

PART - 1

GENERAL REQUIREMENTS

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1. Description of the Works

1.1 OMITTED

1.2 The all works shall be under a single Contract. All items indicated in these Contract Documents and otherwise necessary to complete the Works are the responsibility of the Contractor to both construction and procurement under this Contract, regardless of whether or how they are indicated elsewhere in these Contract Documents. The Construction Work shall include the following:

(1) Expansion of Sanitary Landfill: Area approx. 12,000 m²

- Semi-aerobic Sanitary Landfill
- Appurtenant work

(2) Material Recycling Facility (MRF)

- Structure: Steel Frame, RC
- Building Area: 250 m²

(3) Waste Transfer Station (TS)

- Structure: RC
- Working Area: Asphalt paving 700 m²

2. Standards

In various parts throughout these Specifications, reference is made to the Standards and Specifications, including all revisions, amendments and addenda subsequently issued.

When references to the following capitalized abbreviations are made in these Specifications, they refer to specifications, standards or methods of their respective national or international associations. It also implies that other national standards or internationally accepted standards which ensure an equal or higher quality than the standards mentioned will be accepted. The Contractor shall use latest Standards. The Contractor shall submit any explanatory material upon request of the Consultant concerning the standards in conformity of which his goods will be manufactured. The construction work shall comply with the Volume I and Volume IV as well.

JIS : Japanese Industrial Standards

ISO : International Standardization Organization

ASCE : American Society of Civil Engineers

ASTM	:	American Society for Testing and Materials
BS	:	British Standard
PS	:	Palestinian Standard

3. Meaning of Drawings and Specifications

The Contractor shall carefully examine, compare and verify the Drawings and Specifications. If there is doubt in the Drawings, including notes therein or in the Specifications, the Contractor shall request in writing for the Consultant to give an interpretation and shall conform to the interpretation and decision made by the Consultant.

If, in the Contractor's opinion, any work indicated by the Drawings, or specified in such manner as to be impossible to do good workmanship or engineering manner, he shall refer the same to the Consultant to receive instruction before proceeding with the Work. In case there are no current applicable specifications, the Contractor shall submit a proposal subject to the approval of the Consultant.

4. Drawings

4.1 The Drawings composed of a part of the Tender Documents are listed in **Volume IV**.

4.2 The Drawings were issued at A3 Size as tender drawings, and drawings submitted by the Contractor shall be same size.

4.3. Compliance with Drawings

4.3.1 All works, during its progress and upon completion shall conform to the lines, elevations and grades as shown on the Drawings.

4.3.2 The Contractor shall complete the proposed work in every detail as shown or specified.

4.3.3 Should any detail or details be omitted from the Drawings and Specifications which are essential to its intended completeness, then it shall be the responsibility of the Contractor to design such detail and then furnish and install the Works so that upon completion, the Work will be acceptable, operational and ready for use.

4.4 Further drawings may be issued to the Contractor by the Consultant as work progresses if

necessary.

4.5. Interpretive Drawings

- 4.5.1** Any additional drawings which the Contractor requires to interpret the drawings for the use of his employees shall be prepared by the Contractor.
- 4.5.2** Three (3) copies of each shall be supplied to the Consultant, if required by him.
- 4.6** The Client accepts any necessary omissions or the correctness of the representation of existing features on the Drawings under agreement of the Consultant, and he/her can require necessary modifications.

5. Contract Co-ordination

The Contractor shall co-operate with the Client, other contractors, private and public organizations/authorities with regard to the execution of work, connections to the work, delivery of materials and co-ordinate with them subject to approval of the Consultant.

6. Work Methods

The Contractor shall employ proper methods and equipment to minimize the time period of water service, power supply, irrigation water service and tele-communication stoppage due to the execution of the Work. It will produce a satisfactory quality of the Work and rate of progress which, in the opinion of the Consultant, will ensure the completion of the Work within the Contract period. The Contractor shall submit to the Consultant before seven (7) days of the Work, a detailed methodology (Method Statement) on any particular stage of the work of the Project that may affect the above mentioned infrastructures.

7. Construction CPM

Within the period specified in the Contract, the Contractor shall prepare and submit a general Critical Pass Method (hereinafter referred to as “CPM”) network showing the order and time periods necessary for him to complete various phases of the Work such that the Project is completed in the prescribed period of time. The general CPM network shall reflect the schedule for the submission of the shop drawings, the proper sequence for the construction of the various facilities, the schedule for the manufacture, shipping and installation of the various

materials and equipment and the starting and completion dates of the various parts of the Work.

The CPM shall be updated by the Contractor when required by the Consultant but not more than once per month.

The Contractor shall keep the existing system running, in principle, during the Construction period. On preparing the general CPM network, the Contractor shall carefully examine the situation of the systems and show a process and method of the protection and/or temporary works for the existing facilities so as to keep the system running as much as possible.

8. Details of Contractor's Supervisory Staff and Subcontractors

The Contractor shall provide within fourteen (14) days of the verification of the Contract, the name, age, nationality, working language and degree of proficiency, official position in the firm and title, duration of assignment; qualifications, memberships in technical organizations; and professional experience for each employment held including Client; name and description of work, projects and location; and position held in the project for all key staff. These shall include the Project Manager, Structural and Civil Engineer. The names shall be the same names submitted for key personnel at the site for each position with the pre-qualification documents and with the Tender. No substitution of key personnel shall be permitted except in exceptional circumstances, and then only with the permission of the Consultant.

9. Project Site

9.1 Location

The Project Site is located in the adjacent area of the existing landfill site in Jericho, the West bank as shown in a drawing (Drawing No.PSWM-01) of **Volume IV**. The pictures of the current site condition of the project site are shown in **ANNEX III-1-2**.

9.2 Soil Condition

The soil investigation result of the Project site is described in **ANNEX III-1-3** as a reference. The Contractor, however, shall be responsible for acquiring the data on the soil condition including his additional survey on the soil condition on his expense if necessary.

10. Working Hour

The basic Working Hour shall be set from eight o'clock in the morning (8:00AM) till five o'clock in the afternoon (5:00PM) on Sunday to Wednesday, and from eight o'clock in the morning (8:00AM) till one o'clock in the afternoon (1:00PM) on Thursday except national holidays. In case the Contractor needs to extend the working hour, the Contractor shall obtain a written approval by the Consultant prior to its extension.

11. Quality Control

11.1 Technological Management

If Consultant requests to increase the number of specialists assigned by Contractor, the Contractor has to dispatch the professional expert(s) who have enough experience to execute the assignment works. They shall be thoroughly supervised and controlled by the contractor's project manager to manage the contract schedule.

11.2 Equipment Control

The Contractor always shall prepare the complete construction equipment in good condition before the commencement of or after finishing the daily works. The equipment shall be properly maintained daily basis and keep a maintenance record of all related equipment or machines in order to prevent the suspension /delays of the works as well as accidents.

11.3 Material Control

All materials for execution of the Works shall be supplied from the suppliers having ISO 9001 certificate for the quality guaranteed. The Contractor shall keep a record of the original suppliers and its stock list. All materials shall be stocked under proper location to keep them in a good condition. The record and list shall be reported to Consultant at every month or on the requested basis.

11.4 Progress Control

The Works shall be divided into i) temporary works, ii) preparation works, iii) transportation of equipment and materials, iv) main construction works, v) final inspection, vi) clean-up of the project site. The Contractor shall supervise the all work activities and the sites with his full capacity considering (1) allocation of appropriate workers, (2) procurement of necessary equipment and materials, (3) instruction of appropriate work targets and work breakdown, (4) targeted work period. If the work progress is delayed or other problems are occurred, the Contractor immediately shall investigate the cause and report to Consultant. The construction

work generally and often experience delays regarding the arrival of the procured local equipment and materials. The Contractor shall make efforts to diminish any such delays in order to the works on time.

12. Site Offices

- 12.1** The Contractor shall provide site offices for his own requirements and for the Consultant's Representative and his staff located near to the Project Site in Jericho Municipality for the duration of the Contract.
- 12.2** The space/ground for the site offices shall be provided by the Client, however, the cost for construction, as well as for furnishing all equipment and appurtenances to be installed therein, shall be borne by the Contractor.
- 12.3** The Contractor or his authorized representative shall be present in his own office at all times while the work is in progress.
- 12.4** The Contractor shall submit the layout drawing of the site office of the Consultant for his approval before the start of the construction. The site office for the Consultant's Representative shall be insulated, and painted internally and externally.
- 12.5.** Water and electrical power supply to the site office of the Consultant's Representative shall be provided and the monthly consumable shall also be paid for by the Contractor for the duration of the Contract. The offices shall be well lighted, equipped with wall receptacles, ceiling fans and air-conditioners with temperature control capable of maintaining a constant temperature. The Contractor shall provide all wiring, receptacles and fixtures in accordance with relevant codes and regulations. Offices, in general, shall comply with local building ordinances and be provided with all necessary fire extinguishers and an approved first-aid kit.
- 12.6** The Contractor shall provide in the Site Office of the Consultant's Representative one telephone lines, and provide a broadband e-mail system by LAN and maintain it in good working order for the use of the Consultant as required. The installation and maintenance cost shall be borne by the Contractor till the completion of the project.
- 12.7** The site office of the Contractor, as well as the Consultant, shall be air conditioned, equipped with desk and chairs, computers, laser jet printer, photocopier, telephone and fax machine.

This equipment installed at the consultant office shall be handed over the Client under a good condition.

12.8 Prior to the construction of storage areas, offices, workshops and residence, the plan shall be submitted and approved by the Consultant. Workshops shall not be an obstacle to the movements of the general public, shall not cause noise pollution and shall be aesthetically acceptable. The area shall be kept clean at all times. If the Contractor provides living accommodation for those employed by him, the dwellings shall be maintained in a clean and sanitary condition. Each dwelling unit shall be provided with lights, water supply and sanitary facilities and properly furnished.

12.9 One of the site offices to be constructed for the Consultant's Representative shall have enough space for two (2) Consultant's Engineers and for one (1) staff of the Client and furniture specified below for their own use.

- (1) Three (3) sets of writing desk with chair
- (2) One (1) filing cabinet
- (3) One (1) Living room set
- (4) One (1) Air conditioner
- (5) One latest model of laptop computers for the Client
- (6) Safety equipment: hard cap, safety shoes, coat and etc.

In addition, a meeting room shall also be arranged in one of the site offices for the use of the Consultant and one set of meeting table with chairs and white board shall be furnished therein.

12.10 The Contractor shall keep at the Site of Work, in good order, one copy each of all Drawings and Specifications including all instructions and graphs and relevant articles of JIS or other standards and make this available to the Consultant whenever requested.

13. Temporary Construction Works

13.1 Within a reasonable time (and in any case not less than 14 days) before he commences construction of any of the Temporary Facilities, the Contractor shall submit full particulars, including drawings, of the same for approval of the Consultant. The submission and approval by the Consultant of any such particulars shall not relieve the Contractor of his responsibility for the sufficiency of the Temporary Facilities or his other duties and responsibilities under the Contract. The Contractor shall make safe and reinstate all areas affected by the Temporary Facilities.

- 13.2** The Contractor shall be responsible to ensure uninterrupted water service, power supply irrigation water service and tele-communication during the course of the construction. This will be accomplished through careful sequencing of the Contractor's construction activities, and also the installation, operation and maintenance of any such temporary facilities (e.g., pumps, generators and storage tanks) at the Contractor's sole expense as are necessary to provide such uninterrupted service.
- 13.3** The Contractor is responsible to supply, construct, and afterwards remove, all such temporary facilities as may be required to provide continuous service during the construction period. This includes any additional temporary site piping, temporary pumping and storage facilities, temporary treatment facilities, temporary electrical power, temporary cooling, temporary heating, temporary lighting and temporary ventilation. The cost for any such temporary arrangements and facilities is deemed to be included in the Contractor's quoted rates for other items of work.
- 13.4** The Contractor shall not interrupt the main water supply to the existing service area for a period exceeding 24 hours during the construction period.
- 13.5** The temporary electric power required at the beginning stage of the construction for execution of the Work at the Site shall be provided by the Contractor at the Project site. Arrangement of wiring for electric power shall be made by the Contractor at his own cost and costs for electricity consumption shall be paid by the Contractor.
- 13.6** Any temporary water required at the beginning stage of the construction for execution of the Work at the Site shall be provided by the Contractor at the Project site. The arrangement of piping for temporary water shall be made by the Contractor at his own cost.
- 13.7** The Contractor shall be allowed to construct open storage yards, warehouses, pre-fabrication huts, laborer's huts and laborer's lodges at his own cost, if necessary, on the space/ground, which will be provided in each job site by the Client. The contractor shall install a temporary fence at road side of the expansion area.

14. Removal of the Existing Equipment

The equipment removed by the Contractor shall be stored or transported away as directed by

the Consultant. The equipment to be stored shall be kept in a neat and orderly manner and without causing any obstruction.

15. Protection of the Existing Facilities

The existing landfill site is being operated for solid waste collection in service area. The Contractor shall take necessary care of the existing facilities and be responsible for promptly repairing any damage occurring to the existing structures and facilities on the property of the Client, as a result of the operations by the Contractor. Any such damage occurring shall be promptly repaired to the satisfaction of the Client at the cost of the Contractor.

16. Earthworks and Site Preparation

16.1 The Contractor shall undertake a survey of all construction sites as the need arise. The results of the survey shall be incorporated in the “As-Built” drawings.

16.2 If necessary, the Contractor shall carry out geological preparatory study by own budget. For each trial hole, the Contractor shall furnish a written report together with borehole logs and a neat sketch of the data uncovered including:

- (1) soil characteristics;
- (2) utilities uncovered, materials, sizes, dimensions and depths;
- (3) any other observations, a historical remain and a grave etc.

16.3 On all Contract construction sites, the Contractor shall remove all trees and shrubs that interfere with the placement of new facilities to be constructed, regardless of whether such trees or shrubs are indicated on the drawings. The remaining areas shall be left in their natural state. Compensation to the Contractor for any such removal work is considered to be included in the Contractor’s other rates for site work.

17. Site Investigation and Representation

The Contractor shall acknowledge that he has satisfied himself as to the nature and locations of the Work, the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of equipment and materials, availability of labor, water, electricity, road and uncertainties of weather, or similar physical conditions at the Site, the confirmation and conditions of the ground, the character of equipment and materials

needed prior to and during the prosecution of the Work and all other matters which can in any way affect the Work or the cost thereof under this Contract.

The Contractor further shall acknowledge that he has satisfied himself as to the character, quality and quantity of surface materials to be encountered from inspecting the site, all exploratory work done based on the drawings and specifications made a part of this Contract.

Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the Work.

The Contractor shall warrant that as a result of his examination and investigation of all the aforesaid data that he can perform the Work in a good and workmanlike manner and to the satisfaction of the Client. The Client assumes no responsibility for any representations made by any of the Contractor's officers or agents during or prior to the execution of his Contract.

Representations for which liability is not expressly assumed by the Client in the Contract shall be deemed only for the information of the Contractor.

18. Shop Drawing

18.1 The Contractor shall prepare the shop drawings at his own expense and submit approximate 45 days before the start of any work as described in **ANNEX III-1-1**. Documents shall be submitted before the start of any work with such promptness as to cause no delay in his own work. Three (3) copies unless otherwise required, of all shop or setting drawings, fabrication of equipment and material, as well as schedule required for the Work of the various trades shall be submitted to the Consultant for approval, and the Consultant shall inspect them with reasonable promptness, making desired corrections.

18.2 Before submitting any shop drawings for approval, the Contractor shall check for accuracy all the drawings. The contractor shall control that all works indicated in the shop drawings is precisely and distinctively illustrated, and that the work shown on the drawing is in conformity to the Contract requirements.

18.3 Shop drawings shall be numbered consecutively and represent:

- (1) All working and assembling dimensions
- (2) Arrangements and sectional views
- (3) Necessary details, including complete information for making connections with other work

(4) Kinds of materials and finishes

Shop drawings shall be dated and contain (i) name of project, (ii) descriptive names of equipment, materials and classified item numbers, (iii) the signature of the Contractor's Project Superintendent.

18.4 The Contractor shall submit three (3) sets of prints of shop drawings to the Consultant for approval. Satisfactory shop drawings will be so identified by the Consultant, dated, and one copy thereof returned to the Contractor. Should the shop drawings be disapproved by the Consultant, one set of such shop drawings will be returned to the Contractor with necessary corrections and changes to be made as indicated.

- (1) The Contractor shall make any required corrections and changes and resubmit the shop drawings, in duplicate until the Consultant's approval is obtained.
- (2) Upon receipt of approval, the Contractor shall insert the date of approval on the tracings and promptly furnish the Consultant with three (3) additional prints of the approved drawings.
- (3) No work called for by the shop drawings shall be executed until the Consultant's approval is given.
- (4) If the shop drawings show variations from the Contract requirements because of standard shop practices or any other reasons, the Contractor shall make a specific request of such variations in his letter of submittal.

19. Permits and Licenses

All construction permits and licenses necessary for the execution of the Work or for any temporary work or casements in relation thereto should be secured, and the corresponding required fees paid for by the Contractor. The Client shall assist the Contractor in the negotiations and procedures with the various authorities and public and private organizations for the execution of the Work, if and when necessary.

The Contractor shall be only responsible for the actions taken by him, should the construction be started before acquiring the necessary permits and licenses.

20. Traffic Control

20.1 The Contractor shall obtain all necessary approvals from the appropriate authority having jurisdiction over the road, traffic police, and the Consultant for, and prior to implementation

of, all traffic control operations.

- 20.2** The Contractor shall take all necessary precautions and provide all necessary traffic diversions including watching, lighting, temporary barriers, temporary signals etc., all to the approval of the Consultant and the relevant authorities at no additional cost to the Client.

21. Project Signs

The Contractor shall provide a name board for the project signs and locate it on the Site where required by the Client. The extent of the lettering on the name board shall be directed by the Consultant and/or the Client. Signs other than the said name board may be installed with the approval of the Consultant and/or the Client.

22. Material and Workmanship

- 22.1** All imported products shall be in the name of the Client and originals of all test certificates including the guarantees and warranties with the Client named as the beneficiary shall be submitted to the Consultant at the time of delivery of all such products to site.
- 22.2** The tests carried out by the Consultant are intended solely to check on the acceptability of materials and work completed. If the Contractor requires additional or more frequent testing to be undertaken to reduce the risk of his work being rejected by the Consultant, then this shall be carried out, as the Contractor deems necessary.
- 22.3** All materials and components shall be of good quality, appropriate to the class of work involved, and shall be in full accordance with the Contract requirements. The materials and components used in the execution of the Work shall comply with the Specifications unless otherwise specified or ordered by the Consultant. The Consultant may alter the specified standard when he deems it more appropriate for the Work to do so. Workmanship shall be of high standard and shall conform to the detailed requirements of the Specifications and the appropriate sections of any applicable standards.

23. Storage of Materials

- 23.1** The Contractor shall allot suitable space to sub-contractors for storage of their materials and for

erection of their sheds and tool houses.

- 23.2** All cement, lime and other materials affected by moisture shall be stored on platforms and protected from the weather. Materials shall be so stored as to insure the preservation of their quality and fitness for the Work. Stored materials shall be located so as to facilitate prompt inspection.
- 23.3** Should it be necessary at any time to move materials, sheds, or storage platforms, the Contractor shall do so at his own expense.

24. Defective Materials

All materials not conforming to the requirements of these Specifications shall be considered as defective. No defective materials, unless the defects of which have been subsequently corrected, shall be used until the approval by the Consultant has been given. Upon any failure on the part of the Contractor to comply forthwith to any order of the Consultant made pursuant to the provisions of this article, the Consultant shall have authority to remove and replace defective materials and to deduct the cost of removal and replacement from any money due or to become due the Contractor.

The apparent absence of the Specifications, Drawings, Special Provisions and Supplementary Specifications, as to any detail or description concerning any point shall be regarded as meaning that only the best general practice is to prevail and that only materials and workmanship suitable to execution of the Work are to be used.

25. Manufacturer's Directions

All manufactured articles, materials, equipment, appliances, fixtures and fittings shall be applied, installed, connected, erected, used, cleaned and conditioned, in accordance with manufacturer's printed directions, unless herein specified in the Contract. Where reference is made to manufacturer's directions, the Contractor shall submit specified number of copies of such directions to the Consultant.

26. Site Test

The installation inspection such as appearance and dimensions at the site shall be performed in

accordance with the manufacture's standards approved by the Consultant. The test results shall be submitted to and approved by the Consultant.

27. Final Inspection at the End of Warranty Period and the Contractor's Support

The Contractor shall warrant all the Works to be executed in accordance with the Contract Documents for a period of one (1) year from the date of certificate of completion of the Work. The Consultant shall execute the final inspection within thirty (30) days before the termination date of the warranty period, whether the completed system have any defects or not, if necessary. The Contractor shall assist the Consultant's final inspection including tests with the Contractor's manpower or his cost, if the Consultant requests to the Contractor.

28. Nameplates

On the completion of the project, the Contractor shall provide and submit his proposal on the nameplate as shown below in front of each facility to the Consultant for his approval.

