

Precast prestressed voided slabs were used effectively to replace the superstructure of an old deteriorated vehicular bridge.

Highland Avenue Bridge

The problem facing the engineers was to find an efficient and economical means to replace an old deficient highway bridge in a busy urban area over an active railroad track.

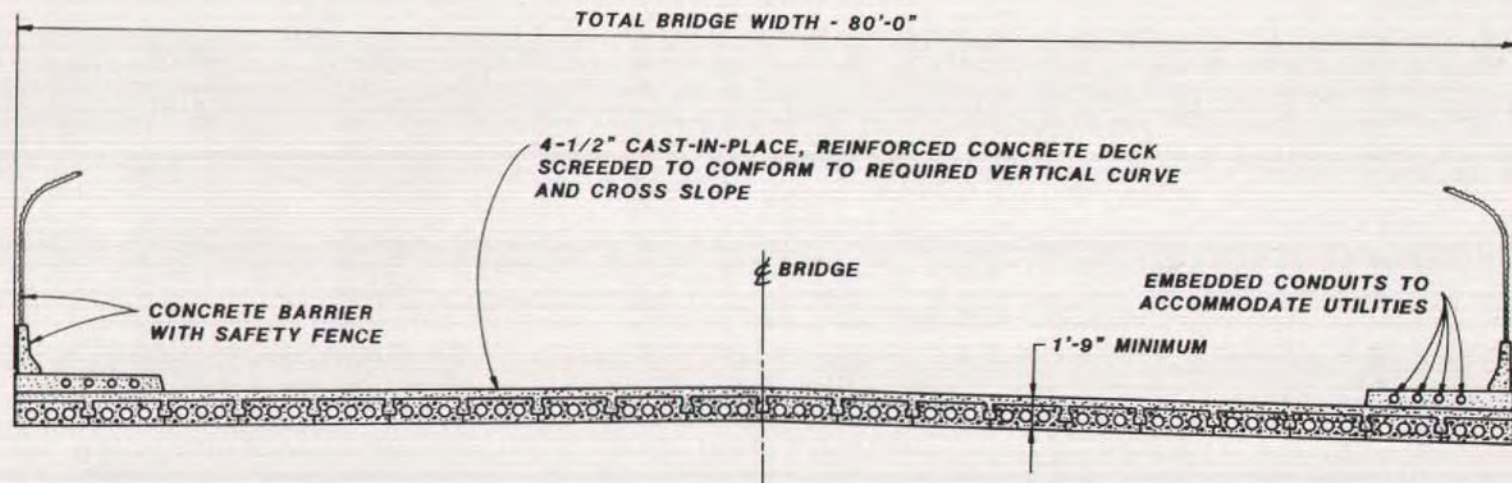
The old structure, located in Montgomery, Alabama, was a four-lane, seven-span bridge with timber stringers, bents and timber flooring with an asphalt overlay. Over the years, significant decay and deterioration of the timber flooring, stringers and bents had occurred. The lane width was also insufficient, being narrower than the street.

It was determined during the preliminary design phase that the existing bridge had a minimum vertical clearance above the rails of only 19.6 ft (6 m) which is considered substandard and inconsistent with current railroad requirements. Additionally, the existing bents located on either side of the railroad tracks were less than 9 ft (2.7 m) from the track centerline. These fragile wooden bents were provided with no crash protection.

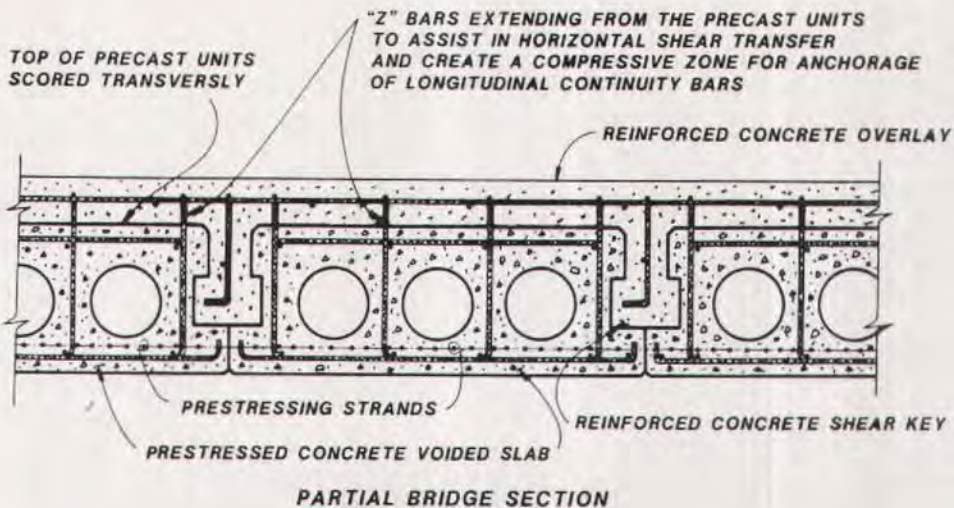
Since this was a federally funded project, the design had to comply with the FHWA regulation which requires bridges spanning over a railroad track to have a vertical



Fig. 1. Old deteriorated highway bridge.



TYPICAL BRIDGE SECTION



clearance of 23 ft (4 m) between the top of the rail and the minimum low chord of the bridge. The preliminary design effort established that considerable approach earthwork would be required at both approaches to satisfy this minimum vertical clearance requirement.

In selecting the structure type, the following considerations were taken into account:

- The structure depth should be as low as possible, in order to provide the required vertical clearance over the track and still allow reasonable access to adjacent existing businesses and buildings.
- The new structure had to fit into the space occupied by the existing bridge; thus, the total bridge length was to be 120 ft (36.6 m).
- Preferably no falsework over the track would be used.
- Crash walls would be constructed with each intermediate support.

