ROADS FOR MODERN TRANSPORT REQUIREMENTS*

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ROAD engineers are now confronted with many factors and difficulties that must be taken into consideration, not only in the construction of new roads, but also in the maintenance, repair and improvement of our existing ones to meet present and future requirements.

In the engineering of new roads, there is scope for the provision of proper alignment, gradient, width, strength and suitable surfacing to meet the reasonable requirements of traffic that may be expected. We have also some data to work on, and practical demonstration that our predecessors were not sufficiently bold or prophetic in making provision for "future extensions." It is gratifying to note that the engineers of our larger cities and towns are not perpetuating the smaller view in their town-planning schemes, and it is to be hoped that others responsible for planning roads will follow their example.

Width

It is not suggested that all new roads should be constructed from 60 to 120 ft. in width in the first instance, but it is urged that sufficient land should be retained or kept on option to provide ample width for all future development of local and through traffic that may reasonably be expected.

It is impossible to estimate the value of the time lost by transport of all descriptions being unduly delayed owing to congestion on roads in and leading to cities, towns and even villages throughout the country.

It is almost heart-breaking to contemplate the widening of practically all our existing main roads—especially in urban areas—to meet even present-day requirements, as it would involve the demolition of so much valuable property. Again although by-passes to towns and villages may, in some instances, meet the case, they cannot invariably be planned or effected, and even so the traveller does not always want to by-pass the places in question.

It is impossible to lay down any hard-and-fast standard width, as no one can foresee future alterations in traffic or local circumstances; but the author's advice is not to err in the minimum width, and should it be found that too much land has been acquired or reserved, which is improbable, it would possibly be found that the money expended has not been badly invested.

The question of alignment and gradient, so far as new roads are concerned, is not, generally speaking, such a great difficulty, as it is unnecessary to lay out new roads in dead, straight lines, as did the Romans. The improvement of our existing roads in these directions is, however, a much more difficult problem. It is well known that the majority of our roads were not planned or laid out, but were simply evolved from tracks, and as our forebears avoided low ground, swamps, etc., the consequence is we have so many tortuous devious lengths now in existence. It is remarkable to what extent a winding and twisty road can be improved by effecting short diversions, widening of turns, etc., and this is not a very difficult proposition, if only the requisite ground can be acquired.

The necessary adjuncts to all good roads are—(*a*) Subsoil and surface water drainage; (*b*) adequate foundation; (*c*) lateral support; (*d*) suitable surfacing.

Subsoil and Surface Water Drainage

Whatever type and volume of traffic use the roads, suitable subsoil and surface drainage is essential, as without doubt the action of water deteriorates and diminishes the effective value of all kinds of foundation and surfacing materials. The greatest difficulties are presented in draining stiff subsoils, such as clay, also unstable ones, including bog land or peaty ground. In the case of the former, longitudinal, cross and herringbone drains of permeable rubble, with the trenches filled in with ashes or other permeable material, leading into pipe drains or ditches, are most suitable, and in the latter, open jointed pipe drains laid on and covered with brushwood or fascines will serve the purpose.

It is well known that road surfaces, particularly if not impervious, deteriorate rapidly when not well drained, and that in many cases the action and scour of surface water causes as much, if not more, damage than the actual traffic.

Foundations

Except in the cases of new roads, it is acknowledged that sufficient consideration has not formerly been given to the provision of adequate foundations, which are just as essential for good, strong roads as for safe buildings. Everyone will acknowledge that it is difficult and costly to strengthen foundations of existing buildings, even so it is similarly difficult to strengthen road foundations without entire reconstruction.

It is remarkable the thickness of rubble pitching and road metal that clay, which is one of the most common subsoils, will work through under pressure of traffic unless a bed of clinker, ashes or sand is superimposed to prevent its doing so. This is especially the case should the surface and subsoil be not well drained.

In the author's opinion it is imperative that the road foundations should be stable, impervious and homogeneous, whatever type of surfacing is adopted.

For sett-paved roads, concrete foundations of adequate thickness are recognized as being the most suitable for all conditions of traffic.

Should the subsoil be unstable or yielding, then the concrete foundations will be in the nature of a raft or slab, and subject to tensile strains. Reinforcement is desirable in such cases, but on hard, firm subsoils a greater thickness of plain concrete may be preferable. This is a debatable point. In the case of bituminous surfacings, including tar-macadam, asphalt carpeting, etc., the author is of opinion that bituminously cemented foundations or base coats are preferable to concrete.

Where the surface is resilient there should be some compensating resiliency in the base or foundation, and when the surfacing is non-resilient, the foundation should possess the same characteristics. Except in the case of sett paving, it is desirable that there should be considerable adhesion between the surface and the base coat or foundation.

Lateral Support

It is essential that all our highways should have adequate side support or abutments, and it is surprising the extent to which this is lacking on many roads. This is necessary, not only to bear the weight of the traffic, but also the thrust and spreading action caused by live loads. We all know that in calculating stresses on buildings and bridges, a higher factor of safety is allowed for live loads, but this appears to be frequently overlooked where roads are concerned.

Generally speaking, in the case of urban roads, ample lateral support is provided by curbs and channels, but not so on most rural roads. If bituminous surfacings consist of tar-macadam and carpetings, unless the sides are well supported to hold up the material to the traffic and prevent water penetrating, the results are soon self-evident. It is true that, in the case of macadam, surfacing, the sod edging of the verges and the foot of banks form some lateral support, but not usually sufficient, especially when the carriageways are narrow and the sides much traversed by wheels.

The author has laid many miles of continuous *in situ* concrete curbings, and this stands well, except where wheels abraid and break it. He has tried the concrete-submerged curb, but does not greatly favor this for various reasons.

Although we are all agreed that water-bound granite macadam is inadequate for heavy (either in volume or character) traffic, it has served its purpose, and will of necessity continue to do so on many roads for years to come. It

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