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GEOLOGY OF THE SUNGAI TEKAI AREA, JERANTUT DISTRICT, PAHANG

INTRODUCTION

The Sungai Tekai area contained in the New Series Topo Sheet 70 is in the Jerantut District of Pahang. It is situated north of the Jengka Triangle, south of the Operation Sat' area and east of Kuala Lipis and Sungai Tembeling.

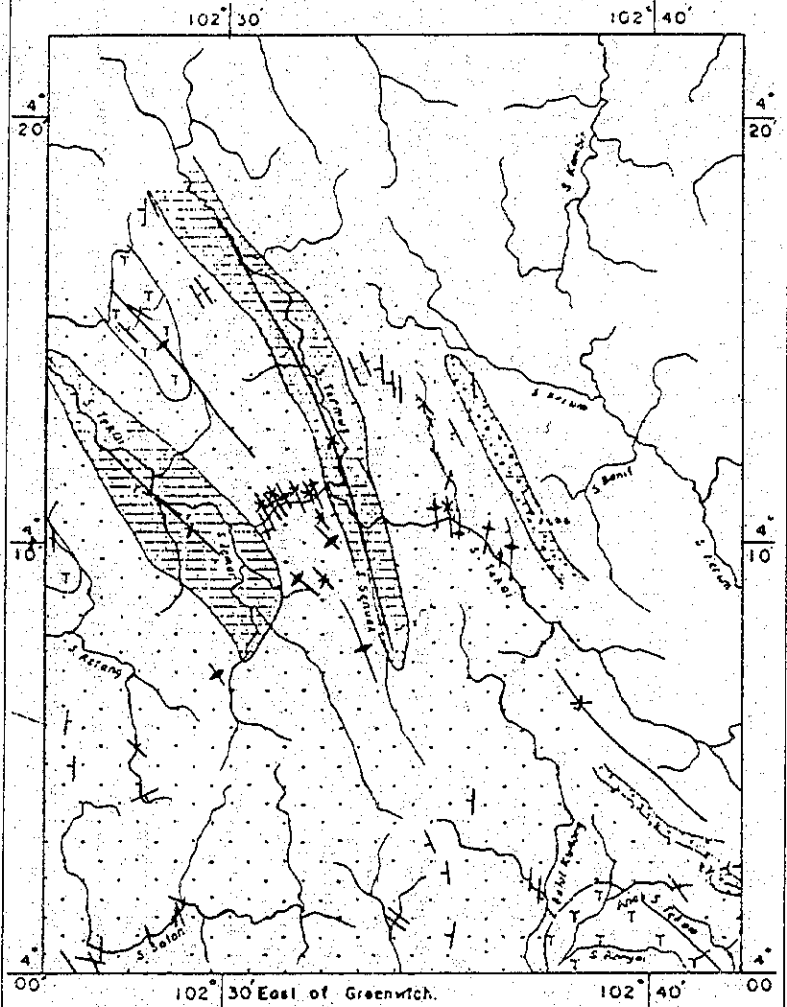
Access into the area is by motor boat along Sungai Tekai, a large river flowing across the area from west to east. Numerous rapids and sand bars in the main river cause much diffuculty and delay in transportation. Work began in March 1971 and in early 1972 mapping was interrupted when the staff at Bentong was directed to do some work near Kuala Tahan in Taman Negara. Most of the work this year was carried out in the central and eastern portions of the map area.

GENERAL GEOLOGY

The area is predominantly underlain by argillo-arenaceous rocks interbedded with volcanics, conglomerate and a few limestone and calcureous beds.

The arenaceous rocks which appear to be the most abundant are exposed in the hilly terrains whilst the argillaceous rocks are exposed in the low lying areas. Extensive exposures of argillaceous rocks are found in the valleys of Sungai Termus, Sungai Senuak, and a stretch of Sungai Tekai between Kuala Jemar and Kuala Sungai Hangus. Redaceous rocks are the least abundant of the sedimentary rocks. They commonly occur interbeded with the arenaceous rocks. They are extensively exposed only in the eastern part of the map area as the NW-SE trending Gunung Laris. This polymict conglomerate strike ridge runs uninterrupted for at least 15 miles. To the south of this are some other smaller ridges of polymict conglomerate.

