

CHAPTER 4

Engineer Construction

During the first months of Operation DESERT SHIELD, as policy makers worked to resolve the issues surrounding host nation support, military leaders carefully shaped the appropriate procedures and standards for engineer construction. Because of the harsh environment and the shortage of engineer troops and equipment, meeting the construction requirements of the theater posed a significant challenge.

Theater Construction Management

By doctrine, the theater commander established the construction priorities, allocated resources, managed the procurement and use of materials, assessed the progress, and planned future construction. Construction could be controlled at the theater level by a theater wartime construction manager. A particularly large theater could have several regional wartime construction managers. The theater manager oversaw both troop and contract construction, integrated each of the service commander's priorities into an overall construction program, and set priorities for U.S. requests for host nation construction support in the region.

During Operation DESERT SHIELD/DESERT STORM, General Schwarzkopf was responsible for engineering support, coordination, and priorities. Rather than delegate this authority to one service, Schwarzkopf retained overall responsibility for managing the theater construction program. However, he delegated to his engineer, Colonel Braden, the responsibility for managing the day-to-day construction planning, programming, and execution.

Managing joint construction in the Kuwaiti theater of operations was complex. It included setting priorities for all construction requirements that exceeded the capabilities of engineer troops or contractors, reallocating construction assets to support these priorities, validating military construction funding requests from the services, providing engineer planning for the commander in chief, and establishing and monitoring reporting requirements and construction standards.¹

Previous operations plans provided for two regional wartime construction managers—ARCENT and NAVCENT (specifically the Naval Facilities Engineering Command). ARCENT further delegated its construction management responsibility to the 416th Engineer Command. This concept, which General Schwarzkopf never implemented, would have the 416th manage construction for both ARCENT and CENTCOM, thus clouding issues of command and control. Also, the engineer command could possibly be located some distance away from the joint command that it supported.

In the weeks before Operation DESERT SHIELD, CENTCOM had, in fact, abandoned the concept of having two regional wartime construction managers. In late July/early August, it had developed a new concept that appeared in the draft regulation 415-1, "Military Construction/Engineering in the USCENTCOM Area." CENTCOM used and disseminated this draft regulation, which had not yet been formally approved.

As specified in the draft regulation, CENTCOM adopted a new concept—regional contingency construction management. Each service would be responsible for its own engineering and construction support. Under this process, the CENTCOM engineer and a team of engineers representing each service and the Department of Defense's contract construction agent, the U.S. Army Corps of Engineers, would help General Schwarzkopf set theaterwide construction priorities and standards and allocate critical construction support. This regional contingency construction management team would monitor the way each service executed its engineering and construction program. It handled all items that were beyond a service's capability, perhaps reassigning projects to another service.

The team also managed the overall contingency construction program for host nation support. One of its main functions was to consolidate, validate, and prioritize contract construction at the theater level and maintain a theater construction priority list. All services had equal access to the team for construction beyond their own capabilities. The Army and the Marine Corps were the biggest customers initially because they had difficulty supporting deployed and deploying troops.²

CENTCOM first activated the regional contingency construction management team on 7 August at MacDill Air Force Base to help deploy engineer resources. The original team was an element of CENTCOM's engineer division, augmented with representatives from each service and the Department of Defense's contract construction agent, the U.S. Army Corps of Engineers. Initially, it included two representatives from ARCENT, none from the Special Operations Command, and one each from the Navy, Marines, and Air Force. Cliff Longfellow from MEAPO represented the Corps of Engineers.³

Colonel Braden and one of his staff members, Lieutenant Colonel John Trelease, along with four team members, deployed to Riyadh on 29 August and quickly set up operations at CENTCOM headquarters. Longfellow followed the next day. The team validated Army requests for 133 major construction project requests estimated at more than \$500 million.⁴

Civil Engineer Support Plan

One important tool for identifying construction requirements was the civil engineer support plan. The plan, produced jointly by the services, was oriented toward the COMMZ and addressed requirements generated by relatively stationary forces. It described the engineer effort required—including the

required facilities and Class IV (construction material) and the critical engineer tasks—to execute the operations plan. The plan's generator, an automated system, let planners weigh alternatives and compare the projected and actual engineering requirements.

The civil engineer support plan was outlined in Annex D, "Civil Engineering Support Plan," of CENTCOM's OPLAN 1002-90. But because the plan had not been completed, no data was available until after the operation started. Operation DESERT SHIELD was the first time planners would use the plan's generator to prepare for a real event.⁵

Planners had developed the civil engineer support plan process in 1980 to determine, in advance, the engineer requirements at echelons above corps for each potential theater of operations. Civil engineer support planning was later assigned to two Army Reserve engineer commands. One of these, the 416th Engineer Command, was designated as the wartime construction planning headquarters for Southwest Asia.

A team from the 416th reported to CENTCOM(Main) headquarters in Tampa in August 1990 to work on the civil engineer support plan for Operation DESERT SHIELD and remained there until October. Early engineer planning at CENTCOM focused on running the civil engineer support plan's generator against the time phased force deployment data.⁶ After planners in Tampa prepared the plan, they sent it to CENTCOM's forward headquarters in Riyadh where the staff used it to validate the need for facilities and the associated costs.

