



# REVOLUTIONIZING CONCRETE STRENGTH MONITORING

**AASHTO T 412**

[www.wavelogix.tech](http://www.wavelogix.tech)

**Date: January 16, 2025**

**Presented by: Joe Turek**



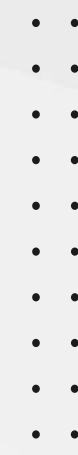


# Introduction

Wavelogix<sup>®</sup>, Inc. was founded in 2021 in partnership with INDOT and Purdue University to improve road and bridge reliability while reducing traffic disruptions.

Our REBE<sup>®</sup> Concrete Strength Sensing System provides real-time, in-place measurements of concrete properties, offering a more precise and versatile solution than traditional sensors.

With patented technology, Wavelogix eliminates the need for pre-set maturity curves, delivering accurate results across various projects and helping teams optimize schedules and reduce costs.





# Joe Turek

## President & COO

Joe Turek, received a bachelor's degree in Electrical Engineering (BSEE) in 1979 from the University of Notre Dame and an MBA from Northwestern's Kellogg School of Management in 1982.

He has been involved in manufacturing his entire career. He holds five patents involving high performance microwave telecommunications circuit board technologies and has been a registered Professional Engineer and a member of the IPC and IEEE.

# AASHTO T412

## The Future of Strength Testing



### Acoustical Resonance Method

Determines real-time, in-place  
strength



### Increases ROI

Shift from traditional to real-time  
accurate testing



### January 2025

Massachusetts DOT adopts T412 in  
concrete specifications

# Why Is Knowing Concrete Strength Critical

Concrete must reach specific strength levels before proceeding with these essential construction steps:



## Structural Form Removal

Safely remove forms surrounding the structure.



## Scaffolding Removal

Clear scaffolding under floors in buildings or garages.



## Post-Tensioning

Enable tensioning in bridges and decks.



## Traffic Release

Allow traffic on new pavement.



## Segment Pouring

Pour the next section of tall columns or walls.



## Panel Lifting

Lift Tilt-Up panels into place.



## Panel Lifting

Lift Tilt-Up panels into place.

# AASHTO T 22 | TRADITIONAL METHOD FOR TESTING CONCRETE TODAY

## DISADVANTAGES

Limited insights after first 20 hrs

Temperature-dependent with inconsistent results

Periodic Testing Intervals (1, 3, 7, 14, 28 days) Rather than REAL-Time Monitoring

High Potential for error ( up to 500%)

Time delays and resource-heavy process



Compression Cylinder/ Break



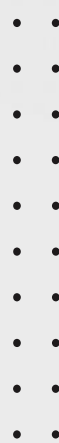
Flexural Beam Break





# Benefits and Impact

- **Calibration Free**  
Independent of mix design, temperature and moisture
- **Real-Time Data**  
Monitors concrete strength up to 56 days and beyond
- **Proven Reliability**  
Lower variability than cylinder, beam and core tests
- **Cost & Time Savings**  
Enables faster project completions and earlier payments
- **AASHTO T 412 - Compliant**  
Fully aligned with the new standard



# Verification Testing : Fast Cure Concrete includes AASHTO-T 412

# REBEL Paving the Way

**Table M4.03.2-4: QC Testing Requirements for Hardened Concrete<sup>[1]</sup>**

Test Method	Quality Characteristic			Limits	
				Min.	Max.
Select One Method	AASHTO T 22 <sup>[2]</sup> ASTM C1074 AASHTO T 412	Compressive Strength (psi) for High Early Strength Concrete (M4.06.3)	24 Hours	2500	-
			3 Days	4000	-
			7 Days	5000	-
		Compressive Strength (psi) for Rapid Hardening Concrete (M4.06.4)	4 Hours	2500	-
			24 Hours	4000	-
			7 Days	5000	-

- [1] QC testing for hardened concrete is only required for high early strength concrete (M4.06.3) and rapid hardening concrete (M4.06.4).
- [2] Three (3) 4 x 8 in. cylinders shall be cast and tested for each set specified for maximum aggregate size less than 1-1/2 inches. Two (2) 6 x 12 in. cylinders shall be cast and tested for each set specified for maximum aggregate size greater than 1 inch.



