Building network arches on reinforced ice between piers

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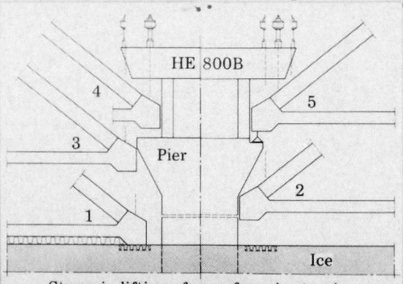
BUILDING NETWORK ARCHES ON REINFORCED ICE BETWEEN PIERS

Bridge for rivers and lakes in arctic areas

This poster deals with an investigation into the possibilities of using a reinforced layer of ice for casting the tie and erecting the structural steel for a network arch. When the longitudinal cables have been stressed, the span can be lifted from the ice up to its final position.

To facilitate formwork and insulation, the under side of the tie has been made flat. To facilitate removal of snow from the finished bridge, longitudinal edge beams have been almost removed. To reduce costs, each arch is a single universal column. If built, the proposed network arch would be more slender than any other arch bridge.

For the proposed span four sets of hangers are warranted to reduce bending in the chords. With the usual stiffness of arches, two sets of hangers will normally give sufficient reduction of bending.



Stages in lifting of span from ice to pier

Bridges in cold regions

Due to sparse habitation arctic roads usually carry little traffic. Still bridges for these roads must be able to carry heavy loads.

The present span has been designed for Danish loads and codes. The heaviest vehicle has 3 axles 1.5m apart and weigh 780 kN. It has been assumed that heavy loads do not occur often enough to cause fatigue.

In arctic regions it is often difficult and costly to keep the building workers employed in winter, so there should be an interest in a structure that leads to more winter work without loss of economy.

When advocating the network arch the author has heard that 50% of savings in steel weight is more than offset by high cost of fabrication and erection. The author points out that 82% of the structural steel in this proposed span is standard profiles. Their fabrication is not costly, but their use contribute to a slightly higher steel weight.

In climates where sufficiently thick ice covers cannot be relied upon, the arch and hangers, supplemented by a light temporary lower chord can be erected on 0.8m thick ice before the span is lifted on to the piers. In the spring the concrete lane can be cast on the temporary lower chord.

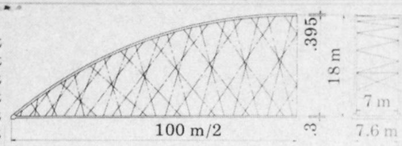
In warmer climates the finished span weighing 540t, can be lifted by pontoons. Then the lifting forces can be applied up to 1m from the the ends of the span.

Complete calculations and drawings can be ordered from the author.

Materials needed:

Universal columns	55 t
Windbracing HE 140A	5 t
Steel ropes	6 t
Ends of hangers	4 t
Other structural steel	3 t
Prestressing steel	9 t
Reinforcing steel	46 t

$$\frac{\Sigma\ 128\ t}{7 \times 100} = .183\ t/m^2 \qquad \text{Slenderness}\ \frac{100}{.395 + .3} = 144$$



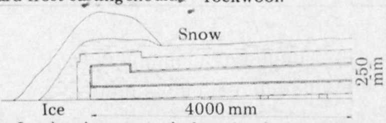
Building on reinforced ice

The ice cover of a lake or river can be reinforced by wood or ribbed bars put on top of the ice early in the winter.

Then the ice can be made 2.5m thick in stages by pumping water on to the ice, or faster by spraying water in the cold air above the ice.

Methods for casting the tie will depend on local climate and usage. In hard frost casting should take place in a well insulated tent that slides along the ice.

If the rockwool insulated tie is covered by snow, the temperature between snow and insulation will be 0°C regardless of ambient temperature. Thus it is not difficult to keep the tie warm once it is cast and covered. Curing heat will keep the deck warm for about 60 days if it is surrounded by .2m of rockwool.



Insulated concrete deck on ice during curing