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TRANSPORT- COMMUNICATIONS

MONTHLY REVIEW

NOVEMBER 1955—No. 103

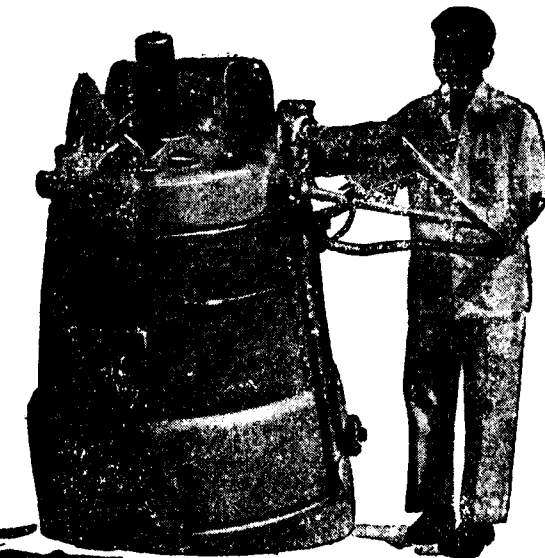
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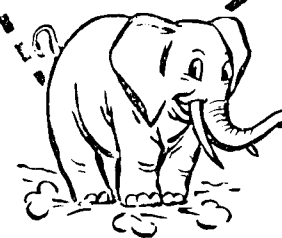
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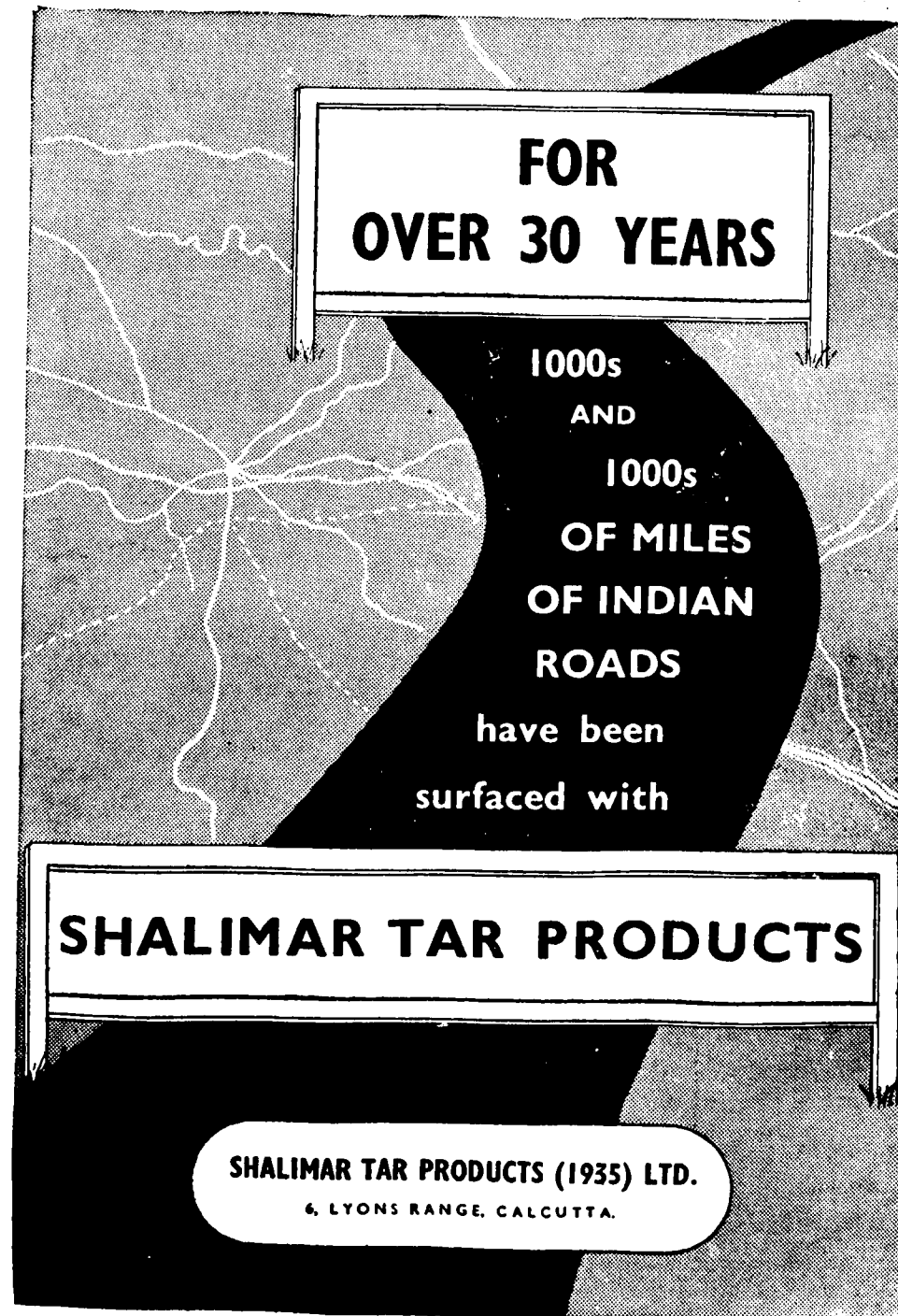
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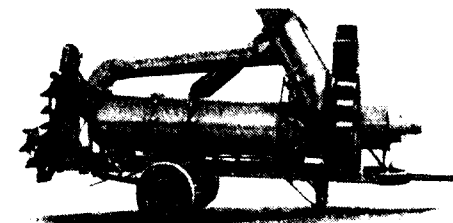
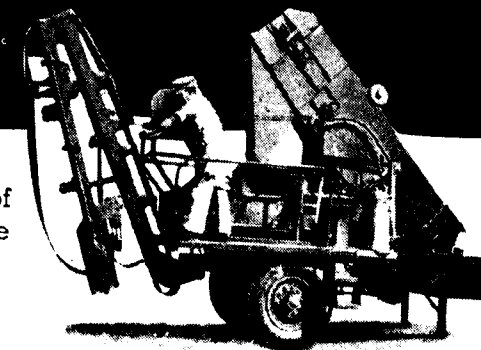
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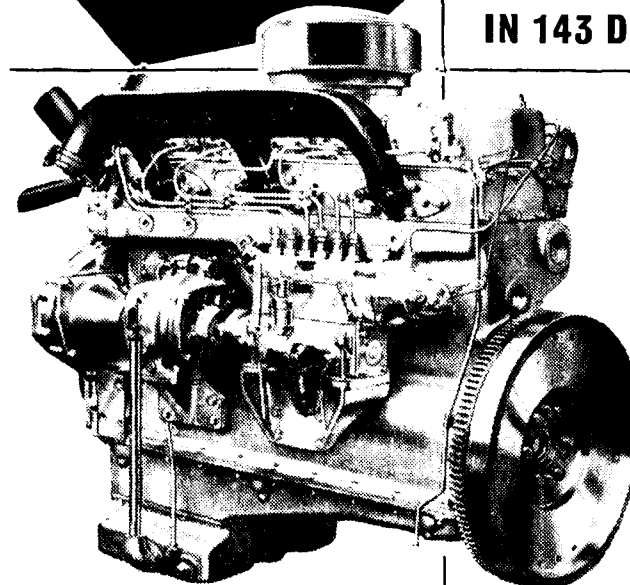
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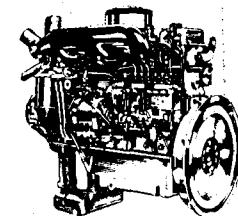
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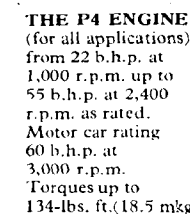
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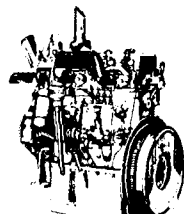
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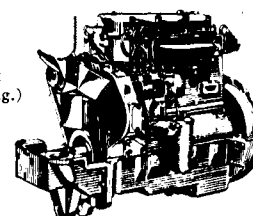
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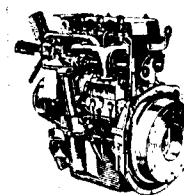
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Shri H. P. Mathrani, the leader of the Indian Delegation speaking at the Tenth International Roads Congress held at Istanbul.



Some delegates from India — Shri W. X. Mascarenhas, Shri W. A. Griffiths, Shri I. A. T. Shannon & Shri Sujan Singh can be seen in the photo.

TRANSPORT-COMMUNICATIONS MONTHLY REVIEW

A REVIEW OF
ROAD ENGINEERING, DEVELOPMENT & TRANSPORT

NOVEMBER 1955

THE INFLUENCE OF BRIDGES ON ROAD LAYOUT AND ALIGNMENT

THE influence of bridges on road layout has always been considerable. In the remote past, the bridge may be said always to have governed; and the smallest bridge was sited in the most convenient and cheapest way, regardless of its effect on the alignment of the highway.

With the coming of motor traffic in this century, alignment became of far greater importance; gradients over a bridge and vertical curves had to be gentle and the road had to be straight or gently curved.

Small bridges and culverts on important roads should generally be governed absolutely by the road, which should not deviate for them either in the horizontal or vertical plane; in such cases it is often better not to construct a special parapet for the bridge but continue the road fence (or even the bridge in the case of culverts) across it so that its presence is quite inconspicuous from the road. Larger bridges have of course some influence on both layout and profile of the road they serve and the largest bridges still govern absolutely. Road and bridge requirements often conflict; and it is a matter of judgment to decide between them in each case.

In difficult country fairly sharply curved or polygonal bridges can give a handsome effect.

Structurally and (from the point of view of the bridge) visually a bridge should generally be straight. It must be remembered, however, that most people see a bridge from the road only.

Short straights should not be inserted between curves in road alignment; and this point needs careful watching.

If the approach curves are very flat there may be no objection to a straight bridge; but this may need to be tested on a model before a decision is taken. Curved girders are sometimes possible, but more expensive and difficult structurally; if straight girders or arch ribs are used with a deck curved on plan there must unnecessarily be different cantilever projections at different points across the span.

Where dual carriageways are separately benched the under bridges will also have to be separate. Where an overbridge crosses a dual carriageway road on a curve needing substantial superelevation and the overbridge carries a road with

a steep gradient in the opposite direction the appearance and properties of the bridge will generally be improved if the carriageways are tilted separately rather than in one plane.

If there is a curve across the bridge and there is superelevation the road gutters on the two sides will be of different heights. Generally the best methods of dealing with this is to keep the heights from girder or beam soffit to parapet coping the same on both sides but vary the heights of the girder bearings. Greater difficulties may arise when a long bridge is straight with one or both approaches superelevated; working out the superlevation across the bridge will often need a model.

With dual carriageways two separate bridges may sometimes be used; and this may justify a slight separation of the carriageways particularly on curves. A special case is where an existing road is to be widened and it is desired to preserve hedgerow trees or avenues. Otherwise the centre reservation will be closed either by cantilevering or by a light covering slab. Long bridges may have a reduced centre reservation (which involves bringing the carriageways closer together) in order to save expense. It is generally better, however, always to make the two halves of the bridge or viaduct separate structurally, unless transverse continuity is desirable in order to spread the weight of heavy indivisible loads across the whole of the actual carriageway road.

It often happens that provision has to be made for future widening. If so, there should be no joint between old and new structures in the carriageway; hence it is difficult to widen a two-lane to a three-lane carriageway satisfactorily, or from a three-lane to dual carriageways. The simplest plan is to construct one carriageway initially (say 22 ft) and to provide for the construction of a second carriageway carried by an identical second bridge when required. Unless only light loads are to be carried transverse distribution is important and therefore a longitudinal joint under the kerb will not do, unless the carriageway edge is well stiffened.