29. Cleaning Up at Completion of the Work

The Contractor shall at all times keep the premises free from waste materials or rubbish caused by his employees or work. At the completion of the Work he shall remove all rubbish from and about the Site including tools, scaffolding and surplus materials and turn over the Work for occupancy with:

- (1) All dirt, stains and the like on all finishing of floors, walls and ceilings, decorative work, finishing hardware and fixtures, removed;
- (2) All woodwork, finishing hardware and all metal works, cleaned and polished;
- (3) All glazing, marble and tile work, washed and polished.

The Contractor shall also clean the building site and all areas which the Contractor used in the operation of the Project.

30. Plans and Documents Submission

The plans and documents certifying the work performance shall be submitted not only as shown below but as and when required by the Consultant.

31. Record Documents

31.1 The Contractor shall maintain one record copy of all Drawings, Specifications, Addenda, Variations, Approved Submittals, Correspondence and Transmittals at the Site in good order and readily available to the Client, the Consultant and the Consultant's representative.

31.2 In addition to the requirements of the Technical Specifications, Record Documents shall be clearly and correctly marked and the Record Specifications annotated by the Contractor to show all changes made during the construction process at the time the changed Work is installed and the Works as executed complete with:

Landfill Site

- (1) existing & finished levels of the ground
- (2) actual cross sections and vertical section of the site after earth work;
- (3) retaining wall details;
- (4) pavement details of access road;
- (5) details of net fence and guard fence;
- (6) details of rain water drainage equipment;
- (7) details of geomembrane liner;
- (8) details of leachate collection pipe materials and bedding;
- (9) details of leachate pond;
- (10) sizes and types of gas exhaust pipe;
- (11) any other information requested by the Consultant.

Waste Transfer Station (TS) & Material Recovery Facility (MRF)

- (1) existing & finished levels of the ground
- (2) retaining wall details;
- (3) pavement details of access road;
- (4) details of net fence and guard fence;
- (5) details of rain water drainage equipment;
- (6) details of building;
- (7) any other information requested by the Consultant.

31.3 Draft Record Documents shall be submitted to the Consultant for his approval, and then finalized in accordance with any amendments required by him. Record Document submission shall be as specified in the Specifications and shall include:

- (1) three (3) bound sets of “As-Built “ Record Drawings on paper to A3 size;
- (2) two (2) sets of compact disks containing the record drawings and all operation and maintenance manuals in MS Word and AutoCAD, or other approved format. The Consultant will make available to the Contractor an electronic copy of the tender drawings and specification;

31.4 Each drawing shall have the Contract Number & Drawing Number detailed to the approval of the Consultant

31.5 The Contactor shall submit the Final Record Documents to the Consultant and the Client with hard copy and soft copy (data).

31.6 No final payment shall be made except for the work that has been completed in accordance with the Specification and has been duly presented on the “As-Built” Record Documentation. The Contractor shall not be entitled to any extra payment or extension of time for the preparation or changes thereto of the As-Built Record Documentation.

32. As-Built Drawings

32.1 The Contractor shall maintain one (1) set of photocopy of all Works on the Site. These prints shall be marked and updated to indicate current job progress and shall show deviations from the construction Drawings. These Drawings shall show the Work as actually built and implemented, showing all sizes, locations, etc.

32.2 After inspection, the Contractor shall transfer all the as-built information such as drawings and manuals of three (3) sets of hard copies and soft copies (Not only PDF data but also data of word, excel and Auto-CAD).

33. Photographs / Video Requirements

Prior to beginning of construction, initial photographs shall be taken prior to construction. Sufficient numbers of photographs shall be taken of the construction sites to record the existing conditions prior to construction.

(1) For the monthly progress, the Contractor shall furnish colour presentation prints. The

contractor at his own expense shall submit once a month, or as the Consultants find suitable, suitable number of colored photographs in 3 copies (size 10x15 cm) for the executed works or works under progress as directed by the Consultant. The original film negative and all copies shall be the ownership of the owner, and the photos can't be use without his approval.

- (2) For the completion record, whole-view photo of about A4 size shall be attached.
- (3) Digital data of photograph shall be also submitted. The format and media shall be proposed by the Contractor and approved by the Consultant.
- (4) The contractor shall take video of major construction stage and submit it to the Client after editing.

34. List of Submittals

The Contractor shall submit a list of all submittals showing the forecast date for submission of each item at the commencement of the Contract. Extension of time will not be granted because of the Contractor's failure to make timely and correctly prepared and presented submittals with allowance for checking and review periods. Unless otherwise specified, initial submittals shall be made within 28 days from the commencement of the Contract.

35. Letter of Submittal

The submission of the shop drawings shall be accompanied by a letter of transmittal in duplicate, containing name of project, Contractor's name, number of drawings, titles, and other pertinent data.

36. Environmental Management Plan

The project will cause some environmental and social adverse impact during construction stage as shown in Table 1 which was estimated by the Consultant at the preparatory survey of the project. The Contractor shall prepare the Environmental Management Plan (EMP) to mitigate these impacts. The Contractor shall prepare the Construction plan detailing the mitigation measures for above adverse impacts and shall submit it to the Consultant. The mitigation measures shall be monitored by the Jericho JC.

Table 1 Estimated Adverse Impact during Construction

Social and Environmental Elements	Estimated Adverse Impact
Transfer Station/ Material Recovery Facility	
Preservation of health	Some infectious diseases such as HIV/AIDS is estimated.
Air pollution (construction)	Heavy machines activities will generate dusts
Noise/vibration	Heavy machines activities will generate noise / vibration
Final Disposal Site	
Preservation of health	Some infectious diseases such as HIV/AIDS is estimated.
Air pollution (construction)	Heavy machines activities will generate dusts
Noise/vibration	Heavy machines activities will generate noise / vibration

37. Safety Work Management

37.1 General

The Contractor has a responsibility to conduct any management activities on risk and educate all their employees about the risk awareness and the occupational safety and health.

37.2 Importance of Safety Work Management

Work activity often has accidents resulting in injury or death. Thus, safety work management shall be thoroughly conducted, advocated, and educated.

37.3 Workers Clothes

The work site has a lot of items that can cause accidents such as rotating pump motors, many electric wires and easily sliding concrete bases. Thus, workers should wear helmets, working shoes, and gloves, etc. during working hours.

37.4 Safety Measures

Especially, each work activity shall be signaled with the loud voice. This performance may prevent accidents before they happen.

37.5 Cleanliness and Arrangements

If construction equipment and materials in the work sites are in disorderly condition, accidents may happen. The field superintendent should always keep clean and neatly arrange sites in mind and secure the safety working area.

37.6 Sanitary Condition Management

The field superintendent shall manage and maintain the sanitary condition of the sites and their living condition for the worker to prevent the absence of working teams due to the illness. In addition, the superintendent shall provide a first-aid kit to treat accidental injuries.

37.7 Antitheft

The Contractor has to keep all material and equipment for the construction in the antitheft store.

38. Site Meetings

During executing the works and on a periodical base, site meetings shall be held every 2 weeks or whenever needed for the purposes to coordinate the works and to be sure that it is properly executed according to contract conditions and technical specification. Minutes of the meetings shall be prepared by the Consultant or his representative and distributed to all parties and it shall be followed.

The contractor shall present in the meeting detailed of the works intended to be executed in the next two weeks, which shall be discussed and proper instruction shall be given, and these instructions and approval issued in the meeting shall be followed by the contractor.

39. Daily Reports

The contractor shall submit to the Consultant (or his representative) a daily report containing the required information on the labor (Nos & types), equipment and materials arrived to the site and works executed in that day.

40. Work Schedules

The contractor shall prepare (in 3 copies) and submit schedule of the work including all tasks of the subcontractors any works in the contract condition. The contractor shall keep a copy in his site office and submit 2 copies to the Consultant.

The contractor has to make monthly (or as the Consultants see necessary) adjustment to the schedule according to site conditions and progress of works. Two copies of the revised schedule shall be submitted to the Consultant.

41. Handing Over Works and Removing Residuals





The contractor must hand over all works clean and insure removing all materials or construction residuals or rejected materials or remains in the site in general or in the buildings or nearby. The completion of the works as explained here shall be on the contractor's expense and according to

the Consultant's approval. If the contractor didn't fulfil this obligation, the Consultant has the right to execute these works on the contractor expense and deduct it from the contractor payments or insurance.

ANNEX III-1-1. Documents to be submitted

<u>Document/Plan</u>	<u>Date of Submission</u>	<u>Number</u>	<u>Remarks</u>
1. Work progress schedule	Within 14 days award of contract	3	CPM Network
2. List of sub-contractors Involved	Within 14 days award of contract	3	
3. List of manufacturers	Within 14 days award of contract	3	
4. Preliminary Construction Plan	20 days after award of contract	3	- Project office - Site office - Stock house - Construction equipment
5. Shop drawings	15 days before commencing respective work	3	
6. Monthly report	Not later than tenth (10th) of each month	6	Progress chart, gap between actual progress and scheduled, problems to require the Consultant's attention, Photographs
7. Minutes of meetings	Immediately after each meeting	1	
8. Request for approval	Each time 1) Shop drawing 2) Completion of each installation work 3) Completion of as-built drawing 4) Final inspection 5) Delivery of equipment and materials 6) Completion certificate 7) Certification for each payment	1	
9. As-Built drawing	Within 20 days after completion of construction	3 1	Photocopy Digital data on CD or DVD
10. Completion report	Within 30 days after completion of construction	3	
11. Others (Shop test & site test, etc.)	Each time	3	Submittals are designated in each clause.

ANNEX III-1-2. Current Site Pictures

Photo-1 :	Photo-2 :
	
Note) Existing Landfill Site in Jericho (1) Signboard (1)	Note) Existing Landfill Site in Jericho (2) Signboard (2)
Photo-3 :	Photo-4 :
	
Note) Existing Landfill Site in Jericho (3)	Note) Existing Landfill Site in Jericho (4)
Photo-5 :	Photo-6 :
	
Note) Existing Landfill Site in Jericho (5) Personnel Office and Truck Scale	Note) Existing Landfill Site in Jericho (6) Existing Leachate Pond

<p>Photo-7 :</p> 	<p>Photo-8 :</p> 
<p>Note) Existing Landfill Site in Jericho (7) Planned construction site for TS and MRF (1)</p>	<p>Note) Existing Landfill Site in Jericho (8) Planned construction site for TS and MRF (2)</p>
<p>Photo-9 :</p> 	<p>Photo-10 :</p> 
<p>Note) Planned construction site for the Landfill (1)</p>	<p>Note) Planned construction site for the Landfill (2)</p>
<p>Photo-11 :</p> 	<p>Photo-12 :</p> 
<p>Note) Planned construction site for the Landfill (3)</p>	<p>Note) Planned construction site for the Landfill (4)</p>

ANNEX III-1-3. Soil Investigation Result

Interpretive Ground Investigation Report

At

Jericho Solid Waste Landfill

Submitted to

NJS Consultants Co. LTD

On behalf of

JICA

Job No. SI-12-058

April 2012

Alquds Center for Civil and Environmental Engineering studies

Al-Medan St

Al-Bireh


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Site Investigation Report for Proposed Solid Waste Landfill in Jericho SI-12-058	Page: Page 2 of 26 Revision: 01 Date: 28/04/2012
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	Title, Company	Name	Signature	Date
Originator	General Manager, Ziad Adi	Ziad Adi		28/04/2012
Approved	General Manager, Ziad Adi	Ziad Adi		28/04/2012

Document Revision History:

01	28/04/2012	Z. Adi	-	-
Revision	Date	By	Section Amended	Details of Amendments

Messrs.: NJS Consultants Co. LTD

Subject: Site Investigation Report for Proposed Solid waste Landfill in Jericho.

Dear Sir,

It is of our pleasure to submit you this geotechnical report for the site mentioned above.
This investigation was carried out according to your request.

This report includes the results of field investigation, laboratory results, and the required conclusions recommendations needed for design & construction of the most safe and economical foundation.

For any further information or clarifications, please don't hesitate to contact us.

Yours Sincerely,
General Manager
Eng. Ziad Adi

EXECUTIVE SUMMARY

Alquds Center for Civil and Environmental Engineering Studies (ACCEES) was commissioned by NJS Consultants Co. LTD to undertake a ground investigation at the site of the proposed Solid Waste Landfill in Jericho.

The purpose of the investigation was to provide geotechnical information on the subsoil to aid in the design of the wastewater treatment plant.

Six boreholes were sunk to a maximum depth of 10.0 meters below ground level (mbgl). Selected soil samples were submitted to our geotechnical laboratory for both geotechnical and contamination analysis.

Stratigraphic records from the boreholes indicate that at the location of the proposed building the ground is underlain by CLAYEY soil and WADI material.

The permeability of the existing soil ranges from 6×10^{-6} to 1×10^{-8} . Thus, the natural existing soil could not be considered a natural barrier for the control of leachate draining into the groundwater. Thus, it is recommended to design a geotextile barrier for the control of leachate.

Groundwater was not encountered at any of the boreholes. However, according to information gathered from different sources, the site is underlain by an aquifer with a substantial source of groundwater.

Qualitative seismic analysis was undertaken using previous information about the site and using UBC code and the site was found not to inhibit any serious risk of seismic activity. The estimated ground peak acceleration that should be used is 0.20g.

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1.0 INTRODUCTION

This report includes the final results of the foundation ground inspection at the location of the proposed solid waste landfill in Jericho.

2.0 PURPOSE OF STUDY

The aim of this study is to determine the physical and mechanical properties of the subsurface soil to provide the structural engineer with information needed for safe and economical foundation design and construction. This report provides information relating to the allowable bearing capacity of the soil recommended as foundation ground, recommended foundation depth and type, expected elastic settlement of soil under foundations, safe side slope excavation, suitable backfill material, geotechnical consideration for earthquake design and other recommendations that would result in safe structure.

3.0 SCOPE OF WORK

The work undertaken consisted of the following:

1. Collecting general information such as site plan, geological maps, topographic maps and other information related to the site.
2. Undertaking site visits in order to collect information about site nature, topography of the site, geological features and other properties concerning the project site.
3. Drilling three boreholes and sampling of disturbed and undisturbed samples.
4. Carrying out necessary field and laboratory tests.
5. Performing classification and description of the sampled soil.
6. Analysis of field and laboratory tests results.
7. Developing comprehensive conclusions and recommendations for design and construction of the most safe and economical foundation system.

4.0 GEOTECHNICAL EXPLORATION & FIELD TESTING

4.1 Borehole Schedule

Table 1 shows the finished drilling program of the boreholes within the plot:

Table 1: Finished Drilling Program of Boreholes

Borehole No.	Depth	Date of drilling	Location	Elevation*
BH 1	10.00	09/04/2012	See Appendix A	-322.88
BH 2	10.00	09/04/2012		-327.96
BH 3	10.00	09/04/2012		-319.60
BH 4	10.00	09/04/2012		-321.52
BH 5	10.00	09/04/2012		-321.70
BH 6	10.00	09/04/2012		-321.80

* This level is at the level of the existing excavation.

4.2 Methods of Sampling

Samples were obtained continuously from the boreholes every half meter or when change in the sampled soil was detected. Down the hole hammer was used at layers of hard bands of rock or highly cemented soil were encountered.

The collected samples were placed in waterproof plastic bags to keep their moisture content, and then they were placed in proper sequence in wooden boxes. These samples were taken to our laboratory to be classified and described by our geological and geotechnical engineers.

5.0 RESULTS OF LABORATORY TESTING

5.1 Laboratory Testing

After carrying out the geological description on the obtained samples, a laboratory tests program was issued. The program included all required tests on selected samples in order to determine the physical and mechanical properties of the encountered materials. The following tests were performed in accordance with **American Society for Testing and Materials (ASTM)** Standards listed below:

- 1. ASTM D 2488-93**, “Description and Identification of Soils (Visual-Manual Procedure).
- 2. ASTM D 2216-92**, "Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures"
- 3. ASTM D 1586**; “Standard Test Method for Standard Penetration Test”
- 4. ASTM D 3080**, “Standard Test Method for Direct Shear”
- 5. ASTM D 6913**, “Standard Test method for Particle-size Distribution”
- 6. ASTM D 2434**, “Standard test Method for Permeability”
- 7. ASTM D 4318**, “Standard test Method for Liquid Limit, Plastic Limit, and Plasticity Index for Soil”

5.2 Laboratory Tests Results:

- **Visual Description:**

The ground is underlain by:

- CLAYEY SOIL
- WADI material

- **Moisture Content:**

- The moisture content of the CLAYEY soil ranges from 21.4% to 32.6%
- The moisture content of the WADI material ranges from 10.7% to 19.3%

- **Liquid Limit**

- The Liquid Limit for the CLAYEY soil ranges from 32.2 to 43.3
- The Liquid Limit for the WADI Material ranges from 35.7 to 44.9

- **Plastic Index**

- The Plastic Index for the CLAYEY soil ranges from 10.4 to 17.4
- The Plastic Index for the WADI material ranges from 9.7 to 15.2

- **Cohesion of soil**

- The cohesion of the CLAYEY soil ranges from 38 KN/m² to 41 KN/m².
- The cohesion of the WADI material ranges from 36 KN/m² to 39 KN/m².

- **Angle of friction**

- The angle of friction of the soil ranges from 14° to 16°
- The angle of friction of the WADI material ranges from 15° to 17°

- **The permeability**
 - Permeability of the CLAYEY soil ranges from 3×10^{-7} m/s to 1×10^{-8} m/s
 - Permeability of the WADI material ranges from 6×10^{-6} m/s to 3×10^{-7} m/s

6.0 Ground Water and Cavities

Groundwater was not encountered at any of the boreholes. No cavities were encountered in any of the boreholes.

7.0 CONCLUSIONS AND RECOMMENDATIONS FOR FOUNDATION SYSTEM.

According to field exploration, laboratory testing, subsurface conditions, and engineering analysis, it can be concluded that the existing ground at the site can support the expected building loads, provided that the following recommendations are strictly followed.

7.1 Foundation Ground, Depth & Type

Foundation Ground:

According to our findings and the encountered materials, the clayey soil and wadi material shall not be considered as a natural barrier for the control of leachate draining into groundwater. Thus, it is essential to design a geotextile barrier for the landfill.

7.2 Allowable Bearing Pressure

The allowable bearing capacity for the MARL is calculated using Terzaghi's equation. By applying a factor of safety (F) to the unconfined compression strength of the intact samples as expressed:

$$q_{ult} = 1.3N_c c + qN_q + 0.4B\gamma N_\gamma$$

$$q_{net} = q_{ult} - q$$

$$q_{all} = q_{net}/FS$$

Where:

q_{ult} = Ultimate bearing Capacity;

q_{net} = Net bearing Capacity ;

q_{all} = Allowable bearing Capacity

FS = Factor of Safety.

c = cohesion of soil =

$q = \gamma D_f =$

γ = unit weight of soil

D_f = Depth of bottom of footing from ground level

B = width of footing

N_c, N_q, N_γ = bearing Capacity factors

Table 2: Bearing Capacity of soil

Soil Type	BH #	c	ϕ	q_{ult} (KN/m ²)	q_{net} (KN/m ²)	FS	q_{all} (Kg/cm ²)
Clayey soil	1	41	14	855	807	4	2.06
	2	41	14	855	807	4	2.06
	3	39	15	885	837	4	2.13
	4	40	14	839	791	4	2.02
	5	38	16	935	887	4	2.26
	6	39	15	885	837	4	2.13
Wadi Material	1	39	15	900	849	4	2.16
	2	36	17	991	940	4	2.40
	3	36	17	991	940	4	2.40
	4	38	15	883	832	4	2.12
	5	37	16	934	883	4	2.25
	6	39	15	900	849	4	2.16

7.3 Settlement Determination

In general the settlement of any foundation can be divided into two major categories:

- a) Elastic or Immediate Settlement: which takes place during or immediately after the construction of the structure.
- b) Consolidation Settlement: this occurs over time.

The elastic settlement of a footing after application of load can be computed from the theory of elasticity equation:

$$\Delta H = q \cdot B \frac{(1 - \mu^2)}{E_s} I_w$$

Where:

ΔH = settlement;

q = intensity of contact pressure in units of E_s ;

B = least lateral dimension of footing in units of ΔH ;

I_w = influence factor, Table (5);

E_s, μ = elastic properties of rock, (Poisson's ratio μ is assumed; (0.15-0.25).

7.4 Modulus of Elasticity Determination

The modulus of elasticity for the CLAYEY soil is 780 Kg/cm².

The modulus of elasticity for the WADI material is 785 Kg/cm².

The modulus of elasticity for the basecoarse material is 875 Kg/cm².

7.5 Modulus of Sub grade Reaction Ks

The modulus of sub grade Reaction Ks for the CLAYEY soil is 390 Kg/cm³.

The modulus of sub grade Reaction Ks for the CLAYEY soil is 392 Kg/cm³.

The modulus of sub grade Reaction Ks for the CLAYEY soil is 392 Kg/cm³.

7.6 Excavation Methods:

It is expected that the excavation will be through CLAYEY soil and WADI material. Therefore, machine mounted jack hammers with compression and rock breakers in

addition to the conventional excavation equipment such as loaders and dozers will be needed for the excavation works.

