（資料）

1. 調査団員・氏名
2. 調査行程
3. 関係者（面会者）リスト
4. 協議議事録（M/D）
5. ソフトコンポーネント計画書
6. 参考資料

１．調査団員・氏名

(1) 第一回概略設計調査（期間：2019 年 9 月 25 日から 10 月 6 日まで）

氏名	担当	所属先
葦田　竜也	団長	JICA 人間開発部保健第四チーム
神作　麗	技術参与	JICA 国際協力専門員
阿部　康昭	協力企画	JICA 人間開発部保健第四チーム
藤沼　傑	業務主任/建築計画	株式会社福永設計
勢山　詔子	建築設計/自然条件調査	株式会社福永設計
鈴木　誠	機材計画／維持管理計画	ビンコーインターナショナル株式会社
諏訪　裕美	保健計画（１）	株式会社福永設計
駒形　朋子	保健計画（２）	株式会社福永設計

(2) 第二回概略設計調査（期間：2019 年 11 月 7 日から 11 月 23 日まで）

氏名	担当	所属先
吉田　友哉	団長	JICA 人間開発部保健第四チーム
神作　麗	技術参与	JICA 国際協力専門員
阿部　康昭	協力企画	JICA 人間開発部保健第四チーム
藤沼　傑	業務主任/建築計画	株式会社福永設計
勢山　詔子	建築設計/自然条件調査	株式会社福永設計
山林　修造	構造設計	株式会社福永設計
岡田　有弘	設備設計	株式会社福永設計
古角　信弘	施工計画／積算	株式会社福永設計
鈴木　誠	機材計画／維持管理計画	ビンコーインターナショナル株式会社
高山　唯華	調達計画／積算	ビンコーインターナショナル株式会社
諏訪　裕美	保健計画（１）	株式会社福永設計
浅沼　靖子	自社補強	ビンコーインターナショナル株式会社

(3) 概略設計説明調査（期間：2020 年 10 月 13 日事前協議、2021 年 3 月 11 日）

氏名	担当	所属先
葦田　竜也	団長	JICA 人間開発部保健第四チーム
阿部　康昭	協力企画	JICA 人間開発部保健第四チーム
藤沼　傑	業務主任/建築計画	株式会社福永設計
鈴木　誠	機材計画／維持管理計画	ビンコーインターナショナル株式会社
勢山　詔子	建築設計／自然条件調査	株式会社福永設計
高山　唯華	調達計画／積算	ビンコーインターナショナル株式会社

２．調査行程

(1) 第１回現地調査

			官団員　総括	官団員 計画管理	官団員 医療技術計画	業務主任／ 建築計画	保健計画1	建築設計／自然条件調査／安全対策計画	機材計画／維持管理計画	保健計画2
No.	月日	曜日	葦田竜也	阿部康昭	神作 麗	1. 藤沼 傑	2. 諏訪　裕美	3. 勢山　詔子	4. 鈴木　誠	5. 駒形　朋子
1	2019/9/25	水				東京→カラチ				
2	2019/9/26	木				10:00 シンド州保健局特別局長表敬、11:30 局長表敬 11:30 インセプションレポート説明 12:30 NICH（国立小児病院カラチ）調査 15:30 カラチ小児病院調査				
3	2019/9/27	金				7:00 カラチーハイデラバード移動 10:00 リアクアット大学病院院長（MS)表敬 11:15 インセプションレポート説明 12:30 ジャムショロ調査 14:00 ハイデラバード調査 16:00 アガカーン母子病院調査				
4	2019/9/28	土				ハイデラバード周辺医療施設視察 1次2次医療施設		リアクアット病院調査		午前　同左 午後　カラチへ移動
5	2019/9/29	日			朝⇒カラチ ⇒ハイデラバード移動	資料整理　団内会議				東京着
6	2019/9/30	月	東京⇒カラチ		MS表敬、病院調査ジャムショロ，ハイデラバード	シンド州営繕局打ち合わせ、病院調査	官団員に同行	1と同様	既存機材調査	
7	2019/10/1	火	午前：病院調査 午後：ワークショップ			午前：各担当調査 午後：リアクアット大学病院とのワークショップ プロジェクト概要協議、病院概要のプレゼン（LUMHSのMS）				
8	2019/10/2	水	午前：　ハイデラバードーカラチ移動 午後：　NICH視察 カラチ小児病院経営状況協議			午前：各担当調査 午後：MS,産婦人科・小児科教授との協議 施設内容、諸室				
9	2019/10/3	木	11:00 シンド州保健局　ミニッツ協議 午後：ミニッツ署名 カラチ発			7:30 ハイデラバードーカラチ移動 11:00 シンド州保健局　ミニッツ協議 午後：ミニッツ署名／各自調査				
10	2019/10/4	金	東京着			現地コンサルタント調査、シンド州営繕局打合せ	シンド州保健局情報収集調査	1と同様	機材調査	
11	2019/10/5	土				自然条件調査 カラチ発	保健調査	1と同様	機材調査	
12	2019/10/6	日				→東京着				

(2) 第 2 回現地調査

			総括	計画管理	医療技術計画	ア 業務主任／建築計画	イ 建築設計／自然条件調査／安全対策計画	ウ 構造設計	エ 設備設計	オ 施工計画／積算	カ 機材計画／維持管理計画	キ 調達計画／積算	ク 保健計画	（自社補強）
No.	月日	曜日	吉田友哉	阿部康昭	神作 麗	藤沼 傑	勢山 詔子	山林 修造	岡田 有弘	古角 信弘	鈴木 誠	高山 唯華	諏訪 裕美	浅沼 靖子
13	2019/11/7	木								東京→カラチ	東京→カラチ	東京→カラチ		東京→カラチ
14	2019/11/8	金								建設価格調査	AM:医療機材代理店調査 PM:カラチ⇒ハイデラバード移動	同左		同左
15	2019/11/9	土								建設価格調査	病院調査	病院調査		病院調査
16	2019/11/10	日	Eid-i-Miladun Nabi			東京→カラチ	東京→カラチ		東京→カラチ	資料整理	病院調査	病院調査	東京→カラチ	病院調査
17	2019/11/11	月				カラチ⇒ハイデラバード 10:00 病院調査（ジャムショロOPD） 14:00 プロジェクト案協議（LUH院長＋小児科長＋産婦人科長）	同左		ｶﾗﾁｰﾊｲﾃﾞﾗ 病院調査	ｶﾗﾁｰﾊｲﾃﾞﾗ 病院調査	病院調査 14:00 施設案協議	病院調査	ｶﾗﾁｰﾊｲﾃﾞﾗ 保健計画調査 14:00 施設案協議	病院調査
18	2019/11/12	火	Guru Nanak's Birthday			施設計画協議調査	自然条件調査／建築計画調査		病院調査	病院調査	病院調査	病院調査	保健計画調査	病院調査
19	2019/11/13	水				施設計画協議調査 18:00 病院調査（ハイデラバードOPD,救急） 20:00 プロジェクト案協議（リアクアット大学病院院長＋小児科長＋産婦人科長）	同左		病院調査	病院調査	病院調査 20:00 プロジェクト案協議	病院調査	保健計画調査 20:00 プロジェクト案協議	病院調査
20	2019/11/14	木				施設計画協議調査	建築計画調査	東京→カラチ	病院調査	ﾊｲﾃﾞﾗ→カラチ	病院調査	病院調査	保健計画調査	病院調査
21	2019/11/15	金				10:00ミニッツ案説明（シンド州保健局＋リアクアット大学病院） 午後：サイト調査	同左	ｶﾗﾁｰﾊｲﾃﾞﾗ 午後：構造設計調査（現地再委託先との打合せ）	病院調査	建設価格調査	病院調査	病院調査	保健計画調査	AM:病院調査 PM: ハイデラバード→カラチ
22	2019/11/16	土				施設計画協議調査	建築計画調査	病院調査	病院調査	建設価格調査		病院調査	保健計画調査	→東京
23	2019/11/17	日	東京→カラチ →ﾊｲﾃﾞﾗ			団内協議	団内協議	ﾊｲﾃﾞﾗ→カラチ	ﾊｲﾃﾞﾗ→カラチ	建設価格調査	団内協議	保健計画調査	保健計画調査	
24	2019/11/18	月	9:00 リアクアット大学病院表敬、病院視察 ミニッツ案ブリーフィング			機構団員随行	アと同じ	構造調査	設備設計調査	建設価格調査	アと同じ	機材調達計画／積算調査	保健計画調査	
25	2019/11/19	火	ハイデラバード→カラチ 10:00 ミニッツ署名 12:30 シンド州計画開発局 表敬、打ち合わせ カラチ→イスラマバード			機構団員随行	アと同様 建築計画調査	構造調査	設備設計調査	建設価格調査	アと同様 機材計画調査	アと同様 積算調査	保健計画調査 カラチ→	
26	2019/11/20	水	パキスタン財務歳入財務省（EAD）面談、JICA事務所報告 日本国大使館報告 イスラマバード発			機構団員随行	午前：団内協議 午後：自然条件調査（現地再委託先と打合せ）	建設価格調査	計画調査 カラチ→	建設価格調査 カラチ→	機材計画調査	調達事情調査 カラチ→	東京	
27	2019/11/21	木	東京着			東京着	10:00 シンド州保健局 15:00 シンド州営繕局	建設価格調査 15:00 シンド州営繕局	→東京	東京	10:00 シンド州保健局 機材計画調査	→東京		
28	2019/11/22	金					建築計画調査 カラチ→	構造調査 カラチ→			計画調査 カラチ→			
29	2019/11/23	土					→東京	東京			→東京			

(3) 第 3 回現地調査

オンライン会議として実施。

３．関係者（面会者）リスト

Department	Position	Name
Health Department, Government of Sindh		シンド州保健局
	Secretary	Mr. Saeed Ahmad Awan
	Special Secretary (Development & Monitoring)	Dr. Dabeer Ahmad Khan
	Deputy Director Development	Dr. Zahid Hussaim Solongi
	Additional Director	Mr. Mohein Almond Shaikh
Liaquat University of Medical and Health Sciences (LUMHS)		リアクアット医科学大学
	Vice Chancellor	Professor Bikha Ram Devrajani
	Medical Superintendent	Professor Mubeen Ahmed Memon
Administration	Director Addministration	Abdul Sattar Jatoi
Administration	Additional Director	Ashique Hussain
Health	Additional Medical Superintendent (AMS) Jamshoro	Dr Niaz Hussain Babbar
Health	Additional Medical Superintendent (AMS)Hyderabad	Dr Mujeeb Rehman
Research Innovation and Commercialization (ORIC) International Relation	Director Office of Research Innovation and Commercialization (ORIC)	Dr Binafsha manzoormsyed
Obstetrics & Gyneacology	OBGYN Chairperson / Unit 2 Professor	Professor Raheel Sikandar
Pediatric	Peadiatric Chairperson /Professor	Professor Shazia Memon
Health	Professor	Dr Salma Sheikh
Engineering Bio Medical	Bio Medical Engineer	Mr. Muhammad Aamir
Statistics		Mr. Muhammad Urs
Laboratory	Pathological	Dr. Dasrath Kumar Shardha
Pathology	Dean	Ikram
Biomedical	Lecturar	Hinesh Kumar
Biomedical		Muhammad li
Peads	Chair person Pediatrition	Prof Shazia Memon
Radiology		Dr Aneela Sheeba
MRC		Dr Sikandar
LUMHS Hyderabad (Civil Hospital)		
Health	AMS general	Dr Shoukat Ali Lakho
Peadiatrics (Unit 3)		Dr. Abdul Salam Memon
Peadiatrics (Unit 2)		Dr. Ibal
ICU / Anesthetics	Director ICU LUMHS	Dr. Saifullah Memon
OBGYN OT	Senior resident medical officer	Dr. Naeem Ahmed Memon
Works & Services, Government of Sindh		シンド州営繕局
Works & Services	Chief Engineer (Architect)	Mr. Akhtar Dawach
Works & Services	Sub Engineer (Architect)	Mr. Mehbeob Alichanna
Works & Services		Mr. Shakeel
Works & Services		Mr. Nassullah
Works & Services		Mr. Laheer

Department	Position	Name
Works & Services		Mr. Shakeel
Works & Services		Mr. Nassullah
Works & Services		Mr. Laheer
National Institute of Child Health (NICH)		国立小児病院
	Director	Prof. Syed Jamal Raza
Aga khan Maternal Health Care		
AKMHC	Finance	AM
AKMHC	HR	Associate
AKMHC	peads	Asst Head Nurse
AKMHC	obgyn	ahn
AKMHC	nsg	cni
AKMHC	peads	si
Child Health Institute in Karachi		カラチ小児病院
	Chief Executive Officer	Dr. Mohammad Tofique
	Special Secretary Admin	Mr. Asghar Memon
BHU Khuda Ki Basti 247		クダ一次医療施設
PPHI	MNAH Coordinator	Dr Farzana Arif
PPHI	FMO	Dr.Fozia Jamal
PPHI	Social organizer	Ajesh Kumar
BHU Sehrish Nagar Qasimabad		ｶｼﾏﾊﾞｰﾄﾞ一次医療施設
PPHI	D.M	Majid
BHU S.Nagar Qasimabad	SMO	Dr Faheem Memon
BHU S.Nagar Qasimabad	WMO	Dr Pashma Memon
BHU S.Nagar Qasimabad	Sonologist	Dr Murk Memon
Sindh Government Hospital Qasimabad (SGHQ)		ｶｼﾏﾊﾞｰﾄﾞ県病院
SGHQ	M.S	Dr Irfan Ashraf
SGHQ	Chief M.O	Dr Hakim Ali Talpur
SGHQ	AMS	Dr Abdul Hameed Mangi
SGHQ	SMO	Dr Nusrat Hussain
SGHQ	AMS	Dr Sumaira Bhutto
SGHQ	DMS	Dr Aramjan Sheikh
SGHQ	Pediatrition	Dr Shafqat Bhurgri
SGHQ	Gynaecologist	Dr Zeenat Sheikh

４．協議議事録（M/D）

４－１．第１回現地調査　協議議事録

４－２．第２回現地調査　協議議事録

４－３．第３回現地調査　協議議事録

４．協議議事録(M/D)

４－１．第１回現地調査　協議議事録

Minutes of Discussions

on the Preparatory Survey for The Project for the Extension of Maternal and Child Health Care Facilities in Sindh

Based on the several preliminary discussions between the Government of the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan") and Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of The Project for the Extension of Maternal and Child Health Care Facilities in Sindh (hereinafter referred to as "the Project") to Pakistan, headed by Mr. Tatsuya Ashida, Director of Human Development Department JICA, from 30th September to 04th October 2019.

The Team held a series of discussions with the officials of Pakistan and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Karachi, 3 October 2019

Mr. Tatsuya Ashida
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Dr. Dabeer Ahmed Khan
Special Secretary
Development and Monitoring Health Department
Government of Sindh

Witness

Syed Mujtaba Hussain
~~Shahid Ahmed Vakil~~
Joint Secretary (Japan)
Economic Affairs Division
Ministry of Finance, Revenue and Economic Affairs

Dr. Mobin Ahmed Memon
Medical Superintendent
Liaquat University Hospital
Govermant of Sindh

Counter Signature

Saeed Ahmed Awan
Secretary Health

ATTACHMENT

1. Objective of the Project

   The objective of the Project is to make better quality of healthcare service for mothers and children at Liaquat University Hospital at Jamshoro through developing facilities and providing equipment.

2. Title of the Preparatory Survey

   Both sides confirmed the title of the Preparatory Survey as "The Project for the Establishment of Maternal and Child Health Center at Liaquat University Hospital, Jamshoro".

3. Project site

   Both sides confirmed that the site of the Project is the place shown in Annex 1.

4. Responsible authority for the Project

   Both sides confirmed the authorities responsible for the Project are as follows:

   4-1. The Health Department Government of Sindh will be the executing agency responsible for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project including preparation of the PC-1 for the Project, and obtain necessary approval from P&D, Planning Commision and Executive Committee of the National Economic Council (ECNEC) no later than September 2020. Also, the Executing Agency ensures that the undertakings for the Project shall be managed by relevant authorities properly and on time.

   4-2 The Health Department Government of Sindh will be the implementing agency through Liaquat University Hospital (hereinafter referred to as "The Hospital") at Liaquat University of Medical and Health Science (LUHMS) Jamshoro. The organization charts with the executing agency are shown in Annex 2.

5. Items requested by Pakistan

   5-1. As a result of discussions, both sides agreed that the items to be included to the Project are described in Annex3.

   5-2. JICA will assess the feasibility of the above requested items through the further process of the survey and will share the result at the coming outline survey.

6. Procedures and Basic Principles of Japanese Grant

   6-1. Pakistan side agreed that the basic principles of Japanese Grant as described in Annex 4 shall be applied to the Project.

   6-2. The Team explained the major undertakings necessary for the smooth implementation of the

Project as described in Annex 5.The Pakistan side agreed to take the necessary measures, as described in Annex 5The contents of the Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.

The contents of Annex 5 will be used as an attachment to the Grant Agreement. Also, the team agreed to provide necessary information for the PC-1.

7. Schedule of the Survey

7-1. The Team will proceed with further survey in Pakistan around November 2019 and June 2020.

7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Pakistan in order to explain its contents around June 2020.

7-3. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by Pakistan side, JICA will finalize the Preparatory Survey Report and send it to Pakistan around October 2020.

7-4. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. Pakistan side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "C" from the following considerations:

Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

8-3. The Pakistan side confirmed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA) /Initial Environmental Examination (IEE) and information disclosure, etc.) and obtain necessary certificate for smooth implementation of the Project. If the project is found applicable to the Guidelines, the Pakistan side shall take necessary measures to obtain environmental licence before the tender and report it to JICA Pakistan office.

