

Evaluating U.S. Air Force Construction in Afghanistan: Applying Lessons Learned to Future Austere Construction

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Abstract

In order to support U.S. national strategic objectives as well as operational commanders' tactical objectives, wartime military construction often represents one of the primary components for not only defeating enemies, but also for fulfilling the United States' greater strategy of democratic nation building. In the troop surge associated with OPERATION ENDURING FREEDOM in Afghanistan in the early part of this decade, the U.S. military faced unprecedented challenges in accomplishing billions of dollars of construction throughout Afghanistan. The Air Force Civil Engineer Center was responsible for managing several billion dollars of construction projects for the Army Corps of Engineers who were nearly over-capacity with their even larger program. The projects served both U.S. and Afghan military interests. As the United States works towards their 2014 deadline for redeploying back from Afghanistan, this paper evaluates construction metrics like cost and time growth for projects completed from 2006 to 2012. Best business practices to overcome austere construction challenges and recommendations to improve future construction programs in developing nations are presented. Specifically, the authors propose globally shared information resources for construction standards and methods in austere areas around the world.

Keywords

Afghanistan, Air Force, Central Asian States initiative, Construction in Developing Countries, Construction Metrics, Contingency Operations

1. Introduction

Through multiple authorities, the U.S. funded over \$12 billion in military construction in Afghanistan over the past decade. A significant portion of the projects were built at large U.S. and Afghan military bases. Many of the high dollar projects were airfield runways, taxiways and aprons. For example, the new runway, shoulders, and keel repair at Camp Bastion cost \$127 million. Other military construction projects included dormitories, headquarters facilities, maintenance facilities and infrastructure. Construction in Afghanistan, much like building in other austere locations, came with a steep learning curve. Indeed, U.S. government research supports that many current U.S. military design standards are not practical for hostile and austere locations (Affleck, 2011). This paper further explores metrics of

military construction in Afghanistan, presents two case studies and provides recommendations to overcome austere construction challenges in developing nations.

2. Background: Air Force Construction in Afghanistan via the HERC

The Air Force Civil Engineer Center (AFCEC) headquartered in San Antonio, Texas, was the lead entity responsible for accomplishing a large portion of the \$12B in U.S. construction in Afghanistan. Until October 1, 2012, AFCEC was known as the Air Force Center for Engineering and the Environment (AFCEE). Therefore, AFCEC and AFCEE can be considered interchangeable for the sake of the rest of this paper. AFCEE created and awarded the Heavy Engineering, Repair and Construction (HERC) Contract in the spring of 2006. The HERC is a unique contract that had a \$6 Billion ceiling over five years with three option years, with the option of increasing the total ceiling to \$15 Billion if necessary. After a competitive solicitation, AFCEE awarded contracts to 20 firms under the umbrella contract. Under this type of contract vehicle, the client solicits market-wide competition originally, but then all future delivery orders are issued against the same contract to one or more firms who are awarded the original contract. However, under the HERC, all delivery orders are still competed to interested firms, and further negotiated before the final award.

The impetus for the Air Force serving as its own agent for multi-million dollar construction can be traced back to December, 2003 when the Chairman of the Joint Chiefs of Staff (CJCS) asked the Chief of Staff of the Air Force (CSAF) for AFCEE to serve as a construction “bridge” in the Southwest Asia area of operations. In January, 2004, the CSAF approved AFCEE support for up to \$1Billion in construction. The first four task orders issued six days later totaled \$148 Million. Over the next eight months, their workload grew to \$705 Million with 26 task orders and 48 projects. In September, 2004 the multinational commander in Iraq directed AFCEE to stay for two more years and execute an additional \$1.5 Billion construction for Iraq’s Ministry of Security and Justice. Later, in December of 2006, AFCEE executed projects via the foreign military sales program in support of the Iraqi Prime Minister. As operations in Iraq subsided, and U.S. interests shifted to support the counterinsurgency surge in 2009, HERC task orders also subsided in Iraq, but increased in Afghanistan.