The same sort of problem arises when old bridges have to be widened. A very narrow mediaeval bridge may sometimes

be retained to serve as a footway, a new bridge being constructed, possibly on a better alignment, with only one footway. Alternatively, a wider bridge may be kept without alteration to carry one single lane carriageway and one footway, a new bridge being built alongside for the second lane and footway.

VERTICAL ALIGNMENT

A small amount of camber is necessary in a bridge so as to at least balance deflection. Somewhat more is needed for an arch bridge otherwise the arch curve will give an appearance of sag to the bridge; and since deflections are larger with suspension bridges, the minimum camber for a large suspension bridge will be quite substantial. It is usual however to give suspension bridges rather more than this with resulting improvement in appearance.

The looks of most bridges (except long viaducts particularly if they rise from one end to the other) are improved by fairly substantial vertical curves or camber, sometimes even from the road standpoint. Nothing more than the minimum referred to in the previous paragraph can generally be justified for small bridges on important roads; and the vertical curve will always be governed by the need to provide sufficient visibility across the bridge. Each case must be decided on its merits. Vertical curves should be as long as possible; and if straights can be avoided so much the better. An exception is a symmetrical multi-span bridge rising on both sides to a larger middle span. There is no visual objection here, from the bridge point of view, to a vertical curve extending only over the middle span, the profile being straight on both sides over the approach spans. It is often necessary to have overbridges with substantial vertical curves; if possible, the bridge or girder soffits should be parallel to the road and parapet curve.

When bridges have to be built or rebuilt in awkward situations the desirable road profile may be difficult to reconcile with that required to give a good appearance to the bridge. In such cases a certain amount of adjustment or making

(Continued on page 6)

ROADS IN CEYLON

(From "Highways and Bridges and Engineering Works, August 17, 1955.")

A total of 11,171.97 miles of road were maintained by the Ceylon P. W. D. during 1954. This total which excludes 20.24 miles of trunk roads maintained by the Municipal Council of Colombo at the expense of the Central Government is 66.27 miles more than the figure given in the Administration Report for 1953. Of the total mileage maintained by the Public Works Department 9,630.90 miles are motorable; 6,542.56 miles are bitumen surfaced and a further 528.63 miles are metalled but not bitumen surfaced.

The average amount spent on the maintenance per mile of all P. W. D. roads in 1954 was Rs 778.19 compared with Rs 1,031.90 in 1952-53; Rs 1,207.59 in 1951-52 and Rs 915.50 in 1950-51.

The number of vehicles on the road, especially the heavier type of vehicles such as buses, lorries and tractors has risen considerably.

Experimental work on road surfacing was curtailed but observations on various types of work carried out continued. It is fairly well established that open textured bituminous macadam though satisfactory in upcountry roads in preventing skidding, will not stand up to the intensity of loading and pounding effect of the iron tyred wheels of bullock carts. The section on the fourth mile of the Negombo Road laid by hand with premix carpet appears to be standing up very well to all types of traffic. It is proposed to carry out such work with mechanical equipment where possible in future.

CLASSIFICATION

A functional classification has been prepared which classifies all P. W. D. roads into three main groups being further subdivided depending on the volume and nature of traffic which the roads are likely

to carry. The new functional classifications are as follows:—

- A. **Trunk Roads.** Those connecting Provincial centres, major ports and airports.
- B. **Main Roads.** Those connecting centres of District Administration (towns with Kacheries or Court), or forming important links with a Trunk Road.
- C. **Minor Roads.** All P.W.D. Roads excluding trunk and main roads.

The above main classes are sub-divided further according to traffic volume as follows:—

A. Trunk Roads.

- (i) Dual carriageways 24-30 feet with 4-foot central strip and two 4-foot footways. Bridges to have 60-foot carriageways with 5-foot pavements.
- (ii) Two lane carriageways (20 feet and two 4-foot verges) with 32 feet formation width (30 feet in hilly country). Bridges to have 22 feet carriageways with two 4-foot pavements.
- (iii) Single lane carriageway (12-feet and two 8-foot verges) with 32 feet formation width (30 feet in hilly country). Bridges to have 32 feet carriageway.

B. Main Roads.

- (i) Two lane carriageways (20 feet and two 4-foot verges) with 32 feet formation width (30 feet in hilly country). Bridges to have 22 feet carriageway with two 4-foot pavements.
- (ii) Single lane carriageway (12 feet and two 8-foot verges) with 32

feet formation width (30 feet in hilly country).

C. Minor Roads.

- (i) 10 feet metalled carriageway with 22 feet wide formation.
- (ii) 10 feet gravelled carriageway with 22 feet wide formation.
- (iii) 10 feet natural track with 22 feet wide formation.
- (iv) 5 feet bridle paths.

Bridges to have 12 feet carriageway for spans below 50 feet and 18 feet for spans of 50 feet and over.

Bridge Loading. Ministry of Transport (British) Standard 15 (BSS Units) for all classes.

Culverts, 28 feet clear width between head walls, for classes A & B; and 20 feet between head walls for Class C Roads.

Future Bridge Replacement

The bridges on trunk and main roads which were designed for light and slow

moving traffic are subjected to very heavy fast moving traffic and also abnormal traffic due to industrial and agricultural developments necessitating the early widening and reconstruction of several bridges on these roads. The replacement of many large steel bridges, most of which are of wrought iron particularly along the coast roads is also an urgent necessity. It has, however, not been possible to take up the widening and strengthening of these bridges due to inadequacy of funds for the construction of bridges and heavy plant necessary for carrying out these works.

The Department is now faced with a very large programme of bridge work for a number of years in order to bring the communications of the Island up to a standard suitable for present-day traffic. It is also proposed to construct some bridges in pre-stressed concrete where this type of construction is economical and a start has been made to provide Naragala Bridge which is about 290 feet long with a pre-stressed concrete decking. It is also realised that a very wide field is available in Ceylon for this type of construction.

(Continued from page 4)

up may be done by varying road and footway cross sections and parapet and plinth heights; but this needs great care and a model is often helpful.

A bridge or viaduct has often to span a valley, with descending gradients on both sides. A positive camber is frequently inappropriate and a straight profile looks bad. In such cases a sagging profile should be given consideration and is generally quite satisfactory. It should be all right for an arch, and also for beam or girder multi-span bridges or viaducts.

It is more difficult to design a single span beam or girder bridge with a sagging profile. One way of doing it which will sometimes work is to give a positive camber to the beam or girder and a negative one (or sag) to the road, parapet and plinth curves, making up at the beam ends (possible by deepening the beams). Should this not be satisfactory there will have to be a small positive camber over the bridge which will need to be integrated into the road profile.

(From Bulletin No. 140 of the Permanent International Association of Road Congresses)

FINANCING THE HIGHWAY PROGRAMME IN THE STATE OF WASHINGTON, U.S.A.

FINANCING road building in Washington has followed the traditional historical pattern. When the early settlement of the State took place, roads were, of course, a necessity, but, as in all pioneer communities, capital was scarce to build them. The solution was forced labour and early legislation required that all males between 18 and 50 except "ministers, the infirm and public charges," were to work at least three days a year on the roads. Also there was an annual road tax of 9 dollars per person which was to be worked out if the person were able. Later these methods of obtaining capital to build the roads were supplemented by a tax of 25 cents on each 100 dollars of assessed property valuation.

Early legislation also authorized private toll roads in counties where there was no local labour along the line of the road, and general obligation bonds were used extensively to build needed road facilities where other revenue raising measures weren't sufficiently productive. When the motor vehicle made its appearance there was revenue from registration fees available for highway construction and later the gasoline tax came into existence as a highway revenue measure.

Thus, before the motor vehicle existed in any appreciable numbers on Washington highways, the wherewithal for building and maintaining the various road systems came from forced labour, property taxes, tolls and general obligation bonds, and after the motor vehicle appeared, the load was assumed by gasoline tax and registration fees. The trend was away from property taxes, tolls, bonds and forced labour. The motor vehicle had become an extremely profitable source for money to satisfy the need for roads at all level of government.

User Taxes Assume the Burden

By 1940 there were no toll roads, no bonds for current highway work and no forced labour required. User taxes produced most of the revenue for highways

at both the local and State levels. Property taxes had become a relatively minor source of funds and proceeds of these taxes levied for road purposes were used for local roads entirely for since 1923 no property tax had been levied for State highway purposes.

Thus, dependence in Washington shifted from property taxes as the principal basis for support of highways, roads and streets to user taxes.

In 1920 highways user taxes paid only 17.13 per cent of the total bill for county roads, city streets and State highways and by 1940 highway users had assumed over 80 per cent of the burden for roads at all levels of government. Since 1940, there has been no appreciable increase in the percentage of the total burden borne by the highway user, however. But it is significant that property tax revenue for roads in 1953 was over a million dollars less than in 1920.

These facts should be pointed out in any discussion of highway finance because they are a part of the whole picture. The fact that the highway user has assumed the larger part of the burden for revenues for roads at all levels of government is important to a road programme, for unless property bears its share of the burden, sufficient revenue for an effective highway programme will not be forthcoming.

More State Aid to Local Units

Another typical trend in highway financing is the fact that the local units have been taking more and more of the highway user fees. For a number of years State highways in Washington have been supported by levies on the highway users and those levies have helped support roads at local levels of government as well.

In 1920, no money from the highway user went to local units; by 1940, over 50 per cent was allocated to cities and counties. The trend was reversed, however, by the 1949 legislature which raised

the gasoline tax from 5 to 6½ cents per gallon, and provided for most of the increase to remain at the State level. In 1953, less than 40 per cent went to local units of government. But it should be pointed out that at the same time the State assumed the burden for constructing and maintaining State routes through cities.

Consequent on the increase in traffic after World War II, the highway situation was considered to be such a serious one that the 1947 legislature directed that a highway needs study be undertaken and a report made to the 1949 session on total needs and on possible ways to finance those needs. This study indicated a large deficiency of funds for the 10-year period 1949-59 at existing levels of taxation. The result was an increase in the fuel tax from 5 to 6½ cents per gallon and increases in the basic registration fee from 3 to 5 dollars. Substantial increases also were made in truck and bus fees.

Bonds

Despite this increase in revenue from normal funds, it was obvious that a further speed-up in the highway programme was necessary. Even this increase in revenue wouldn't build needed highway facilities fast enough. So the 1951 legislature provided for bond issue. Then, in 1953, additional bond authorizations were made.

The "pay-as-you-go" system of building Washington's highways was supplemented by bonding and bond funds were in general allocated only to those highways where sufficient benefits to traffic would result to amortize the bonds.

Benefits to User Pay Bond Cost

One of the objections commonly made to bonding for highways is the extra cost involved in paying interest. The legislature recognised this problem and in general, bond money was spent on those sections of highway where the accumulated benefits to traffic would be sufficient so the money spent in bond interest would be recovered by the highway user well before the time when funds would have been available from normal sources to complete

the improvement. Thus, if we had waited for normal funds to accumulate in sufficient quantities, the motorist would have paid far greater sums in increased fuel consumption, higher accident rates and in many other ways than he will as interest on the money made available under the bond system. Obviously such a principle would not be valid on roads where traffic was scant and not in enough quantities to accumulate benefits in sufficient amounts to amortize the cost of the bond issue.

There is, of course, some traffic that will be encouraged by the new highway improvements. Some miles will be driven which would not have been driven at all without the new improvement. To the extent that this takes place, a net gain in revenue to the motor vehicle fund will be made, assuming, of course, reductions in distance and in other improvements aren't sufficient to decrease fuel consumption.

Toll Method Provides More Facilities

Still roads aren't being built fast enough. Higher highway user fees plus revenue bonds haven't provided enough money to build the highways considered to be necessary. So toll projects have been authorized.

The Washington State Council for Highway Research is studying various aspects of this problem. First, they are measuring just how much money the local units of government should get from the motor vehicle fund each year. Next they are measuring how much money the heavier vehicles should pay. The results of these studies may provide more money for State highways since their studies may show the local units receive more than they should from the State. And these studies may show, too, that the heavier vehicles should pay more for highway services than they do now.

