M.2 MOTORWAY

Front Cover :
Artists Impression of A.228 Bridge

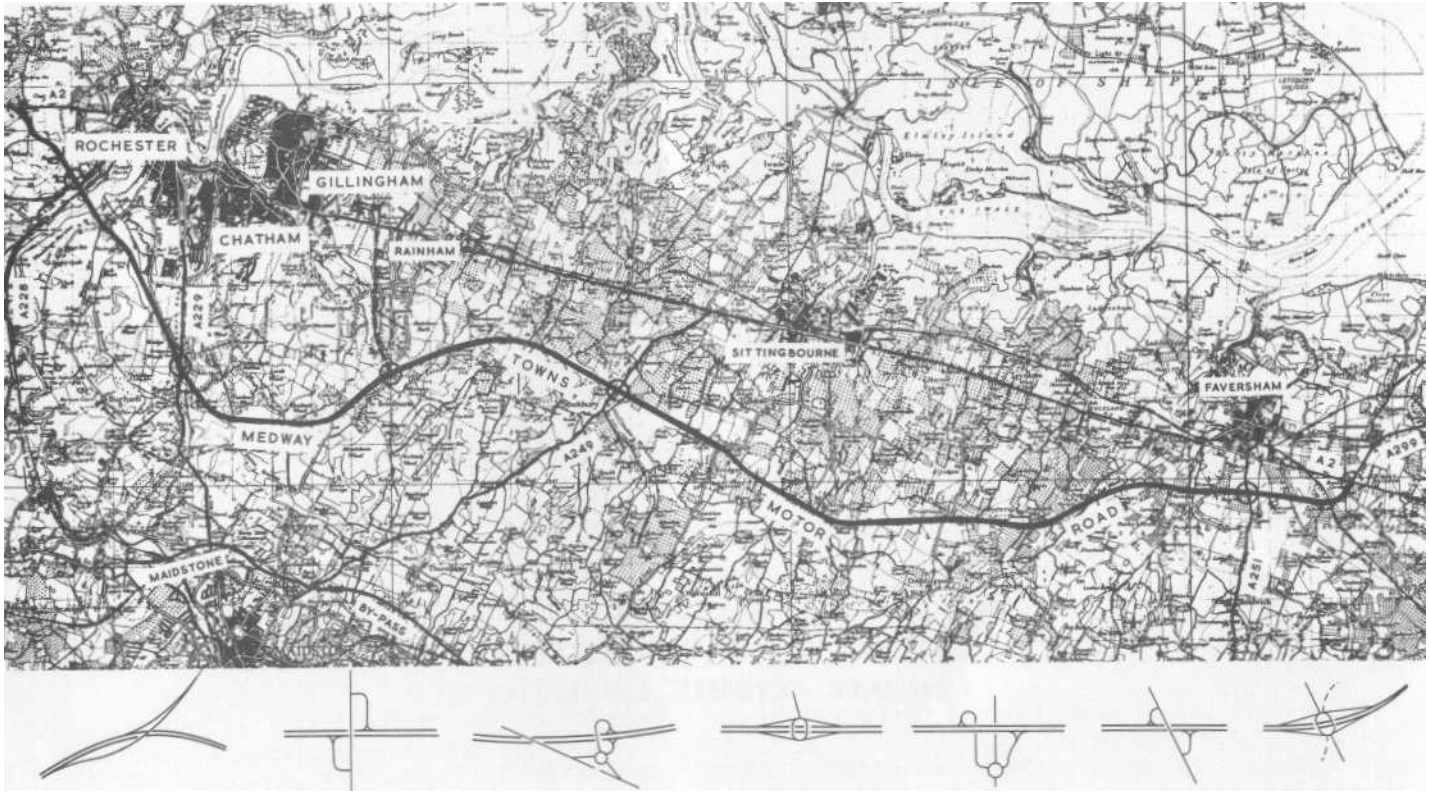
MEDWAY TOWNS MOTOR ROAD

MINISTRY OF TRANSPORT

Consulting Engineers
FREEMAN, FOX AND PARTNERS

Associated with
ROBERT F. EARLEY

Contractors
J. L. KIER & COMPANY LIMITED
CHRISTIANI & NIELSEN LIMITED
SYDNEY GREEN & SONS (CONTRACTORS) LIMITED
GEORGE WIMPEY AND COMPANY LIMITED
.JOHN LAING CONSTRUCTION LIMITED



THREE CRUTCHES INTERCHANGE

CUXTON ROAD INTERCHANGE

A229 INTERCHANGE

GILLINGHAM LINK JUNCTION

STOCKBURY VALLEY INTERCHANGE

A251 INTERCHANGE

BRENLEY CORNER INTERCHANGE

MEDWAY TOWNS MOTOR ROAD

MEDWAY TOWNS MOTOR ROAD

This 25 mile length of motorway leaves the existing A.2 road at "Three Crutches" approximately 2 miles west of Rochester Bridge and rejoins it nearly 2 miles east of Faversham of the junction of the A.2 and the A.299 (Thanet Way) giving easy access to this coastal road which serves the holiday resorts of north Kent.

After leaving the A.2 at "Three Crutches", the motor road runs in a south-easterly direction to the River Medway. Immediately before the Medway Bridge is a two level interchange at the junction with the A.228; this is the first of five two level junctions with trunk roads along the motor road apart from the two terminal junctions.

The main spans of the Medway Bridge are of the cantilever type in prestressed concrete and the bridge, with its approaches, which are of pre-stressed pre-cast beams and in situ slab construction, is nearly two thirds of a mile long; although a motor road bridge it does incorporate facilities for carrying cyclists and pedestrians. These facil-ities are completely separate from the motor road and join with the existing road system at each end of the approach spans.

After leaving the Bridge the road continues in a south-easterly direction till its junction with A.229 where it turns and runs in a more easterly direction passing close to Bredhurst, Bredgar, Milstead and Newham before rejoining the A.2.

Owing to the hilly nature of the country the road will rise to a height of about 600-ft. above sea level between Bredhurst and the A.249. There are several deep valleys which necessitate the use of viaducts, the longest of which is at Stockbury Valley; this viaduct is over 850-ft. long and carries the road 70-ft. above ground level at the highest point.

Apart from the five junctions previously mentioned, all other roads as well as farm and pedestrian accesses will cross the motor road either under or over. This will mean the use of over 60 bridges.

Artists impressions of the various types of bridges have been approved by the Royal Fine

Art Commission. It was decided as a matter of policy that overbridges should be of similar appearance where possible. The road alignment both vertical and horizontal has been designed for a speed of 70 m.p.h., the minimum radius is 2,864-ft. and all curves under 11,460-ft. radius have transition spirals and are super-elevated.

The normal maximum gradient is 1 in 30.

Roadworks

The strata underlying the whole alignment of the motorway is chalk, which is exposed in the majority of deep cuttings. Elsewhere it is generally covered by varying thicknesses of "Clay with flints" or "Thanet sands". As the two last mentioned materials are very variable in quality, where possible the top two feet of embankments are being constructed with chalk. Furthermore, chalk is being used as a selected sub-base material 14" thick in cuttings through "clay with flints" where C.B.R's of the order of 2 may be expected.