9. Other Relevant Issues

9-1. Items requested by the Government of Pakistan, which are described in Annex 3, subject to further discussion between the relevant authorities and the survey team. The final components of facility and equipment for the Project will be defined through the further discussion

9-2. Japanese side requested the Pakistan side to ensure recruitment and distribution of sufficient staff in order to provide quality medical services at The Hospital, not only health personnel but also person who could take charge of management and administration for the new facilities and equipment

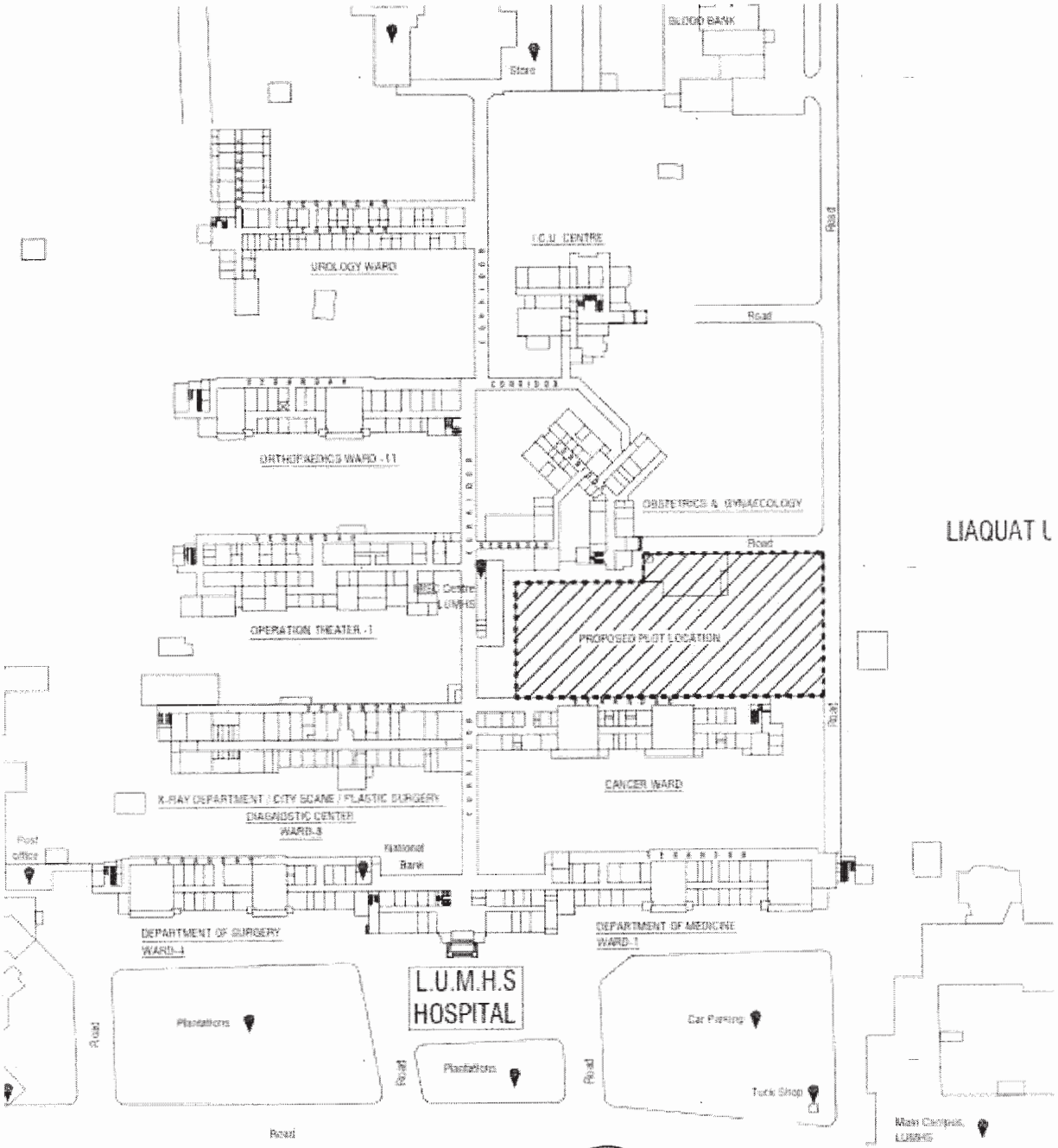
provided by the Project. Pakistan side agreed to take an effort including assuring the human resources and budgets in the aforementioned PC-1 and recruiting quality staff in timely manner.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Components requested by the Government of Pakistan
Annex 4 Japanese Grant
Annex 5 Major Undertakings to be taken by the Government of Pakistan

Annex 1.
Project Location

Location of the new building

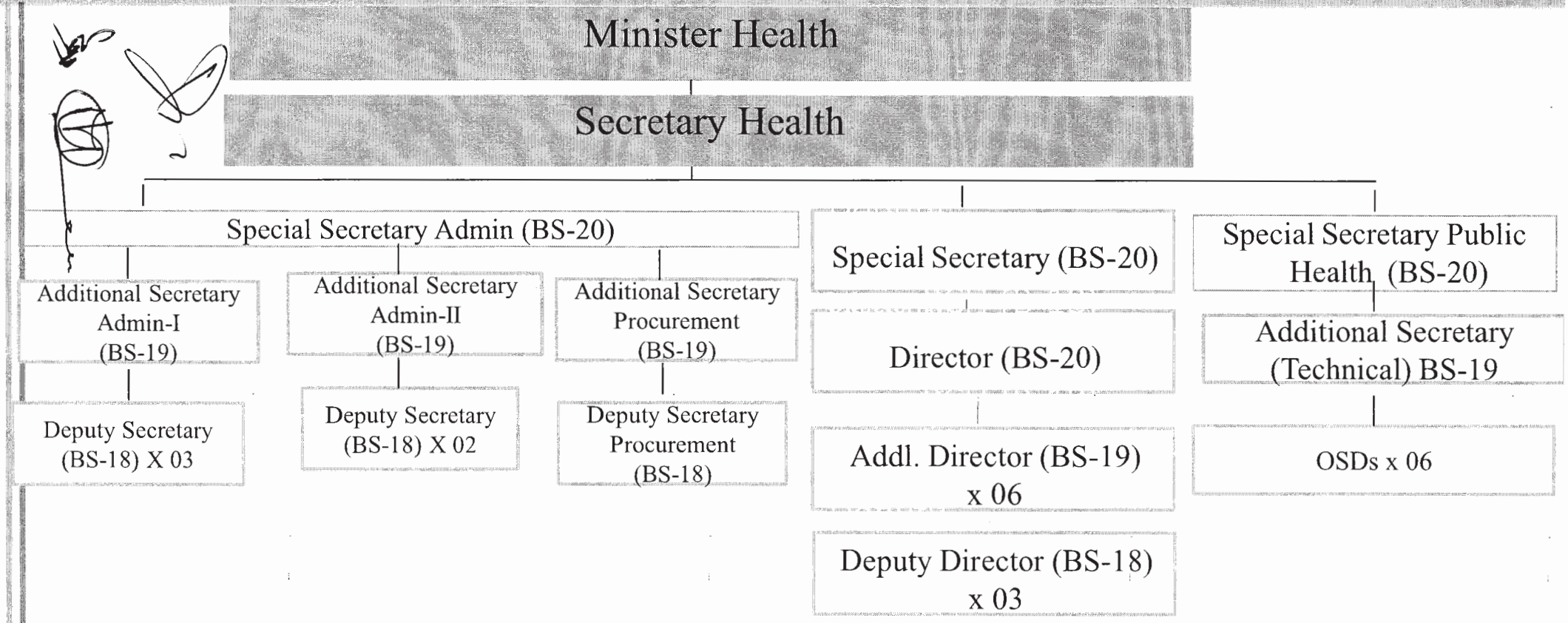
LUMHS Jamshoro



Government of Sindh
Health Department

ORGANO GRAM OF HEALTH DEPARTMENT SECRETARIAT

Annex2



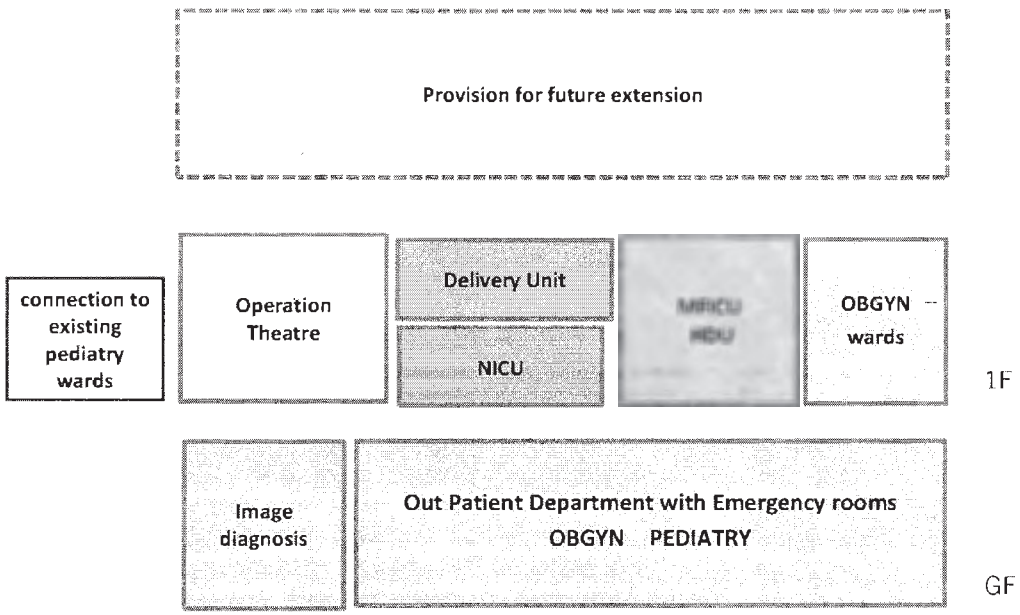
資料-12

Annex 3.

Item requested by Pakistan side

1. Facility Plan

Block plan of medical services



PEDS screening	OBGYN screening
PEDS Immunization	OBGYN antenatal
PEDS OTP	OBGYN treatment
PEDS Under 5	OBGYN consultation
PEDS well baby clinic	OBGYN postnatal
PEDS Feeding room	OBGYN Lactation
PEDS Diabetic	OBGYN Family Planning
PEDS Endocrine	OBGYN lab collection
PEDS Asthama	

Total floor area (ground floor and first floor) of the new building shall be approximately 5,000 to 6,000 m2.

2. Medical equipment plan

1) Medical equipment for the following departments based on the components of the facility shall be basically supplied by Japanese side. Detail list and quantity shall be studied further.
   OPD with Emergency rooms for OB/GYN and Pediatric, Image diagnosis, Operation Theater, Delivery MICU/HDU and Ward for OB/GYN.
2) General furniture such as office tables and chairs, wooden beds for duty doctor, etc. and computers shall be basically supplied by Pakistan side.

Annex 4

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of

relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 5

Major Undertakings to be taken by Recipient Government of Pakistan

1. Specific obligations of the Government of Pakistan which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 45 days after G/A	GoS		
2	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the consultant	within 1 month after the signing of the agreement	GoS		
3	To obtain approval of IEE/EIA and/or No Objection Certificate (NOC) if applicable	within 2 months after G/A	GoS		
4	To secure the following lands 1) Project site for the JICA building 2) Temporary construction yard and stock yard near the Project site 3) borrow pit and disposal site near the Project site	1 month before notice of the bidding document	GoS / LUMHS		
5	To clear and level the Project site by taking measures as follows 1) Relocation of power, water, city gas, sewage and storm water line, and any other on-site infrastructure which are in the new building area, if applicable. 2) Removal of Trees 3) Removal or relocation of building/shed and/or any things which may be obstacleon the Project site 4) Clear the existing rooms and their surroundings by relocation/ removal of existing equipment where the work to be held as a part of the Project.	1 month before notice of the bidding document	GoS / LUMHS /		
6	To obtain building permit(tentative)	1 month before notice of the bidding document	GoS / LUMHS /		
7	To submit Project Monitoring Report (with the result of detailed design)	at the approval of bidding document	GoS /		
8	To clarify the personnel /department to manage the facility constructed	within 1 month after G/A	GoS / LUMHS /		
9	To secure the budget for newly assigned to facility including HR(personnel) and other agreed responsibilities	At the approval of PC-1	GoS		
10	To take necessary procedures for budgetary requests including coming fiscal year	At the approval of PC-1	GoS		

2. During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the contractor and Suppliers(s)	within 1 month after the singing of the contracts	GoS		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the singing of the contract and the agreement	GoS		
	2) Payment commission for A/P	every payment	GoS		
3	To ensure to obtain the necessary exemption for customs, levies and duties the port clearance. Transportation of the equipment, machineries and construction materials will be the responsibilities of vendor however health department of Government of Sindh assist the vendors.		GoS		
4	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	GoS		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted	during the Project	GoS		
6	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the implementation of the Project	during the Project	GoS		
7	To submit Project Monitoring Report.	every month	GoS		
8	To submit a report concerning completion of the Project	within six months after completion of the Project	GoS		
9	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities				
	1) Electricity Connect Electricity power to the JICA building	6 months before completion of the construction	GoS		
	2) Planting and gardening Planting and gardening works around the JICA building	Within 1 year after completion of the construction	GoS / LUMHS		
10	To arrange and secure the temporary land/space in the site for the construction, enough space for temporary storage materials and machines, setting temporary office and accommodation shall be provided within hospital land,	during the construction	LUMHS		
11	To secure the safety of patient and their family who visit the hospital for health services	during the construction	LUMHS		
12	To transfer medical equipment and furniture to the new building	Within 3 months after completion of the construction	LUMHS		
13	To remove unusable medical equipment	Before the installation	LUMHS/ GoS		
15	Allocate sufficient staff with appropriate skills and experiences for operation and maintenance of the JICA building and equipment under the Grant Aid	at the completion of installation work of the equipment	GoS		

3. After the Project

NO	Items	Deadline	In charge	Cost	Ref.
1	To maintain and use properly and effectively the JICA building constructed and equipment under the Grant Aid 1) Allocation of maintenance cost including the expenses necessary for the various maintenance contracts for major building equipment and medical equipment. 2) Allocation of appropriate organization and staff for Operation and maintenance 3) Routine check/Periodic inspection	After completion of the construction	GoS		
2	To renovate and utilize properly the space in existing building after transfer of the function to the facility constructed	After the completion of the construction	LUMHS		

(A/P: Authorization to Pay, B/A: Banking Arrangement, EIA: Environmental Impact Assessment, G/A: Grant Agreement, GoS: Government of Sindh, IEE: Initial Environmental Examination, LUMHS: Liaquat University of Medical & Health Sciences

Minutes of Discussions
on the Preparatory Survey for The Project for the Establishment of Maternal and Child Health Center at Liaquat University Hospital, Jamshoro

Based on the several preliminary discussions between the Government of the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan") and Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of The Project for the Establishment of Maternal and Child Health Center at Liaquat University Hospital, Jamshoro (hereinafter referred to as "the Project") to Pakistan, headed by Mr. Tomoya Yoshida, Deputy Director General, and Group Director for Health 2, Human Development Department, JICA, from 17th November to 20th November 2019.

The Team held a series of discussions with the officials of Pakistan and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Karachi, 19 November 2019

Mr. Tomoya Yoshida
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Dr. Dabeer Ahmed Khan
Special Secretary
Development and Monitoring Health Department
Government of Sindh

Witness

Syed Mujitaba Hussain
Joint Secretary (Japan)
Economic Affairs Division
Ministry of Finance, Revenue and Economic Affairs

Dr. Mobin Ahmed Memon
Medical Superintendent
Liaquat University Hospital
Government of Sindh

Counter Signature

Zahid Ali Abbasi
Secretary Health

ATTACHMENT

1. Objective of the Project

   The objective of the Project is to enhance healthcare service for mothers and children, and to reduce maternal and infant mortality at Liaquat University Hospitals with procurement of medical facilities and equipment. The details of the medical services of the new facility is shown in Annex 1.

2. Project site

   Both sides confirmed that the site of the Project is the place shown in Annex 4-1.

3. Items requested by Pakistan

   3-1. As a result of discussions, both sides agreed that the items to be included to the Project are described in Annex 4.

   3-2. JICA will assess the feasibility of the above requested items. The result of the feasibility survey will be in the Draft Preparatory Survey Report shared at the mission scheduled in June 2020.

4. Major undertakings

   4-1. Pakistan side agreed that the basic principles of Japanese Grant.

   4-2. The Team explained the major undertakings necessary for the smooth implementation of the Project as described in Annex 5. Pakistan side agreed to take necessary measures, as described in Annex 5. The contents of the Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.

   The contents of Annex 5 will be used as an attachment to the Grant Agreement. The Survey team agreed to provide necessary information for the preparation of the PC-1.

5. Schedule of the Survey

   5-1. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Pakistan in order to explain its contents around June 2020.

   5-2. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by Pakistan side, JICA will finalize the Preparatory Survey Report and send it to Pakistan around October 2020.

   5-3. The above schedule is tentative and subject to change.

6. Expected outcomes and indicators

Both parties agreed that the key indicators for expected outcomes of the Project shall be following;

a. Number of deliveries in LUHMS

b. Number of Outdoor patients in LUHMS

c. Number of Indoor patients in LUHMS

Above indicators will be included in the draft Preparatory Survey Report. Pakistan side will be responsible for the achievement of agreed key indicators and shall monitor the progress based on those indicators.

7. Environmental and Social Considerations

7-1. Pakistan side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

7-2. The Project is categorized as "C" from the following considerations:

Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

7-3. The Pakistan side confirmed to conduct necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA) /Initial Environmental Examination (IEE) and information disclosure, etc.) and obtain necessary certificate for smooth implementation of the Project. If the project is found applicable to the Guidelines, Pakistan side shall take necessary measures to obtain environmental licence before the tender and report it to JICA Pakistan office.

8. Necessity of Soft Component

Both sides confirmed the necessity of soft component on proper use and maintenance of the equipment. The team will examine the appropriateness and make the detailed plan in the DOD phase.

9. Other Relevant Issues

9-1. Items requested by the Government of Pakistan, which are described in Annex 4-1 to 4-5, subject to further discussion between the relevant authorities and the survey team. The final components of facility and equipment for the Project will be defined through further analysis considering the budget and priorities.

9-2. Japanese side requested the Pakistan side to ensure enough budget for recruitment and distribution of sufficient trained staff in order to provide quality medical services at The Hospital, not only health personnel but also person who could take charge of management and administration for the new facilities and equipment procured through the Grant. Pakistan side agreed to take efforts including assuring the human resources and budgets in the aforementioned PC-1 and recruiting

T4

quality staff in timely manner. The outline of the required staff is shown in Annex 3.

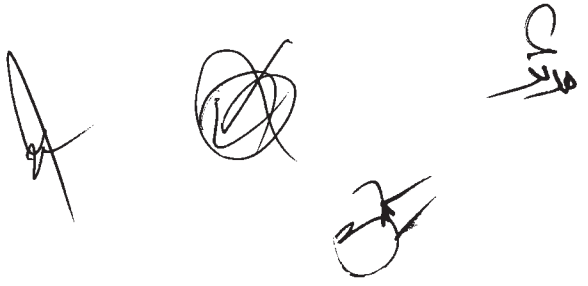
9-3. Pakistan side confirmed that they will allocate total 356 technical staff shown in Annex3 for the new facility by recruiting new staff or allocating existing technical staff no later than one quarter (3 months) prior to the opening of the new building and new equipment procured through the Grant.

9-4. Pakistan side (Government of Sindh or Liaquat University Hospital) confirmed to document and sign an agreement with National Institute of Child Health in Karachi to coordinate the training for the management of NICU operation including usage of ventilators under the cooperation. Such agreement shall be made by the time of Explanation of Draft Final Report Scheduled for June 2020.

9-5. Health Department shall constitute Technical committee comprising of relevant field personnel and end user, for the finalization of the equipment, and shall review and advice on the equipment list shown in Annex 4-5 on the need and performance basis to be procured by the Grant. The result of revision shall be submitted to JICA no later than 20th December 2019.

9-6. Warranty period of medical equipment shall be 1 year and the contract for 2 year additional maintenance shall be considered accordingly. In addition, comprehensive warranty shall be applied to major equipment.

Annex 1 Project objectives
Annex 2 Organization Chart
Annex 3 Required staff for new facility
Annex 4-1 Location plan
4-2 Tentative Facility Components
4-3 Architectural draft plans
4-4 Tentative List of rooms
4-5 Tentative list of Equipment & Furniture
Annex 5 Major Undertakings to be taken by the Government of Pakistan



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1. Goal of the Project
   Increase quality of healthcare service for mothers and children at Liaquat University Hospitals through developing facilities and providing equipment.

