

The Relationship Between Temperature and Strength in High Density Polar Snow

GEORGE L. BLAISDELL¹ AND TERRY MELENDY¹

ABSTRACT

Operating and maintenance decisions for the Phoenix deep-snow runway are based on index strength measurements. In allowing the operation of C-17, C-130, and several commercial aircraft types, Phoenix represents essential infrastructure for the National Science Foundation's U.S. Antarctic Program. To optimize the brief austral summer field season as well as use of military airframes, the Program's flight schedule is established and coordinated with many agencies and research programs well in advance of deployment. To ensure a high mission-completion-to-plan ratio, a runway strength predictive capability, by aircraft type, is required.

Having monitored many environmental and snow properties at the Phoenix runway site over the 30 months since its establishment, we show that near-surface ambient temperature is a reliable indicator of snow pavement strength, even at depth, provided that the snow pavement system is properly maintained (density > 0.6 g/cm³; albedo > 88%).

We show that cone penetrometer index strength ranges from 50 at temperatures near 0°C to over 250 when air temperature is below -40°C (values over about 70 are necessary for C-17 operations). Further, austral summer seasons air temperature records at the Phoenix site show a consistent and predictable rise, plateau and fall, allowing prediction of safe operating time periods by aircraft type.

¹ U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH, USA