The motorway is probably unique in having only two wet crossings throughout its whole length, the River Medway and the Ospringe stream near Faversham which is only a brook. Drainage off the motorway has therefore been disposed of in soakaways excavated into the chalk which have been amplified in some instances by additional boreholes. Even in embankments the drainage is positively contained by a shallow kerb at the back of the hard shoulder and directed down precast concrete channels to ditches and the soakaways. In cutting the water is collected by gullies into a solid pipe while a porous concrete pipe takes any seepage from the sub-base and acts as a cut off drain. There is a porous pipe drain in the central median continuous through cutting and embankment.

The construction thickness of the pavement has been arrived at largely to prevent frost heave of the chalk, the rigid pavement on Contract 4 calling for a 10" or 11" reinforced concrete slab with a granular base to make up a total construction thickness of 18". The flexible designs adopted on Contracts 2 and 3 consist of:

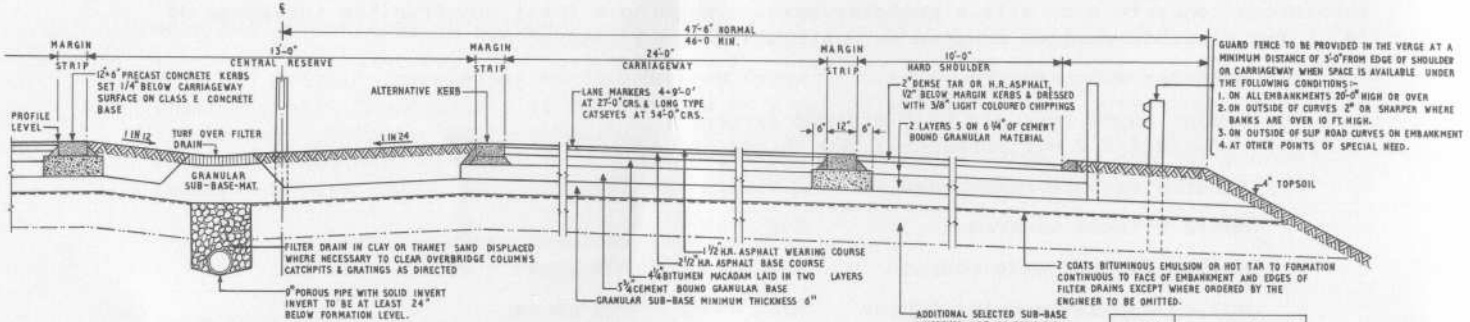
Granular sub-base			6"
Cement bound granular base minimum average corrected 7 day strength 1,200 lb.per sq.in.			6"
Bitumen macadam basecourse	B.S.1621		2"
Dense bitumen macadam	R.N. 29		2"
Rolled asphalt base course	B.S. 594	70% stone	2½"
Rolled asphalt wearing course with precoated chippings	B.S. 594	30% stone	1½"
	Total thickness		20 inches

Hard shoulders are designed to the same total construction thickness and are 10 feet wide. The flexible design including cement bound granular base has been used throughout, even in conjunction with the rigid pavement. Surfacing consists of a 2" thickness of rolled asphalt, 45% stone, surface dressed with light coloured chippings to provide a colour contrast.

Marginal strips consist of precast concrete channels bedded directly on the cement bound granular base, in the flexible design, and on the reinforced concrete pavement a plastic white line, 12" wide is applied to the concrete.

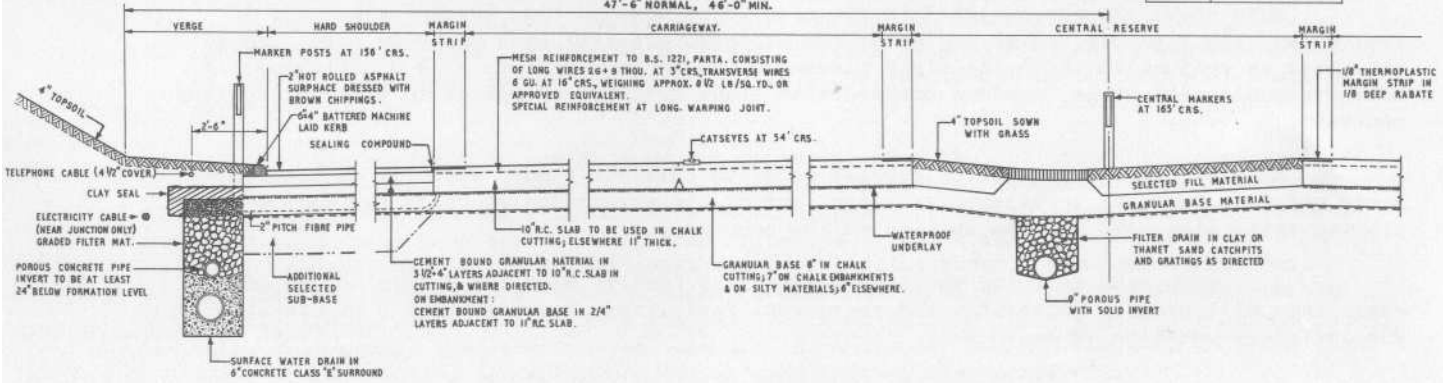
A service area is being provided at Farthing Corner, near the centre of the motorway. This will provide refuelling and restaurant facilities, together with a picnic area. The surfacing consists of dense tar.

The slip roads at all interchanges are dual carriageway.



