Prefabricated Supporting Bridging Systems

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OVERVIEW: As a nation with many rivers and ravines, Japan relies on a large number of bridges to ensure the delivery of essential services. Hitachi supplies two different prefabricated supporting bridging systems to the Japan Ministry of Defense for use when bridges are destroyed by natural disasters such as earthquakes or floods. The two bridges are suitable for different situations, with the Type 92 floating bridge (a prefabricated temporary floating bridge) being designed to float on a river and support vehicle traffic, while the Type 07 mobility support bridge (a prefabricated temporary span bridge) can span rivers or ravines without requiring piers. The Japan Ground Self-Defense Force uses these products for purposes that include civil defense training drills conducted by regional governments. In the Great East Japan Earthquake, a Type 92 floating bridge was used in ferry configuration to transport construction machinery to an island that had become isolated. With the prospect of civilian applications in mind, Hitachi intends to continue developing supporting bridge systems that can contribute to recovery work during disasters.

INTRODUCTION

JAPAN has many rivers and ravines, and bridges are constructed to allow the movement of traffic. Prefabricated supporting bridges are needed to restore essential services rapidly after a bridge has been destroyed by an earthquake, flood, or other disaster. Hitachi supplies prefabricated bridging systems to the Japan Ministry of Defense for use as mobility support equipment to enable the passage of heavy vehicles.

This article describes two prefabricated bridging systems supplied to the Japan Ministry of Defense that are currently in use, and also their civilian applications: the Type 92 floating bridge that floats on a river and supports vehicle traffic, and the Type 07 mobility support bridge that can span rivers or ravines without requiring piers.

Photo courtesy of Japan Ministry of Defense

Fig. 1—Bridge Construction and Vehicles Driving over Type 92 Floating Bridge.
The Type 92 floating bridge consists of floats that float on the river and form part of the bridge structure, and boats that maneuver (push) the floats on the water.

OVERVIEW OF PREFABRICATED SUPPORTING BRIDGING SYSTEMS

Prefabricated Temporary Floating Bridge

Prefabricated temporary floating bridges are used to cross rivers that have become impassable because, for example, an existing bridge has been destroyed. They are made from special-purpose trucks for transporting the floats, which float on the river and form part of the bridge structure, and boats, which push the floats on the water (see Fig. 1 and Fig. 2).

On arriving at the river, each truck reverses down to the river's edge, and then a hydraulic cylinder tips

Fig. 2—Floats and Boats in Transit.
Special-purpose trucks are used to transport the floats and boats used by the Type 92 floating bridge.

up a special frame installed on the truck so that the float (which is attached to this frame) can be released to slide off onto the surface of the river.

The floats are designed to fold up into a compact arrangement compatible with road widths when carried on the truck, and then to use the balance between their own weight and the force of floatation to unfold by themselves once deployed onto the water.

The boats are also launched by sliding off the special-purpose trucks used to transport them.

As the floats do not have any motive power and would float away if not restrained, the boats are used to push them into position and link them together to form the floating bridge. As the floats are designed to be linked together in a chain, floating bridges spanning several hundred meters can be constructed.

In addition to being used as a conventional bridge, the floating bridge can also be used as a ferry capable of transporting vehicles or goods to the opposite shore by linking a number of floats together and using the boats to push them along.

The floating bridge needs to be made small and light so that it can be installed quickly during an emergency, and its design must also allow for factors such as vehicle width, height, and gross weight to ensure that the trucks will be able to carry the floats on conventional roads. Similarly, the floating bridge must have sufficient strength to carry heavy vehicles (such as tanks) both when used as a floating bridge and as a ferry. To satisfy these requirements, the floating bridges are built using a welded structure of high-tensile aluminum.

