ROYAL IRRIGATION DEPARTMENT
MINISTRY OF AGRICULTURE AND COOPERATIVES
KINGDOM OF THAILAND

THE BANG PAKONG DIVERSION DAM PROJECT

BIDDING DOCUMENTS

VOLUME III : SPECIFICATIONS

(Part-1 Main Works)

NOVEMBER 1993

Prepared by :
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC.

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CONTENTS OF SPECIFICATIONS (Part - 1 Main Works)

DIVISION 1 GENERAL

SECTION 1000 GENERAL REQUIREMENT

1001 GENERAL

The Specifications shall be read in conjunction with the Conditions of Contract, the Drawings and the Bill of Quantities, and the Contractor shall comply with all the provisions contained within the Contract Documents and the Employer's instructions.

The Specifications for the construction work of buildings is separately compiled in Volume III (Part - 2 Building Works).

The Contractor shall fully understand the site conditions and the detail extent of the Works and carry out the Works in accordance with the Specifications and Drawings as well as the instructions of the Employer.

The Specifications describe the minimum required standards or criteria to be applied to the Works.

The Contractor shall fulfill all the requirements and obligations of all descriptions of the Conditions of Contract and the Specifications. Where there is not a specific item in the Bill of Quantities and where no statement is made in the Specifications to the contrary, the cost of requirement of obligation such as mobilization of construction equipment, overhead, profit, etc, shall be included in each appropriate pay item in the Bill of Quantities.

1002 PROJECT DESCRIPTION

The Site is located in Bang Pakong district, province of Chachoengsao.

The projected works under the Contract consists of:

a) General requirements
b) Bang Pakong diversion dam & diversion canal
c) Closure dam
d) Road & road bridge

e) Pumping station

f) Building

g) Control system & electrical facilities

h) Test operation & staff training

i) Others

1003 STANDARDS

Throughout the Specifications reference is made to, for example, Thai Industrial Standards (TIS followed by the appropriate number). In all such cases reference to TIS shall be deemed to include the working "or equivalent standard subject to approval by the Employer".

In cases where the Contractor proposes to submit alternative standards for approval, he shall allow sufficient time for the Employer to check such standards and for carrying out any test as directed by the Employer in order to confirm that materials supplied under the alternative standards are acceptable. Two English copies of all standards must be provided by the Contractor for use during the Works.

No claim for delay arising as a result of time required for conducting any test will be accepted, it being the Contractor's responsibility to ensure sufficient time is available in advance for testing any materials required for the Works.

The following refers to internationally accepted standards codes of practice and other publications published by the listed organizations. The respective abbreviation is given for each standard for clarity.

TIS	- Thai Industrial Standards
JIS	- Japanese Industrial Standards
AASHTO	- American Association of State Highway and Transportation Officials
ACI	- American Concrete Institute
AGA	- American Gas Association
AIJ	- Architectural Institute of Japan
AGMA	- American Gear Manufacturers Association
AISC	- American Institute of Steel Construction
AISI	- American Iron & Steel Institute
ANSI	- American National Standards Institute

API	- American Petroleum Institute
ARI	- Airconditioning and Refrigeration Institute
ASCE	- American Society of Civil Engineers
ASME	- American Society of Mechanical Engineers
ASTM	- American Society for Testing and Materials
AWS	- American Welding Society
AWWA	- American Water Works Association
BS	- British Standard
CIPRA	- Cast Iron Pipe Research Association
CISPI	- Cast Iron Soil Pipe Institute
CP	- British Standards Institution (Code of Practice)
DEMA	- Diesel Engine Manufacturers Association
DIN	- German Standards
Fed. Spec.	- United States of America Federal Specification
IEEE	- Institute of Electrical and Electronics Engineers
ISO	- International Organization for Standardization
JEC	- Standard of Japanese Electrical Committee
JEM	- Standard of Japanese Electrical Manufacturers Association
JRS	- Japanese Railway Standard
JSCE	- Japan Society of Civil Engineering
JWWA	- Japanese Water Works Association
MWWA	- Metropolitan Water Works Authority
NEMA	- National Electrical Manufacturer's Association
PWA	- Provincial Waterworks Authority
PEA	- Provincial Electricity Authority
SSPC	- Steel Structures Painting Council

1004 CONSTRUCTION MATERIALS AND WORKMANSHIP

Principal construction materials to be supplied for the Works shall be subjected to the Employer's approval.

(1) The Contractor shall submit samples of construction materials and list of their supply sources and /or manufacturers to the Employer for his approval within two (2) months after signing of the Contract. Principal construction materials being subjected to the Employer's approval include cement, aggregate, sand, water for concrete mixing, materials for riprap, reinforcing bar, steel, etc.

(2) All soil, turf, gravel, stone, timber and other materials obtained in the excavation, clearing of the site of the Works and soil stripping, shall belong to the Employer and must not be removed from the site of the Works without the consent of the Employer. The Contractor, however, may use the construction of the Works timber fallen on the site and any of the materials excavated under the Contract upon approval and directions of the Employer.

(3) When any item is not provided in the Bills of Quantities for the furnishing of any materials required to be furnished by the Contractor, the cost of furnishing, hauling, storing and handling shall be included at the unit price or price of the work for which the materials are required.

(4) All workmanship shall be of the best quality in each respective category of the Works. Except where otherwise stated, or approved by the Employer, all materials used in the Works shall be of the best quality, in the respective kinds specified or described in the Specifications, Drawings and Bill of Quantities, and shall comply wherever possible with the current issue of the reference Standards or other equivalent approved national standards, subject to the approval of the Employer.

1005 CONSTRUCTIONAL PLANT AND EQUIPMENT

The Contractor shall furnish construction plant and equipment which will be efficient and appropriate to secure the satisfactory quality of the Works and a rate of progress which will ensure the completion of the works within the item stipulated in the Contract. If at any time such plant and equipment should appear to the Employer to be inefficient, inappropriate or insufficient for securing the required quality of the Works or for producing a satisfactory rate of progress, then the Employer may order the Contractor to increase the efficiency, change the character or increase the numbers of plant and equipment and the Contractor shall conform to such order. The Contractor shall not be entitled to any extra payment of any other claims in complying with the above Employer's order.

(1) The Contractor shall prepare and submit to the Employer an original and five (5) copies of an itemized statement showing the quantities, rates and specifications for all items of construction plant and equipment required for the Works. The description of each item shall be sufficiently accurate to easily determine its classification , as to type, durability and utility as indicated in the Specifications.

(2) Within a period of 30 days after receipt of the Notice to Proceed, the Contractor shall submit a program to the Employer giving full details of his intended mobilization procedure. This shall be such as will ensure completion of mobilization within a period of 90 days from receipt by the Contractor of the Employer's order to commence the Works.

1006 SUB CONTRACTORS

When and in case the Contractor intends to employ subcontractor(s) for the major part of the Works, such subcontractor(s) shall be nominated by the Contractor and accepted by the Employer at the time of Contract.

1007 WORK SCHEDULE

The Works shall be carried out in accordance with the work schedule attached to the Contract Document.

(1) The Contractor shall submit a detailed work schedule to amplify the one attached to the Contract Document, to the Employer within one month after receipt of the Notice to Proceed. This schedule shall show, in the CPM chart (Critical Path Method), the expected starting dates, progress and completion dates of the component part of each structure and the installation of the equipment. The Contractor shall state and allow in the schedule, a reasonable margin of time for contingencies and shall state his intentions regarding the use of two or three shifts for any work. In addition to the detailed work schedule, weekly or monthly progress schedule of principal works shall be prepared for controlling the progress throughout the construction period.

(2) The schedule shall be revised at any time in accordance with any change in the work condition or the Employer's direction and no additional payment shall be made to the Contractor for any such revisions to the schedule which the Employer considers necessary in order to meet the contracted completion date.

(3) At the end of each month, actual progress for each activity shall be compared with the intended progress indicated on the detailed work schedule. The result shall be reported in the monthly progress report mentioned in section 1016 "Monthly Progress Reports and Photographic Record". Should the Contractor's activities be delayed, then the Contractor shall

include in the monthly progress report a detailed description outlining all corrective actions he proposes to adopt to retrieve the intended schedule status.

1008 SETTING OUT

Benchmarks and reference survey stations have been established at certain points on the site as shown on the Drawings. Before using any of these reference points for setting out the Works, the Contractor shall undertake a survey check using the basic bench mark and satisfy himself as to their accuracy.

The Contractor shall carry out all additional survey works necessary to extend the survey network to the area of the Works and shall establish, maintain and preserve permanent monuments, temporary benchmarks and reference stations.

The Contractor shall carry out surveys of profile and cross section to be required for setting out of structure in accordance with the instruction of the Employer.

These survey results shall be submitted to the Employer for his approval.

The permanent benchmark shall be the control benchmarks for elevation and location control of setting out on this Contract. The bench mark RID BM 1 shall be the control bench mark for elevation control of setting out on this Contract and the elevation of the bench mark is EL. 1.460 m MSL.

The bench mark RID BM 1 and the bench mark RID BM 2 shall be the control bench marks for location control in setting out on this Contract. The cooordination of the bench marks are as follows.

RID BM 1	N 1,515,401.406 m,	E 731,940.912 m
RID BM 2	N 1,515,458.431 m,	E 731,944.262 m

The permanent bench marks and reference bench marks for setting out are shown on the Drawing No. GNL-1003.

The concrete-made temporary bench marks and survey stations shall be installed on the Site by the Contractor.

The number and location of these bench marks will be instructed by the Employer.

Prior to commencing the Works, the Contractor shall undertake the check survey of the reference bench marks and satisfy himself as to their accuracy.

1009 ROYALTIES

Except where otherwise specified in the Specifications, the Contractor shall pay all tonnage and other royalties, rent and other payments, or compensation, if any, for getting stone, sand, gravel, clay or other materials required for the Works.

1010 DRAWINGS

The Drawings consist of Contract Drawings, Instruction Drawings, Shop Drawings and As-built Drawings. The Drawings shall be accurate and clear, denoting the scope of Works.

The Large-scale Drawings shall take precedence over the identical parts of original Drawing. All rights due to Drawings shall be reserved to the Employer.

(1) Contract Drawings

The Contract Drawings form a part of the Contract documents and show the location, type and extent of the Works to be constructed under the Contract.

(2) Instruction Drawings

Instruction Drawings may be issued from time to time by the Employer during execution of the Works to show sufficient dimensions, specific details and typical details defining the various features of the Works as required by the Employer, based on the Contract Drawings or to revise the Contract Drawings taking into account the latest conditions which may be revealed during the progress of the Works.

The Contractor shall cooperate with the Employer for preparation of the Instruction Drawings by submitting the information resulting from site and works conditions.

(3) Shop Drawings

The Contractor shall prepare all Shop Drawings based on the Contract and Instruction Drawings and obtain approval from the Employer. All Drawings supplied by the Contractor shall be, as far as possible, of a uniform size, and numbered and dated at the bottom right-hand corner.

All works shall be carried out in accordance with the levels, dimensions and details shown on the approved Shop Drawings. The Contractor shall also submit the descriptions for materials, equipment, construction plans, standards and workmanship related to the Shop Drawings to the Employer for his approval.

(4) As-built Drawings

The Contractor shall prepare and submit such Drawings in compliance with section 1012 of the Specifications.

1011 SHOP DRAWINGS AND OTHER DATA

(1) General

The Contractor shall prepare Shop Drawings for all Works to be carried out under the Contract.

The Contractor shall prepare the detailed design reports, detailed specifications and detailed construction plans for all kinds of works under the Contract, including but not limited to, the following listed works in addition to the Shop Drawings:

a) Pumping Plants
b) Gate Equipment
c) Bridge Girders
d) Control System & Electrical Facilities

The Shop Drawings and other data shall be submitted to the Employer for his approval.

Should the detailed design reports and/or detailed specifications for all kinds of works under the Contract including the works listed above be submitted and approved by the Employer at the time of Contract and/or during the period of Contract, the approved design report and specifications shall be deemed a part of the Specifications.

(2) Schedule of Shop Drawings and Other Data

Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit a schedule showing drawings and other data which are specified to be submitted for the Employer's approval.

This schedule shall show the proposed dates of submission of the Shop Drawings and of other data - - dates which shall be subject to the Employer's approval.

The schedule shall be updated and re-issued once every two months until substantial completion of all Shop Drawings and other data or such time as directed by the Employer.

The Contractor shall schedule the dates of submission of the Shop Drawings and other data to be furnished to allow ample time to permit the Employer to check these Drawings and other data, but in no case less than fourteen (14) days ahead of the commencement of the respective works unless otherwise specified.

The detailed design reports, detailed specifications and detailed construction plan for the works listed in section 1011, shall be scheduled to be submitted for the Employer's approval at least two (2) months ahead of the commencement of the respective works.

(3) Submission of Shop Drawings and Other Data

Drawings, specifications and other data required to be submitted for approval as specified shall be provided prior to fabrication, construction or ordering of materials as applicable, as follows:

a) One (1) good quality sepia or polyester reproducible, printed on the face side and five (5) clear prints with black lines on a white background of each drawing and five (5) copies of specifications and other data shall be submitted to the Employer for approval.

b) Revisions shall be described by number, date and subject in a revision block on drawings, on the front page of specifications and in a similar, readily identifiable place on other data. Additionally, each revision shall be clearly delineated on drawings, marked in the margin of specifications and similarly identified on other data.

c) For the Employer's use, a blank space, measuring approximately 9 cm by 14 cm, shall be provided on drawings immediately above the title block, on the front page of specifications and in a similar space on other data.

(4) Approval of Shop Drawings and Other Data

One (1) print of Shop Drawings and one (1) copy of Contractor's specifications submitted for approval will be returned to the Contractor marked either APPROVED or APPROVED EXCEPT AS NOTED, as applicable.

Drawings, specifications and other data marked APPROVED shall be deemed to authorize the Contractor to proceed with the construction or purchase of materials or equipment covered by such documents, subjected to the corrections if any are indicated thereon or if described in the letter of transmittal.

Where a drawing, specifications or other data are marked APPROVED EXCEPT AS NOTED, one (1) good quality sepia or reproducible and three (3) prints of the revised drawings and three (3) copies of specifications and other data showing the necessary corrections shall be submitted as mentioned before to the Employer for approval.

