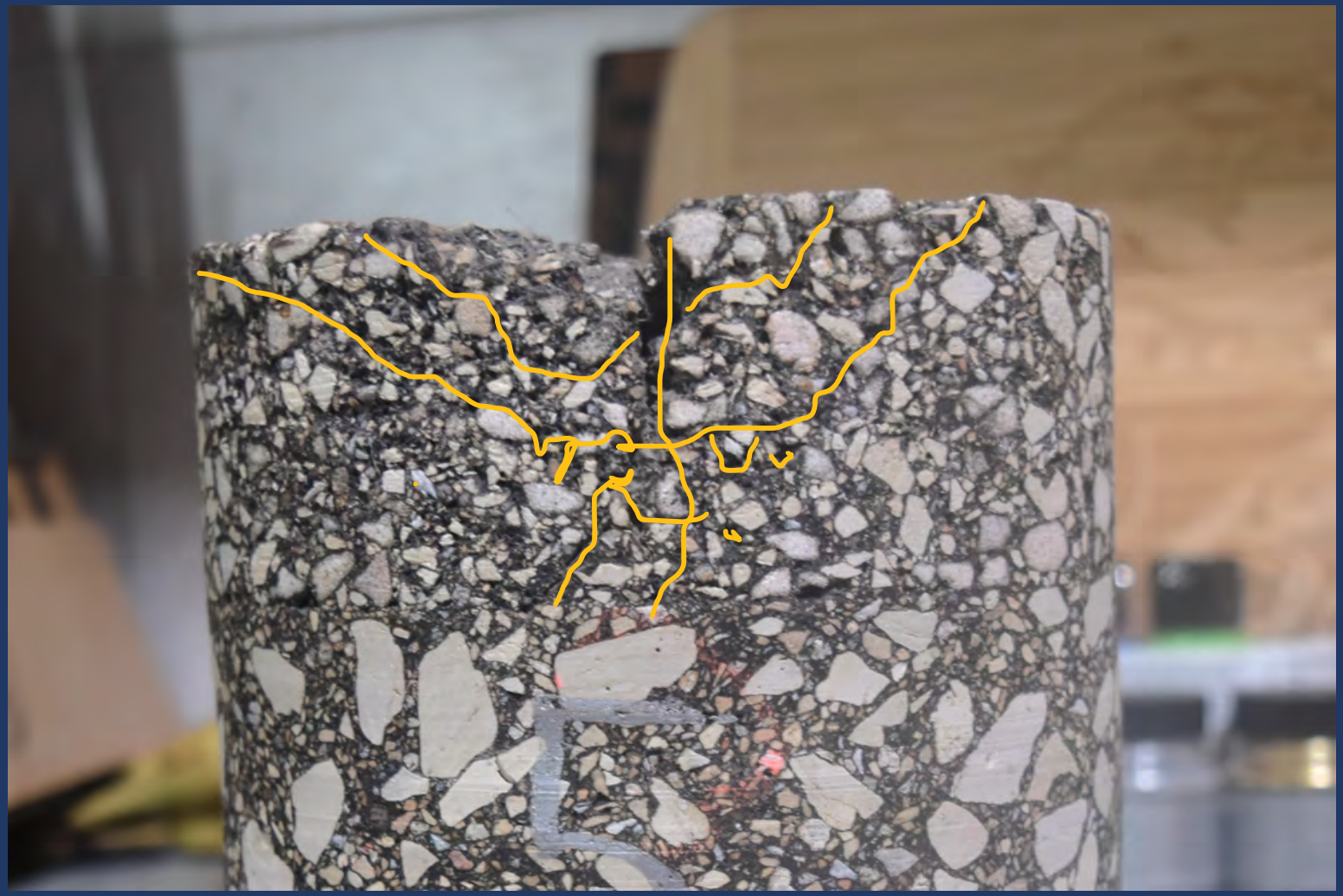
How do we know fatigue isn't the problem?

