Survey of Steel-Formed Bridge Decks in Illinois

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ABRIDGMENT

•PERMANENT GALVANIZED metal bridge deck forms have been increasing in use since 1957. Compared to wood forming, metal forms offer advantages of safety and economy, since all installation work is from the top side and no stripping is required. Although individual jobs formed with metal bridge forms have been surveyed, little or no published information exists on the performance of the metal-formed decks in service. This paper gives the results of a survey on 21 metal-formed and 10 wood-formed adjacent bridges on the Interstate and secondary road system in Illinois.

The purpose of the investigation was to determine:

1. Whether there is a significant difference in the strength and quality of concrete decks on permanent metal forms as compared to wood forms;
2. Whether there are any variations in the condition of the bridge deck surfaces attributable to the forming method;
3. Whether the metal forms are bonded to the concrete; and
4. Whether there were any observable effects of salt, traffic, or weather on the overall appearance of the metal forms and the bridge structure.

Bridges surveyed were from 6 mo to 5 yr old, covering approximately 256,000 sq ft of metal-formed bridge deck and 106,000 sq ft of wood-formed deck. Many configurations and types of bridges, including steel and precast concrete stringers, simple and continuous spans, rectangular and skewed plans, parallel and converging stringers, composite and noncomposite beams, and epoxy, linseed oil and silicone coated decks, were surveyed.

Concrete quality studies used the Swiss hammer, and calibrated impact-rebound nondestructive instrument. Multiple readings were taken at uniformly spaced locations along the bridge decks. Pilot tests had established that for bridge slabs of normal thickness, the method was not affected by the presence of the structural framing members.

A statistical analysis of the Swiss hammer readings resulted in the following observations:

1. The concrete quality was independent of the method of forming;
2. The variations in concrete quality within a given bridge were generally larger than the variations between comparison bridges;
3. Comparison metal-formed and adjacent wood-formed bridges in each of three geographical areas showed no significant difference in average Swiss hammer values; and
4. For three bridges, comparison of metal- and wood-formed areas on the same bridge showed no statistical difference in quality of concrete at the 5 percent significance level.

A hammer, swivel mounted on the end of an extendable 24-ft telescopic aluminum pole, was used to inspect the underside of metal-formed decks for bond and honey-

Paper sponsored by Committee on Construction Practices—Structures.

comb. The bonded sheets give a clear ring, honeycomb areas a dull thud, and unbonded areas a clatter when struck a sharp blow.

The hammer tests showed that the sheets were tightly bonded to the concrete slab on 20 of the 21 slabs. Leakage through floor drains without metal linings caused one bridge to break bond in the edge span. On the 21 bridges, only two 6- by 6-in. areas of honeycomb were found. On two bridges some 2- by 2-in. small unbonded spots, probably due to oil drips from construction equipment, were found. On bridges with a longitudinal edge construction joint, the subsequent placement of the curb caused additional form deflection in the outside formed span since breaking of the sheet bond on the previously poured side of the joint was generally noted. Penetration of moisture through the joint to the metal form and subsequent freezing may have aggravated the breakage of the sheet bond along the joint line.

Scaling and spalling of concrete decks was usually found in the gutters and on the curbs of the more frequently salted bridges near metropolitan areas. Rural structures, not on the Interstate traffic routes, suffered little or no scaling. Popouts seemed in all cases associated with underlying chert aggregate particles.

On 3 of 31 bridges, two metal and one wood formed, rusting of the top transverse reinforcing occurred. This was associated with insufficient cover over the reinforcing bars. Transverse cracks in the deck near the piers were, in many cases, initiated by curb joints.

In general, visual appearance of the metal forms was excellent with the galvanized spangle still showing. One bridge without metal-lined floor drains showed corrosion in the areas of the floor drain. This corrosion was in form of penetrating pits which drained the water and salt away from the slab.

In conclusion, the concrete quality and deck condition were not affected by the use of permanent metal forms. The forms were bonded to the concrete decks and presented pleasing underside appearances.