



Rebalancing the risk equation for the ready-mix producer through in-transit management systems

M. Roberts, K. Redmon, N. Tregger
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American Concrete Institute



WEATHER FORECASTING CAN BE CHALLENGING...

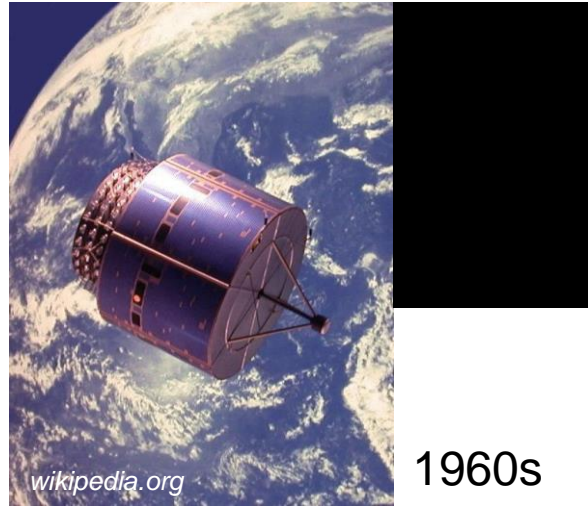


youtube.com/watch?v=iXuc7SAyk2s

FORECASTING PROGRESS SINCE 1958



1958



1960s



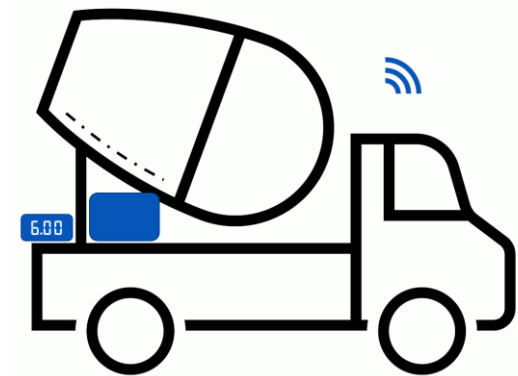
2010s



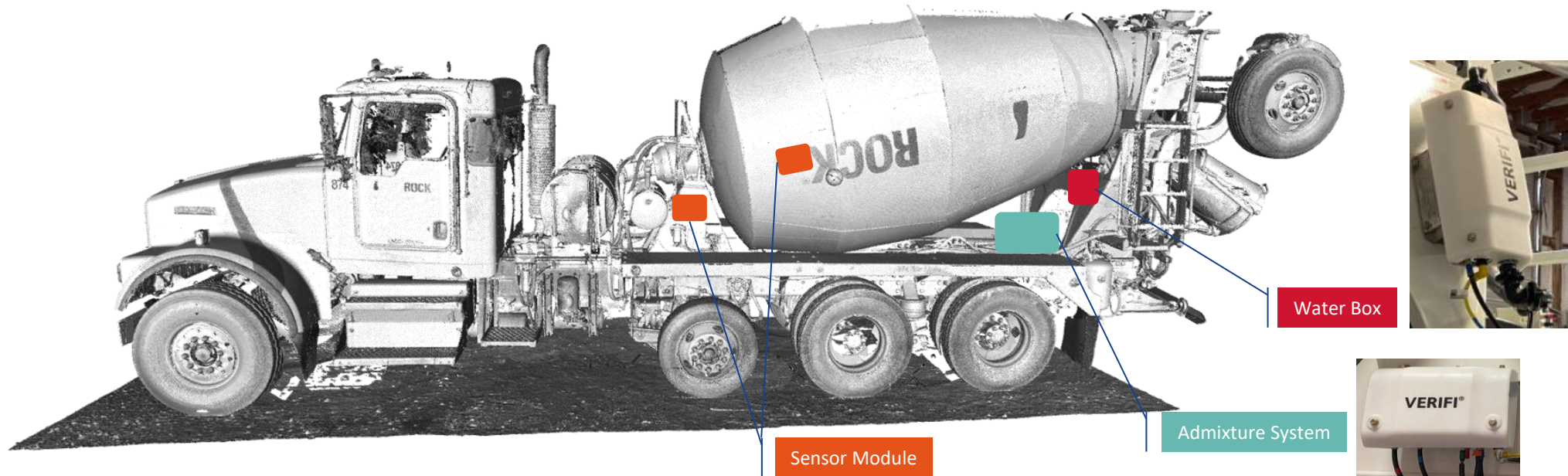
2015



1962



IN-TRANSIT MANAGEMENT SYSTEMS FOR CONCRETE MIXERS



1

Measure

- “Brain” of the system
- Contains the BTLE radio board to talk to other components
- Measure side of the system
- Consolidates other sensors

2

Manage with Water

- Two different systems based on weather
- Contains the BTLE radio board/ PCB to talk to Sensor module
- Contains the meter, valve(s) and cold weather pump

3

Manage with Admixtures

- Flexible source of admixture, can use on-board tanks
- Contains the BTLE radio board/ PCB to talk to Sensor module

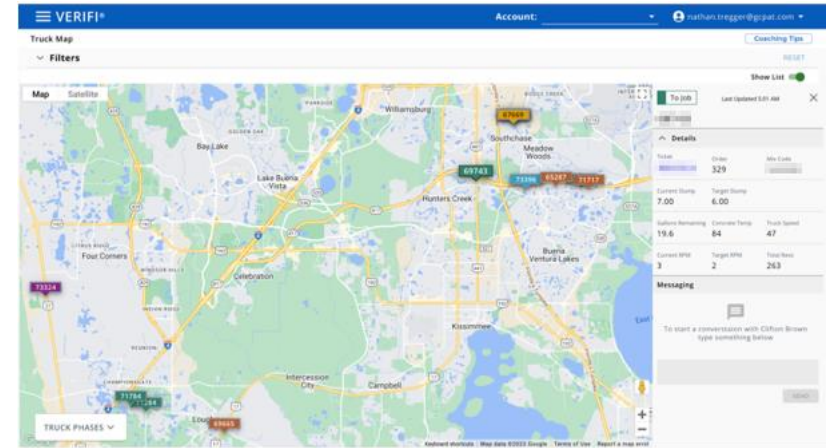
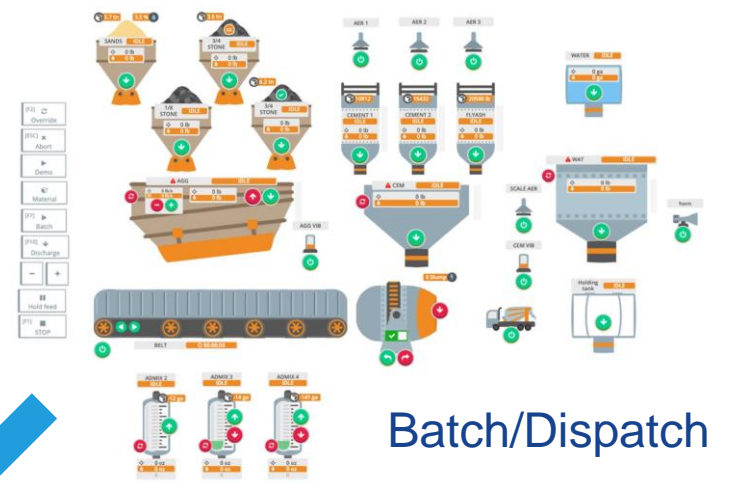
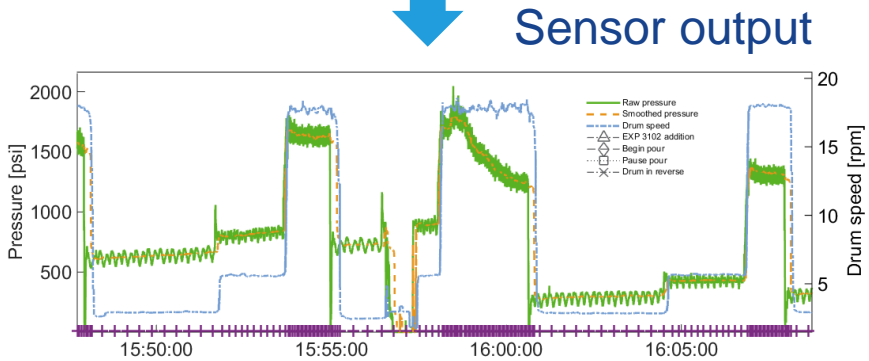
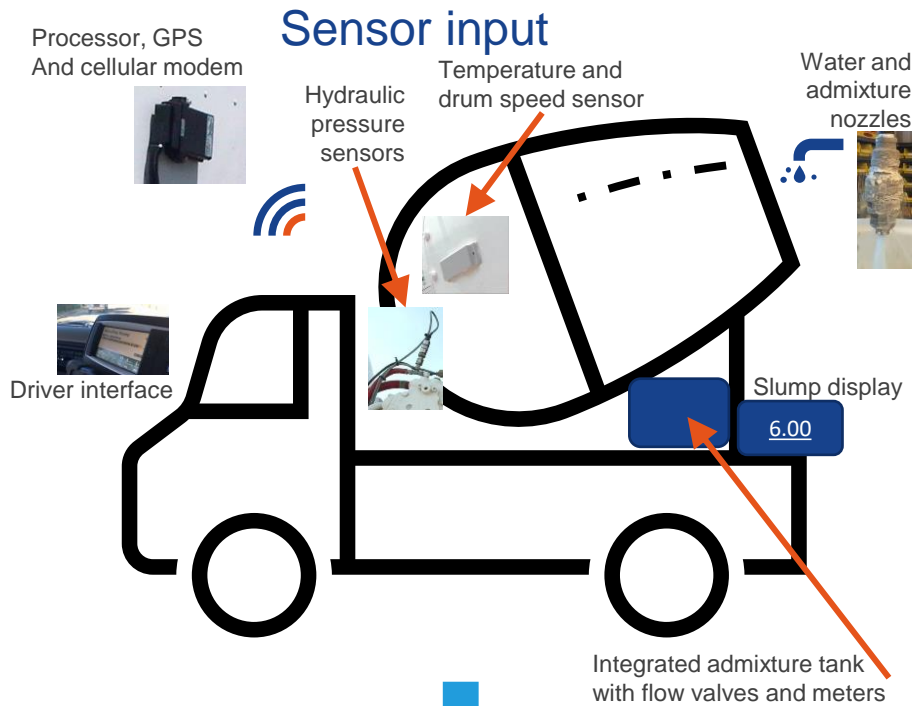
Data / Information / Insights