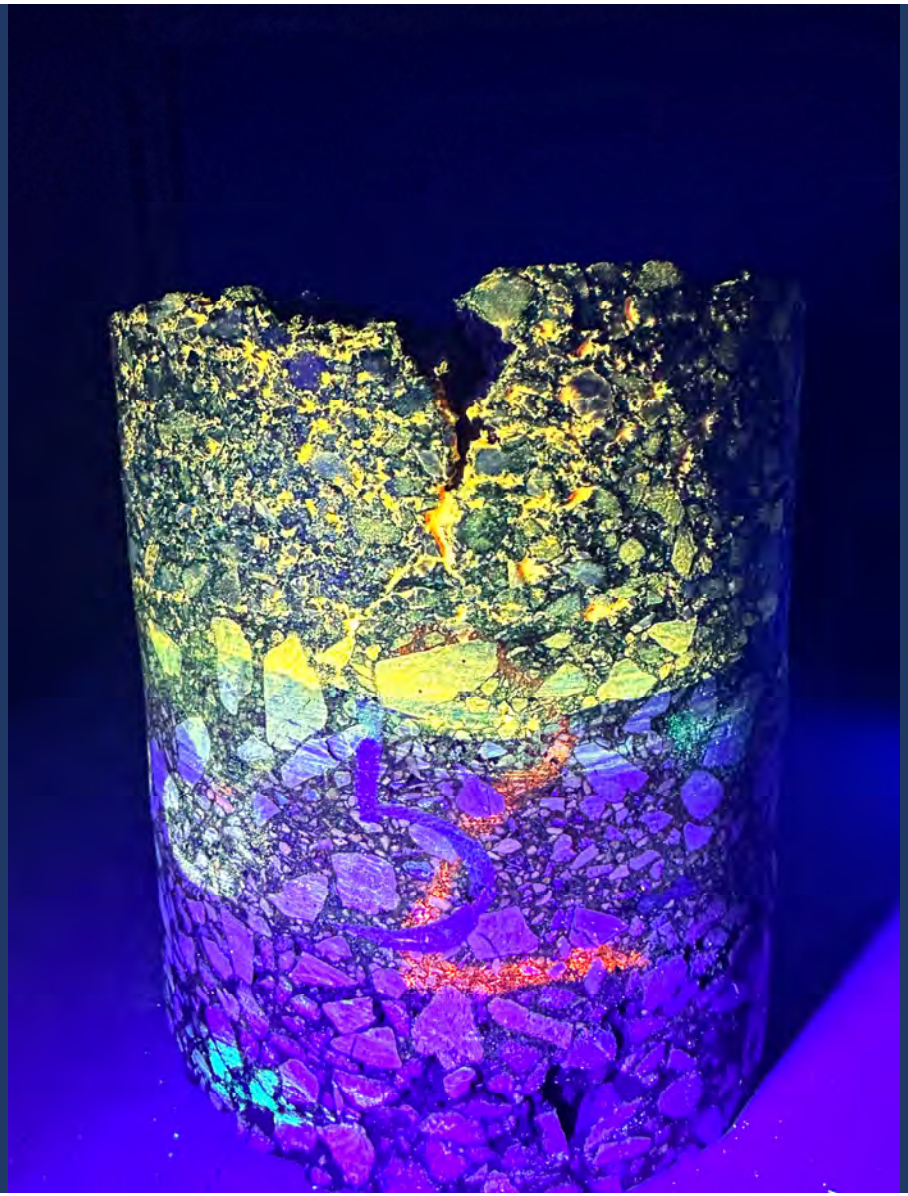
- If fatigue were the issue, we should not find cracks in areas with little loading, such as gore areas and dead lanes.
- Cracks should follow the path traffic takes
- They always follow the path of the paver and rollers.

Cores of roller marks

Top of core is severely damaged

Note damage in top 1”





Centerline core

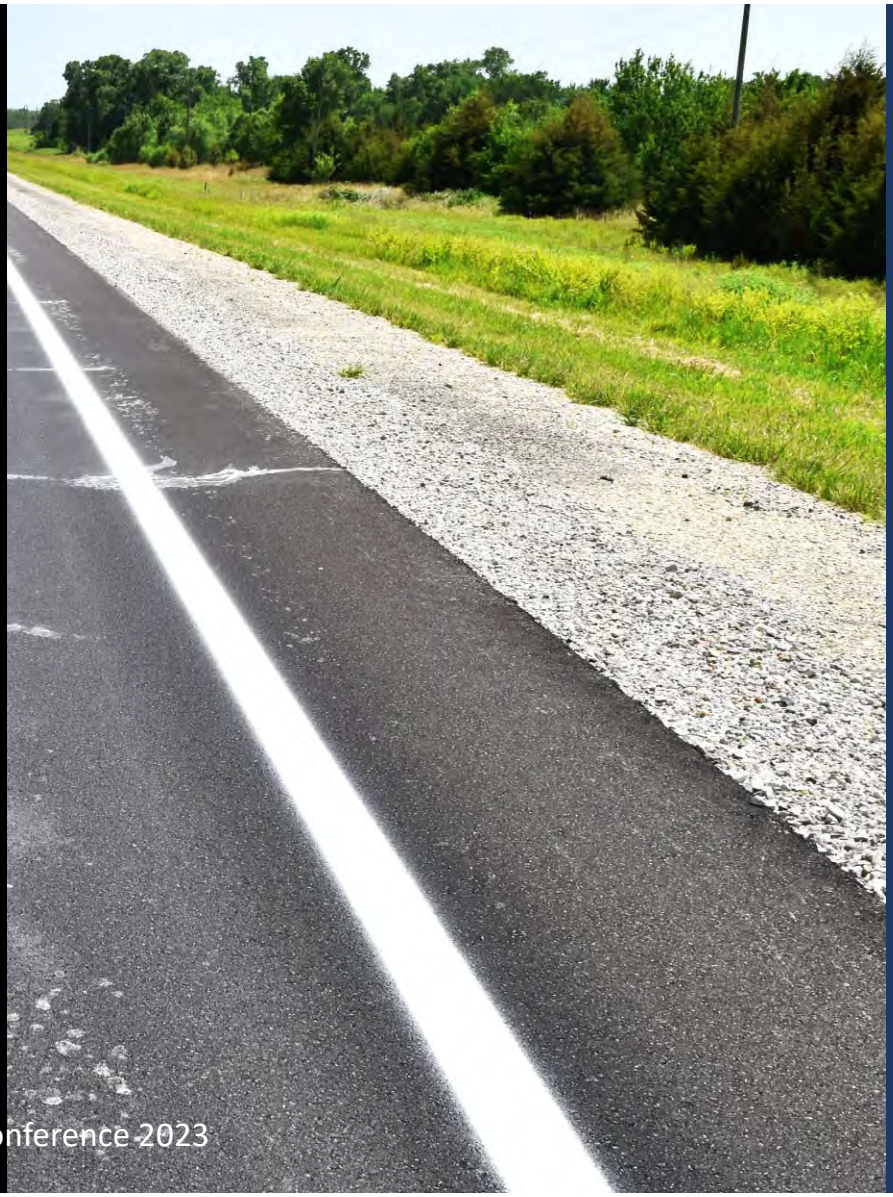
- Some voids in top ¾”at center line
- Open texture on top right
- Excellent density