After soldiers from the 416th arrived in Saudi Arabia, they used the plan's results and planning factors to develop the actual requirements for the theater. They estimated the number and size of the facilities needed to support arriving troops and equipment. These requirements were translated into labor hours, quantities of construction materials, shipping weights, and costs for each project. These figures helped planners estimate requirements for engineer troops, contractors, and construction materials. They were the basis for ordering the shipment of materials, scheduling troop labor or awarding contracts, and obtaining prior approval for the projects. The civil engineer support plan's generator fairly accurately predicted the actual requirements. It anticipated construction requirements at \$1.2 billion. At one point, actual requirements from the services reached \$1.1 billion.⁷

Processing Engineer Requirements

The procedures for identifying, validating, and prioritizing engineer requirements were complex. Initially, with the regional contingency construction management team still at MacDill Air Force Base, CENTCOM had no organization in the theater to process the services' construction requirements. Thus General Pagonis and his staff handled all Army construction requirements. During the first months, Army units submitted their requirements

to the ARCENT SUPCOM engineer on DD Form 1391, "Military Construction Project Data." Pagonis approved or signed the form for ARCENT, and CENTCOM validated the project. That process kept the CENTCOM engineer in control of his projects and reassured Army headquarters and the Defense Department that the colonel concurred with the construction request. Meanwhile, Pagonis sent the forms to the Corps' Dhahran Area Office which began working with the troop units. Cox and his staff kept the general well-informed about the status of Army projects so he understood their relationship to other projects.⁸

Formal procedures for processing the services' engineer requirements did not really evolve until late November and early December when all the units responsible for processing the engineer requirements had arrived in the theater. Army units submitted their requirements on a DD Form 1391 through engineer channels to the corps level where they were consolidated with other requirements and passed on to the ARCENT engineer. He asked the U.S. Army Corps of Engineers to provide cost estimates within 48 to 72 hours. Miller and Cargill agreed to pass the requirements simultaneously to Forces Command, for information purposes, and to MEAPO(SWA), for cost estimates.

The Dhahran Area Office staff received the requirement as a two to three line mission statement. Using this brief description, they either prepared the estimate themselves or passed the requirement to MEAPO headquarters in Winchester, depending on the request's complexity and urgency. Once completed, the estimate went to ARCENT so the information could be entered on the formal DD Form 1391. After the ARCENT staff approved the form, they forwarded it through Forces Command and MEAPO to Army headquarters.⁹

Each service prioritized its own requirements and forwarded those exceeding its capabilities to CENTCOM headquarters in Riyadh. There the regional contingency construction management team consolidated, validated, and prioritized the requirements from all the services. Service representatives on the team met twice a week to explain their priorities. Colonel Braden, working with General Starling, established the initial priorities and made the recommendations. CENTCOM officials compiled the master priority list for the theater, integrating Army priorities with those of the other services. New projects were added at the bottom of the list each week, unless Braden or Starling decided to move a project up on the list.

Once a project appeared on CENTCOM's priority list, the Dhahran Area Office staff began designing it. The staff provided the designs, rough scopes of work, and cost estimates to ARCENT. The priority system was not always clear and precise. A high-priority project sometimes took longer to design than a low-priority project, which could already be under construction.¹⁰

Initially the theater commander had to approve all construction requirements exceeding \$200,000, which caused delays. Schwarzkopf had

neither the time nor the inclination to pour over all of those requirements. In November, General Waller indicated that he would approve the construction requirements exceeding \$200,000, and the approval process became more responsive and flexible. Waller was more accessible than Schwarzkopf.¹¹

When the main body of the 416th Engineer Command arrived in the theater in early December, procedures changed slightly because the command took over managing the approval process for major new Army construction projects. Under the new procedures, unit commanders identified the construction projects they needed and provided the details to the engineer units that supported them.

The 20th Engineer Brigade, 7th Engineer Brigade, ARCENT SUPCOM engineer, and 411th Engineer Brigade helped the units define their requirements and provide the 416th with descriptions of needed materials, project location, projects sketches, and maps. The 416th commander validated the requirement, verified the scope, obtained unit costs, assigned a project number, and selected the appropriate design entity. The engineer command prepared the final DD Form 1391 to submit to CENTCOM and recommended the priority that ARCENT should give the proposed project.¹²

After early November when the Saudi Arabian government formally agreed to provide extensive host nation support, construction could be done either through Saudi or U.S. contracts or by U.S. troops. CENTCOM created a board to integrate Saudi officials into the planning process. The combined civil-military engineer board made up of representatives from the Ministry of Defense and Aviation's Joint Forces Support Unit, CENTCOM's engineer office, and MEAPO(SWA) met twice each week to review the status of projects and determine how to meet new requirements. After considering the resources available and the urgency of the requirements, the board recommended the appropriate method for completing each project. The board worked from CENTCOM's priority list. This list of 100 to 150 approved projects served as a menu from which the United States could get construction from the Saudis. After the board validated the requirement, it went directly to the Ministry of Defense and Aviation for execution.¹³

After Waller blessed a construction project, Braden sent out a message indicating that CENTCOM had approved the project at the estimated cost. Then either the Saudis or the services handled the project. The services used troop labor and materials supplied by the Saudis or purchased. Braden's staff continually reviewed proposals to ensure the projects were still valid and could be accomplished in time to benefit troop operations.¹⁴ By 25 November, the services had submitted 79 proposals—estimated at \$878 million. CENTCOM officials had validated and approved 53 projects—costing \$351 million.¹⁵

After CENTCOM officials prioritized and approved the DD 1391 forms, Colonel Miller transmitted the project priority list to the Dhahran Area Office staff so they could begin design work. Miller forwarded design and contract

specifications for the projects that were designated for host nation support to the Ministry of Defense and Aviation for contract award.

MEAPO(SWA) provided technical oversight of the ministry's contracts to ensure the work met U.S. requirements. Each Wednesday morning Miller and representatives from the Joint Forces Support Unit poured over the design packages. Corps personnel told the Saudis how each project should look, where it was located, and what it would cost. After receiving all this information, the support unit budgeted for and advertised the project, received and evaluated the bids from contractors, and awarded the final contract. After the support unit awarded the contract, MEAPO(SWA) placed some of its personnel on-site to ensure that the contractors built the projects according to the specifications. For example, Captain Steve Adams and his staff oversaw construction at King Khalid Military City, while another Corps representative performed the same function at the air base in Riyadh.¹⁶

Representatives from MEAPO and the Joint Forces Support Unit signed an agreement on 29 January 1991 that defined the responsibilities for project management, engineering, and construction management supporting the Gulf operations. The support unit agreed to use construction contracts to procure facilities at various locations throughout Saudi Arabia. MEAPO and the support unit would provide the quality assurance and technical oversight for these contracts.¹⁷

Construction Standards and Design

In general, construction standards determine the types of materials and the techniques that engineers use to construct facilities. During the first months of the Gulf operation, however, the services were somewhat confused about construction standards. At the time of the invasion, Army planners had not yet established minimum construction standards for the Kuwaiti theater of operations. Such standards affect the number of engineer troops and the amount of host nation support, construction equipment, and construction supplies needed in the theater.

