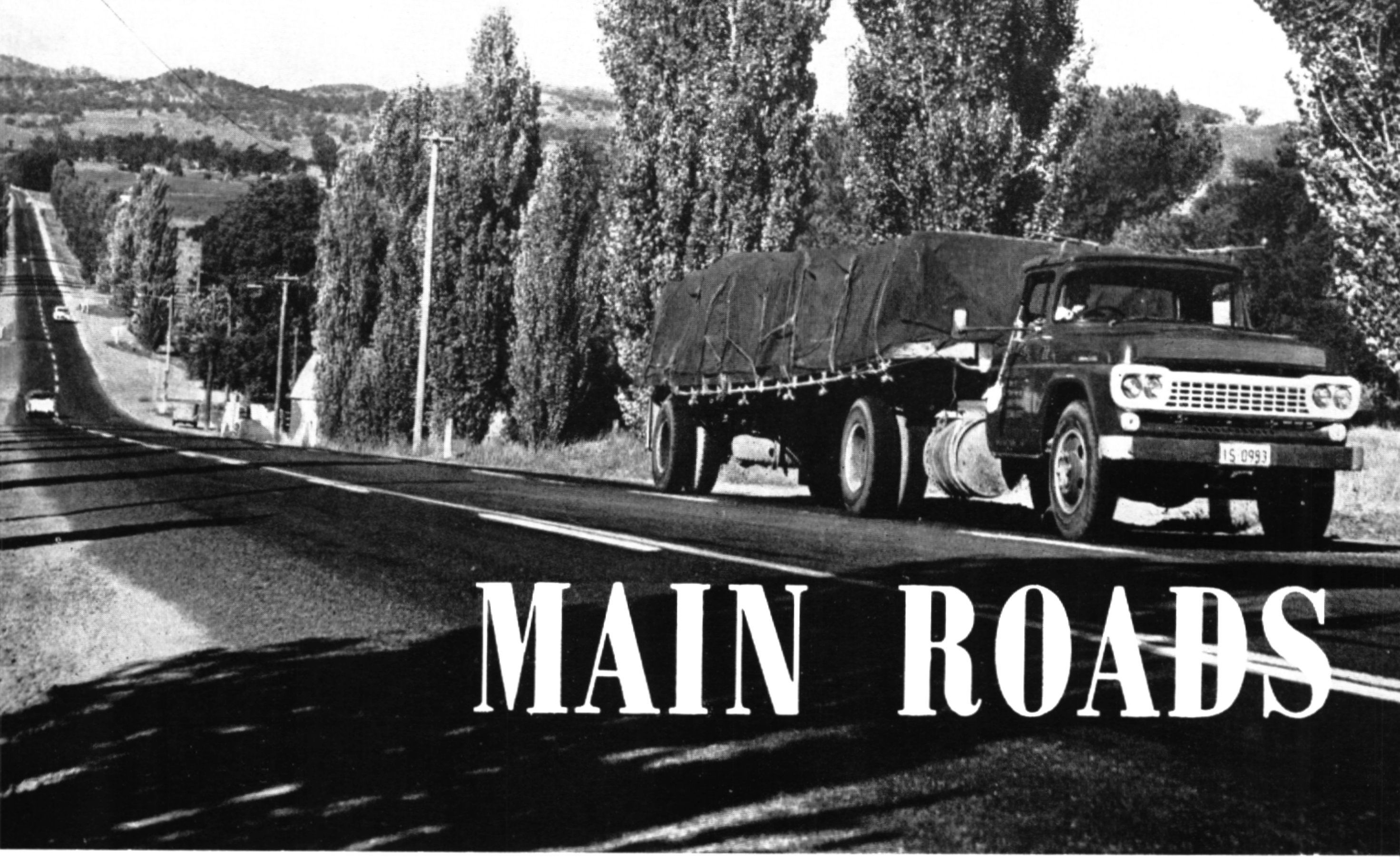
# MAIN ROADS

JOURNAL OF THE
DEPARTMENT OF
MAIN ROADS
NEW SOUTH WALES
SEPTEMBER, 1960




# MAIN ROADS

SEPTEMBER 1960 Volume 26 Number 1

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COVER SHEFT

Droving sheep on the Cobb Highway near Wilcannia

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NEXT ISSUE
*DECEMBER* 1960

# *Establishment of Road Research Facilities at the University of New South Wales*

ON the 2nd August, 1960, the Premier of New South Wales, the Hon. R. J. Heffron, M.L.A., announced that the Government had approved the Main Roads Act being amended to allow the payment by the Department of Main Roads to the University of New South Wales of an amount of £200,000 to be used by the University towards the acquisition of buildings, equipment, furnishings and fittings for carrying out highway and traffic research.

This announcement represented the culmination of negotiations for some time previously between the Department of Main Roads and the authorities of the University of New South Wales in connection with the establishment at the University of road research facilities associated with the Chairs of Highway Engineering and Traffic Engineering already established there.

The Department of Main Roads considered it was highly desirable to expand the scope of road research in New South Wales, having regard to the many problems of a rather fundamental nature awaiting solution. It was thought that these could well be handled at a suitably equipped university because at a university there is a wide range of specialised scientific knowledge and skills and instruments which can be drawn on. In a number of American States arrangements exist whereby a State Highway Department and a university co-operate in research activities, and the success achieved in the United States in this regard influenced the Department of Main Roads in its approach to the University of New South Wales.

After the matter had been fully studied and reported on by a joint committee representing the University and the Department, the University authorities expressed willingness to co-operate, and it was announced some months ago by the Vice-Chancellor that the University Council had decided to proceed with the establishment of an Institute of Highway and Traffic Research within the University.

# Historical Roads of New South Wales

# THE COBB HIGHWAY

THE Cobb Highway (State Highway No. 21) commences at Moama on the Murray River and continues for 374 miles in a northerly direction through Mathoura, Deniliquin, Hay, Booligal, Mossgiel and Ivanhoe, to a junction with the Barrier Highway (State Highway No. 8) at a few miles south of Wilcannia. At Deniliquin the Highway connects with the Riverina Highway (State Highway No. 20) and at Hay it intersects the Sturt Highway (State Highway No. 14) and connects with the Mid-Western Highway (State Highway No. 6).

It follows a route at one time used by coaches of Cobb & Co., the great pioneering firm whose coaching activities of early days extended over three States of the Commonwealth. Following representations by the Councils concerned, and after consultation with the Royal Australian Historical Society, the name "Cobb Highway" was adopted in 1947.

The route of the Cobb Highway did not result directly from the journeys of explorers, but the opening up of the country through which the Highway passes was due, to a considerable extent, to the explorations of Oxley, Sturt and Mitchell.

The first penetration of the area now served by the Highway was made by Oxley who, in March, 1817, received Governor Macquarie's instructions to lead an expedition to ascertain the course of the Lachlan River and to examine the western interior of New South Wales. Starting from a depot which earlier had been established on the Lachlan near Cowra, Oxley followed the course of the river until stopped by "uninhabited morasses in every direction". There is some uncertainty as to the exact point reached by Oxley before he was compelled to turn back but it has been

*The picture above shows a replica of a Cobb & Co. coach taken at Artransa Film Studios, French's Forest, Sydney* established that he crossed the present line of the Cobb Highway near to where Booligal, on the Lachlan River, is now located.

In the following year Oxley attempted to trace the course of the Macquarie River but was again stopped by impenetrable swamps from following the river to its outlet. From these two experiences Oxley thought that the Macquarie River marshes were linked with those of the Lachlan and he came to the conclusion that the rivers emptied into a vast inland sea and that the interior of the country was marsh and uninhabitable. (For the story of Oxley's journeys see "The Story of the Oxley Highway", "Main Roads", Vol. 3, March, 1953.)

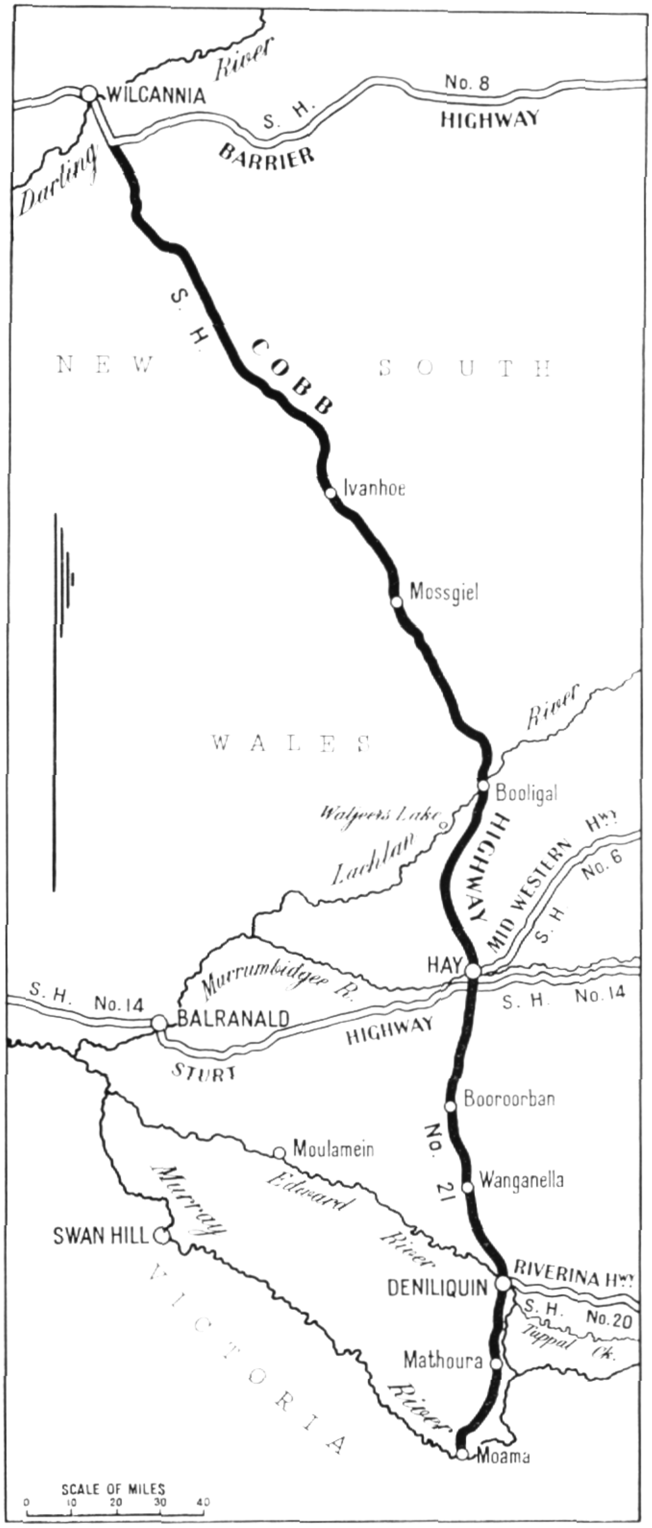
Towards the end of 1828 Sturt was instructed by Governor Darling to lead an expedition to ascertain the nature and extent of the marsh or marshes which earlier had prevented Oxley from following the Lachlan and Macquarie to their outlets.

In the course of his journey Sturt discovered a new river, which he named the Darling, and although the channel of the Macquarie River had been lost in the marshes which had frustrated Oxley's efforts, Sturt was able to show that the Macquarie was actually a tributary of the new river, the Darling, which he had discovered. This disproved Oxley's theory of an inland sea but the problem of the final outlet of the rivers remained. In an attempt to find a solution, Sturt was commissioned to trace the course of the Murrumbidgee River, "or such rivers as it might prove to be connected with."

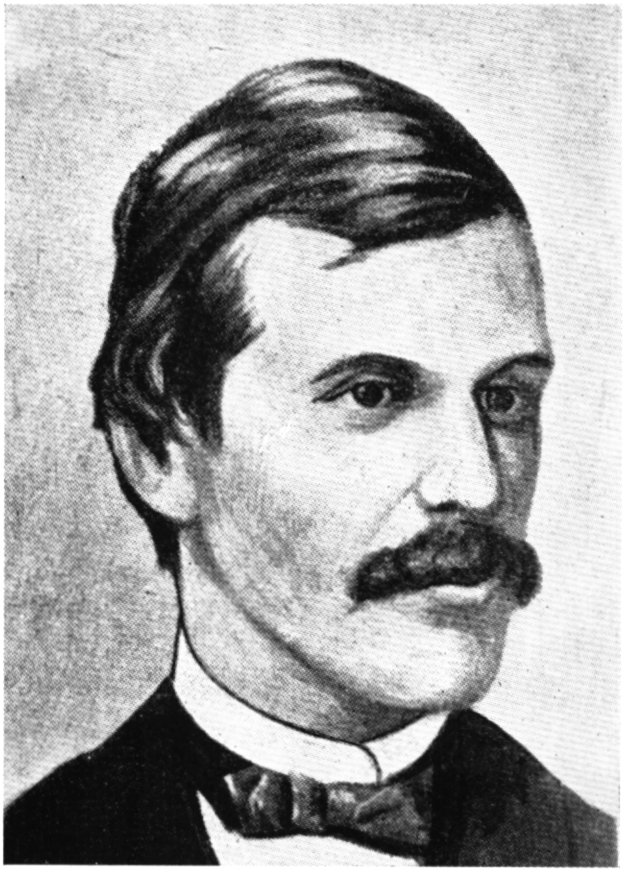
Sturt left Sydney in November, 1829, and early in January of the following year, reached the point at which the Cobb Highway now crosses the Murrumbidgee at Hay. From here Sturt continued his journey in a boat, with which he had provided himself before leaving Sydney. About the middle of January, 1830, the boat party found themselves "hurried into a broad and noble river" which Sturt named the Murray. On the 24th January, 1830, Sturt noticed "a new and beautiful stream" coming apparently from the north. This stream, he decided, was the Darling River, the upper reaches of which he had discovered in the previous year. (See "The History of the Sturt Highway", "Main Roads", Vol. 20, September, 1954.)

The Surveyor-General then in office, Major T. L. (later Sir Thomas) Mitchell, did not agree that the river identified by Sturt as the Darling was the stream which he had earlier discovered and to dispel the doubt it was suggested to Governor Bourke by the British Colonial Office, that Sturt should be employed to carry out an exploration of the Darling River. Before the suggestion reached the Governor, Sturt had left for England on leave and the Surveyor-General was instructed to undertake the task.

In accordance with his instructions an expedition led by Mitchell set out from Parramatta on 9th March, 1835, and towards the end of April, reached the Darling River where a base depot was established. Mitchell




LOCALITY SKETCH



Freeman Cobb, founder of Cobb & Co., 1853

then followed the course of the river downstream and after passing the site of Wilcannia, now the terminal point of the Cobb Highway, reached Laidley's Ponds, or Menindee as the place is now called. Mitchell decided to end his journey at this point, having come to the conclusion that "the identity of this river with that which had been seen to enter the Murray, now admitted of little doubt . . ."

The Governor could not have been satisfied, however, as in a despatch to the Secretary of State he said ". . . It seems probable that the River Darling flows into the Murray at the point indicated by Captain Sturt, but that fact had not been determined when Major Mitchell found it necessary to retrace his steps." Mitchell was therefore instructed to complete the survey of the Darling as far as its junction with the Murray, or if it did not join that river, to follow the Darling to the sea "wherever that might be".

To give effect to this instruction Mitchell left Sydney in March, 1836 and towards the end of May reached the Murray and proved beyond doubt that the Darling did actually flow into the Murray, thus confirming Sturt's theory. In the course of this journey Mitchell crossed the line of the Cobb Highway a little north of Booligal.

**Settlement of the River Country**

By about 1826 the tide of settlement had reached the south bank of the Murray River. The published reports of the explorers, particularly that by Mitchell who had named the country south of the Murray "Australia Felix, the better to distinguish it from the parched deserts of the interior . . ." aroused interest in the country on the north of the Murray and a rush for land which occurred in 1842 resulted in the occupation of a large area between the Murrumbidgee and Murray Rivers which was watered by the Edward River and its tributaries. This formed part of an area which become known as the Riverina country or "Riverina".

The origin of the term "Riverina" is uncertain. A member of Parliament for Balranald—J. Phelps—was credited with having first used the name but this was disputed by the Rev. Dr. John Dunmore Lang, who in the "Australian Witness" of 14th February, 1874, wrote—

> "The name (Riverina) was suggested exclusively by myself after the example of the province of Entre Rios (between the rivers) in South America, being intended to include only the tract, consisting of nearly twenty thousand square miles between the Murray and the Murrumbidgee Rivers, although it has been extended, most improperly, to the great salt bush country of the South where there are no rivers at all".

The name "Riverina" was in use as early as 1857 and later, Anthony Trollope, the novelist, wrote ("Australia and New Zealand")—

> ". . . to the west, in the midst of the great rivers of the continent, is the Riverina, or Mesopotamia of New South Wales . . . The Riverina is essentially a pastoral district . . . But of all the strictly pastoral districts of the world it is perhaps the best".

One of the earlier arrivals in the area was Benjamin Boyd who arrived in Sydney in July, 1842, as the representative of the Royal Bank of Australia which had been formed in London for the purpose of developing trade with the Australian colonies. Boyd was born in Scotland in 1796 and in 1824 commenced business as a stockbroker in the City of London. In 1840 he announced his intention to send vessels to trade in Australian waters and to establish ports for the purpose. To aid his ventures the Royal Bank was formed and on behalf of the bank, Boyd acquired large land holdings in the Monaro and Port Phillip districts as well as an area of 1,220,000 acres located between the Murray and Edward rivers through which the Cobb Highway now passes.

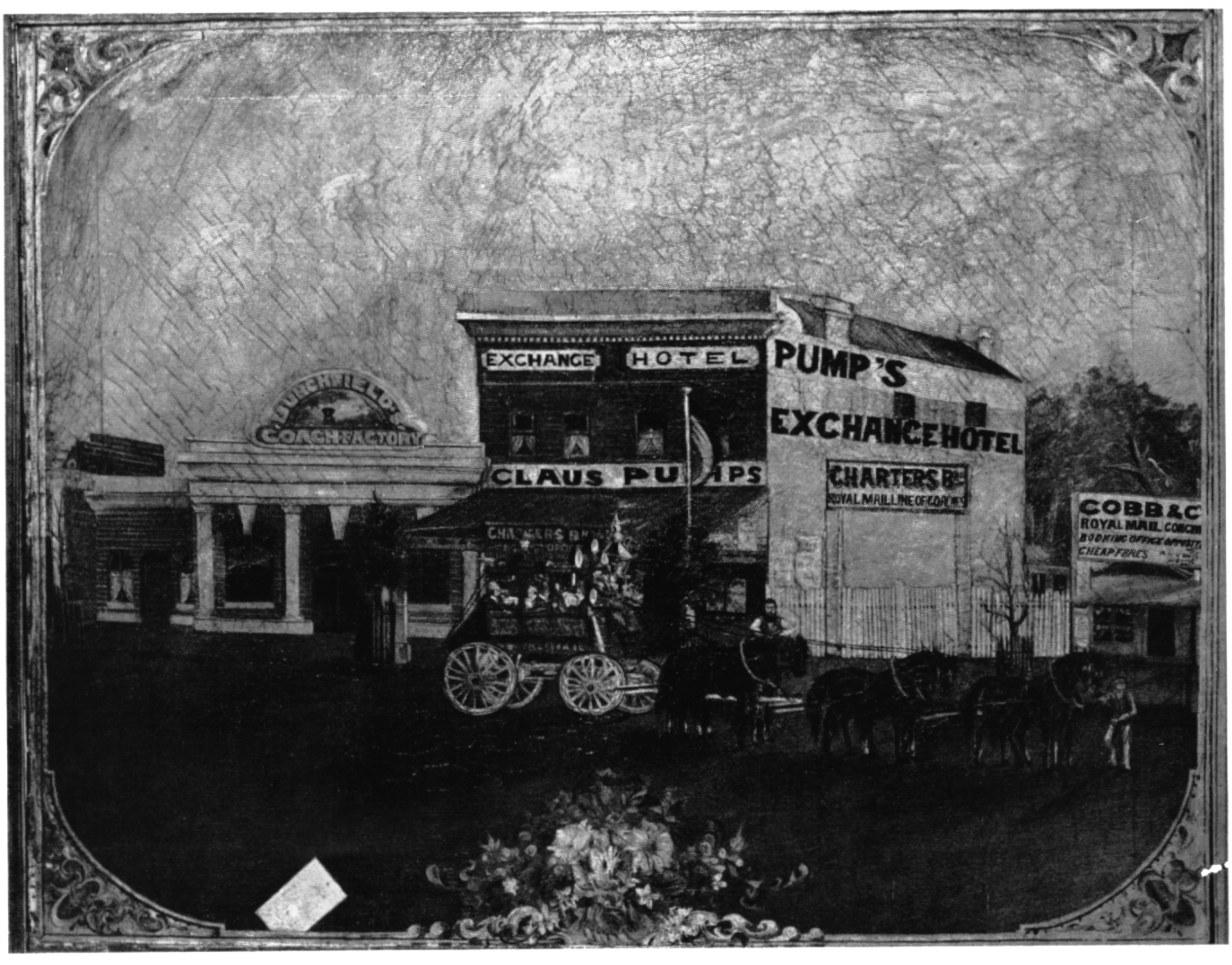
Included in this area was a small station held by one Augustus Morris who, in 1842, with two others, had discovered the Edward River and explored the surrounding country. The rights to this holding were purchased by Boyd from Morris who then undertook, for Boyd, the formation of a group of stations in the area. The head station of this group, comprising 700,000 acres, was named "Denelequin" and was located at the site now occupied by the town of Deniliquin. The total area of the stations so formed is said to have exceeded one thousand square miles of territory. Boyd's ventures ultimately failed and his land holdings passed into other hands.