It is commonly accepted that military construction can often be more expensive than for private owners of similar facilities. That is to say that the same builder completing a college dormitory and a comparable military barracks would likely charge the military more money for the barracks. In fact, in 2011, the House Armed Services Committee noted that military construction typically cost 25% to 40% more than private sector costs (112th Congress, 2011). In 2012, AFCEC found that Air Force costs were up to 37% higher than private industry construction (Hartford, 2012). This served as the basis for Blomberg’s research, where he considered why Air Force projects likely cost more than their equivalent private sector projects (Blomberg, 2013). Examples of “cost premiums” that the Air Force experiences include: overly restrictive requirements, risk-averse acquisition methods, lack of innovation, poor metrics, and frequent unforeseen site conditions. Security requirements for military projects also add cost. Besides costing more than civilian projects, the military construction in Afghanistan was exceeding the budgets and schedules the Air Force projected. Indeed, in the first year of analysis for AFCEE’s HERC work, 2006 average cost and time growth were 129% and 212% respectively.

Table 1 shows the summary data for the average cost, cost growth, and time growth for all 178 HERC task orders completed in Afghanistan from 2006 until 2012. Task orders included a variety of work to include master planning, owner’s representative quality assurance, as well as actual construction. Construction data is not classified information *per se*, but due to operational security, information sensitivity, and professional courtesy, only summary project data will be included here (See Table 1).

Table 1: Summary Data for Air Force HERC completed work from Fiscal Years 2006-2012

Comparison Criteria	Amount (Rounded)
Avg Original Task Order Amount (\$)	\$12.5M
Avg Final Task Order Amount (\$)	\$14.6M
Avg Cost Growth (\$)	\$2.1M
Avg Cost Growth (%)	33%
Avg Time Growth (Days)	211
Avg Time Growth (%)	72%

For any construction manager (or American taxpayer) the numbers in Table 1 are alarming. It is important to note, however, that these are average values. Figure 1, in the next section, shows that project productivity improved greatly over time as the learning curve and productivity initiative benefits were realized. Analysis will focus on direct/primary productivity indicators like cost and time growth, as well as secondary initiatives that focus on supply chain, and lastly provide a tertiary solution for long term portfolio improvement for construction managers.

3. Analysis

After analyzing all the HERC Afghan projects from 2006 to 2012, the cost and time growth changed substantially over time (See Figure 1). Average cost growth went from 129% in 2006 to 6% in 2012. Likewise, average time growth dropped from 212% in 2006 to 17% in 2012.

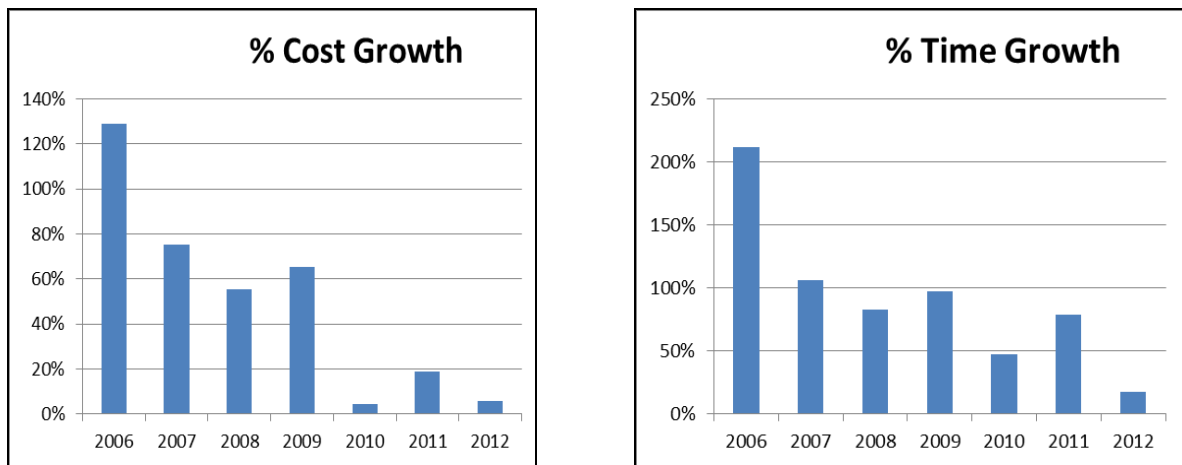


Figure 1. Cost Growth (%) Time Growth (%) from FY06-FY12 for all HERC Afghan work (Data courtesy of Mrs. Lara Schoenenberger, GS-13, HQ AFCEC)