In developing minimum standards for the theater, planners failed to follow the Army's own standard design system—the Army Facilities Component System. Moreover, information about standards was not readily available to engineer planners when they arrived in the theater. The lack of clear guidance about construction standards delayed construction decisions.¹⁸

Recognizing the confusion, Braden directed the services to follow construction standards contained in OPLAN 1002-90. On 6 September, CENTCOM directed that facilities supporting troops in the Persian Gulf would be constructed to "initial standard" and only be upgraded to "temporary standard" with Braden's approval. The military defined initial standard as austere facilities with minimum engineer construction effort, intended for only one to six months of use. By contrast, it defined temporary standard as

minimum facilities intended to increase the efficiency of operations, intended for up to 24 months of sustained operations. Braden indicated that he would only approve exceptions to initial standards on a case by case basis.¹⁹

Braden maintained that the published definitions of initial and temporary standards were broad enough to meet the needs of the services. He noted that services should submit to the regional contingency construction management team any questions they had about how the definitions applied to particular types of construction—such as prefabricated modular structures. The standards, he explained, were “not intended to restrict construction, but rather to control the quality and consistency of construction and to manage the visibility the construction gives to the duration of the operation.”²⁰

General Schwarzkopf was anxious that the operations not appear to be permanent. The Bush administration had assured the Saudis that the U.S. troop presence was temporary, and the theater commander wanted to reinforce this message. Any construction that indicated permanency, such as base camp construction with hard stands and concrete slabs, was “politically unacceptable.” The engineer community, Braden observed, came under a lot of pressure “to keep from gold-plating the theater.” CENTCOM’s decision to adopt austere construction standards—the minimum required to support the troops and the operation—limited the number and scope of the services’ construction requirements.²¹

On 16 September the theater commander established a more detailed strategy for moving from initial to temporary construction standards. As the focus changed from deploying to supporting and sustaining troops, Schwarzkopf announced a plan to move to temporary construction standards to enhance living and working conditions.

In the first 90 days of the operation, the services were to bed down forces to initial standards using their organic assets supplemented by leased facilities or facilities provided by the Saudi Arabian government. If necessary, temporary standard latrines and showers could be built using contract construction, host nation support, or troop labor.

From 90 to 120 days, housing, medical, maintenance, and other key facilities would be upgraded to temporary standards using expedient shelter systems and contract construction. Power distribution systems would be developed for the base camps, and power generation detachments and equipment could replace unit generators. [See *Powering the Theater*, page 187.] Troops would drill or improve water wells.

Over time, troops would need better facilities to operate effectively, and the cost of leasing would become prohibitive. Recognizing this, the theater commander stipulated that after 120 days, the services could upgrade all facilities to temporary standards and construct additional base camps to reduce the number of people using facilities leased with U.S. funds. Existing camps would be improved through a combination of contracted construction, troop

labor, and prefabricated modular buildings. Additional camps would be built by troop labor, contractors, or both.²²

The theater commander continued to emphasize austere construction. In mid-December, General Starling issued revised guidance on theater construction. The arrival of VII Corps prompted CENTCOM to reevaluate its immediate objectives concerning infrastructure. Its priority now was to satisfy "the most urgent requirements" of arriving forces. Starling directed that the engineer force and other construction resources in the theater be applied only to requirements that would directly enhance combat readiness and sustain the force within the next 60 days.

Therefore, construction to house and support troops should remain at initial standards unless otherwise authorized. Construction should focus on projects that were required to support combat—ammunition supply points, airfield improvements, heliports, helicopter refueling/rearming points, main supply routes, and forward supply areas. Only critical troop facilities—particularly latrines, showers, and dining facilities—should be upgraded. The theater commander would evaluate requests for upgrades to other facilities on a case by case basis.

Rudimentary roads and maintenance and storage hardstands could be constructed only to sustain operational effectiveness. U.S. forces might use temporary, relocatable structures such as K-Span buildings to meet the requirements for large maintenance and storage facilities in the rear areas. In sum, CENTCOM directed, "this is to remain a lean theater that takes care of the personal needs of our troops, has the capability to provide flexible logistics, and is prepared for warfighting."²³

Policy makers and planners carefully avoided anything that appeared to be long-term construction. For example, plans for the first life support areas included a concrete block building at each site to be used as a mess hall. These buildings provoked questions at Corps headquarters and in Congress because the cement/masonry structures looked permanent. Concrete block buildings, however, were cheaper to build in Saudi Arabia than portable construction, provided better protection, and were cooler than wooden structures. Officials allowed the Dhahran Area Office to build cement/masonry structures at the base camps but only because they were cheaper than alternatives and could be leveled after the operation ended.

After seeing the austere structures that the contractors provided, Ben Wood argued that it might have been better to build more permanent structures that the Saudis could have used later for joint training exercises and other purposes. "Temporary" construction, he observed, was not necessarily "cheap" construction in a desert environment. In a region where afternoon temperatures soared to 130 to 140 degrees, insulation and cooling became part of the initial standards. By the time contractors provided enough insulation to make the facilities inhabitable, Wood added, they had built "a fairly formidable



Cement masonry building under construction at a life support area.

structure.” He also noted that designing a structure from scratch was easier than paring back a standard Army design.²⁴

MEAPO designed the CENTCOM-approved projects that were not designed by troops. The submission and approval of a DD Form 1391 was MEAPO's signal to begin design. The design work involved conducting a preliminary site investigation, determining layout requirements, developing the site-specific layout, preparing the government estimate and specifications, and performing a quality assurance review.²⁵

