

Project Name:	ONE (1) LOT LABOR AND MATERIALS OF THE PROPOSED 5-STOREY WITH 2-BASEMENT DIAGNOSTIC BUILDING PHASE I
Project Location:	BGHMC COMPOUND, BAGUIO CITY

TECHNICAL SPECIFICATIONS

PROPERTY OF BGHMC

PREPARED BY:

LENON S. BANA-E

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PART 1: GENERAL PROVISIONS AND CONDITIONS

1. GENERAL

These specifications shall encompass all the work necessary for the building construction for the Project for Construction of **"ONE (1) LOT LABOR AND MATERIALS OF THE PROPOSED 5-STOREY WITH 2-BASEMENT DIAGNOSTIC BUILDING PHASE I"** and as further defined herein. The work shall include furnishing all labor, materials, equipments, tools, facilities and transportation to complete the project in accordance the drawings and specifications.

The project site is located in BGHMC Compound, Baguio City, Philippines.

The work is implemented by the BGHMC.

Utilities for the temporary facilities shall be borne by the contractor such as, electricity, water and means of communication during the implementation of the Project.

The Project Management Team shall act as the client's representative for the building construction of the Project and provide construction supervisory services in an effort to ensure compliance by the Contractor with the contract document.

2. DEFINITIONS

The "Project"	means the Project for the "ONE (1) LOT LABOR AND MATERIALS OF THE PROPOSED 5-STOREY WITH 2-BASEMENT DIAGNOSTIC BUILDING PHASE I" to be located at BGHMC Compound, Baguio City.
The "Client"	means the Baguio General Hospital and Medical Center, and shall include any person or persons authorized to act in behalf BGHMC
The "PMT"	means the Project Management Team which consist of engineers and architects hired by BGHMC to oversee the construction of the Project and shall include any person or persons authorized to act on behalf of the client.
The "BGHMC Project Manager"	means the person Designated by the Project Management Team as the over-all project manager who's tasked to coordinated with the contractor's technical personnel, end-users, suppliers and other persons involved in the project as the PMT representative
The "Work"	comprises the completed construction required in the tender documents and includes all labor, services, materials and equipments incorporated in the construction.
The "Contractor"	means the construction firm or company who has been awarded the contract by the client by due process of law and includes the Contractor's personal representatives, successors and authorized assigns.
The "Supplier"	means the person, persons or company where in the materials and equipments are awarded for the supply and installation if any.

3. CONTRACT DOCUMENTS

Unless otherwise when clearly described, the drawings have the priority to the Specifications; the general notes in the drawings and subsequent design drawings shall prevail over the provisions described in the Specifications herein in case of discrepancies.

4. PERMITS AND LICENSES

The Contractor shall secure all the permits, except for the Building permission undertaken by the Client and licenses necessary for progression of work and negotiate and obtain permission with the related authorities.

5. WORKMANSHIP AND SAFETY

The Contractor shall so conduct his operations as to work in harmony with the various trades involved and so conduct his work as not to endanger, damage, or interfere with or delay the operations of the Client and the Supplier during the Contractor carrying out all operations in connection with this contract.

Specially, the Contractor shall cooperate with the Supplier and coordinate his work with that of the latter with regard to the installation and testing of all the equipments.

The Contractor shall provide adequate temporary barracks and communal/sanitary facilities for his constituent or employee including health and insurances as defined under the National Labor Code and Safety.

6. PRESENCE OF THE PMT

Where so required in the Specifications, the Contractor shall carry out the work in the presence of the PMT representative.

The Contractor shall ask the PMT if his attendance to inspect required for any work, inspection is impossible or difficult after completion of the work, in the course of the work.

7. MEASUREMENT SYSTEM

The measurement system for the work shall be metric system.

8. APPLICABLE STANDARDS AND CODES

The National Building Code of the Philippines and its implementing rules and regulations

The Fire Code of the Philippines and Regulations

Japanese Industrial Standards (JIS)

American National Standards (ANSI)

International Electrical Commission (IEC)

National Structural Code of the Philippines (NSCP)

International Organization for Standardization (ISO)

American Society of Testing Materials (ASTM)

National Fire Protection Association (NFPA)

National Organization of Building Officials (NCBO)

National Bureau of Standards (NBS)

National Electrical Code of the Philippines (NEC)

Sanitation Code of the Philippines (SCP)

Plumbing Code of the Philippines (PCP)

General Specifications for Building Construction Works

9. MATERIALS AND GOODS

Unless otherwise specified, all materials and goods shall be new and unused and all workmanship and materials shall meet and conform to the standards specified in the relevant sections of these Specifications. The Contractor shall carry out inspection of the materials to be used immediately upon the delivery to the site and shall promptly report the result of the inspection, any damage or substandard materials to the PMT. The PMT will judge whether they are satisfactory based on these Specifications. The materials and goods which are judged by the PMT unsatisfactory must not be used and be promptly removed from the site.

10. SAMPLES

The Contractor shall furnish for the approval of the PMT, with reasonable promptness all samples as specified in the relevant sections of these Specifications or as directed by the PMT. The work shall be in accordance with approved samples clearly marked must be kept on site at all times until final approval of the workmanship or fixing of the materials to which they apply.

11. APPROVAL OF MANUFACTURERS

The Contractor shall submit to the PMT for his approval a list of materials and equipments to be used and their manufacturer.

Where a name of trade firm or supplier is specified in the Contract Documents, no other products or services of other firms may be used. A substitution may be used subject to the PMT's written approval where it is in all respects equal or superior to the original specification.

12. SHOP DRAWINGS

The Contractor shall check and verify all site measurements and shall submit three (3) shop or setting out drawings and schedules with such promptness as to cause no delay in his own work or in that of any contractors. All of shop drawings shall be done by professional and shop draftsmen.

No Work shall commence before the approval of the PMT on such drawings and schedules.

The Contractor shall submit shop drawings for review by the PMT on a regular basis before required for construction or manufacturing.

The Contractor shall inform the PMT of any discrepancies or contradictions found in the Contract Documents, prepare proposals for resolving the problem.

Prior to every shop drawing, the Contractor shall submit the General Shop Drawings, 1:50 scale plans and interior elevations and ceiling reflected plans drawn all visible things including electrical, plumbing, air-conditioning and ventilation works.

All shop drawings shall be reduced to A3 size bond paper and be submitted to the PMT upon completion of the work.

Shop drawings are subjected to be drawn computer aided. Data of working drawings will be allowed to be used for reference of them.

13. TEST AND INSPECTIONS

Each part of the Work shall be inspected and tested to confirm that the workmanship is satisfactory for the requirements specified in the design documents at each stage of the work or when so directed by the PMT.

The Contractor shall consult with the PMT as to the program of the inspection and test and shall ask the PMT's attendance to the inspection and test. Upon the practical completion of the work, the Contractor shall, in the presence of the PMT, inspect and test the whole of the works to confirm that all the work done is in conformity with the requirements specified in the design documents.

Any defects found during this inspection shall be repaired to the satisfaction of the PMT before the agreed repairing period is over.

All concrete test cylinders, water and reinforcing bars shall be tested at an authorized testing laboratory approved by the PMT and tested with the presence of the PMT representative/s.

All manufacturers' instructions must be strictly observed and adhered to with respect to workmanship, handling and conditions at time of installation or application.

The Contractor shall record the results of each inspection and test and submit them for the PMT's approval without undue delay.

14. RECORDS, REPORTS AND CONFIRMATION

The Contractor shall take photographs of the Site before starting the construction and keep detailed records as specified below and as directed by the PMT and submit diurnally to the PMT for his approval. Photographs shall be taken by digital camera and be submitted by data too.

Daily Weather Conditions

Progress of Work including photographs showing the progress

Delivery of materials and equipment

Site labor time sheets

Details of all visitors to the site

The Contractor shall always be requested to confirm and inspect whole process of the work and shall report that process and inspection record in writing before requesting the inspection by the PMT without failure. No exception shall be accepted.