- 185 million cubic yards \approx 1000 Superdomes!
- Over a **billion** data points



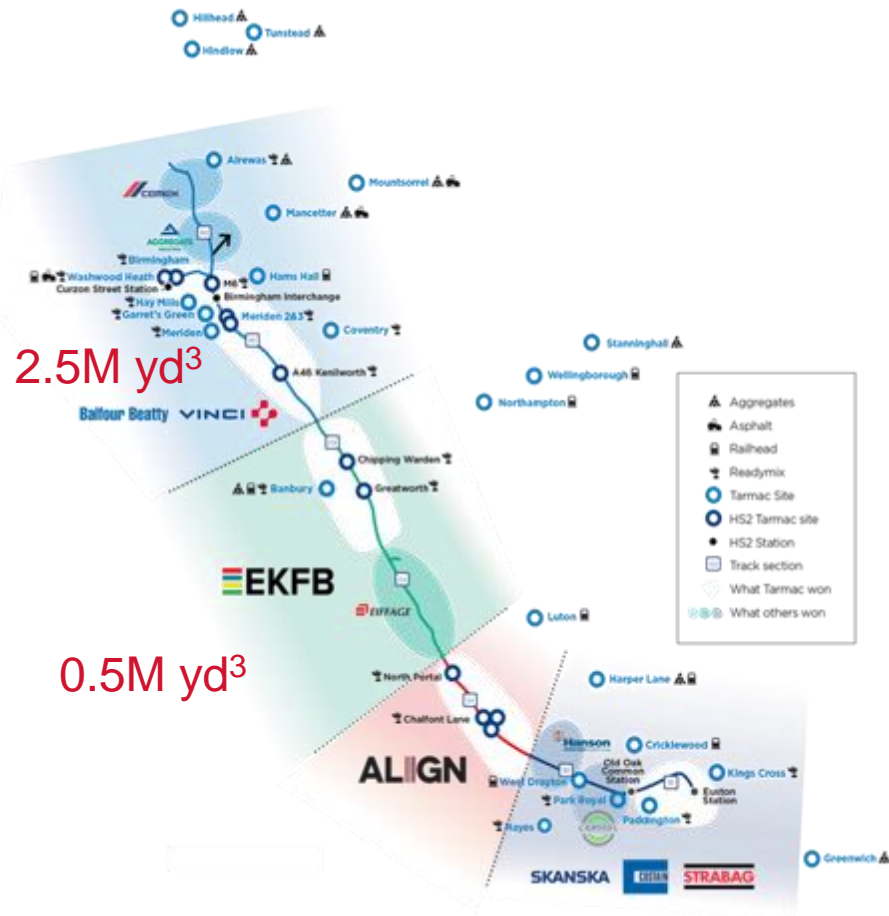
vianolavie.org

THE IN-TRANSIT MANAGEMENT SYSTEM



Portal

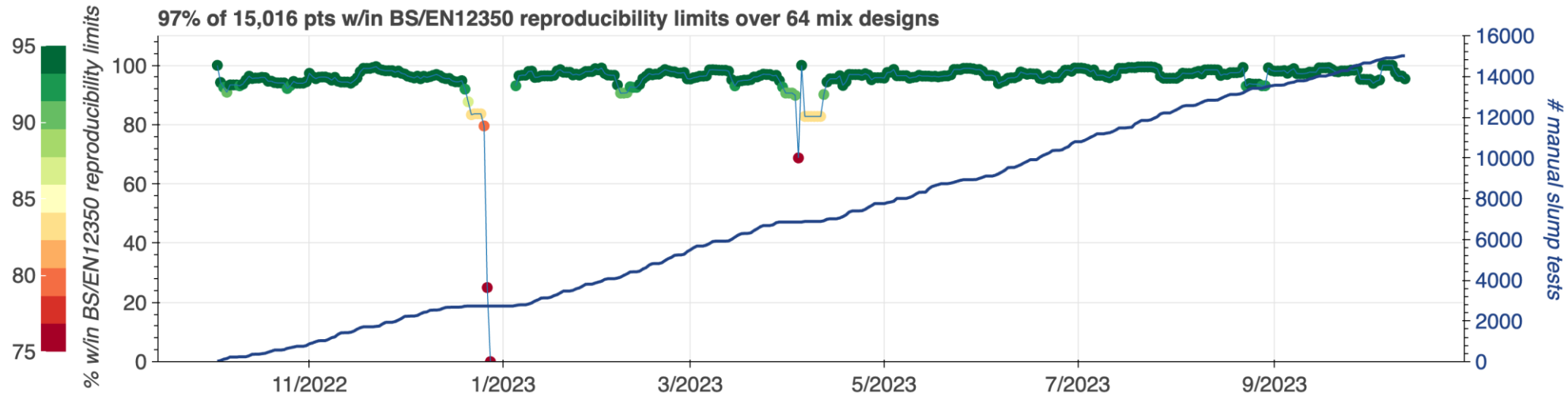
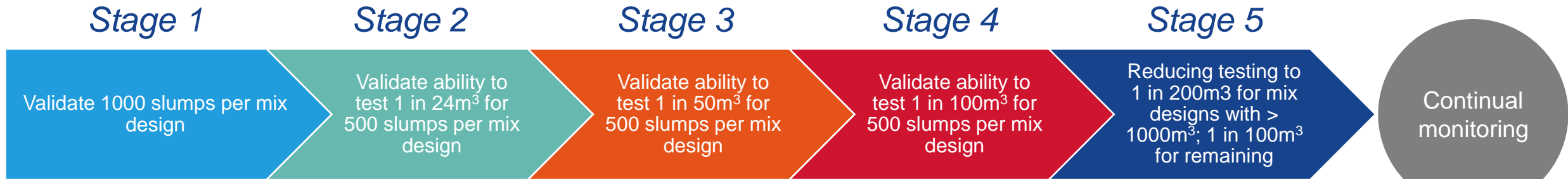
HIGH SPEED 2 (HS2): LARGEST INFRASTRUCTURE PROJECT IN UK



- The BBV N1-N2 project utilizes 3 million cubic yards of concrete
- 42 viaducts, 66 over-bridges, 56 culverts, 66 embankments, etc.
- HS2 specification requires EVERY load to be tested for slump
 - Expensive (\$, CO₂)
 - Labor intensive

