Series of Photos from ONR-funded Project on In-Situ Tests of Arctic Ice Fracture and Size Effect, April-May 1993, directed by Prof. John Dempsey, PI, Clarkson University, with participation of ZP Bazant (who, in the

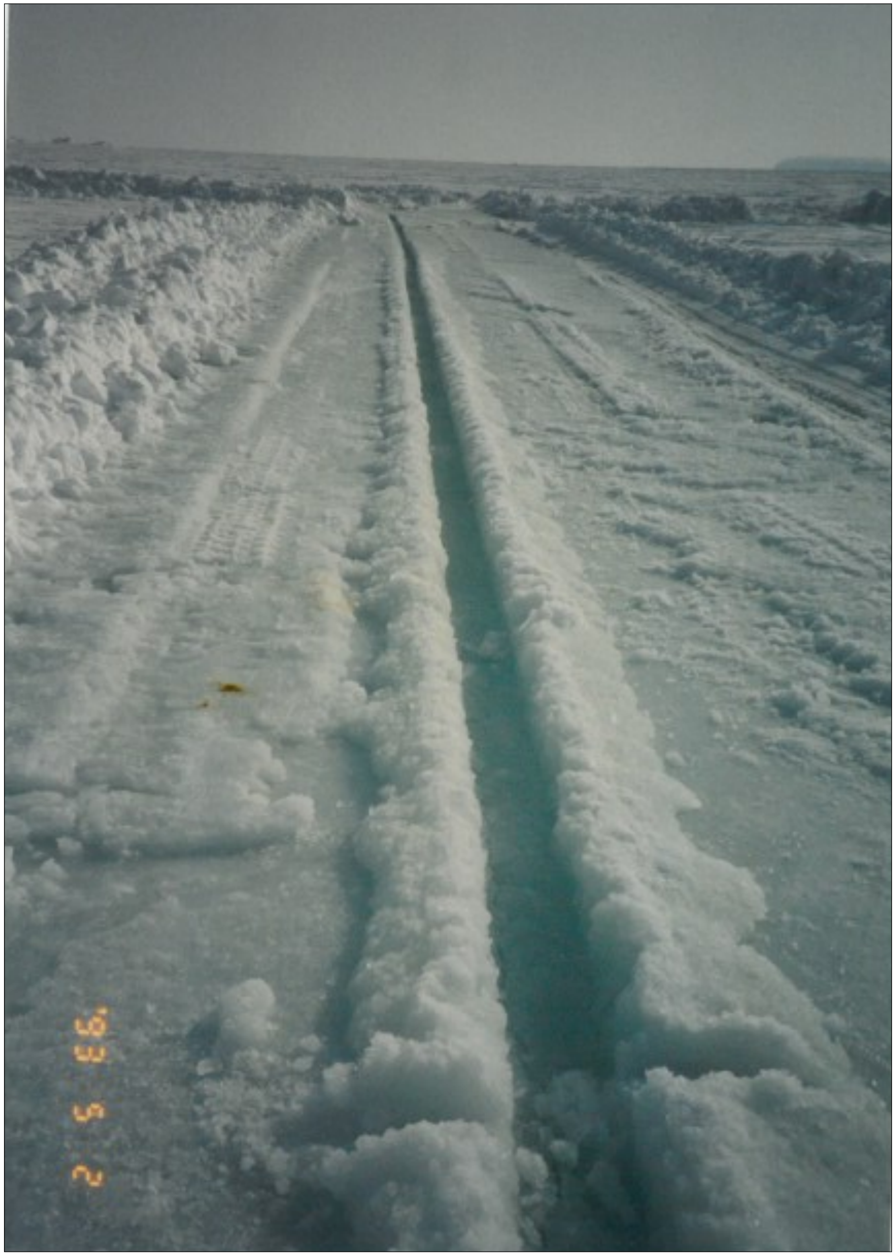

Fig. 1 Edge of a square 80 m x 80 m compact tension specimen in first year ice 1.8 m thick. On the ocean, west of Cornwalis Island (north of Barrow Strait)

This paradigm-changing project proved that sea ice follows on large scales (> 100 m) linear elastic fracture mechanics, while previous laboratory tests (< 1 m) showed no notch or fracture sensitivity.

The nominal strengths measured closely follow Bazant's size effect law (with transitional size ~0.5 m), yield the fracture energy, and in-validate previous general use of plasticity.

For the measurement results on size effect in the range 0.1 m—80 m, (size range 1:160) see JP Dempsey et al., Size effect on the *in-situ* tensile strength and fracture of ice II, Int. J. of Fracture 95 (1999), 347—366.

Bazant's related papers on fracture and size effect in sea ice can are listed on the publications file as 299, 318, 319, 327, 337, 392, 375, 376, 408, 409, 412, 480 and B6. Download from this website.

Pipes of a hydraulic flat jack inserted into a 24 m narrow notch, emanating from one edge of 80 m x 80 m square specimen, whose one edge is visible. The jack is driven by computers located in the cabin at left.

This 24 m long notch cut in the 80 m x 80 m specimen, with pipes of expansive flat jack inserted into the notch. In front: Cayman gage that measures and controls crack mouth opening. 3 more gages a tripod of high speed camera

Crack produced in 80 m x 80 m specimen, extending from notch tip in floating first-year ice 1.8 m thick. Computer cabins at distance.

High speed camera recording dynamic crack propagation in scaled-down mid-size specimen. Hydraulic pump assembly seen at distance.

Scaled down 2 m x 2 m specimen, 1.8 m thick, with notch and 4 crack opening gages, and with a pipe extending from a small flat jack. HP computer in cabin behind (the ice was to thick for specimens of side <2m. Specimens scaled to sizes down to 0.1 m, but of smaller thicknesses, were tested in a lab on the site).

Close-up of crack opening gages from previous photo

Flat jacks from the largest specimen, pulled out and inflated. Heated computer cabin behind.

Standard ditch-witch machine adapted for cutting 1.8 m thick ice. To prevent refreezing, the cutting had to be continuously repeated.

Saw blade for cutting the narrow notch in 1.8 m thick ice (Devon Island in background several miles away)

Saw blade for manual sharpening of notch tip (Devon Island far behind).

Drill for placing under the acoustic sonars recording dynamic crack propagation.

Middle: Prof. John Dempsey of Clarkson University, Director. Right: Pump assembly.

Prof. Z.P. Bazant in front of the ditch-witch machine re-cutting specimen edges

Barracks for the personnel at Resolute on Cornwallis Island (where the northernmost NATO runway was located).

Airport at Resolute, Cornwallis Island (the northern most runway of NATO), with the nose of aircraft that brought the equipment.

Housing and installations at Resolute, at midnight.

Resolute Airport

Landscape at Baffin Island nearby