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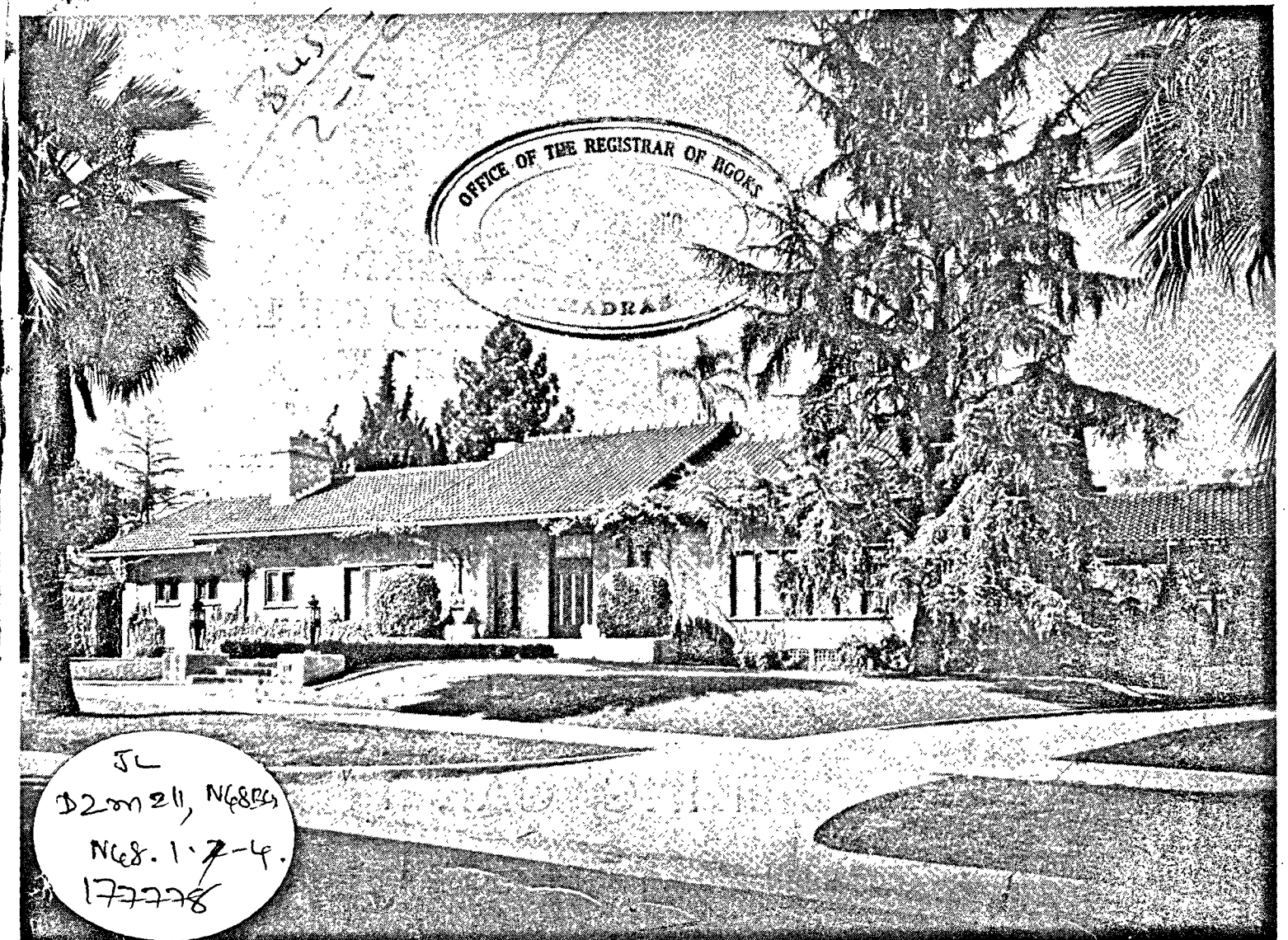
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GAZETTE

Vol. III
Number 4

Deputy Editor

APRIL 15, 1950

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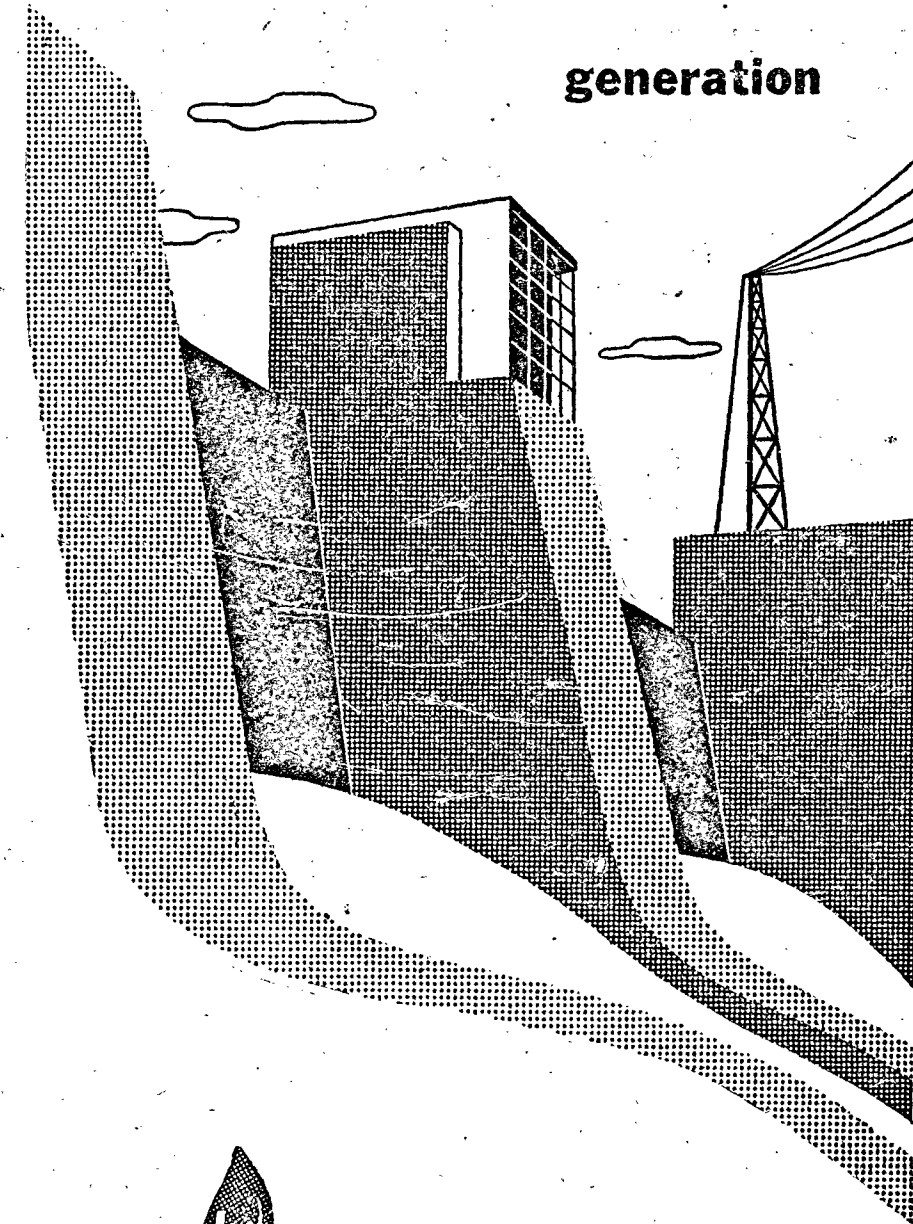
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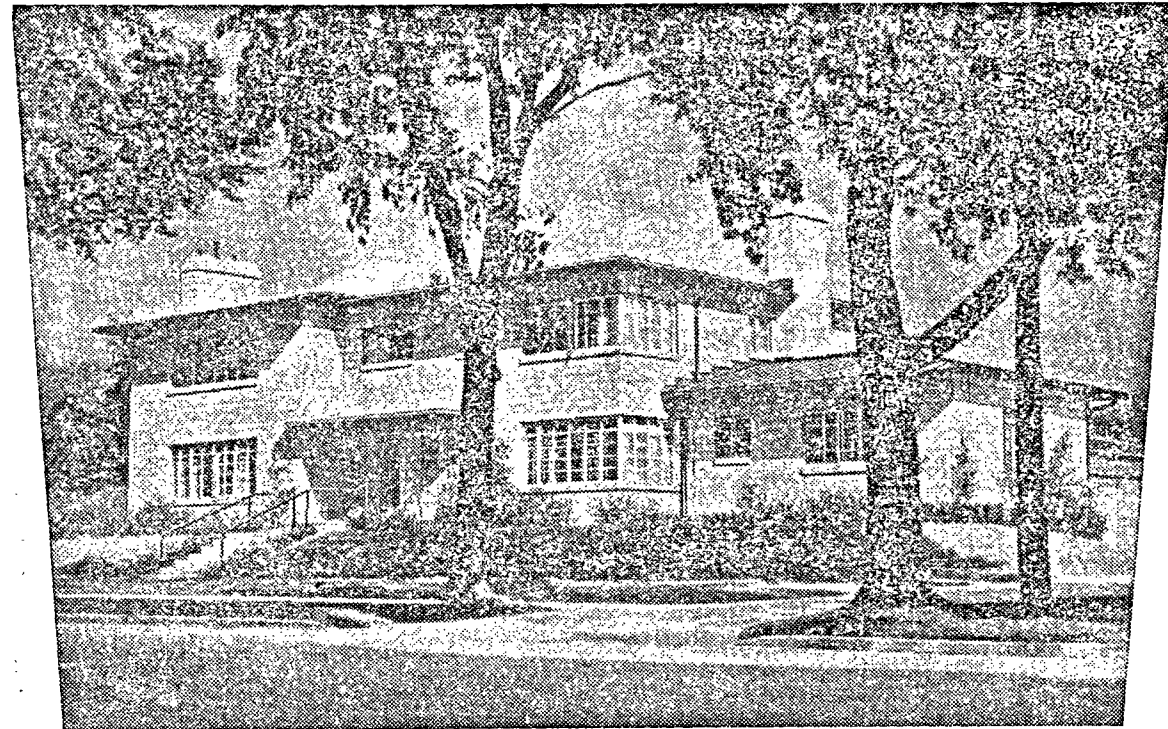
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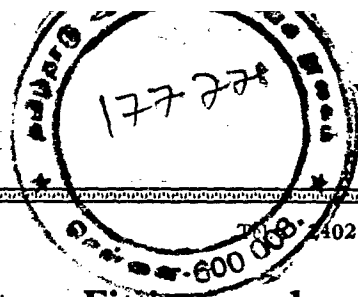
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AN INDEPENDENT MONTHLY JOURNAL DEVOTED TO THE INTERESTS OF BUILDING INDUSTRY

VOLUME III

APRIL 15, 1950

NUMBER 4

Articles, photographs, and drawings with a view to publication will be carefully considered. All such articles and illustration should bear the name and address of the sender, and postage should be sent to cover their return if desired in the event of non-acceptance. All communications on Editorial matters should be addressed to the Editor, and all those pertaining to Advertisements to the Manager, THE BUILDING GAZETTE, 1/11, Mukker Nallamuthu Street, G.T., Madras.

EDITED BY T. N. SUBRAMANIAM
Associate, Faculty of Surveyors of England

PRINCIPAL CONTENTS

Page

- 7 QUANTITIES:—Should they form Part of the Contract?
- 8 NOTES AND TOPICS
- 10 DESIGN FOR "VERTICAL FEATUE" FOR THE FESTIVAL OF BRITAIN
- 12 CONCRETE MIXERS
- 13 THE MECHANISATION OF SMALL BUILDING JOBS
- 20 DELHI PREFAB FACTORY
- 21 SUCCESS CAN FOOL YOU
- 22 LETTERS TO THE EDITOR
- 23 CEYLON'S FIRST MULTI-PURPOSE SCHEME
- 25 CLARIFICATION OF INDUSTRIAL WATER BY FLOC BED OF WATER SOFTENER FOR DISCUSSION
- 26 COLLEGE NEWS
- 27 BUILDING AND CONTRACTING
- 28 HOW WAS MAY FOR BUILDING
- 29 CURRENT MARKET PRICES OF MATERIALS
- 30 CONTRACTS OPEN
- 31 PROPOSED NEW WORKS

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QUANTITIES:**Should they form Part of the Contract?**

There is a broad distinction between the cases of contracts where the quantities do, and where they do not form part of the contract.

Where they do not form part of the contract the matter is fairly simple. The contract sum is not to be varied except by duly authorised extras and omissions, and consequently no errors in the quantities are to be rectified after the signing of the contract. Even if the quantities for a certain particular item are sometimes omitted, the Lump Sum remains inviolate, for the quantities are prepared for the convenience of contractors in framing their estimate. In order to maintain the Lump Sum without any variation, the Plan and Specification, which however must form part of the contract should be a detail document. No mention of the quantities is to be made in addition, in the Agreement.

Where the quantities do form part of the contract it is necessary to draw a line between contractor and the engineer-contractor. In the latter, we find in him a combination of engineering and contracting.

In a country where economy is the key-note of construction it is not generally taken advantage of by the building owner in introducing a third man on small-scale individual building. Engineer-contractor acts therefore to some extent as also a consulting engineer. Be it as it may, it is not in the interest of either party to outwit one another. If at all the engineer-contractor is to lead the 'maistry-contractor', the former should shoulder full responsibility for his quantities and first set up professional integrity. After all we have to remember that "quantities" are but a means to an end.

Logically there is no intermediate standpoint between (a) excluding the quantities altogether from the contract and (b) instituting a system of absolute re-measurement.

The three essential persons concerned in all extensive building operations are the architect, the contractor, and the building owner—the big three—"I design for all, I build for all, and I pay for all.

In practice the architect or the engineer should embody everything required to be done by the contractor which is set forth or implied by the drawings, specification, and conditions of contract. Therefore "quantities" need form part of the contract only when and where a distinct consulting architect or engineer is specifically engaged for building.

NOTES & TOPICS

Architectural Education

Education in Architecture in this country is still in its elementary stage.

The only institution recognised for exemption from the Intermediate Examination of the R.I.B.A. is the Sir J. J. School of Art in Bombay.

The Kala-Bhavan Technical Institute at Baroda, The Government School of Arts and Crafts at Lucknow, The Thomason Civil Engineering School at Roorkee, Sir Amarsingh Technical Institute at Srinagar and the Delhi Polytechnic nevertheless prepare candidates for the All-India Diploma in Architecture.

The Service Commission always stipulate membership of the R.I.B.A. as the prescribed qualification and rarely does it succeed in getting persons of such a calibre.

In Madras this subject is only on the University Calendar for the last thirty years, and although an effort was made in 1946 to set up architectural education, lack of funds appears to have dictated its non-introduction.

The Bengal Engineering College at Shibpore have instituted since 1949 new departments in Architecture, Town and Regional Planning. The former provides five-year All-India Diploma Course in Architecture and the latter provides a two-year Post-graduate Diploma Course in Town Planning. The first batch of 8 students commenced their studies in Town Planning from December 1949.

A First Step

The first step in reform in all spheres is to distinguish between the inevitable and the avoidable. The former we must accept, whether we like it or not. We can do something about the latter, if we wish. But first of all we must know and agree upon what we want. Here there is room for controversy: people want different things; they seek different ends. The second step in reform is therefore to seek agreement about the end in view. Even when we have reached agreement about the end in view we may still disagree about the methods by which we should seek to reach that end. These three spheres of discussion and possible controversy must be recognised by the newly constituted Planning Commission as distinct and separate if we are to make real progress.

Architectural Competition

The Municipal Council of Nairobi has invited Indian Architects to submit designs in competition for new City Halls and Offices which it proposes to erect in Nairobi. The Assessor is Professor L. W. Thornton White, F.R.I.B.A., Cape Town. The amount proposed to be expended is £195,000 and premiums of £550, £450 and £250 are offered.

The Conditions of Competition may be obtained on application to The Town Clerk, Town Hall, Nairobi, Kenya enclosing a deposit of Two Guineas.

The last day for the receipt of questions is April 20, and the last day for posting designs from any Country is August 31, 1950.

Paint Federation

Mr. R. N. Poddar, of Macfarlane & Co., Ltd., Calcutta, has been elected Chairman and Mr. C. R. B. Woolford, of Shalimar Paint, Colour & Varnish Co., Ltd., Calcutta, Vice-Chairman, of Paint Federation, Calcutta, for 1950.

Institute of Builders of India

At the meeting of the Executive Council of the Institute of Builders of India held on March 27, the following were elected as Associates.

Mr. K. G. K. Shetty, Engineer-in-Charge, Janardana Mills Ltd., Singanallur.

Mr. K. Ramamoorthy, Conservation Assistant, Department of Archaeology, Madras.

Mr. M. Ramachandran, Special Works Department, City Corporation, Madras.

Pedestrian Crossings

Experiments have been put in hand in London to find out whether the lighting of pedestrian crossings leads to improved behaviour on the part of both pedestrians and motorists.

At all the four experimental sites the surface of the crossings have been marked with the black and white "zebra" stripes, now being developed as a result of experimental work at the Road Research Laboratory.

At two of the sites the crossings have been specially flood-lit, and at the other two sites the orange globes of the Belisha beacons have been lighted internally with 60-watt lamps; a window of clear glass in the globe is designed to throw some of the light down on to the crossings.

The behaviour of road users, both motorists and pedestrians, was observed before the installation of the lighting, and is now being observed with the lighting in use. Preliminary results show an improved standard of behaviour.

Don't Retire at 55.

Mere strength apart, many men at 55 in many jobs are capable of working as competently, if not more so, than they were twenty or thirty years earlier.

Experience, skill, economy of effort, count against lack of strength, and many good workers are lost through the fixed idea of employers with the backing given to them by regulations, that at a given anniversary in one's life all is over but the funeral.

There is no scientific evidence for our present limit of 55. Now is the good time to make a change. We shall ultimately have to make. So don't retire; keep on with the job you know.

Tapping the Talent

"I am convinced", said Pandit Nehru in the Union Parliament recently, "that special boards or special arrangement should be made for selection of technical personnel. The Union Public Service Commission is an excellent commission no doubt, but it is more or less for administrative services. Its outlook is administrative rather than technical, although it gets the advice of technical people. Apart from other reasons, the delay involved is tremendous." Another defect in making technical appointments through the usual procedure was that "we cannot get rid of them even though they prove thoroughly incompetent."

Aerial Survey

The first air-survey of Bombay was conducted recently by a "Dominie" aircraft of the Air Survey Co. of India, from an altitude of 10,000 feet. With a five-man survey team, it took four hours on the first day for the survey; they took 250 photographs. These were taken vertically through the fuselage of the aircraft, the camera being operated automatically. The Ahmedabad Municipality, it is learnt, has invited this party to visit that town to take aerial photographs of Ahmedabad. This team has already made an aerial survey of about 20,000 sq. miles in India during the last six months.

Housing in Bombay

Bombay alone among the States has a statutory Housing Board charged with the preparation and execution of housing plans. On the recommendation of the Housing Advisory Committee the Government of Bombay has appointed two Sub-Committees to advise it on its housing policy. The two Sub-Committees are the Special Housing Development Sub-Committee and the Research Sub-Committee.

Each Sub-Committee is authorised to co-opt any person subject to a maximum of one-third of the total number of members on it.

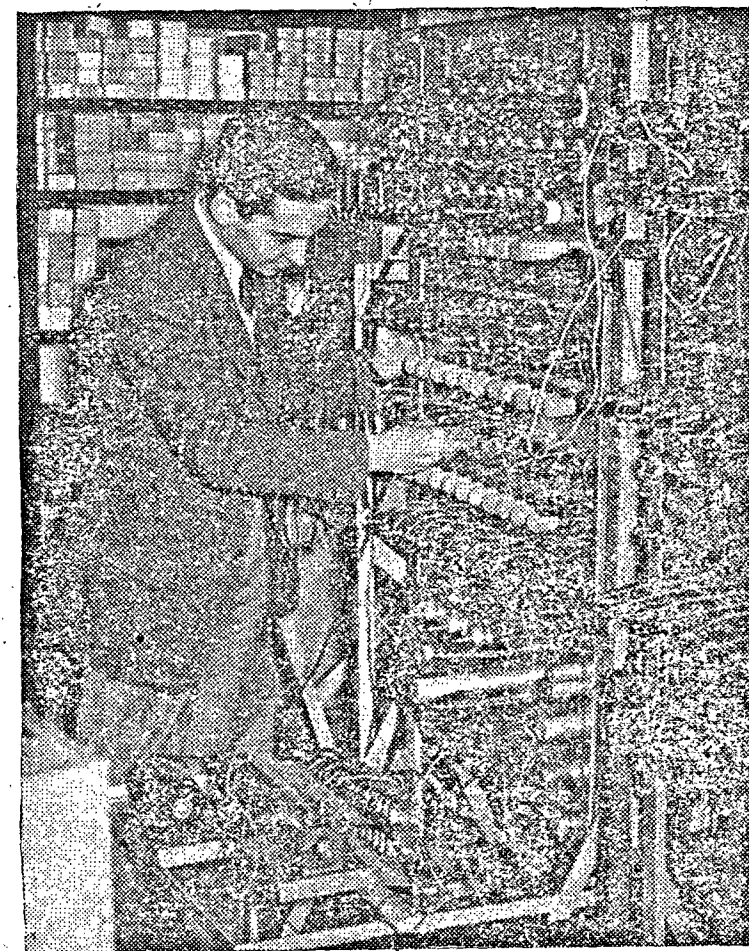
The public does not, however, yet know whether Government have found the necessary money to finance

a continued housing programme even if it be of modest proportions.

Utilisation of Saw Dust

Experiments conducted in the Forest Research Institute, Dehra Dun, on the utilization of saw dust have proved successful and hard boards have been made out of them which compare favourably with foreign boards.

Shavings and saw dust form a considerable part of the waste matter in saw mills and in wood working plants in the country. Normally, they are used as fuel. The experiments conducted at the Institute show that by using protein formaldehyde and synthetic resin binders, hard boards can be made, which in durability and strength compare favourably with foreign boards.



SIMPLIFIED VERSION OF ELECTRONIC "BRAIN"

The Electronic Computing Machine "Sec" is an attempt to reduce, to the smallest possible number of components, all of the functions possessed by the large machines which have been constructed in the U.S.A. As a comparison, "Sec" will contain only 300 valves compared with the 18,000 required by the American "Eniac." On the size of "memory" that of "Sec" is already over ten times larger than that of "Eniac" and this figure is being increased—without additional components. It is hoped that "Sec" will perform in about two to three weeks calculations which would take human beings over 100 years, and the faculty of being able to translate from one language into another is a purely incidental feature. Mr. Norman Kitz, a Ph.D. Student of Birkbeck College, at work on the "Brain."

DESIGN FOR "VERTICAL FEATURE" FOR THE FESTIVAL OF BRITAIN

The drawing and force diagrams reproduced on this page are of a "vertical feature" which it is proposed to erect on the Exhibition site on the South Bank of the Thames for the Festival of Britain, 1951. The design, which has been submitted by Messrs. Powell and Moya, A.A.R.I.B.A., 36, Great Smith Street, London, S.W.1, has been awarded

the first prize (300/.) in a competition set by the promoters of the Festival. The total number of designs submitted was 157.

In their own words, the designers state that their aim has been "to design a simple, dominant, vertical feature soaring upwards, in direct contrast to the complex and horizontal character of the Exhibition lying beneath it. This 'feature,' a tall, thin, pointed, shiny lozenge-like body, is poised 40 ft. above the Exhibition crowds on the large paved area below—a heavier-than-air structure which is suspended in a cradle of steel cables supported on three pylons. These pylons, less than 70 ft. high, would not stand out prominently from the Exhibition buildings and might almost be lost among them. The deliberate illusion is therefore created of an unusual structure, divorced from the earth, defying the laws of gravity and yet with its design based on simple and practical mechanical principles. Viewed from the distance, or from across the river, the feature, shining in the sun by day, illuminated from inside by night, and reflected in the river, would by its very shape, act as an enormous pointer to the Exhibition. At the same time, it is also most important that this feature should be impressive, not only from a distance, but also from close-to. It is felt that, on this somewhat closely packed site, a vertical feature solidly resting on the ground, would lose its impressiveness from near at hand, however important and grandiose it might appear from a distance; its solid connection with the ground might also cut up the fine clear area of paving out of which it would rise. But when it is poised above the ground, the paved area is unbroken, and Exhibition visitors can walk underneath, with over-awing and dramatic views upwards."

The basic assumptions in the structural design have been (1) a maximum wind speed of 80 miles

an hour equivalent to 20 lb. per square foot on a solid body, or, in this case, 10 lb. per square foot on the elevational area of the open-work cladding of the structure; and (2) the working load on the cables to be one-third of their breaking load. The complete structure is divided into four main elements: the "feature," the pylons, the guying cables, and the foundations. The "feature" consists of a 12-sided aluminium frame, 250 ft. high (raised 40 ft. above the ground), measuring 14 ft. across opposite faces at the centre of its height, and tapering in a curve to a point at each end. It is built of channel or "top-hat" section longitudinal members rivetted to circular horizontal rings of tubular aluminium, braced with horizontal steel wires to keep their circular shape. Aluminium is chosen for its ready availability and its lightness.

The bending due to wind is taken by the longitudinal members, braced by diagonal steel wires. The "feature" is built up of four 60-ft. prefabricated units bolted together on the site. In addition, there is a top end consisting of a spum aluminium cone, 5 ft. long, and a bottom end of a solid conical aluminium casting, also 5 ft. long, with eyes cast on for attaching the guy ropes. The three main wind-bracing guys are fixed to a specially-stiffened ring at the mid-point in height. The external covering of the framework consists of a lattice of 7/8-in. wide aluminium strips, interlaced diagonally, and leaving 2 in. by 2 in. spaces. Aluminium has been chosen for the outer covering, as it provides a shining, brilliant finish when lit by day or by night. The covering is in the form of lacing, as opposed to a light mesh on the one hand and a fabric covering on the other, for the following reasons: it reduces the wind pressure; the scale and design of the lattice-work do not detract from the appearance of

solidity, whereas an open netting would make it appear too slight and ethereal for a dominant feature; the textured and lattice-work nature of the covering clearly shows the feature as a "heavier-than-air" object, whereas fabric might give the impression of its being a balloon and thereby destroy the gravity-defying appearance aimed at. The aluminium cone at the top contains an air-speed indicator.

The covering of the third of the four 60-ft. units (from 165 ft. to 225 ft. above the ground) can be arranged as a "rip-panel," controllable from the ground, so that it can be released in the unlikely event of a wind speed of more than 80 miles an hour occurring. The Air Ministry state that, in the last 12 years, only one gust of over 80 m.p.h. (actually 81 m.p.h.) has been registered, and in view of the facts that the structure is only likely to stand during the summer months, and a high factor of safety has been allowed in the design, the "rip-panel" may be considered unnecessary. The feature will be lit by tungsten-filament lamps distributed uniformly inside, and musical wires can be stretched between points inside the framework, so that wind passing through the structure would produce an Aeolian harp effect.

The three pylons, 68 ft. long, support the wire cradle carrying the feature, and are triangular in cross section; they are built as an open lattice-work of aluminium tubes, this material being chosen because of the necessity for economising in steel, although the latter material would otherwise be preferable, especially as the natural finish of aluminium is not required for this part of the structure. The pylons are painted black, or a colour to blend in with the surrounding buildings, in order to reduce their visibility. The tensional forces in the guying cables are shown in the diagrams, and range from a maximum of 29 tons to a minimum of about 16 tons. The 46 tons pull shown in the top left-hand diagram is distributed over three cables. The largest size of cable required is estimated to be 5 in. in circumference. The cables would hardly be visible from an appreciable distance. The nature of the foundations has not yet been determined,

but the designers give some notes on a suggested method of erection. Briefly, it is to use the three pylons as derricks placed vertically around the site; place the upper 60-ft. unit on the ground in the centre; raise it as high as possible by means of cables over the pylons; place the second unit under it; then proceed in this manner until the "feature" is in its final position, using temporary guying cables to the top and permanent cables to the central section to steady the structure as it is raised.

In their report on the designs submitted, the assessors recall that, in the conditions governing the competition, it was stated that, although the "feature" could take the form of a normal three-dimensional structure, it might well be composed of such non-structural elements as, for example, water, steam, gas, or a combination of any of these. It is, they say, a matter of regret that very few competitors made use of non-structural elements.

(Continued from page 12)

CONCRETE MIXERS

fill the gauge box. A man should be constantly spreading the stone as it discharges into the gauge box to keep it level.

- From the above observation, calculate the number of cubic feet of stone being discharged in 1 hour. As an example, assume the gauge box is filled in 210 secs. We have, therefore, 18 cub. ft. discharged in 210 secs.
$$= \frac{18 \times 60 \times 60}{210} = 308$$

cub. ft. per hour.

- Repeat Nos. 4 and 5, this time using sand in place of the stone. The time taken to fill the gauge box should be double that taken by the stone, because, as dispatched from the works, the stone screw is set to deliver twice the quantity that the sand screw is set for, giving a ratio of 2:1.

In practice it will be found necessary to adjust the drop

plates at the outlet end of the stone and sand hoppers so as to obtain, by trial and error method, a true ratio.

- Having obtained the hourly output of the stone and sand, next calculate the required hourly output of cement.

Example.—Required to mix at 4:2:1, the mixer having been set to deliver 2 parts of stone to 1 part of sand.

The 18 cub. ft. gauge box has been filled with stone in 210 secs., which we previously found gave an hourly output of stone of 308 cub. ft. per hour.

The hourly output of cement will therefore be

$$\frac{308}{4} = 77 \text{ cub. ft.}$$

- It is now necessary to refer to the cement sprocket tables supplied with each machine and fit the required sprockets to give an hourly output of 77 cub. ft. per hour.

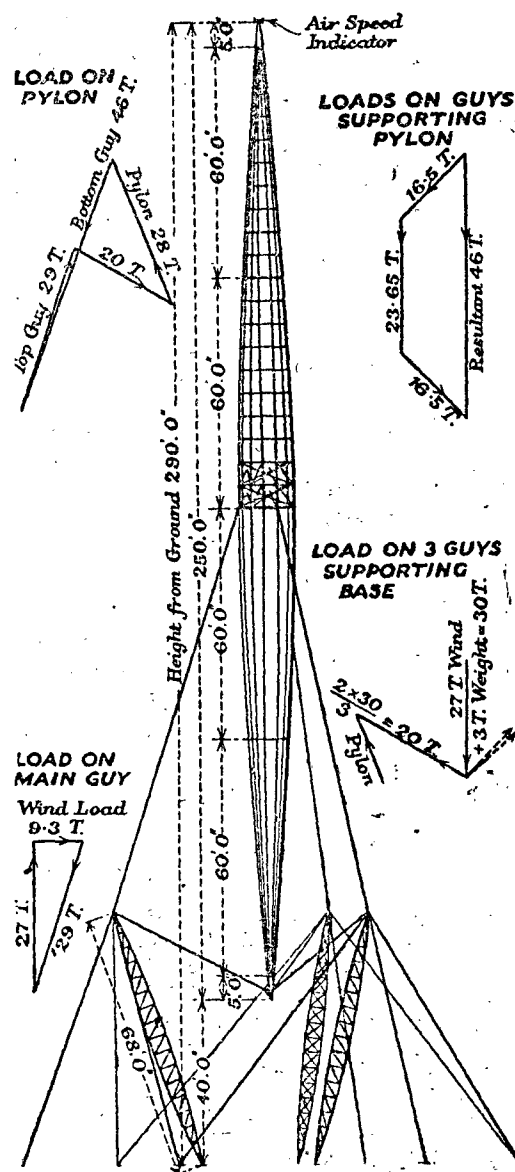
- Adjust water-feed cock to give consistency required.

If the concrete has to be made with a specified water cement ratio, it will be necessary to adjust the water supply to give the required number of gallons per hour.

(“Adopted from Civil Engineering by VERNON C. WHITING and K. MILLS, with grateful acknowledgements).”)

PREFAB HOUSES

India's Health Minister is reported to have said in the Union Parliament recently that there are no Indian Experts to advise her on Housing. It is perhaps preposterous to say that there is none in India available to design a roof for almost a 'dell-house' 20 feet square. In any case where is the necessity to spend thousands for this very simple job? We expect that suitable action will be taken to avoid similar blunders.



CONCRETE MIXERS

Concrete mixer sizes are referred to according to their drum capacity in cubic feet. As an example, the type called a 10/7 machine is one having a drum designed to receive 10 cub. ft. of unmixed cement, sand and stone from which will result 7 cub. ft. of mixed concrete.

The general range of concrete mixer sizes is from 5/3½ to 14/10. It is interesting to analyse the possible output from the various-sized machines, assuming they are working continuously. The following figures are based on a time of two minutes for each complete mix; that is, filling the drum, mixing the materials in the drum and discharging from the drum.

Mixer Size	Drum Capacity		Approximate Output per Hour	Number of Batches per Hour to obtain Stated output
	Unmixed	Mixed		
cub. ft.	cub. ft.	cub. ft.	cub. yds.	
5/3½	5	3½	4	30
6/4	6	4	4½	30
7/5	7	5	5½	30
8½/6	8½	6	6-2/3	30
10/7	10	7	7½	30
14/10	14	10	11	30

Where concrete has to be produced in large quantities under strict control, the best type of mixer is undoubtedly the Weigh Batching Plant. Not only does the weighing of the materials save time over the volume gauge method, but it eliminates faults caused by bulking of sand.

Moisture in sand retains air and, as a result, causes volume bulking of up to 30 per cent. When sand is measured into a mixer by the volume method, it follows that each mix of concrete is minus sand content equivalent to the bulking. This means a loss of up to 30 per cent of the mortar necessary to fill the voids in the large aggregate. Under-sanding of concrete means a loss in yield of concrete for the weight of

cement used, with a consequent increase in cost of production.

Some of the latest types of weigh batching plants have boom-scraper attachments which drag the sand and stone to the elevator buckets in which the material is lifted to storage bins fixed above the mixer. Boom-scrapers are built in lengths from 20 to 50 ft., and will operate in a radius of 170°. This means that lorries or trucks can discharge the material anywhere within the radius of the boom-scraper. Used in conjunction with a bucket elevator, over 200 cub. yards of material can be raised per day, and the whole operation controlled by one man.

Points to watch with weigh batching plants are that the flow of material from the storage hoppers to the weighing hopper is steady, otherwise the weighing machine clock will register jerky and misleading readings. Cement is the most likely to give trouble of this kind,

been found to affect the scales to the extent of several pounds.

A type of mixer of recent design produces concrete in a continuous flow. These machines need careful study to obtain correct results, but after being properly set for the required mix they are fairly simple to operate.

Sand, aggregate and cement are conveyed from their respective hoppers to the bucket elevator by means of steel screw conveyors running at different speeds.

The exact ratios for any mix are obtained by changing the sprocket wheels driving the screw conveyors, a set of sprocket wheels being supplied with each mixer.

The bucket elevator conveys the sand, cement, and aggregate, in the required proportions to the mixing drum. Here the required amount of water is added from a tank having a special fine adjusting tap.

The length of time the material remains in the drum is determined by the angle at which the deflector blades are set to the drum axis. These can be adjusted on site to suit individual requirements, bearing in mind that the materials are, to a certain extent, already pre-mixed before reaching the mixing drum.

An 18-cub. ft. gauge box is supplied with each of these machines and is an essential piece of equipment with a mixer of this type. It is used to check the output and to see that driving sprockets are delivering material in the required proportion.

To test the stone and sand output from any particular sprocket, the following procedure should be carried out:—

1. Shut off the sand bin.
2. Let the mixer run until stone discharges out of the mixing drum, then have mixer stopped. This makes certain that the elevator buckets are full.
3. Place 18-cub. ft. gauge box under discharge hopper.
4. With watch in hand, signal mixer driver to start the machine, then check the number of seconds taken to

(Continued on page 11)

THE MECHANISATION OF SMALL BUILDING JOBS

Some of the research work being carried out by the Ministry of Works Field Test Unit, Thatched Barn, with the object of assisting the building industry in the mechanisation of small jobs was described by Mr. J.F. Eden, B.Sc., A.M.I.Mech.E., in the course of an illustrated lecture given at the Royal Institute of British Architects on December 14.

Mr. Eden began by emphasising the need for an increased degree of mechanisation on building sites and said:

We are all concerned, or should be, about the cost of building today. The cost of building a house, for instance, has more than doubled since the war. Some of this increase is attributable to an increase in the size of houses now being built and to the improved standards of construction, finish and equipment, but rises in the cost of materials, labour, overheads and profits, and plant have all contributed. The major factors responsible for the increased labour cost appear to be a general decline in productivity and, of course, increased wage rates. The proper use of the right type of machines, can reduce labour costs and speed the tempo of building work. We are now spending considerably more in building houses than we can afford to pay in rent, and the Government has to subsidise. Whereas before the war a workman could buy a house with two or three years' wages if he could do so now, it would cost him five or six years' work to pay for it. This position would not get any better if wages were increased, without a very considerable extra amount of work per individual. On the other hand an all-round decrease in wages would merely mean less to be spent in rent. No, the only answer is more output per man, much more output; so much more, indeed, that even a large amount of extra physical effort for the same pay would not be enough, although it would help. This is

why we are interested in mechanisation—in my opinion the only way in which we can hope to get a major increase in output per individual without the individual suffering in consequence.

There are two main arguments advanced against mechanisation for the industry. One is that it may tend to throw people out of work. I do not think this bears close examination. It is not a factor which has been evident in the long run in other industries. Moreover, there is a much greater danger of men being thrown out of work because the cost of building is so high that we cannot afford to pay for it.

Secondly, it has been advanced that mechanisation takes the soul out of building, destroys the crafts. I would suggest rather that it creates new crafts and, in most cases, advances the status of the individual worker and decreases drudgery, because in the main, and in any case at the start, it is the unskilled trades which are principally affected.

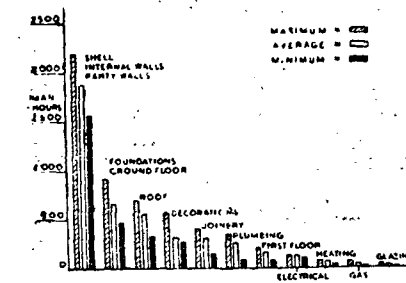


Fig. 1.—Site man-hours in building a pair of traditional brick houses.

How to Mechanise

What do we mean by mechanisation? There is a great deal more to the matter than the development or provision of new machines. Experience in the use of building machines used today shows that they will only perform their function, that of saving labour without an increase in cost, in certain conditions. Machines only save labour and money

when they are working. While they are idle they cost money.

Much building work consists of small items of work dispersed over wide area, and carried out with time intervals between them. If we are going to mechanise them some attempt must be made to bring them together. Let us take for example the building of a house. If we can see where most of the work is carried out, it may assist us in determining the most promising fields for mechanisation.

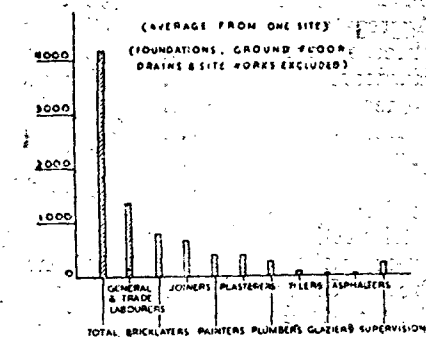


Fig. 2.—Site man-hours in building a pair of traditional brick houses, shown by trades.

Fig. 1 summarises the results in great detail of observing the building of large numbers of traditional houses all over the country. The labour expended has been summarised under main headings, and all the work, with the exception of drainage, site preparation and work on the gardens, has been included. The immense variation in labour expenditure from site to site will be noted, indicating perhaps that traditional methods are not quite so cut and dried as is sometimes supposed.

The construction of the shell is the biggest single component, when we include, as has been done here, the plastering of the walls. Other expensive components are the foundations and the roof, but floors, heating, plumbing and other services are not really big items.

We have the same picture in Fig. 2, under trades. This is interesting

because it shows the enormous amount of work done by the unskilled trades. From the point of view of mechanisation, this is particularly interesting, as it is well known that the simple operations are most readily mechanised.

Weight of Materials.

What do the general labourers do? A large part of the work is in the handling of materials. Table 1 shows how much they have to handle. The total weights of material handled in a pair of brick semi-detached houses adds up to the enormous figure of 378 tons. Much of this

Table 1.—Weights of materials in a typical pair of traditional brick houses.

Bricks	...	92 tons
Excavation	...	60 tons
Sand	...	50 tons
Aggregate	...	44 tons
Miscellaneous	...	50 tons
Hardcore	...	13 tons
Cement	...	19 tons
Water	...	16 tons
Lime	...	5 tons
Tiles	...	5 tons
Timber	...	4 tons
Pitchmastic	...	3 tons
Breeze slabs	...	5 tons
Precast Concrete	...	11 tons
Plaster board	...	1 ton
Total weight Per Pair (Approx.)		378 tons

weight has to be lifted or moved more than once, and if one included these repetitions, the total weight would be more like 1,200 tons. 1,200 tons of materials are lifted or carried manually during the building of a pair of small houses. We surely need machines for this, and it would appear, on the face of it, that there is enough work for machines here. But it is not very simple. Most of the work is not at the moment continuous, but broken up into small operations of short duration. This is a major difficulty in mechanising a great deal of building work, and is not by any means confined to housing.

