1965–66

VICTORIA

COUNTRY ROADS BOARD

FIFTY-SECOND ANNUAL REPORT

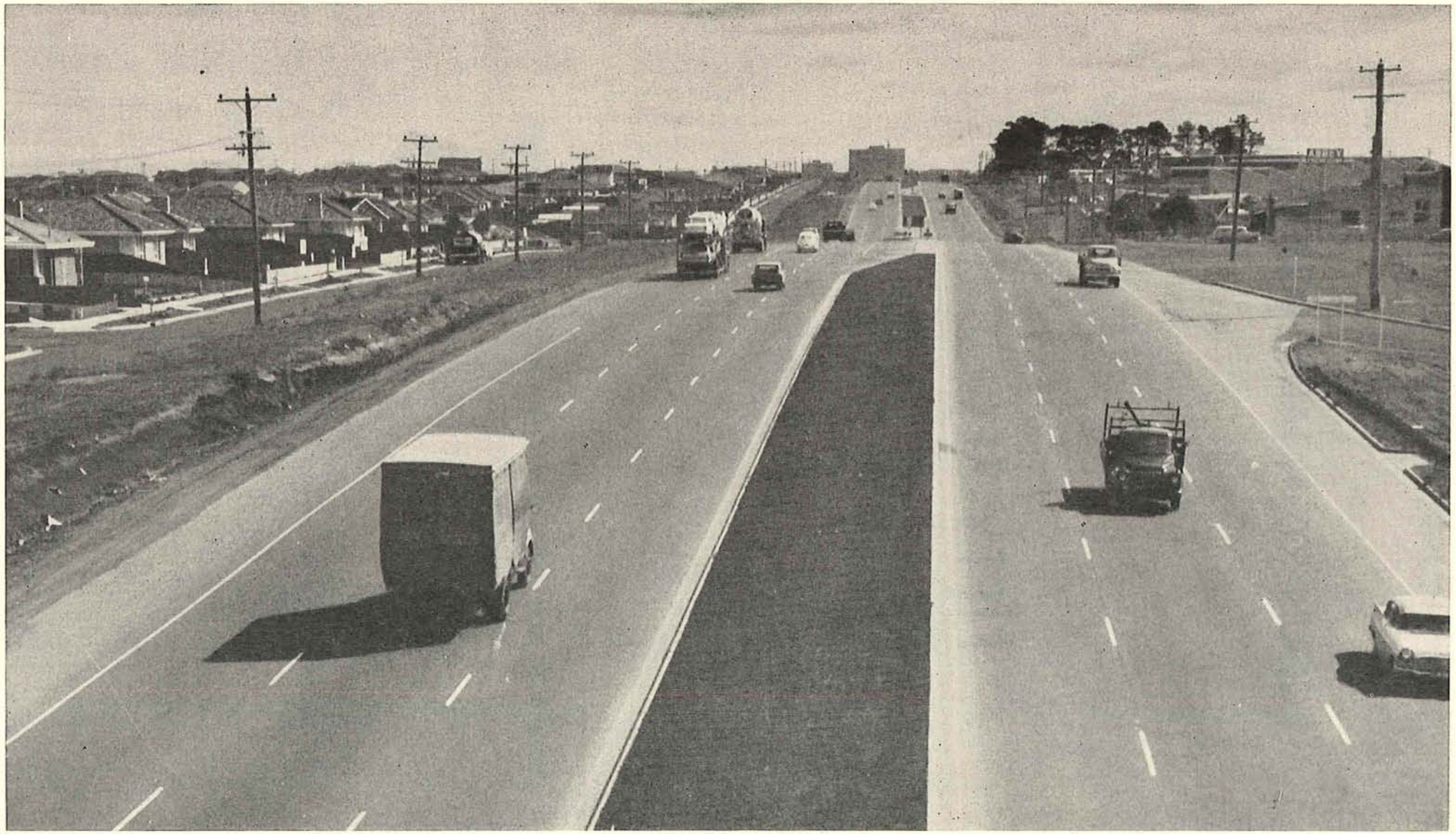
FOR YEAR ENDED 30TH JUNE, 1965

PRESENTED TO BOTH HOUSES OF PARLIAMENT PURSUANT TO ACT No. 6229.

[*Approximate Cost of Report.*—Preparation, not given. Printing (225 copies), $1900.00—.1

By Authority:
A. C. BROOKS, GOVERNMENT PRINTER, MELBOURNE.

No. 35.—[58 cents]—1333/66.



FRONTISPIECE :—Princes Highway East—Six-lane expressway in the City of Springvale between Oakleigh and Dandenong.

COVER :—Roadworks in Progress on the Maroondah Highway at Koriella.

COUNTRY ROADS BOARD

Chairman	I. J. O'Donnell
Deputy Chairman	R. E. V. Donaldson
Member	F. West

PRINCIPAL OFFICERS.

Head Office.

Chief Engineer .. .. H. S. Gibbs.

Deputy Chief Engineers.

Works	*Road Design*	*Bridges*	*Mechanical*
H. P. George.	J. H. Townley.	B. R. Abery.	G. M. Langham

Secretary	N. L. Allanson.
Deputy Secretary	C. C. Liddell.
Accountant	R. G. Cooper.
Deputy Accountant	R. J. C. Bulman.

Divisional Officers.

Division.	*Divisional Engineer.*
Bairnsdale	W. H. Dolamore.
Ballarat	F. F. O'Brien.
Benalla	R. C. Handley.
Bendigo	L. Upton
Dandenong	F. W. Docking.
Geelong	W. F. Neville.
Horsham	A. J. Pryor
Metropolitan	J. R. Galbraith
Traralgon	A. Jacka.
Warrnambool	J. W. C. Pascoe.

COUNTRY ROADS BOARD

FIFTY-SECOND ANNUAL REPORT

60 Denmark Street,
Kew, E. 4.
2nd December, 1965

The Honorable M. V. Porter, M.L.A.,
Minister of Public Works,
State Public Offices,
Melbourne, C.2.

SIR,

In accordance with the requirements of Section 128 of the *Country Roads Act* 1958, No. 6229, the Board has the honour to submit to you for presentation to Parliament the Report of its proceedings for the year ended 30th June, 1965.

1. REVIEW OF YEAR'S ACTIVITIES.

During the year 1964–65 the Board continued its progressive programme of State-wide road improvements including the extension of divided highways and the extension of the length of sealed roads. Despite the many improvements made, the amount of £29,267,345 available to the Board for expenditure, which included £16,676,265 from State sources and £12,591,080 from Commonwealth Aid Roads funds, fell well below that which should be expended to satisfy road needs. The road needs survey 1964–74 which was referred to in last year's annual report indicates that the needs of the State called for the carrying out of work estimated to cost £78,000,000 in financial year 1964–65. The amount actually spent by the Board and other road constructing authorities totalled only £53,000,000. This leaves a further £25,000,000 to be added to the already serious back-log of unfulfilled road needs.

Unfortunately every year in which the amount expended falls short of the annual amount required to satisfy needs, the transportation system has additional charges imposed on it resulting in higher costs to both primary and secondary industries. The Government's action in raising motor vehicle registration fees for the purpose of financing Special Projects on roads in the metropolitan and rural areas will provide some £4,000,000 per annum towards the deficiency.

The position could also be alleviated to some extent if the large amounts incurred each year in the acquisition of land for road purposes were charged to loan funds instead of to the Board's revenue. During the year approximately £2·8 million was spent by the Board on land acquisition. Expenditure on land purchased for right-of-way is undoubtedly capital expenditure for which the burden of payment could well be shared with posterity, and the Board considers that the financing of land acquisition from loan funds instead of revenue is warranted.

Highlights of the year's work were again exemplified by increases in the mileage of divided highways and the completion of a number of bridges. Work performed on the 9½ miles of the Princes Highway East between Oakleigh and Dandenong provides the longest 6-lane expressway at present in Australia, and the opening of the road inter-change bridge between the Calder Highway and Lancefield Road at the south-west corner of the Essendon Airport completed a divided road for a significant part of the route from the city to the Airport.

2. RECEIPTS AND PAYMENTS.

The total moneys received by the Board for expenditure in 1964–65 amounted to £29,263,748, which represented an increase of £2,281,616 over receipts in the financial year 1963–64.

Funds available for expenditure an 1964–65, i.e., total receipts plus balances brought forward from the previous year totalled £29,267,345, which represented an increase of only £884,691 over financial year 1963–64.

Actual expenditure in 1964–65 totalled £29,262,622, which was an increase of £883,565 over the 1963–64 expenditure of £28,379,057.

Of the total expenditure of £29,262,622, £19,462,564 was incurred directly by the Board and £9,800,058 by municipal councils.

COUNTRY ROADS BOARD FUND.

Net receipts of revenue under the *Motor Car Act* 1958 together with municipalities repayments totalled £12,534,110, which was an increase of £31,020 over the amount received in 1963–64.

During the year legislation passed by Parliament resulted in the diversion from the Country Roads Board Fund to Consolidated Revenue of all fines collected as a result of prosecutions for breaches of the Motor Car Act. A special grant of £350,000 was made by the Treasurer to the Board to replace in part the revenue lost as a result of this Legislation.

The proceeds of charges under the Commercial Goods Vehicles Act amounted to £2,963,142, which was an increase of £144,173 over the amount received in 1963–64.

The amount standing to the credit of the Country Roads Board Fund at 30th June, 1965 was £4,723.

COMMONWEALTH AID ROADS ACT.

The year 1964–65 was the first year of operation of the new *Commonwealth Aid Roads Act* 1964.

The total distribution made by the Commonwealth to the States in the year 1964–65 under this Act was £65,000,000, of which the State of Victoria received £12,787,816. Of this amount, £12,591,080 was received for expenditure by the Board and the balance of £196,736 was allocated for works connected with transport by road or water.

LOAN FUNDS.

Loan money received by the Board totalled £381,000 and was spent on main roads and State highways.

GENERAL.

The charts in Figures (1) and (2) show respectively the Board's receipts from the various sources and its expenditures on the various works during the year.

3. SHARING THE COST OF ROADWORKS.

The cost of roadworks which provide for through traffic on State highways, by-pass roads, tourists' roads and forest roads is borne entirely by the Board which, under the Country Roads Act is also responsible for the apportionment to municipalities of part of the cost of works on main roads.

Under the Act, the Board may apportion up to one-third of the amount expended on main roads from the Country Roads Board fund, but is empowered to reduce this amount if expenditure is considered to be excessive and where costs are incurred because of timber traffic or traffic not of local origin.

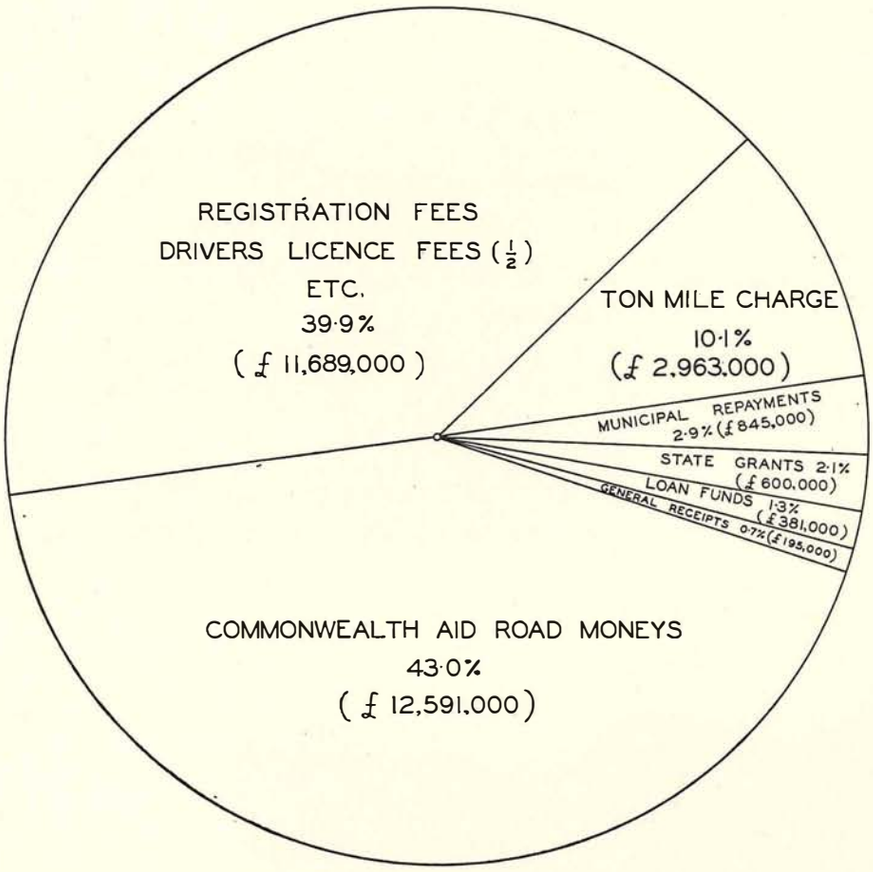


FIGURE 1.- RECEIPTS 1964 65

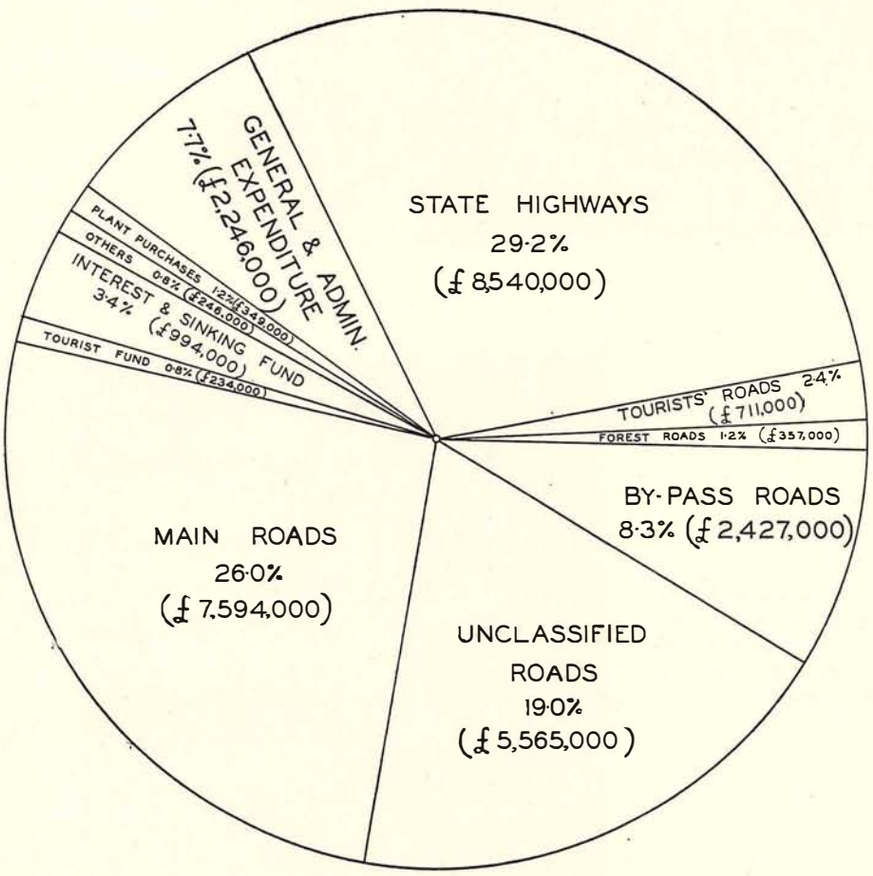


FIGURE 2.- EXPENDITURE 1964-65

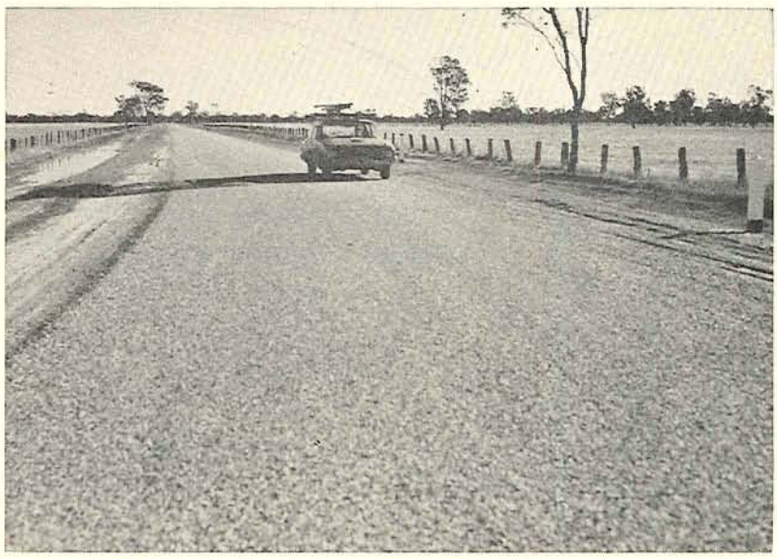


Plate 4.—Wimmera Shire–Horsham–Wal Wal Road reconstructed and sealed.

Plate 5.—Buninyong Shire–Mount Buninyong Lookout Road.—Reconstructed and sealed section of one and a half mile "up" road to Lookout.

Plate 6.—Omeo Shire–Upper Kiewa Valley Road extension—Construction of a new connecting road from the Rocky Valley Reservoir to the Omeo Highway.

Details of expenditure incurred on main roads in 1963–64 and apportioned in 1964–65 are as follows :—

	£
Expenditure from Country Roads Board Fund	4,852,539
Expenditure from Commonwealth Aid Roads Moneys	1,549,035
Expenditure from proceeds of ton-mile tax under the Commercial Goods Vehicles Act	877,399
	7,278,973

Amount apportioned to Councils (based on expenditure from Country Roads Board Fund only)	806,075
	%
Percentage of amount apportioned to the total expenditure from the Country Roads Board Fund	16·6
Percentage of amount apportioned to the total main road expenditure (including Commonwealth Aid Roads and ton-mile tax grants) ..	11·1

If the whole of the expenditure on main roads had been financed from the Country Roads Board Fund and Councils' contributions were based on one-third of the expenditure incurred, contributions by municipal councils would have amounted to £2,426,324.

As shown above, the actual amount apportioned to Councils was only £806,075.

A measure of the extent of the financial relief afforded to Councils is given by the following figures :—

	1963–4	1964–5
	%	%
Percentage of contributions by Councils to the total expenditure on main roads	11·47	11·10

Loan moneys used on main roads were spent in urban areas. This expenditure is shared equally by the Board and Councils, with repayments by the Councils extending over a period of 35 years.

On unclassified roads, Councils are required to contribute towards expenditure charged to allocations provided by the Board. In determining the extent of the contribution to be made by each Council, the Board takes into consideration the nature, extent and location of the work, together with the Council's financial position. On construction works, the Councils' contribution was approximately £1,612,000 out of a total of £7,177,000 expended.

Allocations subject to Council contribution were also made by the Board to assist Councils in the maintenance of unclassified roads. Such allocations were generally on £1 Board to £1 Council basis in urban areas and £2 Board to £1 Council in rural areas.

4. COMMONWEALTH AID ROADS ACT.

The *Commonwealth Aid Roads Act* 1964 provided for the distribution by the Commonwealth to the States of a basic grant of £62 million and a matching grant of £3 million. Victoria received £12,787,815 14s. 3d., of which £196,735 12s. 6d. was allotted for other works connected with transport and £12,591,080 1s. 9d. was expended by the Board.

In accordance with the provisions of the Act £5,115,126 5s. 8d. or 40 per cent. of the total received was expended on roads in rural areas other than State highways or main roads. As the sum required to be spent on such roads is increasing each year, the Board's ability to extend the present declared road system of State highways and main roads will continue to be restricted.

5. ALLOCATIONS FOR ROAD AND BRIDGE WORKS.

The Board, in its Fifty-first Annual Report, published the procedure for the submission of applications for funds by municipal councils and its own engineers. Applications from the Board's engineers are to some extent conditioned by their knowledge of available funds as well as their assessment of needs and priorities. This is not so in the case of municipal councils whose applications are based solely on their assessment of local needs. In determining the allocations the Board gives close consideration to every item applied for by each council and each of its own Divisional Engineers.

The Board's knowledge of state-wide and local conditions and its assessment of the present and future importance of the various works applied for enables it to allocate funds equitably on the basis of road needs for the whole State.

The following table shows the allocation of funds made by the Board in financial years 1963–64 and in 1964–65 :—

—	1963–64. Allocations.	1964–65. Allocations.
	£'000s	£'000s
State Highways	10,962	10,202
Main Roads	11,154	10,834
Tourists' Roads	785	894
Forest Roads	418	429
By-pass Roads	1,905	2,861
Unclassified Roads—		
Construction	6,453	6,627
Maintenance	935	1,003
Total	32,612	32,850

6. CONTRACTS UNDER BOARD'S DIRECT SUPERVISION.

During the financial year 1964–65 the Board continued its practice of recent years by increasing the length of major contract works on State highways and by-pass roads where this is practicable and economical. As a result the average value of major road construction contracts, i.e., those exceeding £30,000, was £95,000.

The advertising of tenders for larger works appears to have encouraged some contractors to build up technical staff and in general to invest in modern and well maintained plant and equipment.

The employment by contractors of engineers and other specialists has resulted in a more efficient approach to estimating, planning and programming of works. Where necessary and prudent, the Board has amended its specifications to meet changing conditions and minimize contractors' risks.

In general, the prices of tenders rose slightly during the year due to increased costs of labour and materials. Reasonable competition has been maintained however, and the Board has experienced no serious difficulty in obtaining satisfactory tenders.

Details of the types of contracts entered into and their respective values are shown below :—

Type of Contract.	Number of Contracts.	Value.
		£
Road Construction (Major Works)	15	1,432,345
Road Construction (Minor Works)	16	147,472
Supply of Roadmaking Materials	77	444,493
Bituminous Treatment and Supply of Materials	120	1,701,713
Bridge Construction	13	513,479
Manufacture of Bridge Components and Fabricated Steel	13	125,099
Supply of Reinforced Concrete Pipes and Box Culverts	12	256,000
Supply of Roadmaking Equipment	25	248,062
Depot Facilities and Workshop Equipment	6	29,034
Miscellaneous Services and Stores	29	341,435
Totals	326	5,239,132

7. CONTRACTS UNDER COUNCILS' SUPERVISION.

In the financial year 1964–65 the Board approved of the acceptance by municipal councils of 581 tenders for a total amount of £3,190,840 for road and bridge works for which the Board provided funds.

Although the value of these contracts was only slightly less than the total amount of £3,202,560 for the previous financial year, the number of contracts let fell from 688 to 581. This indicated a trend towards larger contracts in the municipal field and is in keeping with a similar trend in the Board's direct works contracts.

Approval was also given to the use of 92 municipal period contracts for the supply of materials incorporated in direct labour works financed from funds allocated by the Board.

8. STATE HIGHWAYS.

The total length of 4,465 miles of State highways remained the same throughout the year. The length of seal was extended by 36 miles to a total sealed mileage of 4,172 miles.

An amount of £9,694,000 was originally allocated for works, of which £1,826,000 was for maintenance and £7,868,000 for construction and reconstruction. Expenditure during the year amounted to £8,540,000.

Maintenance of existing sealed surfaces involved 312 miles of sprayed retreatments and 15 miles of plant mix surfacing at a total cost of £465,000.

During the year, a preliminary five-year programme for future major construction and reconstruction works was formulated, and it is intended that this should be revised annually to provide a guide for the necessary preconstruction work for these projects.

Major achievement on State highways during the year were the completion of the provision of six lanes from Ferntree Gully Road, Oakleigh to Dandenong on the Princes Highway East, and of at least four lanes from Box Hill to Mt. Dandenong Road, Ringwood on the Maroondah Highway. On the Murray Valley Highway almost 10 miles of road was reconstructed and sealed north of Boundary Bend.

The following works are typical of those completed during the year :—

Princes Highway West—

Reconstruction of 1·4 miles of the Melbourne-bound carriageway at Lollypop Creek near Werribee to eliminate flooding.

Surface treatment of a further 2·4 miles of the Geelong-bound carriageway near Avalon.

Reconstruction of 4·1 miles east of Tyrendarra.

Realignment of 0·7 mile at Livingston's Hill, west of Tyrendarra (Plate 7).

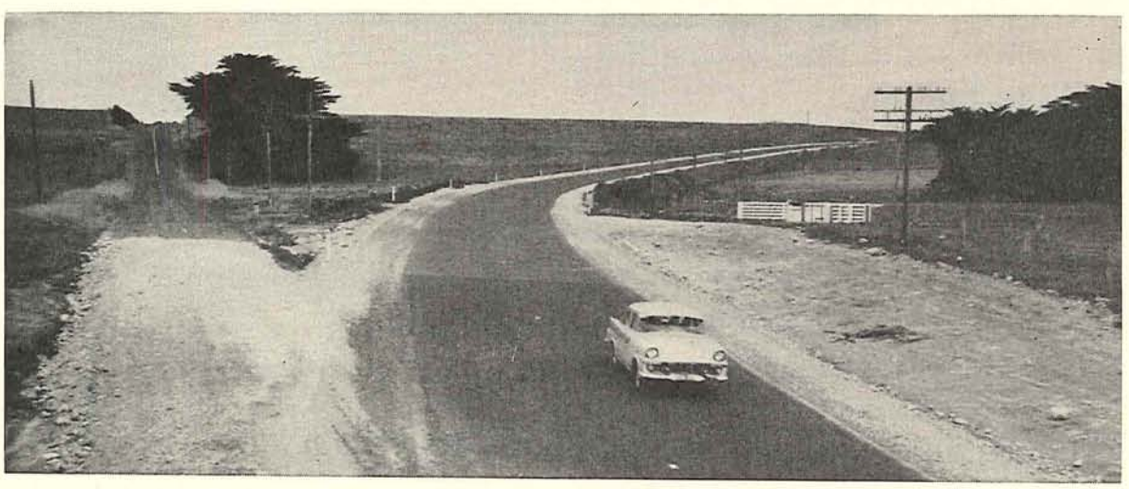


Plate 7.—Princes Highway West—Realignment at Livingston's Hill west of Tyrendarra.

Princes Highway East—

Construction of grade separated access road to the Sandown Racecourse, at the cost of the Victoria Amateur Turf Club.

Construction of 1·4 miles of dual 36-ft. carriageways from east of Heatherton Road to Clow Street, Dandenong.

Reconstruction of 0·3 mile of the Melbourne-bound carriageway east of Dandenong Creek, Dandenong.

Channelization of the intersection with the Pakenham-Koo-Wee-Rup Road at Pakenham.

Reconstruction of 1·3 miles over the Longwarry Flats.

Reconstruction of 0·8 mile and the provision of a climbing lane at Picnic Point Hill.

Reconstruction of 0·7 mile near Hazel Creek, west of Warragul.

Reconstruction of 0·4 mile through Yarragon township.

Bituminous concrete resurfacing of 1·0 mile west and 4·5 miles east of Yarragon.

Reconstruction of 3·4 miles between Kilmany and Fulham.

Reconstruction of 1·3 miles at Wurruk.

Construction of a new bridge and approaches over the Avon River at Stratford.

Reconstruction of 1·5 miles just east of Stratford.

Reconstruction of 2·0 miles just west of Nowa Nowa (Plate 8).

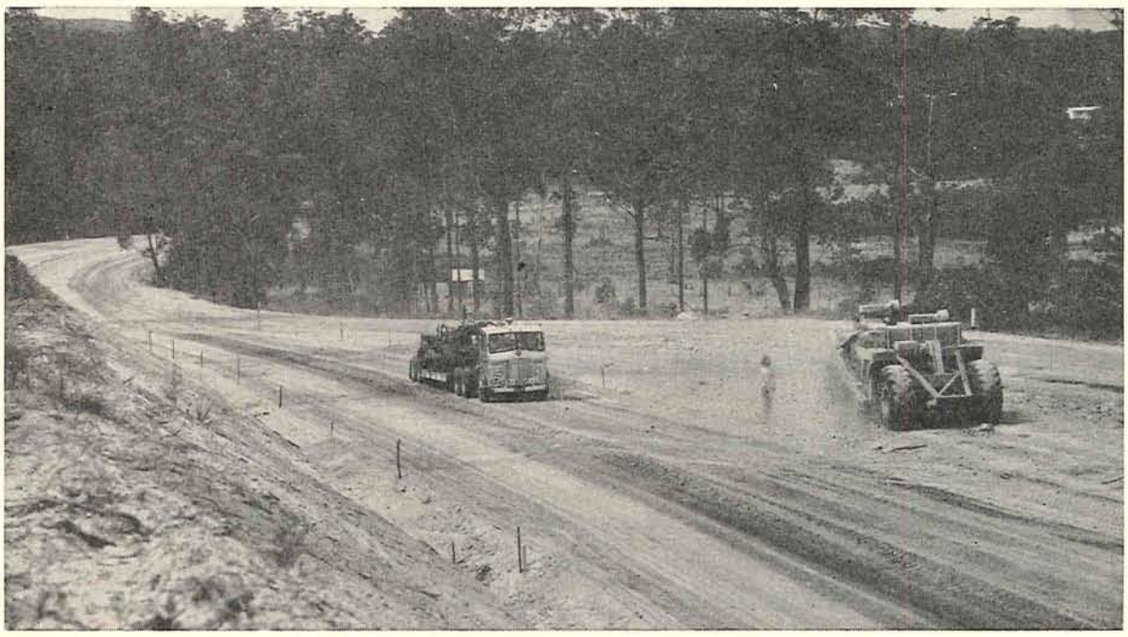


Plate 8.—Princes Highway East—Work in progress at Nowa Nowa.

Western Highway—

Construction of a duplicate bridge over Kororoit Creek near Deer Park.

Construction of a duplicate carriageway for a further 2·4 miles east of Ballarat.

Reconstruction of 3·6 miles west of Burrumbeet.

Construction of a new bridge and approaches over the Mt. Emu Creek at Trawalla.

Reconstruction of 1·6 miles west of Beaufort.

Reconstruction of 2·4 miles west of Ararat.

Reconstruction of 2 miles west of Stawell.

Resheeting of 4·7 miles between Pimpinio and Wail (Plate 9).

Resheeting of 1·3 miles east of Kaniva.

Calder Highway—

Construction of the pavement and bridgeworks for north-bound traffic at the intersection with the Lancefield Road.

Widening of 4·0 miles north of Gap Hill.

Construction of a new bridge and approaches over the Campaspe River at Kyneton.

Reconstruction of 1·0 miles north of Malmsbury.

Construction of new abutments and decking for bridging over the Bendigo Creek at Charing Cross, Bendigo.

Reconstruction of 2·84 miles between Marong and Leichardt (Plate 10).

Widening of 4·66 miles north of Wycheproof.

Reconstruction of 2·86 miles north of Sea Lake.

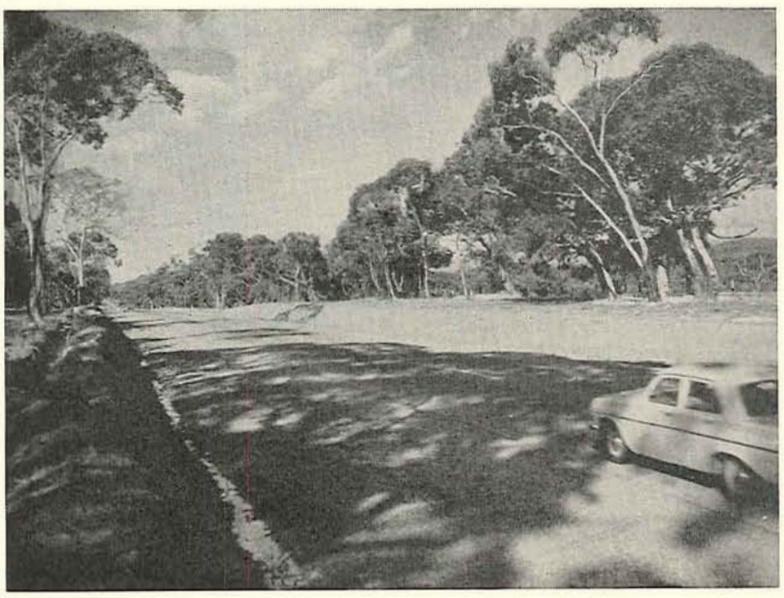


Plate 9.—Western Highway—Reconstructed section between Pimpinio and Wail.

