# The Conformal WIM Site

presented by

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## *Definitions*

The “conformal” WIM site . . . .

conforms in every way to the end-user’s procurement specifications for performance, reliability, operational life, etc.

*Conform (def.)*

1. *To act or be in compliance with.*
2. *To make similar to.*

## *What's needed*

For a WIM site to be "conformal" to performance requirements, at least the following conditions should exist:

a) The WIM sensors must inherently provide sufficient accuracy to support site performance spec (e.g., Type III, per ASTM 1318).

b) Pavement surface local to the site must be sufficiently flat to support the site performance specification (e.g., 1/8" over any 20-foot direction as defined in ASTM 1318).

c) The top (load-bearing) surface of each WIM sensor should be installed "conformal" to the adjacent surface of the pavement.

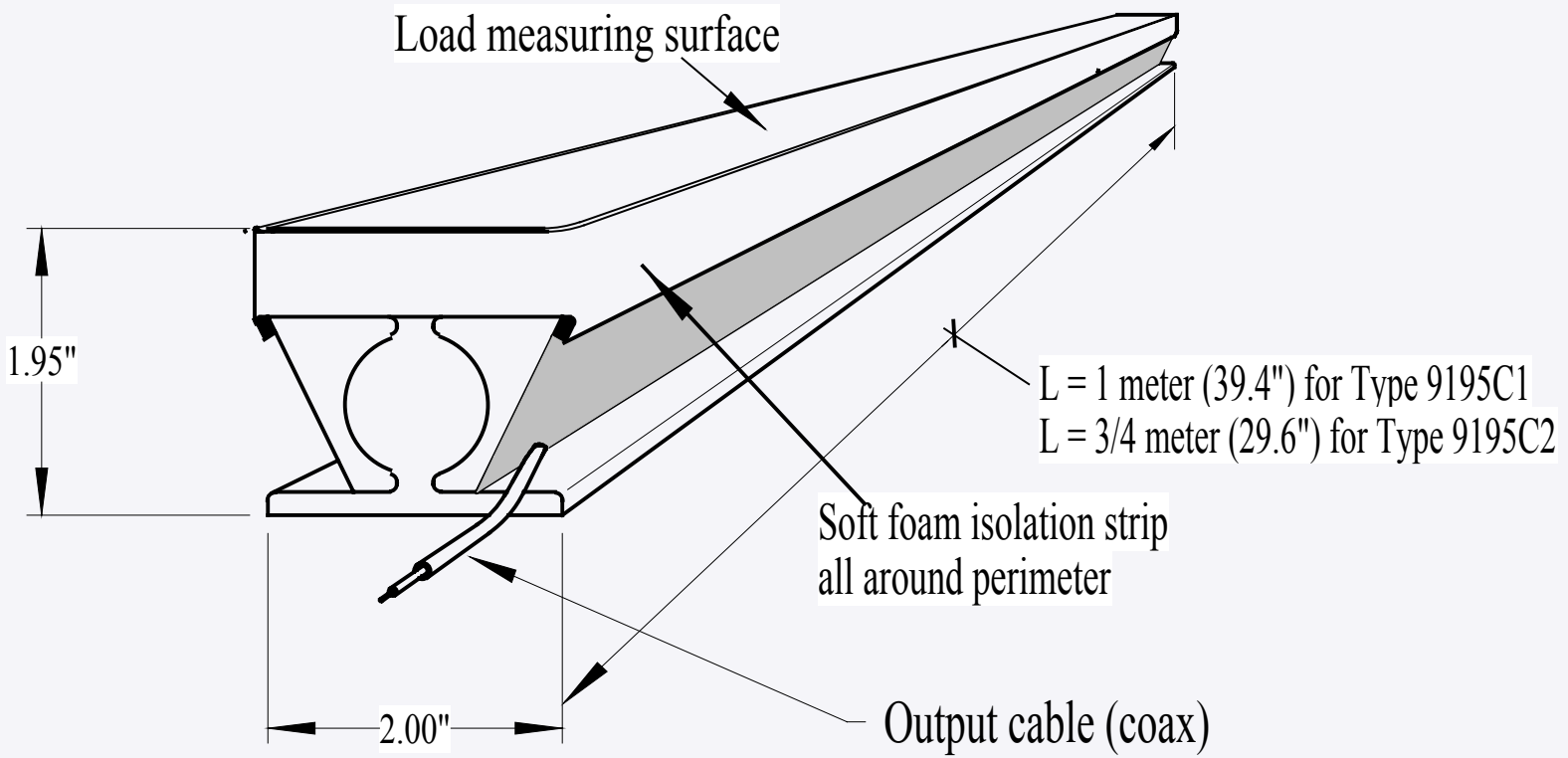
## *WIM sensor characterizations*

- For Type III or better WIM sites (≤ 6% accuracy on GVW), only Kistler's quartz WIM sensors simultaneously meet the conditions of "sufficient inherent accuracy" and "pavement conformance".