By 1848 practically all the land along the river frontages had been occupied and settlement was extending to the "back blocks", as the country away from the rivers was called. In the earlier surveys this country was described as unsuited for cultivation and the vegetation useless for grazing purposes. Cattle bred on the stations, however, proved that the interior pastures were good for stock and were actually good fattening country. When this was realised a great wave of settlement occurred, due primarily to the demand for meat by the miners of the Victorian gold fields in the early 1850's, but also to the success which had attended the growing of wool and the increased value of all squatting properties.

In his book "Colonization in 1876" George Ranken, in referring to the settlement which took place during the 'fifties and 'sixties wrote—

> "Riverina was then all eagerly taken up along every known watercourse; it became the fattening ground for Victorian meat and the outlet for squatting enterprise. Believed at first to be a desert, next considered only available along the water courses, and known to be subject to severe droughts and floods, this district has overcome all prejudices and even contradicted history. The occupation of Riverina was slower, surer and more successful than any later settlement".

**Photograph of an original oil painting dated 1882, at Burchfield Bros. Garage, Deniliquin**



An idea of the extent to which the trade in live stock developed in the comparatively few years after the area was first penetrated, may be obtained from an article which appeared in the "Border Post" of 11th July, 1857. This article had been reprinted from "The Sydney Morning Herald" in which separation of the "Riverine Country" from New South Wales and its formation into a new State, were advocated. In this article it was stated—

"From the interior of New South Wales there is a continuous transit of fat live stock to the shambles at the gold fields. Most of this traffic concentrates at Moama where the sheep and cattle are punted across the Murray. There is no official record of the extent of this trade but from reliable data furnished by the amount of the punting business, it may be safely assumed that not less than a million's worth of property passes annually into Victoria by this road".

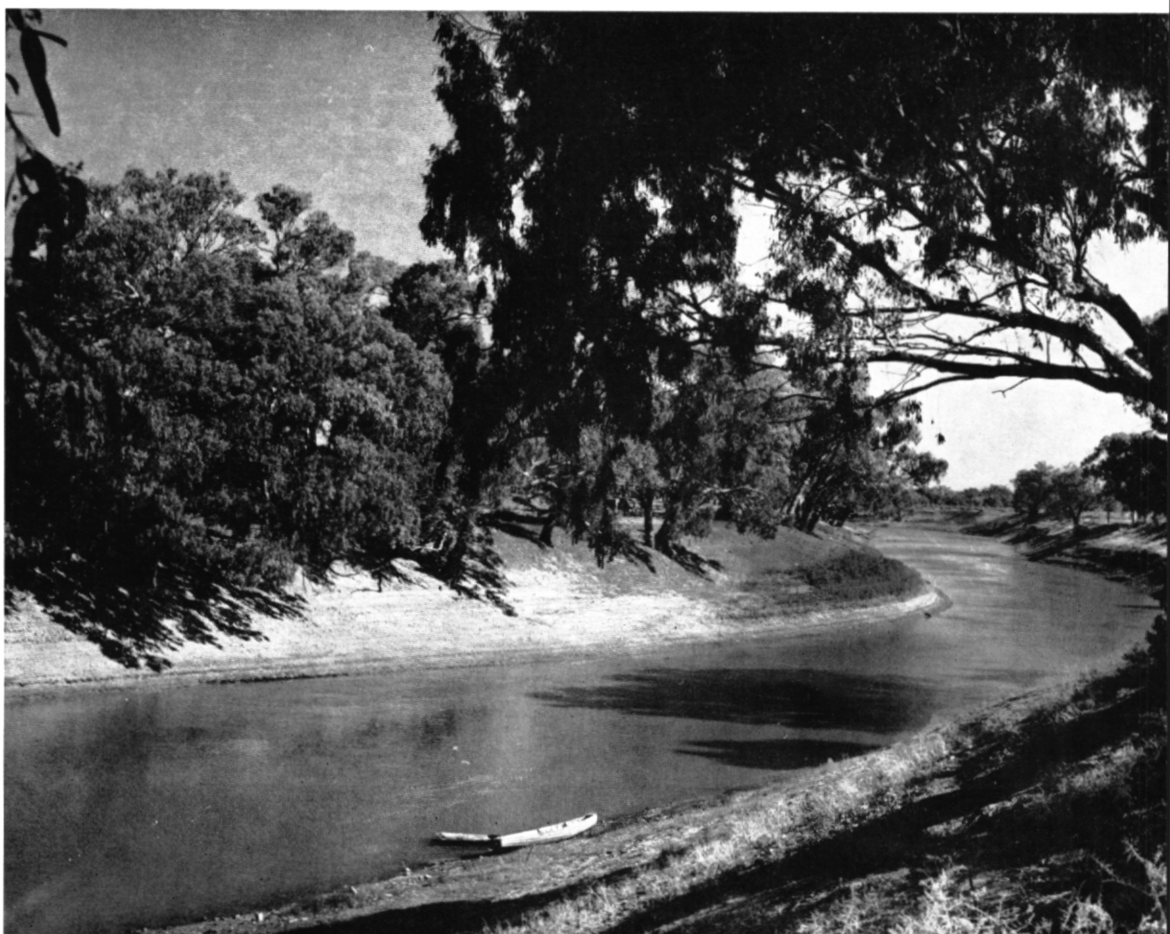
An interesting link with this early period is provided by the fact that the grandfather of the present Governor of New South Wales—Lieut.-General Sir Eric W. Woodward—was one of the earlier settlers in the area and was one of the first to undertake the overlanding of sheep from the Bathurst Plains to Port Fairy. General Woodward's father also was the manager of a pastoral property at Booligal and the Governor, himself, was born at Hay which is now an important centre on the Cobb Highway.

**Road Communications**

A road following the line of the more southerly section of the Cobb Highway seems to have existed from the earliest days of settlement. On a "Map of Australia Felix", compiled and published by Thomas Ham of Melbourne in 1847, a "road or bush track" is shown to have followed the course of the Campaspe River to near its junction with the Murray, and crossing that river at where Moama is now located, reached a point at the junction of the Edward River and Tuppal Creek, approximately the present site of Deniliquin. The track then followed the Edward River in a westerly direction to about the location of Moulamein. This track was that followed by the drovers taking cattle and sheep from pastures in New South Wales to the markets in Victoria.

No defined route for travelling stock existed north of the Edward River and the drovers from the northern districts were compelled to find their way south as best they could.

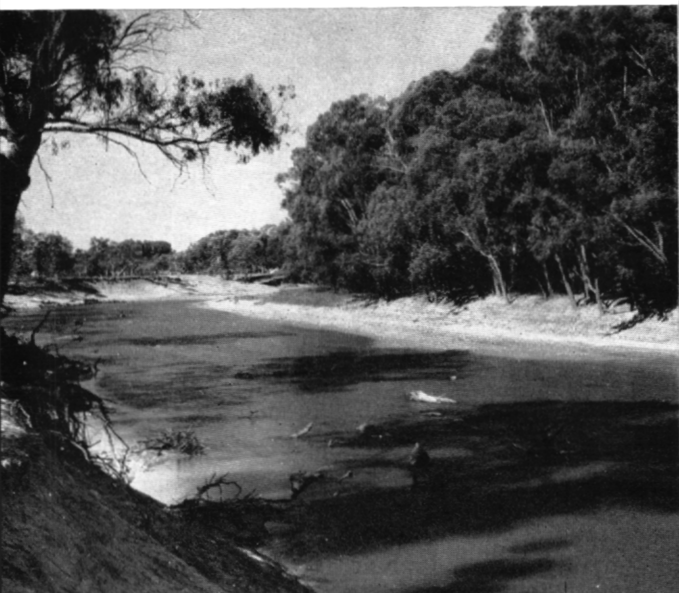
The localities usually agreed upon between the squatters and the purchasers for the delivery and reception of stock were Dubbo on the Macquarie River and Maiden's Punt (Moama) on the Murray and the route generally taken by the drovers was via the Lachlan River to "Lang's Crossing Place" (Hay) on the Murrumbidgee, thence to Deniliquin and on to Maiden's



**The Darling River at Wilcannia**

Punt. An idea of the importance of the route may be obtained from the fact that according to particulars of stock registered at Echuca (Victoria) as having been imported from New South Wales during the quarter ended 30th September, 1857, there passed over the Murray by way of Maiden's Punt, 28,070 horned cattle, 233,364 sheep and 793 horses.

The ferry which became known as "Maiden's Punt" was established by James Maiden who arrived in the district about 1840 with the intention of settling in the "new country". According to the "Sydney Morning Herald" of 12th July, 1860, "The country was then uninhabited—a trackless waste". There were no means of crossing the Murray except by fording, when the state of the river permitted, and which, at any time, was a hazardous undertaking.



(*Above*) **Seventeen miles south of Ivanhoe on the Cobb Highway**

(*Left*) **The Murrumbidgee River at Hay**

(*Below*) **Direction signs at Hay**


Maiden was at first engaged in cattle droving and in the course of one of his journeys saw a punt which had been put into operation at Seymour. He arranged for a similar vessel to be built and brought to Perricoota, about 14 miles downstream from where Moama was later established. This punt he operated, at considerable profit, for about two years when it was replaced by a larger vessel. The punt was capable of safely carrying three bales of wool by themselves but before bullock waggons could cross, the wheels were removed and taken across the river, the body of the vehicle being then sent over separately. The bullocks had to swim across. When all were across the waggon was re-assembled and re-loaded and the journey resumed. The larger vessel was able to carry a fully loaded waggon and team at one crossing and when this was installed, Maiden moved the smaller vessel to the Edward River near Deniliquin. This shortened the route for the northern drovers, who previously crossed the Edward at Moulamein, and it assisted in establishing the line now followed by the Cobb Highway between the Murrumbidgee and the Murray.

With the discovery of gold at Bendigo in the early 'fifties, Maiden developed a trade in sheep and cattle for food purposes and although he could neither read nor write he acquired, in course of time, the ownership of 17 runs, an inn (the Junction Inn) at the Murray River crossing and the mail contracts for the area. His rapid rise and prosperous career was attributed to "his being on one of the great highways over which an enormous quantity of cattle and sheep" travelled from New South Wales into Victoria.

In July, 1856, a correspondent of the "Sydney Morning Herald" informed his paper that "the large number of cattle and sheep that annually cross the river (Murrumbidgee) at a spot known as Police Point" had led to the establishment of a punt at that point and that during the previous six weeks "150,000 sheep and 7,000 cattle (had) crossed the river en route for the Melbourne side". The point of crossing became more widely known as "Lang's Crossing Place" as it was situated on a property owned by two brothers named Lang. Later a township was located at the spot and was named Hay.

Until the installation of the punts the three rivers, Murrumbidgee, Edward and Murray, constituted the greatest obstacle to the movement of stock from the northern and western districts of New South Wales to the southern markets but, with their establishment, the great stock route to Victoria became clearly defined.

On maps prepared for the use of the Post Office Department in 1852 and 1858, a "post road" between Moama and Deniliquin is shown but no roads north of that point are marked. Hay and Booligal are marked on a map dated 1861 but no direct road communication between Hay and Deniliquin is shown to have existed.

On "Bailliere's Gazeteer Map" published in 1866, a road is marked extending from Moama, through Mathoura to Deniliquin, thence through Wanganella and Hay (also shown as "Lang's Crossing Place") to Lake Walgeers. From this point the road followed the Lachlan River to Booligal and on to Condobolin and Forbes from where another road led towards Dubbo. This was the route followed by the drovers overlanding stock from the northern settlements to the Victorian markets.

In 1882 a map showing the postal stations and roads in New South Wales was prepared for the use of the Post Office Department and on this, a "mail line" following exactly the route now taken by the Cobb Highway from Moama via Mathoura, Deniliquin, Wanganella, Boorooban, Hay, Booligal, Mossgiel and Ivanhoe to Wilcannia, is marked. By this date, therefore, the whole of the area through which the highway passes may be said to have been opened up and its lines of communication by road established.

**Coaches and Cobb and Co.**

Although coaches were in use in Australia several years before Freeman Cobb inaugurated his line of coaches to the Victorian gold fields, the name of Cobb has always been associated with coaching in Australia.

Coaching for the purposes of inland communication was first conducted by strong spring carts which were generally in use up to the time of the great gold discoveries in the early 'fifties. The English style of coach which was in use in the more settled districts was too top heavy for unformed roads, and a long low coach similar to those being used in the gold fields of California, was introduced by an Englishman named Twisden Hodges, who was, at one time, a member of the House of Commons.

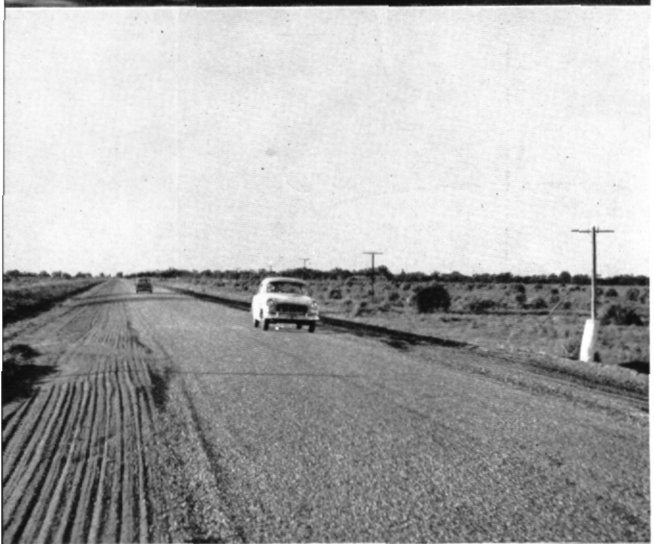
The discovery of gold in Victoria towards the end of 1851 attracted many hundreds of adventurers from all parts of the world, amongst them, four Americans who had been employed by the famous coaching undertaking known as Wells-Fargo and Co. There is some uncertainty as to whether they were sent to Australia to develop, on behalf of their employers, a coaching and carrying service, or whether they were attracted by the lure of gold and came to Australia to seek their fortunes. In this, they at least succeeded, but not as gold diggers. With their experience of the carrying business they quickly realised the need for a swift and reliable system of transport, and in 1853 they formed in Melbourne the firm of Cobb and Co., as a parcels carrying service. In the following year the firm extended its operations to the gold fields and founded the American Telegraph Line of Coaches (Cobb and Co.) using the Californian type of coach which they imported from America. The speed and regularity with which the coaches were operated secured for the firm the mail contracts over a large area and a virtual monopoly of the coaching business in Victoria. The original partners sold their interests in 1856 and, with the exception of James Peck who built up a large mercantile enterprise in Melbourne, returned to America. After several changes of ownership the coaching undertaking was acquired by a syndicate including another American, James Rutherford, who came to Australia at the height of the gold rush and who, after one unsuccessful attempt at gold digging, engaged in various activities including pastoral interests in the Riverina. Rutherford was appointed General Manager of the new concern. The syndicate, which continued to function under the name of Cobb and Co., commenced operations in 1861, and in the following year extended its activities to New South Wales with headquarters at Bathurst. In 1865,

**1. The Cobb Highway passing through Hay**

**2. Cobb Highway near Wanganella between Hay and Deniliquin**

**3. Cobb Highway passing through Deniliquin**

**4. South of Deniliquin, 34 miles from the Victorian border**



Cobb and Co. moved into Queensland and by 1870 the organisation in the three eastern colonies was harnessing 6,000 horses daily; its coaches were travelling 28,000 miles each week; mail subsidies amounted to £96,000 per annum, and the pay-sheet exceeded £100,000 a year.

For several years prior to 1861, coach services were operated over the southern portion of the line of road now known as the Cobb Highway, but the exact date of entry of Cobb and Co. into this area is not known.

In 1859 a coach was advertised to run daily from Deniliquin to Moama and thence tri-weekly to Melbourne. In its issue of Friday, 26th October, 1860, the "Southern Courier" announced that "Messrs. Bill & Co., who are at present carrying the Deniliquin mails to Hay, will on Tuesday, put a comfortable covered coach on the line capable of carrying three passengers . . .". The same newspaper in its issue of 16th November, 1860, carried an advertisement notifying that the Telegraph Line of Royal Mail Coaches (Cobb & Co.) had extended their journeys to Hay (Lang's Crossing Place) and were despatching a coach from Deniliquin to Hay every Wednesday and Saturday mornings. The coaches were advertised to leave Deniliquin at 3.30 a.m. and to arrive at Hay 6 p.m. the same day. On the return journey they left Hay at 2 p.m. and arrived at Deniliquin at noon on the following day.

On 15th February, 1861, the "Southern Courier" informed its readers "that an opposition coach, with a reduced scale of fares has been started to run between Deniliquin and Hay". An advertisement in the same issue indicated that the coach would run twice weekly in each direction, leaving at 4 a.m. and reaching its destination at 6 p.m. The advertisement was signed by "J. Clifford, Proprietor" but the fares were not stated.

From that date on there are records of coach services operating in various directions between the Murray and the Lachlan Rivers, but the first reference to coaches running over the full length of what later became the Cobb Highway, appeared in "Cobb and Co's. Guide" published in 1871. In this, services between Deniliquin and Hay, and Hay and Wilcannia via Booligal, Mossgiel and Ivanhoe, were notified.

**Acknowledgments**

Material used in the preparation of this article has been obtained from—

The Mitchell Library, Sydney.

Journals and Proceedings of the Royal Australian Historical Society.

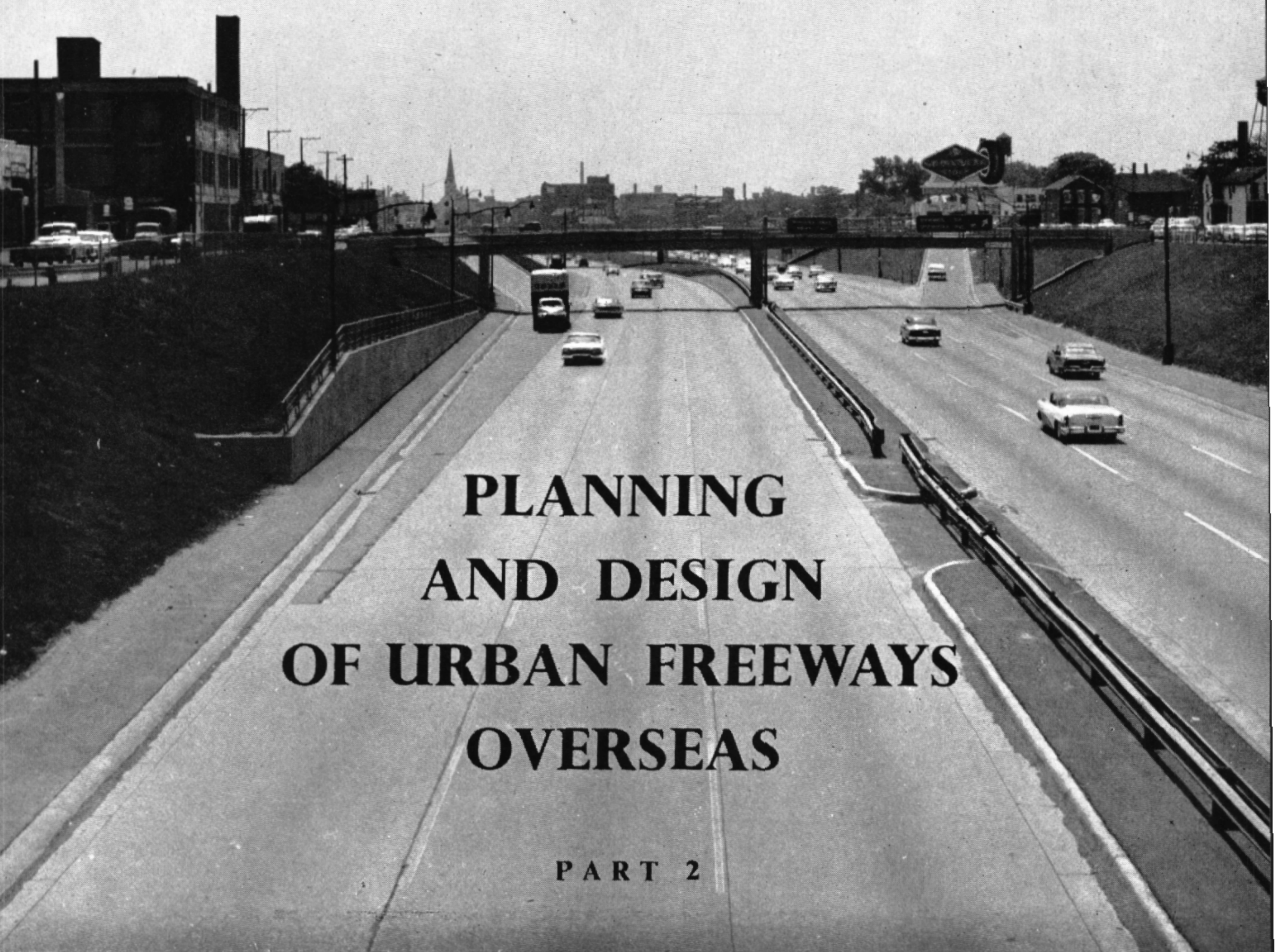
"Victoria in the 'Fifties"—L. Earp.

