LAND FORCE MILITARY

ENGINEER DOCTRINE

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATIONS BY NATIONS

NATION	RESERVATIONS

RECORD OF CHANGES

Change Date	Date Entered	Effective Date	By Whom Entered

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CHAPTER 4 GENERAL ENGINEER SUPPORT

INTRODUCTION

GENERAL

1. Fundamental changes to the global strategic and security environment have taken place in recent years. However, the traditional roles of engineer forces remain enduring and consist of: Mobility, Counter Mobility, Survivability and General Engineer Support. This engineer support may be provided across the full spectrum of operations at all scales of effort, enabling the Joint Force to live, to move and to fight. In the context of the Continuum of Operations, there will be a continuing emphasis on expeditionary deployments, requiring the ability to operate in conditions of limited or non-existent local resources and Host Nation Support (HNS). For these reasons, the importance of effective engineer support to the tactical commander take on an even greater significance both for now and for the future.

2. A transformed NATO must therefore be sufficiently responsive and flexible to conduct expeditionary style operations around the world when required. In order to achieve this, engineer staffs in particular must be fully involved in the planning process, including reconnaissance, from the initial stages in order to ensure that the most appropriate engineer force is deployed to give the Joint Force Commander those capabilities he needs.

AIM

3. The aim of this publication is to set out the role, principles of employment and command and control of engineers in NATO armies, reflecting the changed operational environment and evolving NATO doctrine, particularly AJP 3.12, Joint Engineering. ATP-52(B) is intended for engineer and tactical commanders as well as general staff officers and unit commanders of other branches. An understanding of this publication will enable them to realise the wide range of engineer capabilities available and thereby ensure the optimum use of engineer manpower and resources, which are typically scarce.

SCOPE

4. ATP-52(B) sets out the wide range of tasks that are to be carried out by engineers at the tactical level including command and control responsibilities across the operational spectrum. Although intended to be a single service publication, the reality is that land based engineers have a key role in support of the Maritime and Air components. Whilst remaining focused on the Land component, this document also considers the way in which engineers provide support to a Joint, Inter-agency and Multinational Force in accordance with the key principles established in AJP-3.12.

5. The term engineer and engineering have a variety of meanings. This document is concerned with military engineering which refers to those activities which shape the physical environment for the benefit of any Joint Force component. Definitions are addressed in more detail in chapter 1.

RELATED PUBLICATIONS

6. The engineer support provided to the commander demands a thorough understanding of the land force doctrine contained in AJP-3.2, as well as the concepts of combined joint warfare, contained in AJP-1. Furthermore, AJP-3.12 has already been mentioned and this represents a significant doctrinal development, not least because of the creation of the Joint Force Engineer (JFEngr) who advises the Joint Force Commander on the optimal use and employment of all engineer assets across the Joint Force where applicable. This is a keystone principle upon which this document rests.

7. For an explanation of terms and definitions see AAP-6, NATO Glossary of Terms and Definitions, and AAP-19, NATO Combat Engineer Glossary.

8. A list of current engineer STANAGs is at Annex A to this publication.

CHAPTER 1

ENGINEER FUNDAMENTALS AND ROLES

SECTION I - THE OPERATING ENVIRONMENT

101. INTRODUCTION

1. Whilst it is difficult to predict the nature of future operations, it is clear that NATO Response Forces (NRF) must be capable of acting on an expeditionary, Joint, Interagency and Multinational basis. The technical supremacy that coalition forces have demonstrated in recent operations indicates that very few armed forces could succeed in fighting conventionally against such a capability. The trend will therefore be for the majority of opponents to engage in asymmetric warfare at the earliest opportunity, exploiting a wide range of capabilities from Improvised Explosive Devices (IEDs) to modern anti-armour weapons and mortars. This will involve attempts to inflict indiscriminate casualties, draw our forces into complex terrain, attack throughout our depth and utilise every available means to undermine our will and morale. It is very likely that commanders will need to be able to effectively undertake a conventional warfighting phase, at the same time as being required to deal with stabilisation and peace support challenges. To do this, the engineer capability available to the force must be able to meet a broad spectrum of diverse challenges simultaneously by providing a wide range of combat and technical capabilities, in terms of both skills and equipment. For NATO operations, there may be increasing scope for sharing key engineer capabilities between nations and hence interoperability remains increasingly significant.

102. THE CHANGED ENVIRONMENT

1. The emergence of a potent and effective asymmetric threat has fundamentally changed the operating environment. As witnessed in a number of recent expeditionary deployments, war fighting, peace keeping and humanitarian activities may all take place simultaneously within a small and constrained geographical area. This has spawned the term '3 Block War'[1] which accurately and succinctly sums up the contemporary operating environment. In such a cross-spectrum operational environment, NATO forces are likely to face an omni-directional threat which could emerge quickly with little or no warning. This is likely to demand changes in doctrine, training and equipment for the future in order to effectively counter this evolving threat.

2. The increasing trend to operate in close proximity to centres of population requires specialist engineer capabilities to be developed or be modified to effectively undertake the likely range of tasks on offer. Task vehicles with enhanced protection

[1] This term was coined by MG Krulak USMC.

may well be necessary to survive in such an environment. Engineers also need to develop more effective Force Protection Engineering techniques and procedures in order to better protect the Force from a wide range of threats including suicide bombers. This is addressed in Chapter 4.

103. IMPLICATIONS FOR ENGINEERS

1. As Alliance operations become more expeditionary in nature, the requirement for effective levels of engineer support across the entire Joint Force are increasing. It remains essential for engineer staffs to be involved in all stages of the operational planning process from the earliest time. In this way, the optimum engineer force package can be determined and prepared in a timely fashion. As Engineer tasks are invariably demanding in terms of manpower, resources and time, the early identification of engineer support requirements will assist in identifying potential key planning constraints at all levels from the military strategic to the tactical. Timely engineer reconnaissance will be key in this regard. Additionally, engineers should be consulted in the targeting process to ensure that the battle-space is shaped and prepared to conform to the commander's intent. Engineer advice must be available to the all-arms/branches/joint commander at the appropriate level and must include an ability to influence the subsequent planning and execution of engineer support in order to provide the desired effect. The implications for engineers in an increasingly expeditionary era are therefore considerable.

2. Highly flexible and agile force elements are required to conduct this unpredictable '3 Block War' type of operation. Agility is key in terms of mission, doctrine, structure, posture and organisation. By their very nature, engineers are inherently well suited to such a form of employment and are often used to operating in small task organised groups for short periods of time, re-grouping as necessary. Both during and post conflict, there will be key tasks to be undertaken by engineers such as the inevitable requirement for the provision of essential services including water and power to meet both military and civilian requirements. Though initially provided by military personnel, the intent would always be to make best use of the indigenous workforce if it exists, as soon as possible, perhaps maintaining a military engineer in the project management role. In this way a positive contribution could be made at the same time to the Civil Military Co-operation (CIMIC) and Information Operations (IO) efforts. Increased use will also be made of contractors once it is safe to do so, thus freeing up engineer capability to undertake more demanding tasks elsewhere in accordance with the commanders intent.

SECTION II - THE CONTINUUM OF OPERATIONS

104. The Continuum of Operations provides a framework for understanding the complexity of the operational environment. It has four major elements: the ***spectrum of conflict, predominant campaign themes***, ***types of tactical operations*** and ***land tactical activities***. These will be briefly considered in turn.

105. SPECTRUM OF CONFLICT

1. The spectrum of conflict reflects the environment in which operations take place. The principal discriminator is the level of violence, which ranges from absolute war to absolute peace: neither exists in pure form – levels of conflict range between these theoretical states.

2. No conflict will be at just one point of this spectrum; it will vary in time and place. At any one time there may be a humanitarian crisis in one place, an insurgency in another, and intense fighting between forces nearby. At any one place, there may be house-to-house fighting one day, collection of forensic evidence the next day, and restoration of electricity and water supplies the day after. It is important to recognise that operations are likely to take place across this spectrum.

106. PREDOMINANT CAMPAIGN THEMES

1. As states of peace, tension, conflict and combat may either be local and transient, or widespread and prolonged; the character of any particular campaign may be difficult to define precisely and is likely to change over time.

2. Campaign themes within the Continuum of Operations can be broadly divided into the following categories: major combat operations, counter-insurgency (COIN), peace support operations (PSO), limited intervention operations, and peacetime military engagement. There are overlaps: for example, activities usually associated with major combat operations might be necessary within a PSO, on a limited scale. Descriptions of campaign themes are broad and tend to overlap. It is possible to discriminate between them by characterising the following factors:

a. **Political Risk**. The level of acceptable risk, including risk of casualties, is a measure of the political importance of the campaign, proportional to the threat to the nation or national interests.

b. **Effect Sought**. The strategic effect sought will often determine the character of a campaign: defeat of a hostile state will demand a different approach from separation of warring factions.

c. **Character of Combat**. Combat can be characterised by ***prevalence***, ***scale***, and ***intensity***. Prevalence is a measure of its frequency. Scale describes the level of combat, which can be measured by the level at which forces integrate their activities in combat. For example, in major combat operations, battles may be fought at unit and formation level; in COIN they will be more usual at platoon and company level. Intensity describes the degree of concentration of combat, measurable by the rate of consumption of resources.

d. **Types of Enemy**. The nature and number of enemies, or potential enemies, will have a major influence on the character of the conflict,

ranging from sophisticated networked forces to lightly armed individuals. It is important to appreciate that enemies are adaptive: for example once a regular army has been defeated, it may mutate into an irregular force and change the character of the conflict. Alternatively a successful insurgent group may evolve into a regular army.

107. TYPES OF TACTICAL OPERATIONS

1. Armed forces undertake a wide range of activities within a campaign. Although some may be consecutive, such as attack followed by defence, many occur simultaneously. For example, a force may be attacking in one area while defending in another, and conducting counter-terrorism in a third. Even when activities are sequential, it is important to plan them simultaneously; otherwise early activity may compromise subsequent operations, such as destruction of bridges required later in an operation, or offensive actions that might radicalise a civil population whose support is required for eventual stability.

2. The broad range of tactical activities is divided into three types: ***offensive***, ***defensive***, and ***stabilising*** operations. Together with **enabling** activities they encompass the totality of operational activity undertaken by military force within a campaign. Generally, all three types of operation are conducted simultaneously, regardless of the campaign theme. For example, in a PSO comprising mainly stabilising activities, there may be a requirement to attack a non-compliant element, or conduct a demonstration during the arrest of a war criminal. The balance between types of operation gives a campaign its predominant character – a major combat operation may consist primarily of offensive or defensive operations, while COIN may have a complex mix of all three types. Enabling activities are never conducted in isolation: their purpose is to enable other operations.

3. The combination of simultaneous offensive, defensive, and stabilising operations that gives a campaign its predominant theme can be illustrated by the Continuum of Operations Model, which also demonstrates how the combination can change and the campaign evolve over time. An example of how the Continuum Model can be used to represent such evolution of a campaign is at Figure 1. This is not meant to imply that all campaigns will go through similar evolution – each campaign is unique.

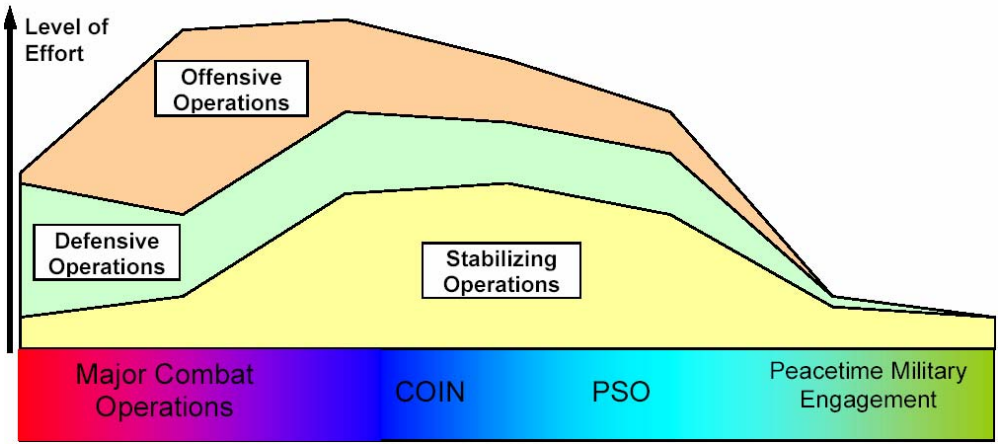


Figure 1 – The Continuum of Operations Model: an illustrative example

108. LAND TACTICAL ACTIVITIES

1. Types of Land tactical activities are shown in the chart below and are discussed from an engineer perspective in chapters 5-8.

Offensive Operations	Defensive Operations	Stabilizing Operations
Attack Raid Exploitation Pursuit Feint Demonstration Reconnaissance in Force Ambush Breakout	Defence Delay	Peacekeeping Peace Enforcement Conflict Prevention Peace Making Humanitarian Assistance Irregular Warfare Post-Conflict Reconstruction Peace Building Non-Combatant Evacuation
Enabling Activities		
Reconnaissance Security Advance to Contact Meeting Engagement	Link-Up Relief of Encircled Force Relief of Troops in Combat Withdrawal	Retirement March Obstacle Breaching/Crossing

Figure 2 – Types of Land Tactical Activities

SECTION III - KEY TERMS AND DEFINITIONS

109. KEY ENGINEER TERMS

1. Engineer functions can be divided into Force Support Engineering and Combat Support Engineering[2]. The balance of effort between the two varies with the type and phase of operation and also at the different levels of operation, Strategic, Operational and Tactical. Engineer forces invariably have utility in both functions. Co-ordinating the

[2] See footnote 1.

available assets in support of the main effort will be a key role for the Joint Force Engineer (JFEngr) supported by engineer commanders at other levels.

2. The following terms will be used in accordance with AAP-6 and AJP-3.12:

a. Joint Force Engineer (JFEngr). The JFEngr is the principal engineer advisor to the Joint Force Commander (JFC) on all military engineer issues. Although he will not act as a commander, he will, on behalf of the JFC, have co-ordinating and technical authority over the employment of engineer assets throughout the Joint Force, in order to ensure capabilities and resources are used most effectively.

b. Combat Support Engineering. Combat Support Engineering encompasses those military engineer tasks associated with direct support to current or imminent operations. Combat support engineering is conducted with an emphasis on speed of operation to fulfil a short term tactical requirement.

c. Force Support Engineering. Force Support Engineering encompasses the deliberate, longer-term preparation for, and indirect support to ongoing or future operations as well as those military engineering tasks associated with sustaining the joint force throughout all stages of an operation.

d. Close Support Engineering. Those actions of the supporting engineer force which are sufficiently near (or organic to) the supported force as to require integration and co-ordination in terms of fires or movement.

e. General Support Engineering. That level of engineering support which can be given to the supported force as a whole.

3. A diagram illustrating the range of engineer capabilities is shown below at the end of this section.

SECTION IV - ENGINEER ROLES

110. ENGINEER ROLES

1. The traditional roles of the military engineer have focussed upon the advice and provision of:

a. Mobility Support.

b. Counter-mobility Support.

c. Survivability Support.

d. General Engineer Support.

2. This description of broad engineer activities remains enduring and will now be considered in greater detail. The priority previously accorded to intimate organic engineer support to fighting echelons (Close Support) has been reassessed by many NATO nations, taking into account the changed operating environment already described, resulting in an enhanced General Support capability for some. It is also important to note the new term Combat Support Engineering which is conducted by the military engineers of any service or component to support Land, Air or Maritime operations. With the emphasis on speed of execution, it frequently relies on prefabricated equipment solutions, may involve a degree of improvisation and is likely to fulfil a short-term tactical requirement. In terms of Force Support Engineering, this will be the predominant engineer focus pre- and post- conflict and for rear operations during conflict. It is an area which may involve a greater degree of cross-component support and the engineer tasks will usually be more enduring, relying more on purpose-designed and built solutions. It is likely to fulfil a longer-term, operational requirement which encapsulates the diversity and scope of tasks undertaken in support of all three services, not just the Land component. For example, infrastructure engineering is a sub-set of Force Support Engineering.

111. ENGINEER RESOURCES

1. Engineer work will only progress smoothly if the necessary equipment, stores and reserves of these items are available when required. Resources must be made to flow to site in the right order and at the right time; work must not be held up for lack of them. Some resources may be decentralised and held by units, but some, particularly those which are scarce, must be kept under central control for use where and when most required. However if they are held too far back their prompt supply will be difficult; if too far forward, lateral movement may be problematic. Similarly if control is vested in too high an authority, delay in release is probable; if at too low a level, they may not be allotted on the best information. Without proper resourcing, engineer activity and output will be severely constrained. It is inevitable that equipment of all kinds will be damaged in operations and so arrangements for repair and replacement must be made, together with an adequate supply of spares.

MOBILITY

112. THE FUNDAMENTALS

1. Military forces require the ability to move rapidly and freely in the area of operations in order to fulfil their primary mission. Mobility is necessary to achieve concentration of effort and to deploy rapidly to engage or to disengage from the enemy. Superior mobility may compensate for numerical inferiority and is affected by terrain, weather and enemy activity will.

113. THE THREAT

1. In the context of the changed operational environment already described in section 1, enemy counter-mobility operations of whatever type, are likely to focus on stopping or slowing NATO forces so as to fix them in some form of target area or they may simply attempt to prevent our freedom of manoeuvre. The means employed to accomplish these aims, may include use of air delivered assets as well as the use of land mines (including scatterable mines) and IEDs. Natural obstacles and damaged infrastructure will also be enhanced in order to create effective obstacles and thereby seek to limit NATO mobility options.

2. Increased use of the urban environment will present a range of new threats and opportunities for a determined enemy and will require the development of bespoke engineer vehicles and solutions to deal effectively with this challenging potential threat to own force mobility.

114. THE CONCEPT

1. All arms/branches will attempt to bypass or overcome obstacles and maintain mobility by use of their own integral resources and efforts. In manoeuvre warfare when obstacles are encountered, the following actions will be attempted in the order shown so as to retain tempo and initiative:

   a. Bypass.

   b. Overcome the obstacles using integral support.

   c. Deploy specialist obstacle crossing resources.

2. The maintenance of tempo and mobility in the face of an effective obstacle, whether laid by the enemy or not, will depend on the following:

   a. An early assessment of the likelihood of obstacles to be crossed.

   b. Deployment of the force in an appropriate manner, in order to overcome likely obstacles speedily as they are encountered.

   c. Early detection and reconnaissance of obstacles.

   d. Effective drills and procedures.

115. MAIN TASKS

1. In supporting the mobility of all arms/branches, the main engineer tasks are:

   a. **Gap Crossing.** Including wet and dry gaps.

b. **Countermine Operations.** The detection, reconnaissance, marking, bypassing, breaching and clearance of mined areas.

c. **Counter Obstacle Operations.** The breaching, bypassing or reduction of obstacles other than gaps or mined or booby trapped areas.

d. **Routes.** Developing and improving routes for tactical movement.

e. **Support to Forward Aviation.** Tasks may include the construction, repair and maintenance of forward airstrips and the preparation of landing areas (such as Forward Operating Bases (FOBs) and Forward Arming and Refuelling Points (FARPs).

COUNTER-MOBILITY

116. THE FUNDAMENTALS

1. Counter-mobility operations affect an enemy's ability to manoeuvre freely and selectively deny him the use of terrain. They may also reduce the effect of an attacker's superiority in numbers, and channel him into areas of our choosing where he can be defeated. Counter-mobility planning must also take account of own-force manoeuvre requirements.

2. There is an enduring requirement for Alliance members to retain a robust counter mobility inventory for the foreseeable future, in spite of the obvious constraints placed upon nations by international and domestic laws. Operational Analysis (OA) has clearly demonstrated the benefits of munitions based capability in particular but there are other ways of achieving this effect including air, direct and indirect fire weapon systems. The planned development of a range of technologically advanced munition based systems for the future featuring Self-Neutralise (SN) and Self Destruct (SD) characteristics, should greatly enhance the ability of NATO forces to create a range of appropriate counter mobility effects (lethal and non-lethal) rapidly across the battle space, shaping it to our own advantage. Such a capability is also likely to be useful in other situations, particularly the urban environment.

117. THE THREAT

1. Enemy military doctrine may emphasise mobility in order to achieve superiority of forces at the decisive time and place and to maintain the momentum of combat operations. Enemy equipment may be designed to enable their forces to meet these requirements. Enemy engineers may be organised and equipped to assist in maintaining high rates of movement by clearing and maintaining routes for the advance of all arms/branches units, including breaching minefields and other obstacles, and crossing gaps.

118. THE CONCEPT

1. Counter-mobility operations must be correctly balanced so as to disrupt the enemy's mobility while limiting the restriction on our own ability to manoeuvre freely. Barriers may be terrain, target or situation oriented, as explained at Annex B. The increasing likelihood of operating in the urban/close terrain environment has already been noted and the requirement for a coherent counter-mobility capability can be demonstrated here as well as in more open terrain, with the common intent of shaping enemy movement into areas of our choosing.

2. In order to achieve the precise effects on enemy manoeuvre that are required by the commander, obstacle planning will take place following Intelligence Preparation of the Battlefield (IPB) and the estimate process, in which the commander will express his intent in terms of Combined Arms Obstacle Integration (CAOI) and will seek to maintain his own freedom of manoeuvre whilst constraining that of his adversary by ***disrupting, turning, fixing*** **or** ***blocking***. CAOI information is at Annex B together with the classification and types of obstacle in use.

119. MAIN TASKS

1. The main counter-mobility tasks are:

   a **Emplacing Obstacles.** This includes a wide range of options such as the use of mines, explosives, digging etc, to achieve the desired effect depending on the situation.

   b. **Reinforcing Man Made Obstacles.** The strengthening of civilian structures and military obstacles.

   c. **Enhancing Natural Obstacles.** The enhancement of natural obstacles, to include gaps and trees.

   d. **Increasing Combined Arms/Branch Synchronization.** The value of obstacles can be greatly increased by overlaying them with effective fires.

SURVIVABILITY

120. THE FUNDAMENTALS

1. Survivability includes all aspects of physically protecting personnel, weapons, and materiel from the effects of enemy weapon and detection systems. It may also include deception measures.

121. THE THREAT

1. An enemy may use massive firepower for suppression or destruction and to enhance the shock action of its attacking forces. They may also deploy an extensive array of surveillance and target acquisition systems. On the other hand, an asymmetric foe may also seek to inflict disproportionate levels of damage on Alliance forces by unconventional means such as human or vehicle borne explosive devices including suicide attacks.

122. THE CONCEPT

1. All arms/branches are responsible for their own immediate survivability requirements. Engineers will augment and enhance unit survivability measures within the limits of available resources and the priorities of the commander. Engineer effort will be concentrated on tasks requiring specialist skills or equipment. Survivability measures begin with the use of all available concealment and cover, followed by digging and constructing fighting and protection positions.

2. During non-warfighting operations, the design, resourcing and construction of appropriate force protection facilities including camps and other facilities, will usually become an engineer responsibility. This key task will demand a range of specialist skills and equipment to protect the force and enable it to conduct operations effectively in a cross-spectrum environment as discussed in chapter 1.

123. MAIN TASKS

1. The main engineer survivability tasks are:

   a. Assistance in the preparation and construction of field fortifications.

   b. Assistance in the hardening and construction of protective infrastructure works, including collective protection against the CBRN threat.

   c. Assistance with camouflage, concealment and deception.

   d. Assistance in the clearance of fields of fire.

GENERAL ENGINEER SUPPORT

124. THE FUNDAMENTALS

1. General Engineer support involves the provision of engineer advice, technical expertise, resources and work other than the intimate combat support engineering provided directly to combat operations. Likely tasks are described in detail in Chapter 4. Some of the broad range of tasks included in this area are as follows:

125. MAIN TASKS

1. The main tasks within the broad title of General Engineer Support, would include:

   a. Emergency supply of water.

   b. Construction of air landing facilities.

   c. Airfield damage repair (ADR).

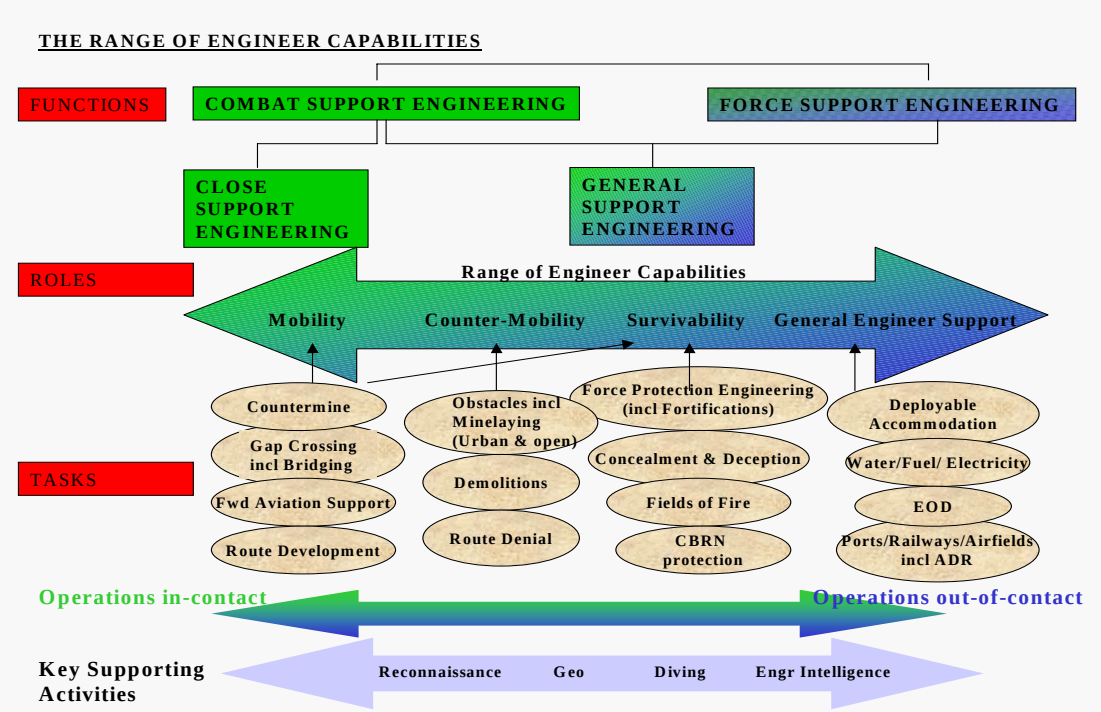
   d. Construction and maintenance of utilities and structures.

   e. Explosive ordnance disposal (EOD). Note that EOD is not exclusively an engineer task. Some nations select EOD operators from a different arm and operations to counter EO hazards may well require EOD trained personnel to be augmented by ammunition technical personnel or divers, for example.

   f. Railways and ports.

   g. CBRN decontamination.

   h. Support to Reconstruction and CIMIC tasks.



