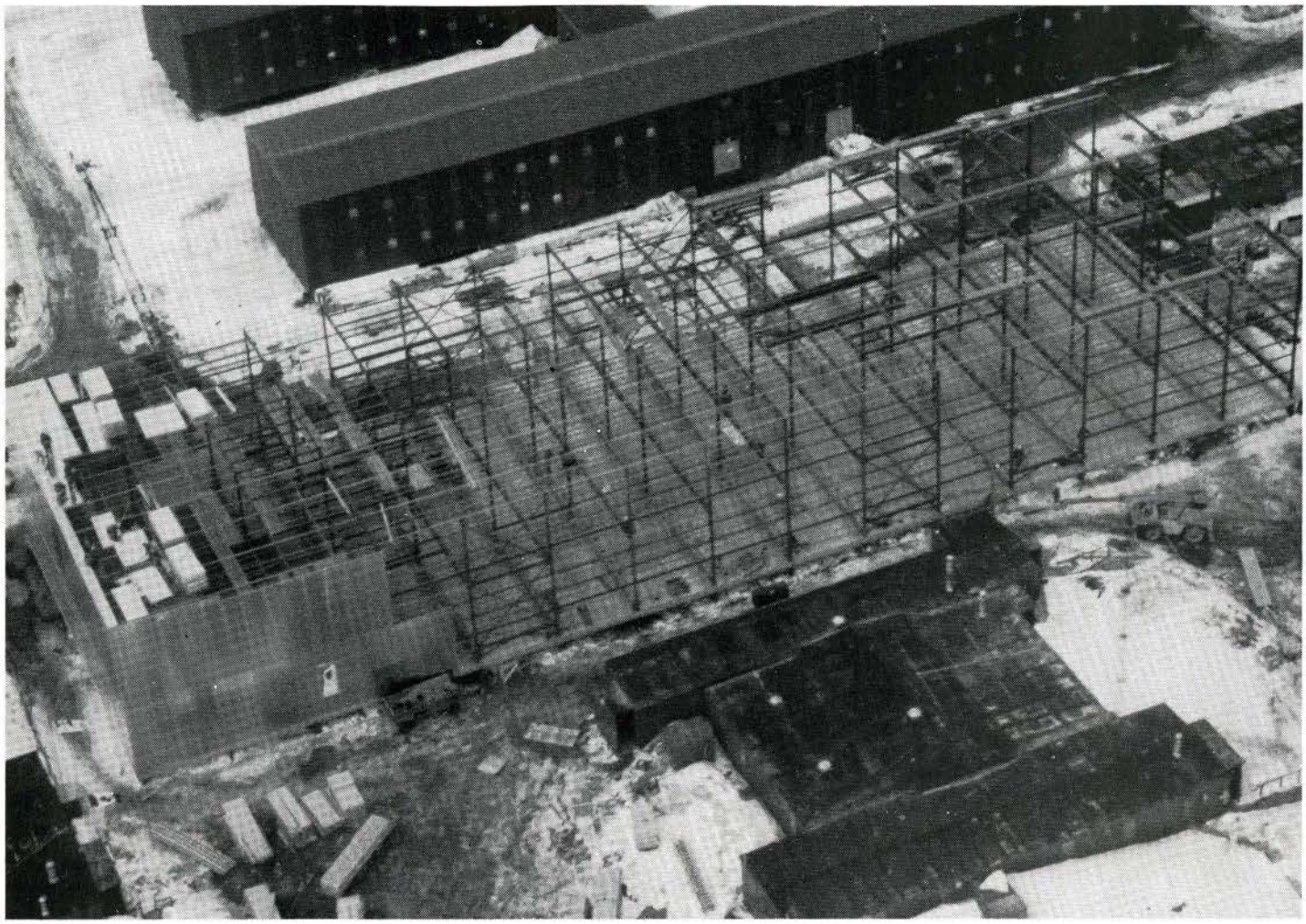


Construction of Operations Building, at CFS Alert.