The approval of the Shop Drawings, specifications, or other data by the Employer shall not be considered as a complete check, but will only indicate that the general method of construction and detailing is satisfactory, shall exonerate the Contractor from any of his responsibilities under the Contract. Any construction prior to approval shall be at the Contractor's risk.

Approved Shop Drawings, specifications and other data shall be signed by both the Employer and the Contractor and no departure from these documents shall be allowed without the approval of the Employer.

The Employer shall have full power and authority to order the Contractor to suspend or stop such works that are not in accordance with the approved Shop Drawings, specifications

and other data or commenced before the issuance of such approved Shop Drawings, specifications and other data.

1012 AS-BUILT DRAWINGS

As-built Drawings shall be prepared and submitted by the Contractor to the Employer before the provisional take-over of works. The As-built Drawings shall show all facilities under the Contract, thereby incorporating all changes, revisions and corrections including the delineation thereon of any physical changes made during construction, assembly or erection, such that the Drawings accurately represent that part or portion of the Works delineated thereon as it was completed and accepted by the Employer. Sizes and titles of Drawings will be directed by the Employer.

Prior to the submission of the As-built Drawings, the Contractor shall take the Employer's approval. Each As-built Drawing to be submitted shall contain one (1) original and three (3) blueprints and one (1) micro film.

1013 TECHNICAL PROPOSAL, DATA AND SAMPLES TO BE SUBMITTED

As soon as practicable after being awarded the Contract of the Works, the Contractor shall submit for the approval of the Employer drawings, catalogs, samples, diagrams and other descriptive data for all mechanical, electrical, architectural and other such materials and equipment, which he proposes for use under this Contract. For certain materials and equipment, data may be required to be submitted in accordance with a detailed form furnished by the Employer. Samples of materials and equipment to be used shall be submitted for the approval of the Employer in sufficient time, but not later than 60 days prior to purchase.

(1) The Contractor has no right to claim for the time spent for any test and the Employer's approval relating to his construction schedule.

(2) One of each approved sample will be retained for reference by the Employer. Finished work shall match the respective approved samples.

1014 TESTING OF MATERIALS

All materials intended for use in the permanent work shall be tested either at the place of manufacture or fabrication or on the Site in order to determine, to the satisfaction of the Employer, whether they comply with the requirements of the Specifications. If such testing is undertaken at the place of manufacture of fabrication, the Contractor shall submit the suppliers' test certificates to the Employer before the dispatch of the relevant consignment. All cost relating to the testing of materials shall be made at the Contractor's expense.

1015 ASSISTANTS FOR EMPLOYER

The Contractor shall provide competent assistants and laborers for the Employer to help him in carrying out the checking of survey in works and the testing of concrete and soil at the field laboratory, etc. Qualifications of the assistants and laborers shall be approved by the Employer and the cost of their provision shall be borne by the Contractor.

1016 MONTHLY PROGRESS REPORT AND PHOTOGRAPHIC RECORD

(1) Before the 10th of every calender month during the course of construction, the Contractor shall submit to the Employer five (5) copies of the Monthly Progress Report for the preceding month which shall at least include the following:

a) List of engaged staff and laborers during the report period.

b) List of construction equipment on site in working order indicating their number of working days.

c) List of activities scheduled to be in progress and actually in progress during the report period, together with the Contractor's estimate of progress achieved up to the report date and actual/forecast start and /or completion date for each activity.

d) List of activities scheduled to be started within two (2) months with forecast starting dates.

e) A progress graph chart showing the monthly progress of major work items together with their scheduled total achievements and their actual total achievements.

f) Physical records such as climatic conditions such as rain, minimum and maximum temperature, relative humidity etc.

g) Record of correspondence, Instruction, Drawings and Proces-Verbaux etc.

h) Accidents and dispensary frequency

i) Special events, trouble shooting, etc.

(2) Five (5) sets of the Photographic Record containing first quality color photographs of all significant aspects of construction works during the report period shall also be submitted in addition to the Monthly Progress Report. This monthly Photographic Record shall contain approximately thirty (30) color photographs of 110 mm by 160 mm in size with brief explanation of aspects, sites and date.

(3) Daily or weekly reports shall be required for the nominated special works in a form approved by the Employer. These reports shall be submitted to the Employer by 9 a.m. of the following day or the first day of the following week.

1017 SITE MEETINGS

The Contractor shall participate in site meeting which will be conducted by the Employer on a regular basis and at any time when called for.

1018 MONTHLY STATEMENT FORMS

The Contractor shall submit the monthly statements for payment including a summary sheet. Before any of the forms are printed, proof copies shall be submitted to the Employer for approval. Seven (7) copies of the completed statement with eight (8) additional copies of the summary sheet will be required each month.

1019 MEASUREMENT AND PAYMENT

No separate payment will be made for complying with the provisions of sections 1001 to 1018 inclusive of the Specifications and all costs shall be deemed to be included in the price entered against Pay Item 1101 in the Bill of Quantities (Part - 1 Main Works).

SECTION 1100 TEMPORARY WORKS

1101 GENERAL

This section covers site preparation, temporary access, electrical power supply, water supply, sewage disposal, telecommunication for construction purposes, Contractor's camp, health services, safety requirements and other temporary works

The Contractor shall submit to the Employer for his approval, the Drawings and full particulars of the temporary works.

The submission to, or approval of, the Employer of any such proposals by the Contractor shall not relieve the Contractor of any of his responsibility for the adequacy of the temporary works for their intended purpose.

The Contractor shall also obtain any necessary approval from the local, statutory or other authorities concerned before construction.

No house, office, store, workshop or other habitable buildings will be permitted to be established underneath or within 10 meters of the nearest point in plan of any conductor of an overhead power line.

Unless otherwise specified, all temporary works shall be removed or otherwise disposed of to the satisfaction of the Employer by the end of the Period of Maintenance. The site of temporary works shall be cleaned up, reinstated or arranged by the end of the Period of Maintenance to the approval of the Employer.

1102 SITE PREPARATION

The area of works nominated in the Contract and handed over to the Contractor as the Site is shown in the Contract Drawing No. GNL-1003. The Contractor shall keep the Site free from any damage after receipt of Notice to Proceed.

The lands for quarries, borrow areas, spoil areas, the Contractor's camping facilities, the Contractor's workshops, stores, the Contractor's other temporary works and facilities , etc. are not nominated in the Contract. When the Contractor intends to use additional lands which

are not provided by the Employer, the Contractor shall obtain such lands at his own effort and expenses, after obtaining the approval of the Employer.

When it is necessary to compensate for existing houses, walls, fences, trees, crops, other artificial obstacles, etc. in the land area not handed over by the Employer, such compensation shall be made at the Contractor's own expense after obtaining the approval of the Employer.

The Contractor shall clear the site in accordance with the Specifications and the instruction of the Employer. The clearing work shall consist of removal and disposal of trees, bushes, roots and vegetation and elimination of unnecessary structures such as buildings, roads, waterways and other obstacles for the Works.

All usable materials such as trees recovered during the clearance of the land handed over by the Employer belong to the Employer as defined in the section 1004. If the Employer orders such materials under the Contract to be stored, the Contractor shall store them in the place to be defined by the Employer.

The destruction of vegetation by fire cannot be carried out without the Employer's prior approval. The Contractor shall be, however, entirely responsible for consequences of such destruction by fire even though it may have been approved by the Employer.

Upon completion of the Works, the Contractor shall destroy all temporary facilities and clear away waste materials or rubbish of whatever kind remaining on the Site. Such refuse material shall be deposited at the place instructed by the Employer.

1103 NOTICE OF OPERATIONS

No important operation and particularly no blocking of any road, track, water pipe or other service shall be carried out without the consent in writing of the Employer, nor without full and complete notice being given to him in writing sufficiently in advance of the operation as will enable him to make such arrangements as may be necessary for its inspection and the provision of all relevant safety precautions.

1104 TEMPORARY ACCESS ROAD

The Contractor shall construct and maintain temporary access roads to, in and around, the various working sites.

Maintenance of temporary access roads shall include measures to control dust such as regular spraying of the road surface with water during dry periods and removal of hazardous mud during wet periods.

The road shall be made by the Contractor's own design and specifications, as approved by the Employer.

1105 POWER SUPPLY FOR CONSTRUCTION

There is no electricity supply for construction purposes by the Employer. The Contractor shall install a substation at the existing public power line or an electric generating plant and a distribution system of sufficient capacity and adequate reliability to meet the demand for construction of the Employer's and Consultant's offices and residences as well as the Contractor's temporary camp and facilities on a twenty-four hour per day basis up to the end of the Construction Period.

1106 WATER SUPPLY

The Contractor shall supply a sufficient amount of water of provable quality to meet all the requirements relating to the Works under the Contract including the demands of Employer's and Consultant's offices and residences, field laboratories, etc. as well as the requirements for testing and test operations on a twenty-four hour per day basis throughout the Construction Period.

The Contractor shall supply a sufficient amount of domestic and potable water to all offices and residential buildings throughout the Construction Period. He may be allowed to provide a suitable treatment plant at his own expense in order to obtain the potable water. The provided potable water shall be in compliance with the quality standard, TIS 257 "Drinking Water".

1107 TELECOMMUNICATIONS

The Contractor shall provide a telecommunication system at the working sites of sufficient capacity and adequate reliability to meet all of his telecommunication needs for the construction of the Works.

The Contractor shall submit the proposal of his own telecommunication system with sufficient details and Drawings to the Employer for his approval prior to construction.

The Contractor shall make all the necessary kinds of arrangements to obtain approval of the authorities concerned for providing his telecommunication system.

In addition to his own requirements, the Contractor shall provide and maintain telephone lines connected to the public telephone system for the uses of the Employer and the Consultant during the Construction Period.

1108 TREATMENT, DISPOSAL OF REFUSE, GARBAGE, TRASH AND CONSTRUCTIONAL REMAINS

The Contractor shall always collect, treat and dispose of refuse, garbage, trash and any constructional remains in order to keep the Site and the Works clean, including storage areas used by him during the Contract Period.

(1) The refuse, garbage, trash and constructional remains shall be separately collected, classifying into inflammables and incombustibles. The Contractor shall provide the necessary incinerator in suitable places approved by the Employer and properly treat the inflammables. Incombustibles shall be collected, conveyed and neatly disposed of at the designated areas on the Site.

(2) At the disposal area, exposed garbage shall be kept to a minimum and adequate vermin control and stray dog control measures shall be taken.

(3) The Contractor shall make and maintain such temporary works by his own arrangement, responsibility and at his own expense.

(4) Upon completion of the Works, the Contractor shall remove all temporary structures, remove and clear away all surplus of waste material or rubbish of whatever kinds

remaining on or about the Site. Such refuse materials shall be deposited at such places as the Employer may designate. If the Contractor fails to do this, the Employer may cause to have this done and the cost will then be deducted from the Contractor's dues under this Contract.

1109 CONTRACTOR'S OFFICES, CAMPS, STORES AND WORKSHOPS

The Contractor shall establish his offices, staff quarters, labor camps stores and workshops etc. at the location approved by the Employer.

(1) The Contractor shall provide and maintain such temporary buildings, offices, workshops and adequately fenced stores and delivery compounds as are necessary for the execution of the Works.

All such facilities shall be designed and submitted to the Employer for approval prior to construction.

(2) The Contractor shall provide and maintain temporary accommodation and living facilities including all necessary services for water supply, drainage, lighting, roads, paths, parking place, sanitation and refuse disposal, fire protection, commercial and recreation facilities for his staff and labor force and for the employees of his sub-contractors.

(3) All temporary and permanent buildings shall at all times be open to the inspection of the Governmental Health Officer and any instruction given by him for the proper cleansing, disinfection and general maintenance in a sanitary and hygienic condition of any building shall forthwith be carried out by the Contractor. Before any temporary or permanent buildings are occupied, the Contractor shall draw up a code of rules and regulations for their control which shall be submitted to the Employer for his approval. The Contractor shall provide necessary transport for his employees between the camp and the Site.

1110 SANITARY ARRANGEMENTS

The Contractor shall arrange for a high standard of sanitation to be maintained throughout the camp and the Works. He shall construct and maintain at his own cost a system of surface drainage and waste disposal which shall be approved by the Employer before any work commences. Sanitary conveniences shall be provided and maintained by the Contractor in accordance with the appropriate regulations to the extent and in such manner and at such

places as may be approved by the Employer, and all persons connected with the Works shall be obliged to use them.

The Contractor shall arrange for the duration of the Contract for the disposal off site of sewage effluent arising from site toilets, Contractor's and Consultant's offices, canteen and the like. Such arrangements shall be subject to the Employer's approval and it shall be noted that a connection from the site into an existing public sewer may not be available.

1111 HEALTH SERVICES

The Contractor shall make satisfactory arrangements for the provision of all medical, and health services for all persons employed by him and by any sub-contractors employed by him on the Works including the dependents of such person (providing such dependents are resident at the site).

The Contractor shall also provide on-site medical, surgical and health services free of charge to such other persons (hereafter called Registered Persons), who may be designated by the Employer, including employees of the Employer and the Consultant and their immediate dependents on the site. The standard of service and facilities to Registered Persons shall not be lower than that laid down for ordinary public hospitals and the extent of the service shall not be less than customarily provided by commercial firms for ordinary standing for persons, in the opinion of the Employer, of equal status in their employ. The services listed below shall be excluded:

a) Special medical attention.

b) Surgical attention apart from first aid and minor injuries.

c) Hospital attention where the illness would normally require residence in hospital for more than fourteen days.

d) Dental treatment.

The Contractor shall draw up a contract with a doctor and hospital located near the Site to enable him to fulfill his obligations under this section. The doctor shall have had about ten years professional experience or more and be adequately experienced in medicine, surgery and obstetrics.

The Contractor shall provide, maintain and service a properly equipped and staffed ambulance with driver which shall be in readiness on the site for use at all times.

1112 SAFETY PRECAUTIONS

(1) General

In the performance of the Works, the Contractor shall exercise every reasonable precaution to protect persons or property from injury. He shall erect and maintain all necessary temporary fencing, barricades, barriers, multilingual signs, and lights and provide fire alarm, fire extinguishing and fire fighting services at strategic points on the Site. The Contractor shall adopt and enforce such rules and regulations as may be necessary, desirable or proper to safeguard the public, all persons engaged in the Works and its supervision and all traffic adjacent to throughfares.