Centerline core

- Smooth on left rough on right
- Joint is tight
- Weighed up at 93%+ density

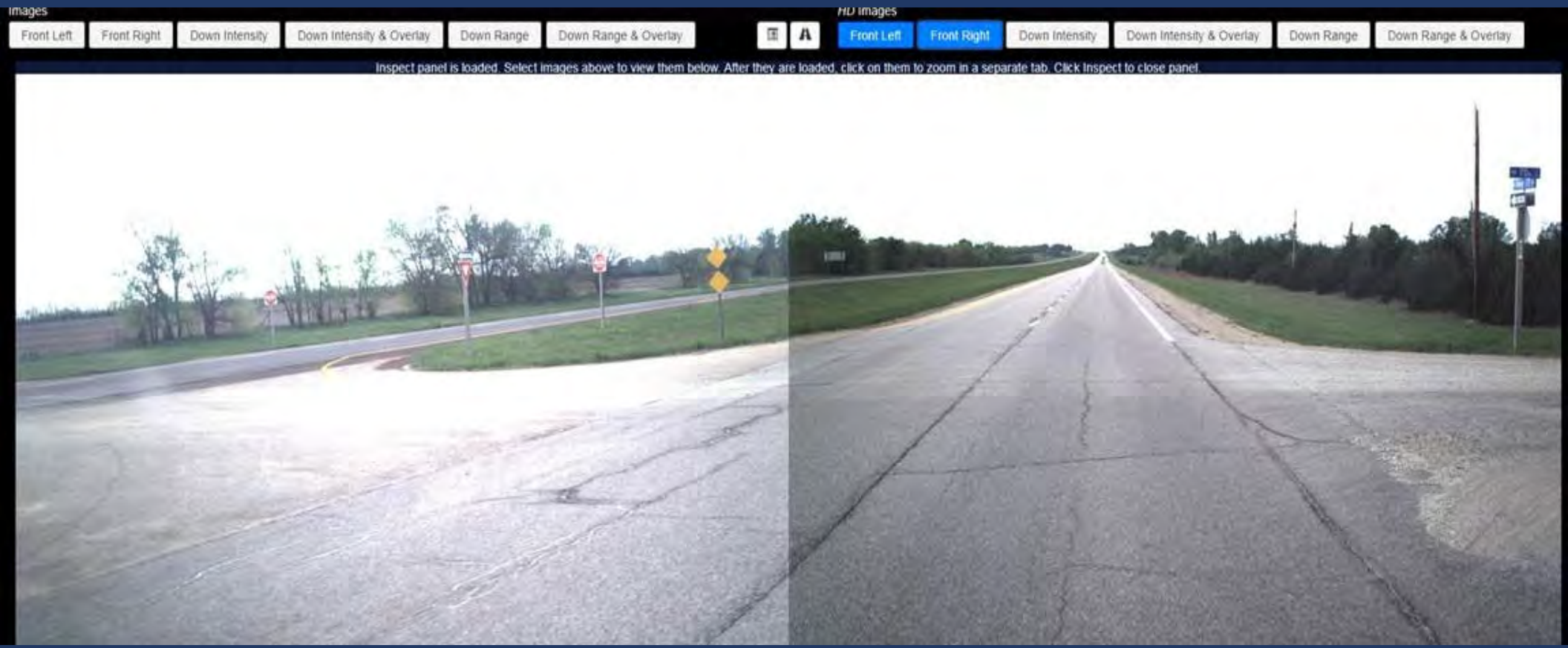
Water can come through the bottom of the lift