The Contractor shall submit from time to time to the PMT reports, notices and other documents as specified in the Specifications and as directed by the PMT such as,

Notification of commencement and information of works

Manufacturer's List

General Work Schedule

Monthly Progress Reports

Work Diary

Detailed Work Schedule

Shop Drawings and Construction Details

Test Results

Daily Activities Report (Submitted Weekly and signed by Contractor and Client representative)

15. CONSTRUCTION AND INSURANCES

The Contractor shall at its expense buy and maintain the following insurance effective during the performance of the Contract such as, Erection All Risk Insurance, Third party Liability Insurance and Workers' Compensation.

15. REPORTS AND SUBMITTALS

The Contractor shall submit to the PMT their daily activity reports every last working day of the week. Use format shown below.

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COMPANY NAME AND LOGO

DAILY ACTIVIES REPORT

PROJECT:

PROJECT LOCATION:

DATE:

WEATHER CHART			
TIME:	REMARKS	TIME	REMARKS
7:00 AM	FAIR	7:00 PM	NR
8:00 AM	FAIR	8:00 PM	NR
9:00 AM	FAIR	9:00 PM	NR
10:00 AM	FAIR	10:00 PM	NR
11:00 AM	RAINY	11:00 PM	NR
12:00 PM	RAINY	12:00 AM	NR
1:00 PM	FAIR	1:00 AM	NR
2:00 PM	FAIR	2:00 AM	NR
3:00 PM	FAIR	3:00 AM	NR
4:00 PM	FAIR	4:00 AM	NR
5:00 PM	FAIR	5:00 AM	NR
6:00 PM	FAIR	6:00 AM	NR

EQUIPMENT			
ITEM	DESCRIPTION	QUANTITY	UNIT
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

MANPOWER					
Qty	Description	Qty	Description	Qty	Description
1	Engineer	5	painter		
3	Mason/tile settler				
2	labor				

ACTIVITIES		ACCOMPLISHED	
ITEM	ACTIVITY DESCRIPTION	QUANTITY	UNIT
1			
2			
3			
4			

PROBLEM ENCOUNTERED									
1									
2									
3									

SUPPLEMENT PICTURES



* Daily Activity Report Format

QUALITY REQUIREMENTS:

A. This Section specifies administrative and procedural requirements for quality control services that are to be performed by the Contractor and his subcontractors for all aspects of project coordination, administration, monitoring and execution. This procedure requires that the Contractor establish an independent internal team staffed apart from the Contractor's administrative team whose sole responsibility is to provide quality assurance monitoring and quality control reporting and implementation of specified standards. This independent team shall act as a separate audit and shall report to the Project Manager and Contractor's administrative staff on a weekly basis covering all aspects of work or preparation for work not yet begun and implementation of repair works and monitoring of repair.

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PART II: PRELIMINARY WORKS

A. GENERAL

This section covers the requirements for providing all the temporary work at the Project Site. The work shall include all labor, materials, equipment, tools and transportation necessary to complete the temporary work specified herein.

B. TEMPORARY CONSTRUCTION AND FACILITIES

The Contractor shall provide and maintain all temporary construction and facilities necessary to complete the Work as shown on the drawings and as specified herein. All temporary installation used for the work shall be removed after completion of the Work.

C. BENCH MARK

The Contractor shall relate his site level to the nearest official Benchmark established by the Municipal Government. Should this prove impractical then the Contractor shall refer to site datum level benchmark to be established inside the site boundary in the presence of the PMT, where it shall rigidly set in position and where it can remain undisturbed during the whole progress of the Work and be provided with adequate protection. It shall be adequately maintained and inspected at regular intervals.

D. PREVENTION OF ACCIDENTS

It is a standard procedure for the Contractor to maintain proper safety inside and around the premises of the job site for his employees, constituents and pedestrians. Adequate gadget for fire and other ways and means shall be readily available at all times in case of emergency and disaster.

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PART III: EARTHWORKS WORKS AND SITE WORKS

A. GENERAL

This section covers the requirements for performing all filling works, excavation required for the construction of footing and foundations, the subsequent backfilling of excavated materials to the designated grade, the disposal of all excavated materials not required for backfill, foundation sub grade works, the preparation of hard core for pavements and other related items necessary to complete the Work indicated on the drawings and specified herein.

Items of works shall include but not limited to the following

- a. Excavation
- b. Removal of excess ground water
- c. Fills and backfill
- d. Disposal of excess excavated materials
- e. Preparation of hard core
- f. Foundation sub-grade work
- g. Termite control

B. SAFETY MEASURE

The Contractor shall survey the existing condition of the site and the adjacent areas noting the subsurface condition and water table level, and shall take proper safety measure not to adversely affect the site condition.

C. FILLS

PREPARATION OF SITE

Grass, stumps, masonry, rubbish, weeds and other unsuitable materials shall be removed from the construction site. In case of low lying area, mud shall be removed.

FILLING MATERIALS

Sand, earth such as clay loam and laterite, or their combination without rubbish, chemicals weeds and other unsuitable materials can be used for fills subject to the PMT's approval.

PROCEDURE

- a. If earth is used, every layer of 30 cm in depth shall be compacted by roller weighing not less than 3 tons. In case of wet soil tamper shall be used for compaction.
- b. If sand is used, every layer of 30 cm in depth shall be compacted by rollers weighing not less than 3 tons, using water. In case of low lying area where sand could be wash away, clay embankment shall be used to confine sand.

COMPACTION

Compacted layer of fill material shall have an in-place density not less than 96 % of maximum density.

LEVEL

The surface of the finished fill shall be flat and level and shall have correct elevation as specified. After finishing fill, level and elevation of the fill shall be inspected and shall be obtained PMT's approval.

D. EXCAVATION

Prior to the start of excavation, the Contractor shall survey the filled site level and verify the designated datum level in the presence of the PMT's representative/s.

All excavation shall be carried out with an adequate angle of repose to avoid the Collapse of ground material. The slope shall be properly protected to the satisfaction of the PMT during the excavation work.

During the excavation work, any settlement or movement of the site or adjacent land and any changes in bearing capacity or water table level shall be recorded and be informed to the PMT as require. If any adverse effects are found as the result of such measurement, the Contractor shall report it to the PMT and shall take proper safety measures without delay.

In the event the excavation work encounters unexpected obstacles, the Contractor shall keep the PMT informed and shall take all possible steps to remove such obstacles after checking to see that is safe to do so or suggest, for the PMT's approval, any remedial action required to prevent delay in the progress of the work.

The Contractor shall excavate to the depths and extend indicated on the drawings and allow additional space as required for construction operations and inspections of foundation.

Bottoms of excavations shall be accurately finished level to the grades shown on the drawings or agreed on site. Excavations for footings carried below the specified grades shall be backfilled to grade at no extra charge. Any disturbed portions shall be compacted to equal or exceed the bearing capacity of surrounding areas. When excavation work reaches the designated levels the PMT's approval must be obtained before proceeding with the Work.

If a suitable bearing capacity is not encountered in the subsoil at the depth indicated on the drawings for foundations, the Contractor shall immediately notify the PMT.

E. REMOVAL OF EXCESS GROUND WATER

The Contractor shall keep the whole of the excavations free from water arising from rain, drains, flood, springs or any other cause by pumping, bailing or drainage.

Care shall be taken not to disturb subsoil conditions while providing drainage ditches or pits.

The Contractor shall keep the site clear of water at all times until 30 days after completion of the foundation work.

F. BACKFILL

All soil used for backfilling shall be approve by the PMT.

No backfilling shall be commenced without the prior approval of the PMT. While backfilling, the soil shall be evenly backfilled and have an optimum water content ratio. Every layer or 30 cm in depth or less shall be compacted enough by tamper, roller or hammer.