"Australia and New Zealand"—Anthony Trollope.

"Colonization in 1876"—George Ranken.

"Industries in N.S.W.—1882"—Charles Lyne.

S.G.P.



# PLANNING AND DESIGN OF URBAN FREEWAYS OVERSEAS

## PART 2

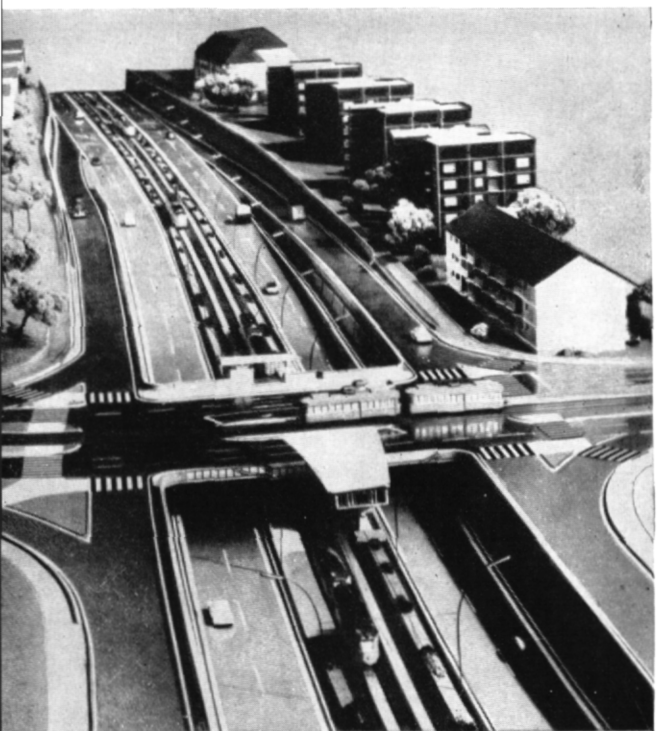
**Extracts from a report by Mr. M. V. Douglas, Design and Urban Planning Engineer, Department of Main Roads, New South Wales, following an overseas mission to investigate and report on latest developments in the planning and design of urban expressways.**

### Routing Along Existing Streets

Examination of any proposal for locating an urban freeway along an existing street must include consideration of the net increase in traffic capacity it would provide, and consideration of whether there would be not only adequate capacity and safety for through traffic but also adequate and suitably arranged capacity on the street system for parallel and transverse local traffic movement. It should be borne in mind that if restrictions imposed by available width were to result in omission or narrowing of breakdown strips or narrowing of median, that is an important factor in the consideration of capacity and safety. It is recognised that there are cases where the volume of traffic to be accommodated is not so high as to require a freeway of major standard and yet it may be possible and appropriate to provide for an important improvement in traffic movement by constructing a freeway or expressway of limited standards within an existing road. But such cases should not be confused with the major freeway system; it is clear that freeways embodying the best safety and capacity standards cannot be constructed within the boundaries of existing streets unless the streets are of exceptional width. Even where streets are wide the standards of freeways constructed within their boundaries usually are inferior to those of a freeway of normal type, and some of the cases where existing roads are followed or planned to be followed are examples of what to avoid.

In some cities in Switzerland consideration is being given to converting some streets to urban motorways with complete grade separation and full control of access, but with extremely narrow median, no breakdown strip, and through traffic separated from the front of residential and other buildings by only a fence and footway. Some of the authorities concerned regard such treatment as most undesirable but are dominatingly influenced by the fact that to a remarkable extent works in Switzerland are subject to referendum, and there is some opinion that when a limited amount of that type *of construction has been carried out its inferior quality* will soon be recognised by the public which then will be better prepared to accept acquisition of properties. At Copenhagen urban motorways are planned to follow existing streets to an important extent, in some cases without general widening, as for instance where the existing width is about 172 feet; breakdown strips are omitted. In other cases it is intended to widen, sometimes on both sides with extensive property demolitions but again shoulders are not being provided. In Essen, a section of the Ruhr Motorway with tram service in the median is being constructed along a wide street which carried heavy traffic. To fit the motorway within the street, only four motorway traffic lanes *could be provided and shoulders were omitted*, but although construction was far from complete at the time of inspection, the authorities now realise that the motorway's capacity in excess of the former capacity of the street is so limited that the whole capacity of the motorway will be absorbed as soon as the motorway is opened to traffic. As a result, planning of a further motorway, this time clear of existing streets, has been commenced.

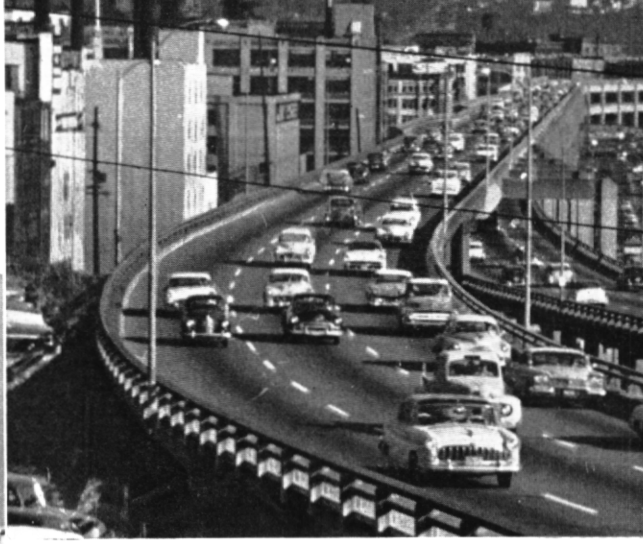
In the United States some urban freeways have been and are being built along important existing streets with retention of good surface street capacity, but with restricted freeway cross section. At Seattle the Alaskan



**Model of part of a German Motorway along a wide existing street. There are trains in the median with passenger access via overbridge. Design is cramped—no shoulders and inadequate acceleration, merging and deceleration lanes**

**Typical of the cramped design (narrow median, no breakdown lanes, restricted side clearance) that tends to result from adherence to route of existing road and yet causes extensive interference to property. Added traffic capacity will not be nearly as great as that obtained by adopting a new location**

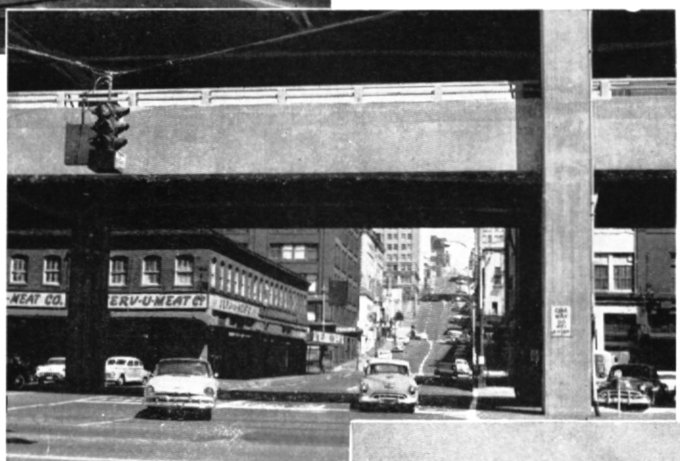
Seattle. Alaskan Way elevated expressway. Single level deck in foreground—two-level deck and port roadway in distance



Fort Worth. Six lane elevated expressway under construction. The street will have four traffic lanes on each side of the viaduct. Full depth property acquisitions were made along one side of the street

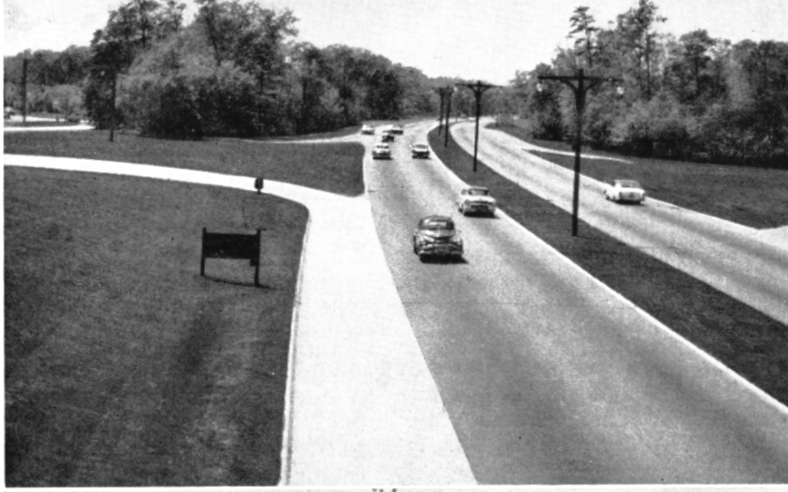
Seattle. Alaskan Way elevated expressway. On this length the space under the viaduct is used for parking, but on other lengths local traffic is carried under and parallel with the viaduct

Seattle. Alaskan Way elevated expressway. Looking under viaduct skirting downtown area



Chicago. Congress Street Expressway. Depressed construction with suburban train service operating in median.

New York. Typical Parkway on Long Island



Expressway at Fort Worth. Rolling grade line giving restricted visibility

Los Angeles. Hollywood Freeway

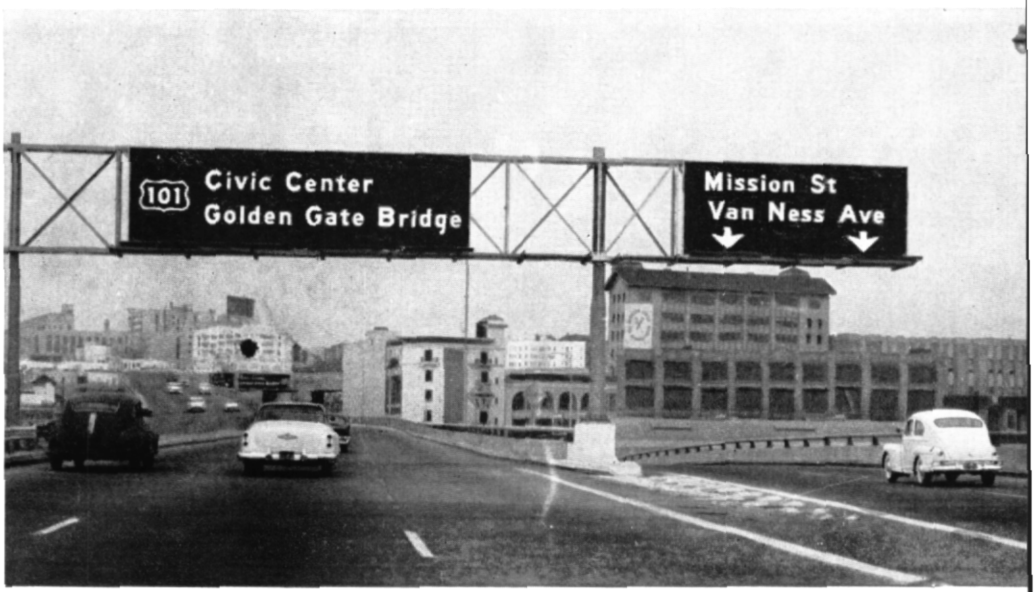
Washington, D.C. Typical Parkway

(*Bottom Right*)
Expressway at Fort Worth. Rolling grade line

(*Below*)
San Francisco. Typical two-deck expressway viaduct

Way Viaduct without breakdown strips, was built above a wharf-side road of such great width that ample traffic capacity on and to the wharf-side road is preserved. At Fort Worth a freeway viaduct is being built over part of the width of an important traffic street, but full depth property acquisitions have been made along one side to enable provision of four surface traffic lanes along both sides of the viaduct. Breakdown strips have been omitted from the viaducts in both of these cities and at Fort Worth the freeway median is narrow. At Detroit there is to be some depressed freeway construction, with breakdown strips and two local service roads each of two traffic lanes, entirely within existing street boundaries except for some widening at freeway-street interchanges, but the existing street width is 204 feet, which is exceptional and the result of widening carried out some years ago in preparation for handling major volumes of traffic. Even so the median width is restricted.

San Francisco. Typical one-deck viaduct expressway, and outlet ramp (*right*)

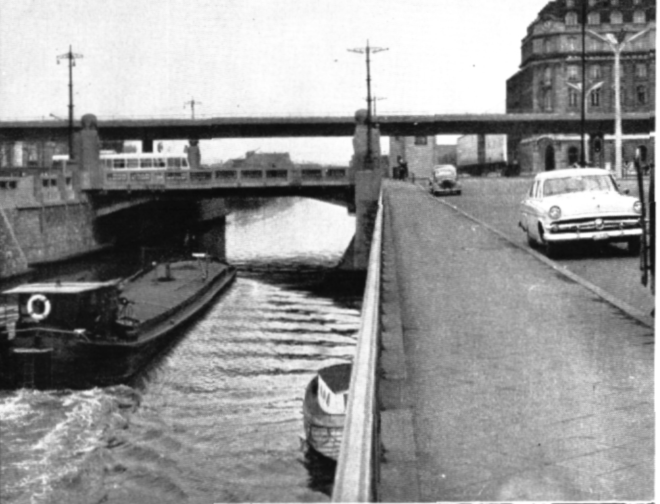



## Depressed Construction

In general, nearby property owners and residents much prefer that an expressway be fully depressed below natural surface, as it is substantially out of their sight, causes a minimum of noise, particularly if trees or shrubs are planted on batters or roadside, and unless there is pronounced crossfall of natural surface there is little, if any, disturbance of street levels. The grading of inlet and outlet ramps assists acceleration and deceleration of vehicles joining or leaving the freeway and generally speaking there is good visibility between joining and through traffic. The cost of earthworks, alterations to public utilities and drainage is high and, because the immediate roadside batters are in full view of motorists the standards (and costs) of roadside maintenance and improvement tend to be high. Of course long lengths of fully depressed construction are practicable only where the longitudinal grade of the natural surface is easy. This type of construction has been used over substantially the whole of the freeway construction at Detroit, and there is a considerable amount of it at Chicago, Los Angeles, Kansas City and other cities. Where land is relatively flat and circumstances do not require viaducts it is more frequently used than roller coaster grading. Except where property values are high or where there is some special feature, earth batters are used rather than retaining walls.

## Roller Coaster Grading with Ramps Linked to Parallel Service Roads

There are conspicuous examples of this type of construction at Fort Worth and Houston. The grade separated roads at Fort Worth pass over and at Houston pass under the freeway. The costs of earthworks are and costs of adjustments to public utilities can be much less than with fully-depressed construction. A further contribution to low cost of construction and to minimum width of land required is the characteristic of this type of construction that the ramps usually are well removed from grade separations at cross streets and where they connect to the through roadways the levels are close to natural surface and the levels of the service roads. These economies have combined to produce undesirable features in many cases. There is excessive weaving in the short distance separating inlet ramps from outlet ramps and this is dangerous and causes congestion. Many inlet ramps and acceleration merging lanes are very short and thus entering traffic and through traffic have inadequate time to adjust their respective speeds to enable them to merge smoothly. The short outlet ramps and inadequate deceleration lanes also create undesirable conditions on the freeway and at the street end of the ramp where the accident rate is poor, particularly where two-way traffic



1. Brussels. Viaduct along part of Inner Ring Road. This is a long grade separation rather than motorway. Presence of canal led to construction of viaduct instead of tunnel as on other parts of the Inner Ring

2. San Francisco. Interchange of Bayshore Freeway—Bayshore Skyway—Central Freeway

is carried on the local service roads. The grading restricts sight distance and increases dangers from headlight glare. In some places the cramped width has resulted in batters so steep that concrete lining of batters has been necessary. Where there is wide spacing between ramps and between grade separations, with ample width of land and one-way traffic on the service roads, this type of ramp design would be less objectionable and would in fact have advantages in some cases, but there would then be less frequent reversals of grade and the term roller coaster would hardly apply.

### Construction Close to Natural Surface, Alternating Cuts and Fills, Side Cutting

In a high proportion of cases topography or economy or both together dictate adoption of one of a combination of these types of construction which generally speaking have a more interesting appearance to the motorist. The principal exception to this is construction close to natural surface, but relatively little of this occurs in urban areas except in the case of parkways and where the road is planned in advance of other development.

### Viaducts

Generally speaking, the viaduct type of construction is the highest in cost exclusive of land acquisitions. It is increasingly common at major freeway-freeway interchanges, and frequently has to be considered where separately or in combination there are the factors of high land values, flat land, particularly at low levels, and high volumes of local traffic parallel to and across the location of the freeway. At Seattle, the north to south Alaskan Way Viaduct is built along a wide and flat strip of port-side road and rail tracks and does not interfere with the parallel or cross flow of traffic serving the wharves; it causes practically no interference with buildings, whereas any other north to south location (other than that reserved on the east for another freeway) serving the central city of very narrow east to west dimension would have involved practically continuous property demolition without conferring any superior facilities for traffic. Another illustration is at San Francisco where the high value of the flat ground through which major lengths of freeways pass, the need for local cross traffic movement and the special local difficulties of below surface construction led to construction of viaduct over much of the freeway system

3. Brussels. Viaduct along part of Inner Ring Road. It has three traffic lanes $9\frac{1}{2}$ ft. wide and no breakdown strip. The centre lane is reversible. The surface road on which the viaduct is situated has three road traffic lanes and two tram tracks on each side of the viaduct. Overall width of road along the length of the viaduct is about 150 ft. (variable)

4. Zurich. A four-lane viaduct motorway is to be built along the centre line of this canal

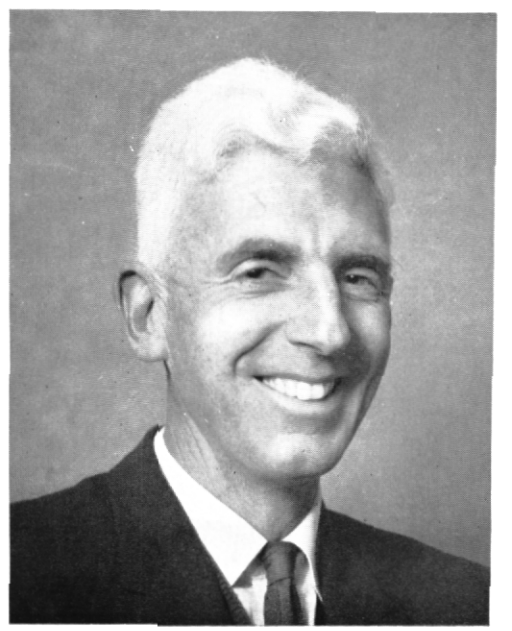
there. Although the three-lane viaduct in Brussels is a long grade separation rather than a motorway, it is a good illustration of viaduct being the practical solution for a particular case. This is one of a number of grade separations distributed along one route; all the other grade separations are tunnels or subways, and viaduct was the solution adopted in this one case because of the presence of a canal which could not be closed or passed under. In Europe there are other cases where a viaduct is the obvious choice. An instance is at Zurich where a motorway is to be built along the centre of a canal which is not used for river traffic but cannot be filled in or diverted.

In Western Germany and in the United States viaducts were seen in cases where the choice between viaduct and earthwork construction would logically be, and fairly generally was, based on comparison of estimated costs, inclusive of land, of the viaduct and other types. Generally, although no doubt there have been exceptions, the comparisons have been biased in favour of the viaduct by omission of shoulders, or breakdown strips, from the viaduct and frequently allowing for very narrow median. The inferior cross section of such viaducts causes them to be less safe, more liable to blockage by disabled vehicles, and thus intermittently of less traffic capacity, particularly at peak hours, than the earth construction with which they have been compared on the basis of costs. As a recent development, and to an increasing extent, provision is now being made for right hand (our left) shoulders, or breakdown lanes on viaducts being planned in the United States and Canada because of the reduced safety and the intermittent congestion and reduced traffic capacity that follows from their omission. In some cases provision is being made for breakdown strips on both sides as in the case of some freeway construction on earth. Whenever the cost of viaduct is compared with cost of construction on earth, full weight should be given to the difference, if any, between the capacity and safety of the proposed cross sections and ramps on the two types of construction.