If we look at one such operation—concreting—we can get an idea of what happens in practice. Any job of work, wherever it is done, and whoever it is done by, can be divided into three parts: preparation, actual performance, and clearing up afterwards.

The more machines are used, the more preparation work and clearing up there will be (Table 2). For them to operate successfully the work therefore must be as continuous as possible. Both builder and architect are deeply concerned in this process, and a very large measure of co-operation is required.

Under present circumstances, the impetus must come from the builder. We cannot hope to do much towards further mechanisation without altering our methods. Here plant designers and manufacturers cannot help very much, it is up to those in the building industry. I do not think I can emphasise this point too strongly. The design, organisation and sequence of work from start to finish of traditional work have been evolved over a long period of time as those best suited to manual methods, and this organisation and sequence only holds good as long as traditional methods are employed. When machines are introduced the whole process must come under review.

Table 2.—Analysis of concreting time, taken from 12 sites using 10/7 and 14/10 Mixers with Barrows and prams on large floors, roads, etc.

Actual concreting	...	66 %
Laying barrow runs	...	2 %
Other preparatory work...	...	6 %
Moving materials, water supply	...	4½ %
Clearing up	...	3 %
Moving mixer	...	5 %
Cleaning tools	...	2½ %
Hold ups	...	3½ %
Tea breaks	...	7½ %

As an example of the way in which design can affect the use of a machine, what actually happened on two housing sites where concrete houses were being built with a crane, to build the shells of nine pairs of houses is that the architect in each case had started off with the idea of building houses with a crane, but in the first case the organisation problem in keeping the expensive crane busy had not been properly considered. On this site the crane took 1,173 hours to build 50 houses; on the second site, it took 760 hours to build 54 houses. The idle time of the crane on the first site was 410 hours

against 64 hours on the second. Consider the problems of the foreman on the first site, as against those of the foreman on the second, bearing in mind that the sequence of following trades would be largely determined by the path of the crane. Note also that on the first site, where there were five distinct crane operations, separated by necessary periods of time while concrete set in grouted joints, it was necessary to have more than 15 blocks on the go in order to complete nine pairs. On the second site the crane had only one visit to each block, and the ninth shell was completed before the tenth was started.

This is a case where the men on the site could do little to remedy the state of affairs at the time, and the house needs re-designing. If, however, the builder had been able to consult the architect at an earlier stage, while the house was on the drawing board, he could have done a great deal towards ensuring that the house was built more cheaply, providing, of course, that he understood the principles involved in the use of plant.

The builder can make a start by trying to reduce the number of separate operations. Whenever, for instance, two concreting jobs can be made to follow on and so become one job, there will be an immediate saving in preparation time, and a better chance for using machines effectively. In many cases this can be done without alteration in design needing the consent of architects, it will be merely a matter of doing things in a slightly different way. In many other cases the builder will be able to point out to the architect, or his representative, how small changes in design will ensure the better use of machines.

Before considering any individual examples it may be worth while at this point to consider briefly the general characteristics of the type of machines required for the class of work being considered.

Of paramount importance is the question of mobility; since the work is dispersed, the machine must be capable of quick and cheap movement. This applies from site to site as well as on the site. Secondly,

since we are up against the problem connected with design—the fact that work is often broken up into small units separated by time intervals—low capital cost is a great help, since it may not be possible to avoid considerable periods of idle time. I do not want to stress the point too much because it is in many cases economically possible to have an expensive machine idle for considerable periods; providing it does a sufficient quantity of useful work during its life, it does not really matter from a cost point of view, whether it does it in one day or 500. Arising from these points is a third; the advantage of having a machine which will perform a number of jobs. This is how the farmer overcomes a similar problem. Instead of having a ploughing machine, a harrowing machine and a threshing machine, he has one machine, the tractor, with a number of attachments which greatly increase the amount of work he can do with it. Among larger building tools, the universal excavator is a case in point.

House Foundations and Floors

Both as regards digging and concreting, the best results will be obtained if all the foundations on the site can be constructed in close sequence one after another. Where there is a large number to do—say more than 30 pairs on the site—a large trencher can be used economically to dig the footings. Smaller sites can be done in this way if conditions are favourable—such as that the trenches required are deep, that there are drain trenches which can be dug at the same time, or that the machine's base is near the site. There is, however, a great need for a small and cheaper machine for this purpose. Developments have been proceeding along several lines at the Field Test Unit, and a smaller trencher constructed to the specification of the Unit by a well-known firm of plant manufacturers is now undergoing tests and it is hoped that it will be in production shortly.

Fig. 3 shows a mock-up built at the Field Test Unit which demonstrated that it would be possible to

construct a small back-acter and crane at a reasonable cost. This machine had an 8 h.p. engine and developed ample power for digging a 22 in. wide trench, to depths of 5 ft. at a rate of 5–6 cu. yd. per hour.

Another development is the mechanical earth auger (Fig. 4). The seasonal moisture movement in clay soils often causes movement and cracks unless the foundations are taken deep. In these circumstances, a trench foundation of the normal design becomes expensive, and the Building Research Station has suggested that in such cases a cheaper and more satisfactory method might be to support the house on piles made by boring holes and filling them with concrete. The machine illustrated was developed by the Field Test Unit for this purpose and was recently used to bore some 250 holes for a school foundation near Barnet—a job which attracted considerable interest. It bores 12-in. or 14-in. diameter holes up to 8 ft. deep at the rate of 1 foot a minute, and is self-propelled at slow speeds over bad ground.

Great progress has been made in the last two years on the subject of placing concrete in house foundations and floors. It may be of interest first of all to consider the method of placing the concrete with wheelbarrows. An examination of the process as carried out during the building of some 800 houses on 20–30 sites discloses that output per man on this class of work varies enormously, but is always low, the variation from site to site in those observed, where practically identical

operations were being carried out, being from .11 to .37 cu. yd. per man-hour, and averaging about .22. In terms of labour and plant cost, this means a variation from about 10s. to 27s. per cu. yd.

In the course of the development of a number of different types of special equipment for concreting on these small jobs, which will be described later, it became necessary to find out the gang constitution and methods giving the greatest efficiency with wheelbarrowing teams in order to obtain some better comparison when new plant was being tested. A number of method studies were made of wheelbarrowing gangs at work placing concrete, and from the details of them it was possible to ascertain the outputs and basic costs of different gangs under determined conditions. Quite apart from the value of these results as standards, conclusions can be drawn from them which can be applied directly on any site.

The average 10/7 mixer, if not delayed, is capable of turning out a batch of 7 cu. ft. of concrete every 2½ min., and then allows the materials to be in the drum for about two minutes. To keep up this pace, the size of the loading gang depends on a number of circumstances such as the design of mix, the methods used to measure the materials and the situation of materials in relation to the mixer.

With the simple methods normally employed, a three-man team is capable of loading at this rate if an all-in aggregate is used. When wheelbarrows are used to take away

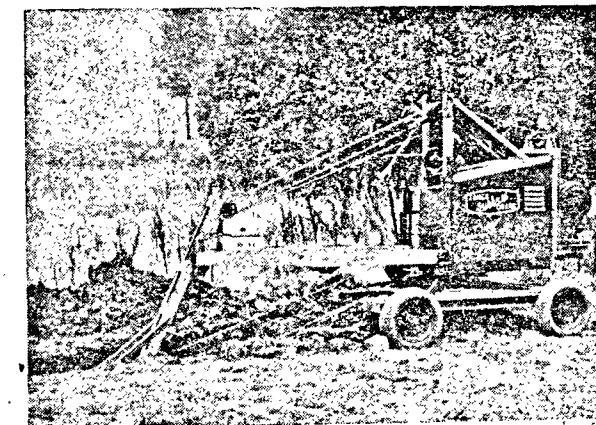


Fig. 3.—Experimental small back-acter.

the concrete, the team can often be reduced to two men. This is because the use of wheelbarrows seriously delays the mixer so that with the average mixer it is impossible without inadequate mixing to attain a batch cycle time of much less than 3½ minutes. This has nothing to do with how hard the men work or how many barrowmen are used. The capacity of a wheelbarrow carrying concrete is about 1½ cu. ft. and each takes about ½ minute to fill at the mixer. Six barrow loads will therefore be required to discharge 7 cu. ft. from a 10/7 mixer, and this will take 1½ minutes, whereas, if the mixer were not delayed in this way, it

could discharge its load in about half a minute. This is illustrated in Fig. 5. The inevitable delay in the mixer cycle time means a reduction in output of about 35 per cent.

Coming now to consider the size of the wheelbarrowing team, it is clear that further delays will take place if the wheelbarrows are not filled up smartly, one after another. The only way to ensure this for runs longer than about 10 yards is to have six barrowmen, each making one journey per batch. Such a team would be able to make very long journeys from the mixer without increasing the cycle time of 3½ minutes. Since there are six

barrow loads to take away, there are only two other teams which need be considered. Two men would each have to make three journeys and may be ignored for practical purposes with the size of mixer. With three men, each making two journeys, the first man has to be back by the time the third barrow is filled if no further delays to the mixer are to occur. At a normal barrowing speed this means a maximum run of about 8 yards away from the mixer.

Speed and output are, however, not the only considerations. The six-barrowmen team is a large one and it is actually cheaper to use a three-barrowmen team on longer runs, though the output, of course, is decreased. (See Figs. 6 and 7).

It is clear, therefore, that with a 10/7 mixer, not overloaded, three barrowmen should be used for short runs and six for long runs. This conclusion is independent of the time of mix or how hard the men work. How hard the men work will only determine the length of run at which it is cheaper or quicker to change from three barrowmen to six.

In order to apply these conclusions on a site, a good team can be organised as follows. Start with the mixer and determine the length

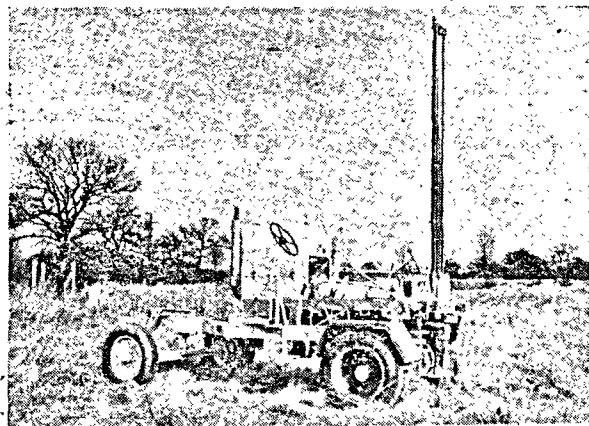


Fig. 4.—M.o.W. earth auger for pile foundations.

Group A.

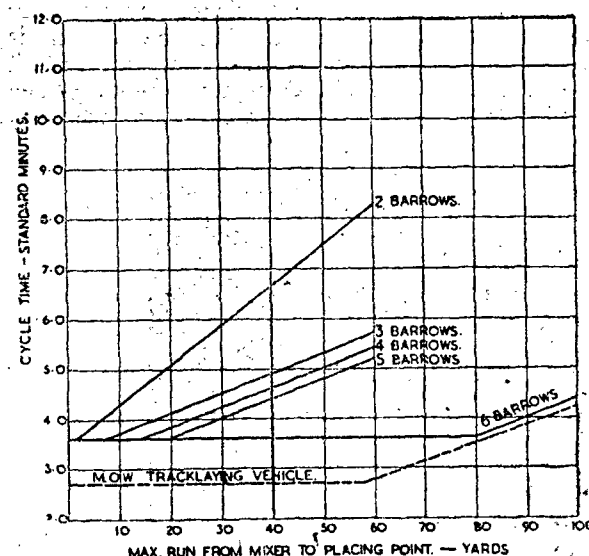


Fig. 5.—Cycle time—10/7 mixer operating with wheel-barrows and M.o.W. track-laying vehicle.

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Group B.

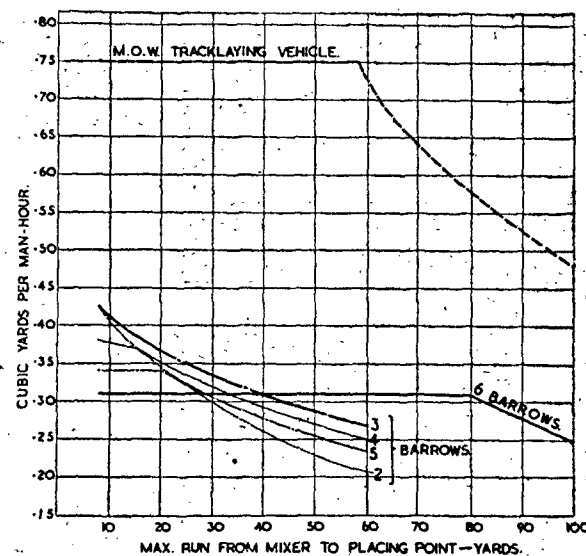


Fig. 6.—10/7 mixer operating with wheel-barrows and M.o.W. track-laying vehicle—output in cubic yards per man-hour.

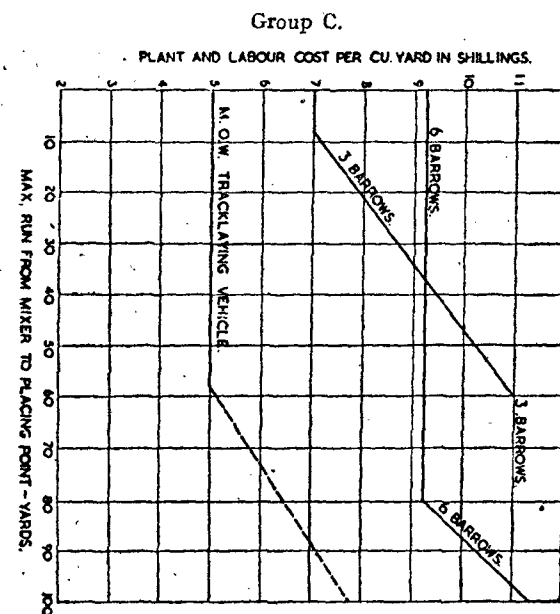


Fig. 7.—10/7 mixer operating with wheel-barrows and M. o. W. track-laying vehicle showing operating costs.

of time in the drum necessary to ensure a good mix. This may be two minutes. Determine the size of batch input to achieve a batch output of 7 cu. ft. Do not overload it—it may cause bad mixing and will introduce organizational problems which are impossible to solve, and so nothing is gained. Arrange the loading gang to work to a cycle time for about 1½ minutes longer than the material is mixed in the drum. Put in three barrowmen to start with and watch the gap between the third and fourth barrow while the team is working. If this is too long, put in three more barrowmen.

Other methods.

Within the last two years a number of special machines have been developed to replace the wheelbarrow on this work. They are all designed to work with a 10/7 mixer and carry the whole batch—7 cu. ft. at a time. This enables the mixer to work at full output. Moreover, because in each case only one man is needed for transport, there is a big reduction in the size of the gang, which need only be five to seven men.

A concreting boom has been developed by the Field Test Unit. One end is suspended by means of a portal frame or a bucket over the

mixer, which is placed opposite the party wall. The boom is nearly 40 feet long and swings round the mixer as a pivot, the other end being supported on wheels. A skip carrying 7 cu. ft. of concrete runs along the bottom flange. This apparatus weighs about 600 lb. and can be moved from one block to another and set up ready for use by a team of eight or six men in half-hour.

During a site trial, five men mixed and placed 22 cu. yards concrete in 4 hours 19 minutes, including all delays and ancillary work. Of this time, 1½ hours was spent moving the mixer and boom. This is at the rate of 1 cu. yd. per man hour inclusive. The cost of labour and plant was under 4s. per cu. yard. This apparatus is now being manufactured. Its operating costs should not amount to more than 2s. per hour even if used for only 600 hours per year. The boom was illustrated and described in *The Building Gazette* March, 1950.

This prototype (Fig. 8) was constructed at the Field Test Unit with the idea of providing a cheap machine for the small man. After trials it was handed over to a manufacturer, who produced the machine at a cost which, assuming that it works for 1,000 hours per year, shows the operating cost to be 1s.

9d. per hour. On a site trial concreting oversite seven men placed 30 cu. yards of concrete in 8½ hours at a cost of 6s. 7d. per cu. yard. Of this time, 31 per cent. was not directly productive. This machine will only travel over soft ground, if mesh is used, but this is a simple business to lay.

The track-laying tractor shown in Fig. 9 was developed at the Field Test Unit and is by way of being a multi-purpose machine. Equipped with a concreting skip and dozer blade, it can travel over any ground, spread spoil, push aggregates nearer the mix, besides handling concrete hardcore and other materials. It has considerable traction power though only equipped with a small-size engine, and will tow a mixer about the site, or a trailer. On a site trial five men, with a 10/7 mixer and this machine, placed 36 cu. yds. of concrete in house footings, besides spreading the spoil around two blocks, in a period of eight hours, including all delays, tea breaks, etc. The cost was 5s. 4d. per cu. yd. of labour and plant.

Handling Bricks and Mortar

Another example which might be quoted is that of handling bricks and mortar on small jobs. For this operation a number of mobile hoists and elevators have recently been placed on the market. It is worth while considering their uses on a housing site, for getting bricks and mortar to the bricklayer.

The main feature of these new hoists and elevators is that they are mobile, and can be set up very quickly. In order to make the best use of them they must use this attribute to the full. If, however, they are to be used for distributing bricks and mortar they need some other device for moving the materials on the ground and on the scaffold. There are a number of trucks on the market for this purpose.

The important point to note is that the outputs which can be achieved, with a properly arranged team, with all this equipment is very much higher than is required for serving the bricklayers on one pair of houses. Even if there were eight bricklayers working on the pair, they could not expect them to

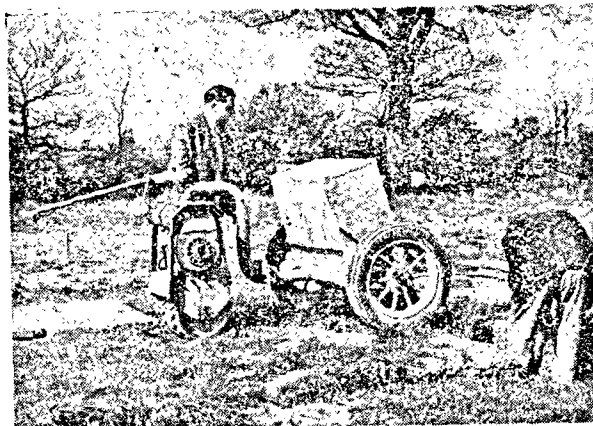


Fig. 8.—Prototype three-wheeled powered concreting barrow from M.o.W. Field Test Unit.

lay, on the average, more than 800 bricks per hour, and a more usual figure would be about 400. The outputs achieved with the combination of hoist and truck are anything up to seven times this amount. If, therefore, the hoist and elevator is used in the way stationary hoists would be used, or the team works in the same way as hod carriers do, that is, it is kept at one pair of houses until the brickwork there is finished, the equipment will be working at a very reduced capacity, and it will be very expensive.

The mobility of the hoist enables another and better method to be used. It can be put in the charge of a team of men, whose job it is to serve bricks and mortar to a number of blocks. The team should move the equipment from block to block, stacking materials on the scaffolding in advance of the bricklayers' requirements.

The equipment should be chosen on the basis of the total number of bricks required per hour on the whole site. The team should be trained, and drilled to move the equipment as quickly as possible from spot to spot and set it up. With good equipment this can be done by the team in five to ten minutes, without any difficulty.

In Fig. 10 are some estimates of the cost of handling bricks and mortar by various mechanical methods. The cost, of course, varies

with the amount of work to be done by the equipment in its life. If this is assumed to be three years, and the equipment reckoned is operated by a builder building 25 houses per year, this would represent a total number of bricks of about 1½ million. Under these circumstances one should expect to be able to handle the bricks with mortar for about 14s. 6d. per thousand by several methods. If twice the number of houses are built, or the equipment lasts for six years, it may be expected to get down to about 12s. per thousand. These figures may be compared with typical manual handling at to-day's outputs and prices of about 18s. to £1. It should be noted that these figures include the mortar as well.

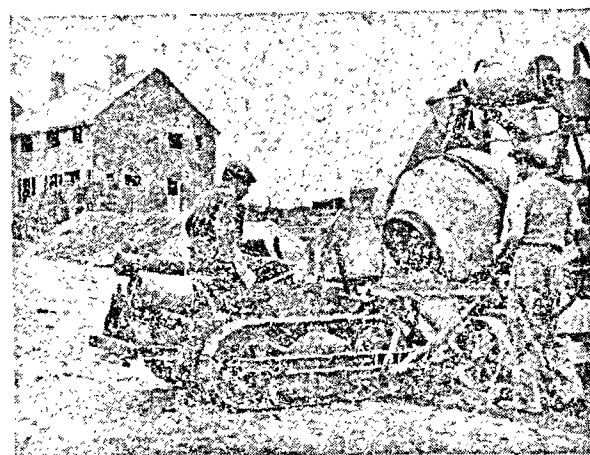


Fig. 9.—M.o.W. prototype track-laying concreting vehicle.

Coming now to consider aspects of the design of plant for small jobs, it is evident that if the builder is to make the best use of plant on these small jobs, the characteristics of the plant he requires are as follows:—

- (1) Mobility, so that the plant can be quickly moved from job to job and be kept busy.
- (2) Cheapness, so that idle time is not expensive.
- (3) Machines which can be used for a number of purposes.

High output is only a secondary consideration. We have been trying at the Field Test Unit to develop machines along these lines. It is, in many cases, difficult to design machines which are cheap enough to carry out economically the small jobs of work which often have to be done. We think that this idea of multi-purposes tools is a promising one. It is an idea which is greatly used in agriculture, where the farmer is supplied with one tractor and a number of implements to do a variety of jobs. A very useful example in the building industry is the universal excavator, which can do three or four types of digging, and also can be used as a crane.

Conclusion

In conclusion the speaker said: If we are to mechanise small jobs successfully, we must study both the design of work, and the organ-

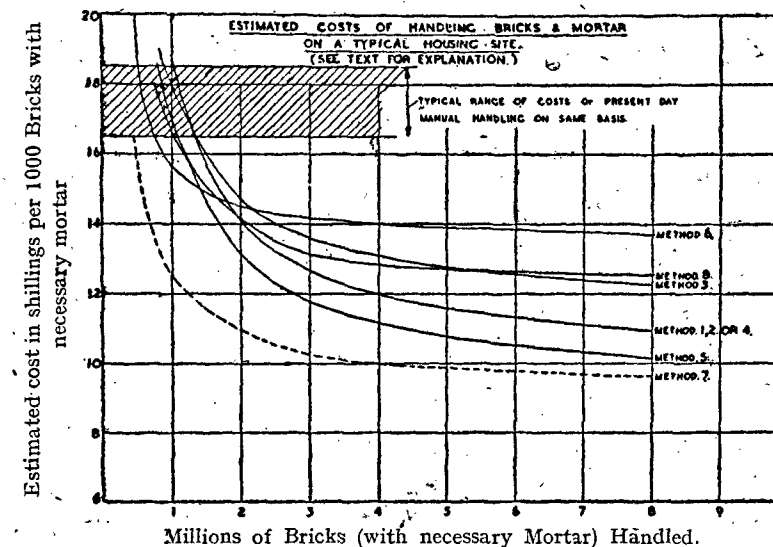


Fig. 10.—Estimated costs of typical brick-building methods.

isation and sequence of jobs on the site. We must endeavour to provide as far as possible a continuous sequence of work for the machine with few interruptions. Similar jobs must be made to follow on, one after the other.

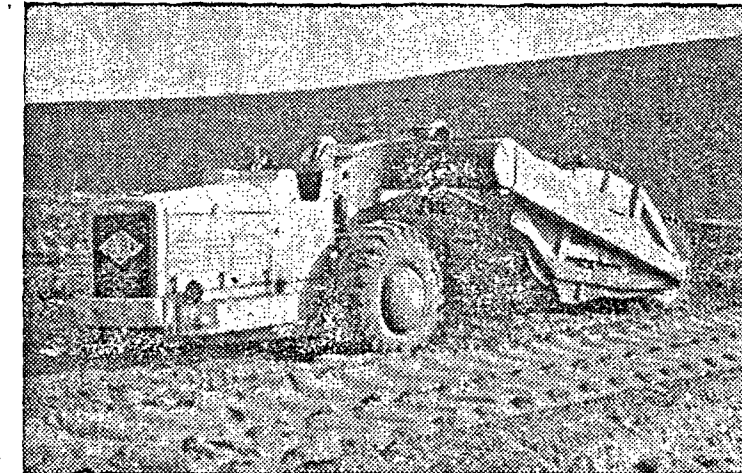
Further, designs must be studied before going on to the site, so that plans of action can be worked out beforehand, and where alterations in design can be seen which would enable better use to be made of machines, they must be brought to the notice of the architects or their representatives as early as possible.

The machines required should be mobile, cheap, and if possible do more than one job.

PIG-PROOF WIRE FENCING

With the requisite quality of wire freely available in the market, the work of manufacturing pig-proof wire fencing under the Government scheme undertaken last year is being done expeditiously. This fencing of a special variety, which was formerly being imported from abroad, is very useful. It is now being supplied to cultivators at cost price, which is about 11 annas per running foot, ex-manufacturing depot in the Dharwar district. It is manufactured in rural areas with the aid of rural artisans, through the agency of the Village Industries Committee, Dharwar.

Those desirous of buying this wire fencing may send in their indents to the Agricultural Engineer, Government of Bombay, Poona 5, through the District Agricultural Officer concerned. The fencing, which is four feet in height, is supplied in bundles each measuring 100 feet and weighing about 150 lbs. An advance of Rs. 25 per bundle is to be paid along with the indent while the remaining charges are to be paid when the bundles are ready for despatch.



GIANT SELF-PROPELLED SCRAPER

Constructional engineers from all over the world are showing a keen interest in the first British self-propelled scraper which is making its debut at this year's British Industries Fair (London and Birmingham, May 8 to 19). It is the "Goliath", manufactured by Blaw-Knox Ltd. of Watford, a self-contained unit designed for digging, loading, hauling, spreading and compacting. It is a high-speed earthmover comprising a two-wheeled tractor unit and a cable-operated open top scraper, coupled to permit operation on extremely rough country. Fitted with pneumatic tyres it will carry a full load over extremely rough country at 20 m.p.h. The tyres were specially designed for the machine.

DELHI PREFAB FACTORY

A visit to the factory, which from the roadside looks like a big hangar, shows that a great deal of machinery has actually been installed.

In the centre of the factory stand the mixers into which cement, ground sand foam and water will enter in measured quantities to form the basic material for construction. The biggest constituent is the Jumna sand which will be converted into a fine powder before entering the mixers.

Sixteen houses per day will be completed when the factory begins to work three shifts a day. Sixteen trucks and 32 trailers will be required to take them to the building sites, where each house will be installed by a team of specially trained men. The first group of technicians is now being trained.

When Prof. Messerschmidt visited the factory some days ago, he expressed satisfaction that India was adopting the technique of foamed concrete in which he had experimented, finding it a good resistant against heat and cold.

Arrangements have been made for Prof. Messerschmidt to send from Germany sketches of houses to suit Indian conditions.

The cost of the prefab housing factory, it is learnt, will be about Rs. 42 lakhs. This investment will be covered in a period of ten years by adding a small amount of about Rs. 70 to the cost of each house.

A committee of directors, including senior engineers of the Ministry of Industry and Supply, the Central Public Works Department and the Ministry of Health, directs the affairs of the factory. They are assisted by two experts of a British firm of consulting engineers who have designed five similar factories for Britain.

The agreement with this firm provides for technical help and the use of patents of light-weight concrete,

invented in Sweden but perfected in Germany and Britain.

An important clause of the agreement provides for payment of royalties for the use of the patents and for expert services of the engineers only after the factory has gone into actual production. The volume of payment has been made dependent upon the output of the factory.

The sale of houses, likely to be priced at about Rs. 3,000, will be made by the Town Planner who will endeavour to avoid monotony in planning development of prefab colonies. Refugees will enjoy the highest priority in securing the houses provided they possess plots of land on which to erect them. They will consist of two living rooms, two verandahs, a kitchen and a bath.

DOCKYARD APPRENTICE SCHOOL, BOMBAY

A school to train apprentices in various aspects of dockyard work has just completed its first year. Boys between 16 and 19 who are of matriculation standard are selected annually on the basis of competitive examination held in June every year. They obtain training both theoretical and practical, for five years in marine engineering, electrical engineering, naval architecture etc. All apprentices undertake to remain in the Dockyard, if required to do so, for a period of eight years after the completion of training. They receive stipends during training which cover board and lodging charges, leaving a small surplus. Their first two years of training are spent in the Dockyard Apprentices School proper while the other three are spent in the workshops and drawing offices of the Dockyard under the supervision of the School authorities.

PERSONAL

Mr. J. A. Parks

Mr. J. A. Parks, F.S.I., Chief Valuer of the Board of Trustees for the Improvement of Calcutta, has been appointed temporarily to act as Chairman of the Calcutta Improvement Trust in place of Sri S. N. Ray, I.C.S.

Prof. C. A. Hart

Professor C. A. Hart of London University, is the new Vice-Chancellor of the Engineering University at Roorkee.

Prof. R. Duerrerr

Professor R. Duerrerr of the Technological College of Zurich, who had been invited by the Ceylon Government to advise them on the prospects of producing iron in the Island has returned to Geneva.

Mr. C. P. Subbiah

The services of Mr. C. P. Subbiah, Divisional Engineer (Bridges), Madras has been placed at the disposal of the Government of India, Ministry of Transport, Roads Organisation, for appointment as Divisional Engineer (Consultant).

Mr. T. C. Kantawala

Mr. T. C. Kantawala, Housing Commissioner and Secretary of the Bombay Housing Board has retired. Mr. C. R. Desai has succeeded him.

Mr. M. N. Kamath

Mr. M. N. Kamath, Divisional Engineer, Highways, South Kanara has been promoted as Superintending Engineer, Highways, and is to be in charge of the Bridges Circle, Madras in relief of Mr. B. N. Shenoy.

SUCCESS CAN FOOL YOU

By Hannen Swaffer

What are the fundamentals of success? Are spiritual values necessary to achieve worldly fame? What are the secrets of happiness? Is happiness easier to achieve for a successful man? Can one be successful and happy? *The Psychology* asked Mr. Swaffer these questions—here are his replies.

With regard to "What do you consider are the fundamentals of success?" I can only thank Dr. Joad for his ever-usual phrase, "It all depends on what you mean by"

"Success" might mean anything—prestige, a title, big financial gains, a century at Lord's or a seat on the local council.

It means, indeed, everything and nothing.

What is certain about it is that it is the world's worst illusion—a mirage far off in the desert, something you never reach, something you pass without knowing it.....

Besides, it depends on so many things—time, opportunity, the right quality for the right time. For instance, if Charlie Chaplin, the most successful of all film artistes, had not been alive at the time of the moving picture, he might still be although quite as clever as when he made *City Lights*—an unknown comic on tour for Fred Karno.

In order that Winston Churchill could reach the pinnacle of success, it was necessary that we had a World War. Since then, by the way, he has been a conspicuous failure.

In order that Joan of Arc should successfully drive the English out of France, it was necessary that the English should have invaded it beforehand. When that job was done, she was so unsuccessful that her co-religionists burned her at the stake.

In order that Nelson should win a great battle like Trafalgar, it was essential that there should be no cast-iron rules about two eyes and two arms. Why, they would not have had him in the last war!

By the way, they would not have Sir William Robertson in the army, even as a private, because he was colour blind, until he was allowed in because of the special influence used by the Duke of Cambridge who had stayed in the East Anglian house where Robertson had worked in the garden. Yet he became Chief of the Imperial General Staff!

Opportunity counts a great deal.

Besides, I do not know what you mean by success. Most people whom you should call successful feel themselves to be abject failures. You are conscious only of the things they have done, things they take for granted, because to them they were easy of achievement. They remember chiefly the much more important things that they could not do.

Then, was Jesus a failure? Was Captain Scott a failure? And what would you say of Chatterton, the poet, who committed suicide, and Van Gogh, the painter, who died in a madhouse? Shakespeare succeeded in the eyes of his contemporaries not because he was a genius but for the strange reason that, during his lifetime, his plays were regarded as ordinary hack jobs done either for the Globe Theatre or to please Queen Elizabeth. And if they had not been printed by his fellow-players because they were fond of him, we might never have heard his name. As it was, it was not until 150 years after his death that he was recognised.

Edgar Wallace merely wrote for money—and by churning out pot-boilers, some almost beneath notice—and yet what a fuss they made of him for several years!

Even if I knew what you meant by "a sense of spiritual values"—and I do not, since, in these days, most of the work of improving the world is being done by men who are so-called materialists—I should doubt whether it was necessary to achieve world fame.

Stalin has none. Hitler, who at one time was much more famous even than Stalin, jeered at such things. Besides, I notice that those who, today, prate most of spiritual values are among those who seek most earnestly temporal power.

What I think you really mean is "How can I make money?" If that is your aim, be selfish and greedy and cunning. Choose friends who will help you and ignore people who won't. Take every advantage you can of anybody you meet or anything that happens. Think of nothing else but money. Collect it, save it, invest it. If the world shortage grows, it may one day be the only thing you have to eat.

If you seek success on the stage, cultivate those people who are already successful. If you want to write a successful book, write something like *Forever Amber* and not something that appeals to the intelligence.

In whatever walk of life you choose keep in the middle of the road and walk only a few yards in front of the crowd. If you are too much in front of the rest, they will throw stones at you because you are going too quickly or because you want to go too far.

As for happiness, I would say that the only way to be happy is to be contented. This means you must be satisfied with things. In fact, you must be a clump and a clod and utterly lacking in imagination. If you are happy, you want things

to continue as they are, and if, by any chance, you want things to continue as they are now, well Heaven help the rest of the world. For the inevitable result of that would be that the mass of mankind would have to remain unhappy so that you can feel contentment.

I do not know whether or not happiness is more difficult to achieve the more successful one becomes. For some people like so-called success and some do not. Some are bored with achievement. Others want achievement without the fight. Still others prefer the fight to the achievement.

There are no rules for this. And anyone who seeks to set down rules, or to offer to anybody else anything but the most general of counsels, is proving himself a fool.

You cannot, for instance, pry into anybody else's soul, even if you think you can. Nor can you measure anybody else's possibility of achievement. That can only be proved by test.

The only think I can ever say to any young man or woman is something like this: "Try and find the sort of job that you want to do. Then, whether you are successful or not, you will enjoy doing it. In doing that job, you will find a measure of self-satisfaction which money cannot buy for you."

As for the idea that you will get satisfaction out of serving others, that I do not believe. Virtue is its own reward, and a poor one at that. Believe me, the mass of mankind, if you seek to serve it, will only blame you for the things you have not done for it. Anyway, who wants gratitude? It is, believe me, a very boring thing. (With grateful acknowledgements to *The Psychology*).

LETTERS TO THE EDITOR

Sulphur Base Jointing Compounds

Sir,

We are very much interested in the article on Cast Iron Water Mains Sulphur Base Jointing Compounds, published in October 15, 1949 of *The Building Gazette*.

We would very much like to know if any sulphur base materials have been used with success in India and if so their source and prices may please be intimated to us.

Yours faithfully,
R. N. Sen.

For Chief Engineer, Eastern Command, Ranchi.

Sir,

With reference to an article appearing in *The Building Gazette* of October issue, on Cast Iron Water Mains, written by F. F. Jaray, we will be much obliged if you will let us know:—

(i) Whether the sulphur base pipe jointing material is available in India; if so who is the supplier.

(ii) Whether this has been used in any of the water-supply or other mains in India and where.

Yours faithfully,
T. R. Rao,
A. C. R. I. E. (E/M.)

Madras 9.

NUTRALEAD, a jointing compound of this nature is available from the Tanks and Linings Limited of Town Wharf, Droitwich, Worcs., England. The present price is £51-5-0 per ton f.a.s. British port. Nutralead is supplied in 56 lbs. packages containing fourteen 4 lb. ingots. It would be interesting to know if our readers know of its being used in this country.—Ed.

FOR DISCUSSION

Professors of universities are the real social and intellectual aristocrats of England. They are inaccessible except for discussion or some subject connected with their studies.

Prof. Bernal says India is making very little effort to evolve large-scale plans of housing based on available indigenous materials.

Dignity consists not in possessing honours but in the consciousness that we deserve them.

Officialdom, it might be concluded on the basis of recent trends, is hardly at its best in matters Housing.

Better lighting and colour in factories lead to higher production.

Key points in the New Zealand's Government Housing Plan are: an immediate increase of one-third in the maximum building loan; introduction of suspensory loans; sale of State houses, sites and building sections.

The Madras Institute of Technology is to receive a grant of Rs. 5 lakhs from the Government of Madras for the purchase of equipment.

The Government of India incurred an expenditure of Rs. 51,000 on the French ship-building experts who had recommended the Vizagapatam yards for development after visiting several places.

Deposits of gypsum have been located near the village of Ran in the Halar district in Sourashtra. Their total reserves are estimated to be about 3,776,000 tons.

THE CEYLON'S FIRST MULTI-PURPOSE SCHEME

GAL OYA DAM AND POWER PROJECT

By* M. C. Abraham, B.Sc., M.Inst.C.E., M.I.W.E., and
A. H. Mendis, Assoc. M.Inst.C.E., A.M.I.W.E.

The following is an abstract of the paper read at the Engineering Association of Ceylon.

The Project which is the first multi-purpose Irrigation Scheme undertaken in Ceylon is to impound the water from the drainage area of 384 square miles by the construction of a dam across Gal Oya at Inginiyagala. The Lake so created will have a surface area of 30 square miles, and a capacity of 770,000 Ac. ft. at its full supply level. The spillway is across a saddle on the left bank of the river. Water from the reservoir will be released through a 13 ft. diam. steel lined penstock. The energy of the flowing water will be used to drive 4 Francis Turbines and in so doing will generate 10,000 K.W. of electrical energy, before being discharged into the tailrace for irrigation. Right and left Bank contour channels will convey the water to the Irrigable area of 120,000 acres.

The Main Dam

The Main Dam will consist of a rolled earth filled Dam of length 3,425 ft., height 154 ft., a crest width of 30 ft., carrying a roadway.

The upstream side slope is 4 to 1 vertical below elevation 225 and 3 to 1 vertical above elevation 225 and will be protected by a 9" thick graded gravel filter with 3 ft. thick stone rip rap laid on top. The downstream slope of 2½ to 1 vertical with two berms of 15 ft. each at elevation 222.0 and 172.0 will be covered with grass sods.

The modified designed section of the main dam consists of two prisms of impervious material with an inclined sand zone 15 ft. wide sandwiched between them. A sand blanket 3 to 4 ft. thick laid at the bottom of the downstream prism at an elevation of 156 M.S.L. and the above inclined sand zone laid up to elevation 225.0 will drain the dam of all seepage water. Cross drains of 9" dia. hume pipes with

uncemented joints and a 12" dia. toe drain loosely packed with graded aggregate from ½" to 2" will lead the seepage water away and keep the downstream prisms of the dam dry.

The total volume of earth work in the main dam is estimated at 5,016,000 cu. yds.

The Spillway Dam

The spillway dam consists of a straight gravity concrete dam 1,000 ft. long at the crest, 68 ft. high from the deepest point of foundation, a top width of 10 ft. a vertical upstream face, a downstream batter of 0.65 ft. to 1 vertical.

The total volume of the concrete in this structure amounts to 38,610 cu. yds. including cut offs. An ogee spillway section 120 ft. long consisting of 3 blocks of 40 ft. each at the elevation of 260.0 is for the present estimated to take care of flood water. The dam will be provided with 6 under sluices each of size 5 ft.-9 in. by 5 ft.-9 in. which will permit draining of the reservoir to an elevation of 212.0. The access to the sluices will be through an inspection gallery 5 ft. x 7 ft. in the body of the dam.

The Power Plant

The Power House will consist of a reinforced concrete structure three storeys high. This will house for the present two Francis Type Turbines 3,000 H.P. each with vertical shafts driving two generators each of capacity 2,500 KVA. There is provision for installing two additional turbines and generators of same capacity and also a service bay.

The steel lined concrete penstock of 13 ft. dia. located in the north abutment is 783 ft. in length from the intake to the Power House and

has two bends of 25° and 20° respectively. The surge tank is 45 ft. in diameter and is of the differential type with a riser 10 ft. 9 in. diameter. The top of the surge tank is at elevation 280.0. The discharge of water through the penstock will be controlled by a tractor gate in the intake structure. The intake structure is a reinforced concrete tower situated at the upstream end of the penstock. It is furnished with reinforced concrete thrash racks to prevent debris entering the penstocks, and with a concrete gate house to accommodate the gate hoist.

The main purposes of the Project are:—

- A more ample and assured supply of water for irrigation.
- Control of floods that damage crops and homesteads, slit up fields, breach bunds and ridges, wash away roads and interrupt communication in the delta below.
- Development of Power for domestic and industrial use—10,000 K.W.
- Assurance of a perennial supply of drinking water in the area under command.