2. Objective of the Project
   Reduce maternity and infant mortality.

3. Preconditions

   1) Target patients at new OPD
      - Paediatric medicine, under 5 years old.
      - OBGYN, especially Obstetrics patients.
        - Immunizations i.e. tetanus
        -Consultations i.e. toxemia (hypertension) etc.
        -High risk antenatal (Cervical problem, lost intra-uterine device (IUD), Retained products of conception (RPOC), needing Colposcopy exam & Hysteroscopic exam))

   2) Pediatric triage
      - Paeds surgery dealt with at existing facility.
      - Minimum treatment i.e. hemostasis.
      - Neonatal (28 days old): Perinatal asphyxia, sepsis, preterm babies, meningitis, etc.
      - Under 5: pneumonia, sepsis, diarrhea, meningitis, acute respiratory infection (ARI), cerebral malaria
      - Referral to NICH: congenital heart diseases, extreme preterm birth

   3) Obstetrics & Gynaecology triage
      - Pregnant patients: complicated cases (eclampsia, HELLP..) , raptured uterus, severe bleeding ,etc.
      - ER >>> HDU: multiple pregnancy, patient with doubt of imminent premature birth, complication after birth, etc.
      - ER >>> OT: Emergency operations (Laparotomy, Laparoscopy, Cystoscopy)
      - ER >>> MFICU: toxemia, unconsciousness from complications (placenta previa, accrete)

   4) Operation Theatres
      - Obstetrics & Gynaecology Operations: i.e. planned cesarean sections and emergency operations.
      - Laparoscopic surgery

Government of Sindh
Health Department

ORGANO GRAM OF HEALTH DEPARTMENT SECRETARIAT

Annex2

[redacted]

[redacted]

Special Secretary Admin (BS-20)

- Additional Secretary Admin-I (BS-19)
  - Deputy Secretary (BS-18) X 03
- Additional Secretary Admin-II (BS-19)
  - Deputy Secretary (BS-18) X 02
- Additional Secretary Procurement (BS-19)
  - Deputy Secretary Procurement (BS-18)

Special Secretary (BS-20)

- Director (BS-20)
  - Addl. Director (BS-19) x 06
  - Deputy Director (BS-18) x 03

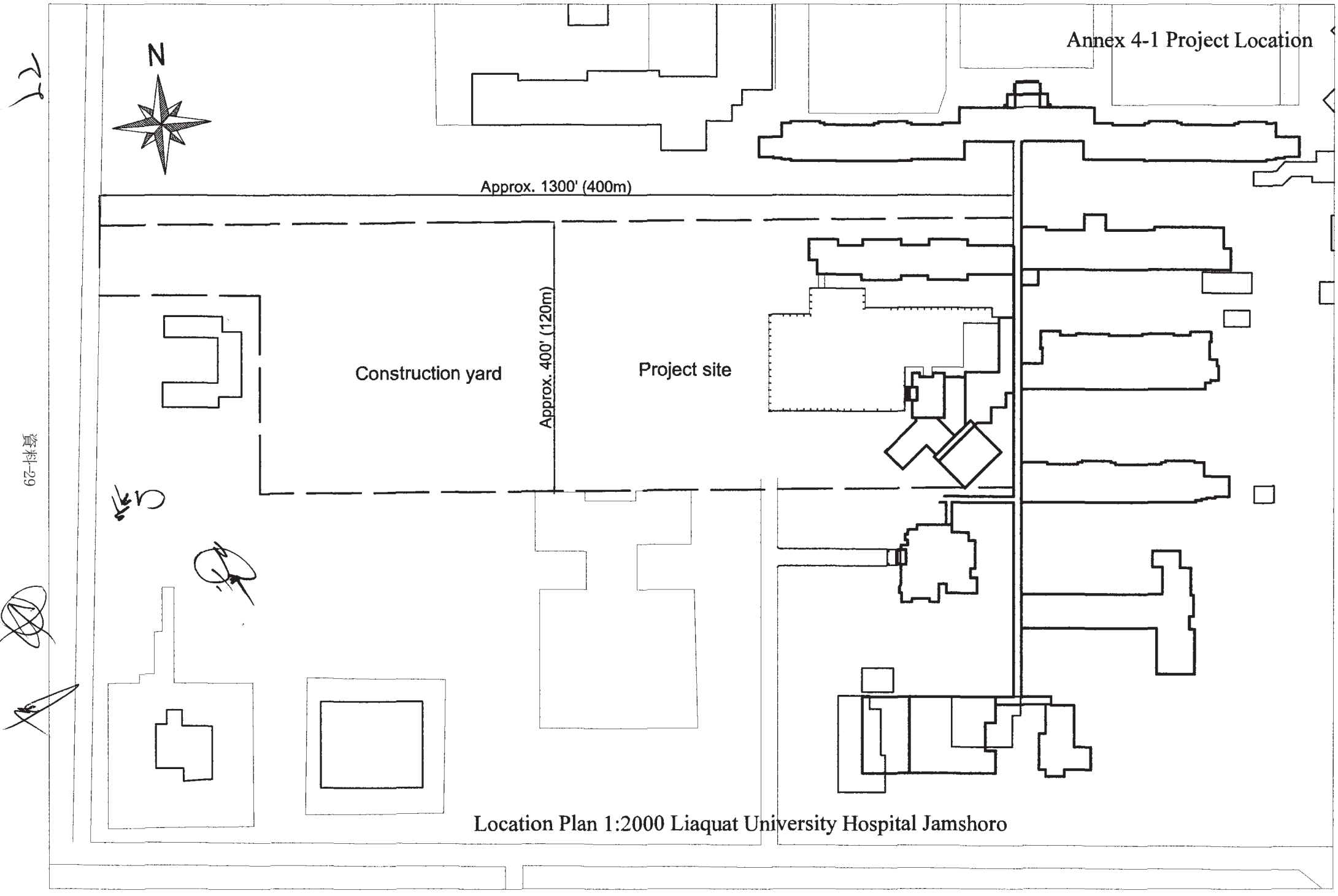
Special Secretary Public Health (BS-20)

- Additional Secretary (Technical) BS-19
  - OSDs x 06

(Draft) Required staff at the new facility

		MFICU / HDU	NICU	OBGYN ward	Delivery	O.T. s	Department of Anesthesia	OBGYN OPD	Paeds OPD	ER (triage) Paeds	ER (triage) Gynae	Pharmacy	Laboratory	Administration, Sterilization, BME, Maintenance
University LUHMS	Consultants													
budget	Professor / Chief of departments	1	1											
19	Associate Professor	1	1					1	1					
staff	Assistant Professor	1	1					1	1					
	Senior Registrar	1	1		1	1	1	1	1	1	1			
	Sub total	4	4	0	1	1	1	3	3	1	1	0	0	0
	Total							19						
Health Departmen	Medical officer	4	4		4		4	4	4	4	4			
Budget	Pharmacist	1	1	1	1	1				1	1	3	1	
337	Techician (Labo /OT)				4	9	4	3	3				12	
staff	Post Graduate Students	6	12	3	9	21	3	9	9	9	9			
	Nurse, midwife	9	9	9	18	9		9	9	9	9			
	per department total	20	26	13	36	40	11	25	25	23	23	3	13	0
	SubTotal							258						
	Administration, ME, others													20
	BME													2
	Maintenance													9
	Receptionist													6
LUHMS	Security													9
Health Departmen	Sanitary worker, ward boy, aya	3	3	3	6	6		3	3	3	3			
Total	per department total	3	3	3	6	6	0	3	3	3	3	0	0	46
356	SubTotal							79						

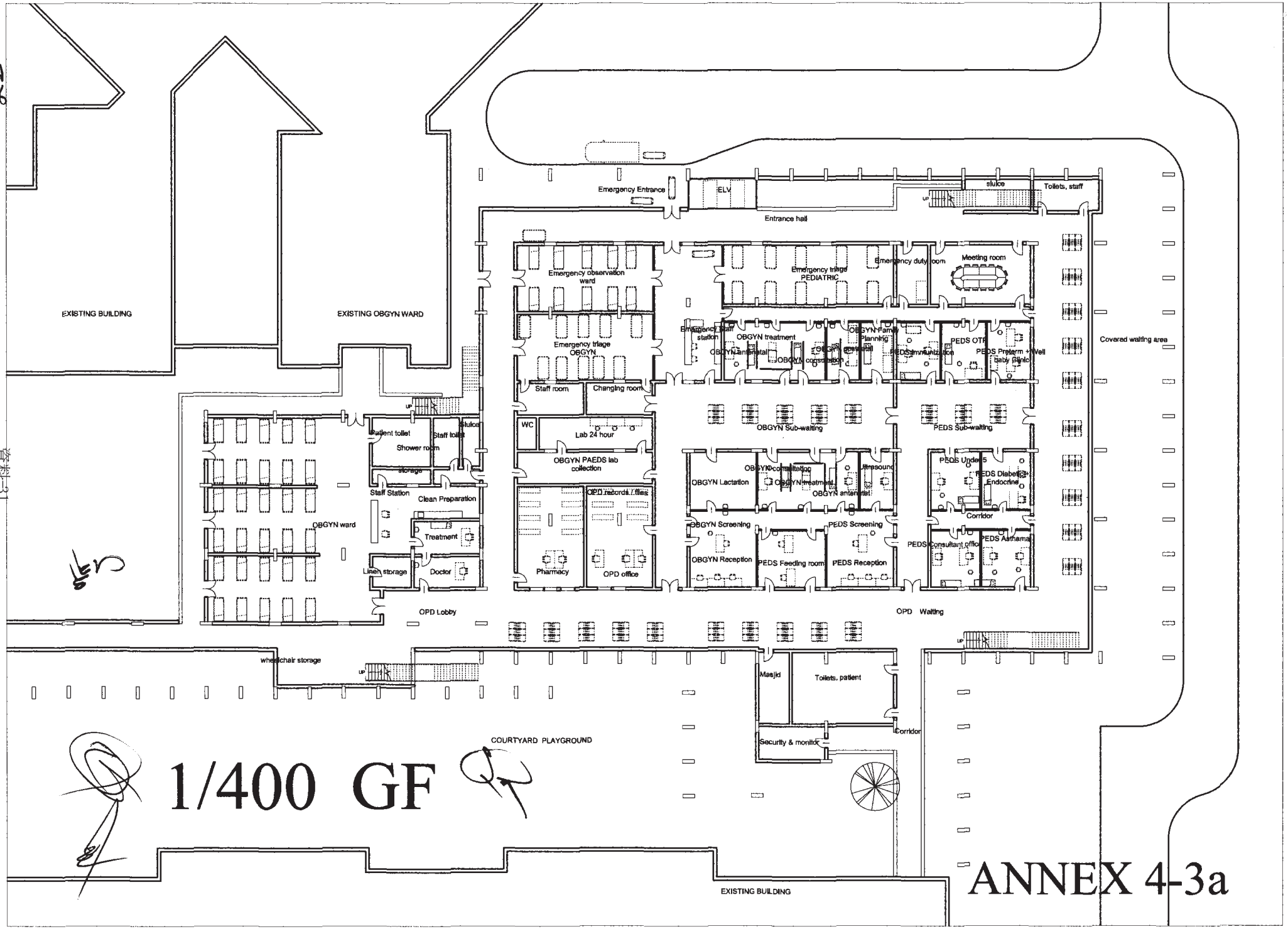
Annex 4-1 Project Location



Location Plan 1:2000 Liaquat University Hospital Jamshoro

Tentative Facility Components

		Number of room	cots	Beds	Priority
OPD	Paediatrics OPD	7			A
	Obstetrics & Gynaecology OPD	3			A
	OBGYN Emergency beds	1		10	A
	Paediatrics Emergency beds	1		10	A
	Common observation ward	1		10	A
	Laboratory	Use existing rooms			C
	24 hour laboratory	1			A
	Radiology (X-ray & Mammography)	Use existing rooms			C
OTs / ICUs	Operation Theatres	3			A
	Maternal & Fetal ICU (MFICU)	1		6+1	A
	OBGYN HDU	1		20	B
	Neonatal ICU (NICU)	1	20		A
	Labour room (Antenatal)	1 room for 8 beds			A
	Delivery room	1 room for 6 delivery			A
	Kangaroo mother care (KMC)	1	5	5	A
	Post delivery room	1		6	A
	Neonatal room	1	5		A
Wards	OBGYN ward	1		30	B
	Paediatrics ward	Use existing rooms			C
Total				98	



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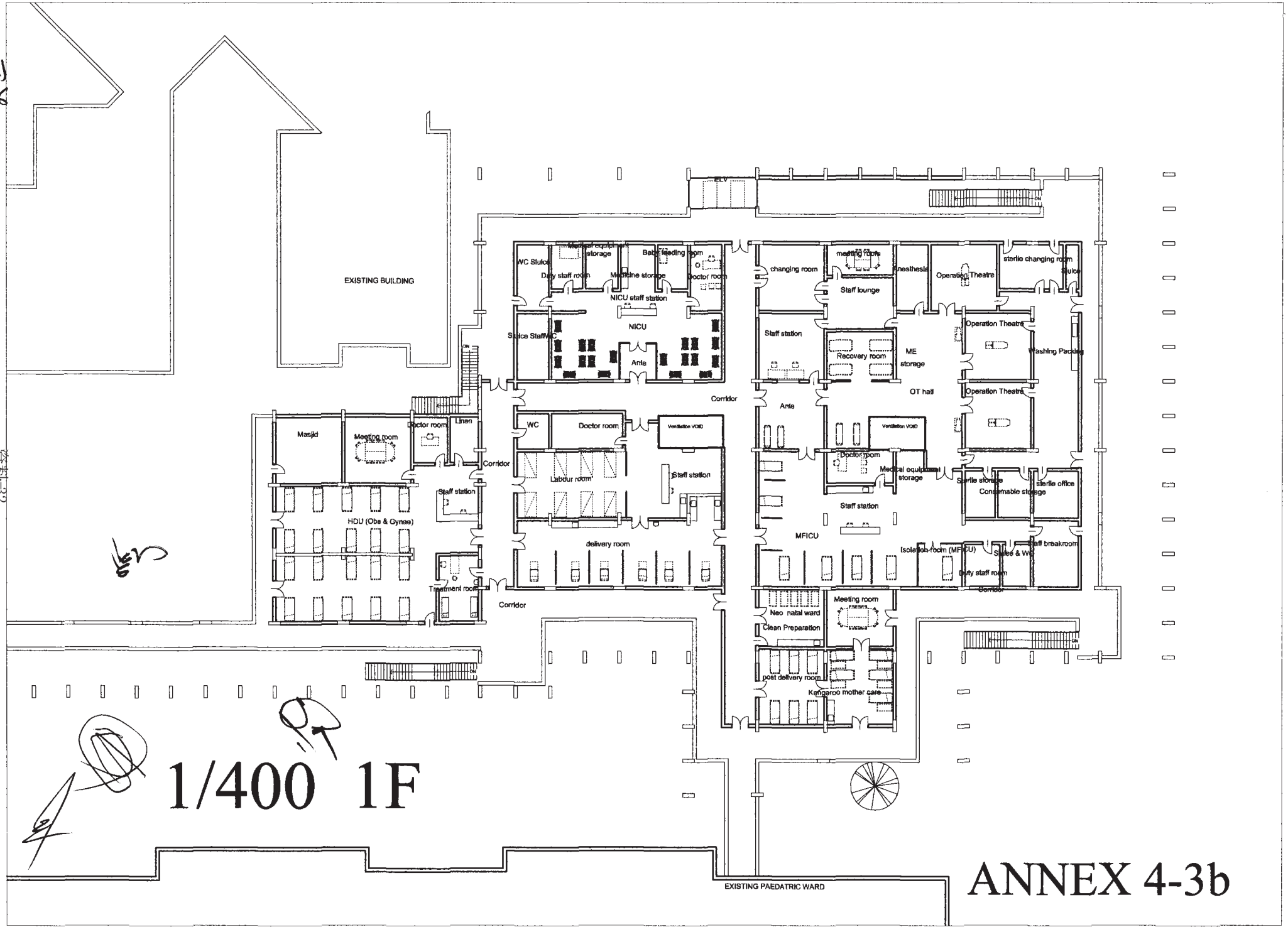
ANNEX 4-3a



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ANNEX 4-3b

Tentative list of rooms (major rooms only)

Category	Room name	Remarks
Out Patient	Security & Monitor Room	
Out Patient	OPD Office	
Out Patient	OPD Records / Files	
Out Patient	Pharmacy	2 separate counters for OBGYN and Pediatry
Out Patient	Obgyn Reception	
Out Patient	Obgyn Screening	
Out Patient	Obgyn Family Planning	
Out Patient	Obgyn Paeds Lab Collection	including toilet for urine collection
Out Patient	Obgyn Antenatal	2 rooms
Out Patient	Obgyn Treatment	2 rooms
Out Patient	Obgyn Consultation	2 rooms
Out Patient	Obgyn Postnatal	
Out Patient	Obgyn Lactation	
Out Patient	Peds Reception	
Out Patient	Peds Screening	
Out Patient	Peds Pretermwell Baby Clinic	
Out Patient	Peds OTP	
Out Patient	Peds Under 5	
Out Patient	Peds Feeding Room	
Out Patient	Peds Diabetic + Endocrine	
Out Patient	Peds Asthma	
Out Patient	Peds Immunization	
Out Patient	Peds Consultant Office	
Out Patient	Emergency Triage Pediatric	10 cubicles
Out Patient	Emergency Observation Ward	10 beds
Out Patient	Emergency Triage Obgyn	10 cubicles
Out Patient	Lab 24 Hour	
Out Patient	Emergency Duty Room	
Out Patient	Meeting Room	
Out Patient	Emergency Staff Station	
Out Patient	Staff Room	
Out Patient	Masjid	with washing
Out Patient	Ultrasound	
Out Patient	Changing Room	
Delivery unit	Staff Station	
Delivery unit	Doctor Room	
Delivery unit	Labour Room	8 beds
Delivery unit	Delivery Room	6 delivery beds
Delivery unit	Kangaroo Mother Care	5 beds
Delivery unit	Post Delivery Room	6 beds
Delivery unit	Neo Natal Ward	5 cots
Operation	Staff Station	
Operation	Anesthesia	including medicine storage

Tentative list of rooms (major rooms only)

Category	Room name	Remarks
Operation	Meeting Room	
Operation	Operation Theatre	3 rooms
Operation	Recovery Room	4 beds
Operation	Washing Packing	autoclaves room
Operation	Sterile Storage	
Operation	Consumable Storage	
Operation	Sterile Changing Room	male and female
Operation	Sterile Office	
MFICU	Staff Station	
MFICU	Doctor Room	
MFICU	Treatment Room	
MFICU	Meeting Room	
MFICU	Duty Staff Room	
MFICU	MFICU	6 beds
MFICU	Isolation Room (MFICU)	1 bed
MFICU	Staff Breakroom	
MFICU	Hdu (Obs & Gynae)	20 beds
NICU	NICU Staff Station	
NICU	Doctor Room	
NICU	Duty Staff Room	
NICU	NICU	20 cots
NICU	Medicine Storage	
NICU	Baby Feeding Room	
OBGYN ward	Obgyn Ward	10 beds room X 3rooms = 30 beds
OBGYN ward	Staff Station	
OBGYN ward	Doctor	
OBGYN ward	Treatment	
OBGYN ward	Meeting Room	
OBGYN ward	Storage	
OBGYN ward	Patient Toilet	for female only, disability
OBGYN ward	Shower Room	for female only
OBGYN ward	Staff Toilet	men and women
OBGYN ward	Masjid	with water
Infrastructure	Elevator	For stretcher
Infrastructure	Water Pump Reservoir	including filtering system
Infrastructure	Ro Water System	for operating theater and laboratories
Infrastructure	Medical Gas Manifold	Use existing oxygen plant
Infrastructure	Generator Room	
Infrastructure	Electric Room	
Infrastructure	Solar Power System	
Infrastructure	Waste Water Plant	
Infrastructure	Garbage Plant	Existing is renewed and functioning. Not included in the Project.

List of equipment requested by Pakistani side Annex-4-5

*1 Priority: A - In principle, equipment necessary for the Project; however it could be changed due to the further study of plan of the facility, etc. in Japan

B - to be decided after further studies in Japan

C - to be excluded from Grant Aid, or to be purchased by Pakistani side

*2 Quantity: Could be changed in the further study in Japan

Department	Room name	Name of equipment	Priority*1	Q't'y*2	Remarks
Out Patient	wheelchair storage	Stretcher	A	2	
Out Patient	wheelchair storage	Wheelchair	A	2	
Out Patient	Pharmacy	Medicine refrigerator (1)	A	1	
Out Patient	Pharmacy	Instrument cabinet (1)	A	1	
Out Patient	OBGYN Screening	Examination couch	A	1	
Out Patient	OBGYN Screening	Diagnostic set, adult	A	1	
Out Patient	OBGYN Screening	Examination set, OB/Gy	A	1	
Out Patient	OBGYN Screening	Weighing scale, adult	A	1	
Out Patient	OBGYN Screening	Mobile LED lamp	A	1	
Out Patient	OBGYN Screening	Foot step	B	1	
Out Patient	OBGYN Screening	Instrument cabinet (1)	B	1	
Out Patient	OBGYN Family Planning	Gynecological table	A	1	
Out Patient	OBGYN Family Planning	Examination set, Ob/Gy	A	1	
Out Patient	OBGYN Family Planning	Mobile LED lamp	A	1	
Out Patient	OBGYN Family Planning	Foot step	A	1	
Out Patient	OBGYN Family Planning	Instrument cabinet (1)	B	1	
Out Patient	OBGYN antenatal (1)	Examination couch	A	1	
Out Patient	OBGYN antenatal (1)	Diagnostic set, adult	A	1	
Out Patient	OBGYN antenatal (1)	Fetal doppler	A	1	
Out Patient	OBGYN antenatal (1)	Weighing scale, adult	A	1	
Out Patient	OBGYN antenatal (1)	Instrument cabinet (1)	B	1	
Out Patient	OBGYN antenatal (2)	Examination couch	A	1	
Out Patient	OBGYN antenatal (2)	Examination set, Ob/Gy	A	2	
Out Patient	OBGYN antenatal (2)	Mobile LED lamp	A	1	
Out Patient	OBGYN antenatal (2)	Foot step	B	1	
Out Patient	OBGYN antenatal (2)	Instrument cabinet (1)	B	1	
Out Patient	OBGYN treatment (1)	Gynecological table	A	1	
Out Patient	OBGYN treatment (1)	Hysteroscopy	A	1	
Out Patient	OBGYN treatment (1)	Examination set, Ob/Gy	A	2	
Out Patient	OBGYN treatment (1)	Mobile LED lamp	A	1	
Out Patient	OBGYN treatment (1)	Foot step	A	1	
Out Patient	OBGYN treatment (1)	Instrument cabinet (1)	A	1	
Out Patient	OBGYN treatment (2)	Gynecological table	A	1	
Out Patient	OBGYN treatment (2)	Colposcope	A	1	
Out Patient	OBGYN treatment (2)	Mobile LED lamp	A	1	
Out Patient	OBGYN treatment (2)	Examination set, Ob/Gy	A	2	
Out Patient	OBGYN treatment (2)	Foot step	A	1	

