Formation and Drainage.

The outstanding features of road-formation in the older countries as compared with ordinary rural-road construction in New Zealand are the flatter batters, the large and well-formed water-tables, and the considerably wider shoulders provided to support the gravel metal, concrete, or other pavement; and before expensive surfacings are laid in New Zealand, in addition to providing better alignment and curvature on the highways, practical consideration must be given to the improvements mentioned above. It should be realized that these improvements are of a much more permanent nature than the most expensive and most scientifically constructed pavements. No sinking fund is required to cover the cost of their replacement, and upon them depends the success of the expensive forms of urfacing which follow.

Large and well-formed water-tables can probably be maintained just as cheaply as small inefficien water-tables, on account of their adaption to the use of machinery; and, in addition, the tendency abroad seems to be to make the inside slope so flat that the ditch can be safely used by vehicles in case of emergency. In England particularly, where the road reserve is narrow, coarse metal is often rolled in practically to the lowest point of the water-table. In California there are now being constructed concrete shoulders 2 ft. 6 in. wide, extending from the edge of the pavement proper to within 6 in. of the lowest point in the water-table. Concrete shoulders or kerbs, and sometimes channels, are even considered for rural water-bound macadam roads in England, and wherever these are found their value is most apparent. The provision of good earth or gravel shoulders alongside modern smooth pavements is of considerable assistance in dealing with horse traffic. Water-tables, however, are not very effective in improving the bearing-power of a subgrade unless placed below the limit of capillary rise of moisture in the particular soil forming the subgrade.

Widths.

The latest standard set for the width of English main roads by the Ministry for Transport is 10 ft. per line of traffic. This is greater than is usually provided in most places. Some American authorities specify 12 ft., 18 ft., 24 ft., and 30 ft., for one, two, three, and four lines of traffic respectively. 16 ft. is generally regarded in England as being sufficient for two streams at moderate speeds, and 20 ft. for two streams at high speeds.

The Bureau of Public Roads, U.S.A., considers 18 ft. to be the minimum satisfactory width for hard surfacing on any main country road, as this width allows a continuous line of cars to pass a large lorry with reasonable clearance. If there are many lorries going in both directions a width of 20 ft. is specified.

On narrow mountain-roads there should be frequent points where extra widths of formation are provided for runoffs and turnarounds.

Curvature and Increase of Widths.

A motor-vehicle in traversing a curve takes up a strip of pavement greater in width than when it is travelling on a straight: hence it is only reasonab e that pavements should be widened at curves. An English authority gives the following table for suggested increases in width for curves of different radii:—

Radius at Centre-line.	Exact Extra Width for one Vehicle.	Suggested Extra Width to allow for turning with Two Lines of Traffic.
Feet.	Feet.	Feet.
25	4·70	12
50	2·50	8
75	1·65	6
100	1·30	5
125	1·00	4
150	0·80	3
200	0·50	3

It will be seen that the figures are appreciably large for curvatures which we are often compelled to adopt in New Zealand.

The use of transition curves, spiral and parabolic, is common in America, particularly for concrete roads.

Visibility.

The question of curvature is bound up with that of visibility. A visibility of less than 100 ft. may be considered dangerous.

For a speed of twenty-five miles per hour a range of vision of 250 ft. to 300 ft. is desirable. An Indian formula is as follows:—

$$(\text{Speed in miles per hour})^2 = 2 \times (\text{Limit of view in feet}).$$

Thus at 20 m.p.h. a view of 200 ft. is necessary.

On many curves in the U.S.A. benches have been cut in the batters about 4 ft. above formation level to increase the range of vision.