

wonderful improvements and will assist wonderfully in selecting the best possible location for the road.

No job of road construction can be considered completed that does not provide adequate drainage facilities. By this is meant the construction of the necessary surface drains, or underground system of tile drains, and the placing of all culverts required in connection therewith, so as to permit the escape of all water which may accumulate along the road.

The cross-section of the road should be so shaped that water will not lie upon its surface, but will have free and uninterrupted access to the gutters or side drains. This is a very essential factor in the life of a road. The construction and preservation of a properly shaped cross-section adds to the comforts and conveniences of travel upon it and lengthens the life and usefulness of the road to an inestimable extent.

The cross-section of an earth road will require a greater rise at the centre than a hard surface road but care should be taken not to make this excessive because it will have the effect of concentrating the traffic at the centre—that being the only part of the road where a vehicle can retain an upright position and thereby cause ruts to be formed which will prevent the rain water falling on the surface to escape to the side gutters: very much to the injury of the road. The rise given to the crown of a road should bear a certain proportion to the width of the roadway. For earth and gravel roads this rise should be about one twenty-fourth of the width of the road surface. Macadam roads do not require this amount and possibly about one-fortieth of the width would be sufficient. On asphalt, brick, creosoted wood block or other surface, the rise may be reduced still more.

Upon the foundation depends the permanency and stability of any road whether it be the common earth road or the highest class of pavement. If the foundation is weak and faulty the surface will soon become broken and impassable. The character of the natural soil over which the roadway is to pass has an important bearing on the forming and kind of foundation. But whatever be the character of the soil, it must be kept dry. Sands and gravel which do not hold water present no great difficulties in securing a solid foundation. It is with clays and soils of retentive nature where the greatest difficulties are encountered.

The essentials necessary to forming a good foundation are:—

- (1) The entire removal of all perishable or yielding material.
- (2) The drainage of the sub-soil wherever necessary.
- (3) The compaction of the natural soil by a roller of proper weight and shape.

Where the traffic demands a more substantial and unyielding foundation than the natural soil will afford, a fourth essential may become necessary, as the placing upon the natural soil compacted as aforementioned, a sufficient thickness of hard durable material such as rock or concrete.

It is the foundation of a road alone, where even relative permanency is possible to be secured, and this can only be accomplished by exercising the greatest care in forming it and afterwards protecting it from the destroying actions of traffic and the elements by a suitable wearing surface.

This wearing surface may consist of a coating of gravel, macadam, asphalt, or other pavement that will act as a protection to the foundation. Upon it comes the inevitable wear and tear of traffic and in a well designed

and constructed road this should be the only portion requiring repairs or replacement so long as the original design of the road remains suitable for the traffic upon it or capable of withstanding any extra traffic that it may through time be exposed to.

A completed job of road work should include permanence of location, adequate drainage facilities, foundations and surface covering compatible with the demands of traffic upon it so that transportation and intercommunication can be carried on with safety to the public with the least possible inconvenience and the lowest possible cost.

### IMPORTANT BLASTING POINTERS.

In loading any kind of a borehole, the Du Pont Magazine advises contractors to insist on the blaster cleaning the hole to the bottom. All sludge and mud from the drills should be pumped or blown out. Air spaces anywhere in the blast hole also cut down greatly the work done by the explosive. A blaster who is not careful to fill all the air spaces is liable to be an expensive man to his employers.

In loading dynamite cartridges, where it is necessary to fill air spaces, each cartridge should be slit lengthwise with a knife once. One cut is as effective as two or three when the tamping stick is pressed against the cartridge, and the powder is not smeared along the sides of the borehole as much as when the cartridge is slit a number of times.

In loading very deep well-drill holes, it is always advisable to place a primer with an electric blasting cap every 15 feet in the load. This is not only insurance against expensive misfires, but makes for more perfect detonation of the entire charge, greater efficiency and increased economy. Remember, however, that a blasting machine is limited as to the number of electric blasting caps that it will fire, and do not overload it.

In loading "lifters," or holes drilled horizontally, or nearly so, and especially when they are "sprung," it is a very good idea to have a loading tube, made of zinc or galvanized iron, as large as will go into the hole, and then load the explosive through this, withdrawing it as the charge rises. Where the loading tube is not used, a bamboo fishing-pole makes an effective loading stick, as the small end can be used as a needle on which one cartridge at a time may be stuck, placed in the bottom of the hole, and shaken off. The pole is then reversed and the charge packed in carefully with the large end. Bamboo tamping sticks have the advantage of being very light, straight and inexpensive. The blaster can load many more holes with a bamboo stick without getting tired than he can with a heavy oak, hickory or other hardwood stick, and in addition, it is safer to have a light tamping stick than one with which the blaster can strike the explosive a heavy blow.

Sand imported from Europe is being used in construction of the new subways in New York City. This is not because suitable sand cannot be obtained in the vicinity, but because the war in Europe has cut down the cargoes which steamships ordinarily bring from the other side of the Atlantic to such an extent that it is necessary for many ships to come over in ballast. They have been using beach sand as ballast. Upon arriving in New York this ballast is discharged to make room for the returning cargoes and is practically given away by the steamship company to anyone who will haul it away and dispose of it.