CANADIAN FORCES COLLEGE / COLLÈGE DES FORCES CANADIENNES
CSC 31 / CCEM 31

EXERCISE/EXERCICE NEW HORIZONS

BRIDGING TO THE ARMY OF THE FUTURE: TRANSFORMING THE ARMY'S BRIDGING CAPABILITIES

By /par Maj T. A. Weber

Abstract

This paper examines the need for the transformation of the Army's bridging capabilities to support the Army of the future. A critical analysis based on first principles is used to extrapolate the engineer bridging capabilities necessary to support the Army based on the tasks the Government of Canada expects the Army to achieve in the present and future security environment. Existing bridging doctrine and equipment is then assessed against the required capabilities, identifying where shortfalls presently exist. Based on the critical analysis, the following recommendations are proposed. Doctrinally, the concept of assault crossing should no longer be considered an activity conducted by Canadian forces. In lieu, the US concept of tactical support bridging should be adopted. In support of this doctrine, the Canadian Army should investigate the acquisition of the US REBS in support of a LAV based expeditionary force. The doctrine for support bridging is sound and the existing MGB and MFB systems are adequate, but dated. As a second priority to the acquisition of a tactical support bridging system, replacements for the MGB and MFB should be investigated. The concept for the American DSB system provides a viable alternative to the MGB system and the newer versions of the MFB would be a relatively easy procurement. Finally the importance of LOC bridging should be reflected in present doctrine. Panel bridging should become a core capability of the engineers as opposed to a "limited" capability.

INTRODUCTION

A man is standing on the bank of a river with a chicken, a cat and a dog. He must cross the river to continue his journey. Due to the velocity of the river current, the steep banks and the depth of the water he can only take two animals across at a time in a large gunnysack. How will he get across without one of the animals killing another? This dilemma will never occur in the Canadian Army. The Canadian Military Engineers will have identified the potential dilemma before hand and provided an appropriate crossing at the time and place necessary to facilitate the mission of getting across the river with minimal losses - or so we hope.

Bridging has been and remains a tactical, operational and often strategic enabler that facilitates maneuver and sustainment, particularly in complex terrain. The seventeen days to Potenza during the Italian campaign in September 1943 is an excellent historical example. The 1st Canadian Division was assigned the right flank over the mountainous terrain with inland towns that were difficult to access.[1]

> Field Marshal Montgomery, in *El Alamein to the Sangro,* has commented at some length on the important part enemy demolitions played in delaying the drive and on the opportunities the enemy sappers had to create trouble and confusion at every "twist and

---

[1] Colonel A.J. Kerry and Major W.A. McDill, *History of the Corps of Royal Canadian Engineers*, Volume 2/3 (Ottawa: The Military Engineers Association of Canada, 1966), 150.

> turn" in this mountainous country. When an advance is made against an enemy who chooses to stand and fight, the infantry have the predominant role. But in this almost bloodless trek the load bore heavily on the engineers. It was emphasized again and again, as in Sicily, that the division could go forward only as rapidly as craters could be filled, diversions or bridges built and roads repaired. A senior officer, who shall be nameless, is reputed to have remarked in an unguarded moment, "What this division really needs is three brigades of sappers and three companies of infantry."[2]

More recently, extensive bridging occurred throughout the Balkans and Operation IRAQI FREEDOM. The difficult crossing of the Sava River near Zupanja, Croatia, on 31 December 1995, made headlines in America. It was the largest operationally required bridge build since WWII with the river swelling to a 600 meter gap due to an early spring thaw.[3] The sustainment of the operation relied on the establishment of this line of communication (LOC). In Iraq, gap crossings were a major concern – in particular the Tigris and Euphrates Rivers and the Saddam Canal.[4] Ribbon bridges were constructed as LOC, medium girder bridges (MGB) were used to over-bridge damaged infrastructure[5] and armored vehicle launched bridges (AVLB) were utilized to drive over oil pipelines perpendicular to the avenue of approach.[6] Bridging capabilities are critical to successful modern military operations and will continue to be a major enabler in the future.

Canadian bridging capabilities must be responsive to the Army's requirements. Present bridging doctrine and equipment are designed to fight an attritional conflict based on Cold War

---

[2] Kerry and McDill, *History of the Corps of Royal Canadian Engineers*, Volume 2/3…, 157.

[3] Maj David L. Treleaven, "Engineers in Bosnia: An Overview," *US Army Engineer School Publications Production Division,* March 1996.

[4] Scott Gourley, "The US Marine Corps in Iraq: Close Combat," *Janes Defence Weekly* vol 41, no 4 (28 January 2004): 29.

[5] LCol Ed Jackson, "A Multifunctional Engineer Battalion*," Engineer- The Professional Bulletin of Army Engineers* vol 34 (January – March 2004): 43.

