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"TEMPORARY MOVABLE BRIDGES"

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INTRODUCTION

Typically, movable bridges are designed to be in service over an extended lifetime, 50 to 75 years. In some large part, this reflects the codes that govern the design, fabrication, and installation of movable bridges, i.e., AASHTO Standard Specifications and AREA Manual. It also suggests they are well established and reflect a conservative approach that is appropriate for the intended service.

Yet, there is a class of movable bridges that is used primarily for construction. These bridges are intended to last for only a short duration, usually 2 or 3 years, and after serving their purpose, they are removed and never seen again. These bridges do not really fall into the type of construction or design envisioned by the codes, and in many cases, they are left for a contractor to develop. These types of structures are less frequently discussed and, perhaps undeservingly, may be forgotten as a result of their brief life and temporary nature. The intent of this paper is to report on some of these temporary movable bridges and to describe how they were used. What follows is by no means an exhaustive listing, nor is it comprehensive. The purpose is merely to report on a number of examples, to suggest that there are many other possibilities, and finally to suggest that the use of temporary movable bridges may be a means of facilitating the construction of a more permanent bridge, be it fixed or movable. The order of discussion is generally chronological, i.e., age before beauty.

Jack-Knife Drawbridge, Westport, Connecticut, 1905

Much of the railway line along the New England coastline between New York and Boston dates back to before 1850. The coast, particularly along Connecticut and Rhode Island, is very irregular with numerous inlets and waterways, necessitating the construction of numerous bridges as part of this line. Where the waterway is navigable, movable bridges are required. Portions of the main line along the coast were reconstructed in 1905 and increased from two to four tracks. While reconstructing the main line bridges over the Saugatuck River in Westport Connecticut, two timber jack-knife draws were constructed as part of two temporary bypass trestles.

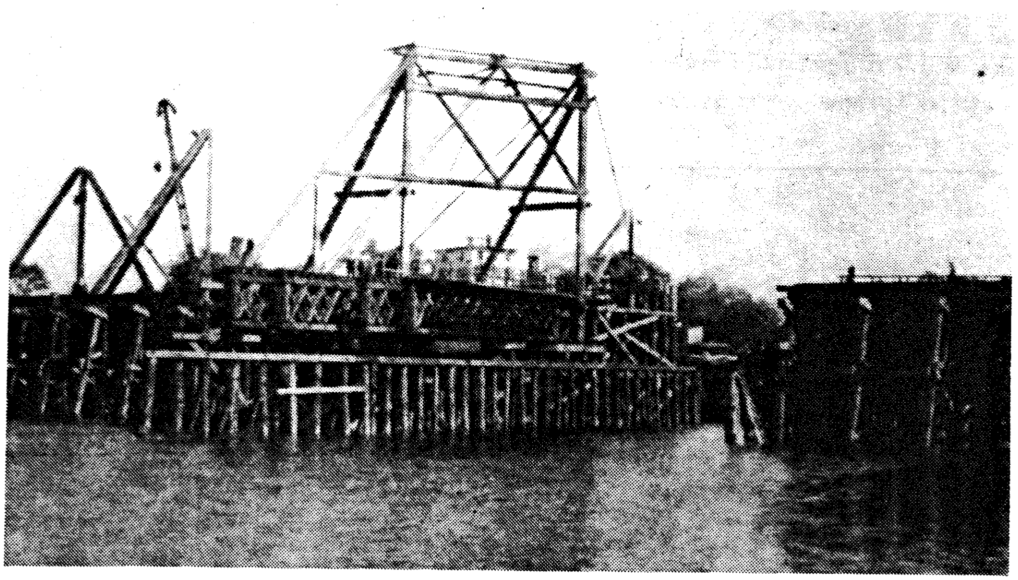

Figure 1 Jack-Knife Drawbridge

They reportedly served well during the reconstruction (Henry B. Seaman, Discussion of Paper No. 1864, "A History on The Development of Wooden Bridges," ASCE Transactions, published November 1932 Proceedings). Seaman noted that "for satisfactory operations of the draw span, it is important that the gallows-frame be inflexible, and that the pile bents from which the trusses swing, be rigidly braced against movement." No details are given, but one can assume some sort of winch system was used to operate the spans. It is interesting to note that as odd as this design may appear now, a somewhat similar jack-knife draw, although of steel construction, was used for many years by the Long Island Railroad across Jamaica Bay until about 10 years ago when it was replaced by a two track, used bascule that was barged up from Florida.