- "Piezocable" more or less conforms to local pavement surface but does not meet Type III performance requirements.

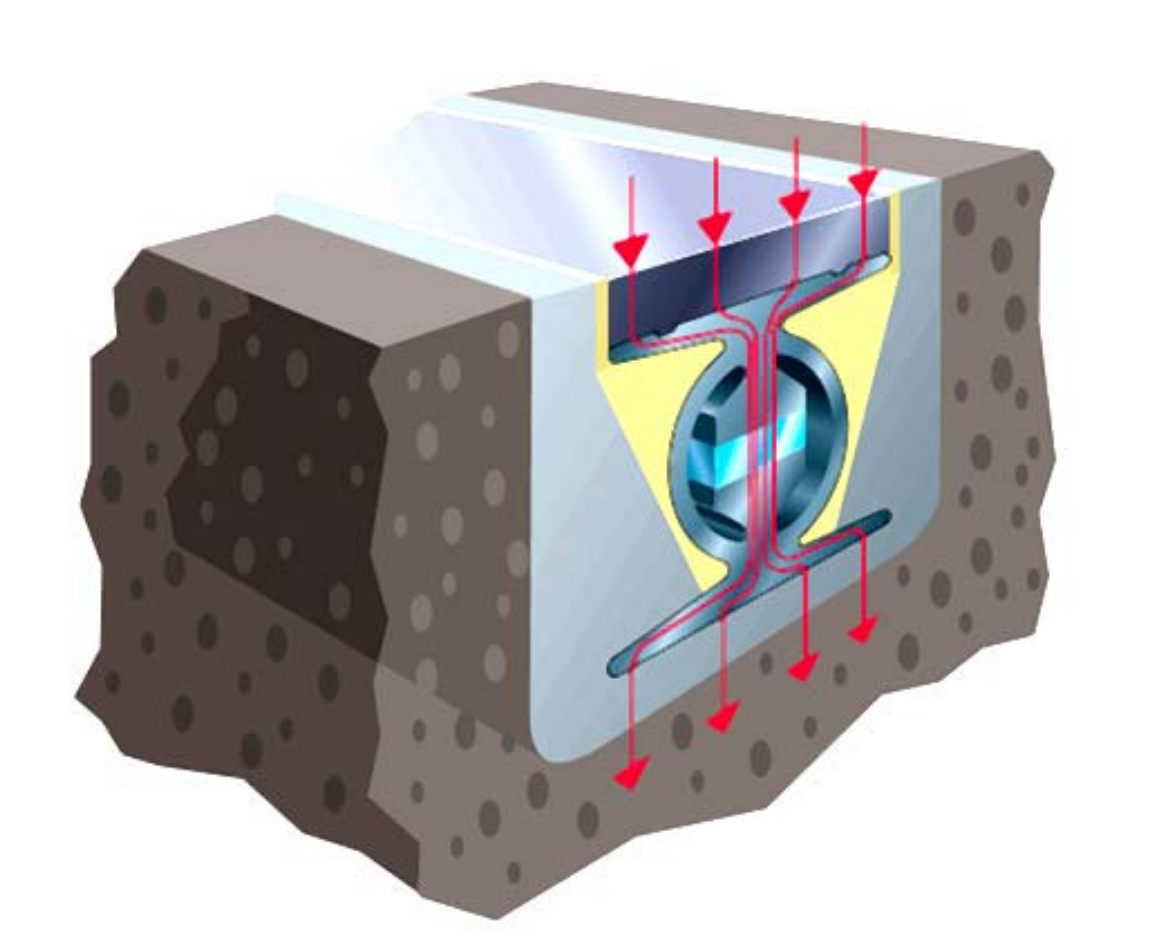
- Extended surface "weigh plates" (strain gage based sensors) can meet Type III performance but do not provide a pavement-conformal sensor surface.