Compacted layer of fill material shall be tested for every 30 cm in depth and must have an in-place density not less than 96 % of maximum density.

Any portion of soil which cannot be compacted by rollers after backfilling shall be well compacted with a hammer or the like. During backfilling work, care shall be exercised not to damage the structure.

Where residual settlement can be reasonably expected after backfilling, extra fill shall be provided as instructed by the PMT.

G. DISPOSAL OF EXCESS EXCAVATION MATERIAL

Excavated material not required for backfill shall be disposed of by filling site areas, filling in building areas or otherwise as directed. All remaining material shall be evenly spread within the site under the PMT's instructions.

It must be the Contractor's responsibility to secure permits for the disposal locations of excess material excavated.

H. PREPARATION OF HARDCORE

Crushed stones to be used for hard-core shall be of a suitable mixture of grades between 30mm mesh and 50 mm mesh conforming to JIS A 5001 "Crushed Stone of Road Construction." Materials for blinding and making up levels shall be fine crushed stones.
Crushed stones shall be laid on the excavated surface in a thickness as indicated on the drawings and be thoroughly rammed.

I. FOUNDATION SUBGRADE WORK

TYPE	RUBBLE SUB-GRADE THICKNESS	LOCATION
Rubble or crushed stone	150 mm	below on grade Below spread footing
Sand	60 mm	below grade beam

Rubble and gravel shall be well compacted. Rubble sub grade below slabs on grade shall be compacted enough by load roller, vibration roller or other proper tools. Care shall be taken to avoid unfavorable effects on the ground below sub grade work by compaction.

Provide P.E. sheets on top of compacted fill for Slab on fill prior to concrete pouring to serve as moisture and thermal protection.

J. LEAN CONCRETE

Unless otherwise indicated in Bill of Quantities or Plans, the specifications for lean concrete shall be the following:

Compressive strength of concrete: $F'c = 14 \text{ MPa}$ (28 days' cylinder test)

Proportion : 1:3:6

Thickness : 50 mm

Where used : As indicated on the drawings

For systems and procedure for the Lean Concrete, Chapter IV of this specification shall also apply.

PART IV: STRUCTURAL WORKS

CHAPTER I: CONCRETE WORKS

A. GENERAL

This section covers the requirements for performing all the work required to construct reinforced concrete work at the Clients' project site. The Provision of this specification shall govern wherever applicable except as otherwise provided in the design drawings. In case of conflicting with requirements, the design drawings shall govern.

B. SUBMITTALS

1. Source of materials
2. Material data
3. Concrete Compressive Test results of the Concrete Trial Mix
4. Shop drawing of the layout as per actual dimensions for PMT's approval.
5. Inspection Request. Inspection request must be submitted at least 2 days before concrete pouring scheduled time.
6. Concrete Compressive Test results of the Concrete actually placed
7. Other Test Results required by PMT

B. MATERIALS

1. CEMENT

The Cement shall be equal to ASTM C 150 Type 1 or Portland Cement Type 1.

The brand of cement to be used for concrete work shall be approved by the PMT and must not be changed during the progress of work unless otherwise approved by the PMT.

The amount of free alkali content shall not exceed the value of 0.6 percent by weight.

The cement shall be used in the order of delivery. No cement shall be used which has been moistened or which has been delivered to the site more than 1 month prior to its proposed use, unless otherwise approved by the PMT.

2. AGGREGATES

The aggregates shall be well graded, clean, hard particle of sand, gravel or crushed stone and conform to ASTM C33 "Standard Specification for Concrete Aggregates".

The aggregates shall have strength higher than that of the cement paste when hardened in concrete. The source of aggregates supply shall not be changed during the course of the work.

- a. **Coarse Aggregates:** Coarse aggregates shall consist of gravel, crushed stone or a combination thereof and shall be clean, hard, durable uncoated particles free from salt, organic matter and clay more than 0.25% by weight. Course aggregates shall be well graded between the following limit sizes and conform to the sieve analysis requirements.
- b. **Fine Aggregates:** Fine aggregates shall be river sand free from salt and organic matter, and shall be composed of clean, hard, strong and durable spherical or cubical particles, Clay shall not be contained more than 1%.
- c. **Maximum Size of Aggregates:** The maximum size of aggregates shall not exceed $1/5$ of the narrowest part of pouring form, $3/4$ of the spacing between each reinforcements or each bundle of reinforcement or 25 mm.

3. WATER

Water to be used in mixing concrete shall be clean and free from matters such as salt, oil, acid, alkaline, organic matter or other substances, in a quantity which will be harmful to concrete or reinforcement.

4. ADMIXTURES

Proper mixtures may be used in concrete, unless it adversely affects the quality of concrete.

Admixture to be used in concrete, when required, shall be subject to prior approval by the PMT and shall conform to the appropriate specifications listed below:

1. Air Entraining Admixtures:
2. ASTM C260 "Specification for Air – Entraining Admixture for Concrete"
3. Water-reducing, retarding, and accelerating admixtures:
4. ASTM C494 "Specifications for Chemical Admixture"
5. Other rational specifications with prior approval by the PMT.

Admixture containing chloride ions shall not be used in concrete.

5. REINFORCEMENT

In general, all Reinforcement steel bars shall be in conformance to "Chapter IV" of this Part of specification.

6. STORAGE OF MATERIALS

- a. Cement shall be stored in a proper manner above the ground not less than 30 cm and in a well ventilated water-tight shed to prevent deterioration.
- b. Cement bags shall not be piled up to the heights exceeding 10 bags and shall be kept neat for easy inspection.
- c. Coarse and fine aggregates shall be stored separately on clean and hard surfaces, and mutual mixing or contamination by organic material shall be prevented.
- d. Care shall be taken to avoid segregation of large and small particles of coarse aggregates in delivery or stockpiling. Stockpiles of aggregates shall be as low as possible and be allowed to drain.
- e. Any materials that has deteriorated or has been contaminated shall not be used for concrete.

C. MIXING OF CONCRETE

1. GENERAL

- a. All concrete shall be so mixed that the required strength, workability, uniformity and durability will be obtained.
- b. Prior to the commencement of the work, the contractor shall determine concrete mix proportions and submit a mixing plan to the PMT prior for his approval.
- c. Standard design strength, dry unit volume and slump of concrete shall be as specified on the drawings.

2. PROPORTIONING

- a. For general reinforced concrete work with specified compression strength less than 240 kg/cm², the quantity of cement used must not be less than 280kg/cm³ (7bags/m³) but not more than 380kg/cm³(9.5bags/m³).
- b. When the selection of concrete proportioning is done by laboratory trial by batches, the strength test shall be made in accordance with the "Methods for Compressive Strength of Cylindrical Concrete Specimens" (ASTM C39) and "Methods of Making and Curing Test Specimen in the Laboratory" (ASTM C192). The highest water-cement ratio used in concrete for structural work shall be based on readings from the curve of relationship between the ratio of water-cement and the compressive stress in order to obtain the stipulated compressive stress except when there are other necessities requiring the reduction of water-cement ratio, or the increasing of compressive strength.

- c. If the appropriate data from laboratory trial batches or field test are not readily available. The maximum permissible water-cement ratio which is given in the table below may be used for concrete proportioning. This table shall be used only for concrete which uses cement in accordance with the standard of Portland Cements in accordance with ASTM C 150.

LIMITS OF HIGHEST WATER-CEMENT RATIO IN CONCRETE		
Required Compressive F'c	Highest Water-Cement	
	Ratio by Weight	Air entrained concrete
180	0.65	0.54
210	0.58	0.46
240	0.51	0.40
280	0.44	0.35
310	0.38	

3. MEASUREMENT OF MATERIALS

- The Contractor shall submit a measurement plan indicating method and equipment of measurement to the PMT for his approval.
- Each material shall be separately measured on a batch method by weight.
- Cement shall be measured by weight or by number of bags.
- Workability aids shall be accurately measured in diluted solution.