Brine from below found the pathways in a new overlay resulting in early failure

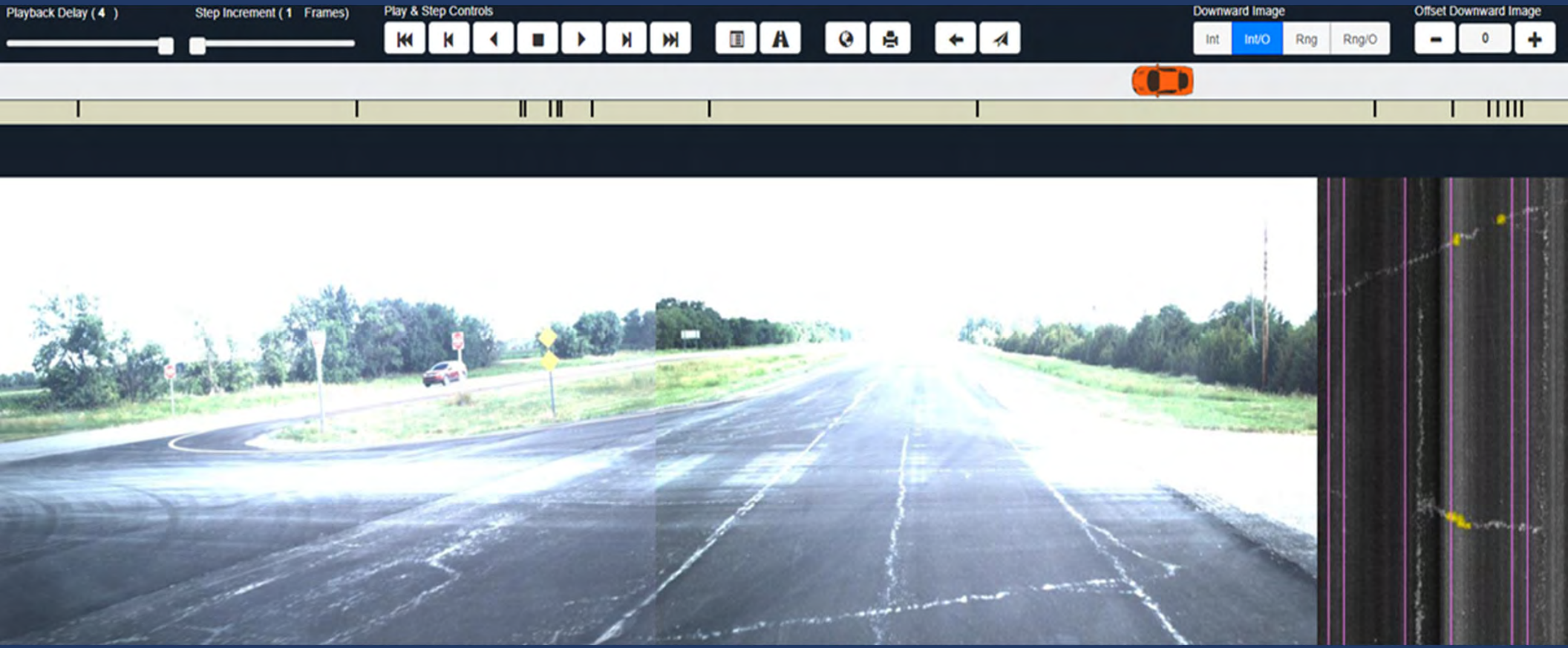


Same pattern as the brine photo

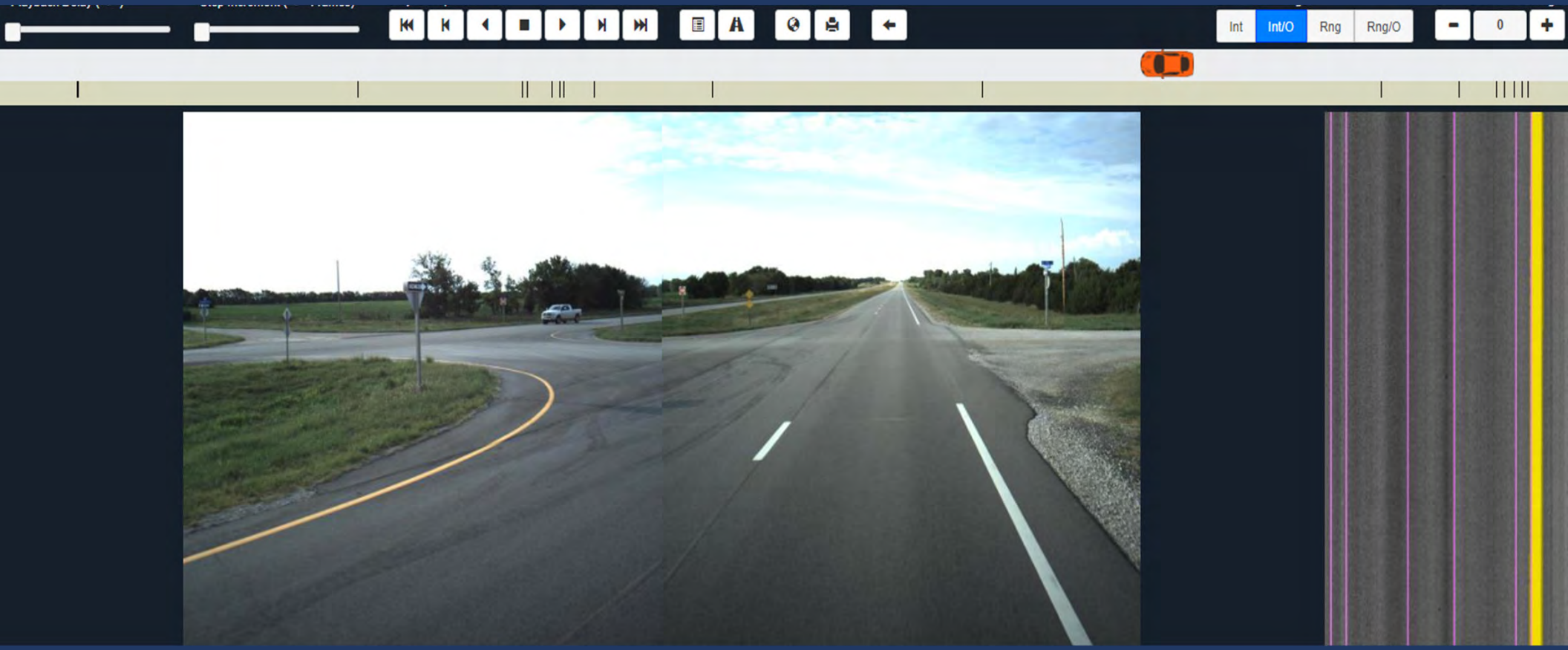
US-77 2018


Images
Front Left
Front Right
Down Intensity
Down Intensity & Overlay
Down Range
Down Range & Overlay
HD Images
Front Left
Front Right
Down Intensity
Down Intensity & Overlay
Down Range
Down Range & Overlay
Inspect panel is loaded. Select images above to view them below. After they are loaded, click on them to zoom in a separate tab. Click Inspect to close panel.