These significant improvements were largely due to AFCEE partnering with its HERC contractors. Ideas eventually implemented to help improve design and construction included:

- Predominately Eastern style standards for toilet and bathing facilities
- Limiting mechanical, electrical, and plumbing to the minimum amount needed and in line with local building standards
- Focus on “Afghan First”, i.e. local labor, for accomplishing as many trades as possible
- Tailoring designs to match available construction materials and practices as much as possible

Additionally, one of the primary, on-going complaints of HERC contractors was the lack of available supplies or materials for supporting construction operations and overhead in Afghanistan. In response to this pressing need, the U.S. DoD, working with the State Department, created the “Central Asian States (CAS)” procurement initiative. It provides temporary authority to provide price preference for, or limit

competition to, Central Asian States for products or services (including construction) in support of operations in Afghanistan. The primary purpose is to reduce transportation costs and risks. Secondary benefits include that it incentivizes expanded supply routes through the Central Asian States into and out of Afghanistan, as well as provides incentives for economic stabilization in the region. Preferred countries in priority order for 2013, according to AFCEC are: Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, and Turkmenistan.

4. Project Case Studies

Of the many projects constructed in Afghanistan, we present two case studies for more in-depth review. The first example is an Army solid waste incinerator project at Forward Operation Base (FOB) Salerno where excessive time growth and overly complex designs were evident. The second example is a sewage treatment facility at Camp Bastion where lessons learned from previous projects were successfully applied.

The U.S. Army Corps of Engineers constructed a pair of 8 ton incinerators at FOB Salerno that will likely never be used. The project contract was awarded on 17 July 2010 for \$5.4 million with a contract completion date of 13 November 2011. The base engineer signed for the incinerators on 11 April 2012, a time growth of 150 days or 31%. Besides being late, the finished project also had significant deficiencies: rusted housings on electrical motors, leaking hydraulic lines, and missing pipe insulation. The facilities maintenance contractor at FOB Salerno estimated it would cost \$235,000 to repair these deficiencies and another \$1 million annually to operate and maintain (SIGAR, 2013). Because of the high price tag and future closure of the base, military officials at FOB Salerno decided not to bring the incinerators into operation and have made plans to dismantle the project.

The incinerator project is an example of a construction project that could be successful in a first-world country, but not in a developing country like Afghanistan. U.S. military officials should have anticipated the high cost of operating incinerators in FOB Salerno. The incinerators use diesel or gasoline which is very expensive in Afghanistan, especially in rural areas. Also, U.S. military officials did not anticipate turning the base over to the Afghan military in the future. Except for some small incinerators at hospitals, there are likely no other large-scale solid waste incinerators in Afghanistan. That means there are no spare parts or skilled Afghan mechanics necessary to operate and maintain such a facility. Furthermore, the Afghan military would not be inclined to spend money on gasoline to burn trash when they could burn the trash in open burn pits. These are some of the reasons why the incinerator facility should not have been built in the first place.

A successful example of a military construction project in a hostile, austere location is a reed bed sewage disposal facility built by the U.K. military in Camp Bastion (see Fig. 2). The facility starts with a tipping point where sewage pumper trucks discharge their waste into an inclined, concrete discharge channel. The sewage flows into a settlement tanks where the large solids settle out. Next, the sewage flows into an 11,000 m² reed bed where it is cleaned by microorganisms. Finally, the waste water flows out a culvert through the perimeter fence into a local stream. The outflow has been tested to meet U.K. river discharge quality (Hewson, 2013).

The reed bed sewage facility is positive example of both constructability and maintainability. Construction of the facility required materials that are readily available throughout Afghanistan, namely concrete. Construction required a minimal amount of skilled labor and employed unskilled workers for earthwork operations. If and when the Afghan military takes over Camp Bastion, the local population should be able to maintain the facility without special training or equipment. The U.K. military learned from the U.S. military that first-world wastewater treatment plant designs do not work in Afghanistan. There are insufficient skilled workers to build complicated sewage lines to distribute waste-water to the plants and there are no local workers that have experience operating these plants. Unfortunately, the U.S. military constructed several waste-water treatment plants in Afghanistan that failed because they were

built to U.S. standards. The U.S. military should adopt austere construction standards for building in a warzone, similar to practices by the U.K. military as demonstrated in the reed bed sewage facility.