# LINEAS WIM Sensor, Type 9195C(x)



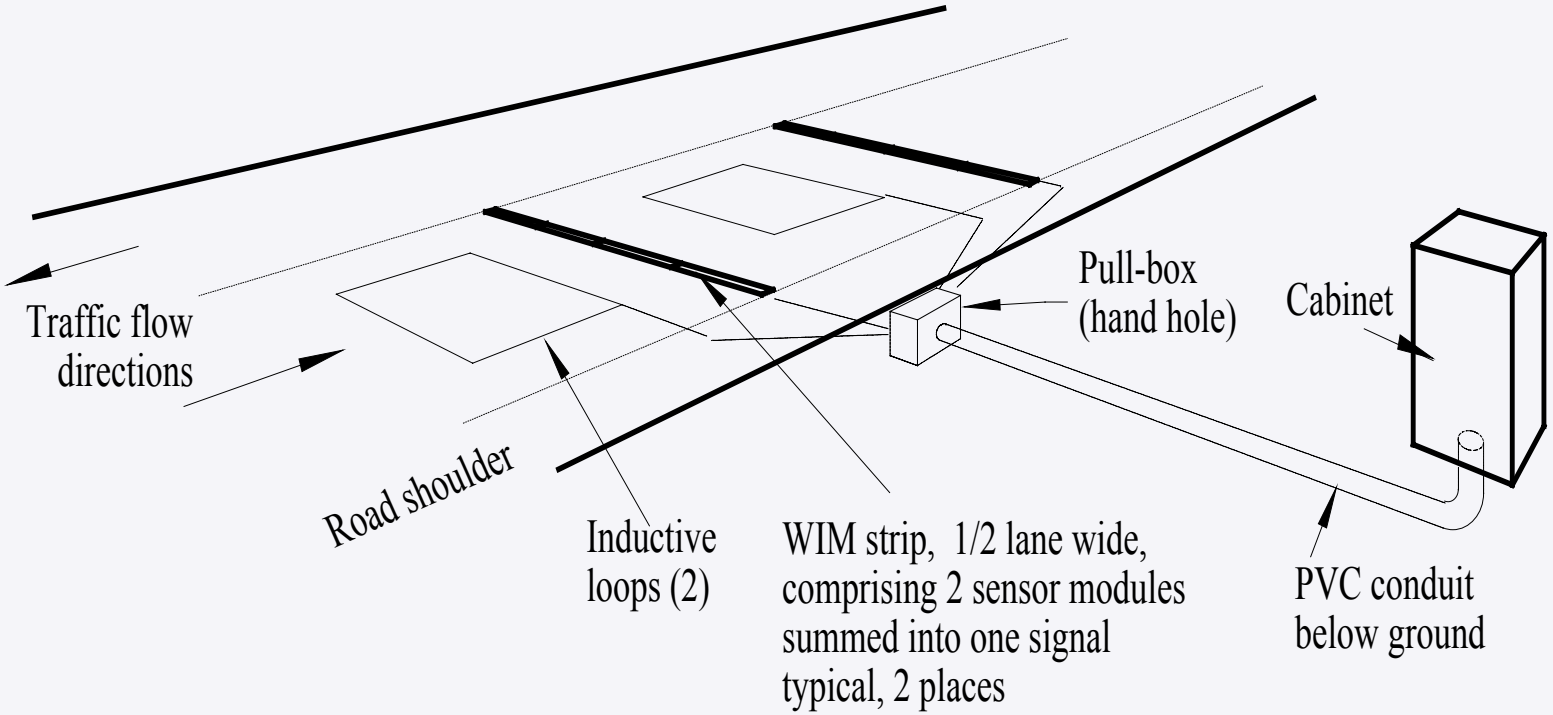
# *Kistler's quartz WIM sensor*

## *X-section*

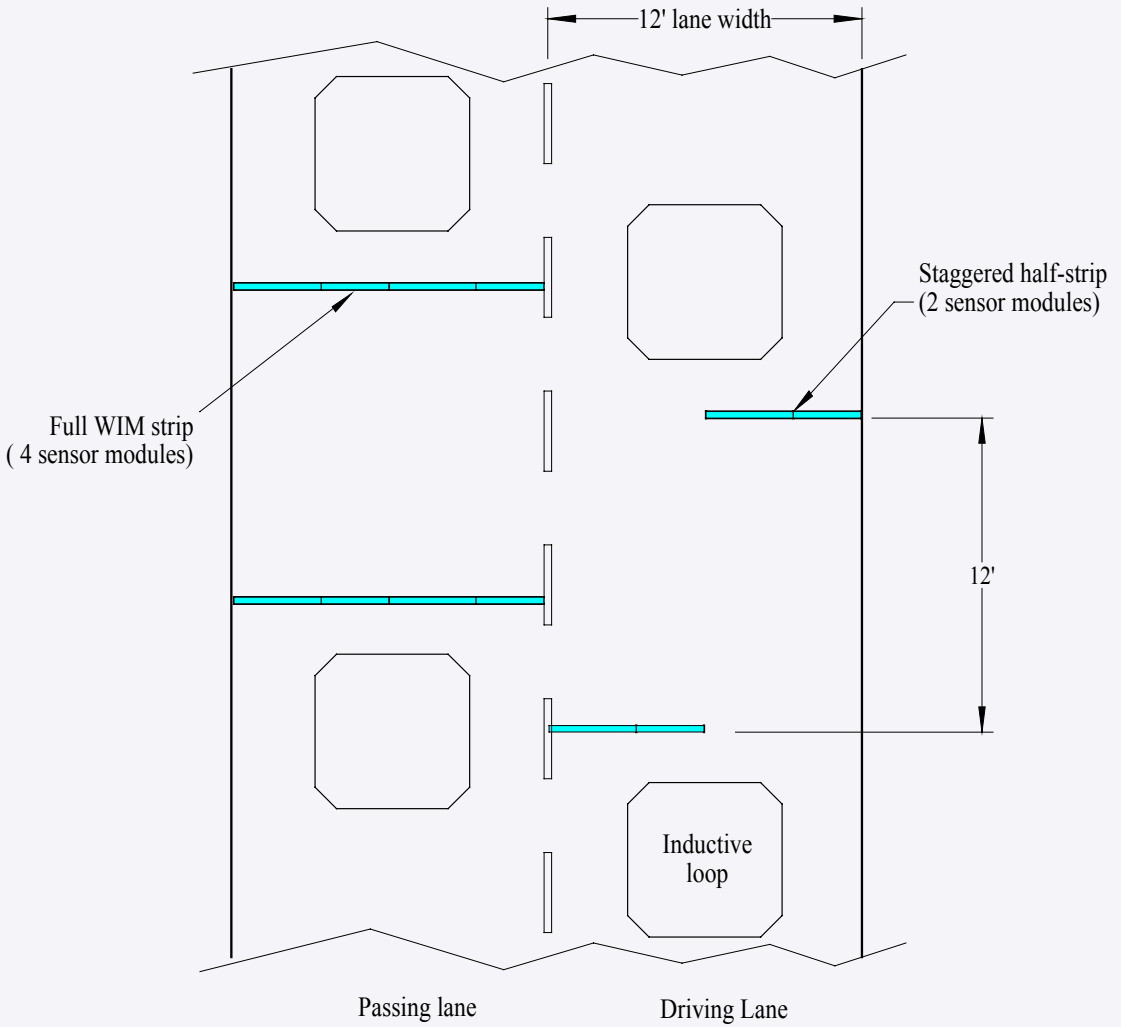


Cross-section of quartz WIM sensor showing installation in asphalt

# Typical WIM site configuration



# *WIM strip configurations*




## Sensor installation options:

- Full strips (shown in left lane) for optimum accuracy

- Half strips (shown in right lane) for reduced cost, modest impact on accuracy, given reasonably flat pavement.