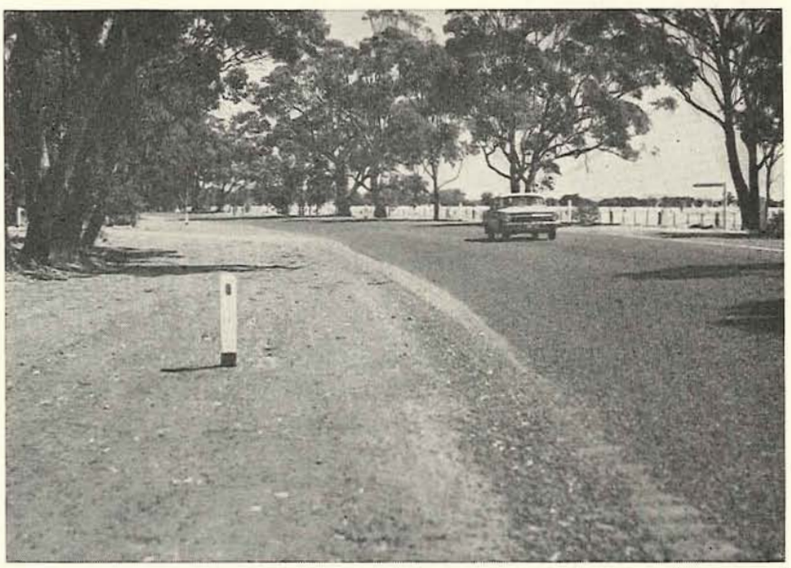


Plate 10.—Calder Highway—Reconstructed section between Marong and Leichardt.

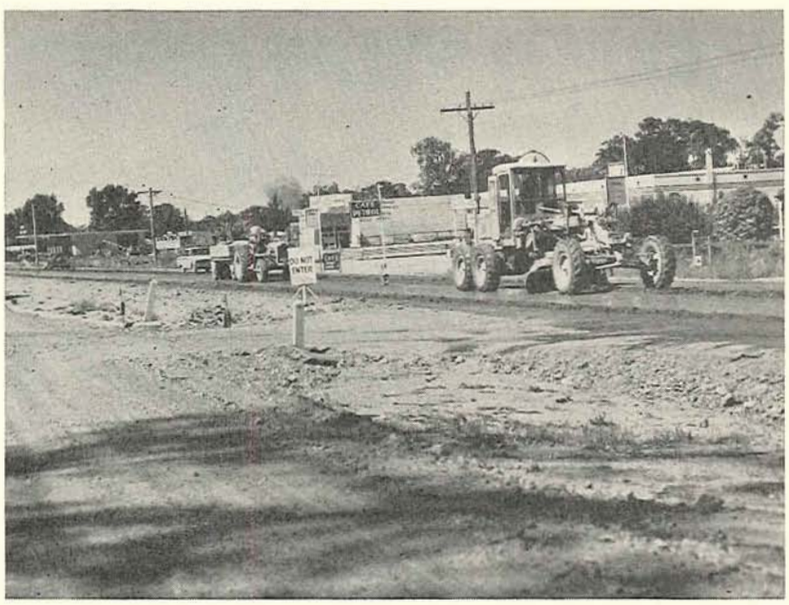


Plate 11.—Hume Highway—Construction of the approaches to the new bridges over the Ovens River at Wangaratta.

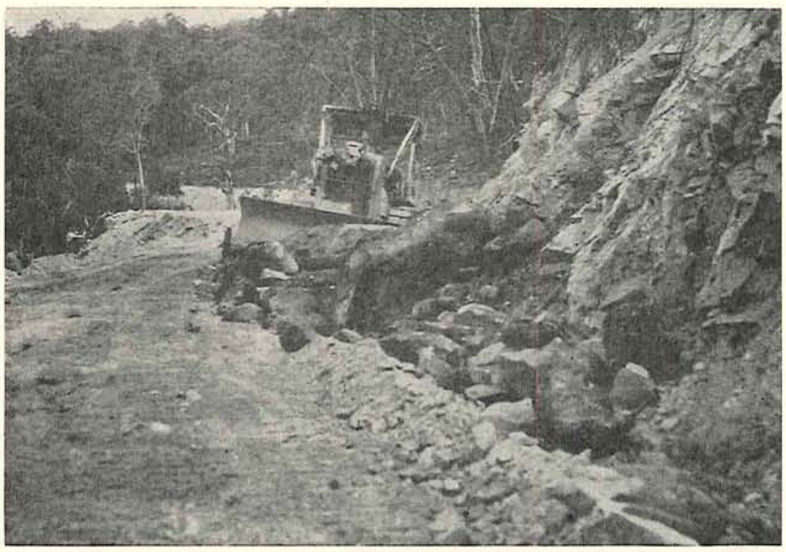


Plate 12.—Omeo Highway—Widening at Anglers Rest.

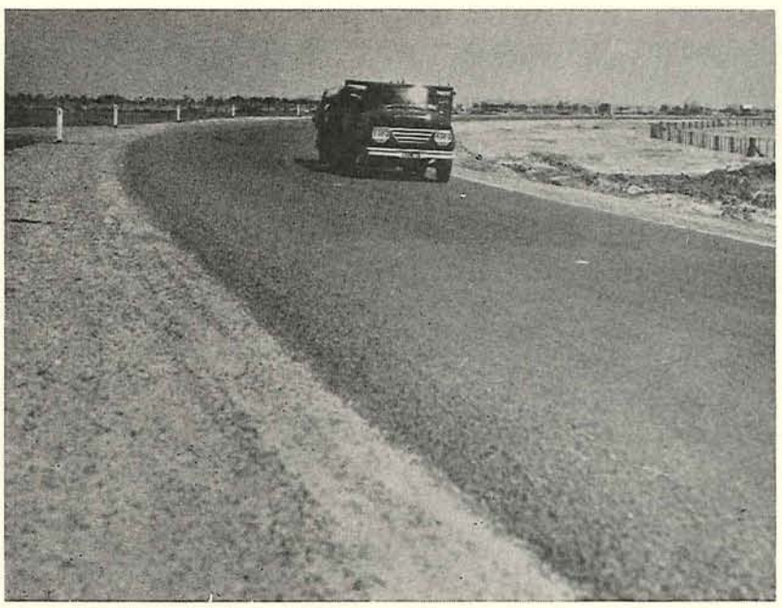


Plate 13.—Murray Valley Highway—Reconstructed section at Kerang East.

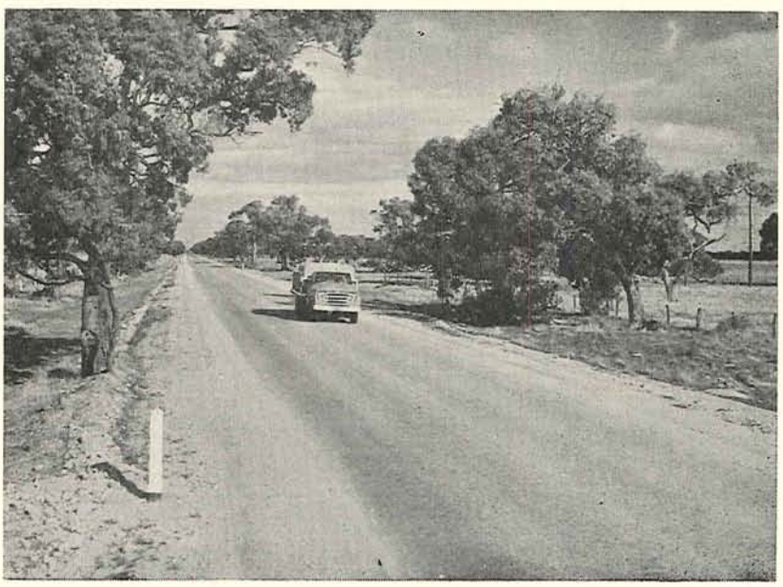


Plate 14.—Henty Highway—Reconstructed section between Rosebery and Goyura.

Hume Highway—

Reconstruction of 2·0 miles of the eastern carriageway from Boundary Road to Camp Road, Fawkner.

Bituminous concrete surfacing of 2·0 miles of the western carriageway from Boundary Road to Camp Road, Fawkner.

Construction of 2·0 miles of duplicate carriageway from Somerton Road to Craigieburn.

Resheeting of 1·1 miles at Pretty Sally Hill, Wallan.

Reconstruction of 1·25 mile and construction of a new bridge at Dry Creek.

Construction of approaches to new bridges over the Ovens River at Wangaratta (Plate 11).

Northern Highway—

Reconstruction of 3·2 miles north of Heathcote.

Omeo Highway—

Widening a further 4·0 miles at Anglers Rest (Plate 12).

Reconstruction of 3·1 miles near Noorongong.

Murray Valley Highway—

Reconstruction of 2·0 miles near Tintaldra.

Reconstruction of 2·4 miles at Kerang East (Plate 13).

Resheeting of 1·4 miles north of Swan Hill.

Reconstruction of 1·8 mile north of Nyah.

Reconstruction of 9·7 miles north of Boundary Bend.

South Gippsland Highway—

Construction of a new bridge and approaches at Cardinia Creek.

Reconstruction of 1·9 miles east of the Yarram–Traralgon Road.

Midland Highway—

Reconstruction of 1·4 miles near Meredith.

Reconstruction of 2·2 miles east of Byrneside.

Reconstruction of 2·5 miles near Woorarra East.

Bonong Highway—

Reconstruction of 1·0 mile north of Orbost.

Henty Highway—

Widening of 6·8 miles north of Hamilton.

Reconstruction of 5·0 miles between Kewell and Kellalac.

Reconstruction of 2·7 miles between Rosebery and Goyura (Plate 14).

Loddon Valley Highway—

Reconstruction of 1·9 miles north of Bear's Lagoon (Plate 15).

Reconstruction of 1·3 miles south of Kerang.

Goulburn Valley Highway—

Widening of the bridge at Hughes Creek.

Reconstruction of 2·5 miles at Mangalore West.

Construction of 0·8 mile of dual carriageway at Shepparton (Plate 16).

Reconstruction of 0·4 mile in Numurkah township.

Reconstruction of 1·6 miles at Kerrisdale.

Plate 15.—Loddon Valley Highway—Reconstructed section north of Bear's Lagoon.

Plate 16.—Goulburn Valley Highway—Dual Carriageways in Shepparton.

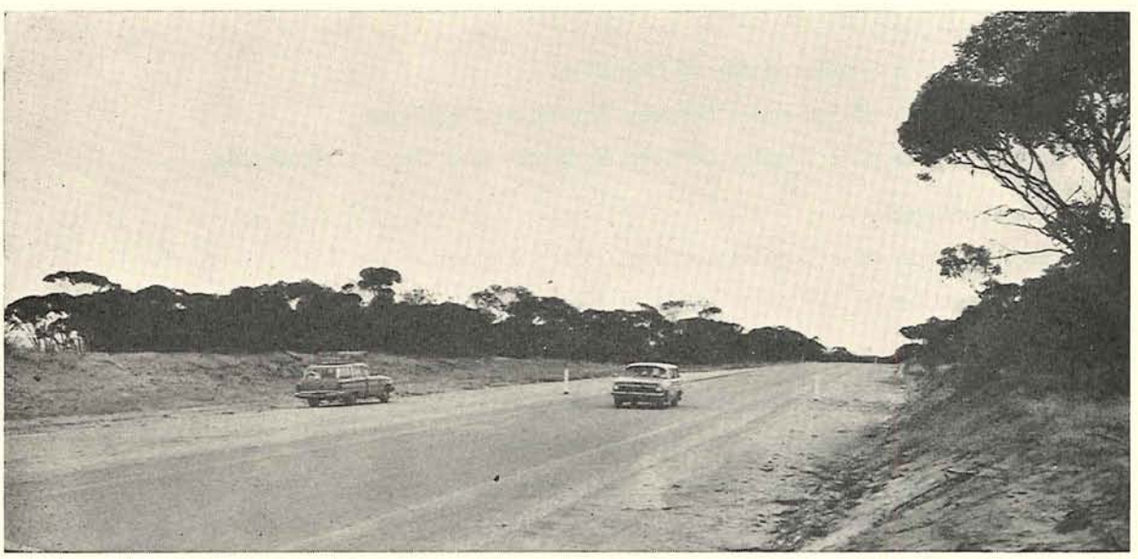


Plate 17.— Ouyen Highway—Reconstruction of 5·3 miles between Boinka and Tutye.

Ouyen Highway—

Reconstruction of 5·3 miles between Boinka and Tutye (Plate 17).

Nepean Highway—

Construction of a further 0·4 mile of dual carriageway at Frankston.

Glenelg Highway—

Reconstruction of a further 2·3 miles east of Glenthompson (Plate 18).

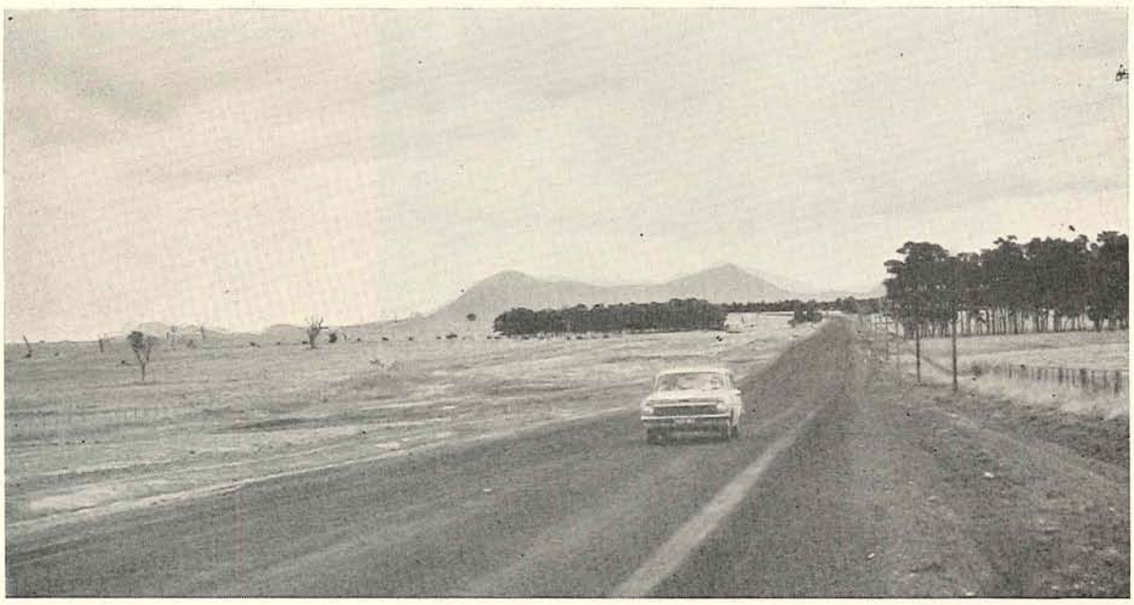


Plate 18.—Glenelg Highway—Reconstruction of a further 2·3 miles East of Glenthompson.

Borung Highway—

Reconstruction of 2·5 miles east of Dimboola.

Bass Highway—

Reconstruction of 6·7 miles between Wonthaggi and Inverloch.

Maroondah Highway—

Realignment of 0·8 mile at Yellow Creek.

Realignment of 1·1 miles north of Taggerty (Plate 19).

Resheeting of 0·9 mile west of Mansfield.

Bellarine Highway—

Construction of a further 0·6 mile of dual carriageway at East Geelong (Plate 20).

Pyrenees Highway—

Reconstruction of 0·8 miles at Moolort.

Reconstruction of 1·3 miles at Warra-Yedin.

Burwood Highway—

Reconstruction of the intersection with Mt. Dandenong Tourists' Road and Monbulk Main Road, Ferntree Gully (Plate 21).

McIvor Highway—

Reconstruction of 2·1 miles at Junorton (Plate 22).

Hamilton Highway—

Resheeting of 0·7 mile at Fyansford Deviation.

Construction of a new bridge and approaches over the Leigh River at Inverleigh.

Widening of 4·6 miles between Wingeel and Cressy.

Reconstruction of 5·8 miles between Derrinallum and Darlington.

Wimmera Highway—

Widening of 4·1 miles between Apsley and the South Australian border.

Widening of 8·5 miles between Dooen and Murtoa (Plate 23).

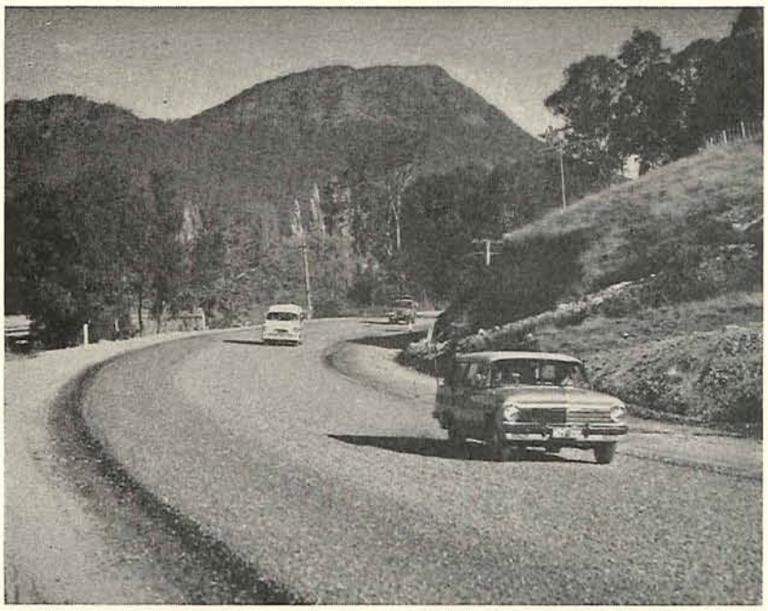


Plate 19.—Maroondah Highway—Reconstructed section near Taggerty.

Plate 20.—Bellarine Highway—Dual carriageway at East Geelong.

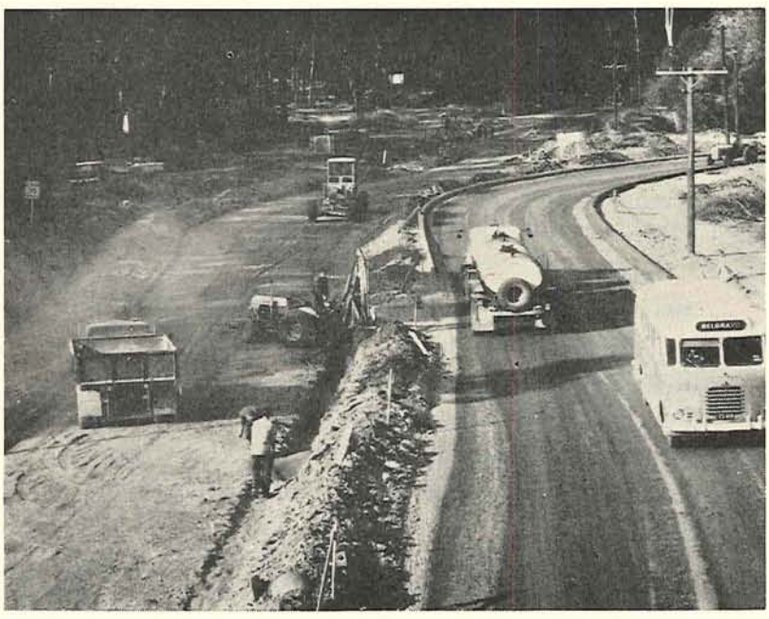


Plate 21.—Burwood Highway—Work in progress at the intersection with Monbulk Road and Mt. Dandenong Tourists' Road.

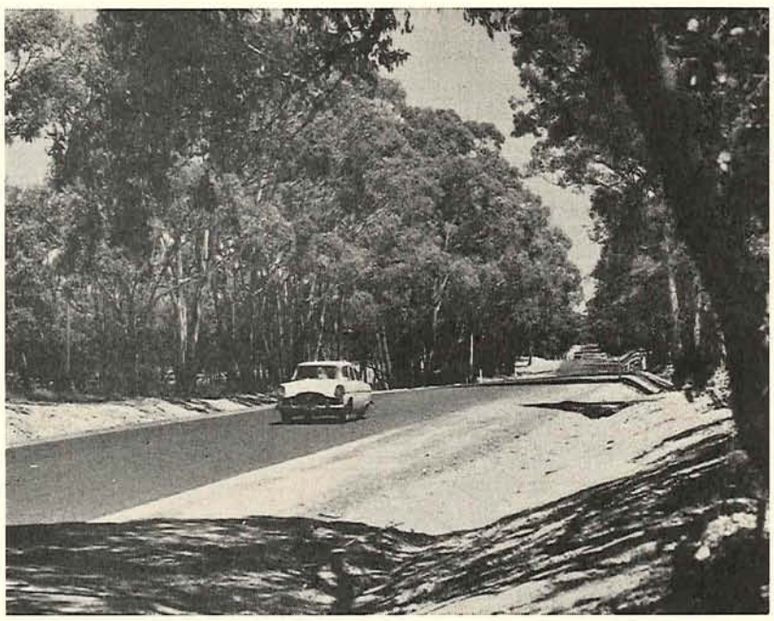


Plate 22.—McIvor Highway—Reconstructed section at Junorton.

Plate 23.—Wimmera Highway—Widened section between Dooen and Murtoa.

Plate 24.—Princes By-pass Road–Hernes Oak—Rolling aggregate on bitumen seal.

9. BY-PASS ROADS.

The total length of declared by-pass roads at 30th June, 1965 was 37 miles.

There were no additional by-pass roads declared during the year.

Major construction work continued on the Tullamarine By-pass Road with the commencement of construction of 1·8 miles of dual carriageways south from the proposed jetport terminal area. The Princes By-pass Road (Haunted Hills Section) between Gunns Gully and Hernes Oak was opened for traffic in December, 1964 (Plate 24).

Land acquisition for a number of future by-pass roads proceeded in a very active manner, and such expenditure amounted to more than £2,100,000 during the year. Projects for which land was purchased were :—

Healesville Freeway By-pass Road.
Hume By-pass Road (Craigieburn).
Mulgrave By-pass Road.
Scoresby By-pass Road.
Strathmore By-pass Road.
Tullamarine By-pass Road.
Frankston By-pass Road.
Mornington Peninsula By-pass Road.
Dingley By-pass Road.
Greensborough By-pass Road.
Calder By-pass Road.
Princes By-pass Road (Laverton).
Cranbourne By-pass Road.
Hume By-pass Road (Chiltern).
Princes By-pass Road (Moe).

10. MAIN ROADS.

Applications for funds received from municipal councils and the Board's engineers for works on main roads totalled £15,385,826. The following table shows applications, allocations and expenditure on main roads for the financial years 1963–64 and 1964–65.

	—	1963–64.	1964–65.
		£'000s	£'000s
A	Applications	14,501	15,386
B	Allocations	11,154	10,834
C	Expenditure	7,445	7,594
		%	%
B	as percentage of A	76·9	70·4
C	as percentage of B	66·7	70·1

Some of the works typical of those undertaken on main roads during the year were :—

Bairnsdale Division.—

Orbost Shire.—Buchan–Orbost Road—Reconstruction and sealing of 5·6 miles between Bete Bolong North and East Buchan.

Combienbar Road—Construction of a new three-span bridge over the Bemm River at Club Terrace (Plate 25).

Tambo Shire.—Gelantipy Road—Reconstruction of a further 1·9 miles and extension of the seal at Murrindal.

Ballarat Division.—

Avoca Shire.—Landsborough Road—A new three-span reinforced concrete bridge over Malakoff Creek 75 feet long and 24 feet wide between kerbs was completed.

Ballarat Shire.—Maryborough–Ballarat Road—Reconstruction and sealing of 2·1 miles to 20 feet wide.

Bungaree Shire.—Daylesford–Ballarat Road—Progress was made with the reconstruction and realignment of 1·2 miles near the " Gong " reservoir, east of Ballarat.

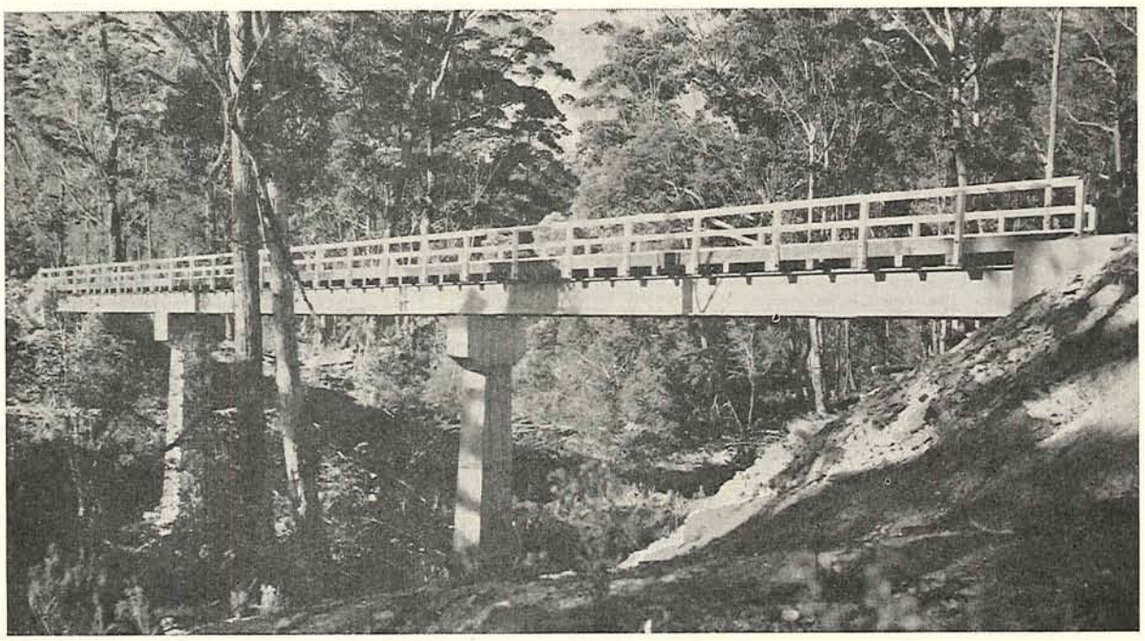


Plate 25.—Shire of Orbost–Combienbar Road—New bridge over the Bemm River at Club Terrace.

Grenville Shire.—Pitfield Road—Construction of a three-span rolled steel joist and concrete bridge 118 feet long and 28 feet wide between kerbs over Woady Yaloak River at Pitfield.

Maryborough City.—Ballarat Road—Reconstruction and realignment of 0·7 mile.

Ripon Shire.—Skipton Road—Reconstruction of 2·2 miles.

Talbot Shire.—Maryborough–Ballarat Road—Reconstruction and realignment of 2·0 miles at Brusachi's Hill.

Benalla Division.—

Beechworth Shire.—Beechworth Road—Realignment and sealing of 1·25 miles.

Bright Shire.—Bright–Tawonga Road—Reconstruction of 1·6 miles (Plate 26).

Myrtleford Shire.—Buffalo River Road—Reconstruction of Nimmo Bridge, 240 feet long and 28 feet wide between kerbs.

Oxley Shire.—Moyhu–Glenrowan Road—Reconstruction of 5 miles.

Towong Shire.—Tallangatta–Corryong Road—Reconstruction of 4·2 miles under Board's supervision.

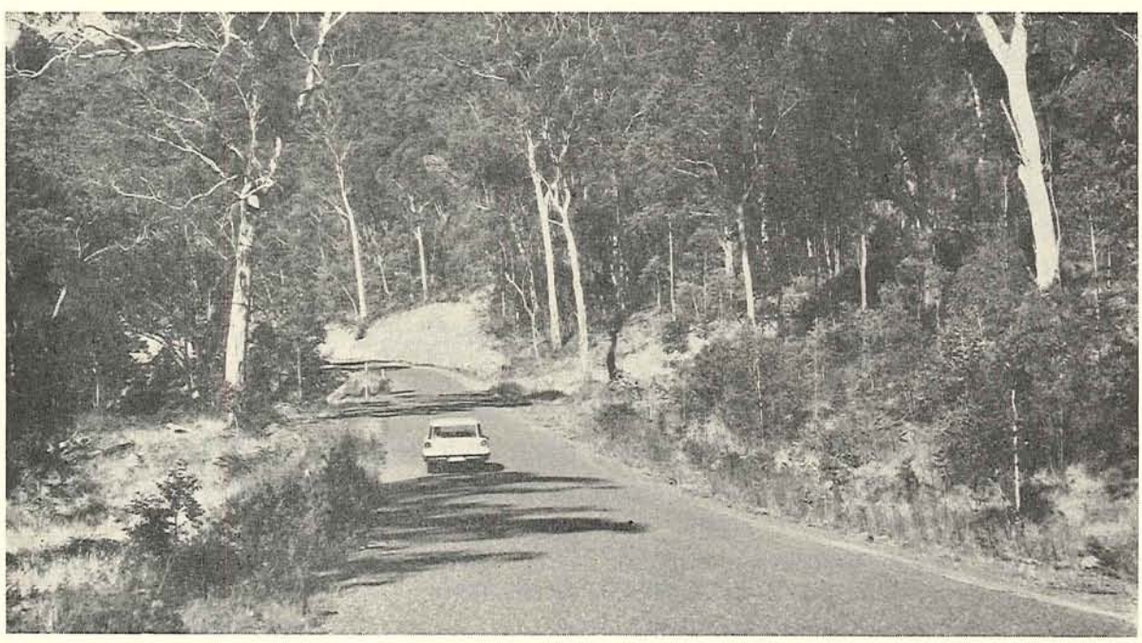


Plate 26.—Shire of Bright—Bright–Tawonga Road.

Upper Murray Shire.—Upper Murray Road—Reconstruction of 2·0 miles.

Yackandandah Shire.—Running Creek Road—Realignment and reconstruction of three sections totalling 5 miles.

Yarrawonga Shire.—Tungamah–Peechelba Road—Realignment and reconstruction of 4·2 miles.

Bendigo Division.—

Cohuna Shire (*Joint with Kerang Shire*).—Koroop Road—Reconstruction and sealing of 1·5 miles using lime stabilization.

East Loddon Shire.—Mitiamo–Boort Road—Reconstruction and sealing of 4·14 miles between the Bendigo–Pyramid Road and the Loddon Valley Highway.

Prairie–Borung Road—Construction of a bridge over Serpentine Creek one mile west of the Loddon Valley Highway and the construction of a bridge over the Loddon River (joint with Korong Shire).

Plate 27.—Echuca City—Echuca Cohuna Road—Widened, resheeted and sealed.

Echuca City.—Echuca–Cohuna Road—Widening, resheeting and sealing of 1·9 miles. Widening of four reinforced concrete bridges (Plate 27).

Gordon Shire.—Pyramid–Leitchville Road—Reconstruction, realignment and sealing of 4·31 miles south-west of Kow Swamp. Construction of a bridge 1 mile east of Pyramid Hill.

Kerang Shire.—Dumosa–Quambatook Road—Reconstruction and sealing of 2·6 miles west of Quambatook.

Kerang–Quambatook Road—Reconstruction and sealing of 3·2 miles west of Kerang. Koroop Road—Reconstruction and sealing of 3·4 miles near the east shire boundary.

Rochester Shire.—Rochester–Bamawm–Prairie Road—Reconstruction and sealing of 1·85 miles east of Lockington.

Rodney Shire.—Mooroopna–Wyuna Road—Reconstruction and sealing of 1·75 miles north-westerly from Undera.

Swan Hill Shire.—Annuello–Wemen Road—Realignment, forming and gravelling of 5 miles.

Ouyen–Piangil Road—Forming and gravelling of 6 miles east of Kulwin.

Sea Lake–Robinvale Road—Preparation and sealing of 9·8 miles between Annuello and Murray Valley Highway at Bannerton.

Waranga Shire.—Goornong–Murchison Road—Widening, strengthening and sealing of 3·7 miles on sections between Rushworth and Colbinabbin.

Wycheproof Shire.—Sea Lake–Ultima Road—Widening and sealing of 4·7 miles easterly from Sea Lake.

Culgoa–Lalbert Road—Realignment and reconstruction of 4·5 miles near the shire boundary.