The average annual rainfall of the catchment is 83 inches of which 63 inches is during the North-East Monsoon season—October to February. The average annual yield of 740,000 Ac. ft. is equivalent to 2,000 Ac. ft. sq. mile. The reservoir capacity is 770,000 Ac. ft. and can thus impound the full yield of an average year starting from empty. Flood discharges up to 86,000 Cu. Secs. have been recorded. Some of the heaviest floods come in February at the tail end of the North-East Monsoon when the reservoir is likely to be full. The Senior author

* The senior author Mr. M. C. Abraham is now the Professor of Civil Engineering, Bengal Engineering College, Howrah.

has noticed a high flood in the river occurring within 5 days of the previous one. In the circumstances, it has been suggested that spillway provision should be adequate to deal with a flood of 160,000 cu.secs. peak followed by a flood with an equal peak. One can well realise the dilemma facing the designer, if he provides a wide spillway, he reduces the flood protection to the valley below while if he provides a narrow spillway, he endangers the reservoir.

Design, Estimate and Contract

On the advice of Dr. Savage, the dam expert who visited the site in 1947, the preliminary designs and data collected by the Irrigation Department were passed on to the International Engineering Co. of Denver, Colorado, U.S.A. for the preparation of final designs, specifications, and estimate. The investigation records furnished by the Irrigation Department of Ceylon, the firm found, were more thorough and systematic than any they had received for similar projects from other parts of the world. The best forecast of the probable cost termed the "Target Estimate" for the construction of the Gal Oya Dam and Power Plant was framed. This has been prepared on a schedule of unit rates mutually agreed on by the contractor and the Government for each item of work given in the bill of quantities. The estimate amounts to \$ 10,500,000.

The operation of the contract deserves a brief note as it is out of the ordinary. Briefly the Government pays all expenses incurred in the construction of the Dam and an advance for the purchase of all equipment which will be debited to the target estimate. The contractor is paid as remuneration a fixed minimum fee of 11% of the above agreed target estimate. It is the aim of the Government and the contractors to execute the work at a cost less than the "Target Estimated" figure. Should the contractor complete the Project at a figure less than 105% of the estimated one then in addition to the minimum fee described above he will be paid 50% of the difference of the actual cost of the works and 105% of the adjusted target estimate. At the conclusion of the work the target

estimate will be adjusted for fluctuations in rates and quantities and cost of equipment and supplies. It is the latter additional remuneration that gives the contractor the inducement to keep always ahead of the schedule and effect the maximum savings. However the maximum remuneration the contractor earns by way of fixed and additional fees is limited to 14% of the cost of works.

To ensure speedy construction, the work of approach road was carried out departmentally, and on job contract. About one-third of the earth work was done by manual labour till machines became available. It was found that power operated drills and crushers could not compete with local rates for rubble. 3 gallons of spramex first coat, followed by 2 gallons as second coat after 3 to 4 weeks wear was the carpet. The senior author's experience is that hand packing 6" rubble for bottoming is a very slow operation unsuited for modern road building; a layer of stone ranging from 4 to 6 inches spread as a base by a grader or tractor and consolidated by a roller is likely to accomplish the same and is quicker and cheaper. With selection and consolidation of the earth subgrade under optimum moisture conditions, some engineers may even say that no rubble bottoming is needed.

Prefabricated steel bridges with steel mesh decks obtained from war disposals were used for culverts over 10 ft. span. These decks were mostly in 26 ft. lengths and were cut by Oxy-Acetylene torches to the requisite lengths from 10 ft. to 26 ft. The high-light of the construction was the bridge over the Namal-Oya (6 spans of 25 feet) with concrete piers and abutments and prefabricated steel decks completed in 3½ months.

Construction Camp

The construction of the 100 buildings required as offices and living quarters for the staff were given on two contracts. Men moved into houses no sooner they could be occupied. Water from wells sunk in the bed of the Gal Oya is pumped to a R.C. Tank of 25,000 gallons capacity on the hillside and distributed. Most of the houses are connected by sewers leading to a central

treatment plant for disposal on the activated sludge principle. The others have independent septic tanks.

Modern Construction Methods

The modern trend in construction is to avoid arduous manual labour. "Let the machine do it" is the slogan. Engineers have been advised to note this and to adjust their designs in such a way as to enable the construction operations to be executed by some machine normally available. Another trend is to "keep the wheels moving". By having a large stock of spare parts, a defective part that normally would have stopped progress pending repairs is exchanged for a new one from stock, while the old part is repaired in the shop and goes back into store. The value of the spare parts stock is often more than double the cost of the machines in operation. A third trend is to reduce overhead and interest charges by working "round the clock" in 2 or 3 shifts. Messrs. Morrison Knudsen Int. Co. Inc., are adopting all these. The importance of the repair shop and the parts warehouse in assuring full output can therefore be readily realised. Welding and flame cutting plays an important part in the repair shop. To tend to the repairs on machinery and warehousing of spares a total floor space of 42,000 square ft. of covered buildings were provided.

Construction Plan and Schedules

The Irrigation Department and the Contractors have agreed generally on a preliminary construction plan and schedule for the total construction period from March, 1949 to April, 1952.

It is planned to construct the Dam and Power Plant in three stages during the three work seasons. A work season starts from about the middle of February to about the end of October. The remaining three months of the year being the rainy season in the Eastern Province, the river runs into floods. During the first stage the Main Dam is to be built up on either side leaving the river to flow its present course until the low water season in June of 1951, care being taken to see that it has a sufficient width to accommodate the floods.

(To be continued)

CLARIFICATION OF INDUSTRIAL WATER BY FLOC BED OF WATER SOFTENER

By R. S. Young and A. Colledge.

The domestic water, and part of the industrial supply, serving the plants and mine township of Rhokana Corporation Ltd., at Nkana, Northern Rhodesia, one of the world's largest copper producers is obtained from the Kafue River. The latter drains a large portion of Northern Rhodesia and is the principal tributary of the Zambesi. The hardness of Kafue River water varies from 2-3 p.p.h.t. in the rainy season to 15-25 p.p.h.t. in the dry season. Two-thirds of the hardness is due to carbonates and bicarbonates of calcium and magnesium, and one-third to sulphates.

Several years ago a lime-soda softner was installed to treat the water required for locomotives and power plant evaporators during the dry season. This Paterson softner had a capacity of 150,000 gallons per day and was the conventional modern type for rapid cold water softening, wherein the treated water flows upward through a thick floc bed in a vertical cone. At first it was believed that the reduction of hardness was the sole benefit of the softner, and the latter was not operated during the rainy season when the hardness of the river water was low. It was observed, however, that a troublesome scale, still appeared on locomotive boiler tubes and power plant evaporator coils. This scale was derived from the clay and suspended matter in the water, and, owing to the continuous operation of power equipment in the war and post-war periods, could not be dislodged by frequent washouts which are standard practice wherever some surplus power is available. Once baked on the boiler tubes or similar equipment, this mud proved exceedingly hard and appeared to form an aluminium silicate scale.

As the Kafue River drains an area where 50 inches of rain fall in seven months, it is little wonder that the water during the wet season is

very turbid, often attaining a turbidity of 1,000 p.p.m. The turbidity is due to finely divided particles of clay, silt, and organic matter in the colloidal condition, and is not removed by filtering through even a close quantitative filter paper.

To remove this mud it was decided to continue passing water from the primary settling reservoir through the floc bed of the softener during the wet season after softening had been discontinued. If the clay could be removed from the water during the rainy season without softening, the latter process could be confined to the dry season when the water, though clear, was slightly too hard to be used directly for many industrial purposes.

For the past two years this practice has been followed softening the water when it is hard but clear, and simply filtering through the softener floc bed when the rainy season yields a soft but very muddy water. The results have been quite satisfactory, resulting in decreased maintenance and more efficient operation of locomotives.

The clay particles are apparently absorbed on the floc and cannot readily be washed off. The composition of the floc at the end of the softening period and commencement of the filtering period is given by a typical sample:

	Per cent.
Mg (OH) ₂	11.30
Ca SO ₄	0.64
Ca CO ₃	80.61
Fe (OH) ₃	0.67
SiO ₂	1.97
Al ₂ O ₃ , 2 SiO ₂ , clay	5.38

When one gramme of this floc is placed on a funnel containing Whatman No. 40 filter paper, several litres of turbid Kafue water can be filtered quite clear, whereas no reduction in turbidity occurs when

filtering through the filter paper alone. Subsequent thorough washing with distilled water to wash out electrolytes does not appear to dislodge the clay from the floc particles.

That the mechanical filtering effect of the floc is important is evidenced by the inability of 1 gm. of this material to completely clarify 100 ml. of turbid water when shaken thoroughly with it and allowed to settle. The supernatant liquid is still turbid. Absorption alone does not lead to clarification.

There is a small but consistent increase in hardness of this turbid, soft river water when passing through the floc bed. It amounts to approximately 1 p.p.h.t., raising the hardness for instance from 2 p.p.h.t. to 3 p.p.h.t. This is not surprising when a natural water flows through a bed of finely-divided calcium carbonate and other salts which may have a height of 12 to 15 ft. The solubility of the floc constituents is decreased by the presence of mutual ions in the incoming water. The small increase in hardness is insignificant, compared with the advantages of removing mud by passage through a floc bed without the labour and expense of softening.

The entrained mud is drawn off with a small quantity of the floc periodically by means of drain cocks installed along the side of the cylindrical tank. With the commencement of the dry season and the resumption of softening, quantities of clean floc soon build up in the tank.

Summary.—Advantage is taken of seasonal changes in the hardness and turbidity of a river water in Northern Rhodesia to soften only during the period of clear, hard water. For the rest of the year the very turbid but the soft water is passed through the floc bed of the softener, without the addition of reagents, to clarify it for industrial purposes. (With acknowledgements to *The Water and Water Engineering*.)

COLLEGE NEWS

**Madras Institute of Technology,
Chromepet, Madras**

Applications for admission to the Institute for the academic year 1950-51 will be received in the prescribed form which will be sent on receipt of postage stamps for annas eight. Copies of prospectus are priced at four annas per copy. A registration fee of Rupee One should accompany the application form. The last date for application for admission is April 20. The entrance examination fee of Rs. 20 should accompany the application form. The entrance examination will be held on May 8 and 9. The courses provided lead to Diplomas in: (1) Electronics (Radio and allied subjects); (2) Instrument Technology; (3) Automobile Engineering; (4) Aeronautical Engineering. The minimum qualification for admission is a degree with Physics or Chemistry as their main subjects and Mathematics as their subsidiary subject.

College of Engineering, Guindy**Arthur Hope College of
Technology, Coimbatore****College of Engineering, Cocanada****College of Engineering,
Anantapur**

Request for application form for admission to any of the four colleges should be made to the Principal, College of Engineering, Guindy, Saidapet P.O., Madras. The degree courses of four years' duration offered by the various colleges are: (i) Guindy: Civil, Mechanical, Electrical, Highways, and Telecommunication Engineering; (ii) Coimbatore: Civil and Electrical Engineering; (iii) Cocanada: and (iv) Anantapur: Civil, Mechanical and Electrical Engineering. The College of Engineering, Guindy as an Overseer Course in Civil Engineering of two years'

duration. The Licentiate in Civil Engineering Course has been abolished. Candidates for admission to the Degree course must have passed the Intermediate Examination of the Madras, or Andhra University with Mathematics, Physics, Chemistry as optionals, or an examination in some other university accepted as equivalent thereto by one of these universities. Applications should reach the Principal not later than 25th June. Forms will be ready for despatch from the college in the first week of May.

Benares Hindu University

The date for the supply of application forms for the Engineering College is 15th April, and the date for the receipt of applications duly filled in is 30th April, 1950.

**Bengal Engineering College,
Howrah**

Bengal Engineering College, Howrah will be open for its new session on July 3, 1950. The College, which is completely residential, prepares students for the B.E. degree examination of the Calcutta University in Civil, Mechanical, Electrical, and Metallurgical Engineering and in Diploma course in Architecture. Admission test will be held on May 8 and 9. Applications should reach the College Office on April 15, 1950.

**College of Engineering and
Technology, Jadavpur**

The College has Degree Courses of four years' duration in Chemical, Mechanical and Electrical Engineering leading to B. Ch. E., B.M.E., and B.E.E., Degrees. Admission will be made on the results of an admission Test. Applications, to be submitted on the prescribed forms available at the College Office, will be received up to the 30th April, 1950. Only such students as have passed or will pass this year I.Sc. Examination in the First or Second Division with Physics, Chemistry and Mathematics

24 seats in the Mechanical, Engineering, 18 seats in Electrical

Engineering, and 18 in Chemical Engineering Courses are reserved for students coming from States other than West Bengal.

**Birla College of Engineering,
Pilani**

The College provides courses of instruction in Mechanical and Electrical Engineering leading to the B.E. degree of the University of Rajputana. The courses are of four years' duration three years at College and one year's practical training. The minimum qualification for admission is the I.Sc., and age limit 17-21 years. The college session commences on the 17th July. Seats are allotted for all States and Provinces. The College is fully residential. The total annual expenditure per student is about Rs. 1,500. Cost of prospectus and syllabus Rs. 2 and application forms annas eight. Last date for receipt of applications 15th June, 1950.

**Bhavsinhji Polytechnic Institute,
Bhavnagar**

This is Saurashtra Government sponsored Institution and provides Diploma Courses in Automobile Engineering, Textile Technology, and Oil Technology. Courses are of four years' duration (three years in the Institute and one year in a factory). Minimum qualification for admission is Matriculation or its equivalent. The next session starts on 20th June, 1950.

**Shri A. V. Parekh Technical
Institute, Rajkot**

The Institute provides courses leading to Diploma in (i) Radio Servicing, (2) Wireless Telegraphy, and (3) Advanced Radio Communications. The next session commences on June 20. Applications should reach before 15th June. Minimum qualifications for 1 and 2, Matriculation or its equivalent and for 3 I.Sc. with Mathematics, Physics and Chemistry. Application forms and prospectus on payment of Annas Ten.

BUILDING AND CONTRACTING

A new feature "Building and Contracting", commences with this issue in the following columns. Building Contract is a matter of vital concern. This feature provides engineers and others a ready reference while drafting building contracts. This will be of particular value to building owners who desire to have his work done through building contractors.

Following is a report of the Quantity Surveyors' Committee of the Chartered Surveyors' Institution on the *Methods of Building Contracts* in general use and the terms usually applied to them:—

**A. Contracts Based on Prime
Cost**

- (i) *Prime cost plus profit. Based on prime cost plus a percentage of the cost.*
- (ii) *Prime cost plus fixed fee. Based on prime cost plus an agreed fixed fee.*
- (iii) *Target cost. Based on prime cost plus a fluctuating fee computed on a comparison between cost and valuation.*

Under this type of contract, (i) and (ii) work is carried out on the basis of cost of labour and material, to which is added either an agreed percentage or a fixed fee for management and profit. It is suitable for conditions where the building owner cannot determine his requirements sufficiently in advance of building operations owing to the exceptional intricacy of the work or to the uncertainty of essential conditions. It is also applied where an early start is deemed to be the predominating issue. Where this is the case, "more haste less speed" and excessive cost are often the result.

Since proper particulars are not available at the start, the success of this type of contract depends on quick decisions being given to the contractor, which do not subse-

quently require modification, on the complete integrity of the contractor and the quality of the supervision of his labour. It is also dependent on the measure of collaboration between architect,..... and contractor in their efforts to apply within their respective spheres those safeguards which experience has shown to be necessary to obtain an economic result. Much depends on the contractor applying himself to the purchase of materials, control of labour and general organization in a manner similar to that which he would adopt after competitive tendering.

If there is complete confidence between all parties, this method can be relied upon within the limits above referred to.

Various methods have been attempted (iii) for the adjustment of the fee, by way of penalty or bonus. The value of these methods depends upon whether the higher administrative costs, resulting from the measurement and valuation of the work in addition to the examination of the prime cost, are justified by the incentive to the contractor to reduce his operational costs. These alternatives have insufficient advantage over prime cost with fixed fee, if properly controlled, to warrant their use for general purposes.

**B. Contracts Based on
Schedules of Prices**

- (iv) *Schedule Contract. Based on Schedule of Descriptions priced and agreed by the contractor and the architect.*

This method consists of a schedule of descriptions (without quantities) of items of work likely to occur, priced and agreed with the contractor as a basis for valuing the measured items of the work as actually carried out, and is applicable to conditions similar to those outlined for prime cost. This gives the parties before entering upon a

contract some form of safeguard as to price which is not obtainable under a Prime Cost Contract.

- (v) *Schedule Contract. Based on Schedule of Descriptions with fixed prices (such as the Standard Schedule of Rates of the P.W.D.).*

The principle is to supply to contractors as the basis for competition a list of priced descriptions of items likely to occur for work more or less stereotyped in character and limited in range. The contractor quotes a percentage on or off the schedule as a whole.

The principal objection to a schedule with fixed rates as a basis for tender is that the contractor cannot in an overall percentage on or off the schedule reflect with accuracy the special conditions of the particular contract. There may be conditions of site applying to measured rates as distinct from Preliminary Items, or special facilities or difficulties he may meet in any particular trade or section of the work, either in the employment of labour, the use of plant and machinery or the purchase of materials. In fact, tendering on this method must introduce a substantial element of gambling, the elimination of which should be one of the principal aims of the quantity surveyor.

**C. Contracts Based on
Approximate Bills of Quantities**

- (vi) *Approximate Bills of Quantities. Based on descriptions with approximate quantities.*

Where the building owner who cannot fully determine his requirements before authorising the work, desires to retain the competitive basis, and is satisfied with a less accurate indication of his commitment than would be provided where full particulars are forthcoming, the committee advocate the use of an Approximate Bill of Quantities, subject to complete remeasurement.

The approximate bill of quantities introduces predetermined measurement of the quantities of material and labour as a common basis for contractors tendering, thus obtaining an early and better control over cost than under any schedule of prices.

Approximate bills should be subject to minimum standards and sufficient particulars must be available for this purpose. The minimum standards necessary to ensure that the main advantages of the bill of quantities are preserved in the approximate bill should be as follows:

1. That items are measured in accordance with the principles of the Standard Method of Measurement and in such a manner as to enable the contractors easily to price every item involved;
2. that the quantities of each item are sufficiently related to one another to afford the contractor a reasonable indication of the relative proportions of work required;
3. that there is a proper description of site conditions, special features, and contractors' risks;
4. that the items, when priced, extended and cast to the total, and submitted as a tender, give to the building owner a reasonable idea of the extent of his commitment (provided he makes no substantial alterations subsequently).

The Committee consider that these minimum standards should be recognised and observed as proper professional practice where this procedure is adopted.

D. Contracts Based on Bills of Quantities

(vii) *Bills of Quantities. Based on accurate quantities and descriptions and subject to minor variations.*

A bill of quantities (subject only to minor variations, is suitable for conditions where the building owner can fully determine his requirements and desires a firm competitive tender for the work before authorising it.

The value of the bill of quantities as compared with alternatives can be understood when it is realised that in no other case can one docu-

ment serve all of the following purposes:—

1. To advise the contractor as to his responsibilities and risks;
2. to analyse the total quantity of labour and material required for the operation in agreed units of measurement and description and so enable the contractor to determine the prices he will apply to the units of construction necessary and to arrive at his tender;
3. to offer a common basis for competition between contractors;
4. to give to the building owner a close indication of his commitment;
5. to set a target for all concerned in the building operation and by the joint efforts of the contracting parties to gain an early control over price;
6. to reduce to a minimum the work involved in arriving at interim payments on account of the work;
7. to reduce by forethought any necessary variations and thereby assist in the organisation of the work and the economic use of man-hours;
8. to provide a basis for the valuation of any work varied or additional work ordered within the terms of the contract.

The Committee believe that a brief examination of these methods will show that some are unsuitable or unnecessary for building operations, and the relative value of the alternatives.

(To be continued.)

BURMA TEAK IN RANGOON

The prevailing price of first class teak in Rangoon end of March was as follows:—

12" x 8" x 14" (with heart)	Rs. 1,350 per* ton.
12" x 8" x 14" (without heart)	Rs. 1,900 per ton.
6" x 2½" x 12"	Rs. 1,250 per ton.
4" x 2½" x 9"	Rs. 1,125 per ton.

* One Ton=Fifty c. ft.

HOW WAS MAY FOR BUILDING

A rainy day is one in which 10 cents or more rain is recorded. The following figures show the average rainfall in inches and the average number of rainy days in the month of September based on data up to 1940:—

	Rainfall in Inches	Number of Rainy Days
Agra	0.4	1.1
Ahmedabad	0.4	0.7
Allahabad	0.6	1.2
Ambala	0.7	1.5
Asansol	2.9	4.4
Aurangabad	0.7	1.3
Bangalore	4.2	6.6
Bellary	1.9	3.3
Bhopal	0.6	1.2
Bhug	0.3	0.3
Bombay	0.7	0.8
Calcutta	5.5	6.9
Cawnpore	0.3	1.0
Chittagong	10.4	10.8
Cochin	11.7	12.3
Colombo	13.2	14.1
Dacca	9.6	11.0
Gaya	0.9	1.7
Hyderabad (Dn.)	1.1	2.3
Jamshedpur	3.1	5.1
Jhansi	0.4	1.0
Jiwani	0	0
Jodhpur	0.4	1.1
Jubbulpore	0.6	1.4
Lahore	0.6	1.3
Madras	1.0	1.1
Mangalore	6.2	6.7
Marmagoa	3.2	2.0
Masulipatam	1.3	2.0
Nagpur	0.8	2.0
New Delhi	0.5	1.6
Patna	1.4	2.3
Peshawar	0.8	2.0
Poona	1.1	1.7
Puri	2.9	3.2
Quetta	0.4	1.1
Rawalpindi	1.3	2.5
Sambalpur	1.1	2.3
Srinagar	2.4	5.4
Trichinopoly	3.3	4.1
Trincomalee	2.7	3.4
Trivandrum	8.8	10.1
Vizagapatam	2.0	2.7

CURRENT MARKET PRICES OF MATERIALS

1. Price vary according to quality and quantity ordered.
2. Those given below are average market prices in Madras.
3. Owing to the unsettled state of market most prices are liable to fluctuate.

	Rs.	A.	P.		Rs.	A.	P.
CONCRETOR				Figured glass white per sq. ft.	0	14	0
Portland Cement per bag	4	11	3	" coloured "	1	6	0
(Upto 20 bags without permit)							
Blue metal ½" gauge per 100 c. ft.	56	0	0	IRONWORKER			
" 1½" " "	40	0	0	R.S. Js. 4" x 3" (Controlled rate) per cwt.	17	6	0
River sand	15	0	0	" 5" x 3" to 15" x 6" " "	17	0	0
Reinforcement M. S. Rods ½" dia. per cwt.	18	15	0	" 18" x 6" and over " "	17	6	0
" " " "	19	2	0	Channels, angles and tees " "	18	4	0
" " " "	20	3	0	M. S. plates " "	18	8	0
" " " "	22	11	0	Black sheets 20 gauge " "	22	10	0
Binding wire 16 gauge per lb.	0	12	0	G.I. plain sheets 24 gauge " "	22	10	0
Sealocrete Concrete Surface dressing per gal.	10	0	0	G.I. barbed wire, 2 ply, 12 gauge " "	39	4	0
Pittsburg Reinforcements—Welded Fabric per sq. ft.	0	3	0	Rivets, flat or round head " "	75	0	0
	to	0	6	Steel Rolling Shutters (upto 120 sq. ft.) per sq. ft.	5	4	0
BRICKLAYER							
Country bricks 2" G.M. ex: Kiln per 1000	22	0	0	PAVIOIR			
Stock bricks 3" T.S.M. " "	37	0	0	White glazed tiles (English) per doz.	6	8	0
Shell lime per 100 c. ft.	66	0	0	" (Japanese) " "	4	8	0
				Coloured " (English) " "	8	0	0
ROOFER				Marble tiles ½" polished white or grey per sq. ft.	4	0	0
Malabar Tiles per 1000	185	0	0	Snowcrete white cement per cwt.	22	3	0
Malabar Ridge Tiles per 100	75	0	0	Colorcrete " "	29	8	0
Terrace bricks per 1000	18	0	0	Sealantone Liquid flooring green per gal.	23	0	0
Asbestos Corrugated Sheets per sq. ft.	0	7	6	" red or black " "	19	0	0
Asbestos Trafford Sheets per sq. ft.	0	10	0				
G. I. Corrugated sheets 24 gauge per sq. ft.	0	4	3	PLUMBER			
				Squatting pans, English 18" each	54	0	0
CARPENTER				Pedestal closets without seat " "	45	0	0
Malabar Teak scantlings per c. ft.	14	0	0	W.W.P. Cisterns, 3 gal.			
" boards " "	18	0	0	(Elephant brand) " "	44	0	0
Mango " planks " "	4	8	0	Sinks 30" x 18" x 10" " "	158	0	0
Insulation boards ½" per sq. ft.	0	8	0	W.H.B. 25" x 18" with waste and one tap " "	118	0	0
Asbestos plain sheets " "	0	5	1	Flat urinals, English " "	56	0	0
Wire nails per lb.	0	9	0				
Wire-screws ½" per gross	1	12	0	PAINTER			
" 1" " "	2	0	0	Himalayan Dry Distemper per lb.	0	8	9
" 1½" " "	2	4	0	Turpentine per gal.	8	0	0
Butt hinges cast brass per pair	2	12	0	Double-boiled linseed oil " "	10	4	0
Cast brass Cabin hooks 6" each	1	4	0	Raw linseed oil " "	9	0	0
Barrel bolts cast brass per r. ft.	4	8	0	Gopal varnish " "	9	6	0
All drop bolts cast brass each	11	8	0	Black japan " "	9	6	0
Plywood 3 mm. per sq. ft.	0	4	3	French polish " "	11	10	0
				Karoit Enamels (all colours) " "	22	2	0
GLAZIER				Goodlass wall paints per lb.	0	10	9
Sheet glass 16 oz. per sq. ft.	0	10	0	Glue " "	0	15	6
" ½" " "	1	2	0	Putty " "	0	12	0
Plate glass ½" " "	4	0	0	Sandpaper per doz.	1	4	0

* Readers are advised that enquiries addressed to the Journal will gladly be forwarded to the concerned suppliers of materials or equipments.

CONTRACTS OPEN

The dates at head of paragraphs are those for the submission of Tenders. Application for forms and particulars should be made to the address given at the end.

PALAMCOTTAH: Water Supply Scheme

April 17.—Constructing infiltration Works etc., at Manapadai Vidu Village for Palamcottah Water Supply Scheme. Estimated cost Rs. 1 lakh. The Sanitary Engineer, P.W.D., Chempauk, Madras.

AHMEDABAD: Oriental Building

April 17.—Building and sanitary work for the Orient Building, Ahmedabad. Architects: Master Sathe & Bhuta, 34-38, Hamam Street, Fort, Bombay.

NEW DELHI: Quarters

April 18.—Constructing 152 E. Type and 96 H Type Quarters for P. & T. Clerks at Factory Road, New Delhi. Estimated cost Rs. 47,088. The Executive Engineer, Construction Division IV, C.P.W.D., New Delhi.

TRICHY: Gandhi Market

April 19.—Construction of A Type stalls two blocks and B Type stalls four blocks in Gandhi Market, Trichinopoly. Estimated cost Rs. 63,100 and Rs. 127,470 respectively. The Commissioner, Municipal Office, Trichinopoly.

GODHRA: Bridge

April 19.—Construction of a Bridge across Goma river at Kalol in mile 16 of Godhra Bodeli Road in Panchmahals District. Estimated cost Rs. 307,590. The Executive Engineer, P.W.D., Godhra.

MADURA: Roads

April 20.—Cement Concreting New Ramnad Road from Kosavapalayam Road to Teppakulam, Estimated cost Rs. 85,000; New Jail Road from the railway level crossing to the Junction of Old Dindigul Road, Estimated cost Rs. 70,000 and Panagal Hospital Road from Alagarkoil Road Jn. to Kuruvikaranchalai Road, Estimated cost Rs. 68,000, for

the Madura Municipality. The Commissioner, Municipal Office, Madura.

KRISHNAGIRI: Bridges

April 20.—Constructing a Bridge at 6/1 of Varatanapalli-Kuppam Road and constructing a Bridge at 0/2 of Chinnathirupathy Road. The Divisional Engineer, Highways, Krishnagiri.

NEW DELHI: Open Drains

April 20.—Constructing open roadside Drains in the Diplomatic Enclave area. Estimated cost Rs. 291,387. The Executive Engineer, Diplomatic Enclave Division, C.P.W.D., New Delhi.

M.S.M.Ry.: Bridges

April 20.—Construction of bridges at mile 205/21-22 and mile 217/10-11 on the North East line between Kadavakuduru and Bapatla. Estimated cost Rs. 52,000 and Rs. 62,000 respectively. The Chief Engineer, M.S.M. Railway, Madras 3.

MADURA: Quarters

April 21.—Constructing Quarters for the Municipal Officers, at Madura. Estimated cost Rs. 19,800 each. The Commissioner, Municipal Office, Madura.

KHURJA: Roads

April 22.—Construction of a portion of Gandhi Road with bitumen concrete, in Khurja. The Chairman, Municipal Board, Khurja.

TIRUPATI: Roads

April 24.—Providing 2½" thick premix asphalt concrete to the Gandhi Road length 1,600 ft., Estimated cost Rs. 29,800 and providing 2" thick premix asphalt concrete to the Bazar Road length 1,915 ft., Estimated cost Rs. 22,700. The Commissioner, Municipal Office, Tirupati.

NAGPUR: X-Ray Block

April 24.—Construction of X-Ray and Radiology Block attached to the Medical College at Nagpur. Estimated cost Rs. 407,700. The Executive Engineer, Construction Division, P.W.D., Nagpur.

NEW DELHI: Flats

April 25.—Constructing 8 Officers' Flats of Reserve Bank of India at Cornwallis Road, New Delhi. Estimated cost Rs. 167,713. The Executive Engineer, Construction Division No. III, C.P.W.D., New Delhi.

METTUR DAM: Staff Quarters

May 1.—Constructing Staff Quarters at Kadambattur sub-station. The Superintending Engineer, Mettur Electricity System, Mettur Dam.

POONA: Saswad Water Works

May 4.—Saswad Water Supply (Head-work) comprising of (i) Raising and extending Weir; (ii) Constructing Jack well; (iii) Constructing flocculator; (iv) Constructing aeration fountain; (v) Constructing Clarifier; and (vi) Constructing pure water tank and Chemical House. Estimated cost Rs. 89,430. The Executive Engineer, Central Public Health Works Division, 7, B. J. Road, Poona 1.

NASIK CITY: Reservoir

May 8.—Constructing R. C. C. elevated (Intze type) Reservoir of 3 lakhs capacity in connection with Malegaon Water Supply. Estimated cost Rs. 101,000. The Executive Engineer, Eastern Public Health Works Division, Nasik City.

LUCKNOW: Electricity lines

June 30.—Construction of Double Circuit 132 K. V. Transmission lines Khatima-Bareilly-Moradabad about 110 miles. The Executive Engineer, Sarda Hydrel Division, 22, Asoka Marg, Lucknow.

(Continued from page 31)

approximately 27 miles in length connecting Mukorian with Pathankot. The project is to be known as the Mukorian-Pathankot Railway Construction.

The master plan of the permanent capital of the Punjab to be located in the Chandigarh area of Ambala district has been received by the Government from the American Town Planner, Mr. Albert Mayer, who had been entrusted with the job, it is learnt. The foundation stone is expected to be laid by the end of May next.

PROPOSED NEW WORKS

Bombay.—The Government of Bombay recently approved a Rs. 5 crore development scheme for Bombay suburbs. The development will be spread over a period of ten years. The major portion of the expenditure will be met by the Government of Bombay and the remainder by the Bombay Municipal Corporation. Under the scheme, 800,000 of suburban population will be benefited by a better system of drainage, water supply, schools and roads.

A sum of Rs. 21 crores will be spent by the Government of Bombay during the next four years for providing housing accommodation to displaced persons, by the construction of two large refugee townships one at Kalyan, near Bombay and the other at Ahmedabad; and smaller colonies in Baroda, Poona and Chembur. Of the total expenditure of Rs. 21 crore about Rs. 7 crores will be utilised for the grant of loans to co-operative societies and individuals.

Bangalore.—Tenders closed on April 5, for the Construction of Administrative Building in Duravani Nagar near Krishnarajapuram Railway Station.

Delhi.—Proposals for the development of a shopping and business centre facing the Ramlila Grounds off Circular Road between Delhi and Ajmere Gates have been finalised by the Delhi Improvement Trust. The proposals include a one-mile long by 60 feet boulevard which will have over 100 shop sites besides space for a cinema house, parking places and petrol stations. Another proposal to survey the congested area between Sadar Bazar and Pul Mithai as a preliminary to a scheme for the widening of Outab Road in this sector has also been approved.

The Delhi Improvement Trust have served notices to about 3,000 plot owners either to construct buildings on the plots within six months or surrender the plots to the Trust.

A housing-cum-occupational colony for displaced persons will be developed in a plot of about 250 acres acquired by the Ministry of Rehabilitation in Gandhinagar, Delhi, on the other side of the

Jumna. The Ministry will allot lands in suitable blocks to co-operative societies after the land is developed with roads and water supply. The projected colony will be adjacent to the village of jhil Kuranjia where a colony is in the making.

Jodhpur.—The Rajasthan Government have sanctioned Rs. 1 crore, for completing work on the Jawai river project in Jodhpur Division which is expected to be finished by next year. Two major hydel dams are also to be constructed in the Chambal river—one in Udaipur Division and the other in Kotah Division—for which Rs. 50 lakhs has been sanctioned.

Jaipur.—Construction of 200 quarters in Gandhinagar, Jaipur, for Government employees has been included in the programme for construction of State buildings in Rajasthan. A scheme estimated to cost Rs. 33 lakhs for the supply of filtered water to Udaipur and Pratapnagar, is receiving the active consideration of the Government. A similar scheme for Kishennagar is also under sanction.

Kishennagar.—Foundation of a new refugee township which will construct 1,000 houses was laid recently near Chakeri.

Madras.—The Madras Government have set apart for 1950-51, Rs. 1 crore for granting loans to house building societies in urban areas and Rs. 20 lakhs in rural areas.

Detailed investigation of the Budameru and Uppateru projects has been completed and the question of taking them up for execution was now engaging the attention of the Government.

New Delhi.—Plans for constructing the first of a chain of five stadia to be built in this country were finalised recently. The work will be started very shortly and is expected to be completed by the middle of October. Work will also start simultaneously on the residential rooms for 40 athletes and a de luxe club house.

Simla.—The Ministry of Railways have sanctioned the construction by the Eastern Punjab Railway Administration, of a broad gauge line,

(Continued on page 30)

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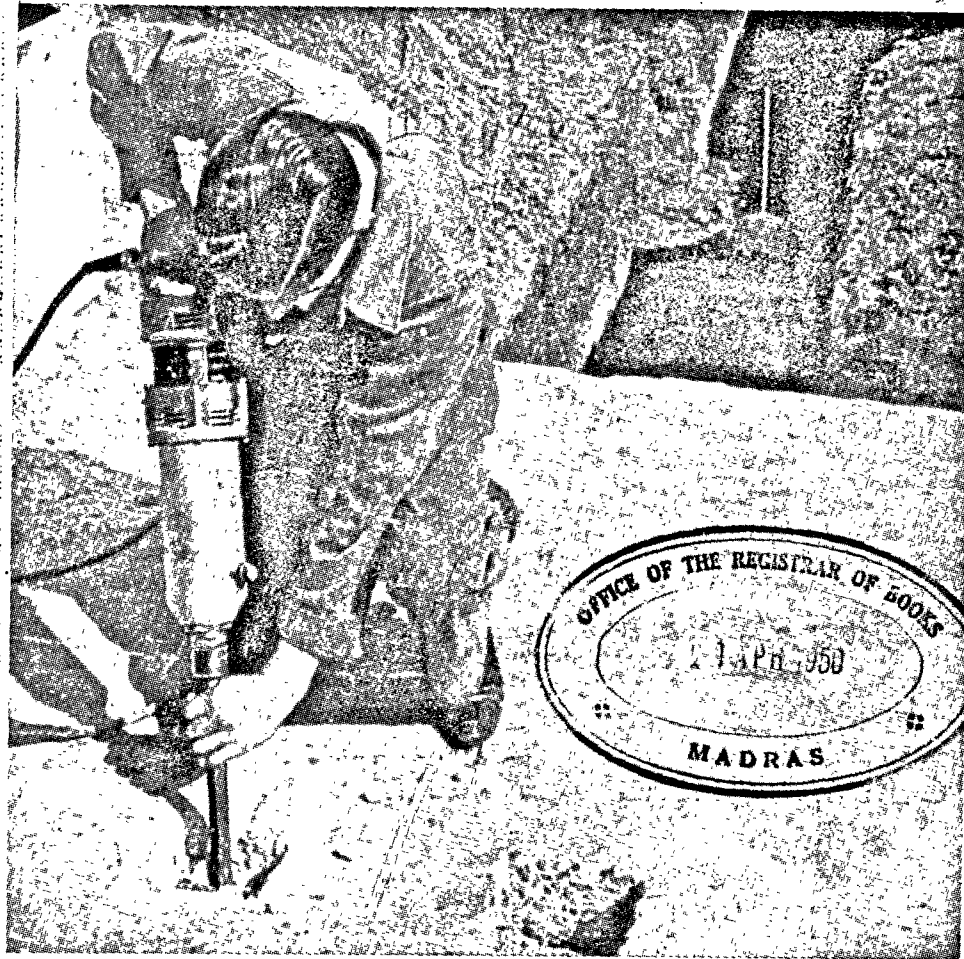
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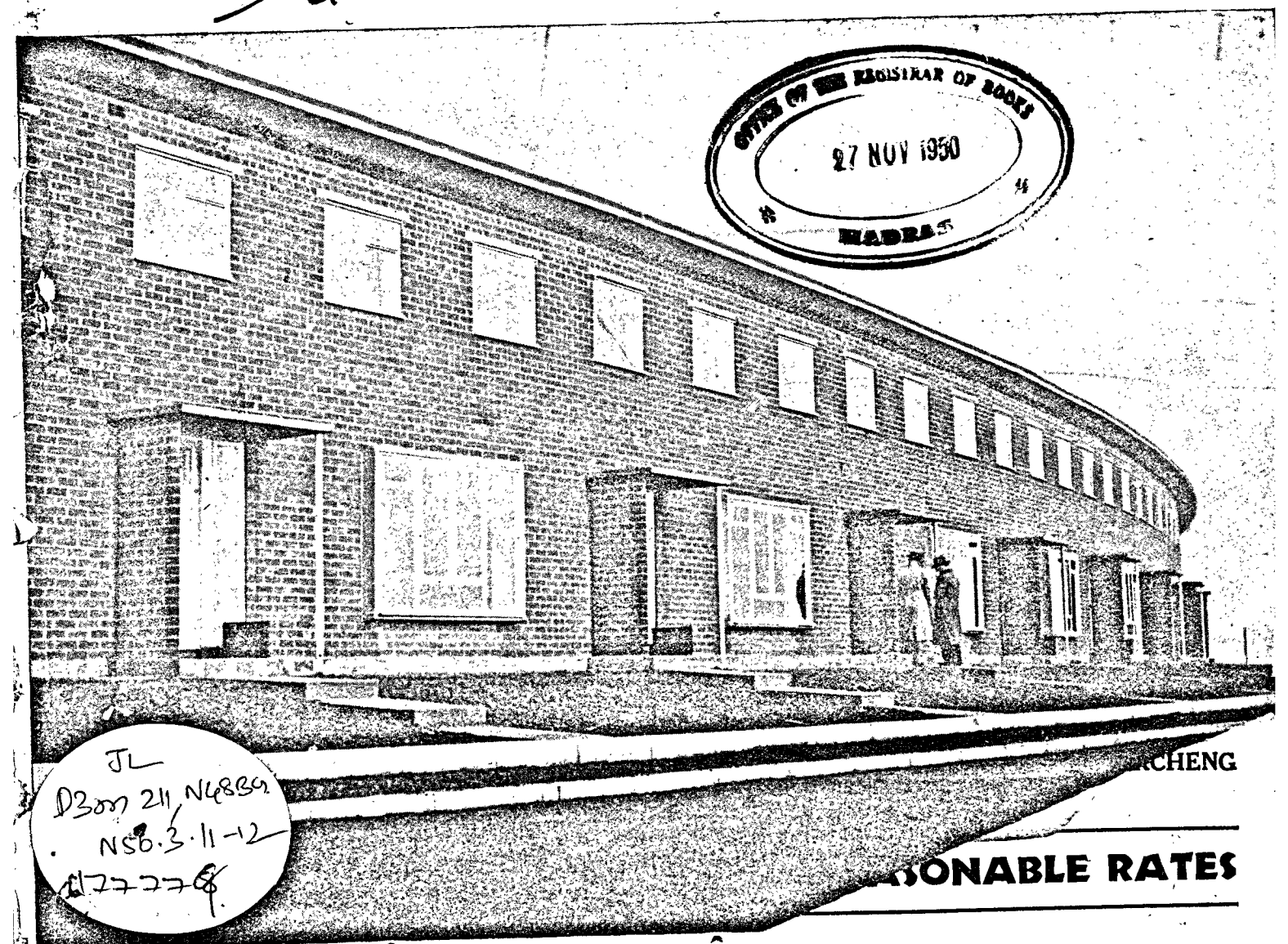
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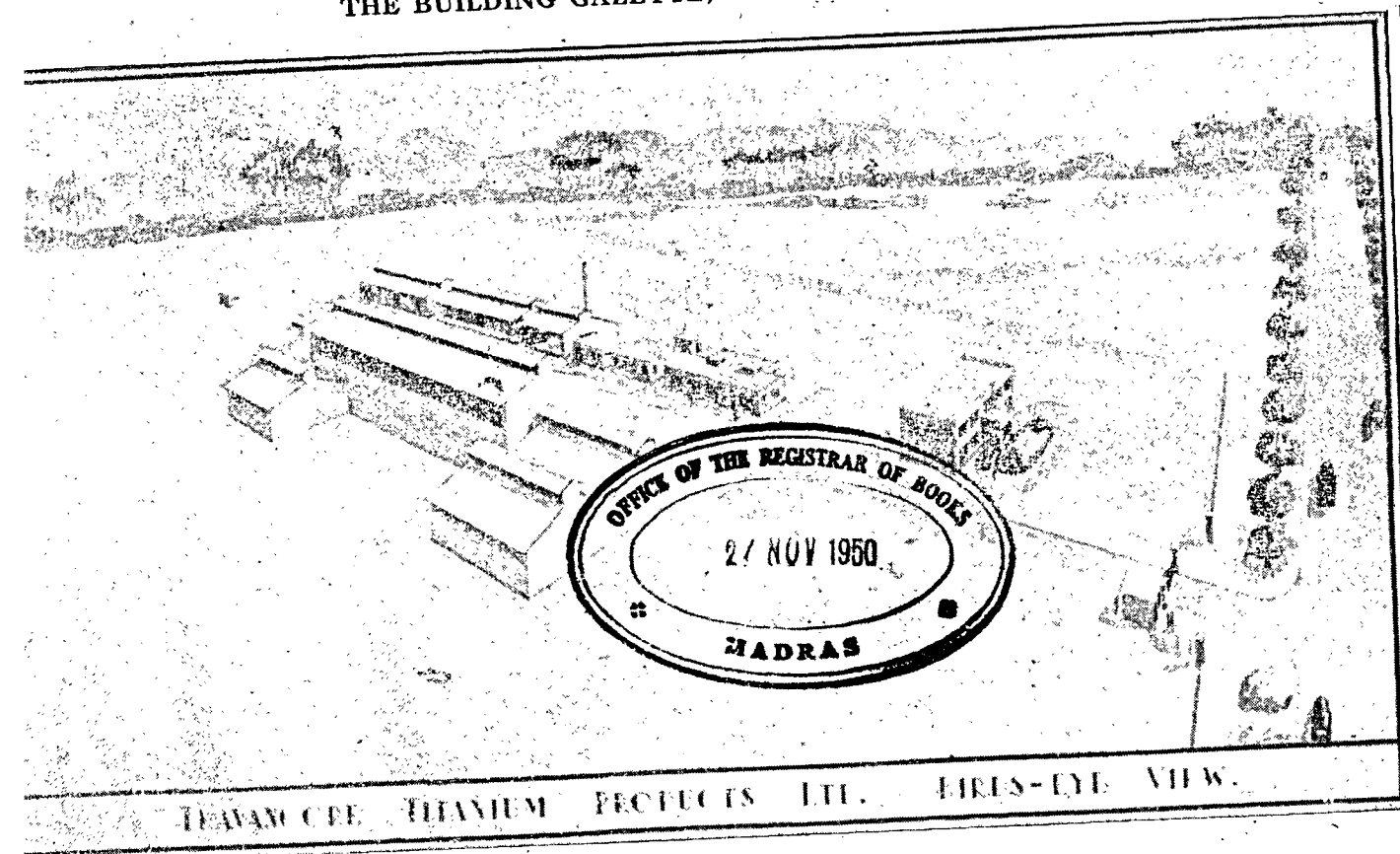
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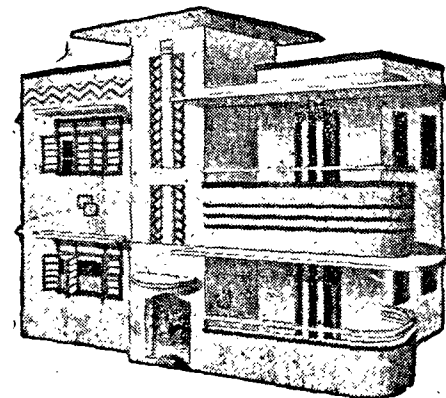
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PRINCIPAL CONTENTS

page	
7	CHIEF ENGINEER CUM SECRETARY
8	NOTES AND TOPICS
10	EARTH AND EARTH MOVING EQUIPMENT
15	CIVIC SURVEYS FOR TOWN PLANNING
16	SEPTIC TANKS
17	DISTEMPERS ON WALLS AND CEILINGS
21	ARCHITECT AND CLIENT
	PERSONAL
22	BITUMINOUS ROAD CONSTRUCTION
27	NEW HOUSE OF COMMONS CHAMBER
28	PORTABLE PILE TESTING RIG
29	RIVER VALLEY PROJECTS
	FOR DISCUSSION
30	BOOKS FOR READING
31	CONTRACTS OPEN

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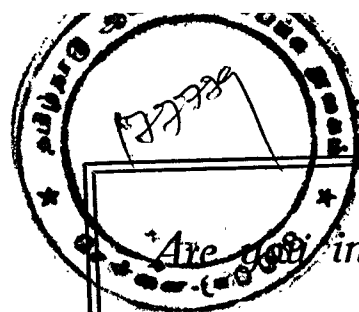
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CHIEF ENGINEER CUM SECRETARY

Speaking at the annual meeting of the Central Board of Irrigation recently, Mr. M. P. Mathrani, Chief Engineer, Irrigation, Bihar suggested the revival of the old system whereby Chief Engineers of States were the secretaries of the P.W. departments which resulted in "greater efficiency of administration and smoother and expeditious execution of irrigation and electrical works." The practice of taking away the secretaryships from the Chief Engineers, he added, was "leading to loss of efficiency and considerable frustration."