[6] Fulvio Bianchi, "Assault Bridges and Bridgelayers," *Military Technology - MILTECH* (3-4/2004): 81.

scenarios as opposed to the existing and future threat environments. This limited bridging capability is not synchronized with the new force structure and does not meet the intent of an effects based expeditionary force. As a key tactical and operational enabler, the bridging capability within the Canadian Army must evolve and transform with the force structure in order for the Army to remain strategically relevant and tactically decisive.

A critical analysis based on first principles will be conducted to determine the appropriate bridging requirements to support the Army of the future and identify the limitations and shortfalls with existing equipment bridging capabilities.[7] The probable Army tasks to meet Canada's defence objectives will be defined and examined followed by an assessment of the gap crossing capabilities required to support these tasks. The assessed capabilities for the future army force structure will then be compared to existing Canadian bridging doctrine and capabilities to determine shortfalls and limitations. In summary, recommendations to transform Army bridging capabilities will be presented.

DEFINING CANADA'S BRIDGING REQUIREMENTS

The Army's bridging requirements are dictated by the Army's mission "… to generate and maintain combat capable, multi-purpose land forces to meet Canada's defence objectives."[8] These objectives are outlined in the 1994 White Paper on Defence and focus on three main pillars: providing for the defence of Canada and Canadian sovereignty;

---

[7] Equipment Bridging is a term used to describe manufactured bridging systems that are designed to be transportable, easily constructed and re-used. This is as opposed to non-standard bridging, a term used to describe bridging designed for a specific gap and constructed out of materials on hand (wood or log bridge, steel girder bridge, etc) National Defence Engineer Field Manual, Gap Crossing, B-GL-361-010/FP-001, 4.

[8] Department of National Defence, *Advancing with Purpose: The Army's Strategy* (Ottawa: DND Canada, 1998), 6.

continued Canada – United States defence cooperation; and contributing to international security.[9] The Army's mission, focusing on these pillars, results in tasks that determine the bridging capabilities the Army will require to achieve success.

Security and Protection of Canada

Although the security environment outside of Canada has changed - to be discussed later with the third pillar- the security threats affecting the first pillar within the borders of Canada have been relatively constant. The threats to peace and security necessitating an Army response have been, and remain, civil disturbances and natural or manmade disasters beyond the ability of civil authorities to address.[10] As demonstrated by the Oka incident in 1990, provinces can call upon the Armed Forces to restore or maintain civil order.[11] In response to natural and manmade disasters the Army was tasked to assist with the Ice Storm, the British Columbia Forest Fires and the Great Toronto Snowstorm as well as the Y2K threat, the Swiss Air crash and the Toronto

---

[9] Department of National Defence, *1994 Defence White Paper* (Ottawa: Canada Communications Group, 1994); available from http://www.forces.gc.ca/admpol/eng/doc/5117_e.htm; Internet; accessed 28 March 2005, chapter 4.

[10] Department of National Defence, *1994 Defence White Paper*, chapter 4.

[11] *Ibid.*

Blackout.[12] These recent events provide excellent examples of the capabilities required of the Army to meet the demands of providing security and protection within the borders of Canada.

Similarly, a historical review of Army bridging support to the protection and security of Canada provides insight into the bridging capabilities and responses required to support Army domestic tasks. In 1969, 2 Field Squadron in Gagetown replaced a collapsed highway bridge at Robinsvillle, New Brunswick with a 140 foot heavy girder bridge. The following year the same squadron constructed a 170 foot Bailey Bridge over the Miramichi River when floods washed out the existing bridge.[13] In 1972 the concrete bridge on the Trans Canada Highway over the Petawawa River, just outside of CFB Petawawa, collapsed due to erosion. 1 Field Squadron opened a 70 mile detour through Algonquin Park and operated a military load class (MLC) 30 light raft to ferry essential support, perishable foods and ambulances across the water.[14] Two days later the squadron constructed a 312 foot MLC 30 floating bridge two kilometers downstream of the collapsed bridge. By the time the semi-permanent bridge was complete by 1 Field Squadron with materials supplied by the Department of Transportation, approximately 100,000 vehicles and pedestrians had crossed the floating bridge.[15] More recently, in support to an Aide to the Civil Power request, 2 Combat Engineer Regiment deployed a medium raft (MR) to Cornwall in 1990 to support and evacuate police forces from the Akwasasnee Reserve in the

---

[12] Privy Council Office, *Securing an Open Society: Canada's National Security Policy* (Ottawa: Privy Council Office, 2004), 23.

[13] LCol K. J. Holmes CD (Retd), *The History of the Canadian Military Engineers* Vol 3, ed. J. R. Newell (Toronto: Thorn Press Ltd, 1997), 370.

[14] MLC refers to the tonnage that can safely use a bridge or road for an extended period of time. MLC 30 would mean vehicles weighing up to 30 tons can safely use the road or bridge.