Berriwillock–Woomelang Road—Reconstruction and sealing of 3·36 miles east of the Birchip–Sea Lake Road.

Birchip–Wycheproof Road—Reconstruction and sealing of 8 miles westerly from Wycheproof.

Dandenong Division.—

Bass Shire.—Wonthaggi–Loch Road—2·08 miles of reconstruction and realignment.

Buln Buln Shire.—Loch Valley Road—Construction of four-span reinforced concrete " U " slab bridge 101 feet long and 24 feet between kerbs over Latrobe River at Noojee.

Cranbourne Shire.—Healesville–Koo-Wee-Rup Road—Construction of approaches and completion of three reinforced concrete bridges near Koo-Wee-Rup—

0·59 mile between Mile Creek and Gippsland Railway ;

0·56 mile reconstruction and widening north of Heatherton Road ; and

0·83 mile of reconstruction and widening at Keysborough.

Warragul Shire.—Brandy Creek Road—0·85 mile reconstruction of dual carriageway at Warragul.

Waverley City.—High Street Road—One mile of reconstruction between Huntingdale Road and Doncaster–Mordialloc Main Road.

Whittlesea Shire.—Epping Road—0·65 mile of widening existing pavement to provide 40 feet between kerbs near Keon Park.

Geelong Division.—

Bacchus Marsh Shire.—Geelong–Bacchus Marsh Road—Regrading to improve visibility, widening and strengthening of 1·4 miles.

Barrabool Shire.—Barrabool Road—Widening from 12 feet to 18 feet with surface correction treatment of 2 miles.

Bellarine Shire.—Ocean Grove Road—Widening to 24 feet for a distance of 1·4 miles.

Bulla Shire.—Mickleham Road—Widening, strengthening and sealing of a further 1·2 miles.

Colac Shire.—Colac–Ballarat Road—Strengthening and sealing of three sections totalling 2 miles.

Colac–Forrest Road—Reconstruction and sealing of 1·4 miles.

Corangamite Lake Road—Reconstruction and sealing extended by a further 1 mile.

Corio Shire.—Geelong–Ballan Road—Widening, strengthening and sealing of a narrow failed section 2·7 miles in length.

Gisborne Shire.—Bacchus Marsh Road—Widening and sealing to 18 feet wide for a distance of 1·6 miles.

Mt. Macedon Road—Reconstruction of 1·5 miles in three sections.

Kyneton Shire.—Redesdale Road—Widening of a further 1·4 miles to provide an 18 feet wide seal.

Trentham Road.—Reconstruction continued for a further 1·25 miles.

Leigh Shire.—Rokewood–Shelford Road—Remodelling of the bridge over Kuruc-A-Ruc Creek in Rokewood to provide a widened reinforced concrete superstructure on the existing masonry abutments and piers.

Shelford–Bannockburn Road—Reconstruction and sealing of two sections totalling 3·3 miles.

Melton Shire.—Keilor–Melton Road —Widening and sealing of 2 miles and the improvement and lengthening of the drainage structure over a 7 mile section.

Otway Shire.—Beech Forest–Apollo Bay Road—Construction of a three-span reinforced concrete bridge 91 feet long, 22 feet wide between kerbs over the Barham River near Apollo Bay.

Charley's Creek Road.—Major realignment of the final section of 1·7 miles to complete the reconstruction of 11 miles of this road.

Romsey Shire.—Gisborne–Kilmore Road—Completion of the reconstruction and sealing of a 2·4 mile section providing a sealed connection between Gisborne and Romsey.

South Barwon Shire.—Barwon Heads Road—Widening, strengthening and sealing under Board's supervision of 0·5 mile from Princes Highway to Bailey Street to make a satisfactory by-pass of the Belmont commercial centre.

Barrabool Road—Widening of 0·3 mile in the programme to improve traffic flow from the new Princes Bridge.

Torquay Road—Construction of a three-span reinforced concrete bridge 61 feet long, 28 feet wide between kerbs over the Waurn Ponds Creek. Reserve widening between Belmont and Groverdale continued with land acquisition, shifting of services and two houses in readiness for deviation of this section of the road.

Werribee Shire.—Geelong–Bacchus Marsh Road—Reconstruction and widening of 1·3 miles.

Winchelsea Shire.—Winchelsea–Deans Marsh Road—total reconstruction and realignment of 1·2 miles south of Bambra (Plate 28).

Plate 28.—Winchelsea Shire—Work in progress on the Winchelsea–Deans Marsh Road.

Horsham Division.—

Birchip Shire.—Birchip–Sea Lake Road—Widening of 7·3 miles to provide an 18 feet wide seal.

Dimboola Shire.—Rainbow Road—Reconstruction of 5·45 miles between Dimboola and Arkona (Plate 29).

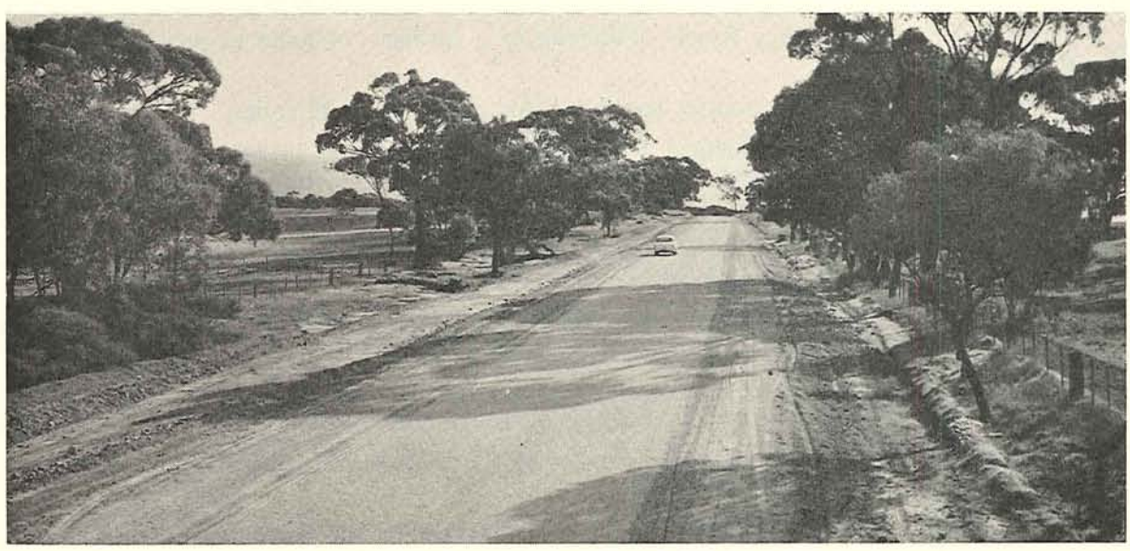


Plate 29.—Dimboola Shire—Reconstructed section of Rainbow Road.

Kaniva Shire.—Kaniva–Edenhope Road—Widening of 5·68 miles to provide an 18 feet wide seal.

Kara Kara Shire.—St. Arnaud–Dunolly Road—Construction of a five-span prestressed concrete beam bridge 24 feet wide between kerbs over the Avoca River at Emu.

Stawell Shire.—Horsham–Wal Wal Road—Reconstruction and sealing to complete the sealing of this road.

Wimmera Shire.—Horsham–Wal Wal Road—Reconstruction and sealing to complete the seal on this road. All main roads in Wimmera Shire are now sealed.

Metropolitan Division.—

Altona Shire.—Millers Road—Reconstruction and duplication from south of Blackshaws Road to the Geelong railway line.

Moorabbin and Caulfield Cities.—North Road—Duplication from Wild Cherry Road to East Boundary Road.

Northcote City.—Heidelberg–Eltham Road—Reconstruction between Merri Creek and Gillies Street to provide a six lane divided roadway.

Oakleigh City.—North Road—Reconstruction of southern carriageway from Princes Highway East to Huntingdale Road.

Preston City.—Fairfield Reservoir Road—Channelization at intersection with Whittlesea Main Road, Summerhill Road and Bolderwood Parade.

Sandringham City.—South Road—Construction of the southern carriageway, Hampton Street to New Street.

Traralgon Division.—

Alberton Shire.—Yarram–Traralgon Road—Sealing under Board's supervision of 2 miles of deviation near Carrajung 70 feet wide.

Maffra Shire.—Maffra–Newry Road—Deviation at Pine Hill 2 miles in length.

Morwell Shire.—Morwell River Road—Construction under Board's supervision of a new reinforced concrete bridge 135 feet long, 20 feet wide between kerbs, together with bridge approaches over the Morwell River south of Boolarra (Plate 30).

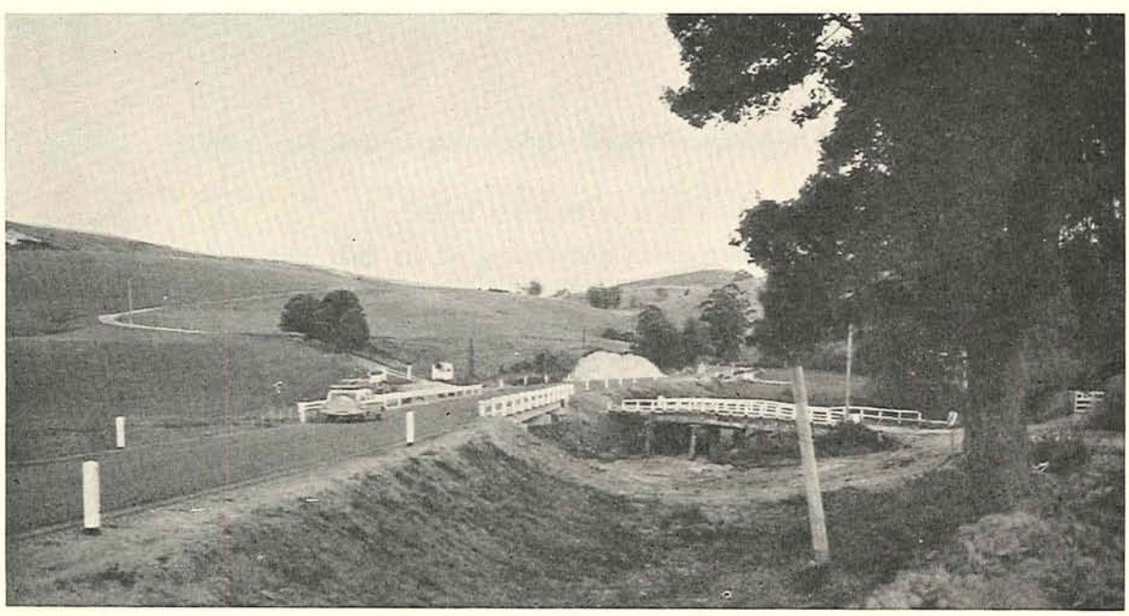


Plate 30.—Morwell Shire—New bridge and approaches on the Morwell River Road south of Boolarra.

Warrnambool Division.—

Glenelg Shire.—Casterton–Apsley Road—Realignment, reconstruction and sealing of 2·7 miles.

Casterton-Edenhope Road—Construction of a three-span "U" slab and reinforced concrete bridge 75 feet long, 26 feet between kerbs over Wando Vale Ponds.

Hampden Shire.—Camperdown–Ballarat Road—Realignment, reconstruction and sealing of 1·92 miles.

Heytesbury Shire.—Cobden–Terang Road—Realignment, reconstruction and sealing of 2·3 miles.

Mount Rouse Shire.—Penshurst–Warrnambool Road—Realignment, reconstruction and sealing of 1·1 miles.

Portland Shire.—Dartmoor-Hamilton Road—Reconstruction and sealing of 2·7 miles.

Warrnambool Shire.—Mortlake Road—Reconstruction of 4·2 miles.

Warnambool-Caramut Road—Reconstruction and sealing of 5·8 miles.

11. UNCLASSIFIED ROADS.

The Board again assisted municipal councils in undertaking works of improvements, construction and maintenance on unclassified roads under municipal jurisdiction. The table below summarizes the applications for funds, the allocations made from Commonwealth Aid Road funds and expenditure incurred by the Board.

Unclassified Road Construction and Maintenance.	1963–64.	1964–65.
	£'000s	£'000s
A Applications	17,432	17,816
B Allocations	7,388	7,630
C Expenditure	5,053	5,565
	%	%
B as percentage of A	42·4	42·8
C as percentage of B	68·4	72·9

Some of the more important works carried out on unclassified roads during the year were :

Bairnsdale Division.—

Omeo Shire.—Upper Kiewa Valley Road Extension—Construction of a new connecting road between the Rocky Valley Dam and the Omeo Highway at Shannon Vale.

Orbost Shire.—West Cann Road—Construction of a new three–span bridge over the Cann River at Noorinbee.

Ballarat Division.—

Ararat Shire.—Willaura–Mininera Road—Reconstruction of two sections totalling 3·4 miles.

Geelong Road—Reconstruction of a further 3·1 miles.

One Tree Hill Road—Reconstruction and sealing of the final mile of the 1·55 mile road to the Pioneer Memorial Lookout in conjunction with the Tourist Development Authority.

Buninyong Shire.—Mount Buninyong Lookout Road—Reconstruction and sealing of the 1·5 miles "up" road leading to the Lookout in conjunction with the Tourist Development Authority.

Creswick Shire.—Werona–Kingston Road—Construction of new reinforced concrete bridge over Deep Creek.

Grenville Shire.—Smythesdale–Snake Valley Road—Realignment and resheeting of 1·3 miles 12 feet wide to the Ripon Shire boundary.

Ripon Shire.—Stockyard Hill Road—Reconstruction and realignment of a further 2 miles (Plate 31).

Tullaroop Shire.—Timor Road—Construction of a new concrete bridge over Bet Bet Creek.

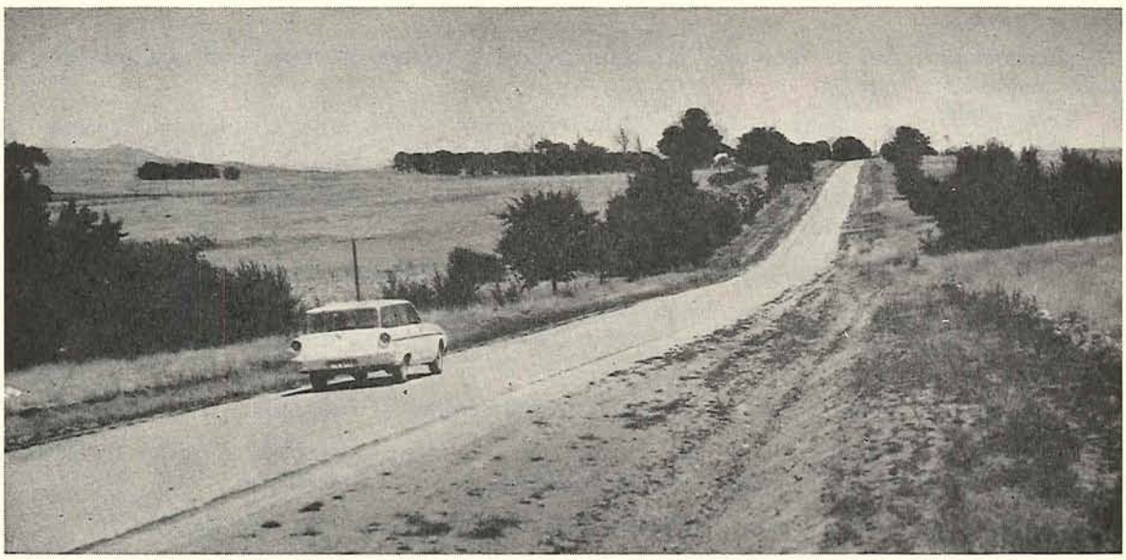


Plate 31.—Ripon Shire–Stockyard Hill Road—Reconstructed and realigned section.

Benalla Division.—

Numurkah Shire.—Walsh's Bridge South—Construction of a five-span prestressed bridge 24 feet wide between kerbs.

Tungamah Shire.—Tungamah–Devenish Road—Reforming, gravelling priming and sealing of 4 miles.

Bendigo Division.—

Bendigo City.—Construction of Chapel Street Bridge.

Deakin Shire.—Tongala Central North and South Road—Resheeting and sealing of 4 miles.

Echuca City.—Annesley Street—Reconstruction and sealing of 1 mile.

Kerang Shire.—Quambatook–Swan Hill Road—Reconstruction and sealing of 3·9 miles north of Quambatook.

Korong Shire.—Hurstwood School Road—Construction of a bridge over the Loddon River.

Swan Hill City.—Beveridge Street—Widening and sealing for a length of 0·8 mile.

Swan Hill Shire.—Quambatook Road—Reforming, gravelling and sealing of 4 miles.

Ultima–Culgoa Road—Reforming, gravelling and sealing of 5·7 miles.

Wycheproof Shire.—Nullawil–Birchip Road—Reconstruction and sealing of 2·4 miles west of Nullawil.

Dandenong Division.—

Alexandra Shire.—Eildon–Jamieson Road—Reconstruction of 3 miles by direct labour.

U.T. Creek Road—2·21 miles of reconstruction.

Cranbourne Shire.—Warrandyte Road—1·48 miles of reconstruction north of Baxter–Tooradin Road.

Healesville Shire.—Lake Mountain access road—Widening and reconstruction of 1·85 miles to Ski Run No. 11 in conjunction with the Tourist Development Authority.

Healesville and Yea Shires.—Yarra Glen–Yea Road—Reconstruction of 0·8 mile at Castella.

Nunawading City.—Bla
of Canterbury Road.

Ringwood City.—Wantirna Road—0·41 mile realignment and reconstruction.

Waverley City.—Huntingdale Road—0·75 mile of widening and reconstruction between Ferntree Gully Road and Waverley Road.

Knox and Berwick Shires and Dandenong City.—Bergins Road and Army Road—Construction of access roads to the Police Paddocks adjoining the Churchill National Park chosen as the location for an International Scout Jamboree in January, 1965.

Geelong Division.—

Bannockburn Shire.—Bannockburn–Maude Road—Reconstruction and sealing involving realignment of 0·5 mile.

Barrabool Shire.—Bells Beach Road—Construction of 1·8 miles to improve access to the beach between Torquay and Anglesea in conjunction with the Tourist Development Authority.

Bellarine Shire.—A number of streets were constructed and sealed in the townships of Portarlington, Drysdale and Ocean Grove.

Bulla Shire.—Mt. Ridley Road—Reconstruction and sealing of 1 mile.

Colac Shire.—Seven Bridges Road—Clearing, forming and paving of this road completed to provide an important connection between the Colac–Forrest and Birregurra–Forrest main roads.

Cundare–Duverney Road—Reconstruction and sealing of 0·9 mile.

Corio Shire.—Woodstock Road—Paving and sealing to complete a route from Corio Overpass on the Princes Highway West to the Shell Oil Refinery, Corio.

Geelong City.—Fyans Street—Construction and sealing of the easterly section.

Geelong West City.—Albert Street—total reconstruction of 1,580 lineal feet with an asphaltic top.

Gisborne Shire.—Honour Avenue, Macedon—Reconstruction and sealing of 0·7 mile.

Kyneton Shire.—Kyneton–Lauriston Road—Reconstruction and sealing of 1·5 miles.

Kyneton–Baynton Road—Reconstruction and sealing of a further 1 mile.

Leigh Shire.—Shelford–Winchelsea Road—Construction of a three-span reinforced concrete bridge over the Warrambine Creek.

Melton Shire.—Leakes Road—Reconstruction and sealing of 1·2 miles.

Newham and Woodend Shire.—Morris and Bawden Road—Reconstruction and sealing of 3,500 lineal feet at Woodend.

Newtown and Chilwell City.—Shannon Avenue—Completion of the widening and strengthening over the final 1,581 lineal feet.

Newtown and Chilwell City with South Barwon Shire.—Princes Bridge—Completion of a five-span reinforced concrete and steel bridge 480 feet long and 28 feet between kerbs over the Barwon River at Shannon Avenue. Work included the construction of a realigned northern approach on Shannon Avenue and the channelization of the four-way intersection on the southern approach.

Otway Shire.—Carlisle North Road—Reconstruction of an additional 1·3 miles.

Apollo Bay Streets—Reconstruction of 1,367 lineal feet of McLennan Street.

Kennedy's Creek Settlement Road—Improvement to flat section by forming and paving 1,200 lineal feet and the provision of multi-cell culverts.

Queenscliffe Borough.—Nelson Road—Construction and sealing of 1,870 lineal feet.

Romsey Shire.—Pyalong Road—Reconstruction of a further 1·5 miles and sealing of another 1·1 miles.

Konagaderra Road—Widening of a rock cutting incorporating alignment improvements.

South Barwon Shire.—Roslyn Road, Belmont—Completion of the widening and asphalt surfacing between the Belmont and Highton Shopping Centres.

Francis Street, Belmont—Total reconstruction including asphalt surfacing of 800 lineal feet for a width of 40 feet between kerbs and channelling.

Werribee Shire.—Boundary Road—Reconstruction and sealing of 1·6 miles.

Winchelsea Shire.—Kildean Road—Provision of multi-cell culvert and floodway.

Lorne streets—Construction and sealing of Albert and Gay Streets.

Horsham Division.—

Arapiles Shire (*Joint Wimmera Shire*).—Polkemmet Road—Construction of a new reinforced concrete bridge over the Wimmera River at Polkemmet.

Kaniva Shire.—Big Desert Area—Construction and sealing of an additional 3 miles of road serving the A.M.P. Land Development Scheme.

Metropolitan Division.—

Camberwell, Heidelberg and Kew Cities.—Burke Road—Construction of a new bridge and approaches over the Yarra River.

Camberwell City.—Belmore Road—Reconstruction and widening between Wood Street and Greythorn Road (Plate 32).

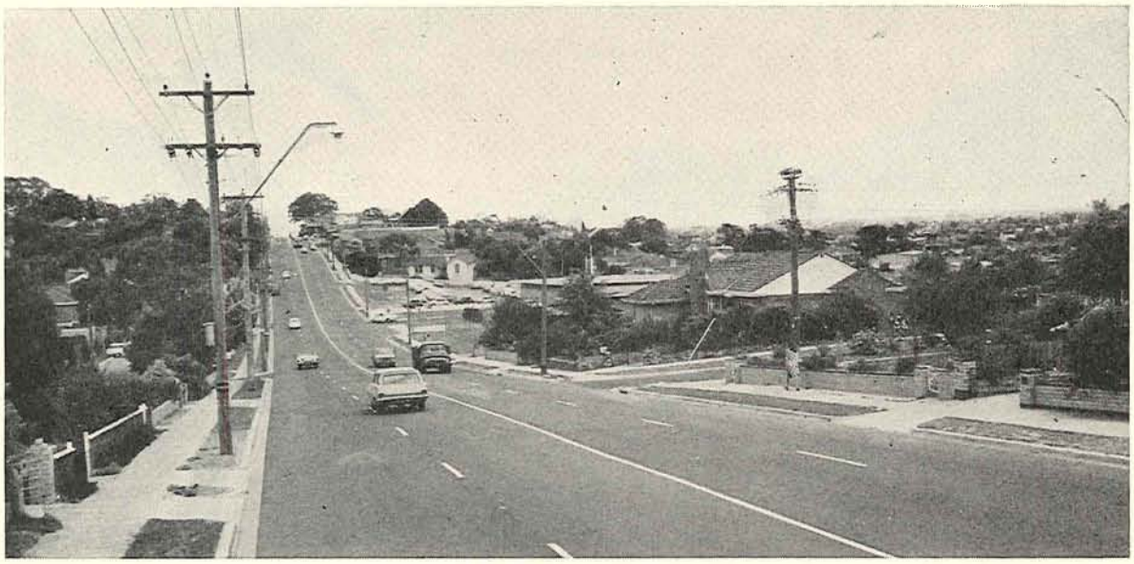


Plate 32.—Belmore Road between Wood Street and Greythorn Road, City of Camberwell.

Coburg City.—Sydney Road—Reconstruction from Bell Street to Baker's Road.

Collingwood City.—Victoria Parade—Reconstruction of northern carriageway from Smith Street to Hoddle Street (Plate 33).

Keilor City.—Milleara Road—Continuation of reconstruction and widening between Calder Highway and Canning Street.

Preston City.—Murray Road—Widening and reconstruction between Jessie Street and the railway line. Construction of a bridge over Darebin Creek to connect Murray Road with Southern Road.

South Melbourne City.—Canterbury Road—Reconstruction and duplication from Fraser Street to Armstrong Street.

Sunshine City.—Forrest Street—Construction of a new bridge over Kororoit Creek.

Station Street—Construction of a new bridge over Kororoit Creek.

Plate 33.—Reconstructed northern carriageway—Victoria Parade, City of Collingwood.

Traralgon Division.—

Alberton Shire.—Tap Tap Road—Reconstruction and sealing of 1·5 miles.

South Gippsland Shire.—Fish Creek–Yanakie Road—Completion and sealing under Board's supervision of the final 2·3 miles south of Fish Creek (Plate 34).

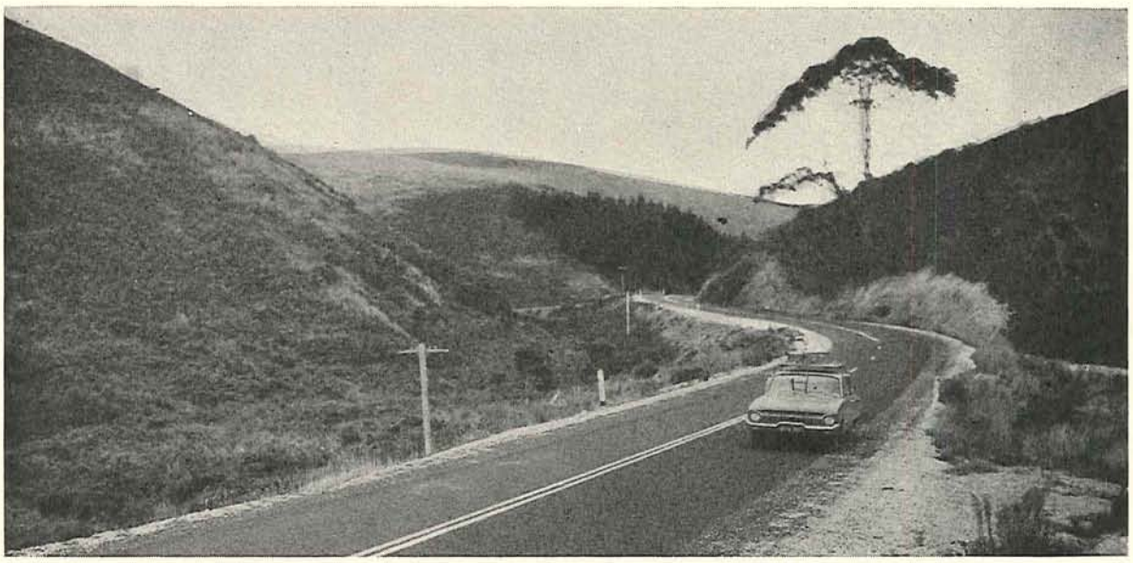


Plate 34.—South Gippsland Shire–Fish Creek–Yanakie Road—completion of final 2·3 miles.

Warrnambool Division.—

Dundas Shire.—Strathkellar Road—Construction of a three-span reinforced concrete and "U" slab bridge over Nine Mile Creek.

Hampden Shire.—Skipton–Geelong Road—Reconstruction and sealing of 2 miles south of Skipton.

Mount Rouse Shire.—Glenthompson–Caramut Road—Reconstruction and sealing of 2 miles.

Portland Shire.—Portland–Nelson Road—Reconstruction and realignment under Board's direct control of 6 miles.

12. TOURISTS' ROADS.

The Board bears the full cost of the construction and maintenance of declared tourists' roads on which an amount of £711,000 was spent during 1964–65.

The total length of tourists' roads remained unchanged at 445 miles.

Particularly heavy snowfalls during the winter of 1964 added to the difficulty and expense of keeping open the tourists' roads to the snow fields.

The most important works carried out on these roads during the year were :—

Mt. Buffalo Road.—Reconstruction of 2·5 miles below Staker's Lookout (Plate 35).

Ocean Road.—Construction of new bridge and approaches over the Kennett River.

Reconstruction of a further 1·5 miles between Kennett River and Apollo Bay.

Construction of a bridge and approaches at Carisbrook Creek to eliminate the last of the floodways on this section (Plate 36).

Repair of flood damage between Lorne and Apollo Bay.

Reconstruction of 1·3 miles between the Calder and Aire Rivers.

Wilson's Promontory Road.—Reconstruction of 2·26 miles north of Derby River (Plate 37).

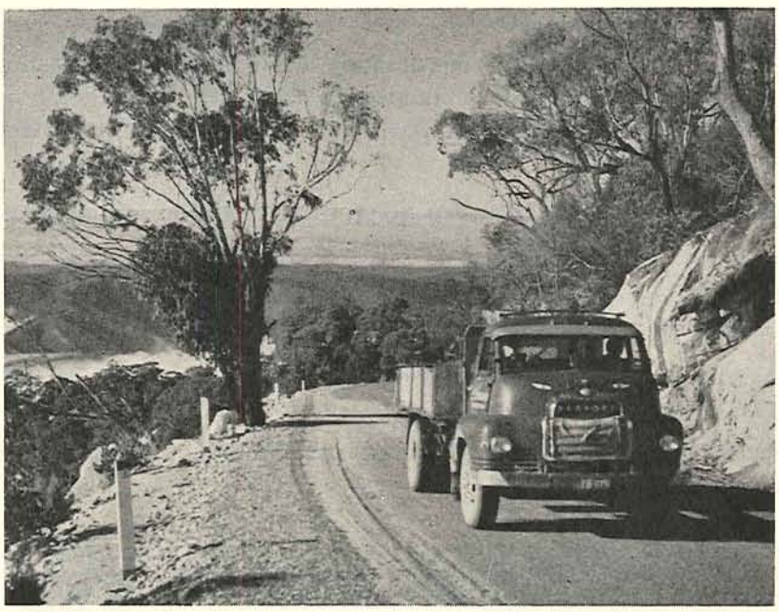


Plate 35.—Mt. Buffalo Road—Reconstructed section below Staker's Lookout.

Plate 36.—Ocean Road—Construction of the approaches to the bridge at Carisbrook Creek.

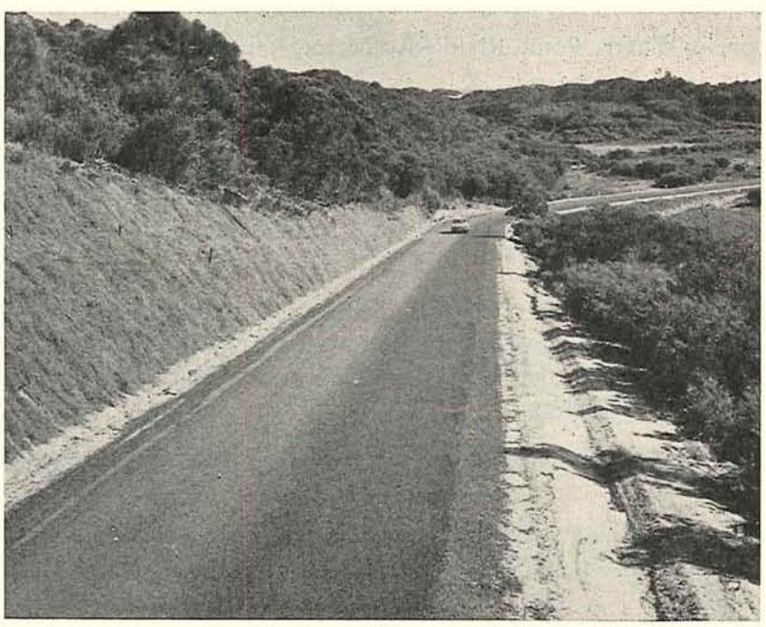


Plate 37.—Wilson's Promontory Road—Reconstructed section north of Derby River.

13. FOREST ROADS.

The Board bears the whole cost of all work both construction and maintenance on forest roads. Total applications for works on forest roads amounted to £485,300 and a total of £428,705 was allocated. Expenditure amounted to £356,880. Some of the more important works carried out during the year were :

Bairnsdale Shire.—Bairnsdale–Dargo Road—Reconstruction of 2·2 miles on an improved alignment at Glenaladale.