Long Bird - Hamilton Island Causeway Bridge, Bermuda, 1941

In 1941, as part of the Roosevelt-Churchill "destroyers for bases" treaty, the U.S. Air Force undertook construction of Kindley Air Force Base on St. David's Island in Bermuda. To provide construction access for this work, it was necessary to demolish an existing road bridge and to provide temporary access by a floating pontoon, which formed a crude but functional swing bridge.

The temporary bridge was constructed using a 75-foot-long by 25-foot-wide barge with two 30-foot-long steel leafs or transition spans, which were supported on an abutment at one end and on the barge at the other. To open the span, the leafs were raised and the barge swung out of position. World War II delayed further work on the base, and the bridge was in service for a 12-year period. In 1953 a permanent replacement bridge, a bob tail swing, was completed by the U.S. Navy who had taken over operations at the field.

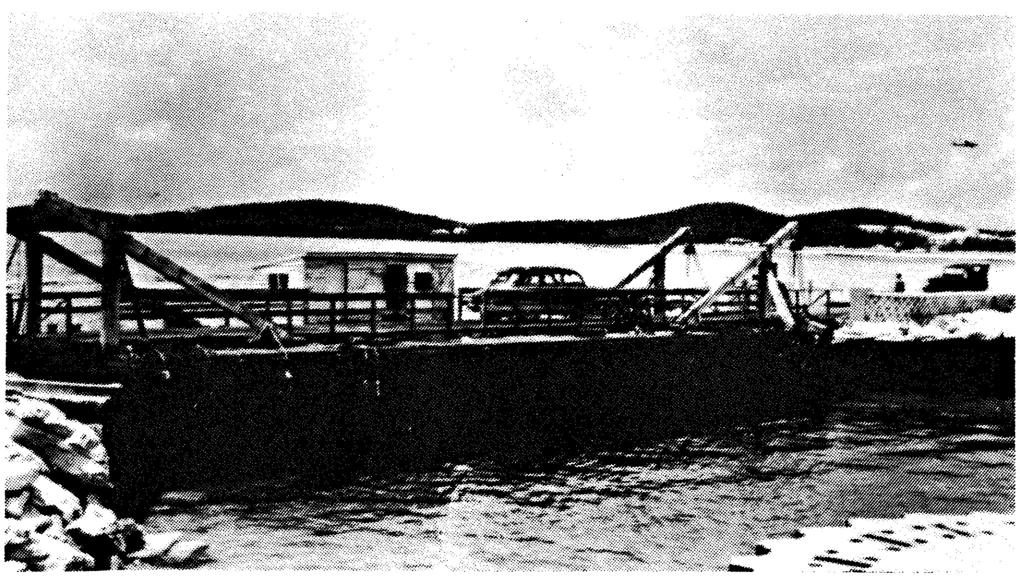

Figure 2 Long Bird Hamilton Island Causeway Bridge

Tchefuncte River Bridge, Madisonville, Louisiana 1977

As part of the construction of a new 240-foot-long, two lane bob tail swing bridge over the Tchefuncte River in Madisonville, Louisiana, a temporary detour was used to permit the demolition and replacement of an existing 180-foot long swing bridge. The new bridge provided for a 125-foot channel versus a 75-foot channel provided by the existing bridge.

The temporary detour, which was fully detailed on the contract drawings, used a floating swing span to provide an 80-foot clear channel. The swing span used a 90-foot by 30-foot barge that was swung open with a cable and winch system. A 16-foot-long leaf or transition span was provided at each end of the opening, with one end resting on the approach trestle and the other end on the barge. A frame with counterweights and hoist was used to raise the transition spans to open the bridge. The frame and leaf arrangement is similar to that typically found at ferry terminals to provide a transition span for vehicles.