SECTION V - PLANNING AND EMPLOYMENT

126. EMPLOYMENT OF ENGINEERS

1. The employment of engineers is an integral part of the tactical commander's plan at all levels.

2. Engineers must be included in the operational planning process from the outset to ensure that scarce assets are optimised in support of the joint force. The role of the JF Engr will be central in this regard.

127. ENGINEER RESPONSIBILITIES

1. Engineer responsibilities can be summarised as follows:

   a. Advice to the tactical commander.

      (1) Engineer advice to the commander, the staff, and to the commanders of subordinate units, to include EOD, CBRN, and infrastructure.

      (2) Integration of engineer plans into combined arms/branches operations plans.

      (3) Planning of engineer employment within the formation.

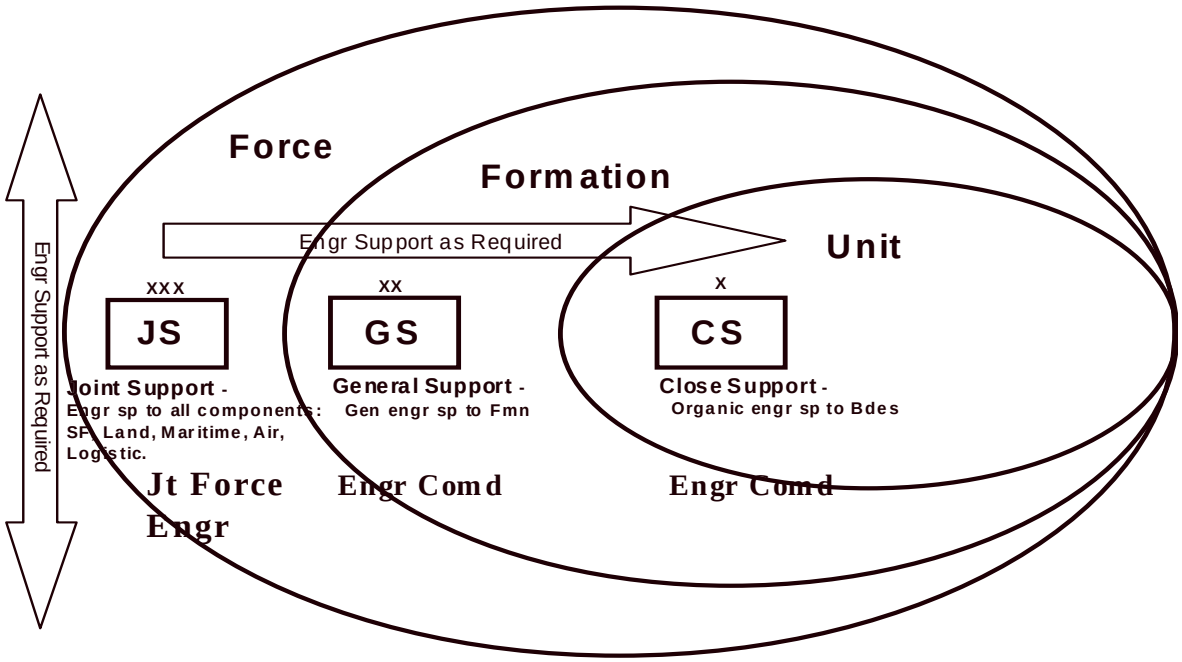
      (4) Coordination of all engineer work within formation boundaries.

2. Command of engineer units and command and control of subordinate engineers.

128. ENGINEER FUNCTIONAL COORDINATION

1. In addition to his responsibilities to the tactical commander, every engineer commander is linked in an engineer functional chain. It is not always a chain of command, but it is at least a channel of engineer coordination. It exists to ensure the most economical employment of engineers and engineer resources.
It enables the JF Engr to coordinate engineer support across all components. It is thus essential that engineer units and sub-units supporting joint and combined formations retain the ability to communicate with the appropriate engineer commanders. The diagram below provides a sense of what is required.

JOINT FORCE ENGINEER CONCEPT



2. Elements of the plan for the employment of engineers will interact with many other aspects of the operational plan. It is essential that the engineer commander ensures that all such aspects are fully co-ordinated with other arms/branches.

129. PLANNING PROCESS

1. The making of the plan should follow the normal method of an estimate, but certain aspects peculiar to engineers need emphasis. These are:

a. **Obtaining Information**. The engineer commander must base his decisions on the best possible information. This will come through engineer channels, from the tactical commander and his staff and from supported units but may take time.

b. **Formulation of the Plan**. The engineer commander may discuss aspects of his plan with his subordinates before he issues his orders. This is particularly important when operating with allied or regrouped engineer forces.

c. **Priorities**. There will always be a demand for more engineer resources than are available. The engineer commander must advise the tactical commander and obtain priorities for engineer work.

d. **Allocation of Resources**. Based on these priorities, the engineer commander allocates resources on the authority of the tactical commander. He will allocate men, materials and time to these tasks in accordance with the priorities for work and his subordinate units' capabilities**.** Additional engineer resources may be available with the assistance of the JF Engr (see Chapter 2).

SECTION VI - MULTINATIONAL STANDARDISATION AND INTEROPERABILITY

130. IMPORTANCE OF STANDARDISATION AND INTEROPERABILITY WITHIN NATO

1. Engineers should be aware that amongst the alliance nations there exists a wide diversity of engineer equipment and material for which there is little standardisation. Engineer structures and organisation at each level of command differ nationally, and while engineer missions are similar, procedures often vary. It is becoming increasingly important for the successful execution of combined operations, or of those involving the subordination of units or formations of another nationality, that major differences in national organisations, engineer tasks and procedures are well understood. It is equally important that any potentially adverse effect of these differences, regarding the outcome of the engineer mission, are minimised.

2. The effective training of engineer commanders and their subordinates in matters of engineer standardisation is therefore fundamental to enhanced multinational performance in the future. Such training should focus on improving standardisation through a combination of awareness of national procedural differences as well as by conducting practical training to encourage familiarisation with the equipment of other nations. The role of ENTEC is key in this regard to both promote interoperability as well as to foster common understanding between the engineer forces of member nations.

3. Commonality of procedures becomes particularly important in times of rapidly changing equipment capability, and the emergence of increasingly diverse organisational structures, as more nations seek to 'transform' their armies.

131. STANAGs

1. NATO Standardisation Agency (NSA) sets out and publishes a matrix of requirements for standardisation in land combat operations, including the levels required for engineer support ranging from compatibility to interoperability and commonality. Further to these requirements, the procedures for a range of key

engineer activities in support of operations are covered by STANAGs; these lay the foundations for incorporation of procedures into national pamphlets. A list of the current agreements reached on engineer procedures is included at Annex A. This list also encompasses those STANAGs which are considered to be of relevance to engineers, but for which responsibility lies outside the engineer domain.

CHAPTER 2

ENGINEER COMMAND, CONTROL, INTELLIGENCE AND RECONNAISSANCE

SECTION I - COMMAND AND CONTROL

201. COMMAND AND CONTROL PRINCIPLES

1. Effective command and control will be a key enabler towards the provision of coherent and optimised engineer support at all levels. The following principles should be applied:

a. Unity of command meaning a single focus for engineer advice and support as well as the full participation of engineer staffs in planning and operational processes.

b. Centralized planning and coordination coupled with de-centralized execution and control.

c. Timely warning, reconnaissance and deployment by engineers is key to success.

d. Use of the Supporting/Supported command concept (via JFEngr) to flex key engineer assets to where they are most required, if necessary, cross component. See diagram in chapter 1. Use of HNS engineers, international organisations etc may also be relevant.

e. Centralised technical authority to ensure that standards of construction (for example) are achieved. If there are no local standards the JF Engr is to set them.

202. ORGANISATION OF ENGINEERS

1. Formations and units at all levels require engineer support. Since the execution of engineer tasks requires the judicious deployment and control of men, equipment, and materials, the most economical and efficient use of engineers must always be sought and engineer priorities must be assigned. The JF Engr must therefore advise the joint commander on the optimum mix of engineer support to formations or units as well as ensuring that the appropriate engineer material to accomplish the mission is provided. This principle will be repeated at subordinate levels as appropriate. This allocation will be altered as priorities change and tasks progress. In this way engineers may be frequently task organised in order to achieve the commander's intent. The command relationship between engineers and

the formations or units they support will therefore depend on the nature of the mission and must be clearly stated to avoid possible confusion.

203. CENTRALISED COORDINATION, DECENTRALISED EXECUTION

1. The most efficient results are achieved by centralised coordination at the highest appropriate engineer level, (which remains the JF Engr level in accordance with AJP-3.12) whereas the details of the execution of the task should be delegated to the lowest practical level. This is illustrated in the diagram in the previous chapter.

204. ALLOCATION OF PRIORITIES

1. Closely linked with engineer task organisation, is the requirement for engineer commanders at all levels to maintain close liaison with their respective tactical commanders and staff to ensure that engineer work is properly and clearly prioritised. This will ensure best use of a scarce resource. Frequent changes in priority resulting in the need for continual redeployment of engineer units and equipment should be avoided as far as possible as this is wasteful. In the likely event that engineers are required at short notice to carry out vital and unexpected tasks, engineers employed on lower priority activities should be earmarked for re-deployment as necessary. This may result in other arms/branches having to undertake non critical tasks where feasible.

205. COMMAND PROCEDURES

1. Effective command procedures are an essential element of any engineer task. All commanders must understand the importance of clear orders and concurrent activity. The engineer commander must ensure that he allocates sufficient time for subordinate commanders to plan, prepare, and give detailed orders. Standing operating procedures (SOPs) will be laid down by the theatre or formation commander; they are used in order to speed up command and deployment activities. It is essential to brief supporting engineers from other nations on SOPs, which are not covered by STANAGs.

2. Engineer support may be provided at each level of command. Specific responsibilities at each level will be determined by the operational plan. An engineer unit or sub-unit can work with forces of an allied nation under any of the command states outlined in AJP-6. Engineer deployments and organisations should normally comply with tactical boundaries. The tactical commander would expect to retain his usual engineer adviser, even when engineers are regrouped. However, if a formation is reinforced by other engineer units, it may be necessary for the tactical commander to decide on the appointment of the engineer commander.

SECTION II - COMMUNICATIONS AND LIAISON

206. ENGINEER COMMUNICATION

1. A clearly defined channel of communication, to pass accurate and timely information, is essential to enable an engineer commander to advise his tactical commander and to command and coordinate engineer operations. Reports and returns should be submitted in accordance with STANAG 2430 and AJP-11.

2. To enable the engineer commander to command his widely dispersed troops effectively, update the tactical commander and review priorities, he must be able to:

a. Receive early reconnaissance reports and information on tasks.

b. Issue orders quickly and clearly on tasks, grouping, resources allocation and movement.

c. Monitor the progress of tasks.

3. Communications are therefore vital to engineers, both within units and to the supported formations. All available means to maintain links must be utilised including liaison officers where appropriate. Best use should be made of ADP based systems for the rapid exchange of engineer information at all levels of command.

207. PROCEDURES

1. **Lateral Communications**. Lateral communications are particularly important for engineer operations that cross unit boundaries.

2. **Communications between Superior and Subordinate Engineer Commanders**. As far as resources allow, Engineer commanders are responsible for the establishment and maintenance of communications for engineer functional coordination to the headquarters of immediately subordinate units or formations.

208. LIAISON

1. If an engineer unit does not have a permanent representative at the headquarters of any formation it is supporting, it must make arrangements to ensure good liaison. It is important that an engineer is represented at all planning meetings, reconnaissance or orders groups. If engineers of more than one nation are involved in a specific operation it is essential that engineer liaison teams are deployed.

2. Principles and procedures for establishing liaison are contained in STANAG 2101. Liaison requirements should be included in all orders. There are three requirements of importance to engineers:

a. Reciprocal liaison when an engineer unit is placed under operational control of a headquarters of a different nationality.

b. Liaison with the host nation authority at the appropriate level.

c. Specific liaison must be established between adjacent formations in order to ensure the detailed coordination of engineer operations that cross formation boundaries.

SECTION III - INFORMATION AND INTELLIGENCE

209. ENGINEER INFORMATION

1. General. Engineer information is unprocessed data, which may be used in the production of engineer intelligence. It may come from many sources including maps, satellite imagery, reconnaissance, POWs as well as military and civilian sources. The engineer must identify information requirements to the HQ staff for inclusion in the intelligence collection plan.

2. Types of Engineer Information. Examples of the type of information that may be of interest in all types of operation are given at Annex C.

210. ENGINEER INTELLIGENCE

1. General. Engineer intelligence is defined[3] as the product resulting from the processing of information concerning enemy engineer operations and resources, environmental conditions, military geographic information and terrain required by a commander in the planning of combat operations. It plays a fundamental role in the successful planning of military operations. Engineer information may be collected and reported by all arms/branches, by intelligence gathering services as well as by dedicated engineer reconnaissance. Once reported, information is collated and managed by engineer staff elements. Many items of engineer intelligence are of interest to other arms/branches, intelligence services and agencies and the ability to exchange information within, and between, headquarters is required. Reporting should be in accordance with STANAG 2430, where appropriate.

2. Intelligence Cycle. Engineer intelligence is one element of the complete intelligence system and is subject to the same intelligence cycle as other battlefield information. Integration with other elements of the intelligence system is essential. The intelligence cycle processes battlefield information and consists of four steps culminating in the distribution of finished intelligence (***Planning, Collection, Processing***, and ***Dissemination***).

[3] AAP-19

211. VALUE OF ENGINEER INTELLIGENCE

1. Engineer intelligence is very wide-ranging in its scope. It may encompass the operational capabilities of friendly and enemy forces, the terrain, the weather, geographic information as well as information on infrastructure, utilities and resources needed to conduct operations. It can be considered as both a product and a process that supports the following functions:

a. Force Generation. Engineer Intelligence informs the force generation process by allowing the engineer commander to advise on and plan the optimal engineer force structures for particular operations paying regard to terrain, tasks and enemy.

b. Intelligence Preparation of the Battlefield (IPB). The purpose of IPB is to help commanders to refine their intelligence requirements, identify decision points and to inform the Operational Planning Process. Within this process the engineer focuses on the terrain aspects of Battlefield Area Evaluation (BAE). One of the products of this analysis classifies the terrain as “GO”, “NO GO” or “SLOW GO” manoeuvre areas by assessing trafficability. Movement template times may also be developed.

c. Situational Understanding. Engineer intelligence adds to the overall situational understanding with particular emphasis on terrain and the capability of enemy engineers. Modern technology offers considerable benefits in ensuring engineer situational understanding information is rapidly and accurately reflected in a complete all arms/branches or joint picture.

d. Joint Targeting Process. Engineer Intelligence can contribute to the joint targeting process by input to the selection of targets, aiming points, and Battle Damage Assessment (BDA). Destroying infrastructure targets may limit the military options for an enemy or faction in the short term, but may create significant limitations for NATO in the longer term. Consequently, engineer intelligence may assist significantly in any Effects Based Approach (EBA) for example by denying rather than destroying targets. Engineer intelligence may also help to identify alternative targets and aiming points that create similar effects without the consequent damage and other limitations such as cost.

e. Force Protection. Engineer intelligence can add considerably to force protection planning and implementation by examining how the enemy could exploit the terrain and what actions our own forces could take to reduce or negate potential enemy action.

212. ENGINEER INTELLIGENCE STAFF

1. The exact organisation of the G2 cell in a joint or component command HQ is a matter for the Commander. A G2 Collection Manager might be appointed who will call upon engineers for their input. Nevertheless the engineer charged with overseeing the gathering of engineer intelligence will need a system for collating and recording such intelligence. Modern information and communication systems are extremely valuable in this area.

2. Engineer intelligence staff are present in most NATO HQs. They will decide which raw data to pass immediately to other staff or HQs and which to use in the processing phase of the engineer intelligence cycle. Their primary roles are:

a. Direction of engineer collection effort.

b. Collation, evaluation, analysis, integration, interpretation and dissemination of engineer intelligence.

c. Maintenance of the HQ's engineer intelligence library and database(s).

SECTION IV - ENGINEER RECONNAISSANCE

213. INTRODUCTION

1. Engineers differ from other arms/branches in that many tasks require stores and equipment that are not permanently held with units. The successful and prompt completion of engineer work depends upon personnel, stores and equipment being available in the right configuration, place and time. Engineer reconnaissance is therefore a key engineer enabling activity in providing the necessary information and warning time. The advent of advanced technology Unmanned Aerial Vehicles (UAVs) allows a wide range of information to be gathered remotely but does not remove the need for a manned engineer reconnaissance capability to provide guaranteed 'eyes on' to the commander in all weathers and environments.

2. The primary role of engineer reconnaissance is to provide combined arms and engineer commanders with timely and accurate engineer information on the natural and manmade environment, and on enemy engineer activity and intentions. Its secondary role is to play an integral part in contributing to combined arms reconnaissance.

3. It is important that the engineer commander accompanies the tactical commander on any significant reconnaissance tasks in order to ensure that engineer aspects are taken into account at an early stage. The composition of the reconnaissance party required for engineer tasks will depend on the nature of the task. The need for local protection should not be overlooked.

214. PRINCIPLES AND TASKS OF ENGINEER RECONNAISSANCE OPERATIONS

1. As stated, engineer operations are resource-intensive and engineer tasks can impose a drag on operational tempo if their sequencing is not planned early. Engineer reconnaissance is therefore essential to ensure that engineer effort is focussed where it can best achieve the desired effect and to allow focussed concurrent activity.

2. Principles. The following principles apply to the provision of effective engineer reconnaissance:

a. Engineer reconnaissance should be command-driven, normally through the Commander's Critical Information Requirements (CCIRs), Priority Information Requirements (PIRs) and Requests for Information (RFI).

b. Engineer reconnaissance should be centrally co-ordinated at each level of command in order to maintain tempo. Thus it may need to be task organised in order to provide the required level and type of detail on time.

c. Engineer reconnaissance generally deploys as part of combined arms recce.

d. Engineer reconnaissance should have the same vehicle signature (though not necessarily exactly the same vehicle) and the same basic combat sensor suite (though engineer additions may be required) as combined arms reconnaissance. This will stop it being a signature vehicle and allow it to meet its combined arms reconnaissance requirement.

e. Engineer reconnaissance requires specialist training.

f. Access to the results of engineer reconnaissance should be available at every level of command.

3. Tasks. The tasks that engineer reconnaissance is likely to carry out in all types of operation and at all levels include:

a. Confirmation of terrain analysis in support of the IPB process.

b. Route reconnaissance to either confirm terrain information or to gather fresh information.

c. Obtaining cross-country movement, trafficability and going information.

d. Reconnaissance of natural, enemy and friendly obstacles in support of manoeuvre.

e. Identification of the location, strength, grouping, movement and procedures of enemy engineers.

f. Support for forward aviation.

g. Identification of local infrastructure, utilities, resources and transportation.

h. Identification of significant UXOs.

i. Obtaining battle damage information.

j. Liaison and escorting duties.

k. Minor close support engineer tasks including small scale demolitions.

SECTION V - RULES OF ENGAGEMENT (ROE)

215. GENERAL

1. ROE are a means of providing guidance and instruction to commanders and commanding officers within the framework of overall political directives. They define the degree and manner in which force may be applied and are designed to ensure that the application of force is controlled. ROE inform commanders of the degree of constraint or freedom permitted when carrying out their assigned tasks, but they are not used to assign specific tasks. They must be succinct and unambiguous, leaving the commander in no doubt as to the limits on force that may be used. ROE will be authorised for all operations and in those cases when NATO forces operate in conjunction with forces under national or other control, the ROE of NATO and non-NATO forces must be harmonised to ensure operational cohesion.

2. ROE may be prohibitive or permissive. When issued as prohibitions, they are orders to commanders not to take designated actions. When issued as permissions, they define the limits of the action commanders may take to accomplish their mission. In order to achieve operational objectives, it may be necessary to develop additional, or modify existing, ROE. Commanders wishing ROE to be changed are to request authority to do so through the chain of command. When implementing ROE for forces under his command a commander is not bound to use the full range of permissions granted and may impose further restrictions as the operational situation dictates.

216. ENGINEER RELATED ROE

1. Engineer operations, and perhaps most notably barrier operations, can greatly affect local civilian populations; therefore, barrier operations and denial measures are always restricted. Since some of the barrier restrictions and denial measures may impact operations, engineer involvement in ROE development to detail these impacts is critical. These restrictions and conditions can be the result of international

conventions, such as the Ottawa Treaty, which bans the employment of Anti-Personnel mines by signatory nations.

2. The purpose of engineer related ROE is usually to authorise or limit the preparation and execution of barriers and other denial measures. Barrier related ROE must reflect the fundamental tenets of the law of armed conflict, military necessity and proportionality. Necessity dictates that force should not be used unless essential to achieve a military objective. The concept of proportionality dictates that military action or response is in proportion to the desired military objective; a corollary is that collateral damage should be minimised where possible. These basic principles mean, with regard to barrier measures, that the execution of barriers will not be automatic. The execution will depend exclusively on the development of the situation and the course of the battle within current ROE. In the planning and execution of obstacles and denial measures, the protection of the vital interests of the population and host nation are to be taken into consideration. Detailed procedures may also need to be promulgated by force or formation commanders for the conduct of demolition operations.

CHAPTER 3

ENGINEER OPERATIONS IN FORCE PROJECTION AND SUSTAINMENT

SECTION I - INTRODUCTION

301. GENERAL

1. The requirement to conduct expeditionary operations across the spectrum of conflict, highlights the broad range of capabilities that will be demanded of engineers in order to support and sustain formations and units deployed in areas where there is likely to be limited or non-existent infrastructure. This requires broad based, generalised engineer support that emphasises engineering in support of logistic and other installations and focuses upon construction and artisan skills. All future NATO operations will require force projection skills and therefore greater emphasis will need to be placed on developing effective and coherent Force Support Engineering capabilities by NATO nations. Ground formations must be deployed strategically into a theatre and then be properly established before they can start 'in-theatre' operations. Engineer support will remain a vital enabling factor in terms of theatre entry, establishing the force, subsequent sustainment etc.

2. Engineering support to force projection and sustainment will be based on three functional groups of engineers; those organic to formations, those responsible for entry and redeployment tasks and those responsible for sustaining the force. It cannot be assumed that formation engineers will carry out entry or sustainment tasks. They would almost certainly be required to stay with their formations for joint preparation, acclimatisation and in-theatre training. Entry and sustainment engineers could have limited combat capability and readiness, but must be prepared to undertake intra-theatre movement to the combat zone to support all force elements if required.

3. Those engineer units conducting force support tasks, may be grouped together under an engineer headquarters. The organisation of the group will be task organised dependant on a wide range of factors. Such a group would likely be responsible for all engineer tasks in support of force sustainment and for the provision of heavy engineer support, horizontal and vertical construction and project and facilities management support to manoeuvre formations. Combat Support engineers may assist in these tasks where necessary and although remaining grouped with their affiliated units, they may be task organised to support those activities deemed most appropriate by the force commander as advised by the JF Engr in accordance with the principles set out in AJP-3.12.

4. The aim of this Chapter is to establish doctrine for engineer support to force projection and sustainment. The factors affecting the nature and level of engineer

support required are examined and related to the sequence of phases involved in the projection and sustainment of a force. The phases of any operation will include: force generation, pre-deployment activity, operational tasks, post conflict operations, redeployment, and reconstitution.

SECTION II - FACTORS AFFECTING ENGINEER OPERATIONS

302. MISSION

1. The assigned mission and any constraints will affect the selected force level, its composition and tasks. The mission may not be clearly defined at the outset of operations and may be modified with time.

303. THE THREAT

1. The nature of the threat and the prevailing or predicted situation will be key determinants of the weight and type of engineer effort required. They affect strategic deployment routes, air and sea and rail ports of disembarkation (A/S/RPOD), restoration of entry facilities, emergency provision of power, water and bulk fuel. The level of Host Nation Support (HNS), the availability of in-theatre resources, the physical state of the national or theatre infrastructure and our ability to use civilians in place of military manpower are all additional factors. Of particular significance will be the enemy's capability to conduct deep operations against targets in the rear areas. Insertion of a force into a contiguous area of operations is likely to pose similar threats to bases, routes and supply areas. As described in chapter 1, the contemporary operating environment is one in which the threat is likely to be multi-directional, persistent and asymmetric in nature.

304. FORCE LEVELS

1. Force levels will be decided in response to the threat and the force's mission. Whilst it is generally true that the larger the overall force, the greater will be the engineer support required, it is neither a fixed ratio, nor a linear relationship. It is highly scenario dependant and has to be determined by engineer intelligence and early detailed reconnaissance. This reinforces the need for the early involvement of engineer planning staffs to ensure that engineer force packaging is both realistic and yet flexible enough to undertake the many unexpected tasks that will need to be addressed.

305. HNS AND INFRASTRUCTURE

1. There is a distinction to be made between HNS which is supplied by the host nation authorities, and In Theatre Resources (ITR), which are contracted for by NATO forces or others acting on their behalf. In the case of recent expeditionary operations, NATO has had to become involved with both types. The availability of HNS/ITR and the state of the local infrastructure will also have a significant bearing on the requirement for engineers. HNS/ITR can provide skilled and unskilled manpower,

machinery (for example offloading facilities or plant hire) or resources, either in the form of finished products or as raw materials. However, in many of the areas to which NATO forces may be deployed, the level of reliable HNS is likely to be low. While available HNS/ITR will always be used to the best advantage, it cannot be relied upon as a substitute for core capabilities. Similarly, in such areas, the local infrastructure may not be highly developed and is likely to be further degraded as a result of military operations. This may increase the level of engineer effort required to create, repair or maintain a satisfactory level of basic facilities.

306. CONSTRUCTION STANDARDS

1. Construction standards must be clearly established by the JFEngr and strictly adhered to by assigned and supporting forces. Early establishment of such standards is essential in order to determine the engineer force structure and other resources required to support force projection operations.

307. TERRAIN

1. The nature of the terrain over which the force will deploy and operate will influence the engineer support requirement to a considerable extent. The construction and maintenance of routes, of all types, is expensive in plant and materials, especially if bridges or other means have to be provided. Clearly, the condition of the road infrastructure is likely to be a key factor in determining the level of effort needed for most operations, but in some countries the emphasis may be on railways, airfields or waterways. An extensive terrain database will be an essential tool supporting both map production and operational terrain analysis; the latter technique in particular being useful in providing early estimates of the required resource levels.

