

Concrete Performance Monitoring – Deep Dive

Verify Fill.

Measure Compaction.

Real-time concrete detection and compaction monitoring for
blind pours and dense reinforcement

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Summary

On many construction sites, the greatest uncertainties hide inside the formwork. Dense reinforcement, embedded parts, complex geometries, and pours against existing structures often create areas where crews cannot see whether concrete has actually arrived. Compaction presents a similar challenge: operators work by experience and sound, but it is difficult to confirm whether dense or blind areas have received sufficient vibration—or whether vibration has become excessive and risks segregation.

PHONO is a concrete detection and compaction monitoring system designed to provide real time clarity during the pour. Using ultrasonic and resonance based sensing, the system identifies whether the material surrounding the sensor is air, water or liquid, or concrete. A simple traffic light interface allows crews to follow fill progression even in the least accessible zones. At the same time, PHONO measures vibration near the vibrator to help verify whether minimum compaction energy and duration have been reached, while also highlighting potential over vibration.

This whitepaper examines two practical applications where PHONO supports on pour decision making:

- Concrete detection around congested reinforcement, embedded items, and blind interfaces, and
- Compaction monitoring to reduce honeycombing risk and improve QA/QC confidence.

Real world examples from the HS2 A46 Kenilworth bypass (UK) and steel formwork testing in Ibaraki Prefecture (Japan) illustrate how the system has been used as part of QA documentation and decision support processes.

PHONO does not eliminate all risks, nor does it replace good craftsmanship. Instead, it provides an additional layer of visibility where visual inspection is not possible and where decisions must be made quickly. Its digital record supports more defensible QA/QC documentation and strengthens communication with project owners and designers.

1 The Challenge: Hidden Areas, Blind Pours, and Compaction Uncertainty

Void formation and honeycombing rarely occur in the areas everyone can see. They typically develop in precisely the places where visibility is worst: behind reinforcement cages, beneath embedded plates, along interfaces with existing structures, or inside deep and narrow formwork sections. When concrete is pumped from below, confirmation at specific elevations can be especially difficult. Even experienced crews must rely on judgment and indirect cues when monitoring fill progression.

Compaction presents an additional set of uncertainties. Insertions are performed according to procedure and operator experience, but the influence of a vibrator in congested reinforcement varies significantly. Operators cannot easily tell whether energy is truly reaching the intended zone or how long it remains above an effective threshold. Over-vibration is equally problematic and can cause segregation, yet the warning signs are subtle and often subjective.

These uncertainties matter. Insufficient filling or compaction may require chipping, repair, or in severe cases, structural reassessment. Documentation is often limited to photos of the surface or general pour notes, which makes it difficult to reconstruct what happened inside the formwork. Owners and designers increasingly request more transparent and defensible QA/QC records for critical elements.

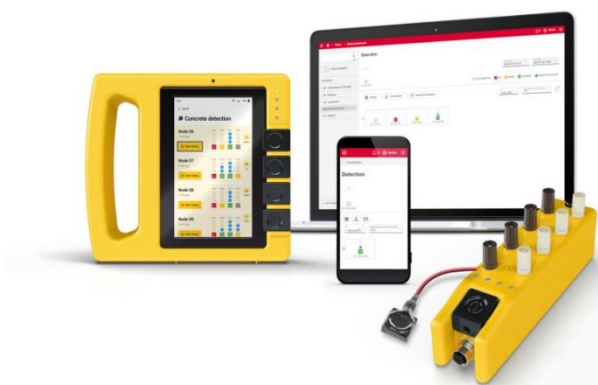
In short: the areas with the highest risk are the areas we cannot see. This is where PHONO adds measurable clarity.

2 How PHONO Works

PHONO uses a combination of ultrasonic and resonance-based sensing to analyze the material that surrounds each sensor. Based on the interaction between the emitted signal and the surrounding medium, the system categorizes the environment as air, water or liquid, or concrete. This information is displayed as a simple traffic-light indicator, making it easy for both

operators and supervisors to track fill progression without interpreting raw data.

The same hardware also captures vibration signals. Using configurable thresholds and minimum time settings, PHONO measures how long vibration intensity stays above the defined limit near the sensor. This helps crews confirm that compaction energy has reached a sufficient level, and it gives supervisors a measurable basis for



consistency between crews or shifts. When vibration continues above the threshold for longer than intended, the system can also highlight a potential risk of over-vibration.

All data—both detection states and compaction information—can be captured and stored, forming part of a digital QA/QC record. This supports internal documentation, acceptance processes, and future pour planning.

Importantly, PHONO provides decision-support, not guarantees. Real-time indicators help crews react during the pour, but outcomes always depend on mix behavior, geometry, and site practice.

3 Deep Dive A: Concrete Detection and Fill Verification

In complex pours, knowing when concrete has truly arrived at a certain elevation or behind a cluster of reinforcement can significantly improve on-pour decision-making. PHONO's detection capabilities are most valuable in exactly these blind areas.