C.B.R. %	THICKNESS (INCHES)
5-5	23
4-3	25
3-5	29
2-8	29
2-3	35
2-0	35

HALF SECTION OF MOTOR ROAD ON EMBANKMENT
FLEXIBLE PAVEMENT



NOTE:
HARD SHOULDER TO BE CONSTRUCTED IN ADVANCE OF CARRIAGEWAY

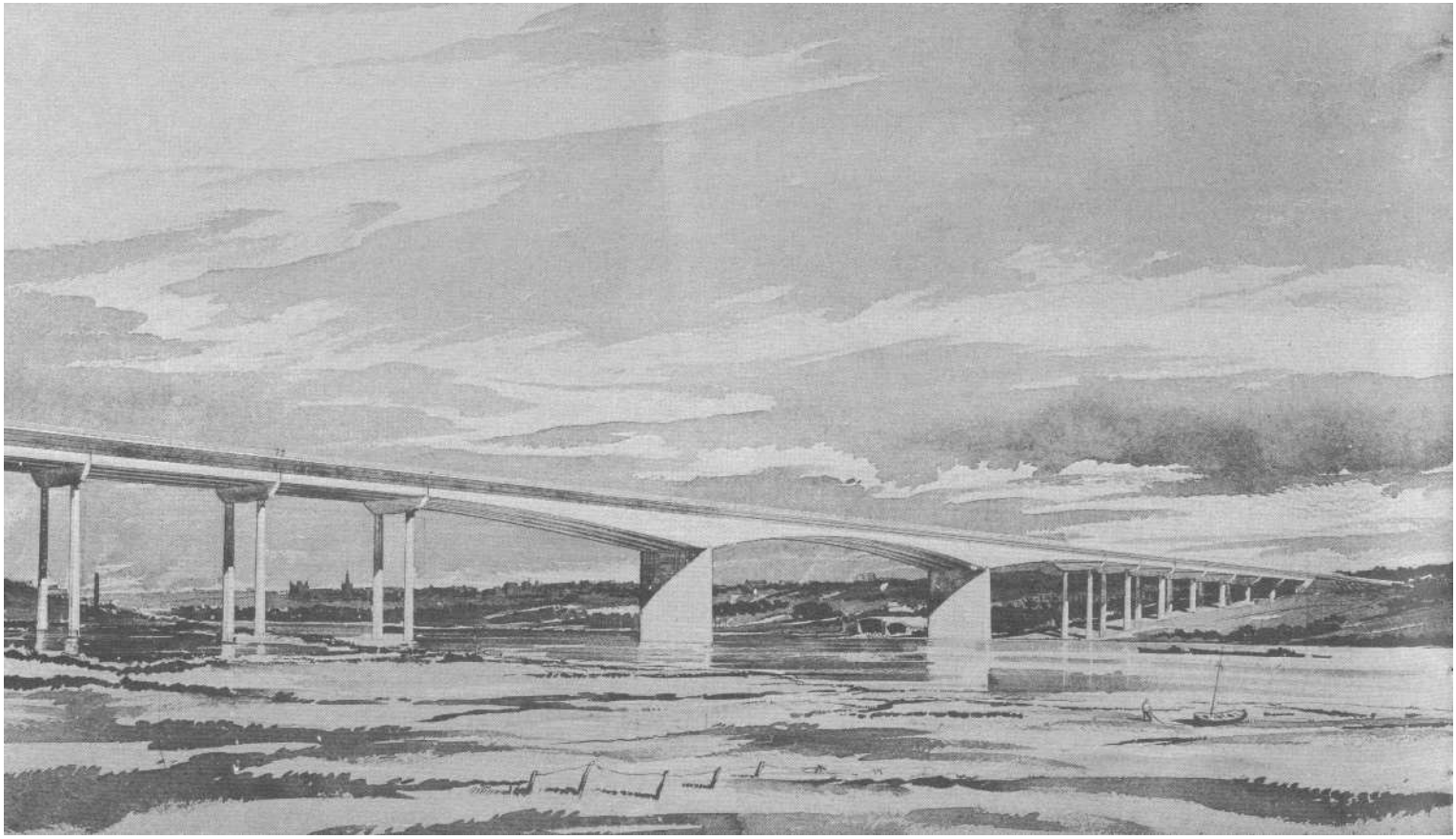
HALF SECTION OF MOTOR ROAD IN CUTTING
RIGID PAVEMENT WITH FLEXIBLE HARD SHOULDER

MEDWAY TOWNS MOTOR ROAD

is 25 miles long, has dual 2-lane carriageways, requires the diversion of 50 existing roads involving a total of 63 bridges, has one service area and requires approximately 750 acres of land.

Approximate quantities of main materials are as follows:

		TONS	
Bulk excavation	Flexible paving	6,000,000	Rigid paving
	(13 miles)		(12 miles)
	(Granular material	202,000	165,000
Base	(Cement-bound G.M.	260,000	92,000
	(Cement	13,000	3,000
	(Asphalt	91,000	2,000
Surfacing	(Bitumen Macadam	73,000	7,000
	(Tar Macadam	4,000	1,000
	(Cement	-	27,000
Concrete	(Fine aggregate	-	60,000
Road	(Coarse aggregate	-	110,000
	(Reinforcing steel	-	1,800
	(Cement	30,900	
Bridges	(Fine aggregate	69,000	
	(Coarse aggregate	124,000	
	(Reinforcing Steel	13,700	
	(Fine aggregate	42,000	
Miscellaneou	(Cement	18,000	
	(Coarse aggregate	75,000	
	(Reinforcing steel	150	



PROPOSED MEDWAY BRIDGE

MEDWAY BRIDGE

This bridge was designed to carry the motorway over the River Medway. The height of the bridge (116-ft. above the river) was governed by the approaches, the central span of 500-ft. by navigation requirements and the remaining spans by economy and appearance. The prestressed concrete structure illustrated was selected as being the cheapest of several, including a braced steel cantilever, a steel suspension bridge, a plated steel cantilever and a steel continuous bridge of box girder type with steel battle deck.

The river spans consist of twin box members, cast and prestressed in-situ and cantilever from each side of the main piers. An additional, in-situ portion provides counterweight at the shore end and the bridge is completed by a 100-ft. suspended span consisting of precast prestressed beams and an in-situ, reinforced concrete deck slab.

The approach viaducts also consist of precast prestressed beams, between 100-ft. and 135-ft. long with in-situ, reinforced concrete deck slabs and are made continuous for live load over the piers, which are of normal reinforced concrete construction. The foundations are either spread footing or on precast R.C. piles with a safe working load of 155 tons, depending on the depth below ground level of good chalk.

The central span of 500-ft. in prestressed concrete is the longest of its kind in the world.