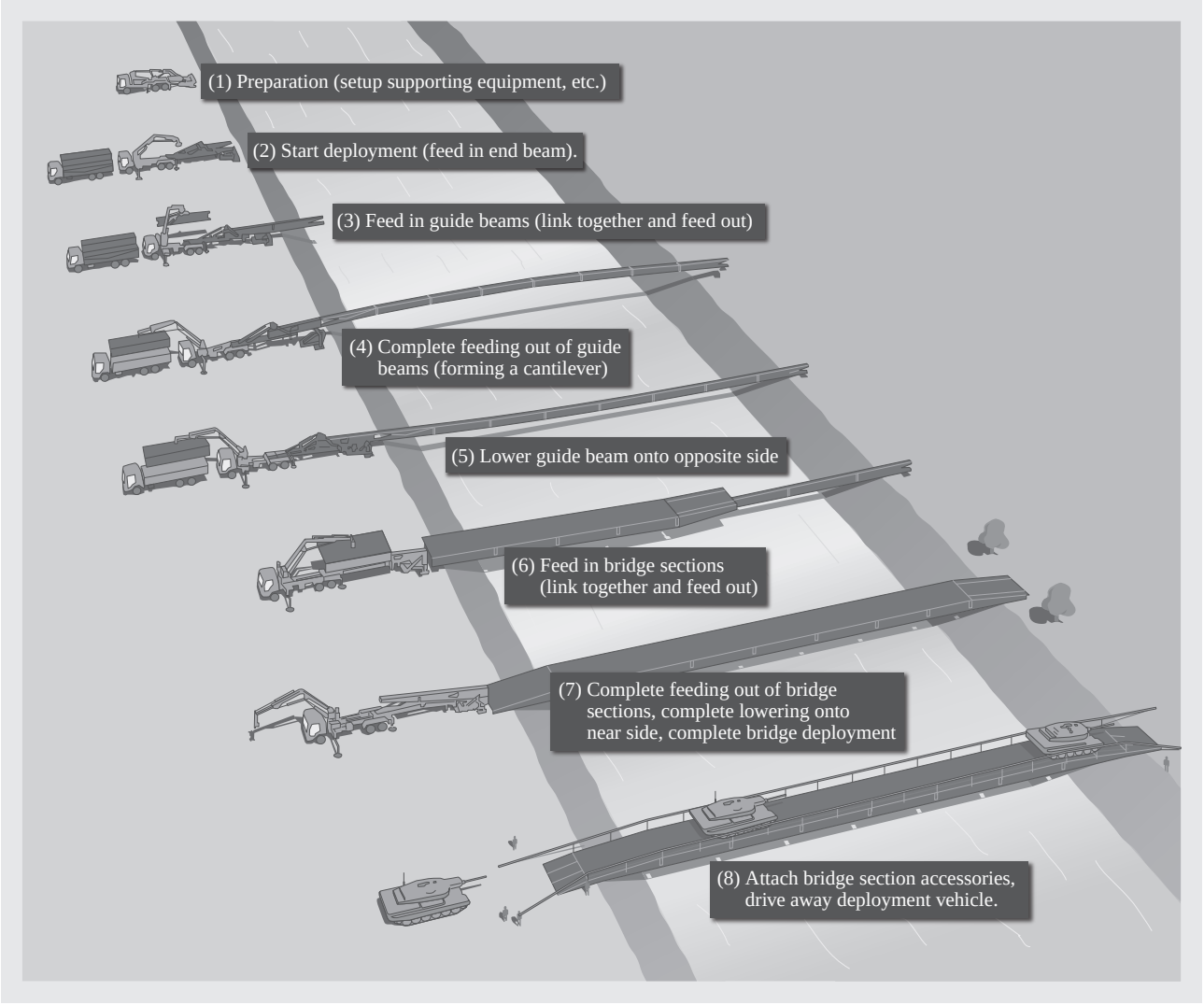

Fig. 3—Deployment Procedure.
First the guide beams are fed out as a cantilever and then lowered onto the opposite side. Next, the bridge sections are unloaded from the transporter and placed on the guide beam where they are linked together and slid along until the bridge is completed.

Fig. 4—Guide Beams during Deployment Process. The guide beams have a welded structure of high-strength aluminum.

Prefabricated Temporary Span Bridge

Prefabricated temporary span bridges are used to cross rivers or ravines in situations such as when an existing bridge has been destroyed. Compared to previous prefabricated temporary span bridges that have used piers (trestles or other bridge supports), the benefits of not requiring piers include eliminating restrictions on the depth of the terrain being bridged and shortening the amount of preliminary work required to level the bottom of the river and erect piers.

The bridge is constructed using a special vehicle fitted with the equipment needed to deploy the bridge, guide beams that guide the deployment process together with the vehicle used to transport them, and bridge sections that form part of the bridge together with the vehicle used to transport them.

Fig. 3 shows the procedure for deploying a bridge. First, a special crane on the construction vehicle unloads the guide beams from their transporter. Next, the guide beams are linked together on the back of the construction vehicle and feed out to form a cantilever. To minimize the weight of the guide beams that form the cantilever, they have a welded structure of high-strength aluminum. Unfortunately, aluminum is more prone to bending than steel and therefore the more guide beams are linked together, the greater the amount of bending. To deal with this, a support is located between the guide beams being fed out and the equipment on the construction vehicle. This support can be raised or lowered to ensure that the far end of the guide beam reaches the opposite side correctly even if a high degree of bending occurs (see Fig. 4).

After feeding out the guide beam, the end is lowered onto the opposite side. Next, the special crane on the construction vehicle unloads the bridge sections from their transporter, places them on the guide beam, links them together, and slides them out along the guide beam to construct the bridge (see Fig. 5).

Like the floating bridge, the span bridge must also be made small and light, taking account of factors such as vehicle width, height, and gross weight to ensure that the vehicles can drive on standard Japanese roads. While the bridge sections used for the bridge must be wide enough for the vehicles passing over the bridge, they must also be narrower than the road when loaded on the transporter. To achieve this, both sides of the bridge sections are designed to fold out, and the special crane on the construction vehicle uses an attachment that automatically folds these extensions out or in when deploying or dismantling the bridge.

Fig. 5—Completed Bridge. The bridge sections have sufficient strength to carry heavy vehicles.

The bridge sections must be strong enough to carry heavy vehicles (such as tanks) when deployed while also being light enough to be carried on conventional roads when loaded on the transporter. Accordingly, they have a welded structure of high-strength aluminum, like the guide beams.