[15] Holmes, *History of the Canadian Military Engineers* Vol 3, 371.

event the international bridge was inaccessible to the police forces on the reserve.[16] Finally, in 1997, 1 Combat Engineer Regiment deployed the MR to support the Army disaster relief efforts during the Manitoba Flood.[17] It was used to move equipment and personnel to and from communities stranded by the floodwaters. All cases involved LOC bridging to support emergency civilian movement across gaps or large bodies of inland waterways.

Based on the historical examination and the present threat assessment, the Army equipment bridging capability must be responsive to manmade and natural disasters, critical infrastructure vulnerability and aide to the civil power. [18] [19] The response must be rapid, therefore the capability required must be dispersed across the country and highly mobile on Canadian roads. The capability must accommodate civilian requirements as well as military. The Army must be prepared to deal with flooding caused by natural disasters or the failure of a dam, possibly due to a terrorist attack. LOC, in particular bridges along Canadian highways, are critical infrastructure that the military must be capable of reopening or bypassing should a bridge close due to natural or human intervention. Therefore, the most relevant capabilities to domestic bridging tasks are being able to cross large gaps, support civilian mobility - possibly for extended periods of time - and providing the crossing support quickly.

---

[16] The author, as a member of 2 Combat Engineer Regiment, commanded the MR detachment supporting the operation for two weeks in August 1990.

[17] As a member of 2 Combat Engineer Regiment the author deployed in support of the Winnipeg Floods and observed the MR in use.

[18] Privy Council Office, *Securing an Open Society: Canada's National Security Policy*, 6.

[19] Although civil unrest (Aide to the Civil Power) is not identified as a threat to national security in Canada's National Security Policy, it is cited in the White paper on National Defence. Given the experiences with the FLQ crisis, Akwasasnee and Oka, it is considered prudent to include it as a possible threat and task for the Army.

United States Defence Cooperation

The second pillar identifies the requirement for a close working relationship with the United States and other allies. "The United States is Canada's most important ally and the two countries maintain a relationship that is as close, complex and extensive as any in the world."[20] The Army recognizes that a relationship with the world super power and is a key factor in determining the Army of the Future and that it must continue to develop its capability for joint and combined operations with its principal ally, the US.[21] The intent is to "…synchronize force development to achieve joint interoperability with the ground forces of the United States, …".[22] Therefore future Canadian bridging capabilities must take into consideration American capabilities.

As part of their Army Transformation, the US Army's equipment bridging capabilities are being developed to support the new framework of an expeditionary force. Existing procurement contracts were cancelled and new contracts developed to meet the requirements of the Future Combat Systems program. The program to replace existing AVLBs with heavier capabilities, based on the M1 Abram chassis, was cancelled and the requirement for heavy assault crossing bridging is currently under review.[23] A new program has been developed to produce tactical support crossing bridging equipment as part of the Stryker Combat Brigade

---

[20] Department of National Defence. *1994 Defence White Paper*. Chapter 5.

[21] Department of National Defence, DLSC Report 01/01, *Future Army Capabilities* (Kingston: DND Canada, January 2001), 8.

[22] Department of National Defence, *Advancing with Purpose: The Army's Strategy* (Ottawa: DND Canada), 8.

[23] Fulvio Bianchi, "Engineer Equipment for Expeditionary Operations (II) – Combat Engineer 2004," *Military Technology - MILTECH* (12/2004): 19.

Team.[24] The intent is to produce a relatively light equipment bridge with an MLC 30 that is air transportable by C-130 aircraft and can be launched and recovered by a vehicle already in service. General Dynamics has been contracted to build the first sets of the Rapidly Emplaced Bridging System (REBS) that will be 13.8 meters long, and installed on a pallet system that can launch the bridge from the back of an existing bridging truck. The bridge will take two sappers ten minutes to launch and it can be transported into theatre by a CH 47 helicopter.[25] Until the REBS arrive, engineers supporting the Stryker Combat Brigade Teams will carry palletized MGBs. The US Army recognizes the importance of LOC bridging as part of its future force requirements. An improved medium floating bridge (MFB) was successfully used to set up a LOC across the TIGRIS River during Operation IRAQI FREEDOM. Since the war, the Army plans to replace its entire aging MFB inventory with the improved version.[26] As well the US Army is procuring a beam-launched bridging system to replace MGB used as a LOC bridging system. This Dry Support Bridge (DSB) system is based on foldable bridge sections loaded on standard pallets. An 8 man section can construct an MLC 70 tracked (MLC 90 wheeled) bridge across a gap of 40 meters in approximately two hours.[27] Although referred to as a LOC bridge, the steep ramps and lack of guardrail make it unsuitable for logistic traffic.[28] The American military engineers also retain the ability to construct panel bridges such as Bailey Bridge variants with the reserve component Bridging Panel Companies. These companies are the first response

---

[24] MGen Anders B. Aadlanders and James L. Allen, "Engineer White Paper – Into the Objective Force," *Engineer – The Professional Bulletin of Army Engineers* vol 32 (April 2002): 6.