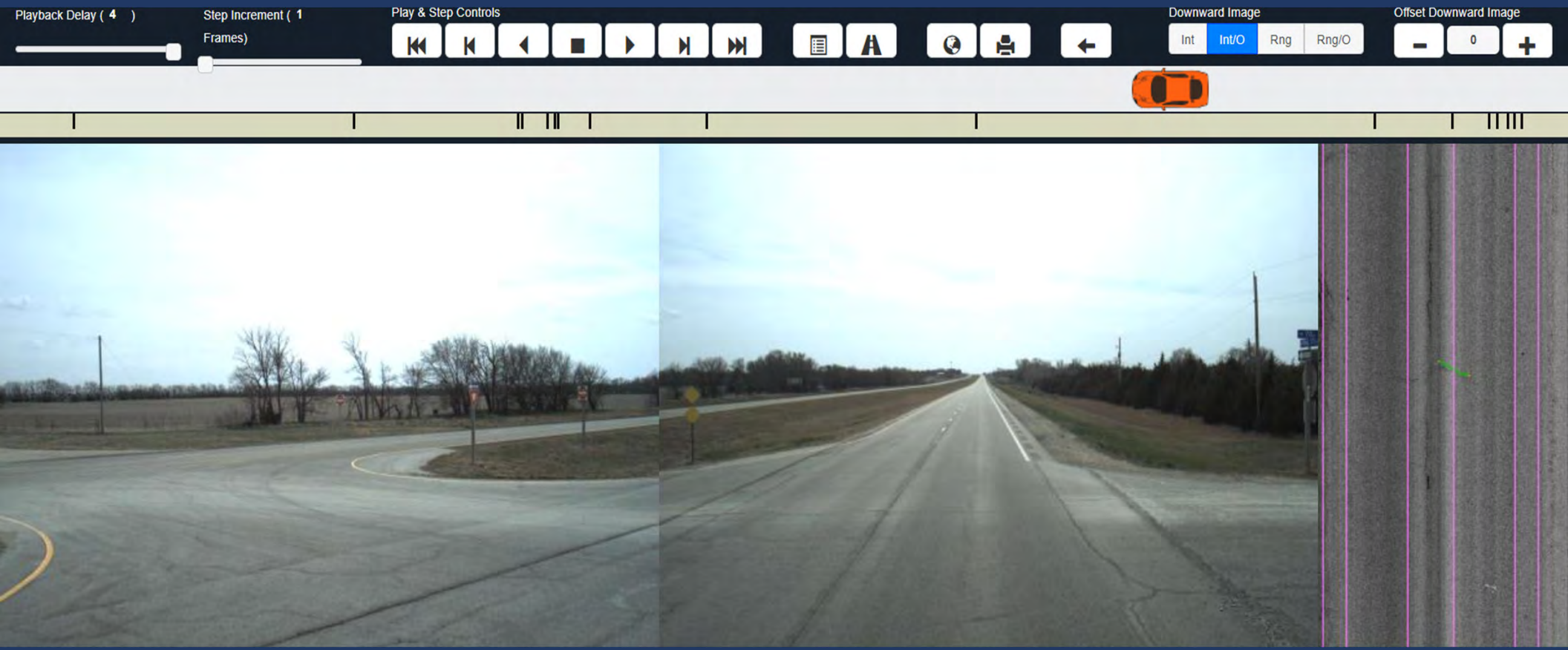
July 2019 ½” mill 1 ½” overlay 12.5A



2020

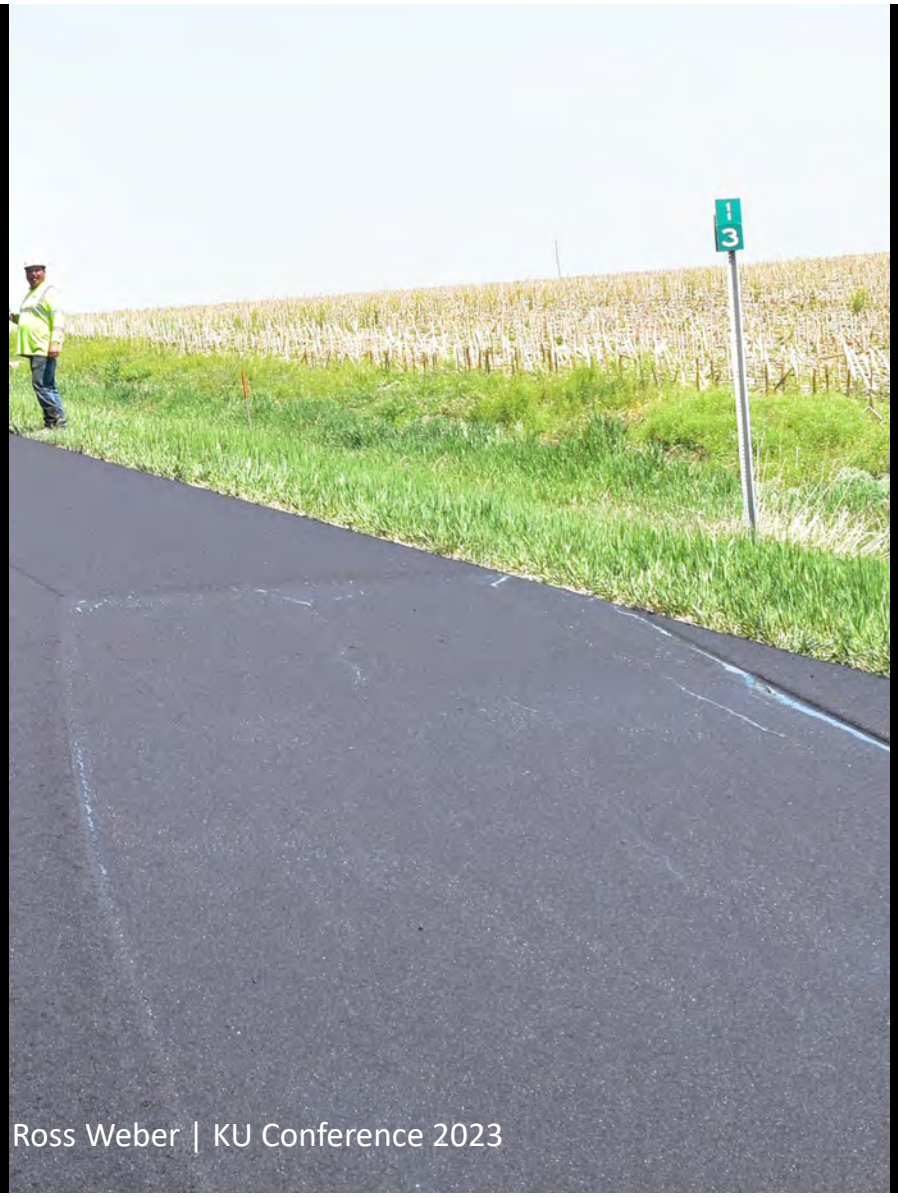


2023

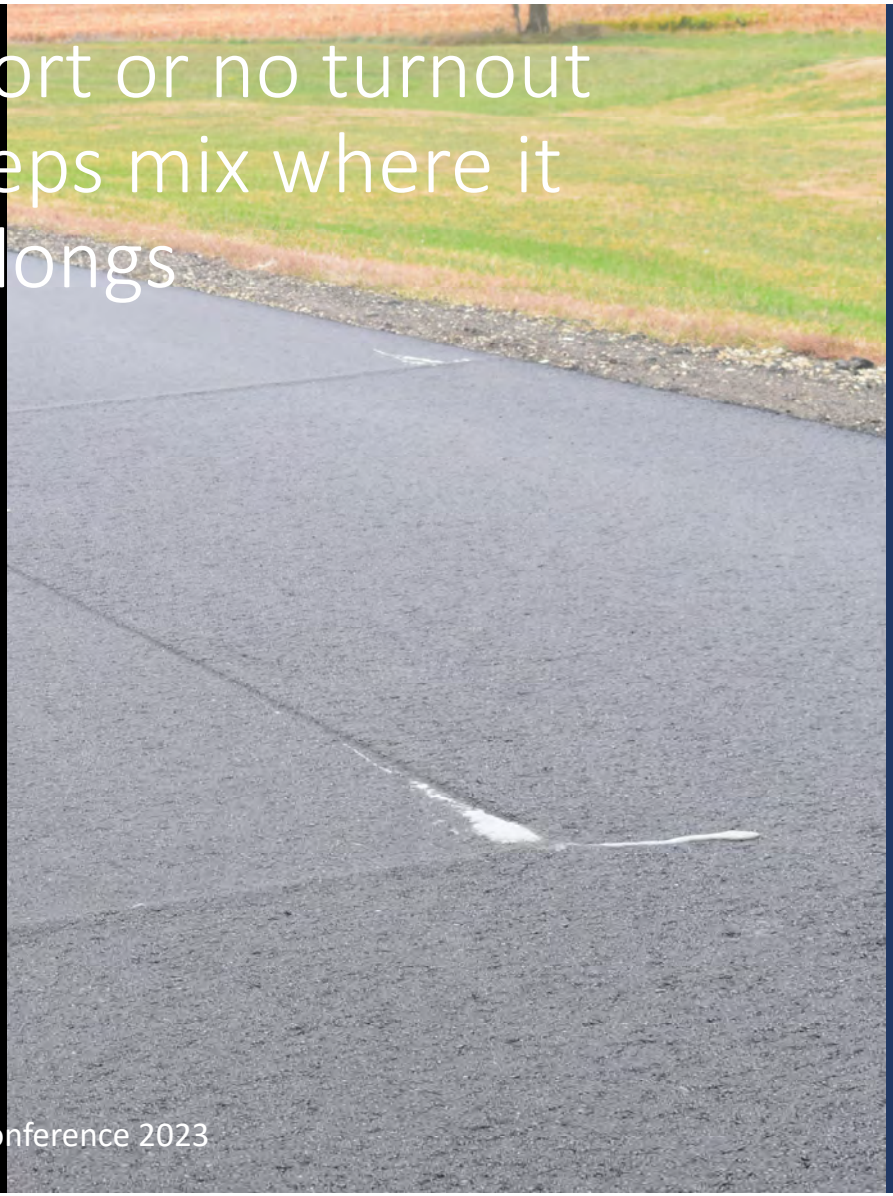

Playback Delay (4)
Step Increment (1 Frames)
Play & Step Controls
Downward Image
Int
Int/O
Rng
Rng/O