308. CLIMATE

1. Each climate has its own characteristics and effect on engineer support. An obvious example is water supply where quantities may double or triple depending on climate. Less obvious are the effects of precipitation patterns on road drainage or a daily temperature range upon power requirements for refrigeration or heating. The effects of climate upon the requirements for engineer support should never be underestimated.

309. TIME

1. The combined effect of the previous factors heavily influences the time taken before operations can commence in theatre. A moderate climate, good infrastructure and high level of HNS will reduce manpower demands, decrease out-loading and off-loading, enable greater concurrent activity and so reduce the time required to get a force to its operational area. In situations where these conditions do not exist, considerable engineer work is required to expedite the early entry of the force. The concept of surge capacity, normally on deployment and recovery, of engineer effort is a

logical consequence. The timing, in sequential terms, of events is also important. A relatively small number of engineers deployed early in the order of arrival, with their equipment, can often achieve much more than a large number arriving with or later than the main bodies.

SECTION III - ENGINEER CAPABILITIES REQUIRED

310. GENERAL

1. The diagram below illustrates typical phases of a deployment into an overseas theatre of operations. The probability that the force can achieve its mission will increase significantly if the earlier phases have been efficiently executed. A typical sequence would run as follows:

a. Force Generation.

b. Pre-deployment activity.

c. Deployment (establishment of staging areas or forward bases may be required).

d. Entry operations which include:

(1) Reception, Staging, and Onward Integration (RSOI)

(2) Training and Acclimatisation

(3) Intra Theatre deployment

e. Operations.

f. Post conflict operations, redeployment and reconstitution.

311. FORCE GENERATION

1. Historically, much of the Alliance Force Support Engineering capability has been maintained within reserve components of NATO Armies, requiring long lead times to bring reserve forces to operational readiness and therefore greatly impeding their commitment on operations with short lead times. The nature of current and future operations (and the emergence of a NATO Response Force (NRF) capability) demands that force elements are now held at readiness to better balance the equation of response time, affordability, risk assessment and earlier lessons learned. The creation of a rapidly deployable NATO therefore, as part of the ongoing transformation process, has replaced the previous reservist based architecture with a commitment to generate the right force elements at the right readiness to project forces quickly and efficiently and achieve early and decisive effect where appropriate.

312. PRE-DEPLOYMENT ACTIVITY

1. In engineer terms, efficient use of the pre-deployment period relies heavily on the information and resources available. The timely exchange of information based upon well defined information exchange requirements and interoperable databases of terrain, infrastructure and resources will have considerable potential to save manpower, equipment and time. Such databases should be developed and maintained for contingency planning. Links with the civil engineering industry, which is deployed world-wide on construction projects, can be invaluable. Retention of an ability to design, construct or repair accommodation, hospitals, roads, railways, airfields and utilities is essential, as will be the ability to control the work of local labour, understand contracts and ensure on-site quality control. It is highly likely that increasing use will be made of contractor support in future Alliance operations where this is considered appropriate.

2. Reconnaissance and planning during the pre-deployment period are crucial in determining the engineer effort required and in deploying it in an efficient and timely fashion. Ground reconnaissance may not always be possible in advance, reinforcing the need for detailed up-to-date databases. However, where ground reconnaissance can be carried out, it is essential to include engineers to assess the effect of the factors discussed earlier. The reconnaissance team should have an ability to negotiate and let contracts, including methods of payment. Where local resources are scarce, there may be competition between coalition partners. Agreements on sharing or apportioning should be made beforehand, with one nation providing resources control. Centralised control should have the effect, not only of ensuring equable shares, but also of keeping down costs.

3. Engineer stores and materiel will often have to be shipped from home bases, in many cases in task tailored sets or in partially prefabricated form. Wherever the origin of these stores and materiel it is likely to be controlled by national organisations until arrival in theatre. Within a NATO force, the mechanism for establishing the state and location of engineer stores, and for their distribution to participating countries, must be clearly established. Where industrial surge capacity is envisaged, or urgent operational procurement procedures are to be used, the production and delivery lead times of engineer stores must be closely matched to the deployment plan.

313. DEPLOYMENT

1. During this deployment phase, it is essential that engineer equipment and stores are clearly marked, in the correct prioritised order and loaded as complete sets on the same ships or aircraft. An engineer element and their equipment must always be amongst the earliest to arrive in theatre. Experience in all NATO nations has shown a requirement for a larger number of engineers at the start of an operation (during the ‘surge’ phase) than when a ‘steady state’ has been established.

2. Deployment of air forces may not coincide with that of ground troops. Whenever it occurs, supporting engineers tailored to the threat and utilities demands, should move in advance of them. Dedicated engineer support may include the provision of bulk fuel handling, aircraft protection, airfield damage repair (ADR), Explosive Ordnance Disposal (EOD) and provision of other utilities. If tactical fuel handling equipment will be required, including ship to shore facilities, it will need to be moved early. In some circumstances, it may be necessary to establish a forward mounting base, close to the theatre of operations, in which case an additional engineer force may be required.

314. ENTRY OPERATIONS

1. **Reception, Staging and Onwards Integration (RSOI)**. Selection of Points of Disembarkation (PODs) will depend largely upon the operational plan but will be heavily influenced by the infrastructure, HNS/ITR and other facilities, for example land for training and logistic storage areas. The requirement for comprehensive databases is reinforced. Reconnaissance of the POD, if necessary by more covert means, must include engineers. Once selected and confirmed, the POD will have to be established, taking into account the provision and maintenance of the facilities and services required to receive the main force. Establishment and sustainment of the POD in a benign environment, with sophisticated infrastructure in place and readily available HNS, would require relatively little engineer support. However, less favourable conditions could demand some or all of the following capabilities:

a. **Ports**. Clearance of underwater obstacles by divers may be required. Design, construction or repair of floating quays or jetties, including container handling and crane facilities must also be considered. Selection of the SPOD should aim to minimise such work in order to save time. Some inshore work may be required to lay moorings for ships or fuel dracones. Depending on the situation, facilities for over-the-beach offloading may have to be constructed.

b. **Airfields**. Early tasks could include ADR requiring heavy and specialist equipment. Provision of hardened command facilities, blast protection for aircraft, construction of weapon storage areas, dispersal areas and fuel farms may be required. Expedient surface materials such as mats would save on time but increase shipping volume. Aircraft are heavy consumers not only of fuel but also of water, particularly for decontamination. Electrical power may be required for runways, ground servicing and domestic use. If the airfields need additional temporary accommodation, it may have to be built and provided with utilities, including sewage disposal.

c. **Camps**. Some form of staging accommodation will normally be required. The level of work will depend on the theatre infrastructure, but even where buildings are available, some conversion or supplementary work to provide for physical security may be required. It may be

necessary to accommodate troops away from the local civilian population. In some circumstances, camp construction on virgin sites will be the only course open. The requirement for tentage, semi-permanent or prefabricated accommodation and its qualitative improvement will depend upon the climate and expected duration of the campaign and are key factors in the establishment of theatre construction standards. Camp stores, including provision of utilities, should be held in standard sets. The enemy threat will affect the level of protection and hardening required.

d. **Logistic Installations**. Where possible, existing hard-standings and storage facilities will be used. They may need protection, both from enemy action and from theft. When facilities do not exist, they must be built, often involving heavy earthmoving plant and the provision of surfacing materials. Bulk fuel farms will usually be required, possibly including ship to shore handling facilities. Ammunition, including air weapons, mines and explosives will need protected facilities in the rear area. Provision of the necessary logistic facilities will be essential before the arrival of the main sea lift of stores and equipment.

e **Hospitals**. As with camps, hospitals may have to be built on virgin sites. Where existing buildings can be converted, work will often be required to widen doorways, provide ramps and install water supply, waste disposal, air conditioning and heating. Medical products invariably require refrigeration. Helicopter pads will be required. Collective CBRN protection may also be needed.

f. **The Road Network**. The facilities described above may be dispersed and may need the construction and maintenance of connecting roads or tracks. SPODs will have to be connected to the logistic storage areas which, in turn, must connect to lines of communication (LOC). Field and general hospitals must be connected to APODs for casualty evacuation to base hospitals. Circuits within discrete installations must also be maintained. The maintenance requirement will be heavily influenced by the weather and usage, but it will be a continuous task.

g. **Railways**. The repair and maintenance of the railway network may be required. In some circumstances its extension may be necessary.

h. **Geospatial Support**. Engineers may be responsible for geospatial support ranging from hard copy maps to digital data. There may also be a requirement for a geo based mission rehearsal facility.

i. **Protection of PODs**. The physical security and protection of the PODs extends beyond measures within discrete installations, such as bund walls round ammunition stocks, to fortification works and minefields.

The nature of the work and effort required will be dependent upon local circumstances.

j. **Mineclearance and Explosive Ordnance Disposal (EOD)**. Engineers may be responsible for mineclearance and EOD tasks (though EOD is not exclusively an engineer responsibility) throughout the area of operations. Generally this would only be conducted for the protection of own troops.

2. **Training & Acclimatisation**. Some engineer support to training and acclimatisation may be required, for example the marking of field firing ranges, targetry manufacture or practice obstacle construction. Such support should come from force support engineers rather than combat support troops where possible, the latter needing to train with their formations.

3. **Intra-Theatre Deployment**. Provision of intra-theatre mobility is an essential engineer task. It must be achieved despite disruption by climate, terrain or enemy action. Engineers will provide routes for use as LOC or for redeployment. Engineers will develop or improve the routes, recover assault bridging and replace it with logistic bridging, ferries or floating bridges. Depending on LOC length and condition, some construction or repair work may be required. Transit or holding areas containing refuelling points, utilities and temporary accommodation may be needed. The routes will require regular maintenance. Further enhancements to intra-theatre movement may be needed in the form of helicopter operating bases or airstrips. Alternative routes, bypasses or laterals may also be required, constructed from scratch or by developing existing facilities.

315. SUSTAINMENT OPERATIONS

1. Sustainment of the force is a critical activity throughout all phases of a campaign. Engineer tasks in this area divide broadly into two areas. Firstly to provide the facilities so that the Joint Force can prepare for and conduct operations and then to maintain those facilities or develop them. Provision of these facilities tends to be concentrated in the entry operations phase, but it could extend well beyond the initial period. As soon as a facility is brought into use, it must be maintained. There is, therefore, an overlap between the work related to entry operations and that required for sustainment. This overlap appears to reinforce the concept of a surge force of engineers, with the implication that a part of the surge could be withdrawn. Some engineers responsible for entry operations work will tend to become involved with sustainment. The extent of the work, both at entry and throughout sustainment, will be unique to a given campaign. In favourable circumstances many sustainment operations may be undertaken by civilian contractors.

2. Warfighting operations and stabilising operations will generate a myriad of additional engineer tasks, for example the construction of Prisoner of War (POW) camps and refugee centres in rear areas.

316. POST CONFLICT STABILISATION OPERATIONS

1. The extent of engineer activity in post conflict stabilisation operations (if indeed this can be separated out from the '3 Block War' environment) is highly situation dependent. In the aftermath of operations, engineers may be required to restore essential public utilities, provide hospital facilities, repair some of the vital infrastructure or provide temporary accommodation for displaced civilians. There is likely to be a significant requirement to recover or clear mines, minefields and unexploded ordnance which have been laid by both enemy and own forces, and destroy confiscated arms, bunkers, and ammunition. Engineers would be assisted in mine clearance work by civilian specialists to prevent the military effort being swamped with essentially civilian /humanitarian tasks. All post conflict operations will require detailed liaison between CIMIC, NGOs, and engineer staff and host nation authorities.

317. REDEPLOYMENT AND RECONSTITUTION

1. Extraction of a force will require engineer support to maintain routes back to the POD. The reception and staging facilities used to introduce the force, if properly maintained, should require little additional effort to extricate that same force. A surge of engineer effort may be required to dismantle entry or exit facilities which may require redeployment of engineer assets; some to be returned to the home bases for reuse, some to be disposed of locally. Forward mounting bases may also be used on redeployment.

318. ENGINEER MATERIEL (CLASS IV SUPPLIES)

1. Engineers differ from other arms/branches in that many of their tasks require stores and equipment in quantities which are not permanently held by units. Engineer work will only proceed smoothly if necessary equipment, stores and reserves of these items are available when required. Resources must be made to flow to a task site in the right order and at the right time. Many of these stores and equipments are used extensively by engineers. They are therefore often referred to as "Engineer Resources" and will vary little from army to army. Because engineer resources are vital to engineer operations, it is important for engineer commanders to identify the requirements by type and quantity to the appropriate logistic organisation and then monitor their allocation and provision even if they do not control them. At each level of command, when the engineer commander formulates his plan, he should ensure adequate allocation of engineer resources for its implementation.

2. International engineer logistics, especially in stabilising operations, will demand a new approach. It cannot be assumed that the assigned forces will be able to bring all the project and contingency materials they require into theatre. Co-ordination between engineer and other logistic supply organisations, including contractors, will be essential. The determination of host nation capabilities and liaison with HNS authorities may also be required. The identification of pre-planned engineer resources and plant for contingencies may provide a better logistic foundation for engineer operations than

complete reliance on statements of requirements drawn up at the outset of operations. The provision of engineer logistics is normally a national responsibility though agreements may be made to share specific responsibilities. NAMSA will normally procure and supply materiel for NATO operational infrastructure.

3. The requirement for local supply, purchase and delivery of materiel to fulfil engineer tasks may be met by the establishment of a single procurement agency. Representatives of this agency may be located at formation headquarters. An engineer materiel supply point may be established as the focus for multinational engineer and labour procurement and supply, in conjunction with host nation and commercial contractors.

319. MOVEMENT AND HOLDING OF ENGINEER RESOURCES

1. The engineer materiel supply point will be located as far forward as is tactically possible, provided security can be guaranteed. It is not likely to be rapidly movable. Its aim will be to service the whole of the area of operations. It will be collocated with existing infrastructure services and will bring together host nation and imported engineering agencies; power, roads and railways are desirable features. Engineer planners have to consider the following:

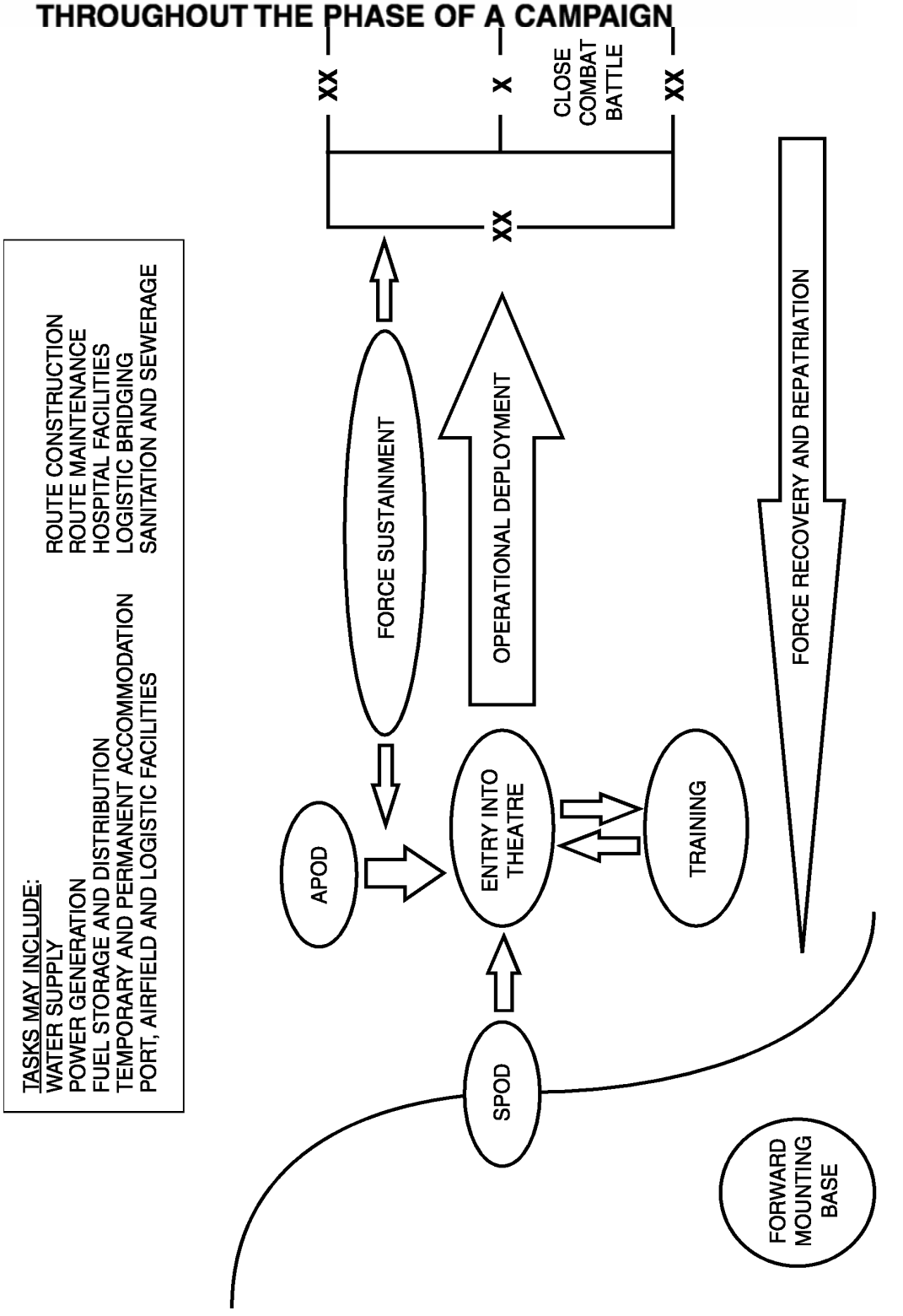
a. Engineers have a limited capability to move engineer stores and equipments, using integral transport, but large quantities of stores will usually have to be moved on other transport. If this movement is not controlled by the engineer commander, it should be monitored to ensure that the stores arrive in the right place at the right time and in the right order.

b. It will never be possible to hold all engineer resources on transport. Some will always have to be held on the ground. The engineer commander must, therefore, make timely plans to ensure that transport is provided to move resources when these are required.

c. It will often be necessary to dump resources forward, at or near work sites. Dumping is costly in labour, mechanical handling equipment (MHE) and time but makes best use of limited transport. The tactical situation must be carefully assessed in determining locations and stock levels. Dumps must be planned judiciously in conjunction with the operations and logistics staffs.

d. The limited numbers of critical engineer equipments require that, in case of damage or breakdown, their repair is high priority. The engineer commander must request that this support is rendered by maintenance forces as far forward and as early as possible, to reduce down time.

ENGINEER OPERATIONS IN FORCE PROJECTION AND SUSTAINMENT THROUGHOUT THE PHASE OF A CAMPAIGN



CHAPTER 4

GENERAL ENGINEER SUPPORT

SECTION I - FUNDAMENTALS

401. GENERAL

1. In addition to the provision of combat support engineering, engineers are also required to carry out a wide range of other tasks. These differ slightly between nations due to differences in national engineer responsibilities and equipment.

402. TASKS

1. Force support engineering encompasses the deliberate, longer-term preparation for, and indirect support to ongoing or future operations as well as those military engineering tasks associated with sustaining the joint force throughout all stages of an operation[4]. It will be the predominant engineer focus pre and post conflict and for rear operations during conflict. It is an area which may involve a greater degree of cross-component support and the engineer tasks will usually be more enduring, relying more on purpose-designed and built solutions. It is likely to fulfil a longer-term, operational requirement. Such tasks may include:

a. Emergency supply of water.

b. Construction of air landing facilities.

c. Airfield damage repair (ADR).

d. Provision and maintenance of utilities and structures.

e. Maintenance and construction of main supply routes.

f. Explosive ordnance disposal (EOD). Note that EOD is not exclusively an engineer task. Some nations select EOD operators from a different arm and operations to counter EO hazards may well require EOD trained personnel to be augmented by ammunition technical personnel or divers, for example.

g. Railways and ports.

h. Fuel storage and distribution.

[4] AJP-3.12

i. Geospatial support.

j. CBRN decontamination.

k. Emergency supply of energy.

l. Diving which can also involve support to close combat operations.

m. Force Protection Engineering (FPE).

403. LIAISON

1. In conducting force support engineering tasks, it will frequently be necessary for engineers to establish liaison with other arms/branches and services as well as the host nation to co-ordinate engineer support throughout the theatre. Detailed liaison and co-ordination will be a pre-requisite for the successful completion of all these tasks.

SECTION II - SUPPLY OF WATER

404. GENERAL

1. One of the most important requirements for a fighting force is an adequate water supply. The need for water will be in two major areas: water required by field units and water required by administrative bases and static units. Water supply to field units and formations will normally be provided by integral resources. Raw water sources will be used if domestic reservoirs are not available. Liaison with the appropriate staff branch is necessary in obtaining the use of domestic water resources from the host nation. The criteria for the emergency supply of water are set out in STANAG 2885.

405. RESPONSIBILITIES

1. The division of responsibilities for water supply is as follows:

a. **G3/G4 Staff**. Authorising scales and establishing policy on general location of water points and distribution methods.

b. **Engineers**. Development of sources, collection, treatment, storage and the operation of water points.

c. **Medical**. Testing and recommending methods of purification.

d. **Consumer Units**. Collecting water at the water point, distributing to sub-units.

406. PLANNING

1. The following information must be considered in planning water supply operations:

a. Quantity of water required.

b. Quality required for uses such as consumption, washing, machinery cooling systems or decontamination.

c. Source characteristics, such as locations, yield, nature, quality.

d. Existing facilities for treatment, storage, pumping and distribution.

e. Protection.

SECTION III - SUPPORT TO AIR OPERATIONS

407. GENERAL

1. The success of the land battle, and access to the area of a conflict, is often dependant on the air support available. The degree of air support is usually dependant on the timely provision of ground installations of suitable type, number and location. The planning and execution of the acquisition, development or construction of air landing facilities is likely to play an important part in all land operations. Engineers may be responsible for this work with appropriate technical advice from the joint air staff.

408. SUPPORT TO HELICOPTERS

1. Helicopter landing sites may require engineer preparation. This may include clearing areas and the provision of adequate angles of approach and take off; this may be a major task for engineers depending on the terrain and location.

409. AIRFIELDS AND AIRSTRIPS

1. Tactical air landing facilities may be required in the forward combat zone as well as in rear areas. These can range from airstrips, with minimal and temporary ‘austere’ facilities, to major ‘well found’ airfields, from which tactical fighter or transport operations can take place. The air force commander will determine the requirement for air landing facilities, the general area and the required standards. The engineer, in conjunction with the air and land component staff, will complete a detailed reconnaissance and estimate of the situation to determine the site selection and the location of various facilities. Technical standards for airfields will be defined by both the air component (required facilities, dimensions and bearing capacity) and by engineers (construction aspects). Facilities construction is an engineer responsibility.

410. EXISTING AIRFIELDS

1. It may be possible to reduce the engineer effort required for airfield construction by the rehabilitation of existing, damaged airfields, those captured from the enemy or by

using portions of roads; this may still entail considerable engineer effort. Work will include clearance of debris and damage caused by air attack or enemy demolitions and, often, the removal of mines or unexploded ordnance (UXO).

411. AIRFIELD MAINTENANCE

1. Airfield maintenance requirements will include the maintenance of buildings and facilities, the repair of runways, taxi-ways, aprons, drainage systems and utilities, and the removal of dust, water, snow or other foreign objects. This usually requires dedicated in-place resources.

412. PLANNING

1. The following information is likely to be required by engineers undertaking airfield tasks:

a. Type of aircraft to use the airfield.

b. Airfield standards: alignment, dimensions, bearing capacity, services and facilities.

c. Military and civilian resources available: heavy equipment, labour and materiel.

d. Time available for reconnaissance and construction.

e. Soil and drainage characteristics.

f. Expected life of the airfield.

g. Any improvements likely to be ordered.

413. AIRFIELD DAMAGE REPAIR (ADR)

1. The resumption of aircraft operations as soon as possible after an enemy air attack is essential, in order to maintain air support to the land battle. A requirement exists to repair airfields damaged as a result of enemy attack. This will encompass the following:

a. Damage definition and assessment.

b. Explosive Ordnance Disposal (EOD).

c. Repair of aircraft operating surfaces (RAOS).

d. Repair of Essential Services and Facilities (RESF).

414. DAMAGE DEFINITION AND ASSESSMENT

1. Reconnaissance may be a joint air and engineer responsibility. The requirement is to conduct both ground and airborne reconnaissance to determine the location and assessment of damage, extent of the UXO task and selection of optional repair areas. Based on damage estimates and engineer recommendations on the length of time and amount of work required to conduct repairs, the air commander selects the minimum operating strip, access and egress routes, and sets priorities for repair of essential services. It may then become an engineer responsibility to effect repairs and conduct EOD tasks as required. Criteria for ADR are set out in STANAG 2929.

415. REPAIR OF AIRCRAFT OPERATING SURFACES

1. The requirement is for rapid repair to provide temporary or permanent surfaces from which aircraft can safely operate for a specified number of passes. Special equipments and techniques are likely to be required in order to repair runways within specified times and meet surface roughness criteria and standards.

416. RESTORATION OF ESSENTIAL SERVICES AND FACILITIES

1. There may be a requirement to restore essential services and facilities such as fuel, electricity, lighting, arrestor gear, shelters, accommodation and roads or provide emergency equipment for these services.

SECTION IV - EXPLOSIVE ORDNANCE DISPOSAL (EOD)

417. GENERAL

1. A military capability is required to dispose of unexploded ordnance whether aerially or ground delivered or placed by hand. This includes the requirement to clear booby traps and improvised explosive devices (IEDs) and also the capability to deal with Chemical, Biological, Radiological and Nuclear (CBRN) threats in a CBRN environment. EOD requirements are laid down in STANAG 2143 and technical procedures are covered in AEODPs. A complete list of EOD related STANAGs is included at Annex A.

2. It should be noted that EOD is not exclusively the responsibility of engineers and the assignment of responsibilities for dealing with an EO[5] threat will depend on many factors such as: the type of operation; operational imperatives and directives; terrain; EOD or other asset availability; risk and EOD policy/ROE. The forces available to counter any EO hazard will consist of specially trained EOD personnel augmented by, amongst others, military engineers, ammunition technical personnel and divers. Former

[5] EO: all ammunition natures, improvised explosive devices (IED) and chemical, biological, radiological and nuclear (CBRN) devices.

belligerents[6], host nation agencies, other nations, international organisations and Non-Governmental Organisations (NGO) may also conduct EOD operations within the COA.

