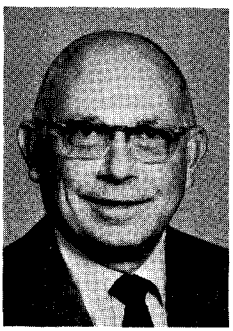
Provisions for Possible Reconstruction of Decks on Segmental Box Girder Bridges



Brice Bender
President
BVN/STS, Consulting Engineers
Indianapolis, Indiana

The author, whose firm has designed many types of box girder bridges, proposes a method for reconstructing the decks of precast prestressed segmental bridges in the event such repair is needed in the future. The construction procedure, the advantages of the method and an example from a current bridge project are given.

Unquestionably, no other problem in bridge maintenance is of more concern to bridge engineers than that of deck deterioration. Much thought has been given to this problem and considerable research has been undertaken; however, most bridge engineers are resolved to the fact that even with the various preventative measures used in construction, such as epoxy coated reinforcing bars and membranes of various types, the decks will continue to be a problem as long as deicing agents are used.

With a longitudinal girder type bridge, the usual procedure is to repair small deck areas and place a membrane. Then, eventually the deck must be reconstructed by removing the old pavement, forming a new one, and finally casting concrete as the original deck was constructed.

Now, when many bridge engineers consider a concrete box girder bridge, they are immediately concerned as to how it can eventually be reconstructed, if need be, because the original deck is an integral part of the structural cross section of the bridge.

We at BVN/STS are convinced that decks on segmental concrete box girder bridges will last longer than regular decks. We believe this because of the quality of concrete and because the decks are kept under compression by the longitudinal post-tensioning. Usually, transverse post-tensioning provides compression in the transverse direction keeping small cracks from shrinkage or temperature tightly closed in any direction. These reasons plus a waterproofing method employed with the wearing surface will provide a durable deck for a long time.

However, we also believe that in most projects a problem will develop eventually. Traffic, weather extremes, and salt will cause probable deck deterioration. When this occurs it can be corrected more readily, quicker, and at less cost than with other types of bridges.

When only spot repairs are required with a new membrane and wearing surface, both types of bridges are the same in time of repair and cost, and indeed in the methods used. Segmental concrete box girder bridges can withstand small areas of the deck to be removed and replaced as now done with other decks. It is when reconstruction is required that our proposed method has distinct advantages.

Proposed Method

To reconstruct the deck on a segmental concrete box girder bridge the following simple steps are the only requirements:

1. Remove the wearing surface and membrane.
2. Thoroughly sandblast the deck surface.
3. Place a new 8-in. deck over the original deck.
4. Place required post-tensioning inside the box to carry the additional dead load.

The bridge is now ready for another period of years. While the method might be employed with other types of bridges, concrete segmental box girder bridges lend themselves most easily to this method. We always design this type of bridge with inside access across all spans, through diaphragms and splices and provide manholes for inspection.

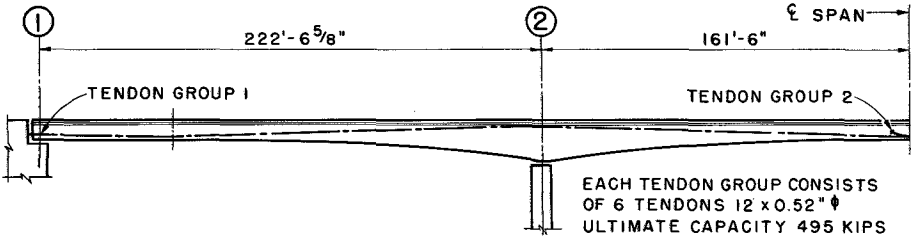
Advantages

When this method is used on the concrete segmental box girder bridge several advantages are gained. These are:

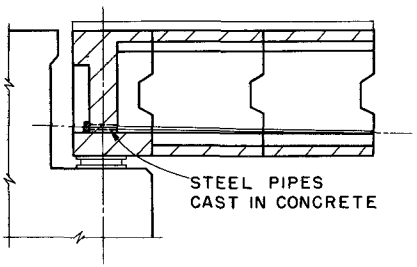
1. The old deck does not have to be removed.
2. No forming is required.
3. Forms, therefore, do not have to be removed.
4. Time is gained.
5. Lesser cost.
6. Part of bridge can be done, and partial traffic can be maintained.