There exist, and are being constructed, several viaducts along streets. Mostly they are limited to those parts of the system that carry only through traffic and do not have ramps, but even so the required width of street is such that either the initial width is great or widening is necessary. If ample width is not provided or buildings not well set back the conditions can be objectionable to owners or occupiers of properties other than warehouses and industries. Where natural surface grades are in excess of those acceptable for freeway, the structure costs are materially increased. Two-deck viaduct construction to minimise overall width and keep within road boundaries increases the cost of ramps, particularly if there is not high ground on one side to which ramps can be linked; and high costs can be involved in achieving ramps of highest standard. An exceptional case where viaduct construction for a considerable distance within an existing street has been appropriate is the Alaskan Way Viaduct at Seattle, as referred to earlier. The conditions there and the general arrangement of structure are in some respects similar to the conditions existing and the arrangement of structure planned for much of the Western Distributor in Sydney, except that breakdown strips are proposed for the latter. The planned ramps linking the Alaskan Way Viaduct to downtown streets have not yet been constructed and it is intended to use the viaduct exclusively for through traffic until the parallel Seattle Freeway on the other (eastern) side of downtown has been constructed.

*(To be continued)*

*Mr. D. F. Glynn, B.C.E., who took up duty in July, 1960, as Director of the recently established Australian Road Research Board. Mr. Glynn is an honours graduate in civil engineering of the University of Melbourne. He was engaged for a number of years in engineering work with the Melbourne and Metropolitan Board of Works. Prior to his appointment as Director of the Australian Road Research Board, Mr. Glynn had been Manager of Stabilisers (Victoria) Pty. Ltd., a firm engaged in road pavement construction by soil stabilisation.*



# State Highway No. 22 now named "Silver City Highway"

WITH the concurrence of the Broken Hill City Council and the Wentworth Shire Council, the north-south State Highway, which parallels the western border of the State, has been given the name "Silver City Highway" and so proclaimed in the Government Gazette of 12th August, 1960. This name was selected because the road primarily serves in New South Wales to give access to and from the mining city of Broken Hill from points north and south, although the road has a wider significance from an Australian point of view as it connects with the road systems of Victoria and of western Queensland.

The Silver City Highway, State Highway No. 22, has its southern commencing point in the village of Buronga at the bridge over the Murray River which connects to Mildura. From Buronga the Silver City Highway proceeds in a westerly direction parallel to the Murray River through Dareton to Wentworth. At this point it turns north to Broken Hill, about a third of its distance to Broken Hill being parallel and close to the Great Ana Branch of the Darling River, which it finally crosses. There is no village or centre of settlement between Wentworth and Broken Hill. The land throughout is used for grazing. The country is generally undulating, and much of it is lightly tree covered. Several lakes are passed, often dry. The length of the Highway from Buronga to Wentworth is 20 miles, and from Wentworth to Broken Hill is 179 miles.

North of Broken Hill for some 50 or 60 miles the road passes through hilly country associated with the Barrier Range, crossing a low range of hills at Fowler's Gap, 67 miles from Broken Hill. From this point to the Queensland border the country is generally undulating except for hills in the vicinity of the village of Milparinka, 188 miles from Broken Hill, formerly an important mining centre with its original road outlet to Wilcannia on the Darling River. About half-way between Broken Hill and Milparinka the Silver City Highway passes Lake Bancannia, a sheet of water which may be up to about eight miles in length, and some distance further north passes Cobham Lake, which may be up to about five miles in diameter. At 213 miles from Broken Hill the Highway passes through the township of Tibooburra, and the Queensland border is reached at 247 miles from Broken Hill, where the road ends at the Warri Gate of the border fence. Some gibber country is passed over in the Tibooburra area.

The northern half of the length of the Highway between Broken Hill and the Queensland border is close to the route followed by Captain Charles Sturt in one of his explorations, and this is commemorated by Mt. Sturt and Mt. Poole near Milparinka, Poole being the deputy leader who died at this point.

# New Bridge Opened Over Horton River Near Barraba

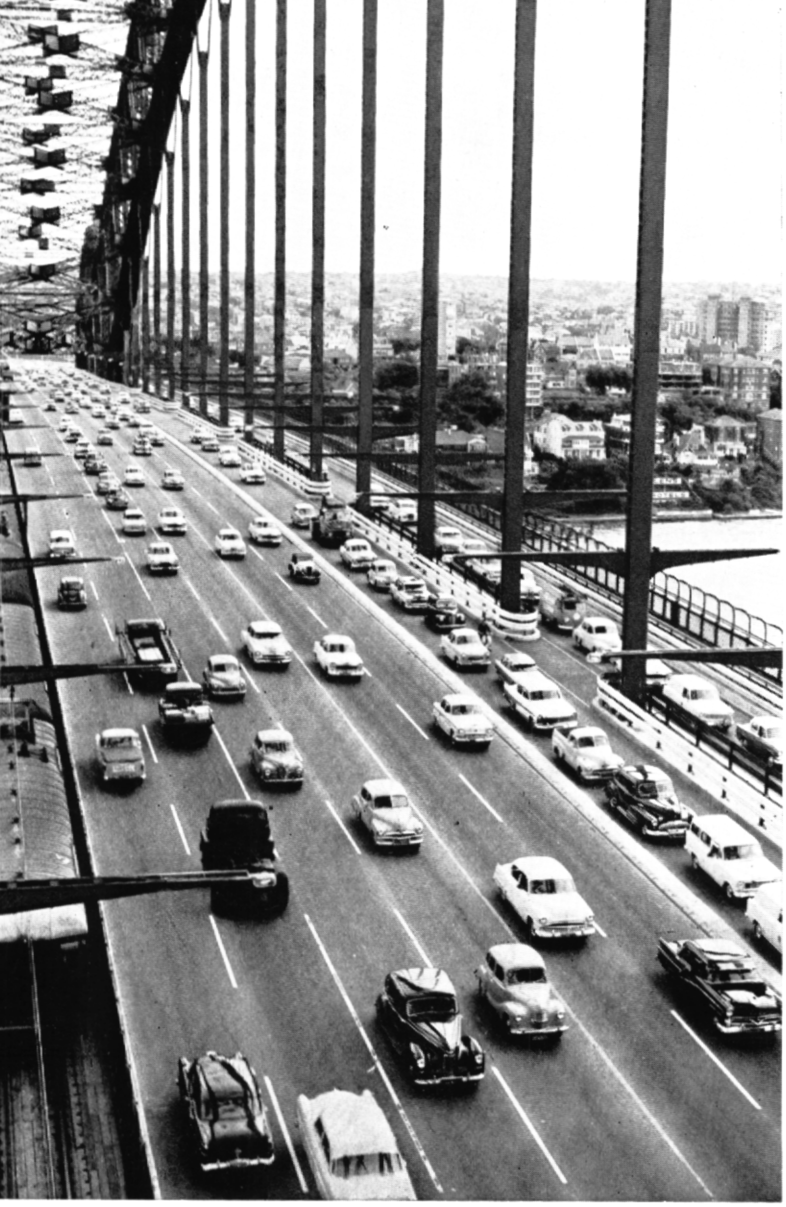
*Official opening of the new bridge over Horton River at Upper Horton. From left to right—Mr. R. Miller, Central Construction Coy. Ltd., Councillor R. McDouall, Barraba Shire Council, Mr. H. M. Sherrard, Commissioner for Main Roads, Councillor P. A. Wilson, President of Barraba Shire Council, and Mr. G. H. Linton, Divisional Engineer, Department of Main Roads, Tamworth*

AT the invitation of the Barraba Shire Council, the Commissioner for Main Roads, Mr. H. M. Sherrard, performed the official opening on the 23rd July, 1960, of a new bridge over the Horton River at Upper Horton on Main Road No. 360, at approximately 24 miles north of Barraba. Main Road No. 360 serves to connect the Barraba district with the Narrabri-Moree district.

The original bridge at this site was destroyed by floods, and pending the construction of a new bridge a concrete causeway built by the Barraba Shire Council has been in use.

The new bridge consists of four steel girder spans each 56 feet 8 inches long, and has on overall length of 227 feet. It has a concrete deck with a carriageway width of 24 feet.

The design of the bridge was carried out by the Department of Main Roads, and the construction was undertaken by the Barraba Shire Council under contract with Central Construction Coy. Ltd. of Dubbo. The approaches were constructed by the Council by day labour. The total cost of the bridge and approaches approximated £32,000, towards which the Department of Main Roads provided about £24,000.



*Morning peak hour traffic on the Sydney Harbour Bridge*

# SYDNEY HARBOUR BRIDGE

## AIDS TO CONTROL OF TRAFFIC

**Introduction of radio telephone communication**

In the year following the opening of the Sydney Harbour Bridge in March, 1932, the average daily traffic was 11,000 vehicles. Except during the war years, there has been a steady increase in traffic and in the year ended 30th June, 1960, the average daily volume reached 73,000 vehicles. During the year there have been occasions when volumes of 90,000 vehicles have been recorded in 24-hour counts.

In the early years, the bridge roadway, which is 57 ft. wide, was used to carry four lanes of traffic. With the growth of traffic in post-war years, the roadway was marked in six lanes. To cater for the growth of traffic, an unbalanced lane arrangement was introduced on the bridge in 1949 when four of the six lanes were set aside for morning peak traffic. In 1951 this arrangement was extended to include the evening peak traffic. With the completion in June, 1959, of the conversion of the area on the eastern side of the bridge formerly occupied by tram tracks, two additional lanes became available for road traffic. This allows of six lanes being used in peak periods for traffic in the direction of greater flow.

Whilst the control of traffic is primarily a function of the Police Department, there is close co-operation between the Police and the Department of Main Roads in relation to traffic using the bridge.

Because of the special conditions which exist on the bridge, the Department of Main Roads provides special facilities, in addition to traffic line marking and the channelisation of the approaches, for the purpose of assisting in the smooth flow of traffic over the bridge. These facilities are as follows:—

- *Traffic markers or "flaps"*, which divide the two directions of flow and guide traffic to and from particular lanes in use during different periods of the day.
- *Signs* which are erected at each end of the bridge advising road users of the number of lanes in use for the particular direction of travel and indicating the periods during which lane changing is prohibited.
- *Tow-truck service*, which removes disabled vehicles during the peak hour periods 7.0 a.m.-9.0 a.m. and 4.30 p.m.-6.15 p.m., Mondays to Fridays, and 10.0 a.m.-6.0 p.m. on Saturdays, Sundays and Public Holidays.
- *Emergency telephones*, provided at intervals of 600 ft. to 800 ft. across the bridge for use by motorists and Police to enable assistance to be called at any time in the event of breakdown or other emergency.
- *Two traffic supervisors*, recently appointed to assist in the general supervision of traffic movement and traffic facilities between 6.0 a.m. and 7.0 p.m. on week-days, and 10.0 a.m. and 6.0 p.m. on Saturdays, Sundays and Public Holidays.
- *Radio telephone equipment*, installed recently to provide direct communication between the Police motor-cycle patrol, tow-truck service and the supervisors.

**Traffic markers**

The traffic marker flaps which are used to separate the opposing streams of traffic and channelise traffic into specific lanes, have also assisted in maintaining the smooth even flow of traffic necessary to obtain capacity volumes.

The flaps are fabricated from a piece of rubber conveyor belting as a base and two pieces of rubber strip, 6 in. wide x ½ in. thick, placed back to back vertically, and are painted with aluminium paint. Pieces of reflecting material 2 in. square are attached to each face of the flaps to make them more conspicuous during hours of darkness. Placing, adjustment and removal of the flaps are carried out by employees of the Department of Main Roads from a trailer drawn by a tow-truck under Police escort. For maintenance and re-painting purposes, flaps are withdrawn from service at least once a week and replaced by other flaps.

**Signs**

Signs indicating the number of lanes in use face on-coming traffic at each end of the bridge. The wording on these signs reads—"Bridge Traffic Use ——left lanes only", the figure 2, 4 or 6 being used in the blank space according to the lane arrangement in operation at the time.

Lane changing is prohibited during peak hours and large signs advising road users of the hours when this applies are provided on the approaches and the bridge structure.

Direction signs are provided on the approaches to the bridge and some of these on the northern approaches are subject to adjustment throughout the day to meet alterations in the routing of traffic and in the direction of flow in some one-way streets.

All adjustments of signs are made by the staff of the Department of Main Roads.

**Tow-truck service**

To reduce delays to traffic caused by the breakdown of vehicles on the bridge during peak periods, a towing service to remove disabled vehicles was brought into operation by the Department of Main Roads on the 31st May, 1951.

In the nine years of operation of the tow-truck service to the 31st May, 1960, a total of 4,696 disabled vehicles has been removed from the bridge and its immediate approaches during week-day peak periods. In addition 212 vehicles have been towed from the bridge during weekends and public holidays since the service was extended in July, 1959, to cover these days.

In the first place, the towing service was provided by one truck. Later in December, 1957, a second tow-truck was placed in service because of the larger volumes of traffic and the extension of the towing service to the Cahill Expressway. With the provision of the two additional lanes following the conversion to roadway of the area formerly occupied by the tram tracks in July, 1959, a third tow-truck was added.

Tables Nos. 1 and 2 set out the services given by the tow-truck service since its inception and the causes of break-downs. It will be noted that lack of fuel was responsible for over 33 per cent. of the break-downs.

TABLE No. 1

**SUMMARY OF CALLS DURING 9 YEARS OF OPERATION—31st MAY, 1951 to 31st MAY, 1960**

| Period | Weeks | Operating days | Calls | Average per day | Average per week |
|---|---|---|---|---|---|
| 31-5-51 to 30-5-52 .. | 52 | 252 | 275 | 1·1 | 5·3 |
| 31-5-52 to 29-5-53 .. | 52 | 252 | 261 | 1·0 | 5·0 |
| 30-5-53 to 28-5-54 .. | 52 | 251 | 312 | 1·2 | 6·0 |
| 29-5-54 to 27-5-55 .. | 52 | 252 | 340 | 1·3 | 6·5 |
| 28-5-55 to 1-6-56 .. | 53 | 257 | 363 | 1·4 | 6·8 |
| 2-6-56 to 31-5-57 .. | 52 | 249 | 422 | 1·8 | 8·1 |
| 1-6-57 to 31-5-58 .. | 52 | 252 | 651 | 2·6 | 12·5 |
| 1-6-58 to 31-5-59 .. | 52 | 251 | 1,088 | 4·3 | 20·9 |
| 1-6-59 to 31-5-60* .. | 52 | 352 | 1,196 | 3·0 | 23·0 |

* Includes removal of vehicles during week-ends and public holidays.

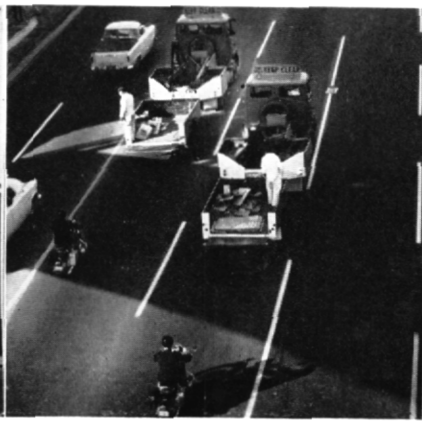
*A traffic supervisor in* **communication with tow-truck**

TABLE NO. 2

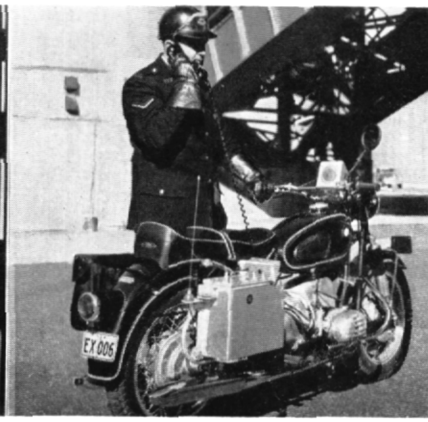
**CAUSES OF STOPPAGES OR BREAKDOWNS OF DISABLED VEHICLES**

| Year ended | Engine | Trans mission | Chassis | Tyres | Lack of Petrol | Accidents | Abandoned | Total |
|---|---|---|---|---|---|---|---|---|
| May: 1952 .. .. | 139 | 26 | 7 | 19 | 75 | 9 | .. | 275 |
| 1953 .. .. | 117 | 14 | 12 | 31 | 76 | 11 | .. | 261 |
| 1954 .. .. | 135 | 27 | 4 | 33 | 103 | 10 | .. | 312 |
| 1955 .. .. | 125 | 30 | 8 | 26 | 133 | 18 | .. | 340 |
| 1956 .. .. | 135 | 23 | 5 | 34 | 144 | 17 | 5 | 363 |
| 1957 .. .. | 196 | 33 | 3 | 17 | 148 | 20 | 5 | 422 |
| 1958 .. .. | 327 | 44 | 8 | 29 | 204 | 35 | 4 | 651 |
| 1959 .. .. | 534 | 87 | 5 | 70 | 339 | 48 | 5 | 1,088 |
| 1960 .. .. | 489 | 113 | 8 | 105 | 427 | 43 | 11 | 1,196 |
| Totals .. .. .. | 2,197 | 397 | 60 | 364 | 1,649 | 211 | 30 | 4,908 |
| Per cent. of Total .. . | 44·8 | 8·1 | 1·2 | 7·4 | 33·6 | 4·3 | 0·6 | 100·0 |

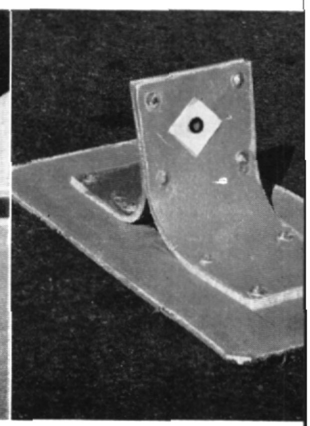
One of the emergency elephones on the bridge



Tow-trucks under police escort collecting traffic markers after morning peak hour traffic



A police constable calling tow-truck to attend to a vehicle breakdown



Traffic marker or " flap divide two directions of

## Emergency telephones

Originally, the operator of the tow-truck was informed of disabled vehicles by a Police motor cyclist patrolling the bridge during peak periods and who accompanied the tow-truck to the scene of the breakdown.

At the beginning of 1955, emergency telephones were installed on the bridge. These telephones are connected to call bells adjacent to the sites at which the tow-trucks are located and patrolling Police motor cyclists are able to call tow-trucks to breakdowns immediately they occur, and at the same time remain on the spot to direct traffic. The telephones also provide a direct line to the Tollmaster to enable requests for assistance to be made.

## Radio telephones

With the continued growth in traffic, consideration was given, in conjunction with the Police, to improvement of the means of detection of breakdowns and of getting the tow-trucks to them. Investigations were made regarding the possibility of using a closed circuit television but it was found that an installation of this type would not enable traffic to be viewed effectively under all light conditions.

Finally it was decided that the service could best be improved by the Department of Main Roads installing radio telephone equipment to provide instantaneous contact between a base station, the Police patrols and the tow-trucks. In June, 1960, this equipment was installed on three Police motor cycles and in three tow-trucks and the utility used by the Traffic Supervisors.

The radio telephone equipment is of the V.H.F. (very high frequency), frequency-modulated type, unaffected by interference from lightning or atmospheric conditions and resisting interference from ignition or other man-made sources. Operation of the equipment is on a frequency in the 156-172 megacycle band.

The base station consists of a transmitter-receiver operated from 240 volts A.C. power supply. The transmitter has a nominal R.F. (radio frequency) power output of 7 watts. A ground plane aerial is mounted on top of a light pole adjacent to the building housing the base station.

The three tow-trucks and traffic supervisor's utility truck are each fitted with transmitter/receivers, operated from the 12-volt batteries on the vehicles. The nominal R.F. power output of these transmitters is 10 watts, and the power supply sections of the units are equipped with silicon diodes and power transistors for greater reliability and economy. A vertical whip aerial, approximately 18 in. high is mounted on the roof of each vehicle.

The police motor cycles are fitted with transmitter/receivers operated from the 6-volt electrical system on the cycles. The nominal R.F. power output of these transmitters is 3 watts and transistors and silicon rectifiers are incorporated in the power supply section of the units. Each transmitter/receiver is enclosed in a metal case and mounted on a pannier carrier on the side of the motor cycle. A speaker is mounted above the fuel tank and a handset type microphone is carried in a compartment in the metal case, when not in use.

If it is not convenient for the motor cyclist to stop and reply to a call from the base station, a press button on the handlebars enables a tone-code reply to indicate that the message has been received. The danger of attempting to reply whilst on the move is thus avoided.

The operating range for the equipment is dependent on the topography between the stations but, provided there is no shielding, contact between the tow trucks or utility and the base station is effective at distances of 10 to 15 miles and between the motor cycles and the base station at distances up to 10 miles. More than sufficient range is therefore available to meet both present and foreseeable future requirements for the traffic control organisation.

With the assistance of the various traffic control measures and traffic aids in operation, the bridge carries over 8,000 vehicles travelling to the City or beyond during the morning peak hour. The total number of vehicles using the bridge in both directions during the morning peak hour is now of the order of 10,000, i.e. almost the same number which used the bridge in a day in the early years.

# MASTER OF TECHNOLOGY

# DEGREE IN HIGHWAY ENGINEERING

TWO of the first students to complete successfully at the University of New South Wales, the recently established course of Highway Engineering leading to the degree of Master of Technology were Mr. P. S. Gregg, B.E., and Mr. R. M. McBride, B.E., officers of the Department of Main Roads, who received their degrees in April, 1960. Mr. Gregg is now Officer-in-Charge at the Department's Local Office, Waratah, and Mr. McBride is Officer-in-Charge at the Local Office, Bega.