The Army Facilities Component System was the Army engineer planning and design system developed in 1951 for use in contingencies worldwide. It consisted of engineer planning data on facilities requirements for all deployable Army units, standard designs for austere facilities, and bills of materials for construction. The system provided construction standards, construction phasing, standard plans, and general guidelines. It provided information on construction materials and techniques plus digitized drawings of individual facilities or entire installations. Designers could not easily substitute materials prescribed by the system- such as lumber-with other construction materials readily available locally.²⁶

Differing systems hampered the communication of standards and design data among the services. The Army Facilities Component System, the Advanced Base Functional Components System used by the Navy and Marine Corps, and the Air Force Design Manual provided construction drawings with varying interpretations of the Joint Staff's construction criteria and standards. The existence of three distinct systems strained the joint-level validation process and created difficulties for the Department of Defense's contract construction agent,

the U.S. Army Corps of Engineers. After the Gulf War, the CENTCOM engineer recommended that the Joint Staff coordinate with service engineers to establish a common set of drawings and specific construction standards for facilities.²⁷

Design was an evolving process. The Dhahran Area Office often modified the Army's standard designs to shorten the construction time and cut costs. Fortunately, the office shared a building with an engineering firm that could print drawings and documents overnight. The Dhahran Area Office staff's knowledge of the types of material available in the Middle East proved to be very helpful when designing projects.²⁸

The actual design work was not particularly complicated. Corps personnel skillfully adapted the generic specifications and design criteria to specific situations. They did their best to respond to unique and rapidly changing requirements. A small group of engineers in the Dhahran Area Office soon dubbed their work area the "ballpark" because other staff members continually asked them, "Can you give us a ballpark estimate of what this will cost?"²⁹

Although the level of design was mostly simple field design, the Dhahran Area Office sometimes created designs that were too elaborate. Shifting gears from peacetime construction to wartime construction could be difficult. Troops needed facilities that could be built quickly, Lieutenant Colonel Cox observed, not ones that would last 50 years.

Normally, Cox stressed three priorities for each project: quality first, then cost and time. During the Gulf operations, however, he directed his staff to emphasize time first, then quality and cost. Occasionally, the staff completed projects in 30 days that normally would have taken six to nine months. To expedite construction, the staff drew on their knowledge of the types of materials available in the region and grappled with shortages of some critical materials and equipment, particularly heavy-haul equipment. They completed designs in 24 hours that might have taken three months. Normally project design could take up to a year, but the average design time during Operation DESERT SHIELD/DESERT STORM was four days from the receipt of the project to the reproduction of the drawings.³⁰

MEAPO lacked sufficient in-house design capability to support the requirements in Saudi Arabia, so it awarded indefinite delivery contracts to four or five design firms. Ollie Werner, chief of MEAPO's engineering division, and Roger Thomas, chief of MEAPO's project management and planning branch, stipulated that all potential contractors should have expressed an interest in providing support services for Operation DESERT SHIELD and should have previous experience working in the Middle East, preferably with MEAPO. At least one firm should be located within 100 miles of Winchester to provide immediate response, and at least one firm should be located in Saudi Arabia to provide minor design and engineering support services to the Dhahran office.

Three additional firms should be able to design airfields, industrial type facilities, and water and power supply and distribution plants and be able to do master planning. Of the 19 firms that expressed an interest in supporting Operation DESERT SHIELD, MEAPO selected Leo A. Daly; STV/Lyon Associates; Stanley Consultants, Inc.; Zuhair Fayez and Associates; and Daniel, Mann, Johnson, and Mendenhall.³¹

After MEAPO signed the contracts, either the Dhahran Area Office staff, MEAPO personnel in Winchester, or one of these architect-engineer firms performed the design work. Problems developed because the designs that MEAPO and its contractors produced did not have the level of detail normally contained in Corps' solicitations. Also Saudi contractors lacked the capability to complete design and build packages, and office personnel spent much time helping the contractors develop the construction details. Since the Dhahran office did not have a large enough staff to continue helping the contractors with the design work, it determined that its designs would have to provide Saudi contractors with sufficient detail.³² After the host nation support implementation plan was signed on 1 November 1990, office staff turned the designs into packages that the Saudis could award and fund.

South Atlantic Division's procedures required that it review and approve the designs that MEAPO produced. Division personnel also reviewed, in a secondary capacity, the designs developed by MEAPO's contract architect-engineer firms to have an overview of all the designs in MEAPO's programs.

Because of the urgency of the Gulf operations, the division modified its required procedures. The division retained its oversight responsibility but only intervened directly when there were potential problems. MEAPO provided an information copy of each design to the South Atlantic Division's engineering division. However, it often submitted copies of each of its major technical designs to the division for approval. A "major design" was any project that would cost more than \$150,000 to construct.³³

The project engineer or construction representative who would be monitoring the work on-site evaluated the plans and specifications to determine if they were feasible. He addressed such issues as correct elevation, adequate utilities, adequate drainage, and suitability to the environment. The project engineer or construction representative did not have much time to review the plans and specifications. If his review was favorable, he directed the Dhahran Area Office to award the contract. The office's construction division monitored the contract after it was awarded. Construction representatives were on-site every day and fed information back to the project managers.

The Corps brought in several officers—Captains Paul Cudney, Ted Kientz, Dana Patterson, and Steve Adams—to act as project engineers. They provided the necessary oversight and, in return, gained valuable experience. They sometimes had the rare opportunity to see projects through from start to finish.

For example, Captain Cudney worked on as many as nine different projects in various stages of completion in the United States, but in Saudi Arabia for the first time he steered a single project through the various stages towards completion.³⁴

The Dhahran Area Office staff encountered significant problems during the design process—to include difficulties developing design criteria and obtaining access to project sites. When staff members received a project, they could not always visit a site because of the great distance or a heavy workload. Sometimes the site visits were made by engineers who had no design experience from other offices, so the Corps received incorrect data. Corps personnel found that it was important for the designer to inspect the site and talk directly with the user. Also, because of the fast-paced design cycle and problems with the design process, some design projects had deficiencies.³⁵

Construction Materials

The availability of construction materials was a major factor in project designs. The Army Facilities Component System designs might be difficult to construct because required construction material was unavailable. In the Middle East, engineers could easily draft a great design only to find that they could not acquire needed materials. If the standard materials were unavailable, the Dhahran Area Office staff developed designs that provided for substitutions, for example, a shower constructed of local materials. Corps personnel tried to ensure that the materials they specified were available locally and would not have to be ordered from the United States. When a contractor for one project indicated that the specified materials would have to come from the United States and would take six months to get, office staff quickly modified the contract to allow a substitution.

