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A man's voice says that Jerry made an observation "this spring" and they have moved over to Jason Draineage where they are trying to find out what is going on in nature in order to establish a norm. He thanks the audience. [Applause.]

Another man's voice thanks Mr. Lewellen who has given them an excellent example on the research activities in the community that rise from man's disturbance of permafrost. The speaker has advocated that they need to zone the area that is required for the pipeline and let the companies develop the pipeline. They'll have a research example that the scientists are able to observe for the next 100 years. They might even tax the pipeline in order to support the research. It might be a good opportunity to get a great deal of research done. They know what temperature the oil going through the pipeline is and the heat distribution. The speaker thinks of experiments that the scientists could do and asks if there are any questions for Mr. Lewellen.

2:10 There aren't any questions and the speaker invites the last paper to be presented by Dr. Max C. Brewer who is the director of the Naval Arctic Research Laboratory and the title of his paper is Road and Airstrip Construction in Arctic Alaska and its effects on permafrost.

Mr. Brewer thanks Dr. Klum [sp?] and says that they owe Bob Lewellen a big thanks for bringing up some of the problems in regards to the construction of the [not mentioned]. In many respects, an airstrip is an overly wide road and it can be treated simultaneously. There are three problems with roads and airstrips: Permafrost, seasonal frost, and erosion.

4:00 Some of the difficulties in regards to construction have been the failure to separate out the effects of permafrost, seasonal frost, and erosion. "They" talk about frost heave and that's not a permafrost problem but a problem with seasonal frost. Talking about it as a permanent, not a seasonal problem adds to the already confused problem. In order to be able to discuss something they have to identify the players and what positions they play. Permafrost is often maligned because it is assumed to have a standard and definable set of physical properties. It is assumed that all permafrost is the same, and that is a problem. Over the years, many design failures have resulted from that erroneous assumption.

Permafrost has been defined as material that is below freezing for two or more years, and it might be considered a condition of being rather than a material. Brewer continues that he's happy that Bob brought up an idea of warm and cold, although in his discussion of thermal erosion, Brewer gave the impression that "we were dumping hot water on tundra." Temperature is only a degree and some of his hot water might have felt awfully nippy if one tried to take a swim in it.

6:53 Permafrost in northern Alaska is cold permafrost. Generally, they have very little seasonal change of some -6 to -8 centigrade [?]. In the Barrow area, they can find permafrost with temperatures of -1.2 or -10.7. Some people might say that it depends on which group one is discussing the problem with, but there's a great deal of variation in the temperatures of permafrost all over Alaska.

8:35 The active layer of permafrost, which is the zone of annual freezing and thawing, also varies markedly in depth depending on material and its drainage. The factors are sometimes accumulative and at other times they are not. What affects the temperature of permafrost is air temperature which is a difficult thing to work with. They should have the thermometer one centimeter below the surface of the ground, which would give them a much more accurate parameter.

Then there is the moisture content of the active layer, including pond water, moisture content of permafrost, surface cover, thickness of organic mat present, snow depth and density, micro relief, the topography, latitude, material grain size, and wind, that affect permafrost. In any discussion of them, one has to factor in the 10 factors.

It becomes rapidly apparent that neither permafrost conditions nor the effect of construction can be assumed to have much cover, except for the material to be water covered and below freezing over wide areas.

11:32 As a result, only the area that is commonly referred to as the North Slope will be discussed, although Brewer will show some slides further south. Using 4-4 ½ feet of fill has proven satisfactory for roads and air strips along the North Coast, and approximately 16 feet of fill would be required in Glenallen area to provide the same protection for permafrost.

It becomes obvious that empirical interpretation of the resulting influences of these factors must be made if construction projects are going to move forward. On the other hand, when the empirical interpretations are applied, they should keep in mind what some of the factors are. If they start now, they can show some of the problems a bit more graphically.