Narracan Shire.—Walhalla Road—Formation widened with minor realignments to provide a 22 feet wide formation over 6 miles north of Walhalla.

Tambo Shire.—Bruthen–Buchan Road—Construction on an improved alignment of the approaches to a new bridge over Boggy Creek (Plate 38).

Red Knob Road—Reconstruction and sealing of the final gravel section 0·6 miles in length just north of Nowa Nowa.

Plate 38.—Tambo Shire–Bruthen–Buchan Road.

Upper Yarra Shire.—Warburton–Woods Point Road—Resheeting of a further 1·85 miles for sealing 18 feet wide.

14. BRIDGES.

During the year approximately 170 new bridges were commenced at an estimated cost of £2,364,000. Of this number, 54 new bridges estimated to cost £1,480,000 were commenced under the Board's supervision and 116 estimated to cost £884,200 were commenced under municipal supervision.

A great deal of planning and design was devoted during the year to the preparation of plans and specifications for the new bridge between San Remo and Newhaven. The new bridge will be 2,100 feet long by 28 feet between kerbs plus a 6-ft. footway, and is estimated to cost approximately £900,000, including approaches.

Included amongst the larger bridges completed under the Board's supervision during the year were :—

(*a*) a prestressed concrete beam and reinforced concrete bridge 122 feet long by 28 feet between kerbs, plus a 7-ft. footway, over the Kennett River on the Ocean Road at 100·1 miles ;

(*b*) reconstruction, under traffic, in reinforced concrete and precast concrete deck slabs of the culvert 346 feet long by 50 feet wide, carrying Bendigo Creek under Charing Cross in the centre of Bendigo ;

(*e*) a prestressed concrete beam and reinforced concrete bridge 241 feet long by 28 feet between kerbs plus a 6-ft. footway, over the Campaspe River on the Murray Valley Highway at Crossenvale near Echuca (Plate No. 39).

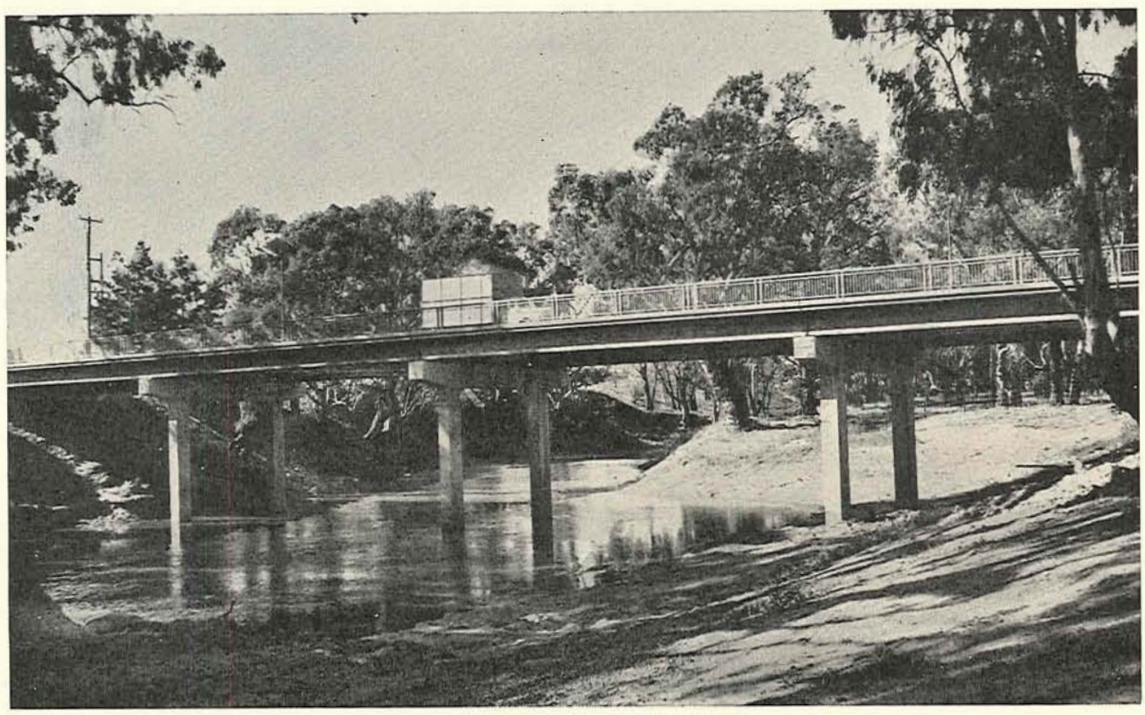


Plate 39.—New Bridge over the Campaspe River at Crossenvale, City of Echuca.

In addition to bridges over streams the Board also completed a further two road-over-rail bridges to eliminate two railway level crossings. These bridges were :—

(*a*) a steel girder and reinforced concrete structure 122 feet long by 28 feet between kerbs over the railway line at Langi Ghiran at 116 miles on the Western Highway ;

(*b*) a steel girder and reinforced concrete structure 174 feet long by 28 feet between kerbs eliminating the level crossing at Wail at 203·3 miles on the Western Highway.

Bridges completed under municipal supervision during the year included :

(*a*) a 5-span prestressed concrete beam and reinforced concrete bridge 181 feet long by 24 feet between kerbs over the Wimmera River on Polkemmet Road in Arapiles Shire (Plate 40) ;

(*b*) a prestressed concrete beam and reinforced concrete bridge 181 feet long by 28 feet between kerbs plus a 6-ft. footway, over Kororoit Creek on Forrest Street in the City of Sunshine (Plate 41) ;

(*c*) a 6-span reinforced concrete bridge 150 feet long by 24 feet between kerbs over Pyramid Creek on the Pyramid–Leitchville Road in Gordon Shire ;

(*d*) Nimmo Bridge, a 6-span prestressed concrete beam and reinforced concrete bridge, 240 feet long by 28 feet between kerbs, over the Ovens River on the Buffalo River Road in the Shire of Myrtleford ;

(*e*) a 4-span reinforced concrete bridge 101 feet long by 24 feet between kerbs plus 5 ft. 6 in. footway, over the Latrobe River on the Loch Valley Road, Noojee in Buln Buln Shire (Plate 42) ;

(*f*) a prestressed concrete beam and reinforced concrete bridge 140 feet long by 28 feet between kerbs plus two 6-ft. footways over the Plenty River on the Heidelberg–Kinglake Road in Greensborough.

(*g*) a 3-span composite steel girder and reinforced concrete bridge 135 feet long by 24 feet between kerbs built on a sharp curve over the Tarwin River on the Leongatha–Yarragon Road in the Shire of Woorayl.

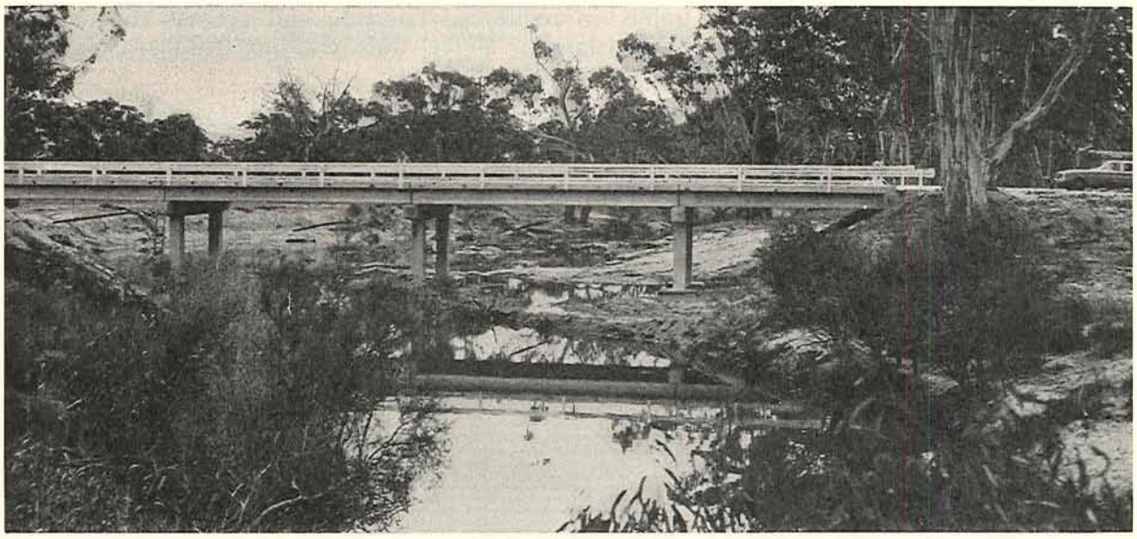


Plate 40.—Arapiles Shire—Five-span concrete bridge over the Wimmera River on Polkemet Road.

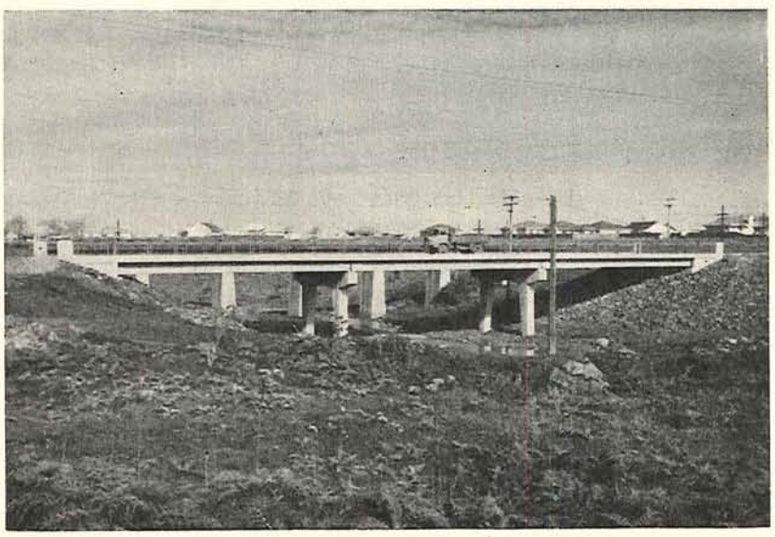


Plate 41.—City of Sunshine—new concrete bridge over Kororoit Creek on Forrest Street.

Plate 42.—Shire of Buln Buln—Four-span concrete bridge over the Latrobe River on the Loch Valley Road Noojee.

METROPOLITAN BRIDGES AND OVERPASSES.

As in previous years the Board continued with considerable work on the design and construction of bridges and culverts in the metropolitan area. Included amongst those on which construction was started during the year were :

(*a*) a prestressed concrete beam and reinforced concrete bridge 480 feet long by 50 feet between kerbs (including two tram tracks) plus two 6-ft. footways, over the Maribyrnong River on Raleigh's Road between the cities of Essendon and Sunshine ;

(*b*) a prestressed concrete beam and reinforced concrete duplicate bridge 451 feet long by 26 feet between kerbs plus a 7-ft. footway, over the Yarra River on Burke Road at the boundary of the Cities of Camberwell, Kew and Heidelberg ;

(*c*) a steel girder and reinforced concrete rail overpass bridge 112 feet long by 28 feet between kerbs plus 5-ft. 3-in. footway on Lancefield Road over the main Melbourne-Sydney railway line ;

(*d*) a prestressed concrete beam and reinforced concrete duplicate bridge 200 feet long by 28 feet between kerbs over Kororoit Creek at 11·2 miles on the Western Highway in the City of Sunshine.

BUSH FIRE DAMAGE TO BRIDGES.

There was considerable damage to timber bridges in three areas of Victoria due to bushfires in the 1964–65 summer.

In Bet Bet Shire, fires in January, 1965, burnt down seven timber bridges costing approximately £29,700 to replace. Fires, several days later in the Longwood area, destroyed a further fourteen bridges in Seymour, Goulburn and Euroa Shires, estimated to cost £53,600 to replace.

Further fires in late February, 1965, in the East Gippsland area destroyed or badly damaged another 26 bridges and culverts estimated to cost £101,950 to replace.

Temporary alternative crossings were provided rapidly in most cases and urgent construction work was proceeding towards the end of the financial year.

Heavy Loads.

Following investigation of metropolitan bridges, suitable routes were found for the transport by road of three S.E.C. transformers weighing from 108–115 tons from dockside to terminal stations at Kensington, Keilor and Burnley.

Further investigations were also made into the proposed road transport of transformers weighing up to 180 tons to other terminal stations in the metropolitan area. A layout was developed for a suitable vehicle, with a gross load of 253 tons, which could safely negotiate certain metropolitan bridges.

Bridge Inspections.

The Board's two Bridge Inspection teams carried out detailed inspections of approximately 200 bridges during the year. Considerable assistance is now being given to municipal councils by carrying out complete bridge inspection programmes in various areas.

Bridge Foundation Investigations.

The Board's bridge boring gang investigated 57 bridge sites, drilling and testing a total of 255 bores amounting to 8,730 lineal feet. This amounted to a 30 per cent. increase over similar work performed last year.

Bridge and Culvert Materials.

Contracts to a value of £131,300 were let during the year for the supply of approximately 6,000 tons of prestressed concrete bridge components. Reinforced concrete pipes and box culverts valued at £238,000 were also supplied under various contracts with metropolitan and country factories. The use of reinforced concrete pipes declined by 28 per cent. compared with last year, while the use of box culverts continued at approximately the same level.

Production of new design high strength " U " type slabs and other precast reinforced concrete bridge units in the Board's casting yards increased over last year by 25 per cent. to 5,900 tons valued at approximately £87,000.

Purchases of corrugated steel guardrail almost doubled over last year to 51,400 lineal feet valued at £21,600, however, there was considerable decline to £19,000 in the total value of corrugated metal pipe culverts and arches used.

There was also a reduction in the use of reinforcing steel. The amount dropped to 1,950 tons from 2,200 tons used in the previous year. Some difficulties occurred in obtaining sufficient supplies of high strength deformed bars for special precast concrete bridge units.

Ample supplies of rolled steel girders were available and 880 tons were fabricated for Board's works.

15. BITUMINOUS SURFACING.

Extent of Work.

Three thousand and seventy-nine miles of bituminous surfacing work were completed at a cost of approximately £4,400,000, and this work included the extension of the length of sealed roads in the State by a further 895 miles. The extension includes 36 miles of State highways, 4 miles of by-pass roads, 26 miles of tourists' and forest roads, 161 miles of main roads and 668 miles of unclassified roads.

The length of sealed pavement on the Board's declared network of State highways, by-pass, tourists', forest and main roads now amounts to 12,391 miles or 85·5 per cent. of the total mileage of declared roads.

The total length of bituminous work done, in addition to providing extensions to the sealed system, included 319 miles of widening of existing sealed pavements, 16 miles of duplication of existing carriageways, 495 miles of restoration of the seal coat on reconstructed sections and 1,207 miles of maintenance retreatment.

It was possible to assist Commonwealth and State authorities and municipalities who required bituminous surfacing work in which the Board was not financially involved, by making available the services of the Board's mobile bituminous surfacing units, and 147 miles of work was completed for these authorities.

Plant mix machine spread work completed during the year amounted to 90 miles providing surface courses on new construction and resurfacing of existing sealed pavements on the more densely trafficked roads. This work involved the manufacture, spreading, and compacting of 189,490 tons of binder and surface courses of bituminous concrete.

Plate 43.—Sprayer at work—Princes By-pass Road, Hernes Oak.

Bituminous Plant and Personnel.

Twenty-four mobile bituminous surfacing units and one mobile asphalt plant manned by approximately 600 men were employed during the major part of the year.

Municipalities and contractors who are equipped with suitable plant are playing an increased part in the bituminous surfacing work, particularly in undertaking priming or light treatments on prepared pavements ahead of the Board's specially equipped mobile sealing units. In all, they completed a length of some 750 miles of priming or light treatment.

The major portion of the plant mix work was undertaken by contractors operating fixed asphalt plants, but the Board's mobile asphalt plant undertook the laying of 6,666 tons of this type of material on the more heavily trafficked roads and streets in the vicinity of Traralgon.

Supply of Material.

The total quantity of bitumen purchased directly by the Board during the year amounted to 30,117 tons, and this was distributed throughout the State in bulk, approximately 68 per cent. by rail, and approximately 32 per cent. by road vehicles. The quantity of bitumen supplied and used by contractors in the plant mix work amounted to approximately 9,000 tons, so that a total quantity of approximately 39,000 tons of bitumen was drawn from the refineries in Victoria for the Board's work during the year.

In addition to the supplies of bitumen, approximately 11,722 tons of other bituminous materials such as cutback bitumen, tars and bitumen emulsion were purchased for the bituminous surfacing and allied maintenance work during the year.

The year's programme of bituminous surfacing required the use of approximately 466,305 cubic yards of mineral aggregate. This quantity included the use of approximately 277,805 cubic yards of covering aggregate in the sprayed work and a quantity of approximately 188,500 cubic yards of crushed stone, sand and filler in the plant mix work.

16. RURAL FINANCE AND SETTLEMENT COMMISSION ESTATE ROADS.

This year, works in conjunction with the Rural Finance and Settlement Commission have been carried out in a new area of the Heytesbury Settlement, east of Simpson, the local Commission headquarters. A new camp has been built in a position centrally placed in relation to work in progress and planned for next year.

During the year approximately 6 miles of new road have been completed and a further 5 miles cleared and partly constructed. The total mileage completed in the project is now 112 miles (Plates 44 and 45).

Plate 44.—Shire of Heytesbury—Clearing scrub near Coradjil with Ball and Chain.

Plate 45.—Shire of Heytesbury—New road under construction near Kennedy's Creek.

Large deposits of gravel have been located and these, together with local coarse sands, have been used for pavement construction.

Expenditure for the year on road and bridge works in the Heytesbury Settlement amounted to £72,882.

Total expenditure in all the various estates established by the Commission since the inception of the scheme in 1947 is £2,544,956, of which the Commission has contributed £1,421,434, the Board £814,373, and the respective councils £309,149.

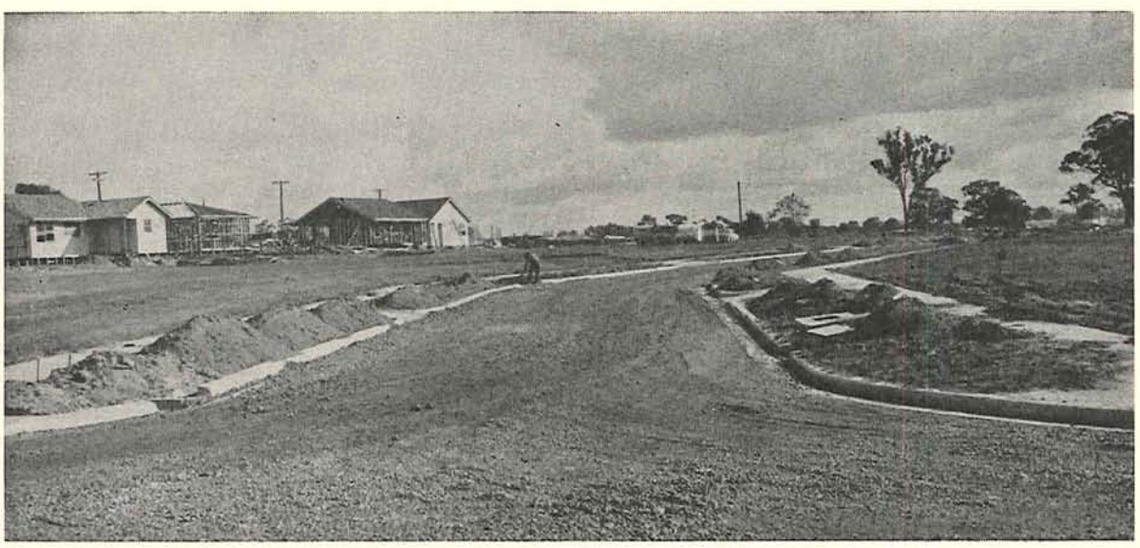


Plate 46.—Roadworks on the Seymour Housing Estate.

17. WORKS EXECUTED ON BEHALF OF COMMONWEALTH AND STATE GOVERNMENT AUTHORITIES FOR THE YEAR ENDED 30th JUNE, 1965.

Departments.	Description of Works.	Expenditure.		
Victorian Departments.		£ s. d.		£ s. d.
State Rivers and Water Supply Commission	Construction of various bridges over Commission channels, roadworks in connection with Lake Bellfield and Buffalo River Deviations	49,449 16 5		
Rural Finance and Settlement Commission	Roadworks—Commission estates throughout the State	64,570 3 7		
State Electricity Commission ..	Roadworks—Morwell Shire	8,551 0 0		
Housing Commission ..	Roadworks—Seymour Housing Estate (Plate 46)	51,925 15 8		
Department of Lands and Survey	Roadworks in Shires of Kaniva, Lowan, Orbost, Portland, Tambo, and Upper Yarra	34,160 3 6		
Department of Public Works ..	Roadworks—Albert Park Lake Reserve Road, Longerenong Agricultural College, and Mallee Research Station	1,875 15 7		
Melbourne and Metropolitan Board of Works	Roadworks—Healesville Shire and repairs to Hume Highway	1,454 1 6		
Latrobe Valley Water and Sewerage Board	Gould Deviation	4 5 2 *Cr.*		
Victorian Railways	Completion of construction of Madden Grove Level Crossing for Boom Barriers	171 3 0		
Premier's Department ..	Roadworks—Stawell Shire and Mt. Dandenong Reserve	2,035 0 0		
Fisheries and Wildlife Department	Roadworks — Warrnambool Shire — Tower Hill Game Reserve	1,600 0 0		
			215,788 14 1	
Commonwealth Departments.				
Department of Works ..	Roadworks—Various access roads to Commonwealth Establishments and to Tullamarine Freeway	7,050 3 4		
			7,050 3 4	
Special Projects.				
Kings Bridge	Sundry expenditure less recoups and receipts from disposal and rental of properties acquired in connection with the construction of Kings Bridge	83,774 13 7 *Cr.*		
Coal Canal Bridge	Construction of bridge over Coal Canal at West Melbourne	6,808 4 4		
Railway Level Crossings ..	Expenditure incurred on grade separation projects recouped from Level Crossings Fund (£57,151 1s. 9d.) and Victorian Railways (£60,312 19s. 8d.)	117,464 1 5		
Municipalities Forest Roads Improvements	Improvements of various roads adjacent to State Forests to facilitate the extraction of forest produce	2,498 2 7		
			42,995 14 9	
			265,834 12 2	

18. ELIMINATION OR IMPROVEMENT OF RAIL LEVEL CROSSINGS.

Expenditure on projects for the elimination or improvement of railway level crossings totalled £766,752.

This expenditure was shared as follows :—

	£
Country Roads Board	359,199
Level Crossings Fund	212,774
Victorian Railways	194,779
	766,752

During the year the following projects were completed :—

Road over rail overpass on the Western Highway at Beaufort (Plate 47).

Installation of boom barriers at Dendy Street, Middle Brighton.

Pedestrian underpass at Templeton Street, Wangaratta.

Work was substantially completed on the following projects :—

Road over rail overpass on the Princes Highway West at Brooklyn.

Road over rail overpass on the Western Highway at Wail (Plate 48).

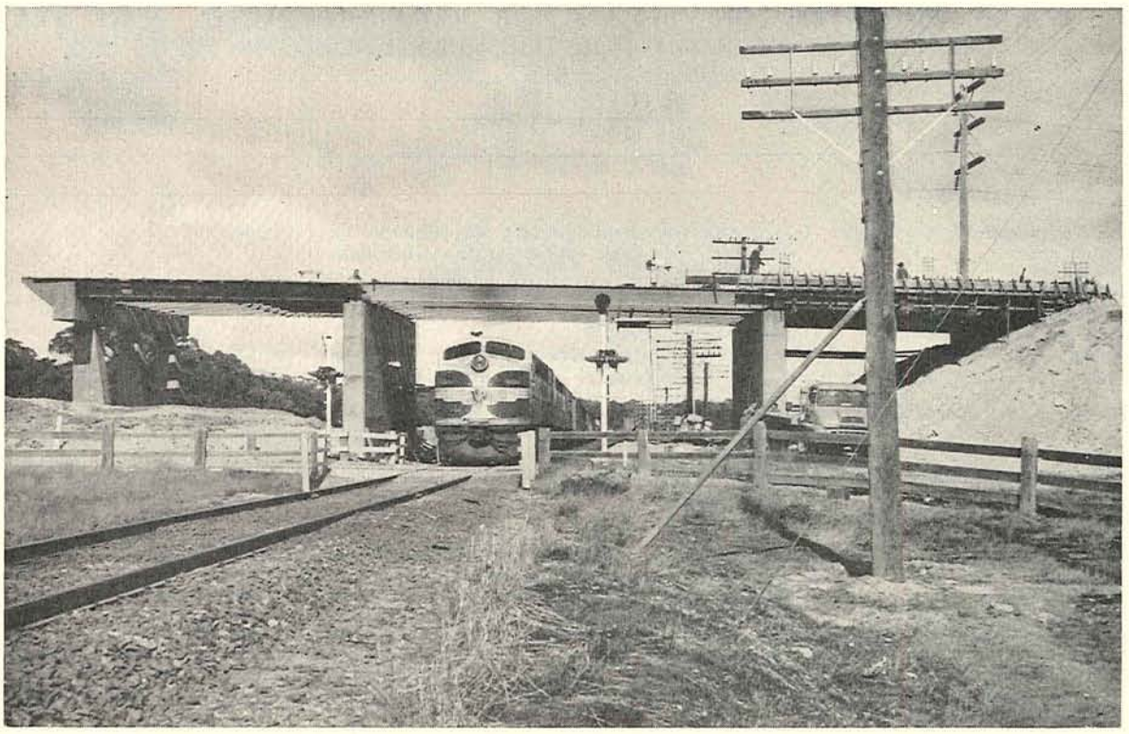


Plate 47.—Road over rail overpass under construction at Beaufort on the Western Highway.

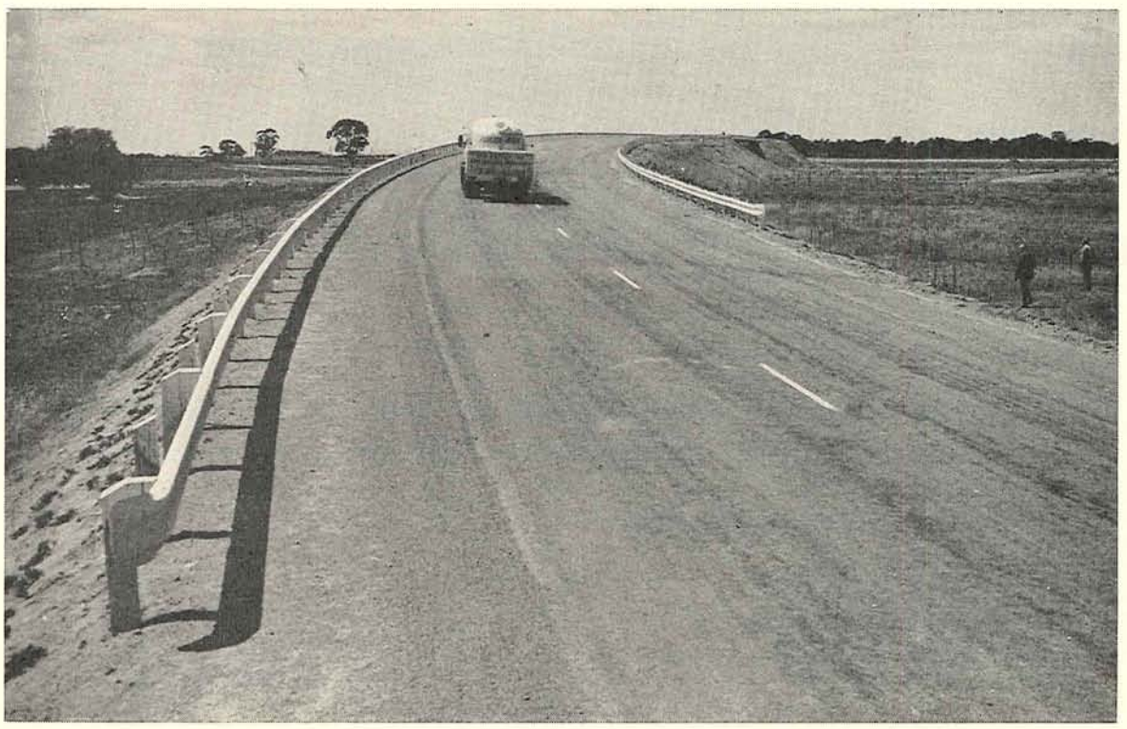


Plate 48.—Completed overpass at Wail on the Western Highway, Shire of Wimmera.

The following projects were commenced :—

Deviation of the Midland Highway to eliminate two gated crossings at Yapeen.

Road over rail overpass on the Princes Highway East at Kilmany.

Road over rail overpass on the Midland Highway at Gheringhap.

Road over rail overpass on Burnley Street, Richmond.

Road over rail overpass on the Western Highway at Kaniva.

Expenditure was also incurred on land acquisition for road over rail overpasses at Warrigal Road, Oakleigh, and Somerville Road, Yarraville.

Flashing lights were installed at sixteen rural level crossings.

The programme for 1965–66 will include provision for commencement of four projects in rural areas, and two in the metropolitan area.

19. FLOOD AND BUSH FIRE DAMAGE.

Heavy rains throughout the State in the spring of 1964, caused floods and considerable damage to road pavements and bridges in North-eastern Victoria, parts of Gippsland, parts of North Central Victoria and in the Otway district.

The estimated cost of repairing the damage was in excess of £120,000. The cost of the repairs was mainly borne from normal road allocations or by the councils concerned. No special provision of funds was made.

As a result of the wet weather, the growth of grass was such as to generate a grave bush and grass fire hazard in the summer months which followed.

During the months of January to March, 1965, severe bush fires occurred in the Tarnagulla, Arnold and Longwood districts and in East Gippsland over a large area, generally to the north of Sale and Bairnsdale. In the Tarnagulla–Arnold areas, seven bridges, mostly small structures were destroyed or very severely damaged. Over the whole State 47 bridges were destroyed or severely damaged involving an estimated replacement cost of £182,250. In the Longwood area lives were lost, residences destroyed and pastoral land burnt out resulting in the total loss of, or injury to, thousands of head of stock which later had to be destroyed. The Board provided earthmoving equipment to open up excavations for the disposal of dead animals in various areas and considerable work was involved on the highways and roads in the removal of burnt timber and other debris left after the fires.

In the Gippsland areas where the fires assumed disaster proportions, personnel, water tankers and other equipment, were provided from the Bairnsdale and Traralgon Divisions of the Board's organization.

20. ROAD MATERIALS AND RESEARCH.

With the object of promoting and co-ordinating research activities within its organization, the Board has established a Materials Research Committee, the members being the Deputy Chief Engineers for Works and Bridges, the Materials Research Engineer and the Assistant Materials Research Engineer, who acts as secretary.

This committee considers proposal for research projects in terms of feasibility, availability of resources and relative importance, and makes recommendations through the Chief Engineer to the Board.

While a number of projects have been recommended, shortages of professional staff and the increasing pressure of routine work have limited progress. Some useful work has been done on lime stabilization of clays, and on the correlations between the results of certain tests, the latter investigation being greatly facilitated by the use of the Board's computer.

An article has been published on investigations of the quality of basic igneous rocks and this work is proceeding. Preliminary studies of the skid resistance of pavements have been made and further equipment for this purpose will be obtained. The roughness of pavements in relation to their serviceability is being measured and improvements are being made to the equipment used for this purpose. The laboratory workshop has been fully occupied with the repair, maintenance and construction of items of equipment and workshop capacity will be a limiting factor particularly in pavement roughness and skid resistance investigations. It will be necessary to obtain more sophisticated equipment than has been used in the past, and this in turn will require a greater number of highly qualified professional staff for its operation and the interpretation of results.

21. CONTROL OF HEAVY TRAFFIC.

The number of offence reports submitted during the year rose to 9,125 against 8,825 submitted in the financial year 1963–64. Of the total offences reported 8,309 or 91·1 per cent. resulted in fines and costs amounting to £157,671, which was a rise of £15,191 over the financial year 1963–64. The number of summonses remaining unserved was 27. This is a reduction from 56 last year and 113 the previous year.