To summarize, the highway financing in Washington is from (1) revenues from the current schedule of highway user taxes; (2) the revenues from bond authorizations; and (3) the revenue financed by toll projects.

(From 'American Highways' April, 1955.)

USE OF "COPACITE" IN SOIL STABILIZATION

By

S. R. Mehra & L. R. Chadda

"COPACITE" is the trade name for a powdered lignin extract.

The following characteristics of the resultant soil-mixtures have been studied.

1. Density and shrinkage.
2. Resistance to abrasion.
3. Resistance to softening action of water.
4. Compressive strength.

It has been claimed that its use in small concentrations increases the strength and resistance to abrasion of stabilized soil roads in dry weather. With a view to compare the effect of adding 'Copacite' with that of adding molasses, a detailed study was conducted with different types of alluvial soils occurring in the Punjab.

Physical characteristics of the soils selected for the study are given in Table I, Fig 1.

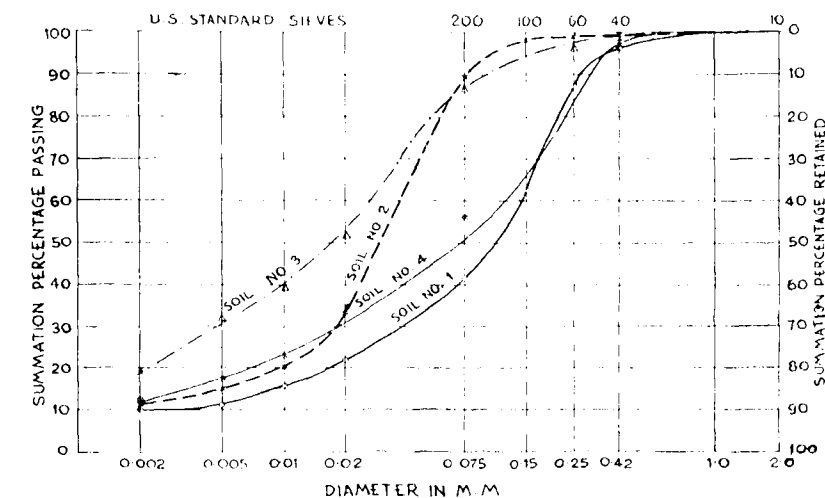


Fig. 1. Mechanical Analysis of Soils Tested

Table I
Characteristics of soils used

Soil No.	Soil type	Liquid Limit	P. I.	Sand per cent	Optimum moisture per cent	Exchangeable Bases		Sulphate per cent
						Ex Ca m. c. per 100 GM	Na & K m. c. per 100 GM	
1.	Sandy loam	24.3	6.7	59.5	12.0	9.80	6.60	Nil
2.	Silty loam	33.9	11.2	12.4	14.0	10.30	4.96	.05
3.	Silty clay loam	36.9	17.5	15.4	13.0	14.30	4.04	Nil
4.	Loam	28.3	10.7	39.5	11.50	11.60	3.48	Nil

EFFECT ON DENSITY AND SHRINKAGE

All the four soils were compacted with a compaction apparatus at 40 blows, with increasing percentages of copacite mixed with water and made upto optimum moisture. Results obtained are given in Table 2.

It will appear from Table 2 that the addition of small percentages like 0.25-0.5 of copacite can increase the density to a

Table 2
EFFECT OF COPACITE ON THE DENSITY & SHRINKAGE OF SOILS.

S. No.	Per cent of copacite	Percentage shrinkage	Density
Soil No. 1 (Sandy Loam)			
1	Blank soil	0.98	1.81
2	0.1	1.05	1.85
3	0.25	1.19	1.90
4	0.50	1.20	1.88
5	0.75	1.37	1.86
6	1.0	1.66	1.89
7	2.5	1.47	1.91
8	5.0	1.81	1.98
Soil No. 2 (Silty Loam)			
9	Blank soil	1.50	1.78
10	0.1	1.55	1.79
11	0.25	1.82	1.79
12	0.50	1.72	1.79
13	0.75	1.85	1.78
14	1.0	1.99	1.84
15	2.5	2.44	1.85
16	5.0	3.33	1.89
Soil No. 3 (Silty-clay loam)			
17	Blank soil	4.22	2.00
18	0.1	4.41	2.01
19	0.25	4.44	2.03
20	0.50	4.66	2.02
21	0.75	5.13	2.03
22	1.0	4.98	2.03
23	2.5	6.54	2.03
24	5.0	6.84	2.07
Soil No. 4 (Loam)			
25	Blank soil	2.84	2.04
26	0.1	2.26	2.02
27	0.25	1.96	2.03
28	0.50	2.37	2.06
29	0.75	3.05	2.04
30	1.0	2.56	2.07
31	2.5	4.94	2.10
32	5.0	2.81	2.10

small extent as in the case of salt solutions, and this may greatly improve the bearing capacity of soils. A slight increase in volumetric shrinkage is also produced with the addition of copacite.

RESISTANCE TO SOFTENING ACTION OF WATER

The effect of increasing concentrations of copacite on the water-resisting quality of soils was also studied. The blocks used for the determination of density were immersed under water and the time taken for complete disintegration recorded. Results obtained are given in Table 3.

Table 3
EFFECT OF COPACITE ON THE WATER-RESISTING QUALITIES OF SOILS.

No. of soil	Per cent copacite	Time of complete disintegration		
		Hours	Minutes	Seconds
Soil No. 1 (Sandy loam)	Blank	—	4	5
	0.1	—	10	11
	0.25	—	10	50
	0.50	—	14	4
	0.75	—	11	30
	0.100	—	20	30
Soil No. 2 (Silty loam)	Blank	—	9	30
	0.1	—	10	45
	0.25	—	12	0
	0.50	—	12	20
	0.75	—	13	5
	0.100	—	22	—
Soil No. 3 (Silty-clay loam)	Blank	—	18	—
	0.1	2	23	—
	0.25	2	45	—
	0.50	2	55	—
	0.75	3	13	—
	1.0	4	3	—
Soil No. 4 (loam)	Blank	—	35	0
	0.1	—	35	0
	0.25	—	29	0
	0.50	—	55	0
	0.75	2	—	—
	1.0	1	58	—
	2.5	4	50	—
	5.0	167	25	—

It will appear from Table 3 that all the four soils considerably improve their resistance to water with the addition of increasing percentages of copacite. The maximum effect is produced in soil 3 & 4 (Silty clay loam and loam).

ABRASIVE-RESISTANCE

Blocks of the soils were made by compacting 200 gm of dry soil in a compaction apparatus using increasing concentration of copacite. These were dried to constant weight and then subjected to abrasion test on a Dorry type abrasion machine worked at a speed of 28-30 R.P.M. The abrasive agent used was sand passing 20 and retained on 30 U. S. Standard Sieve.

Loss in weight due to abrasion at the end of 1000 revolutions is recorded, Table 4 and Fig. 2.

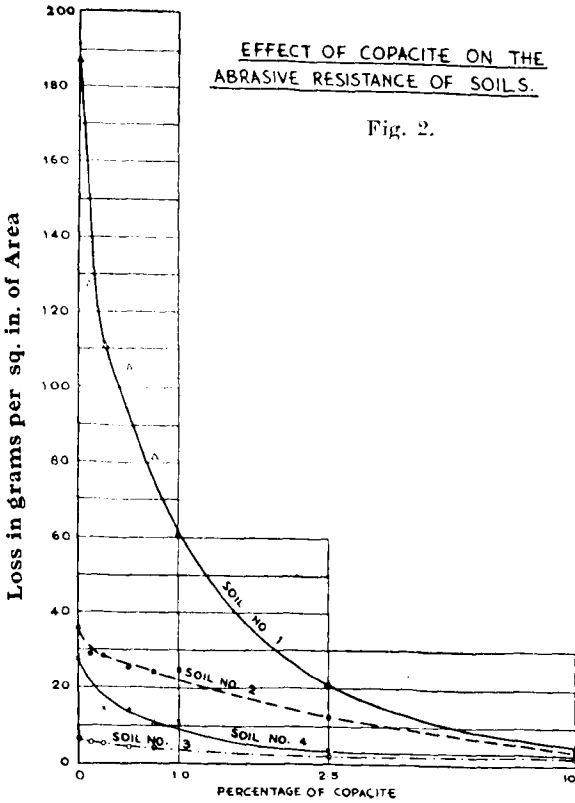


Table 4
EFFECT OF COPACITE ON THE ABRASIVE RESISTANCE OF SOILS

S. No.	Per cent Copacite	Loss in grams per square inch area of contact after 1000 revolutions
Soil No. 1 (Sandy Loam)		
1	Blank soil	186.4
2	0.1	127.8
3	0.25	110.6
4	0.50	104.8
5	0.75	81.6
6	1.0	60.8
7	2.5	20.4
8	5.0	4.8
Soil No. 2 (Silty Loam)		
9	Blank soil	35.8
10	0.1	29.05
11	0.25	28.75
12	0.50	25.60
13	0.75	24.30
14	1.0	24.50
15	2.5	12.70
16	5.0	2.75
Soil No. 3 (Silty-clay loam)		
17	Blank soil	6.2
18	0.1 Copacite	5.9
19	0.25	5.4
20	0.50	4.50
21	0.75	0.30
22	1.0	4.30
23	2.5	2.60
24	5.0	2.45
Soil No. 4 (loam)		
25	Blank soil	27.60
26	0.1	21.20
27	0.25	14.30
28	0.50	14.10
29	0.75	10.70
30	1.0	11.30
31	2.5	3.30
32	5.0	2.40

It will appear from Table 4 that abrasive resistance of soils increases as the concentration of copacite increases. With lower concentration, the effect is well marked in sandy soil than silty or silty clay loams. But with 5 per cent copacite, the effect is more or less identical in all the four soils.

COMPRESSIVE STRENGTH

Blocks made by compacting 200 gm of dry soil mixed with increasing percentages of the stabilizer were allowed to dry in an oven at 50° C to constant weight and tested for compressive strength. Results obtained are given in Table 5.

Table 5
EFFECT OF COPACITE ON COM-
PRESSIVE STRENGTH OF SOILS

S. No.	Percentage copacite	Load at Initial crack lb. per sq. in.	Load at Final crack lb. per sq. in.
Soil No. 1 (Sandy Loam)			
1	Blank soil	230	320
2	0.1	340	470
3	0.25	330	500
4	0.50	370	740
5	0.75	430	724
6	1.0	500	960
7	2.5	520	1050
8	5.0	520	1120
Soil No. 2 (Silty loam)			
9	Blank soil	490	770
10	0.1	630	760
11	0.25	670	805
12	0.50	750	840
13	0.75	745	785
14	1.0	750	940
15	2.5	940	1400
16	5.0	1600	2100
Soil No. 3 (Silty-clay loam)			
17	Blank soil	1240	1430
18	0.1	1350	1535
19	0.25	1500	1675
20	0.50	1500	1678
21	0.75	1350	1770
22	1.0	1650	1800
23	2.5	1650	1750
24	5.0	2200	2600
Soil No. 4 (loam)			
25	Blank soil	1250	1735
26	0.1	1300	1525
27	0.25	1350	1610
28	0.50	1400	1650
29	0.75	1400	2200
30	1.0	1500	1750
31	2.5	1950	2851
32	5.0	2325	3225

It will appear from Table 5 that the addition of copacite in small concentrations appreciably increases the compressive strength of all the four soils and this fact clearly points towards its utility as stabilizing agent.

This study indicates that the addition of copacite in small quantities increases the density, and improves the water resisting quality, as well as the abrasive resistance of soils. The compressive strength of soils is also greatly improved with copacite. Compared with the results obtained by using molasses, copacite is found to be more effective for the same quantity of molasses used. Addition of 0.5 per cent copacite has practically the same effect in improving soil characteristics as 2.5 per cent molasses.