13:19 [Showing slides.] Brewer explains low standing polygons that have a 4-12 feet wide and 10-15 feet deep ice wedge inside and tells they are typical on the North Coast.

- Next slide is a close-up of a high center. That is basically an area [unclear] erosion remnants. There's again an ice wedge in each of the [unclear]. The ice wedges erode which gives the polygonal pattern.

- A picture of a [unclear], gently rolling country, tussocks, and no polygons. Yet, one could find same ice wedges that were shown in other photos.

15:00

- A picture of a cut along a river that shows how the ice wedges extend down into the area.

- Road construction in which tundra has been [unclear] from both sides, providing a firm [unclear] for putting gravel on top of it. It gives a road in which, during the first year, the canals aren't sufficiently deep for boating or to allow ducks or geese to nest. Meanwhile the traffic continues on to the side.

- A picture is of a road that will be usable year-round and the snow will blow right off of it and it will require very little maintenance.

- A road construction where one has rolling country. One of the things to observe about the previous photo is that the road was constructed on the flats. It didn't have the problems one can see "in this particular area." There's very little that can be done in the area because it's hard to re-vegetate something that is on the move.

More slides:

- Three pictures of the close-up of the same road.
- Natural erosion.
- Man-made erosion on a large scale.
- An attempt to add fill to construction and show a little bit of man-made erosion.
- A picture of North country and the coastal plain where they need one type of road construction. When they move to the foothills, they need another type, and then in Bettles area, Tanana Valley, and in Copper River [they need another type?]. The speaker has talked about road construction at North Slope because it is very different from road construction in Glenallen, despite of both places having permafrost.
- A road that is constructed on a flat area without much danger from erosion. There is a problem when insufficient gravel is used in insulation, but the beauty of the roads is that there never are speeding problems.
- Picture of a superfective supercharge that has changed ecology adjacent to the road.
- Road up on the gill. It had been named Alligator Road in the early days. The differential settlement amounted to 12 feet in 2 years.
- A picture of what happens temperature-wise in permafrost. It is in an undisturbed area and they show sign of temperature with time, and they are for air temperature, including 1951 that the speaker has always claimed having been the coldest winter in Barrow. It was also the first one Brewer experienced. In the picture, they can see the temperature in 10, 20, and 30 feet.
- Several pictures of temperatures under various thicknesses of fill.
- Picture of the bases that they designed for roads and air strips in the Western 3rd of the DEW-line and also some of the recent roads and airstrips.
- Pads that were adjacent to one another. The condition on tundra was that it had approximately the same amount of snow on it. There was no difference in the fill and they had about the same snow cover. With 3 feet of fill, they had less snow cover and virtually none on the 5 feet of fill. They are taking adjacent areas and adding fill. The effect at depth is virtually nil because when they added the gravel, they unintentionally had less snow over it. There's also a suggestion that in the case of the tundra, there was no compression of organic matter.
- Time-temperature curve at Alligator Road area, showing that when people move the organic matter, they are removing the insulation. The stripped areas can get colder than the unstripped areas.
- A section of road in Glenallen that shows the time-temperature curve. They found that in wintertime, the coldest spot beneath the road at 10 feet is beneath the center line of the road even though it may have 5 feet of fill underneath it. One could assume that it is well insulated. However, since cars are using it, they keep it free of snow and they lose the effect there. The next coldest area is under the right shoulder, and the warmest is in the ditch. The squirrels have known this for many years, burrowing into the banks, because that's where the snow drifts.

- Time-temperature curve at various depths in Glenallen area. That shows that the area underneath the road sees the greatest change in temperatures because it is in the active layer that thaws and freezes every year. They can see the comparison between temperatures in permafrost and if they are compared with those seen in ridge snow slide in Barrow, they can see that permafrost is different in different areas.

[Applause.]

29:12 A man's voice thanks Mr. Brewer and asks the audience for questions. Quickly, he moves into thanking the audience and announces lunch break.

[End of the recording.]