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5. Denny Creek-Franklin Falls Viaduct, Washington (USA)

Fig. 1 Movable truss scaffold moves from pier to pier across the valley of Denny Creek, leaving behind the bottom and sides of post-tensioned box girder that will support the forms for casting the top and deck of the bridge superstructure.

The Washington Department of Transportation (DOT) was the first in the United States to use a movable scaffold to erect a post-tensioned concrete box-girder bridge. The scaffold – a 100 m long, 540-ton truss – moved across the valley from pier to pier to support the forms for the hollow box girder in the first stage of construction. With 20 spans totaling 1100 m, the post-tensioned bridge carries westbound 1-90 through scenic Snoqualmie Pass.

A viaduct design was selected at the location to minimize disturbance in this environmentally fragile area and avoid building heavy barriers against expected avalanches. Such a design could be constructed without falsework. To achieve it at the lowest possible cost, the Washington DOT prepared one design and retained two consulting firms to design alternate superstructures. The substructure was to remain essentially the same for each.

The superstructure design selected called for traveling forms supported by the piers and completed portions of the superstructure.

Concrete piers are (3×4.9-m hollow rectangular columns that range from 11 to 49 m high. There are 12 piers supported on concrete footings and 8 on pier shafts sunk through talus and till and keyed into solid rock.

The superstructure was constructed in three stages (Fig. 2). In stage 1, the bottom slab and webs were constructed in forms supported by a movable truss. The truss moved on steel legs supported by openings left for this purpose in the side of the piers (Fig. 3). Truss jacks were used at all four corners to adjust scaffold elevation for proper alignment. The scaffold was designed to support the outside forms for the box and to facilitate form removal (Fig. 4). Overhead dollies in the top of the truss lifted and moved the inside forms from the web. The forms were hung on the inside of the truss after removal so they could move forward with the scaffold near the proper location for the next segment. The outside forms and platforms for workers during casting were supported by adjustable legs to permit easy alignment corrections and facilitate removal. The forms were insulated and had electrical heat to ensure rapid concrete strength gain. The system was designed to permit the construction of one span every two weeks. Bottom forms were supported on the trusses at each side and by cables supported by the overhead truss along the centerline. After curing and post-tensioning, they were released to lower the floor forms and permit horizontal removal so the scaffold could move forward (see Fig. 6). After post-tensioning of the longitudinal tendons in the floor and webs the scaffold was ready to move.

The front of the scaffold rode on supports on each side of the piers. The back of the scaffold rode on rollers under the rear jack. The rollers were positioned on a temporary steel structure for the first casting, and then on the top of the concrete box web between two rows of stirrups for subsequent segments.

In stage 2 the top of the box was placed. Forms were supported on lightweight metal brackets and, in turn, by the sides and floor of the box.

Stage 3 consisted of placing the cantilever, which is approximately 4.7 m long, on each side to provide the 3-lane, 15.9 m wide deck. The forms that held the concrete for the cantilever were supported by a movable carriage that rode forward atop the box cast in stage 2. After the cantilevers were cast, all transverse post-tensioning in the top of the box was completed.

Pier construction began in 1976 and casting of the box girder in August of 1977. The project was completed in 1979 and opened to traffic the same year when connecting highway pavements were completed.

(H. U. Aeberhard)

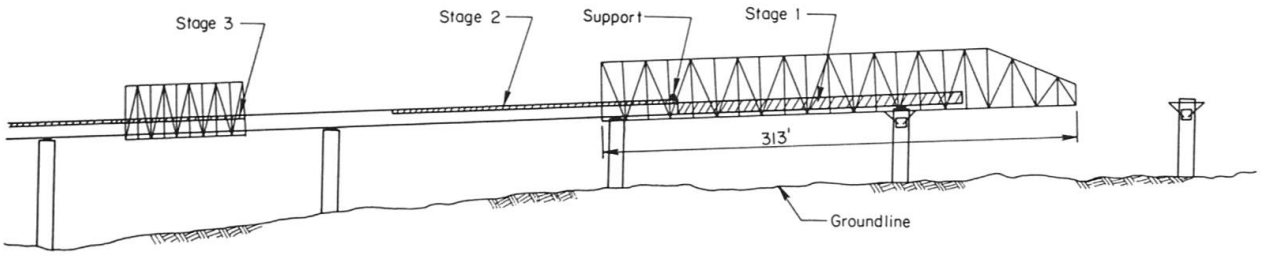

Fig. 2 Schematic drawing illustrates construction procedure using movable scaffold to support form for box girder.

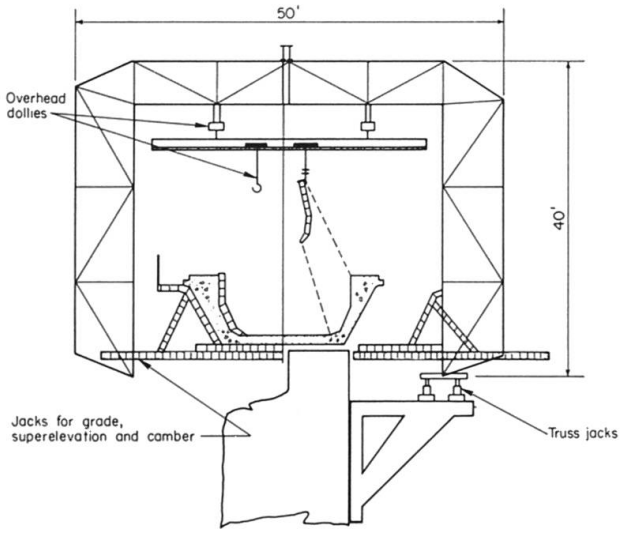

Fig. 3 View from below showing temporary steel-legs attached to piers to support large truss scaffold.

Fig. 4 Drawing of scaffold cross section for stage 1 shows truss jacks, method for supporting and removing forms for bottom and sides of box girders, and overhead dolly for removing inside forms.