Units often requested wood construction because all the temporary structures described in the Army Facilities Component System were wood, but wood was scarce and very expensive in Saudi Arabia. As the Army bought up the available supplies of wood, prices soared even higher, particularly the cost of plywood and 2x4s. In other instances, the specifications called for a certain number of inches of asphalt, but asphalt was also scarce. The Dhahran Area Office had the contractors compact the existing material and put asphalt on top.³⁶

Critical construction materials such as cement, asphalt, prefabricated shelters, pipeline components, sand grids, airfield matting, dust palliatives, lumber, and barrier materials were scarce. The civil engineer support plan had not accurately forecast most of the required construction material.³⁷ By late August, the supply of local construction materials was rapidly diminishing. Competition for scarce construction materials resulted in soaring prices. The cost of a bag of cement jumped from \$2.13 to \$8.00.



Base course stockpile area for work at KingFahd International Airport. The lack of an adequate source of base course in the eastern province of Saudi Arabia forced contractors to haul material from Abu Hadryiah, 100 kilometers away.

The limited capability of the services to produce asphalt, concrete, or crushed rock resulted in heavy reliance upon host nation assets and delayed essential construction projects. No service brought into the theater adequate resources to produce asphalt, concrete, or crushed rock, either because they had underestimated the need for these resources or because of the limitations on transporting heavy equipment.

The civil engineer support plan's generator assumed that all construction materials would be transported to the theater of operations. In reality, local contractors provided most of the Class IV construction materials. The severe shortage convinced Colonel Flowers that in the future the Army should establish strategic stockpiles of such materials.³⁸

The 411th Engineer Brigade reported that obtaining Class IV material was a major challenge. Planners had expected to obtain construction materials through the DD Form 1391 process, but this process could not react quickly enough for critical projects. The brigade requested materials to establish Class IV yards and to obtain aggregate and asphalt products. Local contractors had to purchase these materials. After the Gulf War, the commander of the 411th would report, "The shortage of Class IV material proved to be critical to the mission." He recommended that engineers be activated early to obtain key equipment and supplies for their projects.³⁹

Asphalt was particularly critical. Units needed asphalt pavement to control the dust and sand around helipads, airfields, hardstands, wash racks, warehouses, large "festival" tents, and other relocatable structures. Yet engineer

construction support companies were deployed without their asphalt production and paving equipment and had to rely on Saudi asphalt plants and compaction equipment. This equipment was in very poor condition, the stock of repair parts was limited, and maintenance crews were scarce. Each combat heavy battalion had only two asphalt distributors, not enough to meet the demand. Saudi contractors provided some asphalt pavement, but at a high price.⁴⁰

The paving capabilities of Task Force 43, the task force made up of the 43d Engineer Battalion (Combat Heavy) and various engineer companies, were seldom fully used because asphalt was scarce. At one point, the task force had three asphalt platoons, but it could not keep them supplied. An asphalt platoon from the 13th Engineer Company (Combat Support) arrived on 24 December 1990 but had no asphalt production equipment. The frustrated engineers sat idle until 5 January when contractors began to provide asphalt. Even then, the problems continued. The asphalt shipments sometimes did not arrive on schedule. Often they contained oversized aggregate and were delivered cold.

After 12 January, asphalt deliveries stopped altogether. With war approaching, contractors had difficulty finding drivers who would deliver the asphalt to the construction sites. In January, the 155th and 259th Engineer Companies joined Task Force 43, so it now had three asphalt platoons with six paving teams. The 155th put an old asphalt plant at King Khalid Military City back in operation. It took time before the plant produced at its capacity of 150 tons per hour. Even at peak capacity, the plant produced only enough to supply one of the three asphalt platoons, so the task force continued to rely on commercial sources for asphalt.

In addition, there was a small asphalt plant at Hafar al Batin and a larger plant at Majma'ah. The Majma'ah plant, however, was a long distance from the construction sites, and the hot-mix asphalt cooled during transportation causing quality control problems. An asphalt plant north of King Khalid Military City, operated by one of the Corps' contractors, was dedicated to paving operations at that installation.⁴¹

The 416th Engineer Command, using in-house logistics capabilities; civilian contracting expertise; and civil engineer support plan requirements, projections, and requisitions procedures, managed the procurement of Class IV materials for all the services. U.S. forces ultimately acquired and used 5,000 cubic meters of gravel, 170,000 metric tons of asphalt, and 93,000 cubic meters of ready-mix concrete at a cost of \$64 million. This did not include construction materials that the regional contingency construction management team procured with funds from the governments of Saudi Arabia and Japan.⁴² Although support from the host nation and Japan helped considerably, the shortage of construction materials sometimes delayed or stopped critical construction projects.

Obstacles to Construction

As American soldiers moved into the interior of Saudi Arabia, away from the port areas and major cities where the oil industry had developed infrastructure in the 1970s and 1980s, they required road networks, staging areas, ammunition supply points, heliports, warehouses, and other facilities. Most construction requirements were for the Army, rather than the Air Force and Marines. Yet, the late deployment of its engineers severely limited the Army's ability to construct the necessary facilities.⁴³

The shortage of engineer troops and equipment was particularly great in horizontal construction such as roads, hardstands, and heliports. By the time combat heavy engineer battalions arrived in the theater, Braden observed, the requirements for Army engineer work were "massively weighted" toward horizontal construction. Many of the engineers in combat heavy battalions, who normally performed vertical construction, were diverted to horizontal construction. Carpenters, plumbers, and electricians operated dump trucks or other engineer equipment. Each engineer company had one horizontal construction platoon and two vertical construction platoons, but there was little need for vertical construction in the Middle East. Senior engineers later observed that it would have been better to have had two horizontal platoons and one vertical platoon per company.