Volcanic rocks occur as tuffs and lavas of rhyolitic and andesitic composition. They become important in the Sungai Retang area, the Sungai Tekam area and an area covered by the upper reaches of Sungai Penut and Sungai Tat.



LITHOLOGY

Rudoceous Rocks

Mainly polymict conglomerate and quartzose conglomerale interbedded with sandstone, mudstone and shale

Arenoceous Rocks

Mainly sandstone-oithoquartizite, protoqucrizite, subgreywacke graywacke-interbedded with mudstone, shale, siltstone, conglomerate and volcanics

Argillaceous Rocks

Mainly shale, mudstone and siltstone interbedded with sandstone, conglomerate and volcanics, Dominantly purple-red and red in colour

Volcanic Rocks

Tuffs and lavas of rhyolitic and andesitic composition

STRUCTURES

Anticline

Syncline

Bedding

Fault determined in the field

Fault Interbed from A.P.

Miles 5 0 5 Miles

Kilometres 5 0 5 Kilometres

Figure 22. Provisional Geological Map of Sungai Tekai Area, Sheet 70

The rocks are folded into board, open cylindrical folds with NW-SE trending major and minor fold axes. A series of minor folds of similar orientation are found within each larger fold to give rise to anticlinorial and synclonorial structures.

LITHOLOGY

Rudaceous Rocks

Rudaceous rocks are of two main types, namely polymict conglomerate and quarizose conglomerate of which the former is more abundant. When interbedded with other sediments the quartzose conglomerates are generally associated with quartzone sandstones and the polymict coaglometrates with the more lithic sandstones (subgreywacke and greywacke).

Polymict conglometrate is very extensively exposed at two prominent strike ridges in the eastern part of the map area. The Gunung Laris strike ridge and the ulu Balol Kudong-ulu Tekam ridge appear to belong to the same conglomerate horizon but due to synclinal folding they have become geographically separated. The conglometrate contains pebbles of volcanic rock, quartz and quartzite of varying diameters. Pebbles measuring up to 5 inches have been seen in some parts.

Quartzose conglometrates occur as small exposures interbedded with other sedimentary rocks. One small but prominent exposure occurs about $1\frac{2}{1}$ miles above Kuala Tekai. Pebbles in these rocks are generally much smaller than those in the polymict conglometrate. Some opaque pink quartz is commonly present.

Arenaceous Rocks

Arenaceous rocks appear to be the most abundant in the area, forming long ranges of hills where they predominate. They are broadly of two types, quartzose sandstone and lithic sandstone. The former consists of orthoquartzite and protoquartzite while the latter is of subgreywacke and greywacke. Most of the lithic rocks comprise abundant volcanic components and hence can also be called volcanic greywacke/subgreywacke/sandstone.

Argillaceous Rocks

Argillaceous rocks consist of red and purplish red mudstone, claystone, shale, siltstone, and gradational types. Argillaceous rocks with brown and greay colours are much less common. The red colour of the argillaceous rocks is primary and not a result of weathering since (1) fresh rocks also have this colour (2) it is seen in rocks interbedded with or underlying fresh arenaceous rocks (3) the colour is present even in extensive exposures.

Two large separate tracts of red mudstone/shale are exposed, one at the Termus valley and the other at the stretch of Sungai Tekai from Kuala Jemar to Kuala Hangus. They are probably part of the same thick horizon of red mudstone/shale which have been folded and the anticlinal section eroded to expose the underlying quartzose sandstone and volcanic rocks. In this way the red mudstone/shale become geographically separated by the arenaceous core of the anticline.