All fines resulting from prosecutions in 1964–65 were collected except £9,687 which represents 6·9 per cent. of fines imposed. The equivalent percentage last financial year was 12·2 per cent.

The reduction in the amount of unpaid fines was assisted by the introduction of a new type of warrant called a warrant of apprehension. These warrants enable police officers in other States to apprehend a defendant fined in Victoria. If the defendant fails to pay the fine imposed the police officer may bring him before a court where he may be sentenced to a term of imprisonment in the State where he was apprehended. Police officers seconded to the Board collected £35,958 during the year in unpaid fines from previous years.

Approval was given during the year for outdoor overhead lighting at the Kilmore weighbridge to test the type of lighting most suitable. After a period of trial, consideration will be given to lighting at all weighbridges in the interest of safety.

The number of permits issued for excess weights and over legal dimensional loads increased to 21,134, a rise of 13 per cent. over the previous year. Of the permits issued, 13,539 were single trip permits, 1,947 were fourteen-day permits and 2,388 were annual permits. Single trip permits issued in Divisional offices increased to 3,260. For very heavy loads, permits for 70 tons and over, totalled 223, an increase of 19 per cent., while those over 90 tons decreased to 27, a decrease of 19 per cent.

The Board records its appreciation of the co-operation afforded by the Chief Commissioner of Police and the work of those members of the Mobile Traffic Section Victoria Police, who have been seconded for duty with the Board.

22. TOURIST DEVELOPMENT.

During 1964–65, a further £100,000 was provided by the Government for expenditure on roads of tourist interest apart from the Board's proclaimed tourists' roads. This amount was fully allocated by the Country Roads Board after consultation with the Tourist Development Authority.

Of a total provision to date of £500,000 made available for works within this category over the past five years, expenditure to 30th June, 1965, amounted to £476,814, which included an amount of £123,900 for the year 1964–65. As in previous years, the practice of requiring a contribution towards the relevant grants where the road works were of benefit to ratepayers, was continued.

The amount of £100,000 made available in 1964–65 was again utilized for the provision of further access roads to various seaside resorts, picnic places, waterfalls and other places of scenic attraction to tourists. The Jerusalem Creek Road at Eildon, the Upper Kiewa East Extension Road in the Shires of Bright and Omeo, the Dargo High Plains Road (Plate 49), the Lake Mountain Road, the Mount Alexander Road in Metcalfe Shire, and a further contribution towards the construction of works on the Mount William Road in the Grampians were among the major projects for which allocations were made.

Plate 49.—Dargo High Plains Road—Work in Progress.

23. NATIONAL PARKS.

Reference was made in last year's report to the fact that the State Treasurer made £50,000 available for expenditure on roads in or near National Parks, this being the first occasion on which special finance was made available for works of this nature.

During 1964–65 a further amount of £50,000 was made available for expenditure on such works and with the approval of the National Parks Authority allocations totalling £47,195 were made by the Board from the fund for works on roads within or in the vicinity of the Bulga National Park, Fraser National Park, Kinglake National Park, Wilsons Promontory National Park and the Hattah Lakes National Park. At the close of the financial year, expenditure amounting to £62,000 had been incurred on the respective works, which included an amount of £37,022 spent during 1964–65.

The Board is not directly represented on the National Parks Authority, but acts in close co-operation in carrying out the various roading requirements which the Authority requires from time to time.

24. MUNICIPALITIES FOREST ROADS IMPROVEMENT FUND.

In 1955 the Government established a fund called the Municipalities Forest Roads Improvement Fund, and reference has been made to this Fund in previous reports since that date.

Total amounts provided by the Government since the establishment of the Fund amount to £115,000. A further amount of £25,000 has been appropriated to the Fund by the Government, but the allocation of these funds for particular works had not been finalized by the 30th June, 1965.

The Fund is used for the improvement of roads adjacent to State Forest areas in order to facilitate the extraction of forest produce. Allocations are made by the Board after consultation with and the concurrence of the Forests Commission. Total expenditure reimbursed to Councils to 30th June, 1965, in respect of allocations made was £112,158. A contribution was payable in each instance by the Councils benefiting from the allocations made.

25. LINE MARKING.

The year 1964–65 was the first complete year of operation of the Board's new line-marking machine which was placed in service in December, 1963. With a fleet now consisting of two large and one small line-marking units, the Board was well able to fulfil its programme of line marking. There was a slight increase of 4·6 per cent. over the previous year in miles painted. The Board now maintains lines on 5,018 route miles of road being 3,593 miles of State highways, 1,233 miles of other declared roads, and 192 miles of unclassified roads.

The total mileage of equivalent standard 3-in. line, i.e., 10-ft. line, 30-ft. gap, painted in the year was 9,451 as against 9,012 miles last year. The mileage included 4,330 miles of reflectorized line. The cost of line-marking for the year was £73,597 which, excluding other pavement marking activities carried out by the small unit, averaged £7 2s. 3d. per mile.

The Board at present maintains reflectorized lines on 2,180 route miles of road, mostly in the eastern half of the State, and with another new machine being planned, will later be able to reflectorize all pavement markings in the State.

26. METROPOLITAN ROUTE MARKING.

For some years the Board has, under the general direction of the National Association of Australian State Road Authorities, placed standard route markers on the main interstate routes to identify them with distinguishing numbers. These markers, which are now familiar to all road users, indicate the route number as a black legend on a white shield.

Early in 1964, the Board agreed to co-operate with the Traffic Commission and 43 municipal councils on a similar scheme to identify and mark a network of distinct routes within the Melbourne Metropolitan Planning Area to provide guidance on the most suitable route for those wishing to cross the metropolis from one locality to another. The numbers allotted to routes within the Melbourne Metropolitan Planning Area will be complementary to those allotted to the interstate routes and the signs will be quite distinct being blue with a white legend on a shield of a different shape. Figure 3 illustrates the design and shape of the shield.

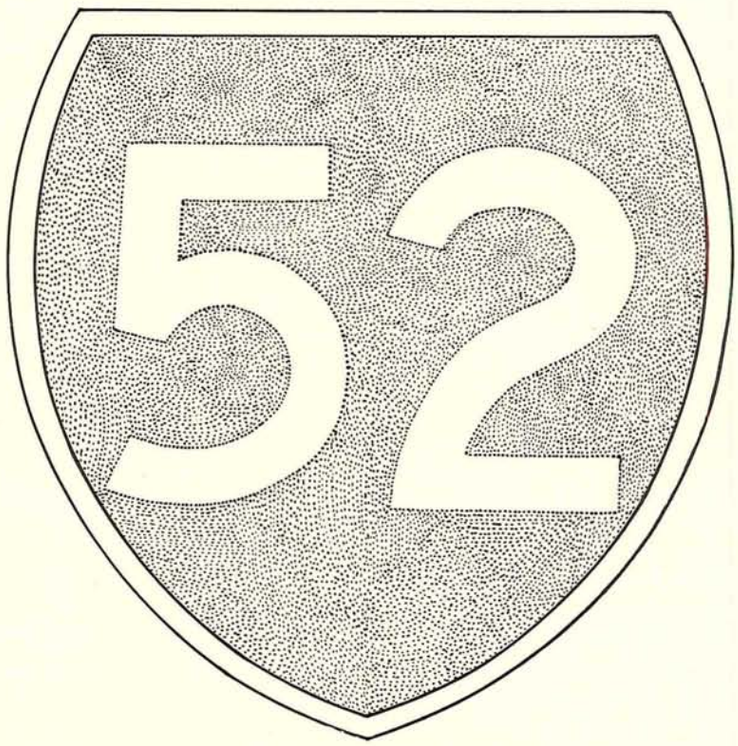


Figure 3.

Estimated costs of installing signs on routes selected amount to £3,900 in respect of State highways, £20,800 on the Board's declared main roads and £21,800 on unclassified roads. The Board will finance the supply and erection of signs on State highways and main roads on the normal bases for these road systems and will allocate funds for signs on unclassified roads on the basis of £1 Board to £1 Council.

27. METROPOLITAN TRANSPORTATION STUDY.

The Metropolitan Transportation Committee was formed in 1963 by a Victorian Act of Parliament to advise the Government on matters of planning, development, co-ordination, control and improvement of transport facilities in and around the metropolitan area.

The Members of this Committee include the Chairman of this Board. The Committee with the approval of the Government initiated the Metropolitan Transportation Study, to comprehensively examine Melbourne's metropolitan transport.

The study will enable future travel demands to be estimated, and the determination of the facilities required. The study area includes 600 square miles, 2,000,000 residents, 450,000 cars, 300 miles of railway, 260 miles of bus routes and 200 miles of tram track.

The study has now reached the planning phase, which is to continue until a satisfactory basic transportation plan has been achieved.

28. PHOTOGRAPHY.

During the year the Board's film unit produced a film entitled " Highway Improvements ". This film illustrates the development of State highways in Victoria and the safety features built in to modern roadways by utilizing duplicate pavements, and the establishment of freeway conditions.

As many of the Board's works now extend over long distances, aerial photographs are a very effective means of depicting extensive improvements in alignment and use has been made of such photographs both in the planning and construction stages of works.

For display purposes increasing use has been made of colour photographs which have a greater impact on the viewer than photographs in monochrome.

Use has also been made of photography in research projects of weathering of road-making aggregate and in performance of various line markings on road pavements.

29. DISPLAYS AND EXHIBITIONS.

The Board again exhibited material at the Annual Show of the Royal Agricultural Society of Victoria and at the Motor Show. In addition the Board took part in the " Science in the Development of Australia Exhibition " organized by the Science Teachers' Association of Victoria.

At the Royal Agricultural Show the Board displayed photographs of its works in town and country areas featuring a large colour transparency of its new line-marking machine in action. Supporting material included film and coloured slides. A copy of the transparency of the line-marking machine was also shown at the New York World's Fair in the General Motors Holden pavilion.

The organizers of the Motor Show, for the first time, offered the Board space for an independent stand. The stand featured " Road Safety " and although the display was not eligible for a prize in the competition for merit, it was highly commended by the panel of judges.

A comprehensive display with a scientific bias was arranged for the Science in the Development of Australia Exhibition indicating the Board's activities in research, surveying, material testing and reflective signs. Appropriate pamphlets and maps were used as free hand-outs to inform the public of the Board's roads and responsibilities.

30. NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES.

The twenty-eighth annual meeting of the National Association of Australian State Road Authorities was held in Perth from 27th to 30th October, 1964.

Representatives of each State Road Authority and the Commonwealth Department of Works attended. The Secretary of the Commonwealth Department of Shipping and Transport, representing the Australian Transport Advisory Council, was present when matters of national interest were under discussion.

There were 64 items on the agenda, including the need to establish a register of computer programmes, the revised edition of Highway Bridge Design Specification, maximum dimensions of buses and articulated vehicles, road furniture and National Route marking signs and standard specifications of materials. A sub-committee was appointed to prepare a definition of a "National Route ".

Mr. J. J. Punch, Commissioner of Main Roads, Western Australia, was appointed to chair the meeting. Following the unfortunate death of Mr. Punch in January, 1965, it was agreed by correspondence between members that the Chairman of the Country Roads Board, Mr. I. J. O'Donnell, who was the immediate past Chairman of the Association, should again assume the Chairmanship of the Association.

Mr. O'Donnell was formally appointed as Chairman at the twenty-ninth meeting of the Association held at the Board's Head Office on 14th May, 1965. The Deputy Chairman and Member of the Board also attended the meeting. Among the items discussed were the issue of N.A.A.S.R.A. publications, policies and guides, representation on S.A.A. Committees, control of weights of vehicles, and the drafting of a Guide for Design of Typical Urban Intersections. A definition of a "National Route " and a statement of the principles which should apply to their selection was also accepted by the meeting.

31. AUSTRALIAN ROAD RESEARCH BOARD.

During the year three meetings of the Australian Road Research Board were held. Mr. I. J. O'Donnell, Chairman, Country Roads Board, Victoria, held the office of Chairman for the first two meetings. At the third meeting held in May, 1965, Mr. G. D. B. Maunder, Director-General of the Commonwealth Department of Works, was elected Chairman, and Mr. O' Donnell was elected Deputy Chairman.

On 5th January, 1965, the Australian Road Research Board was incorporated as a public company limited by guarantee under the provisions of the *Victorian Companies Act* 1961. The Memorandum of Association enables the Board to participate in a wide range of activities associated with road research.

The Second Biennial Conference of the Australian Road Research Board was held from 31st August to 4th September, 1964, at the Chevron Hotel, Melbourne. The Conference was attended by 430 delegates, including visitors from Great Britain, U.S.A., Philippines, India and New Zealand. Seventy-eight papers, including 30 by overseas authors, were presented. The principal guest was Sir William Glanville, C.B., C.B.E., D.Sc. (Eng.) Ph.D., M.I.C.E., F.R.S., Director of Road Research, Road Research Laboratory, Great Britain. The Hon. G. Freeth, M.P. Minister for Shipping and Transport, representing the Prime Minister, opened the Conference.

32. CONFERENCE OF MUNICIPAL ENGINEERS.

The 1965 (Twenty-first) Conference of Municipal Engineers, convened by the Board, was held from 3rd to 5th March, 1965, at the Board's Head Office, Kew. Approximately 250 persons attended, including engineers from most of the municipalities throughout the State, the Chairman, Members and Senior engineers of the Country Roads Board and representatives of various Commonwealth and State Government Departments. The Conference was opened by the Hon. M. V. Porter, M.L.A., Minister of Public Works.

Items on the agenda included the use of computers in road design ; developements in paints and preservative coatings for steel and woodwork ; modern developments in incinerators ; use and costing of municipal plant ; and the use of a hydraulic ripper attached to a heavy motor grader.

On the morning of Friday, 5th March, an inspection was made of the new oil refinery in course of construction by BP Refinery (Westernport) Pty. Ltd. at Crib Point. The Board thanks the Company for its courtesy and the excellent arrangements made for this inspection.

33. MUNICIPAL ASSOCIATION CONFERENCES.

Each year a representative of the Board attends Municipal Association Conferences throughout the State. The following conferences were attended :—

1. Municipal Association of Victoria	At Melbourne on 14th and 15th October, 1964. Attended by the Chairman and Board Members.
2. Gippsland Municipalities Association	At Bairnsdale on 26th March, 1965. Attended by Mr. F. West, Member.
3. Northern Districts Municipal Association	At St. Arnaud on 22nd April, 1965. Attended by Mr. R. E. V. Donaldson, Deputy Chairman.
4. Goulburn North East Municipalities Association	At Numurkah on 27th May, 1965. Attended by Mr. F. West, Member.
5. North-Western Municipalities Association	At Nhill on 21st May, 1965. Attended by Mr. R. E. V. Donaldson
6. Western District Municipalities Association	At Penshurst on 19th March, 1965. Attended by Mr. I. J. O'Donnell, Chairman.

These conferences strengthen the close co-operation which already exists between the Board and local government. The Board appreciates the opportunity to attend them.

34. BOARD'S INSPECTIONS.

During the year Members of the Board officially visited thirty-one municipalities.

Inspections of roads and bridges were carried out in the Shires of Wodonga, Beechworth, Knox, Morwell, Traralgon, Gisborne, Phillip Island, Lillydale, Croydon, Chiltern, Rutherglen, Yarrawonga, Alberton, Pyalong, Upper Murray, Birchip, Donald, Ballan, Mount Rouse and Mansfield ; the Borough of Daylesford, and the Cities of Waverley, Traralgon, Ringwood, Sale, Sunshine, Box Hill, Nunawading, Broadmeadows, Springvale and Dandenong.

It was the Board's first inspection of the Shires of Knox and Croydon, and the Cities of Sunshine and Broadmeadows.

The Board very much appreciates the co-operation and hospitality extended by those municipalities visted during the year.

35. LEGISLATION AFFECTING THE BOARD.

Legislation enacted during the year which affected the Board included the following :—

Country Roads (Amendment) Act 1964 (No. 7178).

This Act amended various sections of the *Country Roads Act* 1958 which related to :—

(*a*) Officers and employees :—

A new section was substituted for the old section 12. The amendment validated the Board's retiring gratuity scheme introduced in November, 1962, gave the Board powers similar to several other statutory authorities with regard to conditions of employment for officers and employees and made provision for the Chairman, Deputy Chairman and Member of the Board to have the same privileges and liabilities as members of the Board's staff.

(*b*) Interest and Sinking Fund Payments :—

Section 32 (*b*) which required the payment from the Country Roads Board Fund to the Treasurer of an annual amount equal to the relief given to the municipal councils under the " Hyland Plan " was repealed to correct an anomaly in the wording of the Act which appeared to require duplication of payment by the Board.

(*c*) Authority to receive payment for carrying out works :—

Section 110 sub-section 1 was amended to enable the Board to receive contributions for works carried out on unclassified roads which are of benefit to a particular organization. Although the Board has received contributions in the past the Crown Solicitor considered it had no statutory authority for so doing.

This amendment rectified the position.

(*d*) Purchase of land by agreement :—

Section 116 was amended to authorize the Board, with the approval of the Minister, to purchase land for road purposes by agreement with the owner, as distinct from obtaining land by compulsory acquisition.

Acquisition of Materials Act 1964 (No. 7203).

Amongst other things this Act amends Section 50 of the *Country Roads Act* 1958 which authorizes the obtaining of roadmaking material from private land.

The amendment makes provision for :—

(*a*) Notice of intention to be served on the owner and occupier and the Soil Conservation Authority setting out in general terms the approximate position and nature of the land before the exercising of statutory powers under the Country Roads Act.

(*b*) The owner and occupier of the land to be notified of the name and place of business of any person authorized to procure material from the land.

(*c*) Within seven days of the expiration of each calendar month, advice to be forwarded to the owner and occupier of the quantities of material removed.

Motor Car (Fines and Drivers' Licence Fees) Act 1964 (No. 7185).

This Act provides for the establishment in the Treasury of a Roads (Special Projects) Fund. Into this Fund will be paid the proceeds of increased motor registration fees. Out of the Fund will be paid such sums as the Treasurer thinks fit for or towards the cost of special projects for the construction and improvement of roads, including bridges and traffic control installations and items as are approved by the Governor in Council on the recommendation of the Treasurer.

36. PERSONNEL.

The number of personnel employed by the Board at 30th June, 1965, was as follows :—

Salaried Staff	1,107
Supervisory Personnel	396
Employees	2,490
	3,993

Recruitment.

With the continuing prosperity of the State, recruitment during the year of experienced professional, technical and administrative staff proved difficult. In particular the shortage of experienced engineers became acute.

As a result of an extensive recruitment campaign conducted at the universities and senior technical colleges, it was possible at the end of 1964 to obtain barely sufficient new diplomate engineers to meet the Board's requirements. No engineering graduates other than the Board's cadets were attracted to the Board's service direct from Victorian universities. This is indicative of the increased number of scholarships being granted to university undergraduates by Government organizations and private enterprise and the value of the Cadetship system to the Board.

In an attempt to overcome the scarcity of experienced highway engineers, the Board advertized for engineers in the United Kingdom but only a small number of appointments have been made. The Board is aware of the need not only to have sufficient trained personnel to carry out current works but also to train staff for the immediate future.

The Board participated in approximately 20 " Career " nights and similar functions sponsored by secondary schools and other organizations interested in vocational guidance. In addition eighteen High Schools, Senior Technical Colleges and Technical Schools in the State were visited and students addressed by the Board's representatives on the opportunities for employment with the Board. These activities are of great assistance in the recruitment of Board's staff, besides performing a public information activity to students and parents on professional administrative and technical careers generally. The Board received many letters of appreciation for its participation in career nights (Plate 50).

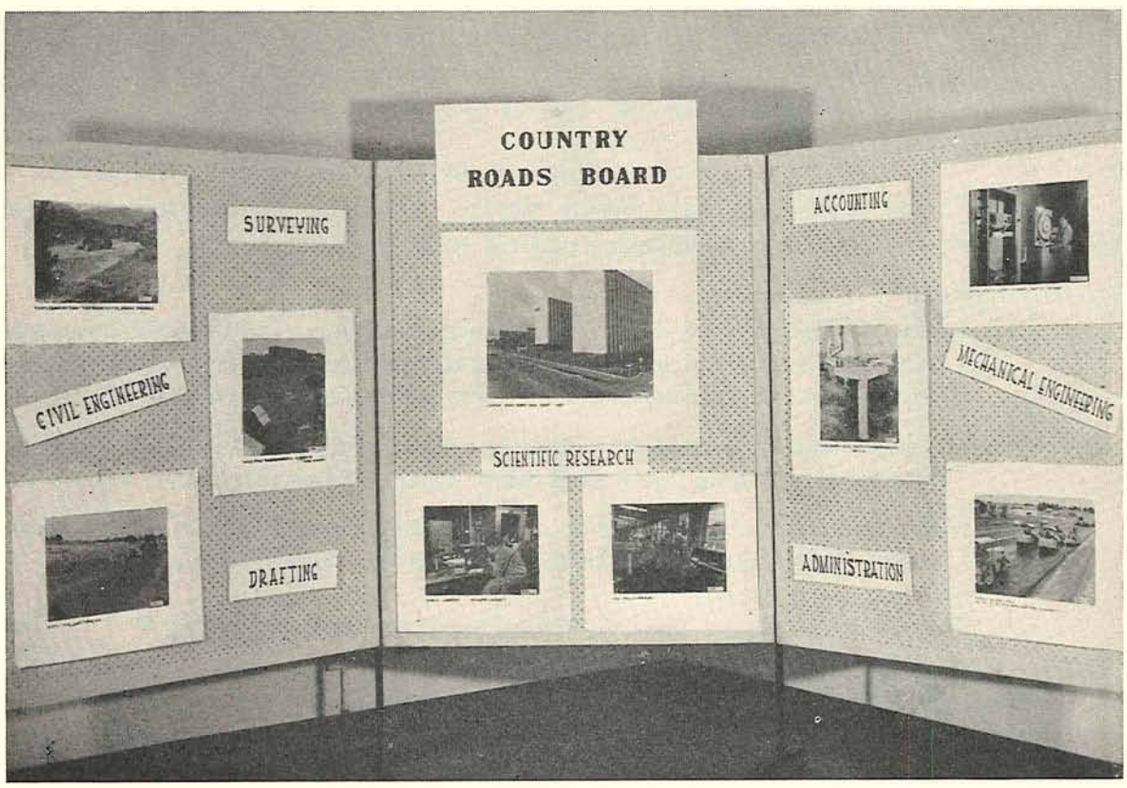


Plate 50.—Typical Career Night Exhibition.

No difficulty was experienced in the recruitment of field personnel for bridge and road construction and maintenance gangs. However, extreme difficulty was experienced in the recruitment of metal tradesmen for the Board's central and divisional workshops.

Obituary.

It is with the deepest regret that the Board records the death of Mr. G. J. Dempster, Deputy Chief Engineer—Road Design and Mr. R. S. Atkinson, Principal Title Survey Officer.

Mr. Dempster, who died suddenly at his home on 13th March, 1965, graduated as a Bachelor of Civil Engineering at Melbourne University and joined the Board in 1928 after gaining experience with the Geelong Waterworks Trust and the Melbourne City Council. For most of his career, Mr. Dempster was engaged in design work and made two world tours to investigate modern trends in design. During his long and valuable career with the Board, Mr. Dempster contributed many papers and articles on the subject of road design.

Mr. Atkinson died on 7th May, 1965, at the Alfred Hospital after a short illness, having served with the Board since 1924. Mr. Atkinson started his career as a pupil surveyor in the Shire of Frankston and, after joining the Board, qualified as a licensed surveyor in 1930. Apart from his many achievements in his service with the Board, Mr. Atkinson had a long and satisfying association with the Army from the time he was commissioned in the Militia in 1927 until his discharge as a Lieutenant Colonel in 1944.

Staff Retirements.

The following officers with substantial service retired during 1964–65 :—

Miss J. M. Hudspeth, Senior Draftswoman, on the 24th July, 1964, after 28 years' service with the Board.

Mr. L. W. Graham, Purchasing Officer, on the 1st September, 1964, after 34 years' service with the Board.

Mr. R. D. Selleck, Supervisor—General Duties, on 4th November, 1964, due to ill-health after 21 years' service with the Board.

The death of the following officers occurred during 1964–65 :—

Mr. R. S. Atkinson, Principal Title Survey Officer.

Mr. G. J. Dempster, Deputy Chief Engineer—Road Design.

Mr. A. R. Martin, Traffic Officer, Warrnambool.

Mr. L. M. Nebenson, Engineer, Bridge Sub-Branch (as a result of accident while in U.S.A.)

Mr. H. T. Stein, General Assistant.

Mr. A. M. West, Clerk.

Industrial Activity.

In October, 1964, the Government introduced the State Incremental Payments Scheme. The resultant cost to the Board was estimated to be £226,000 per annum. The State Incremental Payments Scheme is a system of payments increasing with years of service and which are additional to the award rates of pay.

The State Incremental Payments Scheme and the subsequent adjustment of salaries and wages in the " flow area " was applied by the Board in a similar manner to State Departments.

During the year logs of claims were received from the Municipal Officers' Association for professional staff other than professional engineers, administrative staff and technical staff, from the Association of Architects, Engineers, Surveyors and Draftsmen of Australia on behalf of technical staff and from the Association of Professional Engineers, Australia for salaries of the Board's Chief Engineer and Deputy Chief Engineers. Negotiations were commenced on these claims under the auspices of the Commonwealth Arbitration and Conciliation Commission.

In view of the increasing complexity of industrial awards and the need for uniform application thoughout the Board's State-wide organization, the Board appointed an Industrial Relations Assistant. This officer's function is to advise Divisional personnel on award matters and assist in negotiations with Union officials in the field.

37. TRAINING.

The programming and planning of training continued throughout the whole organization during the year.

Programmes of induction for newly-appointed salaried staff were held at regular intervals and a further course for another group of Senior Administrative Section Leaders was conducted.

A course on Contract Administration, first held in the middle of 1964, was repeated several times before the end of the year for a wide range of engineers.

Appreciation Courses were arranged for representative groups of senior Civil and Mechanical Engineers to assess action proposed for the introduction of training in supervisory skills.

Workshop Foremen and selected Leading Hands were given training on Safety Supervision and in Job Instruction techniques.

A pilot course was conducted with a view to developing for the future a suitable system of training for drivers of the Board's cars.

A course for Roadmasters was held at Head Office. This was followed by similar, but somewhat shorter, courses for Patrolmen in each Division.

At the beginning of 1965 a new attendance course, suitable to the needs of the Board's Overseers was begun at the Royal Melbourne Institute of Technology. Negotiations with the Institute were started with a view to extending the course in 1966 to a correspondence course for the benefit of overseers in country divisions.

External institutions continued to be used for special training purposes. Mr. A. J. Pryor, Divisional Engineer, Horsham attended an Advanced Course at the Australian Administrative Staff College, and Mr. M. L. Williams, Engineer, Dandenong Division, attended No. 4 Civil Engineering Construction Management Course at the University of New South Wales. Mr. G. Marshallsea, Assistant Divisional Engineer, Traralgon, and Mr. W. I. Leslie, Engineer, Traffic and Location Section were members of a Traffic Planning and Control Course at the University of New South Wales.

Arrangements were again made for a quota of students to gain practical experience with the Board in the engineering field during the long school and university vacation.

38. CADETS.

At the beginning of 1965 eight Civil Engineering Cadetships, one Mechanical Engineering Cadetship and one Commerce Cadetship were provided for full time study at Melbourne and Monash Universities. With the drawing to a close of the pupil system for qualification as a Licensed Surveyor the Board also offered a cadetship in surveying at the University of Melbourne but was unable to grant a cadetship because of the lack of a suitable applicant.

The following table shows the number of cadetships at universities in the 1965 academic year :—

Cadets under Training.	Civil Engineering.	Mechanical Engineering.	Commerce.	Economics.	Total.
First year	5	..	1	..	6
Second year	6	1	2	..	9
Third year	10	..	..	..	10
Fourth year	6	1	..	..	7
Total	27	2	3	..	32

39. ACKNOWLEDGMENTS.

The sincere thanks of the Board are tendered to you, Sir, for your help and interest in its work. The Board also thanks the Honorable J. C. M. Balfour, M.L.A., for his assistance during the times that he was Acting Minister of Public Works.

The Board takes this opportunity to place on record its appreciation of the co-operation and assistance of the officers of Government Departments, other State instrumentalities, Municipal Councils and the road authorities in other States.

All members of the Board's staff are thanked for their continued loyal co-operation and work during the year.

We have the honour to be,

Sir,

Your obedient servants,

I. J. O'DONNELL, O.B.E., E.D., B.C.E., M.I.E. Aust., F.A.I.M., Chairman.

R. E. V. DONALDSON, A.A.S.A., A.C.A.A., J.P., Deputy Chairman.

F. WEST, B.C.E., M.I.E. Aust., C.E., Member.

N. L. ALLANSON, A.A.S.A., A.C.A.A., J.P.,
Secretary.

APPENDIX 1.

MOTOR REGISTRATION.

Registration effected during the year under the Motor Car Act totalled 1,114,876, an increase of 5·1 per cent. on the registrations effected during the previous year as compared with an increase in 1963–64 of 7·5 per cent. over the total for 1962–63.

Vehicle.	Financial Year 1963–64.		Financial Year 1964–65.		Increase.	Decrease.
Private—						
New	91,222		96,871		..	..
Second-hand—						
Reregistered	23,065		25,082		..	..
Renewals	719,133		758,848		..	..
		833,420		880,801	47,381	..
Commercial and Hire—						
New	13,656		14,728		..	..
Second-hand—						
Reregistered	4,287		4,178		..	..
Renewals	102,301		105,818		..	..
		120,244		124,724	4,480	..
Primary Producers—Trucks—						
New	4,895		5,374		..	..
Second-hand—						
Reregistered	4,659		4,663		..	..
Renewals	68,164		68,739		..	..
		77,718*		78,776†	1,058	..
Licences under Motor Omnibus Act ..		724		832	108	..
Trailers		15,328		16,951	1,623	..
Motor Cycles		13,631		12,792	..	839
Total		1,061,065		1,114,876	54,650	839

* Includes 38,350 No Fee tractors. † Includes 39,537 No Fee tractors.

APPENDIX 2.

COUNTRY ROADS BOARD.

STATEMENT OF RECEIPTS AND PAYMENTS FOR YEAR ENDED 30TH JUNE, 1965
(Adjusted to nearest pound.)

—		Country Roads Board Fund.		*Commonwealth Aid Roads Act* 1964.		Loan Funds.	Sub-Total.	Total.
		Act 6229.	Act 6222 Road Maintenance Account.	Sec. 7 (1).	Sec. 7 (2).			
RECEIPTS	£	£	£	£	£	£	£	£
Balance as at 1st July, 1964		3,597	..	..	..	..	..	3,597
Motor Car Registration Fees	11,729,208							
Additional Registration Fees	761,705							
Drivers' Licence Fees ..	301,561							
Drivers' Licence Testing Fees	93,435							
Examiners' Licence Fees	4,179							
	12,890,088							
Less Cost of Collection	1,200,941	11,689,147	..	..	..	..	..	11,689,147
Municipalities Repayments—								
Permanent Works — Main Roads	38,888							
Maintenance Works — Main Roads	806,075							
		844,963	..	..	..	..	..	844,963
Moneys provided by *Commonwealth Aid Roads Act* 1964		..	..	7,475,954	5,115,126	..	..	12,591,080
Proceeds from *Commercial Goods Vehicles Act* No. 6222			2,963,142	..	..	..	..	2,963,142
Grant under *Public Works Loan Application Act* No. 7186		350,000	..	..	..	..		350,000
Advance from Public Account		250,000	..	..	..	..	..	250,000
Receipts from State Loan Funds—Act No. 6229		..	..	..	..	381,000	..	381,000
Fees and Fines under Country Roads Act		584	..	..	..	..	..	584
General Receipts		193,832	..	..	..	..	..	193,832
		13,332,123	2,963,142	7,475,954	5,115,126	381,000	..	29,267,345
PAYMENTS.								
Main Roads—								
Construction and Reconstruction ..		3,822,686	..	1,734,678	..	187,567	5,744,931	7,594,354
Maintenance		925,418	923,005	1,000	..	..	1,849,423	
State Highways—								
Construction and Reconstruction ..		2,097,552	..	4,209,164	..	193,433	6,500,149	8,540,286
Maintenance		..	2,040,137	..	..	..	2,040,137	
By-pass Roads—								
Construction and Reconstruction ..		1,802,566	..	600,040	..	..	2,402,606	2,426,762
Maintenance		24,156	..	..	..	..	24,156	
Tourists' Roads—								
Construction and Reconstruction ..		408,844	..	..	70,625	..	479,469	710,887
Maintenance		231,418	..	..	..	..	231,418	
Forest Roads—								
Construction and Reconstruction ..		..	..	..	243,194	..	243,194	356,891
Maintenance		..	..	..	113,697	..	113,697	
Unclassified Roads—								
Construction and Reconstruction ..		..	..	858,026	3,825,193	..	4,683,219	5,565,379
Maintenance		..	..	19,743	862,417	..	882,160	
Murray River Bridges and Punts ..		83,465	..	..	..	..	..	83,465
Traffic Line Marking		83,319	..	..	..	..	..	83,319
Traffic Lights		14,749	..	..	..	..	..	14,749
Plant Purchases		348,567	..	..	..	..	..	348,567
Payment to Tourist Fund		234,268	..	..	..	..	..	234,268
Contribution — Australian Road Research Board		..	..	53,303	..	..	..	53,303
Contribution—Metropolitan Transportation Survey		63,553	..	..	..	..	..	63,553
Interest and Sinking Fund Payments ..		994,059	..	..	..	..	..	994,059
General and Administrative Expenditure ..		2,192,780	..	..	..	..	..	2,192,780
		13,327,400	2,963,142	7,475,954	5,115,126	381,000	..	29,262,622
Balance at 30th June, 1965 ..		4,723	..	..	..	..	..	4,723

NOTE.—Relief to Municipalities granted under Act 6229 Section 32, amounted in 1964–65 to £22,335 6s. 1d.