Figure 2. Reed bed sewage facility panoramic (photo by Mr. Alan Newcombe, AECOM)

5. Recommendations for Design and Construction in Developing Communities

Based on U.S. the military construction experience in Afghanistan, lessons learned can be applied to civilian construction programs in other austere locations or developing countries.

Westerners designing or building projects in other countries can have a “we know best” attitude that can be counter-productive and offensive to others. But taking the time to learn about another country and its people is essential to successful projects in developing countries. This can be difficult for those responding to military crises or natural disasters with little time to prepare for working in an unfamiliar country and much less time to learn about it.

Even so, researching a country’s history, culture and current political situation should be an obvious first step for beginning a project in a developing country. For those not familiar with the country they will be working in, there are multiple sources that are accurate and readily available on the internet. The CIA World Fact Book (CIA, 2013) provides information on every country’s people, government and economy, including major industries and labor force. The U.S. State Department’s website has country fact sheets that focus on U.S. relations with each country, but they also contain useful links for additional information. Their regional topics pages have other helpful publications on individual countries and regional topics. Examples include reports on “*Infrastructure's Role in Arab Spring*” (McCarthy, 2012) and self-help development projects in individual countries funded by State Department grants (U.S. Department of State, 2013). Most countries also have their own public information websites that provide valuable initial information and links to important ministries and agencies. For example, Tanzania has a link on their website to a Five-Year Development Plan. Infrastructure is the first of five core priorities deemed key to Tanzania’s growth potential, especially large investments in energy, transport infrastructure (port, railway, roads, air transport), water and sanitation and communications technologies (United Republic of Tanzania, 2012.)

International organizations are another valuable source of information. The World Bank’s mission is “Working for a World free of Poverty”. Their website provides background information on every country with links to specific World Bank projects and programs in each country. The Dominican Republic, for example, is planning to invest 4% of its GDP on education, including new school construction (World Bank, 2013).

Another important international organization is the United Nations Human Settlements Programme. “UN-HABITAT” is mandated by the UN General Assembly “to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all.” One of their publications in this area is “*State of the world's cities 2010-2011: Bridging the Urban Divide*” which points out that

“by 2050, South America will be the most urban region in the world with 91.4 per cent of its population residing in urban areas” (UN HABITAT, 2010). Another example of their publications is “*Sustainable Building Practices for Low Cost Housing, Implications for Climate Change Mitigation and Adaptation in Developing Countries*”. It advocates sustainable low cost housing that includes new technologies suitable for developing countries, and calls for standardized regional housing guidelines with country-specific variations that integrate local knowledge and building materials (UN HABITAT, 2011).

Many non-governmental organizations (NGOs), such as Engineers without Borders (EWB) provide their volunteers useful guidance on project design and construction in developing countries. For example, Architecture for Humanity wrote the “*Rebuilding 101 Manual, Rebuilding Strategies for Haiti*” just two months after the 2010 earthquake. Available in English, French, Creole and Spanish it is written and illustrated for people with little design or construction experience. Its three main sections emphasize Site Safety for responsible conduct on construction sites, Construction Guidelines for principles and techniques necessary to ensure buildings withstand earthquakes and hurricanes, and Construction Materials and Techniques for availability of building components and their proper manufacture (Architecture for Humanity, 2010). Architecture for Humanity also created the online “Open Architecture Network” which is “dedicated to improving living conditions through innovative and sustainable design” and allows designers to “share their ideas, designs and plans”. Its project database includes thousands of projects that are searchable by keyword, project type, themes and country. For example, it includes design information on 391 different primary school projects (Open Architecture Network, 2013). Engineering Ministries International (EMI) provides its volunteers with civil engineering and architectural design guides for East Africa with specifics on construction methods and materials in that region (EMI, 2007).