COSTS

Comparative costs using 0.5 per cent copacite and 2.5 per cent molasses for constructing one mile 10 feet wide stabilized soil road are given below :-

16,000 cu. ft of soil required for 1 mile 10 ft wide road.

1,200,000 lbs of soil required for 1 mile 10 ft wide road.

1. Cost of 2.5 per cent Molasses

Amount of molasses required for 1 mile 10 ft road = 13.33 Tons.

Cost of molasses @ Rs 61/4 ton F.O.R. Karnal = Rs 816/7/-

say = Rs 816/-

2. Cost of 2.5 per cent Copacite

Weight of copacite required for 1 mile 10 ft wide road = 13.33 tons

Rate of copacite including freight charges from Montreal (Canada) to Bombay in car load lots = Rs 497/- ton (2240 lb).

Freight charges from Bombay to Karnal in wagon lots @ Rs 1-2-7 per maund Rs 32 per ton. Total cost of Copacite in car load lots (F.O.R. Karnal) = Rs 529 per ton.

(Continued on page 27)

MOTORWAYS OF BRITAIN

“MOTORWAY” is the designation of Britain’s equivalent to the American superhighway, the German autobahn and the Italian autostrada. The first stages in the building of motorways to speed the movement of road traffic were recently announced by the Minister of Transport and Civil Aviation.

The total cost of all the roads announced in the first stages is £ 85 million, (Rs. 115 crores) which gives average cost of about £ 250,000 (Rs. 33.7 lakhs) per mile.

TWO AND THREE LANE DUAL
CARRIAGEWAYS

The motorways will be constructed to modern standards with hard shoulders adjacent to the carriageways, as shown in Figs. 1 & 2, so that vehicles can pull up in emergencies clear of the running lanes. The actual carriageways are defined on either side by a marginal strip in contrasting colour, each strip being 1 ft wide. The carriageways will be designed to provide for lane travel and each traffic lane will be 12 ft wide; on the section of the London-Yorkshire motorway between St. Albans and the spur to Birmingham at Ashby St. Ledgers there will be two three-lane carriageways as on this section the road will carry, in addition to the heavy industrial traffic to Birmingham, the industrial traffic to the north-east. The question whether there should be dual two-lane or dual three-lane carriageways on the other motorways is now being investigated in the light of the traffic figures revealed by the traffic census taken in August 1954. The method of defining the lanes in each carriageway has not yet been decided.

In general, lighting on motorways will be provided where they pass close to large centres of population. At these points the volume of traffic will be heavy, and lighting will be necessary to enable vehicles entering and leaving the motorway to do so in safety. The standard of lighting

will be that installed on the best arterial roads.

LANDSCAPE TREATMENT AND
THE USE OF TREES

Landscape treatment of motorways will have two main objectives—to promote safety and to ensure that the introduction of the motorway does not result in the scarring of the countryside. Methods of achieving these objectives are being closely studied, but in general it can be said that the following principles will be observed. Planting will be used to break the monotony of line, to emphasise points of interest and to screen where desirable. Regular rows of trees will be avoided as they tend to accentuate the line of the road and become monotonous and soporific in effect, especially at speed.

The first consideration is that of safety. “Sight” lines must not be obstructed, particularly on curves, and at connections. On the other hand, the combination of ground elevation and planting will help to reduce the dangers of headlight glare. Light-stemmed foliated trees and shrubs have great value in breaking up headlight glare at night. The planting of large trees close to the carriageway will be avoided. The spread of large trees tends to force vehicles out from the edge of the road and there is also a danger from fallen branches. After rain tree-shade also creates intermittent wet patches on the road surface. Care will be taken to avoid the creation of pools of deep shadow which impair the motorist’s vision. Planting will be undertaken where necessary to stabilise soils, particularly on cuttings and embankments where the prevention of soil erosion is a matter of importance to road safety.

Although refuelling stations and eating places will be provided along the routes, there will be no permission given for shops or factories to be built near the motorways, and access will be limited to the

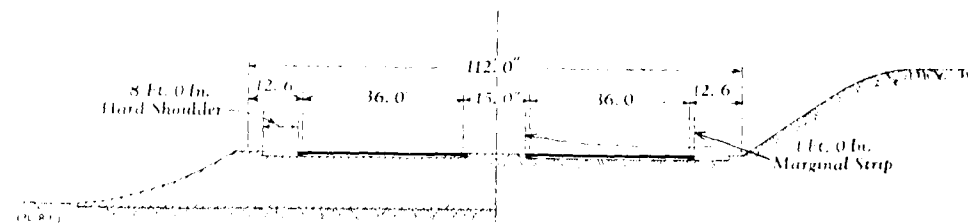


Fig. 1. A section through the Dual Three-lane Carriageway showing the 8-ft hard Shoulder on the Outside of each Carriageway to allow Vehicles to Pull off in Emergencies.

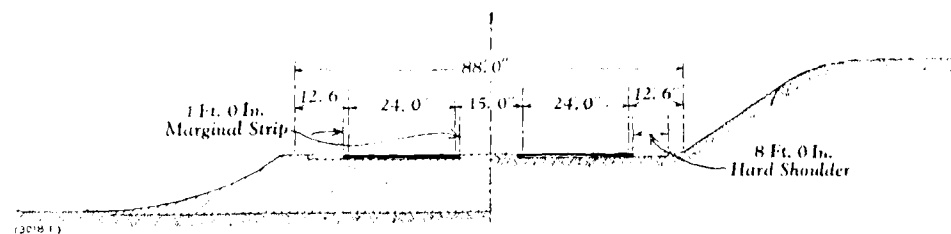


Fig. 2. A Section Through the Dual Two-lane Carriageway, which is used where Traffic is not sufficiently heavy to warrant Three Lanes. The 1-ft Marginal Strips indicate the Edges of the Carriageways, and are coloured Differently to the Traffic Bearing Part of the Road.

planned intersection—six in the case of the first 53 miles of the London-Yorkshire motorway.

THE LONDON-YORKSHIRE MOTORWAY

The first section of the London-Yorkshire motorway runs as far as Dunchurch,

a distance of 53 miles. In this first section there will be six flyover junctions, 46 public road bridges, eight railway bridges, three canal bridges, five river bridges and many public paths, private access and agricultural access bridges.

(From 'Engineering' July 15, 1955).

DEFINITIONS OF HIGHWAY ENGINEERING TERMS

- ABSORPTION:** The entry of a fluid into a body through the pores of the latter.
- ADSORPTION:** The phenomenon that causes attachment of a fluid to the surface of a solid particle owing to a form of molecular attraction.

PROBLEMS ASSOCIATED WITH HOT WEATHER CONCRETING

Some Suggested Solutions from U.S. Engineers

(From *Highways and Bridges and Engineering Works Vol. XXIII*, July 27, 1955.)

HOT cement may contribute to production problems in several ways. First, it raises the overall temperature of the concrete which already tends to be high because the temperatures of the surroundings and the other ingredients are also higher than usual. Concrete at high temperatures requires more mixing water than at normal temperatures, and the extra water reduces strength. Tests made at the University of Maryland showed that concrete mixed at 100° F. required approximately three gallons per cubic yard more mixing water than concrete mixed at 73° F. As a result, the higher mixing temperature resulted in a 300 p.s.i. reduction in 28-day compressive strength.

There is evidence that hot cement may also contribute to the formation of cement balls. If the cement has an opportunity to come into contact with damp sand or a small quantity of mixing water before its temperature has been reduced by mixing with the other ingredients, a quick stiffening may occur. The resulting partially set mass may be difficult or impossible to break up in subsequent mixing.

Finally, the high temperature grinding of cement, which often occurs during the summer months of peak demand and is the cause of cement being delivered hot, sometimes may alter the characteristics of the gypsum and render it unable properly to retard the rate of set.

Concrete placed in exposed locations in hot weather, particularly in flat slabs, may tend to develop plastic shrinkage cracks. Although that is not ordinarily the fault of the concrete or its ingredients,

the concrete product is usually the one called upon for an explanation. Actually, the principal cause is the rapid removal of water from the concrete by evaporation, accompanied by a correspondingly large reduction in volume. As the concrete begins to set and cannot accommodate the volume change by plastic flow and does not have sufficient strength to withstand any appreciable tensile stress, cracks open in the surface. These generally, but not always, appear about the time the concrete is ready for final finishing, while other factors undoubtedly affect the plastic shrinkage tendencies of concrete, the opportunity for rapid surface drying appears normally to be a requisite condition.

Low Strength Test Results

On the contrary, tests have shown that high temperatures may be more detrimental to measured strength than low (but not freezing) temperatures. The data showed that exposure of test cylinders to 100° F air for only one day reduced the 28-day compressive strength 12 per cent below that of properly protected specimens. Specimens left in 100° F air for three days showed strength reductions of 22 per cent and specimens exposed for seven days reductions of 26 per cent below properly protected and cured specimens. In those tests, the specimens compared were from the same batches, mixed at normal (73° F.) temperature and given standard moist curing except for the brief initial exposures at 100° F.

There is no clear-cut single solution to the problems of hot weather concreting

although measures can be taken to minimise some of the difficulties. To the extent of economic practicability, steps should be taken to prevent excessively high concrete temperatures. Where possible the use of cement having a temperature of more than about 150° F. should be avoided (recognising, of course, that short supply and storage limitations might prevent such a precaution being taken). To the extent practicable, cool mixing water should be used. In extreme cases, it might even be worthwhile to cool water artificially or add ice to the concrete mixture to reduce its temperature. That practice has been followed extensively in mass concrete work and, to a limited extent, even in ready-mixed concrete. Aggregate stock piles may be cooled several degrees by spraying with water, although this introduces increased difficulties of mixing water control.

Avoid Over-mixing

Over-mixing at high speed should be avoided. The additional work done on concrete by unnecessary mixing increases its temperature and, for that reason as well as possible effects of grinding, the

mixing water requirement is increased. Where possible, delivery schedules should be co-ordinated to keep the elapsed time from charging to completion of discharge at a minimum. The usual limit of 1½ hours on elapsed time is more than adequately conservative ordinarily but may be too long in extremely hot weather.

Many difficulties with low strength tests during hot weather can be avoided by insistence on proper protection and curing of the test specimens. Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field (Designation C. 31) requires that the temperature of specimens for the first 24 hours be maintained between 60° and 80° F. As demonstrated above, it is just as important to the maximum limit as the minimum. Molding and storing the cylinders in damp sand will help to keep the temperature down as well as protect the specimens from excessive evaporation. Further, the specimens must be transferred to the laboratory for standard moist curing **beginning at the age of one day.** This requirement is of the utmost importance at any season but is most critical during hot weather.

SEASONAL SAMPLES FROM EXAMINATION PAPERS

An adult is a man who has stopped growing at both ends, but not in the middle.

Your spinal column is a series of bones running up and down your back which keeps you from being all legs up to your neck.

Fahrenheit and Centipede are two sorts of weather.

A humorist is a kind of plant that lives on another plant.

Surefooted means like a mule, which never misses when it kicks you.

An eavesdropper is something which lives in the roof like a sparrow.

HERE AND THERE

1. ADMINISTRATION OF FEDERAL AID IN THE U. S. A.

● **FEDERAL-AID** construction programme is administered by the Bureau of Public Roads jointly with the State Highway Departments since 1916. Through the years, the work has been gradually decentralized, more authority being transferred to the regional offices. The Bureau has 10 Divisional Offices located in different parts of the country. Each Division engineer has 4 to 8 District officers under his control and supervises the Federal aid programme of 4 to 8 States.

There is a District office in every State and some of the biggest district offices have as many as 20 to 25 members on the staff, of whom 12 to 15 are engineers in various grades.