## *Sensor accuracy*

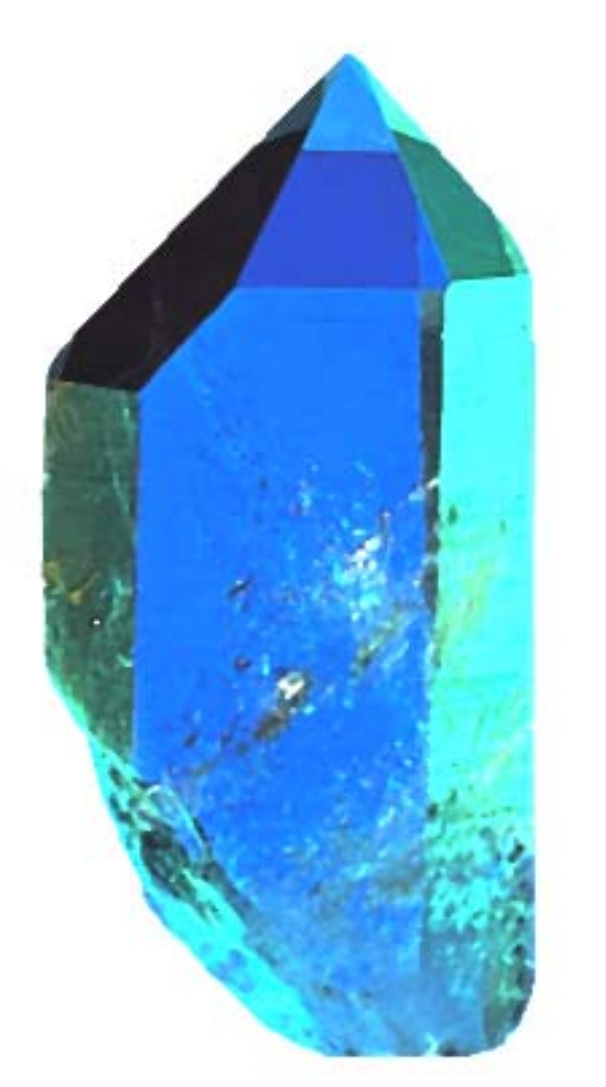
Characterizing Kistler WIM sensor's inherent accuracy:

- Quartz WIM sensors are based on a Kistler-developed, 50 year-old technology that historically returns force measurements to an accuracy of 1% or better.

- Uniformity of output along sensor length is, for Kistler, a non-traditional error source unique to the extended length of "WIM strip" sensors. Kistler routinely achieves 2% uniformity.

- These performance capabilities are more than sufficient to support Type III WIM site requirements

## *Quartz crystal*



Quartz:

The near-perfect transducer material

## Cool things about quartz . . .

- Perfectly linear output
- Stable transducer properties with respect to time - no "aging" which eliminates or minimizes repeated calibrations.
- Stable properties with temperature - compensation for wide ranging ambient temperature not required
- Extremely stiff - virtually no deflection under load. Therefore, high frequency response. Quartz faithfully measures fast-changing load conditions

# Quartz WIM system accuracy

- Quartz WIM on Interstate highways routinely measure truck GVW's to ≤ 5% accuracy at 95% confidence level

- Because of quartz sensors' inherent stability and frequency response, quartz WIM site performance is dictated mostly by surrounding pavement flatness