418. OPERATIONAL TASKS

1. EOD operations require an ability to carry out the following operational tasks:

   a. **Explosive Ordnance Reconnaissance (EOR).** The reconnaissance of EOD tasks to identify the requirement for EOD action.

   b. **Search and Location**. Search an area to accurately locate any UXO either on or below the surface (to a depth of 6 metres).

   c. **Access.** Operate the equipment necessary to gain access to any UXO located, exposing all or part of the munition for further EOD action and stabilise the surroundings sufficiently to allow the operator to work safely.

   d. **Diagnosis**. Identify the UXO and its fusing system where possible, and, using appropriate diagnostic equipment to measure critical thicknesses, assess and monitor the condition of munition fusing systems. This will require the use of such techniques as radiography and an ability to sample biological and chemical weapons without the escape of agent.

   e. **Containment.** Where the UXO presents a hazard to facilities or units which cannot be moved, it may be necessary, as part of the EOD task, to provide protection or containment measures to reduce the hazards from the UXO whilst EOD action is being carried out.

   f. **Render Safe Procedures (RSPs).** RSPs will often require the employment of remote systems. The ability to render a munition safe may require:

      (1) Detonation, where acceptable, deflagration or burning of the munition.

      (2) Disablement of the weapon, for example by disarming and/or defusing the munition.

      (3) Final disposal by removal and safe destruction, for example by detonation or burning, of all types of explosive filling.

   g. **Site Restoration**. On completion of the RSP phase of an EOD operation, restore the site as far as possible with existing resources, and assess and advise on any outstanding hazards or damage which may require additional assessment and work by other agencies.

[6] Notwithstanding the provisions of the 1949 Geneva Convention.

419. OTHER TASKS

1. EOD specialists may be required to assist in a range of EOD related tasks as follows:

a. **Provision of Advice.** Advise commanders, staff and units on EOD matters.

b. **Training.** Train units in mine or UXO awareness and the action to be taken by units on finding UXOs.

c. **Supervision**. Direct and supervise the area clearance of mines and other UXO by other (non EOD) units.

d. **Weapon Exploitation**. Carry out identification and destruction of captured enemy munitions and, where necessary, assist intelligence staffs in the technical exploitation of new weapons and in the production or development of appropriate RSPs for such weapons.

e. **Intelligence**. Maintenance and timely dissemination of EOD information, records and intelligence, including liaison with other formations and forces where necessary.

420. RESPONSIBILITIES

1. All arms/branches units are responsible for reporting EOD tasks through the chain of command.

2. EOD and EOR tasks are undertaken by units with specialist training. The responsibility for provision of EOD units varies between different nations.

421. COMMAND AND CONTROL

1. Command and control of EOD operations is primarily a G3 staff responsibility, but advice on priorities and tasking of military EOD operations may be delegated to engineer commanders, particularly at lower formation levels, such as brigades, where there may not be a specialist EOD cell within a headquarters.

2. EOD operations will require centralised and joint service control by EOD tasking cells at appropriate levels. EOD tasking cells must be capable of liaison with other formations, services and agencies, including those of allied nations. The JF Engr may be an appropriate individual to exercise a co-ordinating function over scarce EOD assets, briefing the force commander as required, as stated in AJP-3.12.

3. EOD team commanders will be primarily responsible for managing and controlling any EOD incident, and for providing advice at the scene to all arms/branches

commanders on the hazards and the action required. Safety of personnel and the minimising of risks will be a major consideration in deciding what action is required.

SECTION V - GEOSPATIAL ENGINEERING

422. GENERAL

1. Geospatial is the term used to describe those scientific and engineering activities involved in the capture, storage, analysis, processing, presentation, dissemination and management of geospatial information.

2. Geospatial support is essential to the conduct of modern military operations. Every weapon system, combat unit, aircraft and ship requires some form of geospatial support to deploy, navigate, manoeuvre and fight. Geospatial support includes a responsibility for updating, revising and maintaining geospatial databases, including paper maps, providing limited production capabilities, distributing geographic data including mapping and softcopy data, and other geospatial products conducting terrain analyses, providing terrain analysis teams to formations and conducting field surveys. Co-operation with the G2 staff, engineer and reconnaissance units is necessary to both obtain and confirm data. Liaison with the appropriate staff concerning the provision of geospatial information from a host nation is also essential.

423. DATABASE MAINTENANCE

1. Geospatial elements provide field support to users of map background displays both in hard and soft copies. It is necessary to ensure that geospatial information is readily available, up-to-date and distributed throughout the theatre. There is a requirement for close liaison with EOD and Engineer Intelligence staff as the maintenance of mines, UXO and general engineer intelligence related databases may also be done by the geospatial staff.

424. PRODUCTION

1. Geospatial elements have a limited capability for the provision of graphic support to staff and production of geomatic products, including mapping. However high speed, high volume reproduction capabilities may not be available in the field, in which case they must be provided by national base-plant resources.

425. GEOGRAPHIC INFORMATION DISSEMINATION

1. Geospatial elements are tasked to establish formation map supply points tied into higher formation, theatre or national networks. Responsibilities include shipping, receiving, inventory control and sourcing of geomatic data in both hard and soft copy. It does not include delivery to field units which remains a service support function.

426. TERRAIN ANALYSIS

1. Terrain analysis studies are undertaken to address specific concerns of the commander about the terrain and how it will affect the implementation of the plan. Terrain analysis consists of applying classic workflows and initiative to produce terrain analysis products using terrain databases in conjunction with other sources. It does not include information collection. The terrain analysis information provided is used by G2/G3/G4/Engineer and other formation staffs in planning operations.

427. FIELD SURVEY

1. Geospatial elements provide theatre level survey support to various weapon systems. They also carry out global positioning system (GPS) or terrestrial survey as required and can collect data for production of mission specific mapping either from the ground or from imagery. Other tasks can include obstacle locating and advice on navigation.

428. GEOGRAPHIC IMAGERY PROVISION

1. Although the majority of imagery is supplied from and for G2, Geospatial staffs also have access to imagery that can be used for production of image maps and graphics for the G3 element. This requires close liaison with G2 to ensure the correct prioritisation/classification, as the imagery sources will often be the same.

429. COMMAND AND CONTROL

1. For all operations at Div level and above it is necessary to appoint a Chief Geographic Officer to sit in the senior formation HQ. They are responsible for coordinating the geographic requirements for the operation. Tasks include production of a map distribution matrix, guidance on datum and coordinate information for the theatre, guidance on any border issues, prioritisation of geospatial support and advice to the formation commander on geospatial issues. Command of control of geospatial staff can sit with G2, G3 or Engr Branches as the nation/formation sees fit, the key point being that liaison between all staff chains is essential to ensure geospatial support is delivered most effectively.

SECTION VI - LOCAL PROTECTION AND SITE SECURITY

430. RESPONSIBILITIES

1. Basic deception, security and protection measures are all arms/branches responsibilities. Engineers are responsible for the provision of specialist advice, personnel, equipment and resources. These requirements will often be in competition with mobility and counter-mobility requirements requiring the same engineer resources. Tactical commanders must set priorities for engineer assistance and equipment and resource allocation. Operational and tactical security measures will include

camouflage, concealment and deception as well as active countermeasures directed at the enemy's intelligence resources; these may all involve engineer effort.

431. PROTECTION PROVIDED BY OTHER ARMS/BRANCHES

1. All arms/branches and services are responsible for their local security at all times and in any place. However, the technical capabilities of engineers cannot be used to maximum advantage if a considerable portion of an engineer element is involved in local security duties. The tactical commander must consider the threat to engineers and whether the provision of protection by other arms/branches will contribute to the overall success of an operation. This may be particularly relevant in an expeditionary style operating environment where engineers may frequently be required to work in small groups along lengthy lines of communication for considerable periods of time. In the latter case, they are vulnerable to a wide range of threats and must be adequately protected.

2. If protection is provided by other arms/branches, either as a specific task or because they are operating in the area of an engineer site, the engineers must liaise with the protecting unit to co-ordinate responsibilities, communications, as well as the exchange of information and intelligence.

3. Regardless of any additional protection provided, an engineer unit or sub-unit is responsible for taking measures to guard itself against enemy action which directly threatens the local security of personnel, resources and equipment.

432. ENGINEERS IN A CBRN ENVIRONMENT

1. Engineers must implement the general rules for defence against the CBRN threat which are common to all arms/branches.

2. National engineers may have specific CBRN responsibilities allocated to them; these vary from nation to nation and are not considered further in this publication.

3. Whatever special responsibilities are allocated to them nationally, engineers are very likely to be involved in the following tasks because of their generic capabilities and organisation:

a. **Assistance with Survivability**. With construction capabilities, engineers are well placed to advise and assist other arms/branches in the provision of field fortifications and other shelters against CBRN attack including improvised collective protection (COLPRO) against chemical attack; these measures are termed "Survive to Operate".

b. **Opening of Routes Through or Around Areas Affected by CBRN Strikes**. As part of their normal task of route opening and maintenance, engineers are likely to be tasked to clear routes blocked by the effects of CBRN strikes, or to open routes to by-pass contaminated areas.

c. **Decontamination**. Engineers may be called upon to construct traffic circuits and facilities in a decontamination point. In some armies, they may operate the point or provide water for it. Area decontamination may also be an engineer task.

d. **Release Other Than Attack (ROTA) and Toxic Industrial Hazards (TIH).** In built up or urban areas, there is considerable potential for engineers to have to deal with the effects of ROTA and TIH. Industrial areas, power stations and even hospitals offer a range of options for potential enemies to exploit.

433. EFFECTS OF CBRN WARFARE ON ENGINEERS

1. Engineers are more often and continuously engaged in hard physical work than any other arm or service. The adverse effects on engineer units of long periods in full CBRN protection will therefore be higher than for other units. Engineer efficiency will consequently be considerably reduced with a possible impact on the operational plan.

2. Engineer units are often widely dispersed in small groups and special arrangements for CBRN warning may, therefore, be necessary. These arrangements should also allow engineers to continue to work at reduced states of CBRN preparedness for as long as possible, allowing local commanders to exercise their own risk assessment based on information received and their own particular circumstances.

SECTION VII - HOST NATION SUPPORT (HNS)

434. INTRODUCTION

1. As mentioned in the previous chapter, there is a distinction to be made between HNS which is supplied by the host nation authorities, and In Theatre Resources (ITR), which are contracted for by NATO forces or others acting on their behalf. During recent expeditionary operations, NATO has had to become involved with both types. The availability of HNS/ITR and the state of the local infrastructure will clearly have a significant bearing on the requirement for engineers and the range of tasks they will be required to undertake. In more detail, HNS is “civil and military assistance rendered in peace, crisis and in war by a host nation to allied forces and NATO organisations which are located on or in transit through the host nation’s territory.” The type of HNS which may be provided ranges from services using only civilian resources, to support from military units. HNS may be provided to all arms/branches; however engineers will frequently be major users of HNS because of their roles and reliance on materiel.

2. Due to the changed operating environment already described, the increasing trend to conduct expeditionary style deployments on a global scale, including to areas which have few resources, means that reliance on HNS can no longer be

assumed. This places greater emphasis on engineer activities which will increasingly be required to meet the demands of the local populace as well as the Alliance force itself. This aspect is considered further in chapters 4, 5 and 6 and in Annex D.

435. HNS RESOURCES

1. Where available, HNS resources which are likely to be of particular interest to engineers include:

a. **Airfields/Sea Ports.** This includes facilities, maintenance services, work areas, warehousing, storage, security, repair and airfield damage repair (ADR).

b. **Civil Labour.** Skilled and/or unskilled labour may be available.

c. **Construction.** Engineering services, damage repair to facilities including ports and transport infrastructure and bridging may be provided.

d. **Facilities.** Maintenance work, spares and storage facilities may be available.

e. **Supplies and Services.** Rations, water and utilities may be provided.

f. **Transportation and Movement.** Transport, traffic control, materiel and container handling equipment may be available.

436. PROVISION OF HNS

1. The efficient provision of HNS requires close liaison between allied forces and the host nation authorities, including the determination of priorities. Whenever possible HNS should be pre-planned in peace. There are three options for the provision of HNS:

a. **Generic Planning.** Generic plans are those which are developed for possible operations where some of the planning factors have not been fully identified or cannot be fully assumed.

b. **Contingency Planning.** These plans are developed for possible operations where planning factors have been identified or can be assumed; they are produced in as much detail as possible.

c. **Ad Hoc Planning.** Ad hoc plans are tailored to meet unforeseen circumstances as they arise or to update generic or contingency plans.

SECTION VIII - FORCE PROTECTION ENGINEERING (FPE)

437. INTRODUCTION

1. **Force Protection Engineering**. Force Protection Engineering (FPE) is defined as “those engineering activities whose primary purpose is the minimisation of the risks to a force’s assets and its operational effectiveness, from the actions of an adversary”. It is the engineering effort conducted in support of the wider aim of delivering protection, a key component of capability.

2. **Active and Passive Protective Measures**. Physical protection is provided by a combination of active and passive measures. It is essential that any FPE planning takes both of these into account and that their interdependence is not overlooked. Any reduction in one must be matched by an increase in the other, if the same level of protection is to be sustained.

   a. Active. Matters of procedure or operation such as mortar baseplate patrols or vehicle checks are referred to as active measures.

   b. Passive. Structures and other physical systems which provide protection eg blast walls and intruder detection systems are collectively known as passive measures.

3. **Maintaining Operational Momentum**. Active measures not only serve to increase protection, they also give a force the means by which it is able to maintain a proactive, offensive spirit and avoid developing a reactive siege mentality. This is an important factor to be considered when planning passive protective works, as an over-reliance on them could undermine the tempo that commanders will seek to maintain within an Operation. In stabilisation operations the maintenance of a physical, presence becomes more important. In this environment, Force Protection Engineering (FPE) becomes more significant.

438. THREAT AND RISK

1. **Threat and Risk**. ‘Threat’ is defined as the possibility of an undesirable event taking place. In the context of military operations it is the possibility of an event which may adversely affect Combat Fighting Power (CFP) or compromise the mission. Threat is the product of capability and intent on the part of an adversary. Both constituent parts must be present for a credible threat to exist. A threat assessment in relation to adversary threat is produced by the J2 staff. The inherent threat from environmental dangers or from our own or allied weapons and systems exists without there being an intent. ‘Risk’ however takes into account both the likelihood of the event and the significance of the consequences, i.e. the impact it will have on a force’s assets or its ability to prosecute its mission. Therefore risk can only be determined with J3 (Ops) input. Once a level of risk has been established following an assessment of the threat, a number of options are available as to how to manage it:

a. **Avoid**. The risk may be avoided by relocating or removing the vulnerable asset from that area.

b. **Reduce Likelihood**. The probability of a threat occurring can be reduced, usually through taking some action to deny an aggressor the opportunity to conduct the attack. Alternatively, physical security measures such as sensors and CCTV may cue an active response.

c. **Reduce Significance**. The impact of an attack can be reduced through a range of physical, mainly passive measures such anti-rocket screens.

d. **Accept**. The Commander may accept the risk and take no further action.

2. **Risk Balance**. It is impossible to eliminate all risks. Therefore whilst work is often done to mitigate it, some level of risk must be accepted. It is important however that the level of residual risk is understood and that a calculated decision is taken rather than a blind one. Figure 1/1 shows the relationship between the threat, protective measures and any residual risk.

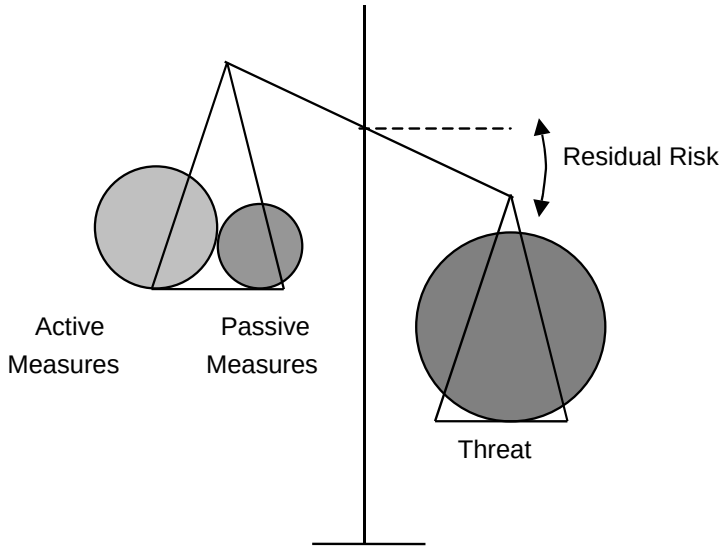


Figure 1/1. The Balance Between Active/Passive Protection, Threat and Residual Risk.

439. THE FPE SPECTRUM

1. **The FPE Spectrum**. In practice, FPE manifests as a series of engineering measures undertaken in all 3 environments present in the Continuum of Operations. Figure 1/2 gives some examples. The engineering structures and systems themselves may be primarily intended for one specific part of the spectrum but may be of wider use.

For example, battle trenches intended for the warfighting environment may have some use in the peace support environment. It is important not to confuse the phase of an operation with the operational environment:

a. **Warfighting**. In the Warfighting environment speed of construction is likely to be essential if the operational objective is to be achieved. Consequently there is a greater readiness to accept casualties in this environment than in the others.

b. **Peace Support**. In the Peace Support environment structures may have to withstand deliberate or accidental attack from conventional or asymmetric threats.

c. **Deployed Garrison**. In the Garrison environment the nature of the assets under protection or the level of threat may justify the adoption of more complex, time-consuming construction. It is also more likely that greater consideration is given to financial factors.

2. **Flexibility and Preparing for Future Threats**. Within any particular Operation or deployment, these 3 environments may well exist simultaneously at different locations. Furthermore, the level of threat faced will most probably fluctuate throughout the progress of the Operation. The protective measures employed may therefore vary considerably across the battlespace as a whole and will most likely change with time. However, the construction of physical protective measures may take some time and can be costly. Therefore they must offer flexibility and allow for subsequent changes in threat either by built-in redundancy or the ability to upgrade simply. The threat picture upon which they are based will always remain fluid and subject to rapid change. Consideration must be given to protection at all stages of a deployment and it must be kept under constant review.

3. **Adapting to Local Conditions**. Great care must be taken when taking FPE solutions from other Operations or theatres and using them as a template. This undoubtedly speeds up the design and ultimately delivers a solution more quickly. However it may not be the most appropriate for local circumstances. As ever, engineering judgement must be applied. The local environment, availability of resources, design support and skill of the construction force will have an influence on the selection of the most suitable solution. Therefore FPE measures must be adapted to take these local constraints and factors into account.

4. **Political and Presentational Factors**. The physical protective measures employed by a force must also take into account the political and presentational impact they may have. The loss of an asset may often have more significance to the overall mission in this context, than if measured purely in terms of physical value to the force.

a. **Force Posture**. The protective measures adopted by a force give a clear indication of how vulnerable it feels itself to be. Any FPE work must be in harmony with the force posture the commander wishes to present.

Indeed, it is likely that the commander may wish to use the physical protective measures adopted by the force, as a principal means by which its posture is expressed. It is therefore important to plan for both the removal and not just installation of those measures. On occasion it may be necessary to make considerable effort to conceal the true level of protection adopted in order to reconcile the need for protection with the demand for an open force posture.

b. **Stabilisation Operations**. Any such construction work also gives a visible indication as to how long the force believes it may take to create a stable security environment. Often commanders will require any adopted measures to have a temporary appearance in order to reinforce the expectation of a speedy return to stability.

c. **Political Resolve**. However, substantial construction work may also be seen as demonstrating commitment by the force to a long-term presence until a more stable security environment exists.

d. **Morale**. Operational experience has repeatedly shown that FPE preserves both the physical and moral components of fighting power. Our Forces must have confidence in the structures and systems provided for their protection. Sagging Hesco Bastion Concertainer shelters may still work but do nothing to inspire a sense of security. Moreover, the morale of a force is better sustained if its personnel are given a secure location in which they can relax when 'off-duty'. Operational experience has shown that constant fear of injury from an attack without respite, quickly erodes fighting power. FPE therefore significantly increases a force's endurance.

e. **Host Nation Perspective**. The host nation may limit what measures may be used, both active and passive.

440. MITIGATING RISK

1. **Systematic Approach**. Effective protection does not rely on a single technique or action but comes from a balanced combination of active and passive measures into a coherent, flexible system. This systematic approach to integrated survivability seeks first to prevent attack. Were an attack to take place, its effect should be reduced. If an effect is felt, the protected asset should have the robustness to maintain operational capability. It is essential that this systematic approach is applied from outside the asset and works towards it.

a. **Prevent an Attack**. Ideally the FP measures adopted should prevent an attack.

(1) Deny. Denying an aggressor the opportunity to conduct recce or to acquire a target may prevent an attack. This may be accomplished

passively through using natural or man-made screens or actively through patrolling.

(2) Deter/Deflect. Robust, active and passive measures may deter in an attack through creating an assertive force posture. Not all aggressors will attack without any concern for their own safety. If their target appears capable of defending itself in a way that may injure or kill them, they may either chose an alternative target or wait for an opportunity to attack when the risk to them is reduced. Even a suicide attacker may be deflected in this way, if he/she feels that their objective may not be attained. Patrols around potential mortar baseplate locations, sniper firing points or likely escape routes may all significantly deter an attacker. By deterring the attack, either it will not take place at all or it may be deflected elsewhere against a less well protected asset.

b. **Reduce the Effect of an Attack**. If prevention fails, FP measures should reduce the effect of an attack.

(1) Detect. Early detection of an attack or breach of perimeter security may cue an active response in time to limit the damage done during an attack.

(2) Defend. All locations should be prepared to defend themselves robustly. Defensive measures should provide an interlocking, mutually supporting network.

(3) Delay. Delaying or slowly an attack will give the defenders the chance to recover the initiative and co-ordinate an active response. Fences or other barriers may delay an attacker. However, to be effective they must be over-looked either by view or more ideally by arcs of fire. The defenders' response time must always be taken into account.

(4) Disrupt. In addition to delaying and attacker, active and passive measures may also disrupt an attack.

(5) Depth. To be both robust and effective, a system of systems is required. Collectively these measures provide depth of protection.

(6) Deception. Deceptive measures seek to reduce the effect of an attack in 2 ways. Firstly they aim to conceal actual vulnerabilities such as Ops rooms. Secondly, they are intended to make an aggressor waste time and effort on less vulnerable assets. Reflecting this, deceptive measures may either obscure the identity of vulnerable assets or make them appear to be something else.

c. **Improve Target Resilience**. In order to ensure the maintenance of operational effectiveness, it is important both to improve the force's resistance to attack and to speed its recuperation back to full effectiveness following an attack. This is done through pre- and post-attack measures.

(1) Dispersion. By dispersing assets the risk of losing them in a single strike is reduced. However more effort is required to protect them.

(2) Duplication. Providing duplicate or back-up facilities creates redundancy in the system, which allows for the loss of critical assets such as communications, electrical power or a HQ.

(3) Deal with the Consequences. Consequence management is an essential part of the process of recuperation. FPE measures such as the preparation of evacuation routes and shelter areas or the construction of alternative ICPs will help a defender deal with the consequences of an attack and restore full fighting power as quickly as possible.

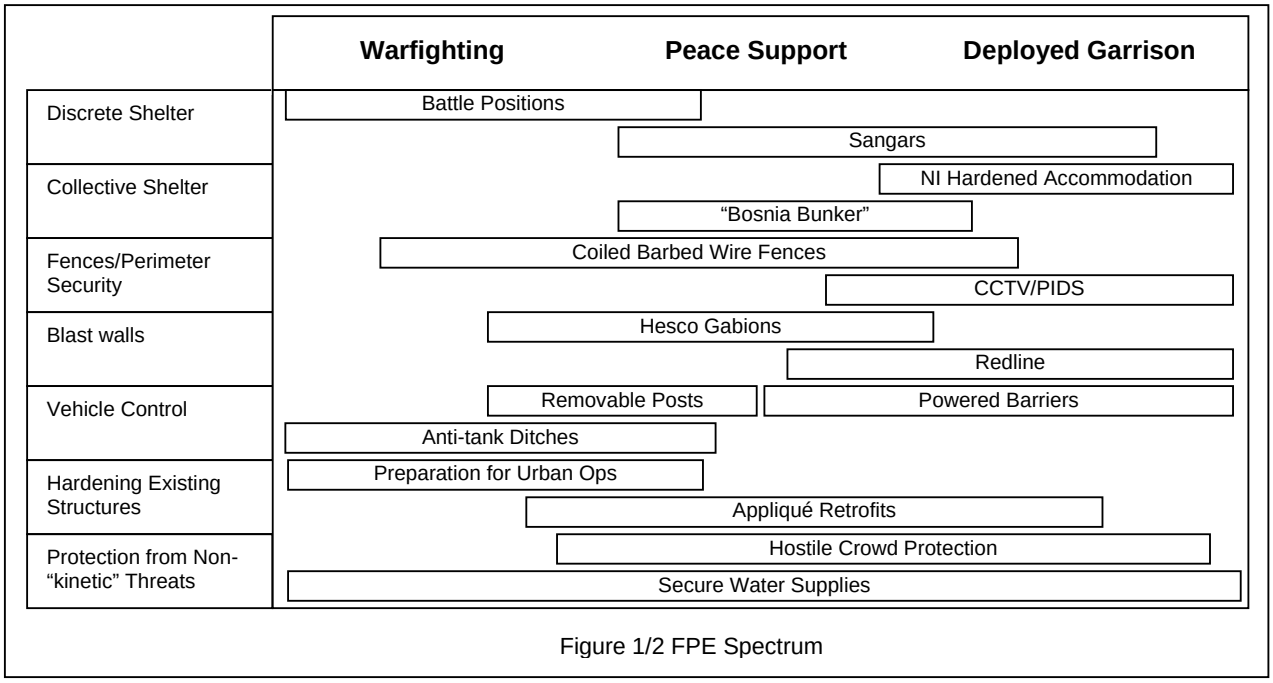


Figure 1/2 FPE Spectrum

CHAPTER 5

OFFENSIVE OPERATIONS

SECTION I - FUNDAMENTALS

501. PURPOSE

1. The manoeuvrist approach seeks to shape the enemy's understanding, undermine his will and shatter his cohesion, exploiting his vulnerabilities in order to degrade his critical capabilities. It is applicable to all types of military operation across the continuum of operations. Implicit in this approach is the requirement to protect friendly forces and to shape the perceptions of civil populations. In this context, the purpose of offensive operations is to defeat the enemy by application of focused violence, not only on the enemy's forward elements but throughout his depth. Manoeuvre in depth poses an enduring and substantial threat to which the enemy must respond. He is thus being forced to react rather than being able to take the initiative. Physical destruction of the enemy is, however, merely a means to success and not an end in itself. The requirement is to create paralysis and confusion thereby destroying the coherence of his defence, fragmenting and isolating his combat power. Further purposes of offensive action might be to:

a. Seize ground.

b. Gain information.

c. Deprive the enemy of resources.

d. Deceive or divert from main effort.

e. Fix the enemy to prevent him from regrouping or repositioning his forces.

f. Pre-empt to gain the initiative.

g. Disrupt enemy offensive action.