Calcareous Rocks

Only two separate exposures of calcareous rocks are encountered, one a gastropodal limestone in the Sungai Salan area (vE 976442 Sheet 70) and the other a gradation of sandy limestone-calcareous subgreywacke in the ulu Retang area (vE 971566 Sheet 70). The gastropodal limestone occurs as a thin lens in a sequence of siltstone and sandstone. These gastropods have been identified as a fresh water species. The sandy limestone and calcareous subgreywacke at ulu Retang occur as a small outcrop (bed/lens/) within lithic sandstone. The calcareous fraction in both rocks consists of calcite clasts as well as crystalline calcite. Lithic grains which form a small fraction of the sandy limestone become the major constituent in the calcareous subgreywacke.

Volcanic Rocks

Volcanic rocks occur extensively enough to be mapped as a unit in the Anak Tekam, Retang and ulu Penut-ulu Tat areas but elsewhere they are interbedded in minor amounts with other rocks.

In the Anak Tekam area, the volcanics are mainly andesite and andesitic crystal-lithic tuff with minor rhyolitic tuff. Veinlets of prehnite are present in the andesitic rocks. Some agglomerate is present.

In the ulu Penut-ulu Tat area the volcanics are mainly tuffs and lavas of rhyolitic composition. The lavas show textural variations, being either flow laminated, spherulitic (as a result of devitrification and recrystal-

lisation), distinctly perlitic or porphyritic. These volcanic rocks are older than the surrounding argillo-arenaceous rocks since they are exposed at the core of the same anticline.

In the ulu Retang area both andesite and rhyolite are found together with some agglomerate and volcanic breccia.

STRUCTURE

Folding

The argillo-arenaceous sequence is deformed by a primary principal compressional stress from NE and SW into wide, open, regional cylindircal folds as well as small folds seen within single outcrops. Both major and minor fold axes trend in a NW-SE direction. Major fold axes are 2 to 4 miles apart.

Two folding mechanisms can be recognized in the area, namely flexural slip folding and slip folding (or shear folding). Flexural folding affects the competent arenaceous bands and the mechanism is sliding of competent beds along bedding planes past each other. Such movements are indicated by slickensides trending more or less perpendicular to the fold axes or bedding strike. Shear folding, on the other hand, affects the argillaceous layers and the mechanism is slipping along closely spaced fractures subparalled to the axial plane.

Within major folds are minor parasitic folds, the latter usually trending subparallel to the former. Hence some of the larger folds may be anticlinorial or synclinorial structures. At the Jemar-Senuak anticline, for example, the structure becomes an anticlinorium in the region where Sungai Tekai cuts across it. Here a prominent series of minor folds occur within the large anticlinal structure whose flanks are near Kuala Jemar and Kuala Termus. The minor folds are well exposed along a stretch of Sungai Tekai between Kuala Jemar and Kuala Termus.

So far four major fold axes, all trending NW-SE have been detected in the mapped area:

(i) a syncline along the Termus valley across Sungai Tekai and into the Senuak valley,

(ii) a syncline located at Kuala Kelantong,

(iii) an anticline between the Jemar and Senuak valleys, and

(iv) a syncline between the prominent ulu Tekam conglomerate strike and Sungai Tekai.

The syncline along the Termus and Senuak valleys plunges to the south-east and continues in a northwesterly direction into the Kuala Tahan area in Taman Negara where its nose outcrops in the form of a synclinorium. It is part of the Berentai Syncline (detected by B.N. Koopmans from aerial photos) which stretches from near Gunung Tahan to Maran town, Pahang.

The general NW-SE trend of other features like major rivers, prominent ridges and ranges of hills, is structurally controlled.

Faulting

In the field slickensides on joint and bedding surfaces are abundant but are too small and localized to be mappable. Brecciated zones indicative of more pronounced fault movements are generally of two types:

(i) Brecciated zones more or less parallel to the bedding. These apparently result from intense flextural slip movements along bedding planes during folding and are not easily mappable.

(ii) Near vertical brecciated zones e.g. at Kuala Sungai Kelantong which may be wrench faults.