Offset Downward Image
0

Roller turnout should be limited

The head of material from the left doesn’t belong on the right.



Short or no turnout keeps mix where it belongs



Roller turn out damages the mix

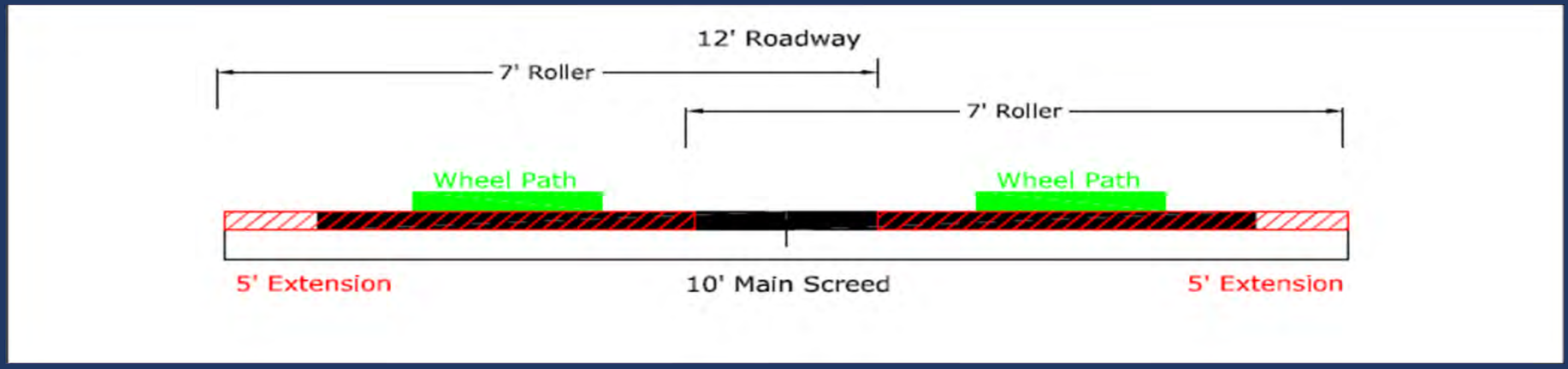
Obviously, roller marks that create cracks