Frank Weemys Sept 1960

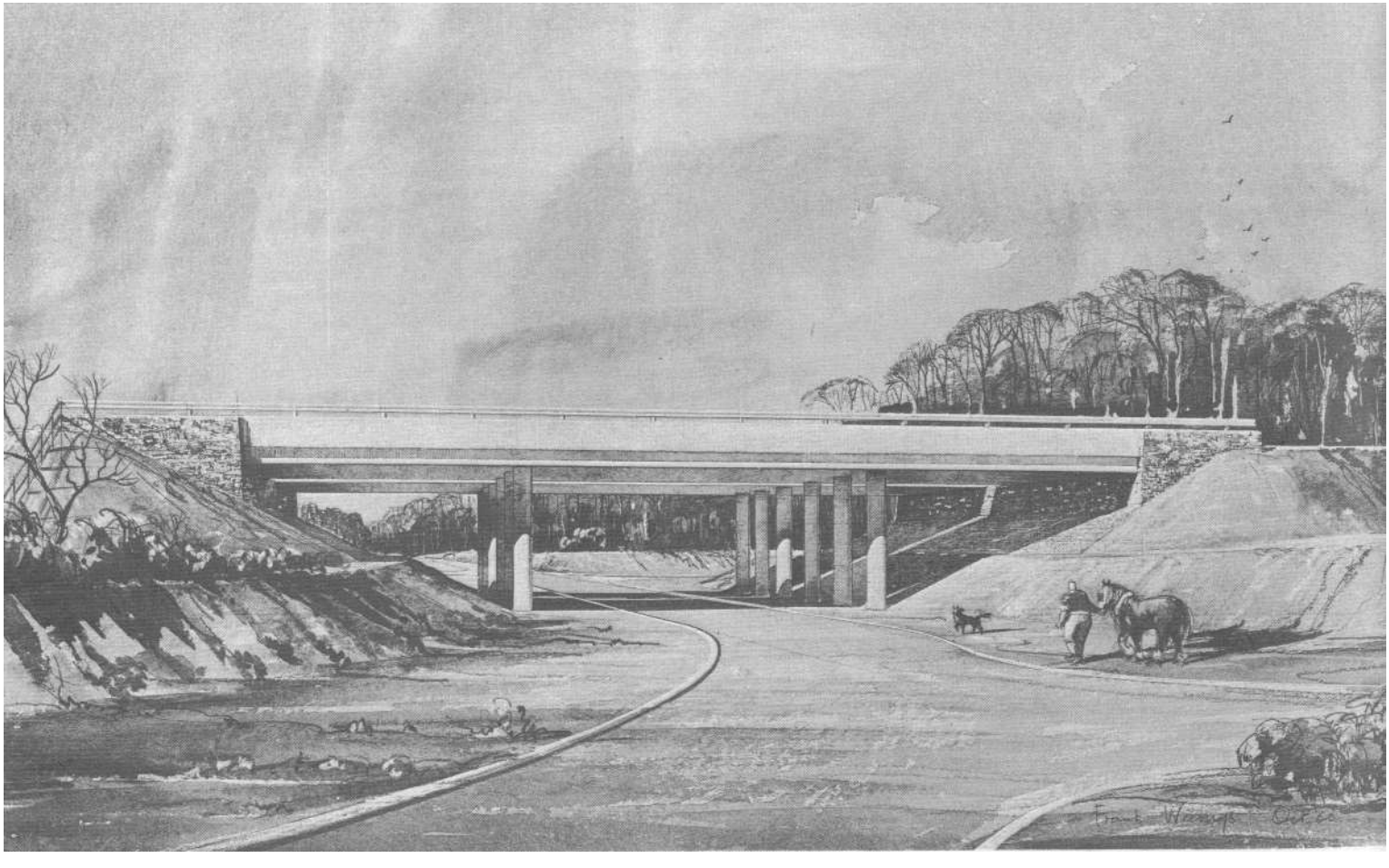
TYPICAL 4-SPAN OVERBRIDGES

These are provided to carry minor roads over the motorway.

The square span of the central spans is 45-ft. 9-ins.; most of these bridges are skewed and some are curved.

These bridges are of reinforced concrete, the deck consisting of a slab generally 26-ins. thick, supported directly on integral coloumns with expansion bearings at the buried abutments. Ducts for services are provided under the footways.

This type of bridge was chosen for its economy and for the ease and economy with which it can be adapted to moderate skews and curves. There are 14 bridges of this class and 8 variations of it.



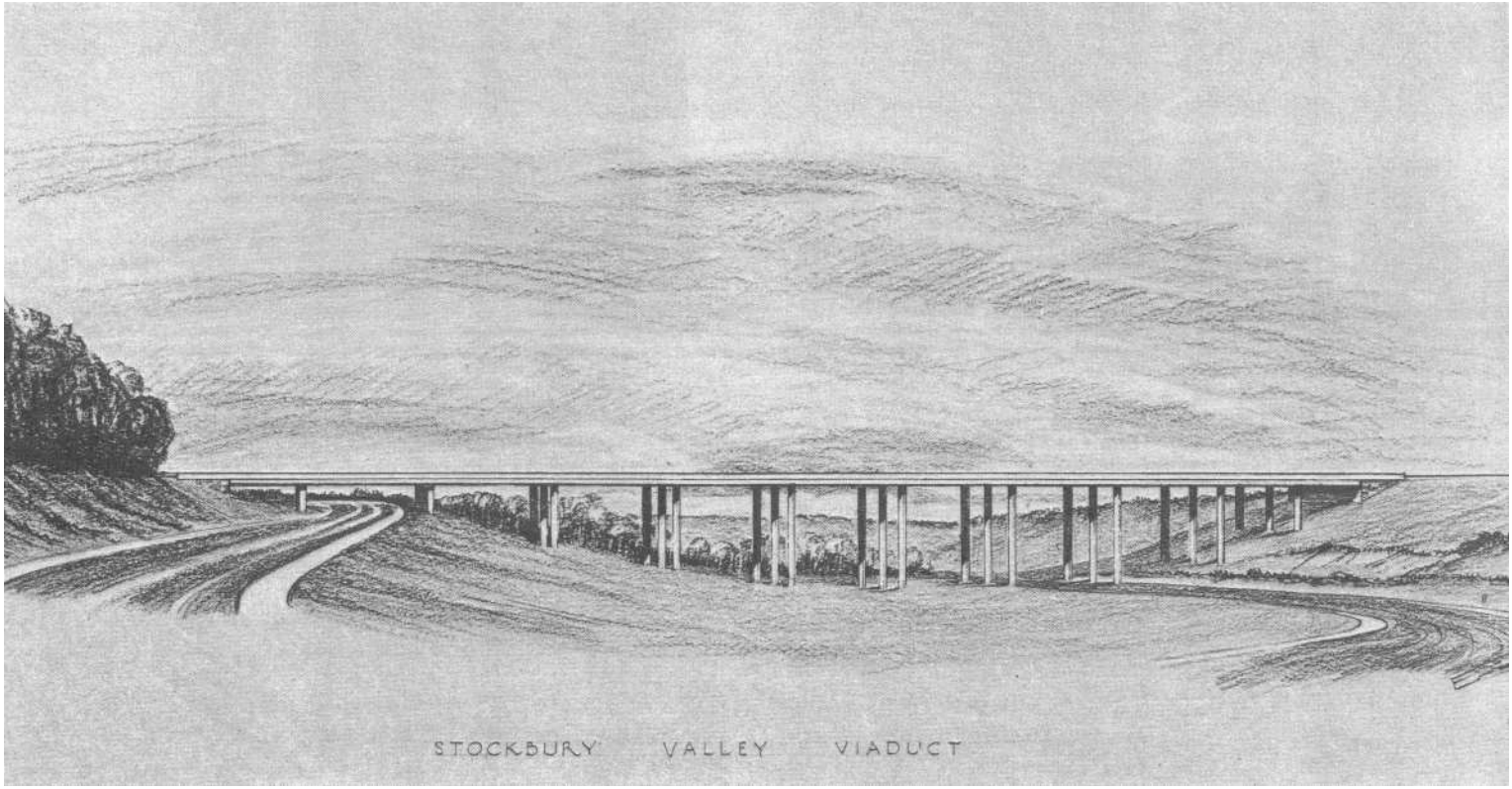
TYPICAL 3-SPAN UNDERBRIDGE

These are provided to carry the motorway over minor roads in locations where adjacent junctions on the minor road require a line of sight through the side spans.

The centre span varies from 41-ft. 3-ins. to 52-ft.O-ins.; the side spans are smaller and are governed by the sideslopes of the earthworks.

These bridges are of reinforced concrete, the deck consisting of a slab generally 23-ins. thick, supported directly on integral columns with expansion bearings at the buried abutments.

There are 4 bridges of this class.


STOCKBURY VALLEY VIADUCT

STOCKBURY VALLEY VIADUCT

This viaduct carries the motorway at a height of 70-ft. over the dry Stockbury Valley. The adjacent interchange with A.249 require the provision of accelerating lanes on the viaduct.

A number of alternative designs were considered, and the design adopted was chosen as being economical and at the same time having appearance in keeping with the other bridges on the motorway.

The spans, generally of 85-ft. were dictated by economics and by clearance requirements for the A.249 road and the west slip road.

The viaduct consists of in-situ prestressed concrete beam and slab construction, transversely reinforced, supported on two-bay portal piers the prestressed crossbeams of which are formed within the depth of the beams. The beams are simply supported in each span for dead load. Continuity for live load is provided by longitudinal reinforcement in the deck slab over the piers. The viaduct is founded generally on spread footings on chalk.

The piers are integral with the deck. A halved expansion joint is provided in the centre span, and fixed hinged bearings at the buried abutments.

Tenders were called for both flexible and rigid designs on all contracts, and contracts were let including bridgeworks as follows:

Contract 1. - Medway Bridge.

Contract 2. - Three Crutches to River Medway, length 1.98 miles.
Flexible pavement. £1,006,411. a joint venture by J.L.Kier & Co.Ltd.
Christiani & Nielsen Ltd.
Sydney Green & Sons (Contractors) Ltd.