7.7 Surface & Subsurface Drainage:

It is recommended to protect the foundation ground and excavation from surface water both during and after construction by providing proper drainage and protection system. Surface water, if existed, should be diverted away from the edges of the excavations. The side walk should be extended beyond the building line for a distance of at least 2.5 meters in every direction. A slope of 1.5 cm in 100 cm is suggested to allow proper drainage.

However, the slab on grade and the foundation system shall be isolated using a proper isolation material. This material shall be selected by the supervisor engineer according to the required specifications.

7.8 Material for Backfilling Purposes:

CLAYEY soil and WADI material excavated is not suitable for backfilling material.

1) The materials to be used for backfilling purposes shall be a soil or soil-rock mixture which is free from organic matter or other deleterious substances. It shall not contain rocks or lumps over 15 cm in greatest dimension, and not more than 15 percent larger than 7 cm. The Liquid limit and plasticity index for the backfill material shall not be more than 35 % and 10 %, respectively.

2) Selected backfill material should not contain more than 25% of fine materials pass sieve #200 (particle size =0.075 mm).

3) It shall be spread in lifts not exceeding 25 cm in uncompacted thickness, moisture conditioned to its optimum moisture content, and compacted to a dry density not less than 95 percent of the maximum dry density as obtained by standard proctor compaction test (**ASTM D 698**).

4) Foundation must be safe against overturning, rotation, sliding or soil rupture; especially for retaining walls. The following parameters for wall design are suggested:

- Height of fill to be retained by the wall (1-3.0 m).
- If surcharge loads are available, take it in consideration.
- Weight of earth (γ) = 1.80 ton/cu.m, fill is level (fill is non expansive soil-selected engineering fill).
- Angle of internal friction (ϕ) = 30 degrees and cohesion (c) = 0.5 Kg/Sq.cm. (For more safety)
- Angle of friction between soil and base slab (δ) = 22 deg.

7.9 Earth Pressure

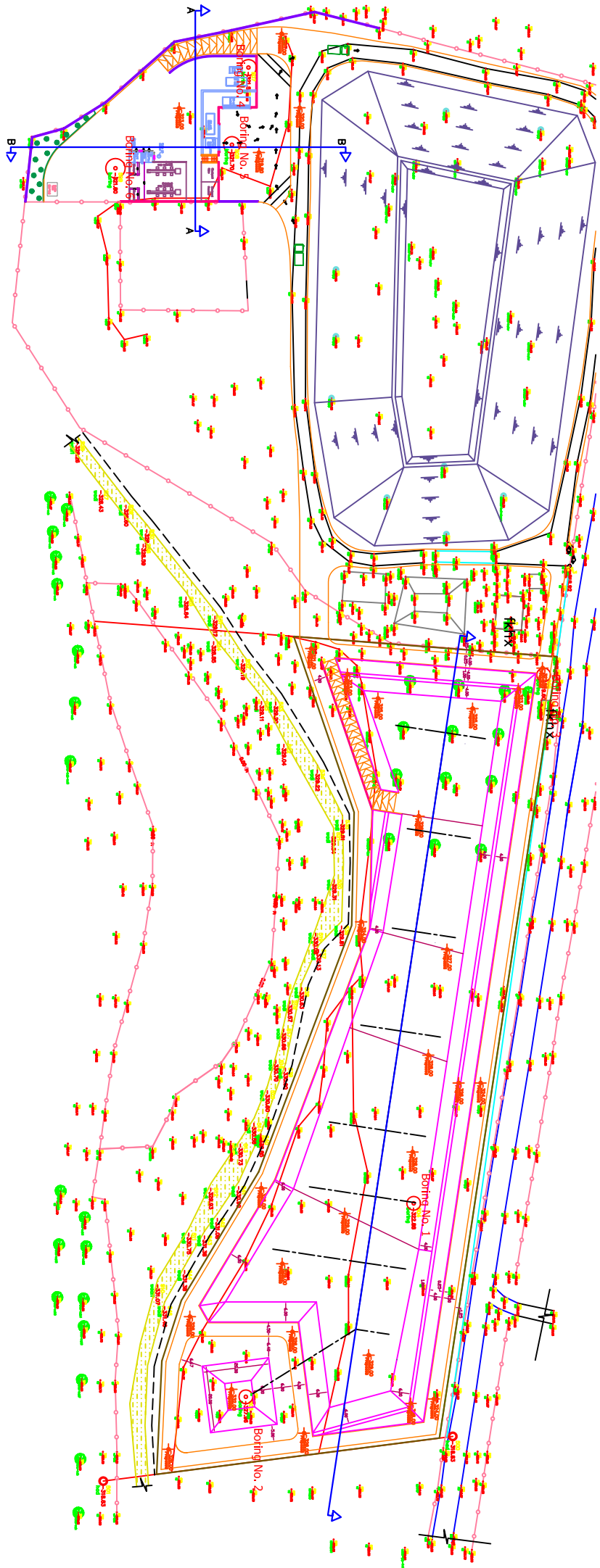
The underground basement walls of the building, if any, shall be designed for an equivalent fluid pressure of 0.8 gm/cm^3 (800 kg/m^3) plus a uniform lateral pressure which corresponds to the maximum expected surface loads.

7.10 Site Seismicity:

- Peak Ground Acceleration: $\text{PGA} = 0.3g$
- Soil Profile = S_E
- $C_a = 0.36$
- $C_v = 0.84$

Appendices

Appendix A – Site Plan and Location of Boreholes



Appendix B – Borehole Log

AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 1	Ground Level	-322.88
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00	7	15	18	33	CLAY	Brownish CLAYEY soil with organic material	-0.00	-322.88	32.6	14.1	32.2	18.6	13.6	41	14	A-6	OL	3*10-7
	1.00							-0.60	-323.48										
	2.00									19.3	17.7	41.8	32.1	9.7	38	16	A-5	OL	6*10-6
	3.00																		
	4.00																		
	5.00																		
	6.00	8	17	18	35			-5.5	-328.38										
	7.00	7	12	17	29					22.4	16.5	35.9	20.7	15.2	40	15	A-6	CL	4*10-8
	8.00	8	12	19	31														
	9.00	8	14	18	32			-10.0	-332.88										

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

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Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 2	Ground Level	-327.96
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00					WADI Material	WADI material	-0.00	-327.96	15.4	16.9	35.7	25.3	10.4	39	15	A-6	CL	3*10-6
	1.00	6	14	19	33	CLAY	Grayish CLAYEY soil	-1.00	-328.96										
	2.00	7	17	17	34					25.7	15.9	35.7	20.5	15.2	38	15	A-6	OL	1*10-8
	3.00	8	15	16	31														
	4.00	7	14	15	29														
	5.00	6	16	16	32														
	6.00	8	13	18	31	CLAY	Dark grayish CLAYEY soil	-7.00	-334.96	23.1	16.2	43.3	25.9	17.4	40	14	A-7	CL	2*10-8
	7.00	7	11	17	28														
	8.00	6	11	19	30														
	9.00	8	14	18	32			-10.00	-337.96										

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

Logged By: ALA
Compiled By: ALA
Checked By: ZA

Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 3	Ground Level	-319.60
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00	8	15	16	31	CLAY	Creamy stiff CLAYEY soil	-0.00	-319.60	22.1	16.1	42.6	32.6	10.0	38	15	A-5	CL	2*10-7
	1.00	5	11	18	29			-2.50	-322.10										
	2.00	7	14	17	31														
	3.00	7	16	16	32														
	4.00	6	16	18	34	CLAY	Grayish CLAYEY soil	-5.00	-324.60	25.6	15.8	37.2	24.6	12.6	41	14	A-6	CL	4*10-8
	5.00	7	15	15	30														
	6.00	8	17	18	35														
	7.00	6	13	16	29	CLAY	Creamy stiff CLAYEY soil	-8.00	-327.60	23.9	16.0	33.5	22.3	11.2	39	15	A-6	CL	5*10-8
	8.00	7	14	18	32														
	9.00	8	14	16	30	CLAY	Dark grayish CLAYEY soil												

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

Logged By: ZA
Compiled By: ZA
Checked By: ZA

Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 4	Ground Level	-321.52
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00	7	14	17	31	CLAY	Brownish CLAYEY soil with organic material	-0.0	-321.52	23.4	16.2	40.6	26.5	14.1	41	15	A-7	OL	4*10-8
	1.00							-1.50	-323.02										
	2.00									12.1	17.5	38.9	27.3	11.6	39	16	A-6	CL	3*10-7
	3.00						WADI Material												
	4.00																		
	5.00																		
	6.00	8	13	18	31			-5.5	-327.02										
	7.00	7	12	16	28	CLAY	Dark grayish CLAYEY soil			22.4	16.4	39.7	23.0	16.7	40	14	A-6	CL	5*10-8
	8.00	8	17	17	34														
	9.00	8	13	19	32			-10.0	-331.52										

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

Logged By: AIA
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Checked By: ZA

Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 5	Ground Level	-321.70
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00	7	15	14	29	CLAY	Creamy stiff CLAYEY soil	-0.0	-321.70	23.5	12.6	37.1	24.5	12.6	41	14	A-6	CL	1*10-8
	1.00							-1.50	-323.20										
	2.00									13.4	17.5	44.9	27.7	17.2	41	14	A-7	CL	6*10-6
	3.00																		
	4.00																		
	5.00																		
	6.00	6	13	15	28			-5.5	-327.20										
	7.00	8	16	17	33	CLAY	Dark grayish CLAYEY soil			21.4	16.7	42.1	30.6	11.5	41	14	A-7	CL	3*10-7
	8.00	8	14	19	33														
	9.00	7	15	17	32			-10.0	-331.70										

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

Logged By: AIA
Compiled By: AIA
Checked By: ZA

Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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AL-QUDS CENTER for CIVIL & ENVIRONMENTAL ENGINEERING STUDIES	BORHEHOLE No. 6	Ground Level	-321.80
START DATE: 09/04/2012 END DATE: 09/04/2012	BORHEHOLE Diameter: 79 mm		

Drilling Method: Down the Hole Hammer for Disturbed Samples

DATE	DEPTH (m)	SPT				Strata		Depth (m)	Level (Relative)	Moisture Content %	Unit Weight KN/m3	LL	PL	PI	c KN/m2	φ	Soil Classification		Permeability m/s
		15	15	15	N	LITHOLOGY	Description of Strata										AASHTO	USCS	
09/04/2012	0.00	6	15	16	31	CLAY	Creamy stiff CLAYEY soil	-0.0	-321.80	23.6	16.4	35.6	25.6	10.0	40	15	A-4	CL	4*10-8
	1.00							-1.50	-323.30										
	2.00									17.2	16.4	37.2	24.8	12.4	39	15	A-6	CL	1*10-6
	3.00																		
	4.00																		
	5.00																		
	6.00	7	17	17	34			-5.5	-327.30										
	7.00	8	14	18	32	CLAY	Dark grayish CLAYEY soil			21.5	16.7	43.3	31.8	11.5	38	16	A-7	CL	3*10-7
	8.00	8	12	18	30														
	9.00	8	16	17	33			-10.0	-331.80										

Notes:
SPT = Standard Penetration Test
LL = Liquid Limit
PL = Plastic Limit
PI = Plastic Index
c = cohesion of Soil
φ = Friction angle of soil

Logged By: ALA
Compiled By: ALA
Checked By: ZA

Project: Jericho Solid Waste Landfill	Job Number: SI-12-058	Status: FINAL	Sheet Number: 1 of 1
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PART - 2
CIVIL & ARCHITECTURAL WORKS

CIVIL & ARCHITECTURAL WORKS

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Chapter 1 Common Works

1. Outline of the Facilities

1.1 Outline of the facilities

The Contractor shall follow the outline of the Facilities as described in **ANNEX III-2-1**.

2. Earth Work

2.1 Work Resources

The Contractor shall furnish all labor, equipment and materials required for undertaking earth works as herein described.

2.2 Survey and Site Preparation

Prior to any commencement of the works, the Contractor shall conduct a Resurvey/Verification of the topography of the project site and, upon request, render a report to the Consultant.

2.3 Clearing and Grubbing

The landfill site, transfer station, material recovery facility and access to these sites shall be cleared and grubbed prior to performing any excavation or placing any fill.

Clearing and grubbing refer to brush, roots, stumps, vegetation, pavement, sidewalks and surface obstructions of any kind that are required to be temporarily or permanently removed and that lie within the actual areas to be excavated.

No trees shall be felled, destroyed, or interfered with by the Contractor without the approval of the Consultant.

Except for those materials or structures that are temporarily removed and later restored at their original places, all debris, refuse, vegetation, and demolished materials shall be entirely removed from the site and disposed of by the Contractor in a satisfactory manner.

Materials and structures temporarily removed for later reinstatement and restoration shall be properly stored and protected.

2.4 Removal and Disposal of Water

The Contractor shall provide and maintain the means and equipment for dewatering and properly disposing the water entering the excavation and other parts of the Works. All excavation works shall be maintained in a dry condition and no foundation material, pipe or concrete shall be placed in water

except with the direction of the Consultant. Water shall be disposed of in a manner satisfactory to the Consultant to avoid damage to property, and inconvenience to the public. If the Contractor elects to provide under drains, these shall be subject to the Consultant's approval.

All dewatering of trenches and other excavations shall be done in a manner that will protect adjacent structures, utilities, and roadways against settlement or other damage. Any accident or damage occurring from dewatering shall be the sole responsibility of the Contractor. Review and approval by the Consultant of the procedures, designs, or activities for the purpose of dewatering shall not relieve the Contractor of his responsibility for any injury, death, or damage resulting from the use of said procedures, designs, or activities.

2.5 Surface Excavation and Restoration

Prior to excavation, the Contractor shall remove all surface materials, and properly store, guard and preserve such quantities of them as may be required for the restoration of the disturbed areas. All surfaces disturbed by the Contractor in the course of excavation and in other works areas shall be restored to their original or better condition.

2.6 Excavation

2.6.1 General

Excavation shall include the removal of all materials of whatever nature encountered including all obstructions that would interfere with the proper execution and completion of the Works. The removal of said materials shall conform to the lines and grades shown or ordered. Rock and other excavated material classified by the Consultant as unsuitable for backfill shall be removed from the site. The Contractor shall supply, place and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching or other approved measures for the removal or exclusion of water, including taking care of stormwater and wastewater reaching the site of the Works from any source so as to prevent damage to the Works or adjoining property. The walls and faces of all excavations in which workers are exposed to danger from unstable ground shall be stabilized by a shoring system, sloping of the excavation, or some other method. The Contractor shall supply, install and maintain such sheating, bracing, etc., as may be necessary to protect the workers and to prevent any movement of earth which could cause injury, delay the Works, or endanger adjacent structures.

2.6.2 Excavation beneath Proposed Concrete Structure

After the structure area has been stripped of all vegetation and debris, loam and topsoil shall be removed and stockpiled for possible later use as fill on or around the structure and for miscellaneous topsoil. Excavation under the structure shall extend to the bottom of the gravel base. After such

excavation has been completed, the exposed surface shall be rolled or tamped with heavy compaction equipment to provide a reasonably smooth surface for placement of the gravel base.

2.6.3 Protection of Existing Structures

Where necessary, hand excavation shall be employed to protect existing structures, utilities, poles, trees, pavements or obstructions.

In areas of proximity to existing fuel and gas lines or facilities, the Contractor shall exercise precaution to avoid rupturing, disturbing, or otherwise causing any damage to such lines or facilities. The Contractor shall further exercise care and precaution against the presence of fuel and gas fumes that may have permeated the soil or have been disturbed during excavation and pipeline operations.

2.6.4 Disposal of Excavated Rocks

Excavated rocks shall not be used for backfill within the excavation limits unless the fragment or boulder sizes are sufficiently small as to satisfy the backfilling requirements specified herein. Excess excavated rock shall be removed from the site.

2.6.5 Unauthorized Excavation

The Contractor shall not excavate outside of the lines and grades shown on the Drawings unless directed by the Consultant. Any unauthorized excavation shall be backfilled with suitable material as directed by the Consultant. Where, in the judgment of the Consultant, such unauthorized excavation requires use of lean concrete or crushed stone, the Contractor shall furnish and satisfactorily place such materials at no extra cost to the Client.

2.6.6 Excavation below Normal Grade

Where the depth of excavation shown on the Drawings is found to be unstable or to include muck, silt, ashes, cinders, refuse, vegetable or other organic material, which should be removed in the judgment of the Consultant, the Contractor shall excavate and remove such unsuitable material to the width and depth ordered by the Consultant.

The excavation below normal grade shall be filled with well compacted selected sandy material, gravel, or sand fill, up to the level of commencement for the bedding for the structure, as shown on the Drawings. Backfill for the excavation below normal grade shall be placed in thoroughly compacted layers, each not to exceed 150 mm in thickness.

2.6.7 Sheathing and Bracing

The soil in construction sites is basically hard and stable and there is no groundwater in the case of ground level minus 5m. Thus large scale collapse of soil is seldom considered, but since soil mass or

rock can be peeled off from the excavated surface, sheathing and bracing. The Contractor shall design, furnish, put in place, and maintain such sheathing and bracing as may be required to support the sides of excavations.

The Contractor shall leave in place, to be embedded in the backfill, all sheathing, bracing, etc. which the Consultant may direct the Contractor in writing to leave in place at any time during the progress of the Work for the purpose of preventing injury to structures, utilities, or property.

The right of the Consultant to order sheathing and bracing left in place shall not be construed as creating any obligation on the Contractor's part to issue such orders, and the Contractor's failure to exercise the Contractor's right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the Works occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheathing and bracing to prevent any caving-in or moving of the ground.

2.7 Bedding, Backfill and Embankment

2.7.1 Definitions

Backfill shall include the supply, placing and compacting of all materials to fill excavation place for structures which are indicated on the Drawing.

Excavated material that is suitable for backfill shall be used for that purpose provided the specified percent of maximum soil density is attained.

(1) Native Material

Native materials (except clay, silt and muck) that are free from grass, roots, brush or other vegetation, boulders or rock pieces having maximum dimensions less than 75 mm may be used as native backfill.

(2) Imported Material

Any earth material (except clay, silt and muck) satisfying the specification for native backfill may be used to replace unsuitable native materials.

(3) Selected Sandy Material

Material that is free of organic matter, does not contain stone or rock fragments larger than 10 mm in greatest dimensions and is non-cohesive shall be used as selected sandy material. The material shall lend itself to ease of compaction and shall be placed at a moisture content approaching its optimum for compaction.

(4) Gravel Base

Gravel Base material shall be hard, durable crushed rock or gravel, free draining and free from organic matter.

(5) Sand Bed

Sand fill shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay surface coatings, and deleterious materials.

2.7.2 Backfilling, Embankment and Compaction

(1) Bedding and Backfill

Materials shall be as shown on the drawing. Compaction of granular material may be achieved by tamping or using vibratory compactors.

(2) Embankment

Embankment shall be constructed at the locations and to lines and grades indicated and shall be placed in lifts of maximum 300 mm thick and each lift shall be compacted by compacting equipment well suited to the soil being compacted before the overlaying lift is placed. If the mixture is excessively moistened by rain, it shall be aerated by means of blade graders or harrows, or blended with excavated, relatively unweathered and dried rock (crushed to proper sizes) or with imported material, until the moisture content of the mixture is satisfactory. The surface of the layer shall be finished by grading or rolling with a smooth roller, or a combination thereof, and shall be smooth.

2.8 Hauling and Disposal

2.8.1 General

This work shall consist of performing all operations required in loading, hauling away, and disposing outside the construction site spoils from excavation which are in excess of, or unsuitable for, the requirements of filling or back-filling. Premature disposal of material suitable for filling, resulting in a shortage thereof, shall be replaced by the Contractor without extra cost. The Contractor shall make his arrangements for the disposal of materials off-site at a location where the Client will designate and shall obtain a written permit from the Client of the proposed disposal site, which shall contain the provision absolving the Government from any and all responsibility in connection with the disposal of materials on the property. This written permit shall be a requisite precedent to issuance by the Consultant of his approval to start hauling and disposal operations. Should spreading and leveling of the materials at the disposal site be required, the cost thereof shall be part of this Contract.

2.8.2 Conduct of Hauling and Disposal

Loading, hauling and disposal operations shall be conducted in such a manner that completed structures and facilities at the construction site are not injured or damaged. If necessary, protective measures shall be provided and maintained for the safety of operations both on-site and off-site. When hauling is done over highways or city streets, or when directed by the Consultant, the loads shall be trimmed and all material removed from shelf areas of carriers in order to eliminate spilling of material. Loads shall be watered after trimming and provided with appropriate covering to eliminate dust. Mud, silt and other water-saturated material that may tend to ooze out of carrier vehicles during transit shall be allowed to dry before hauling.

2.9 Soil Improvement

This work shall conform to the Contract Document including this specification and the Drawings.

Where bearing ground capacities of the buildings and structures are under designed values abovementioned, the soil of the ground shall be improved.

Since the thickness soft soil- layer may be thin based on soil investigation results, method of soil improvement shall be replacement of soil. The material for replacement shall be sandy soil or gravel including Wadi selected materials, because natural soil in the Site is not proper for compaction. The imported materials shall be compacted by necessary soil bearing capacity for each structure.