Density can be great and fall at the joint

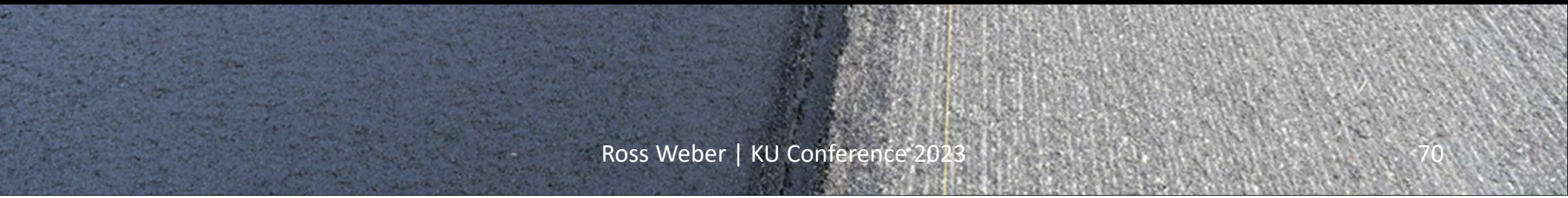
Raised extension to improve joint density

This may improve the joint at the expense of the wheel path

Raising extensions moves the density problem
Any crown within a lane creates density problems