Contract 3. - River Medway to Vinsons Farm, length 11.12 miles.
Flexible pavement. £5,954,183. Geo. Wimpey & Co. Ltd.

Contract 4. - Vinsons Farm to Brenley Corner, length 11.98 miles.
Rigid pavement. £4,734,665. John Laing Construction Ltd.

CONTRACT 1. - MEDWAY BRIDGE

Details of the methods used in the construction of the main bridge are given in the Cement and Concrete Association's booklet on the bridge and need not be repeated here.

Construction of the minor bridges adjacent to the abutments and the main bridge by the same organisation has reduced the adverse effects of limited working space in these areas and simplified programme phasing as well as resulting in some economies of plant and installations.

CONTRACT 2. - CONSTRUCTION

The bulk earth moving on this section amounts to ½ million cubic yards and has been carried out almost exclusively by tractor and scraper, on account of the relative short haulage involved. About half was completed during the first season. The initial section at Three Crutches is in Thanet Sand and it has been found necessary to stabilize with cement the top 12" layer of sand under the granular sub-base, where high equilibrium moisture contents may be expected in cutting. Stabilisation has been done in situ and normal agricultural equipment has been used to spread and mix the materials. The work has been done in two 6" layers with 3% cement in the lower layer and 5% in the upper. Compaction is by 3½ ton vibrating roller and 8 ton tandem smooth wheel roller with careful control of the moisture content. Thanet Sand has been used in forming the embankment at Fuel Pipe Bridge over a length of approximately 1000 ft. and with a maximum height of about 25 ft. this material has also been used in the approach embankments to Three Crutches bridge on the West bound A2. Compaction has been achieved by the use of 3½ ton vibrating rollers used in tandem.

In the shallow cutting in clay-with-flints which follows the sand embankment, a 14" layer of chalk has been placed as selected sub-base and has been compacted by a 12/15 ton smooth wheel towed roller. This material, from the deep chalk cutting adjacent to the Cuxton Road, has had moisture contents in the solid as high as 36% during the Winter months. It has not proved possible to work the material when the moisture content is above about 27%. The balance of chalk from the big chalk cutting has been used to form the high embankments across the Merrals Shaw Valley and at the Cuxton Road Interchange.

As-raised ballast materials for the granular sub-base are excavated in the Medway Valley. The sub-base materials are spread by bulldozer and compacted by 16 cwt vibrating tandem roller and 8 ton smooth wheel roller.

The cement bound granular base in the carriageway and hard shoulders is placed by a Blaw Knox PF.90. paver and compacted by similar plant to the sub-base, 8% of cement being added in a 1¾ cubic yard batch mixing plant with weight batching arrangements located close to the Cuxton end of the Motorway. The mixed material transported to the paver in covered tipping wagons.

Placing of the black-top layers of bitumen macadam and hot rolled asphalt will be by conventional methods working from the Three Crutches end.

Construction of the four bridges crossing the motorway has been phased to suit the earth moving programme. Methods of construction have largely been conventional with extensive use of ready mix concrete. The columns for the bridge at Three Crutches are up to 28 ft. In height and although heavily reinforced are constructed in one lift. Birdcage scaffold of standard patent frames is used to support the deck soffit shutter of the two main bridges. The portal frame design carrying the Cuxton Road A228, is the only one of this kind on the Motorway and has a in situ prestressed deck slab with a centre span of 120 ft. and side spans of 48 ft. It is intended to place the 1400 cubic yards of concrete in the deck slab in one continuous operation.

The two remaining bridges on this contract are both underpasses, one being a farm access and the other for pedestrians only at Merrals Shaw. These have been constructed by conventional method, the only major problem being access under Winter conditions.

CONTRACT 3. - CONSTRUCTION

For the purpose of construction and control the contract was broken down into 4 main sections these being:

(1) Motorway from the River Medway to Harp Farm.

(2) Motorway from Harp Farm to Oad Street.

(3) All road bridges, foot bridges, subways and large diameter culverts. (4) Mixing and laying of Cement Bound Granular Base.

Each section is controlled by an Agent directly responsible to the Project Manager, with supporting field services of Plant and Transport organizations.

Section I

This section consists of some 5 miles of motorway and contains apart from the bridges a major interchange which connects the M.2. with the A.229 Rochester to Maidstone Road. The A.229 is carried over the motorway by a two-span overbridge, and the acute angle of 63° of the A.229 to the motorway at this point together with the nearness of the existing houses, some of them within 20 feet of the works, has caused considerable difficulties in the maintenance of traffic and services. The total excavation of soil, chalk and clay in this section consists of 1 1/4 million cu.yds of which $_{J}$ million cu.yds is to be used and compacted in road embankments, and the remainder, except for top soil, carted to spoil tips.

The majority of this section passes through extremely difficult country along the side of the Nashenden Valley where although stretches of the East bound carriageway are cut into the valley side to a depth of 40ft. the West bound carriageway is on some 20ft. of fill. Excavation commenced in July, 1961.

Section II

This section consists of some 6 miles of Motorway, and most meticulous planning of all earth moving was required because of the restriction of movement of heavy plant and transport caused by two natural barriers Mount Lane and Stockbury Valley. The total excavation of clay, chalk

and sand including top soil is in the order of 12 million cu.yds. of which over $_{j}$ million cu.yds. will be placed and compacted in the embankment and the remainder carted to spoil tips.

The Service Area situated just South of Farthing Corner, and also Gillingham Link Junction come within this section. Excavation commenced in August, 1961.

Bridges Section

The bridges to be constructed in this length of the Motorway are one six-span overbridge, nine four-span overbridges, two four-span overbridges, with prestressed beams, one three-span underbridge, four footbridges, four reinforced concrete subways, and three culverts which will carry services beneath the Motorway. In addition the contract includes two large viaducts and a further three-span underbridge which have been sub-contracted to the consortium of Kier-Christiani & Nielsen.

