



MILITARY BRIDGING

MR Joshi

**Defence Research & Development Organisation
Ministry of Defence, New Delhi, India**

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PREFACE

Mankind has seen wars from the times immemorial. The twentieth century saw some of the worst faces of war when millions of innocent civilians were killed. In recent years, fourth dimension have been added to the war – War in Space. Many wars are waged to save the human life; yet century after century, the wars have become more and more fierce. Even in the twenty first century, armed conflicts are going on in some parts of the world. When we read about the nuclear doctrines, theater nuclear weapons, national missile defence etc., an impression gets created that the age-old weapons have lost their place.

In the pre-historic times, obstacles were being negotiated by using bridges. Ramayana and other Biblical stories clearly indicate use of crossing methods for negotiating obstacles. The history of military bridges can be traced back to those times. Coming straightaway to the twentieth century World Wars, the emergence of the battle tank on the field brought the need for innovative bridging solutions. The famous Bailey bridge is the popular name for any military bridge as far as the common man is concerned. The Bailey bridge had a major impact on the mobility of the battle tanks and progress of the war during the 1940's. Without the Bailey, the successes in Europe and Italian and African fronts by the allied forces would not have been possible.

The Indian armed forces, and particularly the Indian Army carried on the British legacy and thus inherited a large inventory of the Bailey bridge. Even the 1971 Bangladesh war was fought with such equipment. It was only after this war that the bridging equipment from different sources started flowing in. The first to arrive was the Soviet equipment developed

by Russians during the Cold War days. The family of the bridging equipment was very much different from the second World War equipments. In fact it reflected the East Europe's experience in the European theater, primarily for river-crossing. The Indian Army also found such equipment very effective for assault crossing of canals in the western theater. The equipment found its use; but was used for purposes other than what was written in the handbooks. Thus, the handbooks started being 'rewritten' by the field commanders without getting them issued by the higher authorities. After all, what gets proven during the exercises is accepted for working out the tactics. After the induction of a variety of combat engineer equipment from the Soviets, the doors were opened to other equipments coming from Germany and the United Kingdom. Although the manuals and handbooks were well prepared, these were primarily for international market. Therefore, these were not comprehensive to cover the contemplated obstacle pattern on the dynamic Indo-Pak border and the equipment planning and deployment.

Soon after the partition, the obstacle pattern on both sides of the Indo-Pak border got totally changed. Several hundred kilometer of unnatural manmade obstacles were added to the existing network of irrigation canals. There were canals of different widths and slopes of the banks. There were high bank canals, which offer a formidable obstacle – almost non-negotiable. In addition to long and medium spans, there are short spans, which pose certain problems for negotiation of standard equipment. The Army therefore, has to continuously improvise and innovate using the existing equipment. Although the field applications go much beyond the equipment handbooks, no authentic manual has been written on the subject. The second World War saw the publication of the first edition of Military Engineering brought out during the progress of the war itself. Soon after the conclusion of the war, an urgent need was felt to rewrite this publication taking into account the rich experience of the War. Thus, came the Military Engineering, Vol III in 1957 by the War Office, London. The Indian Army brought out a reprint of this publication in 1968, which made some changes in the military bridge classification system without even mentioning the changes. As a result, a dual classification number for the equipment came into existence, creating a

good amount of confusion. Even though NATO has addressed such problems through the standard agreements, the situation on the Indian side has not changed. Therefore, a need was felt to add chapters on the military bridge classification systems and the design methodology to be followed for the equipment bridges. Over the years, considerable changes have occurred in the field of new age materials. The reader will find useful references to the weldable and self-ageing aluminium alloys and composites.

There is a good number of military publications from the reputed publishers like the Janes. Periodically, special issues/compendium are brought out on specialised subjects. These includes the latest developments in the field of equipments related to combat engineering. However, these at best can be considered as catalogues. Sometimes, these also serve as an advertisement for the multi-nationals, who are always looking for foreign military sales. The purpose behind writing this Monograph is altogether different and is generally in line with the DRDO policy of bringing out publications to a wide spectrum of readership at reasonable cost.

The author, having worked in all the aspects of the life cycle of a typical military bridge for over 35 years, thought that there was a void in the field of published material related to combat engineer equipment, and hence this Monograph. The author does not claim that it covers the subject comprehensively, but, it is a modest attempt to make a beginning.