BBV DEPARTURE: BUILDING CONFIDENCE IN DIGITAL SYSTEMS

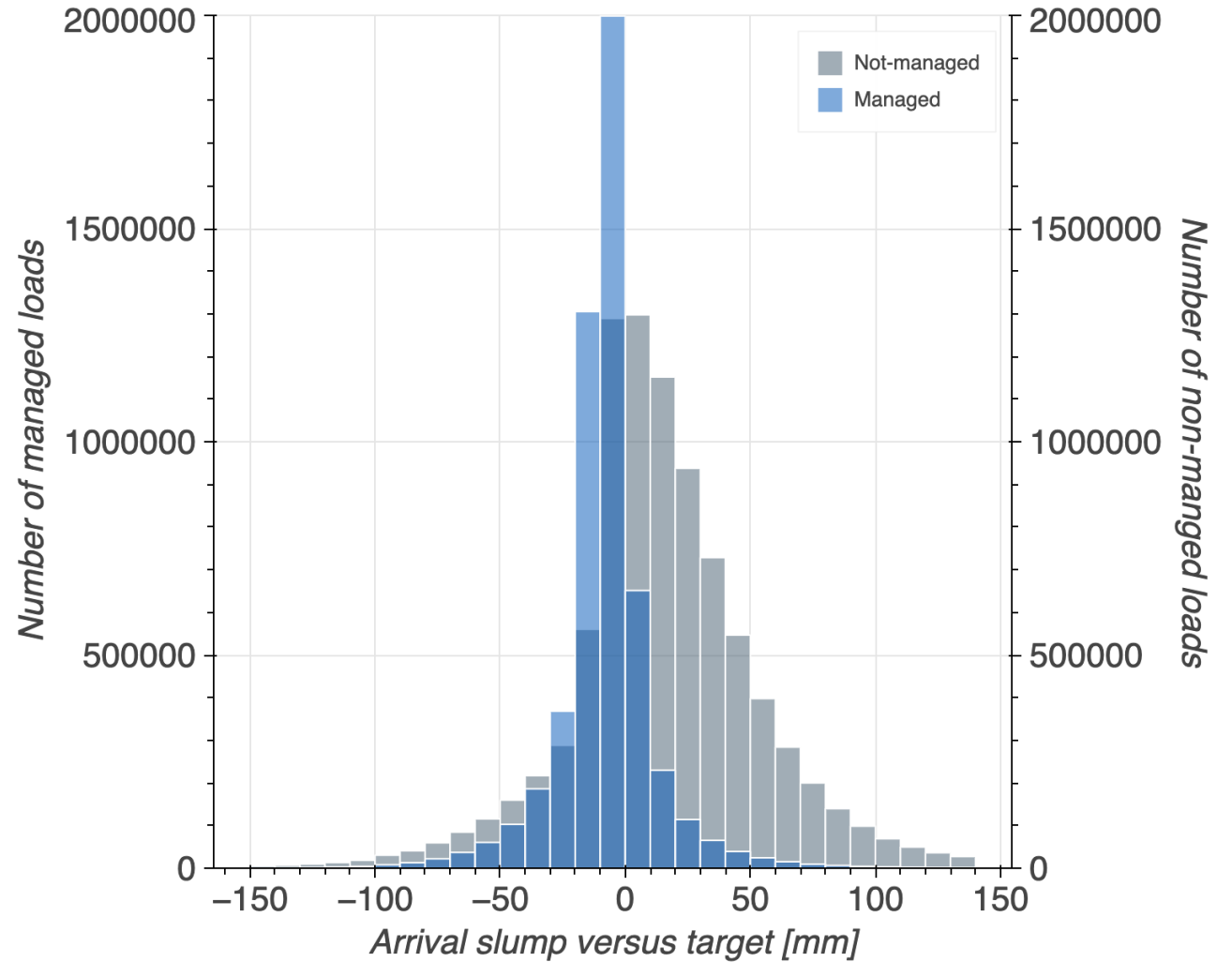
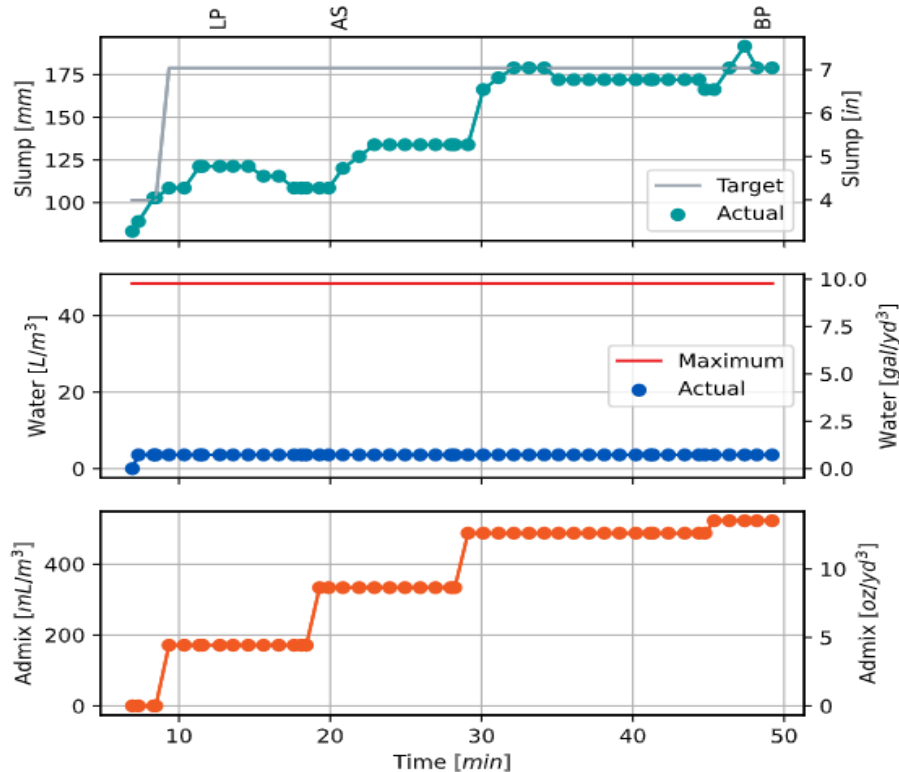
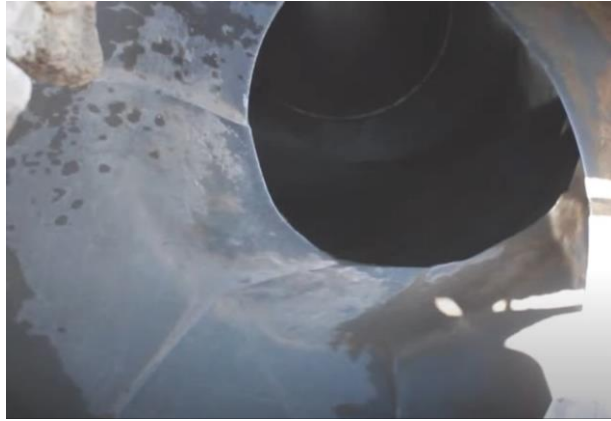
- HS2 have agreed to a departure from the specification in which BBV will progressively replace manual testing (consistence, temperature and cubes) with VERIFI® via a *staged* approach