Military Engineer Involvement in Northern Construction

by Lieutenant-Colonel D.V.B. Riddell

Introduction

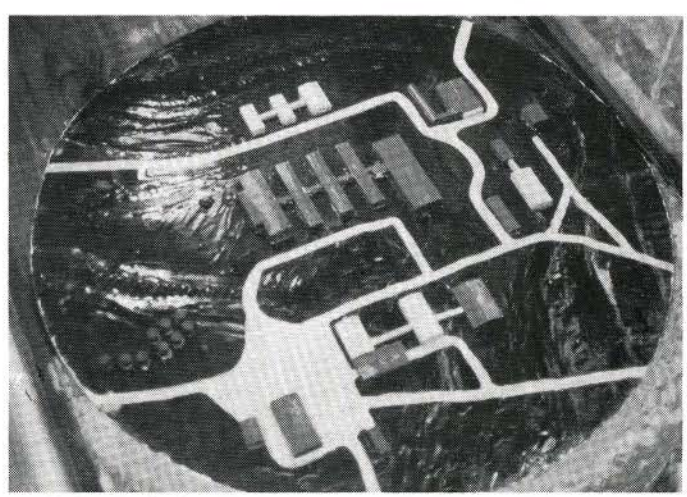
Throughout our Canadian history military construction engineers have contributed not only to our successes in the World War I and II and in Korea but also to the national development of our country, particularly in the North. One unit which was developed as a result of wartime activities in World War II and still exists today, is 1 Construction Engineering Unit (1CEU). Geographically 1 CEU has been employed coast to coast, heavily in the North and throughout the world in Continental Europe, Cyprus, Bermuda and in the Middle East. This is an almost completely military unit which has over the past 25 years involved most Canadian Forces construction engineers who have either been directly employed in the unit or have been employed as augmentation to the unit. This military unit typifies the capabilities and contributions of military construction engineers to northern development.

Aim

This paper is intended to briefly outline 1 CEU's and military engineers' involvement in construction activities in Northern Canada and to address design criteria used in northern construction.

Early Activities

The genesis of 1 CEU was from the Royal Canadian Air Force (RCAF). The RCAF Construction and Maintenance Units (CMUs) were established in 1942, in response to rapidly expanding construction and maintenance work required during World War II. The CMUs developed a capability to do all types of construction and maintenance work, wherever and whenever the need arose. They played an important part in constructing and maintaining many emergency landing fields, buildings and associated physical plant along the Alaska highway. After the war and into the 1960s, airfield and building work was carried out at many locations such as Kittigazuit, Sawill Bay, Cambridge Bay, Baker



Model of CFS Alert for snow testing.

Supply warehouse under construction at CFS Alert, N.W.T.

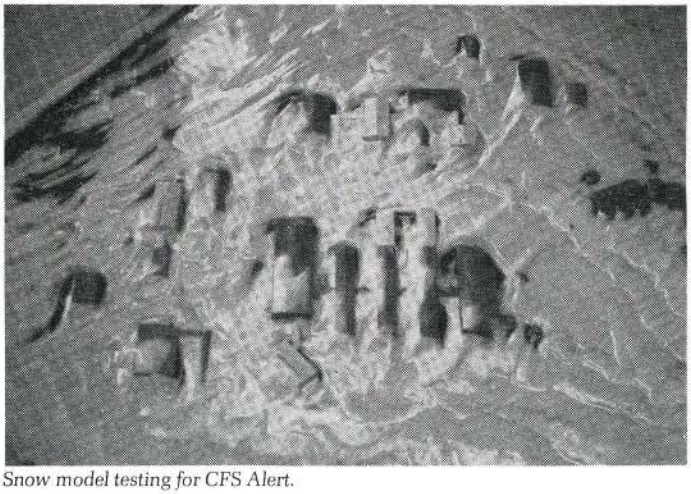
Lake, Inuvik, Resolute Bay and Alert. During the postwar period the CMUs were slowly disbanded. Eventually 1 CEU was created in 1962, from the remaining components and the work continued throughout the North.

Northern projects which employed military units (both combat engineer regiments and 1 CEU) in the 1970s included the construction of six arctic airfields at Pond Inlet, Whale Cove, Spence Bay, Eskimo Point, Cape Dorset and Pangnirtung, as well as the Eagle River and Ogilvie River bridges in the Yudon. These experiences from the past have been used for current projects in Alert and on the new North Warning System.

Alert Reconstruction

The reconstruction of the world's northermost permanently manned settlement—Alert, on the northern tip of Ellesmere Island has been a challenge to 1 CEU for the last 10-15 years. The original 1950s buildings built by 2 CMU were outdated structures, of temporary construction, energy inefficient and required replacement. As a result, a program of reconstruction and modernization was undertaken in the early 1970s. The design principles which were adopted for the projects are the following:

- Material and construction equipment must be transportable by C-140 Hercules aircraft; everything is moved into Alert by aircraft.
- The facilities must be designed to meet the operational requirement.
- The facilities must be simple to maintain since operations and maintenance tradesmen change every six months.
- Designs must address the extreme climatic conditions and must be energy effecient as every litre of fuel is flown into the site. particular attention is also paid to window, door and roofing details.
- The complete facility must be easily and quickly constructed due to the short construction season (June to September.)
- Reliability of the facilities and systems is paramount owing to the logistics backup for the site being located in Trenton, Ontario, some 4200 kilometres to the South.