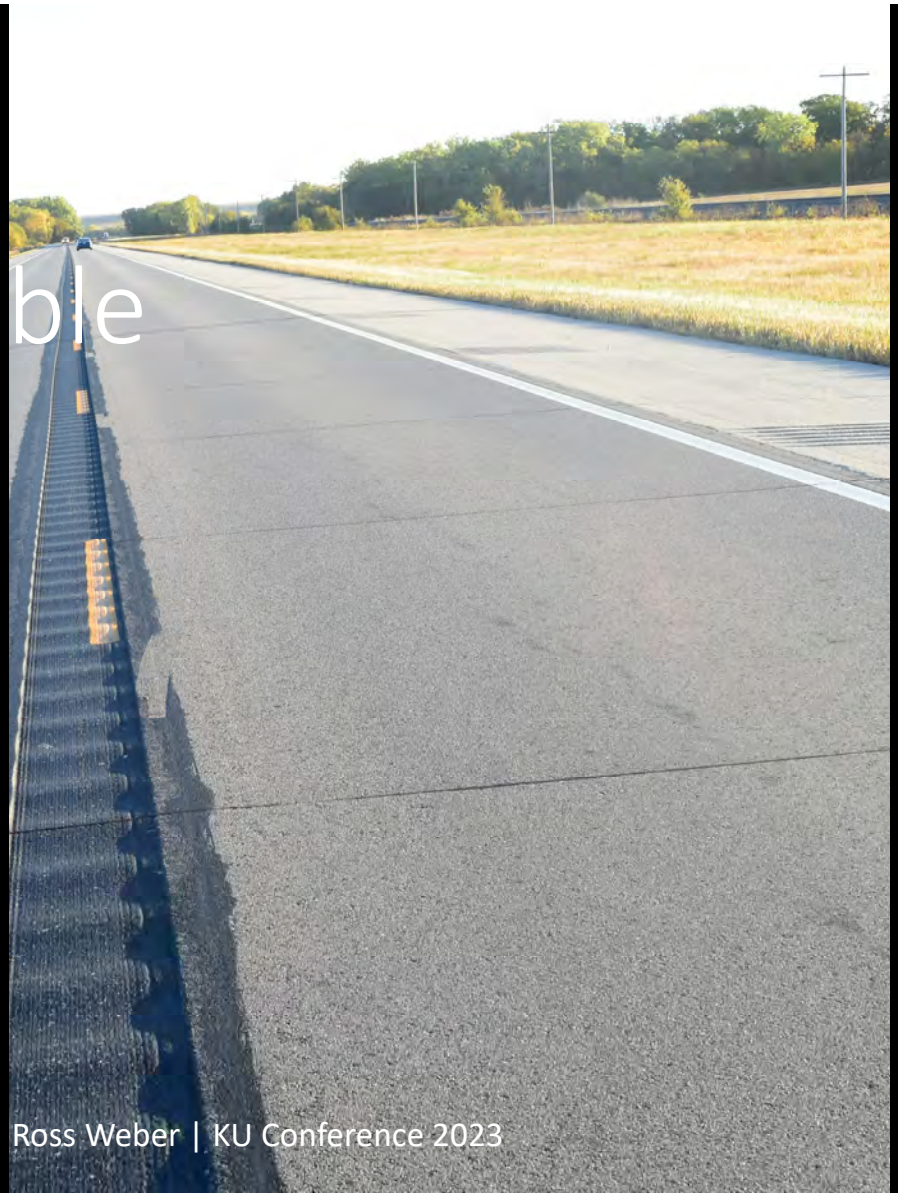
Elevated extension & rolling inside of edge



Most centerlines are paved nearly flat

What are we going to do about it?

Mastic over sinusoidal rumble strips



Sinusoidal with crack after a year

Mastic over conventional rumble strips

Open crack even with mastic applied

J-Band

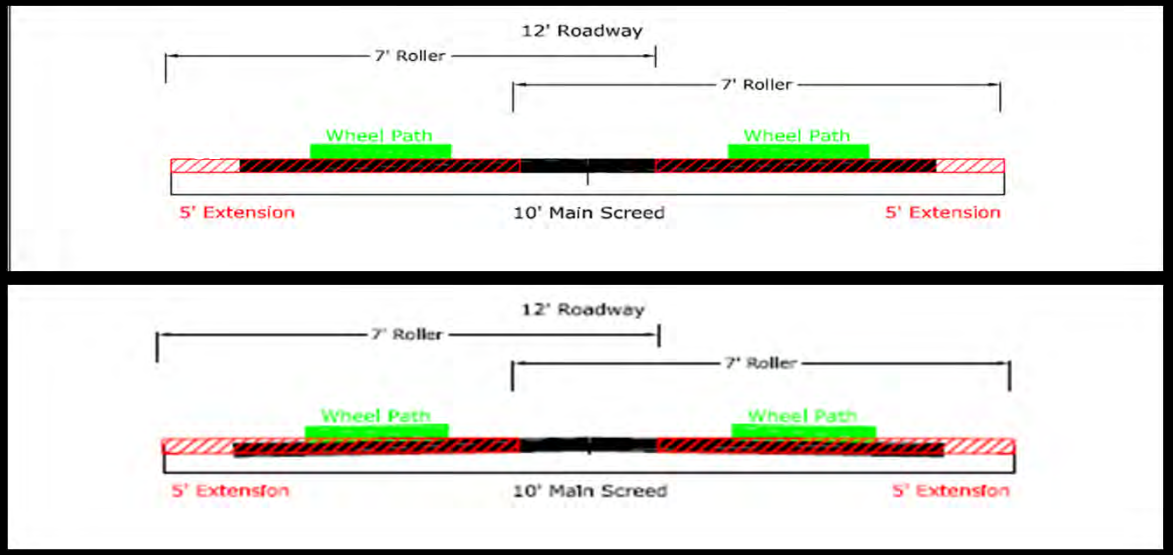

Avoid roller marks as much as possible


Eliminate mixes that strip

Uniform Density

Raising extensions moves the density problem

Any crown within a lane creates density problems



Lower Air Voids

Training is difficult

- J-Band on bottom
- Mastic on Top
- Uniform Density
- Proper Amount of Slope
- Roller Marks
- Flat Screed
- Eliminate Stripping
- Lower Va

Questions