4. MIXING

- Concrete shall be mixed in a power batch mixer of an approved type unless hand mixing is approved by the PMT. Concrete mixer shall not rotate faster than 30 times per minute.
- The batch mixer shall be thoroughly cleaned after each round by running for at least 15 minutes with medium and coarse aggregate and a lavish supply of water. The water used for cleaning shall be kept away from the formwork or placed concrete.
- All the materials for each batch shall be put into the drum at one time. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity specified by the manufacturer.
- Mixing shall be continued for a period of not less than one and half minutes after all materials have been put in the drum and until there is a uniform distribution of materials and the mass is uniform in color. The mixing time of batch shall be kept uniform throughout the work. Standard mixing shall be according to the table below.

STANDARD CONCRETE MIXING TIME		
Capacity (m ³)	Mixing Time	
	Minimum	Maximum
Less than 2	1 min. 45 sec.	5 min. 15 sec
Less than 3	2 min. 30 sec.	7 min. 30 sec.
Less than 4	2 min. 45 sec.	8 min 45 sec.
Less than 5	3 min.	9 min.

- Each batch mixer shall be thoroughly emptied and cleaned before for the next batch is put into the drum.
- Concrete which has set shall not be used nor re tempered, but shall be discarded.
- Before each run of a cleaned batch mixer a preliminary mix of sand and cement shall be run then discarded.

4. SLUMP

- A consistency of concrete shall be such that the mixture will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.

- b. The slump of concrete shall be the minimum that is practicable. When vibrators are used to consolidate concrete, the slump shall not exceed 4-inches (10cm); otherwise, the slump shall not exceed 5-inches (12cm). Addition of water during hot weather to maintain the same slump must be compensated by adding more cement to retain the water-cement ratio.

5. TRANSPORTATION OF CONCRETE

- a. The concrete shall be transported to from the place of final deposit as rapidly as practical, by means which will prevent segregation, consolidation, leakage or drying out.
- b. If segregation is found in concrete during transportation, such concrete shall be mixed again to obtain a uniform distribution of materials.
- c. When a bucket with an opening at the bottom is used for transportation, such concrete such that the opening is at the center of the bottom, easily operated and allows no leakage.
- d. Pouring bucket shall be such a type to deposit concrete uniformly.
- e. The delivery distance by barrows or Lorries shall not exceed 60 m, and a smooth road for such transportation shall be provided to prevent segregation.
- f. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 30m long and chute not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
- g. All equipment used for transporting the concrete shall be thoroughly cleaned at the end of each operation or work day.

6. PLACING OF CONCRETE

- a. Prior to the commencement of placing, a placing plan indicating locations, sequence and amount of concrete to be placed shall be submitted to the PMT for approval.
- b. Concrete shall not be placed before all forms, reinforcement, embedded items and the surfaces upon which the concrete is to be placed have been approved by the PMT.
- c. Before placing concrete, all rubbish, standing water and loose material shall be removed. The face of the formwork in concrete with the concrete shall be sprayed with clean water immediately prior to concreting.
- d. Before placing concrete in sub grade, semi porous sub grade shall be sufficiently sprinkled with fresh water in order to eliminate suction, and porous sub grade shall be sealed in an approved manner.
- e. Slabs on grade shall have a base of rubble compacted and rolled to a dense condition.

7. PLACING

- a. Concrete shall be placed within 30 minutes after discharge from the mixer but in no case more than 60 minutes from the time water was added.
- b. Indiscriminate addition of water to increase slump shall be prohibited. Concrete shall be spaded and worked by hand and vibrated to assure close contact with all surfaces of forms and reinforcements and leveled off at proper grade to receive finish. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the work, nor shall re-tampered concrete be used.
- c. All concrete shall be placed continuously, or in layers not over one-half meter deep, upon clean, well thawed, damp surface free from water, and never upon soft mud nor dry porous earth.

- d. When concrete is deposited in layers, concrete to be superimposed on the preceding layer shall be placed within two hours after previous concrete has been placed.
- e. Concrete shall not be permitted to drop freely over two meters in unexposed work nor over one meter in exposed work to avoid segregation. Where greater drops are required, tremies or other approved means shall be used. Tremie discharge shall be controlled so that concrete may be compacted effectively into horizontal layers not over 30 cm thick.
- f. When concrete is conveyed by chute, a continuous concrete flow shall be maintained. Discharge chute end shall be provided with baffle plate to prevent segregation.
- g. If chute discharge end height is over two meters, a spout shall be used and its lower end maintained as near deposit surface as practicable.
- h. When pouring is intermittent, a discharge chute shall be thoroughly cleaned before and after each run. Waste material and flushing water shall be discharged outside forms.
- i. Concreting for such vertical portions as columns and walls shall be made up to the bottom of beams, placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.
- j. No concrete shall be placed during rain, and any freshly placed concrete shall be protected from rainfall.
- k. The temperature of the concrete shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32°C, pre-cautionary measures approved by the PMT shall be put into effect. When the temperature of the steel is greater than 49°C, steel forms and reinforcements shall be sprayed with water just prior to placing the concrete.
- l. Before placing fresh concrete on or against concrete that has set, concrete shall be thoroughly cleaned so as to expose the coarse aggregate. Forms shall be retightened and all surfaces moistened.

8. CONSOLIDATION

- a. All concrete shall be thoroughly consolidated by vibration, spading, rodding, forking or other suitable means during placement, so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness.
- b. Internal vibrators shall have a minimum frequency of 8,000 vibrations per minute and sufficient amplitude to consolidate concrete effectively. They shall be operated by competent workmen.
- c. Use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 50cm apart.
- d. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds.
- e. A spare working vibrator shall be kept on the job site during all concrete placing operations.
- f. Where the concrete is to have an as-cast finish, full surface of mortar shall be brought against the form by the vibrating process, supplemented if necessary by spreading to work the coarse aggregate back from the formed surface.
- g. Concrete in slabs shall be thoroughly consolidated. Internal vibration shall be used in beams and girders. Consolidation of slabs shall be obtained with vibrating screeds, roller pipe screeds, and internal vibrators or approved means.

9. CURING OF CONCRETE

- a. GENERAL:

Concrete shall be protected against moisture loss, excessively hot temperature, rapid temperature change, mechanical injury from rain or flowing water for the period of the first at least 7 days after placement.

ACI Curing procedure shall conform to ACI 308 "Recommended Practice for Curing Concrete" and 305 "Hot condition at temperature above 10 C but not over 32 C.

The Contractor shall prepare a curing plan taking the weather conditions on site into account and submit it to the PMT for his approval.

b. CURING MATERIAL

Waterproof paper: Non-staining reinforced waterproof curing paper, conforming to ASTM C171, or approved equivalent.

Impervious sheeting: ASTM C171 or approved equal, type optional, except that polyethylene sheeting shall be 0.1 mm minimum thickness, white opaque. In areas of high winds the impervious sheeting shall not be used.

Burlap: Cloth made of jute or kenaf shall conform to AASHTO M182 or approved equivalent and shall weight a minimum 0.29 kg/m².

Liquid membrane forming compound: ASTM C309, Type 1 or approved equal. When non-pig mental compound is used, it shall contain a fugitive dye.

c. PRESERVATION OF MOISTURE

For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:

- Ponding or continuous sprinkling
- Application of absorptive mats or fabric kept continuously wet
- Application of sand kept continuously wet
- Continuous application of steam (not exceeding 65 C) or mist pray
- Application of waterproof sheet materials, conforming to ASTM C171 or approved equivalent
- Application of other moisture-retaining covering as approved
- Application of a curing compound conforming to ASTM C309 or approved equivalent

Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured for at least 7 days by one of the methods above.

d. TEMPERATURE, WIND AND HUMIDITY

Hot weather: When necessary, provision for windbreaks, shading, and fog spraying sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

Rate if temperature change: Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3 C in any 1 hour or 28 C in any 24 hours' period.