The results of soil improvement shall be confirmed by unconfined compression test for the respective target buildings and structures.

3. Cast-in-place Concrete

3.1 Description

- (1) The Contractor shall furnish all materials and construct structures of the forms, shapes, dimensions and elevations shown on the Drawings, and as specified.
- (2) The work includes furnishing all materials and facilities necessary for producing, placing, curing and finishing cast-in-place concrete.
- (3) The Contractor shall use Portland cement for construction of the Works.

3.2 Submittals

3.2.1 Product Data

3.2.1.1 Cement

- (1) Source of cement shall be subject to the Consultant's approval
- (2) Manufacturer's test sheets shall be supplied with each consignment of cement certifying compliance with the relevant standard
- (3) The Contractor shall submit the date of manufacturing and proof that the specifications have been complied with, certified by an independent agency in the country of origin.

3.2.1.2 The Contractor shall submit details of proposed aggregate sources for approval by the Consultant.

3.2.1.3 The Contractor shall submit details of proposed water source for approval by the Consultant. The details shall include the chemical analysis and a certificate from an independent testing agency that the specifications have been complied with.

3.2.1.4 The Contractor shall submit the manufacturer's technical recommendations and specifications for any additives proposed.

3.2.1.5 Current test reports and written certificates for water-stops, joint filler board, joint sealant and primer, slip membrane, sealing strip membrane and repair materials shall be submitted to the Consultant for review and approval.

3.2.2 Approval

During the mobilization period the Contractor shall submit for the approval of the Consultant a method statement detailing his proposals for the organization of concreting activities for each structure or type of structure. The method statements shall be approved before any concrete is placed. Any alteration in the source of quality or proportioning of any of the materials in the mix will necessitate a new method statement. Method statements shall be prepared for each grade and type of concrete in the Contract and shall include, but not limited to, the following details:

- (1) Plant proposed,
- (2) Layout of concrete production facility,
- (3) Proposed method for production of concrete,
- (4) Quality control procedures for concrete and concrete materials,
- (5) Transport and placing of concrete including the use of chutes, conveyor belts or pumps as a means of transporting concrete.

3.2.3 Shop Drawings

The Contractor shall submit shop drawings showing the proposed layout of all construction joints; details for the installation of water-stops in movement joints including location of joints, intersections and changes of direction with cross sections; consolidated shop drawings showing all mechanical penetrations.

3.2.4 Samples

3.2.4.1 Slide bearings: The Contractor shall provide the material(s) proposed, including the manufacturer's technical specifications, application recommendations, and anticipated performance.

3.2.4.2 Slip joints: The Contractor shall provide the material(s) proposed including manufacturer's technical specifications, application recommendations, and anticipated performance.

3.2.4.3 Water-stops & membranes: The Contractor shall provide sample(s) of proposed type, including prefabricated joints and junctions, if applicable.

3.2.4.4 Cement samples shall be provided from each consignment delivered to the Site as required by the Consultant for testing.

3.2.4.5 The Contractor shall provide samples of both fine and coarse aggregates to the Consultant for testing. Samples shall be taken in the presence of the Consultant or Consultant's representative. Aggregate samples shall be provided at least one month prior to beginning deliveries to site.

3.2.5 Trial mixes

For each grade and type of concrete in the contract and shall include:

- (1) Definition of the method of design of the mix, by reference to a recognized published design method.
- (2) Designed aggregated proportions shall be based on measured and not assumed relative densities.
- (3) Proposed mix proportions including any proposed admixture and for new batching installations, results of preliminary batch testing.
- (4) Results of testing of trial mixes to demonstrate that the proposed mix complies with the strength and workability requirements of this specification.

- (5) For concrete mix designs which include an admixture, trial mixes shall be prepared and tested both with and without the admixture to give a clear indication of its effects on the physical characteristics of the mix.

3.2.6 Program

In addition to the scheduling and programming requirements specified in other sections, the Contractor shall submit to the Consultant for his approval as soon as practicable, and not less than thirty (30) days before commencement of concreting on a structure, a program detailing concrete placement sequences. The program shall include details of: estimated time for pours; size of each pour; time of commencement and finish.

3.3 Delivery, Storage and Handling

3.3.1 Delivery

3.3.1.1 Cement shall be delivered in the manufacturer's bulk containers or in the original sealed and branded bags, bearing the manufacturer's name, cement type and date of manufacture, in batches not exceeding one hundred (100) tons.

3.3.1.2 Concrete delivery ticket shall record the actual batched weight of ingredients and the time of addition of water.

3.3.2 Storage

3.3.2.1 Cement

Immediately upon arrival at the Site, cement shall be stored in silos designed for the purpose, or dry, weather-tight and properly ventilated structures preventing absorption of moisture. Different types of cement shall be kept in clearly marked separate storage facilities. Cement delivered to the Site in drums or bags provided by the supplier or manufacturer shall be stored in the drums or bags until used in the Works. Any cement in drums or bags which have been opened shall be used immediately. The Contractor shall provide weighing machines which shall be kept permanently in each shed for checking the weight of the bags or barrels of cement. During transport and storage the cement shall be fully protected from all weather elements. The temperature of the cement entering the mixers shall not exceed 45° C. Any consignment of cement not used within two months from the date of manufacturer, and cement, which in the opinion of the Consultant is of doubtful quality, shall not be used in the Works until it has been re-tested and test result sheets showing that it complies in all respects with the relevant standard have been delivered to the Consultant.

3.3.2.2 Aggregate

The Contractor shall provide a means of storing the aggregates at each point where concrete is made such that:

- (1) Each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times;
- (2) Contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times;
- (3) Each stockpile of aggregate shall be capable of draining freely;
- (4) Storage shall be such as to prevent segregation;
- (5) Stockpiles shall be on hard and clean surfaces with not more than five per cent slope.

3.3.2.3 Chemical curing compounds shall be stored in accordance with manufacturer's recommendations.

3.3.3 Handling mixed concrete

Trucks shall be discharged within the approved period after addition of water to cement. Trucks still containing any concrete after the approved expiry time shall be rejected. The rejected concrete shall be disposed of in a legal manner.

3.4 Products

3.4.1 Concrete Mix

3.4.1.1 Grades of concrete to be used in the Works shall be as described in **ANNEX III-2-2**. The criteria given are designed to produce a workable homogenous plastic mixture and to ensure a long service life under the particular exposure conditions at the site. Where adequate workability is difficult to obtain at the maximum water/cement ratio allowed, an increased cement content and/or the use of plasticizers or water-reducing admixtures may be considered at no additional cost to the Employer. Cement contents in excess of 400 kg/cu.m shall not be used unless special consideration has been given to reduce thermal stress in the concrete.

3.4.1.2 Blinding concrete shall be grade 18 or 20 unless otherwise specified and thickness shall be as shown on the Drawings but in any case not less than 50 mm thick.

3.4.1.3 No-fines concrete shall be made using a coarse natural aggregate conforming to BS 882 and cement to BS 4027. No fines aggregate shall be used. Grading of the coarse aggregate shall be not less than 95 percent by weight passing a 20 mm BS sieve and not more than 5 percent by

weight passing 10 mm BS sieve. The proportions of aggregate, cement and water shall be determined by trial mixes by the Contractor starting with a cement: aggregate ratio of one to eight by volume. All the aggregate particles shall be coated with a film of cement grout. The water content shall be just adequate to ensure that the cement paste completely coats the aggregate. No-fines concrete when placed shall contain no layers of Latinate. No-fines concrete shall not be mixed by hand. Vibration shall not be used to compact the no-fines concrete. Three test cubes of no-fines concrete shall be made of each preliminary mix. Minimum crushing strength of the chosen mix shall be 15 N/sq mm at 28 days.

3.4.1.4 Design of Concrete Mixes: At the commencement of the Works the Contractor shall design a mix for each grade of concrete listed above that is required to be constructed on the Works. The Contractor shall submit full details of the mix designs to the Consultant for approval. For concrete using other than sulphate resisting Portland cement, or incorporating admixtures, the strengths shall not be less than those specified above, but the mix designs shall be revised and agreed with the Consultant. Each mix design shall be such that:

- (1) Aggregate shall comprise fine aggregate and coarse aggregate of the maximum size specified,
- (2) Combined aggregate grading shall be continuous,
- (3) Aggregate quantity shall be calculated by weight,
- (4) Mixes shall be designed to produce concrete cube strength at twenty eight days after manufacture of not less than the cube strength specified above.

3.4.2 Portland Cement Concrete

Consists of a mixture of Portland Cement, fine aggregate, coarse aggregate, water, and additives (when required). The proportion, mix and placing shall be in accordance with BS 5328 and BS 8110 for framed building structures and BS 8007:1987 for water retaining structures. Where these specifications conflict with, or are inconsistent with, the requirements of BS 5328/BS 8110/BS 8007, the requirements in these specifications shall prevail. Specific design requirements shall be as defined in these specifications. All concrete mixes shall be designed for special or ordinary concrete as defined in BS 8110, Clause 6.3.

3.4.3 Cement

3.4.3.1 Ordinary Portland cement, rapid hardening Portland cement, sulphate resisting Portland cement and low heat cement included in ASTM cement types I, II, III, IV and V and these stipulated in BS12 and/or BS4027, shall be used.

3.4.3.2 Ordinary Portland cement and rapid hardening Portland cement shall meet the requirements of BS 12. Low heat Portland cement shall conform to the requirements of BS 1370. Sulphate resisting Portland cement shall conform to the requirements of BS 4027. Portland blast furnace cement and low heat blast-furnace cement shall conform to the requirements of BS 146. Different brands or types of cement shall not be mixed together for use in the works

3.4.3.3 ASTM cement types I, II, III, IV and V shall meet the requirements of ASTM C-150.

3.4.3.4 The testing of cement shall be carried out in accordance with the provisions of BS 4550 Parts 2 and 3

3.4.3.5 Any cement which is, in the opinion of the Consultant, unsuitable for use in the Works shall be rejected and the Contractor shall promptly remove such cement from the Site.

3.4.4 Aggregates

3.4.4.1 General

- (1) Shall consist of tough, hard durable and uncoated particles containing no harmful material in quantities sufficient to adversely affect the concrete or reinforcing steel.
- (2) Shall comply with the requirements of BS 882 except as modified hereunder and shall be washed clean with potable water, if necessary to comply with these requirements.
- (3) Contractor shall provide all data as specified BS 882.
- (4) Sampling and testing of aggregates shall be carried out in accordance with the requirements of the appropriate section of BS 812.

3.4.4.2 Fine Aggregate for Concrete and Mortar

- (1) Gradation shall be in accordance with BS 882 excluding grading designation F. Fine aggregate shall be clean, sharp, natural and/or crushed sand.

- (2) Each batch of aggregate delivered to site shall be kept separate from previous batches and shall be stored for at least three working days before use to allow inspection and tests to be carried out.

3.4.4.3 Coarse Aggregates for Concrete

- (1) Coarse aggregates shall be prepared as single sized aggregate and blended to produce normal size grading. Combined grading shall be within the appropriate grading limits given in BS 882.
- (2) Aggregates that are easy to be reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of concrete shall not be used.
- (3) The Contractor shall mechanically wash aggregate to remove salts and other impurities in order to meet the requirements specified.

3.4.5 Water

3.4.5.1 Water used for concrete-mixes, washing of equipment, wetting of surface or ponding during curing or for wetting formwork and washing reinforcement shall be potable water and shall comply with the requirements of BS 3148 except as modified hereunder. The Contractor shall make his own arrangements and obtain approval for the supply of water.

3.4.5.2 The pH of water used in concrete works shall be not less than 7.0 or more than 9.0. The temperature of water for concrete shall not be less than 5° C nor more than 25° C. Water may be cooled to not less than 5° C by the gradual addition of chilled water or ice. No ice particles shall be present in the mix.

3.4.5.3 Water for curing concrete shall not contain impurities in sufficient amounts to cause discolouration of the concrete. Source of water shall be maintained in such a manner as to exclude silt, mud, grass and other foreign matter.

3.4.6 Admixtures

3.4.6.1 Where approved and or directed by the Consultant, admixtures shall be used as a means of increasing concrete durability; increasing workability of the concrete without increasing the water/cement contents; or controlling and limiting retardation of setting.

3.4.6.2 Admixtures shall comply with the requirements given as described in **ANNEX III-2-3**.

3.4.6.3 The Contractor shall provide the following data and ensure that the product complies with the following specifications:

- (1) Admixtures which comply with ASTM C494 Type G shall be employed to:
 - a Produce highly flowable and self compacting concrete at the lowest possible water cement ratio or as specified.
 - b Produce a consistency of concrete that is free of bleeding and segregation.
 - c Provide slump retention and set control as and when applicable.
 - d Offer the user impermeability and durability.
- (2) Admixture shall be based on naphthalene sulphonates. Where deemed necessary lignosulphonate admixtures conforming to ASTM C494 Type B may also be employed providing this is to the satisfaction of the Consultant.
- (3) No admixtures containing chlorides shall be used.
- (4) The use of the admixtures shall be controlled i.e. strict quality control to ensure correct dosages as prescribed by the manufacturer are used. Admixture is to be dispensed by a transparent unit which enables the operator to see the discharge.
- (5) Concrete supplier shall furnish a series of at least 10 trial mixes which clearly indicate that the use of the admixture has consistently exhibited the specified absorption, permeability and pouring values. These are to be verified by an approved independent laboratory. The concrete supplier shall also conduct (with the above) a trial showing that a control mix without the admixture does not exhibit a greater density than that incorporating the admixture.

3.5 Execution

3.5.1 Trial Mixes

3.5.1.1 As soon as the Consultant has approved the concrete mix design for each grade of concrete and during or following the carrying out of the preliminary tests, the Contractor shall prepare a trial mix of each grade in the presence of the Consultant at least 35 days before commencement of concreting.

3.5.1.2 Trial mixes shall be mixed for the same time and handled by means of the same which the Contractor proposes to use in the Works. Each mix shall be not less than 0.5 cu m of concrete.

3.5.1.3 The proportions of cement, aggregate and water shall be carefully determined by weight in accordance with the Contractor's approved mix design (or modified mix design after preliminary tests). Sieve analyses shall be made, by the method described in BS 812, of the fine aggregate and of each nominal size of coarse aggregate used.

3.5.1.4 The slump of each batch of each trial mix shall be measured immediately after mixing by the method described in BS 1881 and shall be within the limits as specified.

3.5.1.5 The Contractor shall make three separate batches for each trial mix and six 150 mm compression test cubes shall be made from each batch in the presence of the Consultant. Temperature, workability and density of concrete in each batch shall be determined. Three cubes shall be tested at seven days and three at 28 days, after manufacture in accordance with the method described in BS 1881.

3.5.1.6 The Contractor shall only use the approved mix of each grade of concrete in the Works. If, at any time during the construction of the Works, the source of cement or aggregate is changed, then further trial mixes of concrete shall be made, tested and approved for use. Preliminary laboratory tests shall be carried out to determine the mixes to satisfy the specification with the approved materials. Trial mixes shall be tested to determine the following properties of mixes proposed for initial field tests. If the values obtained are unacceptable, the mixes shall be re-designed:

- (1) Bleeding in accordance with ASTM C232 (non-vibrating) shall not exceed 0.5 percent
- (2) Shrinkage in accordance with BS 1881: Part 5 or BS 6073: Part 1 Appendix D
- (3) Air content to BS 1881: Part 106.
- (4) Free water/cement ratio
- (5) Workability to BS 1881: Part 102.
- (6) Fresh and hardened concrete densities to BS 1881: Parts 107 and 114 respectively.
- (7) Compressive strength to BS 1881: Part 116
- (8) Water permeability to DIN 1048 shall be maximum 10 mm at 28 days and maximum 15 mm at 7 days.

3.5.1.7 All costs connected with the preparations of trial mixes shall be borne by the Contractor.

3.5.2 Mixing of Concrete

3.5.2.1 All structural concrete to be placed in-situ shall be manufactured in a computer controlled batching plant. Batching and mixing concrete off-site shall only be with prior approval. Mixing and transporting of concrete produced off-site shall be in accordance with the requirements of ready mixed concrete BS 5328. Concrete shall be mixed in batches in plant capable of combining the aggregates, cement and water (including admixtures, if any) into a mixture of uniform colour and consistency and of discharging the mixture without segregation.

3.5.2.2 Test reports for all concrete shall be submitted at weekly intervals giving test results for workability and strength. For trial mixes the following data shall be submitted:

- (1) Slump,
- (2) Compressive Strength at 7 days and 28 days,
- (3) Maximum aggregate size,
- (4) Unit weight of concrete mix,
- (5) Water/cement ratio and quantity; water content, water adjustment,
- (6) Type of cement and dosage,
- (7) Type of Admixture and dosage,
- (8) Gradation of coarse and fine aggregate,
- (9) Combined coarse and fine aggregate ratio,
- (10) Ratio of fine to coarse aggregate,
- (11) Percentage of absorption for coarse and fine aggregate, based on saturated surface dry material,
- (12) Volume of batch for trial mix.

3.5.3 Concrete Testing

3.5.3.1 Target mean strength: The concrete mix shall have at least the required minimum cement content and mean strength greater than the required characteristic strength.

3.5.3.2 To establish the suitability of any material used in the concrete work, unless specified otherwise, the Contractor shall make preliminary tests and prepare design mixes, in accordance with BS 5328, in a design laboratory acceptable to the Consultant.

3.5.3.3 In addition to the tests required to establish the suitability of materials, the Contractor shall make one test for each design mix to verify that the total chloride ion content and the total sulphate (SO₃) content of each mix is within the specified limits. Chloride tests shall be performed in accordance with BS 812: Part 117 and sulphate (SO₃) tests in accordance with BS 812:Part 118.

3.5.3.4 Under the supervision and direction of the Consultant, the Contractor shall take specimens, as per BS 1881, of each class of concrete from different locations on the site. Each set of cubes shall be made at the point of placement. For each grade of concrete a set of six (6) works test cubes shall be made whenever the Consultant may require and not less frequently than as follows:

- (1) for concrete Grade 35 or above one set of cubes per 30 cubic metres or part thereof, concreted per day,
- (2) for concrete Grade 20 one set of cubes per 40 cubic metres or part thereof, concreted per day.

3.5.4 Works Test Cubes

3.5.4.1 Take test cubes as specified from fresh mixed concrete which is being used in the Works and which has been prepared in the normal way.

3.5.4.2 Cubes shall be numbered consequently and marked with the date, section of work from which they are taken and any other relevant information.

3.5.4.3 Take at least six cubes for each sampling and test 3 at 7 days and 3 at 28 days.

3.5.4.4 Strength of cubes shall be not less than the minimum strength requirements for each type of concrete.

3.5.4.5 If any strength test fails, the Contractor immediately report to the Consultant and obey his/her guidance.

3.4.5.6 Two cylinders shall be cast to determine the tensile strength of the concrete at 7 days and 28 days, as specified in BS 1881: Part 117. Samples shall be taken from every 100 batches, but at least once a week during concreting operations and shall coincide with samples taken for test cubes.

3.4.5.7 Concrete shall be tested for durability properties by undertaking absorption and permeability tests where appropriate, or directed by the Consultant, as directed below:

- (1) Water absorption tests shall be carried out in the laboratory on 75 mm diameter cores cut at an age of 24 to 28 days to enable the tests to be carried out between 28 and 32 days in accordance with BS 1881: Part 122. Upper acceptable limit for absorption after 30 minutes shall be one percent.
- (2) Permeability tests shall be in accordance with the method described in DIN 1048 and the maximum acceptable penetration at seven days shall be 10 mm.

3.5.7 Transporting Concrete

3.5.7.1 Transportation, delivery and handling shall be as specified in BS 5328. Concrete shall be conveyed from the mixer to its place in the Works as rapidly as possible by methods which will prevent segregation or drying-out. The Contractor shall ensure that concrete is of the required workability at the point and time of placing. If segregation has nevertheless occurred in any instance the materials shall be remixed to the satisfaction of the Consultant or discarded. The Contractor shall be responsible for the concrete being placed and compacted within such a time from the addition of the water to the mixer that the previous lift of concrete has not commenced setting.

3.5.7.2 Tolerances shall be to BS 5606 for concrete construction and materials.

3.5.7.3 The Contractor shall record time, date, temperature and slump of all concrete at the mixer and point of placement. The Contractor shall render to the Consultant, not more than twenty-four hours in arrears, a daily return for each grade of concrete comprising:

- (1) Number of batches mixed,
- (2) Number of batches and total volume of concrete placed,
- (3) Number of batches wasted or rejected,
- (4) Weight of cement and admixtures used.

