The Fondu-Bound Road
Cheap, Simple, Durable.
Withstands Motor Traffic
Tasmania's Road Requirements.

In a report to the State Government on his enquiries in London during his attachment to the British Empire Exhibition, Mr. W. D. Reid has given the following valuable information relative to modern road-making for present day traffic service.

I took the opportunity (says Mr. Reid) of studying many of the various methods of road construction in Great Britain and on the Continent. Of the methods examined the one which appealed to me as the most suitable for our conditions, where a good foundation exists, is that devised by the Lafarge Aluminous Cement Company of High Holborn, London, who make use of their Ciment Fondu brand of Aluminous Cement in the preparation of the road.

I have examined a section of their road laid two years ago, and which has been subject to motor 'bus, heavy lorry, and fast car traffic, and the surface was in perfect condition and there was not a loose stone.

I would strongly recommend this system of road making to the consideration of those responsible for the construction and upkeep of the roads in the State. The method is simple and rapid, and given an excellent non-skid surface for motor vehicles.

Pneumatic tyres suck out the sand and grit which lie in the interstices of the macadamised road, and upon which the road metal is dependent for retaining its position as left by the steam roller. The metal thus deprived of its support rapidly works loose, and is uprooted and dislodged by the tyre-wheel.

Efforts have been made in the past to replace the sand and grit by some form of binder, which at the same time give the metal the necessary support and bind the stones into a more or less monolithic mass.

Ciment Fondu

The Lafarge Aluminous Cement Company states: "The names of these 'grouts' is legion. They are usually based upon tar and bituminous products, and whilst they undoubtedly represent a great improvement over the water bound road, they have many serious drawbacks, namely,

(1) They are relatively expensive.
(2) They are liable to soften in hot weather, and produce corrugations.
(3) They are apt to be dangerously slippery.

It is fairly obvious that if a mac dam road could be 'grouted' with a cement mortar, so as to convert the whole into a cement halving the macamam road metal as a wearing surface, the ideal would be reached.

Many attempts have been made in the past to attain this ideal, without success. However, with the advent of Ciment Fondu, with its extraordinary lag in 'initial set' coupled with its phenomenal strength in a few hours, this ideal method of road construction has become possible.

The method of application is simplicity itself, and can be carried out by the gang normally employed on a

water-bound road. It is never necessary to divert traffic for more than 24 hours, and then only half the road.

A point of great interest to engineers in general is the extremely low cost of this method of re-surfacing. For a maximum of 1/- (usually 9d.) per super yard over and above the cost of a water-bound road, an excellent road capable of withstanding even motor 'bus traffic, with waving or loosening, can be produced." (This refers to cost in England).

Fondu Binding

The general principle of Fondu binding is the filling of the voids and interstices of the macadam crust to its entire depth with a cement mortar, with the object of forming a monolithic surface, and not as an attempt to convert a macadam road into a concrete road. The strength of the road to resist weight depends on the strength of the hard-core foundation of the original road.

The Fondu Binder imparts to the metal surface coat the power to resist the disintegrating action of mechanically driven pneumatic-tyred vehicles and, distributing the road, enables the sub-crust to withstand much greater wheel pressure than would otherwise be the case.

Essentials

Sand - The essentials are cleanliness, sharpness and freedom from dust. Of these, cleanliness is probably the most important, as a sand containing more than 2% of loamy matter will not produce a satisfactory mortar. Freedom from dust is next in importance, as dust produces much the same result as loam. We suggest that no more than 5% should pass a 100 mesh sieve. Sharpness, while a great asset, is not nearly as essential as the two above mentioned features. Summarised, the best sand obtainable should be used. Any small extra cost over an inferior sand has an insignificant effect on the cost per square yard, and is repaid many times over by freedom from repaid bills.

Road Metal - As in the case of sand, local conditions obviously control the type of metal available. Note well that Fondu Binder does not strengthen the metal but merely provides such a perfect support as to completely prevent any movement and consequent inter-metal attrition. The metal should be cubical and be strong enough to stand up to the traffic conditions of the road and tough enough not to crack up unduly under the roller. The whole aim and object of the method of application is to completely fill in the voids or interstices in the metal with mortar. If the metal cracks under the roller after the mortar has been slurred in, these cracks represent interstices which are not filled, and consequently not bound. If the metal is tender, do not use too heavy a roller. Basalt and diabase rocks are most suitable for the purpose.

Methods of Application

Whilst the following outlines are based upon actual experience in various parts of the country, the engineer will naturally be guided by his experience as to any modifications of detail which may be necessary owing to local conditions.

Plant Required

Steam roller (weight may be normal, but it

should be fitted with Van Putten sprinklers if possible). Four watering cans (4 gallons), fitted with roses. (It is preferable to use a rose-headed guarded hose from a hydrant, where this is possible. Three soft hair brushes (Archer road type). One mixing board (or preferable concrete mixer.)

Additional Plant

(If road can be closed to traffic) 100 ft. run of 4½ in. by 3 in. battens 36 steel "L" spikes, 6 in. by 5/8 inch, one sledge hammer, one template (for regulating chamber), one long cold chisel or spike.

Preparation of Roadway

Regulate the old surface, removing all disturbed portions, sweep and clean out all dirt etc., from the foundation bed. Spread new macadam (2½ in. gauge) to required thickness, and shape to contour. Dry roll "lightly" to desired crossfalls, etc.

Preparation and Application of Fondu Binder

To each cubic yard of selected sand add four sacks of Ciment Fondu, approximately 5 to 1 mix. Mix either by machinery or hand. Spread the resultant cement grout (in a dry state) on to the surface of the lightly rolled macadam to a thickness of about ½ in. over a length of roadway of about 50 ft.