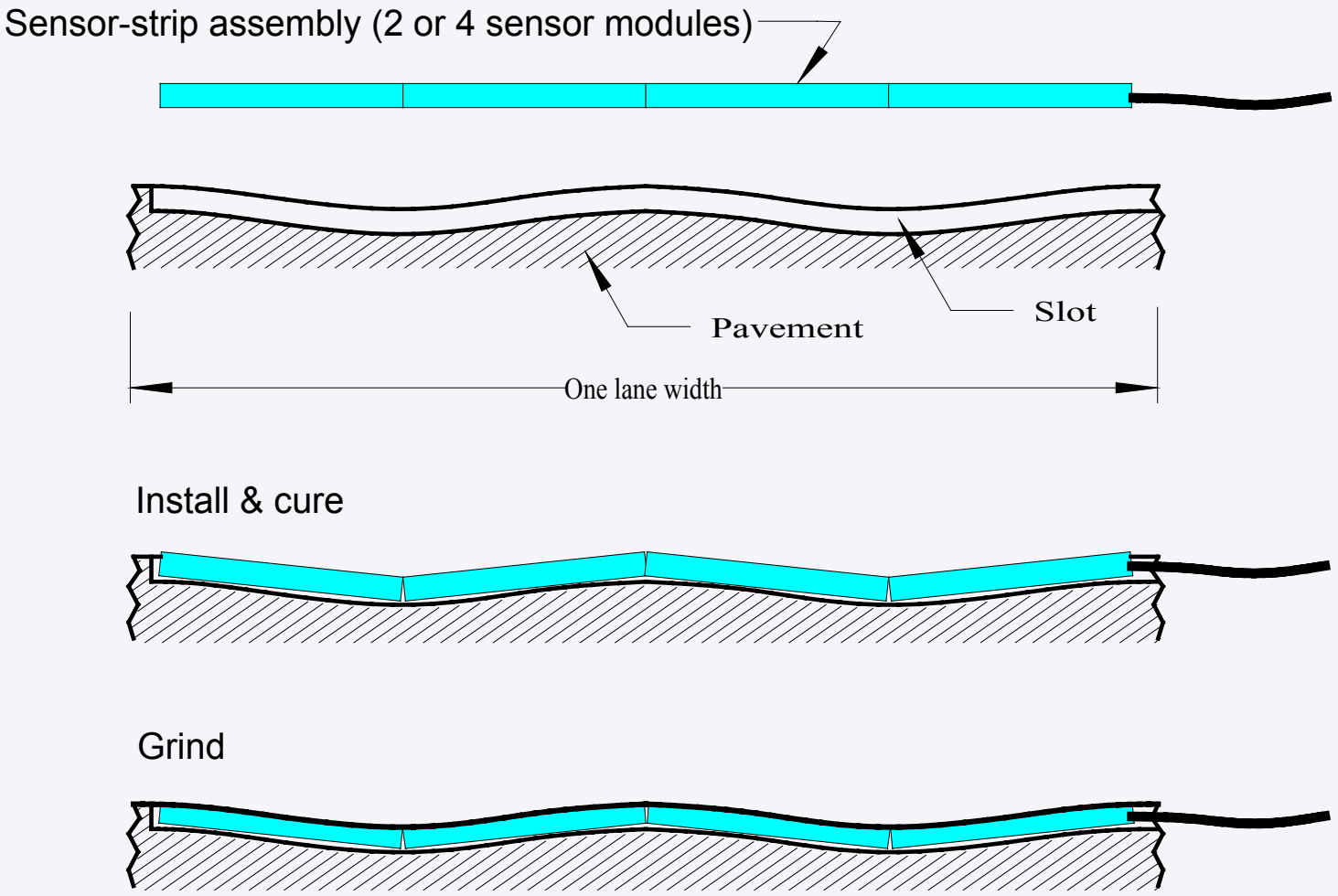
- On a straight, finish-ground concrete off-ramp (~ 45 mph truck speed) quartz WIM has demonstrated ± 2% MAX error on GVW (2 sites in NH)