R. G. COOPER,
Accountant,
29th November, 1965.

AUDITOR-GENERAL'S CERTIFICATE.

The accounts of the Country Roads Board for the year ended 30th June, 1965, have been audited. In my opinion the above Statement of Receipts and Payments fairly presents in summary form the transactions during that period.

A. J. A. GARDNER,
Auditor-General,
2nd December, 1965.

APPENDIX 3.

COUNTRY ROADS BOARD.

LOAN LIABILITY AS AT 30TH JUNE, 1965.

—		Main Roads, &c.	Developmental Roads.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Permanent Works—				
Main Roads	7,634,763 16 0			
State Highways	6,923,989 7 6			
Tourists' Roads	113,658 4 5			
Forest Roads	1,083 18 11			
		14,673,495 6 10	..	14,673,495 6 10
Development Roads	..	..	6,425,757 10 11	6,425,757 10 11
Discount and Expenses	..	281,467 18 11	271,085 18 8	552,553 17 7
		14,954,963 5 9	6,695,843 9 7	21,651,806 15 4
Less Redemption of Loans—				
Redemption Funds	..	85,219 1 1	646,386 7 4	731,605 8 5
Main Roads Sinking Fund	..	285,688 7 7	..	285,688 7 7
Developmental Roads Sinking Fund ..	..	..	55,083 0 2	55,083 0 2
State Loans Repayment Fund	..	1,309,698 4 11	..	1,309,698 4 11
National Debt Sinking Fund	..	2,056,056 3 10	2,329,753 3 7	4,385,809 7 5
		3,736,661 17 5	3,031,222 11 1	6,767,884 8 6
Loan Liability at 30th June, 1965 ..	..	11,218,301 8 4	3,665,620 18 6	14,883,922 6 10

APPENDIX 4.

CHIEF ENGINEER'S REPORT

Country Roads Board,
Melbourne,
22nd October, 1965

THE CHAIRMAN,

SIR,

I have the honour to report on matters of technical interest carried out during the year 1964–65. The report is divided into four major subdivisions corresponding to the four sub-branches of the Chief Engineer's Branch, followed by some matters of a general engineering nature.

WORKS SUB-BRANCH

1. ROAD CONSTRUCTION AND MAINTENANCE

Use of Scoria and Allied Materials in Warrnambool Division

A very valuable source of road making materials occurs in the volcanic residues which are to be found in the vicinity of the many extinct volcanic craters in the Western District of Victoria.

These volcanic materials may be classified into three main types namely :—

(*a*) Scoria
(*b*) Volcanic Tuff
(*c*) Volcanic Ash.

Generally the best type of these materials, the scoria, occurs closest to the crater, the quality tapering off with distance. The very light volcanic ash is thus found furthermost from the crater.

Scoria is a free, clinker type material, the hardness of which varies with the source. Mount Elephant, Mount Rouse and Mount Shadwell deposits have stone of sufficient hardness and durability to be used as sealing aggregate, whilst material from Mount Napier is soft and readily breaks down under a roller. The clinker type of material when used for pavement construction generally lacks sufficient fines to bind, and special construction techniques are therefore required. On the other hand Mount Napier material crushes down sufficiently to provide the necessary fines for binding.

Scoria to be used as a base course material is usually specified to be 2 inch maximum size. Such material can often be obtained directly from the quarry face but may require screening to remove oversize material. Base courses of scoria are placed in layers of 6 inches consolidated thickness, and because of the usual deficiency in fines, except in the case of material from Mount Napier loam is generally incorporated in the proportions of about 1 of loam to 6 of scoria, in order to assist thorough compaction before the application of another course. A suitable loam is one which has a plasticity index of between 1 and 4.

Surface courses of scoria usually comprise a 4 inch compacted layer of material of maximum size $\frac{3}{4}$ inch. Again, where there is a deficiency of fines in the natural material it is necessary to improve the grading by incorporating loam of similar quality, and in about the same proportions, as is used in base course work. A typical grading of the resultant mixture which has proved to be satisfactory is as follows :—

Sieve size	Percentage passing (by weight)
$\frac{3}{4}$"	100
$\frac{3}{8}$"	90
$\frac{3}{16}$"	75
No. 7	60
No. 36	34
No. 200	12

Linear shrinkage per cent. 0·3.

The mixing of scoria and loam in a surface course is usually carried out with a power grader. This does not ensure complete uniformity of the mixture and can be time consuming. Quicker and better mixing may be accomplished with some form of rotary mixer.

When considering the use of this type of material it is necessary to take into account the different compaction factors that may apply to materials from different sources, e.g., the compaction factor for Mount Napier scoria, which can be used without adding loam, is approximately 10 cubic yards loose to 5 cubic yards compacted. The compaction factor for Mount Rouse scoria including the loam which it is necessary to add, is approximately 10 cubic yards loose to 6 cubic yards compacted. On the other hand the compaction factor for an average road-making gravel in the area is approximately 10 cubic yards loose to 7·5 cubic yards compacted.

Scoria of 2 inch maximum size has been found satisfactory for widening macadam pavements. It is important that the widening trenches be drained by mitre drains through the shoulders at approximately 100 feet intervals and at the lowest section of sag curves. These drains are placed on an angle of about 60° to the pavement centre line where the road is on a grade. Where the road is generally level the drains are built normal to the centre line.

Volcanic tuff is usually found bedded in layers having scoria of maximum size about $\frac{3}{4}$ inch interlayered with fine volcanic ash. Vast deposits exist at Tower Hill whilst at Mount Leura and Mount Noorat both tuff and scoria are available. Further deposits exist along the shores of Lake Bullen Merri ; however, the surface layer in this instance is plastic, and is either discarded or mixed with scoria to make up any deficiency in fines.

Volcanic tuff is convenient to work in both wet and dry conditions, but a considerable amount of water is required to prevent a dust nuisance in the drier periods. Although the tuff is generally of fine grading and deficient in the larger particles to provide strength through mechanical interlock, a cementing action holds the material together. In the construction of pavements of volcanic tuff, one course pavements are used.

While the pavement is unsealed, potholing of the surface can rapidly occur, and constant maintenance is required to provide a satisfactory riding surface. It is however a satisfactory pavement making material, which can be further improved by incorporating in it small quantities of crushed rock thus adding to the strength of the surface.

Volcanic ash is of fine grading and its weight per cubic foot is low. It does not bind in a pavement. It has little strength, is often highly plastic, and is therefore of little value as a pavement material. It has, however, occasionally been useful for mixing with non-plastic scoria, in order to improve the stability of the latter.

Use of Scoria as a Sealing Aggregate

The Shire of Hampden uses material from Mount Noorat for both maintenance reseals and initial treatment on lightly trafficked roads. The cost of the material, which is graded from $\frac{3}{4}$ inch maximum size to dust, is 5s. per cubic yard, at the pit. Mount Shadwell scoria is used by the Shire of Mortlake for most sealing work. The aggregate is a graded material obtained by crushing pit scoria, and the cost is 4s. per cubic yard at the pit. Two pits at Mount Rouse supply a great deal of sealing aggregates for Board works over quite a wide area in the south-west. The material is crushed, and screened into a very good one sized stone of cubical shape. Material of $\frac{1}{2}''$ nominal size is most commonly used. This aggregate has a rather high initial rate of break down but appears to settle down after being under traffic for a few weeks. This initial break down is possibly due to the breaking-off of jagged edges. Scoria grit from these sources is extensively used for light treatments and surface enrichment seals.

General

Experience has indicated that scoria has about 5/7th the life of average basalt as a sealing aggregate. Scoria is however a useful and economic material, having in mind that average price per cubic yard on the job is 32s. for scoria as compared with 46s. for basalt aggregates.

Ammonium Nitrate—Fuel Oil Mixture as a Blasting Agent

Increasing use has been made of AN-FO mixtures for blasting work since initial experiments with this explosive in 1962, and it is now generally used for all major blasting work in both quarries and road excavation.

The AN-FO mixture provides marked savings in explosive costs compared with other explosives and is readily and safely handled on the job.

Analysis of large scale blasting at the Board's Stawell quarry has shown an average yield of 1·4 cubic yards of solid quartz porphyry rock for each 1 lb. of AN-FO explosive, and comparable yields are obtained in most roadwork. It has been estimated that use of AN-FO at Stawell quarry alone provides a direct saving on explosives costs of £1,400 per year, apart from other indirect benefits.

AN-FO explosive is normally used (in conjunction with high explosive primers) in 3 in. and 4 in. boreholes, but techniques for its use in $1\frac{1}{4}''$ drill holes were developed during construction of the Mount William-road, in 1962, and it is now frequently used in this manner.

Resheeting with Plant Mixed, Wet Mix, Fine Crushed Rock

The conventional use of fine crushed rock, spread with a grader, watered, rolled, and trafficked until compaction is achieved creates serious problems when work has to be done under high traffic volumes.

The use of plant mixed, wet mix crushed rock has provided a process which enables a pavement of fine crushed rock to be laid, compacted, and given a bituminous surface very rapidly with minimum inconvenience to traffic.

This material is very carefully controlled in respect of grading by combining individually screened components and processing it in a mixing plant where water is added to bring the material to the pre-determined moisture content.

The material is then transported to the site of the work, spread, and with suitable compacting equipment can be brought to satisfactory conditions for the application of a bituminous surface within 24 hours.

Some details of one example of the use of this material and process are contained in the following description of a project carried out during the year when it was necessary to widen, strengthen and raise a length of 1·4 miles on the heavily trafficked four lane divided Princess Highway West some 24 miles south of Melbourne.

The main problem with this project was to resheet the pavement without undue interference to the daily traffic flow of 5,000 vehicles. Wetmix fine crushed rock was used, placed through an asphalt spreader. The shape of the existing pavement was firstly regulated and layers of 4 inches consolidated depth were then spread. These operations were carried out half width in short sections which were completed and primer sealed before the next sections were commenced. Several layers had to be spread to bring the pavement to design levels, and the Wetmix fine crushed rock in each layer maintained a satisfactory surface for up to five days under traffic. The Wetmix fine crushed rock was obtained under contract and the remainder of the work was carried out by direct labour. The following information shows the details of the operation :—

Plant used :

One Asphalt Tamper Spreader (" Blaw-Knox ").

One 7–9 ton steel drum tandem roller.

One 4 ton self propelled vibrating roller.

One 10 ton pneumatic tyred roller.

Quantities used :

13,265 tons in 21 days, an average of 632 tons per day.

Maximum quantity used in one day, 975 tons.

Costs per ton :

	s.	d.
Laying and compacting.. ..	3	9
Wet mix F.C.R. at quarry ..	15	6
Cartage 19 miles..	12	1
Total	31	4

equivalent to 37s. 9d. per cubic yard.

Grading and other characteristics :

Sieve size	Percentage passing
¾	98
⅜	60
3/16th	42
No. 7	32
No. 36	16
No. 200	8

	Specified.	*Actual.*
Moisture content percentage ..	7·5 to 8·5	7·5 to 8·5
Sand equivalent ..	55 min.	55 to 75
Plasticity index ..	3 max.	0. to 1.0
Compaction percentage— Modified A.A.S.H.O.	95 min.	95 to 98 under roller 100 to 104 after 1 day's traffic

The quality of the Wetmix fine crushed rock was checked, as far as grading and moisture content were concerned, at the mixing plant and compaction tests were conducted at the roadbed. The work has since been resealed using ¼ inch aggregate with a view to applying one inch of hot-mix in two to three years' time.

During the work interference with traffic was kept to a minimum, the surface was tight and dust-free at all times and the work was completed quickly and economically.

Computer Tabulation of Earthwork Details

Reference has been made in previous annual reports to the use of a computer for the calculation of finished road levels and earthworks quantities. Computer tabulations consist of finished levels of pavements and formation, distances and reduced levels of batter points, together with depths of cut and heights to fill at the centreline, and earthwork quantitities. Trials on two direct labour jobs and one contract job were carried out in Benalla division to ascertain whether these tabulations could replace the conventional drawings consisting of a large number of sheets of cross-sections. It was found that the tabulations were accurate and quicker to use than conventional drawings, setting out errors were reduced, and that most overseers, gangers and contractors could quickly adapt themselves to their use.

On completion of the works it was found that the overall balance of earthworks was accurate. Neat batter lines resulted, and the character of the work was in no way inferior to that on jobs on which conventional plans were used.

The present earthworks programme is now used wherever possible for new deviations clear of existing roads. The programme has recently been applied to works including the following :—

Hume By-Pass—Beveridge Hill deviation.

South Gippsland Highway—Falls Creek—Foster deviation.

Midland Highway—Nillahcootie deviation.

The programme is not suitable for divided expressways in urban areas because of controls such as services, side roads, private entrances, existing kerbs and channels ; nor for resheets of highways, because of the control, the resheet thickness over a pavement of non-uniform shape. In brief, the present programme is being used when it is not necessary to plot the levels of each cross-section to obtain the design controls for the grade line.

It is proposed in the future to rewrite the programme (originally written for an IBM 650 computer and simulated for the IBM 1620 computer) to obtain a faster and more flexible programme, which may be applied to divided roads.

2. Direct Labour Road Construction Costs

Detailed cost analyses available for 133 road work jobs completed during the year at a cost of £3·6 million indicate continuing stability in unit costs, as shown in Tables 1–4. These tables show figures for the year 1964–65 and the averages over a 5 year period.

Table 1—Distribution of Expenditure (Including Overheads)

Item.	1964–65.	Average Cost over Five Years from 1960–61 to 1964–65.
	%	%
Plant	33·0	34·9
Labour	30·7	32·3
Materials	28·4	23·7
Stores	7·9	9·1
	100·0	100·0

Table 2—Works Overhead Expenditure (Percentage of Productive Costs)

—	1964–65.	Average over Five Years from 1960–61 to 1964–65.
	%	%
Construction expenses	8·3	7·8
On site expenses ..	17·7	20·1
Total	26·0	27·9

TABLE 3—FORMATION COSTS (INCLUDING DISTRIBUTED OVERHEAD EXPENDITURE)

—	Rock.		Earth Unclassified.		Total.	
	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.
	cu. yds.	£ s. d.	cu. yds.	£ s. d.	cu. yds.	£ s. d.
1964–65	97,390	0 17 10	1,524,920	0 11 7	1,622,310	0 12 0
Average over 5 years from 1960–61 to 1964–65	69,560	0 18 9	1,167,106	0 11 5	1,236,666	0 11 10

TABLE 4—PAVEMENT MATERIAL COSTS (CONSOLIDATED IN PLACE INCLUDING DISTRIBUTED OVERHEAD EXPENDITURE)

—	Fine Crushed Rock.		Coarse Crushed Rock.		Gravel, &c.		Total.	
	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.	Quantity.	Unit Cost.
	Cu. Yds.	£ s. d.	Cu. Yds.	£ s. d.	Cu. Yds.	£ s. d.	Cu. Yds.	£ s. d.
1964–65	152,375	2 15 3	96,461	1 12 3	1,245,321	1 1 8	1,494,157	1 5 9
Average over 5 years from 1960–61 to 1964–65	110,981	2 4 4	46,562	1 12 10	933,220	1 0 0	1,090,763	1 3 1

3. TESTING OF MATERIALS AND RESEARCH

Pavement Evaluation Studies

The method of flexible pavement design employed by the Board is based on the California Bearing Ratio of the subgrade and of the material comprising the pavement, and curves have been developed which indicate the total thickness of construction required over the subgrade in various climatic and traffic conditions. It has been recognized that the various materials used in pavement construction have different load spreading abilities and thus differing performance characteristics ; but the C.B.R. method of design does not make any logical allowance for these facts, nor is the C.B.R. test capable of rating these materials in the correct manner. Extensive research into more rational methods of pavement design, and into the characteristics and performance of paving materials, has been proceeding in many countries of the world for a number of years. The basis of this research is the mathematical theory of elasticity, and the parameter of interest is the modulus of elasticity of each material. The Board has carried out tests on a number of sections of pavements to evaluate local materials.

The test procedures have employed both plate bearing tests using a 12-inch diameter plate, and Benkelman beam tests. Test sites have been located on the Maroondah Highway at Mitcham, on the Princes Highway East near Dandenong, and on the Tullamarine By-pass Road. Typical results obtained are listed in Table 5.

Although the results show an increase in modulus generally, from subgrade through sub-base, base and surfacing material, there is a marked lack of uniformity. This may be due to variations in moisture content, density, composition, and layer thickness. It can be seen also that the modulus of the 2 per cent. cement stabilized fine crushed rock was only marginally higher that that of the unstabilized fine crushed rock, and it is probable that for the purpose of pavement design, the two materials should be considered as being of equal value. The 4 per cent. cement stabilized crushed rock had a very much higher modulus than the unstabilized fine crushed rock. However, this material has been known to crack in service and to revert as far as elastic modulus is concerned to the equivalent of unstabilized fine crushed rock.

Future investigations of pavement performance will include studies of the susceptibility of these materials to compositional and environmental changes as well as their resistance to deformation.

Resistivity Method for Prospecting for Deposits of Gravel and Sand

Under favourable conditions gravel occurring at moderate depth below the surface of the ground can be located by measuring the electrical resistance between electrodes inserted into the ground. The electrical resistance is a function of the length and cross-sectional area of the path through which the current flows, and of a characteristic property of the material called the electrical resistivity.

Under dry conditions gravels having large pore spaces will contain very little water and will have a high resistivity, whereas clays under similar conditions will contain more water and will have a lower resistivity. This difference, under favourable conditions, can be used to distinguish between gravels and clays and to determine trends in overburden thickness above gravel deposits. In practice, the subsurface material is not uniform in character, and the resistivity actually considered is the apparent resistivity, which is a function of the resistivities of all the layers through which current flows.

TABLE 5—MODULI OF ELASTICITY OF SUBGRADE AND PAVEMENT MATERIALS

Road.	Description.	Classification.	Properties.	Modulus of Elasticity p.s.i.
Subgrades—				
Maroondah	Brown Silty Clay	A7–6 (11) CL	LL = 33 PI = 15 MC = 14%	3150–5050
Maroondah	Yellow Brown Clay	A7–6 (20) CH	LL = 63–76 PI = 43–55 MC = 22–28%	6600–9250
Princes East	Grey Brown Mottled Sandy Clay ..	A7–6 (18) CH	LL = 73 PI = 58	7000–16500 (subgrade very dry)
Tullamarine Bypass ..	Dark Brown Basaltic Clay	A7–6 (20) CH	LL = 76 PI = 58	2500–7150
Sub-base—				
Maroondah	Coarse Crushed Rock 2″ max. size ..	..	..	28000–50000
Princes East	Coarse Crushed Rock 2″ max. size ..	A2–4 GP–GC	LL= 23 PI = 9	20400–23000
Tullamarine Bypass ..	Coarse Crushed Rock 2″ max. size ..	..	..	11200–16900
Tullamarine Bypass ..	6% Lime Stabilized Clay	..	..	8900–30000
Base—				
Maroondah	2% C.S. Fine Crushed Rock 1½″ max. size	..	Density— 127–133 pcf. Moisture C.— 6·2%–6·8%	65000–162000
Princes East	4% C.S. Fine Crushed Rock 1½″ max. size	..	..	400000–550000
Tullamarine Bypass ..	¾″ Fine Crushed Rock	..	LL =23 PI = 6	33500–63000
Surfacing—				
Maroondah	Bit. Concrete Binder Course ..	..	1¼″ thick	300000–350000

To carry out a test, four electrodes are equally spaced out along a line and inserted about 6 inches into the ground. A known current is applied to the two outer or current electrodes and the potential gradient is measured across the two inner or potential electrodes. The depth of effective current penetration is approximately equal to one-half the spacing between the electrodes.

Either of two methods of test may be employed. In the first method, termed the expanding technique, apparent resistivity measurements are made as the spacing of the electrodes is systematically increased, until the maximum desired depth of penetration is reached, the centre of the electrode spread remaining fixed. In the second method, a suitable electrode spacing for the existing conditions is first determined and this spacing is preserved as the electrodes are moved from point to point within the area to be investigated.

It is always essential to calibrate the equipment and check the indications given by it, with a few auger holes and tests if possible at nearby pits also, if such exist.

Employing the techniques described above, an alluvial deposit of approximately 100,000 cubic yards of coarse sand was located in the Shire of Cohuna.

The technique has been employed without success in the following three instances. In the Shire of Kerang, failure to determine the extent of a sandstone deposit resulted because the deposit proved to be extremely variable in quality. In the Shire of Numurkah, the presence of a high water table and a high salt content in the overlying materials created conditions which rendered the method ineffective. Dry conditions had a similar effect in an investigation in the Shire of Walpeup.

It would appear from the above results that the usefulness of the resistivity technique is limited to locating relatively clean alluvial deposits with favourable ground water conditions.

4. BITUMINOUS WORK

Extent of Work

Table 6 sets out the mileage of all types of bituminous surfacing completed during the past two years and indicates that the work done in 1964–65 was less than that done in 1963–64 by 68 miles—a decrease of 2 per cent. The length of sealed pavement on the declared system was increased by 227 miles and the length of sealed pavement on unclassified roads was increased by 668 miles.

In 1964–65, 3·5 per cent. of the declared system was reconstructed to a higher standard, together with restoration of the sealed pavement, compared with 3·6 per cent. in 1963–64. Of the existing

sealed pavements of the declared system, 7·5 per cent. were retreated, compared with 8·8 per cent. in 1963–64. Table 7 summarizes the lengths of different categories of bituminous work done on all types of roads to which the Board contributed funds in 1964–65.

TABLE 6—LENGTH OF BITUMINOUS SURFACING WORK COMPLETED IN 1963–64 AND 1964–65

Type of Road and Plant Used.	Miles.	
	1963–64.	1964–65.
(*a*) Work on C.R.B. declared roads—		
(i) Board's Plant ..	1,962	1,769
(ii) Municipal Plant ..	42	79
(iii) Contractors' Plant ..	84	51
	2,088	1,899
(*b*) Work on undeclared roads to which the Board contributes—		
(i) Board's Plant ..	869	945
(ii) Municipal Plant ..	54	56
(iii) Contractors' Plant ..	24	32
	947	1,033
(*c*) Work done for other Authorities by Board's Plant—		
(i) Municipalities ..	109	140
(ii) State Instrumentalities	3	6
(iii) Commonwealth Works	..	1
	112	147
	3,147	3,079

Types of Work

Sprayed initial treatments and retreatments continued to predominate in the annual bituminous surfacing programme and amounted to 97 per cent. of the work completed. The use of hot mixed machine spread bituminous concrete was continued on pavements near the metropolitan area and provincial cities. In these high traffic density locations, it is desirable to provide a stronger, smoother and quieter riding surface, requiring less maintenance, than that afforded by sprayed work.

During the year a total length of 89 miles of bituminous concrete work was completed, representing 3 per cent. of the annual bituminous surfacing programme, compared to 134 miles and 4·4 per cent respectively in the previous year.

Cost of Work

Table 8 sets out the average unit costs of sprayed work completed by the Board's mobile spraying units during the year.

The unit costs are higher than in the previous year except in three cases, one of them being the same and two lower. The increases vary with each type of work and are due generally to increased costs of aggregate, labour and plant hire.

Materials

(*a*) Aggregate

The total quantity of covering aggregate used in the sprayed work amounted to approximately 278,000 cubic yards.

Table 9 sets out the average costs of aggregate over the past five years and shows that the average cost has risen by 2·4 per cent. over last year's average cost.

Certain areas of north-western Victoria are deficient in good types of aggregate for sprayed work. The fact that traffic is light on most roads in this area makes permissible the use as aggregate of the locally occurring limestones which suffer in being very absorptive and having poor resistance to wear. These characteristics can lead to the problems of excessive stripping and break down of the aggregate. Unless the limestone aggregate is above the average quality, it is necessary to adopt the two-application-seal procedure, in which the first application aggregate is protected against stripping and break down, by a light weight second application seal. During the year, trials were conducted of an alternative technique where limestone aggregates were precoated with a light petroleum tar and used on single application seals. These examples will be inspected at regular intervals and further trials will be continued during the year.

TABLE 7—SUMMARY OF THE MILEAGES OF DIFFERENT CATEGORIES OF BITUMINOUS WORK DONE ON ALL ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING 1964–65

Category of Work.	State Highways.	By-Pass Roads.	Tourists' and Forest Roads.	Main Roads.	Unclassified Roads.	Totals.
Initial Treatments—						
Extensions to sealed system—						
(*a*) Sprayed Work	36·51	4·12	25·57	160·73	663·52	890·45
(*b*) Plant Mix Work	..	..	..	..	4·48	4·48
Reconstruction of lengths of previously sealed pavements—						
(*a*) Sprayed Work	182·12	..	9·84	218·68	56·96	467·60
(*b*) Plant Mix Work	9·08	..	..	10·86	7·88	27·82
Widening of existing sealed pavements—						
(*a*) Sprayed Work	75·58	..	0·57	218·14	18·02	312·31
(*b*) Plant Mix Work	..	..	..	3·31	3·51	6·82
Duplication of existing sealed pavements—						
(*a*) Sprayed Work	3·09	..	..	1·25	..	4·34
(*b*) Plant Mix Work	6·11	..	..	3·88	1·26	11·25
Retreatments—						
(*a*) Sprayed Reseals	311·96	1·17	34·12	558·66	262·61	1,168·52
(*b*) Plant Mix Work	15·20	..	1·40	7·26	14·98	38·84
	639·65	5·29	71·50	1,182·77	1,033·22	2,932·43

TABLE 8—AVERAGE COST OF SPRAYED BITUMINOUS SURFACING DONE BY C.R.B. PLANT ON ROADS TO WHICH THE BOARD CONTRIBUTED FUNDS DURING 1964–65 (COST IN PENCE PER SQUARE YARD)

Item.	Nature of Work.																			
	I.T.P. and S. $\frac{5}{8}$-in. and Over.		I.T.P. and S. $\frac{1}{2}$-in.		I.T.P. and S. $\frac{3}{8}$-in.		I.T.P. and S. $\frac{1}{4}$-in. and Sand.		I.T. Seal Only.		I.T. Two-Application Seal Only.		Reseal $\frac{5}{8}$-in. and Over.		Reseal $\frac{1}{2}$-in.		Reseal $\frac{3}{8}$-in.		Reseal $\frac{1}{4}$-in. and Sand.	
Square Yards Costed	1,329,736		3,079,075		1,090,493		1,369,380		5,872,384		132,437		280,827		1,419,238		3,638,789		5,346,100	
	d.	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%	*d.*	%
Material ..	21·0	49	20·7	54	19·5	59	13·7	59	14·9	58	26·3	61	20·1	64	16·1	60	12·7	59	10·5	63
Stores ..	1·2	3	0·9	2	0·7	2	0·6	2	0·6	2	1·1	3	0·7	2	0·6	2	0·4	2	0·3	2
Plant Hire ..	9·3	22	7·5	20	6·1	18	4·2	18	4·8	18	7·1	17	5·1	16	4·7	17	3·9	18	2·8	17
Labour ..	11·0	26	9·0	24	6·8	21	4·9	21	5·8	22	8·3	19	5·7	18	5·6	21	4·5	21	3·1	18
Totals ..	42·5	100	38·1	100	33·1	100	23·4	100	26·1	100	42·8	100	31·6	100	27·0	100	21·5	100	16·7	100

TABLE 9—AVERAGE PRICE OF AGGREGATE FOR BITUMINOUS SURFACING PER CUBIC YARD IN STACKS BY THE ROADSIDE FOR THE YEARS 1960–61, 61–62, 62–63, 63–64, 64–65

Material.	Prices per Cubic Yard.				
	1960–61.	1961–62.	1962–63.	1963–64.	1964–65.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Screenings	47 2	46 7	44 10	48 1	49 3
Gravel	43 0	44 1	42 7	39 6	41 2
Sand	21 1	19 3	21 7	23 1	24 9
Scoria	21 3	31 4	32 8	29 10	29 0
Average price all aggregates	45 8	44 11	42 9	44 9	45 10

(*b*) Bitumen

During the year 30,117 tons of bitumen were purchased directly by the Board. This amount was supplied from the two refineries in Victoria and distributed by rail and road by four marketing companies. As usual, the Board's fleet of road tankers assisted in the distribution.

Bitumen supplies were tested regularly and found to conform to the Board's specification.

(*c*) Priming Materials

As was mentioned in the Fifty-first Annual Report, as a result of the reduced demand for coal gas in favour of liquid petroleum gas, supplies of by-product crude horizontal retort tar have diminished rapidly. This tar has proved in the past to be the most satisfactory primer for the soft absorptive limestones which are commonly used for pavement construction in the north-west of Victoria.

A particular grade of petroleum tar produced in N.S.W. was subjected to further trials as a substitute for the crude horizontal retort tar, during 1964–65. So far the trials have indicated that this petroleum tar could be satisfactory. Accordingly, more of it will be used during 1965–66. A typical specification for a suitable heavy priming petroleum tar for this purpose is shown in Table 10.

TABLE 10—TYPICAL SPECIFICATION FOR HEAVY PRIMING PETROLEUM TAR

Viscosity in stokes at 50°C. ..	1·0–2·0
Specific gravity 25°C/25°C. min.	1·05
Insoluble matter in CS_2 percentage by weight	5–15
Water content, percentage by weight, max.	2
Distillation, percentage by weight, max. to 230°C.	8
to 300°C.	36
Softening point of residue after distillation to 300°C. (°C. max.) ..	75
Sieve test (retained B.S. No. 52) percentage, max.	0·25

Plant Mix Work

Of the plant mix work completed during the year, contractors operating fixed plants near Melbourne and Geelong supplied 96·5 per cent. The Board's mobile asphalt plant operating in the country supplied and spread 3·5 per cent. of the material on a heavily trafficked highway remote from contractors' plants. Once again the Board's plant proved to be of value in producing a satisfactory hot mix, machine spread, bituminous concrete to strengthen existing sealed pavements and to provide a smooth riding surface at an economical cost.

BRIDGE SUB-BRANCH

1. DESIGN

Phillip Island Bridge—Foundation Investigation

Extensive investigations of foundation and sea bed conditions were carried out during the planning stages of the design of the new bridge over the eastern entrance to Westernport Bay at San Remo.

Initial stages of the study comprised a topographic survey and visual examination of the sea bed. These were made not only to obtain accurate information as to the existing levels and condition of the sea bed, but also to facilitate comparison with records of previous such studies in order to gauge the effects of scour during the period covered by the existing records, and to predict probable future behaviour.

Sea bed levels were established both by echo-sounding and by leadline measurements. Underwater inspections were made by consultants from the Department of Geology of the University of Melbourne, who subsequently reported favourably regarding the likely stability of the sea bed in the vicinity of the proposed bridge site.