[25] Bianchi, "Engineer Equipment for Expeditionary Operations (II)," 19.

[26] *Ibid,* 20.

[27] *Ibid.*

[28] Captain Kevin A. Brooks, "Bridging Shortfall: Lines of Communication Bridging," *US Army Engineer School Publications Production Division,* March 1999.

for domestic disaster relief and provide LOC bridging for expeditionary operations in austere environments.[29]

To synchronize with the US Army, Canadian equipment bridging capabilities must be capable of supporting the expeditionary requirements of the US Army's Future Combat Systems program. As a minimum, the support crossing equipment bridging must accommodate wheeled MLC 30 traffic. It should be transportable in a C-130 aircraft and on a PLS compatible with US army logistic systems. Ideally, the Canadian equipment bridging would be interchangeable with the American systems, improving the interoperability of a Canadian battle group within an American lead coalition. With common bridging equipment, specific to nation equipment bridging would not have to be transported through out the area of operations (AO). The common bridging equipment would be moved from the nearest location in theater to where it was required. Canadian and American engineers would not have to move throughout each others AO to construct equipment bridging, only the equipment would need to move. The operational logistics of equipment bridging becomes easier with fewer variants reducing the stocks of equipment in theater and streamlining the maintenance support for repair and parts replacement. The more synchronous the Canadian equipment bridging capabilities are with the US Army, the more flexible and sustainable the Canadian component will be in an American coalition.

International Security

The third and final pillar requires the Army to be capable of contributing effectively to international stability operations. The Warsaw Pact threat of a conventional war between peer

---

[29] Brooks, "Bridging Shortfall: Lines of Communication Bridging."

forces in a linear, contiguous battle space fought in relatively open terrain no longer exists. The threats to global security are now assessed as failed or failing states, state sponsored terrorism and weapons of mass destruction.[30] Although the belligerents may have the ability to conduct a high tempo, high intensity operation, it will likely be limited compared to Western capabilities.[31] To counter this advantage, opponents tend to operate in complex terrain such as mountains, jungles or built-up areas in order to limit the effectiveness and lethality of new technology.[32] Also, they tend to adopt asymmetric methods of fighting in order to offensively strike at superior forces.[33] Guerilla tactics of randomly targeting lightly defended sites, convoys or civilian infrastructure are typical examples. Thus the battle space of the future will likely be non-linear, non-contiguous and fought in relatively complex terrain against an asymmetric enemy.[34]

> "In this increasingly unstable international threat environment, Canada must have armed forces that are flexible, responsive and combat-capable for a wide range of operations, and that are able to work with our allies."[35]

The intent is to integrate Canadian defence, development and diplomatic resources to protect and advance our national security interests, international peace and stability and human rights.[36] Canadian society expects operations that inflict the minimum number of friendly, civilian and

---

[30] Privy Council Office, *Securing an Open Society: Canada's National Security Policy*. 48.

[31] Department of National Defence DLSC Report 01/01, *Future Army Capabilities*, 7.

[32] Lieutenant-Colonel Bernd Horn and Regan G. Reshke, "Defying Definition: The Future Battle Space," in *Towards the Brave New World: Canada's Army in the 21st Century*, ed. Lieutenant-Colonel Bernd Horn and Peter Gizewski (Ottawa: DND Canada, 2003), 90.

[33] Asymetric warfare - The intent is to weaken a superior opponent by undermining strengths and exploiting weaknesses, often with a more psychological than physical impact.

[34] Department of National Defence DLSC Report 01/01, *Future Army Capabilities*, 7

[35] Privy Council Office, *Securing an Open Society: Canada's National Security Policy,* 50.

[36] *Ibid,* 51.

enemy casualties.[37] In effect the expectation is a force capable of conducting simultaneous combat and humanitarian operations abroad.

To meet these expectations the Army is transforming from its present Cold War posture into a force that is sustainable, strategically mobile, tactically decisive and able to operate in joint, interagency and multinational environments.[38] To improve strategic mobility the Army is transitioning from a heavier, more maintenance intensive track based forces to wheeled medium and light forces. The new force structure and supporting equipment is MLC 30, air transportable in a C-130 aircraft, easier to move by sea and, due to less route restrictions from MLC or size considerations, is more operationally mobile in foreign theatres. It will be capable of operating in mobility restricting complex terrain and will maneuver quickly throughout the AO utilizing roads as opposed to traveling across country. To remain tactically decisive after the loss of the tracked vehicles the Army is adopting Effects Based Operations (EBO) to compensate for the decrease in firepower, protection and cross-country mobility.[39] ISTAR assets will provide unprecedented understanding of the enemy and allow the synchronization of long-range precision fires to shape and engage him.[40] Civil military cooperation (CIMIC) is one of the cornerstones to humane operations in non-contiguous, asymmetric operations. This encompasses

---

[37] Department of National Defence, *The Force Employment Concept for the Army* (Ottawa: DND Canada, March 2004), 1.