# Verification Testing : General Concrete Includes ASSHTO T-412

# REBEL Paving the Way

**Table M4.06.1-4(a): Verification Testing Requirements for Hardened Concrete**

Test Method	Quality Characteristic		Limits	
			Min.	Max.
AASHTO T 22 <sup>[1][2]</sup>	Compressive Strength (psi)	3 Days	Informational	
		7 Days	Informational	
		28 Days	Target	-
		56 Days	Informational	

- [1] Three (3) 4 x 8 in. cylinders shall be cast for each specified age for maximum aggregate size less than 1-1/2 inches. Two (2) 6 x 12 in. cylinders shall be cast for each specified age for maximum aggregate size greater than 1 inch.
- [2] Subject to Department review and Approval, the following in-place, non-destructive test methods may be used as an alternative to AASHTO T 22 for determining early age strength during construction for certain concrete applications as specified in the Division II: Construction Details Standard Specifications, contract document, or special provisions:
  - ASTM C1074 Standard Practice for Estimating Concrete Strength by the Maturity Method.
  - AASHTO T 412 Standard Method of Test for Real-Time Estimate of In-Place Concrete Strength Using Acoustical Resonance Method.



Verification Testing:  
Precast/Prestress Concrete  
Includes ASSHTO T-412

# REBEL Paving the Way

**Table M4.09.3-7: QC Testing Requirements for Hardened Concrete<sup>[1]</sup>**

Test Method	Quality Characteristic		Limits		
			Min.	Max.	
Select One Method	AASHTO T 22 <sup>[2][3]</sup> ASTM C1074 AASHTO T 412	Compressive Strength (psi)	Form Removal	70% of $f'_c$	–
			Prestressing Strand Release	80% of $f'_c$	–
			Termination of Protection from Adverse Conditions and Shipping	100% of $f'_c$	–

- [1] The specified compressive strength ( $f'_c$ ) is defined as the minimum compressive strength required to be attained at a specified age for a given concrete structure, as identified in construction standard specifications, contract document special provisions, and design plans.
- [2] Three (3) 4 x 8 in. cylinders shall be cast and tested for each set specified for maximum aggregate size less than 1-1/2 inches. Two (2) 6 x 12 in. cylinders shall be cast and tested for each set specified for maximum aggregate size greater than 1 inch.
- [3] For fiber reinforced concrete, specimens shall be filled in one lift and consolidated using external or internal vibration per AASHTO R 100. Rodding of test specimens shall be prohibited.

# Why AASHTO T-412 Matters

- **Effective January 2025.** Massachusetts DOT's Inclusion of T-412 demonstrates leadership in advancing construction practices.
- Benefits of AASHTO T-412:
  - **Non-destructive Testing:** Accurate strength monitoring without delays.
  - **Real-Time Insights:** Predicts 28-day strength in as little as 3 days.
  - **Broader Adoption:** T-412 is expected to be embraced by other states soon.



# REBEL<sup>®</sup> Sensor System Segment Applications

KEY BENEFITS			
<b>Horizontal</b>	<ul style="list-style-type: none"> <li>• Accelerate traffic release</li> <li>• Eliminate cylinder breaks</li> <li>• Enable early payment</li> </ul>	<b>Geo Tech Houses</b>	<ul style="list-style-type: none"> <li>• Expand market reach</li> <li>• Reduce labor costs</li> <li>• Boost profitability</li> </ul>
<b>Vertical</b>	<ul style="list-style-type: none"> <li>• Save time and costs</li> <li>• Achieve 50% cost savings</li> <li>• Improve project timeline by 50%</li> </ul>	<b>Redi-Mix</b>	<ul style="list-style-type: none"> <li>• Confirm product quality for customers</li> <li>• Avoid costly replacements</li> </ul>
<b>Slab</b>	<ul style="list-style-type: none"> <li>• Verify flexural strength and flatness</li> </ul>	<b>Precast</b>	<ul style="list-style-type: none"> <li>• Optimize form removal</li> <li>• Enable early shipment to customers</li> </ul>
<b>Tilt -Up</b>	<ul style="list-style-type: none"> <li>• Ensure safe, confident lifting</li> </ul>	<b>International</b>	<ul style="list-style-type: none"> <li>• Introduce new technology from the U.S. Laboratories</li> </ul>



# Costs with Cylinder Breaks



COST BREAKDOWN	
Labor: 4 hours minimum @\$100/hr	\$400
Transportation: Round trip to/from site	\$100
Cylinder Cost: 15 cylinders @ \$25 each	\$375
Lab Equipment Fee: Flat Rate	\$100
Final Reporting, Profit & Overhead	\$400

**Concrete Use:**  
15 Cylinders/100CY=  
150 lbs of Concrete

**Testing Schedule:**  
3 Cylinders tested at:  
1,3,7,14, and 28 days

Total Cost  
**\$1375/100CY**  
Concrete Poured

.....