HS2 have approved a BBV departure to adopt VERIFI, PROJECT WIDE



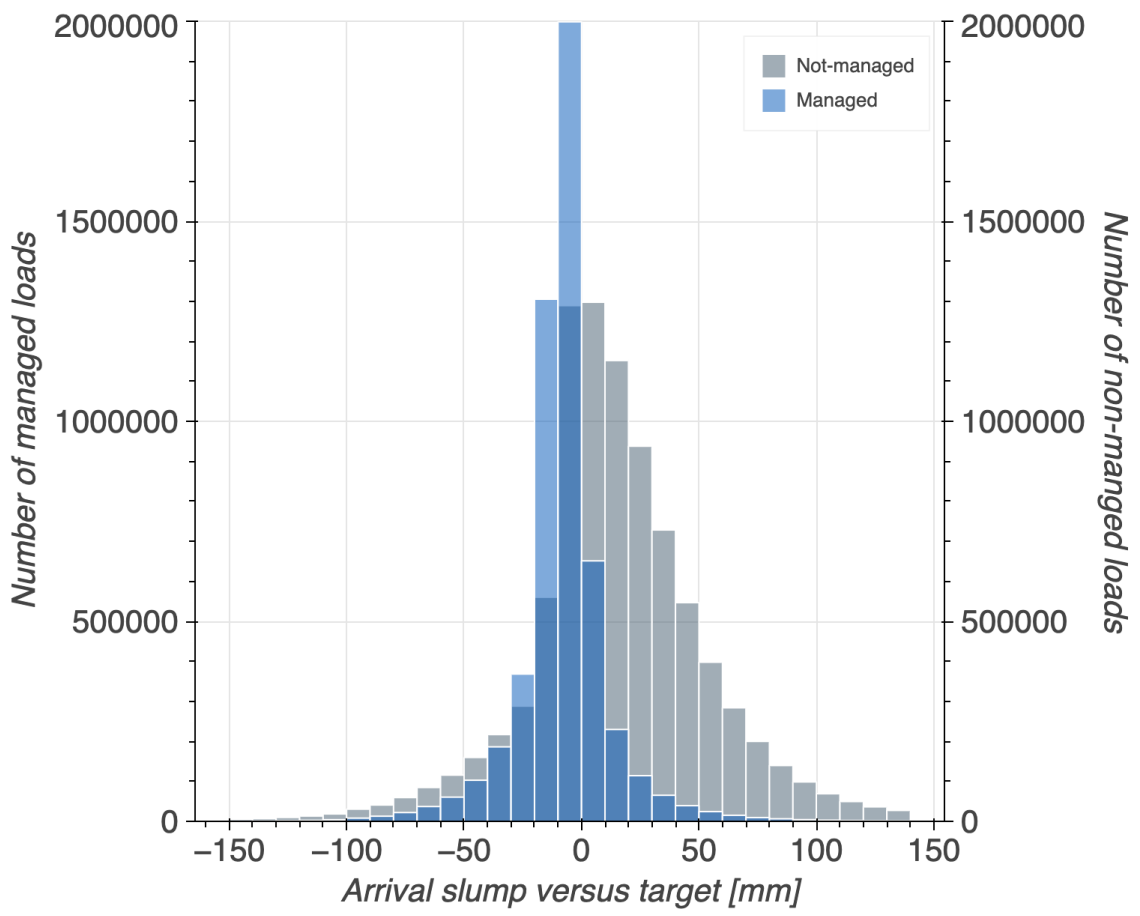
FROM VISIBILITY TO FEED-BACK LOOPS



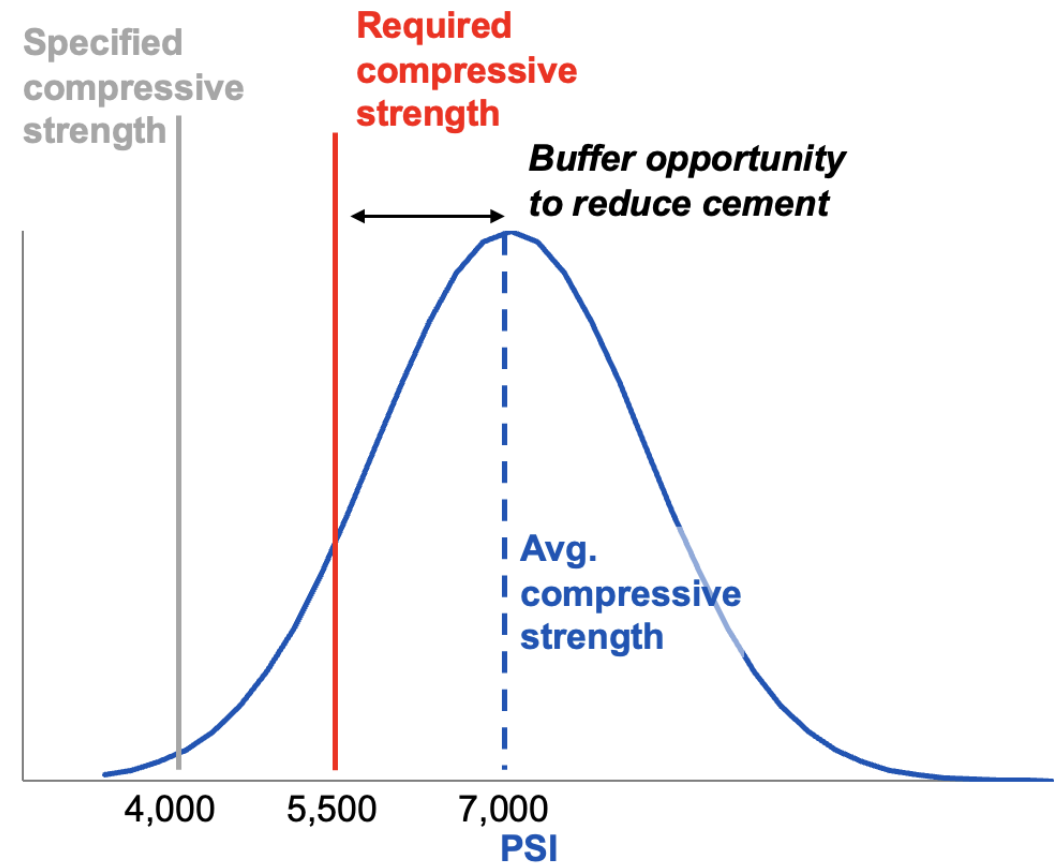
Non-managed: N=8.8M Mean=15 mm; STD=38 mm
 Managed: N=5.3M Mean=-8 mm; STD=20 mm



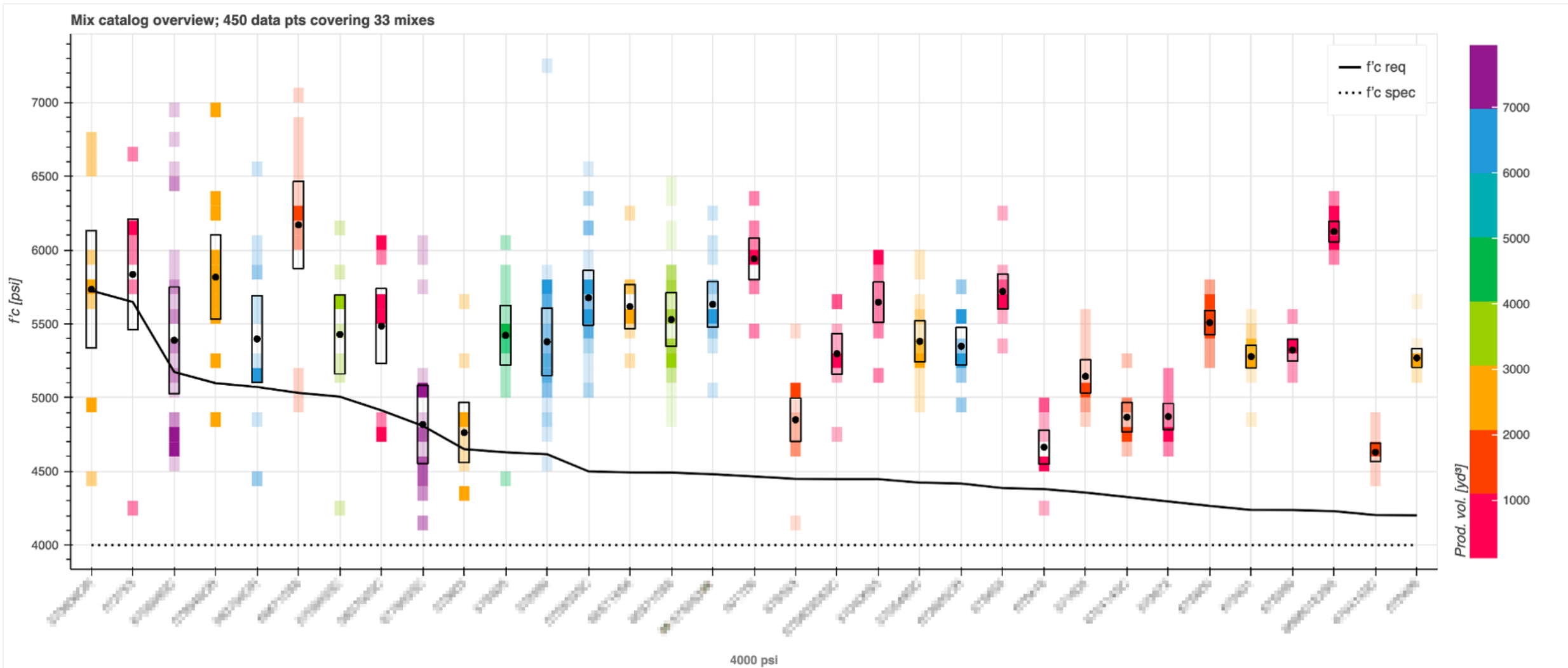
CONTROL OF SLUMP AND WATER → CONTROL OF STRENGTH



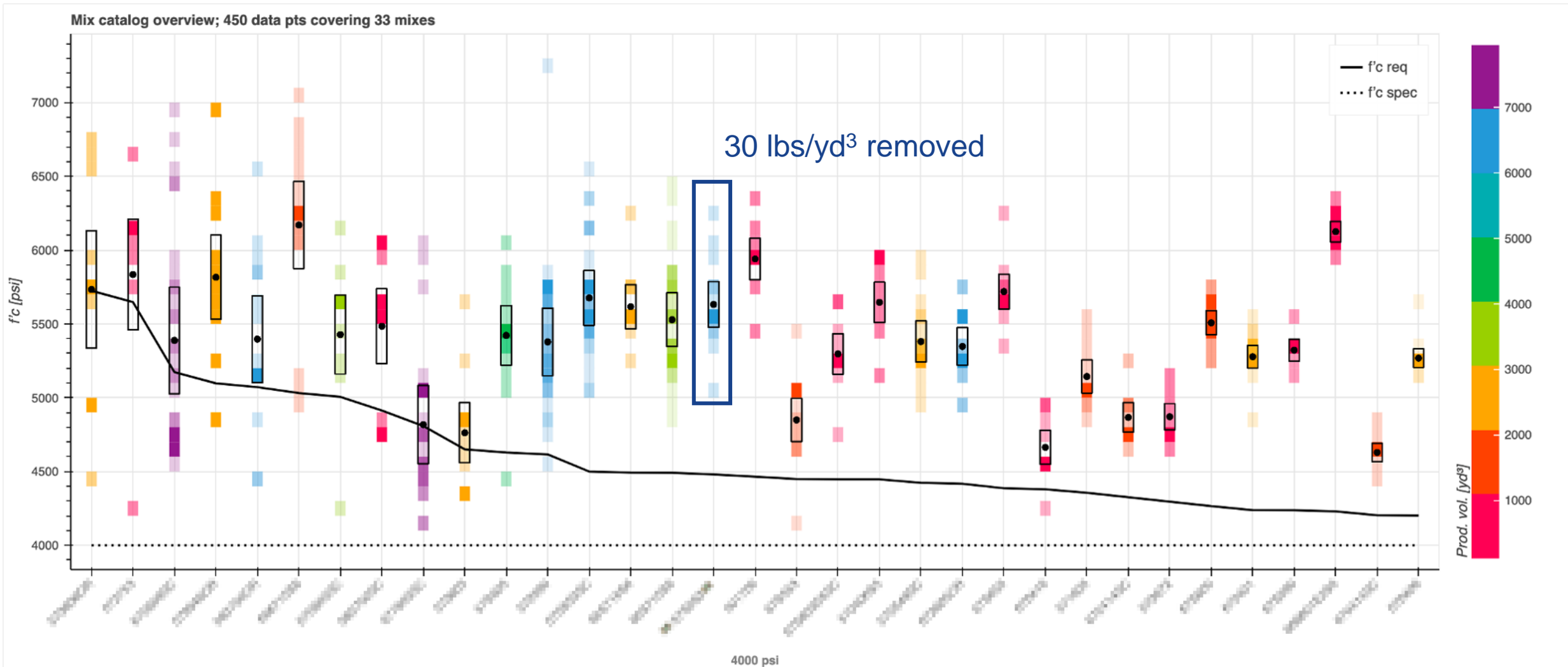
Example of breaking strength test analysis for 301-16 standard