In the area between the headwaters of Sungai Anak Tekam and Sungai Tekai, a large fault can be picked up from aerial photos. This fault appears to have displaced a prominent conglomerate strike ridge in a right lateral manner.

Rock Cleavage

In association with folding, axial plane cleavage is developed in the rocks. They are prominently developed in the argillaceous rocks and may disappear in associated arenaceous beds. The relationship of cleavage to the bedding is difficult to study due to lack of bedding in the rocks affected by cleavage (mainly red mudstone). The relationship of cleavage to the internal fabric of the rock will have to be studied for more detailed classification.

Joints

There is very prominent development of joints especially in the arenaceous rocks. These have been identified, in an carlier report, as shear joints, cross joints, and longitudinal joints.

STRATIGRAPHY

Fresh water gastropod (Viviparus sp.) identified by C.P. Nuttall of the British Museum from limestone in the Sungai Salan area (vE 976442, Sheet 70) indicates a post Triassic age fro the sequence in the south-western part of the area. No other fossils have been discovered. Some rocks with very poor plant remains may contains pollen grains.

Due to lack of palaeontological data and the incomplete picture of the folding style at this state, it is not easy to work out the stratigraphic column for the entire area. However, in the northwestern central section where the folding style is understood, the lithological group could be arranged in stratigraphical succession as shown in Table 7.

Table 7. Stratigraphy of the Sungai Tekai Area

Age	Lithological Groups	Areas of extensive exposure
POST TRIASSIC vvvvv?vvvvv Triassic? . : ?	AGRILLACEOUS FACIES: Mainly red and purplish red mud stone, shale, claystone and siltstone interbedded with minor arenaceous rocks.	1. A large tract along the Termus Valley. 2. A large tract along Sungai Tekai between Kuala Jemar and Kuala Hangus.
	ARENACEOUS FACIES: Mainly ortho-quartate, proto-quartzite, subgreywacke and greywacke interbedded with minor argillaceous and volcanic rocks.	1. Large tract between Sungai Senuak and Sungai Jemar. 2. At ridge separating Ulu Retang and Sungai Tekai.
	VOLCANIC FACIES: Mainly tuffs and lavas inter-bedded with minor argil-laceous and arenaceous rocks.	1. Ulu Sungai Penut area.

Khoo Han Peng

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STRATIGRAPHY OF THE SUNGAI TEKAI AREA, JERANTUT, NORTH PAHANG

ABSTRACT

The Sungai Tekai area is underlain predominantly by a group of Mesozoic sediments and tuff/volcanics. Granite occurs only at the northeastern portion of the area.

The sediments range from argillaceous through to rudaceous beds, with only a few small unmappable occurrences of limestone. One of these contains fresh water gastropods. Near the tuff and volcanic rocks, the sediments is highly tuffaceous or lithic in nature.

As a result of a better picture of the structures of these folded rocks and correlation of several local sections within the area, four formations are now tentatively recognized within this group of sediments.

The oldest unit, named tentatively the Kerum formation, is a thick requence of interbedded tuff/lava and tuffaceous/lithic rocks. This unit is exposed adjacent to a granite mass but its age relationship with the granite is not known as no age dating has been done as yet on the granite.