The Contractor shall appoint a safety officer and hold regularly scheduled safety meetings with the Employer and with his own supervisors and foremen.

Safety measures shall include but not be limited to the specific safety measures specified in this section.

(2) Road Safety

The Contractor shall not use and/or occupy, without obtaining approval from the Department of Highways of the Thai Government, the land inside the right-of-way but outside the limitation of the Site. When and in case the Contractor intends to use the land inside the right-of way, the Contractor shall submit his proposal to the Department of Highways for approval through the Employer, at least six (6) weeks before the commencement of related works.

(3) Temporary Fencing

The Contractor shall erect, maintain and remove suitable and approved temporary fencing to enclose such areas of the Works within the Site as may be necessary to the satisfaction of the Employer. Where any temporary fence has to be erected alongside a public road, sidewalk, etc., it shall be erected to the satisfaction of the authorities concerned.

(4) Lighting

The Contractor shall provide sufficient lighting, in all places where the Works are done at night, to ensure that:

a) Safe working conditions are provided both for the Contractor's personnel and for personnel of the Employer.

b) The Works can be constructed in complete compliance with the Contract.

c) A complete inspection of all works in progress can be made by the staff of the Employer.

Unless otherwise directed by the Employer, the minimum intensity of illumination on ground or working surfaces to be provided for the various operations or work areas shall be as tabulated below:

Operation or Area	Minimum Intensity of Illumination, Foot Candles
Earthworks and piling works	2
Bridges	2
Access and haul roads where cross traffic or other hazardous conditions exist	2
Concrete batching plant	4
Concrete placing	4
Workshops and auxiliary building	5

Illumination for areas or operations not listed in the above table shall conform to the specified requirements for similar areas or operations listed above.

All moving equipment or plant used during night operations shall be equipped with sufficient lights and reflectors to ensure safe working conditions.

Not less than fourteen (14) days before he proposes to start night operation, the Contractor shall submit to the Employer for approval his proposals for lighting in the areas in which he proposes to work at night.

The submission to or approval by the Employer for lighting shall not relieve the Contractor from his liabilities or obligations under the Contract.

(5) Work in the Vicinity of Electrical Equipment

Once any permanent electrical plant has been connected to any electricity supply, its operation and the completion of any outstanding work (such as painting, handrailing,etc.) on the plant shall be subject to a "permit to work" system in a form agreed between the Contractor and the Employer in accordance with the Employer's Standard Safety Regulations for such work.

While the plant is still under the control of the Contractor, the "permit to work" shall be endorsed by the Contractor.

Permits to work on plant which is handed over shall be under the control of the Employer.

(6) Explosives

In the use, handling, transporting and storage of explosives, the Contractor shall comply with the guidelines given in the local regulations. The handling or use of explosives shall be discontinued during the approach and progress of a thunderstorm. All persons shall be removed from danger areas to a place of safety during such periods.

The explosives storage shall be protected with an earth bund surround and enclosed with security fencing and provided with lighting to the approval of the authorities concerned.

1113 PROTECTION OF MATERIALS AND WORKS

The Contractor shall at all times take care to protect and preserve all materials, supplies and equipment of any description and all works to be performed. All requests by the Employer to enclose or satisfactorily protect such property shall be complied with accordingly.

(1) Materials shall be stored so as to ensure preservation of their specified quality and fitness for the Works. When so directed they shall be placed on wooden platforms or other hard and clean surfaces and not on the ground. When so required they shall be placed under cover. The suitability of the said materials for the purposes of the Contract at the time of installation

remains the responsibility of the Contractor. Stored materials shall be located so as to facilitate prompt inspection and control.

(2) Concreting, piling and other works shall not be started if they are to be exposed to inclement weather, except under conditions whereby the Employer may specifically direct or permit such works. This is subject to the protection of finished works and such other measures which may be deemed necessary by the Employer.

(3) If suspension of the works is on account of inclement weather or from any other cause, the Contractor shall, at his own expense, protect carefully his materials and works against any damage or injury and the Site shall be cleaned up and left in good order during the period of such suspension. If, in the opinion of the Employer, any work or materials shall have been damaged or injured, by reason of failure on the part of the Contractor (or any of his sub-contractors) to protect the Works, such work and materials shall be removed and replaced at the expense of the Contractor.

(4) The Contractor shall at all times comply with all laws, ordinances, rules and regulations relating to the performance of the Works, the protection of adjacent property and the maintenance of passageways, guard fences, lights or other protective facilities.

(5) The Contractor shall at all times safely guard the Employer's property from injury or damage in connection with this Contract. He shall at all times also safely guard and protect his own work and that of adjacent property from damage. Such damage or injury that occurs shall be replaced or made good at the expense of the Contractor.

1114 MAINTENANCE OF TRAFFIC SAFETY

The Contractor shall have full responsibility for the safety at the Site.

Where the Works will be carried out at the site near the exiting road, the Contractor shall maintain vehicular and pedestrian traffic at all times. If the Contractor's operations constitute a traffic hazard, he shall repair or fence or take other measures of safety to the satisfaction of the Employer.

Detours around construction sites will be subjected to the approval of the authorities concerned. Where detours are permitted, the Contractor shall provide all necessary barricades

and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor shall expedite construction operations and the period shall be strictly controlled by the Employer.

1115 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

The Contractor shall assume full responsibility for protection of all structures and utilities, public or private, including poles, signs, services to buildings, utilities in the street, water pipes, drains, electric and telephone cables.

The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired at his own expense to the satisfaction of the owner (s) of the structures and utilities or the authorities concerned.

It is the Contractor's sole responsibility to obtain all locations of underground structure and utilities. Services to buildings and accesses to buildings shall also be maintained.

Temporary removal or replacement of some existing utilities or structures will be made by the respective owner (s) of the structures and utilities or the authorities concerned.

In case the owner (s) or the authorities concerned will allow the Contractor to do the work of replacement or removal, the Contractor shall carry out the work under the supervision of the owner (s) or the authorities concerned.

1116 PUBLIC UTILITIES AND OTHER SERVICES

The Contractor shall be responsible for locating all services including drains, pipes, cables and the like whether above or below ground level and shall adopt such method of working as will ensure that no damage is caused to the services. The Contractor shall make good at his own expense any damage whatsoever to existing services resulting from his operations to the complete satisfaction and in accordance with the instruction of the authority or owner concerned and shall keep the Employer indemnified at all times from all claims which may be brought against the Employer for, or on account of, any damage to the said services.

1117 COMPENSATION TO WATER AND FLOW

The Contractor shall ensure the normal flow of sewers, drains, irrigation canals or water courses through the Works during the construction and up to the time of completion of the relevant parts of the Works, except for such quantity as the Contractor may reasonably require for the execution of the Works unless otherwise directed by the Employer.

(1) During construction of those parts of the Works or temporary works which form a barrier to canal flow, the Contractor will be required to divert such quantities of water into the canal downstream from these structures, as may be directed. The Contractor shall not alter the rate of flow of such water except with the approval of the Employer.

(2) In case the flow rate and water quality will not be guaranteed, the Contractor shall compensate such water to meet the demand occurring at the downstream. Any damage or blockage resulting from the Contractor's operation for flow diversion shall be made good at his own expense. The Contractor shall remove all temporary diversion facilities after completion of the Works and restore the original feature of flow.

1118 POLLUTION OF STREAMS, WATERWAYS, PONDS AND RESERVOIRS

The Contractor shall take all necessary precautions to secure the efficient protection of all waterways against pollution, including spillage of oil which may be likely to cause injury to fish or plant life, and shall indemnify and keep indemnified the Employer against any claim arising from any such pollution during the execution of the Works or the period of maintenance.

1119 CARE AND PROTECTION OF PROPERTY

All fences, walks, bushes, trees, shrubbery and physical features shall be protected and restored in a thoroughly workmanlike manner.

All existing pavements, sidewalks and waterways which are disturbed by the Contractor's operation shall be restored to their original or better condition by using similar materials approved by the Employer.

1120 SIGNPOSTS AND NOTICE BOARD

The Contractor shall provide signposts and notice boards at the places indicated by the Employer.

The signposts shall show the direction to the work site and the name of the work site, the Employer, the Consultant and the Contractor. The notice board shall describe the outline of project and illustrate the general plan of project.

The signposts for traffic control shall be required according to the regulations of the authorities concerned in case a part of the existing road will be occupied by the Works and detours will provided.

1121 KEEPING WORKS FREE FROM WATER

Except where otherwise specified the Contractor shall keep the site of the works free from water so that the works may be carried out under dry conditions. He shall construct any cofferdams, flood protection dikes, temporary sheet piling cutoffs, temporary bulkheads, watercourses and other necessary temporary structures, and shall prepare such pumping plants as may be necessary for this purpose.

(1) Notwithstanding any approval by the Employer of the arrangement made of the exclusion of water from the Works, the Contractor shall take responsibility for the sufficiency thereof and will be liable for keeping the Works safe from damage and shall make good any damage to the Work, resulting from any conditions, at his own expense. Any loss of production, additional overheads or additional costs of any kind that may result from damage will be at the Contractor's risk.

1122 CARE OF RIVER

(1) The Contractor shall be fully responsible for the lay out his plan of, and carry out and maintain the works in respect of the care of the river for protection of construction of the project facilities such as diversion dam & canal, pumping station, closure dam and river water gauging stations, during execution of the works.

After having served their respective purposes, such temporary works as constructed by the Contractor shall, with prior approval of the Employer, be removed from the Site or levelled so as to give a tidy appearance and not to hurt in any way the function and operation of the river and the discharge control structures.

The works for the care of river shall be carried out in accordance with the plan and design approved by the Employer, but such approval shall not relieve the Contractor of his responsibility to perform the care of river in accordance with details of this provision.

The Contractor shall not interrupt or interfere with the natural flow of any part of the rivers and streams passing the main facilities above and any other places where the Contractor carries out the Works, without prior approval of the Employer.

(2) At least thirty (30) days before the Contractor desires to commence construction of any work in respect of the care of river, he shall submit, for approval of the Employer, a water control plan showing his proposed method of dealing with the river flow and other water for construction of the project facilitites in accordance with the Contract and design of each component of the temporary works required for the care of the river during the construction period. Timing of construction and removal of each component of the works shall also be indicated in the plan.

(3) The Contractor's plan shall also include dewatering plan for construction of the diversion dam, pumping station, river water gauging stations, etc.

Any damage or failure resulting from the plan and the works made by the Contractor or any other cause other than the Force Majeure, or any delay of completion resulting from such damage or failure as aforementioned shall fully and solely be the responsibility of the Contractor. The Contractor shall reinstate or repair such damage or failure at his own cost and bear any liability occasioned in respect of such delay of completion at this own expense.

1123 MEASUREMENT AND PAYMENT

(1) Payment for all kinds of common temporary works specified in sections 1101 to 1120 inclusive in the Specifications are to be made under Pay Item 1201 of the Bill of Quantities (Part - 1). Thirty (30) percent of the price entered against Pay Item 1201 become payable when the Employer deems the common site preparation and the Contractor's temporary facilities to be competed. The remaining seventy (70) percent will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the provisional take-over of the Works.

The price entered against Pay Item 1201 shall cover the supply, installation, operation, maintenance and removal of all kinds of common temporary facilities and temporary works except otherwise particularly itemized in the Bill of Quantities.

(2) Payments of temporary works specified in sections 1121 and 1122 will be made under the Pay Items stated as "Temporary Works" in Divisions 2 to 6 of the Bill of Quantities (Part - 1).

SECTION 1200 EMPLOYER'S AND CONSULTANT'S FACILITIES

1201 EMPLOYER'S AND CONSULTANT'S OFFICES

(1) This section shall consist of the construction and/or the rent, maintenance and cleaning of the Employer's and Consultant's offices as well as the furnishing and maintenance of the office furnitures including the air-conditioners for the sole use of the Employer and the Consultant and their staffs together with the provision, installation, maintenance and services. The buildings, furniture and equipment shall remain the property of the Contractor. The buildings shall be approved in advance by the Employer.

The Contractor shall provide and maintain the Employer's and Consultant's offices throughout the construction period.

The buildings and services shall be available in full working order within two (2) months after the commencement of the Works and shall continue to be so available during progress of the Works until the certificate of the provisional take-over of the Works has been issued.

The Contractor shall be responsible for the security of the buildings and its contents at all times and shall employ watchmen for this purpose.

(2) Location of the Employer's and Consultant's offices will be directed by the Employer in the vicinity of the Site.

The buildings for the Employer's and Consultant's offices shall have the following rooms and total area of these buildings shall not be less than 600 sq.m.:

a) Room for Employer's Manager
b) Room for Employer's Staff Members
c) Room for Consultant's Manager
d) Room for Consultant's Staff Members
e) Drafting Room
f) Administration Room
g) Conference Room (Large)
h) Conference Room (Small)
i) Storage

j) Kitchen

k) Toilet

(3) The buildings shall be furnished with new furniture and equipment. The following are lists of the minimum basic furniture and equipment to be provided by the Contractor for the Employer's and Consultant's offices.