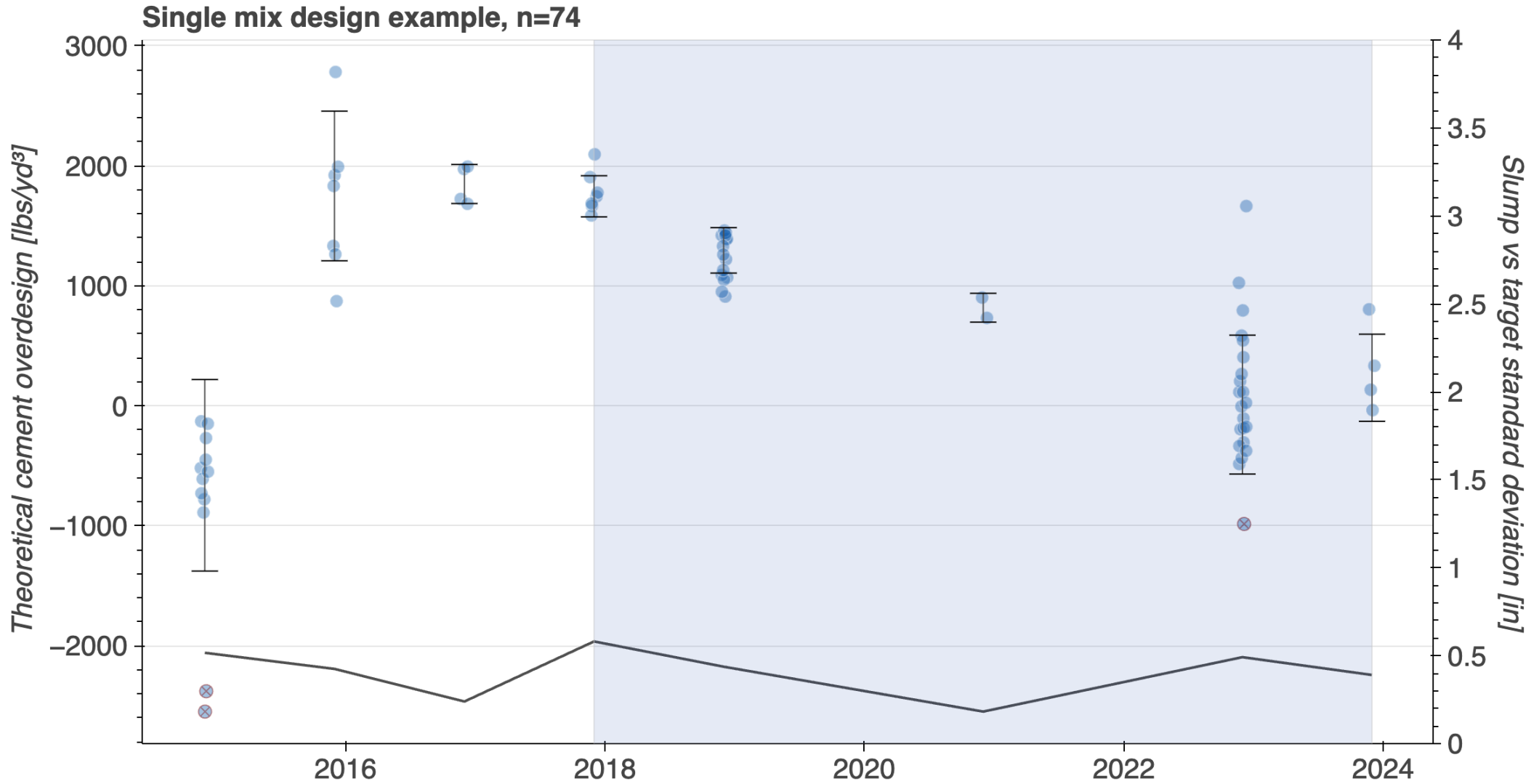
CONTROLLING THE SYSTEM → LOTS OF OPPORTUNITY



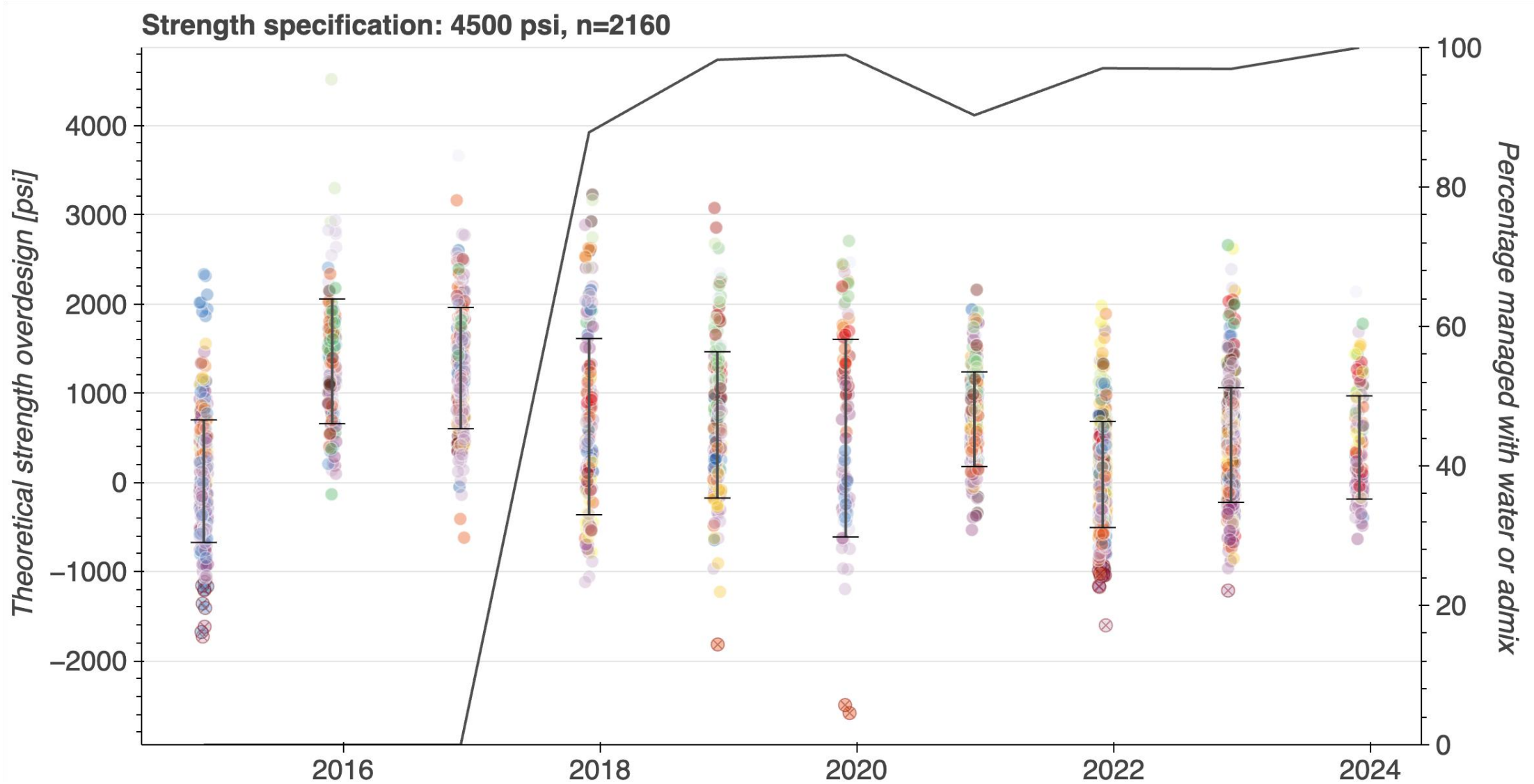
CONTROLLING THE SYSTEM → LOTS OF OPPORTUNITY