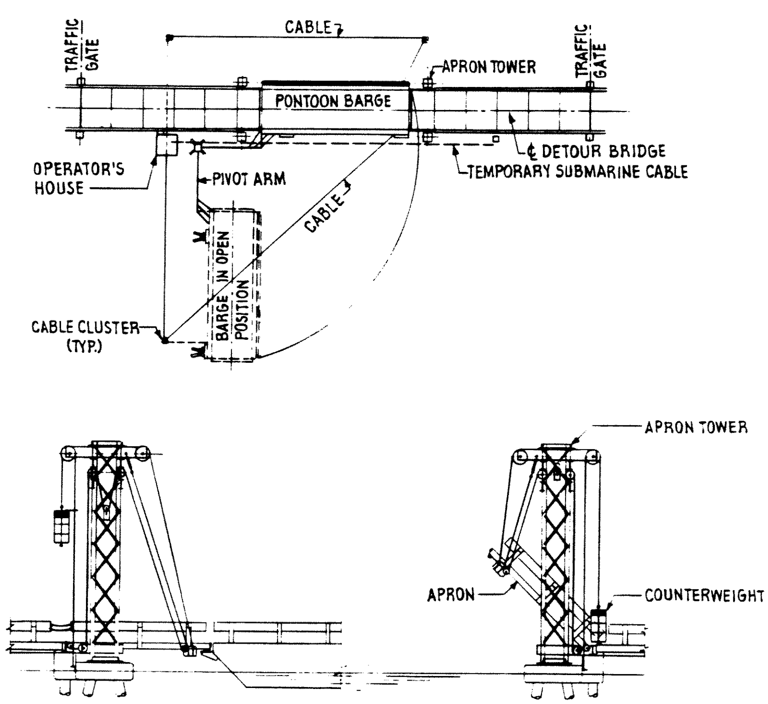

Figure 3 Tchefuncte River Bridge

Canary Wharf Swing Span, London, England, 1991

As part of the massive Canary Wharf project, three temporary movable bridges, i.e., swing, lift, and bascule spans, were designed and built by the Accrow Corporation. The bridges were relatively simple but rugged as they needed to withstand heavy construction traffic for several years.

The swing span was two lanes by 120 feet long and was powered by two electric propulsion units. The propulsion units were incorporated in the pontoon. In its closed position, the bridge was supported on a pile-supported abutment at each end. To open, one end of the span was lifted by two 50-ton hydraulic rams so that it was supported on a pontoon. The pontoon consisted of several steel floats and the two propulsion units so it could be driven open and closed. The other end of the bridge pivoted about one corner on a greased plate while the second corner rolled on a Hillman-type roller along a pile supported, wide flange-beam track.

It was reported that only one propulsion unit was typically needed to open or close the bridge, except that both units were needed in high winds. The bridge was designed to operate in a maximum wind speed of 45 mph, and the span normally opened or closed in less than a minute.

The bridge was operated from a small building with very simple controls. A 75kW variable pitch propeller drive was used so that the motor started with the prop feathered and it then moved to forward or reverse. The prop was reversed to stop the bridge as it reached the nearly open or nearly closed position.

The deck used steel panels with an epoxy/grit surface. The surface was subjected to constant truck traffic, and during a field visit in 1991, it appeared to be in very good condition.

The swing span had been shifted in alignment as part of the construction staging at the Wharf. In its previous alignment, it had been longer by approximately 20 feet. It was to be repositioned and lengthened again as part of a subsequent stage of the project.

