Military Bridging and Maneuver Warfare:
Deficiencies and the Way Ahead

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The United States Marine Corps' concept of expeditionary maneuver warfare focuses on the "ability to take action to generate and exploit some kind of advantage over the enemy as a means of accomplishing our objectives as effectively as possible."[1] This concept has driven the Marine Corps Systems Command to procure equipment that can be rapidly and efficiently employed in order to generate speed and tempo. "Inherent in maneuver warfare is the need for speed to seize the initiative, dictate the terms of action, and keep the enemy off balance, thereby increasing his friction."[2] The Marine Corps, however, falls short in matching equipment with warfighting concepts in the area of military bridging. In fact, current bridge assets possess deficiencies and should be replaced using new technologies in order to support maneuver warfare.

Current Bridge Assets

The Marine Corps currently employs the medium girder bridge (MGB) for dry gap crossings (crossings in which the bridge is supported only by the abutments) and improved ribbon bridge (IRB) for wet gap crossings (crossings in which the bridge or raft is supported by water). Both are steel component bridges that are transported using the logistics vehicle system (LVS)

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[1] Department of the Navy, *MCDP 1 Warfighting*, 1997 (Washington, D.C.), 72.
[2] Department of the Navy, *MCDP 1 Warfighting*, 1997 (Washington, D.C.), 74.

and are constructed using manual labor. Bridging with the IRB and MGB are individual training standards for all combat engineers. The assets are located in the bridge companies of the engineer support battalions.

Medium Girder Bridge

The MGB's maximum length of 47.2 meters can be achieved only under very restrictive conditions. First, the bridge ends must rest on prepared timber or concrete abutments strong enough to support and transfer the weight of the bridge and crossing vehicles. Second, the abutments must also be within 2.3 meters of height in relation to each other. Third, the area beneath the bridge must be cleared of obstruction to a depth of 3.7 meters.[3]

The MGB also has a significant logistical support requirement. To transport a maximum length MGB, (18) vehicles or (18) CH-53 helicopters are required. A well-trained 34-man engineer platoon requires a minimum of three hours to construct the bridge (time increases exponentially due to site conditions and level of training). Forklift and heavy truck support are required to offload and launch the bridge safely.

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[3] Department of the Army, FM 5-34 Engineer Field Data, 2005 (Washington, D.C.), Chapter 10.

Improved Ribbon Bridge

The IRB can be employed as a continuous bridge whose length is limited only by the number of assets on-hand and it can be employed as a raft. The IRB is constructed and propelled with the bridge erection boat (BEB). The BEB can be employed to anchor the IRB continuous bridge or propel the IRB raft. Each IRB section is 6.7 meters in length and requires a minimum water depth of 76 centimeters, maximum launch bank height of 8.5 meters, and maximum current velocity of 2 meters per second to operate.[4]

The IRB requires similar logistical support as the MGB. Each IRB section requires one vehicle for transportation, and each BEB requires one vehicle or one trailer for transportation. For example, a bridge platoon has the assets to construct five IRB rafts (enough to cross a mechanized infantry battalion in 11 round trips). This requires 30 interior bays, 10 ramp bays, and 10 BEBs. The total lift requirement is (50) LVS Mk 48/18 vehicles.

Bridge Deficiencies

The logistical support required to transport and construct the current bridge assets are a hindrance to the Marine Corps' current and future employment of maneuver warfare (to include

[4] Department of the Army, FM 5-34 Engineer Field Data, 2005 (Washington, D.C.), Chapter 10.

ship-to-objective maneuver [STOM]). A bridge platoon would require 64 vehicles to move its complement of MGB and IRB assets and additional vehicles for transportation of heavy equipment, personnel, and communications. If a beachhead is not established, an equal number of heavy lift helicopters would be required. Due to the finite number of vehicles in the engineer support battalions and aircraft in the helicopter squadrons, a rapid and efficient movement of assets and personnel to the objective is not possible.

Moreover, the size and numbers of assets required to construct the bridges produce a large logistical footprint normally located on high, open terrain in heavily trafficked areas. The logistical footprint and open terrain exposes the assets and personnel to enemy indirect fires that do not need to be very accurate in order to be effective. These factors require the bridge unit to either risk personnel casualties and equipment loss or delay operations until enemy indirect fire assets within range of the bridge site are cleared.

Both bridge assets have specific restrictions on approach banks, ramp bearings, and gap depths that may also prevent their employment. If alternate crossing areas cannot be found, time intensive site preparation using bulldozers, scrapers, and graders is required. These additional heavy equipment assets and their necessary transportation assets also create an even larger logistical footprint.