	Quantities
a) Room for Employer's Manager	
- Wooden desk, W ≒ 1.9m × D ≒ 0.9m × H ≒ 0.7m 6~8side drawers and 1 center drawer	1
- Revolving executive chair, on rollers, with armrests	1
- Conference table, W ≒ 1.8m × D ≒ 0.9m × H ≒ 0.7m	1
- Conference chair	4
- Storage cabinet, (Lateral file,W ≒ 0.9m × D ≒ 0.45m × H ≒ 1.0m, 3 drawers and Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	1
- Wood kitchen cabinet, W ≒ 0.6m × D ≒ 0.40m × H ≒ 0.9m	1
- Blackboard, 1.80m × 0.9m	2
- Wastebasket, large, solid sides, no wire	2
- Air conditioner, (4.0 kw)	1
b) Room for Employer's Staff Members	
- Wooden desk, W ≒ 1.5m × D ≒ 0.75m × H ≒ 0.7m 6~8side drawers and 1 center drawer	10
- Executive chair with armrests	10
- Conference table, W ≒ 1.8m × D ≒ 0.9m × H ≒ 0.7m	1
- Conference chair	4
- Cabinet drawing vertical file, W ≒ 1.0m × D ≒ 0.5m × H ≒ 1.5m	2

	Quantities
- Storage cabinet, (Lateral file,W ÷ 0.9m × D ÷ 0.45m × H ÷ 1.0m, 3 drawers and Bookcase, W ÷ 0.9m × D ÷ 0.45m × H ÷ 0.7m)	2
- Wood kitchen cabinet, W ÷ 0.6m × D ÷ 0.40m × H ÷ 0.9m	1
- Blackboard, 1.80m × 0.9m	3
- Wastebasket, large, solid sides, no wire	6
- Air conditioner, 4.0 kw	3

(c) Room for Consultant's Manager

- Same as those for Room for Employer's Manager

(d) Room for Consultant's Staff Members

- Wooden desk, W ÷ 1.5m × D ÷ 0.75m × H ÷ 0.7m 6~8side drawers and 1 center drawer	8
- Executive chair with armrests	8
- Wooden desk, W ÷ 1.2m × D ÷ 0.75m × H ÷ 0.7m 3~4side drawers and 1 center drawer	4
- Executive chair	4
- Conference table, W ÷ 1.8m × D ÷ 0.9m × H ÷ 0.7m	1
- Conference chair	4
- Drafting table, MUTOH Model OT-3 or approved equal	1
- Drafting machine, MUTOH Model LYN-A1 set or approved equal	1
- Drafting equipment and instrument, complete set	1
- Drafting chair	1
- Square table, W ÷ 0.45m × D ÷ 0.45m × H ÷ 0.7m	1
- Cabinet drawing vertical file, W ÷ 1.0m × D ÷ 0.5m × H ÷ 1.5m	2

	Quantities
- Storage cabinet, (Lateral file, W ≒ 0.9m × D ≒ 0.45m × H ≒ 1.0m, 3 drawers and Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	2
- Wood kitchen cabinet, W ≒ 0.6m × D ≒ 0.40m × H ≒ 0.9m	1
- Blackboard, 1.80m × 0.9m	3
- Wastebasket, large, solid sides, no wire	8
- Air conditioner, 4 kw	3

e) Drafting Room

- Drafting table, MUTOH Model OT-3 or approved equal	1
- Drafting machine, MUTOH Model LYN-A1 set or approved equal	1
- Drafting equipment and instrument, complete set	3
- Drafting chair	2
- Square table, W ≒ 0.45m × D ≒ 0.45m × H ≒ 0.7m	3
- Drafting table & chair	2
- Tracing table, W ≒ 1.0m × D ≒ 0.70m × H ≒ 0.8m 5000 lux	1
- Wooden desk, W ≒ 1.2m × D ≒ 0.75m × H ≒ 0.7m 3~4 side drawers and 1 center drawer	2
- Executive chair	2
- Conference table, W ≒ 1.8m × D ≒ 0.9m × H ≒ 0.7m	1
- Conference chair	4
- Cabinet drawing vertical file, W ≒ 1.0m × D ≒ 0.5m × H ≒ 1.5m	2
- Drawing plan file, 5 drawers, lock type, W ≒ 1.3m × D ≒ 1.0m × H ≒ 0.4m	2
- Storage cabinet, (Lateral file, W ≒ 0.9m × D ≒ 0.45m × H ≒ 1.0m, 3 drawers and Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	1

	Quantities
- Wood kitchen cabinet, W ≒ 0.6m × D ≒ 0.40m × H ≒ 0.9m	1
- Blackboard, 1.80m × 0.9m	2
- Ao size blue printing machine, RICOH Model RICOPY SD 900AE or approved equal	1
- Wastebasket, large, solid sides, no wire	4
- Air conditioner, 4.0 kw	3

f) Administration

- Wooden desk, W ≒ 1.5m × D ≒ 0.75m × H ≒ 0.7m 6~8 side drawers and 1 center drawer	2
- Executive chair with armrests	2
- Wooden desk, W ≒ 1.2m × D ≒ 0.75m × H ≒ 0.7m 3~4 side drawers and 1 center drawer	2
- Executive chair	2
- Conference table, W ≒ 1.8m × D ≒ 0.9m × H ≒ 0.7m	1
- Conference chair	4
- Storage cabinet, (Lateral file, W ≒ 0.9m × D ≒ 0.45m × H ≒ 1.0m, 3 drawers and Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	1
- Storage cabinet, (Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	1
- Wood kitchen cabinet, W ≒ 0.6m × D ≒ 0.40m × H ≒ 0.9m	1
- Typewriter table and chair	1
- Electric typewriter, IBM Dual electric, Thai and English or approved equal	1
- Dry photo-copier, electric, RICOH Model RICOPY FT6950 or approved equal	1
- Blackboard, 1.80m × 0.9m	1
- Wastebasket, large, solid sides, no wire	4
- Air conditioner, 4.0 kw	2

		Quantities
g)	Conference Room (Large)	
	- Conference table, on rollers W 1.80m × D 0.60m × H 0.70m	11
	- Conference chair	24
	- Blackboard, 1.80m × 0.9m	2
	- Telephone table	1
	- Wastebasket, large, solid sides, no wire	4
	- Air conditioner, 4 kw	3
h)	Conference Room (Small)	
	- Conference table, on rollers W 1.80m × D 0.60m × H 0.70m	3
	- Conference chair	8
	- Blackboard, 1.80m × 0.9m	1
	- Telephone table	1
	- Television set with video deck, 24 inches	1
	- Coffee table, W ≒ 1.4m × D ≒ 0.9m × H ≒ 0.4m	1
	- Two seat sofa	1
	- Lounge chair	2
	- Wastebasket, large, solid sides, no wire	2
	- Air conditioner, 4 kw	2
i)	Kitchen	
	- Wood kitchen cabinet, W ≒ 0.9m × D ≒ 0.50m × H ≒ 1.8m	2
	- Kitchen necessaries	1 set
	- Tea and coffee set	1 set
	- Electrical refrigerator (300 ℓ)	1

(4) The Contractor shall be required to employ and be responsible for the welfare and housing of the following staff to be available during the hours agreed by the Employer.

- Two cleaners
- Two office boys

(5) Following services shall be provided, installed and maintained in the Employer's and Consultant's offices by the Contractor:

a) An adequate piped supply of clean, fresh water connected to the toilet and suitable sewage disposal facilities.

b) Potable water.

c) Electricity supply, with sufficient and suitable light fittings and socket outlets.

d) Fire extinguishers.

e) Two outside telecommunication lines.

f) Office supplies.

(6) The Contractor shall provide a total of thirty (30) sets of safety helmets, boots, raincoats in the Employer's and Consultant's offices for use of the Employer and the Consultant. Color of these shall be white or other color differing from those of the Contractor, and the qualities of these shall be subjected to approval of the Employer.

(7) The Contractor shall provide the following survey equipment, its required accessories and consumptives for the Employer's assurance and check survey through the Contract Period.

The said equipment etc. shall be the Contractor's properties but for the Employer's exclusive use at all the times during the construction period.

Description	Quantity
- Electric theodolite with electric distance meter and tripod	1
- 2 m long pole	10
- Auto level and tripod	2
- 4 m long staff, (aluminum)	4
- 50 m long tape measure (vynil)	4
- 100 m long tape measure (steel)	1
- Thermal-micro computer aided echo-sounder	1
- 3 m long pocket measure (steel)	10
- Flashlight (pocket torch)	10
- Cotton gloves	100

1202 EMPLOYER'S AND CONSULTANT'S RESIDENCES

(1) This section shall consist of the construction and/or the rent, maintenance and cleaning of the Employer's and Consultant's residences as well as the furnishing and maintenance of the furniture including the air-conditioners for the sole use of the Employer and the Consultant and their staffs together with the provision of services. The buildings, furniture and equipment shall remain the property of the Contractor. The buildings shall be approved in advance by the Employer. The buildings, furniture, equipment and services shall be available in full working order within two (2) months after signing of the Contract, and shall continue to be so available during progress of the Works until the commissioning works have been completed.

The Contractor shall provide and maintain the Employer's and Consultant's residences throughout the Contract Period.

The Contractor shall provide substitute facilities and/or spaces for the Employer's and Consultant's residences during the period until the residences become available, for approximately 30 persons for the Employer and the Consultant.

A few bedrooms and related facilities and services shall be available during commissioning period after the date for provisional take-over.

The Contractor shall be responsible for the security of the buildings and their contents at all times and shall employ watchmen for this purpose.

(2) Location of the Employer's and Consultant's residences will be in the vicinity of the Site which shall be proposed by the Contractor and approved by the Employer.

(3) The building(s) for the Employer's and Consultant's residences shall have at least the following rooms and facilities and total area of the building(s) shall not be less than 900 sq.m.

a) Twenty (20) single-bed bedrooms with bath and toilet.
b) Ten (10) twin-bed bedrooms with bath and toilet.
c) Sitting and recreation room(s).
d) Canteen facilities.

(4) Each building of the Employer's and Consultant's residences shall be furnished with new furniture and equipment. The following furniture and equipment shall be at least provided with each of the residences by the Contractor as the minimum basic requirement:

Description	Quantities
Single-bed Bedroom	
- Single -bed with mattress	1
- Wooden bed table and bed lamp	1
- Wooden table with two chairs	1
- Coat and locker unit	1
- Pillow with two pillow cases	2
- Sheet for single-bed mattress	4
- Blanket	2
- Curtains for window with insect net	as required
- Mirror, 0.45 m × 0.60 m	1
- Refrigerator, 100 ℓ	1
- Air conditioner, 4 kw	1
Twin-bed Bedroom	
- Single-bed with mattress	2
- Wooden bed table and bed lamp	2
- Wooden table with four chairs	1
- Coat and locker unit	1
- Pillow with two pillow cases	4
- Sheet for single-bed mattress	6
- Blanket	4
- Curtain for window with insect net	as required
- Mirror, 0.45 × 0.60 cm	1
- Refrigerator, 100 ℓ	1

- Air conditioner, 4 kw	1
Sitting Room	
- Wooden bookcase	1
- Lounge chair	6
- Wooden tea table	1
- Curtains for window with insect net	as required
- Air conditioner, 4 kw	1
Recreation Room	
- Wooden dining table for four persons	2
- Wooden chair for above table	8
- Wood kitchen cabinet	1
- Curtains for window with insect net	as required
- Air conditioner, 4 kw	1
- Television set with video deck, 24 inches	1

(5) Canteen facilities shall have the capacity to provide mess for at least 40 persons of the Employer and the Consultant.

(6) The Contractor shall provide the sufficient number of personnel, such as cleaners, housemaids, boys, etc., for the welfare and maintenance of the Employer's and Consultant's residences.

(7) Following services shall be provided, installed and maintained in the Employer's and Consultant's Residences by the Contractor:

a) Adequate piped supply of clean water connected to toilets and bathrooms in the buildings and suitable sewage disposal facilities.
b) Potable water.
c) Electric water heaters in the bathrooms connected to the piped water supply.
d) Electricity supply with sufficient and suitable light fittings and socket outlets.
e) One outside telecommunication line for each building.

1203 EMPLOYER'S AND CONSULTANT'S TRANSPORTATION

(1) The Contractor shall provide and maintain until the end of the commissioning period vehicles and motor launch for the Employer and the Consultant for both on-site and off-site transport. The vehicles and motor launch shall be for the exclusive use of the Employer and the Consultant. The property of vehicles and motor launch shall remain with the Contractor during and after the Contract Period. The mileage of monthly off-site transport shall not be more than 5,000 km.

(2) The Contractor shall be required to provide:

a) Two (2) four wheel drive cars, air-conditioned, nominal engine capacity 2.8 liters, or approved equal.

- One (1) car for the Employer use.
- One (1) car for the Consultant use.

b) Three (3) four-door sedan cars, air-conditioned, normal engine capacity 1.8 liters, or approved equal.

- Two (2) cars for the Employer's use.
- One (1) car for the Consultants's use.

c) Three (3) micro-buses, of not less than 10 passenger seats per micro-bus, air-conditioned, nominal engine capacity 2 liters, or approved equal.

- Two (2) micro-buses for the Employer's use.
- One (1) micro-bus for the Consultant's use.

d) Five (5) pick-up trucks of 1 ton, nominal engine capacity 1.6 liters, or approved equal. Vehicles shall be right hand drive and shall be fitted with the following:

- Seat belts
- Fire extinguishers
- First aid kits

e) One (1) motor launch for not less than 10 passengers.

(3) Vehicles shall be regularly serviced and repairs shall be made as soon as required. Vehicles which have to be kept out of service for more than 24 hours due to extensive repairs or maintenance work shall be substituted by similar serviceable vehicles within 24 hours from the time the original vehicles become out of service.

Any vehicle which has become permanently defective, unreliable or otherwise unfit for its intended use shall be replaced with a similar new vehicle within sixty (60) days from the time the supply of such new vehicle has been ordered by the Employer. Until the new vehicle is available for use at Site, a temporary substitute, serviceable vehicle shall be provided.

Vehicle and motor launch maintenance shall include, but not necessarily be limited to, all fuels, lubricants, tires and other supplies, all maintenance repairs, insurance, licenses and other operating requirements.

(4) The Contractor shall provide vehicles and motor launch in accordance with the following delivery schedule:

a) Two (2) four wheel drive cars : within three (3) months after signing of the Contract
b) Three (3) sedan cars : within one (1) month after signing of the Contract
c) Three (3) micro-buses : within three (3) months after signing of the Contract
d) Five (5) pick-up cars : within two (2) months after signing of the Contract
e) One (1) motor launch : within three (3) months after signing of the Contract

(5) A licensed, competent and experienced driver and boatsman shall be provided for each vehicle and the motor launch at all times respectively.

1204 FIELD LABORATORY

The Contractor shall construct the field laboratory and maintain it during the Construction Period to the satisfaction of the Employer. The field laboratory is for the use of the Employer.

The field laboratory, which will be composed of laboratory, office, curing room, toilet and storage,shall be located at the vicinity of the Site which shall be proposed by the Contractor and approved by the Employer.