The first course of Highway Engineering leading to the degree of Master of Technology commenced in May, 1958 and finished in May, 1959. Following completion of their formal course work, students were required to prepare a comprehensive report on a major road project similar to that which would be submitted by a consulting engineer to a public authority.

In addition to supporting financially the Chair of Highway Engineering, the Department of Main Roads sponsors traineeships in the course of Highway Engineering leading to the degree of Master of Technology. Messrs. Gregg and McBride were sponsored by the Department of Main Roads.

In the second course which commenced in 1959, the Department of Main Roads sponsored six trainees, and a further five trainees were sponsored for the 1960 course.

**NEW PUBLICATION**

# "GUIDE TO MAIN ROADS ADMINISTRATION"

A NEW bulletin—"Guide to Main Roads Administration"—has been published recently by the Department of Main Roads. This guide was prepared primarily to assist newly elected Aldermen and Councillors of Municipal and Shire Councils in their consideration of matters relating to Main Roads. Supplies of the bulletin have already been made available to all Councils throughout New South Wales.

The bulletin sets out the classes of Main Roads and explains the sources from which revenue available to the Department is drawn, how it is distributed and the basis of financial assistance to Councils. It also deals briefly with a variety of miscellaneous matters such as the widening of road reserves by re-alignment, motorways, miscellaneous controls on Main Roads, assistance in town and country planning, developmental roads and developmental works, etc.

Included in the bulletin are a summary of the Main Roads Act and maps of the Main Road systems in the County of Cumberland and in the Country.

# Rural Road Design Standards

# Department of Main Roads

## *New Instructions for the Design of Sight Distance, 1960*

THE Department of Main Roads Rural Road Design Standards (1937)* are under revision. Revision of the sections relating to Sight Distance has been completed, and the Sight Distance instructions are set out hereunder. These supersede the following portions of Rural Road Design Standards, 1937, and are for immediate application:—

5.—Sight Distance.
6.—Overtaking.
8.—Benching, Clearing, Obstructions.
Table 7.—Sight distances.
Graphs 8 to 11, inclusive, for design of vertical curves.

### General Considerations

The length of a driver's visibility along a road in the direction of travel is termed his sight distance.

In design there are two sight distance requirements to be met as follows:—

(*a*) At all times a driver must be provided with sufficient visibility to see a stationary object in his lane of travel and stop before striking it. This is known as the "stopping" (or non-overtaking) sight distance.

(*b*) At reasonable intervals a driver should have sufficient visibility to allow safe and uninterrupted overtaking and passing of another vehicle without risk of collision with traffic advancing towards him. This is known as the "passing" (or overtaking) sight distance.

Visibility on a road may be limited by crest vertical curves; horizontal curves in cutting; trees, vegetation, high ground or buildings on the inside of horizontal curves or at intersections.

The provision of adequate sight distance, therefore, requires a determination of the length of crest vertical curves or the radius of horizontal curves. Where the radius of a horizontal curve is not large enough to provide adequate sight distance, it is necessary to determine the extent to which the road formation on the inside of the curve should be widened in cuttings, or the extent of clearing needed to allow a driver to see the required distance along the road.

Calculations to obtain the distance needed to stop or to overtake are made on the assumption that the driver is travelling at the design speed of the road. In practice the actual speed adopted by a driver on a road appears to be influenced more by other geometric features of the road layout than by the sight distance provided, and it should not be assumed in design that the extent of sight distance provided will influence speed. The design speed should be based on factors other than sight distance and the minimum sight distance provided should conform to the design speed thus determined. In no case should design speed be reduced because of sight distance considerations alone.

Numerical values for the two standard sight distances are given in Table 1. These values in respect of perception and reaction time, co-efficient of friction for braking, height of eye and object, vehicle acceleration rates and the theory of passing sight distance, are based on "Policy for the Geometric Design of Rural Roads", published by the National Association of Australian State Road Authorities.

Values quoted in Table 1 for stopping sight distance on level grade are minimum requirements and should be applied only where the limiting factors are the cost of construction or physical features such as buildings. In all cases sight distance should be as long as practicable.

TABLE 1

**MINIMUM SIGHT DISTANCE ON LEVEL† GRADE**

| Type of Sight Distance | Minimum Sight Distance in feet for Design Speeds of | | | |
|---|---|---|---|---|
| | 30 m.p.h. | 40 m.p.h. | 50 m.p.h. | 60 m.p.h. |
| Stopping Sight Distance .. .. | 130 | 200 | 300 | 430 |
| Passing Sight Distance .. .. | 650 | 1,100 | 1,600 | 2,300 |

† See text for allowances to be made for grades.

### Standard Sight Distance

(*a*) *Stopping Sight Distance*

Stopping sight distance is measured along the line of travel from a point 4 feet high representing the height of a driver's eye, to a point 9 inches high representing a stationary object on the road surface. It is equal in length to the distance required to stop a vehicle travelling at the design speed, by application of its brakes.

*The effect of grade* on vehicle stopping distances is illustrated in Fig. 1. Because stopping distances are shorter on upgrades and longer on downgrades than

*Published in the November, 1937, and the February, 1938, issues of this journal, and reproduced as M.R. Form No. 355.

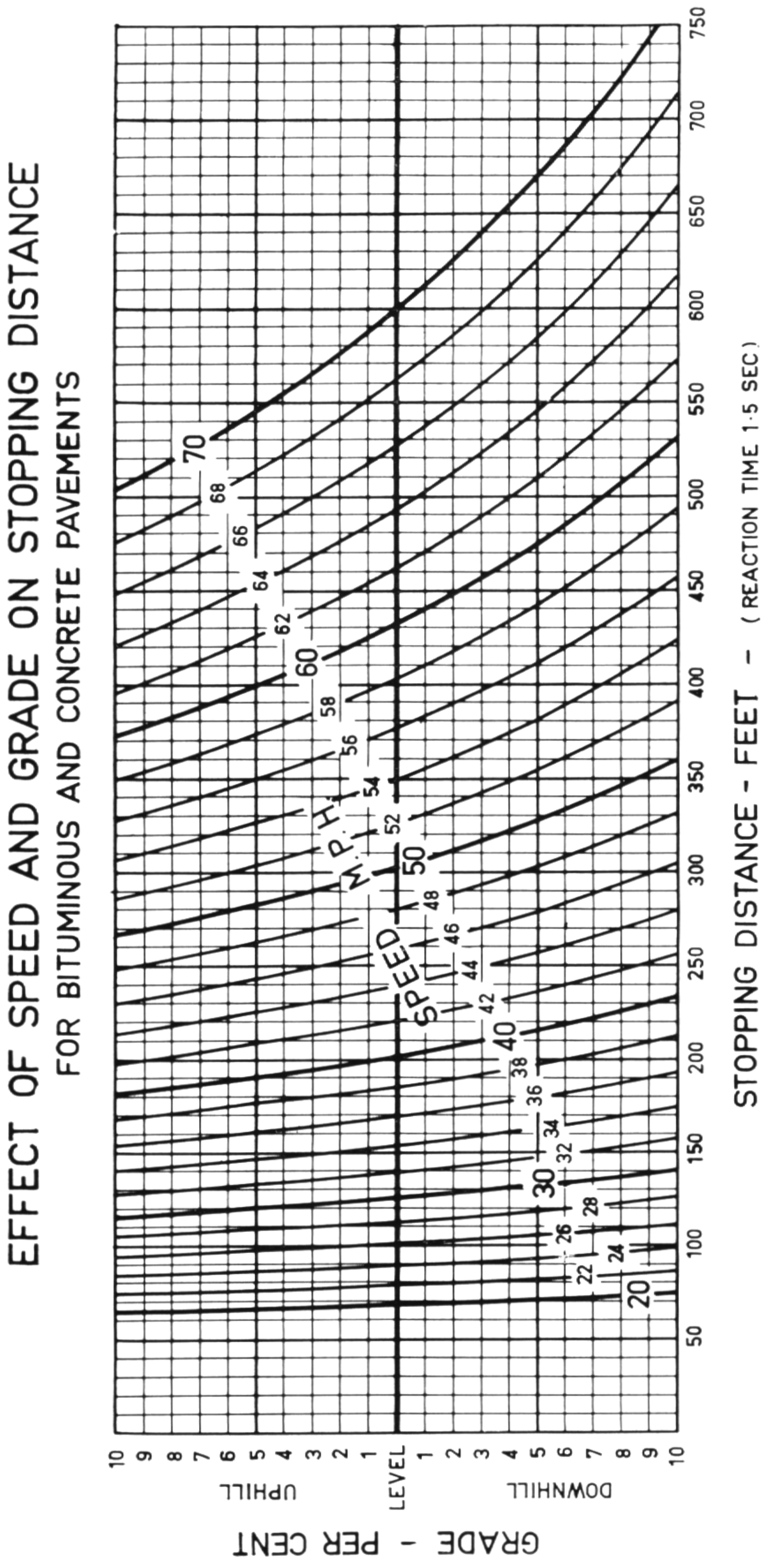

EFFECT OF SPEED AND GRADE ON STOPPING DISTANCE
FOR BITUMINOUS AND CONCRETE PAVEMENTS
STOPPING DISTANCE - FEET - (REACTION TIME 1·5 SEC)
GRADE - PER CENT
UPHILL
LEVEL
DOWNHILL
SPEED M.P.H.
50 100 150 200 250 300 350 400 450 500 550 600 650 700 750
20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70

FIGURE 1

on level grade, appropriate adjustments need to be made to the sight distances provided when minimum stopping sight distance is used. The adjustments are to be applied as follows:—

(i) On downgrades: where the stopping distance on the grade, as given in Fig. 1, exceeds the standard stopping sight distance given in Table 1 by 10 feet or more, the sight distance is to be increased by an amount at least equal to the difference between the two distances.

(ii) On upgrades: no adjustment is to be made.

(iii) On vertical curves: where the two grades in approach to a summit vertical curve are approximately of the same value no adjustment is to be made. Where the two grades differ to an extent that the stopping distance on the mean of the two grades exceeds the standard stopping sight distance by 10 feet or more, the minimum sight distance at the crest shall be increased according to the additional stopping distance needed on the mean grade, e.g., consider two summit vertical curves, one having approach grades of + 2% and — 8%, the second having grades of – 1% and – 5%. In both cases the mean grade is – 3% which for a 50 m.p.h. design speed corresponds with a stopping distance of 318 feet. The stopping sight distance should, therefore, be increased from the standard 300 feet to at least 318 feet.

Where the sight distance provided is longer than the standard stopping sight distance, the effect of grade may be neglected.

(*b*) *Passing Sight Distance.*

Passing sight distance is measured along the line of travel between two points 4 feet above the road pavement. It is equal in length to the minimum distance between two opposing vehicles which will permit the safe overtaking and passing by one of them of a third vehicle, travelling at 10 m.p.h. less than the design speed.

In the application of the standard lengths of passing sight distance quoted in Table 1, there are three factors to be considered, namely:—

(i) the frequency with which passing sight distance should be provided;

(ii) the length of continuous roadway over which the standard length should be applied;

(iii) the treatment to be adopted where the application of standard passing sight distance is not practicable.

The frequency with which passing sight distance may be provided is related to the design speed, the terrain and the cost of construction. In many cases it will occur frequently or continuously, as in undulating or flat country. In some other instances, it may also be found that minor modifications to alignment or grading will provide the sight distance necessary at little or no additional cost.

The frequent provision of passing sight distance is an essential safety measure and to a large degree it should influence both location and design of a road. On a heavily trafficked road, passing sight distance should be provided for, if cost is not excessive, not less frequently than once in each 1½ miles of road.

With regard to the desirable length of continuous roadway throughout which passing sight distance should be available, it may be noted that if passing sight distance occurs only at a point its value is limited. It may be useful in cases where a driver has followed another vehicle for some time waiting for an opportunity to overtake, but under these conditions use cannot be made of it when another vehicle is in the opposing traffic lane within the critical length needed for overtaking. Therefore, the usefulness of a given length of passing sight distance is dependent largely upon the volume of traffic using the road. The length of roadway on which passing sight distance is continuous, should be as long as economically practicable and, for important roads where traffic volumes are high, a length of, say, 300 feet to 500 feet of continuous passing sight distance should be aimed at as a minimum.

Cases may occur where it is not economically practicable to provide passing sight distance at reasonable intervals. The theory upon which passing sight distance is based is for one set of conditions, namely, the overtaking of a vehicle travelling at 10 m.p.h. less than the design speed. In practice there is a wide range of conditions which could be met where a sight distance shorter than the passing sight distance quoted in Table 1 would be useful. For example, a suitable sight distance to overtake and pass a truck travelling at 10 m.p.h. on an average grade of about 5 per cent. on a 30 m.p.h. road is approximately 550 feet. Similarly, for a grade of 4 per cent. on 40 or 50 m.p.h. roads and 3 per cent. on a 60 m.p.h. road, suitable sight distances for overtaking a slow-moving truck are approximately 650 feet, 750 feet and 850 feet respectively. Therefore, in cases where standard passing sight distance cannot be attained, the provision of a reasonable length of sight distance less than standard may meet some overtaking needs likely to be found in practice.

*The Effect of Grade*: The speed of vehicles involved in an overtaking manoeuvre will sometimes be affected by the grade of the road. The rate of acceleration of the overtaking vehicle may also be affected by the grade. Where passing sight distance is provided on a grade the determination of a suitable length is therefore complicated by the number of variables. No definite instruction as to allowances to be made can be given except to state that where opportunities occur to lengthen the overtaking sight distance on a grade without excessive cost this should be done, having in mind that the steeper the grade the greater is the need for a longer sight distance.

**Design Procedure**

The design procedure for determining the length of vertical curves at crests and the extent of clearing or benching needed on horizontal curves to provide for a given sight distance is described in an appendix attached to this instruction.

The combination of a crest vertical curve with a horizontal curve requires special consideration both for safety and the appearance of the road.

A pronounced crest vertical curve which is followed closely by a sharp horizontal curve may create a driving hazard, particularly at night.

The combination of a crest vertical curve with a horizontal curve when both are to minimum standards or where the vertical curve is partly on the horizontal curve and partly on the approach straight may result in an undesirable appearance.

Undesirable effects are reduced by using design values for both the horizontal and the vertical curve which are above the minimum for the design speed. Also, where horizontal and vertical curves must occur together, it is desirable for the length of the horizontal curve to be greater than that of the vertical curve, and for the vertical curve to be contained completely within the horizontal curve.

Where economy in earthworks is a critical factor, or where for other reasons a crest vertical curve of minimum length must be provided, the length adopted shall not be less than:—

(*a*) the length given in Figure 2 of the Appendix, "Length of Crest Vertical Curves", for the sight distance to be adopted.

(*b*) the length given in Figure 4 of the Appendix, "Length of Vertical Curves for Comfortable Riding", for a vertical acceleration co-efficient "a" of 0.10g. for minor roads, or 0.05g. for important roads, for the design speed adopted.

**Sight Distance Graphs**

For each rural road design a graph is to be drawn immediately below the longitudinal section showing the sight distance available for each direction of travel.

The horizontal ordinates of the graph will indicate distance along the road at a scale equal to the horizontal scale of the longitudinal section. The vertical ordinate of the graph will indicate sight distance to a suitable scale so that the range of sight distances between the stopping and passing values will be represented by a vertical height of approximately one inch on the graph.

It is not necessary to determine the sight distance accurately at all points along the road. It is sufficient to determine the critical points and to connect these on the graph with straight lines. Critical points will occur mostly at crest vertical curves and on horizontal curves and will include also those points where the two standard sight distances commence and end.

*APPENDIX*

# SIGHT DISTANCE ON HORIZONTAL AND VERTICAL CURVES AND BENCHING FOR SIGHT DISTANCE

**Sight Distance on Crest Vertical Curves**

Where a crest vertical curve is on straight alignment the length of curve required to provide a given sight distance at the crest is obtained from the graphs Figs. 2 and 3 "Length of Crest Vertical Curves". The length obtained should be checked on Fig. 4, "Length of Vertical Curves for Comfortable Riding" to ensure that adequate riding comfort is provided. In this case the length of vertical curve should not be less than that which produces a vertical acceleration "a" of 0.10g. at the design speed. For important roads the value of "a" should not exceed 0.05g.

Where a crest vertical curve is combined with a horizontal curve, the provision of adequate sight distance requires special consideration which is described in general terms under "Sight Distance on Combined Horizontal and Vertical Curves" and also under "Benching for Sight Distance"—Case B.

**Sight Distance on Horizontal Curves**

A driver's visibility on a horizontal curve may be limited by physical obstructions on the inside of the curve such as trees, vegetation and buildings, or, where the curve is in a cutting, by the batter. The extent to which the obstructions should be removed to provide adequate sight distance is determined by an examination of successive positions of a driver's line of sight as he travels around the curve.

A line of sight is, as the name implies, a straight line along which a driver would look when observing an object in his lane of travel (See A-a on Fig. 5).

If a succession of lines of sight could be viewed three-dimensionally they would be seen to form, on the inside of the curve, an irregular hollow cylinder which might be termed a "tunnel of sight" (shaded area in lower diagram of Fig. 5). For a given sight distance there are on each road as many "tunnels of sight" as there are traffic lanes. Theoretically, if all obstructions could be removed from within each "tunnel", the sight distance needed would be provided around the curve. In practice, only the lower limits of the "tunnel" together with its maximum offset from the road centreline at each cross section are determined, and obstructions are cleared above and towards the centreline from those limits.

The maximum horizontal offset for any line of sight is found on each cross section by preparing a horizontal sight envelope. This is a curved line formed by draw-