Sensor conformance to adjacent pavement surface:

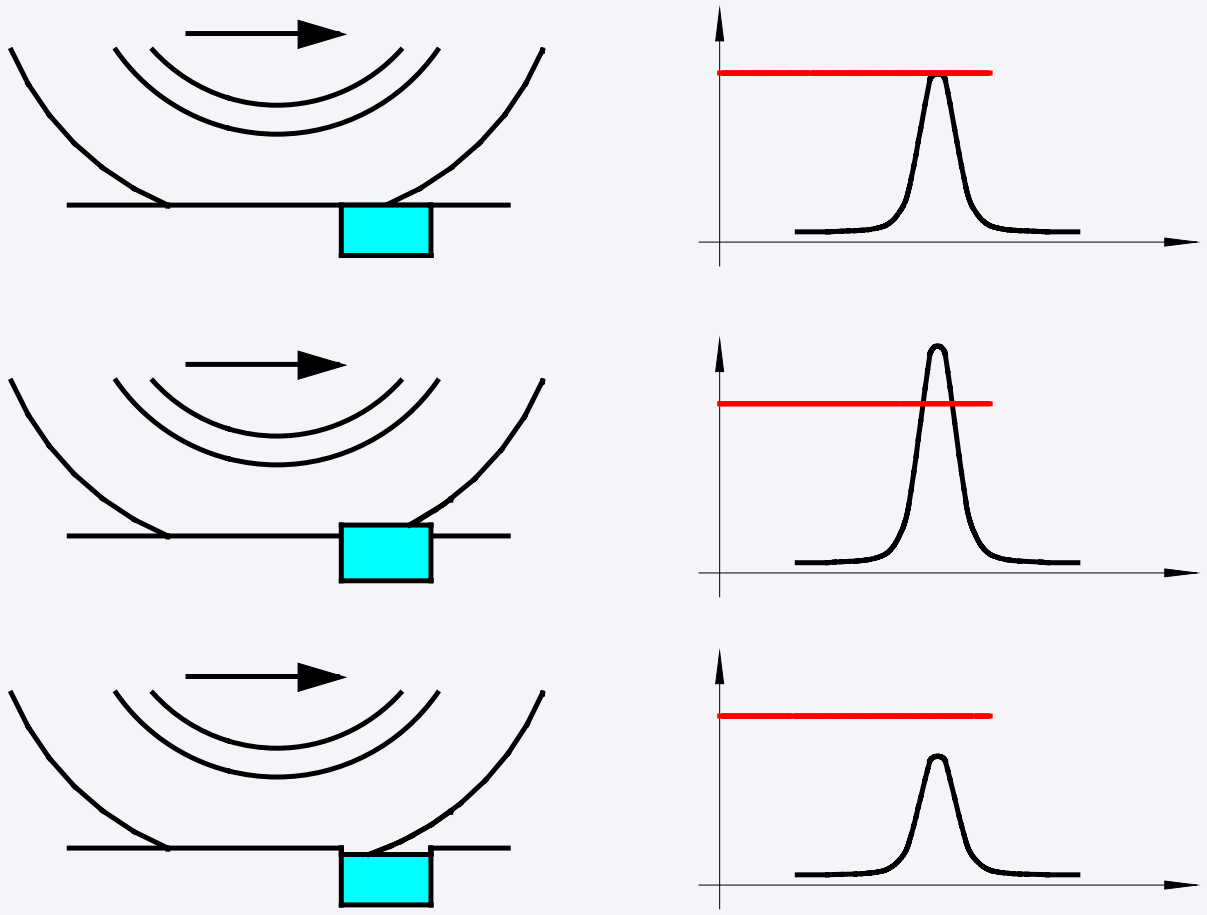
- Quartz WIM sensors are designed to enable “conformal surface grinding” at installation.