With combat heavy engineer units arriving in the theater late, the corps divisions needed much support. The divisions took their organic engineer battalions with them to the forward areas. As a result, the ARCENT SUPCOM had to rely heavily on construction contractors. The shortage of engineer troops continued until February, and some projects were left undone, particularly road construction and maintenance.⁴⁴

Military leaders decided to place the limited heavy construction assets forward with the corps engineer brigades and risk shortfalls at the echelons above corps because of the well-developed infrastructure in Saudi Arabia and the availability of contractors and host nation support. Combat heavy engineer battalions were normally assigned at echelons above corps and did not support the corps, but the corps needed their horizontal construction capabilities. The first combat heavy battalions in the theater went directly into the desert to support the 20th Engineer Brigade. Ultimately, four combat heavy battalions supported the XVIII Airborne Corps, three supported VII Corps, and only two supported echelons above corps.⁴⁵

The preponderance of horizontal work posed a challenge for engineer units. The commander of the 411th Engineer Brigade, General Storat, complained that his units were "stretched thin" on their horizontal work at echelons above corps. To cope with the heavy workload, the brigade leased or purchased extra commercial equipment.⁴⁶

The harsh environment further hampered construction. Engineer productivity suffered in the intense heat. Operating a bulldozer or fork lift in

the desert was difficult. Often, engineers had to develop roads to get to their work sites and then had to level 3-foot to 4-foot sand dunes before beginning construction. Grading was expensive and time-consuming, something many officials in the United States did not realize.⁴⁷

Another obstacle to construction was the restriction on funding. [See Funding Corps Activities, page 63.] Initially CENTCOM had no way to fund anything other than minor construction. Funding new construction projects that cost more than \$200,000 was a major challenge. Four basic legislative authorities could be used to expedite the release of military construction funds during contingency operations—Title 10, U.S. Code, Sections 2803, 2804, 2805, and 2808. These laws required a tedious process of submitting detailed justification for all military construction projects that cost more than \$200,000. The laws had been designed in part to ensure that taxpayer dollars were spent appropriately, but this goal had to be balanced with the maneuver commanders' urgent needs for authority to fund large construction projects.

Title 10, U.S. Code

Section 2803, "Emergency Construction," authorized each service secretary to reprogram up to \$30 million in military construction funds for a military construction project not otherwise authorized by law. The major command requesting the project had to submit a DD Form 1391 to its service secretary, and Congress had to be notified.

Section 2804, "Contingency Construction," provided that within the amount appropriated for such purpose, the Secretary of Defense could carry out a military construction project not otherwise authorized by law or authorize a service secretary to carry out such a project. The secretary had to notify and get the approval of the appropriate congressional committees 21 days beforehand.

Section 2805, "Unspecified Minor Construction," authorized service secretaries to carry out minor military construction projects that Congress had not yet authorized,

but specified that no more than \$200,000 in operation and maintenance funds could be used for each project. Section 2805 also required a 21-day advance congressional notification. While ARCENT could approve projects under \$200,000, projects over that amount had to be forwarded to CENTCOM for approval.

Section 2808, "National Emergency Construction Authority," gave the Secretary of Defense broad authority to spend all the unobligated military construction funds, but only after the President issued a declaration of war or national emergency. Each service submitted a DD Form 1391 to the Defense Department to obtain approval and funding for a specific project. The Secretary of Defense had to notify Congress about the project and its estimated cost, but there was no waiting period. The project could begin as soon as Congress was notified.⁴⁸

Soon after the United States committed troops to Saudi Arabia, the Assistant Chief of Engineers, General Offringa, submitted a request to reprogram fiscal year 1990 military construction funds under Section 2803 to construct basic shelter and support facilities for soldiers in Operation DESERT SHIELD. The Secretary of the Army and the Deputy Secretary of Defense approved the use of Section 2803 authority to construct six base camps. Offringa recommended reprogramming \$30 million from four military construction projects in the United States—Price Support Center, Illinois; Fort Monmouth, New Jersey; Picatinny Arsenal, New Jersey; and Fort Knox, Kentucky.⁴⁹

On 24 August, the Department of Defense comptroller, Sean O’Keefe, asked the chairmen of the House and Senate appropriations subcommittees on military construction to approve the reprogramming action. The Senate subcommittee did so with the understanding that these funds would not be used to construct any permanent facilities without its approval. It also asked the Defense Department to seek host nation funding for projects as much as possible. The House subcommittee also approved the reprogramming action.⁵⁰

Military planners quickly recognized that the \$30 million reprogramming authority in Section 2803 would not provide enough funding. They began to push for the broader authority of Section 2808. General Pagonis argued that ARCENT had “critical” construction requirements that would not be met without both operation and maintenance funding and military construction funding. There was, he reported, an “urgent need” for emergency construction authorized under Section 2808.⁵¹ On 30 October, the Deputy Assistant Secretary of the Army for Installations and Housing, Paul Johnson, asked the Corps for a list of military construction projects in the United States that could be canceled to pay for construction in the Persian Gulf if the President invoked Section 2808 authority. The Corps identified 13 projects that could be canceled if necessary to fund \$98 million of ARCENT’s military construction requirements.⁵²

Sections 2803, 2804, and 2808 gave the service secretaries special authority to carry out military construction faster than normal procedures allowed. Yet, this authority required special processing of funding requests and congressional notification and took too long to meet the needs of the maneuver commanders in the Gulf. The only funds immediately available were operation and maintenance funds. These funds could not normally be used for work classified as military construction, but as noted, Section 2805 authorized the use of operation and maintenance funds for military construction under \$200,000.

