US Army Corps of Engineers

Ice Thickness and Strength for Various Loading Conditions

Every winter it becomes very important to know when the ice is safe to use. Here are some guidelines for determining the safety of freshwater ice. The following table of safe loads is valid ONLY for ice that is clear and sound, with no flowing water underneath. it is not reliable for stationary loads. **When in doubt, stay off the ice !**

It is highly recommended that you familiarize yourself with the Safety on Floating Ice Sheets information by CRREL.

Loads on Ice

Required Minimum Ice Thickness in inches	Description of Safe Moving Load
1-3/4	One person on skies
2	One person on foot or skates
3	One snowmobile
3	A group of people walking single file
7	A single passenger automobile
8	A 2-1/2 ton truck
9	A 3-1/2 ton truck
10	A 7 to 8 ton truck

Ice Load Graphs

Graphs have been developed by researchers which include:

- CRREL Ice Load Chart
- Canadian Field Data Graph

What you need to know

Because there can be many variations in the structure, thickness, temperature and strength of an ice sheet, it is essential to carry out some fairly simple field observations of the ice sheet you want to use to support a load. Be cautious! Never go out on an unknown ice sheet alone, and always probe ahead of yourself with a heavy ice chisel. Consider wearing a personal flotation device and roping yourself to an assistant.

The main thing to determine is the ice thickness. This can be done by drilling holes with an ice auger. Note whether the ice is clear (sometimes called black ice) or white (due to air bubbles sometimes called snow ice). Measure the thickness of both kinds. Take note of the frequency of cracks and whether they are wet or dry. On rivers, be alert to variations in ice thickness that may occur as a result of bends, riffles or shallows, junctions with tributaries, etc.

For both rivers and lakes, warm inflows from springs may create areas of thinner ice. Also, the ice thickness near shore may be thinner (due to warm groundwater inflow or the insulating effect of drifted snow) or thicker (due to the candle-dipping effect of variable water levels).

Observe any snow cover as well as variations in its thickness. Obtain the record of air temperature for the past several days, and continue observing air temperatures during the period the ice will be used to support loads.

Contrary to what many think, a rapid and large air temperature drop causes an ice sheet to become brittle, and the ice may not be safe to use for 24 hours.

If the air temperature stays above freezing for 24 hours or more, the ice begins to lose strength, and the table no longer represents safe conditions. This becomes the general condition in the spring. Even though the ice may have adequate thickness, the strength is quickly lost the longer the air temperature is above freezing. In all cases of air temperature changes, the effects are greatest on bare ice, and are subdued by increasing depths of snow cover. However, no quantitative guidance can be offered.

Other considerations

An ice sheet must be supported by water. Sometimes, near a riverbank, the water level will drop after the initial ice sheet is formed, leaving the ice sheet unsupported near the shore. This occurrence can be detected by hearing a hollow sound when probing with an ice chisel. Naturally this is not a safe location for loads on the ice.

Cracks in the ice are either wet or dry. If dry, they do not penetrate the ice sheet and are not a problem. If they are wet, multiply the vehicle class by 2 to obtain the required minimum ice thickness. Also, drive across the cracks as close to perpendicular as possible, instead of parallel to them.

On thicker ice with very heavy loads, radial cracks may be observed originating from the center of the load. This usually occurs at about one-half of the failure load. After the radial cracks develop, circumferential cracks will form and the ice sheet will fail. If radial cracks are seen, the load should be moved immediately. Because ice will creep, it is only a matter of time before the ice fails. The same process happens with thinner ice at breakthrough loading, but the process occurs so much faster that it cannot be relied upon for any warning.

Additional on-line information can be found in the CRREL Ice Engineering Information Exchange Bulletin. Number 13, January 1996.