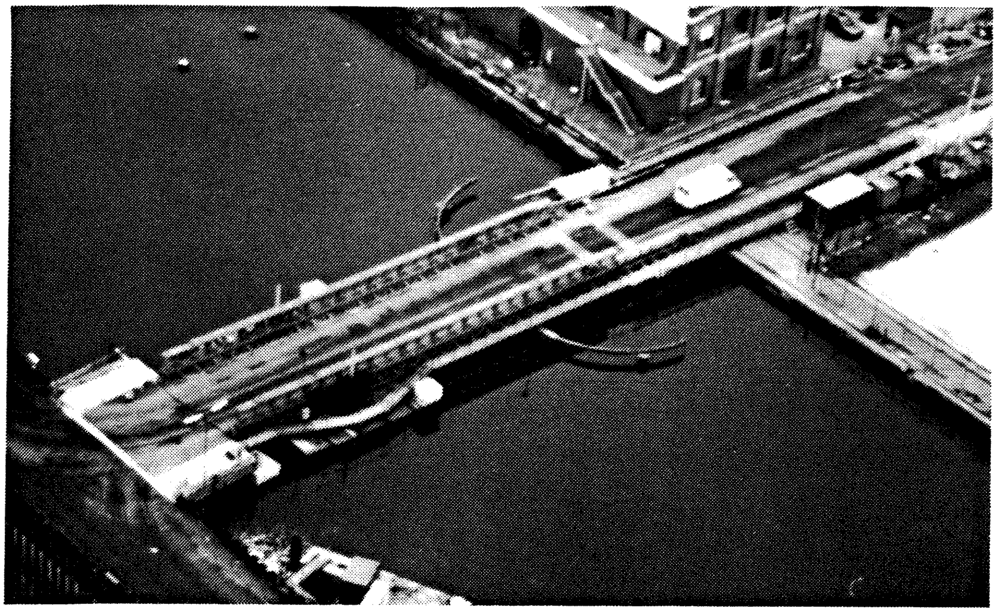

Figure 4 Canary Wharf Swing Span

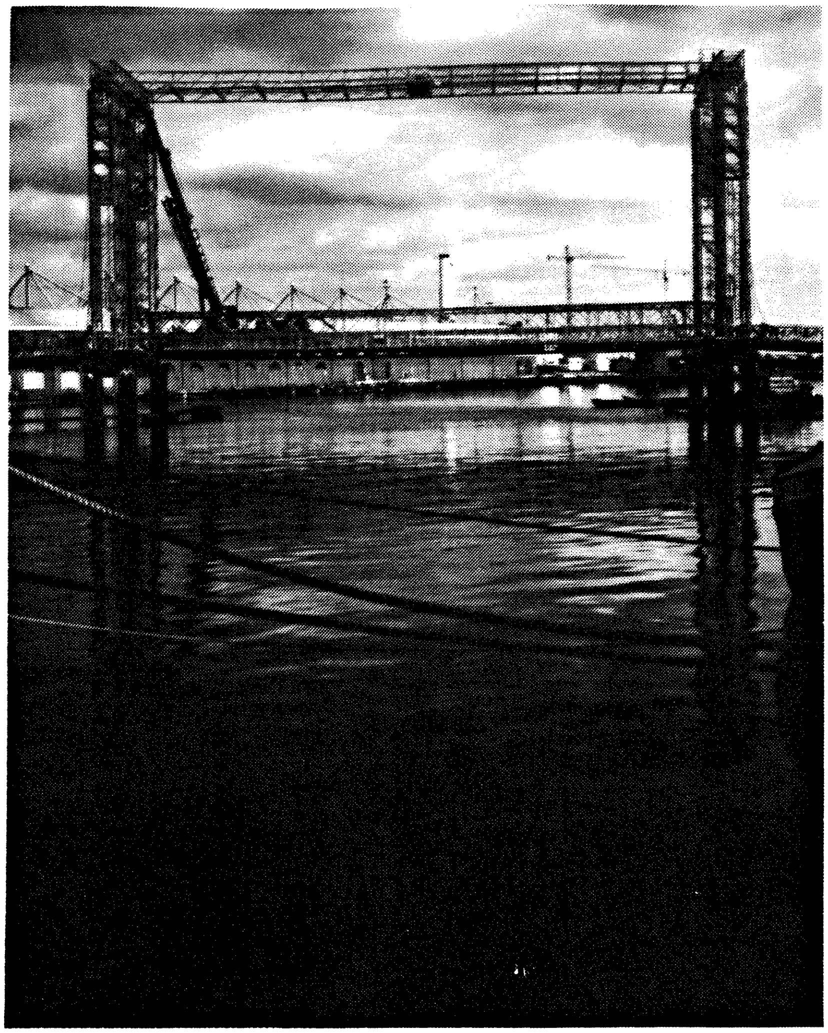

Figure 5 Canary Wharf Lift Span

Canary Wharf Lift Span, London, England, 1991

This lift bridge was part of the same project and was also two lanes. It was counterweighted and driven by a single electric winch at mid-span between the towers, using four operating ropes, one at each corner of the span. The lift span was approximately 135 feet long. The operation was observed to be very smooth.