10. PROTECTION FROM MECHANICAL INJURY

During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods, by

application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

D. FAIR-FACED CONCRETE

GENERAL

1. This subsection covers fair-faced concrete which will be exposed to view as indicated on the drawings.
2. Prior to the construction, the Contractor shall prepare a 'construction joint' program, formwork drawings, clean out details and proposal for remedial and patching methods and submit them to the PMT for his approval.
3. During the whole of the construction, the work shall be properly observed. At least one observer shall be provided for each stage of the work i.e. formwork construction, reinforcement bar arrangement, concrete mixing pouring and vibration, curing and striking.

REMEDY AND PATCHING

1. Remedy and Patching of fair-faced concrete shall be minimized in frequency, and if unavoidable, be carried out carefully according to the approved program (see 9.1.b) only with the consent of the PMT.
2. Whereas-cast finishes are specified, the total patched area shall not exceed 0.2 m² in each 100 m² of as-cast surface. This is in addition to form tie patches, if the drawings permit ties to fall within as-cast areas.
3. Any patches in as-cast fair-faced concrete shall closely match the color and texture of surrounding surfaces.

The mix formula for patching mortar shall be determined by trial to obtain a good color match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

4. Patches in fair-faced concrete surfaces shall be cured for 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

E. TESTS AND INSPECTIONS

GENERAL

1. This subsection describes the item, frequency and methods of tests and inspections.
2. Concrete materials and operations will be tested and inspected as the work progresses. The PMT reserves the rights to order tests on any materials to be used in the mixing of concrete and reinforced concrete, at any time, to examine whether such materials and concrete comply with the specified quality or not. All expenses for tests and inspections shall be borne by the Contractor.
3. The Contractor shall test and inspect the aggregates, cement, any other additives and the concrete mix before and during construction as specified herein. The results of all such tests and inspections shall be satisfactory to the PMT.
4. All tests shall be done by a testing laboratory provided by the Contractor and approved by the PMT, and done according to the standards of the Science Department, Ministry of Industry, or the ASTM methods and procedures. Testing laboratory may supervise the mix and delivery of all concrete.
5. To facilitate testing and inspection, the Contractor shall:
 - a. Furnish any necessary labor and convenience to assist the testing laboratory in obtaining and handling samples at the project site or other sources of materials.

b. Advise the testing laboratory sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

c. Provide and maintain for the sole use of the testing laboratory adequate facilities of safe storage and proper curing of concrete test specimens at the project site.

d. The Contractor shall keep a record of all tests during the construction and for at least two years after the whole construction has been completed.

TEST OF MATERIALS

Materials used shall be tested in accordance with the table

TABLE 5.10.1 Material Test Method

Material	Frequency	Number of Specimens	Test	Method (ASTM)	
Cement	Minimum once for Each different type, Brand and cement Work	1 lot= 100 at minimum	Air content of Mortar	C185	
			1 specimen Per lot	Chemical Analysis	C114
				False Set	C451
Aggregates	Minimum once for Each source and Location	1 lot=300m ³ Minimum 2 Lot	Grading	C136	
			Washing	C117	
			Specimen per Unit Weight	C29	
			Organic Impurities	C40, C87	
			Clay lump	C142	
			Soundness	C83	
Water	Minimum once for Each source of Supply	Minimum once	Chemical analysis	As per JASS 5T-301	
Reinforcing Bars	Minimum one rod for each source of Supply per batch	1 lot=50 ton minimum 3 rods per lot Per size	Mechanical test (tension bending)	A370	

Remark: Standards for the method of test indicated herein may be replaced by appropriate JIS Standards with prior approval of the PMT.

SAMPLES

1. Samples from stock on the site shall be taken by the Contractor as indicated by, and in the presence of the PMT.

a. Cement: Sampled cement shall be tested by the approved testing laboratory. Certified copies of laboratory test reports shall be furnished for each lot of cement and shall include all test data, results and certification that the sampling and testing procedures are in conformance with the specifications.

No cement shall be used until its test results are satisfactory to the PMT. Cement that has been stored for more than four months after being tested shall be retest before use.

b. Aggregates: Aggregate sampling shall conform to ASTM D75. Aggregates shall be sampled and tested by the testing laboratory. No aggregate shall be used until its test results are satisfactory to the PMT.

2. Samples of fresh concrete shall be obtained different batches of concrete on a random basis in accordance with ASTM C172, and shall be transported to a placed in the site where tests can be made and cylinders stored without being disturbed for the first 24 hours.

TRIAL MIX TESTS OF FRESH CONCRETE

1. Trial mix test shall be conducted at least once for each mix proportion in accordance with table 5.10.2 Tests shall be carried out in the presence of the PMT more than 28 days before concrete placing.

Table 5.10.2 Trial Mix Test

Items	Test	Method
Workability	Slump Air content	ASTM C143 ASTM C231
Strength	Compression	ASTM C39
Weight	Unit weight	ASTM C138

Note: Other rational standards such as JIS will be accepted instead only with prior approval of the PMT.

2. Compression strength tests shall be carried for each three specimens at 7 days and 28 days.

FRESH CONCRETE INSPECTIONS

1. Inspections must be carried out closely adjacent to the site of pouring in accordance with table 5.10.3

Table 5.10.3 Fresh Concrete Inspections

Items	Minimum number of Specimens	Test	Method
Fresh Concrete	1 lot= 10 m ³ minimum 1 specimen Per lot	Slump	ASTM C143
		Air content	ASTM C231
	1 lot= 10 m ³ Minimum 3 specimens per lot on a random basis per concrete pouring	Compressive strength	ASTM C39

Note: Other rational standards such as JIS will be accepted instead only with prior approval of the PMT.

2. Where any test result proves unacceptable to the PMT, the Contractor shall be discarded the whole of the concrete batch.

3. Slump tests and air contents tests shall always be made from the same batch from which compressive strength tests are made.

4. The standard age of concrete for strength test shall be 7 days and 28 days. For strength test at 7 days the Contractor shall provide three test specimens for each test taken in the presence of the PMT less than once for each 10 m³ or fraction thereof nor less than once a day, or less than once for each 500 m² of floor area of each class of concrete placed. Samples shall be secured in accordance with ASTM C172 or approved equivalent standards. Test specimens shall be made a cured in accordance with ASTM C31 or approved equivalent standards.

5. Test specimens for strength tests shall be evaluated for each class of concrete specified in conformance with ACI 318, Chapter: 4 "Concrete Quality" or approved equivalent standards

6. When the results of the strength test of the specimens indicate deficiency in specification requirements or where there is other evidence that the quality of the concrete is below specification requirements, core boring tests shall be made in conformance with ASTM C42 or approved equivalent standards, at the Contractor's expense. If deficiency discovered, the Contractor shall ask the PMT for the treatment, and shall yield to the instruction of the PMT.

CONTINUOUS INSPECTION

1. In concrete work, the PMT will inspect the works in every stage and every step of the work.

2. The PMT will supervise and ascertain that the concrete work is in accordance with the plans and specifications, and shall keep records which shall be submitted by the Contractor and cover the followings:

- a. Quantity and proportion of materials for the mixing of concrete
- b. Placing and curing of concrete
- c. Reinforcement
- d. Formwork and shoring
- e. Placement of important load on the floor during the construction
- f. general progress of work

3. When air temperature rises above 35 deg Celcius, a complete record shall be kept of the temperature of concrete and the concrete shall be protected during placing and curing operations.

G. PAYMENT METHODOLOGY

The work under this item shall be measured by the volume of concrete actually installed as per planned. Excess of the quantity due to Contractors corrections such as increase of dimensions shall not be considered in the pay item.

For a work to be considered finished, the concrete must have undergone all the necessary work from preparation, curing and satisfactory test results. The quantities to be paid shall only include those of which completely finished, inspected and acceptable to the PMT.