[38] Department of National Defence, *The Force Employment Concept for the Army,* 6.

[39] EBO is a methodology of operations that uses the full range of effects, both lethal and non-lethal to render an opponent either physical or morally incapable of pursuing an objective. It encompasses conventional strike and maneuver with non-kinetic means such as psychological and Civilian/Military (CIMIC) operations. The intent is to produce cascading systemic effects at the tactical, operational and strategic levels.

[40] ISTAR – Intelligence, surveillance, target acquisition and reconnaissance

the provision of essential services and repairing or constructing essential infrastructure.[41] With these transformations the Army will be capable of supporting Canadian international policies in an asymmetric non-contiguous, non-linear environment.

Cascading from the Army transformation requirements, bridging capability requirements transform as well. Strategic mobility demands that equipment bridging be easily shipped or flown into theatre and, once in theatre, not be subject to mobility limitations in the AO due to size or weight LOC restrictions in complex terrain. The equipment bridge must be capable of keeping pace with the force as it utilizes roads to maneuver. To remain tactically decisive, the Army will require a rapidly deployable gap crossing capability in support of the forward elements. Statistics show that 60% of gaps can be bridged by spans of 6 meters or less, 20% require spans from 6 to 20 meters and the remaining 20% require bridges longer than 20 meters.[42] Therefore a bridging system, or combination of bridging systems, is required that provides a flexible response for rapid support to tactical movement or support to LOC based on ISTAR identification of gap crossing requirements. The system should efficiently use the minimal amount of equipment to defeat the gap in order to maximize limited resources. Fortunately, EBO will minimize the requirement to conduct assault bridging in the face of enemy direct fire. The reduced risk of enemy fire during assault crossings decreases the requirement for heavy armor protection. However an asymmetric enemy will strike at weak links to attack its opponent. Damaging or destroying key bridges is an excellent tactic to disrupt logistics and troop movements. The ability to replace or repair LOCs in the AO could be critical to the success of a mission. As well the capability to replace or repair bridging for civilian use is an

---

[41] Department of National Defence, B-GG-005-004/AF-000 *Canadian Forces Operations* (Ottawa: DND Canada, 2000), 30-2.

[42] Bianchi, *Assault Bridges and Bridge Layers*, 84.

excellent military civil action that can accomplish defence, diplomatic and development objectives and is highly visible as a positive humane contribution to the betterment of the local population. These bridging capability requirements are necessary to support a transformed Canadian Army.

CAPABILITIES VERSUS REQUIREMENTS

The Army presently has three doctrinal bridging categories supported by four distinct equipment bridging capabilities all of which were acquired and designed for use during the Cold War. Doctrinally each equipment capability is utilized to support a specific crossing category: assault; support; and LOC. Comparing the existing equipment and supporting doctrine to the new defined requirements to support the Army of the future will identify where transformation in bridging capabilities is required.

Assault

Assault crossing is defined as intimate mobility support to the fighting echelon often conducted under the threat of direct or indirect fire. It is intended for use over a short period of

time; extended use will require significant maintenance.[43] The Leopard AVLB provides the Army with its assault bridging capability.[44] It is based on a Leopard 1 chassis and can launch an MLC 60 bridge in approximately five minutes to defeat a gap of 20 meters. Doctrinally it provides a rapid armored bridging capability to support tanks and tracked infantry vehicles during an assault or advance to contact. The lack of decking and support rails makes the AVLB unsuitable for wheeled support vehicles and dangerous for civilian vehicles. It is normally used in tandem with two special wheeled bridge transporters pulled by prime movers to re-supply the Leopard chassis with two other bridges. The wheeled bridge transporter has limited mobility, normally following the battle on roads. Once launched, a bridge remains in location until a support bridge is constructed or an alternate crossing site secured. A Leopard chassis with an AVLB is 12 meters long, 4 meters wide and 3.6 meters high and has an MLC of 50.[45]

Based on the bridging requirements to support the three pillars, assault bridging doctrine and equipment must be revisited. First and foremost, assault bridging is not a requirement to support the first pillar. As the threat analysis and historical study has shown, the requirement for an intimate temporary gap crossing capability limited to 20 meters to support armored vehicles is not a probable task. The size of the Leopard chassis complete with a bridge makes it impractical for long road moves on a highway, limiting its domestic use unless it is pre-positioned by a tank transporter. The bridge is not designed for civilian vehicle use so it will have minimal, if any, value in supporting Aide to the Civil Power tasks.