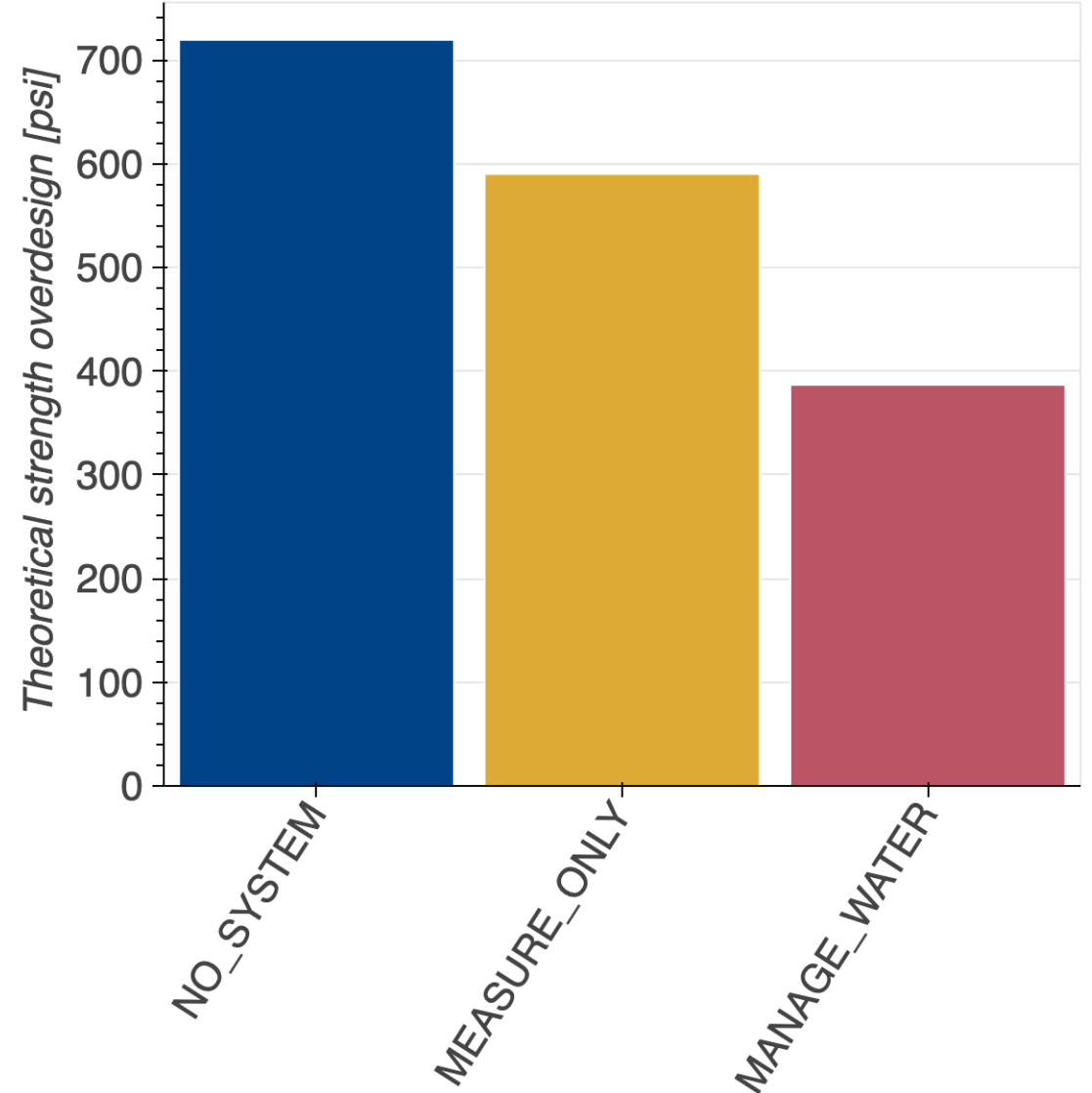
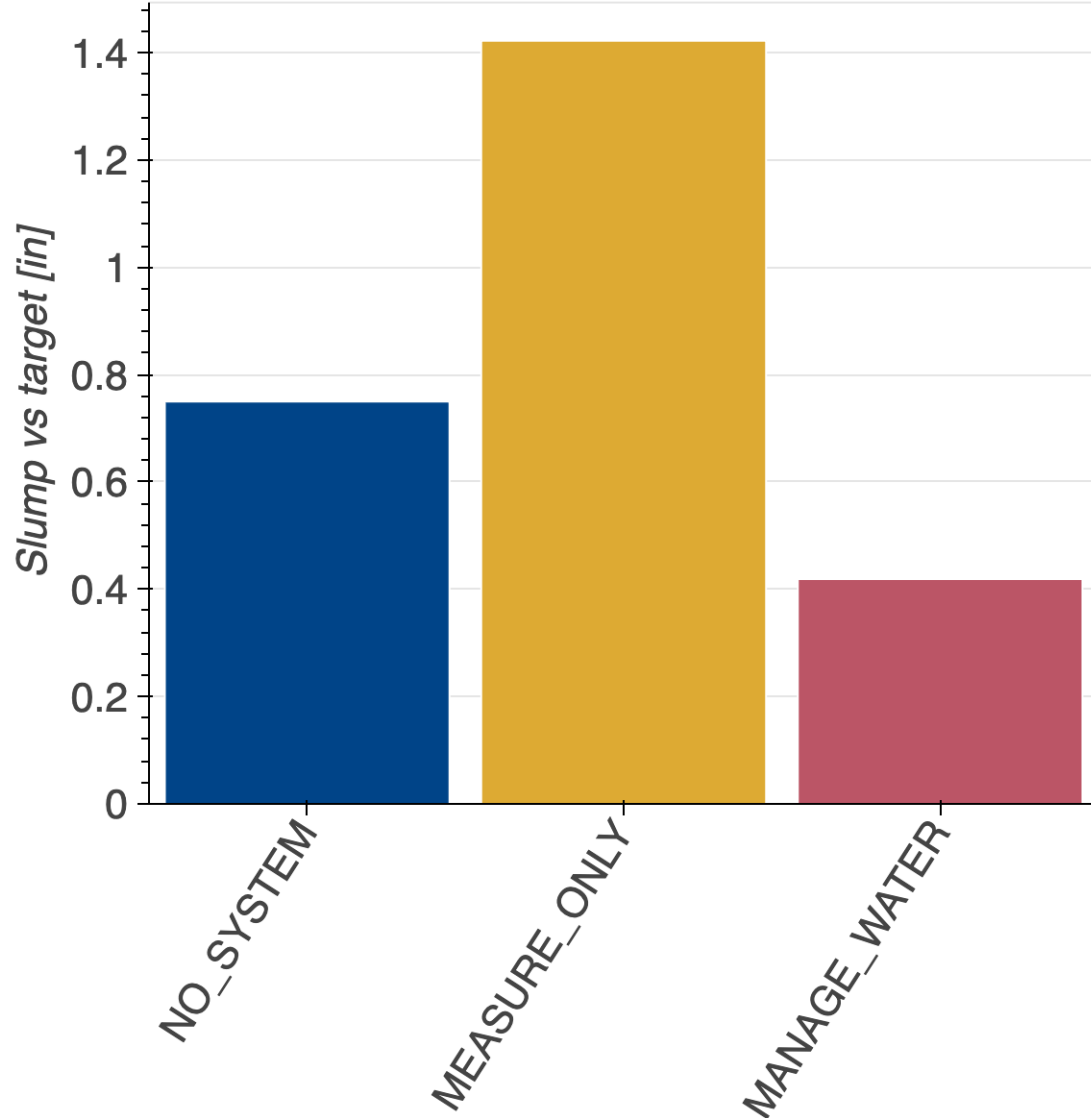
STEPPING THROUGH TIME...