In the present system of administration of public works departments in some of the States, the outstanding defect is the maintenance at a huge cost two sets of offices at the top.

There is no justification to keep the head of the department separate from the Secretariat especially after the advent of a popular Ministry and we therefore suggest the amalgamation of the two offices as an important measure of reorganisation, inasmuch as this system is already partially followed in some of our States with success.

One of the arguments advanced against such an amalgamation is, that it will deprive the Minister of the benefit of the wholesome corrective now supplied by the Civilian. There need be no fear of their being misled for want of an intermediary, as the Ministers, though not possessed of as much administrative experience as their predecessors in office, are in an immeasurably better position, on account of their being in constant touch with the public, in respect of knowledge of the actual work of the department in each district, as different from what it appears from reports and returns, the needs and conditions of various localities and the merits and demerits of the officers.

While we hold no brief from any P.W.D., and as this anomaly exists only in certain of the States including the Centre we rightly believe the Minister for Works, Mines and Power at the Centre will now take up this matter with the Central Cabinet in conjunction with the concerned State Ministries and thus solve the man-power problem at the Secretariat-level with ease and satisfaction, resulting in Chief Engineers identifying with public interest.

NOTES & TOPICS

New World Body of Engineers.

A meeting of 21 international engineering and research organisations held under the auspices of U.N.E.S.C.O. at Paris recently decided to form a new body, the Union of International Engineering Organisations, whose functions will be to co-ordinate the activities of member-organisations.

Mr. A.N. Khosla has been elected Vice-President of the new body, which will have 15 founder-members, one of which is the International Commission on Irrigation and Canals with its headquarters in India.

The Union's two other Vice-Presidents are from the U.S. and France, the chairman being M. Louis Cambournae, of the International Association on Bridge and Structural Engineering, Paris.

Mr. Khosla attended the Paris meeting in his capacity as President of the International Commission on Irrigation and Canals and as Vice-President of the World Power Conference. The other Indian delegate was Mr. H.P. Mathrani, Consulting Engineer, of Ministry of Transport, on behalf of the International Association of Road Congresses.

New Names for Old.

The Bombay Historical Society has rightly registered its "sorrow and regret" at the recent changes in street names.

Hero-worship is merely a manifestation of infantile jingoism which offends as much against

common sense as against the dictates of history.

If the nation cannot contain the continual outbursts of patriotism, the least it can do is to divert them to other developing areas where there is plenty of scope for christening zeal and imagination.

All-India Housing Congress.

The Hon'ble Sri N. V. Gadgil is to inaugurate the All India Housing Congress at Bangalore which will now be held on Dec. 2, under the Presidentship of Dr. S. Kamesam. Mr. N. Vaidyanathan, B.E., is the Organizing Secretary.

Highways and Traffic Census.

The Madras Government have approved the proposal of the Chief Engineer (Highways), to employ special enumerators for taking a census of the traffic on roads both under the Government and District Boards during 1950-51. However the Government have emphasised that their employment should be restricted to the barest minimum that the services of road maistries should be utilised to the maximum extent possible.

Corporation Schools Building Schemes.

Reviewing the Administration Report of the Corporation of Madras for 1948-49, the Government have pointed out that except for the financial position of the Corporation, which continued to be unsatisfactory, the administration on the whole was progressive and efficient.

As regards the accommodation of the 202 Corporation schools, the Government advise the Corporation to implement the suggestion they have made last year, to embark on a 5 or 10 year plan for the construction of school buildings.

Drilling wells for power.

They are inspired by the example of the Italians who, for many years, have exploited the hot springs of Larderello, near Volterra in Tuscany, for the production of electric power. In recent years a vast amount of electricity has been produced in the district of Larderello.

If the New Zealanders can succeed in discovering great stores of underground steam, and if they can succeed in turning this into electricity, then the future supplies of electricity for the Northern Island will be assured.

The hot springs of Tuscany have been exploited for many centuries, but almost entirely for the chemicals, such as boracic contained within them. It was just before the first world war that the possibility of the production of electric power began to be investigated.

In 1930, the annual production of electricity was over 50 million k.w. When in June 1944, the Germans reiterated, they destroyed the apparatus and installations, carrying off whatever they removed, so that the production of electric power came to a complete standstill. Immediately after the liberation reconstruction began and today over 150 bores deliver steam steadily, driving turbines which produce half a million H.P. of electric energy. There are plans for the building of new plants.

The New Zealand engineers who have visited Larderello have learned from early Italian mistakes, and they believe that the earth's heat, as expressed through the gushing geyser, will provide them with cheap power—at least as economical as hydro-electricity and at possibly half the cost of coal or oil-fired steam power.

Uniform Scientific Terminology Experts Board to be set up.

The Government of India, it is learnt, have decided to set up a Board of Scientists and Philologists to consider the question of evolving a uniform scientific terminology and to prepare text books on science subjects.

In the current year's budget there is already a provision of Rs. 90,000 for the setting up of a Board for this purpose and for preparing scientific terminologies and text books on science subjects.

The question of adopting a uniform scientific terminology throughout the country has been under consideration since 1940 by various bodies, including a Committee of

Vice-Chancellors of Indian Universities and specialists and the Universities Commission, says the P.T.I. They recommended that the International Technical Scientific Terminology should be adopted, the borrowed words should be properly assimilated, their pronunciation should be adapted to the phonetic system of the Indian languages and their spellings fixed in accordance with the sound symbols of Indian scripts. These recommendations were accepted by the General Advisory Board.

The Government of India, it is learnt, feel that immediate effect should be given to these recommendations.

It is pointed out that since the achievement of independence, this question has assumed great importance. The States are eager to adopt the regional languages as media of instruction both at the secondary and university stages. Along with the adoption of the regional languages as media of instruction, the question of preparing dictionaries of technical terms and scientific textbooks is being taken up by them.

At present this work is being conducted without much inter-State consultation and the result may well be the creation of different terminologies in different Indian languages. As time goes on it will become increasingly difficult to co-ordinate and harmonise all these different terminologies. Such a situation, it is felt, will be unfortunate from the viewpoint of education and it would also have important consequences on the solidarity and unity of the country.—

Novel Device for Lowering 16 Ton Anvil:

Use of Ice Blocks.

The conventional method of lowering would have been to operate two jacks on side packings. The anvil would have been pulled on loose packings on the pit and after lifting the anvil on slings hanging from a beam resting at either end on two side jacks, the packing under the anvil would have been taken out and the jacks lowered. The jack travel being limited, the process would have been repeated and

might have been done 8 times in the case of this anvil. Also, to take the load of the anvil after the jack was lowered every time, outside packings under a second beam holding the anvil would have had to be improvised, and would have had to be changed every time the jack was lowered. The process would have involved the use of two sets of men working four to five shifts incurring heavy cost and still the job would have been slow and hazardous.

Instead of this, the department enlisted the aid of ice for the job, ice was filled in blocks in the pit, level with the floor and the anvil pulled on top of the ice blocks and left there. This was done in 45 minutes with ice worth Rs. 50,

with 6 men and a 5-ton chain block.

The work was started on one Saturday and the anvil was in position on the morning of the following Monday.

Half the depth of the masonry part of the anvil foundation having been tightly packed with wooden beams forming a cushioned base for the anvil, the possibility of water accumulating and rotting this timber was foreseen and as a preventive measure two vertical holes were drilled through the wood and kept plugged so that water could be syphoned out. Also the crevices on top of the timber were filled with pitch and coats of coal tar given to the same.



Sir Giles Gilbert Scott, designer of the new House of Commons which was opened by H.M. the King on October 26, is one of Britain's most outstanding architects. Born in 1880 and educated at Beaumont College, and Old Windsor, he has been responsible for the designing of many churches and cathedrals throughout Britain.

EARTH AND EARTH MOVING EQUIPMENT

By A. H. MENDIS, A.M.I.C.E., A.M.I.W.E.

(Deputy Resident Engineer, Gal Oya Project, Ceylon)

The following is an abstract of a paper read at the Engineering Association of Ceylon.

Earthwork and earth moving appear to be the most elementary of the engineering trades. They certainly are, when only a handful of earth is moved. But when it involves the movement of five to six million cubic yards of earth within a limited space of time they turn out to be highly organised and skilful trades. Projects be they air ports, Dockyards, Dams, Railways, Roads, Flood Bunds, Residential sites involve earth excavation and earth movement.

The Ignition Compression diesel engines and the caterpillar or crawler track laying tractors have come to the aid of the Civil Engineer. They have taken the place of man and his beasts of burden. The earth moving trade has become so modernised and for fetched that a modern earth contractor's plant yard contains numerous types of machines each designed, for a particular type of work. Nowadays in excavations and earth moving there is practically nothings that cannot be executed with machines. "Let the machine do it" is the modern slogan. Earth moving operations in its simplest form consists of Jungle Clearing, stripping, excavation, loading, hauling, dumping, spreading, compacting and grading. The skill comes in executing the above operations in the most efficient way involving the least expense to the Contractor and the owner. Also when work has to be fitted into a cycle of floods, rains or winter seasons, the job becomes a highly organised and technical undertaking, needing skilled supervision and direction. Each one of the operations mentioned above could be executed by some machine or other, having a special aptitude for a particular operation.

The most versatile machine of the earthmoving family is the self track laying tractor fitted with any of its auxiliary equipment. The tractor can execute each of the operations mentioned above. But it has no equal in clearing jungle, dozing earth and rocks and, hauling heavy loads over comparatively short distances. For hauling the most efficient are pneumatic tyred wagons. For loading there are draglines, shovels and elevating graders, each one having its advantage over the others. For spreading and grading, the bull dozer and motor grader are the best, and for consolidating there is none to beat the sheep foot tamper.

Man Versus Machine

The question is asked whether mechanisation causes unemployment. It is not absolutely so. However a certain amount of unskilled manual labour is eliminated. But these same unskilled labour, if they have the aptitude, turn out to be skilful operators and useful citizens. It is within the writer's knowledge that a well over 200 unskilled labourers who worked with him on earthwork with mammoets and baskets have now turned out to be skilful operators, and foremen. Mechanisation improves the standards of living. With the present programme of national development no amount of mechanisation will create unemployment. On the one hand when it comes to clearing of thousands of acres of jungle and moving millions of cubic yards of earth, it can well be imagined what a problem it will be to house and feed a concentration of labour far away from their homes and families. It will be a problem by itself to do the policing and keep the men in good humour. The chances are that the job may not get

executed at all leave alone within the time limit.

On the other hand in countries like Ceylon where labour is cheap but fuel, spares, machines, and all have to be imported, accompanied by the difficulties of exchange control, a proper comparative study should be made on the economies of executing a job by manual labour, taking into account the housing, sanitation, welfare, policing, maintaining discipline, lock-outs and strikes, labour unions, rates, food supply, hospitals, delays, interest on the initial outlay on camps, benefits, as against the counter parts of mechanisation.

It is when all these arguments have been properly balanced that a decision should be made whether to mechanise or not a particular project in Ceylon. But in U.S.A. it is always cheaper to use machines wherever possible. The time spent in this initial study is time well spent.

Track Laying Tractor

This is often referred to as the caterpillar, which is actually the registered name given by the Caterpillar Tractor Company for their track laying tractors. Besides the Caterpillars there are Internationals, Allis Chalmers and half a dozen other makes manufactured by different Companies. The "Caterpillar" tractor is a favourite make and these machines are designated by the terms D/8, D/7, D/6, D/4, D/2 depending on the power output and capacities. The D/8 is the most powerful of the family.

In its simplest form it consists of a framework carrying a diesel engine, driving an axle fitted on the rear of

the machine and having heavy sprocket wheels as its outer ends. At the front end of the machine is a pair of idler wheels of the same diameter as the rear driving wheels but without the teeth. Passing between these wheels are two belts on both sides of the machine, made of heavy steel plates, flexibly linked. The belts form the treads of the machine. The tension of these belts could be adjusted by means of a screw attached to the front idler wheel. Six rollers attached to the main frame member of the machine pass the load of the machine on to the tracks, while above these are two rollers supporting the weight of the track and checking the tendency to sag unduly. The steel plates fitted on to the tractor belt have different shapes depending on the purpose for which it is used.

For heavy duty in clearing jungle, or dozing earth along muddy tracks, "grouser plates" are fitted on. A grouser is an upright ridge of steel measuring 1-7/8" to 2-19/32" in height depending on the model, formed across the link plates. The purpose of this is quite obvious, namely for increased friction and tractive force. For use on macadamised highways the tracks are fitted with street plates and on hard, unyielding grounds, they are fitted with smooth plates. Tractors are designed so that they have an average bearing pressure of about 8 lbs. per square inch on the ground. It will be interesting to note that the average man's foot pressure on the ground is about 7 to 8 lbs. per square inch when standing and momentarily increases to 12 lbs. when walking and 15 lbs. per square inch when running. Detailed particulars of the models D/8, D/7, D/6, D/4 and D/2 Caterpillar tractors are given in Appendix I. The steering of the tractor is quite simple. The driving axle is in two parts, with clutches to connect it to the track sprockets. With both clutches engaged the machine moves forward. But with the left hand clutch disengaged the tractor moves to the left and for sharp turns the left hand brake should also be applied. A swing to the right is effected by operating the right hand brake and disengaging the right hand clutch. The sharpest turn could be effected

with a minimum turning radius of about half the length of the machine. This way the machine could be very efficiently manoeuvred in highly confined places.

The tractor has an internal combustion engine, petrol or ignition compression diesel usually the latter, as its prime mover. Operating costs of diesel engines are very economical, they are very sturdy and would not stall easily. Hence the preference to the use of same. In countries like India and Ceylon where fuel is expensive, the usual tendency is to go in for diesel engines even on railways. The cold starting of an ignition compression engine is very difficult. It is impossible to start by hand. Consequently tractors are fitted with a small pony petrol engine which could easily be started by hand. This engine spins the main diesel engine at a good sound speed for a few minutes, till engine lubricating oil pressure builds up when half compression of the diesel engine is close and she starts off. Some engines are equipped with electric starter motors. But these are unsuitable when tractors, as they usually do, have to work under rough conditions exposed to the elements. The horse power of the starter motor varies from 1b H. P. at 3,000 R.P.M. to 24 H. P., at 2,709 R.P.M. and of the diesel engine from 130 H.P. to 32 H.P. at the drawbar depending on the model. They have five to six forward gears and three reverse gears. A reference to the Appendix I will furnish reader with all the details.

The operation of a tractor is a quite enjoyable and a thrilling experience at least for the first time. It is a tiring business when it is one's profession. The operation of it can be mastered by anyone with average mechanical aptitude. The machine has tremendous amount of power. It can have its own way through any thick jungle, climb steep inclines as steep as 2½ to 1 vertical. It can move through muddy grounds with tracks almost half buried in oozy, gritty mud. But at times it may fail and then a sister tractor rushes to its aid.

For different operations mentioned earlier, the tractor has to be

fitted with various auxiliary equipment. Described below are their details and uses. Some operations need pushing, while others need pulling.

The Bull Dozer

The bull dozer in its simplest form consists of a shaped blade fitted in front of the machine at right angles to the direction of its motion. It is carried on a massive framework attached to the main frame of the machine. The height of the blade relative to the machine can be varied either by means of a winding tackle and/or by means of a hydraulic lifting gear. This operation of course alters the depth that it will dig into the earth and also is useful in pushing and uprooting trees or shifting large boulders of rock. Some blades are centrally pivoted to the main frame and the angle of the blade can be altered so as to give an oblique action. The angle dozer which it is then called, has its blade set at a definite angle, the maximum limit being 30° and in dozing the cleared spoil is pushed well over to one side. The angle dozer is best used in back filling round structures compacting the earth as it moves along, and for cutting pioneer roads on hillsides.

The action of a properly designed blade is to roll the earth it excavates forward, like the blade of a wood plane rolling the wood shavings clear of the cut.

The bull dozer is used for clearing jungle. Trees less than 12 inches in diameter could be taken in stride, while those up to about 3 ft. can be tackled with an effort. Bull dozers are sometimes fitted with teeth, when it is called a "Rake Cat". It is used for clearing roots and brush without much movement of earth. By lifting the dozer blades one gets an additional leverage in uprooting trees. Trees of size bigger than 3 ft. in diameter need the assistance of a cable of about 2" in diameter and a Hyster Winch which is heavily geared to the tractor itself, for tugging the tree from its top whilst a second tractor at times helps by pushing at the trunk. In clearing jungle it is always advantageous to work a pair of tractors together. In Ceylon the capacity of a D/8 tractor.

is $\frac{1}{2}$ acre of medium jungle and $\frac{1}{4}$ acre of heavy jungle clearing per day of 8 hours. See Plates No. 2 and 3 and Appendix No. 4.

The Ripper or Rooter is a powerful tool that generally follows the clearing work done by a bull dozer. It consists of a group of 3 heavily built steel teeth fixed to a massive carriage. They are set at a critical angle just right to get underneath heavy roots, fair size boulders and hard soil; tearing and loosening them up ready for the levellers. The height of the digging teeth is adjustable, in relation to the axis of the wheels of the rooter, by means of a cable and tackle from the rear winch of the tractor. One operator from the tractor can control both the forward motion of the tractor, and also the work of rooter. The rooter may be used to break up soil to full shank depth of 30 inches. The removal of all trees and obstructions having been accomplished, the levelling, scraping or excavating machinery move in.

Carry-All Scrapers

There are several types of tractor drawn scrapers, ranging from sizes of 3 cu. yards to 27 cu. yards heap measure. But the one most popularly used in Ceylon is 18 cu. yards when heaped and 13.5 cu. yards when struck. In its simplest form it consists of a steel box mounted on pneumatic tyres, and has a bottom with a cutting edge. The box can be raised or lowered which enables its cutting edge to vary the depth of cut. The box is dragged along the surface and it self-loads itself until it is full, when it is raised and a radial sliding gate closes the mouth. This done, the load of earth is trailed on to the dumping place and emptied. The front radial gate opens dumping its load on ground in front of the blade. The forward travel of the tractor allows all the dumped material to roll under the blade into the area between the bottom of the blade and the ground level. Another gate forming the back end of the box is pulled forward, pushing out whatever earth that is remaining. It is again hauled back to the loading place and refilled. This cycle goes on until the necessary levels have been attained. When loading with

deep cuts over short distances, the hauling tractor (colloquially called the "snatch cat") is helped by a second tractor pushing the scraper from behind. This operation is more economical than taking light cuts over long distances with a "push cat". The second tractor is termed a "can". It is necessary to have one "push cat" for a team of say 5 "cats and cans". This is a very efficient means hauling earth over short distance such as for roads and canals. But over long distances the team's efficiency runs out—

Heap Capacity	Length of Economical Haul in feet —One way	Cubic yd. Per hour Ecv. Quantity
6 to 18	200 to 600	110-74 to 130-82
11 to 15	300 to 800	130-82 to 150-96
18 to 23	400 to 1500	180-70 to 220-110

Advantage Should be taken of the beneficial effects of the grades. An adverse or up hill grade is a good consumer of power. For a rule of thumb calculation, the pull is equivalent to 20 lbs. per gross ton per 1% grade. Thus if work is so arranged that a cut is taken when travelling on a down grade one gets the benefit of almost an extra tractor power—thus the services of a push cat could be dispensed with. A team of scrapers working in the same pit should be so routed in traffic patterns so that they will keep out of one another's way. This means working in two directions from a single cut to two dumps and to follow the figure 8 pattern for two cuts with one dump. The figures are self explanatory. See Plates No. 3 and 4.

The scraper when used on the fill does a multiple set of duties. Material is carried to the fill over previously spread earth—thus aiding the compaction and places a new layer with precision alongside or at the end of a previously spread load. Thus a blanket of new layer of earth can be placed all over a fill area in as thin a layer as desired. The natural function of unloading does a better and faster job of putting the new layer of earth in place than a spreading tool would do, and one handling of the material is all that is necessary. Unloading

time is the same or even faster than for a hauling dumper. When working with scrapers as a matter of that with any hauling waggons, the fill should be maintained high against the outside slopes. This keeps the scraper from sliding over the slopes and destroying them as it would, were the shoulders low.

Routing scrapers over different or overlapping paths adds to the kneeding and consolidation of the fill. Scraper loads are tremendous. A 13.5 cu. yds. scraper behind a D/8 has a gross load of 62,450 lbs. But due to its riding on rubber tires, there is less rolling friction and consequently easier tractor work. But there is still a heavy unit pressure of the ground. The full average tire coverage is about 1,560 square inches. Thus the average pressure works out to about 40 lbs. sq. in. Thus the impact of the tires on the new layers of earth is a big contribution towards compaction. A scraper will spread its load as well in the same time that a truck would take to dump its load. Thus the cost of buying and owning a spreading tractor is eliminated. Within economical hauling distances no combination of excavating, loading and hauling units of plant could beat the efficient scraper behind a caterpillar tractor. But for long hauls, Tournapulls are used.

Tournapulls

These are scrapers behind pneumatic tired tractors. These need the assistance of a push cat during scraping and loading operations and thus should be operated in teams of 4 to 6 for each push cat. But once loaded they can haul at an average speed of 15 m.p.h. or so. The Tournapulls have no detrimental features on fills unless they are extremely soft and boggy. If the fill is so soft, then earth fill operations would not be permitted by soils controls control engineers. Tournapulls are similar to tractor drawn scrapers described above in that they are self loading. The only difference is that the tractor itself is equipped with pneumatic tyres which enables hauling to be done at high speeds, over long distances. This is a definite advantage over track laying tractor drawn

bucket scrapers—"cats and cans". In short the Tournapulls excavates, loads, hauls and spreads at truck speed in a succession of operations as a single independent unit. Transition from one operation to another is done with no loss of time or duplication of costs. From makers list the following performance table has been extracted for two sizes of Tournapulls, namely the 11 cu. yds. and 15 cu. yds. at 100% efficiency. But the average working efficiency is 66% to 80%.

One way haul distance in feet	EXCAVATION YARDAGE PER HOUR	
	11 cu. yd. capacity	15 cu. yd. capacity
600	145	180
800	134	168
1000	125	165
1500	103	132
2000	89	116
3000	69	91
4000	57	76
5000	49	65

These figures are definitely on the high side.

Loading Equipment and Methods

The simplest of all loading equipment and the one that involves the least investment is a loading stage. Some of these are given the names "Chinaman", "Grizzly" and "Chute." The writer used the above with advantage when he was constructing the Bolgoda Flood Protection Scheme. They are described below.

Loading Stage

An area 6 ft. x 30 ft. of spoil bank was levelled off. This was paved with some light rails available at hand, with about 4 ft. of the rails projecting out of the vertical face of the spoil bank. Vertical flanks were formed by nailing half round timber horizontals to vertical posts thus forming a chute. The hauling dumper was shunted under the chute. The Bull Dozer which was used to excavate the earth dozed the earth along the chute and directly on to the dumper which was all ready to receive the earth. By trial and error it was found that the ideal difference in height between

the loading stage and the Dumper was 1 ft.

"Grizzly"

This is similar to the loading stage described above but it was found to be more efficient in that there was less loss of earth when the grizzly was used than with the former. This consisted of a cut 13 ft. long x 9 ft. high which was big enough to receive a dumper. This cut was paved on the top with two rows of light rails criss cross and forming a hole in the centre of size 2 ft. x 2 ft. As described before the dozer pushed the earth on to the "Grizzly," and the earth drops through this hole on to the awaiting dumpers down below. By the above method the cost of earthwork was Rs. 4.33 per cube all inclusive to excavate, transport and consolidate with a sheep foot tamper to form the flood bunds. See Plate No. 6.

Excavators

It has to be seen to be believed what a useful piece of equipment an excavator is when fitted up with its different types of auxiliary equipment, it can be used as a dragline, shovel, skimmer, back hoe, clam shell, pile driver or crane. The series of sketches that accompany this paper—Plate 5 are presumed to be self explanatory. There are several makes of excavators. The writer has used at least six different marks. The size of the excavator is designated by the size of the excavating bucket that is hitched on to it. Sizes vary from $\frac{1}{2}$ cu. yd. to 15 cu. yds. with the boom varying from 40 ft. to 200 ft. Excavators are equipped with high power diesel engines as the prime mover and are set on crawler tracks for moving from place to place. The operation of the excavator is done by the movement of a series of levers and pedals by a single operator from his cab. A series of winches, brakes, clutches and wire ropes translate all these movements into work and high yardage movements of earth. A 15 cu. yd. dragline, which the writer saw on an Irrigation Canal project in California, U. S. A. was a "Monaghan Bucyrus". It was a walking dragline and not of the crawling type. It was equipped with a 200 ft. long boom and at each

bite moved 20 tons of earth. The machine was a monster, with a cab measuring 24 ft. by 16 ft. and powered with a 850 h.p. diesel engine.

An excavator fitted with a crowed shovel gets the name "Shovel". The general capacity of a shovel is about 100 cu. yds. per hour per 1 cu. yd. of bucket size. Many details of operations will improve or retard the yardage output of a shovel. For instance a 45° swing from the working earth face takes less time than a 90° swing and in turn a 180° swing. Two small hauling trucks under a large shovel will slow down output due to time consumed in shunting operations. Also a big shovel dipping low to spot a load over a small truck has to slow down its swing. On the other hand a small shovel has to lift its bucket very high to load a large truck resulting in a loss of efficiency. Also small shovels will have to move in the pit very often while too large a unit of waggons are awaiting loading. As a rule the sizes of shovels and hauling waggons should be such that four shovel loads would fill the wagon. As far as possible loading should be set up so that a truck will back into each side of the shovel and a short swing loads one and turns to the other without loss of time. Shovels are generally used to work on a high face, say about 15 ft. high. Draglines are used chiefly when it is necessary to reach below ground level for excavation as for a canal or where excavation is wet as in dredging. The uses of a skimmer are self explanatory. A back-hoe is a useful tool for cleaning up rock pockets in Dam foundations, for digging pits. A Clam Shell is used for picking loose materials like sand mud, gravel and for digging wells or for dredging. The largest excavators in Ceylon are the 2 $\frac{1}{2}$ cu. yd. Marrión; Osgood-1000 and 51-B. Bucyrus Erie, working at the Gal Oya Project. These are mere babies when compared with the monster "Monaghan". A unit cost statement for operation of excavators is given in Appendices No. 4 and 5.

Elevating Graders

By far the most spectacular machine is the Elevating Grader. Euclid Loaders, a particular make, of

these elevating graders, are employed with great advantage at the Gal Oya Project. They are excellent loading tools capable of handling great yardages where long loading areas can be maintained. Its efficiency falls off very rapidly when working in shallow cuts, or short patches of excavation. In its simplest form it consists of a heavy frame fitted at an angle of about 30° to the horizontal and mounted on crawler tracks. The lower edge of this frame carries a disc plow 9 ft. wide capable of taking a 12 inch bite into the ground of average hardness. The loader is dragged along the borrow pit by means of a D/8 Cat, and in so doing the dug material falls on to an elevating endless conveyor belt 48" wide set at an angle of about 30° to the horizontal. The earth is conveyed up through and past the machine frame to the loading elevation of a truck which is about 10 ft. above ground and the earth falls on to the waiting truck which follows the loader along side. The conveyor belt is propelled by an independent General Motor Diesel Engine of Model 6-71 mounted on the loader itself. The depth of cut is controlled by means of hydraulic hoists. Two men are necessary to operate this unit, one on the tractor pulling loader and the other on the controls of the elevating loader. While a third man guides the trucks and a foreman controls all operations. A motor grader is generally used round the machine and the pit to even out spillage and roughness from destroying the efficiency of the trucks. The whole set up moves forward at the rate of 2 miles an hour while excavating and loading. The receiving Euclid trucks too keep space with it. A 13 cu. yd. Euclid truck could be loaded in 40 sec. and when the organisation for the day is good there is very little lost time. A procession of about four Euclids follow the loader waiting for their turn. With Euclid loader and Euclid hauling 1 mile the cost of excavating and transporting earth was \$-/40 cts. a cu. yd, including overheads, but direct cost was \$-/26 cts. If the excavated material could travel off the elevator belt and be cast off at its final resting place, there would be no excavating tool so efficient, as to offer so low a cost for so large a

quantity of yardage moved. The maximum yardage output at Gal Oya was 450 cu. yds. per hour per loader, and 330 cu. yds. per hour was the record average per loader over the best operating working day of 18 hours; while the normal average figure was 274 cu. yds. per hour per loader.

Motor Grader

The Motor Grader or patrol as it is sometimes called is used for spreading and levelling off loads of earth dumped by haul roads in a good state of repair with a desired camber to facilitate drainage. It is mounted on pneumatic tyres and carries a blade which can be set at any desired angle, to the vertical or horizontal, or line of travel. Thus it can be used for cutting drains, forming level slopes, levelling off, or cambering. Its efficiency falls off very rapidly when called upon to work on wet soil. Therefore it should never be substituted for a dozer. It should do only the work for which it is designed. In high gear it moves at a speed of about 20 m.p.h. It is a very useful tool for maintenance of earth or gravel faced roads.

Sheep Foot Tampers

The excavation, loading, hauling, spreading and watering of earth being done, the sheep foot tamper is called upon. It derives its name from the spikes it carries on the roller drum. The principle of this compacting machine is to simulate the tamping of flocks of walking sheep. The spikes or legs have a sectional area of 6 square inches and are about 7 inches long. They are built staggered on the surface of the drum of the roller at the rate of 3 to every 2 square feet. The drums are filled and ballasted with water and sand, delivering pressures varying from 250 lbs./sq. inch to 750 lbs./sq. inch on the fill, depending on the requirements. A travel speed of about 2½ miles an hour is usual to obtain good results of compactions. Four rollers, two abreasts are hauled in tandem by a Cat. On average earth, 12-14 passes of the rollers give the maximum compaction possible. The sheep foot tamper is the best compacting machine; for rolled earth fill dams, air ports, and road sub-grades.

A fair size volume could be written on this subject. But space does not permit so doing in a technical paper of this nature. To make a comparison of earth moving equipment is not easy. The only correct way to do is to take the full cycle of operation into consideration; namely, excavating, loading, hauling, dumping, spreading, compacting and finishing. Time studies of the performance of the loading equipment should be made and those of the hauling and other units. On these figures estimates should be prepared and the correct combinations and quantities of equipment purchased. The little extra time spent on these studies and estimates will save the contractor and the owner a fair amount of money on initial outlay and investments on machines. This branch of cost engineering is an art by itself.

To sum up, the economies of a combination of machines dependent on the size of the project, rate of production and construction schedules; the borrow material available, the type, the depths, working areas, whether in pockets or in long stretches with deep or shallow cuts, and finally the length of haul. The different combinations from which a choice could be made are—

Shovels and trucks.

Draglines and trucks.

Elevating loaders and trucks.

The Grizzly, dozer, and trucks.

Bucket scraper and Caterpillar tractor.

Bucket scraper and a pneumatic tyred tractor.

Each one has its advantages and disadvantages and the choice depends on conditions obtaining and the skill of the engineer.

(To be continued)

CIVIC SURVEYS FOR TOWN PLANNING

NEED FOR EXHAUSTIVE RESEARCH

The following is a report of a speech delivered by Mr. N. K. Gandhi, B.E., A.M.I.E., at the Bombay Centre of the Institution of Engineers, India.

Although town planning was an art and a very ancient science, its study and research as a modern science was limited to the past sixty or seventy years only, said Mr. N. K. Gandhi, addressing the Bombay centre of the Institution of Engineers (India) on "Civic Surveys for Town Planning," last Wednesday in Bombay. The basis of town planning had been changing, from time to time, he added.

In olden times the dominant idea was defence. Those were the days of insecurity and the town had to be defended against attacks either from foreign invaders or internal marauders. In those days, therefore, the town was surrounded by a protective wall along its boundary, the speaker continued. Then came the era of monumental planning. In the Renaissance Period, cities were developed with big streets and avenues with tall buildings alongside. This was followed by the industrial period, in the beginning of the 19th century, when emphasis was laid on production. There was no control on buildings. Factories grew anywhere and everywhere in accordance with the whims of the individual manufacturer. The factories attracted people and large concentration of population grew in those places forming into conglomerations which were called big cities while villages were deserted. Little consideration was given to the living conditions of the workers and consequently there was overcrowding, filth and dirt everywhere which gave rise to big epidemics like plague and cholera, resulting in heavy toll of human life.

Planning For People

It was on the background of these epidemics that the present ideas of planning for the people took root and grew. The object living condi-

tions of the people in general at the time moved philanthropists and social workers and a great deal of attention and thought was given to ameliorating their conditions. It was Patrick Geddes, a sociologist, who propounded the theory that "a city is a living organism and not simple inanimate thing like buildings, factories and streets. It is the people in the city that count and therefore in a town there must be an integration between folk, work and place, or there must be a close relation between the people living in the city, the industry where they work and the open spaces which are necessary for their recreation." He was the pioneer of the idea of carrying out civic surveys for each town.

The research in town planning rapidly advanced, Mr. Gandhi continued, and legislation to implement the ideas closely followed. Towards the close of the 19th century bye-law control over private buildings was introduced. Then came the Housing and Town Planning Law for new development. Between the years 1910 to 1947 the Town Planning Act advanced in stages from being applicable to unbuilt areas of towns to built-up areas and then to the town as a whole. Next it was extended to the country surrounding the town and lastly to the nation as a whole under the Town and Country Planning Act, 1947.

Referring to civic surveys, the speaker stated that there were invariably two types of surveys—the regional survey and the town survey. The regional survey located the settlements in the region, how each town was situated with regard to its surroundings, its sphere of influence and the extent it had to

depend on the surrounding area to satisfy some of its needs. After completing the regional survey, the town survey started. In both cases many details of similar nature were collected and shown on different maps.

Outlining the technique now perfected of carrying out those surveys and mapping out the information collected, Mr. Gandhi stated that the details of the survey were of such a varied nature that the work had to be carried out by a team of engineers, architects, geologists, historians and sociologists—all properly trained in planning. The information was collected from various official records, by field surveys and by contacting the people, whose active co-operation in the matter of planning was of great importance. A plan could not be imposed upon people, he emphasised. Planning must be for the people. "Observe to understand and understand to foresee is the general method of procedure," he added.

Out-of-Date Machines

Compared to the national planning in the U. K., town planning in this country was still in its primitive stage. Under the prevailing the Bombay Town Planning Act, 1915, we were still planning for small areas of towns—in parts not necessarily related to one another. Only people in the area to be contacted under the Act were the holders of land who did not necessarily live in the area to be planned and who represented even less than 1 per cent. of the population. Besides, we were only doing physical planning, that of division into plots and there was hardly any research or study in town planning.

(Continued on page 16)

LETTER TO THE EDITOR SEPTIC TANKS

Dear Sir,—Will you be kind enough to publish in your next issue design of a latest type of a Septic Tank for a family house of about 6 to 12 persons. I shall feel highly obliged for this if you let me know how to construct a Septic Tank and points to be considered re: location, design features, operation, maintenance, disposal, etc. There is no head of water in this town and no flush system and sewer system.

I hope you would do the needful.