On the background explained above, the Monograph can be considered as a quick guide and reference material for engineers from different disciplines. For Military Engineers, it can serve as an additional reference material to the 'Military Engineering, Vol III'. For the users and for the construction industry and highways, it will provide vital design requirements and details. The chapters on design and military bridge classification system can fill up the gaps between the obsolete tables that are referred today. For material technologists, it can provide unique opportunities for design in aluminium alloys and composites. For the institutes and organisations including NGOs and the private/

public sector engineering industry, it can provide vital clues as to how military obstacle crossing is similar to any disaster management exercise. After all, without earthquakes, we hear so frequently the collapse of civil bridges and flyovers as also accidental failure of multi-storeyed buildings in the urban areas. Floods, cyclones, and tsunami are commonly experienced as annual events. The Army is called upon to provide help with the equipment that they can harness. If proper disaster mitigation machinery was in place, it could have acquired and stocked specially designed equipments to provide quick solutions to the problem. This can have a major impact on the minimisation of loss of life and property. In fact, the Indian Railways have emergency bridges named as ‘relieving girders’, which are authorised to be held by each division. All concerned with the above activities may find this Monograph quite useful.

With all that I have covered in this Preface and the subsequent chapters, there may be quite a few deficiencies and errors. After all, this is the first ever attempt and there was hardly any publication to fall back upon. The author will be grateful for the readers’ suggestions and even criticism; because that’s how the life is! Right from our childhood, we fall, learn and improve! At the age of seventy, I can still learn. After all, learning is a continuous process.

I would like to end this Preface with a quote from the famous military engineer – Leonardo da Vinci, who recorded the following in one of his notebooks:

While I thought that I was learning to live

In fact, I was learning to die!

Delhi
31 January 2008

Madhukar R Joshi

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The author would like to place on record the help and assistance provided by quite a few individuals and organisations. Without such a support, it would not have been possible even to make a start to write this Monograph. Firstly, I would like to place on record my sincere gratitude to Mr Ved Prakash Sandlas, the former Chief Controller, DRDO, who against all odds, insisted that I should take on this task. The manner in which he put the proposal for approval proved to be the primary motivating factor for me to accept the assignment. The Directors, DESIDOC, especially Dr Mohinder Singh and later, Dr AL Moorthy gave me spontaneous support with any amount of reference material that was asked for. For the content, the knowledge I acquired over a long period of time from different sources from India and abroad was crucial. The insights in military bridging obtained from the Military Vehicle and Engineering Establishment (MVEE), Christchurch, UK have proved to be quite handy throughout my career. Needless to say that this trickled down in different form in my Monograph.

While I spent several months in the field areas, ranging from the North-East to Northern and Western borders, I had an excellent opportunity to work hand-in-hand with the engineer regiments and the troops. The innovative way in which Brig Sundaram carried out his training programmes and exercises, had a lasting impression upon me as to the exploitation of the equipment. The Engineer-in-Chiefs, right from Lt Gen VN Kapoor to Lt Gen Sinha as well as senior

general officers including Lt Gen Taneja, Lt Gen YV Pandit, and Lt Gen Ashok Joshi were military thinkers and a close association with them helped me to understand the operational situations and tactics.

The Directors of R&DE(Engs), right from late Brig AC Aga to my successor late Mr YP Pathak, gave me excellent support. Especially, Lt Gen TC Joseph and Lt Gen RVN Kadambi groomed me in my young days, which helped me to get deeply involved in the total life cycle of a military bridge. The present Director, Mr B Rajagopalan and his excellent team has always been interacting with me and helping me to keep update with latest developments in the field. I am indebted to all these knowledgable persons without whose guidance this Monograph could not have come out. I am also extremely grateful and acknowledge the help rendered by the US Department of Defense – Army RDECOM for giving copyright clearance for Trilateral Design and Test Code for Military Bridging and Gap Crossing Equipment document.

And finally, it is my duty to acknowledge the contributions of Mr A Saravanan and Ms Kavita and their dedicated team for extending valuable support in preparing the manuscript, compilation of graphs and tables and making valuable suggestions so as to make this publication as flawless as possible.

CHAPTER 1

HISTORICAL BACKGROUND

1.1 INTRODUCTION

From the time immemorial, the man has been engaged in conflicts of different nature. With the advent of civilisation, this tendency never died down; on the contrary for the sake of greed, acquiring scarce resources or for satisfaction of one's ego, these conflicts have grown in size, intensity, and fierceness. With new materials becoming available to the man, there has been every attempt to convert these discoveries into strength that can prove to be the single most winning factor in any battle. The need for solid defence against these weapons was the natural corollary to the destructive power of these weapons. Equally important was the defence preparedness to protect oneself from the military might of the enemy. The rivers and other geographical features became natural boundaries for the ancient rulers since these were not easily negotiable.