Application

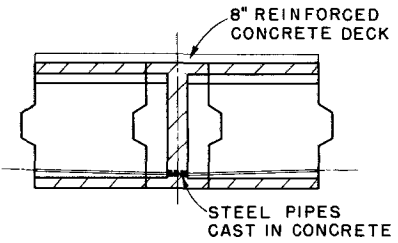
This method can be done on any concrete segmental box girder bridge without constructing in the original construction any part of the post-tensioning system. However, funda-



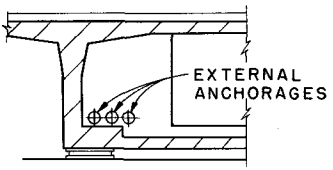
ELEVATION

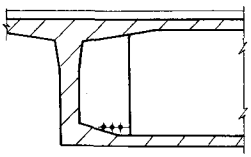


DETAILS AT ABUTMENT



DETAILS
C.I.S. JOINT AT ENDSPANS





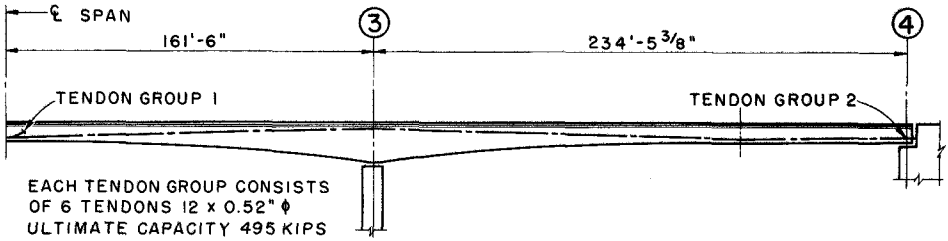
NOTES ON DECK REPAIR

Casting of deck

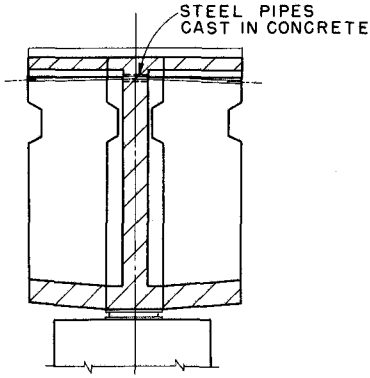
- Remove wearing surface.
- Clean off and remove deteriorated concrete.
- Design is based on assumption of full bond between new and old concrete.
- Apply bonding agent, roughening or other means to assure optimum bond.
- Cast 8-in. thick reinforced concrete deck. Maximum weight: 0.105 kips per sq ft.
- No allowance is made in the design for weight of new wearing surface.

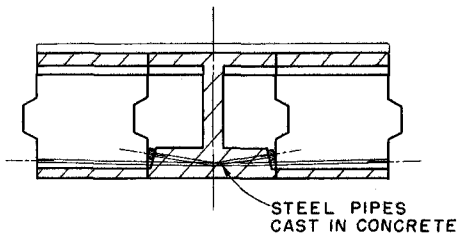
Installation of new tendons

- Tendon Groups F1 and F2 each consist of six tendons having 12-wire ½-in. diameter strands; steel quality: 270 ksi. Tendons are to be stressed to 345 kips each.
- *Installation and stressing of tendons* takes place prior to casting of 8 in. additional deck concrete.
- Tendons and external anchors must be adequately protected against corrosion.
- *All tendons are stressed from one* end only at the midspan splice.



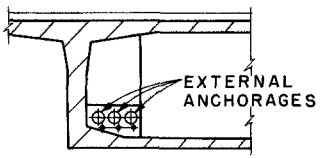
ELEVATION





DETAILS C.I.S. JOINT AT MIDSPAN

DETAILS AT PIER



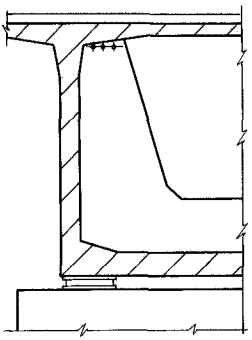


Fig. 1. Details of the elevation and cross sections with notes on deck repair for possible future deck reconstruction (East-West Connection over the Kentucky River, Frankfort, Kentucky).

mental preparation is easily done and very economical to incorporate in the bridge plans.

Charles Cook, director of bridges, Commonwealth of Kentucky, directed us to incorporate the ducts for future post-tensioning. Fig. 1 shows details of the elevation and cross sections for possible future deck reconstruction that was added on the plans for the proposed three-span bridge over the Kentucky River in Frankfort, Ky.

The design included the determination of the proper amount of post-tensioning and the profile of the tendons. These tendons will not be placed, but the ducts will be incorporated in the diaphragms and hold-down points.

Then when needed in future years, the ducts will be ready to receive the external tendons inside the box girder. The tendons, of course, will be placed in a sheath and grouted for protection.

Conclusion

We believe this simple method of reconstructing the bridge deck eliminates a real concern to bridge engineers in their consideration of concrete segmental box girder bridges. It is unique to concrete segmental box girder construction because of access, few diaphragms and usual depth.

While it can be done entirely in the future, as required, incorporating ducts in the original construction and showing the required future tendons on the plans provides a real plus for the bridge engineer in the future responsibility to reconstruct the deck.

Credits

Charles G. Cook, director, Division of Bridges, Commonwealth of Kentucky, has allowed mention of their design technique.

Discussion of this paper is invited.
Please forward your comments to
PCI Headquarters by January 1, 1978.