Thanking you,
Yours faithfully,

M. B. Shukla, Dip. C. E.
Raipur.

The number of persons using the system is the basis for determining the size of the septic tank. The usual allowance of 30 gallons water per diem. is taken for each person. Assuming that six persons will be using, 240 gallons would be the capacity plus 25 per cent say, 300 gallons. This would be the capacity of the septic tank. The tank can be square, oblong or circular: the principles are the same. A circular one is illustra-

ted with accessory installation. Grit pit to have partition in centre full width and height level to that of flow to septic tank. Fit airtight cover. Clean out grit pit every 10 or 14 days. Obtain concrete tubes for septic tank if possible. and cut holes in opposite sides for 4-in square junctions. Run 4 in drainpipes, fixed to sides of tank with strap iron. Intake to be shorter than outflow. Form wood or iron trough to receive overflow from septic tank. This will overflow on to corrugated sheets, in which 1/8-in holes have been punched or drilled in lower corrugations to permit flow of liquid over breeze. Breeze filter to have two layers of bricks laid dry at bottom with open joints. fill in with lowest third coarse 3-in breeze, centre third 2-in breeze, top third 1-in breeze. If land will allow, build filter wall s in half-brick honey-comb. Form cement channel to collect liquid and run 4-in open-jointed land drain to ditch or distribute over land.

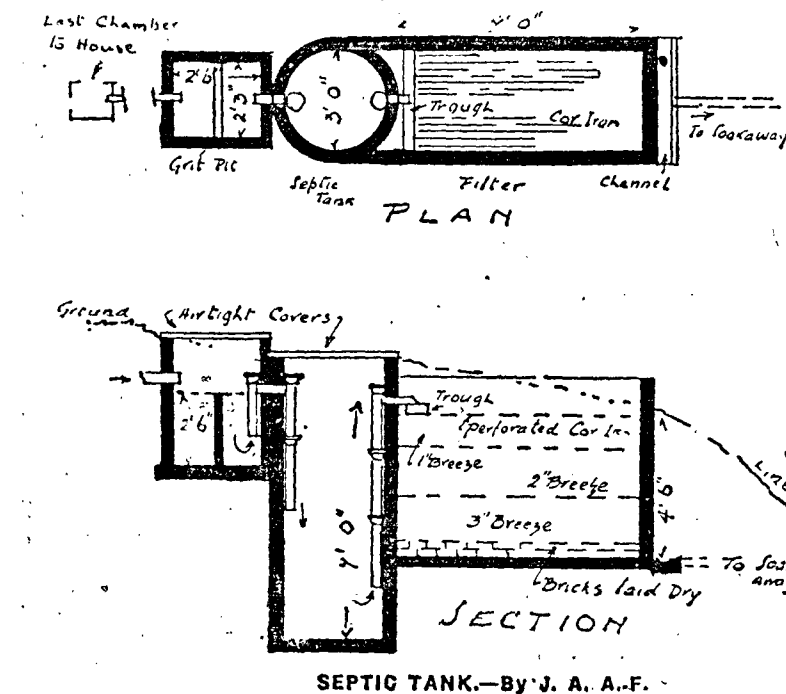
The difference between the ordinary system of cesspool and septic system is that in the former the effluent is simply collected in a large tank, no exit being considered or allowed. When the tank is full of both liquids and solids, it must be emptied. In the septic tank

system a chemical action is encouraged which breaks up the solids into liquids. This breaking-up action is caused by bacteria working in the dark closed area, hence the septic tank having its inlet and outlet pipes well down into the tank, also the top cover sealed. The liquid formation takes about 24 hours. The liquids pass from the septic tank on to the tipper or trough, and become aerated for a short time before passing on to the distribution sheets, and are again aerated. Passing on to the clinker a bacteria action of entirely different character takes place, an aerobic action (in the air) and by filtering through the clinker should come out at the bottom comparatively pure water. The site should be selected with care since adequate fall is required from the building to the outfall and should be situated away from prevailing winds and must be not less than 50 feet from a building. J. A. A. F.

(Continued from page 15)

That state of affairs must be changed and changed soon. One thing must be made clear that for any planning to be of any real value the plan must be based on proper surveys. The work of carrying out these surveys and the preparation of the development plan based on them must be undertaken by our own people. No amount of foreign and expert help in the matter would be of real value. Their method of planning, evolved after a great deal of research and study, could be adopted for that purpose. The immediate task, therefore, was to start courses in planning, for a good number of trained planners would be required.

At present town planning was done by engineers and architects only. Assistance of sociologists, geographers, geologists and lawyers being of vital importance, it was imperative that these courses must be thrown open to all graduates as was the case in the West. Town planning must be made a post-graduate course. A new town planning law in keeping with the modern ideas of planning, need be enacted and made immediately applicable to towns as a whole, Mr. Gandhi concluded.



SEPTIC TANK.—By J. A. A. F.

DISTEMPERS ON WALLS AND CEILINGS

The following is an abstract of notes received from the Building Research Station of England*

Distempers form a cheap, durable and easily applied decoration for internal use on most building materials except wood and metal, whose moisture and thermal movements are likely to cause flaking. They are eminently suitable for decorating large surfaces of plaster, cement products, brick and various forms of wall boards such as plasterboard and insulating boards. If suitably formulated they may be used externally on cement products or on brickwork.

Troubles with distemper are most often due not to the material itself but to its use on surfaces that have been insufficiently or incorrectly prepared, or in situations for which the material is inherently unsuitable. This Digest describes how to avoid defects or cure any that may arise, and includes a table summarizing the information.

Success or failure on a job depends first on knowing which of the various types of distemper is being used and this is particularly important in redecorating.

Types of Distemper

There are two groups of materials that come within the general title of distemper. The first group includes the older types of distemper and the second are recently developed products often called emulsion paints, though the old oil-bound distemper is in fact also an emulsion paint.

The older types of distemper are covered by British Standard 1035: 1950 and fall into three classes:—

1. Washable Oil-bound Distempers (Type A. of B.S. 1053) are suitable for use on internal, or, if suitably formulated, on external walls. These distempers consist of an emulsion of drying oil or varnish, often dispersed by glue, with the

addition of pigments such as lithopone. They are fast to rubbing and after a few weeks acquire a fair degree of washability. They will not however stand frequent washing.

2. Washable Oil-free Distempers (Type B. of B.S. 1053) are similar in properties to the oil-bound distempers, but differ from the latter in that the binder is casein and not oil. They are often slightly more difficult to apply than the oil-bound distempers, but possess the advantage that they are resistant to alkalis, provided that only lime-fast combinations of tinting colours have been used.

3. Soft or Non-washable Distempers (Type C. of B.S. 1053). These distempers are suitable for use on ceilings and are usually based upon size and whiting. They are moderately fast to rubbing but insufficiently so to enable them to be used satisfactorily on walls where people may rub against them and, as their name implies, are not fast to washing.

In recent years a variety of so-called emulsion paints have been introduced which, although similar in some ways to the older types of distemper, e.g., in respect of permeability to moisture, are designed to have superior durability and washability often approximating to those of a flat paint. These new types include:—

1. Emulsion Paints Based Upon Alkyds (a combination of certain synthetic resins and drying oils).

2. Emulsion Paints Based Upon Polyvinyl Compounds, chiefly polyvinyl acetate.

The alkyd type approximate in character of finish to a flat paint, but there are products of the polyvinyl type that give some degree of gloss. Paints of the latter type are

sometimes used in place of tiling, as giving a jointless, though less durable, finish. Although some early forms were liable to settle in the can to a rubbery mass, and were also likely to craze outdoors, some improvements have been made in these respects.

Apart from the actual distemper other materials used in the decoration of surfaces with distemper are:—

(a) Glue Size, similar in nature to that used to bind the pigment in non-washable distempers is used either alone as a solution or as "clearcole" (weak size solution mixed with a small proportion of whiting) to satisfy the suction of surfaces, where this is high or variable, before applying size-bound (non-washable) distemper.

(b) Petrifying Liquid is an emulsion of the oil or varnish of an oil-bound distemper; some makes contain a little pigment. It is used alone, to satisfy the high suction of surfaces; or as a thinner for oil-bound distemper that is to be applied to surfaces of high suction. It is often added to the distemper for external use to obtain greater durability. Most manufacturers produce a liquid for use with their particular oil-bound distemper.

Properties of Distemper

The following properties of the older types of distemper have a bearing on their choice for use in particular circumstances, especially when the conditions are not wholly favourable. Some comments are also made on the newer type emulsion paints, but as some of these are in a development stage it is advisable to consult the manufacturer for further details as to their use.

1. Permeability to water. The older types of distemper and most

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of the new emulsion paints easily allow water vapour to pass through them and thus allow any water that is still in a wall at the time of distemping to continue to dry out. They are therefore less likely to blister than a gloss paint if applied to walls that are not properly dry, but this does not mean that there is no risk of defects occurring, since the moisture in the backing can stimulate alkali attack or mould growth or can, as it dries out, lead to efflorescence. Distempers nevertheless provide the best chance of successful decoration at an early stage.

2. Contraction on Drying. The film of any of the older types of distemper shrinks on drying and this shrinkage may lead to cracking and flaking of the distemper if the surface is weak or friable. They should not only be applied on reasonably sound surface. Flaking is probable if they are applied over non-washable distemper, old limewash, flaking oil-bound distemper, or over heavy coats of some silicate paints of fire-retardant type. Cracking is likely if the surface to which they are applied is insufficiently strong to restrain their drying shrinkage, e.g., old gloss paint or bituminous compounds. Thick coats of distemper are more prone to flake than thin coats and the same applies where numerous coats of distemper are built up.

It is easier to restrain the shrinkage of some of the newer emulsion paints than the old distempers and claims have been made that some polyvinyl emulsion paints can be used over old limewash and over bituminous compounds. The Station has not investigated these claims and the manufacturer should be consulted as to the suitability of a particular paint for use on surfaces of these kinds.

3. Adhesion. The adhesion of paints to a surface is generally much weakened on wetting, but is almost completely restored as the paint and surface becomes dry again. If however the paint and surfaces are wetted and dried repeatedly, flaking and peeling may occur. Condensation can provide sufficient moisture, and as the distemper is sufficiently permeable to allow the moisture to reach the surface of the

plaster there is a serious risk of failure in situations where condensation often occurs, e.g., in bath, rooms and kitchens. Despite this, soft distempers, if lightly bound, usually give a good performance on ceilings. Many of the newer emulsion paints are not so readily wetted by water condensing on them and may be used in preference to an old type distemper except in the most severe conditions, when only a good quality gloss paint can be relied on.

Application and Use of Distempers

The importance of proper preparation of the surface will be evident from what has been said previously. The nature of these precautions and treatment will depend largely on whether or not the surface has been decorated already. The two sets of conditions are discussed below.

Surfaces not Previously Decorated

On the whole, little preparation is generally needed on new surfaces. It is advisable, however, to let constructional water dry out until the wall is at least surface dry; in view of the porous nature of the distempers, decoration often need not be deferred beyond this point. Dusting down is then usually all the preparation that is necessary, but certain conditions may be encountered which necessitate special precautions, as follows:—

Alkaline Surfaces (e.g. cement products, including asbestos cement, or plasters containing lime). The risk of attack of distemper by the alkalis is much less than with oil paints. If therefore conditions are not too severe, sizebound or oil-bound distempers and porous alkyd emulsions are usually successful on alkaline surfaces. In more severe conditions, greater safety against alkali attack can be obtained by the use of oil-free (casein-bound) washable distempers, or porous polyvinyl emulsion paints, but it should be remembered that trouble from other causes (e.g. efflorescence or mould growth) may still be possible. It is advisable to specify that the pigments shall be "lime-fast."

Smooth "Polished" Surfaces. As these provide little mechanical key, the adhesion of distempers is

likely to be poor. With gypsum plaster of the Keene's or anhydrite type, which can be brought to a high polish, better results are often obtained if a coat of sharp colour is applied before distemping.

Surfaces of High or Variable Suction ("Hot" Surfaces). Some care needs to be taken in brush application on "hot" surfaces to avoid building up a thick unsightly film of distemper, which because of its thickness is likely to flake. The suction of the surface will not be known until the first brushfuls have been applied, and even then trial may be needed to find the best remedy.

With size-bound distempers, a thin coat of clearcole or size so thin that it does not build up on the surface) applied before distemping may solve the problem. With oil-bound distempers, thinning with water or petrifying liquid should be attempted first as the most convenient and safest method. If this is not successful a coat of sharp colour should be applied. Each job has to be considered on its merits in relation to the recommendations of the manufacturer whose product is to be used.

Efflorescence may be seen on the surface when dusting down. If this is slight, it may be sufficient to dust down, or wipe off with a slightly damp rag. However, unless further precautions are taken where severe efflorescence is found, the distemper may be pushed off as soon as the first or second coat dries and it may be necessary to give a coat of sharp colour after removing the efflorescence. Where the growth is severe, it is therefore advisable to allow a few days to elapse after first wiping the wall down to see whether further efflorescence appears. If it does the procedure should be repeated until no appreciable growth occurs. The coat of sharp colour may then be applied with safety.

Surfaces Previously Decorated.

Old non-washable distemper should always be completely removed before redecorating. Washable distempers that are dusty, but otherwise sound, can be redecorated with a similar distemper after dusting down. If the old surface of a washable distemper is dirty it should be

well washed down and, if it is then found that much of the old, decoration is removed in the process, it should be completely stripped before redecorating. On the other hand if the surface of a washable distemper is in good condition it may be possible after sponging to redecorate direct, but it is not advisable to build up numerous coats of washable distemper (as can safely be done with oil paint under some circumstances). The weakening effect of water introduced in applying the new coat on the adhesion of the old coats, together with the drying shrinkage of the new ones, is likely to cause flaking if more than four or five coats of distemper are several coats of old distemper and stripping is not possible because of expense or for other reasons, it is advisable to apply a thin coat of sharp colour before distemping. This penetrates into and binds the old coats and also prevents water in the new distemper entering and disturbing their adhesion.

As already mentioned old gloss paint is not a suitable base for distemper for apart from its inability to restrain shrinkage of the distemper it presents a "polished" surface which gives little key.

Causes and Remedy of Defects.

In view of the large quantity of distemper used, often under severe conditions, it is not surprising that defects sometimes occur. The types of defect, their cause and treatment, are given in the table. It will be realised from a study of this table that moisture is the cause of a great proportion of these defects; and when in any particular case it has been established that moisture is at the root of the trouble the first step is to see what can be done to eliminate the source of moisture. This may be a simple matter, as when a leaking gutter or cistern is responsible, but often the cause may be much more obscure and may involve thorough examination of the structure. Remedy of the damp conditions may then call for drastic measures, as when a wall contains no damp-proof course, or when mortar bridges a number of wall-ties. It must be realised that unless the dampness is cured redecoration is unlikely to be successful. When the source of moisture has been elimi-

nated, it is advantageous to let the wall dry for a while before redecoration, although, as the distemper is permeable to moisture and thus allows drying to continue, the waiting period need not be prolonged. Any attempt to seal the moisture back with an impermeable coating is unlikely to be successful.

Notes on the Table

Sharp Colour

A suitable sharp colour can be made by thinning white lead paste, and adding driers, with, if desired, a little red lead or gold size. Alternatively, a well thinned undercoat for a gloss paint is often suitable, and can be used in colours to match that of the distemper to be applied.

Treatment of Mould, Algae, etc.

A suitable wash for destroying mould is Santobrite (1 lb. in 10 gal. of water) supplied by Monsanto Chemicals Ltd., Ruabon, or Shirilan N. A. (1 lb. in 10 gal. of water) supplied by Imperial Chemical Industries Ltd., or zinc silicofluoride (6 oz. in 1 gal. of water). The manufacturers' directions should be followed in making up the proprietary materials. After application, the wall should be kept under observation, and a second application made if the mould still seems to be growing.

A suitable wash for killing algae, mosses or lichens is the follows:—

Copper carbonate	...	...	1oz.
Ammonia solution (0.88sp.gr.)	10oz.		
Water	...	...	10gal.

As with fungicidal washes, the organism should be kept under observation for a few days and a second wash given if it still seems to be growing. When the organism is dead and dry, it can easily be removed with a stiff brush.

If the blue-green colour of this wash is an objection to its use, the washes recommended for moulds may be used.

Stripping Distemper

In the table, no distinction is made between local and general stripping, since a decision on this can only be taken after a full inspection of the work. Where there is

reason to suppose that weakening of adhesion has not extended much beyond the actual area of obvious attack, it may be sufficient to strip locally, feather down the edges with abrasive paper, if necessary coat locally or generally with sharp colour, and redistemper the whole wall or ceiling. Where slightly more doubt exists, it may be worth applying one of the special paints made by some manufacturers for binding down distemper, but such measures are not likely to be successful where adhesion is already poor, or where several coats of distemper have been built up.

Complete stripping of size-bound distemper is not normally difficult and it is usually sufficient to wash down with warm water. Additions of sugar soap or other detergent should not be used except perhaps in special circumstances, e.g. on ceilings over gas cookers, since the background, if porous, is likely to absorb the soap and retain harmful residues in spite of all efforts to wash them out. On large jobs the use of steam strippers, designed primarily for stripping wallpaper, may be preferable.

In general, washable distempers can be readily removed only by steam stripping. The steam softens the distemper so that it can be removed with a stripping knife or washed oil. This method may be particularly useful with polyvinyl emulsion paints, which resist paint removers.

Applying a heavy coat of hot size, with a proportion of flour stirred in, is sometimes helpful where adhesion is weak. As the size dries and contracts, it flakes and pulls with it the old coating. The method is likely to be erratic, however unless drying conditions are good.

Alkaline or solvent (non alkaline) type paint removers may help in removing the oil-bound distempers or the alkyd emulsion paints, but since the removers act on the oil and the amount present is small, these methods may be difficult and expensive. Moreover, on porous backgrounds, there may be difficulty in removing harmful residues of alkalis and salts left from alkaline removers, and of wax from the solvent type.

Defect observed	Cause of defect	Part played by moisture in causing defect	Remedy, if source of moisture can be cured, or if defect not caused by moisture	Best treatment, if source of moisture cannot be cured
Peeling, flaking & blistering	1. Repeat wetting & drying	Essential—condensation is often responsible	Condensation may be reduced by increased ventilation. Strip & redistemper	Strip, dry as much as possible & use flat paint
	2. On Keene's or other dense smooth heavily trowelled (polished) plaster	Condensation may play a part, but need not be heavy to cause trouble	Strip, dry, apply a coat of sharp colour and redistemper	If condensation is contributing, strip, dry as much as possible & use flat paint
	3. On paint	Ditto	Ditto	Ditto
	4. Applied over an unsound foundation e.g. (a) Over non-washable distemper (b) Over weakly adhering washable distemper, or over numerous coats of washable distemper (c) Over some silicate paints (d) Over limewash	Generally very little	Strip completely if possible & redistemper; where complete stripping is impracticable a polyvinyl acetate emulsion might be tried	—
	5. Heavy efflorescence i.e. incrustation or growth of fine white crystals of salts pushing off distemper	Essential—generally from water remaining in background after construction—or may be purely local, due e.g., to defective gutters, or to absence of d.p.c.	Strip, allow to dry until no more efflorescence forms, brush down or wipe with a damp (not wet) cloth, & redistemper. In severe cases, a thin coat of sharp colour before distemping may be necessary	There is little hope of durable redecoration. Strip & redecorate with a distemper which can readily be washed off (e.g. a non-washable distemper), so that redecoration may be easy. It may be cheaper in the long run to batten out and line
	6. Fine efflorescence often visible only under a microscope. In some cases, the background contains salts which are dissolved by water in the distemper and crystallise as the distemper dries, causing blistering and flaking in a few hours	Essential (but that introduced by the distemper is sufficient)	Strip, dry and give a coat of sharp colour before distemping or use flat paint	Strip, dry as much as possible and give a coat of sharp colour before distemping or use flat paint
	7. Thick coats, caused e.g. by high suction or numerous thin coats	—	Strip & redistemper	—
Bleaching, change or fading of colour, with yellow soapy runs in severe cases. Possibly flaking and peeling	Attack on distemper by lime activated by salts and moisture	Essential, but conditions must be severe to cause failure in porous distempers	Strip (washing may be sufficient to strip in severe cases) allow to dry and redistemper	Use a washable oilfree distemper or a porous polyvinyl emulsion, with lime-fast pigments
Spots of various colours (usually black, grey or green) often spreading gradually over the whole surface	Mould	Persistently damp conditions are essential	Strip, treat with fungicidal washes, allow to dry and redistemper	Strip, treat with fungicidal washes, and redistemper, incorporating fungicides in the distemper. Fungicidal paints may be preferable if the moisture is due to condensation
Green slime over surface	Algae, growing under damp conditions in light, usually outdoors	Persistently damp conditions are essential	Application of algicidal washes. It may not be necessary to strip the old distemper	Application of algicidal washes

Defect observed	Cause of defect	Part played by moisture in causing defect	Remedy, if source of moisture can be cured, or if defect not caused by moisture	Best treatment, if source of moisture cannot be cured
Cracking	1. Over paint, where the paint is too soft to restrain the drying shrinkage of the distemper	—	Strip and apply paint. If distemper must be applied, the old finish should be well rubbed down. A coat of sharp colour before distemping may help	—
	2. Induced by cracking of the background, e.g. plaster or cement renderings	Drying shrinkage may be the cause of cracking of the background	Defer redecoration until cracking has ceased. Fill cracks (e.g. with a paste distemper knifed in, if the cracks are small) and redistemper. Alternatively, apply a thick decoration e.g. of plastic paint	—
Bleeding	Soluble colours from old decoration bleeding through the distemper	Damp conditions may play a part, but the moisture in the distemper may be sufficient	Strip old decoration, or seal back with knotting to which a little dental pumice is added to provide mechanical key	—

ARCHITECT AND CLIENT

Like most people, an architect's clients can be segregated into types, and a knowledge of human nature is a very necessary acquisition for every architect. Knowledge of this kind is acquired only by personal experience.

First of all, there is the ideal type of client. He is the client who approaches you assuming that as an architect you are likely to know more about building than he does. He is willing to take your advice, and is always open to reason with regard to aesthetic and utilitarian issues. He does not expect you to live on his job to the exclusion of everything else in your practice; he will not ring you up daily; he will not cavil at spending a little more to obtain a better job; he will settle your account by return and express his satisfaction with the work and effort you have made on his behalf. Alas, how few such clients there are! Their names will be household words in your office.

Then there is the most difficult type of client who leaves you const-

antly wondering why you were employed. He provides you with sketches illustrating just what he requires. He is bursting—as a rule culled from magazines—and will argue indefinitely over the value of any points presented to him, aesthetically or otherwise. He is always complaining, and usually renders your life a misery whilst his job is in progress.

Thirdly, there is the hard-headed business man who knows what he requires and expects you to give it to him plus a little more. His judgement of you will be based on the comparison of your approximate estimate for the work with the final account. The aesthetic value and finer points of your work, except in so far as they are revenue producing, will leave him cold.

Finally, we have the financial speculator who treats building merely as a vehicle for the amassing of profit. His interests are solely limited to the balance sheet of estimated and actual expenditure as against revenue.

Between these limits are many finer shades of difference, and the correct diagnosis by the architect is the first step in the matter of building.—H. Ingham Ashworth.

PERSONAL

Prof. M. C. Abraham

Prof. M. C. Abraham, B. Sc. (Mech.), M. Inst. C.E., M.I.W.E., India's Irrigation Expert is participating in the forthcoming World Congress on Large Dams at New Delhi.

Mr. N. V. Modak

Mr. N. V. Modak, Special Engineer of the Bombay Municipal Corporation has left Bombay on a brief visit to the U. K. and Europe. The purpose of Mr. Modak's trip is to acquaint himself with modern trends in municipal engineering and to obtain first-hand information regarding latest techniques employed in large dam construction works.

Mr. A. N. Khosla

Mr. A. N. Khosla, Consulting Engineer to the Government of India has been elected President of the Central Board of Irrigation for 1950-51.

Mr. M. Hayath

Mr. M. Hayath, Chief Engineer, Electricity Dept., Mysore State has been elected Vice-President of the Central Board of Irrigation for 1950-51.

Mr. W. A. Smith

Mr. W. A. Smith, Senior Lighting Engineer and Manager Overseas Lighting Division of Thorn Electrical Industries Ltd. of London has arrived in Bombay.

BITUMINOUS ROAD CONSTRUCTION

By H. H. CAMPBELL, M.C., M.A., (Cantab.)

The following is an abstract of a paper read at the Engineering Association of Ceylon.

INTRODUCTION

"A country pays for its roads whether it has them or not and it pays more when it does not have them." This statement made by Thos. H. Macdonald (Commission Bureau of Public Roads U.S.A.) embodies a great deal that is common sense and, as food for thought, allows us to consider and enlarge upon all the reasons why an efficient road system is a necessity to the modern community. Just one consideration is that improved roads will facilitate the development of uncultivated land which is of major importance to Ceylon today. A view expressed by the I.R.T.D.A. says: "It can be stated that with the increased road facilities for the various villages, the standard of education will rise. There will be more inter-communication between villages and towns. As regards likely increase in the amount of imports, there will be greater facilities for commercial travellers to sell their goods and in consequence there will be a greater demand. The agriculturists will undoubtedly take advantage of increased facilities for importing fertilizers, seeds, agricultural equipments, pumps, etc. Part of these goods will come by train to the nearest road terminal and thence by road to the villages. This increase cannot be given either as a percentage or as a definite amount, but it will undoubtedly come and grow as education spreads."

In a scheme of Road Reconstruction, it is necessary to make an attempt to classify the roads and to define the function of each category in relation to the requirements. It can be argued that the road system in Ceylon is adequate to meet present demand for, of a total 18,560 miles of roads and tracks, the P.W.D. maintain 6,560 miles, the majority of which have a bituminous surface. In Colombo Municipality, there are 20

miles of trunk roads and 138 miles of branch roads with a similar surface. Nevertheless, it is true to say that until the standard of road surfacing and methods of construction are improved, large scale transportation, which is in the interests of the country's economy, cannot be considered.

Ceylon Road System

It has been said that Ceylon has the finest roads east of Suez and though this was certainly true some twenty years ago, it is doubtful if it is true today. The roads are not, by any means, up to modern standards and in the case of certain trunk roads, the volume of traffic is already greater than can be comfortably carried. In setting out the roads originally the easiest trace was invariably followed, which resulted in a number of acute bends though, generally speaking, the gradients are moderate even in the hill country. Super-elevation has been insufficient and this fact is normally attributed to the high percentage of bullock cart traffic. This controversy is, however, open to considerable doubt and, coupled with certain other deficiencies in design, is probably due in many instances to the incorrect application of the principles of design. Opportunities for the study of modern world construction methods are limited as few Engineers are able to spare the time to take courses in other countries. Roads widths, taken as a whole, are frequently inadequate and a widening programme would be expensive due to insufficient Crown land being reserved initially for roads and the consequent encroachment of buildings in the form of ribbon development. Camber is as a rule, too great and in some cases even dangerous. The loading classification of main roads is limited in most cases to 4 or 6 tons, due mainly to weak bridge structures. Widening and upgrading of bridges is being

gradually carried out but materials are difficult to obtain and the work is costly. Some route classifications have recently been increased to 7 tons and the maximum allowable wheel load in the island is 8,400 lb./sq. in. worked out on the basis of the rear wheels taking 2/3 the load. The standard type of water-bound macadam with a bituminous surface dressing in many cases leaves a deal to be desired and it is hoped that this paper may remind Engineers of the importance of adhering to standard construction specifications and correct methods of maintenance. Sand blinding which is invariably used on account of the cost of stone chippings, greatly reduces the life of a surface treatment and, in many cases, reconstruction becomes necessary every two or three years. The two outstanding powers of destruction which are a constant problem, are: (a) iron tyred bullock cart traffic and, (b) very heavy rainfall which results especially in damage to road edges by surface water drainage. This could however be largely avoided if adequate side support were provided, which again raises the question of cost. A road system such as is found in the U. S. A. depends to a considerable extent upon continuous research and timely dissemination of its results. If a system of research could be adopted in Ceylon it would be a great help towards the gradual organized improvement of road construction methods over a period of years.

There are numerous alternative methods of construction and a wide variety of materials for the modern road so it would be helpful perhaps at this stage to enumerate the necessary properties of a road surface, as follows:—

Waterproofing qualities
Durability
Stability

Non-skid properties
Noiselessness
Hygienic qualities
Colour

The large variety of materials available today would suggest the possibility of producing a standard pattern to fulfil the majority of these wants. However, the divided schools of thought, together with the variety of surfaces to suit loads and speeds make it uneconomic to employ a basic specification for all roads. The Author's endeavour is to revive the interest of all Engineers in this all important and complex subject of road construction. Firstly, by dealing briefly with the standard principles and, secondly, following up with more detailed information of the types of surface best suited to local conditions, with particular reference to flexible pavements and bituminous construction. A brief history of so large a subject is interesting when we realize its relationship to present day road surfaces.

History

The need for some form of road probably arose in the first place when primitive man began to fells in the forests and wished to transport them to various locations. The mere clearing of tracks no doubt resulted in choking dust in dry weather and quagmire in the wet season. To counteract this, fallen tree trunks were laid as logs in an attempt to overcome such inconveniences. Once out of the wood, the selection of hard high ground would be sufficient for tracks across more open country. The advent of horse transport made it necessary to back the logs with earth to prevent stumbling due to unevenness but the invention of the wheel brought with it many other problems. Various attempts were made to improve matters with the eventual introduction of stone highways by the Romans. In Western countries, the Romans were the pioneers in road building on a large scale, this activity being necessitated by their far-flung military campaigns of conquest. The first of the great Roman roads, the Via Appia (Appian Way), was begun in 312 B.C. These Roman roads were constructed more or less

according to a system which may be described as follows:

"Two parallel trenches were dug along the proposed alignment marking the width of the roadway. The soil was then excavated between the trenches until a solid substratum was reached. Upon this were placed . . . large stones . . . then a layer of broken stone 9 inches thick set in lime mortar and over all was usually placed a kind of pavement of large stones, fitted together with the joints filled in by mortar".

In most cases, the Roman road was raised above the level of the adjacent ground to facilitate drainage. Examples of these roads exist to the present day, 2,000 years after they were built, and many remain as the foundation of certain of our main roads in England.

The old builders of Mexico also followed somewhat the same system and evidence of advanced road building on the South American continent has been discovered in Peru where the Incas built incredibly fine highways which archaeologists claim were constructed as early as the 1st century A.D. Many of these highways were surfaced with cut prophytic stone to a width of 20 feet and some sections were surfaced with asphalt. To this day some of the better preserved sections are said to be still in use.

Interest in road building waned in Europe with the end of the Roman Empire and, throughout the Middle Ages, road construction was practically non-existent. This lull seems to have occurred simultaneously in most other countries during the same period.

As social communities developed, usually under some form of local authority, a variety of materials were used in an attempt to better road construction. In England gravel, pebbles mixed with sand, limestone and "flint" were used and whinstone in Scotland. The methods of application were somewhat haphazard and the first real attempts at scientific study were undertaken

by the now famous engineer McAdam and eventually his son, although the father and pioneer of road construction of this type was a French Engineer called Pierre-Marie Jerome Tresaguet (1716-1796). His design is as indicated in Fig. 2 and it will be noted that he improved on the Roman method of construction by making a convex base to aid drainage. Block stones were pitched to from the foundation followed by two layers of wearing course of equal thickness. The depth of broken stone was reduced to ten inches and submerged kerbstones provided lateral support.

Similar work was done by Telford about the same period as McAdam and today we are familiar with the the graded and cleaned aggregate method developed, known as the "Macadam Principle". Thomas Telford (1757-1834) the founder of the Institution of Civil Engineers and President till his death, introduced his design in Scotland some thirty years later than Tresaguet's work in France. Telford's system is described as follows:—

"He excavated a trench of the width desired for the roadway but retained a horizontal bed. Upon this he placed a hand-set soling consisting of stones 9 inches deep in the centre 5 inches at the margins, set on edge. These stones were not more than 4 inches wide at the top. All the projections of the upper surface were broken off and the interstices were well rammed with small stones. By this means he obtained a foundation of a convexity of 1:60. Upon this, he placed a light cushion of sand or sandy clay and then a 6 inches thick layer of hard stone broken so as to pass in all directions a 2½ inch ring. On top of this he placed a 1½ inch thick layer of good gravel."

It was not uncommon to place a 2 or 3 inch layer of good angular gravel over any soft material encountered in the soil base before pitching the foundation, to prevent mud squeezing up into the road structure and causing a weakness. Telford's theory stated that each stone of the

base course should be laid perpendicular to the finished surface and in close contact with the other stones but with staggered joints.

At about the same time that Telford was working out the designs of road pavements, another British road builder, John Loudon McAdam (1756-1836) developed a slightly modified specification. He recognized that the earth on which the road was built ultimately carried the load and he believed that any reasonably good soil, well drained, needed only a comparatively thin wearing coat of broken stone to carry the heaviest load. He achieved structural stability by the mechanical interlocking of small cubical stones forced into position by the wheels of traffic, (and later by rollers). His road was built in layers, succeeding layers being applied only after the preceding ones were firm and dense.

Comparison of theories

McAdam

- (1) Depends on interlocking of stones to carry loads imposed by traffic.
- (2) Used a yielding or elastic subgrade of stable and well drained natural earth.
- (3) Use of any binding material between stones not favoured.
- (4) Macadam specified: Bottom course stone pass 2" ring and depth 4".

Second course stone pass 1½" ring and depth 2½" to 4".

Upper course stone pass ¾" ring and depth 1½" to 2" covered with screenings and rolled.

Telford

- (1) Do do do
- (2) Interposed a hard unyielding foundation of broken stone. Proper drainage was insisted on by both.
- (3) Do do do
- (4) Size of stone not given sufficient importance.

Defects of Telford system over McAdam

(where conditions favourable for either)

- (1) Cost 1½ times Macadam system
- (2) Entirely new surfacing required when wear took place as the hard pitched stone protruded and resulted in a very rough road
- (3) Cost of resurfacing nearly equal to original cost of Macadamised road.

The Macadam surface was for perhaps a hundred years the highest type of road surface known. Though it seldom now forms the wearing surface in countries where motor vehicle traffic predominates (without the addition of at least some bituminous cover), in Ceylon, for many years to come, this form of road surface will probably continue to be the main type because of the large volume of cart traffic to be catered for and the unlikelihood of funds being available for constructing on any large scale higher types of surfaces fit to carry combined motor vehicle and cart traffic.

The production of a more stable foundation and surface from the original haphazard systems, resulted in the possibilities of increased speed but increased speed meant volumes of dust which fact had been overlooked. This resulted in the surface problem which is the main object of this paper, for the use of water to lay the dust was too impermanent to be of value. The introduction of surface dressing was temporarily successful in abating this nuisance but the rapid advance of modern mechanical transport called for heavier duty surfaces as the need for renewal of surface dressings became all too frequent. This is the general limit of advance reached in Ceylon today, a limit reached over twenty years ago; a mile post which requires passing now that the progress of civilization makes greater demands.

Bitumen, in the form of naturally occurring rock asphalt first made its appearance in Western civilization in 1802 when it was used to la-

bridge floors, side walks and floors in buildings. In 1854, compressed rock asphalt was used for paving streets in Paris and fifteen years later in 1869, London paved Threadneedle Street with this rock bitumen. In America it was laid as an experimental pavement in 1870 at Newark, New Jersey, and at Washington in 1876. This constituted an important advance but it was still necessary to find an answer for the communicating roads between the cities. This was solved by retaining the Macadam principle but using bitumen, instead of water, as the binding agent in the mixtures of aggregate. A dustless, durable and waterproof surfacing now seemed possible to suit all practical conditions and this change brought about increased freedom of movement which revolutionized man's mode of life and showed that the advantages of an adequate road system had not been lost on the Romans. The Macadam principle has proved itself throughout the world and is still followed in its original form for certain types of road, of which the roads in Ceylon today are typical; while first class roads in asphalt, tar and concrete are a commonplace in Europe and the U. S. A.

TYPE OF PAVEMENT

There are two main pavement type classifications, Flexible and Rigid. The Macadam type of pavement is rigid. The Telford type is intermediate.

The design of a flexible type pavement is based on the principle of subgrade support at all points. The pavement at all times is considered to move in conjunction with, and remain in contact with, underlying earth subgrade. Where the subgrade has a high supporting power, a relatively thin Macadam construction is possible and economical. Rigid pavements can bridge over relatively small areas by virtue of their beam and slab action but on a really unstable soil, they require the use of an underlying Macadam or similar base.

Some of the advantages of a flexible type pavement are:—

- (a) The effect of temperature change is less prominent than in a rigid pavement

- (b) The strength of the pavement can be increased at any time by the construction of a new top course on the old road, at a minimum cost

- (c) The distributing power is proportional to the square of the depth regardless of the number of layers or interval of construction

- (d) The surface is more or less self-healing so occasional heavy loads are not disastrous.

Macadam surface

Macadam roads alone without a bituminous dressing are not suitable for roads in Ceylon on account of the heavy monsoon storms in the South-West and the arid conditions in the North, both of which are extremes which give this type of construction limitations. Though a Macadam of road depends on the mechanical interlocking of stones for its strength of construction, it is necessary that the voids be filled with fine particles of extraneous cementing material other than its own dust. The extreme of heavy rain not only washes out the cementitious material and allows movement of the stones which causes attrition and eventual raveling up of the surface but also a softening of the subgrade. Whereas the other extreme, dryness, causes dust, cracking, and again sets up attrition between the interlocked stone faces with the same loosening effect. Corrugations are often set up where arid conditions prevail due to fines being lost from gravel surfaces and the coarse stones remaining being formed into waves by traffic. In Africa, it was found that the wave length of the corrugation was related to the rate of oscillation of the non-suspended parts of vehicles travelling at an average speed. At this stage, an extract from the American Highway Practice is self-explanatory:—

"It was thought at first that the rubber tyres produced a 'suction' which pulled out the fines from the top course stones, but later it was found that the tractive effort to the rear wheels,

combined with the partial vacuum under the vehicle itself, largely accounted for the destructive effect produced by motor vehicles. The rapidly moving vehicle thus raised any loosened binder which was then blown off the surface altogether thus robbing the top course. The thrust backward on the individual stones by the rear wheels and the thrust forward under the front wheels formed an effective loosening process which soon completely disintegrated the top".

To the above one must add the additional destructive force in this country of the narrow iron shod wheel of the bullock cart so often revolves unevenly about its axis and gradually grinds and loosens the top course of stone in a Macadam surface. Even a simple bituminous dressing does not provide the complete answer to this problem though it lessens the damaging effect by binding the stones together and holding them in position.

Other bases and surfaces

The science of soil mechanics in recent years has led to the modification of the Macadam design for both base and surface course, gravelled or metalled. In many countries light traffic roads have been designed using a matrix of stabilized soil. The design selected depends on the factors of labour cost and climatic conditions. The West Coast of Ceylon is not eminently suitable for this type of construction but it is hoped that some stretches may be laid in the Gal Oya Development area. In countries where the cost of labour is high and machinery is largely used, soil stabilized gravelled or metalled surfaces are often cheaper to construct than water-bound surfaces. There is less attrition between the aggregates in the surface matrix of this type of road and it is sometimes considered that renewal is less frequent. This method of surfacing is, however, somewhat temperamental as in dry arid areas the stabilized matrix loses its moisture content unless protected by a bituminous seal coat or carpet and then, in wet areas, it is often necessary to protect the matrix from capillary

absorption of moisture. Both these extreme conditions put up the costs of stabilization but, in Ceylon, it would be unwise to contemplate stabilization without the use of a bituminous binder.

Surfaces Discussed

Bitumen provides the basis for most road surfacing in Ceylon as experience has shown it to be the most suitable type of construction to suit the conditions of climate. This paper, therefore, deals mainly with the construction of flexible pavements. Water-bound Macadam is dealt with in fair detail as the majority of roads in the island are constructed in this manner, with a two coat bituminous surface dressing. Other types of grouting construction and premix work applicable to Ceylon are also considered with a view to improving the main thoroughfares, always bearing in mind that bullock cart traffic forms a traffic majority. As it is not possible to consider the pavement by itself, the whole structure and principles leading up to the type of construction dealt with. The Chairman of the Institution of Structural Engineers summed up the situation as follows, thereby indicating the importance that should be attached to the foundation of a road from the subgrade upwards:—

"The average man would probably say that a road is not a structure, but indeed it is a very complex one. In all forms of structural engineering where the engineer is concerned to overcome the force of nature his problem commences at the bottom, whether the structure is a bridge, a road, or a skyscraper. The security and permanence of his foundation control the life of the structure, and in no form of engineering is this truer than in the building of a Highway."

Summarising, the requirements of a modern road are:—(a) A strong foundation

(b) A permanently good resilient surface which is hygienic, impervious, easily maintained, noiseless and dustless.

PRINCIPLES OF DESIGN

LOCATION

In undeveloped sections of a country, the layout of new roads requires a careful study of the lie of the land and the following considerations should be made:—

- (1) Location — on rigid lines as far as possible to secure natural drainage and light earth works
- (2) If the road follows a valley side with the smaller catchment area should be chosen
- (3) Proximity of rock out-crops for quarry purposes.
- (4) Soil conditions.
- (5) Other factors such as river crossings, limiting gradients in hill country, standards of construction, etc.

The longitudinal section is very important from the point of view of ease of travelling and the life of the road. During the layout of the trace spot levels should be taken every 100 ft. along the road edge using a dumpy level and intermediary levels every 20 ft. on the road bed, making a final check from the centre line pegs again spaced every 100 ft.