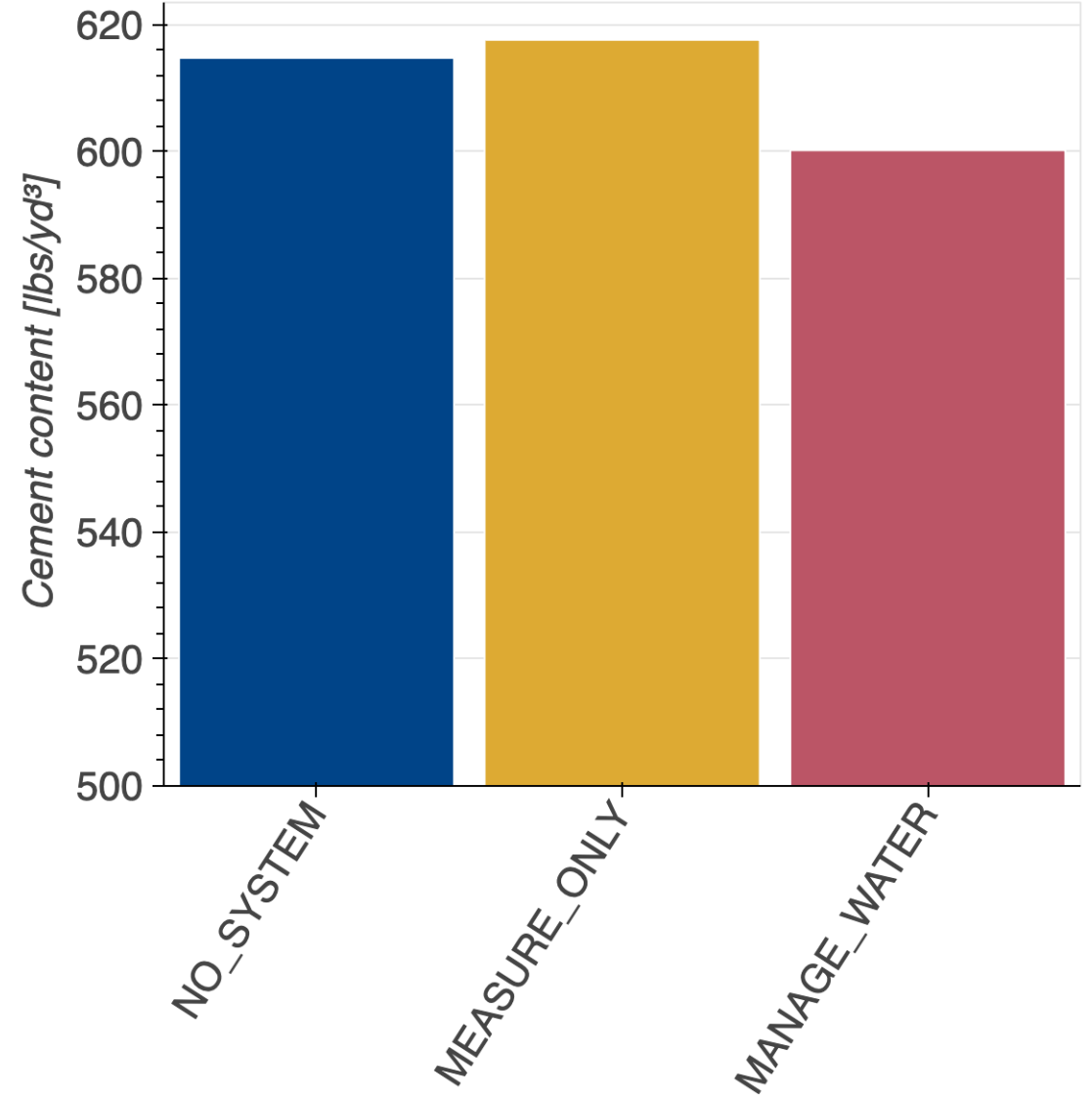
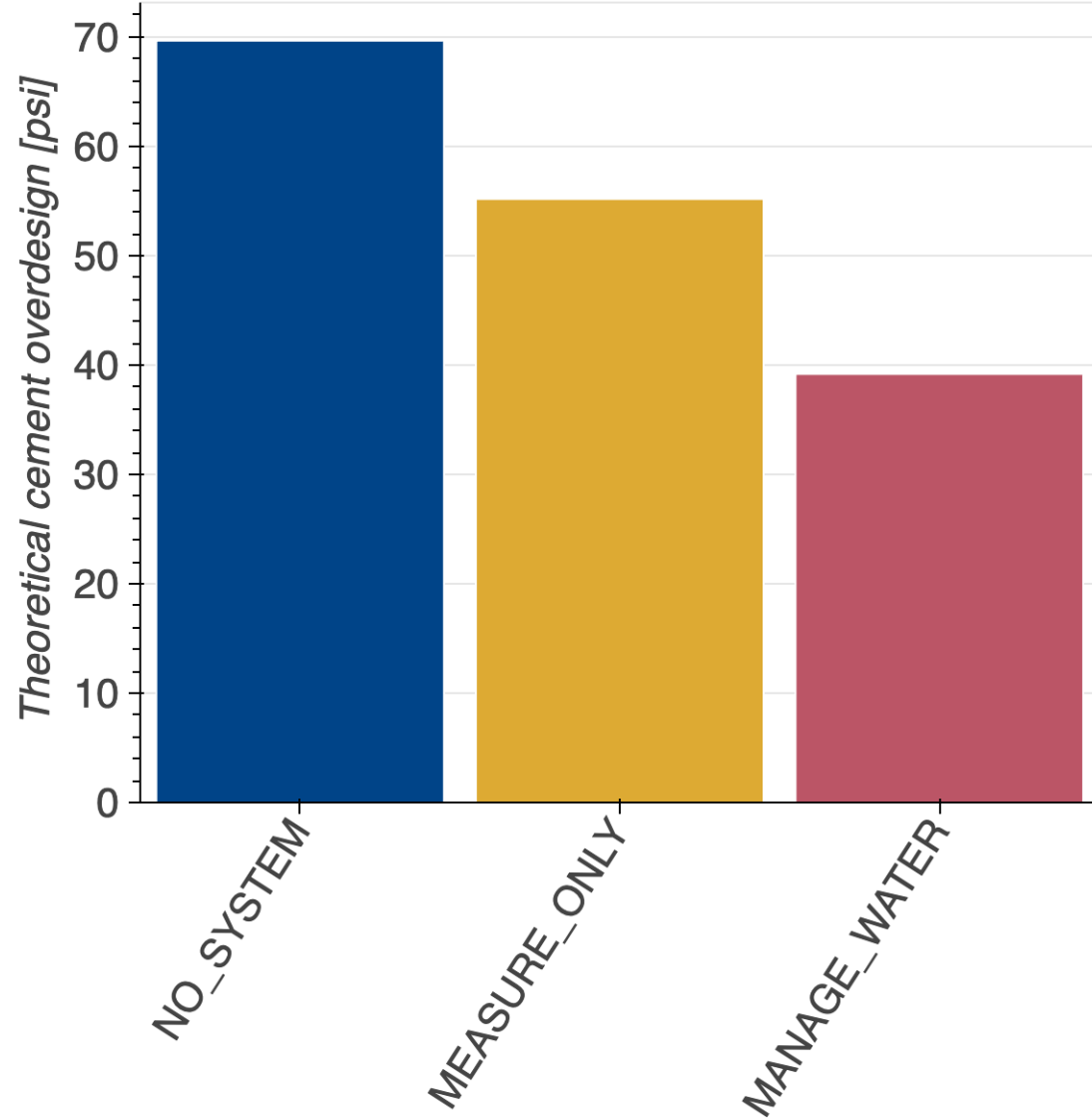
MOVING TOWARDS IN-TRANSIT MANAGEMENT



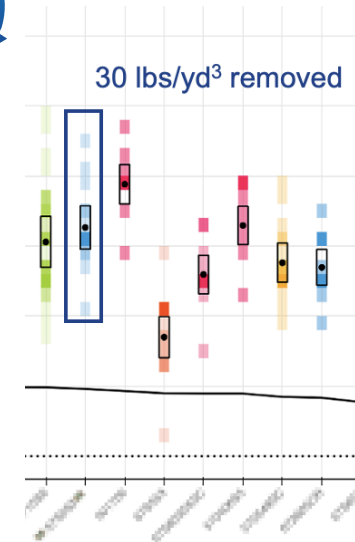
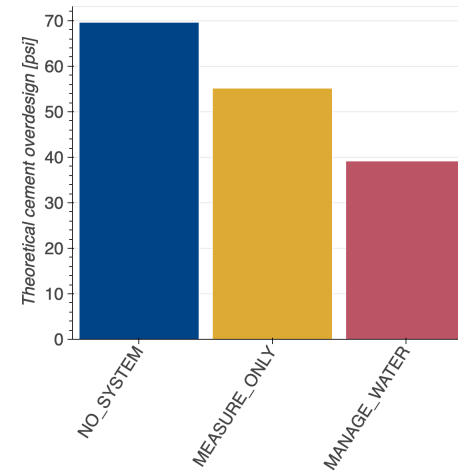
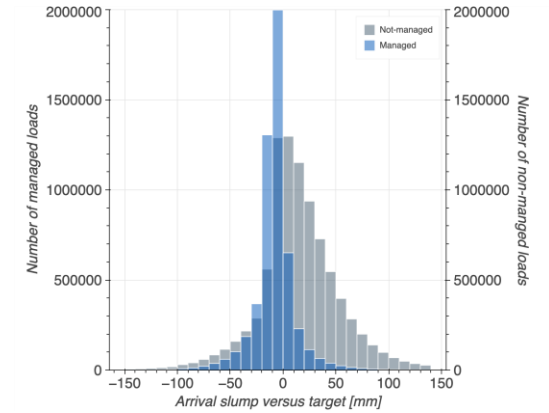
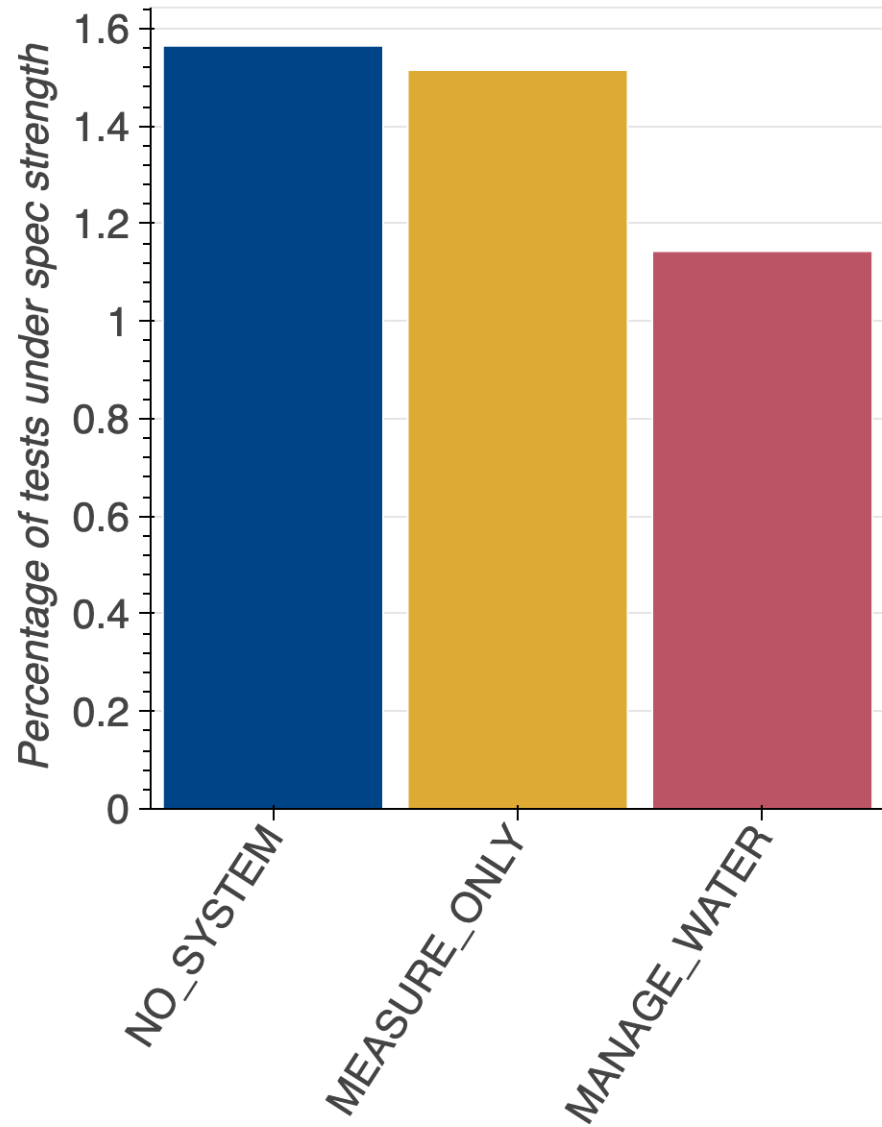
SUMMING IT UP