In cases that the concrete does not pass the required compression test, it is the responsibility of the Contractor to perform any of the following without the expense of the owner.

1. Removal of Concrete installed
2. Retrofitting up to PMT's satisfaction.

CHAPTER II: PRECAST CONCRETE

GENERAL REQUIREMENTS

1. Structural pre cast concrete shall be manufactured in fabrication shop or site fabrication shop.
2. Concrete, reinforcement and other materials used in structural precast concrete members are uniform in color and appearance.
3. Following submittals shall be prepared by the Contractor and submitted to the PMT for his approval.
 - a. Shop drawing showing layout, unit locations, fabrications details, unit identification marks, reinforcement, connection details, support items dimensions, openings and relationship with adjacent materials.
 - b. Product, data showing standard component configurations, deflections, cambers and bearing requirements.
 - c. Fabricator's installation instructions

FABRICATION

1. Plant or job site plan record and quality control program during production of pre cast concrete members shall be maintained and reported to the PMT as per his request.
2. Reinforcing steel, anchors, inserts plates, angles and other cast-in items shall be embedded and located accurately as indicated on the drawings.
3. Pre cast concrete members shall be cured under identical conditions to develop required concrete quality and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

DELIVERY STORAGE AND HANDLING

1. Pre cast concrete members shall be handled in position consistent with their shapes and design. They shall be lifted and/or supported only from support points.
2. Lifting or handling devices shall be capable of supporting member in position anticipated during manufacture, storage, transportation and erection.
3. Members shall be protected to prevent staining, chipping or spalling of concrete.
4. Each member shall be marked with the date of production and final position in structure.

TOLERANCE OF PRODUCTS ANDS INSPECTION

1. The dimensional errors of fabricated products shall be as follows:
 - a. Maximum variation from nominal dimension: 6 mm
 - b. Maximum dimension from intended camber: 25 mm
 - c. Maximum out of square: 3 non-cumulative
 - d. Maximum bowing of members: Length bow/360
2. All products shall be visually inspected by Contractor. All dimensional errors shall be precisely measured by proper means as approved by the PMT. The PMT shall make out and submit the inspection report to the Consultancy for his approval.

3. PMT inspects the products at random. The Contractor shall provide all necessary help and convenience in men materials, instruments, etc. for the inspection of the PMT.
4. Material product or workmanship not in reasonable conformance with the provisions of this specification may be rejected at any time during the progress of work. Any material or workmanship which is rejected by the PMT shall be promptly removed and replaced by and at the expense of the Contractor.

ERECTION

1. Members shall be erected without damage to structural capacity, shape or finish. Damaged members shall be replaced or repaired.
2. Members shall be aligned and maintained uniform horizontal and vertical joints, as erection progress.
3. Temporary bracing shall be maintained in place until final supports is provided. Members shall be protected from staining. Temporary lateral support shall be provided to prevent bowing, twisting or warping of members.
4. Differential camber between pre cast members shall be adjusted to tolerance before final attachment.
5. Tolerance of erection shall be as follows
 - a. Maximum variation from plane or location indicated on drawings: 6 mm in every 3 m and 9 mm in every 30 M, Non-Cumulative
 - b Maximum offset from true alignment between members: +3 mm
 - c. Maximum variation from dimension on drawings" +3 mm
6. When members cannot be adjusted to conform to design or tolerance criteria, the work shall be ceased and modification shall be executed as directed by the PMT.

CHAPTER III: FORMWORKS AND SCAFFOLDING

DESIGN OF FORMWORK

1. All formwork shall be designed to resist the working loads, and the vertical load and the lateral pressure of the wet concrete, having regard to incidental loading and vibration of the concrete.
2. The formwork shall be sufficiently rigid to prevent undue deflection and bulging during the placing of the concrete. Forms shall be properly braced or tied together to maintain position and shape. The Contractor shall submit design drawings and calculations for the proposed formwork to the PMT for their approval.
3. Forms shall be substantial and sufficiently tight to prevent leakage of mortar.
4. The design and engineering of the formwork, as well as its construction, shall conform to AC1 301 "Specifications for Structural Concrete for Buildings" and AC1 347 "Recommended practice for Concrete Formwork".
5. All formwork shall be so arranged as to permit easing and removal without damaging concrete.
6. Slip form type formwork shall obtain the prior approval of the PMT.

MATERIALS

2. All materials used shall be suitable and adequate for the use to which they are put.
3. The form facing material shall produce a smooth, hard uniform texture on the concrete. The Contractor shall submit to the PMT a certificates and samples of the form boards for his approval.
4. All form boards shall be new. If re-used, they shall be approved by the PMT.
5. Cones for the form ties shall be of wood.
6. Form liners shall be of sound and suitable materials to accurately and safely cast the incite concrete structure as shown on the drawings.
7. Timber form boards where used for fair-faced concrete shall be of such new materials as not to cause any defects to the surface of the concrete. Special care shall be taken in fabrication, storage and protection of these boards.

CONSTRUCTION AND ERECTION

1. For construction of forms, fabrication and erection, drawings shall be prepared as required and approved by the PMT.
2. All formwork shall be accurately constructed to meet the requirement shown on the drawings as to position, shape and dimension of members and be fixed in perfect alignment, level and plumb within the tolerances specified (Tolerances)
3. Column bases and wall bases shall be carefully cleaned out and observed immediately before concrete is placed, and temporary openings shall be provided at the base of column forms and wall forms to enable this to be done. The openings shall be after cleaning to prevent leakage of cement paste.
4. Pipes, boxes, embedded steel and inserts placed in the formwork shall be securely fixed in position to prevent displacement during Concreting.

5. The formwork for slabs and beams shall be laid with an upward camber where necessary to ensure a level ceiling and beam soft.
6. No formwork shall be connected to scaffolding or other temporary provisions.
7. All formwork shall be properly protected from impact and vibration due to workmen, materials and equipment.
8. If form boards are reused, the surfaces in contact with the concrete shall be thoroughly cleaned off and be sufficiently repaired before reuse.
9. All formwork shall be fabricated in a place protected from the sunbeam, rain and wind.
10. Where more than one piece of formwork is required, care shall be taken to ensure that the grain, color, and texture of the form boards are well balanced to obtain a uniform concrete surface from the different units of formwork.
11. Corners of beams, columns and openings shall be chamfered adequately.
12. All formwork for fair-faced concrete shall be inspected by the PMT after fabrication for shape, dimension, transition, nail head, grain texture.

TOLERANCES

1. The formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in Table 3.2.1
2. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project sufficient control points and bench marks to be used for reference purposes to check tolerances.

Table 3.2.1 Tolerance for Formed Surfaces

	Items	Tolerance
(1) Variation from Plumb (e/H)	H > 5 m	$e/H \leq 1/600$ and $e \pm 8\text{mm}$
(2) Variation From level (e/L)		$e/H \leq 1/600$ and $e \leq \pm 12\text{mm}$
(3) Variation From Position (e)	General	$e \pm 8\text{mm}$
	Footing	$e \pm 10\text{mm}$
(4) Errors in Span		

Length and story
Height
(e)

$e \pm 8\text{mm}$

(5) Surface Irregularity (e)	Fair Faced Surface	$e \leq 7\text{mm}$ for every 3m
	Plastered Surface	$e \leq 7\text{mm}$ for every 2m
(6) Surface Transition (e)	Fair Faced Surface	$e \leq 3\text{m}$
	Plastered Surface	$e \leq 5\text{m}$
(7) Variation in sizes And location of Sleeves and Openings		$e \leq \pm 10\text{m}$
(8) Variation in Cross Sectional Dimensions of Members	Size of columns and beams	5m +15mm
	Thickness of Slabs and Footings	0mm +10mm for every 3m
	Size of Footings+20m	10m

PREPARATION OF FORM SURFACES

1. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed in them.
2. Before placing of either the reinforcing steel or the concrete, the surfaces of the forms shall be covered with an approved coating material that will not stain the concrete surfaces. A field applied form release agent or sealer of approved type or a factory applied non absorptive liner may be used.
3. Excess form coating material shall not be allowed to stand in puddles in the forms nor shall such coating be allowed to come in contact with hardened concrete against which fresh concrete is to be placed

FORMWORK TIES

Tie bars, if necessary, shall be sufficiently strong and so spaced to withstand the lateral pressure of wet concrete on the formwork without allowing any deflection. The insert holes of the tie bars shall be filled with synthetic resin mortar on the outside surface and left exposed on the inside surfaces.