502. ENEMY

1. The enemy's aim is to halt our offensive operation, destroy our forces and restore his own freedom of action. To achieve his aim, he may:

a. Use obstacles, especially mines, to restrict and disrupt our movement and to cause casualties.

b. Maintain reserves to counter attack and exploit our weakness.

c. Use asymmetric forces and means to achieve his end-state.

503. ENGINEER SUPPORT

1. A range of engineer activities will be required to support the offence. Mobility is vital to achieving success in offensive operations and therefore engineer support will be central in maintaining the speed and momentum of an attack. In this way, the joint force commander can seize the initiative and achieve surprise by his selection of the timing and direction of attack. Counter-mobility tasks, particularly flank protection, the fixing of enemy counter-attacks forces and the closure of enemy withdrawal routes, are also important. Engineers will be required to support attacking forces by any or all of the following actions:

a. Breaching, marking or opening our own, as well as enemy minefields.

b. Providing the means of crossing rivers or other obstacles.

c. Securing the flanks by means of minefields, demolitions and other obstacles. These also help to shape and structure the battlefield and may allow commanders to use economy of force measures for force protection.

d. Preparing and maintaining routes for follow-up echelons.

e. Supporting the consolidation on the objective by digging, laying minefields and creating obstacles.

2. The achievement of these functions depends on adequate reconnaissance, timely provision of the necessary equipment and stores, and on the proper grouping and control of engineer elements, particularly minefield breaching and gap-crossing armoured vehicles.

SECTION II - MOBILITY

504. GENERAL

1. NATO forces require freedom of movement and the ability to cross obstacles so as to maintain tempo and momentum in support of offensive operations. The engineers' most important task in supporting the offence will be to overcome obstacles. They will also need to open, improve and maintain routes, so that follow-on forces can advance, forward re-supply can be carried out and casualties evacuated. Additionally, forward operating bases (FOBs) and forward arming and refuelling points (FARPs) may have to be prepared for aviation elements which are participating in the attack. Given greatly increased levels of situational awareness

and the migration towards network enabled capabilities, NATO nations will be able to assemble engineer mobility assets as required in time to meet known and predicted challenges as a result of their overall knowledge superiority.

505. ROAD MOVEMENT

1. Engineer units must follow the general rules for road movement laid down for all arms/branches. They may move either as separate movement serials or with elements integrated into a support unit's plan. Engineer involvement in supporting mobility is addressed in other chapters.

506. PLANNING MOVES

1. The engineer commander will participate in planning the movement of the supported formation. He will use engineer intelligence to recommend routes, by-passes or necessary reconnaissance to the tactical commander.

507. ROUTE RECONNAISSANCE

1. Engineers should be included in route reconnaissance parties. They should ascertain whether the condition and capacity of the routes are adequate; if not, remedial actions, such as diversionary routes, restrictions and the reinforcement of bridges, are to be planned.

508. ENGINEER SUPPORT TO ROAD MOVEMENT

1. It will normally be the responsibility of the in-place force to maintain routes within its area. Engineer tasks in support of road movement will include:

    a. Engineer reconnaissance.

    b. Establishment of by-passes.

    c. Clearance of obstacles.

    d. Building of bridges.

    e. Damage Repair.

    f. Road Upgrades.

Responsibilities may vary between deep, close and rear operations and across different components.

509. ENGINEERS IN THE MOVING FORMATION

1. In order to maintain the momentum of road movement, engineer detachments will usually move as, or with, the first movement elements. Engineers may be required to pre-deploy some engineers into the theatre of operations in order to:

a. Clear route obstructions.

b. Deal with scatterable mines.

c. Fill craters and repair route damage.

d. Bridge gaps.

2. If engineer tasks are to be accomplished during the preparation for operations by formations, engineer units will frequently have to move independently. In this case, the commanders of the engineer units will be responsible for movement and for movement security. If necessary, they should request the protection of air defence and other units during the move.

510. CROSSING OF WATERWAYS AND BREACHING OF OBSTACLES

1. Any obstacle can be overcome given sufficient resources and time. However, in an attack, the combined arms/branches commander must attempt to force his way to the other side of the obstacle before the enemy can fully organise defensive preparations.

2. At first, leading elements will determine the extent of the obstacle and seek a bypass. If there is no bypass, the tactical commander will attempt a hasty crossing of the obstacle, without loss of momentum, using the resources immediately available to him. He should have assault bridging and breaching resources grouped with the force in anticipation of the minor obstacles which he can expect to encounter during his advance.

3. If an obstacle cannot be overcome, a deliberate crossing operation will have to be carried out which requires new orders, bringing up additional breaching and/or crossing resources, and the employment of specific breaching and/or crossing procedures. Water crossing procedures are contained in STANAG 2395 and are described later in this Chapter.

4. Crossing operations may be carried out in three overlapping phases:

a. Assault, to gain a lodgement on the far side of the obstacle. This phase is not required for an unopposed crossing.

b. Build-up, to extend the lodgement into a bridgehead.

c. Consolidation, to establish a firm base within the bridgehead from which to break out and continue the overall operation.

511. FORCES AND TASKS

1. Forces employed in a crossing operation may be organised as follows:

a. **Bridgehead Force.** The bridgehead force consists of an assault echelon and a main body. The assault echelon is tasked with gaining the lodgement, normally by seizing intermediate objectives. The main body conducts the build-up phase and participates in the consolidation phase. Within its area of responsibility the force has normal responsibilities for security including the far side of the obstacle.

b. **Break-out Force.** The break-out force is tasked with the continuation of the overall operation. This force will conform to the bridgehead force regarding use of ground in the bridgehead. In some circumstances the break-out may be an additional task for the bridgehead force.

c. **Force in Place.** When an allied or national force is already in place along the obstacle it may be called upon to assist the bridgehead force during the crossing. A passage of lines will occur as the bridgehead force and the break-out force pass through the force in place.

512. MINEFIELD BREACHING

1. Minefield breaching will invariably be part of a combined arms/branches operation. In many instances the minefield will be merely one of a series of obstacles to be breached; the overall obstacle, in this instance, is described as “complex”, thereby posing a considerable challenge to engineers. Increasingly such breaching may take place in an urban setting, reflecting the realities of the contemporary operating environment.

a. **Reconnaissance.** The task of determining the boundaries of a minefield is an all arms/branches responsibility. The physical reconnaissance within a minefield is an engineer responsibility.

b. **Locating Minefields.** Modern reconnaissance and surveillance techniques as well as information obtained from maps, terrain analysis and/or other sources enable a commander to determine likely mined areas. The use of all arms/branches reconnaissance, supplemented by engineer reconnaissance well forward, will provide timely advice on minefield locations thus allowing a commander to adjust the deployment of his force and position breaching equipment so that it can be used quickly. It is essential that planning and preparations commence before the obstacle is reached.

c. **Minefield Composition.** It may not always be necessary to determine the exact composition of a minefield, particularly if a combination of explosive breaching and other methods is used. However, if a deliberate operation is to be conducted, it is advantageous to determine the composition of a minefield prior to breaching. As a minimum, the width, depth and details of enemy weapons covering the minefield are essential.

d. **Breaching.** Breaching may be conducted as a hasty or deliberate operation, by hand, mechanical or explosive means, or using a combination of means. Once lanes are established they are marked in accordance with STANAG 2036.

e. **Hasty Breach.** An attacking force will attempt to breach from the march using breaching resources within the force. Very little reorganisation of the assault echelon is required and SOPs may be developed for breaching to commence with little or no additional orders being given. Engineer support will come from resources on hand. The scope of engineer support can include reconnaissance, provision of advice, and the breaching, proving, marking and maintenance of lanes.

f. **Deliberate Breach.** If a breach cannot be conducted from the march or if the obstacle is too complex to be crossed using the resources on hand, deliberate breaching will be attempted. The resultant loss of momentum has to be accepted as more time is required for reconnaissance, planning and the build-up of necessary resources. Engineer support to the deliberate breach is extensive. Timely and accurate intelligence is required to determine the extent and composition of the minefield, and hence the structure of the breaching force. This force normally consists of infantry, armour, engineers, indirect fire support and close air support (CAS). Engineer support to a deliberate breach is likely to include the following:

(1) Detailed reconnaissance of the minefield to determine locations of mine rows and types of mines.

(2) Provision of engineer advice to commanders.

(3) Provision of special engineer equipment and personnel to assist in the conduct of the breach.

(4) Proving, marking and maintenance of lanes.

513. SHORT GAP CROSSING

1. Preparation for the crossing of short gaps must be preceded by map and terrain analysis as well as air and ground reconnaissance to determine gap

locations, widths and the grouping of engineer resources to support manoeuvre units. Short gaps are normally crossed from the march by combat units employing organic engineer support or using expedient means. Armoured engineers employing fascines, vehicle-launched bridges and armoured engineer vehicles will be the likely means of crossing short gaps. Vehicle-launched bridges will normally remain in place to be crossed by follow-on elements and some logistics, and eventually be replaced by support bridging. In addition to the preparation of crossing sites, engineers will also mark the immediate approaches and exits in accordance with STANAG 2036.

514. OPPOSED WATER CROSSING PROCEDURES

1. Water crossing operations will be conducted in accordance with STANAG 2395.

a. **Deliberate Crossings.** When a water obstacle cannot be crossed from the march, using existing bridges, fording, swimming or on-hand bridging resources, and the assaulting force is in contact with the enemy, a deliberate crossing operation will have to be carried out. The crossing may be conducted in three overlapping phases: assault, build-up and consolidation. Two main forces may be involved: a bridgehead force and a break-out force. The critical functions of a water crossing are: security, movement control, terrain control and crossing support.

b. **Movement Control.**

(1) Planning and control of movement across water obstacles is the responsibility of the tactical commander of the crossing operation. He must be aware of the effect that the composition of forces needed on the far side of the obstacle will have on these functions and develop his crossing plan accordingly.

(2) The movement control organisation will be responsible for ensuring a coordinated and effective movement to and from the crossing sites.

(3) Unit Commanders will be responsible for the movement of their own forces subject to the instructions of the movement control organisation and crossing site commanders.

c. **Engineer Advice.** Each level of command in a water crossing operation will normally have an engineer who is responsible for the technical aspects of executing the crossing.

d. **Communications.** The crossing plan must take into consideration the need for key communications nets. These may include nets for tactical command, movement control and engineer command.

e. **Other Support.** Recovery and medical services should be readily available so that delays are minimised.

515. ROUTES FOR TACTICAL MOVEMENT

1. Despite the improved mobility of modern combat and logistic vehicles, engineer support will be required to open and maintain multiple routes for tactical movement. Keeping routes clear of obstacles and mines is a particularly important task for land forces engineers to ensure tactical mobility and sustainment of the force. Such routes and lanes must also be properly marked for friendly forces in accordance with STANAG 2036.

a. **Route Reconnaissance.** Reconnaissance is required to determine the availability and trafficability of routes. Existing route networks must be checked and limitations or shortfalls identified. The reconnaissance must then determine what additional routes must be provided, taking account of the resources available.

b. **Routes for Combat Vehicles.** Routes primarily for use by combat vehicles are normally designed and constructed to carry limited traffic for relatively short periods. Requirements for construction will vary based on local conditions.

c. **Routes for Logistic and Other Wheeled Traffic.** Routes for wheeled traffic in the forward areas are usually built to support a moderate volume of traffic. The construction effort is likely to be more extensive than for tracked combat vehicles but similar techniques will be used; maintenance teams will be required. Routes can be subsequently upgraded if they are to be used more extensively.

516. SUPPORT TO FORWARD AVIATION

1. The types and sophistication of aviation ground facilities will vary but they may be characterised by limited numbers of aircraft and short periods of use. During the preparation of such facilities, expedient techniques are used and construction is limited in order to reduce the chance of enemy detection. The types of support which may be provided are:

a. Construction of helicopter landing sites (HLS); FOBs and FARPs.

b. Construction of landing strips, including the adapting of roads and other hard surfaces for use by aircraft.

c. Maintenance and repair of existing airfields, landing strips and other facilities.

d. Preparation of drop zones.

SECTION III - COUNTER-MOBILITY

517. GENERAL

1. Terrain, situation and target oriented barriers may be used in offensive operations. To limit the restriction on friendly force manoeuvre, control measures, such as Barrier Restricted Areas (BRA) may be imposed; these are further discussed in Chapter 6. In offensive operations, counter-mobility tasks may include:

a. Flank protection.

b. Consolidation on an objective with consequent adoption of a defensive posture.

c. Denying enemy withdrawal routes

518. FLANK PROTECTION

1. Support to flank protection forces is likely to be the most important counter-mobility task for offensive operations with an open flank. Engineer tasks could include:

a. Route denial.

b. The planning and use of rapid scatterable mine systems.

c. Preparing a range of other obstacles depending on time and the terrain.

519. CONSOLIDATION

1. Engineers must plan for and be ready to execute a rapid transition to defensive operations. When an objective has been taken, engineers may carry out counter-mobility tasks in order to support the attacking force against counter-attacks such as those listed above in para 518.

2. Care must be taken during consolidation that any counter-mobility activities undertaken do not impede our own freedom of manoeuvre, in relation to subsequent offensive operations.

SECTION IV - SURVIVABILITY

520. GENERAL

1. During offensive operations, use of multiple routes, dispersion, highly mobile forces and wise use of terrain are the best ways to ensure survivability. Planned measures must not unduly restrict the force's ability to manoeuvre at will. This will allow the commander to achieve concentration, speed and flexibility. The following engineer measures may be used:

a. Field fortifications.

b. Camouflage.

c. Deception.

521. FORTIFICATIONS

1. Engineers may construct fighting positions for tactical vehicles and weapon systems. Although not as extensive as in the defence, protective emplacements for artillery, air defence units and logistic concentrations are normally considered in the plan. Commanders may require hardening of key command and control facilities, especially those with a detectable electronic signature. Engineer assistance during offensive operations also may be required to provide field fortifications for:

a. Reserves waiting in hide areas.

b. Assault forces consolidating on an objective.

c. Manoeuvre forces which are required to halt during the advance.

d. Supplementary and alternate positions.

522. CAMOUFLAGE

1. In a fast-moving offensive situation, time may not allow extensive camouflage measures to be taken. Engineers advise on site selection and proper use of terrain to provide the most expedient camouflage.

523. DECEPTION

1. Deception often plays a significant role in the success of offensive operations. Measures taken by engineers might include the construction of fighting positions, the installation of dummy equipment and the emplacement of phoney minefields to support formation and unit deception plans. Engineer support to diversionary attacks can also be used to help gain surprise and advantage for an attacking force.

CHAPTER 6

DEFENSIVE OPERATIONS

SECTION I - FUNDAMENTALS

601. PURPOSE

1. Defensive operations contribute to achieving decisive victory. They should be seen as a temporary measure to gain time, to reduce the enemy's strength relative to the defence, or to hold the enemy in one place while attacking him elsewhere. The inclusion of delay as a defensive operation (see chapter 1) also means that ground may be yielded in order to retain flexibility and freedom of action. During defensive operations, the enemy may have the initiative and will seek to seize terrain or break through into a vulnerable area. Defensive operations may therefore aim to break an enemy attack, slow his advance, manoeuvre him to expose weakness, determine his main effort and avoid combat under undesirable conditions. In so doing they create the circumstances for offensive action. This aggressive spirit is fundamental to the successful defensive battle which must not drift into a situation where the defending force merely reacts to enemy moves. Every opportunity should be taken to grasp the initiative and force the attacker to react to the defensive plan.

602. ENEMY

1. The aim of a conventional enemy force will be to maintain momentum, unbalance NATO forces if possible or fix them in order to seek a rapid and decisive engagement. To achieve this aim he will rely upon:

a. The maintenance of mobility in order to:

(1) Move his forces quickly to the battle area.

(2) Deploy them into tactical formations without delay.

(3) Concentrate them at the selected points of main effort in sufficient strength to achieve a breakthrough and then reinforce success.

(4) Maintain the appropriate force ratio to sustain the attack by replenishing front-line forces and subsequently replacing them with follow-on echelons.

b. Surveillance to identify and target the positions of our own troops, particularly reserves.

c. Firepower to suppress and destroy those positions.

d. Restricting the mobility of NATO forces so that he can attack or bypass them.

603. DEFENCE PLANNING

1. Fire, movement and obstacles are decisive factors in all operations. Obstacles are an essential element of defensive operations. Engineers must be directly involved throughout the barrier planning process which is an integral part of operational planning.

2. All obstacles, laid by any means or arm, must be coordinated, usually into belts and zones, with the barrier plan. Commanders, advised by engineers, must submit their requests for obstacles planned by the engineers. The appropriate commander will then approve these requests, based on engineer advice.

3. The tactical commander may impose certain conditions on barrier planning and operations such as the designation of BRA to ensure his own freedom of manoeuvre and the main point of engineer effort. Lanes through, and gaps between barriers, must be kept open and then be able to be closed rapidly on order.

4. For obstacles of particular importance, the tactical commander may impose the requirement for guards e.g. for reserved demolitions or other obstacles, or impose restrictions concerning the firing of demolitions and the employment of scatterable mines.

5. In defensive operations, the tactical commander's plan may include the covering force, main defence and rear areas. In the delay, the aim will be to disrupt enemy progress repeatedly, using multiple barriers with minimum time and effort. The enemy will be forced to advance cautiously and present targets, especially his own engineer assets. In this way, obstacles gain time, save manpower and inflict enemy casualties.

604. ENGINEER SUPPORT

1. Engineer support to defensive operations consists primarily of:

a. Counter-mobility tasks, in conjunction with combat forces and coordinated with direct and indirect fire weapons, to deny the enemy the mobility he requires and to cause casualties to his attacking forces.

b. Survivability tasks to enhance the concealment and protection of our own forces.

c. Mobility tasks to maintain routes and to support counter moves over all types of terrain. In this way, the all arms/branches commander is able

to concentrate combat power to achieve favourable force ratios in order to defeat the enemy at a place and time of his choosing.

SECTION II - COUNTER-MOBILITY

605. GENERAL

1. The maximum effect is obtained from obstacles when they are employed in combination, and when they are covered by fire. They are likely to include natural and manmade obstacles which must be coordinated with host nation advisors, when appropriate, and comply with host nation agreements as well as ROE. Anti-tank minefields will often be the most important element of any obstacle plan. Modern mine systems considerably increase the effectiveness of minefields since:

a. Minefields can cause considerable casualties and delay to the enemy as well as disrupting his movement and forcing him to present an attractive target array to Air, aviation and indirect fires.

b. Forces are able to emplace a greater variety and quantity in less time, particularly using scatterable mine systems.

c. The laid life of modern minefields can be pre-selected in accordance with tactical requirements. The effect of laid-life mines on the manoeuvre plan must be considered during engineer planning.

d. Future mine systems will feature self destruct (SD) and self neutralise (SN) capabilities or even the ability to be turned on and off at will to suit the commanders plan. This will be particularly well suited to delaying options.

2. Minelaying procedures are covered in STANAG 2036. Other aspects concerning all obstacle types are discussed below and the family of obstacles is shown at Annex B.

606. CONCEPT OF EMPLOYMENT

1. An effects based approach to counter mobility is required to meet the current and future operating environment. The commander will express his intent in terms of the effect on the enemy which he wants to achieve such as disrupt, turn, fix or block. This approach to obstacle planning is called Combined Arms Obstacle Integration (CAOI) and ensures the optimum integration of available assets. It is briefly described at Annex B. Barriers must be co-ordinated with the overall obstacle plan and can be employed in three ways:

a. **Terrain Oriented Barriers**. Planning for these obstacles may be based on a thorough terrain analysis and long term planning, and is

related to the tactical commander's initial concept of operations. The individual obstacles may be prepared prior to hostilities (increasingly unlikely), and could be either permanent or field type. They may include minefields, demolitions and constructed obstacles. They form the backbone of the obstacle system because they reinforce or modify the existing terrain to the defender's advantage and should be prepared as far forward and as early as possible. Where appropriate, logistic and organisational planning for obstacles is carried out in peacetime.

b. **Situation Oriented Barriers**. Once enemy deployment for an attack has commenced, additional intelligence will become available which will confirm or revise the assessment of the enemy's intentions. Specifically, his likely axes of advance and selected points of main effort should be identified through the dynamic IPB process and an indication of the force ratio expected should be determined. Additional obstacles may then be implemented in these areas to strengthen the existing defence once an anticipated enemy course of action has been confirmed. They may be planned prior to the start of an operation if this is possible, to allow their rapid execution when required. Scatterable and remotely delivered mines or other rapidly emplaced obstacles are likely to be used because of the speed of reaction required especially for the closure of breached obstacles. Other types of mines, demolition and obstacles may be used if time permits.

c. **Target Oriented Barriers**. Scatterable mines, delivered by fixed wing aircraft, helicopter, rocket or artillery, offer the ability to attack targets directly, for example manoeuvring or resting units or key choke points such as defiles or bridges. Pre-requisites for the success of target oriented obstacles are real-time reconnaissance, resources availability and short reaction times. The aim of this type of barrier may be to disrupt enemy deployment by causing casualties and thus prevent the quick and unhindered introduction of follow-on echelon forces. In the future, improved situational awareness across NATO armies will make this type of barrier highly effective and will allow fleeting, high value opportunity targets to be engaged decisively by joint fires. The principal targets may be:

(1) Armoured forces.

(2) Headquarters and fire support elements.

607. ANTI-TANK AND ANTI-PERSONNEL BARRIERS

1. Barriers are employed against armoured forces but where the terrain forces the enemy to dismount, or an enemy is likely to operate on foot, barriers may be

exclusively anti-personnel in nature, such as wire obstacles. Only legally compliant[7] anti-personnel measures will be deployed and their use will be clearly stated in engineer or force ROE. This may include their use within anti-tank minefields so that the enemy will be hindered in negotiating such areas on foot and from clearing anti-tank mines by hand.

608. SITTING OF OBSTACLES

1. Obstacles should be prepared in such a way that they are co-ordinated with the fire plan so that the enemy cannot by-pass them or can do so only in those places where this is in line with the commanders intent. This objective can be best achieved if they are constructed adjacent to natural obstacles or combined with them to produce a more effective obstacle. Their depth must be great enough to inflict heavy losses of personnel and equipment to the enemy while negotiating them in one bound. In many cases, the stopping power of several closely spaced obstacles, in depth, may be greater than that of a single large barrier because the attacker is forced to deploy and expose his breaching resources on several occasions.

609. BARRIERS ON THE FLANKS AND IN DEPTH

1. There is a need for obstacles in depth and on the flanks to contain and restrict enemy penetrations. These must be carefully planned in close coordination with flanking and counter-attack forces. Obstacle plans and the identification of BRA are to be coordinated across boundaries at all levels.

610. BALANCING MOBILITY AND COUNTER-MOBILITY

1. Obstacles and movement are competitive elements in combined arms/branches operations. Balancing the requirement for counter-mobility and mobility is a continuous task for staffs. To ensure that the correct balance is achieved between the effect on the enemy and retaining our own mobility, tactical commanders at all levels must clearly identify:

   a. The priorities for engineer effort and other arms/branches in the execution of counter-mobility tasks.

   b. The areas and routes and that may be required for the assembly and deployment of reserves.

   c. The areas and routes that are required, at least for a specified period, for counter moves and for re-supply purposes.

[7] For example in respect of the Ottowa Treaty banning the use of anti-personnel landmines.

611. BARRIER RESTRICTED AREAS

1. BRA may be declared in order to retain the requisite freedom of movement to guarantee the success of a planned counter move. The restriction may involve time, location or type of obstacle. BRA may be declared by a joint force commander, where manoeuvre of friendly forces must not be hindered by barrier operations. Within them, obstacles may not be emplaced, activated or executed without the authority of the commander who controls the area.

2. Declaration of BRA can create a risk to the defensive plan which must be carefully considered by the tactical commander. The level of risk which can be accepted will be determined by our ability to react quickly to a change in the circumstances in these areas, using appropriate obstacle systems.

3. If a BRA is ordered for a limited period of time, minefields with a limited laid life and, in future, remotely controlled minefields, will be emplaced.

612. CONTROL OF DEMOLITIONS

1. It is the responsibility of the all arms/branches commander to control what is to be fired and when. For this purpose, a system for the control of demolitions is essential; this is set out in STANAG 2017.

613. OBSTACLE NUMBERING

1. Obstacle numbering will be carried out in accordance with agreed procedures (STANAG 2237 currently in draft) and will be reported in accordance with STANAG 2430, Land Force Engineer Messages Reports and Returns, which provides a means of identifying, uniquely, all friendly and any identified enemy obstacles.

614. MARKING OF MINEFIELDS

1. Minefields will be marked in accordance with STANAG 2036.

SECTION III - SURVIVABILITY

615. GENERAL

1. The lethality of modern weapons systems makes the battlefield an increasingly hostile environment. Where there is a threat from enemy offensive air support (OAS), aviation and direct/indirect fires, considerable attention must be paid to survivability. This is likely to become more significant in the future with the advent of a medium weight capability which by definition is likely to lack protection. Survivability may also be threatened by the enemy's satellite, air reconnaissance and interdiction capability. When facing an asymmetric threat, the requirement for effective survivability is not diminished. The need to protect the force from a range of possible threats is enduring

and must include threats posed by vehicle borne IED and suicide bombers for example. Responsibility for survivability depends on the levels of protection required. Basic survivability is an all arms/branches responsibility with engineers providing increased levels of advice and construction support as the complexity of survivability tasks increase. Survivability includes all aspects of protecting personnel, weapons and supplies by employing:

a. Sound tactics.

b. Dispersion and frequent unit moves.

c. Camouflage and concealment.

d. Deception.

e. Emission security.

f. Force Protection Engineering (FPE) including field fortifications.

616. MAJOR ENGINEER SURVIVABILITY TASKS

1. Major engineer survivability tasks will include assistance to other arms/branches in:

a. Field Fortifications.

b. Protection of combat supplies.

c. Camouflage, concealment and deception.

d. Camp and facility construction where appropriate.