The \$200,000 did not go far in an environment where a single water well cost \$340,000, a sunshade cost from \$143,000 to \$162,000, and a 50-helicopter heliport cost more than \$2.6 million and where \$200,000 would only buy one 16,000-square-foot, bare-bones K-Span building or 0.65 miles of road. Corps members quickly became frustrated by the \$200,000 limit and

requested that it be raised to \$5 million. Pagonis argued that the limit prevented urgently needed construction and robbed him of any flexibility to react quickly to the requirements of all the services. In late September, ARCENT officials joined Pagonis in requesting that the funding limit be raised to \$5 million per project.⁵³

In early October he again complained that critical construction requirements existed in eastern Saudi Arabia, such as sunshades, main supply routes, water wells, and heliports, but the \$200,000 limit on operation and maintenance funds did not provide enough flexibility to support U.S. forces. He requested that the limit be raised from \$200,000 to \$5 million. Forces Command also complained about this limit, noting that construction of heliports, helipads, and wells was being delayed.⁵⁴

Army officials found strong support for their position at CENTCOM headquarters. Colonel Braden observed that the normal process for approving and funding military construction projects was "not responsive to the operational requirements in a contingency environment." Raising the funding limit would enable the services to complete many critical projects. On 9 October the theater commander sent a message to the Joint Chiefs of Staff supporting ARCENT and Forces Command requests for relief from the \$200,000 limit. He argued that the limit did not allow for the construction of tactical bases and facilities that the services needed immediately or facilities that the troops needed for their health and welfare. He recommended that the chairman of the Joint Chiefs of Staff ask Congress to increase the limit to \$5 million.⁵⁵

To raise the limit, however, the Office of the Secretary of Defense would have to secure special legislation, and the Joint Staff's director of logistics, Vice Admiral Jimmy Pappas, warned that the mood of Congress was to "get allies to provide needed support." Rather than approach Congress, he indicated, they would have the Secretary of Defense's staff ask the Office of Management and Budget to expedite approval of the request for a Section 2808 presidential declaration of national emergency so the services could tap all unobligated military construction funds.

After receiving a less than satisfactory response from the Joint Staff, Yeosock directed the ARCENT staff to pursue every funding method—host nation, operation and maintenance, military construction—to accomplish his priorities.⁵⁶ The funding situation eased somewhat after 14 November 1990 when President Bush issued Executive Order 12734, declaring a national emergency and invoking the emergency construction authority under Section 2808.

Raising the \$200,000 limit was not the only controversial issue. There was some disagreement about how to define "military construction." When should operation and maintenance funds be used, as opposed to military construction funds? Could military construction funds be used to pay for projects on Saudi-

owned land? Could operation and maintenance funds be used to construct “permanent” structures?

Title 10, U.S. Code, Section 2801(a) defined military construction as “any construction, development, conversion, or extension of any kind carried out with respect to a military installation.” Not all structures could be easily categorized as “permanent” or “semipermanent.” For example, the comptroller general considered a runway a permanent structure, but a helipad or easily removable sunshade might not be. Corps leaders instructed Colonel Miller to use operation and maintenance funds for projects that cost more than \$200,000 only when the facility could reasonably be classified as semipermanent.⁵⁷

The Corps’ chief counsel, Lester Edelman, concluded that construction in Saudi Arabia could be considered military construction if it was performed in relationship to an activity that was under the operational control of the Secretary of Defense. In other words, U.S. ownership of the land was not a prerequisite for military construction, as long as the land was under the operational control of U.S. forces. He also maintained that military construction funds could be used for temporary facilities. The question remained, however, as to who determined that the land was under the Secretary of Defense’s operational control. Construction related to a military installation—defined as an activity under the operational control of the Secretary of Defense—was appropriately funded with military construction funds.

Edelman advised that the Corps could legally use operation and maintenance funds to construct authorized semipermanent facilities. These funds were legally available for projects that did not exceed \$200,000 and construction in Saudi Arabia that did not fit the definition of military construction.⁵⁸

Lieutenant Colonel William Hagan, ARCENT SUPCOM’s staff judge advocate, endorsed Edelman’s opinion. Though Edelman’s position was liberal, Hagan explained, his “special position to comment makes his opinion worthy of the weight we have given it.” He concluded that it was appropriate to use operation and maintenance funds to construct a badly needed heliport at King Abdul Aziz Air Base, even though the base was not under the control of the U.S. military.⁵⁹

Colonel Tonu Toomepuu, ARCENT’s staff judge advocate, however, criticized Edelman’s position. The conclusion that operation and maintenance money was appropriate, he argued, did not necessarily follow from the premise that military construction funds could not be used. “If the contemplated construction is completely on Saudi owned and controlled property in which we have no legal interest, such as right to enter and use, we may not pay for it at all with military funds,” he concluded. “If it is construction for our benefit we must pay with MCA [military construction, Army], more than \$200,000, or we may pay with OMA [operation and maintenance, Army] funds under \$200,000 per project.” Building temporary structures that could serve the

United States may be classified as acquiring supplies, he added, and supplies may be purchased with operation and maintenance funds.⁶⁰

As the debate continued, Colonel Miller requested permission to award an indefinite delivery order contract to provide a 5.1-centimeter layer of asphalt over 1.1 million square meters currently being used as a temporary heliport at King Fahd International Airport. This \$3.5 million project was urgent. Workers had recently applied a chemical spray as a dust palliative, but the surface could not withstand heavy vehicle and aircraft traffic. The dust at the temporary heliport endangered personnel and equipment. Four incidents of "hard landings," where pilots cut off their engines before safely setting their helicopters on the ground, had occurred because blowing dust obscured visibility. Each incident had jeopardized a \$12 million piece of equipment and put its crew in danger. Yet, MEAPO could not award the dust palliative contract because of the \$200,000 limit.⁶¹

General Sobke urged the Corps' director of military programs, General Ray, to give MEAPO authority to award a contract and begin construction using operation and maintenance funds. The project was in support of military operations and the facility would not be permanent, he argued, so this funding was appropriate. Ray refused to grant Sobke's request because he was awaiting an opinion from the Office of the Secretary of Defense's general counsel, Terrence O'Donnell, on the use of these funds. O'Donnell determined they could not be used for a dust palliative contract at King Fahd International Airport. Saudi funds were eventually used for some projects at the airport.⁶²

Host nation support and Section 2808 authority did much to alleviate the problem of funding construction, but funding MEAPO's planning and design work was another matter. Paying U.S. personnel directly involved in administering design and construction activities could only come from two sources—project funds or cost reimbursement. The Corps could either use military construction funds or planning and design funds to pay its personnel who were involved in the design and construction of facilities used by U.S. forces.