---

[43] Department of National Defence, B-GL-361-010/FP-001 *Engineer Field Manual: Gap Crossing* (Ottawa: DND Canada, 2004), 5.

[44] Department of National Defence, *Engineer Field Manual: Gap Crossing,* 22.

[45] *Ibid,* 23.

With respect to interoperability with the US army, Canadian assault crossing doctrine and the AVLB have limited capabilities. Although the project to replace their version of the AVLB was cancelled the US still have an AVLB to support their heavy armored forces. However the Leopard system is not compatible with the Abram system therefore the advantages gained with common equipment in an American lead coalition is not realized. As well, the Leopard bridge has an MLC of 60 with a limited ability to take MLC 70 vehicles such as the M1 Abrams. The American Stryker Brigade vehicles with an MLC of 30 can easily cross the Leopard AVLB.

Finally, support under the third pillar to an expeditionary LAV based force is limited as well. Although the Leopard chassis provides great tactical cross-country mobility, it is not strategically or operationally mobile. The size, weight and shape of the bridging system preclude it from being air portable and it takes up significant space on sea transport. Once in theatre, mobility is further limited by route restrictions due to its weight and dimensions. The AVLB will have restricted ability to follow a LAV based fleet as it maneuvers using roads. With the Army phasing out the tanks, deploying AVLBs in theater would result in a disproportionate logistical support requirement to keep these vehicles operational. The AVLB does meet the requirement for a rapidly deployable bridging system that offers significant protection. However with the implementation of EBO, the concept of assault bridging in the face of enemy fire is less likely. As well, the system is limited to gaps of 20 meters or less. Although statistically this defeats approximately 80% of the gaps, the AVLB lacks the flexibility to expand or contract, making it somewhat inefficient.

Support

Support crossings are used to establish semi-permanent or permanent crossings for planned movements and road networks with expected high use by both wheeled and tracked traffic. Both the MGB and MFB/MR are used by the CF to conduct support crossings. The MGB was developed in 1969 and introduced to the CF in the late 70's.[46] It is designed to be light, easily transportable on a pallet system and quickly constructed by hand with minimal mechanical support. A standard CF MGB set is 45.7 meters long, 4 meters wide and includes the mechanically assisted MACH set, [47] link reinforced sets, and a reduced slope ramp.[48] An MGB is manpower intensive, normally requiring an engineer troop to construct, however the MACH system allows for the same build time with only a section supported by a crane. The MFB/MR was introduced into the CF in the early 80's. It consists of floating pontoons that are launched from an HLVW PLS into the water where they are configured by a bridging boat to create ferries or bridges. [49] A Canadian MFB set allows for the assembly of two rafts or an MLC 60 floating bridge 85 meters in length. The bridge can be longer by adding more pontoons from other sets.

---

[46] Department of National Defence, *Engineer Field Manual: Gap Crossing,* 69.

[47] The MACH system allows the MGB to be constructed with fewer personnel without increasing the construction time by using a crane. Link reinforcement increases a 45.7m MGB MLC to 60. Reduced slope ramp allows civilian or lower clearance support vehicles to use the MGB. National Defence Engineer Field Manual, Gap Crossing, B-GL-361-010/FP-001, 71.

[48] *Ibid*, 70.

[49] PLS – Pallet Loading System, on the HLVW chassis, that allows the truck to pick up and drop pallets the size of sea containers from the ground.

Equipment and manpower required to set up a MFB depends on the bank conditions, the size of the gap and the water speed.[50]

Considering the bridging requirements for the three pillars, support bridging doctrine and equipment are relevant to Army Transformation. The concept of a semi-permanent or permanent support to road networks directly addresses the mobility support requirements within Canada. From an equipment perspective, the MGB is adequate for most gaps while the MFB is excellent for larger bodies of water. Both systems are pallet loaded and easily transported on Canada's primary and secondary road networks. The MGB is easily and rapidly constructed, however it is limited by design to gaps of approximately 45 meters. Although the reduced slope ramp and decking permit civilian vehicles to use the bridge, the small curb along the outside of the bridge provides little resistance to a vehicle driving off the side. As a result traffic on the bridge must be slow and positively controlled. A walkway can be constructed on the side of the bridge to provide limited pedestrian traffic. The MFB is excellent for large bodies of water. It is easily and rapidly constructed, providing a safe and relatively quick roadway over water. The bridge is not limited by the size of the gap, only the number of bridge parts available. If there are insufficient parts to bridge the gap, the MFB can be used as a ferry in the MR configuration.

Canadian support bridging doctrine and equipment are presently interoperable with American concepts and equipment until future bridging developments within the US to support the Stryker Brigade concept are implemented. Presently the US uses palletized MGB in a tactical support role, which is effectively assault bridging using EBO to minimize direct enemy fire on a bridging site. The Canadian MGB system is interoperable with the American system at the moment. However when the REBS and DSB bridging systems come into service, the US

[50] Department of National Defence, *Engineer Field Manual: Gap Crossing,* 78.