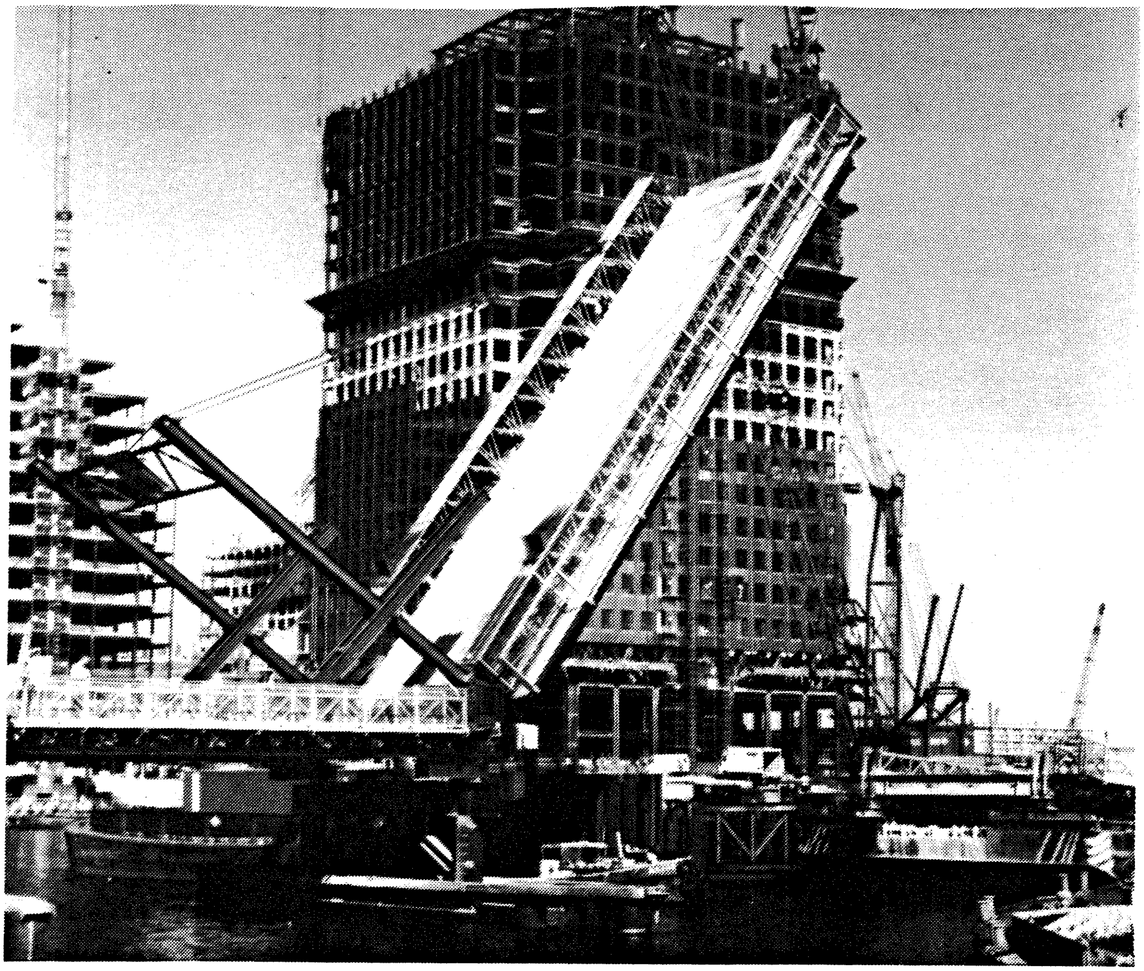

Figure 6 Canary Wharf Bascule Span.
[Figures 5 and 6 were furnished by Accrow Corporation who designed and built all three of the Canary Wharf Structures described in this paper.]

Canary Wharf Bascule Span, London, England, 1991

Again, as part of the same project, a temporary two-lane bascule bridge was constructed. The span does not have a counterweight and is pulled open with wire ropes operated by two matched electric winches. It was two lanes wide with solid decking and had a span of approximately 70 feet.

Coleman Bridge Swing Span, York River, Yorktown, Virginia 1994

The existing Coleman Bridge is a two-lane structure, 3,750 feet long with two double swing spans. The bridge is being widened by replacing its superstructure.

It was originally proposed that the contractor would utilize a temporary floating bridge to accommodate traffic while removing and replacing the trusses, so that during two 2-week periods, traffic would be diverted to the temporary bridge (see Figure 7). Between each of the detour periods, the traffic patterns on the bridge would return to normal.