Typical Placement Strategies

Sensors are typically placed at locations where flow patterns are unpredictable: below embedded parts, behind reinforcement bundles, in corners, or at elevations where voids have appeared in past projects. In tall vertical elements, multiple sensors can be stacked to observe the concrete front as it rises. When pouring against existing structures—such as closure pours, interfaces, or blinding situations—PHONO helps confirm that concrete has filled the narrow interface rather than merely flowing around it.

How Crews Use It During the Pour

Once the pour begins, crews observe the traffic-light indicator for each sensor. A transition from air to water or liquid often indicates the first arrival of bleed water or grout. The moment the signal switches to concrete, supervisors gain real-time confirmation that the material has reached the intended zone.

If a sensor expected to switch remains in "air" while adjacent areas indicate progress, crews may adjust the pour rate, modify vibrator insertion patterns, or change the pumping strategy. These adjustments—made in the moment, rather than discovered later—help reduce the likelihood of voids.

Case Snapshot: HS2 A46 Kenilworth Bypass (UK)

During work related to the HS2 A46 Kenilworth bypass, PHONO sensors and a hub were used to monitor fill progression inside formwork where visual confirmation was limited. The project

team used the real-time readings to support on-pour decisions and later included the logged data in their QA documentation.

This example demonstrates how PHONO can strengthen visibility and documentation, though results always depend on the specific element, mix, and pour conditions.

4 Deep Dive B: Compaction Monitoring and Vibration Verification

Compaction quality is equally critical for structural performance. Even when concrete arrives at the intended location, insufficient vibration can lead to honeycombing, while uncontrolled excess vibration may increase segregation. PHONO addresses both sides of the challenge.

Measuring Effective Vibration

PHONO allows users to set a vibration threshold and a target time that indicate effective compaction. As operators perform insertions, the system measures how long the vibration intensity near the sensor remains above the configured limit. When this duration is reached, crews gain confirmation that the area has received adequate energy. If the time remains below target, they can re-vibrate the region immediately.

In congested reinforcement, the influence range of a vibrator often shrinks significantly. PHONO helps crews detect this early by showing when energy is not reaching the intended area, allowing them to adjust insertion points or techniques.

Avoiding Over-Vibration

Over-vibration is more difficult to detect visually, but PHONO's continuous measurement can show when vibration remains above threshold longer than intended. This helps supervisors address the issue before it affects material behavior.

Case Snapshot: Steel Formwork Optimization (Ibaraki Prefecture, Japan)

During steel formwork testing in Ibaraki Prefecture, PHONO sensors were used to analyze both filling and compaction performance. The data helped the team refine their vibration patterns and improve consistency across different sections of the formwork. The project demonstrates how PHONO can support more measurable compaction strategies, though specific results depend on site practice and geometry.

5 Implementation Guidance and Checklists

To help teams adopt the system quickly, this section outlines key steps before, during, and after a pour.

Before the Pour

- Identify areas with limited visibility or known issues from past pours
- Define these zones as sensor placement locations
- Place sensors in the identified high-risk or blind areas
- Configure compaction thresholds based on concrete mix and element type
- Position the Hub to ensure stable and continuous data capture
- Brief operators and supervisors on traffic-light indicators and interpretation of detection and compaction signals



During the Pour

- Monitor fill progression in real time via PHONO indicators
- Check sensors for delayed concrete arrival
- If delayed arrival is indicated:
 - Adjust vibrator insertion pattern
 - Modify pour rate or sequence
- Use compaction readings to:
 - Confirm sufficient vibration energy
 - Decide on re-vibration where required
- Ensure compaction consistency across crews and shifts
- Record observations and actions in the pour log

After the Pour

- Export PHONO data for QA/QC documentation
- Review detection and compaction logs
- Use findings to:
 - Refine compaction strategies
 - Improve sensor placement for future pours
- Provide data as supporting documentation for: Owners, Designers
- Use PHONO records to complement traditional inspection documentation

6 Integrating Detection and Compaction for Better QA

The best results come from using PHONO's detection and compaction features together. When crews can see both that concrete has reached a particular location and that the area has received sufficient vibration, decision-making becomes more robust. The digital record also helps project teams review performance across multiple pours, identify recurring issues, and demonstrate due diligence during acceptance processes.

Starting with one complex or high-risk pour is often an effective pilot strategy. The learning curve is short, and the system quickly highlights areas where visibility and documentation can be improved.

7 Next Steps

For teams who want to explore PHONO further, a short online demonstration provides an overview of the traffic-light interface, the compaction configuration process, and examples of QA reporting. For your first pilot pour, our team provides hands-on implementation support, helping with sensor placement, configuration, and on-pour readiness —remote or on site.

Contact us or book a 20-minute demo to see PHONO in action and discuss suitable pilot elements for your project.

Contact us today!



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