USE IN GREAT EAST JAPAN EARTHQUAKE

The bridge linking Miyato Island to the mainland at Higashi Matsushima City in Miyagi Prefecture was destroyed in the Great East Japan Earthquake, leaving the island isolated. The Japan Ground Self-Defense Force was involved in the recovery work, which included use of a Type 92 floating bridge in ferry configuration to transport construction machinery and other supplies to the island (see Fig. 6).

The Type 92 floating bridge and Type 07 mobility support bridge are valuable tools for disaster recovery, and have been used in civil defense training drills conducted by regional governments (see Fig. 7).

Photo courtesy of Northeastern Army, Japan Ground Self-Defense Force

Fig. 6—Use of Type 92 Floating Bridge in Recovery Work.
The floating bridge was used to transport construction machinery needed for recovery work to an island cut off by the Great East Japan Earthquake.

Fig. 7—Type 07 Mobility Support Bridge in Deployed Configuration.
The photograph shows the civilian Type 07 mobility support bridge deployed as part of the FY2010 general civil defense drill of Kitaibaraki City in Ibaraki Prefecture. The vehicle in the rear is the construction vehicle.

These prefabricated supporting bridging systems are increasingly being recognized as a very effective means for keeping essential services operating during times of disaster.

SAFETY AND SECURITY MEASURES

Disasters such as earthquakes and floods have been increasing in recent years in countries around the world. Hitachi aims to supply products that provide the means to make an international contribution to safety and security, and that utilize its technology for prefabricated supporting bridging systems that has been built up over many years.

As defense equipment is designed for rapid deployment and withdrawal, product features include automation using special-purpose vehicles. When repurposing these products for civilian and other uses, general-purpose trucks, trailers, and cranes are used so that they can be supplied as a lower price (see Fig. 8).

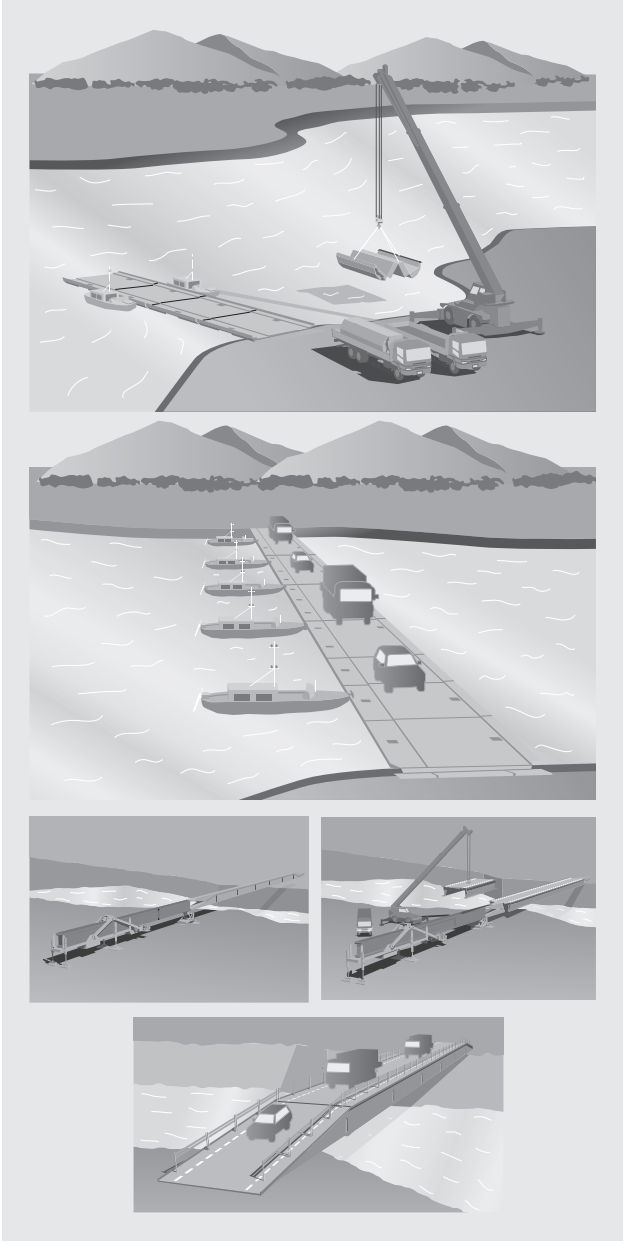

Fig. 8—Example Civilian Uses of Prefabricated Temporary Floating Bridge and Prefabricated Temporary Span Bridge.
Hitachi believes it can supply these bridges for civilian use at low cost by using general-purpose trucks, cranes, and other equipment.

CONCLUSIONS

This article has described the Type 92 floating bridge that floats on a river and supports vehicle traffic, and the Type 07 mobility support bridge that can span rivers or ravines without requiring piers, and also their civilian applications.

Hitachi develops prefabricated supporting bridging systems and supplies them to the Japan Ministry of Defense. In the future, Hitachi intends to contribute to the creation of a safe and secure society by supplying

prefabricated supporting bridging systems that can be used to respond to interruptions to essential services caused by disasters and other events.

REFERENCE

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