General engineering involves activities that identify, design, construct, lease, and provide facilities. Characterized by high standards of design, planning, and construction, general engineering is the primary CSS function performed by engineers. General engineering normally serves the MAGTF at the operational level of warfare, contributing to force sustainment by enhancing the environment to improve operational tempo in the area. It includes horizontal and vertical construction, facilities, environmental impact considerations, provision of utilities, bulk liquids (e.g., water and fuel) support, and EOD.

CONSTRUCTION TYPES

The MAGTF may have extensive requirements for expeditionary horizontal and vertical construction in support of sustained operations ashore. Construction is normally of an initial or temporary standard but can develop into complex construction projects, i.e., the construction of multistory structures or develop paved road networks when assisted by the NCF.

Vertical

Vertical is the improvement or construction of facilities for use by the MAGTF. These facilities can be used in base camps, command posts, and maintenance facilities. Pre-engineered structures should be considered in the planning of any vertical construction project. These structures provide significant savings to the MAGTF in embarkation space and ease of construction and should be used at every opportunity. Types of vertical construction are—

- Wood and masonry.
- Existing facilities rehabilitation.
- Structural reinforcement.

Planning considerations for vertical construction include (total requirement for each type of facility)—

- Beddown.
- Maintenance.
- Command centers.
- Hospitals.
- Bunkers.
- Enemy prisoner of war (EPW) compounds.
- Quantity and quality of existing structures and facilities.
- Amount of new construction required.
- Host nation Class IV availability.
- Unit Class IV stocks.
- Number of engineer units available.

Horizontal

Horizontal construction is the construction required to shape the terrain to meet the operational requirements of the MAGTF. Horizontal construction is—

- MSR construction and/or maintenance.
- Expeditionary airfields.
- Site preparation for beddown facilities.
- Ordnance storage facilities.

The planning considerations for horizontal construction include (total requirement for each type of facility)—

- Tactical situation.
- Soil type.
- Soil stabilization.
- Construction material availability.
- Drainage characteristics.
- Class of road required.
- Location.
- Engineer equipment availability.

NEW AIRFIELD CONSTRUCTION

Construction of an airbase is a complex general engineering construction project performed by a combination of MWSS, ESB, and NCF engineers. However, careful planning and a strict focus on essentials can result in a facility that will support air operations soon after construction begins. Subsequent improvements can be made during use. If construction is guided by an ultimate plan, phased completion of each structure can be designed to serve both expedient operation and the final design of the facility.
The construction schedule in any single construction program is generally established by the theater commander. It is best to complete an air base to its ultimate design in a single construction program. Often, however, it is necessary to design a lower construction standard to get the base into operation within available time and construction support. In such cases, every effort must be made to proceed to the optimum design of the airfield. Repeated modification of a facility plan is to be avoided.

Airfield Facilities

A fully completed airfield includes—

1. Airfield runways including taxi ways, hardstands, aprons, and other pavements, shoulders, overrun, approach zones, navigation aids (NAVAIDs), airfield marking, and lighting.
2. Personnel facilities including kitchens, dining areas, showers, latrines, general housing, and troop quarters.
3. Operational support facilities including ammunition storage, fuel and lubricant storage, and distribution areas.
4. Aircraft maintenance, operations, and supply facilities including maintenance bays, base shops, photo labs, operations buildings, base communications, fire stations, weather facilities, general storage, and medical facilities.
5. Indirect operational support facilities including roads and exterior utilities, such as water supply and electric power.
6. Administration including recreation, welfare facilities, headquarters, and personnel services.

Reconnaissance

Airfield reconnaissance differs from road location reconnaissance in that more comprehensive information is needed. An airfield project involves more man-hours, machine-hours, and material than most road projects. Air traffic also imposes stricter requirements on traffic facilities than vehicular traffic. Consequently, the site selected has to be the best available.

When new construction is undertaken, the planner and the reconnaissance team must choose a site with soil characteristics that meet strength and stability requirements, or a site that requires minimum construction effort to attain those standards. Airfields present more drainage problems than roads. Their wide, paved areas demand that water diverts completely around the field, or that long drainage structures are built. A desirable airfield site lies across a long, gentle slope because it is relatively easy to divert water around the finished installation.

