Research on Non-Destructive Monitoring System for Reinforced Concrete Corrosion Based on Indirect Polarization Technology

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Abstract: Reinforced concrete, as a widely used material in construction engineering, directly impacts the service life and safety of structures. Over time, reinforced concrete structures are susceptible to corrosion and degradation due to various environmental factors, leading to reduced structural performance and even serious safety accidents. Traditional inspection methods typically rely on destructive testing, which, while assessing internal corrosion of reinforced concrete, often damages the structure and hinders continued use. In contrast, non-destructive testing methods primarily utilize techniques such as acoustics, optics, and electromagnetic ultrasonics. However, these methods often struggle to detect corrosion risks in the early stages, usually identifying severe corrosive damage only after it has occurred, thereby compromising the timeliness and effectiveness of protective measures. Therefore, it is necessary to explore non-destructive testing methods. In this study, a novel reinforced concrete corrosion monitoring system was developed. This system monitors the internal corrosion of steel bars in reinforced concrete using indirect polarization technology. Simultaneously designed corresponding corrosion monitoring instruments, data centers, and sensors. Utilizing a four-electrode array sensor in conjunction with the corrosion monitoring device for signal excitation and data collection, the data center aggregates data from multiple corrosion monitoring devices and uploads it to cloud servers for computational analysis. This approach achieves real-time corrosion monitoring of in-service reinforced concrete structures, enabling timely identification of corrosion risks. Additionally, the study validates the accuracy and reliability of data obtained by the non-destructive monitoring devices through finite element simulation, ultimately ensuring comprehensive monitoring of the health status of concrete structures. The measured results are helpful to enhance maintenance and reinforcement efforts, so as to safeguard the safety and reliability of engineering projects.

Keywords Reinforced Concrete, Corrosion Monitoring, Non-Destructive Testing, Indirect Polarization, Structural Durability.