# Cost Comparison

## REBEL<sup>®</sup> Sensor System vs. Cylinder Breaks



COST BREAKDOWN	
Labor: 1 hour @\$100/hr	\$100
Sensor (per ACI Standard)	\$400
Overhead & Profit	\$200
<b>Online Dashboard Automatic Reporting</b> <ul style="list-style-type: none"><li>• Real-time access</li><li>• Instant Strength Results: time vs. strength</li><li>• Strength shown in compression, flexural or modulus</li></ul>	

Total Cost  
**\$700/100CY**  
Concrete Poured

**50% Savings**  
Compared to Cylinder  
Testing

# Easy TESTING SET UP

Drop on Roadbed



Strap to Rebar



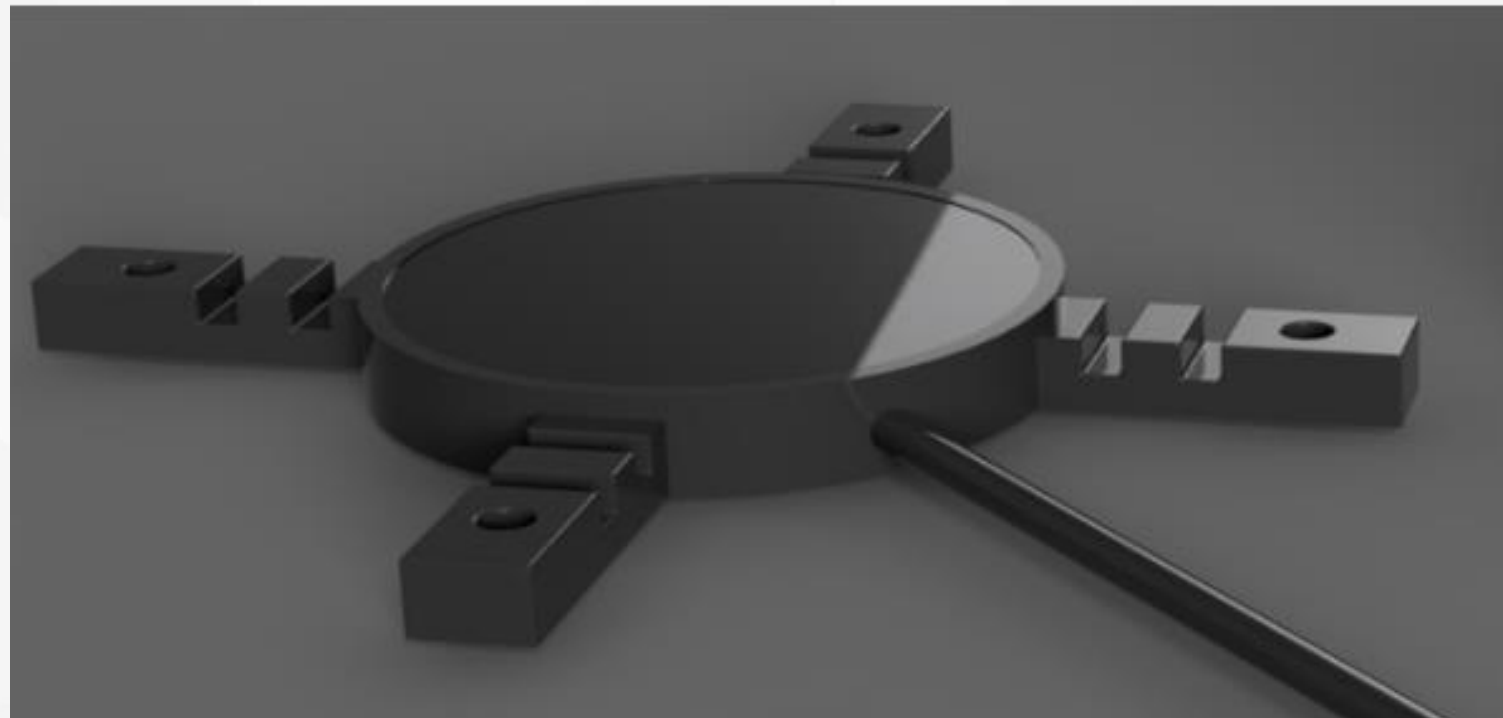