Building of the field laboratory shall have a total area of not less than one hundred (100) sq.m and shall be designed, proposed and constructed by the Contractor after getting the approval of the Employer.

The Contractor shall supply and furnish the field laboratory with the following listed new furniture and equipment:

Description	Quantities
- Wooden desk, W ≒ 1.2m × D ≒ 0.75m × H ≒ 0.7m 3~4 side drawers and 1 center drawer	3
- Executive chair	3
- Conference table, W ≒ 1.9m × D ≒ 0.9m × H ≒ 0.7m	1
- Conference chair	4
- Wastebasket, large,solid sides, no wire	3
- Blackboard, 1.80m × 0.9m	2
- Storage cabinet, (Lateral file,W ≒ 0.9m × D ≒ 0.45m × H ≒ 1.0m, 3 drawers and Bookcase, W ≒ 0.9m × D ≒ 0.45m × H ≒ 0.7m)	1
- Test equipment storage cabinet, lock type	1
- Wood kitchen cabinet, W ≒ 0.6m × D ≒ 0.40m × H ≒ 0.9m	1
- Air conditioner, 4.0 kw	2

The Contractor shall furnish enough equipment and apparatus for the purpose of carrying out the required concrete and soil tests.

The laboratory equipment and apparatus shall be of approved types and shall be adequate in the opinion of the Employer to carry out all the tests as listed in the Specifications.

The following listed equipment and apparatus shall be at least furnished to the laboratory by the Contractor.

Laboratory Equipment

Description	Quantities
(1) Quality Control Test for Fill and Backfill	
a) Compaction Test, AASHTO T 99 or JIS A 1210	
- Mold, 101.6 mm dia × 116.43 mm high	3
- Detachable collar assembly, 101.6 mm dia × 50.8 mm high	3
- Base plate	3
- Rammer, 2.5 kg, 305 mm drop	2
- Sample extruder	1
b) Compaction Test, ASSHTO 180 or JIS A 1210	
- Mold, 152.4 mm dia × 116.43 mm high	3
- Detachable collar assembly, 152.4 mm dia × 50.8 mm high	3
- Base plate	3
- Rammer, 4.54 kg × 457 mm drop	2
- Sample extruder	2
c) Field Density Test, AASHTO T 191 or JIS A 1214	
- Plastic jug	2
- Sand cone	2
- Template	2
- Digging tools and paint brush	2
- Glass plate, 5 mm thickness, 200 mm × 200 mm	2
- Cylindrical can for calibration sand, 2.5 liters	2
d) Moisture Content Determination	
- Drying oven, 100 × 75 × 60 cm internal size thermostatically controlled capable of maintaining a temperature of 100 ± 5 degrees C	2
e) Balance and/or Scale	

-	Table platform scale, capacity 10 kg, sensitivity 1 g	2
-	Beam scale, capacity 10 kg sensitivity 5 g	2
-	Balance, capacity 1 kg, sensitivity 0.1 g	2

(2) Concrete Test

a) Slump Test, ASTM C 143 or JIS A 1101

-	Slump cone, 102 mm dia top, 203 mm dia bottom × 305 mm high	3
-	Iron plate	3
-	Tamping Rod, 16 mm dia × 500 mm length	3
-	Steel ruler	3

b) Making of Specimen, ASTM C 31 or JIS A 1132

-	Cylindrical mold, 150 mm dia × 300 mm high	30
-	Capping set	6
-	Concrete curing bath	2

c) Compressive Strength, ASTM C 39 or JIS A 1108

-	Compression testing machine, capacity 100 tons	1

(3) Miscellaneous

-	Straight edge, 300 mm long	3
-	Beaker, 500 cc	30
-	Small hand scoop	4
-	Large hand scoop	4
-	Vernier calipers, measuring length 300 mm	2
-	Steel staff, 3.0 m long	2
-	Tray, 400 mm × 300 mm	10
-	Wire brush	5
-	Sampling spoon	3
-	Moisture content sample container with lid	40
-	Portable Cone Penetrometer, 16 mm dia × 500 mm long rod × 10, MARUTO Model SS44 or approved equal	1

-	Pocket penetrometer, 16~19 mm dia × 165 mm long MARUTO Model S45AN or approved equal	2
-	Turbidimeter, measuring range 0~550 ppm	1

At the end of the Contract, all equipment, apparatus and furniture of the Field Laboratory shall become the property of the Contractor, and shall be removed from the Site.

The Contractor shall maintain the Field Laboratory and assist the Employer for operation of the Laboratory.

The power, water, and gas shall be supplied to the Field Laboratory by the Contractor. The daily laboratory supplies shall also be supplied by the Contractor.

The Contractor shall supply one laboratory technician, who speaks English well, and two laborers for operation of the Laboratory under the Employer.

1205 MEASUREMENT AND PAYMENT

(1) Payment for provision and maintenance of Employer's and Consultant's offices and residences will be made on a monthly basis as computed from the day the buildings and services being in full working order to the end of the construction period, and will be paid under the Pay Items 1301 and 1302 in the Bill of Quantities (Part - 1) respectively.

If the Employer will not require some of the facilities specified in Sections 1201 and 1202 hereof, the Employer shall so instruct the Contractor and shall determine the value of the items omitted. The value of all facilities omitted shall then be deducted from the unit prices entered against Pay Items 1301 and/or 1302.

The unit price shall cover all of the requirements for respective facilities stated in the Specifications.

(2) Payment for provision, operation and maintenance of four-wheel drive car, sedan car, micro-bus, pick-up truck and motor launch will be made under the their respective Pay Items 1304 to 1308 in the Bill of Quantities (Part - 1). Measurement for the payment shall be done for the cars and motor launch required by the Employer and actually used.

(3) Payment for provision, operation and maintenance of the field laboratory will be made under the Pay Item 1303 in the Bill of Quantities (Part - 1).

Thirty (30) percent of the price entered against the Pay Item 1303 will become payable when the field laboratory is substantially completed and equipped.

The remaining seventy (70) percent will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the provisional take-over of the Works.

The price shall cover construction, furnishing, maintenance of the Laboratory and other requirements as stated in the Specifications.

DIVISION 2 EARTH AND STONE WORKS

SECTION 2000 EXCAVATION WORKS

2001 GENERAL

This section covers stripping and open cut excavation. The Contractor shall carry out the survey works to confirm the final elevation, and dimensions for the excavation site prior to preparation of Shop Drawings. The diversion dam and closure dam foundation will be mostly excavated by the dredging works.

The Contractor shall submit to the Employer for his approval, prior to commencement of excavation works, the excavation method at each excavation site including lists of equipment to be employed, detail work schedule, and layout plans of temporary facilities such as temporary access road, dewatering facilities including cofferdams and temporary sheet piling cutoffs, safety measures, etc.

The division of the Site, for payment of earth and stone works, shall be as follows.

Division of the Site for Payment of Earth and Stone Works

Construction Work	Limit of Working Site	
	STA. No. on the alignment of the Road	STA. No. on the alignment of the Diversion Canal
Bang Pakong Division Dam & Road Bridge	STA.2 + 590 ~ STA.2 + 950	STA.1 + 280 ~ STA.1 + 770
Diversion Canal	-	STA.0 ~ STA.1 + 280 STA.1 + 770 ~ STA.2 + 247
Closure Dam	STA.0 + 920 ~ STA.1 + 200	
Road	STA.0 ~ STA.0 + 920 STA.1 + 200 ~ STA.2 + 590 STA.2 + 950 ~ STA.3 + 160	
Pumping Station	As shown on the drawings of the pumping station	

2002 CLEARING AT THE SITE

The Contractor shall clear the ground on the site and around the structures to be constructed. Such clearing shall comprise taking out trees, roots, and bushes and removal of other objectionable materials such as unstable stones and artificial things.

(1) The Employer reserves the right to have such timbers obtained by clearing operation at the site. All such timber not required by the Employer shall be removed from the site by the Contractor.

(2) The destruction of vegetation by fire cannot be carried out without the approval of the Employer, and the Contractor shall be entirely responsible for the consequences of such destruction by fire, even though such approval may have been given.

(3) Where directed the holes resulting from the grubbing up shall be filled with approved material and well compacted.

(4) The work shall include cutting, grubbing up, removing, loading brushes and trees, transporting them to a tip provided by the Contractor or instructed by the Employer.

(5) No separate payment will be made for clearing, and the cost of clearing shall be included in the unit prices for the pay items of stripping and excavation.

2003 STRIPPING

Stripping shall consist of removal and disposal of topsoil and surface vegetation, tree stumps, roots and any other organic materials.

(1) Stripping shall be performed through the alignment and to such width and depth shown on the drawings or directed by the Employer taking account that surface runoff is assured and impoundment of water is eliminated.

(2) Where so directed by the Employer, the Contractor shall remove top soil and shall separately deposit it from other materials at a spoil bank or shall store it at a place approved or directed by the Employer for later use. The work includes stripping, collecting, loading, transporting, unloading, stocking at a place approved or directed by the Employer and disposing of the unsuitable stripped materials by burying.

2004 EXCAVATION

(1) Materials excavated will not be classified for payment. Except as otherwise provided in the Specifications, material excavated will be measured in excavation, to the line as shown on the drawings or as provided in the Specifications.

(2) Excavation shall be made to the lines, grades, and dimensions shown on the drawings or established by the Employer. No unexcavated material shall be permitted to remain within the limits of the lines shown on the drawings.

The Contractor shall assume all responsibility for deductions and conclusions as to the nature of the materials to be excavated and the difficulties of making and maintaining the required excavations. The Employer does not represent that the excavation can be performed to or maintained at the pay lines shown on the drawings.

The Employer reserves the right, during the progress of the work, to vary the slopes, grades, or the dimensions of the excavations from those specified on the drawings.

All necessary precautions shall be taken to preserve the material below and beyond the established lines of all excavation in the soundest possible condition. Any damage to the work due to the Contractor's operations, including shattering of the material beyond the required excavation lines, shall be repaired at the expense of and by the Contractor.

(3) Where practicable, as determined by the Employer, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The material shall be placed in the designated final locations directly from the excavation or shall be placed in temporary stock-piles and later placed in the designated locations as directed by the Employer.

Excavated materials which, after drainage or drying, are suitable for fill or backfill but which, when excavated, are too wet for immediate compaction in the fill or backfill, shall be placed temporarily in stockpiles until the water content is reduced sufficiently to permit them to be placed in the fill or back fill.

If at any location in the stockpiles, there is excessive moisture, steps shall be taken to reduce the moisture by excavating drainage ditches or by any other approved means.

Excavated materials which are unsuitable for embankment or backfill, as determined by the Employer, shall be deposited in spoil banks shown on the drawings.

2005 SPECIAL CARE FOR EXCAVATION

(1) Where the vertical cut surface is in trenches, sumps, pits and other places, the excavation shall be close sheeted, or carried out within sheet piling made of timber or steel as may be necessary or as will be directed by the Employer, so that the surrounding ground and all structures shall be secured against all risks of damage from landslide or other movement.

(2) The Contractor shall take special precautions for the erection of barriers, removal of scree and loose materials or other means, to prevent landslide or other movement such as might cause injury to persons, damage to the Works or hindrance to the progress of the Works.

(3) The Contractor shall take particular care during construction to avoid deterioration of the ground, due to the exposure to weather or to the passage of construction plant; and in such locations the last 200 mm of excavation above the foundation or formation level shall be carried out by hand immediately before the next stage of construction is to start. A similar method shall be adopted in the case of sides of excavation against which any structure is to bear.

2006 COMPACTION OF EXCAVATED SURFACES

The excavated surfaces, after being cleaned, trimmed and leveled, shall be well rammed and compacted wherever necessary to provide a firm formation. Wherever an excavated surface has been displaced by traffic or has softened or otherwise deteriorated under the action of water or has been broken by temporary drainage channels or sumps or by any other cause, the Contractor shall excavate and remove the soil at such places to provide a firm foundation.

2007 REMEDY OF EXTRA OR EXCESS EXCAVATION

The Contractor shall make good any extra excavation with concrete or with properly compacted filling as directed by the Employer, to whose satisfaction he shall remedy any other consequence of excess excavation.

The cost involved in complying with this section shall be compensated under the appropriate item in the Bill of Quantities unless the work has been caused by the Contractor's miss operation.

2008 DEWATERING AND DRAINAGE FOR EXCAVATION

Before commencing the Works, the Contractor shall submit to the Employer for approval his proposed program for dewatering and keeping the site of the Works free from water. The proposed program shall include the detailed description of all pumping arrangements, equipment to be employed and plan and section of any proposed cofferdams, flood protection dikes, temporary sheet piling cutoffs, etc. To prevent slide or collapse of excavation, earth dikes shall not be built near open cut excavation. The distance between top edge of open cut excavation and toe edge of dikes shall be more than the depth of excavation.

Except where otherwise specified, the Contractor shall construct all concrete work, and fill and backfill in the dry. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water in the excavation sites, including groundwater, surface water and rainfall, and keep such excavation dry so as to obtain a satisfactory undisturbed foundation until structure or fill to be built thereon will have been completed.

2009 SHEETING AND BRACING

Following requirements apply to the designated sheeting and bracing works during trench excavation for constructing the footings of the road bridge piers as shown on the drawings.

(1) The Employer will require that the drawings for the sheeting and bracing work shall be submitted for approval at least fifteen (15) days prior to the anticipated date of installation. Approval of the drawings by the Employer will not relieve the Contractor of

the responsibility in any manner for the adequacy of the design for strength and for the safety of the laborers and inspectors working therein. If at any time during the course of the Works, the Employer is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports to be put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports.

(2) The Contractor shall furnish, put in place, and maintain such wood and/or steel sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation necessary for proper construction. Care shall be taken to prevent voids outside the sheeting, but if voids are formed, they shall be immediately filled with granular materials and suitably compacted.

(3) The Contractor shall leave in place to be embedded in the backfill all steel and wood sheeting and bracing which the Employer may direct him in writing to leave in place at any time during the progress of the Works for the purpose of preventing injury to structures. The Employer may direct that timber used for sheeting and bracing be cut off at any specified elevation.