617. FIELD FORTIFICATIONS

1. The preparation of field fortifications is an all arms/branches responsibility and is a sub-set of the broader issue of Force Protection Engineering (FPE). When time is short or the nature of the terrain requires special techniques, such as the use of earthmoving equipment or explosives, engineers may provide support in accordance with the commander’s priorities. Possible engineer tasks include:

a. Advice on the construction of field fortifications.

b. Construction of command posts.

c. Construction of artillery gun positions, tank scrapes and weapon pits.

d. Preparation of alternate positions.

e. Preparation of sites for tactical air and aviation units.

f. Construction of storage facilities for ammunition and other materiel.

g. Advice on, and on occasions, assistance with, the construction of protective barriers.

h. Strengthening field fortifications.

618. PROTECTION OF COMBAT SUPPLIES

1. Combat supplies should be protected in particular against blast, shrapnel, incendiaries and CBRN contamination. It is most important to provide protection for ammunition and fuel stores. The types of shelter built will depend upon the terrain and soil type as well as on the availability of existing buildings and natural cover. By giving advice to the logistic commander on the selection of the most suitable storage sites, the requirements for engineer support may be considerably reduced.

619. CAMOUFLAGE AND CONCEALMENT

1. In general, all units are responsible for their own concealment and local camouflage. Major positions, facilities, and operational sites, may, however, require special camouflage stores and measures. The tactical commander may then require engineers to undertake such tasks, as advised by his engineer commander. Efforts must be made to mitigate the distinctive signatures that engineer work in preparing battle positions can create. Apart from the use of camouflage nets and natural camouflage material, special camouflage measures often require the employment of engineer equipment and devices. This is especially true for large-scale camouflage requirements.

620. DECEPTION

1. Deception is designed deliberately to give the enemy a false and misleading picture of the true tactical and operational situation thus conferring potential benefit to own forces. Deception measures often include camouflage, although construction work should expend as little time and materiel as possible. It is an engineer responsibility to provide advice on deception to the all arms/branches commander.

2. Deception must always be coordinated at the highest practical level and with all the units involved.

3. Special engineer deception measures can include construction of dummy positions, phoney obstacles, including minefields, decoys and the simulated employment of construction equipment. For the construction of dummy positions and decoys, camouflage and deception material will be used and engineer equipment may be employed to excavate soil. Damaged or captured materiel can also be used

to create deception. Dummy positions and decoys must be carefully planned and coordinated within the framework of the tactical plan and genuine positions.

621. CAMP AND FACILITY CONSTRUCTION

1. Where circumstances permit, engineers will be required to design, resource and construct a range of camps and facilities for a joint, multinational force. Using the full range of FPE techniques and procedures at their disposal, they will aim to mitigate against the assessed risks of a particular operational environment. In the contemporary operational environment described earlier, the threat may range from symmetric direct and indirect fire to asymmetric vehicle borne suicide bombs.

622. SURVIVABILITY OF RESERVES AND KEY INSTALLATIONS

1. The enemy will give particular emphasis to the detection and attack of reserves and also what they deem to be key installations. Whereas these will primarily survive through the use of manoeuvre and concealment respectively, there may be a requirement for field fortifications.

623. SURVIVABILITY OF COUNTER-PENETRATION FORCES

1. Inevitably, counter-penetration positions will be occupied at short notice. Unless preparation of the positions and associated barriers has been carried out in advance, engineer effort will be at a premium. Early planning of contingency counter-penetration tasks may allow the preparation of some obstacles and positions in advance.

SECTION IV - MOBILITY

624. PREPARATION

1. During preparations for defensive operations, engineers will reconnoitre, improve and open routes for use during the battle. These may include lanes through barriers, routes from hides to battle and alternate positions and those for maintenance, re-supply and counter moves.

625. MAIN DEFENSIVE BATTLE

1. **Routes**. When the main defensive battle is joined, the maintenance and improvement of routes will be a major engineer task. Enemy interference by artillery, air forces and scatterable mines, plus the requirement for off-road movement, may require the deployment of counter-mine equipment, assault bridging, trackway and engineer heavy equipment well forward. It is vital that NATO forces be able to manoeuvre freely in the defence so as to be able to concentrate and strike the enemy at the optimum time and place. The same importance is given to maintaining key routes in Other Operations and this will pose particular problems when Lines of

Communication (LoC) are extended over long distances and are subject to asymmetric attack.

2. **Minefield Gaps and Lanes**. Careful planning and coordination with the combat arms/branches will be essential to ensure that the required lanes or gaps are left in minefields or other obstacles for the redeployment of troops and to facilitate counter moves. These gaps and lanes will need to be closed rapidly on order.

3. **Support to Counter Moves**. The enemy's use of obstacles to mine and create tank obstacles for the protection and consolidation of his own offensive operations will require the deployment of close support engineers in support of NATO counter-penetration and counter-attack forces. They must be equipped with assault bridging, armoured engineer vehicles and breaching equipment, in order to provide the close support required.

CHAPTER 7

STABILISING OPERATIONS

SECTION I - INTRODUCTION

701. DESCRIPTION OF STABILISING OPERATIONS

1. Although many of the engineer roles and tasks described previously in this publication are fully applicable to stabilising operations, there are some particular considerations which apply. Such operations are diverse and military involvement will be highly situation dependent. Once again, it will be essential for early engineer planning to be carried out and for the basic principles of engineer C2 to be adhered to as set out in chapter 2. Mobility and counter-mobility aspects have been adequately covered elsewhere in this publication and will not be repeated here.

2. Engineers will conduct a variety of tasks supporting all components during all phases of an operation from strategic deployment through to recovery and post-hostilities activity. This chapter will consider the engineer input to selected stabilising operations which comprise the following elements:

a. **Peacekeeping**. Peacekeeping operations are generally undertaken to monitor and facilitate the Implementation of a peace agreement, in a situation where consent is substantially in place.

b. **Peace Enforcement**. The purpose of peace enforcement operations is to enforce the provisions of a mandate designed to maintain or restore peace and order.

c. **Conflict Prevention**. Conflict prevention operations are used to deter and coerce parties to a potential conflict. They may range from diplomatic initiatives to preventative deployments of forces.

d. **Peacemaking**. Peacemaking describes the activities conducted after the commencement of a conflict aimed at establishing a cease-fire or a rapid peaceful settlement.

e. **Humanitarian Assistance**. Humanitarian assistance aims to alleviate human suffering where the responsible authorities in an area are unable, or unwilling, to fully support a population. Operations may require the direct provision of assistance, or providing support to civilian organizations. This is likely to be very demanding in terms of engineer planning and work output given the sheer size and scope of the civilian requirement, based on recent expeditionary experiences.

f. **Irregular Warfare**. Irregular Warfare denotes a form of warfare where the enemy adopts irregular methods. Irregular troops are any combatants not formally enlisted in the armed forces of a nation-state.

g. **Post-Conflict Reconstruction**. The immediate aftermath of conflict will usually be characterised by the absence of effective government, and the potential for a loss of control that can be exploited by criminals and remaining hostile elements. The transition to civilian control by a legitimate government should be supported by a wider diplomatic, humanitarian and economic strategy, within which military assistance is but one element. Military force has an important role in the early stages to maintain essential services and basic law and order and to prevent the situation deteriorating.

h. **Peace Building**. Although similar to post-conflict reconstruction, peace building implies a longer-term effort, and has particular relevance when the local infrastructure has been severely damaged, or civil and political institutions are ineffective.

i. **Non-Combatant Evacuation**. A Non-combatant Evacuation Operation (NEO) could be mounted as a separate operation or by an in-place force when the situation deteriorates. NEO operations consist of defensive and security measures to collect, process and evacuate non-combatants.

702. ENEMY

1. The enemy's aim will be to disrupt our peace keeping or peace enforcement or humanitarian oriented operations, attack our forces and restore his own freedom of action. The enemy may deploy an extensive array of surveillance and target acquisition systems. An asymmetric enemy may seek to inflict disproportionate levels of damage by unconventional means such as human or vehicle borne explosive devices including suicide attacks. The types of enemy encountered in stabilising operations include, but are not limited to:

a. Irregulars.

b. Terrorists.

c. Insurgents.

d. Organised criminals.

703. ENGINEER SUPPORT

1. Engineer support in its widest sense plays a key 'stabilising' role by contributing to the broader strategic level goal of 'nation building' and assisting the Security Sector Reform (SSR) process in a way that few other force elements can

match. The engineer contribution to developing and enhancing key infrastructure for example, is designed to instil confidence in the population and foster trust in government attempts to re-establish security, law and order, public utilities and the economy. Close interagency links with the major aid agencies and NGOs can be a powerful weapon in enabling the commander of a joint force to support CIMIC related activities and other key objectives in the campaign plan through the close involvement of engineers from the earliest stages of planning.

SECTION II - ENGINEER ROLES AND TASKS

704. GENERAL

1. The two key engineer roles applicable to stabilisation operations are the provision of survivability and sustainability to the force. All arms/branches are responsible for their own immediate survivability requirements. Engineers will augment and enhance unit survivability measures within the limits of available resources and the priorities of the commander. Engineer effort will be concentrated on tasks requiring specialist skills or equipment. Survivability measures begin with the use of all available concealment and natural cover, followed by digging and constructing fighting and protection positions. As time and the tactical situation permit, these positions may be improved as described earlier and particularly in chapter 4.

2. **Survivability Support**. The main engineer survivability tasks include:

   a. **Deception.** Assistance in camouflage and concealment, when deemed appropriate in such operations.

   b. **Fortifications.** The construction of fortified observation posts, gun pits and field headquarters, as well as defensive works in urban and rural environments.

   c. **Hardening.** The hardening of key points, headquarters, service installations, communication facilities and living accommodation, including the provision of collective protection shelters.

   d. **Protective Works.** The protection of logistic facilities, including ground dumped stores and combat supplies.

   e. **Mine Awareness Advice and Training.** The provision of mine awareness to the force and to the civilian population through school and community education programmes as applicable.

   f. **Search.** Systematic procedures used to defeat attempts to conceal munitions, bombs, booby-traps, equipment, documents and people.

This is a powerful weapon that can be deployed in an offensive and defensive manner depending on the circumstances.

g. **Mine Clearance.** The clearance of mines and booby-traps, including area clearance tasks in the aftermath of hostilities. Training in mine clearance may also be provided to civilian agencies.

h. **EOD.** The detection, identification and rendering safe of unexploded ordnance.

3. **Sustainability Support.** The main engineer sustainability tasks, which may be conducted independently or in conjunction with other military and civilian agencies are:

a. **Design.** The design of structures and installations, roads and bridges.

b. **Routes.** The construction and maintenance of primary and secondary routes. This may include the construction and maintenance of military and civilian bridges.

c. **Accommodation.** The construction and maintenance of temporary and permanent living and working accommodation, including the conversion of existing structures

d. **Utilities**. The supply of water and the provision of electrical power and sanitation facilities. The installation and maintenance of heating and air conditioning systems as necessary.

e. **Medical Facilities**. The construction of temporary and permanent medical facilities including the supply of utilities.

f. **Fuel**. The construction of bulk fuel installations, including ship-to-shore and land pipelines.

g. **Airfields, Ports and Railways.** The construction, maintenance and repair of air, port, waterway and railway installations. Support to fixed wing aircraft and helicopters, through the provision of take-off strips, landing pads, hides and fuel installations. The restoration and maintenance of an airfield's operational capability by repair of runway surfaces and the provision of essential services.

h. **Resources.** The procurement, manufacture, storage and handling of engineer materiel including contracting for such resources, if required.

i. **Geospatial.** The provision of maps, terrain information and geographic and survey data.

j. **Diving.** Underwater reconnaissance, construction and demolition.

705. SPECIALIST FUNCTIONS

1. **Force Protection Engineering**. The design, resourcing, and construction of appropriate force protection facilities including camps and other facilities, will also be an engineer responsibility. See chapter 4. This key task will demand a range of specialist skills and equipment to protect the force and enable it to conduct operations effectively in a cross-spectrum environment. Engineers may reinforce existing structures and construct new positions for command and control, troops housing, and logistical support systems. Commanders may require hardening of key command and control facilities, especially those with a detectable electronic signature. A key planning factor when reinforcing existing structures or building new positions is the need to maintain contact with the civilian population in order to build or maintain positive relations. It is likely that stabilising operations will generate a myriad of additional engineer tasks, for example the construction of Prisoner of War (POW) camps and refugee centres in rear areas, including weapons/ammunition storage and destruction facilities.

2. **Civilian Infrastructure**. Engineer expertise will be required to carry out a wide range of specialist functions including technical design and planning for key civilian infrastructure tasks such as the provision of water, fuel and power. There will also be an important role to play in helping to revive local industry and in stimulating nascent industrial activity where applicable. Close liaison with NGOs and CIMIC assets will be essential to ensure that scarce expertise and capabilities remain properly targeted and focused.

3. **EOD**. There is likely to be a significant requirement to recover or clear mines, minefields and unexploded ordnance which have been laid by both enemy and own forces. Engineers will usually be assisted in terms of mine clearance work, by civilian specialists as demand will always exceed supply. All post conflict operations will require detailed liaison between G9 and engineer staff and host nation authorities. A military capability is required to dispose of unexploded ordnance whether aerially or ground delivered or placed by hand. This includes the requirement to clear booby traps, IEDs and also CBRN munitions in an CBRN environment. EOD specifics are covered in earlier chapters.

4. **Mine Action Centre**. There is the requirement to centralise mine and unexploded ordnance information and the engineers are the staff element that performs this action. Mine Action Centres are normally based in brigade and higher staffs for combined operations. There may also be a UN MAC working in the theatre. The MAC is the central receiving, analysis, and dissemination point for that unit's sector. The MAC receives information from the civilian population, military units, and other agencies. Once received, the information is analysed and compared to existing and incoming reports. Once verified, the information is added to the computer mine data base, mine map, and is disseminated to the higher MAC, in sector military units through the G3, NGOs, and civilians.

SECTION III - RESOURCE PROCUREMENT AND FUNDING

706. PROCUREMENT

1. The provision of engineer resources, such as earthmoving equipment, bridging and general construction stores, is normally the responsibility of engineers. The requirement for materiel is dictated by the environment and military considerations but in stabilising operations it may be considerable. Engineer resources will generally be obtained from one or more of the following sources:

a. Engineer field and support units. (Eg Engineer Logistics Park or ELP).

b. Military logistic organisations.

c. Other government or service agencies.

d. Engineer or civilian workshops.

e. The civilian market by requisition or local purchase.

f. By extraction from natural resources; examples are stone and timber.

2. Whether originating from national sources or procured locally, engineer materiel must be controlled by an in-theatre resources organisation that is flexible and able to operate in conjunction with appropriate international and host nation counterparts.

707. FUNDING

1. Funding arrangements may not be agreed until after the force has been established. Until this occurs NATO forces must be prepared to support themselves. In stabilisation operations, an international engineer operating services (EOS) organisation, comprising a mix of international staff and contract personnel, may be created to provide engineering support in parallel with military engineers. The support provided is likely to include design, contracts, civil, mechanical and electrical engineering and materiel procurement and handling. The EOS chief engineer in the force headquarters may authorise all expenditure on engineer materiel up to the delegated powers. There may be little or no delegation below this level, and long delays could occur in the procurement process. There will be occasions when operational level engineering has to be provided and financed from NATO Common Funds. If the situation requires, the NATO Security Investment Programme (NSIP) will provide the funds for infrastructure and Communications and Information Systems (CIS) to support the joint force.

2. The funding process may be complicated, for example some resources expenditure will be recoverable through international organisations and some will not. In order that billing can be carried out and adjustments made, very careful and accurate

accounts must be kept. Those responsible for running accounts must be thoroughly familiar with the relevant accounting procedures and produce the necessary documentation to satisfy auditors.

SECTION IV - HOST NATION SUPPORT (HNS)

708. GENERAL

1. The availability of HNS and the state of the local infrastructure will have a significant effect on the requirement for engineers. The degree of HNS in political and military terms must be established early on and then the attitude of the local population should be assessed to confirm whether it will be hostile or supportive.

709. HNS RESOURCES

1. Civil resources in the form of skilled and unskilled labour, machinery and materials should be exploited whenever militarily feasible, reliable, timely and cost effective. However, when employing civil contractors, military personnel, trained in contracts, will be needed to supervise key projects to ensure value for money and exercise quality control. The availability of HNS will also determine the degree of self-sufficiency required by a force. Timely and effective liaison with the host nation authorities and civil agencies by engineer staffs will, therefore, be critical in the early stages of an operation.

CHAPTER 8

ENABLING ACTIVITIES

SECTION I FUNDAMENTALS

801. DESCRIPTION OF ENABLING ACTIVITIES

1. As described in chapter 1, enabling activities link other operations: they include those intended to make or break contact with the enemy, and those conducted out of contact. The major activities are listed below and certain of them are discussed in more detail during the course of this chapter:

a. **Reconnaissance**. Engineer reconnaissance is covered in chapter 2.

b. **Security**. Security operations provide early and accurate warning of enemy operations.

c. **Advance to Contact**. The advance to contact seeks to regain contact with an enemy under the most favourable conditions.

d. **Meeting Engagement**. A meeting engagement involves action between two moving forces.

e. **Link-Up Operations**. The aim of a link-up operation is to establish contact between two or more friendly units or formations which may have the same or differing missions.

f. **Relief of Encircled Forces**. The purpose of this operation is to break through enemy positions to reach an encircled force, thus restoring freedom of action.

g. **Relief of Troops in Combat**. Relief of troops occurs when combat activities are taken over by one force from another. There are three types of relief operation: Relief in Place, Forward Passage of Lines, and Rearward Passage of Lines.

h. **Withdrawal**. A withdrawal occurs when a force disengages from an enemy force in accordance with the will of its commander.

i. **Retirement**. A retirement is different from a withdrawal in that it is a movement away from the enemy by a force out of contact with the enemy.

j. **March**. A march is conducted to move a military force to its place of tactical employment efficiently.

k. **Crossing and Breaching Obstacles**. Crossing and breaching obstacles normally occurs during offensive operations, but they can occur throughout the battlespace, including the rear area. They often involve a passage of lines. Chapter 5 contains further detail.

SECTION II - ADVANCE TO CONTACT

802. PURPOSE

1. The advance to contact seeks to gain or re-establish contact with the enemy under the most favourable conditions for the main force. Operations will be bold, rapid and often de-centralised in order to surprise the enemy, keep him off balance and exploit success. In order to achieve this, extensive reconnaissance will be required. Enemy protective elements must be destroyed or neutralised without impeding the movement of the main body. Provision must also be made for flank protection.

803. ENGINEER TASKS

1. The major engineer task in an advance to contact is the support to mobility by the opening up and improvement of routes of advance and the maintenance of main supply routes (MSRs) and other important strategic routes. Engineers create obstacles to support flank protection operations. Engineers also have reconnaissance responsibilities, which are intended to facilitate:

a. The selection of routes which require a minimum amount of preparation and maintenance.

b. Preparing for the rapid deployment and regrouping of the engineer units and resources required, including the pre-positioning of heavy engineer equipment.

804. ROUTE OPENING

1. During an advance to contact, the obstacles encountered may not be dense, for example: scattered anti-tank mines, road-blocks, bomb craters, sometimes a demolished bridge, tunnel or viaduct.

2. In opening routes, the predominating factor is speed. Engineer tasks may include:

a. The removal of mines, anti-handling devices and obstructions of any kind.

b. The creation of bypass routes.

c. Filling in or bridging craters.

d. Gap crossing.

e. Marking the routes created through obstacles.

3. The principal engineer equipments required for opening routes are:

a. Dozers (preferably armoured).

b. Armoured vehicle launched bridges.

c. Mechanical tools and explosives.

d. Portable and vehicle mounted mine-detectors.

e. Rapid mine-clearance vehicles.

4. Engineers supporting leading units must, therefore, have access to these vehicles and equipments, which should be held as far forward as circumstances and risk of possible destruction dictate.

805. FLANK AND REAR GUARDS

1. Engineers with the flank and rear guard forces are to be prepared to block enemy avenues of approach. To counter enemy mobility, they rapidly emplace obstacles which are then covered by designated anti-tank and indirect fire. They must be well supplied with ground-delivered scatterable mines, cratering munitions and with rapid bridge demolition materials.

SECTION III - MEETING ENGAGEMENT

806. PURPOSE

1. The meeting engagement is a combat action that occurs when both sides seek to fulfil their mission by offensive action. A meeting engagement will often occur during an advance to contact and can easily lead to a hasty attack. In offensive or delaying operations, it will often mark a moment of transition in that the outcome may well decide the nature of subsequent operations. This is why the meeting engagement is described as an enabling activity. Even when the main part of a force is defending, attacking or delaying, individual elements may find themselves in situations which have the characteristics of a meeting engagement. A meeting engagement can occur in various circumstances:

a. When a force which is moving, either tactically or in column or route, makes contact with an enemy, about whom the friendly force has little or no information.

b. By chance or when reconnaissance has been ineffective.

c. When both sides are aware of the other and decide to attack without delay in an attempt to obtain positional advantage, gain ground of tactical importance, maintain momentum or assert dominance over the enemy.

d. When one force deploys hastily for defence while the other attempts to prevent it.

807. ENGINEER TASKS

1. The rapid deployment of engineers can be crucial in transitional phases of the battle. Engineer reconnaissance must be well forward. Land forces engineers must be readily available for mobility or counter-mobility tasks. An appropriate and quick employment of engineer equipment can ensure freedom of movement and deny it to the enemy. Engineer planning of scatterable mines, for example, can provide counter-mobility support if the assets are available. Even if land forces engineers are immediately available there is likely to be only a short time in which engineers are able to prepare, deploy and undertake tasks. Time for reconnaissance will need to be reduced to a minimum. Considerable speed of reaction and improvisation will be required. Engineer tasks are likely to be restricted to:

a. Breaching or crossing of obstacles.

b. Opening up routes.

c. Rapid emplacement of obstacles to the front and/or flanks.

SECTION IV - LINK-UP OPERATIONS

808. PURPOSE

1. A link-up operation is conducted where forces are to join up in enemy-controlled territory. The aim of a link-up operation is to establish contact on the ground between forces which may have the same or differing missions. In a link-up operation it may be necessary to destroy the enemy between those forces between contact can be established. Frequently, one force will be required to link-up with an isolated force.

809. ENGINEER TASKS

1. These operations demand a considerable effort to coordinate engineer activity, not only with the other arms/branches, but also between the engineers of the two forces. Engineer tasks are likely to include the following:

a. **Engineers Supporting Link-up Forces**

(1) To support the mobility of these units by opening and maintaining the axes of advance and link-up.

(2) If necessary, to support the protection of the flanks of the axes of advance and link-up using rapid obstacles.

b. **Engineers Supporting Isolated Forces**

(1) To provide mobility support to the link-up forces by opening and maintaining the axes of advance and link-up.

(2) If necessary, to support the protection of the flanks of the axes of advance and link-up by creating obstacles rapidly.

(3) To support the reinforcement of the area to be occupied by the isolated force by creating in it obstacles of all types, at the same time taking into account the route(s) envisaged for the link-up proper.

(4) Where necessary to neutralise or eliminate obstacles at the place(s) envisaged for the link-up, just before it occurs.

SECTION V - WITHDRAWAL OPERATIONS

810. PURPOSE

1. A withdrawal occurs when a force disengages from an enemy force in accordance with the will of its commander. It seeks to break contact with the enemy. This does not necessarily imply that reconnaissance and/or protective elements do not maintain surveillance over the enemy.

2. A retirement is different from a withdrawal in that it is a movement away from the enemy by a force out of contact with the enemy and is administrative in nature. It is not discussed further in this document.

811. ENGINEER TASKS

1. Engineer tasks during a withdrawal are similar to those during delaying operations.

   a. During a withdrawal engineer support is required to assist the force to break contact and to keep open the withdrawal routes. Obstacles may be used to assist in breaking contact. Gaps in obstacles will need to be closed when the withdrawing forces have moved through them, frequently in the face of the enemy.

   b. Prior reconnaissance should be carried out where possible.

   c. Grouping of engineer units with the rear elements of the withdrawing forces, as well as good communications and coordination with the tactical commander and the withdrawing forces, will be important.

   d. The need for speed and security increases the importance of rapid bridging and ferrying equipment and scatterable mines. Water crossing procedures are covered in STANAG 2395.

   e. Denial measures need to be carefully coordinated.

SECTION VI - RELIEF OF TROOPS IN COMBAT

812. PURPOSE

1. The types of relief operations are defined as:

   a. Relief in Place. An operation in which all or part of a force is replaced in a sector by an incoming unit.

   b. Forward Passage of Lines. An operation in which an incoming force attacks through a unit which is in contact with the enemy.

   c. Rearward Passage of Lines. An operation when a force effecting a movement to the rear passes through the sector of a unit occupying a rearward defensive position.

2. Whether conducting a forward or rearward passage, the in-place force has the responsibility to provide mobility for the passing unit along cleared routes or corridors through its sectors. Creating lanes through the in-place unit's obstacles requires permission from the force commander who is in command of both the stationary and moving forces.

813. ENGINEER TASKS - RELIEF IN PLACE

1. The handover of barriers to the relieving force is likely to be the major engineer task; this complex procedure becomes more difficult when, within an allied formation, a unit from one nation relieves one from another. Barrier materials and obstacle design and emplacement are likely to differ. As a result, engineers from both forces must be given sufficient notice and time to carry out a detailed handover and must be free to liaise directly. The information to be handed over includes:

   a. Barrier plan and related documentation.

   b. Engineer information and data.

   c. Crossing plans.

   d. Field fortification and other plans.

2. The procedures for the handover of barriers are given in STANAG 2989.

814. ENGINEER TASKS - FORWARD PASSAGE OF LINES

1. The following considerations should be taken into account when planning a forward passage of lines:

   a. The timing of the handover of responsibilities is critical.

   b. The relieving force engineer commander should:

      (1) Establish liaison with the engineer commander of the in-place forces as early as possible.

      (2) Obtain details of identified enemy barriers.

      (3) Take on responsibility for engineer operations in the attack area when the attack starts.

   c. The engineer commander of the in-place force (or the force being relieved) will continue to control operations in support of his own force. He will also normally be responsible for ensuring:

      (1) The maintenance of the routes forward within his sector.

      (2) The passage of barriers within his sector. The in-place force must ensure that there are sufficient gaps and lanes through their barriers and that these are properly marked, including the provision of guides where necessary.

d. Both engineer commanders will consider how the engineer forces to be relieved are to continue to provide support until the beginning of the attack.

815. ENGINEER TASKS - REARWARD PASSAGE OF LINES

1. The withdrawing force will carry out its own counter-mobility tasks and keep open its own routes until it reaches the tactical area of responsibility of a rearward force. This tactical area of responsibility must be clearly defined. The engineers of the rearward force are responsible for:

a. Providing sufficient well marked gaps and lanes through their barriers, with guides when necessary, to facilitate the movement of withdrawing forces.

b. Keeping open routes for the withdrawing force.

c. Rapid closing of gaps and denying routes, once the withdrawing force has passed, where necessary to complete the barrier plans.