Out Patient	OBGYN treatment (2)	Instrument cabinet (1)	B	1	
Out Patient	OBGYN consultation (1)	Examination couch	A	1	
Out Patient	OBGYN consultation (1)	Ultrasound machine, general purpose (2)	A	1	
Out Patient	OBGYN consultation (1)	Diagnostic set, adult	A	1	
Out Patient	OBGYN consultation (1)	Weighing scale, adult	A	1	
Out Patient	OBGYN consultation (1)	X-ray film illuminator	A	1	
Out Patient	OBGYN consultation (1)	Instrument cabinet (1)	A	1	
Out Patient	OBGYN consultation (2)	Examination couch	A	1	
Out Patient	OBGYN consultation (2)	Ultrasound machine, general purpose (2)	A	1	
Out Patient	OBGYN consultation (2)	Examination set, Ob/Gy	A	2	
Out Patient	OBGYN consultation (2)	CTG machine	A	1	
Out Patient	OBGYN consultation (2)	Mobile LED lamp	A	1	
Out Patient	OBGYN consultation (2)	Foot step	B	1	
Out Patient	OBGYN consultation (2)	Instrument cabinet (1)	B	1	
Out Patient	OBGYN postnatal	Examination couch	A	1	
Out Patient	OBGYN postnatal	Diagnostic set, adult	A	1	
Out Patient	OBGYN postnatal	Weighing scale, adult	A	1	
Out Patient	OBGYN postnatal	Instrument cabinet (1)	B	1	
Out Patient	PEDS Screening	Examination couch	A	1	
Out Patient	PEDS Screening	Diagnostic set, pediatric	A	1	
Out Patient	PEDS Screening	Weighing scale, neonatal	A	1	
Out Patient	PEDS Screening	Infantmeter	A	1	
Out Patient	PEDS Screening	Height and weighing scale, pediatric	A	1	
Out Patient	PEDS Screening	Instrument cabinet (1)	B	1	
Out Patient	PEDS OTP	Examination couch	A	1	
Out Patient	PEDS OTP	Diagnostic set, pediatric	A	1	
Out Patient	PEDS OTP	ENT diagnostic set, pediatric	A	1	
Out Patient	PEDS OTP	Weighing scale, neonatal	A	1	
Out Patient	PEDS OTP	Infantmeter	A	1	
Out Patient	PEDS OTP	Height and weighing scale, pediatric	A	1	
Out Patient	PEDS OTP	Medicine trolley	A	1	
Out Patient	PEDS OTP	Instrument cabinet (1)	B	1	
Out Patient	PEDS Immunization	Vaccine refrigerator	A	1	
Out Patient	PEDS Immunization	Vaccine carrier box	A	2	
Out Patient	PEDS Immunization	Examination couch	A	1	
Out Patient	PEDS Preterm-Well baby clinic	Examination couch	A	1	
Out Patient	PEDS Preterm-Well baby clinic	Baby cot	A	2	
Out Patient	PEDS Preterm-Well baby clinic	Weighing scale, neonatal	A	1	
Out Patient	PEDS Preterm-Well baby clinic	Infantmeter	A	1	
Out Patient	PEDS Preterm-Well baby clinic	Instrument cabinet (1)	B	1	
Out Patient	PEDS Under 5	Examination couch	A	1	
Out Patient	PEDS Under 5	Diagnostic set, pediatric	A	1	
Out Patient	PEDS Under 5	ENT diagnostic set, pediatric	A	1	
Out Patient	PEDS Under 5	Weighing scale, neonatal	A	1	

Out Patient	PEDS Under 5	Infantmeter	A	1	
Out Patient	PEDS Under 5	Height and weighing scale, pediatric	A	1	
Out Patient	PEDS Under 5	Ultrasonic nebulizer	A	1	
Out Patient	PEDS Under 5	Suction machine, portable	A	1	
Out Patient	PEDS Under 5	Binocular microscope	A	1	
Out Patient	PEDS Under 5	Instrument cabinet (1)	B	1	
Out Patient	PEDS Diabetic + Endocrine	Examination couch	A	1	
Out Patient	PEDS Diabetic + Endocrine	Diagnostic set, pediatric	A	1	
Out Patient	PEDS Diabetic + Endocrine	Glucometer	A	1	
Out Patient	PEDS Asthma	Examination couch	A	1	
Out Patient	PEDS Asthma	Diagnostic set, pediatric	A	1	
Out Patient	PEDS Asthma	Ultrasonic nebulizer	A	2	
Out Patient	PEDS Asthma	Spirometer	A	1	
Out Patient	PEDS Asthma	X-ray film illuminator	A	1	
Out Patient	PEDS Consultant office	Examination couch	A	2	
Out Patient	PEDS Consultant office	Diagnostic set, pediatric	A	2	
Out Patient	PEDS Consultant office	ENT diagnostic set, pediatric	A	2	
Out Patient	PEDS Consultant office	X-ray film illuminator	A	1	
Out Patient	PEDS Consultant office	Instrument trolley	A	1	
Out Patient	PEDS Consultant office	Suction machine, portable	A	1	
Out Patient	PEDS Consultant office	Laryngoscope set, pediatric	A	1	
Out Patient	PEDS Consultant office	Instrument cabinet (1)	B	1	
Out Patient	Emergency triage PEDS	Bed	A	19	
Out Patient	Emergency triage PEDS	Neonatal resuscitation trolley	A	2	
Out Patient	Emergency triage PEDS	Bedside locker	A	19	
Out Patient	Emergency triage PEDS	Overbed table	A	19	
Out Patient	Emergency triage PEDS	IV stand	A	19	
Out Patient	Emergency triage PEDS	Weighing scale, neonatal	A	2	
Out Patient	Emergency triage PEDS	Infantmeter	A	2	
Out Patient	Emergency triage PEDS	Height and weighing scale, pediatric	A	2	
Out Patient	Emergency triage PEDS	Ultrasonic nebulizer	A	2	
Out Patient	Emergency triage PEDS	Glucometer	A	2	
Out Patient	Emergency triage PEDS	Video assisted laryngoscope, pediatric	A	1	
Out Patient	Emergency triage PEDS	Diagnostic set, pediatric	A	2	
Out Patient	Emergency triage PEDS	ENT diagnostic set, pediatric	A	2	
Out Patient	Emergency triage PEDS	Ambu bag set, neonatal/pediatric	A	2	
Out Patient	Emergency triage PEDS	Medicine refrigerator (2)	A	2	
Out Patient	Emergency triage PEDS	Infusion pump	A	6	
Out Patient	Emergency triage PEDS	Syringe pump	A	6	
Out Patient	Emergency triage PEDS	Suction machine, portable	A	2	
Out Patient	Emergency triage PEDS	X-ray film illuminator	A	2	
Out Patient	Emergency triage PEDS	ECG machine	A	1	
Out Patient	Emergency triage PEDS	Patient monitor, infant	A	6	
Out Patient	Emergency triage PEDS	Patient monitor, pediatric	A	6	

Out Patient	Emergency triage PEDS	Defibrillator	A	1	
Out Patient	Emergency triage PEDS	Emergency cart	A	2	
Out Patient	Emergency triage PEDS	Instrument trolley	A	2	
Out Patient	Emergency triage PEDS	Mobile LED lamp	A	2	
Out Patient	Emergency triage PEDS	Instrument cabinet (1)	A	2	
Out Patient	Emergency triage OBGYN	Bed	A	8	
Out Patient	Emergency triage OBGYN	Gynecological table	A	1	
Out Patient	Emergency triage OBGYN	Bedside locker	A	8	
Out Patient	Emergency triage OBGYN	Overbed table	A	8	
Out Patient	Emergency triage OBGYN	IV stand	A	8	
Out Patient	Emergency triage OBGYN	Ultrasonic nebulizer	A	1	
Out Patient	Emergency triage OBGYN	Glucometer	A	1	
Out Patient	Emergency triage OBGYN	Diagnostic set, adult	A	1	
Out Patient	Emergency triage OBGYN	Laryngoscope set, adult	A	1	
Out Patient	Emergency triage OBGYN	Ambu bag set, adult	A	1	
Out Patient	Emergency triage OBGYN	Medicine refrigerator (2)	A	1	
Out Patient	Emergency triage OBGYN	Infusion pump	A	2	
Out Patient	Emergency triage OBGYN	Suction machine, portable	A	1	
Out Patient	Emergency triage OBGYN	ECG machine	A	1	
Out Patient	Emergency triage OBGYN	Patient monitor, adult	A	1	
Out Patient	Emergency triage OBGYN	Defibrillator	A	1	
Out Patient	Emergency triage OBGYN	Emergency cart	A	1	
Out Patient	Emergency triage OBGYN	Instrument trolley	A	1	
Out Patient	Emergency triage OBGYN	Mobile LED lamp	A	1	
Out Patient	Emergency triage OBGYN	Foot step	A	1	
Out Patient	Emergency triage OBGYN	Emergency trolley	A	1	
Out Patient	Emergency triage OBGYN	Fetal doppler	A	1	
Out Patient	Emergency triage OBGYN	CTG machine	A	1	
Out Patient	Emergency triage OBGYN	Examination set, Ob/Gy	A	2	
Out Patient	Emergency triage OBGYN	Instrument cabinet (1)	A	1	
Out Patient	Laboratory 24 hours	Automated chemistry analyzer	A	1	
Out Patient	Laboratory 24 hours	Centrifuge, table-top type	A	1	
Out Patient	Laboratory 24 hours	Medicine refrigerator (2)	A	1	
Out Patient	Laboratory 24 hours	Automated urine analyzer	A	1	
Out Patient	Laboratory 24 hours	Hot air sterilizer	A	1	
Out Patient	Laboratory 24 hours	Electrolyte analyzer	A	1	
Out Patient	Laboratory 24 hours	Hematology analyzer	A	1	
Out Patient	Laboratory 24 hours	Binocular microscope	A	2	
Out Patient	Laboratory 24 hours	Coagulation analyzer	A	1	
Out Patient	Laboratory 24 hours	Sample mixer	A	1	
Out Patient	Laboratory 24 hours	Water bath	B	1	
Out Patient	Laboratory 24 hours	Deionizer	B	1	
Out Patient	Laboratory 24 hours	Water distillation apparatus	A	1	
Out Patient	Laboratory 24 hours	Electronic weighing balance	A	1	

Out Patient	Laboratory 24 hours	Micropipette	A	1	
Out Patient	Laboratory 24 hours	Glassware and miscellaneous	A	1	
Image diagnosis	-	X-ray unit, DR	C	1	
Image diagnosis	-	Mobile X-ray unit, DR	A	1	
Image diagnosis	-	X-ray film illuminator	B	1	
Image diagnosis	-	Radiology accessories	A	1	
Image diagnosis	-	Mammography machine	C	1	
Image diagnosis	Ultrasound room	Ultrasound machine, color doppler	A	1	
Image diagnosis	-	Ultrasound machine, portable	A	1	
Image diagnosis	Ultrasound room	Examination couch	A	1	
Delivery unit	Labour room	Labor bed	A	8	
Delivery unit	Labour room	Bedside locker	B	8	
Delivery unit	Labour room	IV stand	B	8	
Delivery unit	Labour room	Mobile LED lamp	A	8	
Delivery unit	Labour room	Foot step	A	8	
Delivery unit	Labour room	Kick bucket	A	8	
Delivery unit	Labour room	Suction machine, portable	A	2	
Delivery unit	Labour room	Instrument trolley	A	2	
Delivery unit	Labour room	Diagnostic set, adult	A	1	
Delivery unit	Labour room	Pulse oxymeter	A	2	
Delivery unit	Labour room	Fetal doppler	A	2	
Delivery unit	Labour room	CTG machine	A	2	
Delivery unit	Labour room	Infusion pump	A	1	
Delivery unit	Labour room	Medicine refrigerator (2)	A	1	
Delivery unit	Labour room	Instrument cabinet (1)	B	1	
Delivery unit	Delivery room	Delivery bed	A	6	
Delivery unit	Delivery room	Bedside locker	B	7	
Delivery unit	Delivery room	IV stand	A	7	
Delivery unit	Delivery room	Kick bucket	A	6	
Delivery unit	Delivery room	Suction machine, portable	A	1	
Delivery unit	Delivery room	Foot step	A	7	
Delivery unit	Delivery room	Delivery vacuum extractor	A	1	
Delivery unit	Delivery room	Baby cot	A	2	
Delivery unit	Delivery room	Instrument trolley	A	7	
Delivery unit	Delivery room	Delivery set	A	6	
Delivery unit	Delivery room	Obstetrical forceps	A	2	
Delivery unit	Delivery room	Infant incubator	A	2	
Delivery unit	Delivery room	Diagnostic set, adult	A	1	
Delivery unit	Delivery room	Diagnostic set, neonatal	A	2	
Delivery unit	Delivery room	Weighing scale, neonatal	A	2	
Delivery unit	Delivery room	Pulse oxymeter	A	2	
Delivery unit	Delivery room	Neonatal resuscitation trolley	A	2	
Delivery unit	Delivery room	Fetal doppler	A	2	
Delivery unit	Delivery room	Instrument cabinet (1)	B	1	

Delivery unit	Delivery room	Patient monitor, adult	A	1	
Delivery unit	Delivery room	Infusion pump	A	1	
Delivery unit	Delivery room	Defibrillator	A	1	
Delivery unit	Delivery room	Emergency cart	A	1	
Delivery unit	Delivery room	Mobile LED operating Lamp B	A	2	
Delivery unit	Delivery room	Mobile LED Lamp	A	4	
Delivery unit	Kangaroo mother care	Bed	A	5	
Delivery unit	Kangaroo mother care	Baby cot	A	5	
Delivery unit	Kangaroo mother care	Bedside locker	B	5	
Delivery unit	Kangaroo mother care	Overbed table	A	5	
Delivery unit	Kangaroo mother care	IV stand	A	5	
Delivery unit	Kangaroo mother care	Suction machine, portable	A	1	
Delivery unit	Kangaroo mother care	Instrument trolley	A	1	
Delivery unit	Kangaroo mother care	Diagnostic set, neonatal	A	1	
Delivery unit	Kangaroo mother care	Pulse oxymeter	C	1	
Delivery unit	Kangaroo mother care	Instrument cabinet (1)	B	1	
Delivery unit	Post delivery room	Bed	A	6	
Delivery unit	Post delivery room	Baby cot	A	6	
Delivery unit	Post delivery room	Bedside locker	B	6	
Delivery unit	Post delivery room	IV stand	A	6	
Delivery unit	Post delivery room	Suction machine, portable	A	1	
Delivery unit	Post delivery room	Instrument trolley	A	1	
Delivery unit	Neonatal ward	Baby cot	A	5	
Delivery unit	Neonatal ward	Bedside locker	B	5	
Delivery unit	Neonatal ward	Neonatal resuscitation trolley	A	1	
Delivery unit	Neonatal ward	Diagnostic set, neonatal	A	1	
Delivery unit	Neonatal ward	Pulse oxymeter	A	1	
Delivery unit	Neonatal ward	IV stand	A	5	
Delivery unit	Neonatal ward	Infant warmer	A	2	
Delivery unit	Clean Preparation	Autoclave, table-top	A	1	
Operation	Ante	Stretcher	A	2	
Operation	OT hall	Defibrillator	A	1	
Operation	OT hall	Emergency cart	A	1	
Operation	OT hall	Neonatal resuscitation trolley	A	1	
Operation	OT hall	Medicine refrigerator (1)	A	1	
Operation	OT hall	Blood refrigerator	A	1	
Operation	Operation Theatre	Operation table, electro-hydraulic	A	3	
Operation	Operation Theatre	LED operating lamp	A	3	
Operation	Operation Theatre	Anesthesia machine and ventilator	A	3	
Operation	Operation Theatre	Surgical diathermy unit	A	3	
Operation	Operation Theatre	Suction machine, mobile	A	3	
Operation	Operation Theatre	X-ray film illuminator, large	A	3	
Operation	Operation Theatre	IV stand	A	6	
Operation	Operation Theatre	Instrument trolley	A	3	

Operation	Operation Theatre	Mayo table	A	3	
Operation	Operation Theatre	Infusion pump	A	3	
Operation	Operation Theatre	Diagnostic set, adult	A	3	
Operation	Operation Theatre	Instrument cabinet (2)	A	3	
Operation	Operation Theatre	Capnograph	A	1	
Operation	Operation Theatre	Laryngoscope set, adult	A	2	
Operation	Operation Theatre	Video assisted laryngoscope, neonatal	A	1	
Operation	Operation Theatre	Weighing scale, neonatal	A	3	
Operation	Operation Theatre	Blood warmer	A	3	
Operation	Operation Theatre	Ambu bag set, adult	A	3	
Operation	Operation Theatre	Patient monitor, adult	A	3	
Operation	Operation Theatre	Cervical repair set	A	3	
Operation	Operation Theatre	Kick bucket	A	3	
Operation	Operation Theatre	Operating instrument set	A	3	
Operation	Operation Theatre	Abdominal histerectomy set	A	2	
Operation	Operation Theatre	D&C set	A	2	
Operation	Operation Theatre	Laparoscope	A	1	
Operation	Operation Theatre	Mobile LED operating Lamp A	A	1	
Operation	Operation Theatre	Cystoscope	A	1	
Operation	Recovery room	Bed, ICU	A	4	
Operation	Recovery room	IV stand	A	4	
Operation	Recovery room	Suction machine, mobile	A	1	
Operation	Recovery room	Infusion pump	A	1	
Operation	Recovery room	Diagnostic set, adult	A	1	
Operation	Recovery room	Ambu bag set, adult	A	1	
Operation	Recovery room	Pulse oxymeter	A	1	
Operation	Recovery room	Patient monitor, adult	A	1	
Operation	Washing Packing	Autoclave, horizontal	A	2	
Operation	Washing Packing	Low temperature sterilizer	C	1	
Operation	Washing Packing	Working stainless table	A	2	
Operation	Washing Packing	Stainless shelf	A	4	
Operation	Washing Packing	Stainless wagon	A	3	
Operation	Washing Packing	Sterilizing stainless drums	A	1	
Operation	Washing Packing	Linen cart	A	2	
MFICU	MFICU	Bed, ICU	A	6	
MFICU	MFICU	Bedside locker	A	6	
MFICU	MFICU	Overbed table	A	6	
MFICU	MFICU	IV stand	A	6	
MFICU	MFICU	Patient monitor, adult	A	6	
MFICU	MFICU	Ventilator, adult	A	3	
MFICU	MFICU	Infusion pump	A	4	
MFICU	MFICU	Syringe pump	A	2	
MFICU	MFICU	Diagnostic set, adult	A	2	
MFICU	MFICU	Instrument trolley	A	2	

MFICU	MFICU	Stretcher	A	1	
MFICU	MFICU	Ambu bag set, adult	A	1	
MFICU	MFICU	X-ray film illuminator	A	1	
MFICU	MFICU	Medicine refrigerator (2)	A	1	
MFICU	MFICU	Defibrillator	A	1	
MFICU	MFICU	Emergency cart	A	1	
MFICU	MFICU	ECG machine	A	1	
MFICU	MFICU	Suction machine, portable	A	1	
MFICU	MFICU	Instrument cabinet (1)	A	1	
MFICU	MFICU	Delivery bed	A	1	
MFICU	MFICU	Foot step	A	1	
MFICU	Isolation room (MFICU)	Bed, ICU	A	1	
MFICU	Isolation room (MFICU)	Bedside locker	A	1	
MFICU	Isolation room (MFICU)	Overbed table	A	1	
MFICU	Isolation room (MFICU)	IV stand	A	1	
MFICU	Isolation room (MFICU)	Infusion pump	A	1	
MFICU	Isolation room (MFICU)	Patient monitor, adult	A	1	
MFICU	Isolation room (MFICU)	Ventilator, adult	A	1	
MFICU	HDU (Obs & Gynae)	Bed, ICU	A	20	
MFICU	HDU (Obs & Gynae)	Bedside locker	A	20	
MFICU	HDU (Obs & Gynae)	Overbed table	A	20	
MFICU	HDU (Obs & Gynae)	IV stand	A	20	
MFICU	HDU (Obs & Gynae)	Patient monitor, adult	A	20	
MFICU	HDU (Obs & Gynae)	Diagnostic set, adult	A	2	
MFICU	HDU (Obs & Gynae)	Instrument trolley	A	2	
MFICU	HDU (Obs & Gynae)	Ambu bag set, adult	A	1	
MFICU	HDU (Obs & Gynae)	Infusion pump	A	10	
MFICU	HDU (Obs & Gynae)	Syringe pump	A	5	
MFICU	HDU (Obs & Gynae)	X-ray film illuminator	A	1	
MFICU	HDU (Obs & Gynae)	Medicine refrigerator (2)	A	1	
MFICU	HDU (Obs & Gynae)	ECG machine	A	1	
MFICU	HDU (Obs & Gynae)	Suction machine, portable	A	1	
MFICU	HDU (Obs & Gynae)	Instrument cabinet (1)	A	1	
MFICU	HDU Treatment room	Gynecological table	A	1	
MFICU	HDU Treatment room	Examination set, Ob/Gy	A	2	
MFICU	HDU Treatment room	Instrument trolley	A	1	
MFICU	HDU Treatment room	Mobile LED lamp	A	1	
MFICU	HDU Treatment room	Foot step	A	1	
NICU	NICU	Infant incubator	A	10	
NICU	NICU	Transport incubator	A	1	
NICU	NICU	Neonatal resuscitation trolley	A	2	
NICU	NICU	Infant warmer	A	6	
NICU	NICU	Phototherapy unit, LED	A	5	
NICU	NICU	Patient monitor, infant	A	10	