Support Facilities

Maximum use must be made of existing facilities. However, airfields and heliports may need extensive support facility construction. The advanced base functional components system (ABFC) provides estimates of material, man-hours of construction effort, and material estimates for standard types of facilities.

Expansion and Rehabilitation

Whenever possible, existing facilities must be used. The missions of engineers are so extensive, and the demand for their services is so great that new construction should be avoided. Facility use must be coordinated with host nation authorities because existing airfields, particularly in the rear area, are usually needed by host nation air forces and for commercial purposes. Military operations may require that friendly or captured enemy airfields be modified, expanded, or rehabilitated. When the decision to use an existing facility has been made, a reconnaissance is conducted by the anticipated users and engineers. Support facilities are converted to standards dictated by construction policy. Imaginative use of existing facilities is preferable to new construction. Ground reconnaissance of an airfield previously occupied by enemy forces must be performed cautiously, since facilities may be booby trapped or harbor unexploded explosive ordnance (UXO). Priorities for expanding and/or rehabilitating airfields are usually similar to requirements for new construction and airfield damage repair.

Rapid Runway Repair

RRR is one task of the base recovery after attack team (BRAAT). Materials, procedures, and techniques for rapid repair of bomb-damaged airfield runways and taxi ways have been under development for several years. The need for such developments has grown because of the substantial increase in the...
diversity and lethality of both air-launched and surface-launched weapons capable of inflicting damage on airfield runways and taxi ways.

Since substantial runway and taxi way damage following an attack is expected, quick recovery and support for tactical aircraft launch and recovery operations are paramount. To ensure task accomplishment, the RRR process has been broken down into the following nine elements.

- Base recovery operations command and control.
- RRR planning.
- Airfield damage assessment.
- Unexploded ordnance recognition.
- Minimum operating strip (MOS) selection and/or layout.
- RRR methods.
- Aircraft arresting system.
- Minimum operating strip marking and lighting.
- Airfield lighting.

Rapid Runway Officer in Charge

The RRR officer in charge (OIC) receives the airfield recovery plan from the combat operations center showing the MOS selected requiring immediate repair. The RRR OIC receives problem area information from the roving controller while directing the airfield recovery process.

Rapid Runway Repair Planning

RRR is a type of large-scale horizontal construction operation that requires immediate results. RRRs are usually spontaneous, and they are performed without the benefit of construction drawings or standardized plans. RRR planning should predicate on the worst-case possible and on historical-based data that aid in determining the needs for a particular airbase. RRR planning considerations include—

- Personnel available to work repair crews.
- Equipment availability and requirements.
- Material requirements.
- Number of craters and spalls that would need to be repaired to achieve an MOS.
- Pre-stage RRR kits and aggregate materials along length of airstrips, and/or fields and/or parking aprons.

BRIDGING SUPPORT

The bridging support for gap-crossing operations is critical to the mobility of the MAGTF. The following include types of gap crossings:

- River-crossing operations. River crossing operations are a type of complex obstacle breach. The equipment necessary to conduct the breach, in this case a bridge and associated resources, is placed under the operational control of the CEB until follow-on engineer forces are in place to assume responsibility for the site.
- Dry-gap crossing. These gaps can range from tank ditches to deep canyons. A key factor in the execution of this operation is the limitation of organic standard bridging assets to span large gaps.
- Overbridging operations. These operations place standard bridging assets over existing bridges to decrease the load on the existing structure.
- Nonstandard bridging operations. Nonstandard bridging operations involve the construction of a bridge using normal construction materials (e.g., wood, concrete, stones) vice standard bridging assets. Due to material and time requirements and intense allocation of personnel, equipment, and materials, this is rarely effective for front-line maneuver elements in the battle zone. This would be more appropriately used in the rear areas in lieu of standard bridging or to replace standard bridging for reuse by the maneuver forces. This function would best be supported by ESB or NCF.