Soils

A number of years ago each engineer faced the fact that, although every structure designed was controlled by rigid formulae, the foundations on which they were constructed were unknown variables. The highway engineers were particularly conscious of this fact when it was noticed that some soils would support light traffic under all weather conditions; some were stable in dry weather but impassable in wet weather, some would carry traffic in wet weather but were rough and dusty in dry weather, some would serve as stable subgrades, others would swell and disrupt pavements laid on them, some could be compacted to a permanent high density, others were so highly elastic that artificial compaction was ineffective. Gradually there came the realization that soil is not just plain dirt but under proper control is a very important structural material.

Soils are made up of three principal constituents: silt, clay and sand and each group in its pure form has certain definite characteristics.

Any type of pavement or wearing course to be successful must be placed on a sound, stable subgrade, or it must have a base or foundation course thick enough and stable enough to transfer the loads imposed by traffic, from the Pavement or wearing course to the subgrade in a manner that will not overtax the supporting power of the subgrade in its weakest condition. The importance of achieving maximum compaction in the subgrade cannot be over-emphasized. Experiment has shown that a smooth wheeled roller is most suitable for compacting granular soils and a pneumatic tyred roller for clay soils. Small increases or decreases in the moisture content often greatly reduce the supporting power of the subgrade and base course material, especially certain types of subgrade clay and clay binder material. This factor has led to many failures in both low and high cost types of construction. In some localities, the natural soils fortunately are sufficiently uniform in composition to provide uniform support and will satisfactorily pavements of conventional theoretical design as well as low cost surfaces. Ceylon is particularly fortunate in this respect to have an abundance of laterite or cabook which satisfies these requirements. However, in certain sections of the island the roadbed soil in its natural state is either too unstable or weak under either wet or dry climatic conditions, to support the load. In such cases, an adequate foundation must be provided either by stabilizing the natural soil by using natural materials, chemicals or by providing a base course and in some cases both. Stabilization engineering of roadbeds is primarily a study of the local economics of road construction and is a science which still has to be developed in this country.

What is Soil Stabilization?

Simply stated a stabilized fill, subgrade, road surface or road base is one that will stay out, and stabilization is the process by which it has been made that way.

In practice native fine soil may be stabilized by the addition of coarse granular material (aggregate), naturally occurring granular material may be stabilized by the addition of plastic soil, or a suitable mixture of soil and aggregate may be prepared and placed on the road.

Combining Materials

Unless the native material in place on a road after grading is a naturally stable mixture it is necessary to combine two or more materials from different sources in order to secure the desired result for the purpose at hand, whether surface course, base course or sub base. There are four conditions which will be met although the processes of designing are essentially the same. These are: adding aggregate to the native soil in place; adding soil or soil fines to native material not sufficiently cohesive; proportioning mixtures of soil and aggregate for plant mixing and adding non-cohesive material of the proper composition to a surface course to be revamped for use as a base.

The first part of the problem will consist in finding a nearby source of material which can be combined with material in place on the graded road or with another material to produce a mixture which will be within the specified limits for liquid limit and plasticity index of that portion finer than the No. 40 sieve, and in so far as practicable within the specified grading limits.

(To be continued)

Census of Homeless Persons.

A census of homeless people in Madras State will be taken in February 1951.

In this connection, instructions have been issued by the Census Commissioner to enumerators to start work from February 28, 1951, immediately after nightfall. They should visit buildings within their respective blocks where homeless persons like wandering tribes, beggars, sadhus, etc., may be staying and also persons living in boats and enumerate them.

The local police have been asked to give assistance to enumerators wherever necessary.

NEW HOUSE OF COMMONS CHAMBER

TRADITIONAL ATMOSPHERE PRESERVED

By SIR GILES GILBERT SCOTT, O.M., F.R.I.B.A.

Sir Giles Gilbert Scott is the designer and architect of the new House of Commons. Other well-known buildings and structures designed by him include Cambridge University's new library; Liverpool Cathedral; and Waterloo Bridge, London.

When the House of Commons in London was completely destroyed by enemy action on May 10, 1941, only a small part of the whole Houses of Parliament suffered damage. The result has been that when it became necessary to rebuild the Commons its area and height were automatically limited by the buildings of which it formed an integral part.

Its design, too, was to some extent limited; for while it had to be a new House to answer modern needs, its style had also to be in keeping with the rest of the structure. This was in fact, the centre of the design problem—for the Houses of Parliament, designed by Sir Charles Barry and built in the middle of the 19th century, are an outstanding and individual example of late Gothic architecture in which modern conceptions of design would be out of place.

It has been largely by attention to detail and ornament and to scale (the size relationship of a part to a part within the whole) that we have attempted to solve this problem of creating the new Chamber modern in conception and yet in keeping with its older surroundings.

The design of wood and stone detail in the old Chamber, for instance was not satisfactory; the Gothic detail was lifeless and uninteresting and the richness was spread evenly without relief or contrasts, over the whole area. There has been no attempt to follow that earlier design; yet, while the new design is in effect different from that which went before, it is none the less Gothic in style.

Ruined Archway Retained

Only one part of the original structure remains, and that for a special reason. One archway leading to the Chamber has been retained in its ruined and calcined state as a memorial to the destruction of the

House Commons. The Lobby at the entrance to the Chamber, too, has been rebuilt largely on the old lines with modifications in detail; but apart from this, there has been no attempt to follow the design or detail of Barry's work.

The seating and floor plan of the Chamber have been kept much the same as before, but the galleries at each end have been enlarged. This has given a longer roof and has improved the general proportions of the Chamber which was previously rather square in shape. The posts which supported the side galleries in the old Chamber have been removed, thus giving a simpler design and providing considerable practical advantages for the Speaker and members.

Structural alterations were, indeed, limited by the surrounding (and attached) buildings. But there was a large space under the old Chamber taken up with heating and ventilating equipment and it has been possible to reduce this space very considerably, thus providing additional office accommodation for the Ministers and members. In fact, three floors of offices have been provided, two below and one above the Chamber, while still leaving enough room for heating, lighting and similar services.

Intimate Atmosphere

The rectangular form of the new House of Commons Chamber and arrangements of seating follow the style of the old House. They aim to preserve, indeed to increase, its traditional intimate atmosphere so well suited to the British system of Parliamentary debate. The rectangular plan, too, is better suited to the two-party system than the semicircular plan of many overseas legislatures.

One result of keeping to this traditional plan is that not enough

seats have been provided in the House for all Members of Parliament. This arrangement is more sensible than might appear at first sight, for experience has shown that the occasions when more seats are required are few and that for the everyday work of the House it is more convenient to have a small space will under the view and control of the Speaker.

But in the Chamber there will be seats for 939, including members, "special strangers" (members of the Diplomatic Corps), "ordinary strangers" (members of the public), reporters and officials, as against 802 in the old Chamber.

Flourescent lighting is installed throughout the new House, that in the Chamber coming from the ceiling through glass panels which in daylight are hardly to be distinguished from the surrounding oak panelling.

English Oak Woodwork

The Speaker's Chair and the Table of the House apart, all the Chamber is of English oak treated with a ferro-sulphate solution to give it a soft olive-grey colour with a tint of brown in it. The walls and ceilings of the Division Lobbies are panelled in oak. The seats are upholstered in green leather, the floor is covered with a green carpet in the centre and with brown carpets between the seats.

There have been generous Commonwealth contributions to the new House. Much of the furniture and fittings (all of which, even to the ashtrays and inkstands have been specially designed for the House) are gifts from the Commonwealth countries and the Colonies, while the table in the Prime Minister's conference room has a band of inlay containing woods from the whole of the Commonwealth.

PORTABLE PILE TESTING RIG

Development of Californian Highways Department

In order to obtain a quick economical method of making load tests on piles, the Californian Bridge Department of the Division of Highways has developed a convenient lightweight testing apparatus. The new equipment, according to G. C. Smith, associate-bridge engineer, has been successfully used to make load tests on several jobs, including drilled in piles in the Imperial Valley.

Eighteen reinforced concrete slab bridges were being built on Route 187 which follows up the east shore of the Salton Sea. All of the bridges were founded on drilled-in piles consisting of reinforced concrete columns poured in 14 in. diameter holes drilled in the ground. The foundation in this locality was suited admirably to this system and the holes stood perfectly after drilling.

This technique represented a definite departure from piles previously used by the Department. No pile driving was done. The only equipment necessary was that used in drilling the holes. This consisted of a truck-mounted petrol-powered sugar-type earth drill capable of drilling holes to a depth of about 22 ft. All piles penetrated at least 15 ft. below channel grade. Standard reinforcing for east-in-place piles was used throughout. Pile extensions were poured in 1 1/2 in. diameter steel forms which extended from the ground line to the cap. The design load is 20 tons per pile.

To determine the actual load-carrying capacity of these piles, two load tests were made with the new equipment.

At two sites, one where the specified pile penetration was 20 ft. below channel grade, the other, where penetration was 15 ft., two midway between two plam piles. The test piles were reinforced similar to plam piles. However, the two piles on either side of the test piles, used as another for the jacking truss, were each additionally reinforced with four 1-in. bars. These bars extended from the pips of the piles to approximately 2-ft above out-off. The protruding bars were bent over and around the fins of the truss base and welded one to another.

Load Testing Equipment :

The pile load testing equipment was operated by Bridge Department personnel. This equipment consists of (1) a pin-connected steel truss which is used to transfer reaction loads to the two anchor piles; (2) a hydraulic power unit; and (3) a 115-ton capacity hydraulic jack.

The hydraulic power unit is a self-contained high-pressure constant pressure system designed for field use and powered by a 5 kw. output of 270 r.p.m. is directly connected to a rotary piston type hydraulic pump capable of a maximum pressure output of 3,000 p.s.i. Discharge from pump is piped to manifold. Connected to the manifold are :

- (1) A 3,000 p.s.i. nitrogen loaded accumulator cell which is preloaded to 1,000 p.s.i.
- (2) A close pressure differential mercury switch.
- (3) A 4,000 p.s.i. gauge.
- (4) A 350 p.s.i. overload relief valve containing a relief valve port leading back to a reservoir tank.
- (5) Pressure outlet lines leading to a 4-way control valve by which pressure may be diverted to either side of the piston of the double-acting 115-ton hydraulic pressure cell.

The purpose of the nitrogen loaded accumulator is to maintain a constant load even though slight pile settlement occurs. This enables the equipment to be brought to proper load and left without constant attention to maintain an even hydraulic pressure at the loading cell. The pressure switch may be adjusted to hold the pressure within a 150 lb range. The maximum pressure that may be developed through the mercury switch is 2,500 p.s.i. Two level gauges are mounted on the power unit to ensure levelling of the mercury switch. The 4,000 p.s.i. gauge is used a cross-check on the mercury switch and for setting the switch accurately. A needle valve with a lead-off line is incorporated in the 3,500 p.s.i. overload relief valve and is used for controlling pressures between 0 and 1,000 p.s.i.

The 115-ton pressure cell is a double-acting hydraulic jack having a 103'87 square inch piston area and a 4 in. stroke. Barrel and main base of cell are steel; the piston lock-ring, and two self-aligning plates are of aluminium.

The equipment features simplicity and economy in both its application and operation. The application of load, subsequent removal to measure rebound, and reapplication of load takes only a few minutes contrasted to hours required when loading with either liquid or solid weights.

The surface soil mantle throughout this area consists of a few inches to a few feet of gravelly clay and gravelly fine sandy clay. This is underlain by a hard silty clay generally referred to as Imperial clay. Power borings were made throughout the area during March, 1949, at which time preliminary foundation studies were being made for this project. Drilled holes on two or three occasions were extended to depths in excess of 50ft. without penetrating below the Imperial clay.

With the exception of a few thin layers of volcanic ash encountered in the deeper borings, the clay sediment was essentially uniform in character. Two-inch undisturbed samples were taken and unconfined compressive strengths measured in the field. These tests indicated that the clay sediment had an average shear strength of approximately 3,500 lb. per cent (dry weight). Unconfined compressive strengths upto two tons per square foot were measured at depths of 3 ft to 5 ft below stream beds at drainage and irrigation ditch sites. Such values attest to the impermeable nature of the clay sediment since water had been flowing is certain of these channels for many months prior to this study.

Under three recent contracts, a length of about 26 miles along the east side of the Salton Sea north of Niland is being improved to two-lane width. Ninety posted bridges, many with only a 10-ft roadway, have been eliminated or replaced. (With acknowledgements to "The Contract Journal").

RIVER VALLEY PROJECTS

Mr. M. P. Mathrani, Chief Engineer (Irrigation), Bihar, and President of the Central Board of Irrigation, addressing the meeting, pleaded for a "realistic" outlook in planning the development programmes of the country, the association of engineers in the planning and the desirability of concentrating on a few of the schemes and completing them.

Mr. Mathrani also suggested the revival of the old system whereby Chief Engineers of States were the secretaries of the departments which resulted in "greater efficiency of administration and smoother and expeditious execution of irrigation and electrical works." The practice of taking away the secretaryships from the Chief Engineers, he added, was "leading to loss of efficiency and considerable frustration."

Referring to the forthcoming International Engineering Conference. Mr. Mathrani regretted that the response from some States and industries had not been encouraging.

Mr. Mathrani said that the two important problems facing the country were the need for food self-sufficiency and rehabilitation of displaced persons. Though the deficiency in food was only six to seven per cent and could be wiped out if there was good monsoon without any natural calamities, "we have to reckon with the wild forces of nature and learn a hard lesson. We must make our self-sufficiency proof against all such natural contingencies as far as we can."

Referring to the various river valley projects and irrigation schemes, he said that nearly 160 schemes, estimated to cost on the whole about Rs. 1,279 crores, were under investigation or construction in the various States. If all of them were executed, about 31.2 million acres of land, producing an additional 10.3 million tons of foodgrains would be brought under irrigation and additional 8.5 million Kwts. of power would be generated while vast regions of Bengal, Bihar, Uttar Pradesh, Orissa,

Madras and Bombay would be brought under flood-control.

Pleading for a "realistic" outlook and a "certain amount of introspection" which was "often conducive to better progress". Mr. Mathrani asked: "Have we prepared our blue-prints properly, knowing the limitations of men, material and money? Have we not embarked on some of the schemes with undue haste? Are we going on with the schemes under construction according to a fixed target programme?"

"Let us have a clear-cut programme for the future and stick to some fixed target periods", he continued and warned that if target-periods were not adhered to, overhead costs would increase and productive schemes would become unproductive".

"If there is shortage of funds or materials, it should not happen that all the schemes should progress slowly. It would be desirable to concentrate and complete some of the schemes and have some results".

The multi-purpose river valley projects would provide water for the irrigation of large tracts of undeveloped country and give large blocs of hydro-electric power, which will materially help in the industrialisation of the country. "Both these factors can greatly help in the rehabilitation of refugees", he added.

Mr. Mathrani said that for the integrated development of inter-State rivers, the Government of India had framed legislation which, when passed, would satisfy a long-felt want. Some of the inter-State river disputes had lasted for decades.

Mr. Mathrani said that the Indian river valley schemes and multi-purpose projects were being modelled on the American T.V.A. plan. But this should be done bearing in mind the local conditions. Unlike in the United States, in India almost all hydroelectric schemes had been constructed by Government engineers and there were not many private consultants. Unless the right type of engineers was employed on the river valley schemes being executed through regional water boards, these schemes might prove a failure, he warned.

Mr. Mathrani also pleaded for the revival of the cadre of Indian

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Ministry of Works in England is subscribing for 400 journals.

Service of Engineers. He said that since the stoppage of recruitment to the I.S.E., there had been no systematic recruitment based on competitive tests and this had been "affecting the efficiency of the engineering services"

Mr. Mathrani felt that there should also be a central pool of plant and equipment as private contractor firms in India would not find it economical or possible to purchase and maintain costly machinery needed for the various projects.

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After the pages of Notes and Topics are out of press, the All India Housing Congress proposed to be held at Bangalore on Dec. 2 is postponed.

CONTRACTS OPEN

The dates at head of paragraphs are those for the submission of Tenders. Application for forms and particulars should be made to the addresses given at the end.

NILGIRIS : Power house.

Nov. 15.—Construction of the Moyar Power house Building Superintending Engineer, Moyar Hydro-Electric scheme, Moyar Camp, P.O., The Nilgiris

KORANAD : School Building.

Nov. 15.—Work of construction a new high school building at Koranad, Estimated cost is Rs. 80,000 Commissioner, Municipal office, Mayaram.

GUDIVADA : Roads.

Nov. 15.—Execution of cement Concreting offices road, Estimated cost is Rs. 43,400, Commissioner, Municipal office, Gudivada.

MATWAD : Bridge.

Nov. 15.—Construction of a Bow-string Girder type bridge over Ambala river at Matwad in mile No. 175/3 of Bombay-Nadiad Rajputana-Delhi Road, N. H. No. 8, about 10 miles South East of Narsari Station. Estimated cost Rs. 5,23,395. Executive Engineer, Narsari & Damps Division, Bombay.

BELLARY : Dam.

Nov. 15.—Construction of Masonry Dam in the reach 4-7-380 to 4-7-650.

Construction of R.O. Arch Aqueduct in the reach 5-0-80 to 5-0-440 with a central span of 120 and 2 end span of 60 each.

Masonry side walling in the reaches, 4-7-120 to 4-7-380, 4-7-650 to 5-0-80, 5-0-440 to 5-1-35. Superintending Engineer, Tungabhadra Project, canals circle, Bellary.

SALEM : Buildings.

Nov. 16.—Construction of non Residential Buildings superintending Engineer, General Construction circle, No. 5, Racquet Court Lane, Clive Lines, Tiruchy cont.

TIRUCHY : Towers on River Bed

Nov. 20.—Construction of Masonry foundations on River bed for special towers. Superintending Engineer, General Construction circle No. 5, Racquet Court Lane, Clive Lines, Tiruchy cont.

POONA : Quarters.

Nov. 15.—Construction of 8 Quarters for class II officers at Poona Estimated cost Rs. 1,93,000. Superintending Engineer, Central Circle, Poona.

TADPATRI : Houses.

Nov. 15.—Construction of dwelling house of the types B2, B1, B & C. Approximate value of work is Rs. 2 Lakhs. Tadpatri Co-operative House Building Society Ltd., Tadpatri.

VAITARNA-CUMTANSA :

Supply of Auto Transformer.

Nov. 15.—Tenders for the supply of a 416 K.V.A. 2000 3300 V. Auto Transformer and other Auxiliaries for 2500 K.W. Station at Vaitarna. Municipal Commissioner, Bombay Municipal Corporation, Bombay.

KALYAN : Dombivli water supply.

Nov. 16.—Laying 24 Hume steel rising main estimated cost Rs. 82639.

Construction of a Coagulating tank, Filter house, and Engine house Estimated amount Rs. 319934 Executive Engineer, Eastern Public health works division, Manik Villa, Sharampur Road, North City.

AHMEDABAD : Tenements.

Nov. 16.—Construction of 512 tenements of semi-detached type in Phase I of the Industrial Housing Scheme at Malaksaban Tank Approximate cost Rs. 1133056.

Construction of 304 tenements of semi-detached type in Phase II of the Industrial Housing Scheme at Malak Saban Tank. Approximate cost Rs. 672752 Executive Engineer Housing Division, Lal-Darwaja, Ahmedabad.

BOMBAY : Sanitary work for the new Hostel

Nov. 20.—Sanitary and Plumbing work for the new Hostel, V. J. T. I., Bombay. Architectural Service, Navsan Chambers, Outram Road, Fort Bombay.

KORAPUT : Hydro Electric scheme

Nov. 22.—Excavation in all soils including trimming of flume channel bed and slopes in rock sections. Collection of rubble and spalls, Concrete Lining, Superintending Engineer, Machkund Hydro Electric, Machkund P. O., Koraput Dist., Orissa.

SURAT : Hospital

Nov. 22.—Construction of the Ayurvedic Hospital, Estimated cost. Rs. 2,25,000. Secretary, shree Tape Brahmachary Ashram Sabka, Lal Darwaja, Station Road, surat.

BARODA : Reconstruction of Road

Nov. 27.—Reconstruction of Baroda Khandewadi Road sec 1 Mil 1/5 to 5/0 (supply of materials only) Estimated cost Rs. 53,950. Executive Engineer, Baroda Division, P.W.D. Baroda.

KANHAN : Filters

Nov. 28.—Construction of two filter beds each of 1.5 m. 6. d. capacity with settling Tanks, City Engineer, Municipal committee, Nagpur.

WORLI : Labour welfare Centre

Nov. 28.—Work of conversion of 'A' Type Labour welfare Centre at Worli into a working class Theatre. Estimated amount. Rs. 24,600 Executive Engineer, Presidency Division, Bombay.

BOMBAY : Workshop Building

Dec. 1.—Work of construction of work shop Building for the Elphin stone Technical High school, Bombay Estimated amount Rs. 20,4193.

Executive Engineer, Presidency, Bombay.

BOMBAY : Bridge

Dec. 13.—Work of constructing a bridge over Bhojeshwari river on Pen Division in Mile. No. 63/0 at Pen on Bomday Konkan Goa Road. Estimated amount. Rs. 87,370. Executive Engineer Kolaba Division, Alibag.

MADRAS : Machkund Hydro Electric scheme

Dec. 15.—Manufacture, testing before shipment and delivery. F. R., nearest railway stations distribution to site, erection and testing and setting to work of the carrier current equipment for operation on 132. R. V. Transmission Line of the Machkund system and also for V. H. F. Radio Equipment. Superintending Engineer, (Technical) 157, Mount Road, Madras-2.

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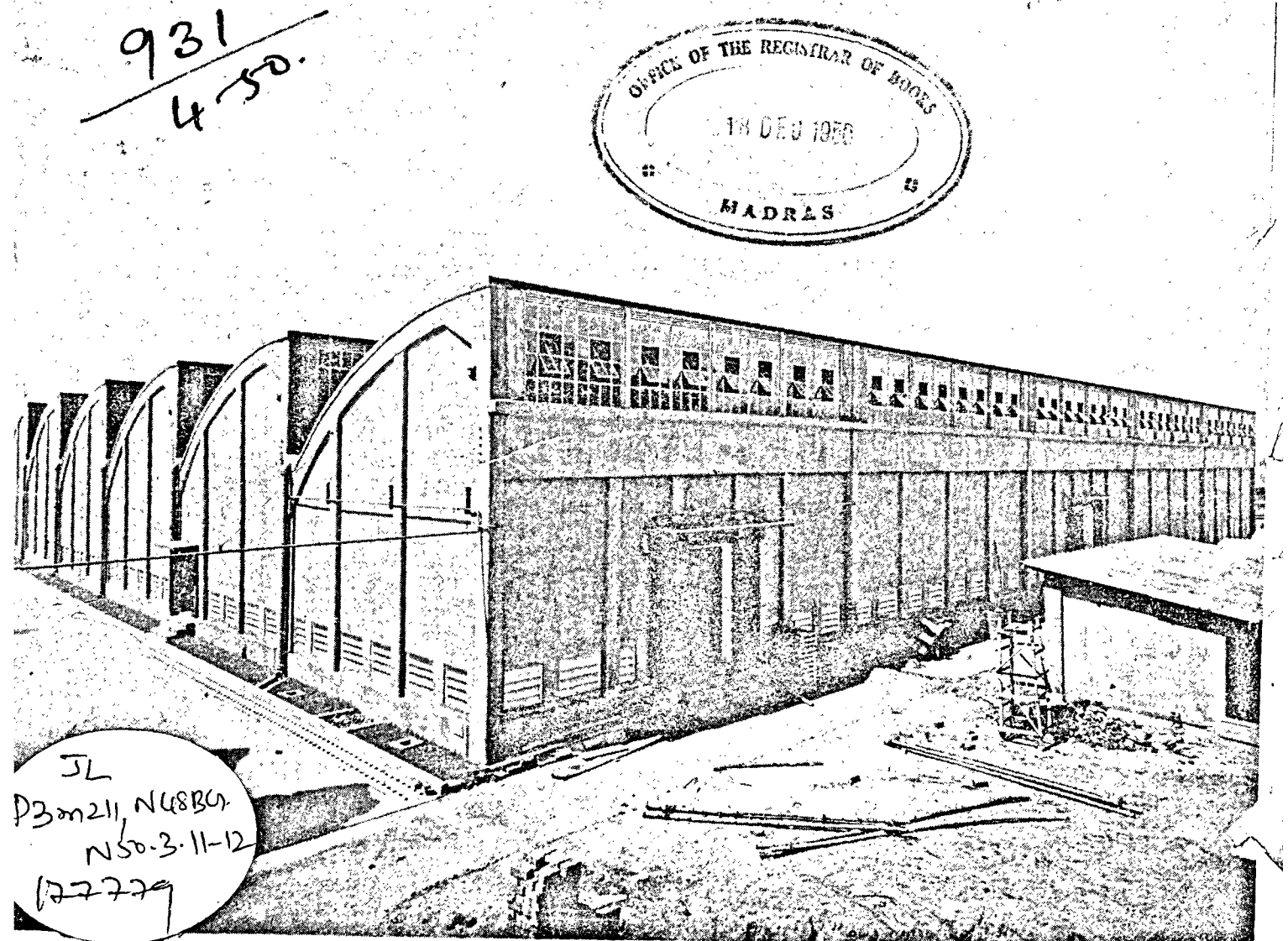
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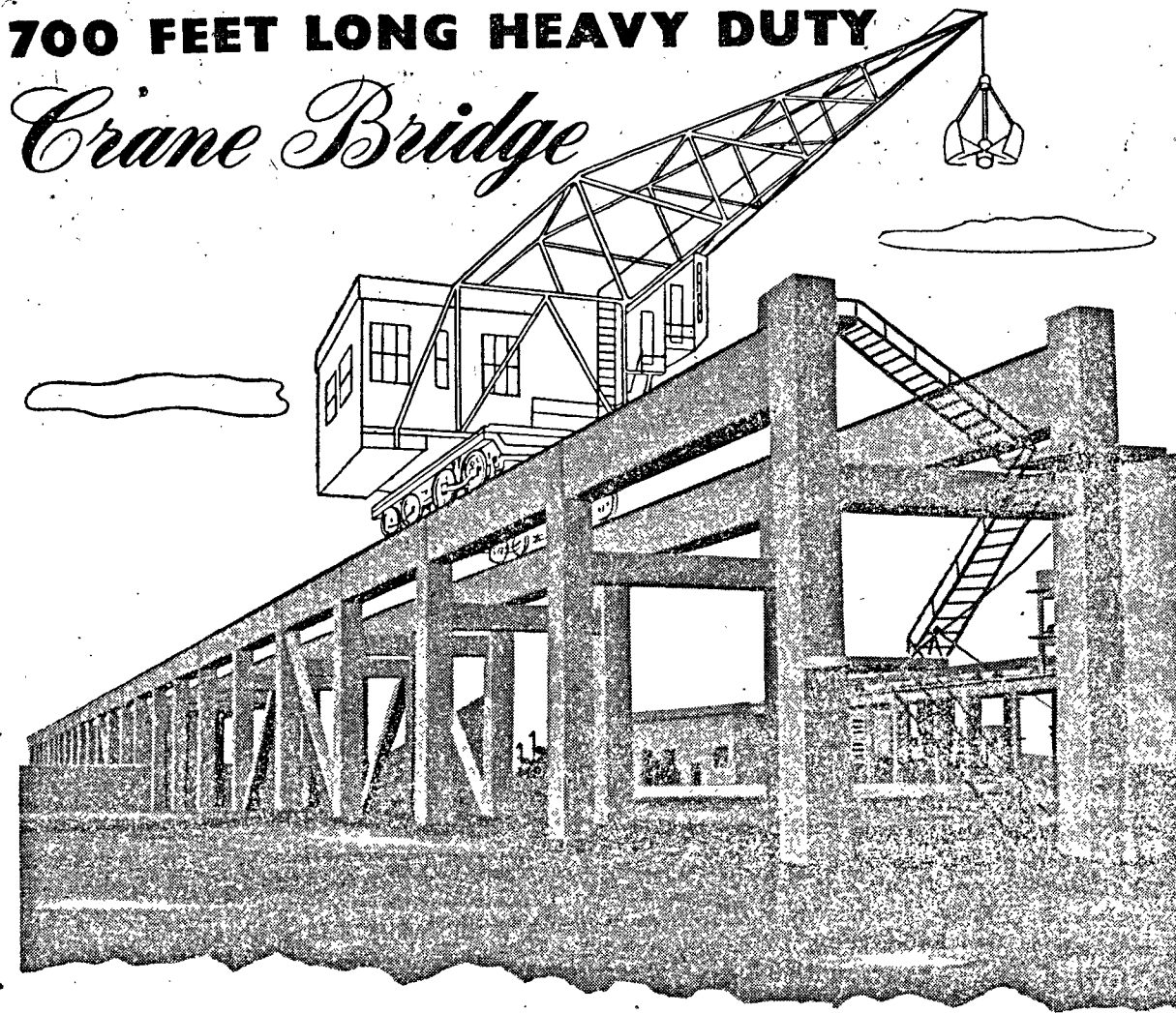
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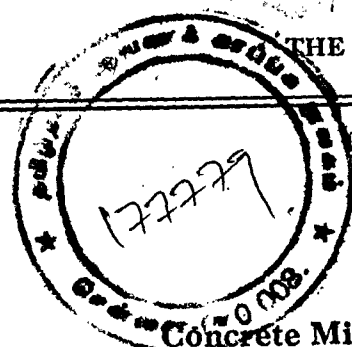
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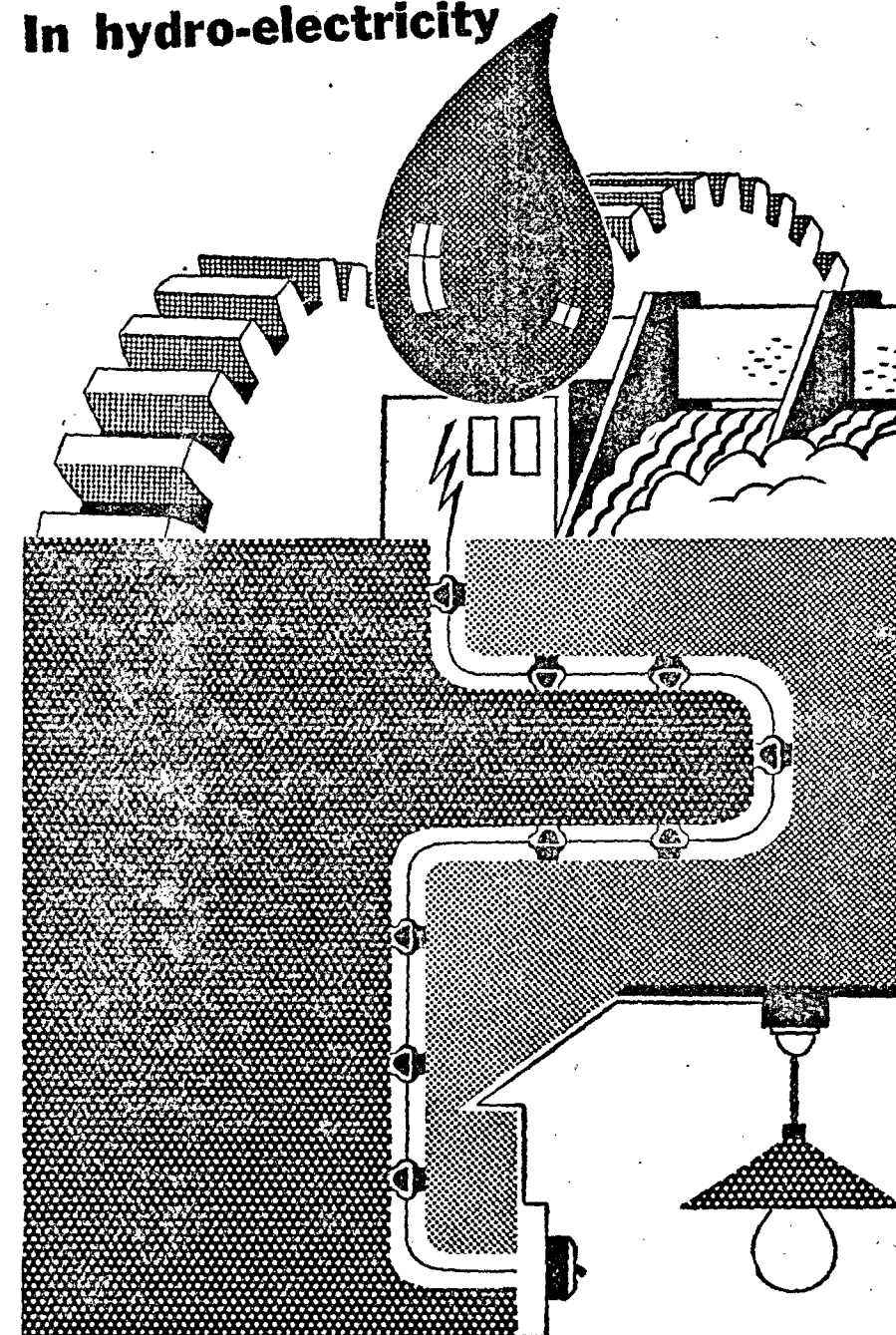
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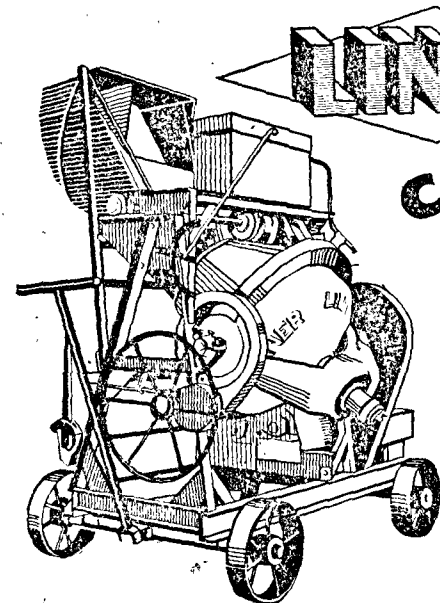
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GOOD TASTE AND GOOD MANNERS

The Prime Minister, Mr. Jawaharlal Nehru, urged recently addressing the Indraprastha College at New Delhi that people should imbibe artistry and aesthetic sense in their everyday lives.

There is much to be done before the ideal can be attained which shall ensure that the growing interest of the youth of today for education in visual appreciation shall be developed and the results of that education become apparent in a lively expression of public opinion.

Whatever the cause, it is a fact that the majority of children leaving school are indiscriminating in their appreciation of design in 'Good-Taste' in matters of everyday life. The capacity for good judgement in aesthetic matters is certainly latent in most children, but is warped or suppressed by bad surroundings or strong misleading suggestions in youth and adolescence, or, at least, is not fully elicited by the educational process.

Something can be done by books, more perhaps by example, but undoubtedly the most important potential influence on the future of public taste lies in the general educational system, and its physical environment.

The best way of securing this aim is to see that the schools themselves are well sited and designed; the rooms light, airy, well-proportioned and well designed; the furniture functionally and aesthetically right. Objects and illustrations used for demonstration purposes should be so chosen as to elicit the highest degree of appreciation possible to the child at successive stages in his education.

As it is, the work in schools often lacks taste, direction and drive; and above all the present education is concerned only with books and not with man. This brings us to the vital consideration of our part as spectators. Is there some pass-word, some "open sesame" which will unlock the door all at once? The answer is "no". It is a gradual process; and WE have EACH of us got to START just where we are and build up our standards.

Unfortunately, it is our indifference, our spineless acceptance of things as they are, our unwillingness to abandon some of our ignorant prejudices, and to confess that we do not know much about art after all, and ought to know more before we start passing judgements, that are at the root of all evils.

NOTES & TOPICS

Functional Standards of Housing

It may be interesting and not without value to consider the practice of the U.S.A., which is not so bound up with tradition as we are, and where our American friends, faced with a housing situation at least as difficult as ours was at the time, formulated and carried out a small Federal-assisted housing scheme. Their Housing Act of 1937 required all houses to be well planned to reasonable densities, and that the rent should cover certain agreed standards. The rents charged are one-fifth of the total family income, reduced to one-sixth if there are more than two children. When and if the family income rises to an economical rent, such families have to leave, and rent or buy a house in the open market. This method of assessing rents involves a means test, which, met with general acceptance as a rational solution of the problem of rents.

Architects and Engineers.

The training of architects is mostly artistic, and naturally they look at town planning very largely from the artistic and architectural aspects. Civil and Municipal engineers have not as a rule had the slightest training in art or architecture; in consequence they design almost wholly from utilitarian motives—although very frequently, their highly trained senses of proportion, weight, and fitness, permit them unconsciously to give a certain clean balance and grandeur to their works.

Only a very small number of the books on city planning have come

from engineers; this honour lies nearly all with the architects. We do not live in an age markedly artistic—the case is rather the reverse—and effectively to place artistic ideas before people who are inartistic, needs the combined strength of the engineer as well as the architect.

Automatic Locking Device.

In Germany workers who live up-country cycle to the suburban terminal stations, store their cycles at the stations, and come to the city in cheap trains. In Berlin, Leipzig, and other big cities, they have developed a remarkable method of parking bicycles and of defeating the bicycle thief.

They erect bicycle racks in the usual way, together with an ingenious automatic locking device for securing the cycle. This automatic locking device consists of a steel box about 7 inches square and 2 inches thick, with a chain for securing the cycle, and an internal mechanism similar to that in the "Home Safes" issued by banks. The insertion of a five pfennig (3d) coin releases one end of the chain from its socket and at the same time delivers a Yale-type key which the cyclist puts in his pocket. The chain is then rove through the wheel or frame of the cycle and the loose end is snapped into the central socket on the face of the box, thus securing the bicycle until the owner's return. The insertion of the key releases the chain again and the bicycle is set free, the key itself remaining fixed in the lock in readiness for the next customer.

This 3d charge not only permits the securing of the bicycle and its protection from the elements, but also insures the cycle for £5 against theft—a really economical proposition for cyclist. As regards reliability, the Berlin Police Headquarters Advisory Bureau on Burglary and Theft, after applying very severe tests, expressed its approval of the device recommended it to the authorities.

City Improvements.

There are only three administrations by which backward cities can be rectified and developed.

- (1) By autocratic single-man rule, adequately financed.
- (2) By a single constituted body of men adequately financed, and with full power given them over all other authorities and over all individual interests.
- (3) By means of genuine, full, and unselfish civic cooperation between all the authorities and interested bodies of a city, and sufficient money.

Anyone entrusted with the job of town improvements should not try to put pen to paper until after a year's study of the town.

New Factory Building.

To the Industrial Buildings in South India, the Metal Box Co. (India) Ltd has added a new kind of factory building in Madras. The important feature is the shell-type concrete roofing (see Cover Page) designed by J. C. Gammon & Co. Ltd. The main office building was constructed by the Coromandel Engineering Co., Ltd. Vitrolite was used for bath rooms.

Building Code for Madras.

The Madras City Corporation Council has approved recently the draft 'Building Code' presented by the Expert Panel constituted by the Government. Accordingly a new building department will be created under the city Engineer.

The Code which has been prepared to ensure the sound and stable erection of building and minimum standards of health and sanitation provides for licensing of Surveyors for submission of applications for construction of buildings.

The Code, it is learnt, is being submitted to the Government for acceptance. It would then be published for eliciting public suggestions and criticism for a period of six to eight weeks, which might be fixed. The code would necessitate the amendment of a few sections of the City Municipal Act, and would be placed before the Council again for confirmation, with the suggestion and criticisms of the public.

U. N. Mission on Tropical Housing.

A Mission of four experts on tropical housing sent out by the U. N. to study and report on housing conditions is expected to arrive in Madras on December 19.

The four members are: Mr. Jacob L. Crane, Adviser to the Housing and Home Finance Agency, U.S.A., Mr. R. J. Gardner-Medwin, Chief Architect and Planning Officer, Department of Health for Scotl and Mr. Antonio C. Kayonan, Chief Planner of the National Urban Planning Commission of Manila and Prof. Jacobus P. Thyse, of the University of Indonesia.

New Assembly Hall, Madras.

The new Assembly Hall, under construction at Madras consists of two blocks connected by an auditorium in the Centre accommodating 330 seats for members, besides 120 seats for Reporters. The contractors are Messrs Sathyanarayana Bros., with Mr. N. Kesava Rao as their Consulting Engineer. Construction has come up to the basement level and scheduled for completion by May, 1951. Roofing for the auditorium consists of 9 Hangar-trusses got from the Military Disposals. Cost is about Rs. 7 lakhs.

Pupils Make Bricks.

Eight-hundred African school children volunteered to make bricks and do building work when labour shortages threatened to hold up work on a new African secondary school on the outskirts of Lusaka.

While the school was closed, teachers and children moved to the building site and began producing bricks at the rate of 15,000 a day. It was estimated that altogether they would make 750,000. No pay was received.

It is expected the new school buildings, which will accommodate 400 boys, will be ready next August.

World Engineering Conferences: Scope of Indian Session.

The scope and programme of the ensuing series of international

engineering conferences, described as one of the largest world gatherings in the East, and the Indian International Engineering Exhibition, which "will be one of the biggest Exhibitions ever held in India and the first of its kind in the world" were outlined by the Minister for works, mines and power, Mr. N. V. Gadgil, at a press conference recently.