- Conformal surfaces eliminate errors due to vehicle-to-vehicle variations in speed and tire pressure.

# Conformance



# Effect of conformal grinding on WIM signal



# *Quartz WIM site pictures*

# *Slot cutting*

## *Finished slot*

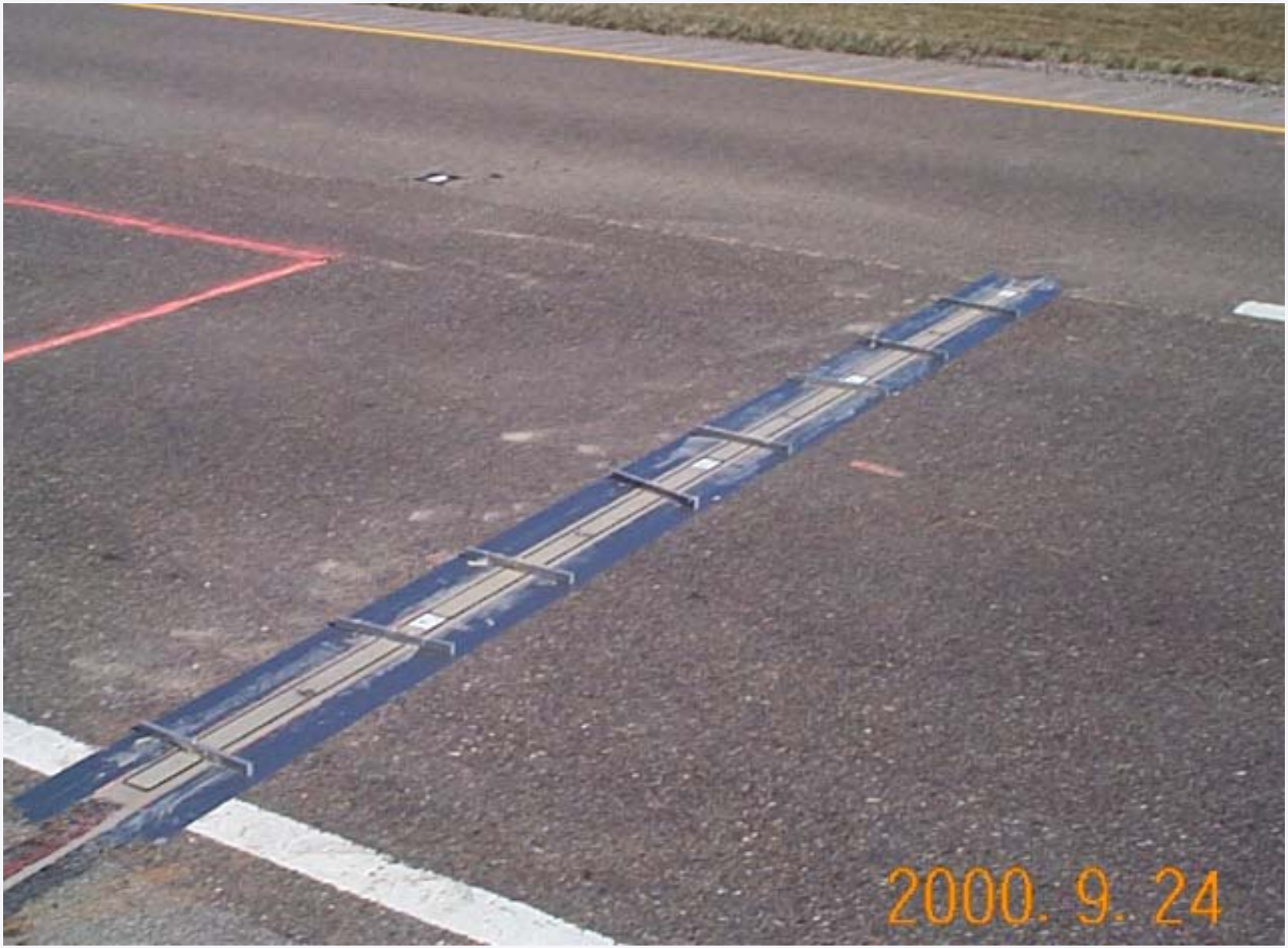
## *Sensor strip assembly*

# *Pouring grout*

## *Installing sensor strip into wet grout*

## *Trowelling-off grout*

## *Grout curing*



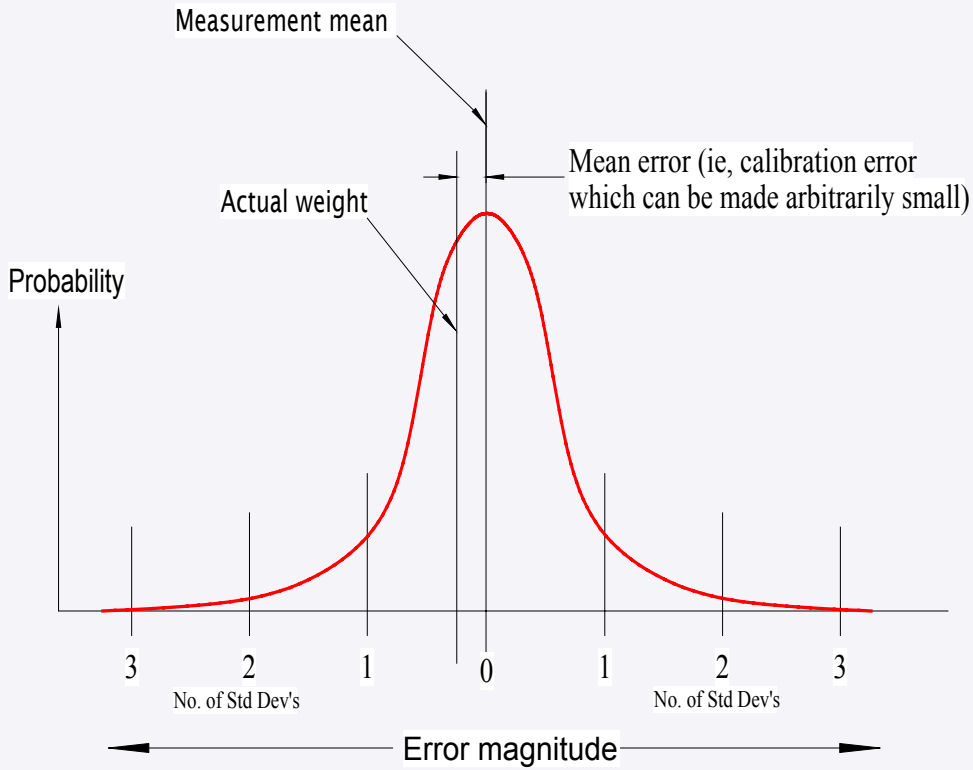
## *Conformal grinding*

## *Finished WIM site*

## *Mean vs random error*

# Characterizing WIM system errors with a 2-sigma specification:

- Average (mean) error minimized by one-time calibration on-site.
- Remaining error is random.
- For 1 standard deviation < 2%. and a near-zero mean, then 95% of all errors are within 2 SD's or within 4%.



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I’m done . . . . .

Thanks for your attention !