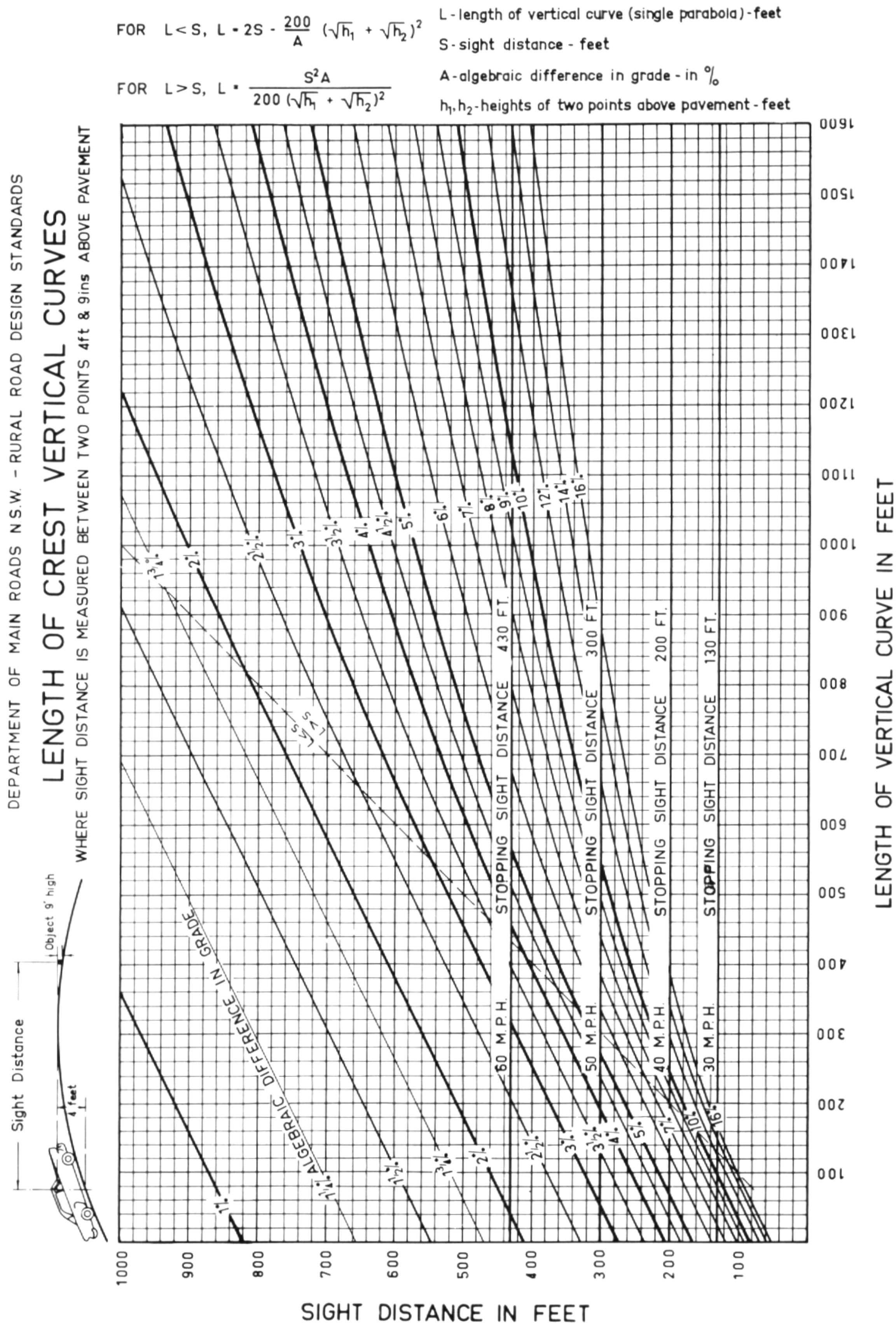
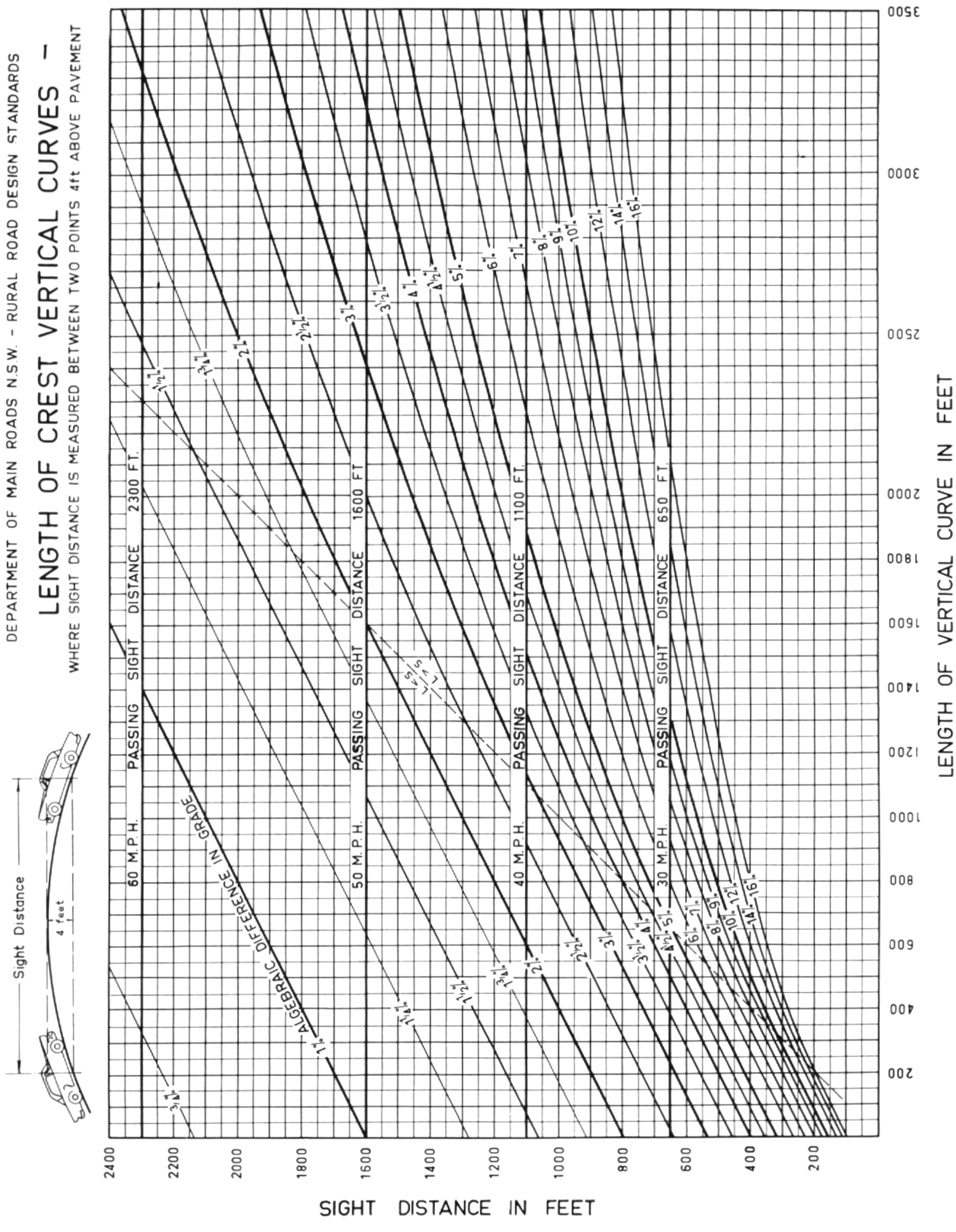

FOR L<S, L = 2S - 200/A (√h₁ + √h₂)²
FOR L>S, L = S²A / 200 (√h₁ + √h₂)²
L - length of vertical curve (single parabola) - feet
S - sight distance - feet
A - algebraic difference in grade - in %
h₁, h₂ - heights of two points above pavement - feet
DEPARTMENT OF MAIN ROADS N.S.W. - RURAL ROAD DESIGN STANDARDS
LENGTH OF CREST VERTICAL CURVES
WHERE SIGHT DISTANCE IS MEASURED BETWEEN TWO POINTS 4ft & 9ins ABOVE PAVEMENT
Sight Distance
Object 9" high
4 feet
ALGEBRAIC DIFFERENCE IN GRADE
60 M.P.H. STOPPING SIGHT DISTANCE 430 FT.
50 M.P.H. STOPPING SIGHT DISTANCE 300 FT.
40 M.P.H. STOPPING SIGHT DISTANCE 200 FT.
30 M.P.H. STOPPING SIGHT DISTANCE 130 FT.
L<S
L>S
SIGHT DISTANCE IN FEET
LENGTH OF VERTICAL CURVE IN FEET

FIGURE 2



DEPARTMENT OF MAIN ROADS N.S.W. - RURAL ROAD DESIGN STANDARDS
LENGTH OF CREST VERTICAL CURVES -
WHERE SIGHT DISTANCE IS MEASURED BETWEEN TWO POINTS 4ft ABOVE PAVEMENT
Sight Distance
4 feet
60 M.P.H. PASSING SIGHT DISTANCE 2300 FT.
50 M.P.H. PASSING SIGHT DISTANCE 1600 FT.
40 M.P.H. PASSING SIGHT DISTANCE 1100 FT.
30 M.P.H. PASSING SIGHT DISTANCE 650 FT.
ALGEBRAIC DIFFERENCE IN GRADE
L > S
L < S
SIGHT DISTANCE IN FEET
LENGTH OF VERTICAL CURVE IN FEET


FIGURE 3

DEPARTMENT OF MAIN ROADS N.S.W.
RURAL ROAD DESIGN STANDARDS

# LENGTH OF VERTICAL CURVES FOR COMFORTABLE RIDING

a = acceleration due to vertical curve, expressed in terms of acceleration due to gravity "g"

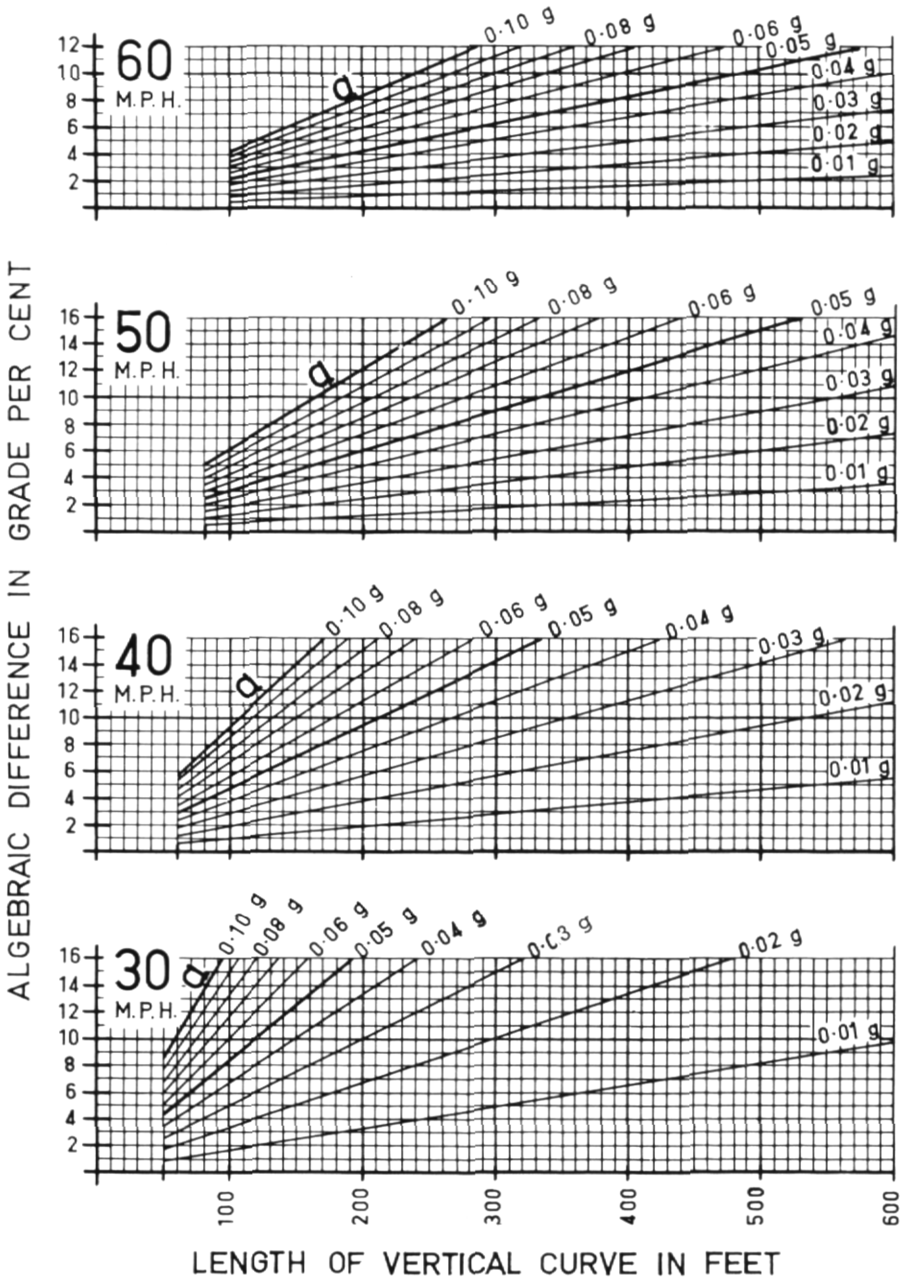



**FIGURE 4**

## SIGHT DISTANCE ON COMBINED HORIZONTAL-VERTICAL CURVES
( NOT TO SCALE )

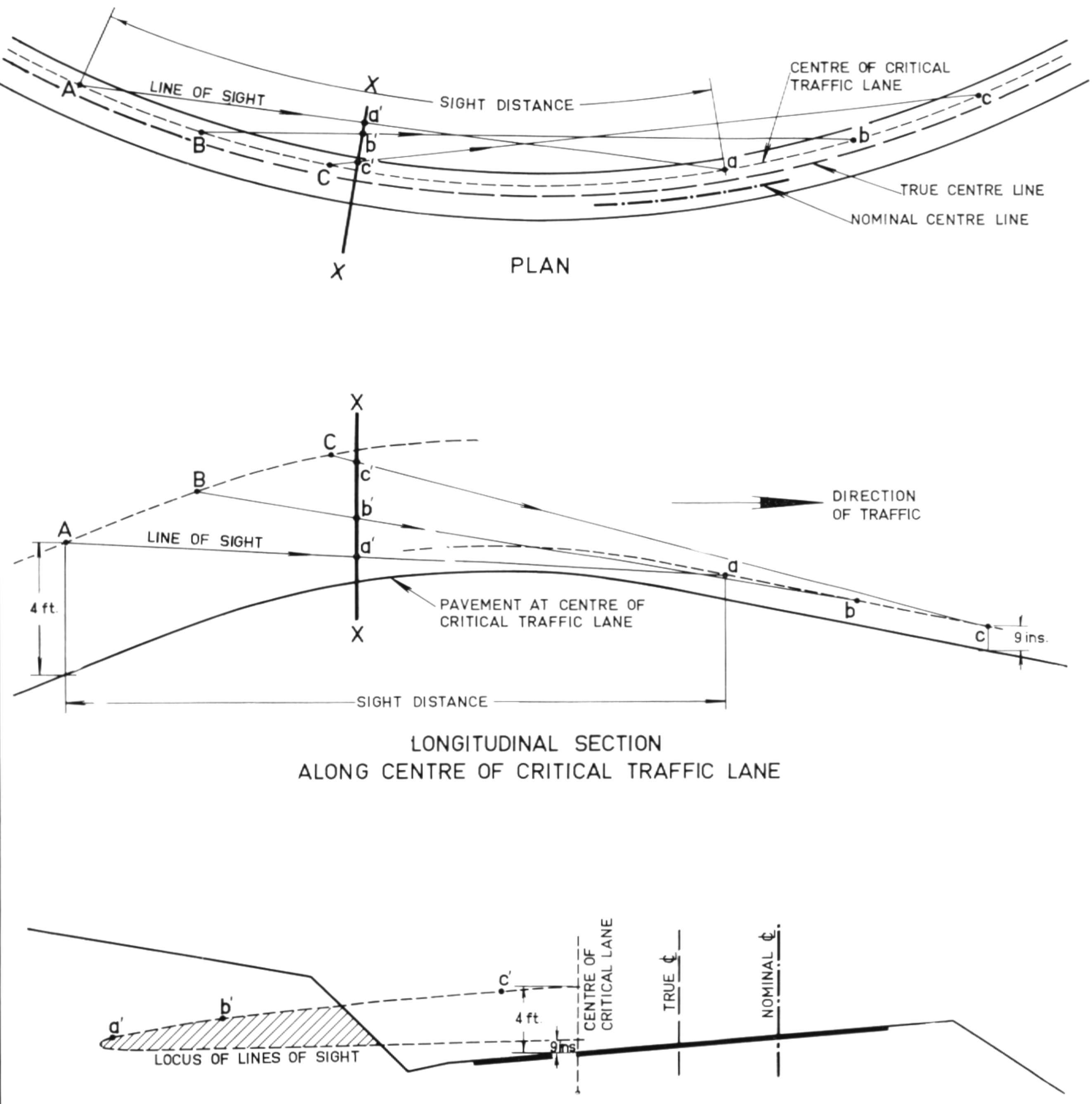



**FIGURE 5**

ing on a plan of a large scale, a series of lines of sight from successive positions the driver of a vehicle would occupy as he travels around the curve (see upper half of Fig. 6). The horizontal sight envelope so formed applies to one traffic lane only but may similarly be drawn for any traffic lane. The inner lane is usually the critical one.

When a line of sight intersects only the circular arc of a horizontal curve, the maximum offset may be read from the graph Fig. 7. The offsets given are the maximum from the centre of any traffic lane to the horizontal sight envelope for that lane. To obtain the maximum offset from the pegged centreline, the distance from the centre of the traffic lane to the pegged centreline must be added or subtracted depending upon the position of that lane in relation to the centreline.

Where a line of sight intersects a curve transition or a straight in approach to the curve the graph cannot be used, and a horizontal sight envelope should be drawn on the plan to obtain the offsets.

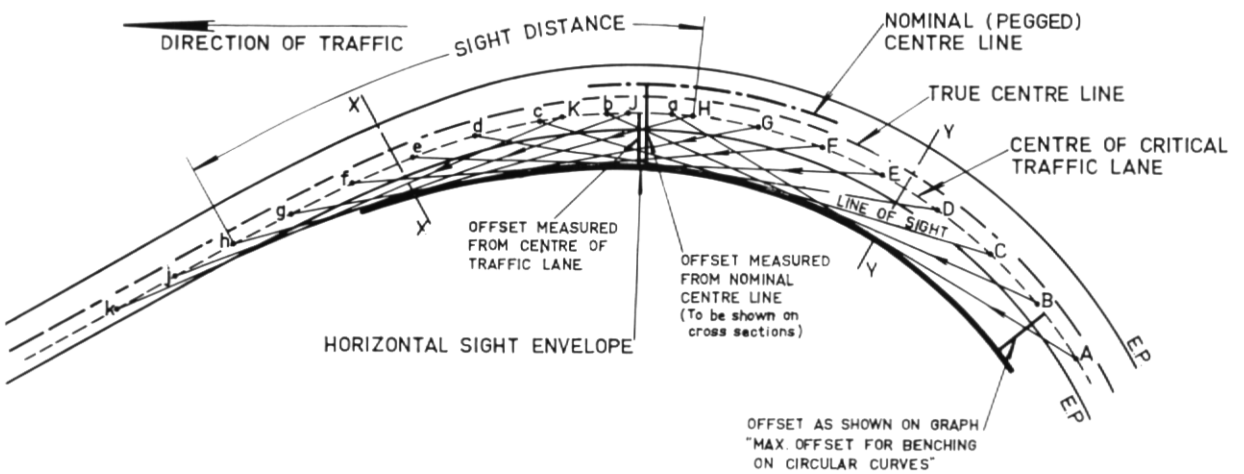
Where clearing is required to provide sight distance, the extent of clearing is shown on the cross sections by quoting an offset from the pegged centre line. Where additional earthworks are necessary to provide sight distance the limits of the earthworks are also shown on the cross sections by quoting an offset and a level to define the limits of excavation. To do this it is necessary to examine the manner in which a succession of lines of sight cut the vertical plane of a given cross section as a driver approaches it.

To find the lowest limit of lines of sight in a vertical plane, a series of lines of sight are drawn on a longitudinal section in the same manner as for the plan, the lines starting and ending at fixed heights above the road pavement level of 4 feet and 9 inches respectively. Some of the lines of sight may not form a sight envelope. (See also under Case A.)

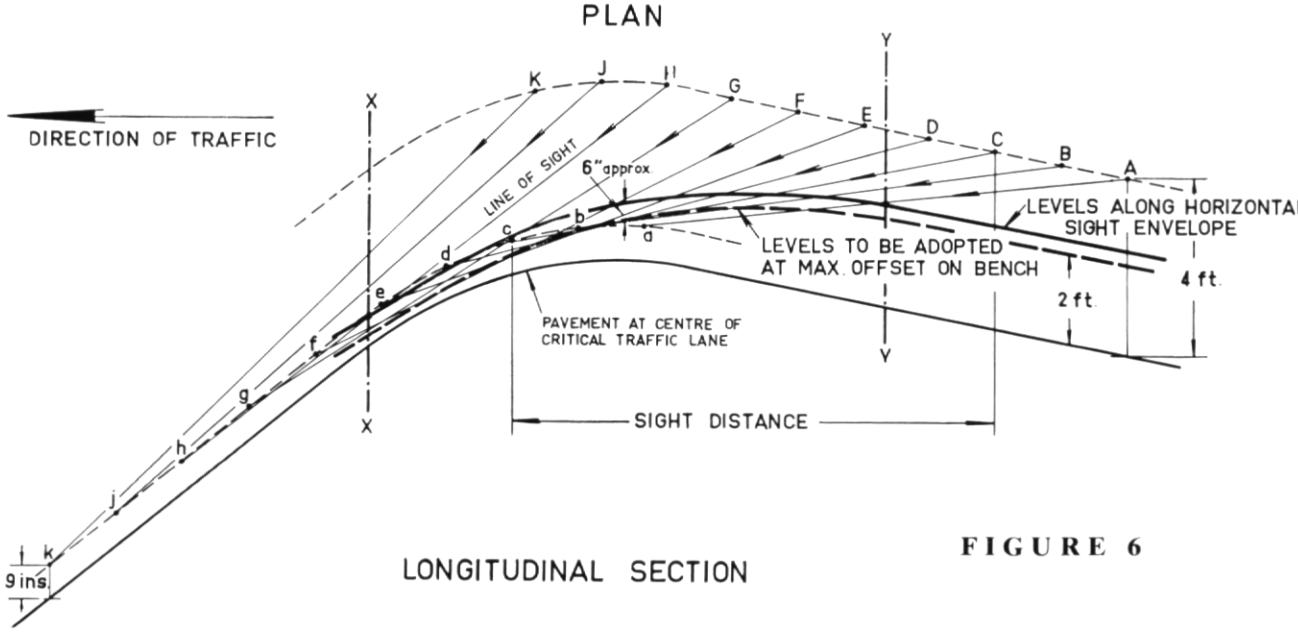
Fig. 6 illustrates a horizontal sight envelope and lines of sight on a longitudinal section.

Normal centreline levels may be used in many cases for the longitudinal section on which lines of sight are to be drawn. However, where the section of roadway being investigated falls within the transition of a horizontal curve, differences in pavement level between the true centreline and the centre of the critical traffic lane may be significant. In such cases the longitudinal section should show levels for the centre of the critical traffic lane.