After a preliminary alignment for the proposed structure had been selected, a refraction seismic survey was performed to obtain a general indication of the foundation materials in the vicinity of the proposed structure, and to determine the depths to solid rock.

The seismic survey was supplemented by diamond drilling at a number of sites on the tidal platform on each side of the navigation channel. This drilling was useful as a check on the depths to hard rock as shown by the seismic survey, and also provided core samples which enabled the identification of the strata indicated by the seismic survey.

The characteristics of the materials encountered on the tidal platform were then further investigated by static penetrometer testing, and by the recovery of undisturbed samples, which were subsequently subjected to laboratory examination.

After the results of the above preliminary work had been assembled and reviewed, a contract was let for a more extensive investigation of the site, including drilling at, and recovery of undisturbed samples of foundations from, the locations of the proposed abutments and of alternate piers on the tidal shelf, and at the location of each of the proposed piers in the navigable channel. The undisturbed samples were submitted to a full range of laboratory tests by the contractor.

This work was satisfactorily completed except for the drilling at the pier sites in the navigable channel. The problem associated with tidal flow made drilling from a floating platform at these sites impracticable.

Further, attempts at underwater drilling by divers operating on the sea bed proved unsuccessful, and investigation was accordingly restricted to boring to limited depths into sound rock at two only of the pier sites. At the site of the other piers, surface examination and sampling confirmed that conditions there were consistent with those at the two sites where boring had been possible.

While this work was proceeding, the sea bed in the vicinity of the deep water pier sites was filmed. A visual record of the sea bed conditions at these locations was thus obtained.

A test pile was driven satisfactorily to the proposed toe level at the Newhaven abutment, thus confirming the results of the various tests which had been done on the basaltic clays encountered on the tidal platform.

Calder Highway
Lancefield Road Overpass Bridge

(*a*) Test Loading

This structure is a curved continuous four span (55 ft.—94 ft.——94 ft.—41 ft.) concrete box girder bridge supported on three single column piers along the centreline and conventional buried abutments at each end. The crossheads are replaced by heavy diaphragms built into the superstructure and resting on pot-bearings which act as hinges at the tops of the pier columns.

Because of the unusual construction and the resulting complexity in design of this bridge, it was felt that some of the design assumptions and calculations should be confirmed by the application of loads, similar to the working loads to which the finished structure would be subjected.

The test loads used were two transporter vehicles loaded with concrete blocks, giving gross loads of 41 tons 10 cwts. and 41 tons 3 cwts. respectively, which would produce stresses of approximately 50 per cent. working stress in bending and 90 per cent. working stress in torsional shear (Plate 1).

These loads were placed in seven different positions on the structure and measurements were made of deflections (by dial gauges) and strains at the surface of the concrete (by Demec mechanical gauges) at a large number of points throughout the structure. The load positions included two cases of extreme eccentricity relative to the single-column piers to produce maximum torsional effects in the superstructure.

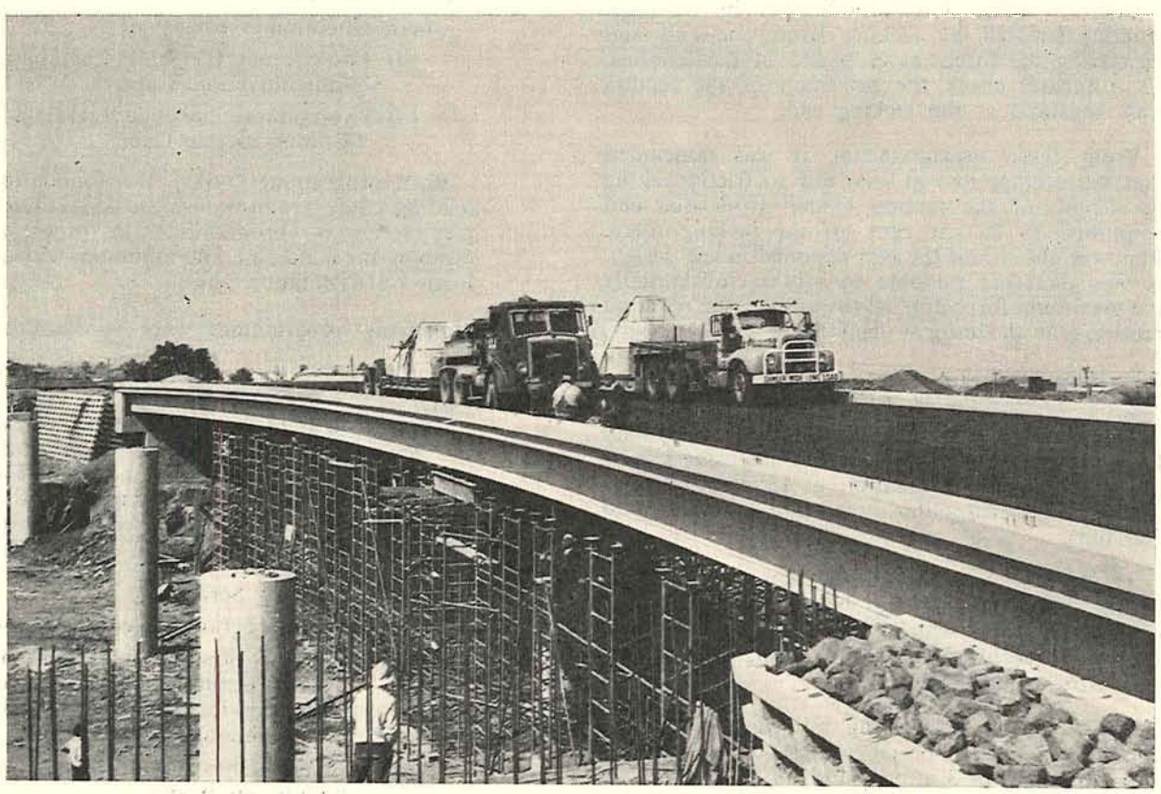


Plate 1.—Test loading of the Calder Highway–Lancefield Road Overpass Bridge.

The maximum measured deflections at midspan under centrally placed loads was 0·193 in. which is in good agreement with the calculated deflection of 0·206 in. For loads placed eccentrically to the road centreline, at the outer edge of the deck opposite the middle pier, there was a maximum deflection of 0·156 in. This effect is the combination of torsional rotation of the superstructure and deflection of the transverse diaphragm over the middle pier. The calculated value was 0·159 in.

As the strains measured in the concrete were small in magnitude when compared with the possible experimental errors in the mechanical gauges, few readings could be regarded as significant. However, the overall pattern of strain measurements was consistent with the pattern of calculated stresses.

Taken together the measurements of deflection and strain under the various load arrangements showed satisfactory agreement with the design assumptions. Further, the results clearly demonstrated the great torsional stiffness of this type of structure.

(*b*) Friction Losses

This structure was post-tensioned by means of eight 138 ton, and eight 125 ton, B.B.R. tendons each placed in a 2½ inch diameter lead-coated sheathing.

The 138 ton tendons are lapped at the centre pier. The outer end of each is attached at one extremity of the bridge, and the inner end is terminated in the deck.

The 125 ton tendons run the full 286 feet length of the bridge, with stressing heads at each end. As they are draped over the three intermediate piers and the ducts follow the horizontal curvature of the bridge deck considerable friction was expected.

Friction losses were determined in the first tendons stressed by jacking from one end and measuring the forces at each end of the tendons. As a further check the extension of the tendon was measured at the jacking end.

From these measurements, it was concluded that the average loss of load due to friction along the length of the tendon loaded from one end amounted to 20 per cent. of the jacking force. This was about half the loss assumed in the design. It was therefore possible to reduce substantially the maximum force applied to produce the required prestress at the critical sections of the members.

Heavy Transformer Loadings

The Board was notified by the State Electricity Commission during 1964, that transformers proposed for future installation at terminal stations around the metropolitan area, would weigh up to 180 tons.

To transport such transformers, the vehicle layout shown (Fig. I) has been developed. The only bridges over which the loads may travel, are those of recent construction, designed for the H20 S16 standard load.

While a load is crossing a bridge, it will be necessary for the special vehicle to maintain a constant speed of 3 m.p.h., and for other traffic to be excluded from the bridge.

Use of Board's Computer in Bridge Design

The use made of the Board's computer increased steadily during the year.

Computer Programming

The seven library programmes for analysing a two-colum rigid framed pier, which were described in last year's Annual Report, have been completed and tested. They are now available for productive work.

The following library programmes were also completed during the year :—

(*a*) Analysis of Circular Reinforced Concrete Columns.

This programme analyses a circular R.C. column subjected to axial load and uni-axial or bi-axial bending. It can be used either in association with the series of pier programmes (in which event an elimination procedure is used to reduce the number of cases to be considered), or to analyse a specific number of load cases for any design problem.

(*b*) Analysis of Rectangular Reinforced Concrete Columns.

This programme, which is for the analysis of a symmetrically reinforced rectangular column subjected to axial load and either uni-axial or bi-axial bending, consists of two parts. The first part carries out the load case elimination as well as editing and collating, and the second part analyses the remaining critical loading cases.

This latter part is a modification of a programme written by the Commonwealth Department of Works, Canberra. The use of the programme is similar to that for circular columns.

(*c*) Foundation Analysis.

These programmes consist of :—

(i) Two-column Pier Pile Loadings—Individual Pile Caps.

(ii) Two-column Pier Pile Loadings—Combined Pile Cap.

Both programmes utilize the foundation loading cases produced by the two-column pier series of programmes in order to evaluate the maximum and minimum vertical loads on foundation piles.

The following programmes were substantially completed :—

(*a*) Beam Section Properties.

These programmes compute the properties of generalized cross sections for non-composite and composite beams. The data generated is suitable for input to other programmes or can be used to solve individual problems.

(*b*) Continuous Beam Series.

This series of programmes comprises :—

(i) Deflections of single span and continuous beams subjected to concentrated loads and/or partial or continuous uniform loads.

(ii) Moments, shears and reactions in continuous beams.

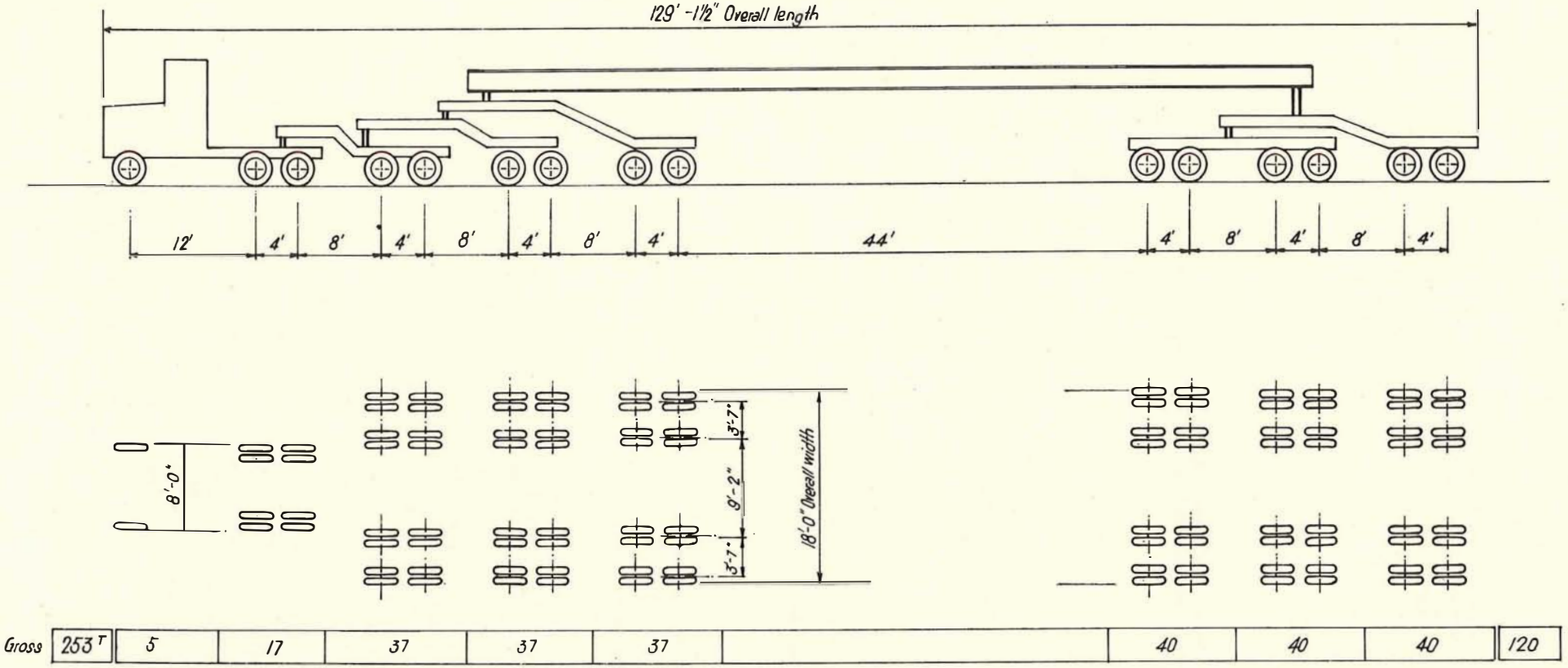


Figure 1.—Vehicle designed for transportation of transformers of up to 180 tons weight.

(*c*) Analysis or Design of Composite Steel Beams and Girders.

This programme analyses or designs simple span steel beam and girders, either composite or non-composite. It is a modification and extension of a programme written by the Maine Highway Department of U.S.A.

"One-off" type computer programmes were written for :—

(*a*) Tendon profiles and fixed-end moments due to prestress in prestressed concrete beams.

(*b*) Load distribution analysis for articulated plates applicable to precast slab bridges.

Computer Usage

Three hundred and twenty-nine hours of computer time were used during the year consisting of 101 hours for processing problems and 228 hours for programme development.

Processing included :

Bridge Geometry ..	.. 12 bridges
Two-Column Pier Analysis	.. 4 bridges
Beam Section Properties .. Beam Deflections ..	.. .. 6 bridges
Moments and Shears ..	.. 3 bridges
Tendon Profiles ..	.. 3 bridges
Load Distribution Analysis	.. 7 bridges

Economics

An investigation has revealed that computer usage is economical for bridge design. It is intended to write further programmes in order to increase the productivity of the design staff and to shorten the time taken to design bridges.

Shear Connector Tests

The majority of steel girder bridges built by the Board in the past 12 years have incorporate shear connectors for the purpose of transferring shear between the girders and concrete deck slab. This practice results in an improvement in structural efficiency, and leads to economy in the structure. The most common type of shear connector used by the Board is of the type shown in Fig. 2. This connector has been designed on the basis of the horizontal shear being resisted by bearing of the concrete on the face of the connector, the permissible bearing pressure being 1,725 p.s.i. for a nominal concrete strength of 3,000 p.s.i. Normally the underside of the deck concrete is level with the top of the steel girder but the use of precast concrete formwork slabs placed on the top flange has the effect of forming a small haunch between the deck slab and the girder. It was considered desirable that the structural action of the connectors should be established for this condition.

The testing programme comprised four pushout type specimens as in Fig. 3, which were loaded through the steel member while being supported on the ends of the slabs, with the haunches clear of the supports. Each specimen included eight connectors spaced at 6, 8 or 10 inches centres. The total working load of the connectors was 56,000 lbs. for a design minimum concrete strength of 3,000 p.s.i.

The specimens developed small hair cracks in the haunches at loads of 50,000 lbs. to 80,000 lbs., and after loading to maximum loads of 250,000 lbs. were found to have behaved essentially in an elastic manner, with permanent set only of the order of 0·001 in. to 0·002 in. When tested to failure, the maximum loads sustained were as shown in Table 11.

TABLE 11—LOADS AT FAILURE—SHEAR CONNECTORS

Specimen.	Connector Spacing.	Maximum Load.
	in.	lb.
1	6	297,500
2	6	374,100
3	8	431,500
4	10	469,000

All specimens failed by shear in the concrete along the interface between slab and haunch, i.e. through the concrete haunch in the plane 1½ in. above the top of the R.S.J. flange. The average shear stress over the failure planes ranged from 1,240 p.s.i. to 1,560 p.s.i.

The actual strength of the concrete involved in the tests was 6,160 p.s.i. If the failure load of the connectors is reduced in proportion to the ratio of the design concrete strength to the actual concrete strength, the factors of safety with respect to working load of the individual specimens range from 2·6 to 4·1. It is considered that the observed behaviour and factor of safety give adequate confirmation of the effectiveness of these shear connectors.

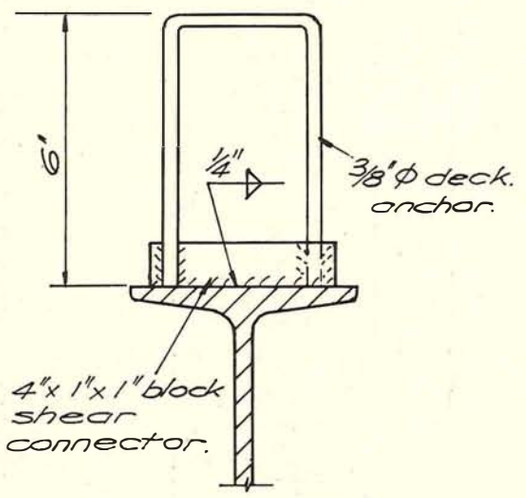


Figure 2.—Shear connector used in bridge construction.

2. CONSTRUCTION

Raleigh's Road Bridge over Maribyrnong River
Settlements at Sunshine Abutment

Special measures were required to deal with anticipated consolidation settlements at the Sunshine approach to the bridge now being constructed over the Maribyrnong River at Raleigh's Road, Maribyrnong.

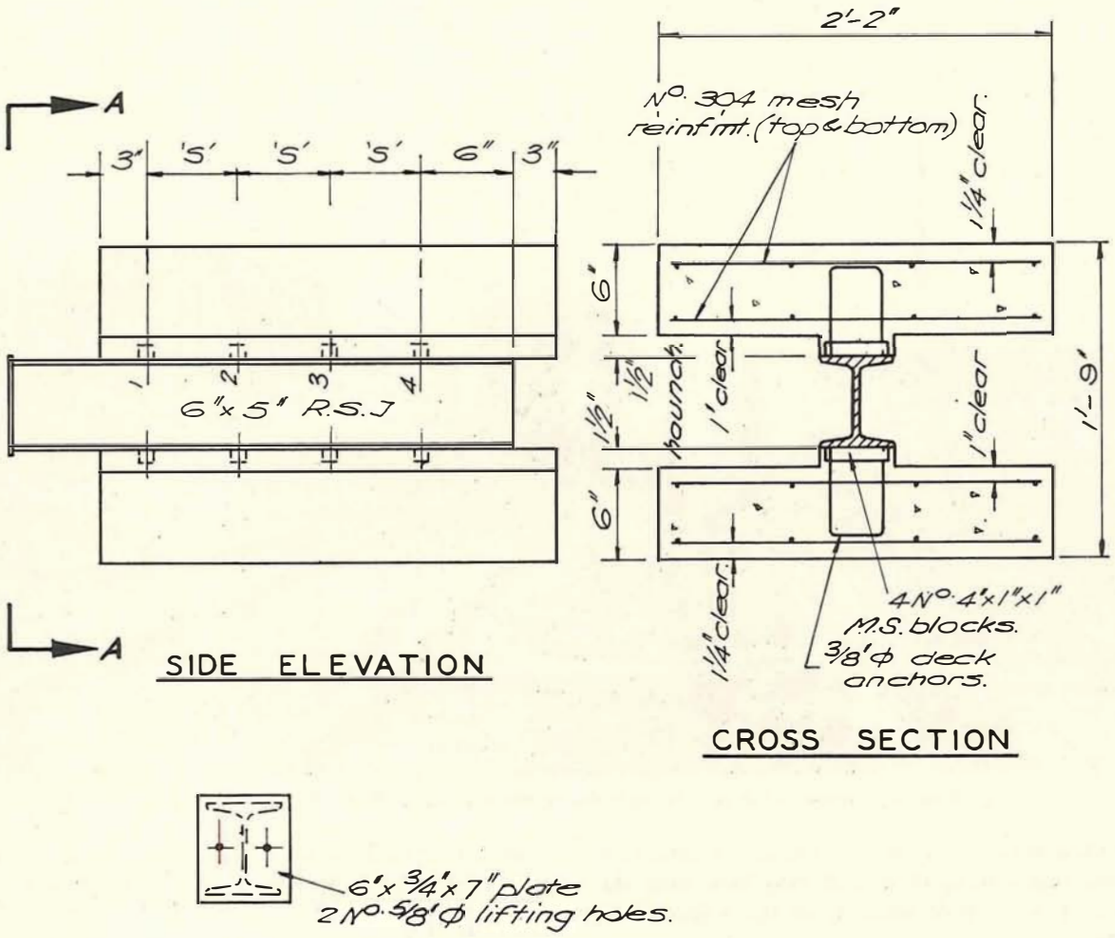


Figure 3.—Test specimen for shear connector tests.

Preliminary foundation investigations revealed, below subgrade level, the presence of layers of very soft compressible silts averaging about 40 feet in depth and extending over the whole length of the Sunshine approach embankments. Calculation of the probable consolidation of this material indicated that settlements of the order of 2 feet were likely to occur under the embankment adjacent to the abutment ; about half of the predicted settlement was expected to occur within the first year after the application of load.

Vertical movements of such magnitude after completion of the bridge and approaches could not be tolerated, because the formation would be required to carry tram traffic. Further, concern was felt that the vertical movements would produce lateral earth movements, with resulting effects on the bridge abutment.

It was therefore clearly desirable that embankment filling—and also some surcharge—should be placed on the Sunshine approach at the earliest possible stage before commencement of the bridge works.

The placing of filling was complicated by the need to maintain tram services over the filled area, and to minimise obstruction of road traffic. The depth of filling adjacent to the abutment of the existing tramway bridge was limited to a maximum of 2 feet. The maximum depth of filling below the final gradeline will be about 10 feet, but filling beneath the tram tracks at this early stage was limited to about 8 feet by the traffic considerations outlined above. Additional material was therefore placed behind crib walls located outside the limits of the tram tracks, to a total depth of 15 feet (Plate 2).

This loading should produce settlements at a rate at least equal to those which would have been produced by the embankment constructed to the final gradeline. An additional advantage was gained by early placing of filling, in that the rate of placing could be regulated to take account of unstable conditions which developed during placings.

A number of minor slip failures occurred behind the cribwalls while the filling was proceeding and it was necessary to suspend operations in these areas until the strength of the underlying soil had increased to such an extent that placing could be safely resumed.

An additional opportunity of accelerating settlement was afforded by utilizing the pervious gravel layers which intersected and underlay the compressible silts. A well point was sunk

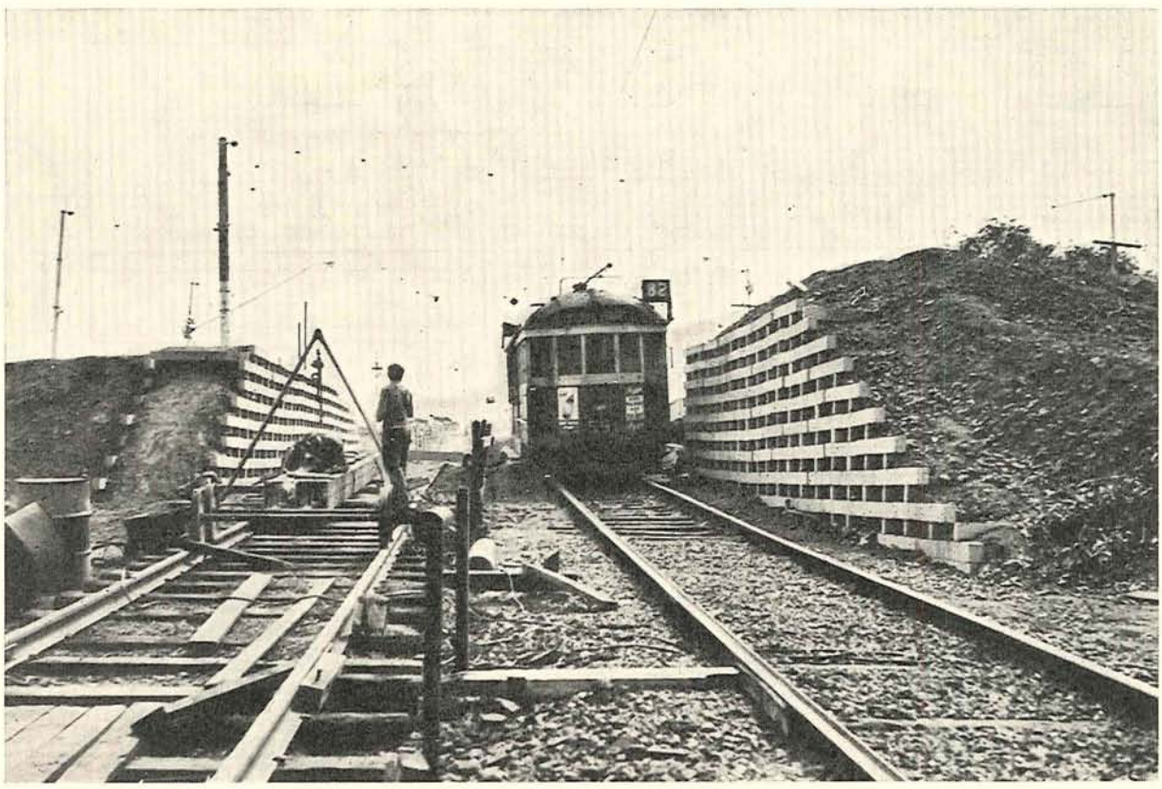


Plate 2.—Surcharge behind crib walls during construction of Raleigh's Road Bridge.

into these pervious layers with the aim of removing ground water from them and thus increasing the rate of flow of pore water from the adjacent silt layers.

A system of indicators has been established in order to ascertain the extent of vertical and horizontal consolidation effects. The indicators have shown that substantial vertical movement has already resulted, thus indicating the value of the early commencement of the filling operations.

Prestressing of an Existing Mild Steel Truss

The Bemm River Bridge on the Bemm Lower Road (Shire of Orbost) was built in 1954, incorporating three 80 feet span Commercial Box Girder trusses. The bridge superstructure had been designed for a maximum load of 10 tons but the subsequent expansion in activities of two nearby saw mills resulted in heavy traffic using the bridge, causing total stresses of up to 31,000 p.s.i. in the lower chords of the trusses. As relief measures, neither strengthening with unstressed material, nor temporary propping, would have been economic, the former due to the dead load stresses in the lower chord being as high as 12,000 p.s.i., and the latter due to the difficult site conditions.

It was decided to prestress the new strengthening material against the old members before welding the two together, thus permitting savings in material of up to 60 per cent.

A simple prestressing arrangement was devised which reduced the tensile stresses in the old member while stressing the new member. The prestress was developed by tightening a 1½ in. diameter bolt connected to the new member, the reaction force being utilized to relieve the tensile stress in the old member (Fig. 4).

Demec strain gauge readings were taken to determine the point at which the new and old members were equally stressed. At this point the two members were welded together. For each truss, the prestressing operation required less than fifteen minutes.

After completion of the strengthening, the strains in the lower chord members were measured at several points while a load test was carried out on the bridge. The readings were in near agreement with the calculated values, showing that the new and old members were sharing the load as intended in the design.

Bridge Deck Surface Irregularities

In order to determine the quality of concrete bridge deck surfaces, an investigation was carried out on two recently completed bridges in Dandenong Division.

Two measuring devices were used : One, a " travelling-beam " type straight-edge, and the other, a 2 in. x 1½ in. aluminium straight-edge, both 10 feet long. The " travelling-beam " straight-edge consists of an aluminium beam supported on two wheels 10 feet apart, with an indicating device located at the centre point (Plate 3). The operation of this straight-edge differs in principle from that of a sliding straight-edge in that the latter finds its own points of support and the depths of depressions can be measured at any point between them, whereas a travelling-beam device has fixed points of support and a fixed indicating point, and it measures both elevations and depressions.

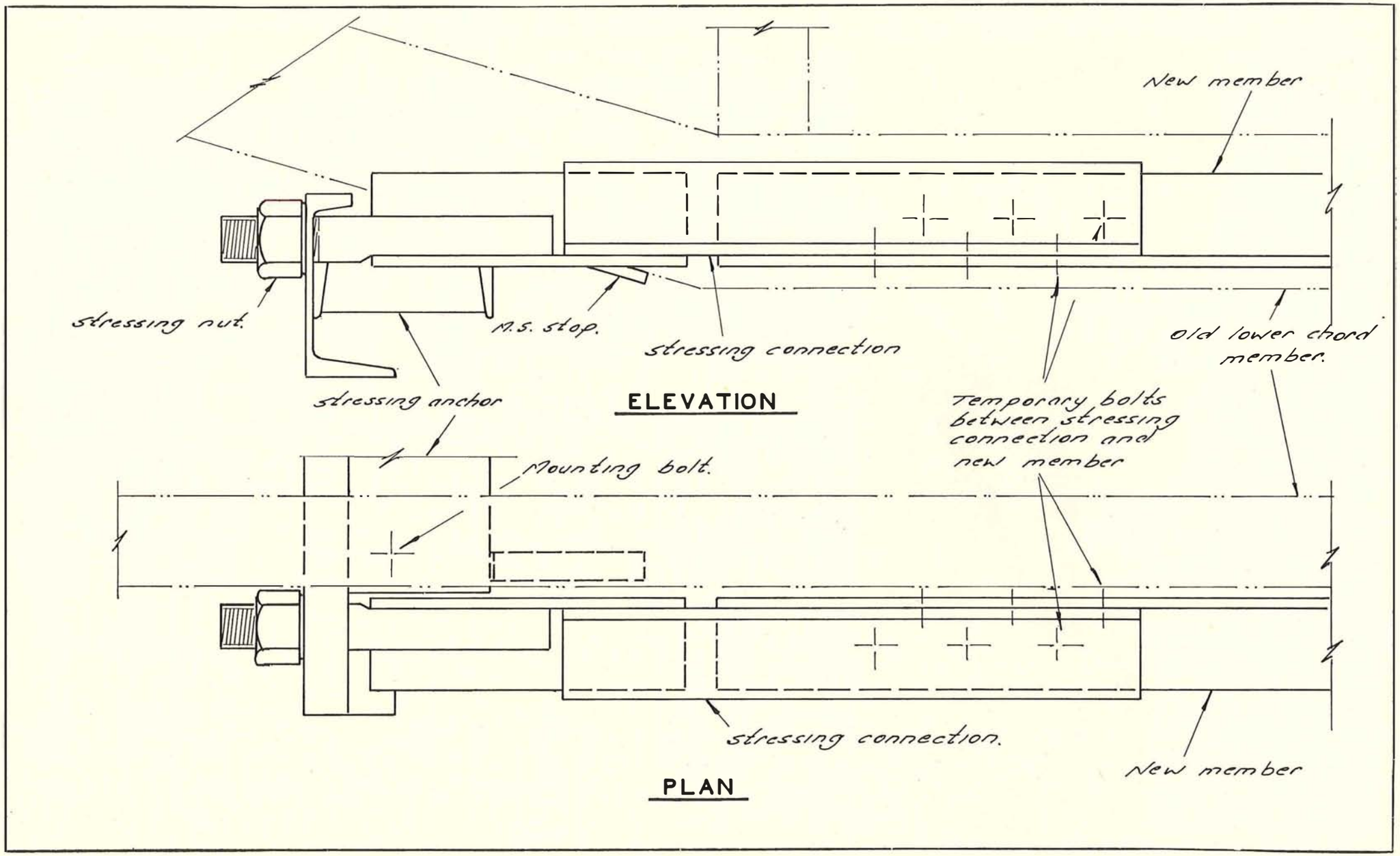


Figure 4.—Arrangement for prestressing new strengthening member at Bemm River Bridge.