Programming

Each State draws up a programme of projects based on preliminary surveys according to the amount of Federal aid available. The selection of the projects, their location and design are settled in the early stages. After the Bureau of Public Roads accepts the programme, the State makes detailed surveys, prepares the plans, specifications and the final cost estimates. After these are approved by the district engineer, tenders for the work are advertised by the States and contracts awarded subject to the concurrence of the Bureau of Public Roads. The day to day supervision of the work is done by the engineers of the State, but an engineer from the district office of the Bureau of Public Roads makes periodic inspections of the sites.

The contractor is paid periodically by the State as the work progresses. The State then makes a claim for reimbursement of the Federal share of the cost. When the work is completed and accepted after inspection, final details of the cost are made by the States and reviewed by the auditors of the Bureau of Public Roads, after which final payment of the Federal

share is made. Even after the completion of the project, engineers of the Bureau inspect the work at least once a year to see that it is being maintained properly.

Powers of District &

Division Engineers

(a) Divisional Engineers

Authority is delegated to Division Engineers to take final action with respect to the following items :

Systems Revision in Federal aid secondary routes that are part of the State primary highway system provided such revisions do not change the major control points.

Adjustments in Federal aid secondary routes that are not part of the State primary highway system provided such adjustments do not affect the local traffic—generating facilities they were intended to serve.

Programmes Increases in total cost and Federal funds programmed for Federal aid projects provided the increase does not exceed approximately 25,000 dollars or 50 per cent of the project amounts, whichever is greater, for projects costing less than 250,000 dollars and approximately 125,000 dollars or 25 per cent of the project amounts, whichever is greater, for projects costing 250,000 dollars or more, and provided there is no material change in the character of the proposed work, and provided that in case of projects in urban areas there is no material change in the termini of the project. Decreases of any amounts in total cost and Federal funds subject to same provisos mentioned above.

(b) District Engineers

The Division Engineers are authorized to re-delegate to the District Engineers such portions of that authority as may in their discretion seem desirable. The re-delegation may be on a selective basis with respect to District Engineers as well as with respect to subject matter. The

head office has to be kept informed regarding the extent to which the authority is re-delegated.

District Engineer is also authorised to take final action on behalf of the Bureau of Public Roads in connection with the following items and is charged with responsibility therefor :

- 1. Rail-road and public utility agreements for Federal aid highway projects.
- 2. Route reports and sketch maps.
- 3. Plans, specifications and estimates for Federal aid highway projects,

Co-operative Forest Highway projects and Indian Reservation road projects.

- 4. Concurrence in award of contracts for the above projects.

In any case, where the above items involve questionable or unusual features, the advice and approval of the Division office, and, in the more important cases, of the head office is obtained before final action is taken by the District Engineer.

(From the report by R. L. Gursahani of work done during U. N. Fellowship Training.)

2. SOIL-CEMENT LOAD-BEARING CAPACITIES

THE table below gives bearing values for soil-cement and other pavements at five airports for which comparative data were available from U. S. Government agencies.

carried wheel loads ranging up to about 30,000 lb for long periods of time without damage.

“These tests confirm the results of

Subgrade bearing value	Base-course type	Bearing value — k *
k - 125	6-in. soil-cement †	535
k - 125	8-in. compacted gravel †	355
k - 400	6-in. soil-cement	1012
k - 376	5½-in. macadam, 2-in. bituminous surface	626
k - 120	6-in. soil-cement, 2-in. bituminous surface	400
k - 220	6-in. Emulsion stabilised 2-in. bituminous surface	229
—	6-in. soil-cement	940
—	8-in. sand-clay, bituminous seal	520
CBR-30	6-in. soil-cement, bituminous seal	424
CBR-17	8-in. bituminous stabilised, 2-in. bituminous surface	275

“Recent condition surveys have shown all of these five airports to be in good condition. At all of them, little or no maintenance has been necessary on the soil-cement base. The pavements have

bearing tests made in many parts of the United States by various highway and engineering agencies.”

(From “Roads and Streets, June, 1955”).

* Load-bearing tests were performed using various-sized bearing plates. In order to obtain some common basis for comparison at any individual airport, the bearing data were converted to k values for a 30-in. plate at 0.2-in. deflection.

† Subbase for concrete pavement.

3. PLASTIC THEORY

THE principal purpose of concrete research carried out at Imperial College during the last 7 years has been to try to establish a general ultimate load theory for improvement and simplification in the design of reinforced and prestressed concrete frameworks. Present methods of design are based partly on ultimate load conditions.

The plastic-hinge theory enables complex frameworks to be designed to have an economic distribution of bending moments at failure and a uniform factor of safety. Calculations for many types of frame used in practice may be reduced to the application of simple formulae. Further economies may be made in many structures by the use of smaller concrete sections of high-grade concrete.

In spite of the variable nature of deformations in concrete prior to failure, the plastic-hinge theory enables bending moment distributions in framework to be calculated with sufficient accuracy for practical design.

The theory prepares the way for establishing simple bending moment formulae for vertical and horizontal loading in many kinds of framework within a wide range of stiffness ratios.

The approximate bending moments in a framework for the elastic condition may be quickly found by trial and adjustment, using the same influence co-efficients required for hinge rotation values in the plastic condition. The use of special binding greatly increases available strains in plastic zones. Deformation calculations are necessary to establish stiffness ratio limits.

The position of the neutral axis in framework members is governed mainly by strain values at the extremities of the sections. Variations due to bond conditions are small and conveniently expressed by the factor F. In non-bonded beams the factor F, however, has very low values, indicating that it is important to carry out effective grouting.

Bending moment values for concrete may be calculated from formula Qbd^2C_u with suitable adaptations for T and I beams. Q generally equals 0.2 for reinforced concrete or for prestressed-concrete beams having adequate prestress and bond.

Considerable economy could be made in the design of many structures by using high-grade concrete and basing ultimate load calculations on values of C_u of, say, 4,500 per sq. in. when the mean value of a small number of preliminary cube tests is 6,000 per sq. in. or in special cases higher strengths. It should be pointed out that the strength variation on most sites at present is probably over 2,000 per sq. in. but this could be reduced to 1,500 per sq. in. or 1,000 per sq. in. in special cases. In the future when sufficient test results have been obtained for statistical examination, it may be possible to show that the safe limiting values of $e'e$ and xe' and C_u are so unlikely to occur simultaneously that the value of Q may without risk be increased to 0.25, or even higher, for the low values of C_u .

A factor of safety of 2 would be used in the calculations so that provided the standard of quality control in the field was such that in the structure no concrete was used at critical sections weaker than 4,500 per sq. in., the actual factor safety in regard to the concrete would be the same as for the steel, i.e., about 2, which is generally considered adequate.

The use of deformed bars enables higher working stresses to be used because of the reduction in crack width. Approximately, deformed bars develop similar crack-widths to plain bars of similar diameter at 1½ times the stress. However, the better bond does not greatly influence the position of the neutral axis which is governed by the strain, so that deformed bars at high stress have smaller values of n_1 compared with plain bars of similar diameter at low stress; n_1 may be found from the strains at the extremities of the section. The value of F is only very slightly higher than for plain bars.

(From “Roads and Streets, June, 1955”).

4. TELEPHONE COMPANY MUST PAY COST OF REMOVAL AND RELOCATION OF FACILITIES NECESSITATED BY CONSTRUCTION OF NEW EXPRESSWAY

● THE State Road Department of Florida, U. S. A. embarked on a federal-aid highway project known as the Jacksonville Express-way System. The new express-way embraced portions of existing state roads along with the Southern Bell Telephone Co. had located its facilities. The project necessitated the removal and relocation of these facilities. A dispute arose as to who was to pay the cost of moving and relocating the telephone facilities-the telephone company or the taxpayers of Florida.

Telephone and telegraph companies were granted permission by statute to locate their lines, wires, posts, or other fixtures on or beside any public road of highway as long as they did not "obstruct or interfere with the common uses of said roads or highways." Thus the privilege granted was a limited one. The telephone company admitted that under this law, it must pay for the relocation of facilities when a highway was merely widened or otherwise improved for local uses, but claimed that the construction of the Jacksonville Expressway did not constitute a "common use" of the highway because it involved more than merely widening or improving the highway. In short, the company claimed that this was a new kind of high-speed highway, that the statutory limitation on their privilege to locate their facilities, along the public highway did not apply here and therefore the state must pay for the removal and relocation of facilities.

The court, however, did not agree and stated that the same rules of law which apply to ordinary improvements applied

here. The court pointed out that the building of the expressway was the "natural result of progress and we should so construe the statute as to give our forefathers credit for knowing that progress and improvement would never cease." The streets were built primarily for the traveling public and the telephone companies' rights to use them were subservient to the rights of the public.

The telephone company also argued, that since this was a federal-aid project, the state was an agent of the federal government and it might not use its police power in compelling the telephone company to relocate its facilities to further the works of the federal government. The court dismissed this contention by pointing out that the federal-aid legislation was designed merely to assist the states and did not assume the state's control over its highways. Thus the state in requiring relocation of facilities was acting for itself and not in behalf of the federal government.

The company further contended that since railroads by federal aid legislation were relieved from paying the cost of relocating their facilities, to require telephone companies to pay was a violation of their constitutional rights. But the court held that the special provision the federal government had made for railroads in no way limited the rights of the State of Florida.

(From "Highway Research Board Circular" No. 288.)

FAITH COUNTS

Do not fear to defend new ideas, even the most revolutionary. Your own faith is what counts. But have courage also to admit error as soon as you have proved to yourself that your idea is wrong. Science is the grave-yard of ideas.....but some ideas that seem dead and buried mayrise up to life again more vital than ever.

(Louis Pasteur 1822—1895.)

CURRENT LITERATURE

ABSTRACTS

PROCEEDINGS OF A SYMPOSIUM ON A CONCRETE SHELL ROOF CONSTRUCTION, July 1952, Published by the Cement and Concrete Association, 52, Grosvenor Gardens, London S. W. 1. 1954.

THE book is divided into 3 Sections viz., Architectural Aspect, Design and Research and Construction and Formwork. The Section on the Architectural Aspect contains the following 3 papers.

1. Domes, Vaults and development of Shell roofing.
2. Various forms of shell roofing and their application.
3. Architectural problems of shell concrete construction.

Three Papers including, one on "the combination of shells and prestressing" and "Research on concrete shell structures" are included in the section of Design and Research. The Paper Design and Construction from Economic aspect deals with the general economics of shell construction while the 3 other papers included in this section deal with description of works two of which deal primarily with shuttering.

A comprehensive bibliography arranged chronologically from 1828 to 1954 is also included.

SOIL MECHANICS ASPECTS OF THE DESIGN OF FOUNDATIONS—BEARING CAPACITIES AND SETTLEMENT, by F. D. C. Henry, 'Engineering', September 23, 1955.

THE present position and the possible future trend of soil mechanics investigations in relation to the design of pad, strip and raft foundations located on the surface of the ground or at a relatively

shallow depth are discussed in this Paper. These investigations can be considered under the four headings: (a) bearing capacity of the soil, (b) settlement of the foundation, (c) bearing pressure distribution at the soil foundation contact surface, and (d) constructional problems due to the nature of the soil. Headings (a) and (b) are discussed in the first part of the Paper published in 'Engineering', September 23, 1955. The subject of heading (c) will be discussed in part two of this article to be published subsequently. Constructional problems (d) are met by special excavation techniques or by geo-technical processes. Thus, for example, excavation can be carried down several feet at a time in stiff clay before each set of timbering is inserted, whereas in loose sand it is necessary to drive down vertical timber sheeting as excavation proceeds. If sand is water-bearing then well-point pumping, cementation or other geotechnical process must be employed to keep the excavation dry. These problems are so varied that it is impossible to discuss them further herein.

PLASTIC STRENGTH OF STEEL FRAMES by L. L. Beedle. Proceedings of the American Society of Civil Engineers, Vol. 81, Paper No. 764, August 1955.