The great Indian epic *Ramayana* gives a vivid account of bridging the gap between Rameshwaram and Sri Lanka across the Indian Ocean. The crucial bridge built manually across the ocean by the *Vanarsena* (Simian army) was not only instrumental but also essential for *Sri Ram* to defeat *Ravana* and liberate *Sita*. Researchers of the 20th century studied the ocean bed characteristics through aerial survey at the place where the crossing was achieved and found that though the water depth was shallow, yet not negotiable. The site was therefore converted into a ford with relatively little effort. The *sena* could then cross over to Sri Lanka comfortably.

In Biblical stories, there have been references to crossing of rivers in Central Asia, such as Euphrates. Later, Alexander the Great is known to have moved his troops across Euphrates. Mesopotamia is known to be the

cradle of civilisation; and in Greek, the word Mesopotamia means the land between two rivers, i.e., Tigris and Euphrates. For thousands of years it has been a setting for strife on a grand scale as powerful regimes toppled and replaced each other. One such world-shaking event took place near the northern Iraqi city of Arbil on October 1, 331 BC. It was a conflict of a global proportion, pitting West against East, Europe against Asia. Persia was the most powerful empire in the world at that time, and Babylon, its capital, was the world's richest city. The empire stretched from the Mediterranean Sea, including Egypt, encompassing most of what we today call the Middle East. The Persian emperor Darius III massed his huge army against the invading Macedonians of Alexander the Great. After crossing the Tigris river, Alexander the Great sent a letter to Darius saying, "*If you dispute the kingship of Asia with me, stand and fight*". Although Alexander was greatly outnumbered, the tactics and fighting spirit of the Macedonians prevailed. The Persian army was routed, and Darius had to flee in disgrace. Meanwhile, Alexander crowned himself as the king of Asia. He was only 25 year old then, and in the following years, he extended his conquests to the Hindu Kush mountains of Afghanistan and the Indus Valley of northern India. The ancient land between the rivers, however, was conquered and reconquered many times in the centuries that lay ahead. The crossing of Tigris and Euphrates came into focus even in the 21st century, when the coalition forces had readied their improved Ribbon bridge for the crossing operations to march towards Baghdad.

This chapter intends to introduce the reader the basic concept of military operations related to combat warfare, obstacles, and the need to have a quick solution for crossing such obstacles.

1.2 BRIDGES – THE BEAUTIFUL MONUMENTS

The bridges built as early as 2000 years ago are still existing in the world. The author himself has visited a 13th century bridge, Ponte Vecchio in Florence, Italy. This bridge even today is surrounded by a market place and is in regular use. These bridges were basically civilian structures. Apart from strength and the other essential requirements, one striking feature of the ancient bridges was the aesthetics and architectural beautification that was an integral part of the bridge design. Later, as the renaissance was

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About the Authors

Shri. Madhukar R. Joshi obtained his initial education from Gogate College, Ratnagiri and the Civil Engineering degree from the College of Engineering, Pune. After working in the Military Engineer Services during the 1962 operations, he joined DRDO in 1963. After a rich experience of 36 years in the organization, he retired from service in July 1999.

During his tenure in DRDO, he worked extensively on the new materials, relevant technologies for military bridges and field testing and evaluation. In the process, he traveled extensively from the Rann of Kutch to Siachen. His work in the field of applications of weldable aluminium alloys and advanced composites is particularly notable. He also contributed to the development of ground systems for the missile programme and for the design and construction of the first all-weather Antarctic habitat named Maitri.

Shri. Joshi was also trained extensively Abroad and at the National Defence College. He has been honoured with various awards, prominent amongst them are the Scientist of the Year and FIE awards.

About the Book

The Monograph on Military Bridging bridges the gap that has somehow crept in over the years between the acquisition of different types of Combat Engineer Equipment and availability of comprehensive reference material that can establish a relationship between these equipments. The large inventory, though always felt as too inadequate by the user, has to be seen in the larger sense of developing tactics and doctrines around them. Also most important factor is the dynamic battlefield that can pose different problems at different times. Therefore, one has to have an innovative solution to select the equipment in a non-traditional manner. The way the technological developments are rapidly taking place, new solutions must emerge at shorter intervals. Thus the User 'Pull' and Technology 'Push' should produce dramatic results.

This Monograph is not a panacea for all these problems. It only attempts to put the things together so as to enable a knowledgeable user to find a common thread from the age old battles to the future. Of particular importance will be the material technologies, design codes and integrated logistics support. In the process, if the reader gets some useful guidance and information from this book, the purpose will be well served.

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