3.5.8 Placing Concrete

- 3.5.8.1** No concrete shall be placed until the Consultant has inspected and approved the surfaces upon which the concrete is to be placed, the formwork and the reinforcing steel. The Contractor shall give the Consultant not less than 24 hours to enable this inspection to be carried out. If concrete is not placed within 24 hours of approval being given, approval shall be obtained again before concreting. An inspection shall be made immediately prior to concreting to check the cleanliness of the forms. None of the requirements of this specification shall relieve the Contractor of his responsibility to place in the Works only sound well-compacted concrete free from voids and cracks.
- 3.5.8.2** The Contractor's staff for approval of concrete work shall be on site whenever such work is executed.
- 3.5.8.3** Before placing concrete, the Contractor shall remove from the surface of the foundations or previously placed concrete all oil, Latinate, loose fragments of rock, earth, mud, timber and other debris, and standing water to the satisfaction of the Consultant. Unless otherwise specified or directed by the Consultant, all excavated surfaces are to be covered with blinding concrete Grade 20 not less than 50mm thick.
- 3.5.8.4** Concrete dropped into place in the Work shall be dropped vertically. It shall not strike the formwork between the point of its discharge and its final place in the Work. Except by prior approval of the Consultant, concrete shall not be dropped freely through a height greater than 1.5 m. Chutes and conveyor belts shall be also designed so that there is no segregation or loss of mortar.
- 3.5.8.5** During the placing of all reinforced concrete, a competent steel fixer shall be in attendance on each concreting gang. He shall ensure that the reinforcement and embedded fittings are kept in position as work proceeds.
- 3.5.8.6** The Contractor shall take precautions to prevent the temperature of concrete rising above 32°C. The concrete temperature shall be maintained at, or below 32°C, until it has hardened, and shall be shaded from direct sunlight to the satisfaction of the Consultant. Concrete shall not be mixed or placed when the ambient shade temperature exceeds 40°C and rising or 43°C on a falling thermometer. The times at which concreting will be allowed to take place will be agreed with the Consultant.

3.5.8.7 No concrete shall be placed in water in the Project.

3.5.8.8 Except for slabs less than 100 mm thick, all concrete placed in situ shall be compacted with power-driven internal type vibrators supplemented by hand spading and tamping. Unless otherwise agreed by the Consultant slabs less than 100 mm thick shall be compacted by approved vibrating screeds. Vibrators shall at all times be adequate in numbers, amplitude and power to compact the concrete properly and quickly throughout the whole of the volume being compacted to the satisfaction of the Consultant. Spare vibrators shall be readily on hand in case of breakdown.

3.5.9 Curing of Concrete

3.5.9.1 Immediately after compaction, and for a continuous minimum period of 7 days thereafter, concrete shall be protected from the harmful effects of weather, including rain, dry winds rapid temperature changes, premature drying and resulting effects of thermal shrinkage. The Contractor shall obtain approval of curing methods.

3.5.9.2 Formed surfaces, including the undersides of girders, beams, supported slabs and the like, shall be cured by moist curing with the forms in place for the full curing period.

3.5.9.3 Unformed surfaces shall be cured initially by moist curing and finally by any applicable specified method, unless otherwise indicated.

3.5.9.4 Backfill shall not be placed over concrete surround to pipes for a minimum of six hours after completion of concreting and dewatering equipment shall continue in operation for at least this period. Compaction of backfill over the pipe surround concrete shall not commence until at least 48 hours after completion of concreting.

3.5.10 Joints

3.5.10.1 Construction joints shall comply with BS 5328 except as modified here-in. Waterstops are not considered necessary in properly formed construction joints. If the contractor wishes to install waterstops in construction joints to satisfy the requirements of these Specifications, then waterstops shall comply with these Specification and Drawings, the cost of which shall be borne by the Contractor. The Contractor shall submit detailed proposals not less than three weeks before the commencement of concreting and the details shall include the

sequence of placing concrete; sizes of concrete pours; positions of all vertical and horizontal construction joints; and height of lifts. No concreting shall be started until the Consultant has approved the detailed proposals. Construction joints shall be so located as not to impair the strength of the structure.

3.5.10.2 Expansion joints: reinforcement or other embedded metal items bonded to the concrete (except dowels in floors bonded on only one side of joints) shall not extend continuously through any expansion joint. Joints shall not be sealed until adjacent concrete is at least 28 days old. Joint sealant shall be prepared and installed the Consultant and manufacturer's instructions.

3.5.10.3 Waterstops shall be fixed at locations indicated on the Drawings and shall be installed to give a continuous diaphragm in each joint. Pre-moulded waterstop shall be in maximum possible lengths to minimise the number of end joints. Joints at ends and intersections shall be made in the manner most appropriate to the material used and according to manufacturer's recommendations.

3.5.11 Concrete Finishing

Concrete surfaces that are not exposed in the completed work will require no special finish other than such pointing-up as is necessary to leave them smooth and impervious. The pouring of the concrete and finishing shall be scheduled so that all finishing work is done by capable, experienced hands before the concrete has attained a final set.

Exterior concrete slabs, interior platforms and interior concrete steps shall be finished by tamping the concrete with suitable approved tools to force the coarse aggregate away from the surface screening and from floating, and to bring the surface to the required uniform finished level. While the concrete is still wet, but sufficiently hardened to bear a man's weight without deep imprint, the surfaces shall be wooden trowel to a true even surface, such that no coarse aggregate becomes visible.

Exterior concrete steps and walkways shall be wood floated and then given a brushing finish surface by lightly brushing in one direction with a soft hair broom to produce a non-skid surface of uniform appearance where required by the Consultant. All other unformed slab surfaces as interior slabs to which no other surface finish is required, bottoms of reservoirs or any other surface over which liquid flows, shall receive a steel-troweled finish. Such surfaces shall first receive a wood-float finish, followed then by hand troweling with steel trowels to bring the surface to a uniform, smooth, hard, impervious surface free from marks and blemishes. Troweling shall not be started until moisture film

has disappeared from the surface and over-troweling shall be avoided. Dusting with dry cement or other mixtures or sprinkling with water will not be permitted.

4. Form Work

4.1 General

4.1.1 Standards

Formwork design, fabrication and erection shall comply with BS 5328 and BS 5975 or equivalent.

4.1.2 Formwork Design Criteria

4.1.2.1 The erected forms shall be watertight from the ingress of external liquids and egress of internal liquids.

4.1.2.2 The design of formwork shall take into account; height and rate of pour; thickness of member; concrete slump and density; placing temperature; texture of finish; construction joints; wind load.

4.1.2.3 In the assessment of loads, the worst combination of self-weight, formwork forces, reinforcement weight, wet concrete weight, construction loads, wind loads, incidental dynamic effects caused by placing, vibrating and compacting concrete, the use of externally applied vibrators, method of concrete discharge and access for concrete placement and vibration shall be used.

4.1.2.4 Adjustable steel supports and shores shall allow form-boards and framework to be accurately adjusted to line and level.

4.1.2.5 The design shall allow free movement and accessibility under formwork.

4.1.3 Shop Drawings

Shop drawings shall include plans and sections, giving the following minimum information for each level: details of individual panels, position, size and spacing of adjustable steel shores, position, size and spacing of joists, soldiers, ties, details of formwork for columns, beams, parapets, slab and kickers; details of construction joints and movement joints; details of retaining walls and deep beams showing the position and size of ties, joints, soldiers and sheeting, together with detailed information on erection and casting sequences and construction joints; general assembly details; full calculation

sheets; details of all penetrations through concrete; proposed sequence of shoring/re-shoring beams and slabs for different spans and floor heights and number of floors shored, and the stripping time for supported and suspended structural elements, clearly identifying the supported element and suspended element.

4.1.4 Form Materials

Form materials shall conform to requirements of BS 5328 and BS 5975 unless stated otherwise.

4.1.5 Unformed surfaces

- 4.1.5.1** The type of finish will be uniformly levelled and screeded to produce a ridged surface, specified on the drawings or as directed by the Consultant.
- 4.1.5.2** Initial finishing of unformed surfaces shall commence immediately after placing and compaction have taken place.
- 4.1.5.3** Suitable access boards or platforms shall be provided to allow access to all parts of unformed surfaces to be finished.

4.1.6 Formed surfaces

- 4.1.6.1** Finishes to formed surfaces of concrete shall be classified as F1, F2 and F3, or such other special finish as may be particularly specified.
- 4.1.6.2** Where the class of finish is not specified, all internal concrete shall be finished to Class F3 and external concrete below ground shall be finished to Class F1.
- 4.1.6.3** Where surfaces are covered with paint or sheeting, the formwork shall be capable of achieving a finish suitable for the proposed covering as approved by the Consultant.
- 4.1.6.4** Formwork for Class F3 finish shall be lined with as large panels as possible of non-staining material with a smooth unblemished surface such as sanded plywood or hard compressed fibre board, arranged in a uniform approved pattern and fixed to back formwork by oval nails. The same type of lining shall be used throughout any one structure. Unfaced wrought boarding or standard steel panels shall not be permitted.

4.1.7 Form Ties

Form ties shall be; factory-fabricated; adjustable in length; removable or snap-off metal form ties; cone ends if required by the drawings; designed to prevent formwork deflection and to prevent the spalling of concrete surfaces on removal. No metal shall be left closer than 38 mm to the surface of the concrete. Ties shall not leave a hole larger than 10 mm diameter in the concrete surface, when using snap ties.

4.2 Execution

- 4.2.1** The Contractor shall be responsible for the calculations and designs for the formwork and shall submit them to the Consultant prior to the start of construction.
- 4.2.2** Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects, and all formwork shall be clean and free from standing water, dirt, shavings, chippings or other foreign matter. Form joints and tie holes shall be watertight to prevent the escape of mortar or the formation of fins or other blemishes on the face of the concrete. The Contractor shall verify lines, levels and measurement before proceeding with formwork. The Contractor shall ensure that the sides and bottom of earth forms are hand trimmed.
- 4.2.3** Windows shall be provided in forms wherever directed or necessary for access for concrete placement and vibration if necessary. Windows shall be tightly closed and sealed before placing higher concrete.
- 4.2.4** Conduits or pipes shall be located so as not to reduce the strength of the construction. Conduits, piping, and other wall penetrations or reinforcements shall be subject to Consultant's review and approval.
- 4.2.5** Holes formed in concrete surfaces by formwork supports or the like shall be filled neatly with non-shrink epoxy/cement grout. The Contractor shall clean any hole that is to be filled with non-shrink epoxy/cement grout. The concrete surrounding the hole shall be then be thoroughly soaked after which the surface shall be dried so as to leave a small amount of free water on the surface.

4.2.6 Pipes through walls:

- (1) Pipes and pipe specials through concrete walls and floors shall as far as possible be positioned and built-in during construction and shall be located exactly in the positions shown on the drawings and shall be true to line and level. The Contractor shall prepare shop drawings for the position including installation methods of each pipe.
- (2) The Contractor shall place orders for these items immediately after the Contract is awarded and shall make every effort possible to ensure early delivery to site. The supply and delivery of built-in pipework shall be clearly shown on the detailed construction program to be submitted by the Contractor.
- (3) The Contractor shall take particular care to ensure that fully compacted concrete is in contact with the pipe at all points.
- (4) When the pipe is later fixed, the remaining hole shall be re-formed and filled with non-shrink epoxy grout or non-shrink concrete. In the case of water-retaining structures the Contractor shall ensure that measures adopted shall provide a finished joint which is adequately strong and free from leakage.
- (5) In either case, the Contractor shall be solely responsible and all additional costs, if any, shall be borne by the Contractor.

4.2.7 The Consultant shall be notified prior to the removal of any formwork.**4.2.8** Concrete shall be thoroughly wetted as soon as forms are first loosened and shall be kept wet during the removal operations and until curing media is applied.**4.2.9** The period of time elapsing between the placing of the concrete and the striking of the formwork shall be approved by the Consultant after consideration of the loads likely to be imposed on the concrete and shall in any case be not less than the periods as described in **ANNEX III-2-4**.**4.2.10** Stripping of formwork within the time limits listed above does not relieve the Contractor from successfully crushing test cubes and achieving specified compressive strength results.

- 4.2.11** Notwithstanding the foregoing, the Contractor shall be held responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

5. Reinforcement

5.1 General

The work includes furnishing, fabrication, and placement of reinforcement for cast-in-place concrete, including reinforcing steel bars, welded wire fabric, ties, and supports.

5.2 Product Data

The Contractor shall provide the manufacturer's specification and installation instructions for proprietary materials and reinforcement accessories.

The Contractor shall furnish the manufacturer's records of chemical and physical properties of billet steel bars and a certificate that the respective material furnished meets the requirements for the steel reinforcement specified. The manufacturer's records shall include mill certificates as well as chemical analysis, tensile and bend tests.

5.3 Shop Drawings

- 5.3.1** Detail fabrication and placement drawings for all reinforcing steel which are correlated with forming and concrete placement techniques and requirements.

- (1) Reinforcing steel bars shall be detailed based on construction joint locations which have been shown on shop drawings approved by the Consultant.
- (2) Drawings shall consist of sections, plans and details clearly showing locations, sizes, spacing and shapes of all reinforcing steel, caps and splices supporting bars and accessories.
- (3) Include bar bending schedules and diagrams to indicate bends, sizes and lengths of all reinforcement prepared in accordance with BS 4466.

- 5.3.2** A separate set of shop drawings, showing construction joint locations, shall also be submitted for approval and shall indicate all floor openings, wall openings and edges of concrete. Floor openings, wall openings, pipe inserts and sleeves for all mechanical, plumbing and electrical work shall be co-ordinated with the respective trades and shown on these shop drawings in accordance with the criteria indicated on the Contract Drawings.

5.3.3 No work shall be fabricated until both sets of shop drawings (Reinforcement and Concrete Dimensions) have been reviewed by the Consultant (with corrections and re-submittals as required by the Contract Documents). After the approval by the Consultant, the Contractor shall furnish all copies needed for fabrication and erection, and for the use of other trades.

5.3.4 The approval of shop drawings, or revised bar schedules shall in no way relieve the Contractor of his responsibility for the correctness of such drawings or schedules.

5.4 Samples

5.4.1 Representative samples of all reinforcing steel that the Contractor proposes to use in the Works must be submitted to the Consultant for his written approval, before work is commenced. The Contractor shall submit manufacturer's certificates stating clearly for each sample:

- (1) Place of manufacturing,
- (2) Expected date and size of deliveries to site,
- (3) All relevant details of composition, manufacture, strengths and other qualities of the steel.

5.4.2 The Consultant reserves the right to sample and inspect all reinforcement steel upon its arrival at the work site.

5.4.3 The Contractor shall provide a certificate confirming that samples taken from the bars delivered to the works pass the re-bend test.

5.5 Delivery

5.5.1 Reinforcing steel bars in each lot shall be legibly tagged by the manufacturer. The tag shall show the manufacturer's test number and lot number and other applicable data that will identify the material with the certificate issued for that lot of steel.

5.5.2 Fabricator shall furnish three copies of a certification which shows the heat number or numbers from which each size of bar in the shipment was fabricated.

5.6 Storage

5.6.1 Bundles of reinforcement shall be clearly tagged with bar schedule and bar mark reference and these shall not be removed until the material is at the location where it is to be incorporated into

the works.

- 5.6.2** Reinforcing steel bars shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, earth, paint, or any other material which may impair the bond between the concrete and the reinforcement.

5.7 Handling

Reinforcement shall not be handled roughly, dropped from a height, or subject to shock loading or mechanical damage.

5.8 Reinforcing Steel

- 5.8.1** Reinforcing steel shall conform to BS 4449 and shall have the minimum yield strength as described in **ANNEX III-2-5**. The yield strength of the reinforcing steel is defined as the stress corresponding to a strain of 0.35 percent, and shall correspond to that delivered by tests on full size bars.
- 5.8.2** After fixing and immediately prior to placing of concrete the reinforcement shall be pressure-washed with fresh water.
- 5.8.3** Welded steel wire fabric shall conform to BS 4483. Welded intersections shall not be spaced more than 310 mm for plain round bars or 400 mm apart for deformed high yield bars in direction of calculated stress except when used as stirrups.
- 5.8.4** Tie wire shall conform to BS 4482. No wires smaller than size D-4 shall be used.
- 5.8.5** Spacers shall be made of concrete, metal, or other as approved by the Consultant.
- 5.8.6** Welding, if permitted by the Consultant, shall conform to the requirements of AWS D 1.4 or BS 5135
- 5.8.7** Tests shall be carried out in strict accordance with BS 4449 and at the discretion of the Consultant from time to time.

5.8.8 Tensile tests providing information on the following will be required from each lot delivered:

- (1) Elastic limit,
- (2) Ultimate strength,
- (3) Stress-strain curve,
- (4) Cross-sectional area,
- (5) deformation/bond characteristics of deformed bars

5.8.9 The Contractor shall allow for all tensile, bond, re-bond and chemical tests for each size of bar to be used in the concrete construction. Test results for each bar size shall be submitted to the Consultant. Further tests may be called for when the source of supply of reinforcement changes. When any test results do not conform to the relevant standard, the reinforcement steel shall be removed from the Site.

5.9 Execution

5.9.1 General

5.9.1.1 All reinforcement shall be securely and accurately fixed in positions shown on the Drawings to ensure that the reinforcement steel framework as a whole shall retain its shape. The reinforcement framework shall be so temporarily supported as to retain its correct position in the forms during the process of depositing and consolidating the concrete.

5.9.1.2 The ends of all tying wires shall be turned into the main body of the concrete and not allowed to project towards the surface.

5.9.1.3 No part of the reinforcement shall be used to support access ways, working platform or for the conducting of an electric current.

5.9.1.4 Specific attention is drawn to the following general requirements:

- (1) Lapped joints shall be as indicated on the Drawings and/or in accordance with the requirements of BS 8110.
- (2) Hooks shall be semi-circular with a straight length of at least four bar diameters for mild steel and six diameter for high yield steel.

5.9.2 Welding

5.9.2.1 Welding shall not be permitted unless authorised by the Consultant and recommended by the reinforcement manufacturer.

- 5.9.2.2** Welding shall be executed under controlled conditions in a factory or workshop.
- 5.9.2.3** Welding on site shall not be permitted unless suitable safeguards and techniques are employed and the types of steel have the required welding properties.
- 5.9.2.4** Welding if approved, may be used for:
- (1) Fixing crossing or lapping reinforcement in position;
 - (2) Fixing bars to other steel members;
 - (3) Structural welds involving transfer of loads between reinforcement or between bars and other steel members.

5.9.3 Others

- 5.9.3.1** Mechanical Splices shall be submitted for approval and shall comply with BS 8110. Their use shall be used as indicated on the structural drawings.
- 5.9.3.2** Bundling and splicing of bars shall be in accordance with BS 8110. Splicing, except where indicated on the Drawings or approved shop drawings, will not be permitted without the approval of the Consultant.
- 5.9.3.3** The Consultant shall be notified at least 24 hours before commencing fixing reinforcement for inspection of formwork. Spaces to receive reinforcement shall be thoroughly cleaned.
- 5.9.3.4** Reinforcement shall not be fixed or placed in contact with non-ferrous metals.
- 5.9.3.5** Correct concrete cover to reinforcement shall be maintained with the aid of approved spacer pieces. Concrete cover to any and all reinforcement shall be a minimum of 50 mm unless a larger cover is detailed on the Drawings.
- 5.9.3.6** Spacers, chairs and other supports shall be provided as necessary to maintain reinforcement in its correct position. Spacer bars of same diameter as longitudinal bars, but not less than 25 mm diameter, shall be fixed between the two layers at 1.5m centres, except where bundled bars are detailed.
- 5.9.3.7** Placing of all reinforcement will be checked by the Consultant and in no case is concrete to be placed around any reinforcement that has not been approved by the Consultant. Insertion of

bars into or the removal of bars from concrete already placed will not be permitted. Reinforcement temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Consultant.

5.9.3.8 Reinforcement shall not be cut and heated to bend into shape. Cut and bent reinforcement shall be to bar schedules and details, unless otherwise instructed. The Contractor shall provide on-site facilities for hand-bending of small rebar only to deal with approved minor adjustments. All bending shall be done cold with the use of an approved bending machine.

5.9.3.9 Inspection of reinforcing steel and the installation thereof will be conducted by the Consultant. The Contractor shall give 24-hour notice to the Consultant before closing forms or placing concrete.

6. Asphalt Work

6.1 General

The Contractor shall construct the area to be paved in accordance with the applicable specifications stipulated herein after, in conformity with the alignment, dimensions, and typical sections shown on the Drawings, or as directed by the Consultant.

6.2 Type of work

For the purpose of these specifications, the following type of asphalt works is designated:

- (1) Preparing and leveling of existing base - course.
- (2) Compacting of existing base - course.
- (3) Prime coat.
- (4) Single asphalt surface layer.

6.3 Base-course

6.3.1 General

The Contractor shall provide only an aggregate material for the base-course consisting of hard, durable, crushed limestone or crushed wadi gravel, provided that the crushed aggregates retained on sieve No. 4 shall have 80% by weight of at least two fractured faces, which have to be crushed by approved crushing plant and shall be free from any organic matter or any other deleterious substances and also free from clay balls.

Base - course aggregate shall conform to the gradation as described in **ANNEX III-2-6**.

6.3.2 Construction

Aggregate for base-course shall be delivered to the area to be paved as a uniform mixture and shall spread in layers.

Segregation shall be avoided and the base-course shall be free from pockets of coarse or fine materials. The base-course shall be spread by a grader or any other mechanical method, approved by the Consultant, watered, shaped and compacted to the required grade and cross section.