SUMMING IT UP



MANAGING RISK AND SAVING THE ENVIRONMENT

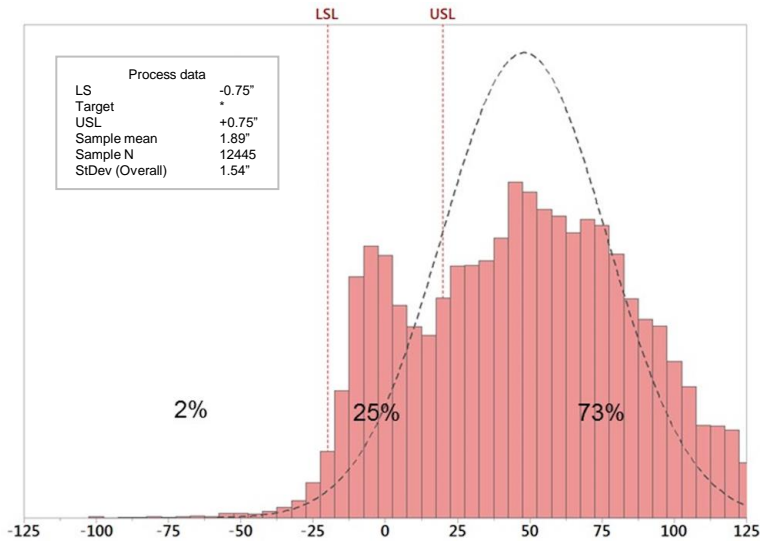




QUESTIONS?

LOOKING BEYOND STRENGTH...

Thanks to T. Barrett, L. Roberts, K. Hover!

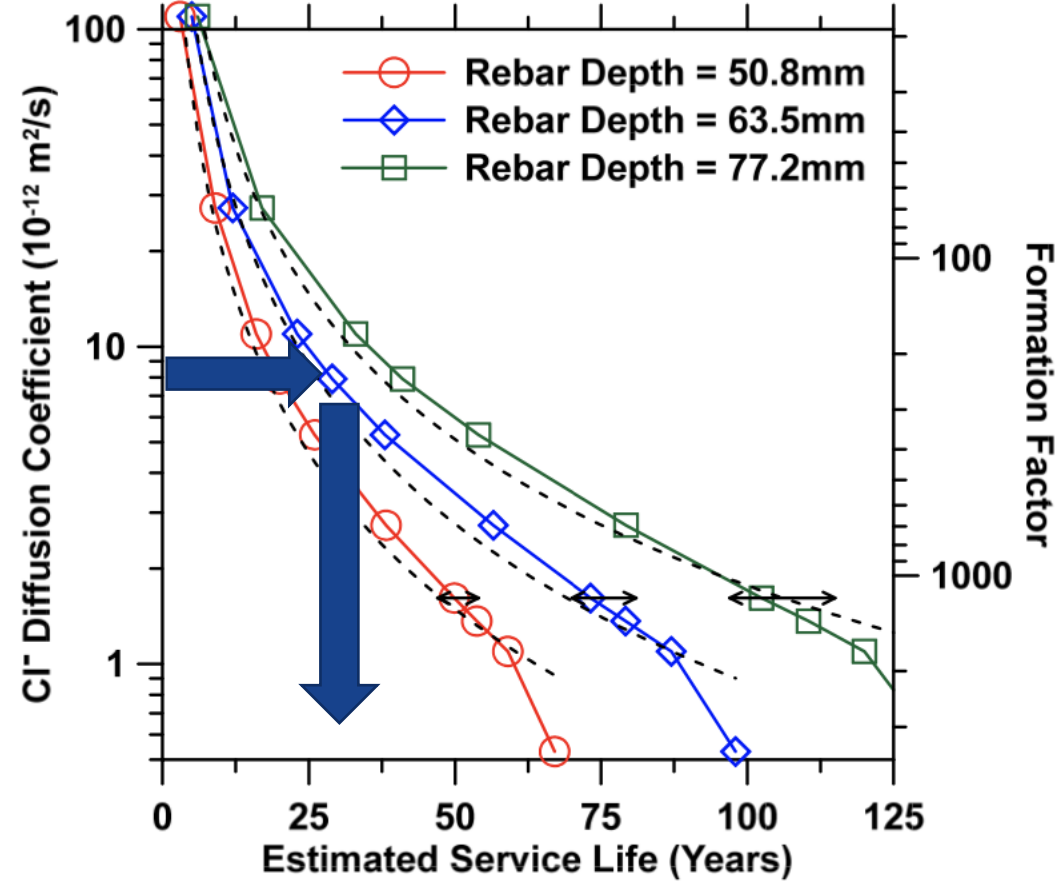


$$D \left(\frac{m^2}{s} \right) =$$

$$10^{(-10.22 + 8.58(W/C) - 4.99\alpha - 3.04V_{agg} + 5.09\alpha(W/C) - 0.91(W/C)V_{agg} + 1.6\alpha V_{agg} - 6.58(W/C)^2 - 0.92\alpha^2 + 0.53V_{agg}^2)} \quad (4)$$

Bentz et al. 1998

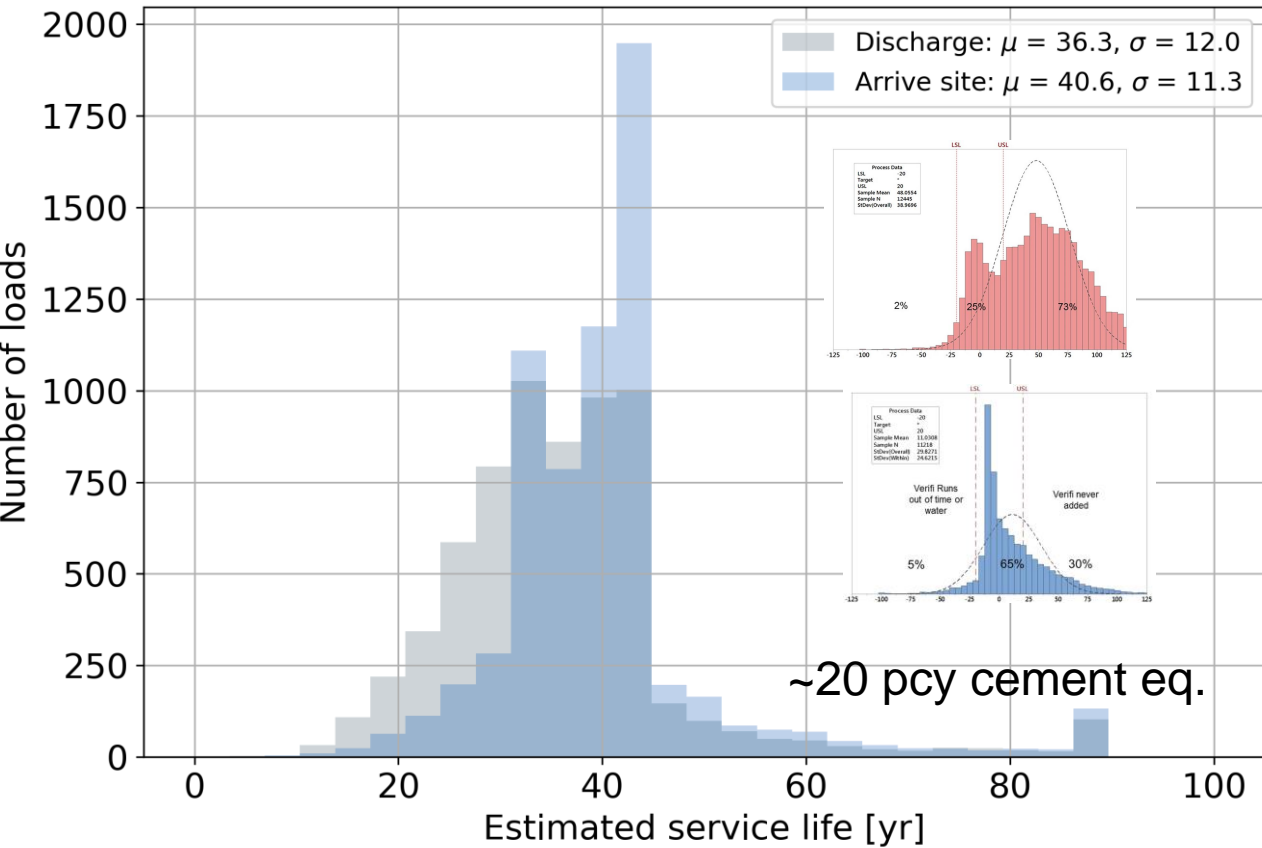
T. Barrett Thesis



LOOKING BEYOND STRENGTH...

Thanks to T. Barrett, L. Roberts, K. Hover!

Estimated service life for Arrive vs. Discharge
loads = 6626



Estimated service life for Manual vs. Auto