CHAPTER 9

ENGINEERS IN SPECIFIC ENVIRONMENTS AND SITUATIONS

SECTION I - URBAN OPERATIONS

901. GENERAL

1. Urban areas including cities, towns, villages and concentrations of industrial installations are increasing in number and size throughout the world. It is becoming increasingly likely that future expeditionary operations undertaken by the Alliance will be set in the urban context. For this reason, the tactics, techniques and procedures related to operating in this environment are becoming increasingly important. Urban areas are also significant because they represent political and economic centres of power and the hubs of physical and electronic communications networks, including: roads, railways, waterways and telecommunications. Due to the overwhelming influence of terrain on the urban battle, land forces engineers have a major and decisive part to play in such operations across the spectrum of conflict.

902. CHARACTERISTICS

1. Operations in built up areas are characterised by:

   a. Degraded Surveillance and Target Acquisition (STA) and reduced fields of vision.

   b. Fields of fire tend to be limited. The performance of modern weapon systems (direct, indirect and air-delivered) and conventional artillery may be reduced; infantry and short-range weapons may tend to dominate.

   c. Excellent protection, cover and concealment for troops and equipment, which increases the difficulty of estimating the strength of the defending forces.

   d. Reduced possibilities for manoeuvre caused by building rubble, particularly for mechanised units, but conversely, increased possibilities for infiltration and by-passing.

   e. Close-quarter combat including the increased vulnerability of vehicles and personnel to short-range attack.

   f. The presence of a civilian population which may seriously limit military action.

   g. Difficulties in command, control and communication.

h. A battle that is likely to be fought at four levels:

(1) In the air.

(2) Above the ground on rooftops and in buildings.

(3) On the surface at street level.

(4) Underground in sewers and subway systems.

903. ENGINEER TASKS ON THE OFFENCE

1. Engineers may perform the following tasks during offensive operations in a built-up area:

a. Conduct a technical reconnaissance to determine the location and type of enemy obstacles and minefields, and to make breaching recommendations. The 3 dimensional nature of the battlefield makes this more challenging.

b. Clearance of obstacles including mines, booby traps and rubble where necessary. Armoured engineer equipment with earthmoving blades and buckets to push debris, winches and booms to move obstacles, and demolition guns are invaluable, but their manoeuvrability may be limited.

c. Use of hand-emplaced demolitions to destroy fortifications and strong points that cannot be removed with the unit's organic assets.

d. Lay mines to protect flanks and rear areas.

e. Conduct mobility operations (gap crossing). Covered and concealed routes may be constructed for both personnel and combat vehicles. Personnel access holes are blown into buildings and dug to gain access to sewers.

f. Restoration of utilities during subsequent consolidation.

904. ENGINEER TASKS IN THE DEFENCE

1. Engineers may perform the following tasks during the defence of a built-up area.

a. Construct complex obstacle systems. Obstacles are planned and installed in depth, starting well forward of the urban area, to allow penetration only on routes selected by the defender.

b. Provide technical advice to commanders, to include use of existing facilities.

c. Rubbleise buildings.

d. Lay mines.

e. Assist in the preparation of defensive strongpoints.

f. Maintain counterattack, communications, and resupply routes.

g. Enhance movement between buildings, catwalks, bridges, and so on.

h. Fight as infantry, when needed.

2. In defensive situations, when opposed by an armour heavy enemy, priority should be given to the construction of anti tank obstacles throughout the built-up area. Use of local materials, where possible, makes obstacle construction easier and reduces logistics requirements. Streets should be barricaded in front of defensive positions at the effective range of anti tank weapons. These obstacles are used in order to: increase the destructive effect of available fires, to separate dismounted enemy infantry from their supporting tanks, and to assist in the delay and destruction of an attacker. The use of modern third generation anti tank mines in and around obstacles and covered by fire, will help to break-up an enemy attack, cause considerable attrition and uncertainty for the enemy whilst reducing own force casualties and increasing mission success. Such mine systems will have sophisticated sensors and ‘a man in the loop’ to optimise their effectiveness in a range of operational scenarios whilst reducing fratricide and mitigating against the presence of civilians.

905. SURVIVABILITY

1. Engineers also assist in the selection of the most survivable structures for defensive positions. They make the urban area safe for defence by neutralising specific hazards like electrical systems, gas storage facilities, fuel depots and potentially, Toxic Industrial Hazards (TIH) of varying types. They also construct firebreaks in high-risk areas. Engineers reinforce structures against direct and indirect fire, as well as producing construction materials by dismantling structures that are not required. They can provide tools, equipment and expertise to help the defenders prepare.

2. Engineers may also provide a military search capability, both intermediate and advanced, as described in ATP-73 Military Search (EOD).

SECTION II OPERATIONS IN WOODS AND FORESTS

906. GENERAL

1. Forested areas are characterised by conditions of limited mobility and, frequently, by poor visibility and limited fields of fire.

907. PLANNING

The following factors require special consideration when planning operations in wooded areas:

a. Engineers may need to be deployed in small, widely dispersed, dismounted detachments.

b. Command, control and communications will be more difficult.

c. Commanders at each level will require greater freedom of action.

d. Because troops are more widely dispersed, there will be a greater requirement for them to be able to defend themselves and act as infantry. This may require new equipment and revised structures.

e. Forested areas are generally unsuitable for reserved routes, though routes will need to be kept open for rapid re-deployments and counter attack.

f. Forests are not necessarily impenetrable to armoured vehicles. Some areas will need to be reinforced with anti-tank mines and other obstacles.

908. INFLUENCE OF TERRAIN ON ENGINEER TASKS

1. **Mines**. Wooded areas facilitate the use and camouflage of mines.

2. **Obstacles**. There is plenty of raw material (tree trunks) available for the creation of effective obstacles in wooded areas. Abatis type obstacles may be widely employed.

3. **Road Network**. Route maintenance, route improvement and obstacle clearance will assume particular importance. Many routes through forests are unsuitable for heavy tracked and wheeled vehicles; therefore considerable effort may be required to improve them.

4. **Terrain Clearing**. Other possible tasks for engineers include the clearing of terrain for:

a. Helicopter landing sites.

b. Drop zones.

c. Artillery firing positions.

909. MOBILITY TASKS

1. The initial emphasis in counter-mine operations is likely to be on the close support of combat units, primarily to prevent casualties. Counter-mine teams will generally work dismounted using manual clearance methods. Later, zone clearance tasks for the likes of key routes, landing sites and artillery positions, may assume a higher priority and will be conducted by mechanical and/or manual means.

2. The removal of obstacles may be achieved by armoured vehicles equipped with cranes, dozer blades and winches. Personnel will be equipped with chain saws.

3. Road network maintenance will require the use of plant, surfacing material and, possibly, trackway.

4. The personnel and materiel mentioned above can also be used for the construction of helicopter landing sites, air drop sites and the preparation of artillery firing positions.

910. COUNTER-MOBILITY TASKS

1. Anti-tank obstacles can easily be created in wooded areas using surface laid mines, road cratering charges and abatis. The use of anti-personnel obstacles will significantly delay the enemy's progress.

911. SURVIVABILITY TASKS

1. Other arms/branches may require the assistance of engineers in the clearance of fields of fire and construction of field fortifications. Manoeuvring and operating engineer equipment amongst the trees is likely to be difficult. Forests will frequently be used as hide areas and engineer support to camouflage, concealment and deception may be required. Firebreaks may need to be constructed to enhance the survivability of friendly positions.

SECTION III - OPERATIONS IN CONDITIONS OF LIMITED VISIBILITY

912. GENERAL

1. Technology now allows a range of operations to be conducted with increasing efficiency and confidence at night and under conditions of limited visibility, such as dust, smoke and fog. However, improvements in surveillance devices also increase the possibility of detection by an enemy and this therefore enhances the importance of counter-surveillance measures. Commanders must consider the implications of

limited visibility in their plans. Engineer tasks are likely to take longer but the effectiveness of obstacles may be enhanced as a consequence.

913. OFFENSIVE OPERATIONS

1. Command, control, reconnaissance and obstacle breaching are difficult at night or in limited visibility conditions. Consequently, planning must be more detailed, cover anything unexpected and comprehensive contingency plans must be prepared. If the enemy does not have efficient systems for night observation or detection, limited visibility may assist in concealing crossing and breaching operations, thereby improving the chances of success. However, in such conditions engineer tasks will take longer and may need additional resources.

914. DEFENSIVE OPERATIONS

1. Engineer defensive preparations also require more time at night or in other conditions of limited visibility. Obstacle siting and coordination between units is difficult. Engineers working in forward areas may require additional protection to limit the chance of surprise attacks. The efficiency of obstacles will be increased in limited visibility conditions and most enemy reconnaissance systems will be degraded by smoke. Scatterable mines are the quickest obstacles to employ in limited visibility conditions and constitute an effective solution in many circumstances.

SECTION IV - OPERATIONS IN MOUNTAINS

915. GENERAL

1. Mountainous terrain is characterised by marked differences in elevation with steep slopes and valleys over an extended area. It may include built-up areas and plains between mountain ridges, plateaus, passes and the mountain sides themselves. Success in operations in mountains is usually achieved by the forces that gain control of key terrain, such as ridge tops, valley outlets, mountain passes, defiles and routes. Some of these have a canalising effect and can be controlled by forces on the dominating heights around them. The battle for the heights will, therefore, be the governing factor in operations in mountains. Accordingly, they will be likely objectives in an attack and will be the key terrain on which the defences will be based. Due to the restricted mobility of ground vehicles, the use of helicopters for tactical mobility, reconnaissance, re-supply and evacuation may have decisive importance.

916. PLANNING

1. In common with other arms/branches, command and control of engineers may become more difficult because of the terrain and possible extremes of climate.

Engineer reconnaissance must be positioned well forward during any advance. Plant and equipment must be readily available to the lead engineer elements.

917. EMPLOYMENT IN OPERATIONS

1. **Defensive Operations**. Defensive planning may be based on the following considerations:

   a. There are areas which may seem to be impassable or extremely difficult for ground troops to use, however, the ability of an enemy to overcome such obstacles must never be underestimated.

   b. A scarcity of roads restricts the employment of tanks and other combat vehicles.

   c. Considerable time must be allowed for the preparation of defensive positions.

   d. Equipment can be moved quickly using helicopters capable of all-weather operations.

   e. The creation of obstacles along a restricted number of routes will be particularly useful in delaying operations as part of the defence. Mountainous terrain can be used very effectively for ambushes.

2. **Offensive Operations**. Plans should be based on seizing the dominant terrain features as objectives and maintaining the momentum so as to prevent the enemy from regrouping, reacting and regaining the local initiative. Combat support tasks for engineers are:

   a. Clearance of mines, booby traps, debris and other obstacles.

   b. The destruction of strong points and fortifications.

   c. Maintenance and, where possible, improvement of routes to allow friendly forces movement.

918. TASKS

1. **Mobility**. Mobility support is likely to be the major task; particularly the construction, improvement and maintenance of routes. Main supply routes may be vulnerable particularly where they run through defiles. The provision of drainage and bridging is likely to be required because of the large number of mountain streams and their susceptibility to flash flooding. New bridges may be required to cross streams, replace weak bridges and cross gorges. Construction of new routes is likely to involve major engineering work especially excavation and fill. Because of the

shortage of routes and restricted access, the following mobility tasks will also assume particular significance:

a. Obstacle clearance.

b. Construction of passing and parking areas.

c. Snow clearance.

d. Helicopter landing sites.

e. Tasks related to resupply by air.

2. **Counter-mobility**. As routes are restricted the effect of obstacles will be greatly enhanced. The blocking of roads and passes, the destruction of tunnels and minelaying are particularly effective in rugged terrain. Care must be taken not to restrict the movement of own forces. All obstacles may have to be coordinated at a higher formation level than for normal operations.

3. **Survivability**. Digging in may be difficult even using explosive means. It is likely that defensive positions will largely be based on raised fortifications and sangars. The construction of such defences remains an all arms/branches responsibility but engineer may be called upon to provide more advice and enhanced capability when required. Irregular mountain terrain provides many opportunities for cover and concealment. Light engineer equipment transported by helicopters can provide valuable assistance in the protection of manoeuvre units. There may also be the need to construct support bases for artillery and air defence weapons.

4. **Other Tasks**. Other tasks may include:

a. Construction and operation of aerial ropeways.

b. Construction of logistic facilities.

c. Anti-helicopter measures.

d. Support to remote signals sites.

e. Geographic and survey support.

SECTION V - COLD WEATHER OPERATIONS CONDITIONS

919. GENERAL

1. In arctic and cold weather conditions, the temperature is usually below freezing point and the snow lies on the ground throughout the winter. Inland the climate is normally cold and dry; near the coast the cold is less intense but wet. Variations between night and day temperatures and rainfall may cause alternate thawing and freezing, making movement difficult. Weather changes are sudden and dramatic in mountains and near the coast. Storms, clouds and mist can reduce visibility to zero in minutes. Whiteouts are disorientating and make movement difficult and dangerous. The wind-chill factor induces exhaustion, depression and thirst and the climate degrades efficiency.

2. Forces operating under arctic/cold weather conditions should be capable of all types of operations, although it should be understood that the execution of these will be exceptionally difficult and be more time-consuming. The critical aspect of operations in arctic winter or extreme cold conditions is that the survival of the force may be a more difficult problem than dealing with the enemy. Success will depend on the training, equipment and acclimatisation of forces.

920. PLANNING

1. Engineer planning must take account of likely weather conditions and possible changes. The impact of weather changes on engineer operations will be considerable. For example:

   a. Deep falls of snow may render minefields ineffective while thaw conditions will increase the number and size of water obstacles.

   b. In extreme cold every engineer task requires more time to execute and allowance for this must be made in planning.

   c. Individual preparation for an operation requires great attention to details, such as clothing and equipment. Personnel operating in these conditions require additional time for rest.

   d. Planning must take account of the absolute requirement for shelter and water supply.

921. TASKS

1. It is likely that in winter warfare conditions, greater emphasis will be placed on mobility and survivability:

a. **Mobility**. Mobility will be impeded by snow, ice-covered terrain, weather and long hours of darkness.

(1) Increased engineer effort will be necessary for the construction, improvement and maintenance of forward airstrips, helicopter landing sites and roads, especially LOC, which are likely to be high priority targets.

(2) Roads and tracks may quickly become impassable to wheeled and tracked vehicles in heavy snowfalls. Snow clearance and route maintenance equipment must always be available.

(3) LOC will often follow river valleys and cross many bridges which may become impossible to bypass if destroyed. There may be a major requirement for new bridges, over-bridging, rafting and/or ferrying. Improvisation is possible using ice and snow. Equipment bridging can be used but the following should be borne in mind:

(a) It must be used with care as light alloy and cast metal can become brittle at low temperatures.

(b) Construction times are increased (normally doubled).

(c) An adequate reserve of spare parts is required.

(4) Heating equipment and warming/drying facilities should be readily available.

b. **Counter-mobility**. Counter-mobility tasks are likely to concentrate on the limited routes available. Route denial, demolitions and off-route mines will be particularly important. Minefields may also be used but the following must be considered in their planning and laying:

(1) The effect of cold on materials.

(2) The reduced work rates in arctic and cold weather conditions.

(3) The variable performance of equipment and systems in deep snow conditions, especially scatterable mines.

(4) The need for subsequent adjustment to be made after fresh falls of snow or sudden thaws.

c. **Survivability**. Shelter is essential to survival. The preservation of our own shelters and the destruction of the enemy's become important ends in themselves, which can influence the outcome of the battle.

Measures to increase chances of survival from enemy action and from the hostile environment will include:

(1) The construction of field defences, snow and ice fortifications with overhead protection using either improvised or equipment shelters and snow/ice-concrete.

(2) The provision of advice and assistance with counter-surveillance plans and works.

d. **General Engineer Support**. It is necessary to allocate increased resources for water supply and facilities for shelter with heating and lighting.

SECTION VI - OPERATIONS IN DESERTS AND EXTREMELY HOT CONDITIONS

922. TERRAIN

1. Arid regions make-up about one-third of the earth's surface, a higher percentage than that of any other type of climate. Desert terrain varies considerably from place to place, the sole common element being lack of water with its consequent environmental effects, such as sparse, if any, vegetation. The basic land forms are similar to those in other parts of the world, but there has been erosion of the topsoil, due to a combination of lack of water, heat and wind, to give deserts their characteristic barren appearance. The bedrock may be covered by a flat layer of sand, or gravel, or may have been exposed by erosion. Other common features are sand dunes, escarpments, wadis and depressions. Roads are usually scarce and primitive.

923. CLIMATE

1. This environment can profoundly affect military operations. Equipment and tactics must be modified and adapted to a dusty and rugged landscape where temperatures vary from extreme highs down to freezing and where visibility may change from 10 kilometres to 10 metres in a matter of minutes. It is important to realise that deserts are affected by seasons. Those in the Southern Hemisphere have summer between December and March. This difference from the Northern Hemisphere is important when considering equipping and training non-acclimatised soldiers for desert operations south of the equator. The desert is fatiguing, both physically and mentally. Factors such as heat injury, climatic stress, radiant light and desert wildlife can adversely impact soldiers' effectiveness.

924. GENERAL

1. In some desert areas, natural obstacles such as wadis or other terrain features can be found. Often, however, it will be necessary to use artificial obstacles in order to shape enemy manoeuvre.

925. TASKS

1. Important tasks for engineers in desert operations include:

   a. **Mobility**. The vastness of the desert makes mobility a prime concern. Cross-country mobility may be poor in soft-sand, rocky areas, and salt flats. Greater engineer reconnaissance effort will be needed to identify routes, existing obstacles and minefield locations. Engineer tasks may include:

      (1) Assistance to manoeuvre by reducing slopes, smoothing rock steps and route maintenance.

      (2) The provision of dry-gap crossings including those required to traverse oil pipelines.

      (3) Increasing weight-bearing capacity by soil stabilisation to provide good roads or sites for aircraft landing strips.

      (4) Dust suppression using, for example, diesel fuel or oil mixtures.

      (5) Obscuration of enemy lines of sight during breaching operations.

   b. **Counter-Mobility**. A minefield, to be of any tactical value in the desert must usually cover a relatively large area, so mechanical means are best suited. Since there are often too many avenues of approach to be covered with mines, it is usually best to employ tactical minefields to cover any gaps between units, especially at night. Target-oriented obstacles may often be the best choice to reduce the enemy's mobility. Terrain dependent obstacles may be extensive and must be used in conjunction with each other and with any natural obstacles. Sand is effective in covering mines, but also creates potential problems such as exposing the mines, causing them to malfunction and degrading their performance due to excessive accumulation. Shifting sand can also cause mines to drift. Anti-tank ditches require extensive preparation time. Caution must be exercised to prevent the ditch from identifying a defensive front or flank and to deny their use as protection for enemy infantry.

   c. **Survivability**. Deserts provide little cover and concealment from ground-based observers and even less from aircraft. Because of the lack of

concealment camouflage must be used. Hull and turret defilade positions for tactical vehicles may be important. Dispersion and frequent moves are other survivability techniques. Preparation of fortifications in the desert is difficult. Sandy soil requires revetments, while rocky plains or plateaus may be impossible to dig in; to counter this problem, emplacements are built up with rocks and depressions are used. Hardening of logistics facilities, command and control nodes, and up-grades or construction of forward landing strips and main supply routes are important in desert operations. A safety inspection of construction works is likely to be required daily, after heavy rain and after receiving direct or indirect fire.

d. **General Engineer Support**. Other engineer tasks that may be applicable in these conditions include terrain analysis, provision of water and fuel and the erection of sun shelters for equipment and personnel.

SECTION VII - JUNGLE OPERATIONS

926. GENERAL

1. Initially, improving and maintaining mobility in the jungle will be the commander's main priority and engineer resources will normally be allocated to this in the first instance. After this comes the task of countering the enemy's mobility. When planning the allocation of engineers to other combat arms/branches it should noted that because of the difficulties of redeployment in the jungle, engineers should be attached to all forward units.

927. MOBILITY

1. The construction and maintenance of roads and tracks are the initial means of improving mobility. Heavy rainfall, the clearance of vegetation, drainage and the movement of plant and stores all combine to make this a long and painstaking task. Once constructed, routes will need regular maintenance. Landing sites and drop zones will also need to be constructed to enhance the ability to move troops and stores by air transport and helicopters more swiftly within theatre. However, with training and advice, other troops should be able to take on some of these tasks. Crossing obstacles such as large rivers, may well need engineer advice, specialist watermanship support and, possibly, some plant and machinery, but once suitable material for the construction of boats, rafts and small bridges has been provided other troops will often be able to complete the task. Bridging of obstacles to allow vehicle passage normally requires specialist equipment and should remain an engineer task. Minefields in the jungle are likely to be of the nuisance or protective variety and will remain an engineer task for clearance. Engineers may also be required to breach enemy defensive positions and to clear booby-traps.

928. COUNTER-MOBILITY

1. The main counter-mobility tasks for engineers will be to block roads, lay mines and booby traps (where ROE permit) and to carry out demolitions. Blocking roads or tracks is always particularly effective to provide opportunities for counter action such as ambush or air strike. Counter-mobility tasks may also assist in the development of a deception plan, provided this is coordinated at the highest appropriate level.

929. SURVIVABILITY

Engineers may be required to construct defensive positions, field fortifications, including artillery gun positions, and protective locations for combat supplies.

930. GENERAL ENGINEER TASKS

1. Engineers will have a large variety of other tasks and commitments which will demand their advice and attention. In the early states of a deployment these are more likely to be concerned with the establishment of a secure base. In jungle operations particular emphasis may be on:

   a. Water. The supply, purification and treatment of water in conjunction with the medical authorities.

   b. Survey. The provision of mapping and other survey tasks as appropriate

SECTION VIII - OPERATIONS IN ENEMY CONTROLLED TERRITORY

931. PURPOSE

1. Forces operating in enemy controlled territory may have been given one or both of the following missions:

   a. Information reporting.

   b. Direct (or offensive) action.

932. CONDUCT OF OPERATIONS

1. Operations will be conducted with emphasis on mobility, evasion, and surprise, where offensive action is required, or on concealment and stealth, where the role is intelligence or target acquisition. The forces involved should not allow themselves to be contained by the enemy.

933. ENGINEER EQUIPMENT

1. Most engineer equipment and stores are large and heavy and are not well suited to this type of operation. Equipment and stores should ideally be light, be man transportable and be quick and easy to operate.

934. TASKS

1. Tasks for engineers may include:

   a. Engineer reconnaissance; for example terrain, enemy obstacles and minefields.

   b. Counter-mobility.

      (1) Demolitions and rapid cratering of routes.

      (2) Using off-route mines and certain types of scatterable mine systems.

   c. Mobility.

      (1) Clearance of landing strips and zones.

      (2) Minefield breaching; normally only for dismounted troops.

      (3) Neutralisation of prepared enemy obstacles.

SECTION IX - AIRMOBILE AND AIRBORNE OPERATIONS

935. AIRMOBILE OPERATIONS

1. An airmobile operation is an operation in which combat forces and their equipment manoeuvre about the battlefield in helicopters under the control of a ground force commander in order to engage in ground combat. When airmobile operations are conducted, they are an integral part of the land battle. They may be conducted during all types of ground operations, offensive, defensive or stabilising. Airmobility provides an additional dimension to ground force mobility, but technical restrictions and aircraft vulnerability limit the potential. Airmobile operations are likely to lack integral armour protection and to have limited engineer equipment and little, if any, artillery support. Engineer support will be important for such tasks as minefield construction, off-route minelaying, rapid road cratering, to canalise and delay enemy armour, and substantial survivability support to protect the force against enemy fire and to allow anti-tank weapons to be used to maximum effect.

936. AIRBORNE OPERATIONS

1. An airborne operation is a joint operation involving the air movement of combat forces onto an objective. The combat forces may be self-contained for short-term operations, or the operations may call for the insertion of combat support and service support units. The troops employed may be a combination of parachute and air-landed elements, depending on the mission and the tactical situation. Improvisation and maximum use of local resources are key aspects of airborne engineer operations. These operations represent a genuine rapid intervention capability for many NATO armies whilst recognising their limitations and inherent lack of mobility and protection. They will continue to be ideally suited to certain ‘coup-de-main’ type tasks.

937. PLANNING

1. The time required for engineer planning and preparation should be taken into account. Engineer equipment and stores are heavy and there will be severe restrictions on the amount that can be moved in an air-lift. The engineer commander must anticipate possible tasks and advise the tactical commander on priorities so that the best use can be made of the limited lift available. Cross-load planning, based on the landing and operational plan, is essential to maximise engineer survivability and to ensure the proper engineer capabilities land at the best locations to meet mission requirements. Once forces are deployed, communications are likely to be difficult, so each engineer sub-unit must have clear orders on its tasks and priorities. Troops will normally only deploy with stores and equipment for one major task. Subsequent tasks will necessitate re-grouping and the collection of further stores from drop or landing zones. The following will be fundamental to the engineer plan:

a. Engineer intelligence on the availability of equipment of resources in the area of responsibility.

b. Provision of engineer task stores, principally mines and explosives, in the committal area, by host nation or formation.

c. The number and types of support helicopters allocated to engineer units by the commander and the point at which they are placed under tactical control.

938. TASKS

1. The fundamental characteristics of airmobile and airborne engineer operations are the need for speed and the limited air lift available. Tasks for engineers operating in an airmobile or airborne force should be coordinated with any ground force affected. Tasks will be planned and resources allocated based on information and intelligence, using standard planning data. Adjustments to engineer tasks must be cleared with the local commander and reported up engineer channels; the

absence of vehicles and any imposition of radio silence may make this very difficult. These tasks may include:

a. **Counter-mobility**

(1) Rapid laying of tactical minefields from the ground or helicopters (airmobile/air transportable mining systems). The resources to lay large patterned minefields will seldom be available; engineers will, therefore, rely more on scatterable and off-route mines and area denial weapons.

(2) Demolitions and rapid cratering of routes.

b. **Mobility**

(1) Limited preparation of areas for helicopters, such as pick-up points (PUP), pick-up zones (PZ), landing sites (LS), forward arming and refuelling points (FARPs), clearance of landing strips, zones or drop sites and limited airfield damage repair (ADR).

(2) Countermine operations: detection, breaching and marking of mined areas.

(3) Neutralisation of prepared enemy obstacles.

(4) Explosive ordnance reconnaissance (EOR) and EOD.

(5) Bridging, wet and dry, including over-bridging, and ferrying.