Mixing and Laying Cement Bound Granular Base

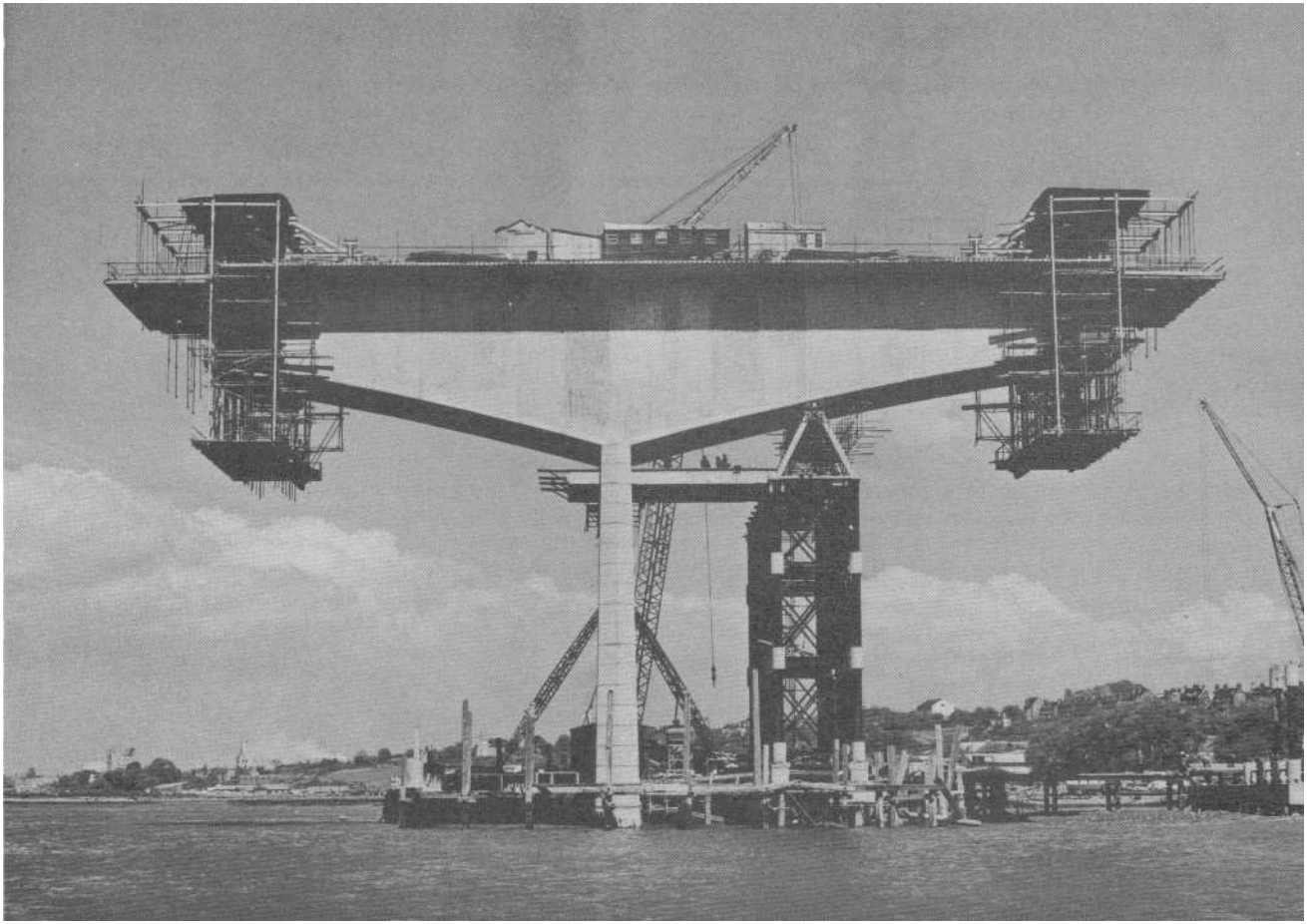
Three plants are used to mix the material, 2 Barber-Greene mixers and an A.P.100 Blaw Knox mixer. The laying is by Blaw Knox P.F.90. spreaders, and consolidation by vibrating and smooth wheeled rollers.

In this contract there is some 266,000 tons of Cement Bound Granular Base.

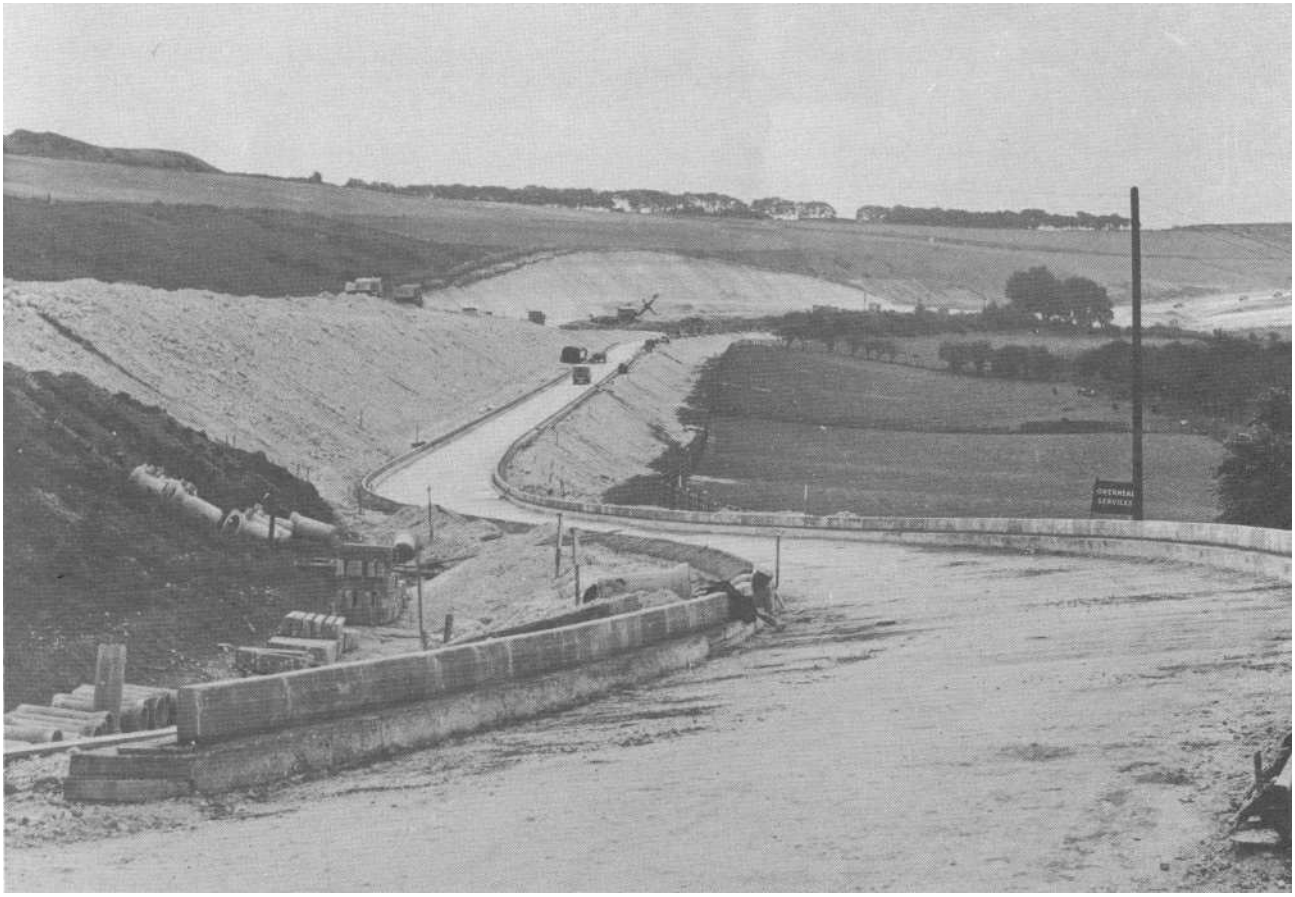
During the Summer of 1961, wooded areas were cleared which covered some 40% of the motorway, soil strip was carried out by D.9 and D.8 caterpillar tractors and scrapers, and earth moving by face shovels using A.E.C. trucks and tractors and scrapers. The fill was consolidated by vibrating and rubber tyred rollers, and by October, 1961 when it was necessary to close down on earthmoving operations because of bad weather some ¾ million cu. yds. had been moved.

Work on the bridges continued during the Winter, and in March, 1962 earthmoving operations were recommenced using T.S.24 Euclid twin engined scrapers, S.21 Motorised scrapers, D.9 and D.8 caterpillar tractors and scrapers with 54 R.B. Face Shovels, A.E.C. trucks and smaller diggers where necessary. By May, 1962 the majority of the 24 million cu.yds. of earth had been moved, and a concentration was then made on trimming formation with graders, placing Cement Bound Granular Base, followed by precast kerb laying and surfacing. The surfacing is being carried out by George Wimpey & Co. Ltd., Ashphalt Department.