All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger persons and structures. All voids left or caused by withdrawal of the sheeting shall be immediately refilled with granular materials by compacting with tools especially adaptable for that purpose, by watering or otherwise as may be directed.

Wood for bracing and sheeting shall be of adequate section and quality and shall be sound, and free from knots, twists or other weakening effects. Steel sheeting shall conform to JIS A 5528 "Steel Sheet Piles". The sheeting shall be braced at all times to prevent slips and cave-in of walls or subsidence of adjacent areas.

(4) Measurement, for payment, of the nominated sheeting and bracing works required for constructing the footings of the road bridge piers will not be made, and the cost of the nominated sheeting and bracing works shall be included in the price for the pay item No. 2101 "Temporary Works" in the Bill of Quantities (Part-1 Main Works).

2010 MEASUREMENT AND PAYMENT

(1) Measurement, for payment, of stripping will be made of the areas stripped to the lines shown on the drawings and on the basis of the nominal thickness shown on the drawings or prescribed by the Employer.

Payment for stripping will be made at the unit price per cubic meter, which unit price shall include the costs of clearing, stripping, stocking, disposing of the unsuitable stripped materials by burying, and incidental works necessary for the completion of stripping.

(2) Excavated material will be measured for payment in excavation to the lines shown on the drawings or described elsewhere in the Specifications.

Where concrete is to be placed directly upon or against the excavations, such excavations shall be sufficient at all points to provide for the minimum dimensions of concrete. Where dimensions of a concrete structure are shown on the drawings or if the elevation of the foundation is indicated, such dimensions shall be considered as the minimum dimensions and such elevation shall be considered as the elevation determining the minimum dimensions of the structure. Where a dimension or an elevation is not indicated on the drawings, minimum dimensions will be established by the Employer.

Where concrete is to be placed directly upon or against the excavations, measurement for payment will be made only of the excavation within the neat-lines of the concrete structure.

(3) Payment for excavation will be made at the unit prices per cubic meter. The unit prices for excavation shall include the cost of all labor, equipment, materials, timbering and sheeting, machinery for excavating and of all pumping, bailing, draining, and all other work necessary to maintain the excavations in good order during construction and of removing such temporary construction where required.

The unit prices for excavation shall also include the cost of:

a) Transportation of materials from the excavation to points of final use, to spoil banks, to temporary stockpiles, and from temporary stockpiles to points of final use or spoil banks.

b) Rehandling, drying and wetting excavated materials which have been deposited temporarily in stockpiles.

c) Disposal of excavated waste materials.

All excavated materials actually placed in completed fill, backfill and embankment construction will again be included for payment under appropriate pay items covering such construction.

Payment for stripping and excavation will be made under the pay items as indicated in the following table.

Description of Work / Construction Work	Stripping	Excavation (Open Cut)
Bang Pakong Diversion Dam & Road Bridge	2201	2202
Diversion Canal	2201	2203 *
Closure Dam **	3201	3201 *
Road	4201	4202
Pumping Station	5201	5202 *

* Including payment for dredging excavation

** No separate measurement will be made between stripping and excavation for payment. The costs of stripping and excavation shall be included in the unit pirce for Pay Item No. 3201

Cost of stripping and excavation required for the following works and to complete the following structures shall be included in the respective unit prices or prices.

- Common temporary works
- Temporary works
- Concrete river bed protection
- Log booms
- Jetty construction
- Guardrail
- Curbs
- Fence, Entrance gates
- Traffic sign, Lighting post
- Control house, Electric house
- Control system and electrical facilities as listed in Division-6 of the Bill of Quantities (Part-1 Main Works)

SECTION 2100 DREDGING WORKS

2101 GENERAL

All dredging machineries owned by the Contractor or by any company in which the Contractor has a controlling interest shall, when brought on to the Site, or in the case of hire purchase the dredging machinery on the site on its becoming the property of the Contractor, immediately be deemed to become exclusive possession up to completion of dredging work.

The Contractor's proposed plan of dredging to the regulated depth of water, slope, extra excavation, transporting and placing exhausting material (and any subsequent modifications thereto), together with a detailed list of attachment and type of dredger to be used for all these operations, shall be subject to the Employer's approval before work starts on the Site and shall be amended in accordance with any instruction of the Employer which may be issued from time to time.

2102 NAVIGATION FOR DREDGER

When a dredger is brought on to the Site from any foreign country, the Contractor shall obtain the permission of the authority concerned. The dredger shall not be removed from the site without the written consent of the Employer.

During dredging work, the Contractor shall set buoys and display lights for the safety of navigation as may be required by the Employer or any other authority having jurisdiction in connection with the Site.

2103 SURVEYS AND SOUNDING

Before the commencement of dredging, all areas to be dredged, together with any adjacent areas whose level might be affected by the dredging shall be surveyed and sounded and plans and sections shall be drawn accordingly.

When the dredging has been completed, the Contractor shall demonstrate to the Employer by means of soundings, survey and sweeping, that the work has been executed as shown on the drawings. Sounding shall be executed by means of an echo-sounder.

2104 BED AND SLOPE FORMATION TOLERANCES

The Contractor shall make the lines and grades by means of dredging indicated on the drawings or otherwise directed by the Employer and ensure that no portion of the finished dimension and section shall, at the time of inspection, be higher than the formation line as shown on the drawings.

2105 DREDGED MATERIAL

Dredged material shall be disposed directly to the spoil banks in the existing river channel near the closure dam. The way and method of disposal of dredged material shall be proposed by the Contractor and approved by the Employer.

2106 FOUNDATION EXCAVATION FOR CLOSURE DAM

Prior to any kind of embankment of the closure dams, the Contractor shall carry out the foundation excavation by means of dredgers and excavating machinery.

The foundation excavation shall be made to the lines shown on the drawings or prescribed by the Employer to obtain the consolidated foundation for the closure dam embankment.

2107 MEASUREMENT AND PAYMENT

Dredged material will be measured for payment in excavation to the lines shown on the drawings or established by the Employer.

Payment for dredging excavation will be made at the unit prices per cubic meter. The unit prices for dredging excavation shall include the cost of all labor, equipment, materials, timbering and sheeting where required, dredgers for excavating, and all other work necessary to maintain the excavations in good order during construction. The unit prices for dredging excavation shall also include the cost of:

a) Transportation of materials from the excavation to spoil banks.

b) Disposal of excavated waste materials.

c) Incidental works necessary for the completion of dredging works.

Excavation method will not be classified for payment. Payment for dredging excavation will be made under the following pay items in the Bill of Quantities (Part-1 Main Works).

Pay Item Application to Dredging Excavation

Construction Work	Pay Item No.
Diversion Canal	2203*
Closure Dam	3201*
Pumping Station	5202*

* including payment for open cut excavation

SECTION 2200 FILL AND BACKFILL

2201 GENERAL

The section covers the material to be used as fill and backfill and the placing, compaction and testing.

2202 MATERIAL

(1) General

Material for fill and backfill shall consist of soil obtained from borrow areas, excavation for structures and other sources as specified or directed by the Employer. The materials shall not contain boulders and rock fragments larger than 100 mm.

The material shall be well graded as delivered to point of use. It shall conform to the requirements specified in the Specifications and the drawings and shall be free of organic materials, or any other material which in the opinion of the Employer is unsuitable.

(2) Fill and Backfill Material

Fill and backfill materials shall be the approved materials in compliance with (1) "General" in this section and the following requirements.

Material - a:

Approved materials obtained from excavation for structures.

Material - b:

Materials obtained from the approved borrow areas or other approved materials having the C.B.R. value at saturated condition, as determined in accordance with JIS A 1211, of more than five (5) percent.

Material - c:

Materials obtained from the approved borrow area not containing more than twenty (20) percent of particles passing the No.200 (0.074 mm) sieve.

(3) Fill and Backfill

Unless otherwise indicated, the materials for fill and backfill shall be "Material-a" specified in (2) above.

(4) Fill and Backfill with Selected Material

The materials for fill and backfill, to be carried out under the pay items as stated "Fill and backfill with selected material" in the Bill of Quantities, shall be "Material-b" specified in (2) above.

(5) Embankment of Earthfill Zone of Closure Dam

Unless otherwise indicated, the materials for embankment of earthfill zone of the closure dam shall be "Material-c" specified in (2) above.

2203 FOUNDATION PREPARATION

The area of foundation for fill and backfill shall be stripped and excavated as shown on the drawings or as directed by the Employer.

Before placing the first layer of fill and backfill on such compacted foundation area, the surface shall be scarified to a depth not less than 50 mm, in order to roughen the surface and provide good bonding of the fill placed thereon.

2204 PLACING

(1) The fill and backfill shall be placed and spread in continuous layers parallel to the major axis of the structure. Layers shall not exceed 150 mm compacted measure in thickness except as approved by the Employer.

In area inaccessible to the compaction equipment selected for normal use, the fill and bakcfill shall be placed in layers not exceeding 50 mm in thickness, and compacted by using hand operated vibrating roller and/or mechanical tamper as approved by the

Employer. The placing of fill and compaction with hand operated equipment shall be continued until satisfactory to the Employer.

The surface of the filled layers shall slope transversely at a grade of 5 percent so that surface shall drain freely and away from structures. The fill shall not be contaminated by other materials and it shall be free of lenses, pockets, streaks or layers that are more previous and lumps or clods shall be broken down. Where the surface of the fill is considered by the Employer to be too smooth for proper bonding with next layer, such surface shall be scarified or harrowed as directed immediately prior to the placing of the next layer of fill.

(2) Where the surface has dried too much for proper bonding, it shall be uniformly sprinkled with water, scarified, harrowed and mixed until the moisture content of the in place material is within the required limits.

If the moisture content of the in place material is higher than the limit required, such fill shall be scarified, harrowed and treated until its moisture content is within required limits or it shall be removed from the fill site where directed by the Employer.

(3) The Contractor shall immediately suspend any or all fill placing operations during rain or at anytime the Employer considers conditions or procedures to be unsatisfactory.

2205 MOISTURE CONTROL

The Contractor shall conduct his operations so that the moisture content of the fill and bakcfill material at the time of compaction shall be as uniform as practicable and the Contractor shall control the placement moisture content within the specified limits unless otherwise directed by the Employer.

Unless otherwise directed by the Employer, the placement moisture content of the fill and backfill shall be maintained between minus 2 percent and plus 2 percent of the laboratory optimum value as defined in JIS A 1210 (Standard).

2206 COMPACTION

Each layer of the fill and backfill material shall be compacted by an approved compactor so that the fill material shall form a single homogeneous mass. When so directed by the Employer, hand operated heavy duty tampers and/or smooth faced vibrating rollers shall be used for the compaction of fill and bakcfill material placed in areas inaccessible to the compaction equipment selected for normal use. These tampers or rollers shall be air, gasoline or diesel powered. They shall be easily manoeuvrable and of sufficient capacity to obtain the specified density.

The dry density of the fill and backfill shall be as specified below:

Description of Work	Required Compaction*
Fill and backfill	90%
Fill and backfill with selected material	95%
Embankment of earthfill zone above	95%

* Percent of the maximum dry density as determined in accordance with JIS A 1210 (Standard)

2207 TESTING OF FILL

The Employer will perform tests on the material. Testing by the Employer will be done as frequently as deemed necessary and the Contractor shall furnish labor and construction equipment to assist in obtaining the samples for testing.

(1) The compaction test of fill and backfill shall be conducted in accordance with JIS A 1214 to control density of filled material in place.

(2) The Contractor shall, if directed by the Employer, excavate test pits for inspection and testing of material. These pits shall be backfilled and hand tamped, as directed by the Employer.

2208 BORROW AREA

The Contractor shall submit to the Employer for approval proposals including the drawings for excavation and working of borrow area showing the proposed extent of excavation required to expose and obtain approved borrow material.

(1) The location of borrow areas and selection of materials shall be subjected to the approval of the Employer. When worked out, the borrow areas shall be left in a safe, neat and sightly condition sloped to drain properly.

Borrow areas shall be stripped and graded to divert surface runoff from area which material is to be obtained. Ditching including diversion of natural water courses, the construction of sumps and pumping therefrom shall be carried out as required to keep the working area and the excavated material free of impounding water at all times.

(2) In case the Contractor may provide stockpiles, to stock material for convenience of construction method, the stockpiles shall be approved by the Employer and shall be cleared, stripped, graded and compacted prior to the placement of usable material.

(3) Should a borrow area be developed, all the expenses for preparation of temporary access road, clearing, grubbing and stripping of ground surface, disposal of top soil and unsuitable materials, excavating, extracting and hauling of suitable materials, royalty and right, drainage, cleaning and trimming during and after operation, and other incidentals shall be borne by the Contractor.

2209 MEASUREMENT AND PAYMENT

Measurement, for payment, of fill will be made of the materials in place in completed fill to the lines, grades, slopes, and thickness shown on the drawings or established by the Employer.

Measurement, for payment, of backfill about structures will be made only for the quantities actually placed within the limits of the established pay lines for excavation for structures.

The fill and backfill caused by the extra excavation made to insure the Contractor's working spaces beyond pay lines shall not be measured for payment, and be deemed to be included in the rate of fill and backfill.

Measurement, for payment, of embankment of earthfill zone of the closure dam on the completed embankment foundation will be made only for the quantities actually placed within the limits of the lines shown on the drawings or established by the Employer. The cross sections obtained by surveys made after completion of excavation for embankment foundation of the closure dam will be used in computing the quantity of embankment placed.

No allowance will be made in measurement for payment for settlement, shrinkage, and consolidation of the foundation or of the material in the fill and backfill, and embankment.

No separate measurement will be made between fill and backfill. Payment for fill and backfill, and embankment of earthfill zone of the closure dam will be made at the unit prices per cubic meter, which unit prices shall include all the expenses for labor, equipment, machinery, right or royalty of material acquisition in quarry or borrow area, extracting, hauling, loading, unloading, spreading and compacting of materials, shaping and trimming of fill and embankment, cleaning and treatment of quarry or borrow area after worked out and incidental works necessary for the completion of fill and backfill works or embankment.

The unit price for embankment of earthfill zone of the closure dam shall also include all the expenses for transporting and placing materials by barges or other approved machinery. The expense for loading piers which can load materials into the barges shall be included in the price for the Pay Item No. 3101 in the Bill of Quantities (Part-1 Main Works).

