Experiments on a Scaled Rebar Structure to Quantify Lightning Strike Induced Fields on Rebar Reinforced Concrete Structures

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Understanding electric and magnetic fields induced by lighting strike events is crucial to developing efficacious techniques for mitigating the negative effects of lightning strikes. However, experiments investigating the matter are sparse in literature as the prohibitive cost and complexity associated with a full-scale experiment make it impractical to perform. Utilizing electromagnetic scaling relations, scaled experiments allow for the collection of data that may be directly translated to equivalent full-scale quantities. As a second benefit, scaled experiments may also be used to validate computational models that can then be employed for full-scale simulations.

Using this scaling principle, a single-layer rebar structure with a 1:4 scale has been constructed consistent with standard construction practices for steel-reinforced concrete structures. Unlike typical rebar structures, this scaled structure features a U-type electrical discontinuity in the roof, which is representative of the full-scale structure of interest to this study. A four-stage Marx generator is used to excite this structure with a peak current of 50 kA. Using a low inductance path, the output of the generator is fed to an attachment point on the structure while maintaining the required scaled rise time of 1.5 μs. Using a Prodyn B-10/20D B-Dot and AD-100R D-Dot probe, the fields produced during the attachment event are investigated. The ground point of the structure is controlled through a single low inductance strap attached to a point on the cage and fed to the building ground. The current passing through the grounding strap is monitored by a Pearson coil (Model #1330), allowing for strike current and waveform shape to be collected. Experimental measurements are compared with the computational model results to verify the computational model.