SHORING

1. All shores for the formwork shall steadfastly and adequately support the weight of formwork, wet concrete and construction loads above. Adequate safety margins shall be included in all structural calculations for shores. The shores shall be carefully positioned to secure a rigid installation.
2. Materials
 - a. Steel pipes. All tubular steel shores for beams and slabs shall meet the requirements of JIS A 8651 "steel Pipe Supports" or approved equivalent standards.
 - b. Timbers and Composite Members. Wherever timbers or composite support members are used, they shall be sufficient to provide a safe and rigid support to the weight of formwork, wet concrete and construction loads above.
3. Erection of Shores
 - a. Wherever both steel and timber shores are employed they shall never be used to support the same formwork to avoid the adverse effects caused by differential compression.
 - b. Centering of all vertical shores shall be adequate to carry the vertical loads on the formwork without causing undue deflection in the horizontal support members.
 - c. Ample strut supports, braces and guys shall be provided to prevent overturning or twisting due to horizontal loads on formwork for slabs and beams during concreting.
 - d. Where the shores for formwork of excessive floor-ceiling heights stands on the staging, the staging and the supports shall be securely fixed, and well braced and laterally supported to prevent undue overturning, twisting and buckling due to various loads during concreting.
 - e. Where vertical shores stand directly on the ground, care shall be taken to prevent any settlement when such shores is loaded with wet concrete and other loads.

INSPECTION OF FORMWORK

Prior to concreting all formwork shall be inspected by the PMT to check their correctness and that all dimensions, positions and quantities of conduits, inserts, cones, boxes for chases, sleeves, pipes and services are correct, and meet the drawings.

REMOVAL OF FORMS AND SHORES

1. All forms and shores shall be removed without shock, vibration or any damage to the concrete.
2. The period in which formwork shall be left in place after concreting be determined from the concrete mix portion, position and size of members, test results of compression strength, loading, climate and other curing conditions and shall be agreed with the PMT.
3. Formwork shall remain in place after concreting for a period specified in the Table 4.2.2, in a general way.

Table 4.2.2 Minimum Periods for "Striking" Formwork

Formwork Type	Form Boards			Shores	
	Foundation, Sides of Beams, Columns And walls	Slab & Beam Soffits	Slab Soffits	Beam	Soffits
Members					

Curing days	4	7	20	25
Compressive Strength of Concrete	80 kg/cm ²	50% of the specified compressive strength	85% of the specified Compressive strength	100% of the compressive strength

- Notes:
1. form boards may be removed after reaching of either required curing days or required compressive strength of concrete.
 2. Shore shall be left in place until both them have been reached.

4. Where concreting loads on the upper floor are transmitted to the lower floors by shores, the member's stresses in the lower floors shall be examined, and if necessary the shores for lower floors shall be left in place for a longer period than stated above until they can be removed without any damage to the structure.
5. Struts supporting cantilevered beams and slabs shall be left in place until struts for upper floors have been removed.
6. Where formwork is provided for long span beams or slabs, or carries particularly heavy loads, the period in which formwork must remain in place shall be extended to avoid damage to the concrete.

RESHORING AND REPOSITIONING OF SHORES

No re shoring and repositioning of shores shall be permitted. If repositioning is unavoidably needed, it shall be approved in advance by the PMT.

INSPECTION AFTER REMOVAL OF FORM BOARDS

Upon striking of form boards, the surfaces of concrete shall be inspected by the PMT and any defective portion shall be promptly repaired.

JOINTS AND EMBEDDED ITEMS

CONSTRUCTION JOINTS

1. Construction joints shall be made only where shown on the drawings or in positions approved by the PMT, so as not to impair the strength of the structure. Construction joints shall be reduced to the minimum.
2. In general, joints in floors shall be located near the middle of the spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset distance equal to twice the width of the beam. Joints in columns shall be at the top of slabs, beams, girders and footings, and at the underside of beams and girders.
3. Joints shall be perpendicular to the main reinforcement.
4. The upstanding edge beams as parapets shall be poured continuously and monolithically with the roof slabs.
5. The surface of concrete at all construction joints shall be thoroughly cleaned and all laitance and standing water removed prior to placing adjoining concrete.
6. When required or permitted, bond shall be obtained by roughing the surface of the concrete in tan approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface, or by other means approved by the PMT.

EXPANSION JOINTS

1. Reinforcement or other embedded items bonded to the concrete shall not be permitted to extend continuously through any expansion joint.

2. Pre molded expansion joint filler and sealant shall be of the type required by the drawing and shall conform to one of the following:

a. "Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)" (ASTM D944) or approved equivalent.

b. "specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non extruding and Resilient Non bituminous Types)" (ASTM D1752) or approved equivalent

JOINTS IN SLABS ON GRADE

Joints in the slabs on grade or concrete pavements shall be located and detailed as indicated in the drawings. If saw-cut joints are required or permitted, cutting shall be timed properly with the set of the concrete: cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and shall be completed before shrinkage stress became sufficient to produce crackling.

EMBEDDED ITEMS

1. All sleeves, inserts, anchors, and embedded items required for adjoining work or its support shall be placed prior to concreting.

2. All sub-contractors whose work is related to the concrete of must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

3. Expansion joint material, water stops, and other embedded items shall be positioned accurately and supported against displacement.

4. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete or mortar into the voids.

CONCRETE PLACING AND CURING

1. Before placing concrete, all formwork shall be thoroughly sprinkled with water.

2. Construction joints shall be provided as the approved program (see 9.1 b) Special care shall be taken to follow the construction joint 'shutter stop' and finish the concrete true to line and level with the top surface of the 'stop'. Also all starter bars be well protected with taped polythene to prevent rust from staining the surface of concrete.

3. While placing concrete, the coarse aggregates shall be worked back from the forms, leaving a full surface of mortar but avoiding the production of surface voids.

4. Vibrators shall be allowed to contact the formwork for expose concrete surfaces.

5. After removal of formwork, where necessary, the surface of fair-faced concrete shall be protected against staining by suitable Kraft paper and against physical damage by adequately robust boards or sheet material.