NICU	NICU	Ventilator, neonatal	A	5	
NICU	NICU	Baby cot	A	5	
NICU	NICU	Bedside locker	B	5	
NICU	NICU	IV stand	A	20	
NICU	NICU	Suction machine, portable	A	2	
NICU	NICU	Instrument trolley	A	2	
NICU	NICU	Video assisted laryngoscope, neonatal	A	1	
NICU	NICU	Ambu bag set, neonatal	A	2	
NICU	NICU	Weighing scale, neonatal	A	1	
NICU	NICU	Infantmeter	A	1	
NICU	NICU	Diagnostic set, neonatal	A	2	
NICU	NICU	Blood gas machine	A	1	
NICU	NICU	X-ray film illuminator	A	1	
NICU	NICU	Syringe pump	A	10	
NICU	NICU	Pulse oxymeter	A	4	
NICU	NICU	Ultrasonic nebulizer	A	2	
NICU	NICU	Medicine trolley	A	1	
NICU	NICU	Mobile rechargeable LED lamp	C	2	
NICU	NICU	Nasal CPAP unit	A	5	
NICU	NICU	Emergency cart	A	1	
NICU	NICU	Defibrillator	A	1	
NICU	NICU	Vein viewer	A	2	
NICU	NICU	Cooling water-filled mattress	A	5	
NICU	NICU	Air-oxygen blender device	A	5	
NICU	NICU	Heated humidifier	A	5	
NICU	NICU	ECG machine	C	1	
NICU	NICU	Digital rectal thermometer, infant	A	5	
OBGYN ward	OBGYN ward	Bed	A	30	
OBGYN ward	OBGYN ward	Bedside locker	A	30	
OBGYN ward	OBGYN ward	Overbed table	A	30	
OBGYN ward	OBGYN ward	IV stand	A	30	
OBGYN ward	OBGYN ward	Glucometer	A	1	
OBGYN ward	OBGYN ward	Laryngoscope set, adult	A	1	
OBGYN ward	OBGYN ward	Diagnostic set, adult	A	2	
OBGYN ward	OBGYN ward	Medicine refrigerator (2)	A	1	
OBGYN ward	OBGYN ward	Infusion pump	A	2	
OBGYN ward	OBGYN ward	Suction machine, portable	A	4	
OBGYN ward	OBGYN ward	Instrument trolley	A	1	
OBGYN ward	OBGYN ward	Ambu bag set, adult	A	1	
OBGYN ward	OBGYN ward	Medicine trolley	A	1	
OBGYN ward	OBGYN ward	Wheelchair	A	1	
OBGYN ward	OBGYN ward	Fetal doppler	A	1	
OBGYN ward	OBGYN ward	Instrument cabinet (1)	A	1	
OBGYN ward	Clean Preparation	Autoclave, table-top	A	1	

OBGYN ward	Treatment room	Gynecological table	A	1	
OBGYN ward	Treatment room	Examination set, Ob/Gy	A	2	
OBGYN ward	Treatment room	Instrument trolley	A	1	
OBGYN ward	Treatment room	Mobile LED lamp	A	1	
OBGYN ward	Treatment room	Foot step	A	1	
OBGYN ward	Treatment room	Instrument cabinet (1)	A	1	
OBGYN ward	Linen storage	Linen cart	B	1	
OPD	Security & monitor	Desk 1500w	C	2	General
OPD	Security & monitor	Desk Chair	C	2	Furniture
OPD	Security & monitor	Shelves	C	2	
OPD	OPD office	Desk 1500w	C	3	
OPD	OPD office	Desk Chair	C	3	
OPD	OPD records / files	Shelves	C	6	
OPD	Pharmacy	Desk 1500w	C	2	
OPD	Pharmacy	Desk Chair	C	2	
OPD	Pharmacy	Shelves	C	8	
OPD	OPD Waiting	Waiting Chair 3 person	C	40	
OPD	OBGYN Reception	Desk Chair	C	3	
OPD	OBGYN Reception	Laboratory Table	C	3	
OPD	OBGYN Screening	Clinic Desk 1500w	C	1	
OPD	OBGYN Screening	Desk Chair	C	1	
OPD	OBGYN Screening	stool	C	3	
OPD	OBGYN Screening	Waiting Chair 3 person	C	1	
OPD	OBGYN Family Planning	Clinic Table 1200w	C	1	
OPD	OBGYN Family Planning	Desk Chair	C	1	
OPD	OBGYN Family Planning	stool	C	2	
OPD	OBGYN PAEDS lab collection	Clinic Desk 1500w	C	2	
OPD	OBGYN PAEDS lab collection	Desk Chair	C	2	
OPD	OBGYN PAEDS lab collection	stool	C	2	
OPD	OBGYN PAEDS lab collection	Waiting Chair 3 person	C	2	
OPD	OBGYN Sub-waiting	Waiting Chair 3 person	C	10	
OPD	OBGYN postnatal	Clinic Desk 1500w	C	1	
OPD	OBGYN postnatal	Desk Chair	C	1	
OPD	OBGYN postnatal	stool	C	1	
OPD	OBGYN Lactation	Clinic Desk 1500w	C	2	
OPD	OBGYN Lactation	Desk Chair	C	2	
OPD	PEDS Reception	Desk Chair	C	3	
OPD	PEDS Reception	Laboratory Table	C	3	
OPD	PEDS Reception	Table w1200	C	1	
OPD	PEDS Sub-waiting	Waiting Chair 3 person	C	6	
OPD	PEDS Screening	Clinic Desk 1500w	C	1	
OPD	PEDS Screening	Desk Chair	C	1	
OPD	PEDS Screening	stool	C	3	
OPD	PEDS Screening	Table w1000	C	1	

List of equipment requested by Pakistani side

Annex-4-5

OPD	PEDS Screening	Waiting Chair 3 person	C	1	
OPD	PEDS Preterm + Well baby Clini	babycot	C	2	
OPD	PEDS Preterm + Well baby Clini	Clinic Desk 1500w	C	2	
OPD	PEDS Preterm + Well baby Clini	Desk Chair	C	2	
OPD	PEDS Preterm + Well baby Clini	stool	C	2	
OPD	PEDS Preterm + Well baby Clini	Table w1000	C	1	General
OPD	PEDS OTP	Clinic Desk 1500w	C	2	Furniture
OPD	PEDS OTP	Desk Chair	C	2	
OPD	PEDS OTP	stool	C	2	
OPD	PEDS OTP	Table w1000	C	1	
OPD	PEDS Under 5	Clinic Desk 1500w	C	2	
OPD	PEDS Under 5	Desk Chair	C	2	
OPD	PEDS Under 5	stool	C	2	
OPD	PEDS Under 5	Table w1000	C	2	
OPD	PEDS Feeding room	Clinic Desk 1500w	C	2	
OPD	PEDS Feeding room	Desk Chair	C	2	
OPD	PEDS Diabetic + Endocrine	Clinic Desk 1500w	C	2	
OPD	PEDS Diabetic + Endocrine	Desk Chair	C	2	
OPD	PEDS Diabetic + Endocrine	stool	C	2	
OPD	PEDS Asthama	Clinic Desk 1500w	C	2	
OPD	PEDS Asthama	Desk Chair	C	2	
OPD	PEDS Asthama	stool	C	5	
OPD	PEDS Asthama	Table w1000	C	1	
OPD	Emergency triage OBGYN	Table w1000	C	1	
OPD	Emergency duty room	Duty room bed	C	1	
OPD	Emergency duty room	Wardrobe	C	1	
OPD	Ultrasound	Clinic Desk 1500w	C	1	
OPD	Ultrasound	Desk Chair	C	1	
OPD	Ultrasound	stool	C	2	
OPD	Staff Station	Cabinet	C	1	
OPD	Staff Station	Desk Chair	C	2	
OPD	Doctor	Cabinet	C	1	
OPD	Doctor	Clinic Desk 1500w	C	1	
OPD	Doctor	Desk Chair	C	1	
OPD	Treatment	Clinic Desk 1500w	C	1	
OPD	Treatment	Desk Chair	C	1	
OPD	Linen storage	Shelves w1800	C	2	
OPD	OBGYN antenatal	Clinic Desk 1500w	C	1	
OPD	OBGYN antenatal	Desk Chair	C	1	
OPD	OBGYN antenatal	stool	C	1	
OPD	OBGYN antenatal	Table w1000	C	1	
OPD	OBGYN antenatal	Clinic Desk 1500w	C	1	
OPD	OBGYN antenatal	Desk Chair	C	1	
OPD	OBGYN antenatal	stool	C	1	

List of equipment requested by Pakistani side

Annex-4-5

OPD	OBGYN antenatal	Table w1000	C	1	
OPD	OBGYN treatment	Clinic Desk 1500w	C	1	
OPD	OBGYN treatment	Desk Chair	C	1	
OPD	OBGYN treatment	stool	C	1	
OPD	OBGYN treatment	Table w1000	C	1	
OPD	OBGYN consultation	stool	C	1	General
OPD	OBGYN consultation	Clinic Desk 1500w	C	1	Furniture
OPD	OBGYN consultation	Desk Chair	C	1	
OPD	OBGYN consultation	stool	C	2	
OPD	PEDS Immunization	Clinic Desk 1500w	C	2	
OPD	PEDS Immunization	Desk Chair	C	2	
OPD	PEDS Immunization	stool	C	3	
OPD	PEDS Consultant office	Clinic Desk 1500w	C	2	
OPD	PEDS Consultant office	Desk Chair	C	2	
OPD	PEDS Consultant office	stool	C	4	
OPD	Emergency triage PEDIATRIC	Clinic Desk 1500w	C	1	
OPD	Emergency triage PEDIATRIC	Table w1000	C	1	
OPD	Emergency observation ward	Clinic Desk 1500w	C	1	
OPD	Emergency observation ward	Table w1000	C	1	
OPD	Lab 24 hour	Laboratory Table	C	2	
OPD	Lab 24 hour	stool	C	2	
OPD	Meeting room	Meeting table	C	6	
OPD	Meeting room	Meeting chair	C	12	
OPD	Emergency Staff station	Desk Chair	C	3	
Delivery unit	Staff room	Clinic Table 1200w	C	3	
Delivery unit	Staff room	Desk Chair	C	6	
Delivery unit	Staff station	Clinic Table 1200w	C	2	
Delivery unit	Staff station	Desk Chair	C	6	
Delivery unit	Staff station	Table w1200 with caster and drawer	C	1	
Delivery unit	Labour room	Table w1200 with caster and drawer	C	1	
Delivery unit	delivery room	Shelves w1800	C	1	
Delivery unit	delivery room	stool	C	2	
Delivery unit	Doctor room	Clinic Table 1200w	C	3	
Delivery unit	Doctor room	Desk Chair	C	6	
Operation	Staff station	Clinic Desk 1500w	C	2	
Operation	Staff station	Desk Chair	C	2	
Operation	Staff station	Shelves w1800	C	1	
Operation	Anesthesia	Clinic Desk 1500w	C	1	
Operation	Anesthesia	Cupboard for drugs	C	1	
Operation	Anesthesia	Desk Chair	C	1	
Operation	Meeting room	Meeting table	C	6	
Operation	Meeting room	Meeting chair	C	12	
Operation	changing room	Bench	C	4	
Operation	changing room	Locker	C	12	

List of equipment requested by Pakistani side

Annex-4-5

Operation	Staff lounge	Dining Chair	C	6	
Operation	Staff lounge	Dining Table 1500w	C	1	
Operation	Sterile storage	Shelves w1800	C	3	
Operation	Consumable storage	Shelves w1800	C	3	
Operation	sterile changing room	Bench	C	2	
Operation	sterile changing room	Locker	C	4	General
Operation	Meeting room	Meeting table	C	12	Furniture
Operation	Meeting room	Meeting chair	C	24	
Operation	sterile office	Clinic Desk 1500w	C	1	
Operation	sterile office	Desk Chair	C	1	
NICU	Staff station	Desk Chair	C	2	
NICU	Doctor room	Clinic Desk 1500w	C	1	
NICU	Doctor room	Desk Chair	C	1	
NICU	Doctor room	Dining Chair	C	3	
NICU	Duty staff room	Duty room bed	C	1	
NICU	Duty staff room	Wardrobe	C	1	
NICU	Medical equipment storage	Shelves w1800	C	2	
NICU	Staff breakroom	Dining Chair	C	6	
NICU	Staff breakroom	Dining Table 1500w	C	1	
NICU	NICU staff station	Desk Chair	C	2	
NICU	Doctor room	Clinic Desk 1500w	C	1	
NICU	Doctor room	Desk Chair	C	1	
NICU	Doctor room	Dining Chair	C	3	
NICU	Doctor room	stool	C	1	
NICU	Duty staff room	Duty room bed	C	1	
NICU	Duty staff room	Wardrobe	C	1	
NICU	Medicine storage	Shelves w1800	C	1	
NICU	Medicine storage	Table w1200	C	2	
NICU	Baby feeding room	Dining Chair	C	4	
MFICU	Staff station	Desk Chair	C	2	
MFICU	Doctor room	Clinic Desk 1500w	C	1	
MFICU	Doctor room	Desk Chair	C	1	
MFICU	Doctor room	stool	C	2	
MFICU	Duty staff room	Duty room bed	C	1	
MFICU	Duty staff room	Wardrobe	C	1	
HDU	Linen	Shelves w1800	C	2	
HDU	Doctor room	Clinic Desk 1500w	C	1	
HDU	Doctor room	Desk Chair	C	1	
HDU	Doctor room	stool	C	2	
HDU	Treatment room	Clinic Desk 1500w	C	1	
HDU	Treatment room	Desk Chair	C	1	
HDU	Treatment room	stool	C	2	
HDU	Meeting room	Meeting table	C	6	
HDU	Meeting room	Meeting chair	C	12	

Annex 5

Major Undertakings to be taken by Recipient Government of Pakistan

Specific obligations of the Government of Pakistan which will not be funded with the Grant

(1) Before Tender

NO	Items	Deadline	In charge	Estimated Cost (million PKR)	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 45 days after G/A	GoS		
2	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the consultant	within 1 month after the signing of the agreement	GoS	-	
3	To obtain approval of IEE/EIA and/or No Objection Certificate (NOC) if applicable to be done by GoS	within 2 months after G/A	GoS		
4	To secure the Project site 1) Project site for the new facility 2) Temporary construction yard and stock yard near the Project site	1 month before notice of tender	GoS / LUMHS	-	
5	To clear and level the Project site by taking measures as follows 1) Relocation of power, water, city gas, sewage and storm water line, and any other on-site infrastructure which are in the new building area 2) Removal of Trees, if applicable 3) Removal or relocation of building/shed and/or any things which may be obstruction the construction 4) Clear the existing rooms and their surroundings by relocation/ removal of existing equipment where the work to be held as a part of the Project.	1 month before notice of tender	GoS / LUMHS /		
6	To obtain building permit / No Objection Certificate (NOC) or any relevant document	1 month before notice tender	GoS / LUMHS /		
7	To submit Project Monitoring Report, with the result of detailed design	at the approval of award of tender	GoS	-	
8	To identify the personnel /department to manage the project monitoring in Pakistan side	within 1 month after G/A	GoS / LUMHS /	-	
9	To process and disburse the budget	At the approval of PC-1	GoS		

2. During the Implementation of the Project

NO	Items	Deadline	In charge	Estimated Cost (million PKR)	Ref.
1	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the contractor and Suppliers(s)	within 1 month after the singing of the contracts	GoS		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Commission of A/P	within 1 month after the singing of the contract and the agreement	GoS		
	2) Payment commission for A/P	every payment	GoS		
3	To give possession of the Project site and temporary construction yard for the construction works	At the commencement of the work	LUMHS		
4	To assist and facilitate to obtain tax / duties exemption from federal and government of Sindh.	during the Project	GoS		
5	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	GoS		
6					
7	To bear all the unforeseen expenses, other than those to be borne by the Grant Aid, necessary for the implementation of the Project	during the Project	GoS		
8	To submit Project Monitoring Report	every month	GoS		
9	To submit a report concerning completion of the Project	within six months after completion of the Project	GoS		
10	To provide facilities for the distribution of electricity, water and gas supply, drainage and other incidental facilities				
	1) Electricity Connect Electricity power to the new facility	1 months before completion of the construction	GoS		
	2) Medical gas (oxygen)				
	3) Water				
	4) City gas				
	5) Any necessary miscellaneous items (linens, dustbins, etc) not procured by the Grant.	Within 3 months after completion of the construction	GoS		

11	To secure the safety around and outside of the construction site, and warn the patient and their family who visit the hospital	during the construction	GoS LUMHS		
12	To transfer medical equipment and furniture to the new building	Within 3 months after completion of the construction	LUMHS		
13	To remove unusable medical equipment	Before the installation	LUMHS		
14	To complete training of staffs with NICH Karachi	Within 6 months after completion of the construction	GoS		
15	Allocate required number of trained staff for operation and maintenance of the new facility and equipment provided by the Grant Aid	at the completion of installation work of the equipment	GoS / LUMHS		

3. After the Project

NO	Items	Deadline	In charge	Cost (million PKR)	Ref.
1	To maintain facility and equipment of the Grant Aid properly and effectively; 1) Allocation of maintenance cost including the expenses necessary for the various maintenance contracts for major building equipment and medical equipment. 2) Allocation of appropriate organization and staff for Operation and maintenance 3) Routine check/Periodic inspection	After handover	GoS / LUMHS		
2	To renovate the existing building after transfer of the function to the new facility	After handover	GoS / LUMHS		

A/P: Authorization to Pay,
B/A: Banking Arrangement,
EIA: Environmental Impact Assessment,
G/A: Grant Agreement,
GoS: Government of Sindh,
IEE: Initial Environmental Examination,
LUMHS: Liaquat University of Medical & Health Sciences

Minutes of Discussions

on the Preparatory Survey forthe Project for the Extension of Maternal and Child Health Care Facilities in Sindh

(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Government of Sindh and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on3 October 2019 (hereinafter referred to as "MoD 3 Oct. 2019") and on19 November 2019(hereinafter referred to as "MoD 19 Nov. 2019") and in response to the request from the Government of the Islamic Republic of Pakistan(hereinafter referred to as "Pakistan"), JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for the Extension of Maternal and Child Health Care Facilities in Sindh(hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Karachi, 11th March2021

For

Mr. Tatsuya Ashida
Team Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

11/3/21

Dr. Dabeer Ahmed Khan
Director (Dev.-I)
Dev. Wing, Health Department
Government of Sindh

Witness

Ms. Syeda Adeela Bokhari
Joint Secretary (Japan, INGO/NGOs)
Ministry of Economic Affairs,Economic Affairs Division
Government of Pakistan

Medical Superintendent
Liaquat University Hospital
Hyderabad/Jamshoro

Dr. Mohammad Siddique Memon
Medical Superintendent
Liaquat University Hospital
Government of Sindh

Counter Signature

SECRETARY HEALTH
Government of Sindh

Dr. Kazim Hussain Jatoi
Secretary to Government of Sindh Health Department, Karachi

ATTACHMENT

1. Objective of the Project

   The objective of the Project is to enhance healthcare service for mothers and children, and to reduce maternal and infant mortality at Liaquat University Hospitals with procurement of medical facilities and equipment. The Hospital plays an important role as the regional care hospital, hence the Project will contribute to strengthen regional capacity of providing medical care for prevention and treatment of COVID-19as well.

2. Title of the Project

   Both sides agreed that following project title is appropriate, but the final title will be decided based on the coordination by the Government of Japan.

   "the Project for the Extension of Maternal and Child Health Care Facilities in Sindh"

3. Project site

   Both sides confirmed that the site of the Project is the place shown in Annex 1.

4. Responsible authority for the Project

   The Government of Sindh will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. Health Department , Government of Sindh will be thefocal point of the necessary coordination of the Project. The organization charts are shown in Annex 2.

5. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Pakistan side agreed to its contents. JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Pakistan side around June 2021.

6. Cost estimate

   Both sides confirmed that the cost estimate including the contingency explained by the Team was provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, and unforeseen circumstances etc.

7. Confidentiality of the cost estimate

Both sides(including the consultant of Preparatory Survey) confirmed that the cost estimateof the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.However the specification and warranty of equipment issues would be decided at the time of tendering as per the available budget and after obtaining the inputs of end users as well as JICA side.