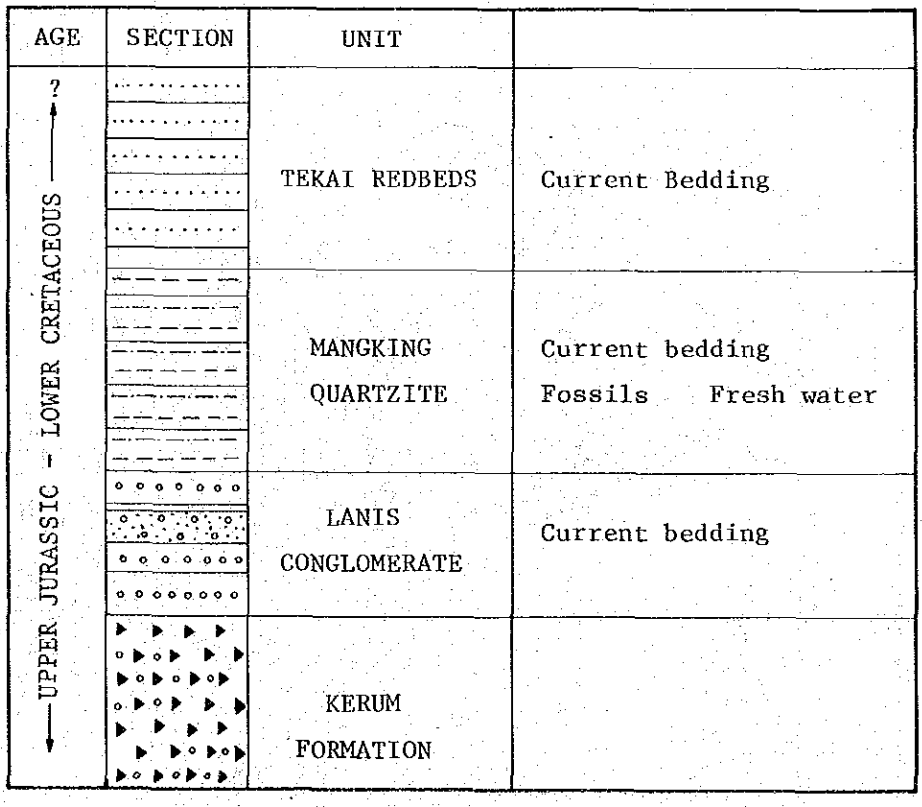


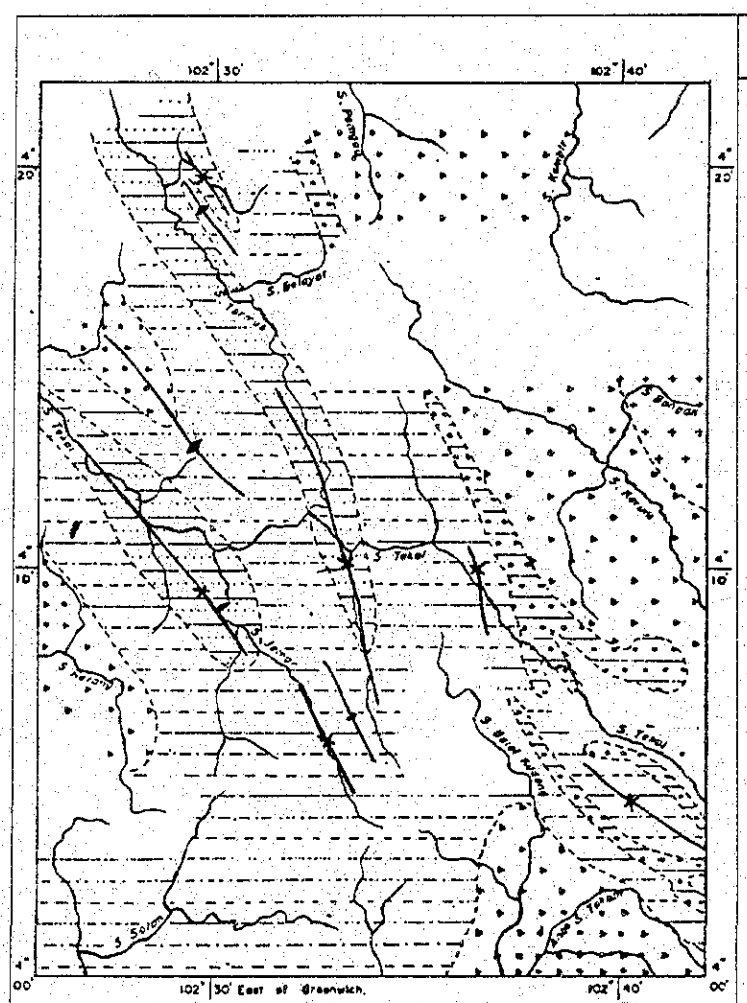
Figure 26. Stratigraphic Section of the Sungai Tekai Area

However, the occurrence of bornfels near the contact suggests that the granite might have intruded into this formation. Conformably overlying this is the Lanis conglomerate, which is a thin sequence of reddish-purplish polymiet conglomerate and conglomeratic areno-arigillaceous rocks.