6. After striking the formwork, all concrete surface shall be inspected by the PMT, it shall be promptly treated in the approved manner (see 9.1b)

CHAPTER IV: REINFORCEMENT

A. GENERAL

1. This subsection covers steel reinforcement for cast- in-place concrete, where indicated on the drawings, where required and as specified herein.
2. Shop drawings, showing all fabrication dimensions and locations for placing of reinforcing steel and accessories shall be submitted to the PMT for his approval. Approval shall be obtained before fabrication.
3. Details of concrete reinforcement and accessories not covered herein nor on the drawings shall be in accordance with the regulations of "Building Code Requirements for Reinforced Concrete" (ACI 318) and "Manual of Standard Practice for Detailing Reinforced Concrete Structure" (ACI 315)

B. FABRICATION

1. Prior to the fabrication and placing of reinforcing steel, the Contractor shall prepare detailed fabrication and placing drawings and submit them to the PMT for his approval.
2. Bars with bends not shown on the drawings shall not be used.
3. All reinforcement shall be accurately bent cold to the required sized and shape with care taken not to damage it
4. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:
 - a. Sheared length : ± 2.0 cm
 - b. Depth of truss bars : ± 1.5 cm
 - c. Overall dimension of Stirrups, ties and Spirals : ± 1.5 cm
 - d. All other bends : ± 2.0 cm

C. PLACING

1. Reinforcing steel shall be accurately placed and spaced in accordance with the drawings. All bars shall be firmly supported and fastened together to prevent displacement during the placing of concrete. Over formwork, concrete metal, plastic or other approved bar chairs and spacers which will not adversely affect the concrete shall be used
2. Minimum concrete protective covering for reinforcement shall conform to the standard details of the drawings and within a tolerance of ± 5 mm for slabs and ± 10 mm for all other members
3. The intersections of all bars shall be securely tied with galvanized soft iron wire of not less than 1.20 mm in diameter in compliance with TIS 138, the ends being turned into the body of the concrete.
4. Bars shall be placed within the following tolerance:
 - a. Clear distance to formed surfaces : ± 0.6 cm
 - b. Minimum spacing between bars : ± 0.6 cm
 - c. Top bars in slabs and beams
Members 20 cm deep or less : ± 1.3 cm
Members more than 20 cm but Not over 60 cm deep : ± 2.5 cm
 - d. Crosswise of members : Spaced evenly within 5.0 cm
 - e. Lengthwise members : +5.0 cm

5. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval.

6. Vertical bars in columns shall be offset at least one bar diameter at lapped splices as shown on the drawings.

7. No reinforcement shall be embedded after concreting.

8. Unless permitted by the PMT, reinforcement and column dowels shall not be bent after being embedded in hardened concrete. If any correction in the position of reinforcement of dowels by bending is necessary after concrete has been placed, the reinforcement position shall be corrected over as long as possible a distance with a deviation of not more than 1:7.

D. CLEANING OF REINFORCEMENT

1. All reinforcement, at the time concrete is placed, shall be free from mud, oil, and paint, loose scale or other materials which may adversely affect or reduce the bonding capacity.

2. After bending and placing of reinforcement, not more than a light rust of ferrous oxide will be permissible before concreting commence.

3. Where loose rust scaling has occurred on bars, the bars shall be well brushed with stiff wire brushes to remove all loose scale.

4. Where reinforcing bar are kept exposed for a long period after placing, they shall be inspected again before concreting and cleaned as necessary.

E. SPLICES

1. All splices in reinforcing bars shall be made with a lapped splice. Other suitable means of splicing may be used subject to approval of the PMT.

2. The locations, length and anchorage of splices shall be as specified on the drawings. Any changes in locations shall be subject to the approval of the PMT.

3. All splices not shown on the drawings shall be subject to approval of the PMT.

F. INSPECTION AND REPAIR

1. All reinforcement after placing shall be inspected and approved by the PMT before concrete placing.

2. All incorrect position and location of reinforcement shall be promptly repaired, and all mis-fabricated and damaged bars removed and replace with new bars, as directed by the PMT.

G. PAYMENT METHODOLOGY

The work under this item shall be measured by the weight of Reinforcing steel actually installed as per planned. Excess of the quantity due to Contractors corrections such as increase of dimensions shall not be considered in the pay item.

For a work to be considered finished, the surface must have undergone all the necessary work from surface preparation to final coating of paint. The quantities to be paid shall only include those of which completely finished, inspected and acceptable to the PMT.

For uniformity of computations, the weight of Deform reinforcing bars shown at table below shall be used in this contract.

Diameter (mm)	Weight (kgs/m)	Diameter (mm)	Weight (kgs/m)
6	0.222	20	2.466
8	0.395	22	2.984

10	0.617	25	3.853
12	0.888	28	4.834
14	1.208	32	6.313
16	1.578	40	9.865
18	1.998		

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CHAPTER VI: STRUCTURAL STEEL WORKS

SCOPE

The work to be undertaken in this section shall comprise the furnishing, fabrication, reassembly in site, painting, delivery, erection, and installation of all materials including anchor bolts, base plates, erection bolts, bracing and all other structural steel work indicated in the plans or specified herein.

SUBMITTALS

The contractor shall submit to the PMT for his approval of samples of all materials required of this section such as but not limited to:

- a. **Fabrication drawings.** Prior to the commencement of the work, Contractor shall submit construction drawings and details to the PMT for his approval of the position of the Structural Steel and layout of steel section.
- b. **Fabricator certificates.** Prior to the commencement of the work, Contractor shall submit construction drawings and details to the PMT for his approval of the position of the Structural Steel and layout of steel section.
- c. **Material test results.** Dimensions conformity, Bending and Tensile stress test results
- d. **Weld test results.** X-ray weld test results

MATERIALS

- a. Unless otherwise indicated in the plans, structural steel shapes and plates shall conform to ASTM -A36. Certified Mill Test and shall be submitted by the fabricator to the PMT.
- b. Light-Gauge Cold-formed structural steel shall conform to pertinent specifications of the American Iron and Steel Institute (AISI)
- c. Machine Bolts shall conform to ASTM A-307. Each bolt shall be provided with standard nuts and washers.
- d. Anchor Bolts shall conform to ASTM A-141
- e. Cross Bracing with turnbuckles shall conform to ASTM A-307
- f. Welding shall conform to AWS standard, and E60 or E70 electrodes shall be used unless otherwise specified by the Structural Engineer.
- g. The fabricator shall have the welds tested by X-ray method by an independent company engaged in non-destructive testing as directed by the Structural Engineer. The welds are considered satisfactory if 9 out of 10 samples passed the requirement otherwise the welds shall be corrected.

FABRICATION

- a. Field fabrication shall be kept to a minimum. Shop fabrication shall be employed to the greatest extent possible with members' shop fabricated as practicable with a minimum requirement for field connections.
- b. Contractor shall submit shop drawing showing complete detailed connections for approval by the Structural engineer. No material shall be ordered nor fabrication started until the PMT approves such drawings.
- c. All dimensions in the plans shall be verified by the steel fabricator in the field in coordination with the Contractor and the PMT.
- d. Unless otherwise specified in the plans, gusset plates and stiffeners shall be minimum thickness of 6 mm.
- e. Splices shall be kept at minimum and shall be staggered. No splices shall be permitted at point where critical stressed occur. Splice plate shall have a minimum length of 300 mm. the contractor shall submit drawing for the locations of splice for the structural engineer's approval.
- f. All bearing plates shall have a minimum thickness of 12 mm
- g. All erection bolt holes shall be 3 mm plus nominal bolt diameter
- h. All cuttings shall be neat cut
- i. Shop paint (epoxy primer; 2 coats) shall be provided.

- j. Any work that is not in conformance with these specifications will be rejected at any time during the progress of the works.

ERECTION

- a. The erection of all structural steel shall conform to the applicable requirements of the AISC Specification and AISC Code of Standard Practice. All structural steel work shall be erected accurately to the lines and levels shown on the Drawings. All columns and other vertical members shall be plumb and horizontal members level before permanent connections are made. All temporary bracing, guys and bolts as may be necessary to insure the safety of the structure until the permanent connections have been made shall be provided by the Contractor. Members shall be connected, as erection progresses, to resist all dead load, wind and erection stresses.
- b. Bolted Connections. Mating faces of bolted connections shall be cleaned to bare steel, free from paint, grease and other foreign matter. Field connections shall be accurately fitted up before the bolts are taken up. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the hole or to distort the metal. All unfair holes shall be drilled or reamed. After joints are fitted up properly, bolts shall be tightened by the turn-of-nut method.
- c. Cutting and Burning. The use gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Its use may be permitted on minor members if the member is not under stress and then only after the written approval of the Structural Engineer has been obtained.
- d. Tolerances. The tolerances of erection and fabrication of structural steel, unless otherwise specified, shall comply with the AISC Specification. The maximum deviation from true vertical shall be one part in 500.

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