Note: One cubic yard of this dry grout will cover about 50 super yards of 3 in. coat work.

Pass the roller over the dry ground surface, two men with brooms following up the roller track, and sweeping the grout into the interstices of the macadam, two other men continuing to spread dry grout.

The remaining hands are employed mixing further quantities of binder. It will be observed that as the roller passes over the macadam, the dry grout will fall readily into the interstices.

This rolling, spreading, and sweeping of dry grout must be continued until it is observed that the voides of the macadam are completely filled in and seem to be firmly "bound up" by the steam roller.

Watering

Remove the roller from the work and proceed to sprinkle the rolled in grout with a hose or watering cans, fitted with a fan-shaped nozzle or rose, until the grout is thoroughly saturated and the whole road appears quite damp.

Note: It is extremely important (perhaps the most important part of the whole operation) to avoid 'flooding' for an excess of water weakens the mortar, and too heavy watering has a tendency to wash the cement away from the sand.

Rolling

Bring back the roller and with its wheel sprinklers in operation proceed to roll and thoroughly consolidate the road crust until a slurry appears on the surface. Patches will appear showing where the grout

has not completely filled in the voids in the macadam. Superfluous slurry must be brushed on to these patches, and, if necessary more dry grout added until no patches are visible.

Continue rolling and sweeping the slurry under the roller until complete consolidation is attained. This ends the days work, and superfluous slurry remaining on the surface being brushed on to the portion of the roadway to be dealt with on the morrow.

Initial set of Cement

Care must be taken not to pass the roller over the completed work after the initial "set" has commenced. This should be calculated at three hours after watering the dry grout.

Joining up the previous days work

When starting a new days work, loosen all ungrouted stones with a pick and build up with new macadam. Cut away previous days work at an angle with the centre lines.

Note: No apprehension need be felt about passing the roller over the end of the work grouted on the previous day, as owing to the extremely rapid hardening properties of Ciment Fondu no damage whatsoever will be done.

Gradients

In steep gradients (for which the Fondu Binding is eminently suitable) commence grouting from the lower end of the gradient, working upwards in order to counteract undue drainage of the cement mortar.

Opening of Road to Traffic

If the road can be closed during the re-surfacing it may be opened to traffic the following morning if necessary. When possible, it is preferable to keep the treated portion of the road closed for 24 hours after watering the grout. Nothing will be gained by keeping the road closed for any longer than the above mentioned 24 hours.

Procedure when road cannot be closed

When a road cannot be closed to traffic, a half width must be dealt with at a time, and the work carried out in the following manner:-

Having regulated the old surface, place the 4½ in. battens longitudinally along the road, and 9 in. on the further side of the centre line from the half-width to be re-surfaced.

Fix these battens in position with steel spikes (3 to each batten). These spikes may be driven into the roadway if a preliminary hole is made with a cold chisel. Spread the new macadam up to the battens and proceed as directed above, but do not allow the roller track to come closer than 6 in. from the battens. The levels may be adjusted by means of the camber template. By this means an entire half roadway from haunch to centre line may be grouted up. When a half-width has been completed for the desired length the remaining half-width is dealt with as follows:

Having removed the battens, cut away and remove the loose macadam between the battens and the centre line of the road. After regulation of the old surface, "butt-joint" with new metal, proceed to light roll, dry grout, water and consolidate as before described.

Cost

It may be accepted that an ordinary water-bound gang (including roller-driver) is composed of 8 men, and is capable of completing, say, 250 super yards per day. With this process can be completed per day with exactly the same gang, by dividing the work into two operations, namely,

Morning - Regulating, spreading and lightly dry-rolling the macadam.
Afternoon - Mixing and spreading of Fondu Binder, watering and rolling to complete consolidation

The extra costs involved are, therefore,

(1) The cost of Ciment Fondu.
(2) The possible slightly extra expense in order to obtain a clean sand.

The finished cost of the road varies from 7d. to 1/- per super yard more than the cost of water binding (in England). The proportion of sand to cement in the mortaring can be somewhat varied according to the quality of sand obtainable: 7 to 1 can be and has been used with success when the sand is ideal.

Five to 1 represents a safe proportion when ordinary good clean sand is used. If the best local sand is of doubtful quality, dispatch a sample to the Government Laboratory, and we will test and advise as to mix. Mix proportions by volume calculating Ciment Fondu at 90 lbs. per cubic foot. Do not apply Ciment Fondu to a road with weak foundations. To summarise the foregoing, Fondu-Bound Road is:-

(1) Extremely cheap.
(2) Simple in application
(3) Durable.
(4) Capable of withstanding motor traffic.
(5) Perfectly non-skid.
(6) Quite incapable of undulating.
(7) Unaffected by temperature.
(8) Causes the minimum dislocation of traffic during application.
(9) A cheap and excellent medium as a sub-coat for asphalt carpeting work on heavily trafficked highways.

It may be asked, since Portland Cement has been known for 100 years, why has this not been done successfully before? The answer lies in two of the extraordinary properties of Ciment Fondu, which is aluminous and not a Portland Cement, namely,

A lag in the initial set of about three hours.
A phenomenal strength when 24 hours old.

Cement must not be stressed after the initial set has taken place. The lag in Ciment Fondu gives three clear hours for consolidation with the roller. The preceding days work must be capable of withstanding the roller when consolidating the following days work. The phenonenal strength of Fondu when 24 hours old ensures this.

W. D. Reid
1st September, 1926.