FOLLOW-ON BREACHING AND/OR AREA CLEARANCE

At the FEBA, there are normally two priority tasks for support engineers to perform in maintaining speed and momentum: follow-on breaching (clearing additional lanes through obstacle or mine fields) and area clearance (final reduction) of obstacles or mines. It is imperative that combat forces following the assault force and all necessary support units and supplies pass through the breach as quickly as possible. As there will usually be far more elements and supplies in trace of the assault force than the
assault force itself, the initial breaching effort may be insufficient to support the heavy track flow.

**Follow-on Breaching**

The additional flow of personnel, equipment, and materials will normally require widening existing lanes and breaching and proofing additional lanes. The support engineers will need to plan additional lanes or widening operations that do not endanger elements passing through the obstacle field or cut off usage of the existing lanes.

**Area Clearance**

A significant cleanup, repair, and maintenance effort is usually required to convert the enemy infrastructure to friendly use. The demolition of damaged facilities, clearance of minefields, unexploded ordnance, battle debris from MSRs, and CSS areas constitute a major part of follow-on operations. As the combat engineer elements will advance with the maneuver forces, the area clearance requirement falls to support engineers and other engineering assets.

**ELECTRICAL SUPPORT**

Mobile electric power (MEP) support, especially to the MAGTF command element and the command elements of subordinate units, becomes increasingly more important when the MAGTF is unable to rely on local electrical utilities for its power needs. Planning considerations include—

- Commander’s priorities.
- Support sources.
- Environmental considerations.
- Power requirements.

**BULK LIQUID SUPPORT**

All operations rely heavily on the supply of fuel and water. Bulk-fuel Marines and utility Marines in the ESB are responsible for planning and executing bulk liquid operations for the MAGTF beyond the elements organic capabilities. The ESB is responsible for the transfer of Class III (bulk fuel) from amphibious and/or commercial sources, and acts as the main source of fuel storage for the MAGTF. The ESB provides fuel to the ACE, GCE, and CSSE. The ESB also provides the MAGTF with potable water production and storage as well as laundry and shower support when the requirement exceeds the organic capabilities of the elements of the MAGTF. Planning considerations include—

- Commander’s priorities.
- Supply sources.
- Environmental considerations.
- Space, terrain, and weather conditions.
- Storage and distribution requirements.
- Support requirements.

**EXPLOSIVE ORDNANCE DISPOSAL**

EOD assets to support operations in the MAGTF AO are normally found with the support engineer and wing engineer units, i.e., MSSG, ESB (in the FSSG), and MWSS (in the MAW). The operations typically supported by EOD units include—

- Clearing ordnance.
- Rendering ordnance safe.
- Identifying, collecting, evaluating, and exploiting foreign ordnance.

These operations play a vital role in the conduct of operations in the battlespace. The following paragraphs are some examples of when this can occur.

Large, existing minefields (enemy or friendly), ammunition supply points, unexploded ordnance, or the existence of chemical or biological weapons systems can impact the commander’s use of the battlespace. Disposition of units, equipment, or supplies in an operation may prevent conventional clearing operations, or operational tempo may not allow time for combat engineers to remain in rear areas to clear these hazards. These situations may require the use of EOD teams to disarm or destroy ordnance without endangering friendly unit.

EOD unit’s knowledge of foreign ordnance can aid the commander’s planning to avoid situations such as having units remain in the vicinity of an enemy’s self-destructing mines. Even after breaching such a field, it would be imperative to keep units away from the field until the self-destruct cycle has completed. Inspecting foreign ordnance to ascertain the existence of chemical or biological delivery systems would be necessary to prevent contamination of units when these items are destroyed.

EOD brings a vast array of skills and knowledge to the engineer commander and the commander’s staff
that should be incorporated into the MAGTF commander’s planning and execution of an operation. EOD operations require early and continuous involvement of EOD personnel in operational planning. Given the complexity and number of U.S. domestic and foreign ordnance, EOD personnel must coordinate with intelligence, logistics, and aviation staffs to ensure they have a complete understanding of possible ordnance types in the battlespace.