6. In-Country Information

Architects, engineers and builders need to go even further and learn about the country’s building codes. Local codes and standards do exist in most developing countries and should form a baseline when deciding on design and construction standards. More specifically, national standards for specific building types such as educational or healthcare facilities may also be available. Program or project managers should find local partners from industry, professional organizations, or government to provide input and feedback during planning and design. This is consistent with Integrated Project Delivery, which can lead to higher quality projects delivered more quickly without additional cost (El Asmar, Hanna & Loh, 2013). The overall goal should be to design and build projects that are better than what already exist, but not necessarily to first-world standards. Architecture for Humanity makes a point of working with local licensed professionals and embeds their design fellows “directly with a community group on a specific project for an extended period of time” to ensure they understand the community and are serving its needs (Architecture for Humanity, 2013). It is not uncommon for their design fellows to stay in a country for a full year before beginning their assigned projects, in order to ensure the designer has a full understanding of how to best make their end product meet their client country’s needs.

Not all architects and engineers can spend a full year in-country before accomplishing their projects. The need exists for a compendium of lessons learned so that all people who may work in austere locations worldwide would be able to benefit from others’ knowledge and experience. There should be a tool that collects and provides these lessons learned for those who don’t have the finances or time for a year-long investigatory visit. The rest of this paper outlines the kinds of information that such a tool could provide.

7. Applying Critical Design and Construction Considerations

Lessons learned from military construction in Afghanistan and the various resources described earlier provide a number of factors for designing and constructing projects in developing countries or other austere locations. Any architect, engineer or builder working on an overseas project should consider:

- **Climate** – This consideration includes temperature range, humidity and storm risk. The design should optimize things like building orientation, natural ventilation and daylighting to make facilities as comfortable as possible while minimizing or eliminating the need for expensive (or unavailable) air conditioning or heating systems.
- **Culture** – Designers must be sensitive to local cultural standards. Ideas of privacy or adequate size may be quite different. For example, the desire to keep men’s and women’s living quarters separate can predominate over the quality, efficiency, or effectiveness of a space. Islamic ablution requires different design of washrooms and toilets than westerners are accustomed to.
- **Materials** – Project managers must analyze the availability of key materials such as cement, reinforcing steel, structural steel, and others in the project location. Importing materials from great distances is not only expensive, but uses great quantities of fuel and exposes the project to increased risk from delays (See Figure 3).



Figure 3. Masonry units drying in the sun in Tanzania (photo by Dr. James Pocock)

- **Methods** – Most developing countries rely much more on labor than the heavy and specialized construction equipment more commonly used in the first world. Labor-intensive construction tends to be less expensive than heavy equipment in most parts of the world and provides employment to many more people. Local builders have developed effective and efficient methods of construction and their expertise should be considered
- **Skilled and unskilled labor** – Projects should be designed so that local people can build them. This not only stimulates the local economy but prevents issues and expenses related to bringing in outside labor, often from third countries. Some amount of on-the-job training may be justified to avoid importing labor. If local people build a project it is more likely to be maintained.
- **Maintainability** – The project design and materials should also result in a completed project that local people can maintain themselves without special training or equipment. Otherwise, the project will deteriorate until it is no longer useful or is scavenged for building materials.
- **Infrastructure** (or lack thereof) - Large parking lots don’t make sense if few people own cars. Project design should acknowledge an unreliable power supply by including daylighting or small scale solar for lighting. Rainwater capture might be an important water source. If there is no local wastewater treatment system, primary treatment of some kind might need to be part of the project scope.

Taking these factors into consideration can result in projects that use appropriate standards, materials and methods for successful construction and ultimately to serve the people they are intended for.

8. Concluding Remarks

As demonstrated in Afghanistan from 2006 to 2012, the Air Force was tasked with completing a massive construction portfolio. However, after initial projects saw triple digit cost and time growth, leaders knew that they needed a solution. Multiple initiatives were implemented to improve construction productivity. These included increased indigenous labor, locally-sensitive/adapted building standards, and improved material acquisition strategies. There should be a consolidated resource, much like the CIA World Factbook is for geo-political questions, that provides regional and local building standards and design considerations like materials, methods, infrastructure, climate, and culture. If such a tool existed, owners/financiers would likely experience more productive builds. Clients would likely receive projects more quickly, that are easier to maintain, and more in line with their cultural norms. Future work should capitalize on governmental or NGO tools like the ones discussed here in order to provide this needed resource for anyone building facilities in foreign locations.

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