# The REBEL® System

**Miniaturized IoT Hardware for:**  
Data collection and Computational Transmission

**AI-guided algorithm for:**  
Concrete strength measurement Concrete strength prediction

## REBEL Sensor

Inside: Piezo wave generator and temperature probe



## REBEL Data Logger

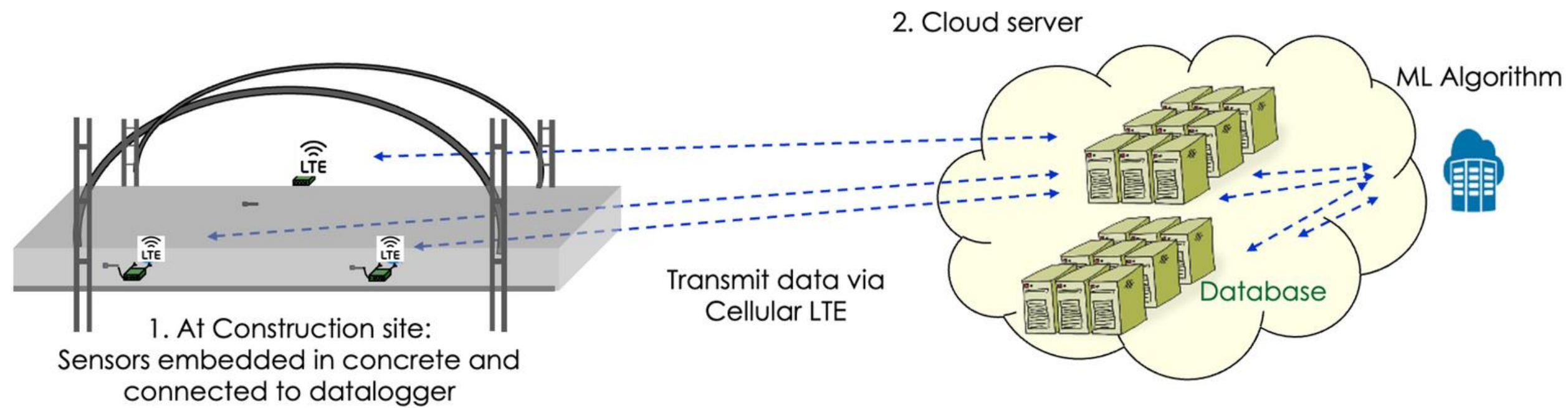


Inside:

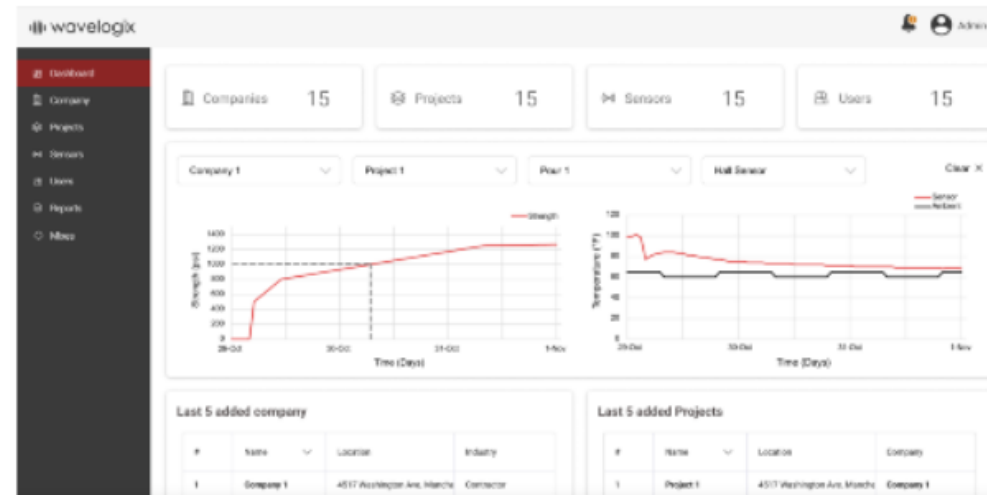
- Impedance meter
- GPS location chip
- Cellular radio
- Lilon Battery (28 day capacity)
- Wireless recharging with a cradle charger
- Sealed case that can work under water
- Durable housing to withstand environmental pressures