The Lanis conglomerate is in turn conformably overlain by the Mangking quartzite. This unit comprises predominantly orthoquartzite and proto-quartzite interbedded with subordinate amounts of brown-grey stilt-stone, shale, and mudstone. In the Sungai Pelandok area, the unit is considered to be Upper Jurassic-Lower Cretaceous on the evidence of the plant fossil Gleichenoides gugateensis. In the Sungai Salan area a lense of limestone within this unit contains fresh water gastropods of the species Vivipurus (Upper Jurassic-Recent).

The youngest unit determined so far is a sequence of redbeds which is mainly argillaceous. This is tentatively referred to as the Tekai red-beds.

Khoo Han Peng



AGE	UNIT		STRATIGRAPHY
?	Tekai Redbeds		Chiefly red/purplish orgilloceous rocks with some interbedded red sandstone and non red quartzose sandstone
LOWER CRETACEOUS	Tekai Quartzite		Predominatly white orthoquartzite and grey protoquartzite. Slightly conglomeratic with quartz pebbles and granules in some horizon. Interbedded with grey/brown siltstone, shale 8 mudstone
UPPER JURASSIC	Lanis Conglomerate		Polymict, reddish/purplish, pebbls-granute conglomerate interbedded with subordinate amount of reddish/purplish sandstone/siltstone/shale/mudstone which are of the some clostic composition and commonly conglometratic. In some areas, valcanic closts are the dominant components of the conglomerate
?	Kerum Formation		Interbedded tuff/lava ad tuffaceous sediment and lithic sediment. Locally tuff/lava predomanate
			Granite
Major	told' axes		Anticline
			Syncline

Miles 5 0 5 Miles

Kilometres 5 0 5 Kilometres

Figure 25. Provisional Geological Map of the Sungai Tekai Area, Sheet 70

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Steels". Butt welds shall be of the double V-type and two butt weld bend tests shall be carried out on a specimen prepared to represent each form of butt welded joint used in welding. The method of making weld test shall be that laid down in B.S. 709. The specimen shall pass the tests to the satisfaction of the Superintending Officer before approval is accorded to use the joint which the specimen represents. Tack welds between reinforcing bars used merely to fix them in position shall not be subjected to tests.

Storage of Aggregates and Reinforcement

A. The fine and coarse aggregates shall be stored in properly constructed open bins with hard, clean drained floors. Each size of aggregate shall be stored in a separate bin. The reinforcement shall be stacked tidily in a manner that permits its inspection.

Equipment for Sampling and Testing Concrete

B. In order to carry out some of the specified tests on site the contractor shall provide the following equipment:-

(a) 12 sets of 6" steel or cast iron moulds with base plates to Part 7 Clause 51 (a) of B.S. 1881.

(b) 2 No. tamping bars to Part 7 Clause 51 (b) of B.S. 1881.

(c) 1 No. Slump cone with tamping rod as Clause 7 and Fig. 1 of B.S. 1881.

(d) 1 No. 12" Steel rule.

(e) 1 set compacting factor apparatus as Clause 12 and Fig. 2 of B.S. 1881.

Sampling and Testing Concrete

(a) **For Strength**

C. While work on concreting is in progress, samples of the concrete, as placed, shall be taken and works test cubes made from them while at the same time consistency tests shall be made from the samples and the compacting factors and slumps recorded. A record of these tests shall be kept on Works identifying them with the part of the test cubes made and matured in accordance with the standard methods laid down in Clause 601 of the B.S. Code Practice, C.P. 114, (1957) — "The Structural use of Normal Reinforced Concrete in Building". The samples shall be taken and the cubes made in each day when there is concreting and, in addition, whenever any of the materials or the proportions of the mix are changed or whenever so directed by the Superintending Officer. Three test cubes shall be made from each of four samples taken in each day of concreting. Four cubes consisting of one from each of the four samples shall be tested after 7 days, four after 14 days, the remaining four after 28 days.