(6) Road maintenance; the task will be only to maintain operational routes and will not include major infrastructure damage repair.

c. **Survivability**. Airmobile and airborne forces will need to dig in rapidly. Priorities for engineers are likely to include support to gun, mortar and anti-tank weapon positions, and command posts. Engineers may also have to assist with camouflage, concealment and deception.

SECTION XII - AMPHIBIOUS OPERATIONS

939. GENERAL

1. Amphibious operations against undefended or defended coastlines present particular problems for engineer support to the landing force. They should be considered in terms of the initial landings and then subsequent operations; engineer support is essential in both phases. The requirement to be able to create a rapid build up ashore accounts for the organisational and technical differences between

amphibious and land warfare. Amphibious operations are focused on mobility, characterised by extensive reconnaissance and massed engineer effort to assist in breakout operations.

940. PLANNING

1. An amphibious operation will normally be commanded by the commander of the naval forces involved, until the landing force is ashore when command will be vested in the senior land force officer. Initial planning will be done before embarkation of the landing force, but subsequent detailed planning may be done at sea. It is possible that when plans for the amphibious operations are confirmed, embarked engineer assets will not be suitably located for the amphibious offload. Movement of assets between ships, or “cross-decking”, may be required before the landing force moves into the combat zone.

941. TASKS

1. The range of tasks likely to confront the engineer commander in an amphibious operation is extensive and is likely to encompass:

   a. **During Initial Landings**. Combat engineer effort to clear beach obstacles, defences and mines and to construct or improve beach exits and dump areas. The most important engineer focus is to enable rapid mobility across the beach for the force.

   b. **During Subsequent Operations**. The full range of engineer tasks is likely to arise in forward or rear areas. There could be requirements for support to helicopters or aircraft if it is decided to move them ashore, also the provision of tactical fuel handling equipment (TFHE) facilities and water supply. Engineers are essential in facilitating the break-out from the beach. The construction of expedient port facilities or repair of existing installations to support over-the-shore operations may also be required.

2. All units should land with the maximum equipment and be prepared to survive on it for an indefinite period of time. Emphasis must be placed on improvisation and the full use of local resources after landing.

ANNEX A

RELATED STANAGs

GENERAL

1. NATO nations have concluded a number of agreements on a wide range of engineer matters, which are regularly reviewed with more subject areas under negotiation. This Annex is a non-exhaustive list of STANAGs of relevance to engineers; the complete list is to be found in the NATO Standardization Documents Database (NSDD).

RESPONSIBILITY

2. Responsibility for these STANAGs is vested in the Military Engineering Working Group (MILENGWG) of the NATO Standardisation Agency (NSA), whilst this same body also takes an active interest in the work of other working parties engaged on developing related STANAGs. This list classifies these STANAGs separately and further subdivides the key STANAGs for engineer operations into the categories according to their function.

LIST OF STANAGs FOR ENGINEERS

3. The list of STANAGs of relevance to engineers, for which the MILENGWG has either responsibility or interest in their content is shown below:

a. **STANAGs Sponsored by MILENGWG.** Military Committee Land Standardization Board promulgated engineer STANAGs are listed below with the custodian nation shown in brackets:

(1) STANAG 2010 - Military Load Classification Markings (FRA).

(2) STANAG 2017 - Orders to the Demolition Guard Commander and Demolition Firing Party Commander (Non-nuclear) (GBR).

(3) STANAG 2036 - Land Mine Laying, Marking, Recording and Reporting Procedures (USA).

(4) STANAG 2238 – Joint Engineering (AJP-3.12) (JHQ, Brunssum).

(5) STANAG 2280 – Design Threat Levels and Handover Procedures for Temporary Protective Structures (NOR).

(6) STANAG 2394 - Land Force Combat Engineer Doctrine (ATP-52) (GBR).

(7) STANAG 2395 – Deliberate Water Crossing Procedures (CAN).

(8) STANAG 2430 – Land Forces Combat Engineer Messages, Reports and Returns (R2) (AEngrP-2) (GBR)

(9) STANAG 2485 – Countermine Operations in Land Warfare (USA)

(10) STANAG 2885 - Emergency Supply of Water in War (DEU).

(11) STANAG 2989 - Transfer of Barriers (ESP).

(12) STANAG 2991 - NATO Combat Engineer Glossary (AAP-19) (CAN).

b. **Other STANAGs of Interest to Engineers**. Other STANAGs of interest to engineers, showing the responsible agency in brackets, are listed below. Further details can be obtained from the NATO Standardization Documents Database (NSDD).

(1) STANAG 2002 - Warning Signs for the Marking of Nuclear, Biological and Chemical Contaminations (MCJSB - CBRNWG).

(2) STANAG 2019 – Joint Symbology (APP-6) (MCJSB - IERHWG).

(3) STANAG 2082 - Relief of Combat Troops (MCLSB - LOWG).

(4) STANAG 2101 - Establishing Liaison (MCLSB - LOWG).

(5) STANAG 2136 - Minimum Standards of Water Potability During Field Operations (AmedP-18) (MCJSB-FHTVS).

(6) STANAG 2143 - Explosive Ordnance Reconnaissance/Explosive Ordnance Disposal (MCLSB - EODWG).

(7) STANAG 2221 – Explosive Ordnance Disposal Reports and Messages (AEODP-06) (MCLSB – EODWG).

(8) STANAG 2259 – MGD - Terrain (MCJSB - IGEOWG).

(9) STANAG 2269 - MGD - Engineer Resources (MCJSB - IGEOWG).

(10) STANAG 2282 – Interservice EOD Operations on Multinational Deployments (ATP-72) (MCLSB - EODWG).

(11) STANAG 2369 – Identification and Disposal of Surface and Air Munitions (AEODP-02) (MCLSB - EODWG).

(12) STANAG 2370 – Principles of Improvised Explosive Device Disposal (AEODP-03) (MCLSB - EODWG).

(13) STANAG 2377 – EOD Roles, Responsibilities, Capabilities and Incident Procedures when Operating with Non-EOD Trained Agencies and Personnel (MCLSB - EODWG).

(14) STANAG 2389 - Minimum Standards of Proficiency for Trained Explosive Ordnance Disposal Personnel (MCLSB - EODWG).

(15) STANAG 2391 – Explosive Ordnance Disposal Recovery Operations on Fixed Installations (AEODP-05) (MCLSB - EODWG).

(16) STANAG 2437 - Allied Joint Doctrine (AJP-01) (MCJSB - AJODWG).

(17) STANAG 2818 - Demolition Materiel: Design, Testing and Assessments (CNAD - AC/326 – SG3).

(18) STANAG 2834 – The Operation of the Explosive Ordnance Disposal Technical Information Centre (MCLSB - EODWG).

(19) STANAG 2884 – Underwater Munition Disposal Procedures (AEODP-01) (MCLSB - EODWG).

(20) STANAG 2897 – EOD Equipment Requirements and Equipment (AEODP-07) (MCLSB – EODWG).

(21) STANAG 2929 - Airfield Damage Repair (MCASB - AOSpWG).

(22) STANAG 3680 - NATO Glossary of Terms and Definitions (English & French) (AAP-06) (NCS – NCSTP).

(23) STANAG 5621 - Standards for the Interoperability of NATO Land Combat and Combined Operations Systems (NHQC3S- ISSC - AC/322 – SC/5).

ANNEX B

FAMILY OF OBSTACLE TERMS

BARRIER
OBSTACLE

BARRIER
RESTRICTED
AREA

PURPOSE

Disrupt
Turn
Fix
Block

BARRIER PLAN
OBSTACLE PLAN
OBSTACLE BELT

LETHAL*
NON LETHAL*

CATEGORIES

HASTY OBSTACLE
DELIBERATE OBSTACLE
PERMANENT OBSTACLE

TERRAIN ORIENTATED MINEFIELD
SITUATION ORIENTED MINEFIELD
TARGET ORIENTED MINEFIELD

BARRIER OPERATIONS*

MINEFIELD

REMOTE CONTROL LEVELS

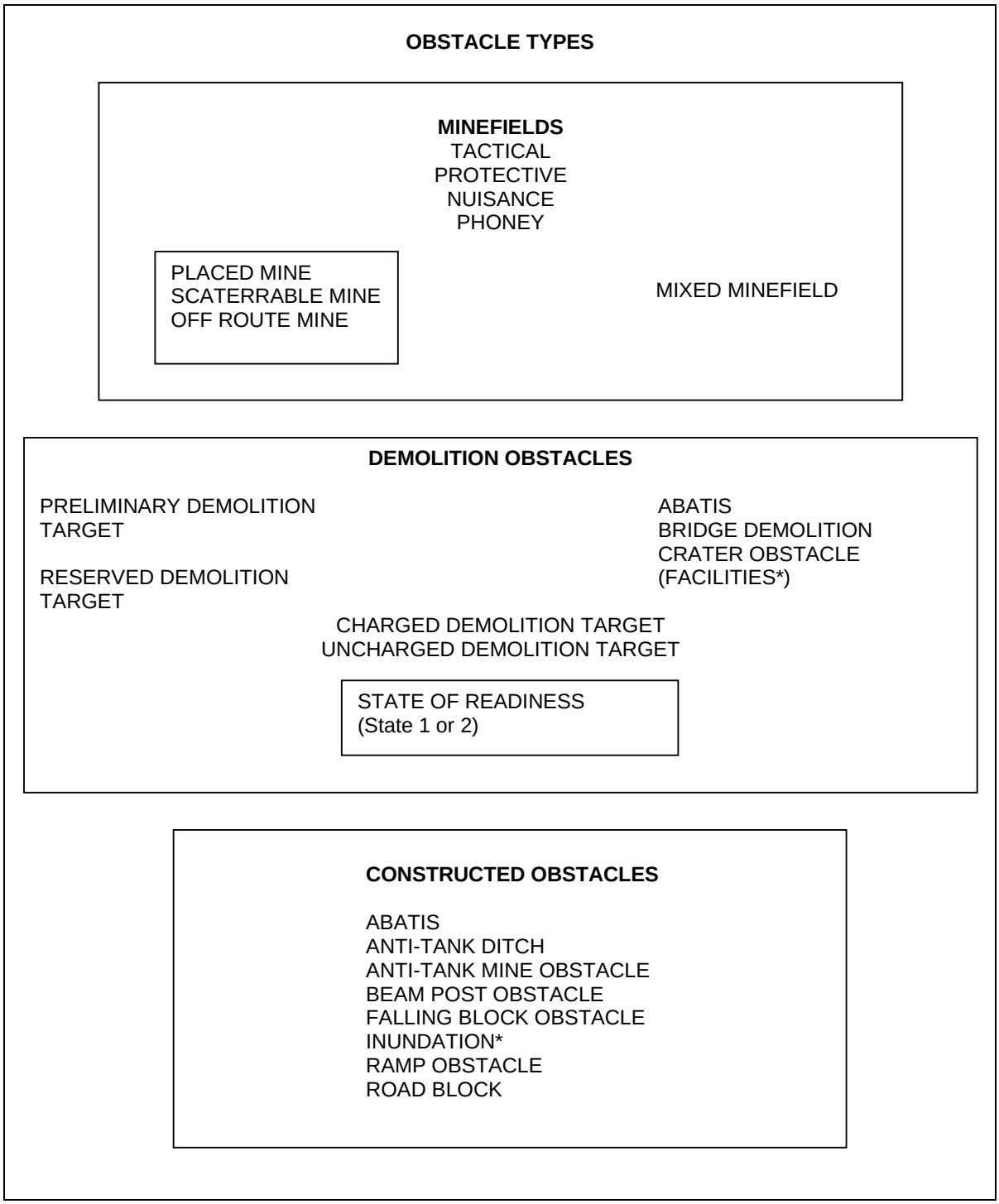
REMOTE/SELF DESTRUCTION

REMOTE/SELF NEUTRALISATION

DEMOLITION
OBSTACLE

REMOTE DELIVERY
STAND-OFF

* = Not a defined term.



* = Not a defined term.

COMBINED ARMS OBSTACLE INTEGRATION (CAOI)

CAOI includes various concepts:

1. Obstacle Control Measures. In order to ensure friendly force mobility, obstacle control measures are applied. At force or divisional level, Obstacle Zones are identified. These Zones may be divided into Obstacle Belts that will be normally be controlled at divisional or brigade level. Within these Belts and normally controlled at Battlegroup Level, Obstacle Groups (one or more individual obstacles) are established. Very few obstacle groups are planned above battlegroup level because of the need to integrate the desired obstacle effect with the fire plan. NATO doctrine also includes the concepts of 'Obstacle Restricted' or 'Obstacle Free' areas.

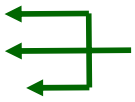
2. Obstacle Employment. Obstacles may be *terrain*, *situation* or *target orientated*:

3. Terrain Orientated Obstacles. Terrain Orientated Obstacles form part of a static obstacle plan and are prepared as early as possible. Terrain Orientated Obstacles are considered to have less utility than situation or target obstacles. Nevertheless obstacles that deny enemy forces the use of particular terrain, for example wooded areas and thereby result in them using open ground where they can be engaged with firepower, do have considerable utility. These obstacles are likely to be used along the most likely enemy Avenues of Approach (AA).

4. Situation Orientated Obstacles. Once operations have commenced, it will become possible to confirm or revise the assessment of the enemy's intentions. With a rapid obstacle emplacement capability, friendly forces are able to respond to such a situation, reduce the enemy's manoeuvre and thereby enemy tempo and subsequently combat power.

5. Target Orientated Obstacles. With a capability to remotely deliver obstacles enemy Combat Forces, HQs, Fire Support Elements, Reserves and Logistic Elements can be targeted.

6. Obstacle Effect. An intended obstacle effect which may be to *disrupt*, *turn*, *fix* or *block* the enemy:

Effect	Symbol	Description
Disrupt		Disruption is designed to break up the enemy formation by differential delay across the enemy formation, encouraging the premature commitment of breaching assets, thus reducing his tempo.
Turn		Turning aims to divert an enemy towards ground of our own choosing e.g. Engagement Areas or alternative AA.
Fix		Fix should slow an enemy within a specified area. It is used to allow a force time to detect, acquire and destroy enemy forces using air, aviation and direct and indirect fire.
Block		A blocking effect is required to stop penetration of a specified area or AA, thus assisting in either his complete destruction, or by causing sufficient delay to render his action no longer a threat.

ANNEX C

ENGINEER INFORMATION REQUIREMENTS

INTRODUCTION

1. Engineer intelligence concerns enemy and friendly engineer operations and capabilities, the terrain, the weather, military geographic information and resources information required for the planning of operations. It is vital to the successful and prompt completion of engineer work that depends on personnel, stores and equipment being readily available when they are required and flowing to the task site in the right order at the right time.

2. The most important aspect of engineer intelligence is terrain. Terrain influences the conduct of joint operations throughout the Spectrum of Conflict from high intensity operations through to peace support operations. Particular areas of interest requiring detailed information are covered in the sections below:

a. Geographic information.

b. Geological information.

c. Routes.

d. Waterways.

e. Railways.

f. Airfields and landing sites.

g. Obstacle information.

h. Sources for water supply.

i. Engineer materiel.

j. Local infrastructure facilities available in theatre of operations including power, water, waste & sewage disposal and civil transport.

k. Forces capabilities.

l. CBRN.

3. Engineers have an interest in specific areas of the terrain that concerns engineer operations. Collecting and reporting engineer information is undertaken by all arms/branches and intelligence gathering services as well as dedicated engineer reconnaissance. Once reported, information is collated and managed by engineer staff elements. Many items of engineer intelligence are of interest to other arms/branches, intelligence services and agencies and the ability to exchange information within, and between, headquarters is required. Reporting should be in accordance with STANAG 2430, where appropriate.

4. Intelligence Preparation of the Battlefield (IPB). The purpose of IPB is to help commanders to refine their intelligence requirements, identify decision points and to help the staffs fulfil the commanders' requirements. Within this process the engineer focuses on the terrain aspects of Battlefield Area Evaluation (BAE). One of the products of this analysis classifies the terrain as "GO", "NO GO" or "SLOW GO" manoeuvre areas.

5. Intelligence and the Joint Targeting Process. Engineer Intelligence can contribute to the joint targeting process by input to the selection of targets, aiming points, and Battle Damage Assessment (BDA). Sometimes destroying infrastructure targets will limit the military options for an enemy or faction in the short term, however this may subsequently create significant limitations for NATO in the longer term. Engineer intelligence may help to identify alternative targets, and aiming points, that create similar effects without the consequent limitations and costs. For example, destroying a bridge may not be the most cost-effective means of denying a route to an enemy.

GEOGRAPHIC INFORMATION

6. Geographic information is required by engineers in order to carry out BDA and plan engineer operations. It covers all aspects of the natural physical properties of the ground on which the operation is to be conducted and the influence of weather on the terrain. Engineer intelligence requires geographic information in the following areas:

a. Natural features e.g. topology and vegetation.

b. Man made features e.g. civil infrastructure.

c. Battlefield damage as a result of friendly and enemy activity.

d. Damage caused by natural disasters e.g. Flooding and landslides.

Geographic Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Natural features	Terrain elevation data, hydrology, vegetation etc. and their effect on cross country movement.	NATO DIGEST Standards See also details on waterways below.
2	Man made features	Urban areas, canals, bridges, international boundaries and protected areas (e.g. Sites of cultural and scientific interest to world heritage) etc	See also detail on routes, waterways, railways, airfields and local infrastructure below.
3	Battlefield damage	Damage affecting civil infrastructure, damage-limiting manoeuvre including munition polluted areas and area denials.	See also details on obstacle information.

GEOLOGICAL INFORMATION

7. Geological information covers all aspects of natural sub-surface physical properties and is required for the planning of engineer operations such as countermine operations, locating quarries, borrow pits and drilling for water Geological Information Requirements.			
Serial	Information Requirement	Reporting Detail	Other References
1	Rock type	Type, location & availability of rock for the provision of stone, aggregate, sand and gravel.	See also detail on local infrastructure facilities
2	Soil type	Surface and sub-surface condition to advise on the going.	See also detail on local infrastructure facilities
3	Geological strata	Strata layout to advise on drilling operations	See also details on sources for water supply.

ROUTES

8. Route information covers all aspects of the routes available for the conduct of operations. Routes Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Route information	Road & route type, surface type, road classification (MLC), width, gradient, constrictions (width & height), sharp curve or junction, ford, verges.	For reporting see STANAG 2430, Messages E110 & E111
2	Bridge information	Overhead clearance, bridge classification (MLC), number of carriageways, carriageway condition and width, total width.	For reporting see STANAG 2430, Messages E110 & E111
3	Tunnel information	Tunnel height & width, bends in tunnel.	For reporting see STANAG 2430, Messages E110 & E111

WATERWAYS

9. Waterway information covers all aspect of waterways that might influence the conduct of operations. Amphibious operations may also require input from engineers with regard to suitable amphibious landing areas and exits for littoral operations.

Waterways Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Waterway details	Navigability, fordability, course, water course and water surface width, depth, seasonal variation, profile of banks, bank vegetation, embankments, levée and dykes, flow direction and speed.	See STANAG 2395 – Water Crossing Procedures
2	Port Facilities	Jetties, fuel facilities, cranes, warehouses, slipways, protection, defences etc.	
3	Crossing Sites	Type of site, location, capacity, water depth, water surface & water course width, midstream current, river bed soil type, main stream (location & current)	See STANAG 2395 – Water Crossing Procedures

RAILWAYS

10. Movement by rail is a very important capability for any Force that intends to deploy abroad and conduct continuous operations requiring heavy assets. Railway Engineers are capable of constructing, repairing and maintaining railroad, bridges and other rail facilities. Railway information covers all aspect of railways that might influence the conduct of operations.

Railways Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Railroad Standards	Rail gauge, number of rails per track, type of permanent way, electrification details if applicable.	
2	Network Characteristics	Type of traffic control systems, shunts/switches, train signs and signalling system, Km of railroads, numbers of tracks in each direction, maximum % of slope on rail, minimum track radius of curvature, Main railway nodes and integration with the road network, airports and seaports, state of maintenance of railroads, stations, electric lines, bridges, systems and facilities.	

Railways Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
3	Local Rail Facilities	Capability of construction, railway management and availability of rolling stock, switch engines and locomotives (Diesel and electric), staging areas in proximity of railroads and roads, storage areas in proximity of railroads and roads.	
4	Support facilities	Road network, electric power plants and lines, quarries, water supply.	See also detail on routes, local infrastructure and sources for water supply.

AIRFIELDS AND LANDING SITES

11. Engineer information on airfields and landing sites is limited to the military engineering tasks in support of air and aviation operations.

Airfields Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Airfield and Landing Sites	Location, pavement type, pavement strength and condition including runways, taxiways and parking aprons, runway length; existing facilities; equipment for Airfield Damage Repair (ADR) and snow and ice clearance (SNIC).	

OBSTACLE INFORMATION

12. Obstacle information requirements include details of enemy and friendly obstacles that may be water obstacles, dry gaps, physical barriers and explosive obstacles. EOD information requirements are covered in STANAG 2143, the responsibility of the EOD WG.

Obstacle Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Water Obstacles (e.g. rivers and waterways)	Type, location, physical dimensions	STANAG 2395. Full reporting details are found in STANAG 2430, Message E303A,
2	Dry Gaps (e.g. anti-tank ditches, wadis)	Type, location, physical dimensions	Full reporting details are found in STANAG 2430, Message E303A
3	Physical Barriers (e.g. barbed-wire, abatis)	Type, location, physical dimensions	Full reporting details are found in STANAG 2430, Message E303A.

Obstacle Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
4	Minefields and areas containing Unexploded Explosive Ordnance (UXO), Improvised Explosive Devices (IED) and booby traps.	Type, location, physical dimensions	Full reporting details are found in STANAG 2430, Message E303A. See also STANAG 2485 and STANAG 2036
5	Explosive Obstacles (e.g. craters, bridge demolitions)	Type, location, physical dimensions, status.	Full reporting details are found in STANAG 2430, Message E303A.
6	Peace-time Prepared Obstacles	Type, location, physical dimensions, status, associated storage sites.	May be reported in obstacle folders (See STANAG 2123)

SOURCES FOR WATER SUPPLY

13. Water is required to support all deployed forces for many purposes including drinking and cooking, personal hygiene, use in hospitals and other medical units and facilities, and for CBRN decontamination (See STANAG 2103 and 2113).

Water Supply Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Developed Water Sources (Public & private water supply facilities)	Location, type of water source, quantity of supply, rate of supply, extraction, storage & distribution facilities, quality of water, origin of water, road or rail access.	See STANAG 2885 – Emergency Supply of Water in War - & STANAG 2136 - Minimum Standards of Water Potability in Emergency Situations.
2	Undeveloped Water Sources (e.g. wells, boreholes, underground supplies, fresh, brackish & saltwater surface water sources	Location, type of water source, quantity of supply, rate of supply, extraction, storage & distribution facilities, quality of water, origin of water, road access.	See STANAG 2885 – Emergency Supply of Water in War - & STANAG 2136 - Minimum Standards of Water Potability in Emergency Situations

ENGINEER MATERIEL

14. Engineer materiel is ideally procured from the area of operations in order to reduce the burden of transportation. Some information on available materiel may be gained from the host nation, from neighbouring nations, industry in NATO countries, the Internet and Embassy staff.

Engineer Materiel Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Manufacturing Capabilities for Construction Materiel	Location and output capacity of: Saw-mills, quarries & crushing plants, cement works, concrete works, steel mills, asphalt works, steel fabricators, joinery shops, sheet glass producers, plastic extruders/moulder etc.	
2	Stores of Construction Materiel	Location and quantity of: Timber: Type of timber, quantities and quality of rough sawn and finished timber, and sheets of blockboard and ply Stone: Types of stone and quantities available. Cement: Lime, sand and additives Steel: Availability of sheet steel, corrugated iron and reinforcing rod Paint: Paint, thinners, varnish and other “finishing” materiel Fixings: Nails, screws, fasteners and hinges. Welding Materials: Gas, rods and abrasives Electrical Items : Cable, switches, transformers and relays Plumbing Materiel: Pipes, joints, guttering, waste pipes, sanitary products, basins, toilet cisterns, septic tanks and associated sealant. Road Repair: Asphalt, gravel, and kerbing.	
3	Construction Machines and Engineer Equipment	Location, type, quantity and capability of: Dozers and tractors Dumpers & dump trucks, scrapers, graders, rollers, back-hoes etc. Mechanical handling equipment (including cranes) Engineer construction plant (e.g. drills, hand & power tools, compressors, concrete mixers) Mobile generators Pumps Snow & Ice clearance equipment Quarrying equipment	
4	Bridging Equipment	Location, type, quantity and capability of: Bridges, bridge construction stores, boats, ferries, pontoons,	

		raft.	

LOCAL INFRASTRUCTURE CAPABILITIES

15. Engineers require information on local infrastructure capabilities in order to provide facilities for the force and local populations until CIMIC can assume responsibilities. These capabilities include power, water, waste and sewage disposal and environmental regulation pertinent to the area of operations. Detailed information is not essential but basic information will be required in order to inform military planning.

Local Infrastructure Capabilities Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Electricity generation, transformation & distribution	Location of facilities Capacity & output rating (voltage, current, phase & frequency) Generation means (e.g. coal, nuclear, hydro-electric) Management & Control systems Available work force Distribution system	
2	Gas production, storage & distribution	Location of facilities Type of gas source Calorific rating and output Management & Control systems Storage and distribution systems Available work force	
3	Water production, treatment, storage & distribution	Location of facilities Quality Capacity Management and Control systems Treatment systems Storage and distribution systems Available work force	See also STANAG 2885 and STANAG 2136
4	Waste & Sewage Disposal	Location of facilities Processing throughput Type of facility Management & control systems Available work force	
5	Civil transport Systems	Network layout Network capacity Type of transport (e.g. bus, rail, trams) Management & control systems Available work force	
6	Force Accommodation	Infrastructure available for use by forces as troop accommodation	

FORCE CAPABILITIES

16. Engineers require a detailed knowledge of their own, host nations, and the engineer capabilities of other forces in the theatre of operations in order to make detailed engineer plans for operations. The following information is required.

Force Capability Information Requirements			
Serial	Information Requirement	Reporting Detail	Other References
1	Own Engineer Troops	Troop strength Capability Equipment availability Materiel availability	
2	Host Nation Engineer Troops	Military engineer troops Construction contractors Design contractors Civilian equipment rental Construction materiel stockpile or sources	
3	Other Forces' Engineer Troops	Troop strength and capability Engineer equipment availability and capability Doctrine Templating Civilian resource availability and capability.	

CBRN

17. Engineers should be prepared to provide advice on water supply to, and contaminated water runoff from, CBRN decontamination areas.