The finished surface of the base-course shall not vary at any point by more than 1 cm below the grade established by the Consultant, and the total thickness of the base-course shall not vary by more +0.50 cm. In addition to level checking, longitudinally the surface shall be checked with a straight edge (4m long), where irregularities in this direction shall not vary by more than 1 cm.

A minimum of (4) levels of the base at the total longitudinal side shall be taken and if (2) or more of these levels exceed the tolerance given the Contractor shall re-grade the entire length of the area. If one of these levels exceeds the tolerance then the Contractor shall make good this point.

The aggregate base shall be compacted to not less than 100% of the maximum density determined in accordance with the latest modified AASHTO T-191, T-205 or T-205 and T-239.

The base-course shall be maintained in a condition satisfactory to receive surfacing material. Aggregate base-course which does not conform to the above requirements, shall be reshaped or reworked, watered and thoroughly re-compacted to conform to the specified requirements at the Contractors own expense.

6.3.3 Method of Measurement

Base-course shall be measured per cu.m in place, acceptably laid and compacted according to the dimensions shown on the Drawings.

6.4 Prime-coat

6.4.1 General

Liquid asphalt for prime coat shall be medium curing grade MC70, in conformance with AASHTO standard M82, or emulsion type SS1, SS2 or equivalent according to the manufacturer instructions and lab tests results.

The surface to be treated shall be smooth, compact and tight. It shall be true to grade and cross-section where dust shall be removed by brooming.

6.4.2 Equipment

The equipment used by the Contractor shall include a power broom or a power blower or both; a self-propelled , pneumatic roller, or steel-wheeled tandem (5 to tons) or both; mechanical or self-propelled

aggregate spreading equipment that can be adjusted to spread accurately the specified amounts per square meter, a pressure distributor and equipment for heating the asphalt material. Pneumatic - tired rollers shall have a total compacting width of not less than 120 cm and shall have minimum contact pressures of 2.8 kg/cm² or as specified by the Consultant. Other equipment are to be used in addition to, or in lieu of the specified equipment when approved by the Consultant.

The pressure distributor shall be designed and operated to distribute the asphalt material in a uniform spray with atomization, in the amount and between the limits of temperature specified. It shall be equipped with a tachometer having a dial registering feet or meters of travel per minute. The dial shall be visible to the truck driver so he can maintain the constant speed required for application at the specified rate. The pump shall be equipped with a flow meter having a dial registering litres, or gallons per minute passing through the nozzles. The dial shall be readily visible to the operator.

Means for indicating accurately the temperature of the asphalt material at all times shall be provided. The thermometer reservoir shall not be in contact with a heating tub.

The spray bar shall be adjustable to a reasonable width. A hose and spray nozzle attachment shall be provided for applying asphalt material to paths and areas inaccessible to the spray bar.

The distributor shall be provided with heating attachments and the asphalt material shall be circulated during the entire heating process.

6.4.3 Application of Prime-coat

The Consultant will select the rate of application for the asphalt primer to be used. The Contractor shall keep a record of the application rates selected. Tentatively an application rate of 1.0-1.5 Kg/m² of MC 70 shall be used.

Application of the asphalt prime shall be made uniformly at this rate with the pressure distributor. The asphalt prime shall be applied at the temperature specified by the Consultant. When heating is required, precautions shall be taken to avoid fire hazard.

Application shall be made when the surface is dry or slightly damp and, unless otherwise permitted by the Consultant, when the air temperature in the shade is not less than 10°C. After application of the asphalt prime, at least forty - eight (48) hours shall elapse before further applications are made.

Before beginning application, building paper shall be spread over the surface, from the joint back, for a sufficient distance for the spray bar to begin spraying and be operating at full force when the surface to be treated is reached. After the asphalt is applied the building paper shall be removed and destroyed.

The spray bar shall be shut off instantaneously at each construction joint to assure a straight line and the full application of asphalt prime up to the joint. If necessary to prevent dripping, a drip pan shall

be inserted under the nozzle when application is stopped. A hand spray shall be used to apply primer material necessary to touch up all spots unavoidably missed by the distributor.

Following the application the primed surface shall be allowed to dry for a period of not less than 48 hours without being disturbed or for such an additional period of time as may be necessary to permit the drying out of the prime until it will not be picked up.

The surface shall then be maintained by the Contractor until the surfacing has been placed and no traffic (other than that necessary for the Contractor) shall be allowed on the primed surface before placing of the surface treatment.

6.4.4 Method of Measurement

The quantities to be paid for shall be the total quantity in sq.m. of the primed surface area, actually applied, and shall be based on the approved records of the application rates as selected by the Consultant .

6.4.5 Hot Mix Asphalt Surfacing

6.4.5.1 Scope

Furnishing and mixing non plastic aggregate crushed limestone and asphalt binder at a central mixing plant, spreading and single layer surface course.

Construction shall be in accordance with these specifications and in conformity with lines, grades and thickness as shown on drawings or established by the Consultant.

6.4.5.2 Composition of Mixes

The paving mix shall be composed of specified aggregates and asphalt cement within the limits of the table described in ANNEX III-2-7.

6.4.5.3 Filler Material

When the combined grading of the coarse and fine aggregate is deficient in material passing No. 200 sieve, a filler conforming to the requirements specified hereafter shall be added.

Mineral filler shall comply in all respects with AASHTO Standard Specification M17.

The amount of commercial filler to be added shall be only that amount necessary to make the combined grading of the material comply with the grading requirements for the complete mixture.

In no case shall the amount of commercial filler added exceed three percent (3%), sample obtained from hot bins, by weight of the combined aggregate, The material passing No. 200 sieve may consist of fine particles of the aggregates or mineral filler, or both. It shall free from organic matter and clay particles.

6.4.5.4 Job Mix Formula

The Contractor shall submit for the Consultant's approval a job mix formula within the limits of these specifications.

The maximum permissible variation from the job mix formula within the specification limits, shall be as described in **ANNEX III-2-8**.

6.4.5.5 Mix Test Criteria

Test requirements and criteria for the paving mixes prepared these specifications shall be as described in **ANNEX III-2-9**.

6.4.5.6 General Equipment Requirements

All equipment furnished by the Contractor shall meet the requirements of this section and shall be maintained in its best mechanical condition. Equipment shall be serviced and lubricated away from the paving site; units drip fuel, oil, or grease shall be removed from the site until such leakage is corrected.

6.4.5.7 Elements for All Plants**(1) Uniformity**

The plants shall be designed, co-ordinated and operated to produce a uniform mix within the specified job mix tolerances.

(2) Job Mix Formula

The Consultant will make frequent gradation analyses of the hot aggregates and of the completed mix to be certain that the materials being used and produced are within the tolerances of the job mix formula and the specifications of the mix number being used.

If the mix is found to be outside the job mix formula tolerances or outside of the specification limits, correction shall be made in quantities measured from the hot bins and adjustments made the cold bin feeders and the Contractor shall submit a new mix design.

(3) Sampling and Testing

Stockpiles and bins will be sampled for gradation analyses and examined for dust coating and for other purposes, in compliance with stated requirements. Gradation analyses of each hot bin will be performed and a combined analysis conducted at least twice a day once in the forenoon, and once in the afternoon. If materials do not run uniform, more frequent tests will be made.

When requested by the Consultant, the Contractor shall provide representative samples by taking aggregate from each bin through the mixing chamber (without asphalt) into a truck or other receptacle.

At least one sample shall be taken from each truck of the hot mix being delivered to the site. Samples will be used to determine compliance with general and special requirements set forth in these specifications.

6.4.5.8 Construction Method

(1) Weather Limitations

When the moisture of the aggregate in the stockpile or from the dryer in the plant interferes with the quality of mix production, or with normal plant operations, or when pools of water are observed on the base, then mixing and placing of hot-mix asphalt will not be permitted. The temperature of the surface on which the hot-mix asphalt is placed shall not be less than 5°C. When the surface temperature on which the material is to be placed falls below 10°C, precautions shall be taken to compact the mix before it cools too much, to obtain the required density.

All truck loads shall be delivered continuously and immediately spread and compacted. In cold weather and for shall be delivered at a temperature within 8°C of that temperature specified by the Consultants Representative.

(2) Preparation of Area

The area to be paved shall be true to line and grade, and have a dry and properly prepared surface prior to the start of paving operations. It shall be free from all loose screenings, and other loose or foreign material.

The surface shall be primed as specified. The surface of structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of asphalt material to provide a closely bonded water - tight joint.

(3) Proportioning and Mixing

To aid in determining the proper temperature of the completed batch, current viscosity data shall be available at the plant at all times.

With information relative to the viscosity of the particular asphalt being used, the temperature of the completed mix at the plant and at the paver shall be designated by the Consultant's Representative after discussing with the Contractor the hauling and placing conditions.

The asphalt shall be heated so that it can be distributed uniformly throughout the batch. For mixing applications, the specified temperature will generally be such that the asphalt viscosity is within the range of 150-300 centistokes (75-150 seconds, Saybold Fuyol). The material shall be sufficiently fluid to produce a complete coating on every particle of aggregate within the specified mixing time. The temperature of the aggregates and asphalt immediately prior to mixing shall be approximately that of the completed batch.

When the mix is produced in a batch type plant the aggregate shall be weighed accurately in the designated proportions to provide the specified batch weight. The temperature of the aggregate at the time of introduction into the mixer shall be as directed by the Consultant's Representative with a tolerance of + 8°C .

In no case, however, shall temperature of the mixture exceed 165°C .

(4) Transportation of Mix

The mix shall be transported to the job site in vehicles and painted, or sprayed, with a limewater, soap or detergent solution, at least once a day or as often as required.

After this operation the truck bed shall be elevated and thoroughly drained; no excess solution shall be permitted. The dispatching of the vehicles shall be so scheduled that all material.

Delivery of material to the paver shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

(5) Spreading and Finishing

Spreading and finishing shall be conducted in the following manner:

The binder and surface courses shall be spread and struck-off with a mechanical paving machine connected with an automatic sensor. The paving machine connected with an automatic sensor. The paving machine shall be operated so that material does not accumulate and remain along the sides of the receiving hopper.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operation, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface shall not be used.

Lines for the paver to follow will be established by the Consultant's Representative parallel to the centre line of the proposed roadway. The paver shall be positioned and operated to follow closely the established lines.

In backing trucks against the paver, care shall be taken not to jar it out of its proper alignment.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity.

Segregation of materials shall not be permitted if suspended until the cause is determined and corrected.

Transverse joints in succeeding courses shall be offset at least 60 cm.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Edges against which additional pavement is to be placed shall be straight and immediately vertical. A lute or covered rake shall be used immediately behind the paver when required to obtain a true line and vertical edge. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed by a shovel or lute. Indented areas shall be filled with hot mix and smoothed with the back of a shovel being pulled over the surface.

Fanning of material over such areas shall not be permitted.

(6) Hand Spreading

In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so authorized by the Consultant's Representative. Wood or steel form, approved by the Consultant's Representative, rigidly supported to assure correct grade and cross-section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross-section. Placing by hand shall be performed carefully, the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregate

Broadcasting of material shall not be permitted. During the spreading operation, all materials shall be thoroughly loosened and uniformly distributed by lutes or covered rakes. Material that has formed into lumps and does not break down readily shall be rejected. Following placing and before rolling, the surface shall be checked with templates and straight edges and all irregularities shall be corrected.

Heating equipment used for keeping hand tools free from asphalt shall be provided. Caution shall be exercised to prevent high heating temperatures which may burn the material. The temperature of the tools when used shall not be greater than the temperature of the mix being placed. Heat only shall be employed to clean hand tools; petroleum oils or solvents shall not be permitted.

6.4.5.9 Compaction General

(1) General

Except for small jobs, such as driveways, at least two rollers shall be required at all times. As many additional rollers shall be used as necessary to provide specified pavement density. During rolling, the roller wheels shall be kept moist with only sufficient water to avoid picking up the material.

After the edges have been compacted rolling shall start longitudinally at the sides and gradually progressing toward the centre of the pavement.

The rollers shall move at a slow but uniform speed with the drive roll or wheel nearest the paver. The speed shall not exceed 5 kph for steel-wheeled rollers or 8 kph for pneumatic - tired rollers.

The line of rolling shall not be changed suddenly. If rolling causes displacement of the material, the affected areas shall be loosened at once with lutes or shovels and restored to the original grade of the loose material before being re-rolled.

Heavy equipment or rollers should not be permitted to stand on the finished surface before it has been compacted and has thoroughly cooled.

Rolling shall be in the following order-

- i) Transverse joints.
- ii) Outside edge
- iii) Initial or breakdown rolling, beginning on the low-side and progressing toward the high side
- iv) Second rolling, same procedure as (iii)
- v) Finish rolling.

The compaction temperature (laboratory) shall be (viscosity) of bitumen is 280+30 centistoke, as follows:

148+3°C for 60/70 penetration.

(2) Transverse Joints

Transverse joints shall be held to a minimum and thoroughly compacted to provide a smooth riding surface.

Joints shall be straight edges and string - lined to assure smoothness and true alignment. If a joint is formed with a bulkhead, such as a board, to provide a straight line and vertical face, it shall be checked with a straight edge before fresh material is placed against it to complete the joint. If a bulkhead is not used to form the joint and the roller is permitted to roll over the end of the new material, the line shall be located back of the rounded edge a

sufficient distance to provide a true surface and cross-section. If the joint has been distorted by traffic or by other causes, it shall be trimmed to line.

In either case, the joint face shall be painted with a thin coating of asphalt before fresh material is placed against it.

To obtain through compaction of these joints, material placed against the joint shall be tightly crowded against the vertical face of the joint.

To accomplish this, the paving machine shall be positioned so that the material shall overlap the edge of the joint by 3 to 5 cm. The depth of the overlapped material shall be kept uniform.

The coarse aggregate in the overlapped material that was dislodged through raking or luting shall be removed from the pavement surface and discarded.

A tandem roller shall be placed on the previously compacted material transversely so that no more 15 cm of the rear rolling wheel rides on the edge of the joint.

The roller shall be operated to pinch and press the mix place at the transverse joint. The roller shall continue to roll along this line, shifting its position gradually across the joint, in 15 to 20 cm increments, until the joint has been rolled with the entire width of the roller wheel. Rolling joint is obtained.

(3) Edges

Care shall be exercised in consolidating the course along the entire length of the edges. Before it is compacted, the material along the unsupported edges shall be slightly elevated with a tamping tool or lute.

This will permit the full weight of the roller wheel to bear on the material to the extreme edges of the mat. In rolling pavement edges, roller wheels shall extend 5 cm to 10 cm beyond the pavement edge.

(4) Breakdown Rolling

Breakdown rolling shall commence at a temperature of not less than 120°C and immediately follow the rolling of the longitudinal joint and edge. Rollers shall be operated as close to the pavement as necessary to obtain adequate density without undue displacement. The breakdown roller shall be operated with the drive roll or wheel nearest the finishing machine. Exceptions may be made by the Consultant's Representative when working on steep slopes.

When both three-wheeled rollers and tandem rollers are used, the three-wheeled rollers shall work directly behind the paver following by the tandem rollers. Only experienced roller operators shall be used for this work.

(5) Second Rolling

Pneumatic-tired rollers shall be used for the second rolling. The second rolling shall follow the breakdown rolling as closely as possible and while the paving mix is still of at a temperature that will result in maximum density from this operation.

Pneumatic-tired rollers shall be continuous (at least three complete coverages) after the initial rolling until all of the mix placed rollers on the hot paving mix which causes undue displacement will not be permitted.

(6) Finish Rolling

The finish rolling shall be accomplished with two-axle tandems or three-axle tandems while the material is still warm enough for the removal of the rollers marks. If necessary to obtain the required surface finish, the Consultant's Representative shall specify the use of pneumatic - tired rollers. All rolling operations shall be conducted in close sequence.

In places inaccessible for the operation of standard rollers as specified, compaction shall be performed by trench rollers or others. The trench roller shall be operated at the direction of the Consultant's Representative until the course is thoroughly compacted. Hand tamping, manual or mechanical, may be used in such areas if it proved to the Consultant's Representative that such operations will give the desired density.

(7) Shoulder

The shoulder material shall not be placed against the edges of the pavement until the rolling of the surface course has been completed.

Adequate precaution shall be taken to prevent distortion of the pavement edge from specified line and grade.

When the rolling of the surface course has been completed and the edges have been thoroughly compacted, shoulder material shall be immediately placed against the edges and rolled.

(8) Density and Surface Requirements

The completed pavement shall have a relative compaction equal to or greater than 98% (from daily Marshall) of a laboratory specimen prepared as specified in Section A, "Test Methods and Definitions" , and made from plant mix conforming to the result of density from samples taken on site.

The final surface shall be of uniform texture and shall conform to line and grade shown on the plans. Before final acceptance of the project, or during the progress of the work, the thickness of all courses will be determined by the Consultant's Representative.

All unsatisfactory work shall be repaired, replaced or corrected.

Both density and thickness shall be carefully controlled during construction and shall be in full compliance with the plans and specifications. During compaction, preliminary tests as an aid for controlling the thickness, shall be made by inserting a flat blade, correctly graduated, through the material to the top of the previously placed base, or by other means approved by the Consultant's Representative.

In checking compacted depth, the cutting of the test holes, refilling with acceptable materials, and proper compaction shall be done by the Contractor under the supervision of the Consultant's Representative.

For the purpose of testing the surface on all courses, a 3- meter long aluminum straight edge at the longitudinal direction shall be used.

Any irregularities which vary more than 0.5 cm in 3 meters shall be corrected. Irregularities which vary may develop before the completion of rolling shall be remedied as may be required.

Should any irregularities or defects remain after the final compaction, the surface course shall be removed promptly and sufficient new material laid to form a true and even surface.

All minor surface projections, joints, and minor honeycombed surfaces shall be ironed smooth to grade as may directed by the Consultant's Representative.

(9) Method of Measurement

Asphalt concrete shall be measured by square meters of the actual area paved and accepted in place including the bitumen according to the dimensions shown on the Drawings.

Edge slopes shall be done but will not be measured for payment.

7. Gate, Net Fence and Handrail

7.1 General

The site is surrounded by the net fence which is shown in Drawings. Safety fence is installed the site road along to wadi side shown in the Drawing. The handrail is installed at the top of the retaining wall as shown in the Drawings. The material and type of the gate and net fence is same as those of the existing landfill in Jericho.

The gate and net fences items shall comprise the following:

- 1- Chain link gate and fence.
- 2- Miscellaneous metalwork: frames and gratings, frames and plate covers, safety racks, steel guides for emergency stop planks, and all other items of miscellaneous manufactured metalwork where shown on the Drawings

7.2 Gate

7.2.1 Fabrication

The Contractor shall fabricate gate perimeter frames of tubular members and provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories. Space so that frame members are not more than 2.00 m (6.5 ft) apart. Provide 60 mm (2.5 in) nominal outside diameter frame pipes weighing not less than 5.45 kg/lin-m (3.66 lbs/lin-ft).

Assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 380 mm (15 in) on centers. Attach hardware with rivets or by other means which will provide security against removal or breakage.

Install diagonal cross-bracing consisting of 10 mm (3/8 in) diameter adjustable length truss rods on gates where necessary to ensure frame rigidity without sag or twist.

7.2.2 Hardware

The Contractor shall furnish the following hardware and accessories for each gate:

- a. Hinges: Pressed or forged steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degrees gate opening. Provide 1-1/2 pairs of hinges for each leaf of the gate.
- b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- c. Gate Stops: Provide gate stops consisting of mushroom type or flush plate with anchors. Set in concrete to engage the center drop rod or plunger bar. Include locking device and padlock eyes as an integral part of the latch, using one padlock for locking both gate leaves. Provide one padlock with 4 keys for each gate. Padlocks shall be keyed the same.

7.3 Net Fence

7.3.1 Type of Net Fence

The fence shall be standard chain link fence with gates and a guard of stands of barbed wire in accordance with the details shown on the Drawings.

The Contractor supply all materials for the chain fence including fabric and barbed wire, posts, gates and accessories, cement, sand and coarse aggregate and other materials for complete erection of the fence, and padlocks.

The Contractor shall submit to the Consultant; for approved shop Drawings showing layout and details of construction and erection of fence and accessories required before starting any works.

7.3.2 Material

The chain link fencing and accessories shall conform to the American Society for Testing and Materials (ASTM) A116.A120.A123A153 and A392 as well as the Chain Link Fence Manufacturers Institute (CLFMI) Product Manual: FS-RR-F191.

7.3.3 Fabric

The fabric shall be as below;

- Furnish chain link fabric in one-piece fabric widths of 4.0 mm (9 gauge) diameter wires and 50 mm (2 in) mesh with top salvages twisted and barbed and bottom salvage knuckled.
- Galvanized Finish: Finish with not less than 0.40 kg/m² (0.20 psf) zinc complying with ASTM A 392, Class I.