8. Procedures and Basic Principles of Japanese Grant

The Pakistan side agreed that the procedures and basic principles of Japanese Grant (hereinafter referred to as "the Grant") described in Annex 3 shall be applied to the Project. In addition, the Pakistan side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation

The Team explained to the Pakistan side that the expected timeline for the project implementation is as attached in Annex 4.

10. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes were as follows. The Pakistan side will be responsible for the achievement of agreed key indicators targeted in year 2027 and shall monitor the progress for Ex-Post Evaluation based on those indicators.

[Quantitative indicators]

Indicators	Base data (actual figure)	Target figures (2027, 3 years after project completion.)
1) LUH Jamshoro Number of delivery (per year)	7,500 (2018)	9,700 (per year)
2) LUH Jamshoro Number of outpatients	48,636 (2018)	63,000 (per year)
3) LUH Jamshoro Number of patients in MFICU (patients per year)	0	80 (per year)
4) LUH Jamshoro Number of patients in NICU (patients per year)	0	420 (per year)

[Qualitative indicators]

- Patient service quality will be improved by provision of new delivery unit.
- Infrastructure to provide medical service to pregnant women and children will be strengthened in LUH Jamshoro.
- The maintenance management system of LUH will be strengthened and become more effective

11. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle,with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, and Sustainability). The result of the evaluation will be publicized. The Pakistan side is required to provide necessary support for the data collection.

12. Technical assistance ("Soft Component" of the Project)

Considering the sustainable operation and maintenance of the products and services granted through the Project, following technical assistance is included under the Project. The Pakistan side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

13. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 5.With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in No 4 of "2)During the Implementation of the Project" of Annex 5, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by the Government of Sindh during the implementation stage of the Project.

The Pakistan side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 5 will be used as an attachment of G/A.

Both sides confirmed that the Government of Sindh shall take necessary measures to ensure and maintain the security of the Project site and the persons related to the implementation of the Project, in cooperation with relevant authorities during the Project period. Such security measures shall reasonably reflect needs of the Consultant/the Contractor engaging in the Project, as shown in Annex 5.

Both sides agreed that in case the additional security cost would be necessary for the implementation of the Project, such cost shall be borne by the Recipient without using the Grant.

14. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR)attached as Annex 6.The timing of submission of the PMR is described inAnnex 6.

15. Project completion

Both sides confirmed that the Project completes when all the facilities constructed, and equipment procured by the Grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

16. Items and measures to be considered for the smooth implementation of the Project

Both sides confirmed the items and measures to be considered for the smooth implementation of the Project as follows:

- Periodic WEB meeting between Pakistan and Japan.

17. Environmental and Social Considerations

17-1 General Issues

17-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

18. Other Relevant Issues

18-1.Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

18-2.Pakistan side agreed to take efforts assuring the human resources and budgets in the PC-1 and recruiting quality staff in timely manner. Government of Sindh Health Department under take / commit to provide all required staff to functionalize the hospital.

18-3.Both sides confirmed that contents of both MoD 3 Oct. 2019 and MoD 19 Nov. 2019 are effective unless stated otherwise in this document.

18-4. In 2.Preparatory Survey, (1)Contents of the Survey of Annex3 Japanese Grant,"JICAreqeststheRecipienttotake measures necessarytoachieveits self-relianceinthe implementation ofthe Project. Suchmeasures must beguaranteedeventhoughtheymayfalloutsideofthejurisdictionoftheexecutingagencyofthe Project.Therefore,thecontentsoftheProjectareconfirmedbyallrelevant organizationsoftheRecipientbasedonthe Minutesof Discussions" is mentioned. Regarding this point, the Executing Agencyteam have raised objection and advised to rephrase it as the Executing Agency will take all possible measures to execute and functionalize the Hospital to make the project sustainable and successful.JICA team explained thatAnnex3 Japanese Grant shall not be modified.

In 3.Basic Principles of Project Grants, (1)Implementation Stage, 4)Selection of Consultants of Annex3 Japanese Grant,"In ordertomaintaintechnical consistency,theconsulting firm(s) whichconductedthe survey will be recommended byJICAtothe Recipient to continueto work on

the Project's implementation after the E/N and G/A".The Executing Agency team is in view that in the interest of merit & transparency at least 2-3 consultants should be considered for the smooth execution of the project. JICA team explained thatAnnex3 Japanese Grant shall not be modified since this content is defined in Procurement Guidelines for the Japanese Grants which is stipulated in the G/A.

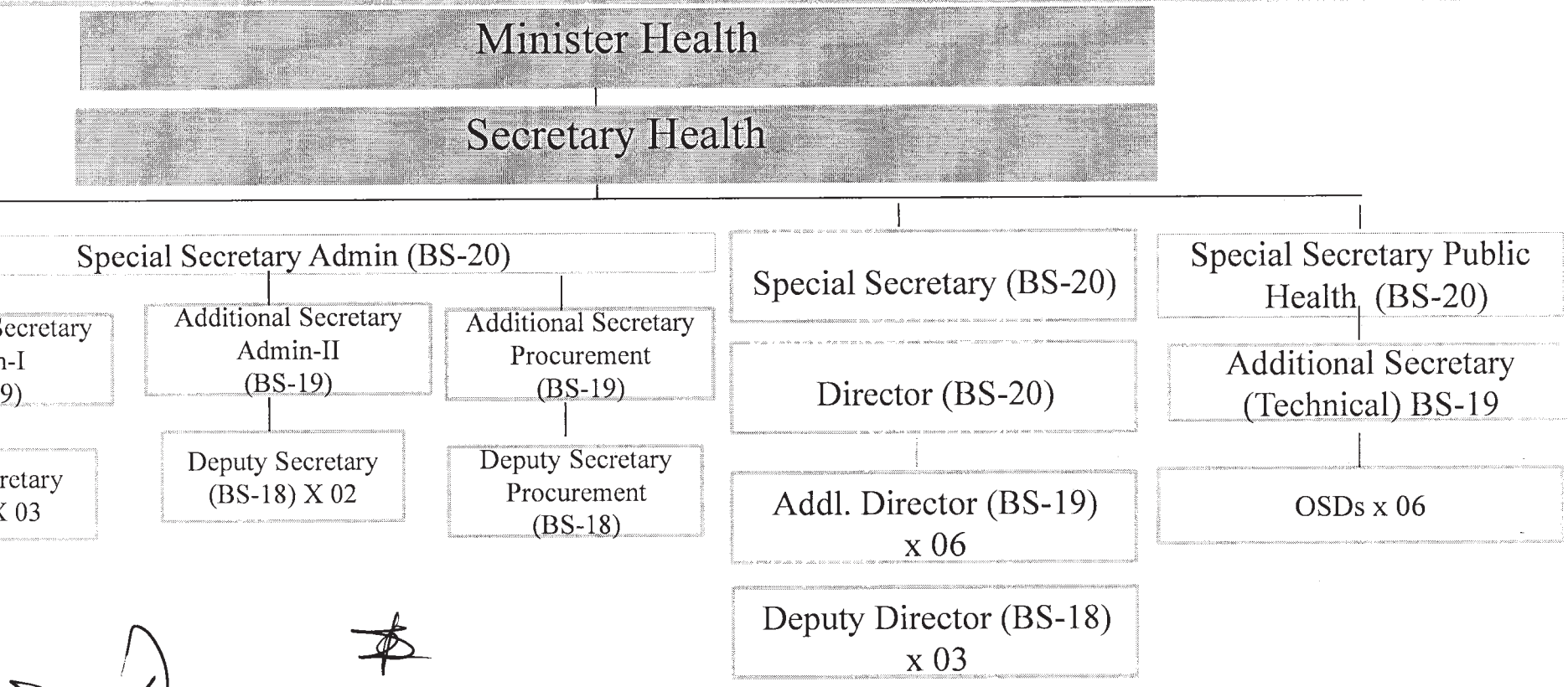
Both sides agreed on all above mentioned contents.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3Japanese Grant
Annex 4 Project Implementation Schedule
Annex 5 Major Undertakings to be taken by the Government of Pakistan
Annex 6Project Monitoring Report (template)

Government of Sindh
Health Department

ORGANO GRAM OF HEALTH DEPARTMENT SECRETARIAT

Annex2



資料-57

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

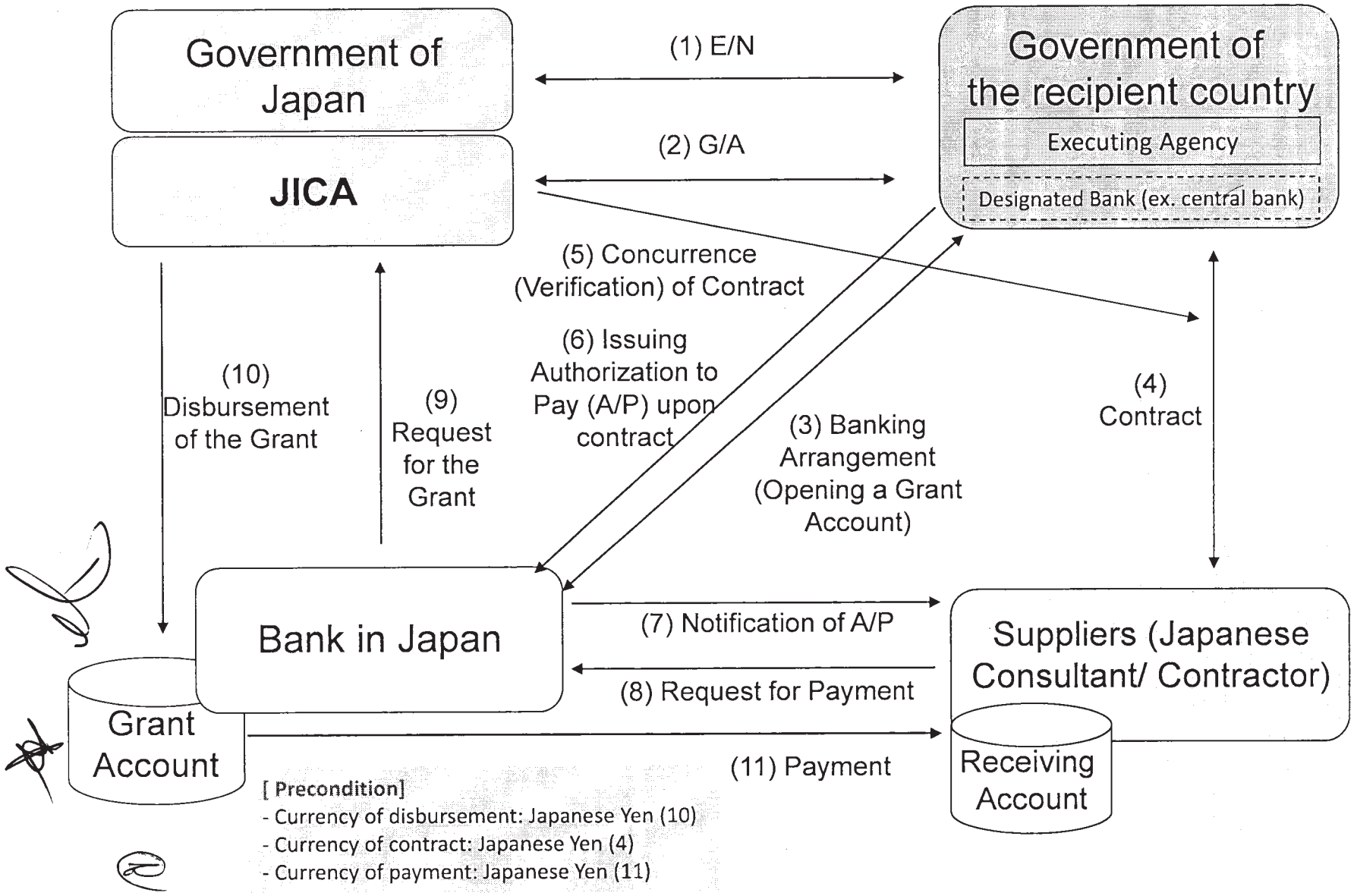
3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Financial Flow of Japanese Grant (A/P Type)



Annex 3-3

PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

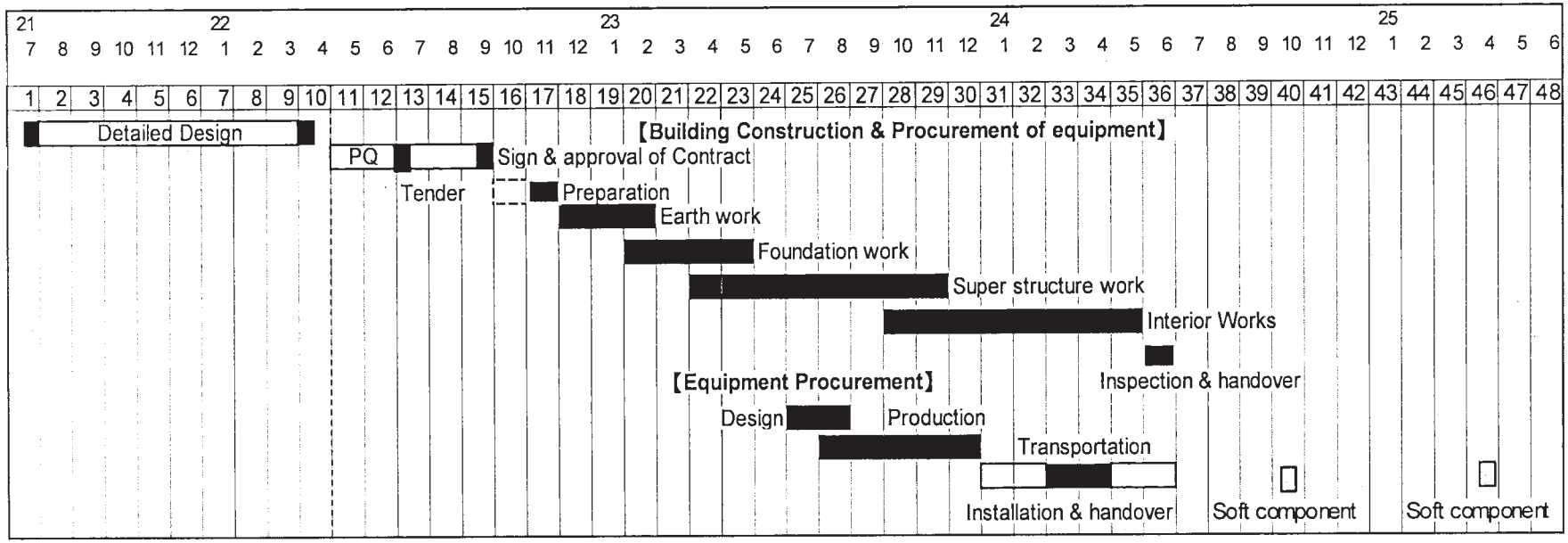
1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

ANNEX 4

Project implementation schedule

The estimated implementation period of the Project is about 36 months, considering the complexity of the facilities. Tender document preparation and tender will be 15 months, contract negotiation and validation will be about 1 month, construction and procurement of equipment shall be 20 months. It is necessary for the Pakistan side to disburse the allocated budget for the items to be borne by Pakistan side smoothly and in time, and to implement and finish the works to be done by Pakistan side according to the Project schedule, which is shown below.



Major Undertakings to be taken by Recipient Government of Pakistan

1. Specific obligations of the Government of Pakistan which will not be funded with the Grant

(1) Before Tender

NO	Items	Deadline	In charge	Estimated Cost (million PKR)	Ref.
1	To process and disburse the budget	At the approval of PC-1	GoS		
2	To open Bank Account (Banking Arrangement (B/A))	within 45 days after G/A	GoS	25.000	
3	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the consultant	within 1 month after the signing of the agreement	GoS	-	
4	1) To obtain approval of IEE/EIA and/or No Objection Certificate (NOC) if applicable to be done by GoS	within 2 months after G/A	GoS		
5	To secure the Project site 2) Project site for the new facility 7,000 sqm (75,000 sqf) Temporary construction yard and stock yard near the Project site 11,200 sqm (120,500 sqf)	1 month before notice of tender	GoS / LUMHS	-	
6	To clear and level the Project site by taking measures as follows 1) Relocation of power, water, city gas, sewage and storm water line, and any other on-site infrastructure which are in the new building area 2) Removal of Trees, if applicable There are 12 trees within the new building site. The largest 3 trees are to be kept. Other 9 trees are to be removed. 3) Removal or relocation of building/shed and/or any things which may be obstruction the construction The waiting area with toilet (approx. area 145 sqm, 1,560 sqf) are to be removed. The garbage plot is to be removed. 4) Clear the existing rooms and their surroundings by relocation/ removal of existing equipment where the work to be held as a part of the Project. The new building will be connected to existing building at 3 points. Ground level of the slope, first floor level of the slope, and first floor corridor of the Pediatric ward. All these connection points are just corridors. These corridors are to be cleared for connection works.	1 month before notice of tender	GoS / LUMHS /	10.000	
7	To obtain building permit / No Objection Certificate (NOC) or any relevant document	1 month before notice tender	GoS / LUMHS /		
8	To submit Project Monitoring Report, with the result of detailed design	at the approval of award of tender	GoS	16.000 (PIU cost)	
9	To identify the personnel /department to manage the project monitoring in Pakistan side	within 1 month after G/A	GoS / LUMHS /	-	

*Note: All cost of GOS based on estimated cost it may increase or decrease as per the need basis but GOS responsibilities would be full filed as per MODs.

During the Implementation of the Project

NO	Items	Deadline	In charge	Estimated Cost (million PKR)	Ref.
1	To issue Authorization to Pay (A/P) to a bank in Japan (Agent Bank) for the payment to the contractor and Suppliers(s)	within 1 month after the singing of the contracts	GoS		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A			Included in item 1-1	
	1) Commission of A/P	within 1 month after the singing of the contract and the agreement	GoS		
	2) Payment commission for A/P	every payment	GoS		
3	To give possession of the Project site and temporary construction yard for the construction works	At the commencement of the work	LUMHS		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted	during the Project	GoS	25.000	
5	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	GoS		
6	To bear all the unforeseen expenses, other than those to be borne by the Grant Aid, necessary for the implementation of the Project	during the Project	GoS	8.500	
7	To submit Project Monitoring Report	every month	GoS	Included in item 1-7	
8	To submit a report concerning completion of the Project	within six months after completion of the Project	GoS	Third party monitoring budget 1.725	
9	To provide facilities for the distribution of electricity, water and gas supply, drainage and other incidental facilities				
	1) Electricity Connect Electricity power to the new facility From the existing HT line to the new power plant. Connection line distance approx. 95m	1 months before completion of the construction	GoS	5.000	
	2) Medical gas (oxygen) Connect oxygen pipe from existing plant to new facility. Connection distance approx. 120m.				
	3) Water and sewerage Connect water from 6" main water line in the south road to the new building. Connection distance approx. 180m.			15.000 (water) 10.000 sewerage	
	4) City gas Connect from existing line to the new building. Connection distance approx. 50m.			2.000	
	5) Any necessary miscellaneous items (linens, dustbins, etc) not procured by the Grant. Priority C items (furniture and radiography) a. Linen: bed linen, surgical gowns, masks, gloves etc.	Within 3 months after completion of the construction	GoS	Non Medical Hospital Furniture 30.000 Misc. Civil work	

NO	Items	Deadline	In charge	Estimated Cost (million PKR)	Ref.
	b. Office items : dustbins, document cabinets, office consumables (pens, paper, stapler, etc), plates and utensils, etc. c. Office machines: Copy machine, printers, shredders, desk lights, etc. d. Telephone system. PABX, telephones and wiring. Conduits only to each room is included in building work. e. Hospital IT system. Network server, data storage, hubs, LAN wiring, computer and software necessary for hospital management and medical interface. LAN conduits only is included in building work. f. Exterior works. Trees and plants around the building, and in the children playground area. Pavement around the building is included in building work.			5.000 External development charges 20.000	
10	To secure the safety around and outside of the construction site, and warn the patient and their family who visit the hospital	during the construction	GoS LUMHS	15.000 Security charges	
11	To transfer medical equipment and furniture to the new building	Within 3 months after completion of the construction	LUMHS		
12	To remove unusable medical equipment	Before the installation	LUMHS		
13	To complete training of staffs with NICH Karachi	Within 6 months after completion of the construction	GoS		
14	Allocate required number of trained staff for operation and maintenance of the new facility and equipment provided by the Grant Aid.	at the completion of installation work of the equipment	GoS / LUMHS	Annual establishment charges for staff 164.790	

(2) After the Project

NO	Items	Deadline	In charge	Cost (million PKR)	Ref.
1	To maintain facility and equipment of the Grant Aid properly and effectively. 1) Allocation of maintenance cost including the expenses necessary for the various maintenance contracts for major building equipment and medical equipment. 2) Allocation of appropriate organization and staff for Operation and maintenance 3) Routine check/Periodic inspection	After handover	GoS / LUMHS	Annual recurring cost budget 284.705	
2	To renovate the existing building after transfer of the function to the new facility The existing OBGYN will be used for additional beds. Refurbishment work for approx. 1,450 sqm, 15,590 sqf of this existing OBGYN ward	After handover	GoS / LUMHS		

A/P: Authorization to Pay,

B/A: Banking Arrangement,

EIA: Environmental Impact Assessment,

G/A: Grant Agreement,

GoS: Government of Sindh,

IEE: Initial Environmental Examination,

LUMHS: Liaquat University of Medical & Health Sciences

Note: All costs of (G.O.S.) based on estimate costs, it may increase or decrease as per the need basis at the time of approval of PC-1, however (G.O.S) fully committed to fulfill the responsibilities given in all MODs of the project.

