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INFORMATION NOTE:

APPLICATION OF NDT THERMOGRAPHY FOR HIGHWAYS AND BRIDGES

The maintenance and rehabilitation of aging transport infrastructure, particularly highways and bridges, present significant engineering and economic challenges worldwide. To address these challenges, Non-Destructive Testing (NDT) methodologies have become essential for evaluating structural integrity without causing damage or requiring extensive traffic disruptions. Among these advanced technologies, Infrared (IR) Thermography stands out as a highly effective, rapid, and non-contact diagnostic tool. It allows engineers to accurately map subsurface anomalies over vast areas, making it a cornerstone for modern pavement and bridge deck condition assessments.

The scientific principle behind IR Thermography relies on the measurement of radiant heat emitted from a surface. When solar radiation heats a concrete or asphalt surface, the heat conducts downward. However, subsurface defects—such as delaminations, air voids, or moisture accumulation—have different thermal conductivities compared to solid construction materials. These discontinuities disrupt the normal heat flow, causing localized hot or cold spots on the surface. High-resolution infrared cameras capture these minute temperature gradients, generating a thermal map that visualizes the hidden flaws.

One of the most critical applications of NDT thermography is the evaluation of concrete bridge decks. Over time, the ingress of de-icing salts and moisture leads to the corrosion of reinforcing steel (rebar). As rebar corrodes, it expands, causing the surrounding concrete to fracture and delaminate parallel to the surface. IR thermography excels at identifying these weak zones long before they manifest as surface spalling or potholes. By pinpointing the exact location and extent of the deterioration, maintenance teams can execute targeted, highly efficient repairs rather than replacing entire sections unnecessarily.

Beyond evaluating existing damage, thermography plays a proactive role during highway paving operations. Ensuring uniform temperature during the laydown of hot mix asphalt

(HMA) is critical to achieving proper compaction and density. Thermal imaging systems mounted behind the paving screed continuously monitor the asphalt mat for temperature segregation. Identifying cold spots in real-time allows paving crews to adjust their processes immediately, preventing premature pavement failures such as raveling, fatigue cracking, and accelerated water damage.

To maximize the reliability of infrastructure assessments, IR Thermography is frequently integrated with other complementary NDT methods, such as Ground Penetrating Radar (GPR). While thermography is unparalleled in detecting near-surface defects and delaminations, GPR provides deeper structural insights by mapping rebar depth, concrete thickness, and deep internal voids. The synergy of these two technologies creates a comprehensive 3D profile of the bridge or highway, compensating for individual technological limitations and delivering a highly accurate, holistic structural health report.

The operational, economic, and safety advantages of IR Thermography are substantial. Traditional inspection methods, such as chain dragging or sounding, are notoriously slow, subjective, and perilous for personnel exposed to live traffic. In contrast, vehicle-mounted thermal arrays can collect continuous, digitized data at highway speeds. This eliminates the need for disruptive and costly lane closures, ensures maximum safety for inspection crews, and provides an objective, permanent data record that can be analyzed and referenced for future lifecycle modeling.

In conclusion, the integration of NDT Thermography into transport infrastructure management represents a significant advancement in proactive asset preservation. By embracing precise, data-driven thermal diagnostics, project directors and infrastructure managers can shift from reactive repairs to predictive maintenance. This strategic approach optimizes the allocation of rehabilitation budgets, significantly extends the service life of highway and bridge networks, and ultimately ensures the continuous safety and mobility of the traveling public.