As such a large quantity of material is required for the Granular Sub-Base and Cement-Bound Granular Base, George Wimpey & Co.Ltd., purchased a gravel pit at New Hythe near Maidstone, only a few miles from the Motorway. Some 600,000 cubic yards of material will have to be excavated and hauled for this contract.



MEDWAY BRIDGE - PIER 13.



NASHENDEN LANE - LOOKING S.E. FROM WOULDHAM ROAD

STOCKBURY VALLEY - EAST SLIP ROAD - EXCAVATION

CONTRACT 4. - CONSTRUCTION

The motorway construction consists of rigid pavement with flexible hard shoulders. There are 28 structures which incorporate 20 overbridges and 8 underbridges, including Bottom Pond Viaduct spanning a valley, and Clock House Bridge, spanning the main London/ Dover railway line below Faversham. The contract includes two major interchanges at the junctions with the motorway of the A251 and of the A2.

For administrative purposes Contract 4 is divided into two six-mile sections with headquarters at Faversham and section offices at Bredgar, near Sittingbourne, and also at Faversham. The peak labour force engaged is about 1,000 men.

Earthmoving commenced in mid-August 1961. Various methods of compaction are used, depending on the nature of the excavated material, and in general four passes of a 3.1/2ton roller are followed by two passes of a 20-ton flat-wheeled roller, which achieves the specified compaction. The highest fill is approximately 55ft. and the deepest cut 30ft.

Bottom Pond Viaduct

The largest single structure on Contract 4 is the 375ft. long Bottom Pond Viaduct which spans a valley near the village of Milstead. This structure, which is being constructed by Holloway Brothers Limited as sub-contractors, has five 75ft. spans and the deck is so designed that it forms a continuous slab. The deck is supported on four piers, each consisting of three slender rectangular columns about 70ft. high. These are supported on groups of in situ reinforced concrete piles.

The construction of each span follows the same pattern: beams and slabs are cast while supported on scaffolding and after stressing the load is transferred to heavy rolled steel joists, braced together and supported temporarily for this purpose at the top of each bent of columns. When adjacent spans have been completed, the reinforced concrete cross-beam lying over each bent is cast and the continuity of the whole bridge deck is thus achieved.

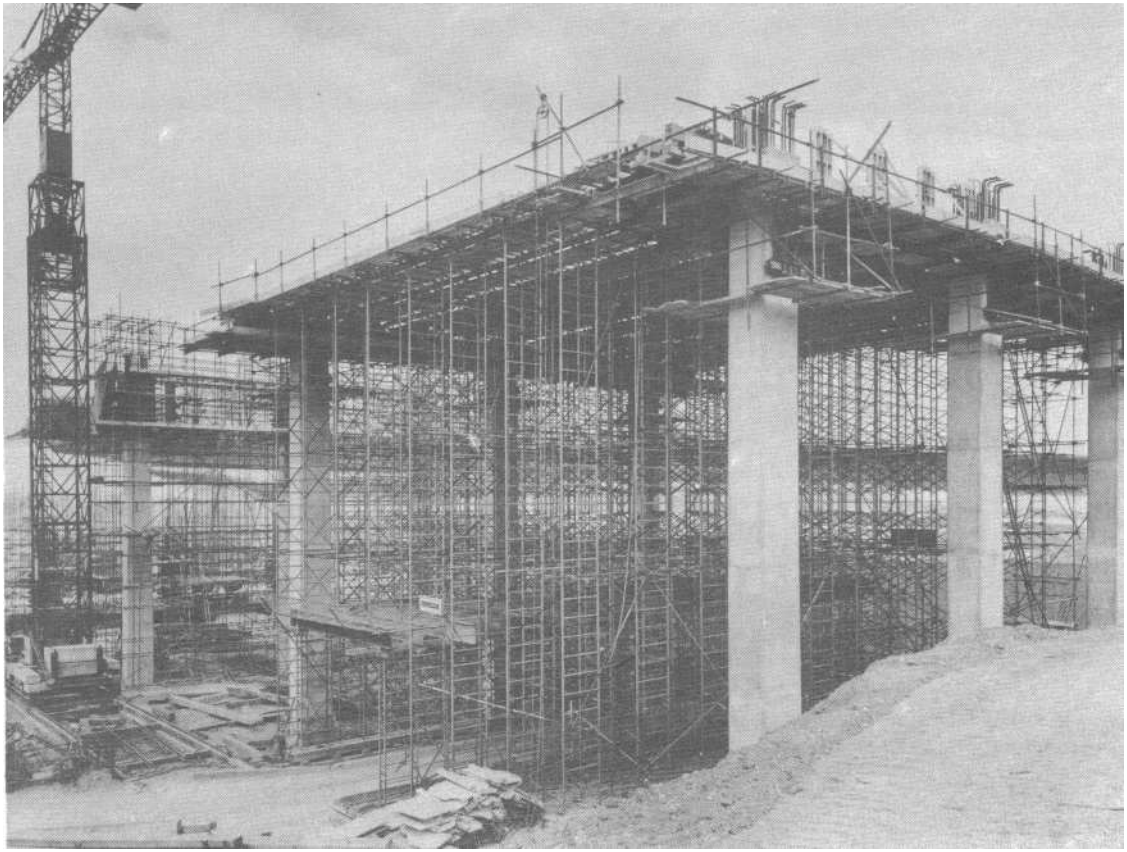
Clock House Bridge

This bridge carries the motorway over the main London/Dover railway and is a single-span underbridge with prestressed concrete deck. Each abutment is founded on 23 McKinney bored piles, 3f t. in diameter and approximately 32ft. long. Because railway traffic had to be maintained, it was necessary to sheet-pile the embankment along the face of the foundation beam to the west abutment, and a good deal of work had to be carried out at night during track possessions. To limit the number of possessions required it was decided to support the deck formwork on a travelling shutter supported by scaffolding. The 2 ft. thick deck slab, of 56ft. span, is simply supported and prestressed by the P.S.C. Freyssinnet multi-strand system and 88 cables are stressed to give a final force of 134 tons per cable.

Construction of Rigid Pavement

The pavement construction throughout Contract 4 consists of 11" or 10" of reinforced concrete slab, according to ground conditions. The slab is laid in two layers - the bottom layer being a relatively lean mix upon which mesh-reinforcement is laid. The top layer consists of 3" of high quality air-entrained concrete. The concrete train for laying the pavement in a continuous operation has been specially assembled and modified by John Laing Research and Development Limited, and the method is as follows:

(1) A layer of 150-gauge polythene is laid on the granular base by a specially designed dispenser:



BOTTOM POND VIADUCT

(2) Dry-batched materials are delivered in four-compartment batching trucks to a Koehring Paver which discharges the mixed concrete for the bottom layer by means of two conveyor belts into a screw-spreader and compactor. This discharges the concrete finally across the 26ft. width and compacts it by means of a hydraulically-operated beam which imparts both pressure and vibration progressing at 4" steps of road at each compacting cycle.