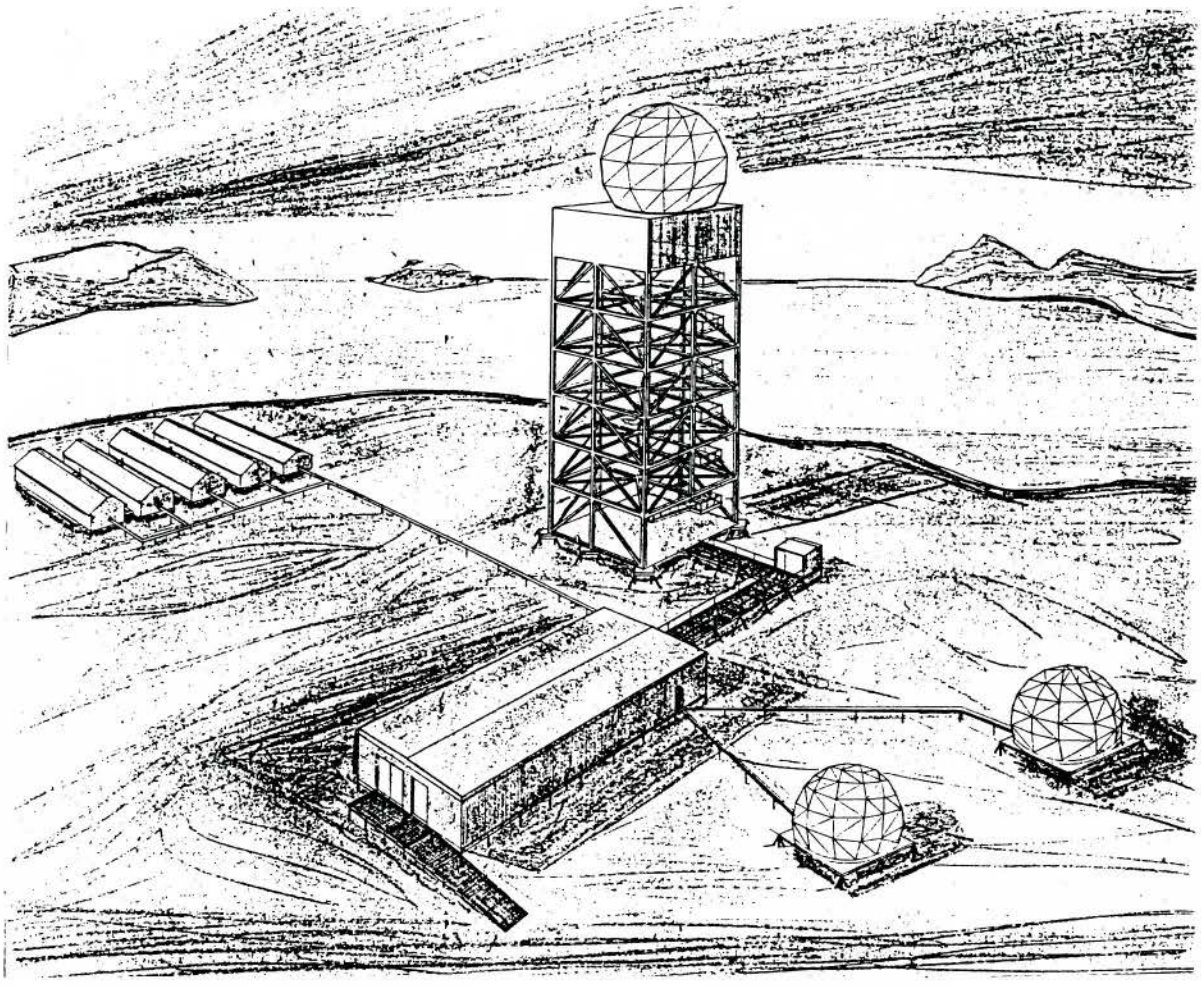


Snow model testing for CFS Alert.

The permafrost soil in Alert is a silty shaley material with low organic content and some ice lenses; the active layer is not more than 45 cm (18 in) thick. It is normal procedure to install foundations in one year and after stabilization construct the buildings the following year.