Furthermore, littoral regions around the world create unique crossing restrictions that the current bridge assets cannot overcome. Tidal rivers with extreme ranges restrict the IRB crossing times to a few hours per day for two main reasons. First, the IRB cannot structurally support carrying vehicles if beached on a tidal flat. Second, once beached on the tidal flat, the IRB may not have the buoyancy to free itself from the tidal flat. The IRB properties that prevent operations on tidal flats also prevent operations in swamps and salt flats.

Proposed

In order for bridging to enhance current and future employment of maneuver warfare, the Marine Corps must align with the Army to pursue current and new technologies to develop expeditionary bridging. The new bridge assets must reduce logistical burden while expanding capabilities in comparison with current bridge assets. Two technologies that can be advanced to support the future of military bridging include composite materials and air cushions.

Composite Materials

Dr. John Kosmatka of the University of California, San Diego, is leading research into developing military bridges using lightweight composite materials:

> UCSD composite structural engineers are developing lightweight bridges for the military that make use of modern aerospace-grade advanced composite materials. These graphite/epoxy bridges weigh considerably less than existing metallic bridges but can still easily support 80-ton tanks. UCSD is involved with the design, analysis, fabrication, lab testing, and field testing.[5]

The Marine Corps' goal should be to fund and develop this and similar research to the point that composite materials can be formed into a composite bridge at or near the crossing objective. Further, the ability to produce materials in the area of operations and the characteristics of the material would greatly reduce the current logistical burden. Dr. Kosmatka has been leading research to form graphite and epoxy composite material bridges for the Army that include a 14-meter and 4-meter rapidly employed bridges that are lighter than existing military bridges with a military load classification of 100 tons.[6] Dr. Kosmatka has also been developing a manufacturing plant that can be transported by C-17 Globe Master aircraft.[7]

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[5] Dr. John Kosmatka, Department of Structural Engineering, Research Projects, Lightweight Composite Military Bridging, <http://www.structures.ucsd.edu/index.php?page=research/projects/proj_lightBridge> (15 December 2007)

[6] Dr. John Kosmatka, *UCSD/ONR Meeting: Composite Military Bridging*, 2007, University of California, San Diego, CA, Presentation Slides 10–15.

[7] Dr. John Kosmatka, *UCSD/ONR Meeting: Composite Military Bridging*, 2007, University of California, San Diego, CA, Presentation Slides 50-54.

Air Cushion

The Marine Corps must also develop current air cushion (i.e. hover craft) technologies that can be integrated with the composite materials bridge for wet-gap crossings. Air cushion components can be easily attached to the composite bridge in order to form hovering bridges or rafts. When employed, the air cushion bridge would not be restricted by tidal flats, swamps, or salt flats.

Counterarguments

The Marine Corps and Army are successfully employing throughout Iraq a line of communication (LOC) bridge developed by Mabey & Johnson Ltd. The LOC bridge is a component panel bridge that can be designed to cross dry and wet gaps of indiscriminate size. It is much more flexible than the MGB and IRB in employment and requires much less site improvement. The LOC bridge does have two fatal flaws that prevent it from supporting maneuver warfare, however. First, it still requires a large logistical support package for transportation and presents a large logistical footprint at the crossing objective. Second, it is technically complex and often requires a technical representative from Mabey & Johnson for proper construction. These representatives will not likely be available during initial combat operations of a campaign.

Other opposition is posed by those who anticipate the cost of training to increase. Composite material production and operation of air cushion crafts will require additional schooling and licensing for Marines serving in the bridge companies. These skills will not be useful in any other combat engineer unit. Although valid, this argument has become moot because of the manner in which the bridge companies currently operate. With a trained bridge master giving directions and licensed equipment operators, the majority of the labor needed to construct a composite bridge does not need to be trained to produce the materials, to operate and maintain the air cushion craft, or even be combat engineers. Currently, a bridge platoon only requires 10 BEB operators. Therefore, only a limited number of combat engineers will require the additional training and licensing.

Conclusion

The Marine Corps' current successes in opening and maintaining main supply routes through Iraq using current bridge assets have given it a false sense of security that it will have the same success in the future. As future adversaries study USMC current operations, they will quickly understand that the key to the Marine Corps' expeditionary maneuver warfare concept is the speed with which it can move logistics, and the simplest way to stop its logistics is to destroy bridges along re-supply routes. The MGB and IRB assets cannot be employed without a time and transport vehicle intensive operation, and the bridges are extremely limited as to the type of terrain they can cross. Without reducing the logistical burden and expanding the capabilities of military bridging, future maneuver warfare integrated with ship to objective maneuver will not be possible. Advantage in the future will belong to those who are faster and lighter.

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