Army will phase out the MGB. Therefore interoperability for support bridging will be drastically reduced if Canada retains the MGB system. Since the US continues to use the MFB system, upgrading to the improved version, the Canadian MFB remains compatible.

Support bridging doctrine and equipment address the capabilities necessary to support the third pillar. Both the MGB and MFB are transported on a pallet system that can be shipped or flown into theatre and, once there, easily moved with minimal route restrictions. From a tactical perspective, a palletized MGB system on HLVWs has little difficulty supporting a LAV based maneuver force. ISTAR provides advanced notice of the likely gap sizes and EBO minimizes the risk of direct fire in order for the appropriate sized MGB to be available and constructed at the right time and place. The draw back to the MGB in a tactical supporting role is the manpower and time required to complete a bridge compared to an AVLB. From an operational and strategic perspective, both the MGB and MFB can provide bridging for civilian use, although, as discussed in support to domestic operations, there are limitations associated with MGB.

LOC

LOC crossings differ very little from support bridging in Canadian doctrine. Normally LOC bridging is more permanent than support bridging and is built in areas that are free from direct enemy action. A LOC bridge tends to have a larger load class requirement, a longer gap to cross and potentially a longer life than a support bridge. Doctrinally combat engineers retain a limited ability to construct LOC bridges and will require refresher training and rehearsals to

successfully construct a bridge.[51] The 700 Series ACROW bridge, an improved version of the Bailey Bridge, was introduced to the CF around 1990. It is designed for construction with heavy equipment to assist the construction crew, however it can be built by hand. A standard CF ACROW set allows for the construction of a through type bridge with an MLC 60, a span of 48 meters and a width of 4.24 meters.[52]

Of the three doctrinal crossings and associated bridge equipment, LOC bridging receives the least attention doctrinally although it provides noteworthy support to the Army's requirements. It is an excellent resource to address Aide to the Civil Power tasks. Panel bridging is designed for safe use by civilian vehicles and can accommodate large traffic flows. It is easy to palletize and rapidly transport to site utilizing the national road network. Once on site a 40 meter bridge can be constructed within 12 hrs with the assistance of two cranes.[53] Although more difficult and time consuming to construct than an MGB, a panel bridge can cross a larger gap and provides a much greater volume of safe traffic flow. Unfortunately present doctrine does not provide an inherent panel bridging capability that would be responsive to a domestic emergency.

Attempting interoperability with the US Army for LOC bridging is problematic. At the moment the Americans are still using Bailey Bridges in reserve bridging companies while Canada has procured the more advanced ACROW bridge system.

LOC panel bridging is a valuable operational and strategic enabler for support to the third pillar, international stability operations. It is palletized making it easy for strategic shipment

---

[51] *Ibid*, 6.

[52] *Ibid*, 90.

[53] Mabey & Johnson Ltd, *The Mabey Logistic Support Bridge*, promotional documentation, available from http://www.mabey.co.uk; accessed 24 April 2005.

overseas and operational movement once in theatre. The LOC panel bridging system is not designed to support tactical mobility – the construction time is significantly longer than the AVLB and the MGB. However compared to the time required to reconstruct or repair a steel truss or reinforced concrete bridge, the panel bridging system provides an immediate and effective solution to logistic mobility requirements. The bridging system is extremely flexible, capable of spanning single gaps up to 60 meters providing a 100(+) MLC crossing.[54] Given the asymmetric threat to key infrastructure, the ability to replace or repair a LOC bridge becomes an operational risk consideration. The panel bridging system mitigates this risk. As well the construction of a panel bridge for civilian use is an excellent method of controlling the movement of civilians for security and logistic requirements. From a strategic perspective, the replacement of a damaged bridge critical to the infrastructure of the local population is a recognized diplomatic and CIMIC action.[55] As discussed in support to domestic operations, the panel bridge is designed for use by civilian traffic. It provides a highly visible Canadian contribution to the betterment of the lives of the local population. The LOC panel bridging system is an excellent enabler to international stability operations.

RECOMMENDATIONS

Based on the proceeding critical analysis, the following recommendations are proposed to ensure Canada's bridging capabilities support the Army's mission. Doctrinally, the concept of assault crossing should no longer be considered an activity conducted by Canadian forces as the Leopard chassis is no longer a viable deployment option. In lieu, the US concept of tactical

[54] *Ibid.*

support bridging should be adopted. In support of this doctrine, the Canadian Army should investigate the acquisition of the US REBS in support of a LAV based expeditionary force. This system provides a replacement for the AVLB for intimate support to the fighting echelon and promotes interoperability with the Americans. In the interim, the MGB can provide both a tactical and more general bridging support capability. The doctrine for support bridging is sound and the existing MGB and MFB systems are adequate, but dated. Both these systems have been in use for over 20 years. As a second priority to the acquisition of a tactical support bridging system, replacements for the MGB and MFB should be investigated. The concept for the American DSB system provides a viable alternative to the MGB system and the newer versions of the MFB would be a relatively easy procurement. Finally the importance of LOC bridging should be reflected in present doctrine. Panel bridging should become a core capability of the engineers as opposed to a "limited" capability. The existing ACROW bridging system meets the requirements for the Army's present and future LOC bridging requirements.