As shown, the temporary bridge would be anchored to the river bottom and transition spans were proposed at each end to accommodate tidal movement. Two small boat channels were included, one at each end, and a swing span was proposed to accommodate larger ships. The swing span was to be powered by pontoon-mounted propulsion units, similar to those used at Canary Wharf. It was proposed to provide redundant propulsion units as well as have a tug backup available.

However, the Virginia Legislature felt that the cost of the temporary bridge, approximately $15 million, was too high, and the temporary bridge has been eliminated. Thus, during the shutdown periods, traffic will be detoured 30 miles (50 km) upriver.

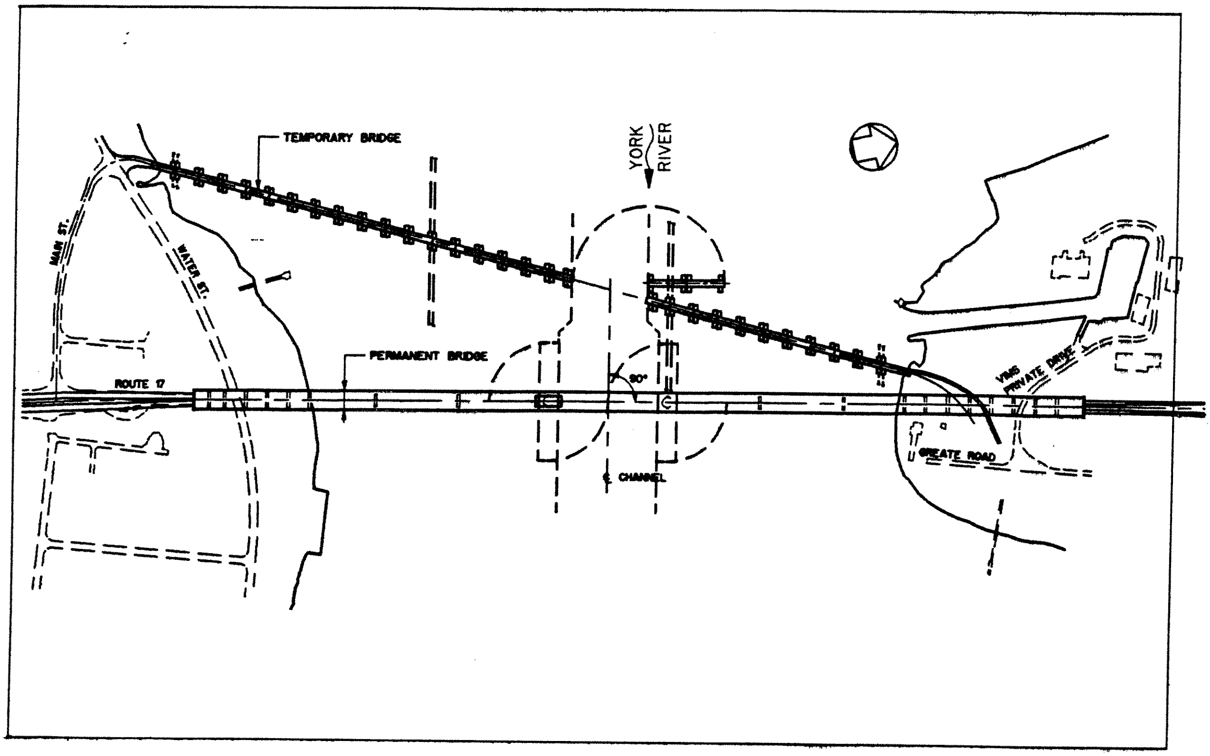

Figure 7 Coleman Bridge Swing Span

SUMMARY

As demonstrated above, temporary movable bridges can be used in a wide variety of projects and can serve either rail or vehicular traffic. They can be built using very simple elements, such as a barge or timber, or they can be more sophisticated and use prefabricated panel bridge components.

Given the wide range of possibilities and lack of strict code applicability to such structures, their inclusion in a project needs to be done with an understanding as to the extent of latitude that will be allowed by the contractor. Possible approaches range from allowing the contractor complete freedom to develop a design to providing a complete design of a temporary bridge and possibly allowing the contractor to propose an alternative structure. In any case, temporary movable bridges have proven useful and should be considered for future projects.