In mid-November Sobke asked Corps headquarters for specific guidance about the type of funding the Corps should use. Since no funds had been specifically designated for planning and design, Sobke requested \$2 million in military construction funds to pay for MEAPO's support of host nation construction. MEAPO had already received \$250,000 to plan and design the life support areas, \$150,000 for an ammunition supply point, and \$50,000 for a heliport project.⁶³

The Corps provided the Saudis with construction support under the host nation support agreement to ensure that the facilities that the Saudis constructed satisfied the requirements of U.S. forces. Military construction funds were scarce, and the Corps believed its support functions should be funded with operation and maintenance appropriations.

Edelman maintained that military construction planning and design funds were appropriate to manage projects that the Saudis constructed, that operation and maintenance funds were appropriate for advance planning activities, and that no authority existed to perform comprehensive designs for projects to be constructed by foreign governments. He concluded that Title 10, U.S. Code, Section 2807 did not authorize the use of military construction funds to plan and design projects that foreign governments funded and constructed.

Edelman added that since Section 2807 explicitly provided for the funding of construction management of foreign-funded projects using planning and design funds, those were the only funds available for that purpose. Section 2807 authorized the Secretary of the Army to provide construction management services for projects that the Saudis executed for Operation DESERT SHIELD, he added, and the military construction planning and design account was the appropriate source of funds for these services. He believed that the Corps could appropriately use operation and maintenance funds to complete the advance planning activities necessary to ensure that the projects the Saudis executed met the needs of the military department using the facility.

Edelman's legal opinion went to the Army's general counsel on 7 December 1990. The Corps proposed that the fiscal year 1991 DESERT SHIELD supplemental budget request authorize the use of operation and maintenance funds for planning, design, and construction management of DESERT SHIELD projects that were going to be funded by foreign governments and thus preserve scarce military construction resources.⁶⁴

The Army's general counsel determined that Section 2807 authorized the use of military construction funds for planning and designing projects that were funded and constructed by foreign governments. It should be used for all Corps activities supporting projects that the Saudis funded and constructed. This would result in a direct dollar-for-dollar reduction in the design and construction of authorized non-DESERT SHIELD military construction projects.

Faced with a potentially devastating impact on military construction resources, the Chief of Engineers asked Assistant Secretary Susan Livingstone to help get the Army's general counsel to reconsider his position.⁶⁵ On 20 March 1991, Corps headquarters released more than \$2.6 million in military construction funds to MEAPO for design and construction management support for projects being performed by the Saudi government and under the Japanese government's Gulf Peace Fund contract. By the end of the ground war, MEAPO had expended \$5,954,000 in operation and maintenance funds, \$1,796,000 in military construction funds, and \$748,000 in connection with the Gulf Peace Fund, for a total of \$8,498,000.⁶⁶

Operation DESERT SHIELD clearly demonstrated that funding procedures for wartime construction were cumbersome and placed severe limitations on commanders in the field. Initially, funding regulations, such as the \$200,000 limit on operation and maintenance funds, severely hampered the Corps'

operations. Until mid-November, when Section 2808 authority was granted, the Corps basically could not construct any projects costing more than \$200,000. Thousands of troops arrived each day with no place to go, and the Corps was trying to function within the normal peacetime regulations. Ultimately, CENTCOM was able to house 44,000 troops in the Dhahran area because there were real estate vacancies. But the question remains, if those vacancies had not existed, where would the troops have gone?

Colonel Miller later recommended that during wartime, the authority to approve military construction expenditures be decentralized and that Congress approve a lump sum of military construction dollars under emergency legislation for expenditures in the theater. Section 2805 authority, he observed, would have been responsive to a prehostility environment if the \$200,000 limit had been increased. If the Section 2808 authority had been delegated to the theater commander, he would have had the necessary authority in the theater. Neither of these actions occurred.⁶⁷

Miller and others continued to argue that the limit on operation and maintenance funds for individual projects be raised to \$5 million. Colonel Pylant also recommended that wartime military construction funding approval authority should be decentralized and that the operation and maintenance funding ceiling for individual projects should be raised to \$5 million.⁶⁸ After the war, Pagonis called the \$200,000 limit a "tremendous barrier to a commander faced with the prospect of war in a theater with little infrastructure." Once again, he recommended that the authority limit be raised to \$5 million.⁶⁹

In their final report to Congress on the Persian Gulf War, Defense Department officials recommended that procedures be implemented to raise operation and maintenance funding limits during contingencies and activate Section 2808 authority quickly to ensure responsive construction funding support to the combat commander.⁷⁰

Observations

The procedures that CENTCOM established to coordinate and prioritize the construction requirements of the services was effective. By the time the regional contingency construction management team was deactivated on 3 April 1991, it had successfully coordinated a joint construction program valued at more than \$600 million. The CENTCOM engineer called the team a "success" and recommended that it be maintained as a tool for contingency construction. The team, he added, had "served with distinction." Pentagon officials would later report to Congress that the regional contingency construction management concept worked well.⁷¹

Although managing the theater construction process with the regional contingency construction management team was very effective, the actual project execution was more difficult. U.S. forces found themselves ill-equipped to meet the large volume of urgent construction requirements that they faced

in the Middle East. Moreover, there remained some confusion about construction standards. Often existing standards were ill-suited to the situation in the theater. Problems such as the shortages of engineer troops, engineer equipment, and construction material and the limitations on funding prompted the military to rely increasingly on civilian contracts to meet construction requirements.