CONCLUSION

The critical analysis of the Canada's bridging capabilities clearly illustrates the changes required in both doctrine and equipment to support the Army in its mission. Although the present Cold War doctrine and equipment provide some support, both are found wanting with respect to the tasks required based on the three pillars: security and protection of Canada; interoperability with the United States; and international security. The proposed recommendations will synchronize the doctrine and bridging systems with the new Army

---

[55] Department of National Defence, B-GG-05-004/AF-023 *Civil-Military cooperation in Peace, Emergencies, Crisis and War* (Ottawa: DND Canada, 1999), 5-6.

doctrine and force structure, providing key tactical, operational and strategic enablers to mitigate risks and promote government policies. As a result, the transforming Canadian bridging capabilities will become the solution to the dilemma of the man at the rivers edge, supporting the Canadian Army aim of being strategically relevant and tactically decisive.

BIBLIOGRAPHY

Aadlanders, MGen Anders B. and James L. Allen. "Engineer White Paper – Into the Objective Force," *Engineer – The Professional Bulletin of Army Engineers* vol 32 (April 2002): 4-10.

Bianchi, Fulvio. "Assault Bridges and Bridgelayers." *Military Technology - MILTECH* (3-4/2004): 76-84.

Bianchi, Fulvio. "Engineer Equipment for Expeditionary Operations (II) – Combat Engineer 2004," *Military Technology - MILTECH* (12/2004): 17-45.

Brooks, Captain Kevin A. "Bridging Shortfall: Lines of Communication Bridging," *US Army Engineer School Publications Production Division,* March 1999.

Canada. Department of National Defence. *1994 Defence White Paper*. Ottawa: Canada Communications Group, 1994. available from http://www.forces.gc.ca/admpol/eng/doc/5117_e.htm; Internet: accessed 28 March 2005.

Canada. Department of National Defence. *Advancing with Purpose: The Army's Strategy.* Ottawa: DND Canada, 1998.

Canada. Department of National Defence. *Force Employment Concept for the Army.*. Ottawa: DND Canada, 2004.

Canada. Department of National Defence. B-GG-005-004/AF-000 *Canadian Forces Operations.* Ottawa: DND Canada, 2000.

Canada. Department of National Defence. B-GG-05-004/AF-023 *Civil-Military cooperation in Peace, Emergencies, Crisis and War.* Ottawa: DND Canada, 1999.

Canada. Department of National Defence. B-GL-361-010/FP-001 *Engineer Field Manual: Gap Crossing*. Ottawa: DND Canada, 2004.

Canada. Department of National Defence Directorate of Land Strategic Concepts. *Future Army Capabilities*. Kingston: DND Canada, 2001.

Canada. Department of National Defence. *The Force Employment Concept for the Army.* Ottawa: DND Canada, 2004.

Canada. Privy Council Office. *Securing an Open Society: Canada's National Security Policy*. Ottawa: Canada Communications Group, 2004.

Gourley, Scott. "The US Marine Corps in Iraq: Close Combat." *Janes Defence Weekly* vol 41, no 4 (28 January 2004): 27-30.

Holmes, Lieutenant-Colonel K. J. *The History of the Canadian Military Engineers Volume III to 1971.* ed. J. R. Newell. Toronto: Thorn Press Limited, 1997.

Horn, Lieutenant-Colonel Bernd and Regan G. Reshke. "Defying Definition: The Future Battle Space," in *Towards the Brave New World: Canada's Army in the 21st Century*, ed. Lieutenant-Colonel Bernd Horn and Peter Gizewski, 87-122. Ottawa: DND Canada, 2003.

Kerry, Colonel A. and Major W. A. McDill. *The History of the Corps of Royal Engineers Volume I 1749 – 1939.* Toronto: Thorn Press, 1962.

Jackson, LCol Ed. "A Multifunctional Engineer Battalion." *Engineer - The Professional Bulletin of Army Engineers* vol 34 (January – March 2004): 42-45.

Mabey & Johnson Ltd. *The Mabey Logistic Support Bridge*, promotional documentation. available from http://www.mabey.co.uk; Internet accessed 24 April 2005.

Treleaven, Maj David L. "Engineers in Bosnia: An Overview." *US Army Engineer School Publications Production Division.* March 1996.