# How It Works



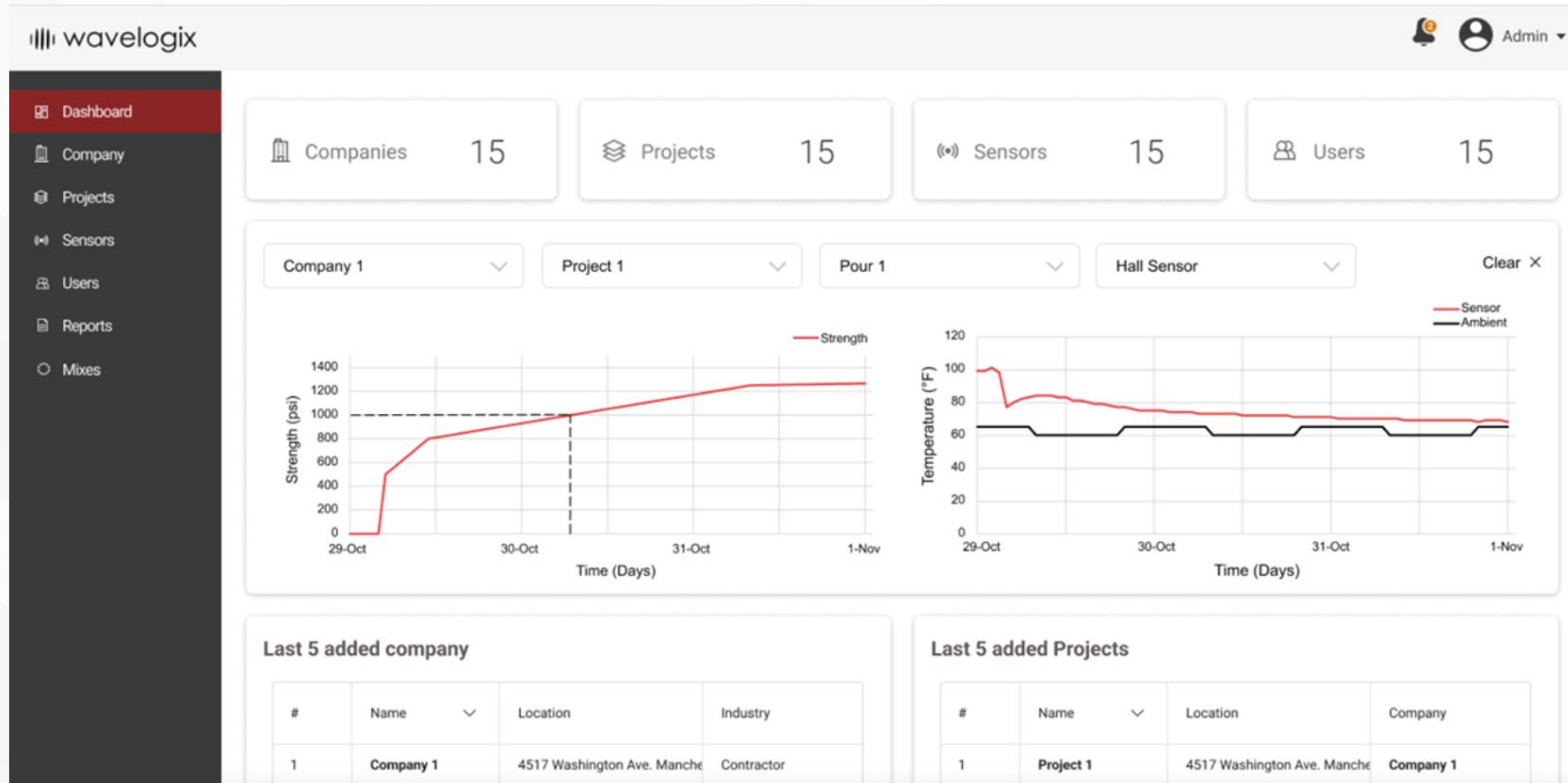
## 3. Front end



## 4. User Interface



# Dashboard and User Interface





**Book a meeting:**

Explore how the REBEL System can transform your concrete monitoring process!

**Learn More:**

[sales@wavelogix.tech](mailto:sales@wavelogix.tech)



SCAN ME

THANK YOU