IN order to demonstrate the applicability of plastic analysis to structural design in steel, the results of large-scale experiments are discussed in the light of theoretical predictions and correlated with current design specifications. The fundamentals of plastic analysis are briefly described. It is shown how the design of ordinary structural frames may be based on the maximum load the structure will support, as against the conventional methods which are based on the load at "first yield."

Although this report does not purport to be a complete review of current investigations into the behaviour of steel structures loaded beyond the elastic limit, sufficient evidence is presented to show that in many instances design may properly be based upon ultimate strength.

UNSYMMETRICAL BENDING OF BEAMS WITH AND WITHOUT LATERAL BRACING by Lev Zetlin and George Winter. *Proceedings of American Society of Civil Engineers*, Vol. 81, Paper No. 774, August 1955.

BEAMS loaded obliquely with respect to the principal axes deflect perpendicular to, as well as in the plane of the load; in addition, the beam twists about a longitudinal axis. This situation occurs if symmetrical sections (such as I-beams) are loaded in a plane other than a principal one, or if unsymmetrical sections are loaded in this manner (such as Z-beams loaded in the plane of the web). If rotations are held within close limits, their influence can be neglected. For this frequent case computation of deflections and stresses by ordinary methods is lengthy since the neutral axis is neither a principal axis nor perpendicular to the plane of loading. In this paper simple equations are derived which are identical in form with the elementary formulas for symmetrical bending and which permit the calculation of deflections and stresses with great ease. The method is then used to analyze the case of an obliquely loaded beam braced at intermediate points

against lateral deflection. It is problems of this kind which are difficult to handle by existing methods and for which the proposed approach furnishes extremely simple solutions. A sample computation is given of a Z-beam so braced, and loaded in the plane of the web; its results are compared with test data, and close agreement is established.

CODE OF PRACTICE FOR USE OF TIMBER IN BUILDING.

TIMBER has been used from very ancient times in building, yet the information regarding the species suitable for building construction, strength of such species and the extent of defects normally found in timbers is very limited with the result that only the very well-known species of timber like teak and sal, are widely used and are in demand.

A draft Indian Standard Code of Practice for use of Timber in Building has been prepared by the I. S. I. and circulated for comments. The Code lays down basic requirements regarding material, species of Timber, their strengths, defects and the working stresses.

Dissemination of accumulated knowledge available with the technical departments and research stations in the country in the form of a code of practice would, it is hoped, encourage the use of the lesser known species of timber in building construction.

SELECTED RECENT LITERATURE IN ENGINEERING JOURNALS

I. GENERAL

1. **Records Help Us to provide Better Facilities for Travel**; GORDON BAIRD, *Better Roads*, March 54, pp. 19-20 & 52.
2. **Notes on a Year's Road Research**; *Better Roads*, March 54, pp. 23, 24, 44 & 46.
3. **The Engineer Task in Future Wars**; Paper No. 5984, MAJOR GENERAL GEORGE NEWSAM TACK, *Proceedings of the Institution of Civil Engineers*, Part I, Vol. 3, May 54, No. 3, pp. 324-351.
4. **Statistical Methods**; J. J. LEEMING, *The Journal of the Institution of Municipal Engineers*, May 54, pp. 509-520.
5. **Measuring the Load-Bearing Capacity of Roads—a Non-destructive Technique**; *Engineering*, April 9, 54, pp. 470-471.
6. **A Swiss Access Road to Mont-Blanc Tunnel**; L. S. PERRIN, *Strasse und Verkehr*, August 53, pp. 323-326 (in French).
7. **Improvements to Zurich Right and Left Bank Lake Roads**; W. PFIFENER, *Strasse und Verkehr*, November 53, pp. 420-424 (in German).
8. **Bypass Road and Through Road—Traffic Engineering Arrangements with an Example at Andel Fingen**; S. SULGER BICEL—*Strasse und Verkehr*, November 53, pp. 424-432 (in German).
9. **Residential Roads and Through Roads—Two Practical Examples from Winterthur**; H. TEXTOR, *Strasse und Verkehr*, November 53, pp. 439-442 (in German).
10. **The Influence of Axle Loadings on the Behaviour of Road Slabs—American Large Scale Investigations**; DR. ROB. RUECKLI, *Strasse und Verkehr*, December 53, pp. 457-461.
11. **New Equipment in the Reinforced Concrete Laboratory at the University of Ghent for Static and Dynamic Testing of Large Structural Members**; F. G. RIESSANW—*Magazine of Concrete Research*, No. 15, March 54, pp. 131-138.
12. **Statistical Methods in Concrete Research**; P. J. F. WRIGHT, *Magazine of Concrete Research* No. 15, March 54, pp. 139-149.
13. **Assessment of Particle Size—Determination of Two Profile Parameters for Irregular Shapes**; H. H. WATSON & A. J. CRUISE, *Engineering*, May 7, 54, pp. 594-596.
14. **Engineering Works in Basildon New Town**; H. W. DUPREE, *The Surveyor*, May 22, 54, pp. 425-429.
15. **Tables Give Area of Segment and Length of Arc**; KANKICHI TAIRA, *Civil Engineering*, May 54, pp. 61-62.
16. **Bus Garages and Stations—Some Factors in their Provision**; A. A. JACKSON, *Modern Transport*, May 22, 54, pp. 18 & 24.
17. **Efflorescence on Structures**; HANS HOLZACH, *Schweizerische Bauzeitung*, May 29, 54, pp. 313-315 (in German).
18. **Proposals for Constructing a Road Tunnel under the Mont-Blanc**; JEAN FREDERIC ROUILLER, *Strasse und Verkehr*, April 54, pp. 150-154 (in French).
19. **Construction of Inter-American Highway**; E. W. JAMES, *Separate No. 350, Proceedings of the American Society of Civil Engineers*, November 53.

20. Rock "Sausages" Provide Economical Protection Against Erosion; C. J. POSEY, *Engineering News Record*, May 13, 54, pp. 45-46.
21. Electrical Subsurface Exploration Simplified; H. E. BARNES, *Roads and Streets*, May 54, pp. 81-84 & 140.
22. Specific Priority Scheduling Backs Mayland Program; ROY, E. JORGENSEN, *Better Roads*, May 54, pp. 19-20 & 48.
23. Call in the Geologist for Help with these Highway Problems; W. A. WARRICK, *Better Roads*, May 54, pp. 24, 25 & 40.
24. Colorado Highway Tunnel will Pierce Continental Divide; STANLEY W. ZAMONSKI, *Better Roads*, May 54, pp. 33-35.
25. Controlling Roadside Vegetation; *Better Roads*, May 54, pp. 26-28.
26. Picnic Spots for Turnpike's Service Areas; *Better Roads*, May 54, pp. 50.
27. How to Find What You Need; *Engineering News Record*, May 20, 54, pp. 46-47.
28. The Power and Expended Energy in Bending of Steel Reinforcement in Relation to the Size, Shape and Quality of Steel; PAUL WOLFF, *Beton und Stahlbetonbau*, May 54, pp. 115-122 (in German).
29. Adequate Highways for a Prosperous America; A. E. JOHNSON, *American Highways*, April 54, pp. 3 & 17-19.
30. Transportation and Changing Economic Conditions; WIFREAD OWEN, *American Highways*, April 54, pp. 4 & 19-21.
31. Application of Geology to Highway Engineering as seen by a Highway Engineer; W. A. WARRICK, *American Highways*, April 54, pp. 5, 21 & 22.
32. Recommended Principles for a State-Local Partnership in the Use of State and Federal-Aid Funds on Jointly Financed Road Systems; *American Highways*, April 54, pp. 6, 7, 23 & 24.
33. Federal Aid Highway Act of 1954; *American Highways*, April 54, pp. 12, 13 & 26.
34. The Growing Structure of International Motor Traffic Agreements; H. H. KELLY AND W. G. ELLIOT, *American Highways*, April 54, pp. 10, 25 & 26.
35. The Construction of Forward Airfields; CAPT. T. C. WHITE, *The Journal of the Institution of Military Engineers*, January 54, pp. 43-51.
36. When Is a Verge Not a Verge? J. R. MUGGERIDGE, *Contractors Record and Municipal Engineering*, February 3, 54, pp. 9-10.
37. Geophysical Surveying - Seismic Methods; F. D. C. HENRY, *Contractors Record and Municipal Engineering*, February 17, 54, pp. 17-19.
38. Geophysical Surveying - Field Methods; F. D. C. HENRY, *Contractors Record and Municipal Engineering*, March 17, 54, pp. 11-13.
39. Barrier System Toll Roads—Their Merits; SAMUEL G. NOWELL, JR., *Traffic Engineering*, May 54, pp. 277-279.
40. Bay Area Freeways; B.W. BOOKER, *California Highways and Public Works*, March-April 54, pp. 1-16.
41. Estate Road Construction—Choice of Type of Road Construction; J. MERCER, *The Journal of the Institution of Municipal Engineers*, June 54, pp. 529-531.
42. Research in United Kingdom—Five Year Expansion Plan; *The British Constructional Engineers*, June 54, pp. 35-36.

43. Road Research 1953, Board's Comments on Progress and Problems; *Highways and Bridges and Engineering Works*, June 2nd 54, pp. 1, 3 & 4.
44. Dutch Civil Engineering Accomplishments; *The Engineer*, June 11, 1954, Institution of Mechanical Engineers, Summer Meeting in Holland, pp. XI-XXI.
45. The Design and Construction of a High-Speed Test Track for Motor Vehicles; RALPH FREEMAN, AND JOHN ANTONY NEILL, *Road paper No. 43*, pp. 189-221.
46. 'Pay-As-You-Ride' Road Finance in Texas; *The Surveyor*, June 26, 54, pp. 537-538.
47. Texas Expressways; *The Surveyor*, June 26, 54, pp. 538-541.
48. Road Development in Yugoslavia; *Road International*, Spring 54, pp. 19-20.
49. Mapmaking; *Road International*, Spring 1954, pp. 21-27.
50. Roads and Motor Traffic in Finland—Progress in Construction and Maintenance; K. J. TOLONEN, *Road International*, Spring 1954, pp. 28-33.
51. Estimation of Flood Probabilities; LEO. R. BEARD, *Separate No. 438, Proceedings of the American Society of Civil Engineers*, May 54.
52. Statistical Theory of Droughts; E. J. GUMBEL, *Separate No. 439, Proceedings of the American Society of Civil Engineers*, May 54.
53. Industry and Freeways—Spectacular Industrial Growth Adjacent to Eastshare Freeway; JOHN F. KELLY, *California Highways and Public Works*, May-June 54, pp. 22-29.
54. Freeway Benefits—Oceanside—Carlsbad Project Relieves Congestion and Reduces Accidents; M. H. WEST, *California Highways and Public Works*, May-June 54, pp. 31-33 & 51.
55. Expressway Construction in Texas; *Highways and Bridges and Engineering Works*—June, 30, 54, pp. 1 & 3. See also *Roads & Road Construction*, July 54, pp. 217-280.
56. The Construction of Llangyfelach By-pass; J. A. GAFFNEY, *The Journal of the Institution of Municipal Engineers*, July 54, pp. 33-34.
57. Housing—The Full Circle?; J. A. KERYON, D. M. O'HERLIHY and G. S. JHOUT, *The Journal of the Institution of Municipal Engineers*, July 54, pp. 9-30. See Also—*Roads & Road Construction*, July 54, pp. 211-214.
58. Main Roads Administration in New South Wales—A Brief Account of the Functioning of the Main Roads Act; *Main Roads*, June 54, pp. 97-101.
59. Reversible Longitudinal Ventilation for Railway and Road Tunnels; BARTH, KLEIN and RAAB, *Der Bauingenieur*, June 54, pp. 222-224 (in German).
60. Model Investigation for Stress Conditions in Dams; *Der Bauingenieur*, June 54, pp. 224-228 (in German).
61. The Construction of Nomograms for use in Statistics—Part I. True and Empirical Nomograms; PHILIP LYLE, *Applied Statistics*—June 14, Vol. III, No. 2—pp. 116-125.
62. Giving Evidence at a Public Local Inquiry; *The Surveyor*, July 17, 54, pp. 599-600.
63. Post-War Trends in Road Planning and Construction; J. G. TAYLOR, *The Journal of the Institute of Transport*, July 54, pp. 400-405.
64. The Parking Problem in Central London—an Economic Appraisal; A. C. L. DAY and RALPH, *Turkey-The Journal of the Institute of Transport*, July 54, pp. 406-411.
65. July Start Planned for Indiana Turnpike; *The Engineering News Record*, July 24, 54, pp. 38-39.