To satisfy the above requirements, the solution adopted was to use a three-span concrete bridge consisting of precast prestressed voided slab units with a composite cast-in-place reinforced concrete overlay.

The span lengths were set at 35 - 50 - 35 ft (10.7 - 15.2 - 10.7 m) for an overall span of 120 ft (36.6 m). The bridge width was 80 ft (24.4 m).

The precast units were 4 ft (1.2 m) wide and 16½ in. (419 mm) deep. With the 4½ in. (114 mm) concrete overlay, the total depth of the deck section was 21 in. (533 mm). The voids of the slab were 8 in. (203 mm) in diameter. For more details, see the typical and partial bridge sections.

The prestressing comprised 22 ½-in. (13 mm) diameter strands per 4 ft (1.2 m) unit in the 50 ft (15.2 m) span and 14 ½-in. (13 mm) diameter strands per 4 ft (1.2 m) unit in the 35 ft (10.7 m) spans.

The bridge superstructure was constructed at a skew angle of 35 deg 38 min 50 sec. The substructure consisted of driven steel piles. At the bents, the piles were extended above ground and encased in concrete to serve as columns.

The decision was made to develop continuity over the supports for live loads. A reinforced concrete overlay will aid in shear transfer between adjacent slab units and also provide a superior vehicle riding surface.



Fig. 2. Placement of voided slabs.



Fig. 3. 35 ft (10.7 m) span on the west side of new bridge.



Fig. 4. Adjoining slabs prior to placement of reinforced concrete overlay.

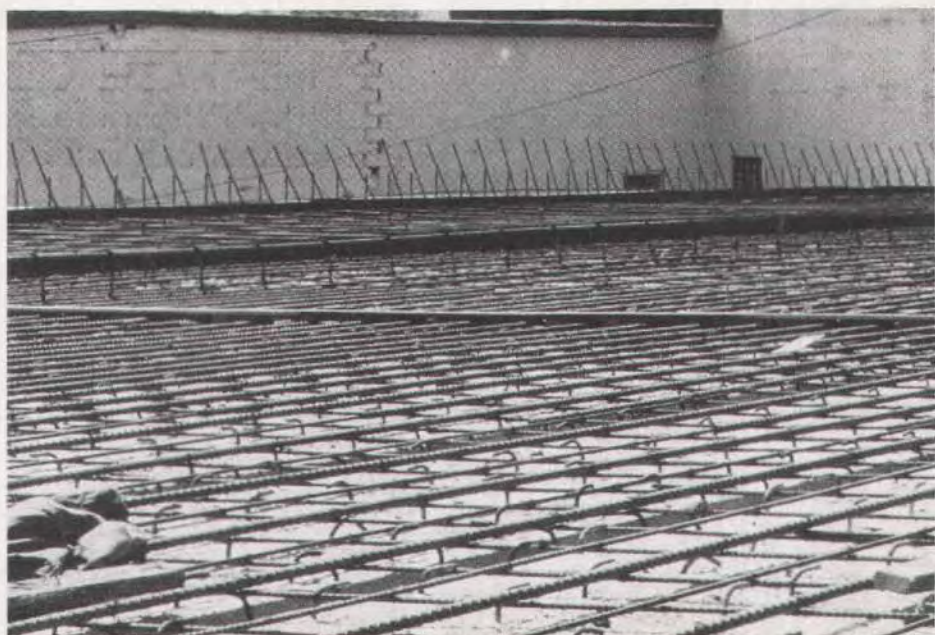


Fig. 5. Reinforcing steel in place for concrete overlay.

It is worthwhile to mention some of the special features associated with the shear keys and composite action on this bridge structure.

- Shear keys between precast units — Usually, voided slab type structures are constructed with small grouted shear keys and, occasionally, a thin [2 to 3 in. (51 to 76 mm)] asphalt overlay. Under normal traffic conditions, the grouted shear keys generally fail, leading to differential movement of precast units, unravelling of the



Fig. 6. Improved clearances with new precast prestressed bridge.



Fig. 7. Completed bridge.



Fig. 8. Aerial view of the new bridge and roadway (during construction).

asphalt overlay and subsequent expensive patch and repair efforts. On this structure, the shear transfer between precast units proceeds through larger reinforced concrete shear keys assisted by the transversely reinforced overlay.

- **Composite action** — Composite action between the precast units and the cast-in-place overlay is assured by the use of transverse scoring of the top surface of the units as well as the use of "Z" bars. The "Z" bars, shown in the partial bridge section, are bars with a hook at each end extending from precast units into the reinforced concrete overlay, thus assisting in horizontal shear transfer and also creating a compressive zone for anchorage of longitudinal continuity bars.

Bridge demolition and construction began in September 1983. The bridge structure was completed in April 1984 and after the approach work was finished, the bridge was opened to traffic in August 1984 on schedule. During the past year the bridge has been operating with total satisfaction.

The contract price for the project was \$847,000. The design work was entirely funded by the City of Montgomery and construction funded with Federal (80 percent) and City (20 percent) funds.

Credits

Owner: City of Montgomery, Engineering Department, Montgomery, Alabama.

Construction Agents:

State of Alabama Highway Department, Montgomery, Alabama.

Federal Highway Administration, Washington, D.C.

Design Engineering Firm: CH2M Hill, Montgomery, Alabama. (Project Manager: J. Steve Newton; Project Design Engineer: Ostap Bender.)

Contractor: W. B. Goodwyn, Inc., Montgomery, Alabama.

Precast Concrete Manufacturer: Southern Prestressed Concrete, Inc., Montgomery, Alabama.