*Continued on page 32*




PLAN




LONGITUDINAL SECTION

FIGURE 6

DEPARTMENT OF MAIN ROADS N.S.W. RURAL ROAD DESIGN STANDARDS

# MAXIMUM OFFSET FOR BENCHING ON CIRCULAR CURVES

WHERE SIGHT DISTANCE IS EQUAL OR LESS THAN THE LENGTH OF CIRCULAR ARC

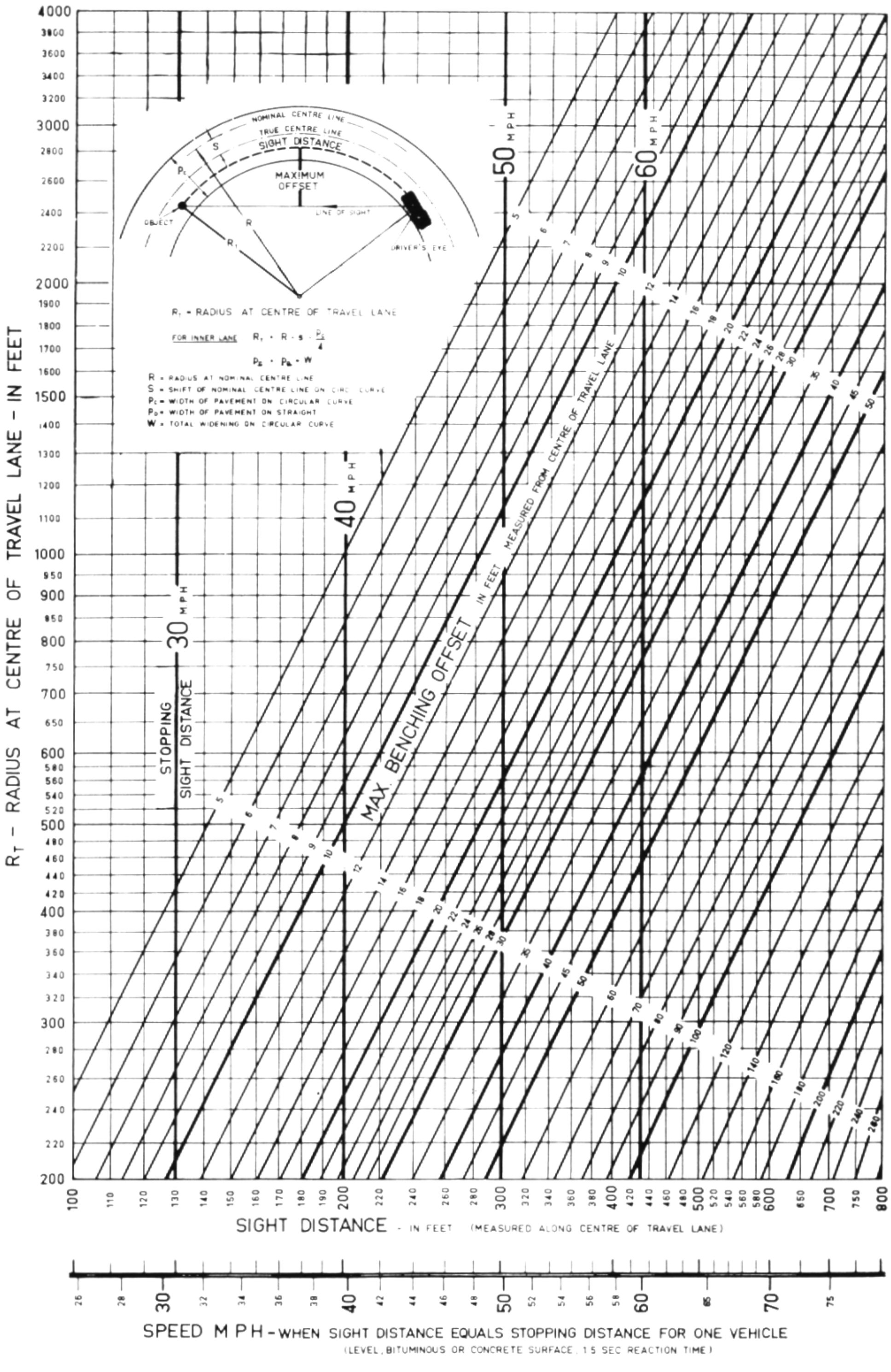



**FIGURE 7**

## Sight Distance on Combined Horizontal and Vertical Curves

The effect on the position of lines of sight when both horizontal and vertical alignment are changing can best be seen by considering in plan, longitudinal section and cross section, a horizontal and vertical curve combined as shown in Fig. 5.

When a driver is in the position marked A on both the plan and the longitudinal section, his line of sight, which is marked A-a, intercepts a cross section, marked XX, at the point a¹. The point a¹ may be established on the cross section by scaling its height above the centre of the inner traffic lane from the longitudinal section, and by scaling its offset from the centreline from the plan. Similarly, from subsequent positions the driver will occupy as he approaches XX, such as B and C, other intercepts b¹ and c¹ may be established on the cross section. By examining a large number of positions for the driver, a curved line is developed on the cross section which is the locus of the intersection of the line of sight with the cross section. The portion of the cross section which obstructs the driver's visibility is thus the area shown shaded. The shaded area indicates the earth which, together with that immediately above it is removed by cutting back or "benching" to provide the required sight distance. It should be noted that it is not necessary to draw a complete locus of the line of sight for sight distance investigations. The critical parts of the locus are its maximum offset and its shape on the lower side.

Although it is necessary to consider all aspects of the geometric layout which may affect the sight distance design, a high degree of accuracy is not warranted. When levels for offsets are quoted, an accuracy of 2 to 3 inches below calculated levels is all that is required, while the offsets may be quoted to the nearest 6 inches longer than the calculated offset.

## Benching for Sight Distance

Benching on horizontal curves should be the exception rather than the rule, i.e., in each case the possibility should be investigated of adopting a curve radius large enough for the horizontal sight envelope to be wholly between the road pavement and the batter of a cutting.

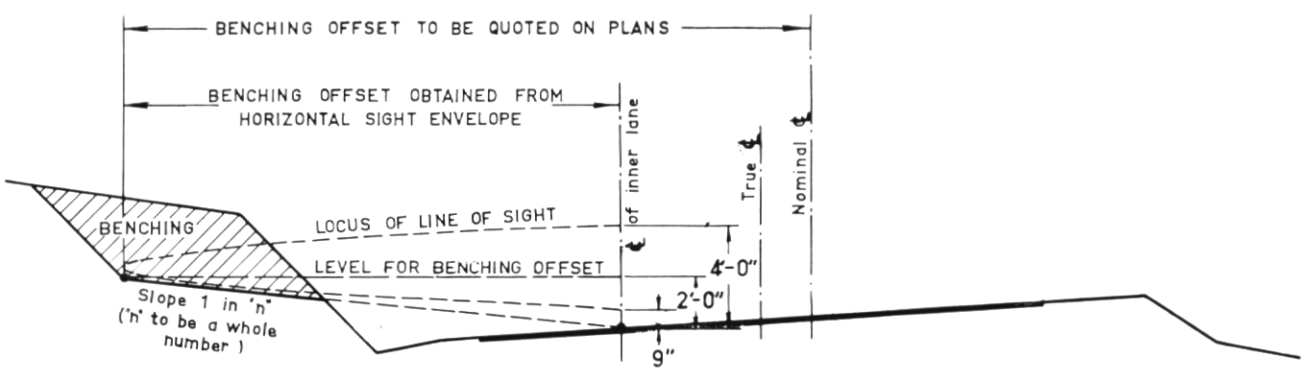
When benching is necessary for the provision of stopping sight distance, there are two cases to be considered.

*Case A: Benching on a horizontal curve where the road grading is a continuous straight*

Where a horizontal curve is on a straight grade, consecutive lines of sight do not form an envelope when examined on a vertical plane, because they are parallel lines (see lines of sight A-a and B-b on Fig. 6). When a line of sight intersects only the circular arc of the horizontal curve, its maximum offset in the horizontal plane is at the mid-point of the line of sight and its level at this point must be 2 ft. 4½ in. (i.e., half of 4 feet plus 9 inches) above the centre of the critical traffic lane. Due to the concave shape of the locus of the line of sight on its lower side, the level to be adopted for the bench at its maximum offset must be lower than 2 ft. 4½ in. With sufficient accuracy a level 2 feet above the centre of the critical traffic lane may be adopted, as shown on Fig. 8.

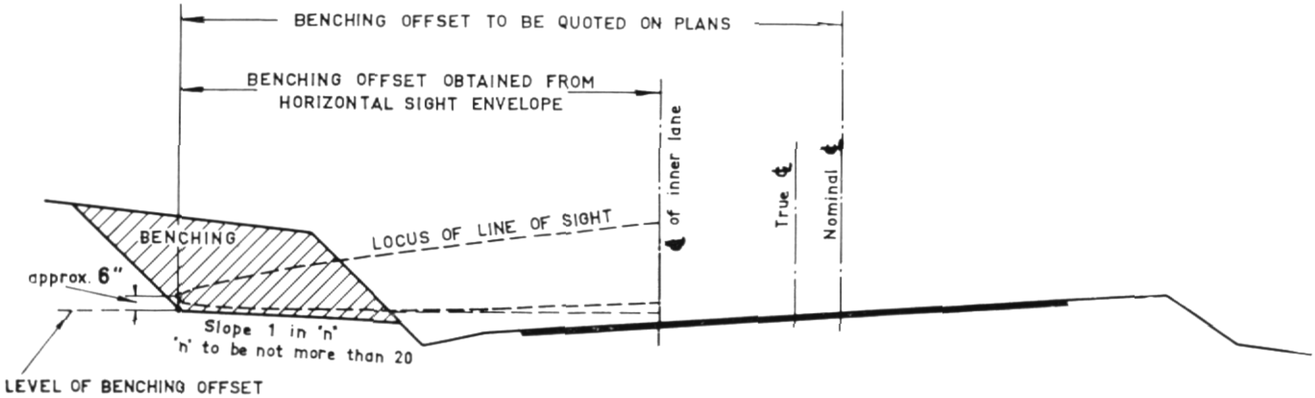
For the case where the lines of sight intersect only the circular arc of the horizontal curve, the procedure should be as follows:—

(i) Draw a horizontal sight envelope and determine the maximum offset at each cross section. Dimension the offset from the pegged centreline.




BENCHING ON HORIZONTAL CURVES
WHERE LONGITUDINAL GRADING IS STRAIGHT

**FIGURE 8**




BENCHING ON A HORIZONTAL CURVE
COMBINED WITH A SUMMIT VERTICAL CURVE
**FIGURE 9**

(ii) Compute the level for the bench at its maximum offset by adding 2 feet to the level of the road pavement at the centre of the critical traffic lane. Show this level on each cross section where the maximum value of offset applies.

(iii) Determine the slope of the bench by joining the level adopted for the maximum offset to the pavement level at the centre of the traffic lane under consideration. Quote this slope as one in "n" where "n" is a whole number.

A typical cross section for Case A is shown in Fig. 8.

Where the length to be benched is partly on the curve transition or on the straight in approach to the curve, the level of the bench above the road pavement will not be a constant 2 feet. It may be determined by drawing a line of sight on the longitudinal section which has its mid-point at the cross section under consideration. A level approximately 4 inches below the mid-point of the line of sight may be adopted as the level of the bench where the maximum value of offset applies for that cross section.

*Case B: Benching on a horizontal curve combined with a summit vertical curve*

Where horizontal and vertical curves are combined, offsets and levels for benching are found as follows (see Fig. 6):—

(i) Mark on plan and longitudinal section the position of all cross sections where offsets and levels are to be determined.

(ii) Draw on the plan the horizontal sight envelope, and find for each cross section the line of sight which determines the maximum offset. In Fig. 6 the line of sight H-h gives the maximum offset at the cross section XX.

(iii) The lines of sight giving the maximum offset on each cross section should now be drawn on the longitudinal section, and the level marked where each line of sight intercepts the corresponding cross section.

(iv) A line joining the points obtained in (iii) establishes the levels required along the horizontal sight envelope.

Due to the concave shape of the locus of the line of sight on its lower side, the level to be adpoted for the bench at its maximum offset must be below the levels along the horizontal sight envelope. The level and slope of the bench could be obtained accurately by plotting on each cross section the lower level at which the locus of the line of sight intercepts the batter of the cutting, together with the level of the line of sight which gives the lowest intercept at the particular cross section chainage on the longitudinal section. This accuracy is not warranted, however, and it is sufficient to adopt levels which are approximately 6 inches below the levels along the horizontal sight envelope. Therefore, proceed as follows:—

(v) From the horizontal sight envelope measure the maximum offset at each cross section and mark it on the cross sections.

(vi) Plot on each cross section at the maximum offset a level approximately 6 inches below the level of the horizontal sight envelope established in (iv). Write the level on the cross section.

(vii) Determine the slope of the bench by joining the point plotted in (vi) to the pavement level at the centre of the inner traffic lane. To ensure adequate drainage the slope should not be flatter than 1 in 20.

(viii) On each cross section, dimension the maximum benching offset from the pegged centreline.

A typical cross section for Case B is shown in Fig. 9.

# Tenders Accepted by Councils

**The following tenders (in excess of £3,000) were accepted by the respective Councils for road and bridge works during the three months ended 30th June, 1960.**

| Council | Road No. | Work | Name of Accepted Tenderer | Amount £ s. d. |
|---|---|---|---|---|
| Bogan S. | 8 | Supply of loam, shaping and consolidating 8·85 m. to 17·87 m. west of Nyngan. | E. & S. Projects Pty. Ltd. | 17,135 8 6 |
| Bowral M. | 260 | Supply and spread 401 tons ¾ in. hotmix and 228 tons ⅜ in. asphaltic concrete between Merrigang and Bowral Streets. | Bituminous Pavements Pty. Ltd. | 5,377 0 0 |
| Burrangong S. | 78 | Construction of R.C. bridge over Bendick Murrell Creek 18 m. north of Young. | Oswyn Hails Pty. Ltd. | 12,268 7 6 |
| Canobolas S. | 237, 245, 526, 559, 573 | Supply and delivery of 10,470 cu. yds. of gravel to various locations. | M. Dawson | 3,984 2 3 |
| Canterbury M. | 167 | Reconstruction between King George's Road and Warren Parade. | Ready Mixed Concrete | 26,341 17 6 |
| Carrathool S. | 501 | Manufacture, supply and delivery of prestressed bridge units for Mountain Creek Bridge and Cabbage Garden Creek Bridge. | Monier Pipe Co. Pty. Ltd. | 4,823 8 0 |
| Carrathool S. | 501 | Construction of 2/30 ft. span R.C. bridge with prestressed concrete girders over Cabbage Garden Creek, 10 m. south-west of Hillston. | Celestin Condoti | 6,577 14 0 |
| Cessnock G. C. | 220 | Construction of bridge over Deep Creek 4·5 m. south of Cessnock. | C. C. Turnbull and Sons Pty. Ltd. | 10,999 19 0 |
| Cobar S. | 416 | Supply and delivery of gravel to various locations (Average length of haul 4½ m.). | L. Prisk | 4,025 2 11 |
| Cockburn S. | 63 | Reconstruction and bitumen surfacing of 2,000 lin. ft. between 5 m. and 6 m. north of Tamworth. | W. H. Marshall | 5,143 8 10 |
| Culcairn S. | 125 | Supply and delivery of 8,975 cu. yds. gravel between 6·15 m. and 10·15 m. north west of Walbundrie (Average length of haul 8·70 m.). | T. G. Kirk | 4,925 12 6 |
| Dumaresq S. | 74 | Construction of bridge over Baker's Creek | Central Constructions Pty. Ltd. | 27,963 0 0 |
| Dungog S. | 101 | Construction of road over Wallarobba Mountain section 0·73 m. to 1·60 m. approx. 10·00 m. south of Dungog. | R. W., R. T. & R. W. J. Hogan. | 11,487 15 6 |
| Gilgandra S. | 11 | Construction of 2 R.C. box culverts at 5·82 m. and 6·33 m. east of Gilgandra. | Ajax Construction Co. | 3,750 10 0 |
| Gloucester S. | 3,139 | Construction of 8/30 ft. span timber beam bridge over the Barnard River at Kauthi. | Central Constructions Pty. Ltd. | 28,247 0 0 |
| Gloucester S. | 1,150 | Reconstruction and deviations for a length of one mile southward from Teni's Bridge (approximately 17·5 m. to 18·5 m. north of Gloucester). | R. W., R. T. & R. W. J. Hogan. | 6,386 12 8 |
| Gosford S. | 225 | Construction of 5/56 ft. 8 in. span prestressed concrete bridge over Mangrove Creek at Oystershell. | Beattie & Frost Pty. Ltd. | 57,653 5 0 |
| Guyra S. | 135 | Bitumen resurfacing 10·32 m. to 14·82 m. east of Guyra | Emoleum (Aust.) Ltd. | 5,435 2 0 |
| Jemalong S. | 17, 61, 236, 350, 377 | Bitumen surfacing various lengths | B.H.P. By-Products Pty. Ltd. | 9,486 7 3 |
| Jerilderie S. | 59 | Supply and delivery of 27,000 gals. bitumen between 6·15 m. and 16·15 m. east of Jerilderie. | Shell Co. of Aust. | 3,937 10 0 |
| Kyeamba S. | 384 | Reconstruction, drainage, culverting and gravelling between 34·44 m. and 38·40 m. south of Wagga Wagga. | W. A. Winnett & Son | 11,844 3 8 |
| Leeton S. | 80 | Priming and bitumen surfacing between 0·39 m. and 5·33 m. west of Leeton. | B.H.P. By-Products Pty. Ltd. | 4,415 10 3 |
| Leeton S. | 80 | Sand stabilisation of 44,668 sq. yds. of pavement between 0·39 m. and 5·33 m. west of Leeton. | Stabilisers Ltd. | 3,029 4 0 |
| Liverpool S. | 154 | Construction of a 2 cell 12 ft. x 7 ft. R.C. box culvert at Badgery's Creek and approaches. | Central Constructions Pty. Ltd. | 12,398 0 0 |
| Lockhart S. | 370 | Supply and delivery of 955 cu. yds of ½ in. aggregate between 0 m. and 7 m. north of Yanco Shire Boundary. | Murray Valley Sand and Gravel Co. | 3,325 3 4 |
| Lockhart S. | 370 | Supply and delivery of 10,568 cu. yds. of gravel between 0 m. and 7 m. from Yanko Shire Boundary. (Average length of haul 5 m.). | Ryan Bros. | 3,118 12 11 |

# Tenders Accepted by Councils—*continued*

| Council | Road No. | Work | Name of Accepted Tenderer | Amount £ s. d. |
|---|---|---|---|---|
| Mitchell S. .. | 59 | Construction of a 3 span R.C. bridge 90 ft. long over Bullenbung Creek. | Siebel Bros. Pty. Ltd. .. | 11,604 12 6 |
| Moree M. .. | 12, 17 | Bitumen re-surfacing 86,148 sq. yds. .. .. .. | Shorncliffe Pty. Ltd. .. | 5,208 5 7 |
| Stroud S. .. | 90 | Cement modification of gravel pavement from Stroud Road to Gloucester Shire Boundary. | E. & S. Projects Pty. Ltd. .. | 25,860 0 0 |
| Sutherland S. .. | 2,034 | Construction of a new ferry vessel for George's River at Lugarno. | Carrington Shipways Pty. Ltd. | 33,700 0 0 |
| Tallaganda S. .. | 51 | Reconstruction to base course stage between 5 m. and 9 m. east of Braidwood. (Average length of haul 5 m.). | Jedco Construction Pty. Ltd. | 28,714 1 4 |
| Tamarang S. .. | 126 | Reconstruction and bitumen surfacing between 0·96 m. and 4·49 m. east of Quirindi. | C. T. Marshall .. .. | 10,593 6 0 |
| Tumut S. .. | 279 | Construction of 5 span concrete bridge and 3 cell 6 ft. x 6 ft. box culvert over Gilmore Creek near Tumut. | Tumbarumba Constructions | 13,722 18 0 |
| Wakool S. .. | 386 | Supply, delivery and rough spreading of 11,288 cu. yds. of limestone gravel between 6·75 m. and 11·75 m. north of Swan Hill. | J. C. Jones .. .. .. | 4,327 1 4 |
| Waradgery S. .. | 14 | Priming and bitumen surfacing between 39 m. and 51 m. west of Hay. | B.H.P. By-Products Pty. Ltd. | 13,521 2 6 |
| Waradgery S. .. | 319 | Reshaping, shouldering, resheeting between 6·0 m. and 8·0 m., 14·6 m. and 16·2 m., 17·6 m. and 20·5 m. and 22·4 m. and 26·0 m. north of Windouran Shire Boundary. | L. G. Jones .. .. | 5,532 0 0 |
| Waradgery S. .. | 501 | Reshaping, shouldering, resheeting between 0 m. and 8 m. east of Booligal. | L. G. Jones .. .. | 4,480 0 0 |
| Waugoola S. .. | 1,156 | Construction of bridge and approaches at Kangarooby Creek 4 m. from Gooloogong. | J. W. Bailey .. .. | 3,981 11 7 |
| Wellington S. .. | 573 | Supply and delivery of 1,894 cu. yds of aggregate to various locations. | Furney Bros. (Wellington) Pty. Ltd. | 5,320 17 6 |
| Wellington S. .. | 7 | Supply and delivery of 11,380 cu. yds. gravel between Wellington and Maryvale. | Cec. Swords Pty. Ltd. .. | 3,495 14 9 |

# Main Roads Funds

**Receipts and Payments for the financial year ended 30th June, 1960**

**General Purposes**

| Heading | County of Cumberland Main Roads Fund | Country Main Roads Fund |
|---|---|---|
| | £ | £ |
| RECEIPTS— | | |
| Motor Vehicles Taxation (State) .. | 1,705,479 | 6,821,916 |
| Charge on heavy commercial goods vehicles under Road Maintenance (Contribution) Act, 1958 (State) | 629,007 | 2,516,027 |
| Road Transport and Traffic Fund | .... | 178,048 |
| Commonwealth Aid Roads Act, 1959 | 1,383,916 | 5,335,664 |
| Commonwealth Aid Roads Act, 1954 | 56,672 | 218,357 |
| From Councils under Section 11 of Main Roads Act and for cost of works | 1,547,046 | 102,076 |
| Other | 134,930 | 112,805 |
| Total Receipts | £5,457,050 | £15,284,893 |
| PAYMENTS— | | |
| Maintenance and minor improvements of roads and bridges | 1,010,769 | 5,275,140 |
| Construction and reconstruction of roads and bridges | 3,661,814 | 7,852,551 |
| Land acquisition | 460,566 | 59,920 |
| Administrative expenses | 209,782 | 614,421 |
| Loan charges— | | |
| Payment of interest, exchange, management and flotation expenses | 6,400 | 196,039 |
| *Miscellaneous .. *Dr.* | 22,790 | 1,151,333 |
| Total Payments | 5,326,541 | 15,149,404 |

* Includes transfer to and refunds from Special Purposes Accounts in respect of finance for Operating Accounts, Suspense Accounts and Reserve Accounts.

