



## Technology-led Internal Audits to Review Construction Quality and Integrity for a Leading Renewable Energy Firm

Protiviti partnered with a leading renewable energy company in order to conduct an audit which focused on evaluating construction quality and maintaining structural strength over time. The main aim was to

recognize inefficiencies and improve quality standards throughout operations, with special emphasis on guaranteeing the structural robustness of wind turbine foundations.

### Client Challenges

A prominent player in the wind energy sector encountered significant challenges within its Engineering, Procurement, and Construction (EPC) division. The key challenges included:



**Project Performance:** There were issues in project execution leading to cost overruns, schedule delays, and quality issues.



**Enhancing Quality Assurance:** There was an urgent need to enhance quality checks and ensure compliance with industry standards, particularly regarding the foundations of wind turbines. Optimizing Operational.



**Efficiencies:** The client aimed to optimize project management processes and improve construction quality.

### Work Performed

Protiviti conducted a series of technology-enabled quality checks to assess the structural strength and integrity of the foundations, which must withstand a design life of over 25 years.

These foundations support Wind Operated Electricity Generators (WOEGs) valued at over INR 30 million per unit and are built to withstand high wind loads.

During our assessment, we observed that field quality evaluations were predominantly restricted to a standard set of laboratory tests on concrete. The stringent project timeline resulted in the oversight of critical aspects such as workmanship quality and in-situ conditions.

To ensure structural quality and durability, we implemented non-destructive testing (NDT) to evaluate concrete integrity without compromising the material, addressing gaps and enhancing the client's quality assurance.

## • • • CLIENT STORY

- **The Rebound Hammer Test** was conducted to determine the compressive strength of the concrete and test if it satisfies the specified design requirements. With this test, we ensured that the concrete applied in the foundations conforms to the necessary strength requirements for long-term performance and longevity.
- **The Ultrasonic Pulse Velocity (UPV) Test** was also done to analyze the density and the modulus elasticity of the concrete. Analyzing the UPV Test results, we detected any possible voids, cracks, or discontinuities in the concrete that might affect its performance.
- **Rebar mapping** was carried out to check if the installed reinforcement bars (rebar) meet the design drawings specified. Through a comparison of the mapped information with the architectural and structural drawings, discrepancies that would have implications on the structural integrity and load-bearing capacity of the foundations were detected.
- **The Half Cell Potential Test** was conducted to identify possible corrosion in the reinforcement bars (rebar) that are buried in the concrete. By analyzing the half-cell potential measurement, we determined regions of corrosion risk since low values normally represent active corrosion processes.
- **The Carbonation Depth Test** was used to determine the depth of carbonation penetration into the concrete. This data was utilized in formulating maintenance plans and ensuring proactive measures were taken to protect the structural stability of foundations.

## Key Outcomes

1. Following the structural integrity assessments conducted by Protiviti on selected foundations, we identified 12 out of 43 elements exhibited borderline results. This information prompted the client to implement additional quality checks to address potential weaknesses before they could escalate into more significant issues.
2. The client has incorporated several critical tests into their quality assurance processes (FQAP list) to enhance their operational standards. These tests include the Ultrasonic Pulse Velocity test, Half Cell Potential test, Rebar Mapping, Rebound Hammer test, and Carbonation Depth test, all of which will be conducted at regular intervals to ensure ongoing compliance with quality benchmarks.
3. A solid inspection process was established to identify issues in the quality of material/equipment delivered on the project in tandem with the suppliers/Original Equipment Manufacturers (OEM). This process involves meticulously documenting each case in a Non-Conformance Report (NCR) Log, ensuring that all repairs/replacements are tracked and managed effectively. This proactive approach not only enhances the quality control measures but also reinforces the commitment to maintaining the highest standards of safety and durability in the client's operations.
4. Identified design defects at the manufacturing level that could jeopardize the structural integrity of the Wind Operated Electricity Generators (W.O.E.G). Specifically, a crucial component had been inadequately repaired on-site, raising concerns about its long-term performance and reliability.

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