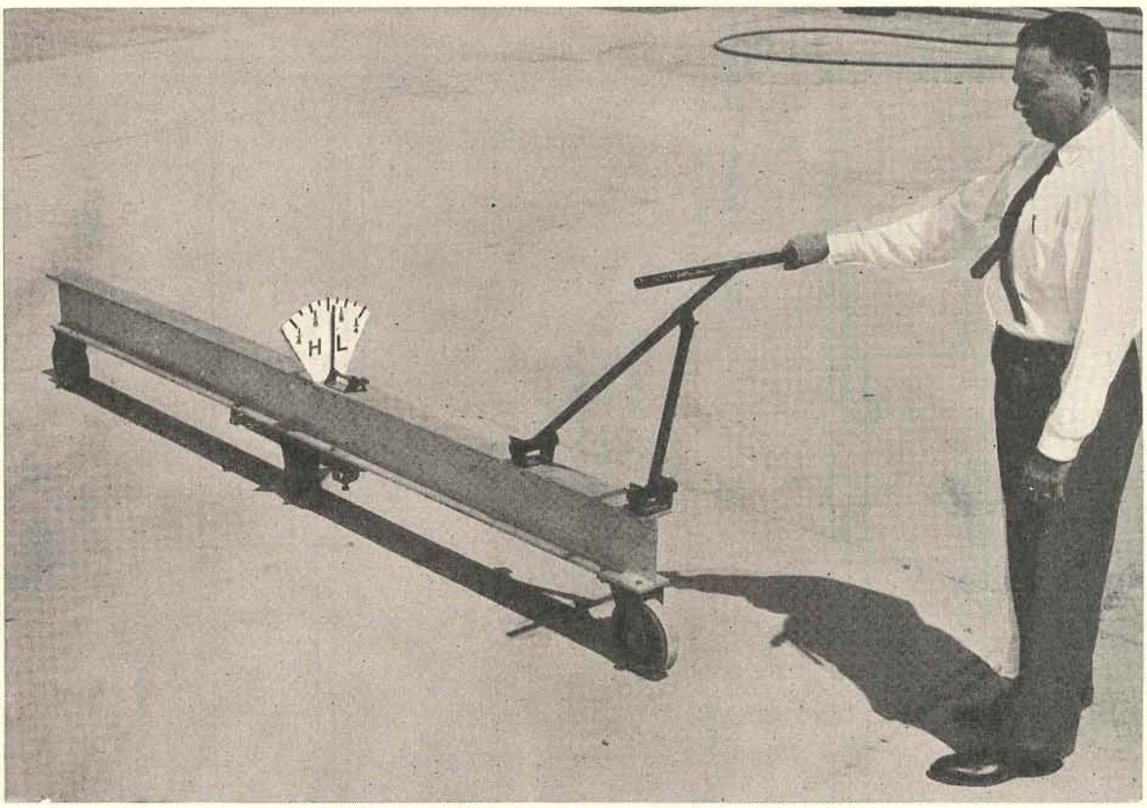


Plate 3.— Travelling-beam straight-edge.

The " travelling-beam " straight-edge was used to locate sections which appeared not to comply with the specification, and then the normal straight-edge was used to check the suspect areas. Readings were taken on longitudinal lines spaced 2 feet apart. Results are shown in Table 12.

TABLE 12—FREQUENCY OF DEPRESSIONS EXCEEDING SPECIFIED LIMITS

Bridge and Span (in Order of Casting).	Number of Depressions Outside C.R.B. Specifications.	Length of Deck Investigated (feet) (14 traverses per span).	Depressions per 500 feet.
A1 ..	19	650	15
A2 ..	10	630 (= 14 × 45 ft.)	8
A3 ..	8	650	6
B1 ..	18	500	18
B2 ..	8	490 (= 14 × 35 ft.)	8
B3 ..	0	490	0
B4 ..	0	500	0

From the above results the following conclusions were reached :

(*a*) Wide variations are observable in the quality of deck finishes obtained. However, the evidence from the better-finished decks shows that it is possible to achieve the requirements of the Board's specification without resorting to more elaborate methods.

(*b*) Finish improved markedly as each job progressed.

(*c*) A significant proportion of depressions appeared to have been caused by concrete moving into the gap left by the removal of screed boards. (Both bridges used transverse screed boards).

Effects of Prolonged Compaction on the Strength of Concrete

The foundations of the bridge over the Murray River at Barmah consist of 140 steel shell piles varying in length from 33 feet to 45 feet. Late in 1964, the contractor submitted a proposal for driving these piles using a drop hammer falling inside the shells on to a 3-ft. cushion of freshly mixed concrete.

Some concern was felt regarding the effect of prolonged compaction on the concrete cushion, and experiments were carried out with a view to evaluating this effect.

The concrete used for the experiment had a water-cement ratio of 0·41 and a maximum aggregate size of $\frac{1}{2}$ in. Immediately after each batch was mixed, concrete was placed in three layers in a 4 inch diameter compaction mould, each layer being rodded for two minutes. The nominal depth of the concrete in the mould was $4\frac{1}{2}$ inches.

When thirty minutes had elapsed after mixing, the mould containing the concrete was placed in a motor driven compaction machine where the concrete was subjected to top surface compaction by a 10-lb. hammer falling through 18 inches thirty times per minute, for varying periods as shown in Table 13. After removal from the mould, the cylinder was immersed in water and cured for 7 days.

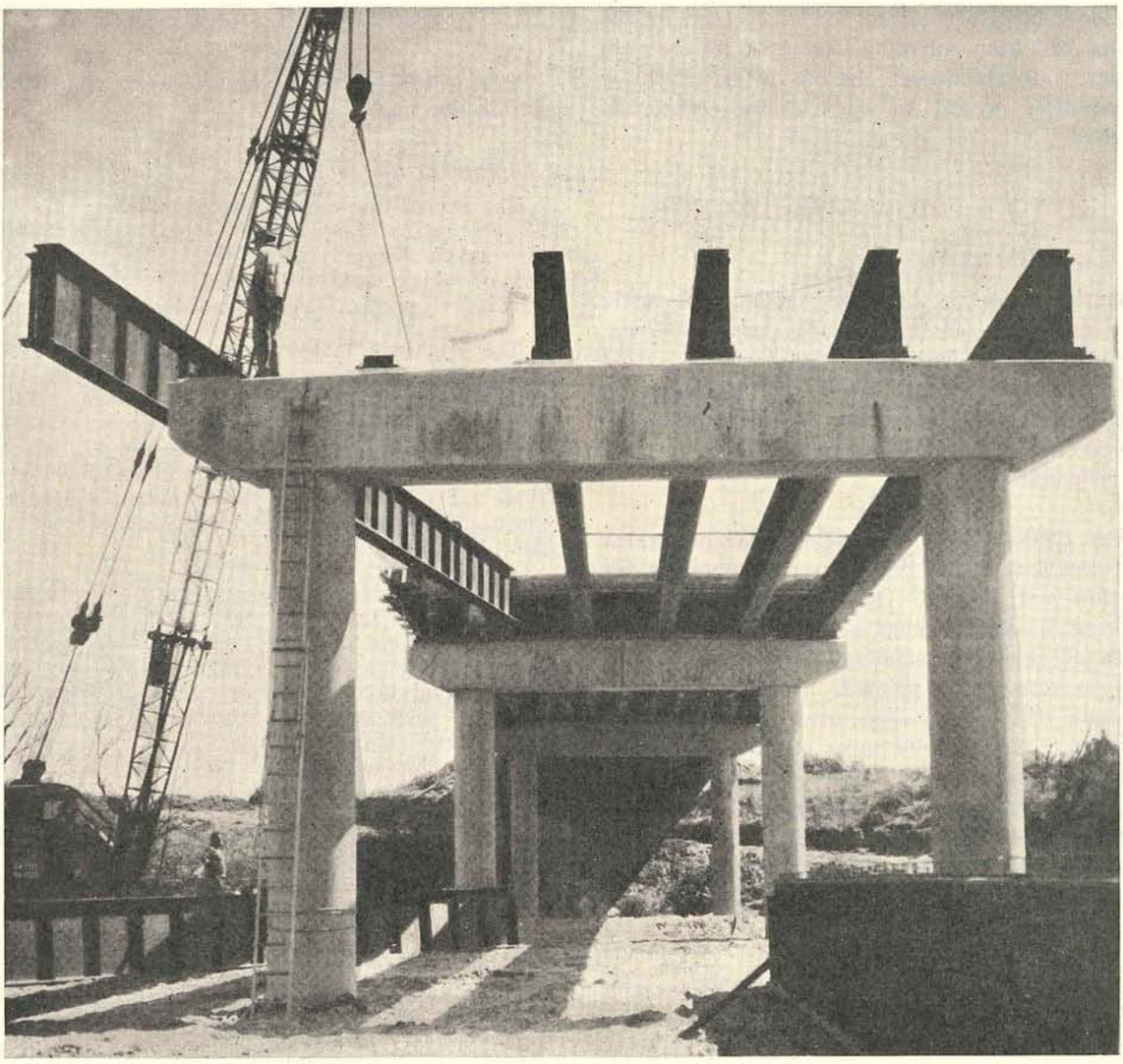


Plate 4.—Construction of Avon River Bridge at Stratford.

Compression test results were as follows :

TABLE 13—COMPRESSION STRENGTHS OF CONCRETE SAMPLES SUBJECTED TO VARYING PERIODS OF TOP SURFACE COMPACTION

Compaction Period (hours).	Compression Strength at 7 Days (p.s.i.).
1	7090
2	7010
3	9220
4	8880
5	7590
6	8820

From the results of the experiment it was concluded that pile driving on a cushion of concrete would not adversely affect the concrete provided driving did not continue beyond 6 hours.

However, it was noted that an appreciable amount of top layer pulverization occurred during compaction, producing a very fine dust. The contractor was informed that it would be necessary to remove this dust before casting the remainder of the concrete in the pile.

Subsequently the contractor decided not to adopt this method of driving, but it was later used by the contractor for the Burke-road Bridge over the Yarra River.

Self-Curing Zinc-in-Silicate Protective Coatings

Steel work for the Avon River Bridge at Stratford (Plate 4) has been protected against corrosion by coating with a self-curing Zinc-in-Silicate preparation. The curing time varies from 12 hours at 40°F to 6 hours at 85°F, and the coating is unaffected by rain which falls later than 20 minutes after application. The material was sprayed onto the sand blasted steel surfaces of the structure to provide a minimum specified thickness of 0·004 inches.

The handrails were coated in Melbourne and transported to the bridge site. It was found that extreme care was necessary in packaging the units for transport, so that the coating would not be rubbed off at points of contact. The girders were treated in situ after the deck had been cast. This method of application proved satisfactory in that damage to the coating through handling the girders and disfigurement by leakage of concrete mortar through the deck framework, were avoided.

Zinc-in-Silicate coatings previously used by the Board had been cured by baking or by chemical means. In this instance the use of the self-curing preparation proved to be a more economical method.

ROAD DESIGN SUB-BRANCH

1. Line Marking

During 1964–65, the Board maintained centre line markings on 5,018 route miles of road, comprising 3,593 miles on State highways, 1,233 miles on other declared roads, and 192 miles on unclassified roads, the latter having been maintained at the request, and at the cost of municipalities.

The Board's new linemarking machine, which was described in the 1963–64 report, operated for the full year 1964–65. With the greater capacity afforded by this machine a total length of 9,451 miles of equivalent standard stripe (i.e., 10 feet line, 30 feet gap) was painted. This length was an increase of 4·6 per cent. over that marked in 1963–64. Of the 9,451 miles of line, 4,330 miles were reflectorized with " drop-on " glass spheres, so that all lines painted in the Board's Dandenong, Benalla, Bairnsdale and Traralgon divisions, together with the first sections of the Princes Highway West and the Western Highway, have now been reflectorized.

The line marking fleet now consists of two large units, one of recent origin, and the other of early origin for which a replacement is being planned, and a small unit. Replacement of the older unit will enable the Board to reflectorize all markings in the State.

The diverse activities of the small unit were further extended this year, and in addition to a small length of longitudinal striping, it painted or repainted 1,352 pavement arrows, and 25 complete rail crossing markings, and removed 19·2 miles of standard stripe using paint stripper. The unit also provided some useful service to Divisions, in striping urgently required short lengths of new seal when other units were not available.

A major development during the year was the initiation of striping in the inner metropolitan area at night. Freedom from the interference of heavy traffic led to a substantial increase in both output and quality of line, which practically offset the increased labour cost. Safety to operators and plant by adequate floodlighting of the unit, was subjectively observed to be greater than by day. This activity will continue in the coming year.

The total cost of pavement marking carried out by the sub-branch this year was £73,597. The average cost per mile of equivalent standard stripe was £7 2s. 3d.

2. Traffic Studies and By-Pass Road Location

The following traffic studies were completed during the year :

Annual Traffic Census

The annual traffic census was conducted on 24th March, 1965. Twelve hour classification counts were taken manually at a total of 1,651 stations, 755 of which were on State Highways, and the remainder on other declared roads.

The Highway Traffic Index (100 in base year 1933) rose from 768 in 1964 to 840 in the current year, an increase of 9·3 per cent. This is the first indication of an upsurge away from the 1959 prediction (Technical Bulletin No. 17), which had remained reasonably valid until and including 1964. The 1965 upsurge should not be viewed as the beginning of a changed trend, however, unless the 1966 result confirms it.

Additional traffic counts were made with the use of permanent automatic traffic counting stations at nine locations on major State highway outlets from the Metropolitan area. The stations are each located between 20 and 30 miles from the centre of Melbourne. Continuous hourly counts for at least 12 months are available for each of these stations. Summaries have been published with the Annual Traffic Census results.

A trial " coverage " type count, aimed at establishing a method of obtaining traffic patterns on roads in a given area by using automatic traffic counters, was begun in August, 1964. The area chosen was that bounded roughly by Ringwood, Mt. Slide, Alexandra and Warburton.

In this area there have been maintained one permanent or " primary " station, six " secondary " stations counted on the basis of one week's hourly recorded count per month, and twenty-nine " tertiary " stations counted on the basis of two 12-hour day counts per month. An analysis of the data collected at the conclusion of a full year of the trial will determine the practical value of the method, and enable the design of a coverage count to cover a much wider area.

To obtain the " tertiary " counts mentioned above more economically, the Board has developed a " dual " non-recording counter fitted with a time clock, such that two separate 12 or 24 hour periods can be counted during one week, without an intermediate visit by a field officer. The two figures are displayed on separate counters.

Miscellaneous traffic counts were conducted consisting of :

(*a*) A number of peak hour turning movement counts at urban intersections, to assist in intersection design ;

(*b*) two origin and destination surveys. The first of these was made at St. Georges-road level crossing at Norlane, Geelong, to determine the degree of inconvenience to traffic which would be caused by a proposal to close the level crossing and construct a rail overpass at Sparks-road. The second survey was made on the Hume Highway on either side of Seymour, to determine the feasibility of a by-pass at Seymour and to find the best location to suit traffic needs.

Human Factors Engineering

It was reported last year that an engineer of the Traffic and Location Section had spent a period of secondment to the Aeronautical Research Laboratories Human Factors Group.

The knowledge and experience gained was put to use this year in three experiments each involving a particular piece of road furniture. Investigation of optimum designs for the following were made :

(*a*) Hazard Markers

The study resulted in a recommendation that a hazard marker giving directional information by means of horizontally pointed chevrons, should replace the existing type consisting of alternate diagonal black and white strips only. The optimum shape and size of chevrons was also determined (Plate 5).

(*b*) Pavement Arrows

The study found that the design of pavement arrows used in South Australia, was the best of those used in any Australian state as regards driver recognition. This study was initiated by NAASRA Traffic Engineering Committee, and the results will be made available to that Committee.

(*c*) Sign Arrows

This study was designed to find the most suitable shape and proportions of directional arrows for road signs. A design was found which was of optimum value regardless of legend/background combination (Plate 6).

The above studies were conducted as laboratory experiments in the Board's road sign testing tunnel at Head Office, using scale models or photographs, and specially designed apparatus to display these to observers.

With observers drawn from a wide cross section of Head Office staff, two types of experimental techniques were used. Each was shown designs, firstly in pairs with the request that the more legible be selected, and secondly one at a time, the period required for recognition of the symbol being measured. Statistical ranking methods were used to evaluate results in each case. The laboratory results are now being followed up by evaluation in the field.

Road Signs

The Board has used waterproof marine grade plywood in increased quantities for large permanent signs this year. Many ground mounted signs have now been erected using this material, the largest being an advance direction sign measuring 15 ft. by 8 ft. on the Princes By-pass Road near Moe.

The use of reflective delineators on guide posts was further extended during the year to include all roads having a striped centre line, and other sealed roads on poorly aligned sections. A large proportion of these latter roads have now been treated.

The Board has collaborated with the Traffic Commission in launching a route numbering system in the Melbourne Metropolitan area. The Board has agreed to subsidize municipal councils for route numbering signs on both declared and unclassified roads (Plate 7.).

By-pass Roads

Preliminary design work and detailed design have continued for those by-pass roads, the construction of which has been announced previously. Typical

Plate 5.—Hazard marker providing directional information with horizontally pointed chevrons.

Plate 6.—Sign arrows of optimum size and proportions.

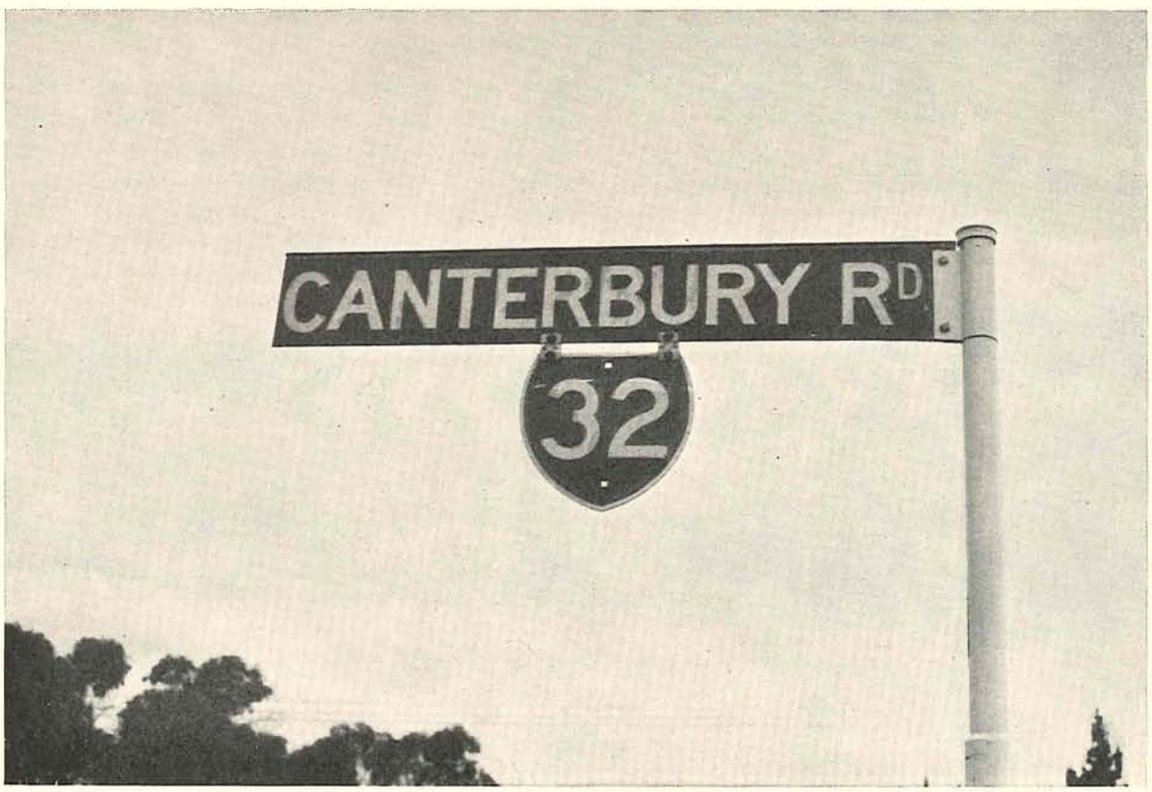


Plate 7.—Route numbering signs.

of the works currently being undertaken are the following projects :

(*a*) Investigation of the conversion to freeway standard of the Princes Highway West from Kororoit Creek to Maltby By-pass, and from Maltby By-pass to Corio By-pass. Geometric design of the interchanges and grade separations is involved, together with provision for alternative access and circulation on the local road system.

(*b*) Investigation of the proposed by-pass of Bacchus Marsh on the Western Highway, in conjunction with duplication work from Deer Park to east of Bacchus Marsh.

(*c*) Examination of the eastern end of Strathmore By-pass, so that together with the M.M.B.W. Route 14 (Tullamarine Freeway) a continuous divided highway route from Flemington Bridge to Tullamarine Airport will be made available.

(*d*) Engineering survey for the Mulgrave By-pass road. Precise geometric design is well advanced, the section between Huntingdale-road and Ferntree Gully-road being complete.

(*e*) Investigation of the highway system in the vicinity of the proposed new township of Churchill (formerly Hazelwood) in the Latrobe Valley area. Churchill will have an estimated population of 40,000 by 2,000 A.D., and the Housing Commission, Victoria, has adopted in principle a freeway facility from Morwell to and beyond the town centre.

3. Engineering Plans and Surveys

Plans for Road Construction

Final construction plans were completed for a smaller number of jobs and a reduced mileage of road, compared with the previous year. The value of the work involved was almost the same, which is indicative of the increasing complexity of the design work now being undertaken.

Plans were completed for 83·5 miles of road for works totalling £3·8 million involving 1,060 final plan sheets for 52 separate projects. Design work on some 16 miles was facilitated using the Board's computer for shifted curves, co-ordinates for complex work and alignments with intersection points tied into the State grid system. Three jobs to a value of £360,000 were designed by consultants.

Final construction plans completed during the year included the following :—

Road	Description
Princes Highway East, Section 1	Three sections between Dandenong and Warragul (9 m.)
Princes Highway East, Section 6	East of Cann River (4 m.)
Princes Highway West, Section 2	Stoney Rises (3 m.)
Hume Highway, Section 1	Duplication Broadford-Tallarook (4·5 m.)
Hume Highway, Section 1	Reconstruction of three sections south of Seymour (4·4 m.)
Northern Highway, Section 1	Between Kilmore and Pyalong (6·5 m.)
Calder Highway, Section 3	Near Glenalbyn (5 m.)
Maroondah Highway ..	Duplication in Ringwood (2·3 m.)
Maroondah Highway ..	Reconstruction in Alexandra area (8 m.)
Ouyen Highway, Section 1	Cowangie and east of Murrayville (5·2 m.)
Murray Valley Highway, Section 4	Near Lake Powell (8 m.)
South Gippsland Highway, Section 1	West of Foster (3·7 m.)
Tullamarine By-pass Road	To freeway standards (2 m.)

The plans for the Phillip Island Bridge approaches, the Burnley-street Overpass and Mordialloc Under-pass were also completed.

Plans are now well advanced for the following projects :—

Road	Description
Hume Highway, Section 1	Duplication Craigieburn to Kal Kallo (4 m.)
Hume Highway, Section 2	Duplication through Seymour (1 m.)
Hume Highway, Section 1	The Goulburn River crossing
Princes Highway East Section 1	Continuation of duplication beyond Hallam (2 m.)
Maroondah Highway ..	Continuation of duplication to Bushy Creek (2·2 m.)
Glenelg Highway, Section 1	French-street overpass at Hamilton
Western Highway, Section 1	Pykes Creek Reservoir section (2 m.)
Western Highway, Section 1	Duplication through Deer Park (2 m.)
Tullamarine By-pass Road	Three grade separations and the Lancefield-road Interchange (1st stage) (3 m.)
Princes By-pass Road ..	Moe section (3 m.)

Specifications

During 1964–65, 158 specifications were prepared for which tenders were invited. The total value of supply and construction contracts was slightly more than £3,000,000.

Tenders were invited for nineteen major construction contract specifications prepared by Head Office and one minor specification from a division. The twenty contracts were let for £1,500,000, compared with 46 contracts let for £2,300,000 in 1963–64.

4. Title Surveys and Plans

Title Surveys

During the year 442 Survey Plans were completed, of which 274 were produced by the Board's Title Survey parties. Included in the total were twenty-one by-pass plans. The computations connected with the plans produced by the Board's surveyors have been greatly accelerated by the use of the electronic computer. The computer was first used for this work in August, 1964, 300 lines being processed during the first week of its operation. This figure has risen to a weekly maximum of 6,020 lines recently and 3,000 to 4,000 lines per week is quite usual. The progressive total at the end of July, 1965, was 96,765 survey lines processed or analysed.

Plan and Offset Printing

A feature of the past year in the Printing Section has been the large saving in cost due to the Photo Direct process. By Offset Printing a total of 1,764,000 sheets were produced during the year, of which 900,000 were produced from 2,708 Photo Direct plates. Had metal plates been used, as in the past, the cost for this production would have

(*c*) Considerable progress was made in the training of workshop foremen and plant instructor drivers on subjects relating to supervisory skills. T.W.I. courses on Job Instruction, Relations, Methods and Safety, were presented.

(*d*) Engineering staff of the Sub-Branch have received a variety of special courses as follows :—

A T.W.I. Course on Job Instruction, for Senior Engineers.

Contract Administration.

Computer Appreciation.

Computer Programming.

Symposium on Thermodynamics, at Monash University.

Symposium on Noise, at Monash University.

Course of lectures on Civil Engineering, as applied to road design and construction.

It is proposed to continue this form of training.

ENGINEERING COMPUTER SECTION

The Board's I.B.M. 1620 computer, installed in June, 1964, has operated very satisfactorily during the year. Data preparation equipment now consists of two key-punches, one verifier, and an I.B.M. 870 Document Writing System for listing the computer output. Consideration will soon be given to securing a faster listing device, as delays in listing will soon become troublesome.

The staff of the section was increased to cope with the steadily increasing volume of work. It now consists of an Acting Officer-in-Charge, one Senior Engineer Programmer, a computer operator and three key-punch operators.

Programming work performed by the Section consisted of :—

writing programmes for Rectangular Column Analysis for the Bridge Sub-Branch ;

computing centreline co-ordinates for given road curvatures for the Traffic and Location Section ; and

dating a Critical Path Network.

Modifications were made to :

the Digital Terrain Modelling Design Programme ;

the Survey Traverse Analysis Programme ; and the P.E.R.T. Programme.

Two programmes for preparing Bituminous Surfacing Statistics for the Asphalt Division have been substantially completed.

UTILIZATION OF THE 1620 ELECTRONIC COMPUTER DURING 1964–65

(*a*) *Computer Usage* (*Hours*)

The total computer time used by Sections of the Board during the year for productive work and programme development is shown in the following table :—

TABLE 14—1620 ELECTRONIC COMPUTER USAGE BY BOARD SECTIONS DURING 1964–65, IN HOURS

Sub-Branch or Section.	Production.	Development.	Total.
Bridge	102	229	331
Title Survey	172	..	172
Materials Research ..	94	71	165
Plans and Survey ..	119	8	127
Engineering Computer ..	..	127	127
Traffic and Location ..	84	27	111
Planning Research ..	10	51	61
Works	3	..	3
Totals ..	584	513	1,097

(*b*) *Details of Utilization by Board Sections*

Details of the work processed by the computer for the Bridge Sub-Branch, Plans and Survey Section and Title Survey Section are given elsewhere in this Report.

The Traffic and Location Section processed 31½ miles of highway using Digital Terrain Modelling, and 7 miles by the Curvilinear Programme. Computations of 42 traverses were made and seven " one-off " type of programmes were written.

The Planning Research Section carried out regression analyses for various statistical problems in connection with Adequacy Rating and Classification investigations. A series of programmes was developed to produce tables and graphs of traffic volumes from the tapes obtained from Fisher and Porter automatic traffic counters.

The Materials Research Division used the computer in connection with the following :—

Research Projects

Correlation of Los Angeles Abrasion Loss Test with aggregate impact value.

Thixotropy and age hardening of bitumen.

Stability of bituminous concrete as indicated by wheel tracking machine.

Studies of the compaction and durability of bituminous concrete as achieved in the field.

Correlation of plasticity index with linear shrinkage.

Use of the sand equivalent test for predicting the acceptability of certain road making materials.

Estimation of C.B.R. from grading and plasticity tests.

Investigational Work

Settlement analysis.

Calibration of the Piatec Hydrodensity Meter.

Sieve calibration checks.

Miscellaneous problems in regression.

Development of Library Programmes

Detailed Settlement Analysis (2 parts).

Simple Linear Regression.

Compatibility of Linear Regressions.

Correlation Analysis—Part 1.

Correlation Analysis—Part 2 (Multilinear Regression).

Generalized Analysis of Variance.

Control Chart Data for Benkelman Beam Test Results.

Utility Sub-Routines for :—

Matrix Inversion

Solution of Simultaneous Equations

Diagonalization of a Real Symmetric Matrix

Eigenvalues and Eigenvectors of a Real Symmetric Matrix.

Matrix printout, addition, subtraction and multiplication.

Preparation of three " one-off " type computer programmes.

(c) *Use by Bodies Other than the Board*

Computer time aggregating 101 hours, was hired by other Government Departments and Instrumentalities viz :

Australian Road Research Board.

Department of Lands and Survey.

Department of the Army (Survey).

Gas and Fuel Corporation of Victoria.

Commonwealth Department of Works.

Commonwealth Scientific and Industrial Research Organization.

Data preparation was also carried out for the Melbourne Metropolitan Transportation Study.

TRAINING

1. External Training

Plant

The Board's workshop personnel attended a number of courses presented by equipment manufacturers, to ensure an up-to-date knowledge of servicing and maintenance procedure on particular items of plant.

Technical Developments

To ensure that the Board is kept informed of the latest developments in technical fields, engineers from the specialist sub-branches attended short courses on concrete technology, engineering mathematics, problems associated with expanding clays, photogrammetry, scaffolding, and the theory of reinforced concrete.

Explosives

Several of the Board's powder monkeys, overseers and engineers, attended a very useful one-week course on explosives, conducted by the State Electricity Commission of Victoria. The course assisted in improving the general knowledge of the participants as regards the use of explosives and the safety precautions to be observed in handling them.

Administrative

Courses relating to administration, particularly in the use of network analysis, were attended by several of the Board's senior engineers.

2. Internal Training

Increasing consideration is being given to the basic training of engineers on their initial appointment to the Board, and the training of supervisory personnel. Arrangements were made during the year, in conjunction with the Local Government Engineers' Association, and the Municipal Superintendents of Works' Association, for a two-year part time course to be conducted at the Royal Melbourne Institute of Technology. The aim in sponsoring this course, is to ensure an adequate supply of supervisory personnel in the road-making industry. Lecturers for the course were drawn from Board and Municipal engineering staffs.

PUBLICATIONS

The following papers were presented during the year in connection with the Board's engineering works :—

Paper.	Author.
Some aspects and Problems of a Human Engineering Study of Road Features Presented at the Second Biennial Conference of the Australian Road Research Board, Melbourne, September, 1964	J. T. Smith, B.E. (Civil)
Road Furniture and Pavement Markings Presented to the Highways and Traffic Engineering Branch of the Melbourne Division of the Institution of Engineers, Australia, 14th April, 1965, and also to the Gippsland Group of the Melbourne Division of the Institution of Engineers, Australia, June, 1965	K. D. Freeman, F.R.M.I.T., C.T.P.C.
Vehicle Performance on Hills Published in " Queensland Roads " Vol. 3, No. 6, December, 1964	J. T. Smith, B.E. (Civil)

Four issues, Nos 76–79 inclusive, of " Engineering Notes " were made during the year, publishing diverse matters of technical interest. Seven issues of " Construction News ", the first issue of which appeared in May, 1964, were published, and disseminated some thirty articles.

STAFF

Total staff of the Chief Engineer's Branch was 796 at 30th June, 1965.

Total expenditure on Board's direct works and by municipalities with funds provided partly by the Board was £27,255,700 for this financial year.

The volume of the work has again increased. There have been particularly heavy demands on the staff, and a part of this has been related to the design and construction of complex works. It is desired to acknowledge the able way in which the staff has met these demands, and to thank them for it.

The death of Mr. G. J. Dempster (Deputy Chief Engineer—Road Design) during the year meant the loss of a very able officer. Mr. Dempster made a major contribution to the Board's work in his field of road design.

H. S. GIBBS,
Chief Engineer.

By Authority: A. C. Brooks, Government Printer, Melbourne.