After the line has been staked out the level party goes over it and stakes levels, the rod being held on the ground by the stake. Levels are also taken at the opposite side of the road, the width of the road being measured by pacing. Profiles are made of each side of the road approximately paralleling each other on the same piece of profile paper. This will give sufficient information to very closely approximate the balancing of the cuts and fills without the necessity of cross-sectioning. No slope stakes are set, as the cuts are usually light. The road bed is graded down to its proper depth and the banks afterwards shaped up.

We have sometimes carried out the whole operation of surveying a road with a party of only three men: an instrument man carrying a transit equipped with level tube and stadia hairs, a rodman carrying a self-reading level rod and a stakeman.

The instrument man, after he has set up his instrument and gotten his alignment, signals the rodman forward or backward until he is the proper distance away as shown by the stadia, then lines the rod in for the exact position of the stake. After this is driven he determines the elevation of the station by using his instrument as a level. As the distances are usually in hundreds of feet and the telescope horizontal no stadia notes will have to be kept or reduced. If the ground is practically level transversely no further levels need be taken, but if not the rodman must return, after going as far as the rod can be read, and hold his rod on the opposite side of the road. This method is very laborious and subject to errors by the instrument man overlooking some of his manifold operations and is suggested only for short pieces of work or when assistants cannot be had.

The stakes are of course numbered when set and if the foreman of construction is an experienced man he is simply furnished with a profile with the cuts and fills for each station written on it, or merely a list of the stations with the amounts of the cuts and fills. If he is not so experienced he will require considerable more supervision by the engineer.

Some may infer from what has been said that since certain approximations in the surveys are to be used, the services of the engineer may be dispensed with as unnecessary and the road located by the eye alone. Such, however, is very undesirable. The knowledge, judgment and experience of an engineer are always needed for the proper location of a road, and the responsibility should be his for grading the road and so balancing the cuts and fills, yet keeping within the limits of allowed grade, that the minimum amount of earth will be handled, and for placing proper culverts that the storm water may be at all times taken care of.

Experience has shown that the cost of construction is often very materially increased by not having proper grade stakes set beforehand. As an example, on one occasion in grading a hill, 6 ins. seemed enough to take off. So it was plowed to this depth and the dirt hauled to the next fill and the road shaped up. The grade still did not look right and it was plowed 6 ins. more, the dirt hauled down and the road shaped up. If grade stakes had been set at the beginning this plowing would have been done at one time and the road shaped but once, thus saving the cost of the whole construction force for some time. Again, in a piece of side hill work, the road authorities, without consulting an engineer, decided that the road should be built at a certain elevation. They thought that a shallow cut there and a slight fill at the bottom of the hill would give them an easy grade. The final result was a very deep cut, a very steep grade and greatly increased cost, when all their expectations might have been gained if the road had been located a little further down hill in the beginning.

Even in the flat sections the eye is often deceived and where there seems sufficient grade for drainage there often develop low places in the road which hold water after rains.

TEMPERATURE EQUIVALENTS OF WIND VELOCITIES.*

By W. H. Whitten.

A comparison of records taken at the group of buildings of the Harvard Medical School on the total heat expended and average temperatures and average wind velocities showed that one mile of wind movement per hour required substantially the same amount of heat supply as one degree change in temperature. A further study of similar records, however, has shown that there is a greater proportion of loss due to wind movement as the temperature drops.

This led the author to make investigations as to the impact effect of wind of the same velocity at different temperatures. It was found that there is a regular rate of increase in effective pressure as the temperature drops, although the wind velocity remains constant. This regular rate of increase of pressure is maintained only while the barometer readings are normal. A barometrical change caused changes in the impact pressure. The exact rate of this change was not determined, but the fact of such change was detected, the tendency being for an increase in pressure as the barometer rose and for a decrease as it fell.

It was estimated that, with the barometer and the wind constant, the increase in pressure is 0.4 per cent. per degree drop in temperature. It was also found that the non-pressure or suction on leeward sides of buildings increased in about the same proportion. The point at which heat loss from one mile of wind movement per hour and temperature were equal seemed to be between 36 and 39 degrees above zero. Above this temperature, the effect of wind became less important than the temperature changes, and below it, correspondingly more important.

For example: If, at 37 deg. plus, one mile of wind movement per hour is equal to one degree drop in temperature, at zero one mile of wind movement per hour will equal

$$1 + (37 \times 0.004) = 1.148 \text{ deg.}$$

If the temperature increases to 50 deg. plus, then one mile of wind movement equals

$$1 - (13 \times 0.004) = 0.948 \text{ deg.}$$

As a rule for personal guidance, the author has adopted the following: From 40 to 15 deg. plus, one mile of wind movement per hour is equal to one degree drop in temperature; from 15 degrees plus to 20 degrees minus, one mile of wind movement per hour is equal to 1.15 degrees drop in temperature. This is for buildings constructed in the ordinary manner, that is, without protected windows. Applied strictly to the glass surface, with leakage standardized, the loss from wind movement may be calculated as only three-sevenths of the loss under usual and ordinary conditions. This not only applies to the sides having the so-called greatest exposure, but, owing to the suction or non-pressure existing on the sheltered sides, should be applied to all sides of the building.

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* Abstract of paper read before the American Society of Heating and Ventilating Engineers, at Detroit.

The Canadian Pacific Railway Company is acquiring several independent lines in Ontario, Quebec and Alberta, which now act as Canadian Pacific Railway feeders. Notice is given of the application to the railway commission next month, for a recommendation to the governor in council to sanction the lease by the Canadian Pacific Railway of the following lines: The Alberta Central Railway, the Campbellford, Lake Ontario and Western Railway, the St. Mary's and Western Ontario Railway, the Kingston and Pembroke Railway, and the Cap de la Madeline Railway.