Depending on the loading conditions a wide variety of foundation designs have been employed including ventilated fills of various types. Thermisters have been installed in most fill foundations to confirm that the permafrost is not melting. Thermal syphons have also been used as well as other foundations such as wooden or steel piles.

The buildings are normally of the pre-engineered steel structure type which reduce the time needed for construction. Additionally, the components have to be small enough to fit into a Hercules aircraft. R values exceed R30 in all cases and thermal bridging must be eliminated to protect both building components and the permafrost. For the largest building constructed in Alert, urethane walk-in freezer panels were used for the walls and roof. This 60 × 25 metre, $12 million headquarters and personnel services building for the station became a walk-in freezer in reverse.



Conceptual sketch for the Short Range Radar Site.

North American Air Defence Modernization Project

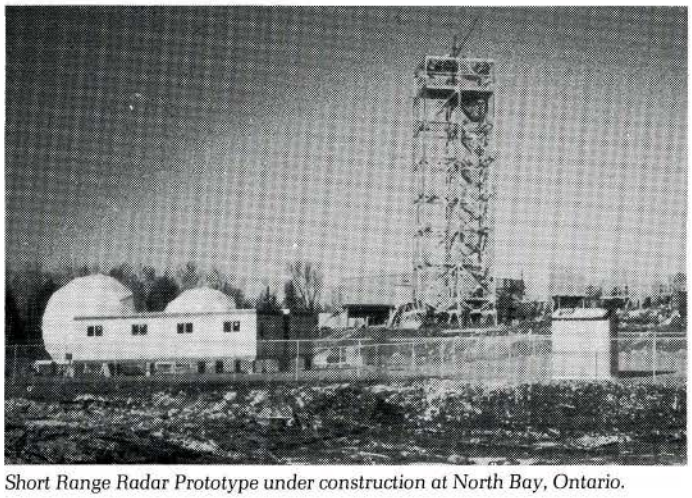
As a result of an agreement struck by Prime Minister Mulroney and President Reagan at the Shamrock Summit, the Department of National Defence has been committed with the United States Air Force to participate in the North American Air Defence Modernization Project. This project involves: the creation of forward operating locations for the CF 18 fighter aircraft at selected airfields in the North; the upgrading and conversion of 11 of the existing Distant Early Warning (DEW) Line System stations into manned long-range radar sites; the construction of three new long-range radar sites; and the construction of 36 unmanned short-range radar sites between them. 1 CEU has been tasked as the design manager for the 36 unmanned short-range radar sites and a prototype facility at North Bay, Ontario. The criteria developed from the experiences in Alert are being used in the design of the short-range radar sites which will have a 15 to 30 metre radar tower with an eight metre dome mounted on top. The site building will house the power plant, electronic equipment, shelter, workshop and computer controllers. There will also be satellite ground terminals and a transient shelter. Much of the design and construction work will be tendered to contract for the Department of National Defence by Defence Construction Canada (DCC) from Ottawa.

The peacetime construction activities described in this article indicate the work that can and has been done by military engineers, including those of 1 Construction Engineering Unit for the Department of National Defence and other departments. All of the work in the harsh northern environment has helped in preparation for wartime activities yet has been useful in developing the North.

Military construction engineers have proven their ability to operate in the north and have made a substantial contribution to the engineering and development of infrastructure throughout the North. The military engineers provide a tried and tested vehicle for the execution of new construction technology in the far North.

With respect to utilities, a high degree of consideration has been placed on reliability and energy conservation because all power is diesel generated and the oil has to be flown in. A number of buildings are currently heated by heat recovery from the dieseals. The introduction of this system achieved substantial energy savings. All building systems are interconnected for redundancy and simple controls have been installed to ensure rapid repair in the case of failure. The water supply system is on continuous circulation and temperature sensors activate heating tapes on the pipes as necessary. The water, sewage and fuel piping is primarily aluminum to reduce the weight for air shipment. Power distribution cables are normally laid on the ground surface.

The work over the last 15 years at Alert has resulted in the reconstruction of a large portion of the station at a cost in excess of $30 million. These costs do not include the equipment, fuel and transportation costs associated with moving 700 tons of construction material each year. The work has been done almost completely by military tradesmen. The scope of this project and the limited military engineer manpower in the Canadian Forces has resulted in most engineer tradesmen having spent two months or more in Alert. □



Short Range Radar Prototype under construction at North Bay, Ontario.