The Government of India's invitation, he said, had met with satisfactory response from foreign countries. State Governments and engineering organisations and institutions in India.

About 30 countries are sending 275 delegates, including 40 women to the various conferences. There will be about 300 Indian delegates. Preparations are under way for a joint session of the fourth International Congress on large dams, a sectional meeting of the World Power Conference and the first International Congress on Irrigation and Canals, in Parliament buildings on January 11.

The delegates will also go on a study tour of the various river

valley projects, other engineering establishments and factories.

The exhibition, in which several foreign countries are also participating, will be held in Delhi. The grounds will cover an area of half a million square feet and several attractive features will be displayed at the exhibition.

Immediately before the Delhi conferences, a meeting of the International Association for Hydraulic Research is to be held in Bombay on January 2.

Minimum Wages Committee.

The Government of Madras have constituted four committees to advise them in the matter of fixation of minimum rates of wages for (i) Employment in any plantation; (ii) Employment on road construction, or building operations and employment in stone breaking or stone crushing; (iii) Employment in Carpet making; and (iv) Employment under any local authority.

According to the provisions of the Minimum Wages Act, 1948, minimum rates of wages have to be fixed by the State Government in all the scheduled employments before March 15, 1951.

PLANNING THE CITY OF LONDON.



The enemy raids which caused millions of pounds worth of damage in the City of London are giving rise to the first town-planning which the City has experienced since the Great Fire 1666. Joseph Bamford, who is employed by the Guildhall, is seen at work on a model of St. Paul's Cathedral area as it will appear in the re-planned London.

GRAVITY OR PUMPING?

AN EXAMPLE IN COMPARATIVE ESTIMATING

By L. B. ESCRITT, A.M.I.C.E., F.I.S.A.N.E., M.R.S.A.N.I.

Estimates often have to be made to determine which of a number of schemes will be most economical in the long run, and very frequently the comparison is between initial capital expenditure and running costs. A typical example is the preparation of estimates to decide whether or not it will pay to embark on an expensive gravity sewerage scheme when the capital cost of a pumping scheme is considerably lower.

Estimates for local government proposals are eventually expressed in terms of annual cost chargeable to the rates. Thus, capital cost has to be converted to an annual payment which is then directly comparable with running costs. As local government works are largely financed by loans raised with the sanction of the Ministry of Health and repaid in equal yearly or half-yearly instalments over a period of years, and as the loan periods approved by the Ministry are more or less in proportion to the useful life of the

works concerned, the annual value of capital expenditure is fairly represented by repayment of loan in equal instalments, including capital and interest.

The approved loan periods are not officially stated, but it is understood that the following are usual. The longest loan period of sixty years is allowed for freehold land: loan periods of forty to fifty years have been approved for very permanent structures e.g., impounding reservoirs: the vast majority of civil engineering works including water and gas mains, pumping stations, treatment works, etc., are financed on thirty-year loans: twenty years applies to reinforced concrete works, highways, tramways and the main machinery of electrical generation and distribution and gas manufacture: fifteen years is the usual period allowed for water and sewage pumping plant and the electrical equipment of waterworks, sewage works, etc.

REPAYMENT OF LOANS.

£'s annual repayment, including capital and interest, per £100 of loan.

Percentage interest.	Period of loan.			
	Fifteen years (machinery).	Twenty years (reinforced concrete).	Thirty years (works).	Sixty years (land).
2	7.7825	6.1157	4.4650	2.8768
2½	7.8555	6.1897	4.5421	2.9645
3	7.9289	6.2642	4.6199	3.0535
3½	8.0026	6.3392	4.6985	3.1438
4	8.0767	6.4147	4.7777	3.2353
4½	8.1511	6.4907	4.8577	3.3281
5	8.2259	6.5672	4.9384	3.4220
5½	8.3011	6.6441	5.0198	3.5171
6	8.3767	6.7216	5.1019	3.6133
6½	8.4526	6.7995	5.1847	3.7106
7	8.5289	6.8779	5.2682	3.8096
7½	8.6055	6.9568	5.3525	3.9084
8	8.6825	7.0361	5.4371	4.0088
8½	8.7599	7.1159	5.5226	4.1103
9	8.8376	7.1962	5.6088	4.2127
9½	8.9157	7.2770	5.6956	4.3160
10	8.9941	7.3582	5.7830	4.4202

Example Calculation.

The example chosen to illustrate the making of such comparative estimates is the drainage of a housing estate by either a long gravity soil sewer, or a soil sewage pumping station and comparatively short rising main. The conditions are as follows:

Number of houses	... 262
Number of persons per house	... 4
Estimated water supply	... 30 gallons per head per day.
Total dry-weather flow	31,440 gallons per day.
Sewers are designed to take four times dry-weather flow	=125,760 gallons per day.
	= 13.97 cu. ft. per min.

Gravity Scheme.

The gravity scheme involves a 6-in. sewer laid at a gradient of 1 in 140. This delivers 30.9 cu. ft. per min., which is ample. The total cost of 2,200 yds. of sewer, including manholes, etc., is estimated at £4,090, and no allowance is made for maintenance.

Assuming that the current rate of interest is 3 per cent, annual repayments over the appropriate period of thirty years will be:

$$4,090 \times 0.051019 \text{ (see table)} \\ = \text{£}209 \text{ (approx.)}$$

Pumping Scheme.

The appropriate diameter of rising main for 13.97 cu. ft. per min. is 4 in., as this gives the self-cleansing and economic velocity of about 2½ ft. per sec. The rising main is 600 ft. long; the hydraulic gradient, accor-

ding to Crimp and Bruges' tables, is 1 in 78.

$$\text{Then: Friction loss} = \frac{600}{78} \dots \\ = 7.7 \text{ ft.}$$

The station losses are made up as follows:

Fitting	Equivalent length of main in feet.
Sluice valve	... 1.5
Sluice valve	... 1.5
Reflux valve	... 10.5
Bend	... 9
Bend	... 9
Bend	... 9
Junction	... 18
Total	... 58.5

$$\text{Loss of head in station pipework} = \frac{58.5}{78} \\ = 0.75 \text{ ft.}$$

$$\text{Dead lift, 290.5 O.D. to 345.0 O.D.} = 54.5 \text{ ft.}$$

$$\text{Total manometric head} = 62.95 \text{ ft. Water} \\ \text{horse-power} = \frac{13.97 \times 62.5 \times 62.95}{33,000} \\ = 1.66 \text{ horse-power.}$$

Unchokeable pumps of this size may be expected to have an overall efficiency in the region of 25 per cent.

$$\text{Then electric horse-power} \dots = \frac{1.66 \times 100}{25} \\ = 6.64 \text{ E.H.P.}$$

$$\text{Allowing a 10 per cent margin, installed horse-power} = 6.64 \times 1.1 \\ = 7.3$$

$$\text{Installed kilowatts} \dots = 7.3 \times 0.746 \\ = 5.45$$

$$\text{Allowing a power factor of 87 per cent, Kilovolt amps.} = \frac{5.45 \times 100}{87} \\ = 6.26$$

If K.V.A. charge is £10 per annum per K.V.A., total K.V.A. charge will be £62.6 per annum.

If pumps are installed to deliver four times dry-weather flow, they

will run 6 hours per day during dry-weather. Then:

$$\text{Units consumed} = 6.64 \times 0.746 \times 6 \times 365 \frac{1}{4} \\ = 10,850 \text{ units per annum}$$

10,850 units at 0.9d. per unit = £40.7. To this should be added an allowance for wet-weather flow which, without local knowledge, is largely guesswork. In the present instance, we will assume that on the basis of local knowledge 33½ per cent should be added, giving a total charge for consumption of electricity of:

$$\frac{40.7 \times 133 \frac{1}{2}}{100} = \text{£}54.2$$

While electricity charges can be calculated with some degree of certainty, the other running costs—labour, repairs, stores, etc.—are not easily estimated except by comparison with existing works. These items can vary considerably according to local conditions and the practice of the authority. For example, if there is only one pumping station, maintenance could be by contract or else could be charged as part of the time of mechanics mainly employed on other work. If, on the other hand, several pumping stations were to be installed, staff could be taken on for the specific purpose of maintaining these stations, in which case the labour charge could be more closely estimated.

Examination of the actual costs of running a number of all-electric pumping stations suggests that the following formula could be used for estimating these costs for automatic electric soil-sewage pumping stations of capacities between the limits of 2,500 and 500,000 gallons per day dry-weather flow:

$$\text{Annual charge in pounds} = 6 \times \sqrt[3]{\text{gallons per day dry-weather flow.}}$$

$$\text{Then: Annual maintenance cost} = 6 \times \sqrt[3]{31,440} \\ = \text{£}189.4$$

$$\text{Total running costs are: } 62.6 \\ 54.2 \\ 189.4 \\ \text{£}306.2$$

To these running costs are added annual repayments of loan.

$$\text{Cost of pumping plant} \dots \text{£}780$$

$$\text{Repayment annually over 15 years at 3 per cent interest} = 780 \times 0.083767 = \text{£}65.3$$

$$\text{Cost of pumping station building} \dots \text{£}590$$

$$\text{Cost of rising main} \dots \text{£}1,050 \\ \text{£}1,640$$

$$\text{Repayment annually over 30 years at 3 per cent interest} = 1,640 \times 0.051019 \\ = \text{£}83.7$$

$$\text{Cost of land for pumping station site} \dots \text{£}200$$

$$\text{Repayment annually over 60 years at 3 per cent interest} = 200 \times 0.036133 \\ = \text{£}7.2$$

$$\text{Total annual cost: Maintenance, etc.} \dots \text{£}306.2$$

$$\text{Repayment of loan: Machinery} \dots \text{£}65.3 \\ \text{Pumping station and rising main} \dots 83.7$$

$$\text{Land} \dots 7.2 \\ \text{£}462.4$$

Thus it is found that the gravity scheme (which involved the greater capital cost) is the scheme to be selected in that it involves less than half the total annual costs of the pumping scheme. (All calculations above are by slide-rule.)

(With acknowledgements to the Surveyor.)

AUSTRALIA'S AIRCRAFT INDUSTRY

Aircraft production in Australia, in the sense of the production of complete aircraft in premises designed and organised specially for the manufacturing of aircraft on a continuing basis, began in 1936, when the Commonwealth Aircraft Corporation was established. Prior to that time, and dating back even as far as the years immediately preceding the first World War, aircraft had been made in Australia.

The first Australian-made aircraft to fly was actually built by John Duijan in the woolshed at Spring Plains sheep station in Western Victoria. Constructed from ash timber, piano wires, steel bands from wool packs and similar materials, with rubber-coated cotton fabric to cover the wings, the crude flying machine was powered by a 25 h.p. engine made in Melbourne by J.E. Tilly.

On July 16, 1910, it left the ground under its own power for the first time and "flew" for 24 feet. Within three months, its hops had grown to 196 yards at a time at an altitude up to 12 feet. With further adjustments and modification, its performance steadily improved.

After the 1914-18 War, enthusiastic flying men from the Australian forces encouraged by the Commonwealth Government formed a number of companies with the idea of making aircraft for Air Force training, and some aircraft were manufactured. By 1923, for instance, the Larkin Aircraft Company, with headquarters at Coode Island, Melbourne, had completed 30 Gipsy Moth biplanes of wood and fabric construction, but the company did not survive the depression years when Government orders were suspended. Small numbers of other types of aircraft were produced by the Larkin Company and other interests and six Gipsy Moths were made by the Munitions Workshops at Manlybrynong.

From 1928, the Australian branch of the British De Havilland Com-

pany, engaged first in the assembly and later in the part manufacture of De Havilland types of aircraft, and other commercial interests also imported and assembled aircraft of several types. A feature of those early ventures in aircraft manufacture was that the engines and metal parts were almost invariably imported.

The Commonwealth Aircraft Corporation was established towards the end of 1936 with the backing of some of the leading industrial organisations in Australia—the Broken Hill Pty. Ltd., the Broken Hill Associated Smelters Pty. Ltd., General Motors Holden's Ltd., Imperial Chemical Industries of Australia and New Zealand, the Electrolytic Zinc Company of Australia and the Orient Steam Navigation Co., Ltd.

Licenses were obtained from the North American Aircraft Corporation for the production in Australia of airframes to that Company's NA33 design and, from the Pratt Whitney Corporation, for the manufacture of single row Wasp engines to be installed in the aircraft. This machine was put into production at a factory established by the company at Fishermen's Bend. Modifications required by the R.A.A.F. were incorporated in the aircraft and it was given the name Wirraway.

The first Wirraway was flown on March 27, 1939. This low-wing monoplane of all-metal construction, with stressed-skin wing design, variable pitch propeller and hydraulically-operated retractable undercarriage landing gear, introduced into Australia the most modern developments at the time in aircraft design and necessitated the establishment of workshop capacity based upon the latest production technique.

It laid the foundation of experience in building all-metal types of aircraft that was developed so

extensively and so successfully in Australia during the war years in Australian Beauforts, Beaufighters, Boomerangs and Mustangs. Production of single row Wasp engines at Fishermen's Bend not only paved the way for expanding output rapidly when the war began in September, 1939 but also provided the background for the establishment and management by the company of the Government's aero-engine factory near Sydney from which twin row Wasp engines were delivered in large numbers for Beaufort aircraft.

The decision to make Beauforts in Australia was reached jointly by the British and Australian Governments concurrently with the initial flights of the first Wirraway. The Government factories for Beaufort production were being organised two months before World War II began.

To meet wartime demands for trainer aircraft, production of Wirraways and, later, of Wackett Trainers designed by the company was pushed ahead by the Commonwealth Aircraft Corporation under instructions from the Australian Government. The complete manufacture in Australia of Tiger Moth elementary trainers was undertaken by De Havilland Aircraft Pty. Ltd., with General Motors-Holden's Ltd. making the Gipsy Major engines.

Hundreds of trainers, without which Australia could never have made her magnificent contribution through Air Training Scheme to the Empire pool of air crews, had been delivered to the R.A.A.F. by the time the Japanese entered the war in December, 1941. Beaufort Aircraft, the first purely operational aircraft to be produced in Australia, had also started to flow off the assembly lines. From early 1942, all aircraft manufacturing capacity available was concentrated on the production of operational aircraft and this policy was continued until the war ended.

In 1942, extensions were made to the existing facilities at Mascot and Fishermen's Bend for Beaufort production and a new assembly plant for the production of Mosquito aircraft by the De Havilland Company was set up at Bankstown near Sydney. Establishment of annexes for the production of propellers, electrical accessory equipment for aero engines, undercarriages and gun turrets was also undertaken to enable the war-time needs of the expanding industry to be met as far as possible from local sources.

So successful were the wartime efforts to assist in strengthening Australia's air defence that this country which, before 1939, had not established even a motor car manufacturing plant, had developed industrially by the war's end to the stage where it was possible to produce original designs of operational aircraft and to manufacture them in quantity almost exclusively from Australian materials.

By August 31, 1945, Australian aircraft factories had delivered to the Royal Australian Air Force, 3,500 aircraft of 11 different types and 2,850 of the engines required for installation in those aircraft had also been made in Australia by Australian workmen and, largely, from Australian materials.

In brief, Australia had developed under wartime conditions a highly skilled well-organised manufacturing industry that was largely independent of overseas supplies, that was effectively backing up the R.A.A.F. and that was engaged in the production of three essential operational types of aircraft—fighter, attack and heavy bomber—on a scale sufficiently large to meet the needs of the R.A.A.F. for those types.

When the 1939-45 war ended, deliveries were being made of Beaufighters from the Government factories, Mustangs and Wirraways from the Commonwealth Aircraft Corporation's plant and Mosquitos from the De Havilland works. Production was in hand at the Government factories of Lincoln

four-engined heavy bombers, while Rolls Royce Merlin engines for those aircraft was being made at the Aircraft Engine Factory in Sydney.

The rate of production of aircraft was drastically reduced immediately the war ended, but in accordance with Government policy a nucleus of aircraft manufacturing capacity capable of rapid expansion in an emergency, manufacturing facilities were concentrated at three main centres and production of Lincoln, Mustang and Mosquito aircraft continued.

During 1947, with the approaching delivery of the last of the Mosquito aircraft, authority was given for the production of Vampire jet propelled fighter aircraft as designed by the De Havilland Aircraft Company in England. Australian production of the Vampire air frames was entrusted to the De Havilland Australian Company and the Commonwealth Aircraft Corporation undertook the manufacture of "Nene" turbo-jet engines by arrangement with Rolls Royce Ltd., of England, designers of the engine. The Nene engine is more powerful than the Goblin engines of the British Vampires. Australian Vampires and Nene engines were being delivered by the close of 1949.

With the approaching termination of the production programmes for Lincoln and Mustang aircraft, authority was given early in 1950 for the Australian production of the most advanced jet-propelled bomber and fighter aircraft developed by the British aircraft industry, the English Electric Company's "Canberra" twin-engined bomber and a swept-wing single-engined fighter developed by Hawker Aircraft Ltd., both of which operate in the high subsonic speed range, better than 600 m.p.h.

Concurrently production of a more powerful and more modern type of turbo-jet engine—the Rolls Royce "Avon" was put in hand by the Commonwealth Aircraft Corporation to provide engines to the Government Aircraft Factories for the Canberra bombers. The Hawker fighters, which the Commonwealth Aircraft Corpora-

tion is making, have Nene engines similar to those which the Company has been manufacturing for Vampire aircraft.

Since the end of the war, provision is being made in the national interest for the continuance of aeronautical research and for the development of original aeronautical designs. Aeronautical research is being continued in Australia and developed through close co-operation between aircraft manufacturing sections and the Aeronautical Research Laboratories and Aeronautical Engineering School of the Sydney University.

The first of the post-war Australian aircraft design projects to be developed was the Drover Light transport designed by De Havilland Aircraft Pty. Ltd., for operation on out-back air routes in Australia, New Guinea and elsewhere. Drovers were being delivered to the airline operators during the latter part of 1950. This policy of progressive development of the Australian industry, combined with close collaboration with the British aircraft industry and the British Government, will have far-reaching effects. It will preserve the highly efficient aircraft manufacturing industry that already exists in Australia. It will ensure that Australia will always be building aircraft types capable of engaging on at least equal terms the most advanced aircraft of any country with which we might find ourselves at war.

'PREFAB' FACTORY ENQUIRY.

A committee of enquiry, with Mr. Mulgaonkar, Director of the Tatis, as Chairman, has been appointed, by the Govt. of India to investigate into the Government prefabricated Housing Factory, it is learnt.

Besides Mr. Mulgaonkar, two other engineers, one superintending engineer of the C.P.W.D. and one casting engineer, will be included in the committee.

BITUMINOUS ROAD CONSTRUCTION

By H. H. CAMPBELL, M.C., M.A., (Cantab.)

The first part of this paper read at the Engineering Association of Ceylon appeared in the Nov. Issue.

Having selected the materials it will then be necessary to determine the relative proportions in which they are to be mixed. The solution may be approached in three ways. One is to combine the materials so that the plasticity index of the mixture may be expected to be within the allowable range. It will then be necessary to make up a combined sample and test it to determine if the PI is as expected, if the liquid limit is within the allowable limits and if the grading is reasonably close to the specified limits. Another method is to combine the materials so that the grading is within the specified limits and then test a sample of the combined mixture to see if the LL and PI are satisfactory. The third method is simply to make trial mixes until a satisfactory one is secured.

Compaction of the soil aggregate mixture is a vital part of the stabilization process. To secure the desired result it is necessary that the surface, base or foundation be left in as compact a mass as possible. Compaction is measured by the density of the mass. Density as such, however, is not the controlling factor, since density is affected not only by compaction but by the amount of fine material present. What is wanted is to have the proper mixture for the purpose compacted to as great a density as possible for that mixture.

After all necessary care has been exercised to provide adequate foundations, to select and proportion suitable materials and to thoroughly mix them, granular stabilized roads must be properly compacted before it is advisable to cover them with bituminous tops. This requires a judicious use of water and strict control of the rolling operations.

Shrinkage must be controlled if a soil is to have proper stability for use in road building. There are two

kinds of soil moisture:—(1) Film or capillary water which adheres to the surface of the soil grains and is not removed by the force of gravity. Powerful centrifuges exerting a pull of hundreds of thousands of pounds fail to remove film moisture which is more adhesive or glue-like than ordinary water, and (2) Free water which is drained away by the force of gravity.

Film or capillary water is absorbed in various molecular thicknesses which explains why some soils are more plastic than others. Adhering films are more glue-like than dripping water and their thicknesses vary widely on different kinds of soil particles. The two factors that control the moisture film thickness are:—

- (1) Chemical composition. Colloids high in silica absorb thick films and their volumes undergo great changes upon wetting and drying whereas Iron and Alumina Colloids absorb thin moisture films and undergo little volume change upon wetting and drying, and
- (2) Effect of ions. The effect is two-fold () like colloids these electrified particles depend upon their material composition and position in the metallic scale. For instance, the potassium ion only holds 16 molecules of associated water whereas at the other end of the scale lithium holds 120 molecules and (b) these water film coated ions in turn ionize a soil colloid and the character of the ion determines the water film thickness on the colloid.

This can be demonstrated by the fact that in practice we find clay particles with their surfaces coated

with ions of hydrogen, iron, calcium, etc. The clay particles thus become endowed with swell, shrinkage and plasticity of the several ions. Variation in the stability of road soils results from shrinkage and swell of soils which, in turn, depends on the changes in water film thickness with changing weather conditions. Soils containing more than 70% clay are practically non percolating. The sand: silt ratio evidently influences the rate of percolation when soils contain less than 70% clay. The principal aims of soil stabilization are: (1) to make the soil as dense as possible and (2) to prevent the thickness of the resulting adhesive film from changing once the optimum water content has been attained. In order to control any fluctuation from the optimum water content, chemical solutions and insoluble binders are used and selected to provide a substitute for moisture film strengths. The treatment of highly capillary clay soils presents the most difficult problem in surface treatment work to say nothing of the more expensive types of paying. Such soils even though water-proofed from above, may still become saturated from the rise of the ground water level and become completely impassable. To maintain the optimum moisture content in a great depth of highly capillary soils, is not practicable, but to maintain it for such a depth as to prevent shearing during times of low support, in the saturated material underneath and thereby meet the demands of traffic, is possible by providing an impervious sub layer (often a bituminous layer) with a further foot depth of subgrade on top.

The subject is extremely complex and it is not proposed to give more than this brief outline of theory here but it will put the engineer in the right frame of mind to appreciate

the importance of the next section. Appendix 1 explains some of the standard tests carried out on soils, together with the standard form of classification.

Drainage

One of our early road builders made the following statement: "There are five fundamentals to good road construction. The first is drainage: the second is Drainage: the third is DRAINAGE: the fourth is line, and the fifth is grade". All too often this all important subject with its many and varied aspects is neglected.

More failures in surface treatment work have been caused by lack of drainage, the improper preparation of the road bed and poor construction methods than have ever occurred because of too much traffic on surfaces constructed with due consideration of the fundamental principles. During the past few years much has been learned about the physical and chemical make-up of soils and the reasons for their behaviour under changes in weather. It is now clearly recognized that many conditions of wet weather can be overcome by proper drainage. It is easy to determine the optimum moisture content at which any soil has the highest stability and it is the function of proper drainage to provide that such moisture conditions shall not be materially changed. Various soils required different degrees of drainage but the cost of providing proper drainage is much cheaper than the cost of building unnecessarily heavy pavements. So the first essential in preparing a road bed for surface treatment is a first class drainage from one end of the road to the other.

To ensure proper drainage, well adapted for flat and rolling country which forms a high percentage of Ceylon's terrain, a method of "high line" grade should be adopted. This simply consists of setting the grade from two to four feet above the level of the surrounding country and obtaining the fill material from wide ditches on either side of the completed roadway. This has the effect of lowering the ground water level well below the road surface and permits run off of heavy

monsoonal rainfall without injury to the road surface, even when water stands in the ditches for a time. Open ditches are used in rural districts where space is available for intercepting and disposing of surface water from the roadway and verges. A minimum width of 18" at the bottom and 1½ to 1 battered and turfed sides are recommended. Adequate ditch width is particularly important in a tropical country like Ceylon to dispose of the sudden downpour and allow for the rapid growth of vegetation. Capillary water at the road surface is also greatly reduced, if not eliminated, and the result is a stable condition of surface which appears to be of an entirely different material from that in the field alongside. In hilly country of course the best drainage is a system of cross culverts which has been adequately provided in most parts of the island. In order to ensure the best results the side ditches should be completely free from boulders or similar projecting obstructions. The number of cross culverts should vary according to the demands made by rainfall and roadway gradient. The great thing is that surface water should be conducted away before it has time to saturate the road bed from the side ditch. Where there is a high clay content subsoil drainage is very necessary to help to prevent softening of the subgrade as clay holds moisture by capillarity and is reluctant to part with it. Herring bone subsoil drains at intervals of 25 ft. or less are the most effective type of drainage using French construction, i.e., stone filled. The bottom of the drain is usually kept 12" below the subgrade and the invert at the outlet 12" above the ditch bottom to prevent clogging and back flooding. Summarizing therefore, subsoil drains can be put into two main categories:—

- (1) To intercept subsoil water before it reaches and softens the subgrade under the pavement.
- (2) To keep the water table well below the subgrade.

Drainage is just as important for high cost pavements, as neglected drainage in this case will only be delayed action of the deterioration. It is immediately apparent in surface treatments. This section is given to

the item of drainage because it is of paramount importance and to impress the fact that, if good drainage is properly obtained, little difficulty will be found later in constructing and preserving a smooth durable surface with the aid of a thin asphalt treatment.

Uniformity of Surface

The second important condition before treatment, is uniformity of the surface material whether the subgrade consists of natural earth or a selected surfacing material. Every square foot should have the same quality and characteristics. Potholing of a surfacing occurs almost invariably because of lack of uniformity. Owing to an uneven division of coarse and fine material, the bituminous treatment penetrates unevenly; one area settles more than the other and under traffic wear develops in spots. If the surface has become full of potholes, it is better to scarify to below the depth of the deepest pothole than to endeavour to patch to the general level of the adjoining surface. Thus regardless of width, grade or alignment with which it is not proposed to deal in this paper and all of which naturally should be made as good and all economically as possible, the two outstanding factors which must receive attention are complete drainage and a maximum degree of surface uniformity.

PAVEMENT DESIGN

A road pavement is defined as a layer (or layers) of road material laid on a natural earth subgrade) to form a carriage-way for the passage of wheeled traffic. Its three main functions are:—

- (1) to provide a smooth running surface suitable to carry the class and intensity of traffic anticipated
- (2) to protect the underlying subgrade from the effects of rain water
- (3) to distribute the live load pressure over a wider area of subgrade.

The thickness of surfacing that should be laid on any particular type of base, however, continues to be very largely a matter of opinion.

THE BUILDING GAZETTE, DECEMBER 15, 1950

A flexible, or semi-flexible pavement consists of:—

- (a) Wearing Surface
- (b) Base Course
- (c) Subgrade

Wearing Surfaces

The function of the Wearing Surface is to receive and transmit the wheel loads to the underlying layers. It imparts a smooth riding surface and protects the other layers from traffic abrasion and surface moisture. It may consist of one or two layers. In bituminous construction, the thickness of the wearing course is usually between $\frac{1}{4}$ " and 3" thick and is invariably made up of two layers.

The desirable properties of a wearing surface are:—

Waterproofing Properties: It must be sufficiently waterproof to ensure that the water will not remain in or on the surface. As well as having an adequate fall for run off purposes, the material of which the surface is composed should have the property of waterproofing the subgrade.

Durability: It should resist abrasion under the disruptive action of traffic (wheeled or tracked), and serve its purpose with the minimum of material. The material should have adequate length of life and, as far as possible, be taken from that available in the vicinity. Maintenance and repair work should be low.

Stability: It should transmit loads to the base under all weather conditions without creep or undue deformation occurring. At the same time it should be sufficiently flexible to adjust itself to considerable base settlement of up to $\frac{1}{2}$ " without rupture. It should also possess sufficient shear strength to resist shear failure under traffic.

Nonskid Properties: A relatively smooth, fine textured road surface offers perhaps greater area of contact to a pneumatic tyre and may, under certain conditions, provide less risk of skidding than a roughened effect with less surface area of contact. The surface should not be

excessively slippery under normal conditions to either animal or wheeled traffic and should retain its non slip character under the action of weather and traffic. The fundamental facts relating to skidding are summed up by Roads and Road Construction and the International Road Congress as follows:—

"The resistance of a road surface to skidding may be measured in two ways, i.e. either under conditions representing sideways skidding or straight ahead skidding. The former method involves measuring the side-way force at right angles to a wheel, which is drawn forward and revolving in a vertical plane inclined at an angle to the direction of travel, while the second involves measuring the tractive force, or braking force on the wheel when it is drawn forward either locked or partially slipping. In each case the load on the wheel is also measured enabling coefficients which are a measure of the slipperiness of the surface to be derived. These coefficients have been called the 'side way force coefficient' and the 'braking force coefficient' respectively, and it has been found that, in general, each method places surfaces of different types in the same order of slipperiness, and that both coefficients are affected in a similar way by the speed of the vehicle and other less critical factors".

The following general conclusions and table of typical results are summarised from the Report to the Eighth International Road Congress, The Hague, 1938.

- (1) The principal factor affecting the skidding properties of a surface is its texture, but the inherent properties of various stones and binders may exert subsidiary influences.

- (2) High coefficients are obtained on both fine and coarse textured surfaces in good condition.

- (3) Coarse textured surfaces are not so prone to polishing as fine textured surfaces, and the latter require careful proportioning of the mix and the selection of suitable material.

- (4) Coarse textured surfaces, in cases where they become slippery, do so by reason of loss of stone or by the stone becoming submerged in the binder.

- (5) Surfaces which are smooth and which contain pits or grooves are particularly liable to be slippery, as the indentations can retain water, and thereby assist in the maintenance of a fluid film of lubricant between tyre and road. Such surfaces are characterised by the absence of the usual increase of coefficients at low speed, resulting in low values of coefficients at all speeds".

Stopping Distance

Speed miles per hour	Thinking Distance Feet	Braking Distance Feet	Overall Stopping Distance Feet
10	10	5	15
20	20	20	40
30	30	45	75
40	40	80	120
50	50	125	175

Thinking Distance = Distance travelled before driver reacts.

Braking Distance = Distance travelled after driver applies brakes.

On a skiddy road the braking distances should at least be doubled.

Noislessness: A factor that is often overlooked. The type of road surface employed has a surprisingly marked effect on the volume and intensity of traffic noise. Asphalt has shown itself capable of reducing this irritation to a considerable degree.

Hygienic Qualities: The general state of roads is contributory in no small measure to the health of a society. Asphalt is notably non-toxic and is, therefore, non-injurious to plant and other life. During its application and life, there is no danger of pollution of water. The readiness with which asphalt streets can be cleaned of dirt is a valuable asset.

Colour: The colour effect of a road surface plays an important part in the prevention of accidents. Asphalt, with selected aggregates, provides a contrast which shows up road signs, markings and objects in adequate relief in both day and artificial light. Glare and eyestrain to drivers is avoided in strong sunlight.

Base Course

Dependent on the type of construction, is sometimes known as soling or bottoming and is laid either direct on the subgrade or on an intermediate subbase. Its function is to transmit the wheel load stresses on the wearing surface through to a greater area on the subgrade. And hereby distribute the shearing stress.

In order to perform its duty efficiently the base course must (a) have sufficient structural stability, strength and thickness to stand up to the complex stresses set up by stationary or moving wheel loads and, at the same time, distribute the wheel load pressures, (b) resist vertical pressure that might cause further consolidation of the base and (c) resist volume changes or softening due to moisture and climatic variations.

Sub-base

The sub-base is superimposed upon the subgrade (or formation) or any or all of three purposes, to provide.

- (a) A subsidiary formation to minimize the effect of shrinkage and elastic rebound
- (b) A pervious layer through which water may percolate to the subsoil drains to minimize the effect of plasticity due to excess of moisture.
- (c) A temporary working surface on which to construct the main road structure, particularly where pitching is specified.

It is constructed of any locally available granular material of intermediate bearing capacity between the subgrade and surfacing, such as stabilized soil, hoggin, broken stone or sand, when the main purpose is drainage aid. A sub-base is sometimes formed by treating the top 6"

of the natural soil subgrade with a bituminous stabilizer and compacting direct on the stabilized subgrade.

Subgrade

The sub-base is a part of the subgrade strictly speaking but generally has a higher supporting value than the compacted subgrade. The subgrade proper is the natural soil existing in the line of the road. All types of road have to rely on the bearing power of the subgrade soil and the importance of obtaining maximum subgrade compaction cannot be over emphasized, as any irregularities in the subgrade will be reflected in the finished surface. The bearing capacity is of maximum importance as failure of the subgrade will bring about the collapse of the pavement. Where an expensive surfacing is to be used every step must be taken to eliminate any local foundation weakness. The tolerance allowance in level of the subgrade is $\frac{1}{4}$ " from the correct levels. Where the subgrade consists of compacted gravel, laterite or cabook a base course will not normally be necessary and provided there is adequate drainage the wearing course may be laid direct on the subgrade. In Ceylon, India, Burma, Malaya, the Dutch East Indies and non-desert Africa, a suitable laterite is found but in other areas the soil must be firm, solid and nonfriable and graded to give adequate stability. The soil should contain sufficient clay to provide the necessary cohesion and water to give it the optimum moisture content so that when rolled a hard surface will be produced.

Kerb-stones

All pitched base courses tend to spread laterally and therefore should be provided with adequate haunch support in the form of rigid abutments or kerbs. Where new roads are being made, old roads widened or realigned, it is recommended that abutments should be provided. In rural areas submerged kerbs laid flush with the wearing surface using large hand pitched stones firmly held in position by the berm are advisable. Where a road is constructed across a sand subgrade it would be dangerous to consider it as being confined and the provision of abutments would be advisable to

prevent possible movement by the wheel load pushing up the pavement on either side. In built-up areas, on embankments and over and under bridges kerb-stones should be used with an effective colour contrast to depict the line of the road. Here a concrete abutment as deep as the pitching with 2" upstanding to form the channel is recommended where a bituminous carpet is going to be laid. The kerb should then go on top of this and have a face of 4". To improve visibility at night a white cement finish is advisable.

Pitched Foundations

These should be bedded normally on a sub base of 3" to 4" of gravel. Stones passing a 9" ring but retained on a 5" ring are a suitable size for pitching. They should be bedded on their broadest face with the apex uppermost and the spaces filled with $1\frac{1}{2}$ " to 3" stone and any projections knocked off with a knapping hammer. Soling stones should not be laid flat otherwise wobble will occur under heavy traffic and the pavement will be loosened and crack up. Compaction should be carried out with a 10-ton roller and the surface watered and blinded as necessary whilst rolling, until thoroughly compacted. Rolling should be commenced at the sides and worked progressively towards the crown. Stone pitching is a matter of some controversy and largely dependent on the shape of the stones but the broadest face down method works on the principle of the wedge-shaped cavities between the bedded pitching being filled with the $1\frac{1}{2}$ " to 3" stones, which are forced in giving a dense, stable mass. Whatever the shape of the stones the object of pitching them is the same. The cost of good pitching is high nowadays.

Macadam Base

Alternative consists of successive layers of broken stone, with each layer blinded with fines. This type of base is "flexible" as opposed to the "semi-flexibility" of pitching. A waterbound Macadam surface is invariably laid with a compacted thickness of 4" on a pitched foundation. Alternatively it is laid on a 4" base or more, dependent on the stability of the subgrade

of broken stone on top of a compacted subgrade as is shown earlier in the paper in the Cross-Section of McAdam's road. Where the road is laid on a pitched foundation it is usually laid in two layers, a base course of 2" to 2½" stone being rolled in after the surface has been watered, then after complete compaction a second course of 1½" to 2" stone is applied. Rolling as before is commenced at the sides and worked progressively towards the crown of the road. A thin binding course of fine gravel and sand, road metal screenings, or grit, is then spread on the surface at 3 to 4 cu. ft. per square, watered and rolled to complete compaction. It is important to effect the mechanical bond between the pitched stone and/or fill before the binding is applied otherwise interlocking will not take place. In this last operation the surface is thoroughly wetted and the slurry worked up by the roller is brushed over the surface to fill any interstices prior to the next pass of the roller. Dependent on the hardness of the stone a 6 to 10 ton roller is usually found adequate. In Ceylon where the stone is somewhat crystalline and therefore a friable igneous rock, an 8-ton roller should suffice.

In a Macadam surface the importance of grading metal to secure perfect interlocking cannot be overstressed and the following points are worthy of note:—(1) The size of stone should be inversely proportional to the toughness of the stone, with a limiting maximum of 2½" approximately. However, 3" is permissible for softer stones like laterite and harder stones should be limited to 1½" gauge though, in general, in Ceylon, 2½" gauge will be safer, (2) The stone should be angular with well defined edges and cubical rather than flaky, (3) The stone should be raked off stacks into baskets and screened free of dirt, (4) Spreading should be done by a twisting motion of the basket to avoid segregation of the stones and allowance made for 25 to 30 per cent. compaction, (5) During laying the camber should be checked by a template at 25 to 50 ft. intervals, (6) The amount of screenings (½" to 1/8") necessary will be in the region of 1 cu. ft. to 3 squares. A final

topping of granular cobble or clay soil containing 75% coarse sand may be used but on no account should a vegetable soil be used. The quantity of water required will be 80 to 90 gallons per square, (7) A new road may be open to traffic 2 to 3 days after completion depending on weather conditions but some authorities consider it unwise to open newly consolidated work to traffic until it has dried. Traffic should be made to use the whole surface so that any weak spots may become apparent before applying a bituminous dressing and also "tracking" will be prevented. The road should be left open to traffic for 2 to 3 months or as long as possible to allow for settlement before surfacing, (8) When consolidation is complete the berms should be made up on either side with lateritic soil, sloped to a slightly greater camber than that of the road and compacted by hand rollers, (9) The berm on each side could well be made a maximum of half the width of the road surface to allow for possible widening later and/or to prevent the encroachment of ribbon developed building. In conclusion the Department of Scientific and Industrial Research, Harmondsworth, England say:

"Water-bound macadam depends for stability upon the mechanical interlocking of the stones; the fine material required for binding is added only after the maximum interlocking has been obtained by heavily rolling the dry stone. It is essential, therefore, that the stone should have a high crushing strength.

For similar reasons the resistance to attrition abrasion and impact should be as high as possible, though these properties were probably more important in the days of horse traffic and iron-tired wheels, having a high load-concentration.

The binding properties of the stone dust as measured by the cementation value have little relation to the other mechanical properties. Obviously a high cementation value is an advantage, but it should not be sought at the expense of crushing strength".

Rolling

Some authorities consider that the use of a light roller primarily is necessary for correct mechanical interlocking as a heavy roller is considered to crush the stone surfaces unduly without consolidating. This may be true where soft stone is encountered as in Madras but in Ceylon should not be necessary. Certain specifications call for the use for either three wheel or tandem rollers but in recent years rollers between 6 and 10 tons have been found suitable for most road compaction tasks. The actual weight of the roller is not the measure of its compacting power but rather the way in which its weight is transmitted through the wheels to the road surface. Accordingly, rolling normally means the use of a three-wheel roller having a compression of not less than 350 lb. per lineal inch width of roll; except in special cases involving sand clay or top-soil, where a tandem roller is sometimes preferable and similarly for asphaltic concrete work, rolling should continue until there is no appreciable movement in front of the advancing roller. A satisfactory degree of compaction has been obtained if a loaded bullock cart leaves no indentation when passing over the rolled surface. The average progress of a power roller might be approximately 80 squares of compacted roadway per day but naturally this varies with the type of water and local conditions. The action of the roller should be smooth as unnecessary vibration in the early stages will set up waves in the surface. The progress should be continuous and uniform with change of direction carried outside the limits of the newly compacted surface. If rolling is carried out over half the width at a time it should commence at each side and work towards the crown with a central strip being left to make a final clean joint. Cross rolling is recommended afterwards, where the road is wide enough. Frequently, soft or wet subgrades will compel suspension of the rolling.

(To be continued)

EARTH AND EARTH MOVING EQUIPMENT

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Earth and Excavation Material

The materials encountered in excavation and hauling vary considerably in composition, weight and texture. Materials vary from granite, rocks, porous sand, to hard or soft impervious clay. Granite and rocks need blasting operations using pneumatic drills, jack hammers, compressors and explosives. The only possible way of loading rocks on to trucks is by means of high powered shovels. These shovel buckets should be constructed out of tool steel, to withstand the heavy wear and tear. However in confined places like in tunnels, the writer has seen muck conveyors employed. These are elevating graders with a shovel attachment fitted in front of it. The wear and tear on these machines are very heavy indeed.