D. The resistance to crushing of test cubes shall exceed the values set out below:-

Normal Mix	Coarse Aggregate	Minimum Crushing Resistance lbs # sq. in. 7 days after mixing	Minimum Crushing Resistance lbs # sq. in. 28 days after mixing
1:3 :6	1½" or 1	1200	1800
1:2 :4	¾"	2000	3000
1:1½:3	¾"	2500	3750

The average cube strength of the cubes tested shall be accepted as the resistance to crushing of the Cubes, provided that the difference between the greatest and the least of the cube strengths does not exceed 15 per cent of their average strength. If the difference is more than 15 per cent, the cube strengths shall only be accepted if the least is greater than

(a) **For Strength [Cont'd]**

the strengths specified above, when the cubes tested at 7 days show a resistance to crushing less than that stipulated above the right is reserved to the Superintending Officer to order work on concreting to stop until the results of the test at 28 days are known. If the resistance to crushing of the cubes at 28 days is less than that stipulated above, the concrete from which the test cubes were taken shall be broken out and removed from the site. The sampling, making, curing and testing of the cubes shall be carried by the Superintending Officer or his representatives, the Contractor affording all facilities. The Contractor or this representatives may, if they so elect, be present while the cubes are being made and tested.

(b) **For Consistency**

A. While work on concreting is in progress, tests on workability of the mix shall be carried out twice daily and, in addition whenever any materials or the proportions of the mix are changed, or when directed by the Superintending Officer. The tests shall consists of either the Slump test or the Compacting Factor test, as described in B.S. 1881.

B. The slump shall be as small, and the compacting factor as low as practicable, consistent with the efficient working and full compaction of the concrete mix in the formwork using the specified methods of compaction.

Concrete Proportions

C. (a) The concrete shall be proportioned in the following manner, cement by weight, aggregates by weight and water by volume. The fine and course aggregates shall be measured separately. The concrete shall be proportioned in the several parts of the works as follows (except where varied in accordance with (b) on the next page).

Nominal Mix	Portland Cement	Fine Aggregate	Coarse Aggregate	Water including Water in Aggregate
1 to 9 or 1:3 :6	112 lbs..	348 lbs.	652 lbs.	As directed by Superintending Officer
1:2 :4	112 lbs.	235 lbs.	435 lbs.	6.2 gallons
1:1½:3	112 lbs.	180 lbs.	331 lbs.	5.6 gallons

D. (b) While the proportions of the mix are to be generally as above, the Superintending Officer shall have the right to order variations in these proportions should tests show such variations to be necessary to produce a dense concrete of the specified strength and of a consistency that will permit of its being worked into position and compacted satisfactorily in the different parts of the work. The proportions of the mix as specified in the table above give a water/cement Ratio of 0.55 for 1:6 mix and 0.5 for 1:4.5 mix and are expected to produce works cube strengths in excess of the requirements of the Specification and a workability sufficient to ensure that concrete can be worked and fully compacted using the the methods of vibration specified later in this section. If, however, it is shown during the course of the works that the concrete mix is stiffer than can be placed satisfactorily, and adjustment of up to 5 per cent may be made in the water/cement ratio but any further adjustment of the mix shall be made by increasing the proportions of both the water and the cement without increasing the water/cement ratio. The cement proportions shall be increased if the works cube strengths fall below those specified.

E. (c) The weights of fine and coarse aggregate specified in the table above refer to the materials in a dry state. Tests shall be carried out twice daily, or more frequently if considered necessary by the Superintending Officer, to as certain the moisture content

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右岸側上流よりUpper Jeramを見る

上流側からUpper Tekai Siteを見る