2. Other obligations of the Government of Pakistan funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To construct the facility of the Maternal and Child Health Center To procure and install medical equipment of the facility		
2	To implement detailed design, bidding support, construction supervision and soft component (Consulting Service)		
3	Contingencies		
	Total		3,445

*The Amount is provisional. This is subject to the approval of the Government of Japan.

Annex 6

Date:
Ref. No.

JAPAN INTERNATIONAL COOPERATION AGENCY
JICA XXX OFFICE
[Address specified in the Article 5 of the Grant Agreement]
Attention: Chief Representative

Ladies and Gentlemen:

NOTICE CONCERNING PROGRESS OF PROJECT

Reference : Grant Agreement, dated 署名日(signed date of the G/A), for プロジェクト名 (name of the Project)

In accordance to the Article 6 (3) of the Grant Agreement, we would like to report on the progress of the Project up to the following stages:

[Common]
- ☐ Preparation of bidding documents - result of detailed design
- ☐ Completion of final works under construction/procurement contract

[Construction]
- ☐ Monthl y progress [Month/Year]

[Procurement of Equip ment]
- ☐ Shipping/ delivery, hand-over (take over) of equipment
- ☐ Installation works
- ☐ Operational tr aining

- ☐ Oth er _____

Please see the details as per attached Project Monitoring Report (PMR).

Very truly yours,

[Signature]_____
[Name of the signer]
[Title of the signer]
[Name of the executing agency]

cc:
Director General
Financial Cooperation Implementation Department
Japan International Cooperation Agency
[Address specified in the Article 5 of the Grant Agreement]

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) _____ Contacts Address: _____ Pho ne/FAX: _____ Email: _____
Executing Agency	Person in Charge (Designation) _____ Contacts Address: _____ Pho ne/FAX: _____ Email: _____
Line Ministry	Person in Charge (Designation) _____ Contacts Address: _____ Pho ne/FAX: _____ Email: _____

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2 -5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design)*

Potential Risks	**Assessment**
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

資料-77

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

５．ソフトコンポーネント計画書

パキスタン・イスラム共和国
シンド州母子保健医療施設拡充計画準備調査

ソフトコンポーネント計画書

目　　次

２０２１年６月

共同企業体
株式会社 福永設計
ビンコーインターナショナル株式会社

1. ソフトコンポーネントを計画する背景

1-1 本計画の概要

「パキスタン国シンド州母子保健医療施設拡充計画」は、シンド州のジャムショロ県/ハイデラバード県及び周辺エリアの妊産婦・新生児・小児（周産期から 5 歳未満児）を対象とした母子保健にかかる診断・治療体制を強化することを目的に、リアクアット大学病院（LUH）/ジャムショロにおける母子保健センターの建設・機材の整備を行うものである。

1-2 LUH における医療機材維持管理と新生児集中治療室（NICU）における現状と課題

本計画は、リアクアット大学病院（LUH）の運営組織下にある「LUH/ハイデラバード」と「LUH/ジャムショロ」のうちの「LUH/ジョムショロ」の母子保健センターの増築及び機材の整備である。

「LUH/ハイデラバード」と教育・研究機能を持つ「LUH/ジャムショロ」の医療機材維持管理にかかる現状は、LUH として一つの運営体制下にあるため、両者の医療機器の維持管理も「LUH/ハイデラバード」内に設けられた医療機器維持管理部門（Biomedical Engineering Department-LUH Hyderabad/Jamshoro）が担っている。同部門には、バイオメディカルエンジニア（BME）が 1 名及び数人のテクニシャンと呼ばれる技術者が配属されているが、現在の維持管理部門主体の保守管理方法では両病院が保有する機材維持管理のすべてを担うことは実質的に不可能な状況にあり、このため、少ない BME でも臨床部門が主体となった日常保守管理を主とする維持管理体制の整備を目的としたソフトコンポーネントを検討する必要がある。また近年製造物責任法（PL 法）の強化により認定技術者以外が修理対応にあたる事が禁止されていることから、主要機材の修理が必要となった場合は認定技術者を抱える現地代理店等に修理を依頼している。代理店による保守サービスが提供されている機材は、MRI、CT スキャン、結石破壊装置及び人工透析装置など高度保守管理医療機器、体外循環医療機器であり、これら以外の保有機材については院内の機材維持管理部門が実施することになっている。しかしながら、既存施設の現場で見受けられる機材の不具合・故障件数を減少し、医療機材を安全かつ継続的に使用するためには、医師・看護師やコメディカルなどによる日常点検及び、代理店またはバイオメディカルエンジニアなどによる定期点検の機材予防メンテナンスが欠かせない。

新生児医療を取り巻く現状として、シンド州では 2000 年代に入り、新生児死亡率が悪化しているが[1]、超低出生体重児やハイリスク状態の新生児の人工呼吸器を用いたケアが行える医療施設は州都カラチや一部のハイデラバード市内の民間病院だけである。なお、2019 年 11 月現在 LUH には新生児室はあるが、重篤な患児ケアを行うための新生児集中治療室（NICU）がない。また、LUH には新生児医療において重要な役割を持つ新生児用人工呼吸器が不足している。新設の NICU では、2019 年 11 月現在受け入れている患児よりも、ハイリスクの患児を受け入れるための NICU の整備が計画されており、NICU でのハイリスク患児の様態の見極め、主要機材の使い方指導などの円滑な立ち上げを目的としたソフトコンポーネント支援が欠かせない。

本計画で整備される大半の機材は既存施設で既に使用されている機材である。しかし下記に示す通り、既存施設では上述の通り 2 つの課題があるため、医療機材引渡し後の円滑で安全な運用及び患児看護技術向上を目標に、2 種類のソフトコンポーネント（ア.機材に係る維持管理体制の

[1] シンド州における新生児死亡率（出生千対）：1990 年以降 44、2010 年前半 54（出典：Pakistan Demographic and Health Survey 2012-13）

整備支援、イ.NICUの運用管理支援）を実施する。課題の詳細とソフトコンポーネント支援内容は下記の通り。

〈課題１：ア.機材に係る維持管理体制の整備支援〉

LUH/ジャムショロにおける医療機材の維持管理に関する課題は以下のとおりである。

① 日常点検や定期点検が十分に実施されておらず、かつ点検の記録が残されていない。
② 故障や修理の記録、発生した修理費などの記録が残されていない。
③ 機器の消耗品の在庫管理が徹底されていない。整理整頓が不十分であり、また各部門ごとに独自に管理されている状況である。

〈ソフトコンポーネント１：ア.機材に係る維持管理体制の整備支援〉

医療機材の引渡し後の継続的かつ安全な使用を目指して、以下の機材維持管理体制整備の支援に係るソフトコンポーネントを実施する。

・ 医療機材の保守管理を前提とした日常点検・定期点検、記録管理、適切な在庫管理を目的とした整理・整頓[2]についての指導を行う。

〈課題２：イ.NICUの運用管理支援〉

LHU/ジャムショロの新生児医療に関する課題は以下のとおりである。

① 実際の患児ケアを行う小児科専門医以外のレジデント医[3]やコメディカルは、新生児ケアに特化した座学の教育は受けているものの、現場経験が少なく症例に合わせた看護、患児の様態変化のモニタリング技能などが不足している。
② 本計画では新生児室からNICUに機能を格上げすることに伴い、新生児人工呼吸器など新たに整備する機材が含まれている。

〈ソフトコンポーネント２：イ.NICUの運用管理支援〉

本計画で新規に整備されるNICUを適正かつ安全な運営が行えるようにするために、以下のソフトコンポーネントを実施する。

・ 新設されるNICUの適正な運営管理が行えるよう、実践的な患児ケアについての技術移転・提言を行う。
・ 新たに整備する人工呼吸器や新生児蘇生台など新生児関連機材については初期操作指導だけでなく、機器の構造、装着方法や様態別呼吸モードの設定などの技能を習得し、装置を適正且つ安全に運用出来るようになる。

2. ソフトコンポーネントの目標

本事業で実施するソフトコンポーネントの目標は以下のとおり。

ア.機材運営維持管理体制整備

① 医療機材の使用前、使用後の日常点検方法および記録の取り方を習得し、予防メンテナン

[2] 5Sのうちの二つの「整理」と「整頓」を指す。
[3] レジデント医師とは小児科には配属が決まりマスターコースに所属している大学院生を指す。

ス活動を実践することにより、医療機材の故障件数及び不稼働時間を確認できるようにする。

② 主要機材について、機器ごとの運用管理台帳を作成して、修理履歴（修理代金を含む）の記録を取り、機器の稼働状況を管理し、更新計画の立案にも活用する。

③ 5S の考え方[4]を理解し、部品、消耗品などの在庫管理が徹底される。

イ.NICU の運営支援

④ 適正なハイリスク新生児の看護・管理体制が構築され、新生児死亡率の低下に貢献する。

⑤ 新規導入する新生児用人工呼吸器を含む機器を適正かつ安全に使用するための技術の定着、患児の様態管理技術が向上する。

３．ソフトコンポーネントの成果

ソフトコンポーネント完了時に達成されるべき成果は次のとおりである。

表１．ソフトコンポーネントの成果

ソフトコンポーネントの投入内容	期待される成果	目　標
A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	・機材ごとの任命済維持管理責任者の確認と、機材個票に基づいて使用前、使用後の日常・定期点検および記録が実践される。 ・予防保守管理の重要性が認識され、日常・定期点検方法および記録方法が機材操作者（エンドユーザー）に修得される。	①
B. 主要機材の運用管理台帳の作成等	・機器ごとの運用管理台帳を作成し、各機器の稼働状況管理が把握できるようになる。 ・作成された運営管理台帳が、機器の更新検討にも活用される。	②
C. 機材整理整頓についての研修と実践指導	・5S（整理、整頓、清掃、清掃、躾）の考え方の中でも整理、整頓を中心に実践方法を紹介し、部品、消耗品などの在庫管理が徹底される。	③
D. NICU 施設･医療機器の適正かつ安全な運営	・適正なハイリスク新生児の看護・管理体制が構築され、新生児死亡率の低下に貢献する。 ・新規導入する新生児用人工呼吸器を含む機器を適正かつ安全に使用するための技術の定着、患児の様態管理技術が向上する。	④、⑤

４．成果達成度の確認方法

本ソフトコンポーネント終了時に達成されるべき成果の達成度を確認する項目は以下のとおりとする。

表２．成果達成度の確認方法

投入内容	確認方法
A	日常・定期点検票（使用前、使用後）の活用状況（予防メンテナンス実施状況確認）
B	機器運用管理台帳の活用状況（予防メンテナンス実施状況確認）
C	部品、消耗品などの整理整頓状況（5S 活動実践状況確認）
D	・NICU に入室した児のうち、生存して退院できた児の割合 ・蘇生を行った児のうち、生存して退院できた児の割合 ・蘇生を行った児のうち、（カラチ国立小児病院などに）転院させた児の割合

[4] 5S は整理、整頓、清掃、清潔、しつけの 5 段階に分かれているものの、本件では在庫管理を目的として整理と整頓を中心に指導を行なう予定である。

５．ソフトコンポーネントの活動（投入計画）

5-1 投入時期及び期間

本ソフトコンポーネントは、第 1 回目現地指導と第 2 回目現地指導の 2 回に分けて行い、投入の時期は機材引渡し時からそれぞれ 3 ヶ月と 9 ヶ月経ってからが適当であると考える。その理由は、以下のとおりである。

① 機材引渡し（2024 年 6 月予定）後 3 ヶ月程度の期間は症例数が限定的で機材が十分に活用されていないことが想定され、効果的な指導結果が期待できないため。

② 第 2 回目現地指導を第 1 回目現地指導の約 6 ヶ月後に行うことで第 1 回目現地指導で習得した内容の定着度が確認でき、より適切な補講指導を行うことができるため。

表 3. ソフトコンポーネント投入期間（指導日数、移動日除く）

投入内容	第 1 回目現地指導	第 2 回目現地指導	合計指導日数
A, B, C	9 日間	6 日間	15 日間
D	8 日間	5 日間	13 日間

5-2 指導対象機材と活動内容

本ソフトコンポーネントは、整備機材の適正な運営維持管理、機器安全使用及び適正な NICU の運用を目的として、現地技術指導を 2 回に分けて行う計画とする。ソフトコンポーネントの対象機材及び活動内容は以下の通りである。

表 4-1. ソフトコンポーネント対象医療機材

投入内容	管理医療機器	一般医療機器
A, B,C	麻酔器(人工呼吸器付),除細動装置,閉鎖型保育器,輸液ポンプ,持続陽圧呼吸器、電気メス,シリンジポンプ,搬送用保育器,人工呼吸器(成人用),人工呼吸器(新生児用)	高圧蒸気滅菌器(横型),自動生化学分析装置,血液ガス分析装置,血液凝固測定装置,分娩監視装置,電解質分析装置,血球計数装置,軟性子宮鏡,開放型保育器,腹腔鏡,LED 無影灯,移動式 X 線撮影装置(DR),新生児蘇生台,吸引器(床置型),超音波診断装置(カラードップラー),超音波診断装置(多目的用),超音波診断装置(ポータブル)
D	閉鎖型保育器,開放型保育器,搬送用保育器,新生児蘇生台,人工呼吸器(新生児用),持続陽圧呼吸器,患者監視装置(新生児用),シリンジポンプ,除細動装置	

＊指導対象機材は現在保有しておらず、新たに整備するもの、あるいは保有しているものの型式が異なり追加指導が必要なものに絞り込んだ。

第 1 回目及び第 2 回目現地指導の活動は次表の通りである。

表 4-2-1. 第 1 回目指導の活動内容

ソフトコンポーネントの投入内容	指導内容	受講者（人数）
A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	・機材維持管理責任者の職務分掌の明確化、予防保守管理についての研修【2 日間】 ・機器使用前、使用後の日常・定期点検方法指導【2 日間】	院長/事務長/准教授/助教授/医師/看護師/シニアレジストラ/レジデント医師/臨床検査室スタッフ/バイオメディカルエンジニア（院内、リアクアット大学）
B. 主要機材の運用管理台帳の作成等	・機器台帳作成指導等【3 日間】	事務長/バイオメディカルエンジニア（院内、リアクアット大学）/各部門の代表者
C. 機材整理整頓についての研修と実践指導	・医療現場での整理整頓（５S）についての研修と実践指導【2 日間】	事務長/バイオメディカルエンジニア（院内、リアクアット大学）/各部門の代表者（教授陣）、NICU・MFICU で勤務予定のコメディカルスタッフ、医師、看護師
D. NICU 施設・医療機器の適正かつ安全な運営	・NICU の基礎知識、児の管理方法（簡易マニュアルに基づく指導）【1 日】 ・正常な新生児、低出生体重児の生理等の基本的知識実習【2 日間】 ・新生児蘇生方法指導【2 日間】 ・新生児用人工呼吸器の操作、医師と看護師の連携体制づくり【1 日】 ・新生児患者監視装置、シリンジポンプの使用方法【0.5 日】 ・NICU における医師、コメディカルの職務分掌【0.5 日】 ・総括、理解度確認【1 日】	事務長/小児科専門医師/NICU スタッフ全員（テクニシャン、看護師）/産科スタッフ全員/コメディカル/リアクアット大学（教育機能を担う部署）

表 4-2-2. 第 2 回目指導の活動内容

ソフトコンポーネントの投入内容	指導内容	受講者（人数）
A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	主要機材の日常・定期点検の実習【2 日間】機器の性質ごとに臨床検査室機材、新生児室機材、手術室機材とグループ分けして指導を実施	事務長/看護/レジデント医師/大学院生/臨床検査室スタッフ/バイオメディカルエンジニア（院内、リアクアット大学）
B. 主要機材の運用管理台帳の作成等	機器管理台帳の精度向上のための追加指導【2 日間】	事務長/バイオメディカルエンジニア（院内、リアクアット大学）/各部門の代表者
C. 機材整理整頓についての研修と実践指導	チェックリストを用いての整理・整頓のルーチン化【2 日間】	院長/事務長/バイオメディカルエンジニア（院内、リアクアット大学）/各部門の代表者（教授陣）、NICU・MFICU で勤務予定のコメディカルスタッフ、医師、看護師
D. NICU 施設・医療機器の適正かつ安全な運営	第 1 回目指導内容の実技実習【5 日間】	事務長/小児科専門医師/NICU スタッフ全員（テクニシャン、看護師）/産科スタッフ全員/コメディカル/リアクアット大学（教育機能を担う部署）

表 4-3-1. 第 1 回目指導の活動内容ごとの時間割

ソフトコンポーネントの投入内容	指導内容、具体な講義例		
	日目	午前	午後
A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	1日目（水）	機材維持管理責任者の職務分掌の明確化、予防保守管理についての研修（ワークショップ形式）	
		医療機材維持管理における維持管理責任者の職務分掌と役割分担（対象：施設全体責任者、部門責任者）	医療機器クラス分類、追加保護手段、漏れ電流基準（B,BF,CF形）、予防保守管理についての研修
	2日目（木）	機器使用前、使用後の日常点検方法指導	
		日常点検実践指導（外来部門・救急部門機器）	日常点検実践指導（24時間検査室機器）
	3日目（金）	日常点検実践指導（手術部門器・産科部門機器）	（午後休み）
	4日目（土）	日常点検実践指導（MFICU・HDU機器）	日常点検実践指導（NICU機器）
B. 主要機材の運用管理台帳の作成等	1日目（月）	機器台帳作成指導、定期点検計画書と定期点検についての指導（ワークショップ形式）	
		説明書に基づく機器台帳の特徴、データ入力、操作、活用方法の指導（患者監視装置の台帳作成）	定期点検計画書の作成と定期点検についのて指導（麻酔器の台帳作成及び定期点検計画書作成）
	2日目（火）	手術室関連機材の台帳作成及び定期点検計画書作成	新生児室関連機材のの台帳作成及び定期点検計画書作成
	3日目（水）	臨床検査室機材の台帳作成及び定期点検計画書作成	その他機材の台帳作成及び定期点検計画書作成
C. 機材整理整頓についての研修と実践指導	1日目（木）	5Sの考え方、実践意義についての研修と実践指導（医療安全の基礎となる日常的な改善活動であることを説明）（ワークショップ形式）	
		調達機材の付属品、消耗品、マニュアル、引渡し書類、日常的に使用するインベントリー・機器修理依頼書等の作成についての研修	整理整頓 1（手術部門）（日常使うものと使わないものを分け使わないものを倉庫などに移動して作業スペースを最大限確保、必要なものを使いやすい配置にするなど。以下同様）
	2日目（金）	整理整頓 2（NICU部門、臨床検査部門他）	（午後休み）

＊機器台帳の作成により、個別機材の稼働・不稼働・修理代金累計を把握することは、機器更新のタイミングを知らせるデータともなることから、院長・事務長などが主導しトップダウンで行なうと、病院経営改善にも繋げることができる。

ソフトコンポーネントの投入内容	指導内容、具体な講義例		
	日目	午前	午後
D. NICU 施設・医療機器の適正かつ安全な運営方法指導	1日目（水）	NICUの基礎知識、児の管理方法（簡易マニュアルに基づく指導）	
		座学（NICUの基礎知識、感染管理等について）	座学で学んだ内容についての現場での確認・応用
	2日目（木）	正常な新生児、低出生体重児の生理等の基本的知識実習	
		正常な新生児､低出生体重児の生理､新生児疾患の病態生理についての実習	新生児の代表的疾患の病態生理、感染症についての実習、ペーパーテストによる理解度のチェック
	3日目（金）	正常な新生児､低出生体重児などの新生児疾患別ケア方法､新生児蘇生台､閉鎖型保育器を用いての実践指導	NICU(24時間体制)の運営状況確認
	4日目（土）	新生児蘇生方法指導（実技とレクチャー）	
		羊水の吸入､拭き取り､体温保持、蘇生バッグを用いての児蘇生法	羊水の吸入、拭き取り、体温保持、蘇生バッグを用いての児蘇生法