# Tenders Accepted by the Department of Main Roads

**The following tenders (in excess of £3,000) for road and bridge works were accepted by the Department during the three months ended 30th June, 1960.**

| Work or Service | Name of Accepted Tenderer | Amount £ | s. | d. |
|---|---|---|---|---|
| State Highway No. 1—Prince's Highway. Shire of Imlay. Reconstruction between 28 m. and 35 m. south of Eden. | Mammoth Haulage (Cooma) Pty. Ltd. | 47,575 | 8 | 0 |
| State Highway No. 2—Hume Highway. Shire of Mittagong. Construction of bridge over Wingecarribee River at Berrima. | Allied Constructions Pty. Ltd. .. .. | 80,853 | 5 | 0 |
| State Highway No. 5—Great Western Highway. Shire of Blacktown. Construction of new bridge over Eastern Creek. | Central Constructions Pty. Ltd. .. | 22,085 | 0 | 0 |
| State Highway No. 10—Pacific Highway. City of Newcastle. Construction of new bridge over Ironbark Creek. | Central Constructions Pty. Ltd. .. | 115,133 | 0 | 0 |
| State Highway No. 21—Cobb Highway. Municipality of Deniliquin. Construction of bridge over Brick Kiln Creek (Moran's Bridge). | Oswyn Hails Pty. Ltd. .. .. | 29,599 | 2 | 11 |
| Trunk Road No. 51. Shire of Eurobodalla. Supply and delivery of aggregate for reconstruction from Nelligen Creek to Mongarlowe River. | Australian Blue Metal Ltd. .. .. | 8,623 | 10 | 0 |
| Trunk Road No. 51. Shire of Eurobodalla. Supply and delivery of aggregate for reconstruction from Nelligen Creek to Mongarlowe River. | Messrs. Peter R. Hayes and Southern Trading Co. | 11,572 | 16 | 10 |
| Trunk Road No. 68. Shire of Central Darling. Construction from 15 m. to 20 m. north of Menindee. | J. H. Furney & Co. .. .. .. | 14,512 | 16 | 2 |
| Trunk Road No. 62. Shire of Merriwa. Construction of bridge over Smith's Rivulet at Merriwa. | A. Goor Pty. Ltd. .. .. .. | 59,190 | 9 | 0 |
| Main Road No. 511. Shire of Nymboida. Supply of steelwork for bridge over Main Creek approximately 21·17 m. west of South Grafton. | Superior Weld Pty. Ltd. .. .. | 15,998 | 0 | 0 |
| Main Road No. 511. Shire of Nymboida. Manufacture, supply and delivery of precast, pretensioned concrete bridge units for new bridge over Jackadgery Creek. | Concrete Industries (Qld.) Pty. Ltd. .. | 3,654 | 4 | 0 |
| Main Road No. 532. Municipality of Auburn and City of Parramatta. Construction of bridge over Parramatta River at Silverwater. | John Holland (Constructions) Pty. Ltd. | 460,000 | 0 | 0 |
| Shire of Tumbarumba. Construction of new bridge over the Murray River at Indi. | Peters Constructions Pty. Ltd. .. .. | 7,441 | 5 | 0 |
| Supply and delivery of bitumen emulsion during the period 1st July, 1960 to 30th June, 1961. | Emoleum (Australia) Ltd. .. .. | 57,750 (estimated) | 0 | 0 |
| Supply and delivery of 80/100 penetration residual bitumen during the period 1st July, 1960 to 30th June, 1961. | Bitumen and Oil Refineries (Australia) Ltd. | 187,252 (estimated) | 10 | 0 |
| Supply and delivery of 80/100 penetration residual bitumen during the period 1st July, 1960 to 30th June, 1961. | Shell Co. of Australia Ltd. .. .. | 152,156 (estimated) | 5 | 0 |
| Shire of Cobar. Manufacture, supply and delivery of steelwork for construction of bridge over Darling River at Tilpa. | Superior Weld Pty. Ltd. .. .. | 14,193 | 14 | 9 |
| Shire of Cobar. Construction of bridge over Darling River at Tilpa. | A. R. Dickinson .. .. .. .. | 92,386 | 0 | 0 |

## SYDNEY HARBOUR BRIDGE ACCOUNT

**Receipts and Payments for the financial year ended 30th June, 1960**

*Receipts*

| | £ |
|---|---|
| Road Tolls .. .. .. .. .. .. .. | 1,076,662 |
| Contributions— | |
| Railway passengers .. .. .. .. .. .. | 143,804 |
| Omnibus passengers .. .. .. .. .. .. | 14,705 |
| Rents from properties .. .. .. .. .. | 22,998 |
| Other .. .. .. .. .. .. .. .. | 524 |
| | £1,258,693 |

*Payments*

| | £ |
|---|---|
| Cost of collecting road tolls .. .. .. .. | 153,16 |
| Maintenance and minor improvement .. .. .. | 191,65 |
| *Payment of loan Charges .. .. .. .. | 272,21 |
| Installation of new toll office and toll gates and alterations to existing structures .. .. .. .. | 62,96 |
| Provision for traffic facilities .. .. .. .. | 27,44 |
| Administrative expenses and miscellaneous charges .. | 14,21 |
| †Conversion of tramway area to roadway .. .. | 149,56 |
| | £871,22 |

* Charges due to the Treasury for year ended 30th June, 1960, totalled £426,470 but the payment of Sinking Fund and Flotation expenses amounting to £154,260 was deferred.

† Capital expenditure financed from revenue.

# MAIN ROADS STANDARD SPECIFICATIONS DRAWINGS AND INSTRUCTIONS

**NOTE: Drawings are prefixed by letter " A ", instructions are so described; all other items are specifications or forms. Year of revision, if within last 10 years, is shown in brackets.**

Form No.

## ROAD SURVEY AND DESIGN

A 478, A 478A Specimen drawings, country road design.
A 478C Specimen drawing, flat country road design.
A 478B Specimen drawings, urban road design.
A 1645 Stadia reduction diagram.
355 Design of two-lane rural highways. (Instruction.)
369 Design of urban roads. (Instruction.)
288 Design of intersections. (Instruction.) (1952.)
402 Design of acceleration and deceleration lanes. (Instruction.)
499 Design of kerb-lines and splays at corners. (Instruction.) (1952.)
A 1614 Widening at points of " A " sight distance.
A 83 Earthwork quantity diagram.
A 1640 Mould for permanent mark block.
Manual No. 2—Survey and design for main road works*.
Policy for geometric design of rural roads—State Road Authorities*

## STREET DRAINAGE

243 Integral concrete kerb and gutter and vehicle and dish crossing, and drawing. (A 134A.)
245 Gully pit and drawings: with grating (A 1042); kerb inlet only (A 1043); with grating and extended kerb inlet (A 1352) extended kerb inlet (A 1353), (1956).
A 190 Gully grating.
A 1418 Concrete converter.
A 3491 Perambulator ramp.
A 3536 Mountable type kerb with reflectors.

## CULVERTS

138 Pre-cast concrete box culvert (1957) and drawing: 12 in., 18 in., 24 in., and 30 in. high (A 3847).
206 Re-inforced concrete culvert (1948) and instruction sheets. (A 304, A 305, A 306, A 359.)
A 1012-20 Single cell reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1012); 1 ft. 4 in. to 3 ft. (A 1013); 4 ft. (A 1014); 5 ft. (A 1015); 6 ft. (A 1016); 7 ft. (A 1017); 8 ft. (A 1018); 9 ft. (A 1019); 10 ft. (A 1020); 11 ft. (A 1020A); 12 ft. (A 1020B).
A 1021-29 Two cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in; (A 1021); 1 ft. 4 in. to 3 ft. (A 1022); 4 ft. (A 1023); 5 ft. (A 1024) 6 ft. (A 1025); 7 ft. (A 1026); 8 ft. (A 1027); 9 ft. (A 1028); 10 ft. (A 1029).
A 1031-36, A 1038, A 1040 Three cell, reinforced concrete box culvert: 6 in. to 1 ft. 3 in. (A 1031); 1 ft. 4 in. to 3 ft. (A 1032); 4 ft. (A 1033); 5 ft. (A 1034); 6 ft. (A 1035); 7 ft. (A 1036); 8 ft. (A 1038); 9 ft. (A 1040).
25 Pipe culverts and headwalls, and drawings: single rows of pipes: 15 in. to 21 in. dia. (A 143); 2 ft. to 3 ft. dia. (A 139); 3 ft. 6 in. dia. (A 172); 4 ft. dia. (A 173); 4 ft. 6 in. dia. (A 174); 5 ft. dia. (A 175); 6 ft. dia. (A 177); Double rows of pipes: 15 in. to 21 in. dia. (A 211); 2 ft. to 3 ft. dia. (A 203); 3 ft. 6 in. dia. (A 215); 4 ft. dia. (A 208); 4 ft. 6 in. dia. (A 207); 5 ft. dia. (A 206); 6 ft. dia. (A 213). Treble rows of pipes: 15 in. to 21 in. dia. (A 210); 2 ft. to 3 ft. dia. (A 216). Straight headwalls for pipe culverts: 15 in. to 24 in. dia. (A 1153) (1957).
A 1 Joint for concrete pipes.
A 142 Inlet sump for pipe culvert 3 ft. dia. or less. (1947.)
139 Timber culvert (1950) and drawings, 1 ft. 6 in. high (A 427); 2 ft. (A 428); 3 ft. (A 429); 4 ft. (A 430); 5 ft. to 8 ft. high (A 431).
A 1223 Timber culvert 20 ft. roadway. (1949.)
A 3472 Timber culvert 22 ft. roadway. (1949.)
303 Supply and delivery of pre-cast reinforced concrete pipes.

## BRIDGES AND FERRIES

18 Data for bridge design. (1948.)
371 Waterway calculations. (Instruction.)
300 Pile driving frame, specification for 25 ft. and drawings for 50 ft. (A 209); 40 ft. (A 253); and 25 ft. portable (A 1148).
A 3693 Pontoon and pile driving equipment.
164 Timber beam bridge (1947) and instruction sheets, 12 ft. (A 3469); 20 ft. (A 70) (1949); and 22 ft. (A 1761) (1949).
326 Extermination of termites in timber bridges. (Instruction.)
350 Reinforced concrete bridge. (1949.)
495 Design of forms and falsework for concrete bridge construction. (Instruction.)
314 Regulations for running of ferries. (1955.)
A 4 Standard bridge loading. (Instruction.) (1957.)
A 26 Waterway diagram. (1943.)
A 1886 Arrangement of bolting planks. (1948.)
A 45 Timber bridge, standard details. (1949.)
A 1791 Timber beam skew bridge details. (1949.)
A 3470, A 3471 Low level timber bridge, for 12 ft. and 20 ft. between kerb. (Instruction.) (1949.)
A 1216 Running planks.
A 1207 Reinforced concrete pile—25 tons. (1945.)
A 1208 Reinforced concrete pile—35 tons. (1957.)
A 1621 Reflector strip for bridges.
Highway Bridge Design Specification of State Road Authorities.*

## FORMATION

70 Formation. (1955.)
520 Sub-soil drains. (1957.)
A 1532 Standard typical cross-section.
A 4618 Flat country cross-section, Type A. (1955.)
A 4619 Flat country cross-section, Type B. (1955.)
A 4620 Flat country cross-section, Type C. (1955.)
A 4621 Flat country cross-section, Type D. (1955.)

Form No.

A 1101 Cross-section one-way feeder road.
A 1102 Cross-section two-way feeder road.
A 114 Rubble retaining wall.

## PAVEMENTS

71 Gravel pavement. (1949.)
228 Reconstruction with gravel of existing pavement.
254A Supply and delivery of gravel.
72 Broken stone base course. (1956.)
216 Telford base course.
68 Reconstruction with broken stone of existing pavement to form a base course.
257 Haulage of materials
65 Waterbound macadam surface course.
230 Tar or bitumen penetration macadam surface course, 2 in. thick.
66 Tar or bitumen penetration macadam surface course, 3 in. thick.
125 Cement concrete pavement, and plan and cross-section. (A 1147.)
A 380 Galvanised iron strip for deformed joint.
A 381 Bituminous filler strip for transverse expansion joint.
493 Supply of ready mixed concrete.
266 Asphaltic concrete pavement.

## SURFACE TREATMENT

93 Surfacing and resurfacing with bitumen, tar-bitumen mixture, or tar. (1957.)
466 Fluxing of binders for bituminous flush seals and reseals. (Instruction.)
351 Supply and delivery of cover aggregate for bituminous surfacing work (1957.)
354 Road-mix resealing. (1949.)
397 Fluxing for tar road-mix reseal. (Instruction and chart.)
A 1635 Fluxing chart for bitumen road-mix reseal.
167 Resheeting with plant-mixed bituminous macadam by drag spreader. (1951.)

## FENCING AND GRIDS

141 Post and wire fencing (1947) and drawings: plain (A 494): rabbit-proof (A 498); flood gate (A 316).
143 Ordnance fencing and drawing. (A 7.)
144 Chain wire protection fencing and drawing. (A 149.)
246 Location of protection fencing. (Instruction.)
224 Removal and re-erection of fencing.
A 1705 Plain wire fence for use in cattle country.
A 3598 Wire cable guard fence.

## ROADSIDE

A 1337 Concrete mile post, Type A.
A 1338 Concrete mile post, Type D.
A 1366 Standard lettering for mile posts.
A 1367 Timber mile post, Type B1.
A 1368 Timber mile post, Type B2.
A 3497 Timber mile post, Type B3.
A 2815 Concrete kerb mile block.
A 1420 Steel mould for concrete mile posts.
A 1381-3, A 1452-5 Tree guards, Types A, B, C, D, E, F, and G.
Manual No. 4—Roadside Trees.

## MATERIALS

296 Tar. (1949.)
337 Residual bitumen and fluxed native asphalt.
305 Bitumen emulsion. (1953.)
349 Light and medium oils for fluxing bitumen. (1948.)
A 27 Slump cone for concrete.
A 178 Mould for concrete test cylinder.
76 Design of non-rigid pavements. (Instruction.)
Manual No. 3—Materials.*

## TRAFFIC PROVISION AND PROTECTION

121 Provision for traffic (1954) with general arrangement (A 1323), and details (A 1325) of temporary signs. (1947.)
252 Supply and delivery of guide posts.
253 Erection of guide posts. (Instruction.)
A 1342 Temporary warning sign, details of construction.
A 1346 Iron trestle for road barrier.
A 1341 Timber trestle and barrier.

## PLANT

A 1414 Gate attachment for lorries with fantail spreader.
A 1450 Half-ton roller with pneumatic tyres for transport.
A 2814 Two-berth pneumatic tyred caravan.
A 2828 Multi-wheeled pneumatic tyred roller.
A 2976 Fantail aggregate spreader.
A 3530 Benders for steel reinforcement.
A 3547 Steel bar cutter.

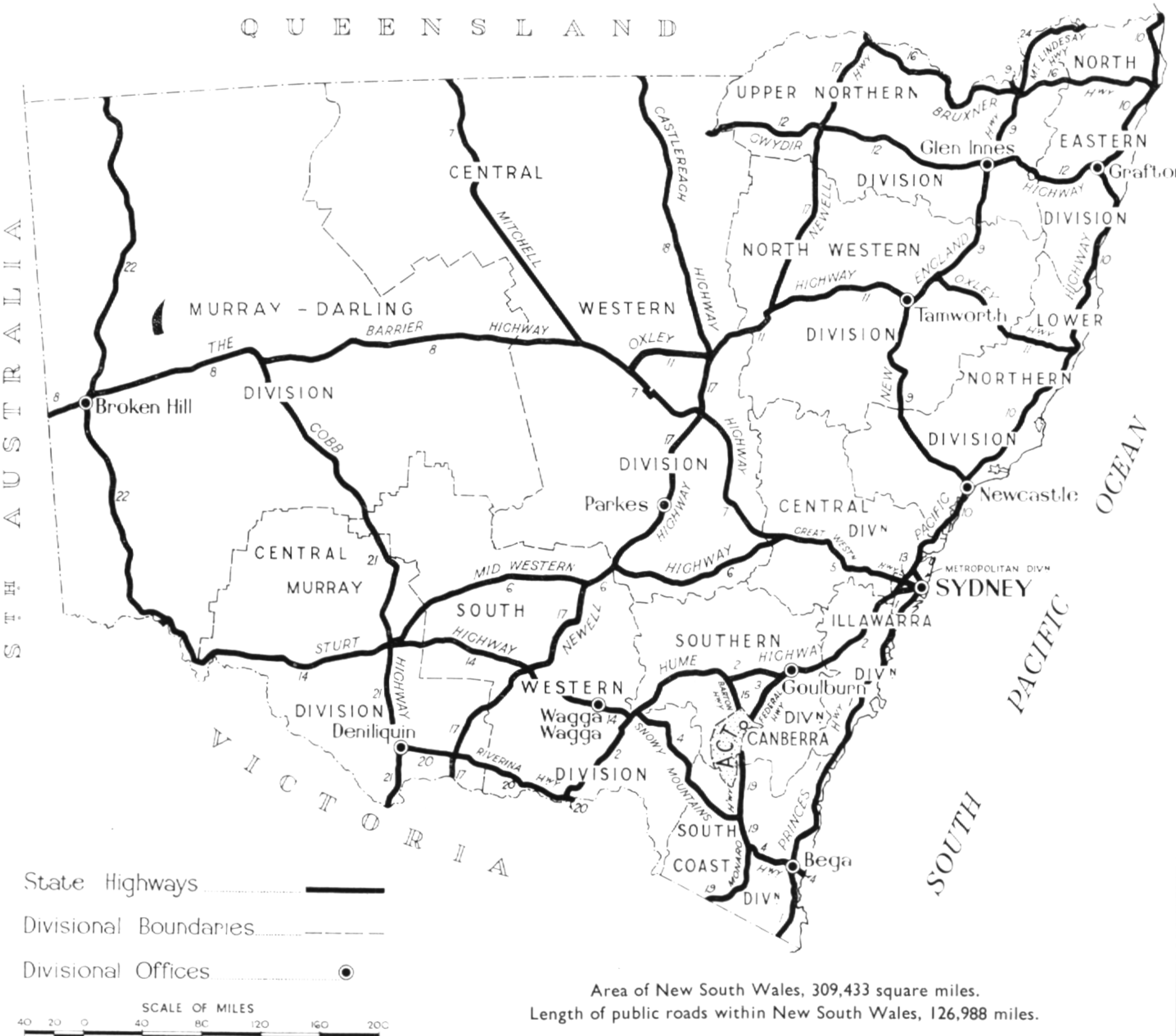
## CONTRACTS

24B General conditions of contract, Council contract. (1956.)
342 Cover sheet for specifications, Council contract. (1950.)
64 Schedule of quantities form.
39 Bulk sum tender form, Council contract. (1946.)
38 Bulk sum contract form, Council contract.
193 Duties of superintending officer. (Instruction.)
498 Caretaking and operating ferry.

All Standards may be purchased from the Head Office of the Department of Main Roads, 309 Castlereagh Street, Sydney. Single copies are free to Council except those marked *.

Sydney: V. C. N. Blight, Government Printer—1960

# State Highway System of the State of New South Wales





Area of New South Wales, 309,433 square miles.
Length of public roads within New South Wales, 126,988 miles.

MILEAGE OF MAIN AND DEVELOPMENTAL ROADS, AS AT 30th JUNE, 1960.

| | |
|---|---|
| **State Highways** | 6,503 |
| **Trunk Roads** | 4,181 |
| **Main Roads** | 11,727 |
| **Secondary Roads (County of Cumberland only)** | 87 |
| **Developmental Roads** | 2,864 |
| | 25,362 |
| **UNCLASSIFIED ROADS, in Western part of State, coming within the provisions of the Main Roads Act** | 926 |
| **TOTAL** | 26,288 |