7.3.4 Posts, Rails and Braces

The Contractor shall take consideration on the following;

1. Furnish end and corner posts of the minimum sizes and weights by Providing 90 mm (3-5/8 in) nominal outside diameter pipe weighing not less than 11.3 kg/m (7.6 psf).
2. Furnish line posts of the minimum sizes and weights as follows:
 - Space posts 2.0 m (6.5 ft) on centers maximum unless otherwise indicated.
 - Up to 2.0 m (6.5 ft) fabric height: Provide 60 mm (2-5/8 in) nominal outside diameter pipe weighing not less than 5.45 kg m (3.7 lb/ft) unless otherwise indicated.
3. As indicated, furnish gate posts for supporting each leaf of the gate by 75 mm (3 in) nominal outside diameter weighing not less than 8.65 kg/m (5.82 lbs/ft).
4. Top Rail: If required, furnish top rails of 42 mm (1-5/8 in) nominal outside diameter pipe weighing not less than 3.40 kg/m (2.3 lb/ft). Furnish in manufacturer's longest lengths, with expansion type couplings, approximately 150 mm (6 in) long, for each joint. Provide means for attaching the top rail securely to each corner and end post.

5. Center Rails: As indicated, furnish center rail of the same size and weight as top rail as required.
6. Tension Wire: Provide tension wire consisting of galvanized 4.5 mm (7 gauge) coiled spring wire at top, center and bottom of fabric.
7. Post Brace Assembly: Furnish bracing assemblies at end posts and at both sides of corner posts with the horizontal brace located at mid-height of the fabric. Use 42 mm (1-5/8 in) nominal outside diameter pipe weighing not less than 3.40 kg/m (2.3 lb/ft) for horizontal brace and 10 mm (3/8 in) diameter rod with turnbuckle for diagonal truss.
8. Post Tops: Pressed steel, wrought iron, or malleable iron, designed as a weathertight closure cap for each post.
9. Stretcher Bars: One piece lengths to full height of fabric, with a minimum cross-section of 10 x 6 mm (0.4 x 0.25 in). provide one stretcher bar for each gate and end post, and 2 for each corner and pull post.
10. Stretcher Bar Bands: Steel, wrought iron, or malleable iron, spaced not cover 300 mm (1 ft) on centers to secure stretcher bars to end, corner, pull and gate posts. Bands may also be used with special fittings for securing rails to end, corner, pull and gate posts.

7.4 Handrail

7.4.1 Material

The material of the handrail shall be galvanized steel.

7.4.2 Installation

The handrail shall be fixed with anchor bolts or post embedding. The handrail shall be covered by base paint in the factory and coating shall be carried out after fixing.

Chapter 2 Piping Work and Laying Work of Geomembrane Liner for the Expansion of Sanitary Landfill

1. Piping Work (leachate collection pipe and gas exhaust pipe)

1.1 General

The work shall consist of furnishing materials, testing and installing the pipes and of the types specified for removal of the leachate water and exhaust of the methane gas which will be generated at the project site of the expansion of the sanitary landfill; all as and where shown on the Drawings.

1.2 Material

The material of the leachate collection and gas exhaust pipes shall be unplasticized Poly Vinyl Chloride Pipe (uPVC) type without containing fillers. The pipes shall be manufactured at company awarded the ISO9001 series approval or equivalent which has good experiences. The pipes shall be processed in porous as shown on the Drawings.

1.3 Definition

For the purposes of this Specification, the following definitions shall apply:

"Pipes": Straight pipes with either plain ends or with an integral joint at one or both ends.

"Fittings": All bends, branches, tees and similar items which are made to the requirements and dimensions in Standard Specifications or are included in manufacturers' standard ranges.

"Specials": Any pipework item which is not covered by Standard Specifications, or is not normally in manufacturers' standard ranges of items, or has any special features which render it different from the standard pipes and fittings.

"Joints": Any joint assembly or components to connect items of pipework together.

1.4 Dimensional Requirement

Unless otherwise specified a manufacturing tolerance of +2 per cent shall be allowed on the nominal internal diameter of the pipe.

The dimensions and tolerances applying to the jointing surfaces, and sealing rings or gaskets, of pipes, fittings and special shall be such as to ensure that the required sealing performance of the joints is maintained under service conditions, and will not be impaired by normal installation practices.

1.5 Nominal Outside Diameter

UPVC shall comply with ISO 4422, ISO 4435, or equivalent. The pipes shall be designed for a tensile strength of 50 MPa at 20°C, Specific gravity not less than 1.40gr/cc and Modulus of Elasticity not less

than 3,000 MPa. The nominal outside diameters and wall thickness of the pipes are shown in the following table:

Nominal Outside Diameter (mm)	Minimum Wall Thickness (mm)
50	2.4
63	3.0
75	3.6
90	4.3
110	5.3
140	5.4
160	6.2
225	8.6
280	10.8
315	11.9
355	13.4
400	15.0

1.6 Manufacture

UPVC pipes and fittings shall be manufactured and tested to the relevant approved standard for their pressure or gravity duty. UPVC pipes for gravity pipelines shall have a standard dimension ratio, D:t (Diameter to thickness) of between 35 to 45. Any pipes exhibiting cracks, notches or deep scratches or other damage will be condemned and shall not be incorporated into the permanent work under any circumstances.

1.7 Marking for Pipes and Fittings

All UPVC pipes shall be indelibly marked at maximum intervals of (3mt). The fittings shall be indelibly marked or labelled.

The marking shall show at least the following information:

- Manufacturer's name and trade mark.
- Dimensions (nominal diameter (ND), wall thickness).
- Material, material class, and pressure class (PN).
- Production period (date).
- Serial Number.
- Batch Number.

The pipes and fittings shall be rejected, if the above information for marking is not shown clearly on each piece.

Certifications

The contractor shall submit:

- 1) Certified copies of manufacturers' quality control test results and reports.
- 2) Certified copies of compliance certificates for UPVC pipes, fittings and other components.

“This is to certify that pipes and specials delivered in this consignment comply with the required specifications.”

No payment shall be made in respect of any consignment of pipes and specials in case it is not accompanied by above mentioned certificates.

1.8 Testing

The Contractor shall submit all test reports by manufactures including any evidence of performance to comply with design specifications, and shop drawings to the Consultant for review and approval.

Tests for determining the resistance of pipes to a constant internal pressure and the bursting time of these pipes are required and should comply with (ISO-1167).

Two types of test are required:

- 1) Acceptance Test: carried out at a temperature of 20 °C (1 hr test). This allows a fast verification of the conformity of a batch of pipes to a specified type. At least one sample test for each size shall be carried out for lot batch of pipes not greater than (5 km) length delivered to the site.
- 2) Quality test carried out at an elevated temperature as a nature of the pipes tested. It is a type test for material and should be carried out for each dimension of pipes as follows:
 - When a change is made in composition or method of manufacture of the pipe.
 - Not less than one test every twelve months.
 - At least, one test for each lot not greater than (5 km) in length delivered to the site.
 - At least one test for each size of the pipes.

The above two tests (1+2) allow evaluation of the standard of the production and the pipe material used. The pipe shall meet the DIN 8061, BS 3505.

Test Type	Temperature (°C)	Time (Hr)	Induced Stress (N/mm ²)
Acceptance Test	20	1	42
Quality Test	60	200	11.3

1.9 Perforated uPVC Pipes

The perforation of the uPVC pipe, the holes diameter and the distance between them shall be as shown on the related Drawings of the Contract.

1.10 Related Standards for Pipes

The following standards or other internationally accepted standards or manufacture's standards shall be applied,

- (1) Pipes shall conform to ISO or Palestinian Standard (PS) and shall be installed in accordance with the manufacturer's guidelines. All jointing shall be by socket and spigots with sealing rings which shall conform to BS 2494 or equivalent. Solvent welded joints are not permitted. Pipes shall be capable of withstanding ultraviolet

degradation and shall incorporate a rodent inhibitor. Pipes shall be furnished in standard laying lengths of 6 m and shall be grey in colour.

- (2) Fittings made of uPVC shall conform to BS 4346 or equivalent and shall be manufactured by heat injection moulding or extrusion machine only. Fittings shall have the same strength as the connecting pipe.
- (3) All joints shall be designed to have the same characteristics and strength as the connecting pipe. Unless otherwise specified;
 - 1) joints for underground pipes and fittings 90 mm and larger shall be push in type using rubber gaskets;
 - 2) joints for underground pipes and bends of 63 mm shall be welded using solvent cement;
 - 3) joints for other underground fittings of 63 mm shall be push in type using rubber gaskets;
 - 4) joints for all exposed pipes, and pipes smaller than 63 mm, shall be welded using solvent cement.
- (4) For push in joints, the pipes shall have an integral socket end and spigot end. The socket shall be designed by the manufacturer. One neoprene ring shall be furnished for each joint. The neoprene ring shall conform to JIS K6353, BS 2494, ASTM F477, or equivalent .
- (5) For welded joints, the pipes shall have an integral socket end designed by the manufacturer. Solvent cement shall conform to BS 4346 or equivalent and shall be mixed in strict accord with the manufacturer's instructions. Any impurities in the cement shall be cause for rejection. Data on the pot life of the cement shall be approved by the Consultant.
- (6) Flanged joints shall be made using flange adapters.

1.11 Quality Control

The requirements of the Specification relating to the quality, performance and finish of pipes and pipeline components, will apply to their condition as installed. The certification or approval of items at the manufacturers' works, at a stockyard, or at any other temporary location, will in no way relieve the Contractor of his responsibilities for the condition of the items when installed.

Any damage, or circumstances capable of giving rise to damage, shall be reported immediately to the Consultant, who will give instructions regarding the testing and/or repair of the suspect items.

Any protective lining, coating or wrapping damaged during construction shall be repaired as soon as is practicable after the damage occurs in order to limit the extent of any resulting corrosion. Any such damage which cannot, in the opinion of the Consultant, be satisfactorily repaired in-situ shall render the item or items concerned liable to rejection and they shall be replaced by the Contractor at his own expense.

1.12 Storage and Handling

UPVC pipes and fittings shall be stored according to the manufacturer's recommendation regarding storage and should be followed strictly.

During storage, handling, transporting, and every precaution shall be taken to prevent damage to the pipes and fittings. Pipes shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or other approved methods for the pipe used. Dropping or bumping of pipe will not be permitted. Damaged pipe shall be replaced or repaired by the Contractor at his expense. Pipes shall not be dragged over the ground and, if rolled, shall be rolled only over adequate timber bearers to prevent damage.

The following requirement shall be taken into consideration;

- Contact with burrs or sharp metal edges on racks, etc, should be avoided.
- The ends of pipes should be protected from damage to avoid the risk of unsatisfactory jointing.
- The pipes should be stored under cover and protected from direct sunlight including when stocked at the places of installation.
- Storage of pipes in heated area exceeding 25°C should be avoided.
- If, due to unsatisfactory storage or handling, a pipe is damaged or kinked, the damage portion should be cut out completely.

1.12 Jointing

All joints shall be designed to have the same characteristics and strength as the connecting pipe.

For push in joints, the pipes shall have an integral socket end and spigot end. The socket shall be designed by the manufacturer. One neoprene ring shall be furnished for each joint. The neoprene ring shall conform to JIS K6353, BS 2494, ASTM F477, or equivalent.

Any repair work or replacement work requested by the Consultant shall cost the Contractor.

The Contractor shall furnish the Consultant with responsible facilities and space for inspection, testing and obtain such information as is required with respect to character of materials used, progress and conditions of the work, and the results obtained.

1.13 Pipe Laying

The pipelines shall be laid and maintained to the required alignments and grades with fittings, accessories, etc., at the required locations shown on contract drawings.

The Site shall be inspected by the Contractor in conjunction with the Consultant to fix the alignment of the pipelines which shall be agreed and recorded in writing.

Pipes shall be laid and jointed in accordance with all relevant recommendations of the manufacturer copies of which shall be provided to the Consultant at the time of bid. Any variations between the manufacturer's recommendations and this specification shall be notified to the Consultant and installation of pipes shall not commence until the conflict has been resolved. All pipe laying shall be performed by experienced and competent pipe layers.

The joints and interiors of all pipes and fittings shall, if necessary, be carefully cleaned before installation. Particular care shall be taken to prevent sewage or polluted water of any kind from coming into contact with pipes for water supply. Whenever pipe laying is interrupted for any reason, the open end of the pipeline shall be sealed with a suitable expanding stopper.

The line of the pipe shall be set out and agreed with the Consultant well in advance of the excavation. Surface stripping, excavation, pipelaying, backfilling and reinstatement shall follow each other without undue delay or distance between them.

Pipes shall be laid to true inverts and, except when using rigid joints, each pipe shall be separately set by laser or boned between sighting rails. Any pipe which is outside the permissible tolerances shall be unjointed and removed; the bedding shall be adjusted, and the pipe relayed and rechecked for line and level. After the laying of a length of a pipeline but before preliminary testing, the crown of the pipeline shall be checked for level and alignment and any necessary adjustment shall be carried out by unjointing and removing the pipes concerned, adjusting the bedding, relaying the pipes and rechecking for line and level. The permissible tolerances for pipelines shall be 6mm in level and 25mm in line between manholes or changes in direction or gradient. In addition, where a gravity pipeline is shown on the drawings as being straight between manholes it will not be accepted unless a light can be sighted through the length concerned.

The pipelines should be covered with gravel layer as per and as specified on the related Drawings.

1.14 Cutting Pipes

Where pipes are required to be cut for any reason the cutting shall be done by the Contractor in accordance with the recommendations of the manufacturer and in a manner approved by the

Consultant. Care shall be taken not to damage either section of the cut pipe, and the Contractor shall be responsible for the accuracy of the measurement of the cut pipe as well as the actual cutting.

The Contractor shall take all necessary safety precautions. In particular, all personnel involved in cutting or turning asbestos cement pipes must be warned that inhalation of asbestos cement dust is dangerous to health. When cutting or turning pipes by any process which creates dust, all personnel shall be provided with, and instructed to wear or use appropriate clothing and equipment including where necessary suitable face masks or respirators.

2. Laying Work of Geomembrane Liner

2.1 General

The work shall include furnishing, fabrication, and laying of High-Density Polyethylene (HDPE) sheet including supports to prevent the underground seepage of the leachate water at the bottom of the Expansion of Sanitary Landfill.

The HDPE liner shall:

1. Be free from defects or tears.
2. Be resistant to ambient temperatures, acid and alkaline conditions, microorganisms and insects.
3. Be for the intended purpose and have dimensional stability.

2.2 Product Data

The Contractor shall provide the manufacturer's specification and installation instructions of the HDPE liner and its accessories.

The Contractor shall furnish the manufacturer's records of chemical and physical properties of HDPE liner and a certificate that the respective material furnished meets the requirements for its specification. The manufacturer's records shall include mill certificates as well as chemical analysis, tensile and bend tests.

2.3 Shop Drawings

2.3.1 The following shop drawings indicating the details of the fabrication and laying for all HDPE liner which are correlated with forming and concrete placement shall be submitted to the Consultant for his review and approval;

- (1) Details of the base of HDPE liner at the construction joint locations
- (2) Detailed drawings indicating sections and plans of the laying of HDPE liner clearly.

A separate set of shop drawings showing construction joint locations, shall also be submitted for approval to the Consultants.

2.3.2 No fabrication work shall be allowed until a set of shop drawings (Detailed drawings indicating dimensions of laying HDPE liner) is reviewed by the Consultant (with corrections and re-submittals as required by the Contract Documents). After the approval by the Consultant, the Contractor shall furnish all copies needed for fabrication, laying and other uses..

2.3.3 The approval of shop drawings, or revised drawings shall in no way relieve the Contractor of his responsibility for the correctness of such drawings or schedules.

2.4 Samples

2.4.1 The samples of HDPE liner that the Contractor proposes to use in the Works shall be submitted to the Consultant for his written approval, before the laying work is commenced. The Contractor shall submit manufacturer's certificates certifying the following information clearly for each sample:

- (1) Place of manufacturing,
- (2) Expected date of delivery to the site,
- (3) All relevant details of chemical composition, manufacturing and technical quality data such as strengths of the HDPE liner

2.4.2 The Consultant reserves the right to sample and inspect all HDPE liner sheet upon its arrival at the work site.

2.4.3 The Contractor shall provide a certificate confirming that the samples taken from the liner sheet delivered to the works have passed the manufacturer's sample test.

2.5 Delivery

2.5.1 Each lot of the HDPE liner sheet shall be legibly tagged by the manufacturer. The tag shall show the manufacturer's test number and lot number and other applicable data that should identify the material with the certificate issued for that lot of HDPE.

2.5.2 The Contractor shall furnish three (3) copies of the certificate which shows the heat number or numbers from which each size of the lot of the HDPE liner in the shipment was fabricated.

2.6 Storage

2.6.1 Rolls of HDPE liner sheet shall be clearly tagged with bar schedule and bar mark reference and these shall not be removed until the material is at the location where it is to be incorporated into the works.

2.6.2 HDPE liner sheet shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, earth, paint, or any other material which may impair the bond the sheet.

2.7 Handling

The HDPE sheet shall not be handled roughly, dropped from a height, or subject to shock loading or mechanical damage. The Contractor shall be careful the heavy machinery operation and not to damage the sheet during earth covering and compaction of protective soil. The bottom part (50 cm lower from the bottom) of the protective soil shall be covered by manpower and compacted by vibrator. For preventing to damage the sheet, the Contractor shall provide at least one (1) normal worker as a watchman.

2.8 Execution

2.8.1 General

All HDPE sheet shall be securely and accurately installed in the positions as shown on the Drawings to ensure that the HDPE liner sheet as a whole shall retain its shape.

No part of HDPE liner sheet shall be used to support access ways, working platform or for the conducting of an electric current.

Specific attention shall be taken for the following general requirements:

- (1) Lapped joints shall be as indicated on the Drawings and/or in accordance with the requirements of BS 8110.
- (2) Hooks shall be semi-circular with a straight length of at least four bar diameters for mild steel and six diameter for high yield steel.

The Contractor shall provide full rolls of geomembrane as furnished from the manufacturer. Protect against damage and deterioration by storing rolls in a dry place and above ground at all times until placement. Cover rolls and partial rolls until used with a dark protective covering. The HDPE liner shall be rejected by the Consultant if found to be defective, deteriorated or damaged.

2.8.2 Welding

Welding shall not be permitted unless authorised by the Consultant and recommended by the HDPE

manufacturer. Welding shall be executed under controlled conditions on site.

Welding on site shall not be permitted unless suitable safeguards and techniques are employed and the types of steel have the required welding properties.

Welding shall be executed by a thermal fusion bonding equipment with self-propelled. The width of thermal fusion bonding shall be more than 40 mm.

Thermal fusion bonding test shall be executed twice a day for determining the working condition (heating temperature, automotive velocity and roller pressure) on site. The sheet for the construction shall be used for the test. Method of the test shall be described on method of statement for the work.

2.8.3 Quality Control

The basement of the sheet shall be flat, not be bumpy, step and crack fissure on its surface.

The Contractor shall decide the working condition with the Consultant based on the result of the thermal fusion bonding test on site before conducting the work

The Contractor shall check all overwrapped width, connection width and water tightness for the liner sheet as the bonding test. The Contractor shall be careful the heavy machinery operation and not to damage the sheet during earth covering and compaction of protective soil. The bottom part (50 cm lower from the bottom) of the protective soil shall be covered by manpower and compacted by vibrator. For preventing to damage the sheet, the Contractor shall provide at least one (1) normal worker as a watchman.

Chapter 3 Architectural Works for Material Recovery Facility (MRF) and Waste Transfer Station (TS)

1. General Specifications

1.1 General

This specification shall specify the quality of materials, level of workmanship, and methods to be applied for the architectural works for the Material Recovery Facility (MRF) and Waste Transfer Station (TS).

1.2 Scaffolding

The Contractor shall provide scaffoldings. The Contractor shall erect and maintain the scaffoldings to be necessary for executing the Works. Upon completion the contractor shall remove them. The contractor shall take all necessary safety measures related to these scaffoldings and repair any damages caused by the scaffoldings to the permanent works during execution period.

1.3 Materials and its Equivalent

All materials and goods shall follow the technical specification. The Contractor shall submit the specification of the materials that he intends to supply with all necessary information to the Consultant to investigate before supplying. These information shall include, but not limited to, trade name, manufacturer address and the contractor shall submit samples if asked by the Consultant.

The contractor can propose alternatives for the materials provided it is with the same level of specification, and shall obtain the Consultant's approval.

1.4 Samples

The contractor shall submit the samples for materials and equipment according to Consultant's instruction. The contractor shall execute the works according to the accepted samples and following conditions:

- (1) The cost of all samples shall be borne by the contractor.
- (2) The contractor shall submit samples before a reasonable time for commencing the work to give the Consultant time to inspect the samples.
- (3) The samples shall be submitted with a letter containing all the needed information to obtain the Consultants approval.

1.5 Test of Materials

The Consultant has the right to ask the Contractor to accompany the required materials with a testing certificate from the source either from the manufacturer or a laboratory approved by the Consultant.

1.6 The Construction specified for the Use of Supervision Staff

The cost of the offices for the Consultant's use shall be included in the contractor's prices in the bills of quantity. The contractor shall complete construction of the Consultant and his inspectors offices within 30 days of receiving the order to commence the works, and during this period, the contractor shall provide temporary movable offices for the use of the Consultant and supervision staffs.