66. **The Calculation and Construction of Nomograms in Engineering**; H. W. STEPHENSON—Part I—*Civil Engineering and Public Works Review*, July 54, pp. 714-716.
Part II—*Civil Engineering and Public Works Review*, August 54, pp. 849-851.
Part III—*Do*—September 54, pp. 951-952.
67. **Colombia Modernizes Its Highway System**; FOREST H. GREEN, *Engineering News Record*, July 8, 54, pp. 30-36.
68. **Design of Open Channels in Rocky Cuts: Values of Rigidity Coefficients**; N. S. JOSHI, *Journal of the Institution of Engineers (India)*, June 54, pp. 479-500.
69. **Building a Mountain Railway Across the Vindhya-Construction of the New Down Line Between Budni and Barkhera**; N. M. THADANI and K. SITARAMAN, *Journal of the Institution of Engineers (India)*, June 54, pp. 501-552.
70. **Highway Development in the State of Texas**; D. C. GREER, *Traffic Engineering*, June 54, pp. 315-318.
71. **Highway Problems in Northamptonshire—Heavier Traffic Loads. Increased Speeds and Road Design**; *Highways and Bridges and Engineering Works*, August 4, 54, pp. 4 & 6.
Do. Roads and Road Construction, August, 54, pp. 254-256.
72. **A Case for Sett Paved Roads**; THOMAS VICHERS, *The Surveyor*, August 14, 54, pp. 689-690.
73. **Qualifications for Special Library Work**; A. G. KAY, *The Engineer*, July 23, 54, pp. 130-132.
74. **Rainfall Intensity-Frequency Data for N.S.W. Stations Discussion and Communications**; *The Journal of the Institution of Engineers Australia*, June, 54, pp. 119-122.
75. **Trials by the Ordinance Survey on the Application of Direct Reading Tacheometers to Large-Scale Survey**; 'BERT WALTERS'—*Roads and Road Construction*, August 54, pp. 243-247.
76. **Weed Control**; *Roads and Road Construction*, August 54, pp. 264-265.
77. **The Technical Interpreter**; *The Engineer*, July 30, 54, pp. 171-172.
78. **Impact of Society on Municipal Engineering**; *The Surveyor*, August 7, 54, pp. 669-671.
79. **Some Field Examples of Scour at Bridge Piers and Abutments**; DOUGLAS E. SCHNEIBLE, *Better Roads*, August, 54, pp. 21-24 & 50 & 52.
80. **Development in Portable Roads**; *Highways and Bridges and Engineering Works*, August 25, 54, p. 8.
— See Also *Highway Research Abstracts*, July 54, pp. 9 & 10.

PUBLICATIONS ADDED TO THE ROADS WING LIBRARY DURING SEPTEMBER, 1955

1. **Half-yearly Civil List for the Hyderabad State Corrected up to 1st April, 1954**. (Govt. Press, Hyderabad-Dn. 1954).
2. **Half-yearly Civil List for the Hyderabad State Corrected up to 1st Oct., 1954**. (The Director. Govt. Printing & Stationary, Hyderabad-Dn.).
3. **L'Instabilité en mécanique automobiles - Avions - ponts suspendus** by Y. Rocard (Masson et Cie, Editeurs - Paris, 1954).
4. **Steel Designers' Manual** by Charles S. Gray & Others.
(Crosby Lockwood & Son Ltd., 26 Old Brompton Road, London S. W. 7, 1955).
5. **Administrative Report of the Directorate General of Supplies and Disposals for year 1952-53**. (The Manager of Publications, Delhi, 1955).
6. **The Concise Oxford Dictionary (Third Edition)**. Adapted by H. W. Fowler and Others. (The Oxford University Press, Amen House, E. C. 4).
7. **Town Planning and Road Traffic (1942 Ed.)** by Alker Tripp. (Edward Arnold & Co., London).
8. **India's development and her need for external aid January-June, 1953 (Report of India's representative for India of the U. N. Tech. Assistance board)** prepared by Leon Steinig. Planning Commission, New Delhi, 1953).
9. **India's development and her need for external aid, July-December, 1953 (Report of India's representative for India of the U. N. Tech. assistance board)** prepared by Leon Steinig. (Planning Commission, New Delhi, 1953).

(Continued from page 12)

ACKNOWLEDGMENT

Cost of copacite for 1 mile 10 ft wide road in car load lots Rs 7052.

The Authors have been assisted in the laboratory work by Shri R. N. Kapur.

Cost of 0.5 per cent copacite for 1 mile 10 ft wide road in car load lots = Rs 1410.

REFERENCE

Use of soluble binders in soil Stabilization by S. R. Mehra & H. L. Uppal.

SUMMARY

Being a foreign product and slightly expensive, its use in India on a large scale for stabilized soil roads has limited scope.

(Symposium on Soil Research in India) Bulletin No. 3, National Institute of Sciences of India.

BUDGETS AND ADMINISTRATION REPORTS

ANDHRA STATE BUDGET FOR 1955-56

The following extracts relating to Civil Works have been taken from the Andhra State Budget for 1955-56

	(In lakhs of rupees)		
	Accounts 1953-54 (Six months)	Revised Estimate 1954-55	Budget Estimate 1955-56
REVENUE			
Rents	1.19	1.20	1.54
Receipts from Workshops	0.33	1.57	1.62
Recoveries of expenditure	11.59	22.17	19.10
Transfer from Central Road Fund	10.28	13.81	16.91
Ferry Receipts - Highways Department	0.99	1.66	1.78
Miscellaneous	3.39	3.11	3.01
Deduct - Refund	-0.49	-0.16	-0.09
Total	27.28	43.36	43.87
EXPENDITURE			
Buildings			
Original Works	4.94	15.82	21.36
Repairs	6.90	9.99	12.60
Communications			
Original Works	6.43	10.77	15.21
Repairs	91.22	106.25	102.91
Development Schemes			
Buildings	—	3.87	2.11
Communications	22.55	19.43	18.01
Miscellaneous	0.19	0.58	0.06
Suspense	-9.67	7.82	9.85
Lump addition for regrant of lapses	—	0.05	0.05
Lump sum deduction for provable savings	—	-7.00	-7.00
Establishment Charges	12.47	16.20	16.51
Tools & Plant Charges	7.63	18.44	18.46
Grants-in-aid	31.13	40.12	30.22
Total	173.79	242.34	240.35

Capital Account of Civil Works outside the Revenue Account

	(In lakhs of rupees)		
	Accounts 1953-54	Revised Estimate 1954-55	Budget Estimate 1955-56
Original Works-Buildings	33.45	162.37	156.52
Roads	—	0.19	—
Establishments	2.96	9.06	9.21
Tools and plants	.01	.71	0.36
Lump addition for regrant of lapses	—	0.10	0.10
Total	36.42	172.43	166.19
Receipts from Roads			
Receipts under the Indian Motor Vehicles Act	7.82	23.50	23.50
Receipts under the Madras Motor Vehicles Taxation Act, 1931	58.81	115.52	115.52
Receipts under Madras Motor Vehicles (Taxation of Passengers and goods) Act, 1952	7.52	18.00	18.00
Other receipts	1.61	0.27	0.27
Refunds	-0.49	-0.91	-0.91
Total	75.27	156.38	156.38

ANDHRA STATE GOVERNMENT BUDGET FOR THE YEAR 1955-56

(A brief review with reference to Civil Works)

THE total revenue of the State for 1955-56 is estimated at Rs 2198.03 lakhs as against Rs 2138.62 lakhs (revised estimate) for the year 1954-55. The corresponding figures of revenue expenditure are Rs 2564.74 lakhs for 1955-56 (Budget estimate) and Rs 2487.44 lakhs for 1954-55 (revised estimate) indicating deficits of Rs 366.31 lakhs and Rs 348.82 lakhs respectively.

Revenue Expenditure on Civil Works including Development expenditure (Original Works and Repairs only) is estimated at Rs 172.20 lakhs for 1955-56 while the revised estimate for 1954-55 places it at Rs 166.13 lakhs. In terms of

total State revenue the expenditure works out to 7.83% for 1955-56 and 7.77% for 1954-55. The expenditure on Communications alone (Original Works and Repairs only) forms 6.19% of the revenue for 1955-56 and 6.38% for the previous year.

The provision for Capital expenditure on Civil Works amounts to Rs 166.19 lakhs for 1955-56 while the revised estimate for the previous year (1954-55) indicates an amount of Rs 172.43 lakhs. No Capital expenditure is to be incurred on Roads in 1955-56 while the revised estimate for 1954-55 shows a provision of Rs 0.19 lakhs under this head.

LIST OF APPROVED WORKS ON NATIONAL HIGHWAYS

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
UTTAR PRADESH			
1.		Two Works each costing less than 2 lakhs	1.44
ASSAM			
2.	1391 AS 37	Construction of a bridge over the Davika river in mile 226 of Assam Trunk Road in Dibrugarh West Division.	4.69
3.	1392 AS 37	Permanent restoration of flood damages to certain miles of Assam Trunk Road (East) between miles 110 and 125 in Nowgong Sub-division.	6.03
4.	1398 AS 39	Remetalling and surfacing 9 miles of Numaligarh-Dimapur Road between miles 12 and 20—N. H. No. 39 in Golashah Sub-division.	4.33
5.	1434 AS 39	Construction of 28 bridges on diversion road between Barpathar and Dimapur on N. H. No. 39.	3.50
AJMER			
6.		Two Works each costing less than 2 lakhs	0.58
PUNJAB			
7.		Four Works each costing less than 2 lakhs	0.51
8.	1444 PB 2	Constructing a bridge over Burriawala Nallah in mile 13/5 of Delhi-Mathura Road (N. H. No. 2) in Gurgaon District, including approaches.	2.08
9.	1445 PB 1	Construction of high level bridges in place of existing submersible bridges on the G. T. Road (N. H. No. 1) miles 241 to 246.	6.61
10.	1452 PB 1	Providing high level bridges in place of five gaps in miles 241 to 246 of G. T. Road (N. H. No. 1) in Jullundur Circle.	23.67
BIHAR			
11.	1396 BR 2	Improvement to Grand Trunk Road from mile 150/III to 169 mile - 19.5 miles under Dhanbad Division N. H. No. 2.	4.96

