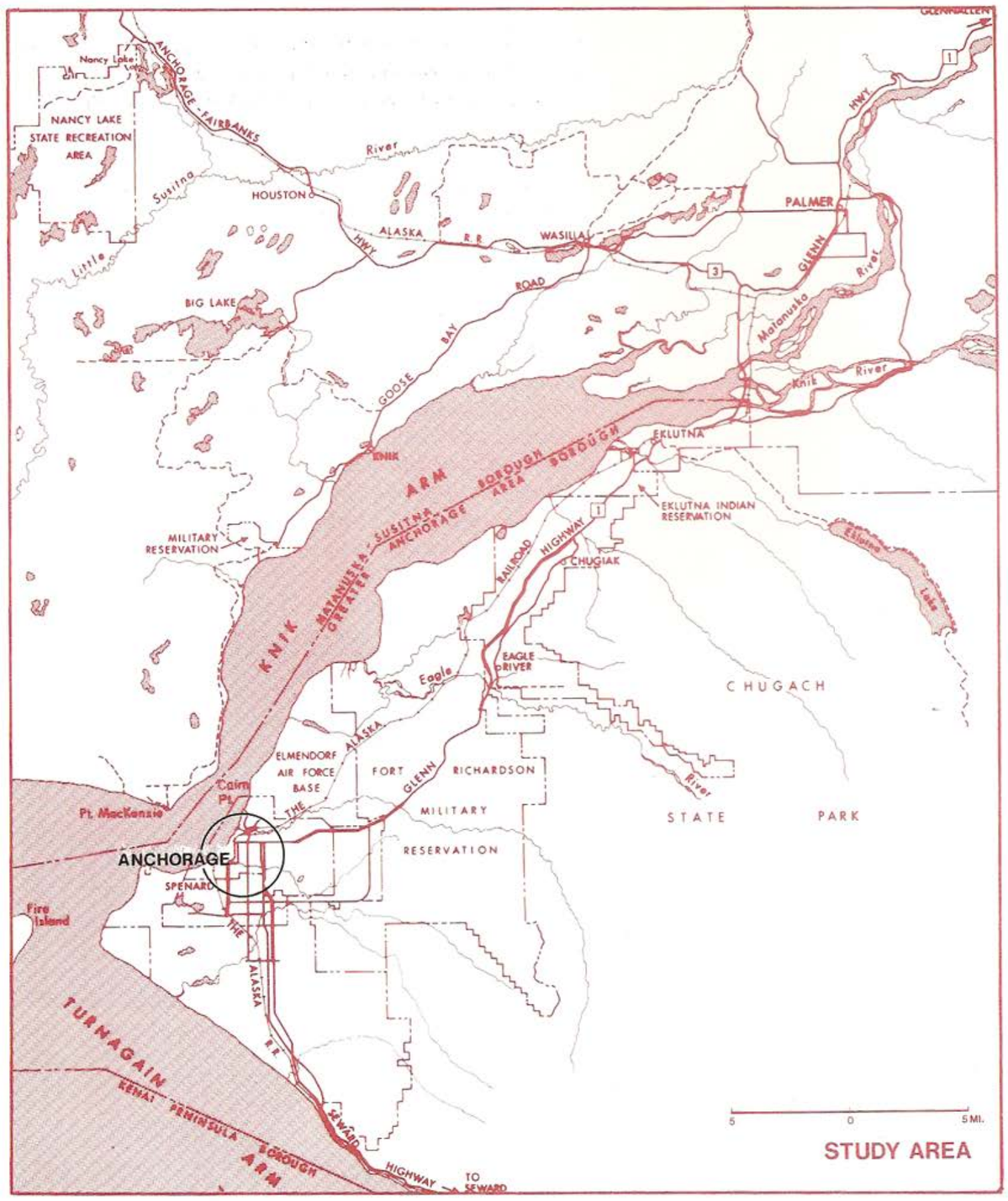
THE ENGINEERING DESIGN

Overcoming the unique conditions imposed upon the engineer by the project's location involved the design of a pile system that would support the dock structure, a snow load and the ice encasing the piles. Ice 20 feet thick builds up under the structure over the winter because of tidal action. This underdeck ice aids in the absorption of impact loadings from rapidly moving floe ice.

The loads supported by the wharf foundations include a deck live load of 600 psf, 40-psf snow loads, railroad loading, trailer-truck loading, crane loads, wind forces, vessel mooring and docking forces, the dynamic force of the ice floes impinging on the wharf, and the dead load of 20 feet of ice surrounding the piles of the pier. In addition, the foundations must sustain earthquake forces. Considering that the harbor bottom at the face of the wharf had to be dredged to 35 feet below mean lower low water in order to provide sufficient draft at extreme low water, the unsupported length of many of the piles had to be greater than 70 feet. The use of bracing in the tidal zone to reduce the unsupported length was not feasible because of possible damage by ice.

The substructure design for the first wharf segment consisted of a reinforced concrete deck supported on steel pipe piles varying in diameter from 16 inches at the landside of the wharf to 20 and 24 inches at the waterside of the wharf, and steel caissons 42 inches in diameter along the outboard face of the wharf. Support of the piles, many of which sustain 120-ton loads, in the soils at the site posed unusual problems. If founded in the clay stratum underlying the site, the high-capacity piles would have to be deeply embedded in this relatively low-strength material, resulting in excessively long piles which would be expensive and difficult to handle. The solution lay in supporting the piles entirely in the dense silt, sand and gravel overlying the clay stratum. However, this upper composite stratum, already relatively thin in its natural state, would be reduced to as little as 20 feet in thickness as a result of dredging. Thus, to found the piles in the dense materials of the thin upper strata, bearing shoes up to 3 feet in diameter were attached near the bottom of the piles.



THE SITE

The siting of the Anchorage Marine Terminal on Knik Arm, a part of Cook Inlet and the Gulf of Alaska, presented TAMS' engineers with the task of designing a pier structure in a severe earthquake zone, in an area with an extreme tidal range of 42 feet and in a body of water where ice floes 4 feet thick, carried by currents of up to 5 knots, can impinge against the structure.

To prevent collapse of exposed sections of the piles by ice and debris, pipe piles and caissons along the perimeter of the wharf were filled with concrete and all other pipe piles were filled with sand.

The pier structure as designed has withstood well the severe winter ice conditions and it was one of the few structures in Southcentral Alaska to survive the 1964 earthquake.