The Contractor shall during the execution of works provide all the required services for the above-mentioned offices including maintenance, cleaning, keeping and guarding the offices and its content at all times.

The contractor shall be responsible for all the costs of the needed services of the Consultant and inspectors offices and their maintenance including electricity, water, telephone, cleaning the sewage pit and drinking water for the works according to Consultant's approval.

The required offices shall be erected in the place approved by the Consultant. The Contractor shall hand it over in a good condition without any defects.

1.7 Temporary Construction for Contractor's Use

The Contractor shall from the day of the order to commence works, have an a movable or temporary office for the use of his staff to receive the Consultant's instruction when needed. The office shall be in the size suitable for the Contractor's needs and requirements and he shall obtain the prior approval of the Consultant on this office.

The warehouses needed for the Contractor's use shall be sufficient to store all construction materials needed for the project including equipment and tools. These warehouses shall have all the conditions required to protect the materials from the environmental conditions.

The contractor shall be responsible for guarding and maintaining all the above mentioned temporary offices that are used by the Contractor. He shall also be responsible to provide the required services for these constructions.

The contractor shall bear all the costs of constructing these temporary constructions.

1.8 Removal of Temporary Constructions

All temporary constructions for the contractor use shall be kept in all times in a good condition until all stages of works are completed and finally handed over. Afterwards, the contractor shall remove all these constructions and its residuals and cleaning its locations properly so that they leave no trace.

1.9 Temporary and Permanent Services

The contractor shall, on his own cost, repair any damages to the public services such as telephone, electrical, sewage and water services for the concerned authorities or a third party.

If these authorities or the third party decide to repair the damages by themselves, the Contractor shall bear the cost of these repairs.

2. Block Work

2.1 Manufacturing

2.1.1 General

Generally the blocks used shall be of local manufacture made with concrete in approved vibrated pressure machines. The fine aggregate to be used for blocks shall be clean and sharp approved sand. It shall be chemically and structurally stable and shall comply with the Table of Grading as described in ANNEX III-2-10. The cement, coarse aggregate and water to be used for the blocks shall comply with the requirements given for Concrete Works, and the methods of measuring and mixing the material shall be the same.

2.1.2 Coarse aggregate 10mm single size aggregate.

The blocks shall be hard, sound, square and clean with sharp well defined arises and shall, unless previously approved by the Consultant, be a work size of (400 x 200 x 200 mm) with properly formed half blocks for bonding.

Hollow blocks, where required, shall have similar quality and overall size to solid blocks, and shall be of local manufacture made with concrete as described above in approved vibrated pressure machines. The design of the cavities and webs shall be submitted to the Consultant for approval before manufacturing. The thickness of the membranes or solid portions of hollow blocks shall be not less than (30 mm) each and the combined thickness of the solid portion shall exceed one third of the total thickness in either horizontal direction

Immediately after molding the blocks shall be placed on clean, level, non-absorbent pallets. Blocks shall not be removed from the pallets until inspected and approved by the Consultant. Blocks shall be cured by being kept thoroughly wet by means of water sprinklers or other approved means for a period determined by the Consultant but in all cases for not less than three days. Blocks shall not be left on earth or sand during the curing process. Blocks shall be stacked in honeycomb fashion. Solid stacking will not be permitted.

2.2 Mortars

The sand to be used for mortar shall be clean and sharp. It shall be chemically and structurally stable and shall comply with the Table of Grading described in Table 1 of **ANNEX III-2-11**. The lime if used for mortar shall be hydrated lime complying with BS 890.

Where coloured mortars are required these shall be obtained either by the use of coloured cement or by addition of pigments complying with BS 1014.

The cement and water to be used for mortar shall comply with the requirements given in “3. Cast-in-Place Concrete” in Chapter 1 “Common Works”. The Mixing Table is shown in Table 2 of **ANNEX III-2-11**

Note: the figures described in ANNEX III-2-11 represent the limits of percentages (by weight) passing sieves of the sizes mentioned.

The ratio of cement to mortar shall be 1:4 generally.

Where plasticity is added to the mortar, the following mixing ratio shall be used:

- (1) Building mortar - cement and sand (1:6) and
- (2) Mortar for pointing - cement and sand (according to plasticizer manufacturer recommendation)

The plasticity shall be used strictly in accordance with the manufacturer's instructions, and subject to the Consultant's approval.

2.3 Construction

All block work shall be set out and built based on the dimensions shown in the Drawings.

Walls shall be installed regularly without leaving any part more than one meter lower than another unless the permission of the Consultant is first obtained. Work which is left at different levels shall be racked back. In the case of cavity walls, both thicknesses shall not be carried up more than about 400 mm.

The courses of block work shall be properly leveled. The perpendicular joints shall be properly lined and quoins, jambs and other angles plumbed as the work proceeds.

All walls shall be thoroughly bonded in accordance with the best constructional practice and as directed by the Consultant. Broken blocks shall not be used except where required for bond (if approved by the Consultant).

All concrete blocks shall be soaked with water before being used and the tops of walls left off shall be wetted before work is resumed. The faces of walls shall be kept clean and free from mortar droppings and splashes

All blocks shall be properly spread with mortar before being laid and all joints shall be thoroughly flushed up solid through the full thickness of the wall at each course as the work proceeds.

For block walls the gauge shall be ten courses to 2100 mm.

Walls to be left unplastered shall have a fair face consisting of selected blocks pointed with a neat weathered or flush joint as the work proceeds using the same mortar mix as for jointing. Walls to be plastered shall have the horizontal joints raked out to depth of 8 mm to form a key. Block work shall be bonded to concrete columns and the like with 200 x 60 x 6 mm non ferrous metal ties cast in concrete and subsequently bent down, ragged and built into every 2 courses of block work.

3. Roofing

3.1 General

The work shall include furnishing, fabrication, and placement of specified roofing materials including supports.

3.2 Product Data

3.2.1 The Contractor shall provide the manufacturer's specification and installation instructions for proprietary materials and accessories.

3.2.2 The Contractor shall furnish the manufacturer's records of chemical and physical properties of roof material and a certificate that the respective material furnished meets the requirements for roof material specified. The manufacturer's records shall include mill certificates as well as chemical analysis, tensile and bend tests.

3.3 Shop Drawings

3.3.1 Detailed fabrication and placement drawings for all roof material.

(1) Roof material shall be detailed based on construction joint locations which are shown on shop drawings approved by the Consultant.

(2) Drawings shall consist of sections, plans and details clearly.

3.3.2 A separate set of shop drawings, showing construction joint locations, shall also be submitted to the Consultants for approval.

3.3.3 No work shall be fabricated until a set of shop drawing is reviewed by the Consultant (with corrections and re-submittals as required by the Contract Documents). After approval by the Consultant, the Contractor shall furnish all copies needed for fabrication and erection, and for

the use of other trades.

- 3.3.4** The approval of shop drawings, or revised drawings shall in no way relieve the Contractor of his responsibility for the correctness of such drawings or schedules.

3.5 Samples

- 3.5.1** The samples of roof material that the Contractor proposes to use in the Works shall be submitted to the Consultant for his written approval, before work is commenced. The Contractor shall submit manufacturer's certificates stating clearly for each sample:

- (1) Place of manufacturing,
- (2) Expected date and size of deliveries to the site,
- (3) All relevant details of composition, manufacture, strengths and other qualities of the sheet.

- 3.5.2** The Consultant shall reserve the right to sample and inspect all roof material upon its arrival at the work site.

- 3.5.3** The Contractor shall provide a certificate confirming that samples taken from the sheet delivered to the works pass the sample test.

3.6 Delivery

- 3.6.1** Bars in each lot shall be legibly tagged by the manufacturer. The tag shall show the manufacturer's test number and lot number and other applicable data that will identify the material with the certificate issued for that lot of roof material.

- 3.6.2** Fabricator shall furnish three copies of a certification which shows the heat number or numbers from which each size of bar in the shipment was fabricated.

3.7 Storage

- 3.7.1** Rolls of roof material shall be clearly tagged with bar schedule and bar mark reference and these shall not be removed until the material is at the location where it is to be incorporated into the works.

3.7.2 Roof material shall be kept clean and shall be free from pitting, loose rust, mill scale, oil, grease, earth, paint, or any other material which may impair the bond the sheet.

3.8 Handling

Roof Material shall not be handled roughly, dropped from a height, or subject to shock loading or mechanical damage.

3.9 Execution

Roof material shall be securely and accurately installed in positions shown on the Drawings.

Lapped joints shall be as indicated on the Drawings.

The Contractor shall be careful the heavy machinery operation and not to damage the roof material. On completion all roofs etc are to be left sound, water- tight and in clean condition before handing over.

4. Steel Frame and Miscellaneous Metal Works

4.1 General

The Contractor shall supply, fabricate and, where required, install all miscellaneous metalwork items needed to complete the Work shown on the Drawings. Such items are, in general, specified herein, but their extent is not necessarily limited thereto.

The Consultant can request the Contractor to submit shop drawings for miscellaneous metal works. Shop drawings shall be for the complete fabrication and installation showing dimensions, class of metal, method of assembly and joining of pieces, hardware, anchorage, bracing and means of connecting to other work. Where appropriate, the shop drawings shall be based on actual field dimensions and those dimensions shall be identified on the shop drawings.

4.2. Materials

4.2.1 Steel Metal

Steel metal shall conform to JIS G 3101 and 3106, or equivalent and close-grained, free from blow holes, shrinkage cracks or other defects. Steel metals shall be smooth and clean.

All steel metal shall be accurately made to the dimensions indicated on the Drawings, or on the shop drawings. Surfaces shall be planed or ground smooth and true, to insure correct and proper fitting of the work.

4.2.2 Bolts, Anchor Bolts and Nuts

Bolts, anchor bolts, nuts and washers shall be of low carbon steel, and shall be hot-dip galvanized or electroplated coating or equivalent.

All dimensions and clearances shall be for the finished bolts or nut after galvanizing. Bolt head and nut shapes shall be hexagonal. Each bolt shall be long enough to extend entirely through the nut but not more than 4 threads beyond. Washers shall be provided under nuts and under the heads of bolts.

4.3 Execution

4.3.1 General

All miscellaneous metalwork shall be formed true to detail, with clean, straight, sharply refined profiles, and smooth surfaces of uniform color and texture, free from defects. Connections and accessories shall be of sufficient strength to safely withstand strains and stresses to which they will be subjected.

Accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Where ferrous and non-ferrous metals come into contact they shall be insulated from each other by an approved dielectric insulating bushing. Threaded connections shall be made so that the fitting conceals the threads. Templates and patterns shall be provided for miscellaneous metalwork to be built into concrete or adjoining work, and all items to be built into masonry shall be set as the work progresses.

Metalwork shall be fabricated and installed in a manner that will provide for expansion and contraction; prevent the shearing of bolts, screws and other fastenings; ensure rigidity, and provide close fitting of the sections. All items shall be installed square, plumb and true at correct elevations and positions and with adequate anchorage.

Miscellaneous metalwork shall be fitted together at the shop as far as possible and delivered to the job-site complete, ready for installation with all lugs, connections, rivets, bolts, anchors, anchor rods and such other items necessary for the work.

4.3.2 Finishing

Steel work shall be thoroughly cleaned of all loose mill scale, rust, grease and foreign matter and shall be given one (1) shop coat of primer after fabrication but before shipping. Galvanized surfaces shall not be painted, unless noted otherwise. Iron Casting shall receive a coat of coal-tar varnish before shipment. The varnish shall have a smooth finish; tough but not brittle. Plates and shapes shall be galvanized with zinc coating. Bolts, nuts, washers, locknuts, and similar hardware shall be galvanized coating.

Uncoated spots or damaged coatings may be a cause for rejection. Repair of damaged coatings will be at the direction of the Consultant. Products that are warped or distorted to the extent of impairment for the use intended, shall be rejected.

4.3.3 Welding

Parts shall be welded only where shown on the Drawings, specified, or permitted by the Consultant. Welded joints shall be rigid and in conformity with the type of weld shown on the Drawings. Unless otherwise noted, the faces of welds shall be dressed flush and ground smooth. Exposed joints shall be close fitting and joined where least conspicuous.

5. Guard House and Utility Facilities

5.1 Guard House

The Contractor shall build a Guard House which consists of a Guard Room, a Store Room and a Toilet next to the MRF building. The size of the Guard House shall be 7.00m X 3.00m X 3.2 m Height as drawn in **PSWM-43, Volume IV**.

5.1.1 Guard Room

The Guard Room shall have a door and three (3) windows. The Contractor shall prepare and install a small kitchen, small desk, sofa, electrical panel and lighting.

5.1.2 Store Room

The Store Room shall have a door and window. The Contractor shall prepare and install a cabinet and lighting.

5.1.3 Toilet

The Contractor shall build the Toilet with two (2) washbowls, a toilet bowl and lighting. The Toilet shall have two (2) doors (external and internal), and at least one (1) window.

5.2 Utility Facilities

5.2.1 Electricity

The Contractor shall install primary and secondary electrical cable, an Electrical control panel and lighting equipment for the Guard House. The Electrical voltage shall be single phase, 200V. The capacity shall be enough for the lighting and small usage.

The primary electrical cable shall be connected from the property boundary suggested by the Client to the electrical panel located in the Guard Room and the cable for the secondary electrical cable shall be connected from the electrical panel to use points such as lighting and wall sockets.

5.2.2 Water Supply System

The Contractor shall install water supply system which consists of two water tanks on the roof of the Guard House and water distribution lines from the water tanks to the use points in the Guard House. The each capacity of the water tank shall be not less than 1.5m^3 . The Client prepares supplying water by water tanker and transfers to the water tank.

5.2.3 Wastewater Treatment System

The Contractor shall install waste water treatment system which consists of a septic tank and wastewater pipe lines from the Toilet and kitchen in the Guard Room to the septic tank and from the septic tank to the discharge point. The pipe line shall be 6 inches PVC installed underground and the slope of the pipe line shall be more than 1%. The practical capacity of the septic tank shall be not less than 28m^3 (3.6m X 2.6m X 3mH).

ANNEX III-2-1. Outline of the Facilities

Outline of the Facilities

Name of Facility	Specification, Size/Dimension
1. Sanitary Landfill	
1.1 Type or Landfill	Semi-Aerobic Sanitary Landfill Capacity: Approx. 50,000 m ³
1.2 Road in the site	Width: 5 meters Paving: Asphalt paving
1.3 Fence	Net Fence: Height=1.8 meters
1.4 Rainwater Discharge	U-shaped gutter : 30 cm
1.5 Water Sealing	HDPE 1.5 mm
1.6 Leachate Collection	Main Pipe: 400 mm (perforated), PVC Branch pipe: 200 mm (perforated), PVC
1.7 Gas Exhaust	Drum Rubble Wall, PVC 200 mm
1.8 Leachate Treatment	Leachate Storage Capacity: Approx. 1,400 m ³ Water sealing: HDPC 2 mm
2. Material Recycling Facility (MRF)	
2.1 Structure	Steel Frame, RC
2.2 Building Area	Approx. 258 m ²
2.3 Sorting System	Hand Sorting
3. Waste Transfer Station	
3.1 Structure	RC (height: 4 meters, Width : 18 meters)
3.2 Dumping Stage	RC Wall: Height : 4 meters, Width: 18 meters
3.3 Working Area	Asphalt Paving: Approx. 700 m ²

ANNEX III-2-2. Concrete Strength

Concrete Strength

Concrete Grade	Max. Size Agg. (mm)	Min. Cement Content (kg/m ³)	Max. Free Water/Cement Ratio	Cube Crushing at 28 days	
				Trial Mix (N/mm ²)	Works Test (N/mm ²)
40	20	370	0.45	50	40
35	20	350	0.45	45	35
30	20			40	30
20	20		0.60	30	20
21	20				21
18	20				18

ANNEX III-2-3. Admixtures

Admixtures		
Water Reducing Admixture	ASTM C494	Type A
Retarding Admixture	ASTM C494	Type B
Water Reducing, high range and retarding admixtures	ASTM C494	Type G

ANNEX III-2-4. Type of Formwork and Minimum Period before Stripping

Type of Formwork and Minimum Period before Stripping

Type of formwork	Minimum period before stripping (times are exclusive of the day of concrete placement)
Beam sides, walls and column	1 day
Soffits of slabs-props left under	4 days
Soffits of beams-props left under	10 days
Props to slabs	10 days
Props to beams	14 days

ANNEX III-2-5. Minimum Yield Strength of Reinforcing Steel

Minimum Yield Strength of Reinforcing Steel

Bars	Yield Strength	Symbol
Plain round mild steel	250 N/mm ²	R
Deformed high yield bars	460 N/mm ²	Y

ANNEX III-2-6. Base - course aggregate for Asphalt Work

Base - course aggregate for Asphalt Work	
Sieve Size	Passing (%)
1 1/2 inch (38.10 mm)	100
1 inch (25.40 mm)	75-10
3/4 inch (19.10 mm)	60-90
1/2 inch (12.70 mm)	45-80
3/8 inch (9.52 mm)	40-70
No.4 (04.76 mm)	35-65
No.10 (02.00 mm)	20-40
No.40 (00.42 mm)	8-20
No.200 (00.075 mm)	5-10

The fraction passing No. 200 sieve shall not be greater than 70% of the fraction passing No. 40 sieve.

Base - course aggregates shall confirm to the requirements of the following standard tests:

Los Angeles Abrasion (AASHTO -T- 96) 35 max.

Liquid Limit (AASHTO -T- 89) 25 max.

Plasticity Index (AASHTO -T- 90) 2 min. 6 max.

Flaky & Elongated Particles (B.S.812) 15% max. each.

The base-course shall be compacted to not less than 100% of the density obtained at optimum moisture content as determined by ASTM-DT 99C.

The following test shall also be performed:

a. Gradation tests shall be performed on samples of base - course taken after mixing with water and spreading before compaction and shall have a maximum % passing sieve No. 200 of 10%.

b. Gradation tests shall be performed on samples of base - course taken after compaction and the maximum material passing sieve No. 200 shall not exceed 10%.

The thickness of the compacted layer shall be measured and recorded when performing filed density tests and sieve tests on samples taken from compacted layers in place.

ANNEX III-2-7. Composition of Mixes for Hot Mix Asphalt Surfacing

Composition of Mixes for Hot Mix Asphalt Surfacing

Standard Sieve Size	Passing Surface Course(%)
1 inch (25.40 mm)	100
3/4 inch (19.10 mm)	90-100
3/8 inch (90.52 mm)	56-80
No.4 (04.76 mm)	35-65
No.8 (02.00 mm)	23-49
No.50 (00.42 mm)	5-19
No.200 (00.075 mm)	2-8

Asphalt to be added by weight of total weight according to design.

The aggregate shall have a percentage of wear of not more than 35% in 500 revolutions as determined by AASHTO T96. The sand equivalent shall be 50 minimum according to AASHTO T-176. Aggregate shall in all respects comply with the relevant standards. Aggregate limestone to be used be fresh mechanically crushed coarse aggregate. Materials on sieve No.4 shall have 90% by weight of at least two fractured faces.

ANNEX III-2-8. The Maximum Permissible Variation
from the Job Mix Formula

The Maximum Permissible Variation from the Job Mix Formula

Standard Sieve Size	Permissible Variation Percent by Weight of Total Mix
3/8 inch and larger	+5.00
No. 4 to No. 80	+4.00
No.200	+1.00
Asphalt	+0.30

ANNEX III-2-9. Mix Test Criteria

Mix Test Criteria

Minimum Stability (Kg)	900	
Flow (1/100")	2-4	
Percent air voids	3-5	
V.M.A. using bulk S/Gr. (Tolerance - 1%)	min.14%	
V.F.B.	60-75 %	
Loss of stability	max.25	(soaking 24 hours compared with 30 min. at 60°C for all specimens in water bath).
Plasticity Index for material	non plastic	
Passing sieve No.40(from hot bins)	uncoated	
Stripping Test(ASTM D1664)	aggregate	

Laboratory test specimens of paving mixes, combined in the proportions of the job mix formula, shall be prepared and tested in accordance with the procedures of the Marshall method of mix design as detailed in the 'Asphalt Institute Manual - MS2' and ASTM method of Test D 1559.

ANNEX III-2-10. Table of Grading

Table of Grading

BS 410 Sieve No.	Approximate Size	Percentage (by weight) Passing Through Sieve
-	3 mm	95-100
7	2.4mm	80-100
14	0.2mm	60-100
25	0.6mm	30-100
52	0.3mm	5-65
100	0.15mm	0-15
200	0.08mm	0-5

ANNEX III-2-11. Mortars

Table 1. Table of Grading

BS 410 Sieve No.	Approximate Size: mm	Percentage (by weight) Passing Through Sieve
-	10	100
-	5	90-100
7	2.36	75-100
14	1.18	55-90
52	0.6	35-59
100	0.3	8-30
200	0.15	0-10

Table 2. Mixing Table

Nominal Mix	cement (kg)	Sand (m ³)	Lime (dry Hydrate) (kg)
1:4	360	1.00	as approved by the Consultant