Cost of fill and backfill required for the following works and to complete the following structures shall be included in the respective unit prices or prices.

- Common temporary works
- Temporary works
- Concrete river bed protection
- Log booms
- Jetty construction
- Guardrail
- Curbs
- Fence, Entrance gates

- Traffic sign, Lighting post
- Control house, Electric house
- Control system and electrical facilities as listed in Division-6 of the Bill of Quantities (Part-1 main Works).

SECTION 2300 STONE WORKS

2301 GENERAL

This section covers the materials to be used and the placing for stone works.

Stones for various purposes shall be the best kind, sound and durable, free from flaws and from soft, weathered or decomposed parts. The borrow area and quarry site to collect stone material shall be proposed by the Contractor to the Employer for his approval. When required by the Employer, samples of stone shall be submitted by the Contractor for testings.

2302 RIPRAP

The riprap as shown on the drawings or as directed by the Employer shall be constructed of sound and durable rock obtained from approved quarry sites.

Rock shall be free from cracks, seams, or defects that would tend to increase unduly its deterioration from natural causes. The inclusion of objectionable quantities of dirt, sand, clay and rock fines shall not be permitted.

(1) Material

The riprap material shall be either field stone or rough rock stone at quarry. Material shall conform to the following gradation requirements except when otherwise mentioned in the drawings.

Diamter (cm)	Percent Finer by Weight
50	100
30	30 to 100
15	0 to 50
10	0 to 10

The diameter of rock 10 cm or larger shall be determined by passing rock through a square opening with dimensions equal to the required diameter. The length of the rock shall not exceed 1.5 times the diameter.

(2) Placing

Riprap shall be placed in such a manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and shall be constructed within the specified tolerance to the lines and grades shown on the drawings. Stakes shall be set both ways at 5 m intervals, and at points of grade changes, before riprap is placed. A tolerance of plus 15 cm from the thickness shown on the drawings will be allowed in the finished surface of the riprap. Where thickness of riprap exceeds the allowable tolerance, excess riprap shall be redistributed or removed from the work. No minus tolerance will be permitted. Riprap shall be placed to its full course thickness in one operation and in such a manner to avoid displacing the underlying material. The large stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded. The finished riprap shall be free from pockets of small stones and/or clusters of larger stones.

Placing riprap by dumping into chutes or by similar methods likely to cause segregation of the various sizes shall not be permitted. The desired distribution of the various sizes of stone throughout the mass shall be obtained by selective loading of the materials at the quarry or other sources, the controlled dumping of successive loads during final placing, or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand shall be required to the extent necessary to obtain a reasonably well-graded distribution of stone sizes.

2303 SAND AND GRAVEL BEDDING FOR RIPRAP AND STRUCTURE

(1) General

Bedding for riprap and structure shall be placed to the prescribed lines, grades, and thicknesses and at locations shown on the drawings and elsewhere as directed.

(2) Materials

The materials shall be pervious mixtures of sand, gravel, and cobbles reasonably well graded from 4.76 to 150 mm in maximum dimensions, but may contain materials less than 4.76 mm in quantities not to exceed the amount required to fill the voids between the materials larger than 4.76 mm. The material shall contain not more than 5 percent, by weight, of material passing a No. 200 sieve.

Should cobbles and boulders having dimensions of more than 150 mm be found in otherwise approved materials, they shall be removed by the Contractor either at the site of excavation or after being placed.

(3) Placing

The bedding for riprap need not be compacted in place, but shall be placed in such a manner as will result in uniform layers of bedding for riprap of the specified thickness.

The bedding for structure shall be compacted as specified in the section 5103 "Base Course" of the Specifications. The minimum dry density of compacted bedding for structure shall not be less than 95% of the maximum dry density.

2304 ROCKFILL ZONE OF THE CLOSURE DAM

The rockfill zone of closure dam shall be constructed under the water and be commenced immediately after the foundation excavation is finished. The rock fragments used for the rockfill zone shall be angular with not less than 5 kg in weight and its quality shall be followed to the statement of section 2302 of the Specifications.

The rockfill zone shall be brought up in layers of about one meter in thickness with a slope as shown in the drawings and placed from the inside to outer side of the rockfill zone but to be leveled along the line parallel to the axis of the closure dam.

2305 MEASUREMENT AND PAYMENT

Measurement, for payment, of riprap will be made of the outlines of the riprap in place and on the basis of the nominal thickness shown on the drawings or prescribed by the Employer.

Measurement, for payment, of sand and gravel bedding for riprap and structure will be made for the nominal thickness shown on the drawings, and to the outlines of the bedding in place.

Measurement, for payment, of embankment of rockfill zone of the closure dam on the completed embankment foundation will be made only for the quantities actually placed within the limits of the lines shown on the drawings or established by the Employer.

No allowance will be made in measurement for payment for settlement, shrinkage, and consolidation of the foundation or of the material in the riprap, bedding for riprap and structure, and rockfill zone of the closure dam.

Payment for riprap, sand and gravel bedding for riprap and structure, and embankment of rockfill zone of the closure dam will be made at the respective unit prices per cubic meter, which unit prices shall include all the expenses for labor, equipment, machinery, right or royalty of material acquisition in quarry or borrow area, extracting, hauling, loading, unloading, spreading and compacting of materials, shaping and trimming, and cleaning and treatment of quarry or borrow area after worked out and incidental works necessary for the completion of the works. These unit prices shall also include the cost of transporting and placing materials by barges or other approved machinery.

SECTION 2400 SODDING WORKS

2401 MATERIALS

(1) Topsoil

Topsoil furnished by the Contractor shall consist of a natural friable surface soil without admixture of undesirable soil, refuse or foreign materials. It shall be free from roots, hard clay, gravel, stones, noxious weeds, tall grass, brush, sticks, stubble or other litter, and shall have indicated, by a healthy growth of crops, grasses, trees or other vegetation, that it is free-draining and non-toxic.

(2) Grass

Grass shall be of species native to Thailand, harmless and inoffensive to people and animals and not recognized as a nuisance to agriculture. The seedling so called "Chao-chou" shall be sodded on slopes of excavation or fill, the "Nual-noi" on flat places. They shall be free of disease and noxious weeds, deep rooted and sufficiently rapid growing and spreading to give complete cover over the planted area within two months of planting.

The term "grass" embraces sprigs and sods which shall be of rectangular shape of at least 300 mm long, with widths as shown on the drawings, and not less than 40 mm in the thickness.

Fertilizer shall be Grade 10-10-10 or equivalent as available in local market.

Sods and sprigs shall be planted with their root system substantially undamaged and packed around with moist earth in which they have grown.

2402 CONSTRUCTION PROCEDURE

(1) Preparation of Bedding for Sodding

The topsoil shall be evenly spread on the designated areas to depths which, after settlement and compaction, shall be 10 cm. Spreading shall not be done when the ground or topsoil is excessively wet or otherwise in a condition detrimental to the work.

After spreading has been completed, large clods, stones, roots, stumps and other litter shall be raked up and removed.

(2) Grassing

Sodding shall be done by planting sods to give continuous cover the whole area. The pattern of sodding shall be block sodding, or strip sodding done by planting strips of sods at a spacing not more that the width of the sods, or as directed.

Surfaces to be planted shall be trimmed in such a way that the ground surface after planting shall be sloped as shown on the drawings.

Any grass which has not struck within 2 weeks of planting or any grass which dies within 3 months of planting shall be replaced by the Contractor at his own expense.

2403 MEASUREMENT AND PAYMENT

Measurement, for payment, of sodding will be made along the surface of the areas actually planted as directed. Payment for sodding will be made at the unit price per square meter, which unit price shall include the cost of all labor, materials, and equipment required for sodding and preparation of bedding for sodding. The unit price shall also include the cost of fertilizer, maintenance for sound growing and all other materials and operation necessary to complete the work.

DIVISION 3 CONCRETE WORKS

SECTION 3000 CONCRETE

3001 GENERAL

This section covers the material, workmanship, equipment and methods to be used for the production of concrete and the requirements for the conveyance, placing, curing and finishing of the concrete. Except where otherwise approved by the Employer, ready-mixed concrete shall not be used.

Unless otherwise specified, all materials, methods and procedures for concrete works shall conform to applicable standards of the American Society for Testing and Materials (ASTM), Japanese Industrial Standards (JIS) or Thai Industrial Standard (TIS), where not covered by ASTM, JIS and TIS, such materials, method and procedures shall conform to Recommend Practices of the American Concrete Institute (ACI) or Standard Specification for Design and Construction of Concrete Structures of the Japan Society of Civil Engineers (JSCE).

The following standards and other publications are referred to in this section:

ACI 214	Guide for Evaluation of Strength Test Results of Concrete
ACI 302	Recommended Practice for Concrete Floor and Slab Construction
ACI 304	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 318	Building Code Requirements for Reinforced Concrete
ASTM C 33	Specification for Concrete Aggregates
ASTM C 39 or JIS A 1108	Test for Compressive Strength of Concrete Specimens
ASTM C 94	Specification for Ready-Mixed Concrete

ASTM C 109	Test for Compressive Strength of Hydraulic Cement Mortars
ASTM C 127 or JIS A 1110	Test for Specific Gravity and Absorption of Coarse Aggregates
ASTM C 128 or JIS A 1109	Test for Specific Gravity and Absorption of Fine Aggregates
ASTM C 136 or JIS A 1103	Test for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 150 or JIS A 5210 or TIS 15	Specification for Portland Cement
ASTM C 151	Test for Autoclave Expansion of Portland Cement
ASTM C 204	Test for Fineness of Portland Cement by Air Permeability Apparatus
ASTM C 186	Test of Heat of Hydration of Hydraulic Cement by Vicat Needle
ASTM C 227	Test for Potential Alkali Reactivity of Cement-Aggregate Combination
ASTM C 260 or JIS A 1117	Specification for Air Entraining Admixtures for Concrete
ASTM C 451	Test for Early Stiffening of Portland Cement (Paste Method)
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM E 4	Standard Methods of Verification of Testing Machines
USBR	Concrete Manual

3002 PLANT

The Contractor shall submit to the Employer for approval a complete set of drawings together with a detailed description of his proposed plant and equipment for concrete production, transportation and placement of concrete, and method of operation. This submission shall be made before any order to purchase, fabricate or ship such plant and equipment is made.

3003 CEMENT

(1) Type of Cement

Unless otherwise specified, the cement shall be Ordinary Portland Cement Type V specified in TIS 15. The use of any other type of cement shall not be permitted without the approval of the Employer.

At least 30 days prior to the first delivery of cement, the Contractor shall advise the Employer in writing of the mill from which the cement is to be supplied.

(2) Testing Cement at Source

The Contractor shall arrange for mill test sheets covering physical and chemical testing by the manufacturer for each consignment of cement and shall obtain the consent and cooperation for the manufacturer for independent testing to be carried out for samples obtained at the Site from time to time as directed by the Employer.

The following tests shall be carried out in accordance with the ASTM Standards shown and the results shall be forwarded to the Employer on each consignment of cement:

a)	Soundness	ASTM C 151
b)	Time of Setting	ASTM C 191
c)	Compressive Strength	ASTM C 109
d)	False Set	ASTM C 451
e)	Fineness Tests	ASTM C 204
f)	Air Content of Mortar	ASTM C 185

The complete test data as specified herein shall be supplied to the Employer prior to shipment of cement to the Site.

(3) Testing Cement at Site

The Contractor shall provide access to the Employer for obtaining samples from storage as required for testing. This testing may include any or all of the tests specified in clause "(2) Testing Cement at Source". Any consignment from which a sample has been obtained and which does not meet the requirements of the Specifications, shall be deemed defective and the cement shall be removed from the Site as directed by the Employer.

(4) Storage of Cement

Sufficient weatherproof, properly ventilated storage, including covered unloading bays, shall be provided at the Site to ensure that no delay is caused due to shortage of cement and that sampling can be carried out at least 7 days prior to use in the Works.

Exterior surfaces of the cement silos shall be painted with white or other heat reflecting paint.

Cement shall be used in the sequence in which it arrives. Silos shall be voided and cleaned out at least once every three months. If cement becomes lumpy due to partial hydration, it shall be removed from the Site immediately. The maximum temperature of cement entering the batching plant shall be less than 43 degrees Centigrade.

3004 WATER

Water for concrete shall be clean, potable and free from injurious amounts of oil, alkali, salts, acid, silt, organic materials, or other deleterious substances. Sources and treatment of water shall be approved by the Employer.

3005 AGGREGATES

(1) General

Concrete aggregates will be obtained from local suppliers subjected to the approval of the Employer. Unless otherwise specified, the specific gravity of saturated surface-dry aggregates shall not be less than 2.60 when tested in accordance with ASTM C127 and C128.

Immediately after the delivery of aggregates has commenced, the Contractor shall send representative samples of all sizes of aggregate to the laboratory for testing as required by the Employer. Further samples required for testing and control purposes shall be supplied as directed by the Employer. The laboratory shall be proposed by the Contractor and approved by the Employer.

(2) Storage of Aggregates

All aspects of aggregate handling and storage are subjected to the approval of the Employer and shall be such as to eliminate segregation and breakage and to prevent contamination by deleterious matter or aggregates of other sizes, so that adequate supplies are available in advance of the requirements.

Each size of aggregate shall be stockpiled at approved locations which shall be cleared and stripped. Stockpiles shall be sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed. The bottom portion of the stockpiles within 300 mm of the ground shall not be used for production of concrete.

Stockpiles shall be free-draining and coarse aggregate stockpiles shall be kept continuously moist by spraying as necessary to control the water content as specified in this section. Sprays shall be arranged so that the stockpiles are wetted uniformly.

The moisture content of the fine aggregate as delivered to the mixer shall be controlled so as not to exceed a value of 6.0 percent, expressed as a percentage by weight of the saturated surface dry aggregate. Variations in the percentage of free moisture in any aggregates shall be limited to less than 1.0 percent in any hour of mixing plant operation.

The Contractor may accomplish the required moisture control by use of covered storage, mechanical dewatering devices or any other satisfactory means or combination thereof. Conveyors between aggregate stockpiles and the batching plant shall be covered to prevent the moisture content being affected by the rain.