Impervious, semi-pervious and clayey material are cohesive and therefore cut very well under a scraper blade or under the blade of an elevating grader. These materials have the property of cutting in the form of a ribbon and therefore without much loss, they fill the bowl of a scraper. Sand acts very poorly under a scraper or elevating grader. The sand being cohesionless just slips off. Sand is best handled by a clam shell or dragline bucket and dumping trucks. However sand contains less voids in a similar heap and will give more yardage than earth or clay. Thus it will be appreciated how much the difference in the material handled affects the performance of excavation and hauling. The unit weight of the material will either retard or accelerate a load. All other factors being the same, a light material will make a bigger load than very heavy material. Moisture in one material acts as a lubricant towards reducing loading and rolling frictions and resulting in a bigger load, while moisture in another material will cause stickiness and consequent hampering of progress such as in clay. Therefore each type of mate-

rial needs a different treatment and method of handling. An inaccurate calculation around which equipment would be bought might run investment and purchase figures clean out of proportion. Here is another instance where the skill of the Excavation Engineer comes to play.

The distinction between the various classes of material is a matter of relative porosity and permeability depending upon the mechanical grading and clay content.

In general materials classed as impervious contain not less than 10% and not more than 35% by weight of particles having a diameter less than 0.002 mm. as determined by the Standard Method of Mechanical Analysis, and has a rate of percolation less than 2 ft. per annum.

Materials classed as semi-pervious contain not less than 20% by weight of particles passing the 200 mesh sieve as determined by the Standard Method of Mechanical Analysis.

The Standard Proctor Method of Soil Compaction governs the construction of rolled fill embankments. The Standard Proctor Method determines optimum placement conditions, and determines optimum moisture content of material to obtain the maximum density. Materials are usually placed in rows approximately parallel to the axis of the structure, spread in layers of 8" in thickness and then compacted with about 12 roller passes of sheep-foot tamper.

Roots and stones larger than 6" in diameter should be removed. If the material is found to be too dry water is sprinkled by mobile bowlers and the material brought close to its optimum moisture content.

In a dam the most impervious materials are deposited in the core with semi-pervious material on the upstream prism. The most pervious material should be deposited in the downstream prism with such gradation between them that there is no

demarcation between materials of widely different porosity.

Care should be taken to avoid the formation of lenses pockets, streaks or layers of materials differing substantially in texture, gradation or quality to that of the surrounding material.

Sand and crushed rock are used in dams in the form of inverted filters. Such pervious filters have the property of drawing down the seepage line of water and safely discharging the seepage water out of the dam without any detrimental effect to the dam—namely by avoiding the washing away of soil particles, and keeping the seepage line well within the body of the dam. The theory of the inverted filter can well form a subject by itself to be embodied in a technical paper.

Maintenance

Besides efficient operation, the efficiency of an earth moving fleet depends largely on the efficiency of the repair gangs. This includes the Mechanical Engineers, Master Mechanics and their foremen. Their business is to see that all mechanical equipment are efficiently maintained, promptly repaired and daily serviced. Direction of operations in the field is not their responsibility. They need not assume any responsibility at all in this direction. The time they spend in the field watching civil engineering operations could be more usefully spent in the shops and with the greasing trucks, in keeping the machines in a proper state of repair.

The writer's way of judging the efficiency of the mechanical repair staff is to take count of the number of machines lying idle in the shops awaiting repairs. The less the number of machines in the shops and in the field on this score the more efficient is the Mechanical Engineer and his staff. Preventive maintenance should be the first aim. A quick efficient repair and a

prompt turnover of the machine should be the constant object. "Keep the wheels moving" should be the motto of a repair workshop.

To assist the mechanical engineer in running his shop efficiently, he should have the services of a competent spare parts warehouseman. This person should be thoroughly conversant with the market prices of spare parts, sources of supply and should know what minimum stocks of spares of all varieties should be carried in stock. When stocks run below a certain minimum, he should have the foresight to have them replenished in time. To unnecessarily hold up a machine due to the lack of a spare part is nothing short of being "criminal waste". A whole earth-moving fleet can be crippled by an inefficient warehouseman. It is within the writer's knowledge where tractors have been idle for months on end due to the lack of a small item like a heavy cotter pin or a bolt. When the occasion demands, it would pay at times, even to pay five times the recognised market price to purchase a spare part, should it be out of stock at the stores, and put the machine to work rather than wait for days till a part arrives from the agents overseas through normal channels. It should be borne in mind that the hourly cost of allowing a machine to lie idle includes the cost of owning and paying interest on the original investment; leave alone the bad reflection on production out on the job. In countries like the U.S.A. and England it is not quite necessary to carry a large stock of spares to maintain the machines. A phone call on the local dealer and the express delivery available would allow the mechanic to have the spare part he needs in a fraction of an hour. But in countries like Ceylon which by steamer is two months from U.S.A. and one month from England at the minimum, it is imperative that the parts warehouse should be well stocked. By having a large stock of spares, a defective part that normally would have stopped progress pending repairs could be exchanged for a new one from stock, while the old part is repaired and reconditioned at the shops and goes back to the stores.

The value of the spare parts stock may often more than double the cost of the machines in operation. But yet this is a sound investment. It is by no means idle capital.

If the writer has his own way he would charge to the overhead account of the parts warehouse, the hire charges on a machine including that of the operators kept idle due to a depleted stock of spare parts. Similarly the overhead account of the mechanical repair shops should be debited the cost of hire of machine and operators kept idle due to inefficient repair methods. Whilst it is reasonable to charge the cost of reasonable down time to effect a repair on a damage occurred by a field operation, to the field work item. This way there will be a correct reflection in facts and figures on the efficiency of each individual party. It is also poor business to expect an old part to be returned to the store before obtaining a new part in exchange, merely because a storekeeper wants to keep his stock books straight. Storekeepers little realise the harm they do in keeping machines idle due to inconsiderate actions on their part.

Cost Keeping

In purchasing a new machine, a person is investing money with a view to obtain a profit in addition to recovering the original outlay plus the bank interest. To do this he has to cut down the overhead and interest charges by working round the clock in two or three shifts. At the Gal Oya Project all the above methods are adopted.

The above should not be achieved at the expense of preventive maintenance, greasing and lubrication. It is not necessary to have the machines in a showroom condition, well washed and polished. It is in fact impossible to keep earthmoving machines in that condition if they are usefully employed. Inner cleanliness is the most important thing—correct and proper lubrication. Makers who have spent much time and money on lubrication research specify the lubricants and the time intervals. Their recommendations are hard to be improved upon by anyone in the field and the owner is well advised to adopt them.

At Gal Oya greasing is done at the end of every 4½ hours operation. This way the whole fleet operates for 13 hours and is serviced for 6 hours. Highly mobile machines like trucks and Euclids are serviced at a central station, while modern pressure servicing units installed on trucks move, from one field job to another, servicing slow moving machines such as Tractors, Shovels, and Loaders.

The hire charge per hour for owning and operating a D/8 is made up as follows:—

	Rs.	Cts.
i Cost of purchasing, freight, delivery and assembly; divided by the number of machine hours during its useful life. —	Rs. 79,500	5—30
	Hours 1,5000	
ii Interest on the initial outlay divided by the number of machine hours ...		—96
iii Cost of fuel, oil, grease, an average worked over a large period of time for the particular make and size of machine..		9—03
iv Cost of servicing, greasing, maintenance, running field repairs, an average worked over a large period of time for the particular make and size of machine.		8—00
v Cost of shop repairs and replacements an hourly average worked over a large period of time for the particular size and make ...		5—00
vi Cost of operational labour ...		3—15
vii Cost of supervisory overheads ...		3—05
viii Profits; office overheads and administration ...		4—06
Total cost of owning and operating per hour Rs.		38—55

From the cost study made as shown below it will be appreciated that it costs a pretty tidy sum to own a machine even for one hour. Therefore it will be realised how important it is to keep the machine working and earning for you at all times.

It is sometimes asked whether it is economical to mechanise when it costs so much per hour even to own a machine. Mechanisation is a sound investment in spite of the initial outlay. It brings about a quick return and turnover. However the situation must be handled by capable men and estimators. It is a safe estimate to expect earth moving machines to work efficiently for 3 years and at the most 6 years.

Therefore planning of jobs should be done accordingly. However the above is not a hard and fast rule. In six years makers radically change their models making it difficult to obtain spares for the obsolete ones. Also materials like rubber and fabric perish through passage of time, even if the machine is not used frequently. Therefore one must get the best out of the machine during its useful lifetime.

Conclusion

In passing mention must be made of what Einstein says in that "Good brains are wasted on men who march in rank and file to the rhythm of a drum, the spinal chord would do".

This is true of men carrying baskets of earth on their heads. Men are meant for better work.

Acknowledgement

Many thanks are due to several of my brother officers who spent many hours of their leisure time in preparing diagrams and rendering general assistance in the preparation of this paper. Sincere thanks are due to Messrs. George Gavin, Moss, Hoover and Harry Ackerman, with whom the writer has great pleasure in working together at Gal Oya, or their valuable suggestions.

Permission granted by the Director of Irrigation to read this paper is gratefully acknowledged.

APPENDIX 1: PRODUCTION AND UNIT COST TABLES

Rates Include Cost of Owning, Operating, Repairs and Depreciation

Work Item	Type of Equipment	Production for 8 hours per machine	Unit	Unit Rate Rs. cts.
1. Jungle Clearing				
Light	Dozer & D8	1'00 Ac.	Acre	308'40
Medium	" "	0'75 Ac.	"	462'60
Heavy	Cables, Dozer & D8	0'50 Ac.	"	616'80
2. Stripping Borrow Areas	Cats & Cans	180 Cu. yds.	Cu. yd.	2'75
3. Excavation				
(a) Deep cuts & large area	Elevating graders	2392 Cu. yds.	Cu. yd.	0'63
	Pneumatic tired bottom Dumpers (600' to 2 mls. haul)	257 Cu. yds.	Cu. yd.	1'15
(b) Deep cuts in pockets	Shovel and dumpers (Euclid end dump)	928 Cu. yds. 153 Cu. yds.	Cu. yd. Cu. yd.	0'79 1'92
(c) Excavating in river bed and loading sand	Dredge Euclid Bottom Dumpers	670 Cu. yds. 261 Cu. yds.	Cu. yd. Cu. yd.	0'83 1'14
4. Spreading	Dozer & Rakes	4291 Cu. yds.	Cu. yd.	0'08
Watering	Water wagon 3000 gals.	5216 Cu. yds.	Cu. yd.	0'060
Consolidating	Sheepfoot tampers and Tractor D/8	1584 Cu. yds.	Cu. yd.	0'228
5. Finishing grading slope	Dozer D8	80 sqrs.	Square	3'85
6. Dozing earth short distance (say 300')				
	(a) D/8 Cat	320 Cu. yds.	Cu. yd.	0'96
	(b) D/7 Cat	276 " "	" "	0'97
	(c) D/6 Cat	230 " "	" "	0'98
	(d) D/4 Cat	96 " "	" "	2'00
	(e) D/2 Cat	60 " "	" "	2'60

APPENDIX 2: UNIT COST PER HOUR

Equipment	Cost of new Machine	Useful Life of Machine	Owning and Depreciation	Major Over-haul	Fuel and Lub. Oil	Labour for repairs and service	Labour for operating	Over-head charges	Interest and Profit	Cost per hour
	Rs. cts.	Hours.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs
1. D8 Tractor	79500'00	15000	5'30	5'00	9'03	8'00	3'15	3'05	5'02	38'55
2. D6 Tractor	65685'00	15000	4'40	4'50	6'00	4'50	3'15	2'25	3'72	28'52
3. Carry all Scraper	39050'00	20000	1'95	10'05	'50	2'50	'31	1'53	2'52	19'36
4. Cat and Can Combination			7'25	15'05	9'53	10'50	3'46	4'58	7'55	57'92
5. Euclid Loader	90760'00	10000	9'07	47'50	6'25	20'00	3'15	8'60	14'18	108'75
6. Loader and one Cat Combination			14'37	52'50	15'28	28'00	6'30	11'65	19'20	147'30
7. Loader, Push Cat & Pull Cat			19'67	57'50	24'31	36'00	9'45	14'70	24'41	186'04
8. Euclid Bottom Dumper (10 Cu. yd.)	68548'00	28000	2'45	14'25	5'02	6'00	1'58	2'92	4'82	37'04
9. Euclid End Dumper (5 Cu. yd.)	65677'00	28000	2'35	14'25	5'02	6'00	1'58	2'92	4'82	36'94
10. Shovel R. B. 51 (2½ Cu. yd.)	175592'00	15000	11'70	37'30	9'50	9'50	3'75	7'17	11'81	90'73
11. Shovel Osgood (2½ Cu. yd.)	266550'00	15000	17'75	31'50	8'35	11'65	3'75	7'30	12'04	92'34
12. Shovel Osgood (1½ Cu. yd.)	174035'00	15000	11'60	23'40	6'00	12'40	3'75	5'71	9'41	72'27
13. Shovel R. B. 22B	86010'00	12000	7'20	7'80	3'75	6'75	3'75	2'92	4'82	36'99
14. Motor Grader	47637'00	15000	3'18	18'82	4'75	5'94	3'52	3'62	5'97	45'80
15. Bucyrus Erie 38B (2½ Cu. yd.)	195515'00	15000	13'05	24'05	4'75	9'50	3'75	5'51	9'10	69'71
16. Cat and Roller combination			8'50	5'25	9'28	10'00	3'15	3'57	5'89	45'19
17. Water Wagon	65677'00	2800	2'35	14'25	5'02	6'00	1'58	2'92	4'82	36'94
18. H. D. Ripper			Flat	Rate	Per Month	Rs.	1500			
19. Sheepfoot Rollers (4 Nos.)	31860'00	11600	2'75	'25	'25	2'00	—	'52	'86	6'63
20. D/7 Tractor	73968'00	15000	4'93	4'75	7'50	6'25	3'15	2'65	4'38	33'61
21. D/4 Tractor	34650'00	15000	2'31	4'50	5'00	4'00	3'15	1'86	3'13	24'02
22. D/2 Tractor	27100'00	15000	1'81	4'00	3'00	3'50	3'15	1'54	2'55	19'55

LAW REPORT

LEVY OF PROPERTY TAX

The procedure to be followed by the Corporation of Madras in assessing property tax was decided by Their Lordships the Chief Justice and Mr. Justice Viswanatha Sastri in a case between the Corporation of Madras and a tax-payer, referred to them by the Chief Judge of the Court of Small Causes.

The dispute arose in respect of premises No. 37, Mount Road. The annual rental value of the property was fixed at Rs. 5,939 and property tax levied on that basis prior to April 1947. During the first half year of 1947-48, the Corporation determined the value of the same property as Rs. 41,490 and assessed a tax of Rs. 4,771-5-7. The assessment was confirmed by the taxation Appeals committee of the Corporation and on appeal by the assessee, the Chief Judge of the court of Small Causes fixed the annual rental value at Rs. 19,035. The present assessee purchased the property in February 1946 for Rs. 5 lakhs and effected additions at a cost of Rs. 2,30,000. The Corporation based the assessment at 6 per cent of Rs. 7,30,000.

In appeal the Chief Judge of the Court of Small Causes fixed the value partly on the basis of the annual rent and partly on the basis of 6 per cent of the capital of Rs. 2,30,000 invested for improvements and additions. Both the assessee and the Corporation disputed the validity of this conclusion and applied that the matter be referred to the High Court.

In the course of their judgment, their Lordships observed that the fact that a portion of the building was reconstructed so as to enable a trade or business in motor cars to be carried on did not render the main part of Section 100 (2) of the City Municipal Act inapplicable or to attract the first proviso of the same clause. The main part of the Section applied to all land and buildings capable of being ordinarily let whether for residence or

for carrying on trade, business, profession or vocation and whether actually let or occupied by the owner. Their Lordships also observed that Section 100 (2) of the City Municipal Act did not limit the gross annual rent of land and buildings to the fair rent fixed by the Rent controller under the Madras Rent control Act. This was an enactment intended to operate as a check on rack-renting and arbitrary evictions and not an enactment dealing with the valuation of land and buildings for assessment of tax.

Dealing with the decision relied on by Counsel for the Corporation, Their Lordships observed: "We do not, however, consider it proper to regard the statement of the Judicial Committee (of the Privy Council) cited as a pronouncement of universal application to all land and buildings assessed under Section 100 (2) of the City Municipal Act, irrespective of the nature, extent and locality of the property, the history of its letting, the rents paid for it and similar properties in the neighbourhood and other like circumstances. Moreover, the Judicial Committee lent no countenance to the view that six per cent of the estimated market value of the land at the time of assessment and the estimated rent of the building, as prescribed by the provision should or could be taken as the basis for assessing the annual value of land and building under the main part of Section 100 (2). They merely suggested a reasonable percentage of the capital value—not six per cent as proper to be taken into consideration in assessing the annual value."

Their Lordships further expressed the view that in the present case it would be oppressive and unreasonable to take six per cent of the capital cost or the total outlay, namely, Rs. 7,30,000 as the basis for assessing the annual value. They considered that three per cent on the outlay would be a safe basis for arriving at the annual value. If the assessing authority or the Chief Judge of the Court of Small Causes had proceeded on right principles in fixing the annual value, Their Lordships observed, they might not have been inclined to interfere with their decisions as regards mere valuation.

PERSONAL

Dr. K. L. Rao.

Dr. K. L. Rao, Designs Engineer, Madras P. W. D., has joined the services of the Union Government as Director, Central Water Power, Irrigation and Navigation Commission, New Delhi.

Mr. S. Krishna Iyer.

Mr. S. Krishna Iyer, the veteran Building Contractor of Madras has been appointed a member of the Committee which is to go into the question of fixing of minimum wages for employments on road construction, building operations and stone crushing.

Mr. N. Kesava Rao.

Mr. N. Kesava Rao, B.A., B.E., I.S.E., M.I.E., has joined Messrs. Sathyanarayana Bros., Madras as their Consulting Engineer and is in charge of the new Assembly Hall.

Mr. A. Komora.

Mr. Komora, an American engineer of out-standing ability has been appointed Chief Engineer of Damodar Valley Corporation at a salary of 25,000 dollars per annum, subject to income tax.

Mr. N. S. Lamba.

Mr. N. S. Lamba, of Ambala has been elected an Associate Member of the Institution of Sanitary Engineers, England.

Mr. M. Meeran.

Mr. M. Meeran, City Engineer, Madras, it is learnt, has been invited to address the annual gathering of the Institute of Builders of India, which is scheduled to be held in the last week of December.

But both of them had proceeded on an inadmissible basis and on an erroneous interpretation of Section 100 (2) of City Municipal Act. Their Lordships in the circumstances directed that the annual value of the property be fixed on the basis of a monthly rent of Rs. 1,825 less a deduction of 10 per cent allowed under the Section 100 (2) of the City Municipal Act.

MODEL INVESTIGATIONS OF A VENTILATION SYSTEM FOR THE DEBATING CHAMBER OF THE HOUSE OF COMMONS.*

BY L. E. PROSSER B.Sc., M.I.MechE., R. EDMONDS AND R. J. STEFFENS, B.Sc.

The adequate ventilation of the House of Commons has been a constantly recurring problem. A Select Committee appointed in 1913 investigated the matter with particular reference to the amount of air required, its temperature and humidity; and in 1920 experiments were made by the National Physical Laboratory in order to provide quantitative data which would indicate the best method of applying the general principles of ventilation which Dr. Leonard Hill had propounded to the 1913 Committee. These principles were defined as "A general circulation of air over the heads of the occupants of the Chamber without prejudicing the natural heat at the feet and extremities of the members." As a result of experiments made by the National Physical Laboratory in 1921-23, both on a one-eighth scale model and in the Chamber itself during a summer recess, modifications to the ventilation scheme were suggested by the Laboratory and some of these were incorporated in the existing ventilation system.

The proposed rebuilding of the Debating Chamber, following the destruction by enemy action in 1940, afforded a suitable opportunity for replanning the entire ventilation system, and the Select Committee, on appointing the architect, Sir Giles Gilbert Scott, O.M., R.A., and the consulting engineer, Dr. Oscar Faber, O.B.E., suggested that the National Physical Laboratory should

* Communication from the National Physical Laboratory. Abridged.

be consulted on any scientific problems involved. The following report is an account of the model tests carried out by the Engineering Division of the Laboratory on the ventilating system proposed by the consulting engineer. The investigation was carried out for the Chief Scientific Adviser, Ministry of Works.

The problem is essentially one of cooling, as the Debating Chamber is almost completely enveloped by other rooms which are themselves to be kept at an equable temperature. Accordingly, the not inconsiderable thermal output of the occupants confined in the relatively small chamber must be absorbed by artificial cooling to prevent a dangerous rise of temperature. The method suggested is to introduce clean air at about 8 deg. or 10 deg. F. below the mean temperature of the Chamber, a maximum quantity of about 30,000 cub. ft. per minute being required to remove the heat generated by the occupants. This quantity is greater than that required for normal air replenishment and the chief difficulty is to introduce it without creating unpleasant draughts. In the novel scheme suggested by Dr. Faber the air is not introduced through floor gratings, as in the old unsatisfactory method, but through horizontal ducts below the galleries and inclined ducts in the ceiling, so that the cool denser air will fall diagonally and cause local circulatory systems. By this means the air currents will blow towards the faces of the occupants, and a certain amount of variability

can be obtained by supplying the air alternatively from one side or the other.

It was considered that reliable information could be obtained by the use of a small-scale model of one end half of the Chamber, the air currents being mostly transverse to the length of the chamber and hence parallel to the plane of section. It will be realised that the choice of a suitable scale is a result of compromise between conflicting requirements. In this case it was considered essential to simulate in the model the effects caused by differences in density between the cool incoming air and the warmer air in the Chamber, so that the correct trajectory of the air currents should be obtained. This requirement (which is tantamount to full-scale "Froude number") can be obtained by increasing the temperature difference in proportion to the decrease in linear scale, or by decreasing the inlet air velocities, or a combination of both. There were objections to decreasing the air velocity, while high temperature differences in the model were undesirable owing to radiation errors. It was thought that a quarter-scale model using fullscale velocities, with temperature difference about four times full scale, i.e., up to 40 deg. F., would be reasonable, and such a model was constructed at the National Physical Laboratory.

The model was however, working at only one-quarter full scale

"Reynolds number," which meant that any forces arising from viscosity effects would be exaggerated. It was expected, however, that at the relatively high Reynolds number involved these effects would be small, but in view of the importance which had been given to simulating full-scale Reynolds number in the earlier model work (a one eighth scale model using eight times full-scale velocities) it was considered desirable to check the assumption by constructing in the Exhibition Hall at Earl's Court a full-scale mock-up of a section of the Chamber. Tests carried out on both models under similar conditions indicated that there was no appreciable effect involved due to the difference in linear scale between the two models, and confirmed that the quarter-scale model adequately represented conditions obtaining in a full-scale test as far as air velocities and the air-flow pattern were concerned. The quarter-scale model had the advantages not only that stable conditions could be more quickly obtained, but that modifications to the ventilation system which suggested themselves during the course of investigation could be more easily tried out on this smaller scale.

The model erected in the Engineering Division of the National Physical Laboratory was a formalised reproduction to one-quarter scale of the half of the Debating Chamber containing the Speaker's Chair. It was approximately a 13-ft. cube and the front, corresponding to the centre section of the Chamber was glass panelled for observation purposes. The roof, back and two sides were double-walled, so that the warm air passing from the Chamber through ducts in the ceiling practically enveloped the model before escaping at about floor level, and thus minimised conduction losses from the Chamber.

All the air inlets envisaged in the new ventilation scheme were included in the model. These comprised three parallel rows of apertures under both side galleries and a row of inlets over the galleries at the junction of each side wall and the roof. The "roof" inlets were extended during the experiments, at

first to the full length of the side walls, and then further to include the whole of the end wall (i.e., above the Press Gallery). The air outlets consisted of two longitudinal slits in the roof itself. The rows of benches in the Chamber were reproduced in the model and fitted with 60-watt electric lamps, supplied from a reduced voltage, to simulate the body heat of the occupants. Metal cowls were placed over each lamp to reduce loss of heat by radiation (the human body dissipates its heat largely by warming the surrounding air in contact with it and thus causing convection currents).

Cool air was drawn by a fan from outside the Laboratory and passed, by means of a system of control valves, to any set, or any combination of the four sets, of the inlet ducts. The quantity of air supplied to each of the sets of inlets was measured by calibrated orifice plates. The air delivery from each inlet was made approximately uniform by feeding it from the supply duct through perforated plates offering a relatively high resistance, so that variation in pressure in different parts of the duct was unimportant. A final adjustment was made by blocking up a proportion of the holes until a uniform discharge was obtained as measured by a Pitot tube connected to an electrical micro-manometer.

As it was desirable that the air flow and temperature in the model should be disturbed as little as possible during test it was found necessary to make observations and measurements from outside the model. This was achieved by employing hot-wire anemometers for measuring air velocities, and by reading temperatures indicated by mercury thermometers with the aid of a suitable telescope placed outside the model. The hot-wire anemometers used were made to a pattern designed in the Aerodynamics Division of the Laboratory. They consisted of an electrically-heated wire housed in one bore of a twin fine-bore silica tube, the other bore containing the thermocouple wire.

To permit of observations of the general air-flow pattern obtaining under specified test conditions, a

simple form of smoke generator was devised. The generator consisted mainly of an electrically-heated boiler containing medicinal liquid paraffin. The vapour is produced under a small head of liquid in a reservoir connected to the boiler by rubber tubing, and escapes as a fine jet through several small holes, each about 0.02 in. in diameter, in the heated outlet tube. The vapour cools on emerging and condenses to form a white, non-heavy cloud, thus permitting observations of air currents in its neighbourhood.

The results of tests carried out on the quarter-scale model form the basis of the conclusions given later. As far as possible these tests were conducted in a set manner throughout the investigation. For instance, velocity and temperature measurements were generally taken at about 20 different positions in the model, each of these positions being decided upon initially and used throughout. Slight variations were, however, made in some of the gallery positions. Thus, the variation of velocity with differing inlet conditions could be obtained for each test position and this information used as supplementing that which showed how the mean velocity in the Chamber varied from test to test.

The general procedure adopted for each test was, firstly, to obtain an idea of the flow pattern by means of smoke observations and then to proceed to actual measurements of air velocity and temperature. The measurements were carried out in three stages, the anemometers and thermometers on the floor and on the side galleries being moved at each stage. Usually, the two anemometers on the back gallery were kept in the same position throughout the test.

No attempt has been made in this report to present the large amount of quantitative data obtained in the course of the investigation, and in order to simplify the presentation of results the tests have been divided into a number of groups, a general description of each group of tests being given. In most cases an exploration with a smoke generator was made. For quarter-scale model

tests the quantity of air supplied was 1/16th of that required for full-scale tests, and the temperature difference was four times the full-scale value. This produces, theoretically, air velocities equal to those obtained in full-scale tests and the air-flow pattern should also be similar in both full-scale and quarter-scale model tests carried out under relatively the same conditions. A note on the scale effect is given in the Appendix.

The tests conducted can be summarised as follows:—

(1) In order to verify the assumption that a reduction in Reynolds number to one-quarter of full-scale value—which is necessary in order to preserve the correct buoyancy forces in the heated model—would not materially affect the results of tests, some preliminary experiments were carried out with a range of inlet velocities, air being admitted under the gallery at one side only. For these investigations the heating lamps were not used and the incoming air was at approximately the same temperature as the model and its existing air content. The general air-flow pattern obtained remained substantially the same throughout this series of tests and

the results indicated that the induced velocities were approximately directly proportional to the quantity of air supplied.

(2) A series of tests was then carried out admitting air from the Speaker's left-hand side, both from the gallery inlets and from those in the roof above these inlets. The quantities of air admitted (376 cub. ft. per minute under the gallery and 564 cub. ft. per minute from the roof inlets) were equivalent to flows in the Chamber itself of 12,000 and 18,000 cub. ft. per minute, respectively. These quantities were those originally considered to be necessary for adequate ventilation of the Chamber. The results of this series of tests showed several velocities in excess of 100 ft. per minute at head level, under conditions representing either a full or empty House.

(3) A test made with air admitted on both sides of the model simultaneously, the total quantity being the same as for the previous test, gave velocities which were of the order of 30 ft. per minute on the ground floor, but which exceeded 100 ft. per minute in parts of the gallery.

(4) It was then found necessary to reduce the depth of aperture in each row of gallery inlets in order to reproduce to scale the area of aperture which would be available in the chamber itself. This reduction in area would have the effect of producing increased velocities at the apertures, although an attempt made at this stage to improve the longitudinal distribution might to some extent offset this effect. The tests described in (2) were therefore repeated, giving velocities somewhat higher than those previously obtained.

(5) As it was considered desirable to confirm the soundness of the principles upon which the quarter-scale model tests were based, special test were carried out for direct comparison with similar tests made on a full-scale model of a central section of the Chamber. For these tests the back gallery was screened off completely and air admitted through gallery inlets only. The velocities obtained were in good general agreement with those obtained from tests carried out under similar conditions in the full-scale model, as is shown by the figures given in Table I; the temperature measurements are given in Table II.

TABLE I.

Comparative Velocity Measurements for Full—Scale and Quarter-Scale Tests.

Model.	Test No.	Air Input, cub. ft. Per min.*	Conditions of Test.	Air Velocities, ft. per minute.						
				Ground Floor.			Side Galleries.		Ground Floor Extra.	
		Under Gallery.		1.	2.	3.	4.	5.	6.	7.
Quarter Scale	121	12,000	Back gallery screened off. Full heat—							
	124	12,000	Input left of speaker ...	25.50	40.80	45.75	40.80	20	40.65	45.65
			Input from both sides ...	45	25.35	55.60	—	—	30.40	25.30
Full-Scale	—	12,000	Full heat—Input one side only.	40.70	30.90	40.85	—	—	25.75	35.60
	—	12,000	„ Input both sides together.	40.60	10.40	30.50	—	—	30.40	30.50

* The actual flow has been scaled-up to give the equivalent for the full-sized Chamber.

TABLE II.—Temperature Measurements on Quarter-Scale Model.

Test No.	Air Temperature, deg. C.		Temperature Excess Over Incoming Air Temperature, deg. C.									
	Outside the Model.	In-coming Air.	Ground Floor.				Side Galleries.		Ground Floor.		Ex-tract Air.	Calculated Value for Extract.*
			1.	2.	3.	Maximum Under Gallery.	4.	5.	Front Row.			
									Right.	Left.		
121	—	24.9	16.4	11.8	14.8	—	13.9	14.5	11.9	11.5	14.4	27.8
124	—	24.5	13.7	12.2	14.1	—	11.4	12.3	12.3	11.3	15.2	27.8

* Assuming no heat losses.

(6) The tests so far conducted indicated that the induced air velocities were generally too high, but it was possible that a reduction would be obtained if the total area of inlet ducts could be increased thus reducing the inlet velocities for a given total flow. The roof inlets were therefore extended along the full length of the chamber on both sides, and a further series of tests carried out. These changes produced markedly lower velocity figures and, after improvements had been made in the distribution of the air input from the roof inlets, velocities at all head-level points in the Chamber were less than 100 ft. per minute.

(7) In all the tests so far described the total quantity of air admitted to the model was the equivalent of 30,000 cub. ft. per minute full-scale: 12,000 cub. ft. per minute through the inlets under the two galleries and 18,000 cub. ft. per minute through the roof inlets. Measurements taken at various positions showed, however, that the temperature rise of the incoming air was unnecessarily low. To take advantage of this fact the gallery flow was first of all halved (to the equivalent of 6,000 cub. ft. per minute) and later the total quantity of air admitted was reduced to half the original amount. Tests showed that a considerable improvement had been effected as a result of these modifications, and with this reduced quantity of air being admitted at all inlets, head-level velocities were everywhere less

(8) In a further attempt to reduce air velocities, an extension of the roof inlets was made round the back of the model (i.e., over the back row of the Press Gallery). Velocities obtained as a result of this modification were mostly well below 40 ft. per minute.

(With acknowledgements to 'Engineering').

S. THIRUNAVUKKARASU

Engineer and Contractor

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Mylapore, Madras

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CEMENT INDUSTRY

FOR DISCUSSION

What Governments have done in the past and continue to do to-day is to put every obstacle, hurdle and restriction on private initiative and raise barriers against whatever it is, thus denying to the country the advantage of progress.

In designing and equipping dwellings, account should be taken of the way in which a house is run and the use which is made of the various rooms; in this matter the housewife is the expert and designers should have constant regard to her views.

At last, after having had a trip to England a city administrator has said that public cleansing is sanitary engineering; that is what exactly one of our leading sanitary engineers, Mr. A. V. Raman has been vehemently advocating years back.

The best guide for humanity in all its progress lies in observing the experience of others, studying the mistakes others have made, and analysing the causes which lead to failure on the one hand and brought success upon the other.

The Hindustan Construction Co Ltd., Bombay has secured the contract for the construction of the dam across the Vaitarna River for the Bombay Municipality costing Rs 5 crores and is the first Indian Contractors entrusted with works of such magnitude.

Corrupt influence is itself the perennial spring of all prodigality and of all disorder; it loads us more than millions of debt; takes away vigour from our arms, wisdom from our councils, and every shadow of authority and credit from the most venerable parts of our constitution.

The several multi-purpose projects which are already in hand comprise the Damodar Valley project (Rs 50 crores) the Hirakud project (Rs 30 crores) Bhakra Nangal (75.7 crores) Kakrapar (Rs 9.4 crores) Tungabadra (Rs 31.98 crores) and Chambal (Rs 15.3 crores).

A Conference of the representatives of the cement industry was held recently to discuss and formulate a five-year development plan. Mr. G. L. Mehta presided and the representatives of the Ministries of industry and Supply and Works, Mines and Power were present. The cement industry was represented by Col. Leslie Sawhney, Dr. R. A. Hathiangedi and Mr. M. M. Jayakar (A. C. C. Ltd.); Mr. J. D. Dalmia (Dalmia Cement Co.); Mr. L. C. Jain (Rhotas Industries Ltd.); Mr. N. C. Moitra and Mr. S. K. Nag (Sone Valley Cement Co Ltd.); and Mr. G. D. Somani (Digvijaya Cement Co.).

The discussion disclosed that the actual production of cement during 1949 was 2.1 million tons, while the rated capacity of the industry comprising 21 units was estimated at 2,931,000 tons on January 1, 1950. This capacity is likely to be stepped up to 4,165,000 tons by the beginning of 1952 and to 4,515,000 tons by extensions of existing units as well as installation of some new plants.

There was considerable discussion on the size of an economic unit for cement production and the basis for the fixation of the rated capacity of the industry. It was suggested that the rated capacity of various units should be examined on a technical level so as to determine the total installed capacity of the cement industry. Further, there was a free exchange of views on the various difficulties experienced by the industry in regard to the supply and prices of raw materials, coal and fuel oil, freight rates charged and facilities offered by railways and the abnormal rise in the cost of gunny bags and imported paper bags. It was urged that these factors have been responsible for the high cost of indigenous cement and various suggestions were put forward for meeting these difficulties.

While discussing the question of the future demand for cement, attention was drawn to the desirability of exploring and nursing export markets in Iran and other adjacent countries to off-set any contraction in internal demand, if it

should arise from diminished civilian consumption or restriction of developmental activities on the part of Government owing to financial stringency. The importance of offering competitive and steady prices to build up export markets was also emphasised.

The representatives of industry expressed some anxiety on the subject of future gypsum supplies in view of the competitive demand from the fertiliser industry. A statement containing the results of the latest surveys of gypsum deposits was placed before the meeting which showed that the available deposits were adequate to ensure regular supplies to the cement industry.

Other aspects of the industry considered at the conference related to the best methods of attaining the targets with the minimum of capital expenditure, indigenous fabrication of cement machinery and spare parts, organisation for research work and a central marketing organisation. For arriving at proper decisions on several matters such as the most suitable system of price fixation, centralised marketing, etc., a thorough and impartial inquiry into the cost of production of cement by various units by a body like the Tariff Board was suggested.

In the light of views expressed by the representatives of the cement industry, the Planning commission is expected to formulate a programme of development for this basic industry at an early date.

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ORISSA: Bridge.

Dec. 15.—Construction of a Road bridge on the Baitarni on national High way No. 6 through the Eastern States of Orissa. The Estimated cost of the work is Rs. 5,34,462. Additional Chief Engineer C.P.W.D. New Delhi.

UDAIPUR: Dam.

Dec. 15.—Construction of north saddle Dam of Jawai River Project Costing about Rs. 12 Lacs, Superintending Engineer, Irrigation, Udaipur.

MERCARA: College Building.

Dec. 18.—Construction of a First Grade College at Mercara. Estimated cost of the work is Rs. 10,00,000. Executive Engineer C.P.W.D., Mercara.

ORISSA: Road Bridges.

Dec. 18.—Constructions of (1) a road bridge about 1,800 ft. long on the Brahmani River at Barkot and (2) a road bridge about 200 ft. long on the Kolanallah at Kola on the National High way No. 6 in the Eastern states of Orissa. The Estimated cost of the works is Rs. 14 Lacs. and 1.75 Lacs respectively. Additional Chief Engineer C.P.W.D., New Delhi.

MUKERIAN PATHANKOT RAILWAY: Engineer of rail & Girder.

Dec. 18.—Erection of one 350 ft. clean rivetted type rail and road girder span 362 ft. centre of bearings, B. G., M. L. standard, over the chakki Khund on the Mukerian Pathankot Railway. Chief administrative officer, Delhi.

PALANPUR: Posts.

Dec. 19.—Construction of 4 Reservoir-cum-stand posts with taps for the emergency water supply scheme at Palanpur. Estimated cost is Rs. 23268 Executive Engineer, Northern Public Health works Dvn. Surat.

SURAT: Bridge work.

Dec. 20.—Construction of masonry piers, abutments wing walls etc. for 4 Railway bridges on Ralania, Nanicher, Dankania and Moticher Kharis. Approximate cost of Rs. 150000. Executive Engineer, Kakrapar Head works Division, Surat.

BILASPUR: Institute Buildings.

Dec. 20.—Special repairs to C.T.C. and Central Institute Buildings at Koni, Bilaspur. Estimated cost is Rs. 59700. Executive Engineer, Nagpur Central Dvn., P.W.D., Nagpur.

ALWAYE: Factory Building.

Dec. 21.—Construction of factory Building for Messrs. Indian Rare earths Ltd. at Alwaye. Architect Spinners Building, No. 8, Lane, Fort Bombay.

POONA: Quarter

Dec. 21.—Construction of Staff quarters, Store Room, and Aquapriy for saswad. Approximate cost is Rs. 13440. Executive Engineer, Central Public Health works dvn., Poona-1.

RAJAHMUNDRY: Erection of Pumping sets.

Dec. 25.—Works of supply and erection of 4 sets of electrically driven pumping sets, for the Rajahmundry Municipal water supply scheme. Executive Engineer, (P.H.) Vijayawada.

ANNAMALAI: Supply of cast Iron pipes.

Dec. 26.—Supply of 4000 feet of 10 inches diameter and 2750 feet of 6 inches diameter cast Iron pipes and specials class B. B.S.S. No. 78-1917 for the drainage scheme. The Registrar Annamalai University, Annamalai Nagar. P. O.

BAREJADI: Residential Buildings.

Dec. 27.—Construction of Residential colony Buildings at Barejadi, Estimated amount Rs. 95817. Executive Engineer, Electric Grid Dvn., Nadiad.

RAKHIAL: Buildings.

Dec. 28.—Construction of residential Buildings, for accommodating 384 tenements on the additional lands at Rakhial Ahmedabad. Estimated cost Rs. 429520. Executive Engineer, Housing Division, Laldarwaja, Ahmedabad.

MADURAI: Bridge.

Dec. 30.—Work of constructing a bridge of 6 vents of 30 feet span at mile 6/1-2 of Dindigul Aravakuruchi Road, Divisional Engineer Highways, Madurai Division.

Dec. 31. Supply of 1 Kandla Port, Secretary to Development Commission
glazed tiles (English) per doz. 0 10 9
polished white or grey per sq. ft. 0 9 9
concrete white cement per cwt. 0 7 6
and 132 K.V. Transmission Lines. 20 0 0
Chief Engineer, Punjab P. W. D., Electricity Branch, Simla. 4 8 0
0 5 6 to 1 5 0
20 8 0
21 8 0
0 13 9
6 0 0
22 V.

JAMKHANDI: Buildings.

Jan. 4.—Additions & Alterations to Buildings at Jamkhandi for accommodating Kannada Training College, Estimated cost Rs. 150000. Executive Engineer, Bijapur Division, Bijapur.

BOMBAY: Water Pipes.

Jan. 9.—Laying and jointing of circulation water pipes for the above power station. General Manager, G. I. P. Railway, Bombay V. T.

ALIBAG: Roads.

Jan. 11.—Construction of Division Road outside Mahad Town. Estimated amount Rs. 176679, Executive Engineer, Kolaba Division, P. W. D., Alibag.

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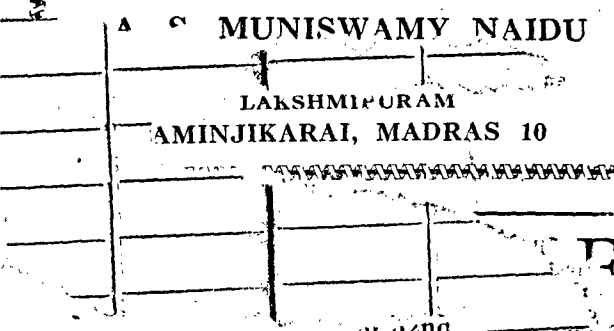
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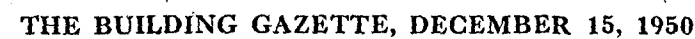
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