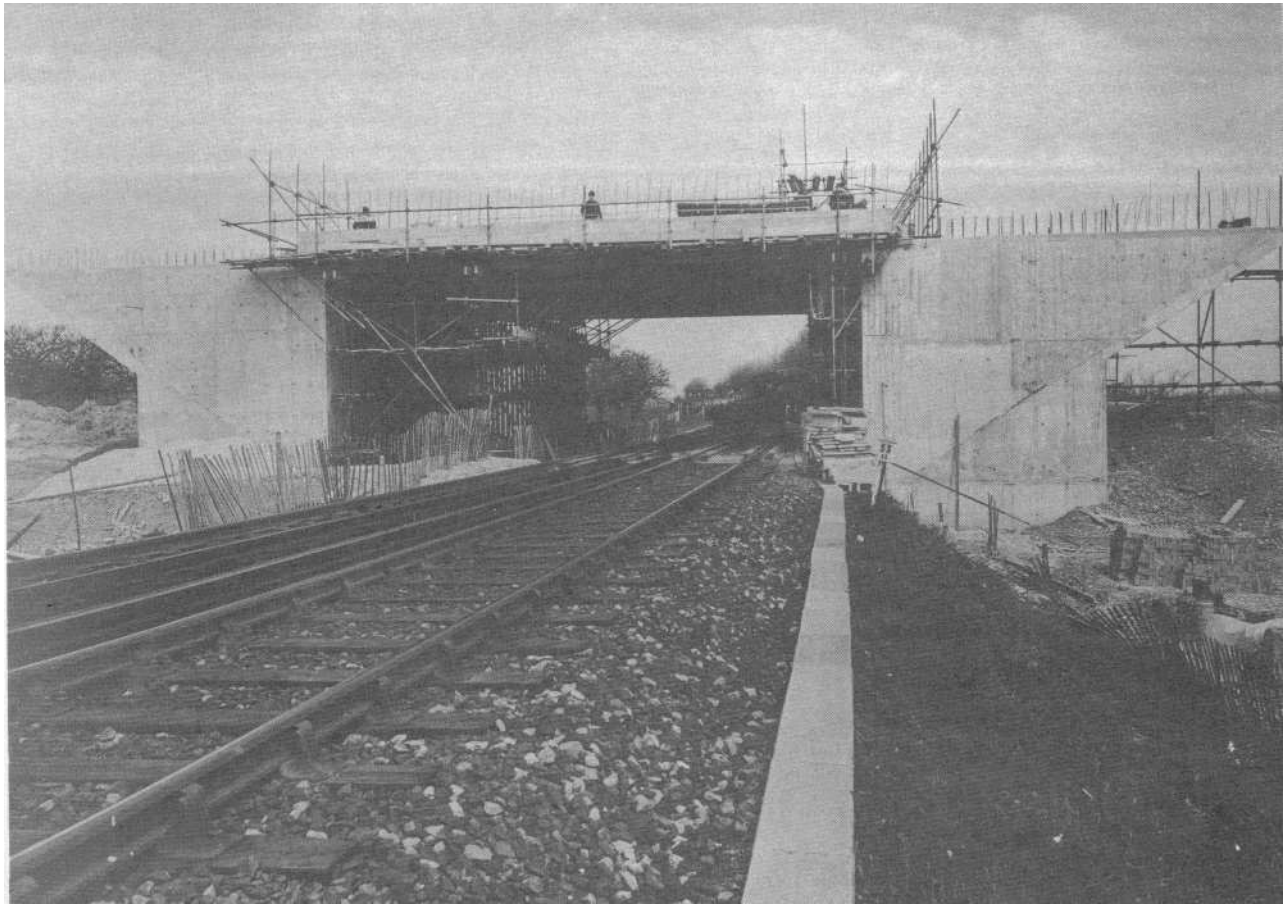
(3) Mesh-reinforcement is then laid by hand in three widths of 8ft. 10.1/2" by 4Oft. long;

(4) Air-entrained concrete of high workability is weigh-batched in side-tipping trucks, discharging into a hopper-spreader which spreads the concrete uniformly across the road slab;

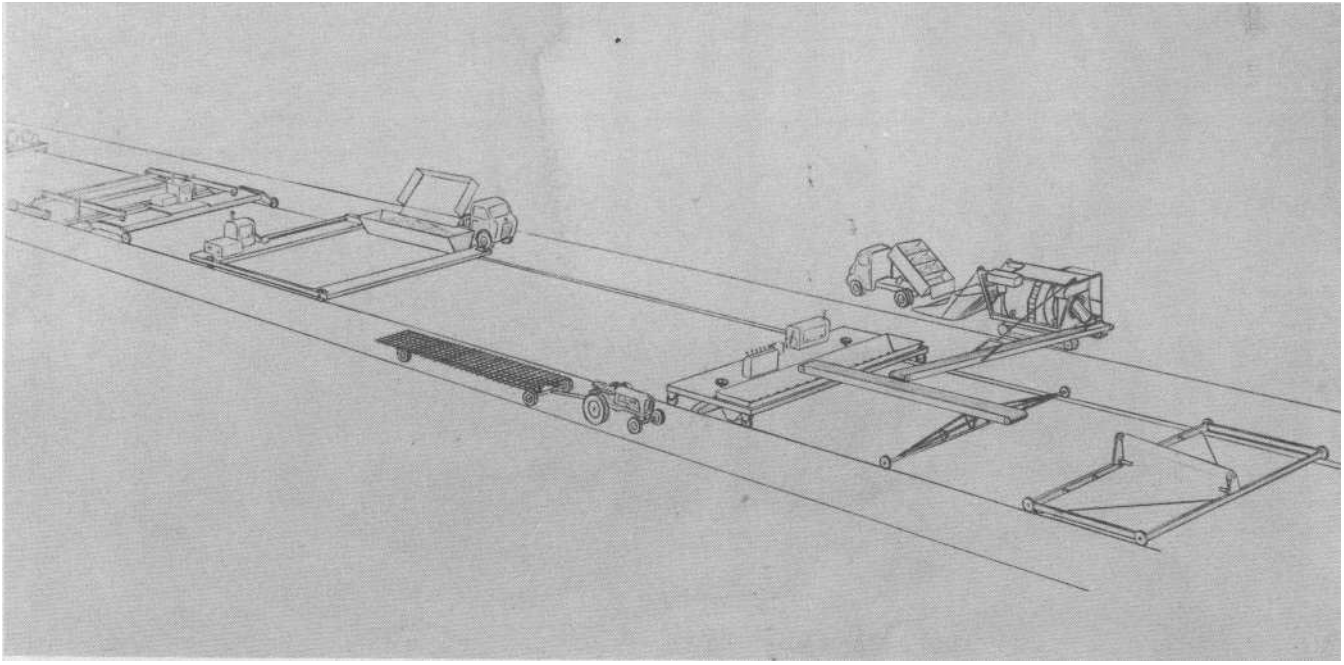
(5) The final machine consists of a vibratory beam compacting unit in front, followed by a heavy finishing beam mounted in an articulated carriage. The effect of the articulator is to produce a very accurate finish.

(6) The finished concrete is protected before application of the curing membran by a length of waterproof tenting, which is towed behind the articulated finisher.

Concrete is batched at two central mixing plants - one to each six-mile section. Each plant consists of two independent units: A dry-batching plant for the bottom layer of the pavement and a wey batching plant for the top 3" layer.



CLOCK HOUSE BRIDGE



ARTISTS IMPRESSION OF " CONCRETE TRAIN "