(3) Fine Aggregates

The fine aggregates shall consist of clean, hard, dense, durable, uncoated rock fragments. Fine aggregate shall be removed from the Site immediately if it fails to meet any of the following quality requirements:

a) Organic Impurities in Sand (ASTM C40) ..... Color no darker than the specified standard.

b) Sodium Sulfate Test for Soundness (ASTM C88) .... Shall have 8 percent maximum weighted average loss, by weight.

c) Deleterious Substances .... As shown in Table 1

TABLE 1 ALLOWABLE PERCENTAGES OF DELETERIOUS SUBSTANCES IN FINE AGGREGATE

	Maximum percent by weight, as batched
Material passing No. 200 sieve (ASTM C117)	2
Lightweight material (ASTM C123, using a solution of zinc chloride)	2
Friable particles (ASTM C142)	1
Other deleterious substance such as mica, coated grains, soft-flaky particles, and loam	2
Sum of all the above deleterious substances	5

The fine aggregate shall be well-graded, and when tested using standard sieves (ASTM C136), shall conform to the limits in Table 2.

TABLE 2 FINE AGGREGATE GRADING REQUIREMENTS

Sieve No.	Individual percent, by weight, retained on sieve
4 (4.76 mm)	0 to 5
8 (2.38 mm)	5 to 15*
16 (1.19 mm)	10 to 25*
30 (0.59 mm)	10 to 30
50 (0.297 mm)	15 to 35
100 (0.149 mm)	12 to 20
Pan	3 to 7

* If individual percent retained on No. 16 sieve is 20 percent or less, maximum limit for individual percent retained on No. 8 sieve may be increased to 20 percent

Samples of fine aggregate together with coarse aggregates and cement to be used for the production of concrete shall be tested according to ASTM C227.

(4) Coarse Aggregates

Coarse aggregates shall be graded according to Table 3 when tested in accordance with ASTM C117 and C136 or JIS A1103.

TABLE 3 COARSE AGGREGATE GRADING REQUIREMENTS

Nominal Aggregate Size (mm)	Percent finer than, by Weight	
	40 mm to 5 mm	20 mm to 5 mm
50	100	
40	90 - 100	
25	25 - 55	100
20	0 - 15	90 - 100
10	0 - 5	15 - 40
5		0 - 5

The weight of coarse aggregate having the ratio of largest dimension to smallest dimension of more than 3 shall be limited to not more than 20 percent.

The coarse aggregate shall consists of clean, hard dense, durable uncoated rock fragments. Coarse aggregate shall be removed from the Site immediately if it fails to meet any of the following quality requirements:

a) Los Angeles Abrasion Loss (ASTM C131, using grading A) ..... Shall have a 10 percent maximum loss of weight at 100 revolutions, or 40 percent maximum loss of weight at 500 revolutions.

b) Sodium Sulfate Test of Soundness (ASTM C88) ... Shall have 10 percent maximum weighted average loss, by weight, after 5 cycles.

c) Deleterious Substances. ..... These substances, in any size of coarse aggregate, are as shown in Table 4.

TABLE 4 ALLOWABLE PERCENTAGES OF DELETERIOUS SUBSTANCES IN COARSE AGGREGATE

	Maximum percent, by weight, as batched
Light weight material (ASTM C123, using a solution of zinc chloride)	2
Friable particles (ASTM C142)	0.5
Other deleterious substances	0.5
Maximum allowable sum of all the above deleterious substances	2

Samples of coarse aggregates, together with fine aggregates and cement to be used for the production of concrete shall be tested according to ASTM C227.

3006 ADMIXTURES AND ADDITIVES

(1) General

The use of all admixtures shall be subjected to the written approval of the Employer. The manner of use, storage, handling and measurement may also be subjected to controls in addition to those specified below, depending on the manufacturer's recommendations and test results. Multi-purpose admixtures shall not be used.

(2) Air Entraining Agents

An approved air entraining agent shall be used to produce the specified amount of stable entrained air in the concrete mixture, and shall conform to the requirements of ASTM C260 or JIS A1118. The required air content of the concrete is as follows:

Maximum Aggregate Size (mm)	Total Air (%)
40	5 ± 1
20	6 ± 1
Grout	as directed by the Employer

(3) Water Reducing Admixture

A water reducing admixture that does not retard the initial set of the concrete shall be added to the concrete mix during mixing. The amount of admixture to be added shall be as directed by the Employer. The admixture shall conform to the requirements of ASTM C494 or JIS A6204.

(4) Initial Set Retarding Admixture

An initial set retarding admixture shall be added to the concrete mix during mixing in order to obtain the necessary retardation of the initial set of the concrete. The amount of admixture to be added shall be as directed by the Employer. This admixture shall conform to the requirement of JIS A6204.

(5) Expansive and Non-shrink Additives

An expansive and non-shrink additive shall be added to the concrete mix of the secondary concrete in order to prevent shrinkage cracks and to increase water tightness, tensile strength under restrained conditions and shearing strength. The amount of additives to be added shall be as directed by the Employer. This additive shall not generate hydrogen gas when it starts a chemical reaction and shall conform to the requirements of ASTM C494 and JIS A6202.

(6) Calcium Chloride

The use of calcium chloride or of admixtures containing calcium chloride is prohibited.

(7) Compatibility

The compatibility of admixtures, where more than one is used, shall be proved to the satisfaction of the Employer and satisfactory test results shall be obtained before incorporation in the works.

(8) Storage and Dispensing of Admixtures and Additives

Admixtures shall be stored in suitable weatherproof buildings. Admixtures in solution shall be stored at a temperature not higher than 35 degrees C. Powdered admixtures shall be put into solution prior to use in accordance with the manufacturer's recommendations.

Accurate automatic dispensing equipment shall be provided for the measurement of and for the introduction of the admixtures into the mixer. The individual admixtures shall be added separately to the concrete in the mixer during the first half minute of the mixing cycle.

3007 CONCRETE MIX DESIGN

(1) Mix Proportions

The Contractor shall propose mix proportions for all kinds and classes of concrete which he intends to use in compliance with the following requirements.

Unless otherwise approved by the Employer, the net water-cement ratio for concrete of the respective structure shall be less than 0.6.

Any kind of concrete mix proportions shall be approved by the Employer in the light of the trial mix and its results as specified.

The mix proportions may be modified by the Employer from time to time in accordance with the work conditions such as climate, concreting method and so on.

The Contractor shall not change or modify any mix proportion without written consent of the Employer.

Compliance with concrete compressive strength requirements shall be based on compressive strength tests carried out by the Employer on standard 150 mm diameter by 300 mm high test cylinders of concrete at the age of 28 days in accordance with ASTM C 39 or JIS A 1108. Coarse aggregate over 50 mm size shall be removed from the concrete for the compressive strength test.

(2) Classification of Concrete

The major classes of concrete and the aggregate sizes and the workability of concrete for various types of construction are set out in Table 5.

The class of concrete to be used for respective structures are as indicated on the Drawings or directed by the Employer.

TABLE 5 CONCRETE CLASSIFICATION

Class of Concrete	Type of Construction	Design Strength 28 days, kg/cm^2	Coarse Aggregate Max. size, mm	Slump Max., mm
A	Prestressed Concrete	500*	20	8
B	Reinforced Concrete (1)	240	20	8~15
C	〃 Concrete (2)**	210	40	8~15
D	Secondary Concrete***	210	20	12~15
E	Plain Concrete*	180	40	8~15
F	Lean Concrete	135	20	8~12

* For P.C. box girder of bridge, it shall be 400 kg/cm^2.

** Where directed by the Employer, a smaller maximum size aggregate shall be used.

*** Expansive and non-shrink additive shall be added where so required.

The selection of concrete mix shall be such that the maximum size of aggregate shall not be larger than:

a) One-fifth of the narrowest dimension between sides of forms;

b) Three-quarters of the minimum clear spacing between reinforcing bars; or

c) One-third the depth of slabs.

(3) Trial Mixes

At least 60 days prior to the start of permanent concrete work, the Contractor shall produce trial mixes for each of the classes of concrete specified, using the batching and concrete mixing plant provided for the execution of the Works. Such trial mixes shall be repeated until concrete complying with these specifications is produced.

(4) Dry Pack

The dry pack mix shall be proportioned by weight; one part cement to 2 1/2 parts of sand that will pass a No. 16 screen. Only enough water shall be used to produce a mortar that

will stick together while being molded into a ball by slight pressure of the hands and will not exude water but will leave the hands damp.

(5) Mortar

Mortar to be used for joint treatment shall have the same sand, cement and air proportions as the mortar used in the mix of the concrete at the joint.

Mortar to be used for repair work shall have the same sand, cement and air proportions as the mortar used in the mix of the concrete to be repaired.

3008 FIELD QUALITY CONTROL

Concrete tests will be carried out by the Employer in conformity with ASTM C 39 or JIS A 1108 and test evaluation will be in accordance with ACI 214. The Contractor shall provide such assistance as may be required by the Employer in procuring samples and transporting them to the field laboratory. Samples of fresh concrete will be obtained from the forms or as required by the Employer.

Concrete samples taken for conducting strength test in accordance with ASTM C 39 or JIS A 1108 consists of 3 or more samples per pour. The Contractor shall arrange for temporary storage of fresh cylinders at or near the forms and shall maintain and protect the same under moist curing conditions for a period of up to 24 hours after the completion of the relevant pour.

Where compressive strength tests are made to monitor formwork removal, two additional cylinders will be prepared and field curing under similar but not more favorable conditions than those existing for the member represented shall be made.

3009 BATCHING

(1) Type of Plant

The Contractor shall provide at least one modern and dependable automatically or semi-automatically controlled batching plant at each construction site of the Bang Pakong diversion dam and the pumping station. These plants shall be capable of supplying concrete at

rates adequate to meet the requirements of the work schedule and shall be as approved by the Employer.

(2) Measurement and tolerances

Cement shall be weighted separately on an individual scale. Water shall be weighted separately on an individual scale or it may be measured by volume. All other ingredients shall be measured by weight except that liquid admixtures may be measured by weight or volume. Each aggregate shall be measured separately. If water is measured by volume, two flow meters shall be installed in parallel so that no delay will result due to faulty operation of the meters.

3010 MIXING

Concrete shall be thoroughly mixed in a batch mixer of an approved size and type which will ensure a uniform distribution of the component materials throughout the mass.

The entire contents of the mixer shall be discharge from the drum before materials for a succeeding batch are placed therein. The materials composing a batch shall be deposited simultaneously in the mixer.

Water for the batch should be released first and continue to flow while the solids are entering the mixer, and should have completed flowing shortly after the last of the solids of the batch have entered the drum. This flow shall not continue for more than the first 25 percent of the mixing time.

The first batch of concrete materials placed in the mixer at the beginning of each period of mixer operation shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a period equal to, or in excess of , 75 percent of the time interval of initial set of the mix, the mixer shall be thoroughly cleaned.

3011 TRANSPORTATION

Concrete shall be transported from the mixers to the place of concrete placement by methods which will prevent segregation, gain or loss of materials, and which are such that the

maximum difference in the slump of samples of concrete taken immediately after mixing and immediately after placement in the forms shall not exceed 25 mm.

Concrete shall be delivered to the forms not later than 45 minutes after the addition of mixing water. Where a set retarder is employed, this time may be extended at the discretion of the Employer.

Where truck mixers are used, they shall be used in accordance with the applicable sections of ASTM C94 and ACI 304. Truck mixers, unless otherwise authorized by the Employer, shall be of the revolving drum type, watertight and so constructed as to ensure a uniform distribution of materials throughout the mass of concrete being mixed. All solid materials and admixtures for the concrete shall be accurately measured and charged into the drum at the batching plant. The truck mixer shall be equipped with an in-line flowmeter by which the equality of water added can be measured.

3012 PLACING AND HANDLING

(1) Cleaning

All equipment employed in the measuring, mixing, conveyance and placing of concrete shall be thoroughly cleaned prior to each use. Concrete waste deposited in or on the equipment shall be thoroughly removed immediately after each use.

In preparation for the placing of concrete, all sawdust, chips and other construction debris shall be removed from the interior of forms. Prior to placing concrete on construction joints, the joint surfaces shall be thoroughly cleaned and kept in a saturated surface dry condition and the concrete placing shall be preceded by a 10 to 20 mm - thick layer of cement mortar with sand and cement in the same proportion as the mortar in the concrete to be placed. Wood struts, stays or braces in the forms are prohibited. Struts, stays and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

(2) Placing

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes or conveyors, multiple or single, for conveying concrete from the mixer or hauling unit to the forms shall be permitted only upon written approval of the Employer. In case an inferior quality of concrete is produced by the use of such conveyors, the Employer may order discontinuance of their use and the substitution of a satisfactory method of placing. Open troughs and chutes shall be steel or steel lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. Baffles or boxes or vertical drop pipes shall be arranges so that the concrete drops vertically from the delivery end of all conveying units and so that there is no segregation of the concrete mix. Free drop without control of trunks or baffles shall be limited to 1.5 m.

Buckets for placing of concrete shall have a discharge area not less than 60 percent of the cross-sectional area of the bucket. The discharge gates shall be positively closing, shall be maintained in a watertight condition and the rate of discharge shall be readily controlled without any consequent segregation of the concrete.

The use of pneumatic or pumping methods of placing and handling concrete shall be subjected to the approval of the Employer. Prior to the use of such methods, the Contractor shall submit for the Employer's approval the details of the equipment proposed, its arrangement and the proposed operating procedures. The Contractor shall produce and convey concrete using such equipment for the trial mixes until concrete is produced that conforms to the Specifications. Pumping methods shall comply with the recommendations of ACI 304, "Placing Concrete by Pumping Method". Water reducing admixture may be used to obtain high slump concrete without increasing of water cement ratio.

(3) Compacting

Concrete during and immediately after placing shall be thoroughly compacted. The compaction shall be done by mechanical internal vibration subjected to the following provisions.

Vibrators shall be electric or pneumatic power driven type and shall operate at speed, when immersed in the concrete, of not less than 9,000 revolution per minute for vibrating heads less than 10 cm in diameter and not less than 7,000 revolutions per minute for vibrating heads of 10 cm or greater in diameter.