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
WEST BENGAL			
12.	1397 BG 34	Upgrading the Berhampur - Raghunathganj Section of N. H. No. 34.	6.09
13.	1407 BG 34	Extension of the existing Raghunathganj Dhulian section of N. H. No. 34 by a length of 2.07 miles in the Murshidabad district.	3.42
14.	1433 BG 34	Construction of a bridge over Paglachandi on Krishnagar-Plassey section of N. H. No. 34.	5.96
15.	1438 BG 34	Construction of a bridge over the Channel at the 6th mile of the diversion of N. H. No. 34 near Krishnagar.	2.19
16.		Two Works each costing less than 2 lakhs	1.19
BOMBAY			
17.	1420 BM 8	Constructing a bridge across Rangan river on Bombay - Ahmedabad Road, N. H. No. 8.	4.41
18.		Four Works each costing less than 2 lakhs	3.58
RAJASTHAN			
19.		Four Works each costing less than 2 lakhs	4.61
TRAVANCORE-COCHIN			
20.		Two Works each costing less than 2 lakhs	2.28
HYDERABAD			
21.	1419 HD 7	Construction of Diversion below Medchal Tank at mile 20 of the Hyderabad - Nagpur Road - N. H. No. 7 in Hyderabad Distt.	2.15
22.		Two Works each costing less than 2 lakhs	2.80
MYSORE			
23.	1406 MY 4	Widening the culverts and bridges in miles 28/4 to 71/2 of Madras Cannanore Section of N. H. No. 4. in Kolar Distt.	0.71
VINDHYA PRADESH			
24.	1428 VP 7	Widening of road crust of N. H. No. 7 from 10 ft to 12 ft including surface painting between miles 67/7 to 97/3.	2.67
25.	1448 VP 7	Widening and black topping miles 73-112 (17 7/8 miles) of N. H. No. 7.	4.25
26.		Four Works each costing less than 2 lakhs	1.86

S. No.	Job No.	Name of work	Amount (Rs in lakhs)
ANDHRA			
27.	1409 AH 5	Diversion of M. 83/1+100 to 85.7+50 of N. H. No. 5 (near Gudur) and construction of bridge across Upputem.	14.52
MADRAS			
28.	1437 MD 7	Constructing a bridge across river Vaigai on the bypass near Madurai on N. H. No. 7.	7.38
29.		Five Works each costing less than 2 lakhs	5.76
HIMACHAL PRADESH			
30.	1421 HP 22	Widening narrow portions of Hindustan-Tibet Road (N. H. No. 22) between miles 9.0 to 18/0 to full formation width.	4.48
31.	1422 HP 22	Widening Hindustan-Tibet Road (N. H. No. 22) from mile 30 to 39/0	15.47
32.		Two Works each costing less than 2 lakhs	2.01
JAMMU & KASHMIR			
33.		Two Works each costing less than 2 lakhs	0.66
34.	1453 JK 1-A	Widening the formation width and the road crust of the Jammu-Srinagar-Uri Road from Bannihal to South portal of the low level tunnel.	5.54
KUTCH			
35.		Two Works each costing less than 2 lakhs	1.93
MADHYA BHARAT			
36.	1430 MB 25	Construction of a bridge on N. H. No. 25 on the outlet of Dinara Tank in mile 47 in Shivpuri Division.	0.68
37.	1431 MB 3	Widening Road width from 12 ft to 22 ft of the portion of N. H. No. 3, lying in towns having a population of less than 20,000 in Madhya Bharat.	5.24
ORISSA			
38.	1435 RS 6	Construction of 14 small culverts between Gourpalli and Badarma on N. H. No. 6	0.47
MADHYA PRADESH			
39.	1446 CP 6	Widening and surfacing miles 149 to 172/5 of N. H. No. 6 between Raipur and River Seonath.	11.18

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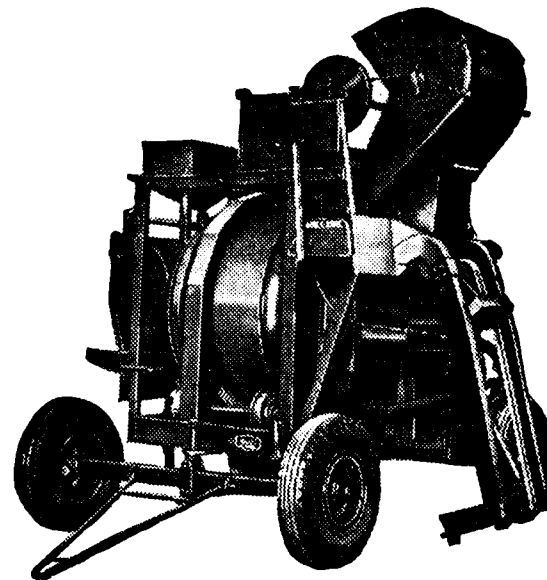
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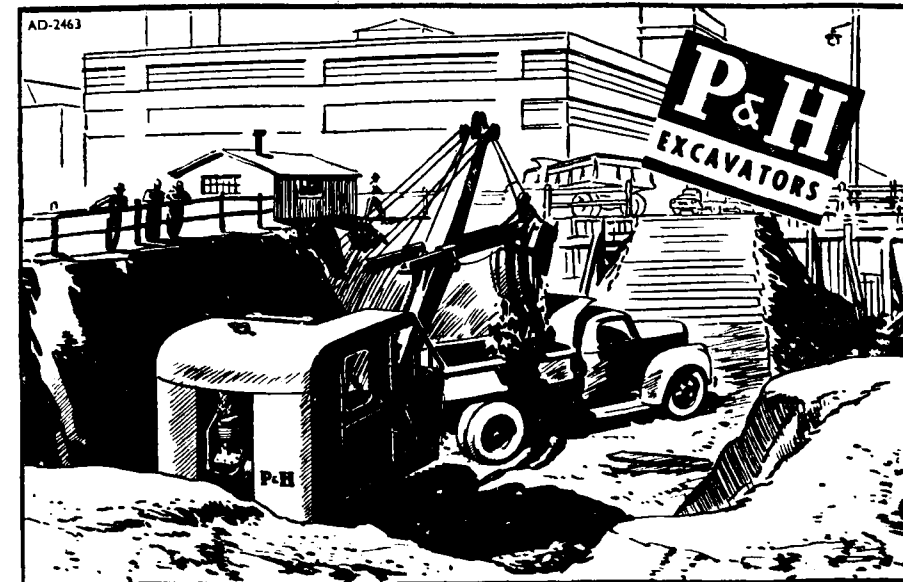
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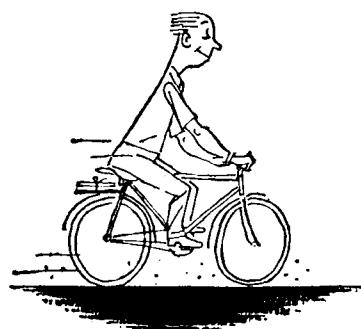
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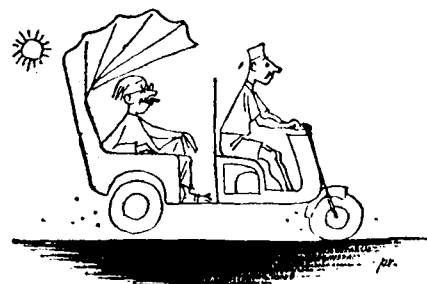
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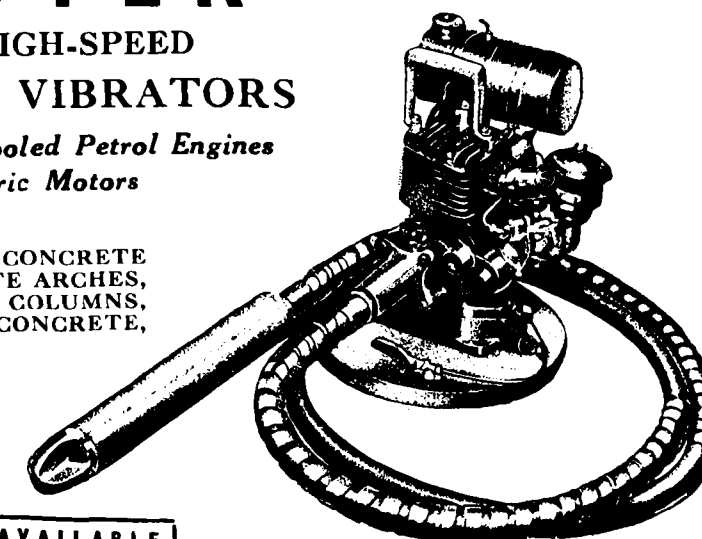
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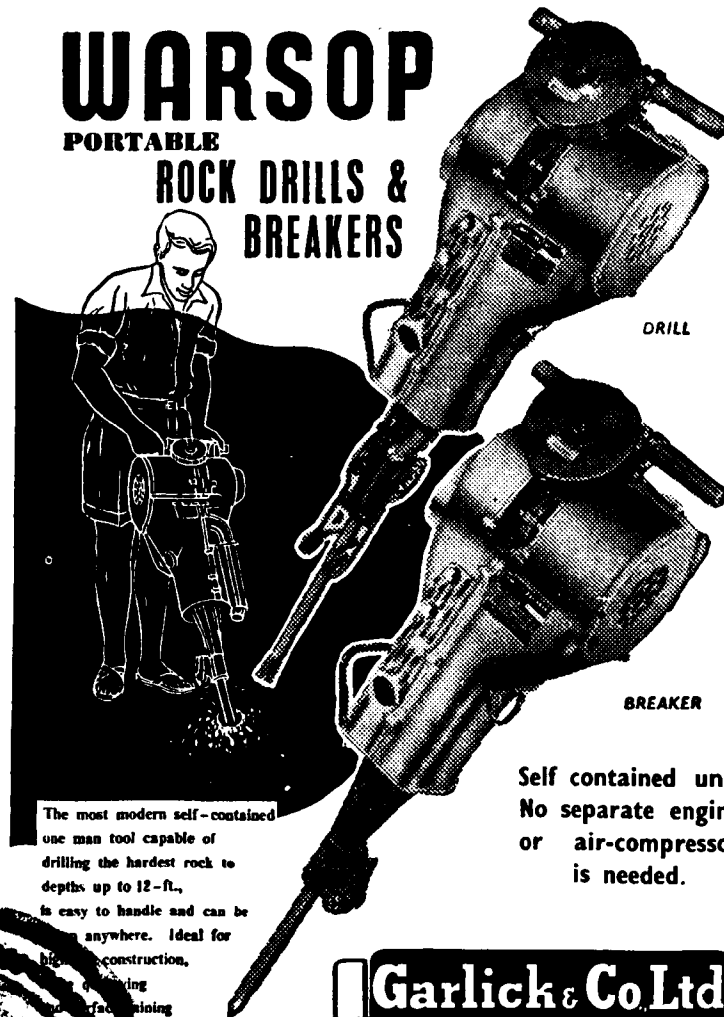
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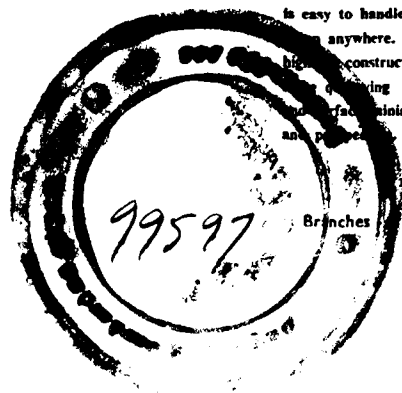


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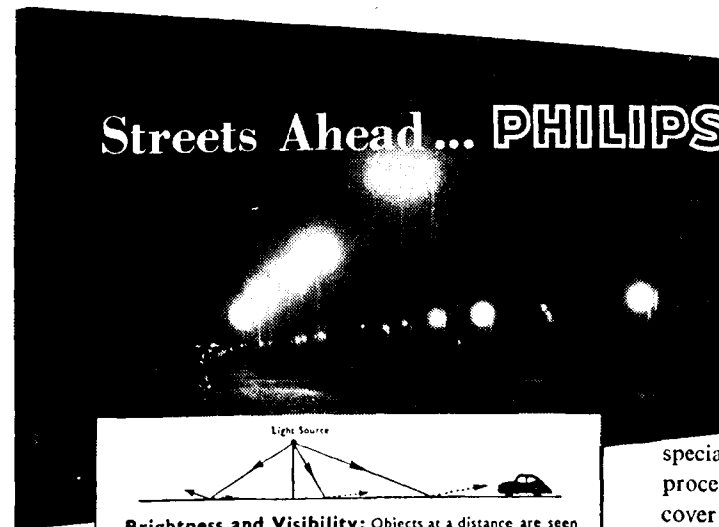
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