		(1)	(2)、実技テスト
	5日目（月）	チューブの固定方法から人工換気中の吸入の仕方､人工呼吸器使用時に挿管している児の体位変換､観察項目､人工呼吸器が外れてしまった場合などのトラブル対応、感染管理指導（1）	チューブの固定方法から人工換気中の吸入の仕方、人工呼吸器使用時に挿管している児の体位変換、観察項目、人工呼吸器が外れてしまった場合などのトラブル対応、感染管理指導（2)、実技テスト
	6日目（火）	新生児用人工呼吸器の操作、医師と看護師の連携体制づくり	
		人工呼吸器の装着､操作についての実習、医師と看護師の役割分担・連携体制づくり	人工呼吸器を用いての実践指導、実技テスト
	7日目（水）	新生児患者監視装置､シリンジポンプの使用方法、実技	NICU患児ケアにおける各人の職務分掌
		患者監視装置の電極の装着・操作､シリンジポンプの接続・操作方法、感染管理、患者監視装置[5]、シリンジポンプ[6]を用いての実技	小児科医､看護師､新生児テクニシャン、清掃員などNICUで勤務する医療従事者、非医療者の患児看護におけるそれぞれの役割分担を再認識し、患児異常を発見するための医療スタッフ間の連携の重要性について講義、ディスカッション
	8日目（木）	総括、理解度確認	
		総括（実習） 生後すぐの新生児蘇生の方法について､新生児蘇生台、低圧持続吸引器などを用いて指導を行なった内容を踏まえ､医師・看護師に交代で実技実践を行う	チェックリストを用いての実技テストによる理解度チェック

表 4-3-2. 第 2 回目指導の活動内容ごとの時間割

ソフトコンポーネントの投入内容	指導内容、具体な講義例		
	日目	午前	午後
A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	1日目（火）	各部門の日常点検票の確認、定着度の確認	主要機材の日常点検の実践指導（1階の各部門の機材）
	2日目（水）	主要機材の日常点検の実践指導（2階の各部門の機材）	質疑回答等による定着度の確認
B. 主要機材の運用管理台帳の作成等	1日目（木）	機器管理台帳と定期点検票の活用状況の把握、	機器管理台帳と定期点検の精度向上のための実践指導
	2日目（金）	機器管理台帳と定期点検の精度向上のための実践指導、機器管理台帳と定期点検の精度向上のための実践指導	（午後休み）
C. 機材整理整頓についての研修と実践指導	1日目（土）	5Sの考え方を紹介（中でも、整理、整頓について指導し、部品や消耗品の在庫管理改善を目指す）	チェックシートを用いての整理・整頓のルーチン化（外来・救急）
	2日目（月）	チェックシートを用いての整理・整頓のルーチン化（手術部門・分娩部門）	チェックシートを用いての整理・整頓のルーチン化（MFICU/HDU）

[5] 先天性疾患や低出生体重児など患児の状況によって測定項目が異なるため、数人の症状の異なる患児の実技を想定している。

[6] 受講者全員が同じ時間帯に参加することは困難であることが想定され 2 回以上の実技を予定している。

ソフトコンポーネントの投入内容	指導内容、具体な講義例		
	日目	午前	午後
D. NICU 施設・医療機器の適正かつ安全な運営方法指導	1日目（火）	第1回目の指導内容の定着度の把握	第一回の4～7日目の各項目の指導内容についての実践指導
	2-4日目（水・木･金）	第一回の4～7日目の各項目の指導内容についての実践指導	
	5日目（土）	・総復習、ラップアップミーティング	チェックリストを用いての定着度の確認と総括

表 5-1. ソフトコンポーネント日程表（第 1 回目現地指導）

日付	曜日	邦人コンサルタント A（臨床工学士） 指導内容	邦人コンサルタント B（小児科医師） 指導内容
1 日目	月	成田―カラチ（移動）	成田―カラチ（移動）
2 日目	火	保健局表敬、ソフトコンポーネント日程説明 カラチーハイデラバード 病院表敬、ソフトコンポーネント日程説明	邦人コンサルタント A 同行
3 日目	水	病院指導開始（1 日目） ・A 内容指導	病院指導開始（1 日目） ・D 内容指導
4 日目	木	病院指導開始（2 日目） ・A 内容指導	病院指導開始（2 日目） ・D 内容指導
5 日目	金	病院指導開始（3 日目） ・A 内容指導	病院指導開始（3 日目） ・D 内容指導
6 日目	土	病院指導開始（4 日目） ・A 内容指導	病院指導開始（4 日目） ・D 内容指導
7 日目	日	資料整理	資料整理
8 日目	月	病院指導開始（1 日目） ・B 内容指導	病院指導開始（5 日目） DE 内容指導
9 日目	火	病院指導開始（2 日目） ・B 内容指導	病院指導開始（6 日目） ・D 内容指導
10 日目	水	病院指導開始（3 日目） ・B 内容指導	病院指導開始（7 日目） ・D 内容指導
11 日目	木	病院指導開始（1 日目） ・C 内容指導	病院指導開始（8 日目） ・D 内容指導 ハイデラバードーカラチ カラチ発
12 日目	金	病院指導開始（2 日目） ・C 内容指導	成田着
13 日目	土	病院への報告 ハイデラバードーカラチ 保健局への報告 カラチ発	―
14 日目	日	成田着	―
現地派遣日数 14 日			現地派遣日数 12 日

表 5-1. ソフトコンポーネント日程表（第 2 回目現地指導）

日付	曜日	邦人コンサルタント A（臨床工学士） 指導内容	邦人コンサルタント B（小児科医師） 指導内容
1 日目	日	成田―カラチ（移動）	成田―カラチ（移動）
2 日目	月	保健局表敬、ソフトコンポーネント日程説明 カラチーハイデラバード 病院表敬、ソフトコンポーネント日程説明	邦人コンサルタント A 同行
3 日目	火	病院指導開始（1 日目） ・A 内容第 1 回目指導内容の実習	病院指導開始（1 日目） ・D 内容第 1 回目指導内容の実習
4 日目	水	病院指導開始（2 日目） ・A 内容第 1 回目指導内容の実習	病院指導開始（2 日目） ・D 内容第 1 回目指導内容の実習
5 日目	木	病院指導開始（1 日目） ・B 内容第 1 回目指導内容の実習	病院指導開始（3 日目） ・D 内容第 1 回目指導内容の実習
6 日目	金	病院指導開始（2 日目） ・B 内容第 1 回目指導内容の実習	病院指導開始（4 日目） ・D 内容第 1 回目指導内容の実習
7 日目	土	病院指導開始（1 日目） ・C 内容第 1 回目指導内容の実習	病院指導開始（5 日目） ・D 内容第 1 回目指導内容の実習
8 日目	日	資料整理	資料整理
9 日目	月	病院指導開始（2 日目） ・C 内容第 1 回目指導内容の実習	病院への報告 ハイデラバード―カラチ 保健局への報告 カラチ発
10 日目	火	質問票回収・確認、報告書案作成	成田着
11 日目	水	病院への報告 ハイデラバード―カラチ 保健局への報告 カラチ―イスラマバード	―
12 日目	木	JICA パキスタン事務所報告 イスラマバード発	―
13 日目	金	成田着	―
現地派遣日数 13 日			現地派遣日数 10 日

【国内事前準備の内訳】

A. 任命された機材維持管理責任者の確認と予防保守管理活動の実践指導	・電気安全に関するテキスト・医療機器クラス分類（1枚程度） ・機材維持管理責任者の職務分掌と役割の定義（2枚程度） ・使用前、使用後の日常点検方法指導（5枚程度） ・定期点検指導合計（5枚程度） ・発電機回路接続の医療機器、発電機始動までのUPSの役割（1枚程度） ・日本国内の運用管理台帳事例（5枚程度、機器ごと） 合計19枚程度
B.台帳ひな形作成	・ひな形（5機器程度）（5枚程度）
C.整理整頓の研修資料作成	・５S-KAIZEN説明資料（5枚程度）
D. NICU施設・医療機器の適正かつ安全な運営方法指導	・簡易マニュアル　（15枚程度）
	合計　44枚

＊文献での調査、メーカーマニュアルの参照などテキストを作成するまでの資料整理　2日
＊資料作成　2日
＊現地とのやり取り、調整、修正　1日

６．ソフトコンポーネントの実施リソースの調達方法

本ソフトコンポーネントの技術指導者は、途上国の医療施設で機材運営維持管理の指導にあたった経験豊富な法人コンサルタント（臨床工学士又はME2種[7]有資格者）1名とNICUの運用管理について技術指導を行うことができる法人コンサルタント（小児科医師）1名の計2名を現地に派遣する。

邦人コンサルタントA(臨床工学士)は､国内事前準備としてテキストの作成等5日間(0.25MM)、第1回目現地派遣期間14日間(0.47MM)、中間報告書作成･JICA報告などに3日間(0.15MM)、第2回目国内準備に2日間（0.10MM)、第2回目現地派遣期間13日間（0.43MM)、帰国後ソフトコンポーネント完了報告書の纏めなどで3日間（0.15MM）配置する。

邦人コンサルタントB(小児科医師)は､国内事前準備としてテキストの作成等5日間(0.25MM)、第1回目現地派遣期間12日間(0.40MM)、中間報告書作成･JICA報告などに2日間(0.10MM)、第2回目国内準備に1日間（0.05MM)、第2回目現地派遣期間10日間（0.33MM)、帰国後ソフトコンポーネント完了報告書の纏めなどで2日間（0.10MM）配置する。

表6. 配置コンサルタントの種類ごとの役割

コンサルタント種類	役割
邦人コンサルタントA（臨床工学士）	医療機器の運営維持管理、医療機器の整理整頓、医療機器の安全情報の入手、伝達・活用についての指導を行う。
邦人コンサルタントB（小児科医師）	本事業で新規整備されるNICU施設・医療機器の安全な運用について指導を行う。実際に新生児ケアの臨床経験のある小児科医師を派遣することを計画する。

出典：コンサルタント作成

７．ソフトコンポーネントの実施工程

本ソフトコンポーネントは、機材引渡し時から約3ヶ月後に第1回目現地指導、9ヶ月目に第2回目現地指導を実施する計画である。次表にに本ソフトコンポーネント計画の実施工程（案）を示す。

表7. ソフトコンポーネントの計画実施工程（案）

年　　度		2024年度													2025年度			MM	
カレンダー月	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	国内	現地
施設建設工事･機材調達																		
建物･機材引き渡し				▲														
邦人コンサルタントA																	0.65	0.90
邦人コンサルタントB																	0.50	0.73
ソフトコンポーネント実施状況報告書									▲									
ソフトコンポーネント完了報告書															▲			

[7] ME2種：ＭＥ機器・システムの安全管理を中心とした医用生体工学に関する知識をもち、適切な指導のもとで、それを実際に医療に応用しうる資質を検定する試験

８．ソフトコンポーネントの成果品

8-1　ソフトコンポーネント実施状況報告書

ソフトコンポーネント実施状況報告書は 2024 年 11 月中旬を目処に提出する。

8-2　ソフトコンポーネント完了報告書

2025 年 5 月中旬を目処に提出する。この際、添付書類として下記成果品を併せて提出する。

① 日常点検票（実施例）
② 定期点検票（実施例）
③ 機器運用管理台帳（実施例）
④ 整理整頓チェックリスト（実施例）
⑤ NICU 運営維持管理テキスト
⑥ ソフトコンポーネント出席者リスト
⑦ 実施状況の写真

９．ソフトコンポーネントの概略事業費（経費積算内訳）

本ソフトコンポーネントの全体概略事業費は、約 11,582 千円である。経費積算内訳は次表の通り。

表 8. ソフトコンポーネント内訳表

ソフトコンポーネント内訳表

1米ドル= 108.30円

項目・費目	総額(円)	日本円	米ドル		円換算計	適用
			米ドル	円換算（円）		
ソフトコンポーネント費合計｛(1)+(2)+(3)｝	**11,582,178**	**11,084,048**	**4,599.54**	**498,130**	**498,130**	
(1)直接人件費	2,870,080	2,870,080				
(2)直接経費	2,742,332	2,244,202	4,599.54	498,130	498,130	
(3)間接費	5,969,766	5,969,766				

ソフトコンポーネント明細書

1米ドル= 108.30円

項目・費目	仕様・規格	数量	単位	日本円		米ドル		適用(単価表)
				単価	金額	単価	金額	
(1)直接人件費								
1)国内業務								
邦人コンサルタントA	3号、1名(ソフトコンポーネント、事前準備など)	0.65	MM	974,000	633,100			人件費2
邦人コンサルタントB	2号、1名(ソフトコンポーネント、事前準備など)	0.50	MM	1,106,000	553,000			人件費1
2)現地業務								
邦人コンサルタントA	3号、1名(ソフトコンポーネント)	0.90	MM	974,000	876,600			人件費2
邦人コンサルタントB	2号、1名(ソフトコンポーネント)	0.73	MM	1,106,000	807,380			人件費1
直接人件費　合計					**2,870,080**			
(2)直接経費								
1)邦人コンサルタント								
①航空運賃								
邦人コンサルタントA	成田-カラチ(エコノミークラス　エミレーツ、往復1ヶ月有効)	2	往復	237,549	475,098			運賃4
邦人コンサルタントB	成田-カラチ(ビジネスクラス　TG、往復1ヶ月有効)	2	往復	497,552	995,104			運賃1
②日当								
邦人コンサルタントB	2号、1名(ソフトコンポーネント)	12	日	4,500	54,000			日当1
邦人コンサルタントB	2号、1名(ソフトコンポーネント)	10	日	4,500	45,000			日当1
邦人コンサルタントA	3号、1名(ソフトコンポーネント)	14	日	4,500	63,000			日当2
邦人コンサルタントA	3号、1名(ソフトコンポーネント)	13	日	4,500	58,500			日当2
③宿泊費								
邦人コンサルタントB	2号、1名(ソフトコンポーネント)	10	日	13,500	135,000			宿泊1
邦人コンサルタントB	2号、1名(ソフトコンポーネント)	8	日	13,500	108,000			宿泊1
邦人コンサルタントA	3号、1名(ソフトコンポーネント)	12	日	13,500	162,000			宿泊2
邦人コンサルタントA	3号、2名(ソフトコンポーネント)	11	日	13,500	148,500			宿泊2
⑤車両借り上げ費								
1回目/2回目派遣時	レンタカー(4x4) プラド/ランドクルーザ(ガソリン・ドライバー付き)日契約	23	日			85.46	1,965.58	車両1
	護衛用:エスコート車(ガソリン・ドライバー付き) レンタカー(4x4) プラド/ランドクルーザ、日契約	23	日			85.46	1,965.58	車両2
	車両同乗ガードマン(日契約)	23	日			29.06	668.38	車両3
直接経費　合計					**2,244,202**		**4,599.54**	
(3)間接費								
その他原価	直接人件費x120%	1	式		3,444,096			
一般管理費等	(直接人件費+その他原価)x40%	1	式		2,525,670			
間接費　合計					**5,969,766**			

１０．相手国の責務

本ソフトコンポーネント実施に際して、以下項目を相手国の主な責務とする。

① ソフトコンポーネントの実施段階でパキスタン国側は、研修受講者となる准教授、助教授、医師、大学院生、看護師、バイオメディカルエンジニアなどが確実に研修に出席できるよう、臨床活動業務の調整を行う必要がある。

② LUH で今後雇用することになっている数人（予定では 5 名）のバイオメディカルエンジニアのうちの 1 名を新施設の機材維持管理部門の責任者として、機材引渡し 1 ヶ月前までに任命する。

③ 機材維持管理部門用のパソコンとプリンター1 式をパキスタン国側で、ソフトコンポーネント開始までに用意する。

④ 整理整頓のためにかかる費用（文具、ファイル、ラベル、ごみ箱、テープなどの購入）を確保し、ソフトコンポーネント開始までに用意する。

⑤ 技術面においては、上記指導で対象となっていない機器運用台帳の作成、定期点検計画書の作成をソフトコンポーネント実施後随時整備し活用することを推奨する。

６．参考資料

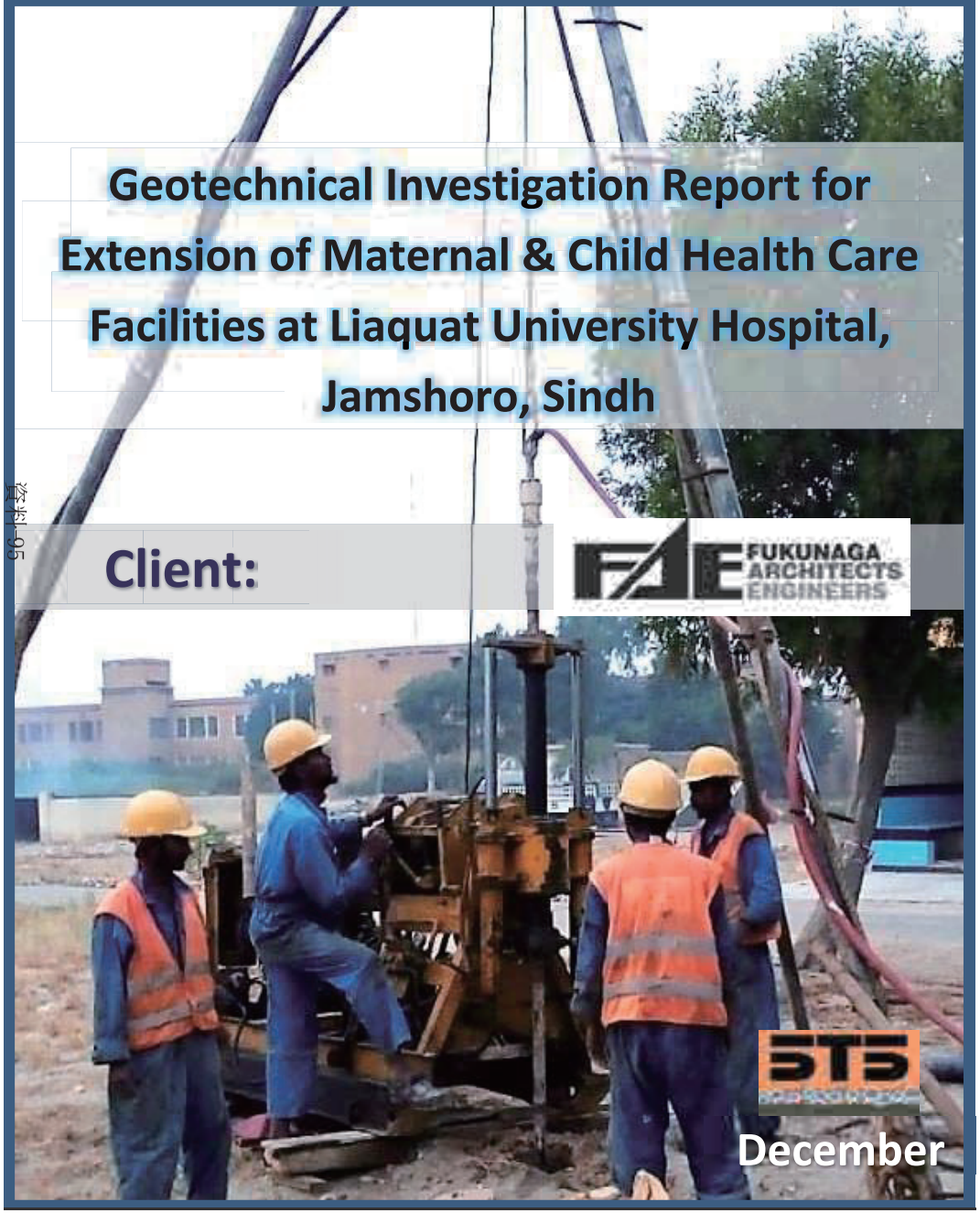
６－１．地質調査結果

６－２．水質検査結果

2019 K19-1229-101

Geotechnical Investigation Report for Extension of Maternal & Child Health Care Facilities at Liaquat University Hospital, Jamshoro, Sindh

Client: FUKUNAGA ARCHITECTS ENGINEERS



December

SOIL TESTING SERVICES

GEOTECHNICAL ENGINEERS
&
MATERIAL TESTING LABORATORY

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SOIL TESTING SERVICES	Geotechnical Investigation Report	Revision	
		#	Date
	Report No.: Vol I	01	02/12/2019

PROJECT: Geotechnical Investigation for the Extension of Maternal and Child Health Care Facilities at Liaquat University Hospital, Jamshoro, Sindh

	NAME	SIGNATURE	DATE
PREPARED BY: (Project Engineer)	Abdur Rehman		
REVIEWED BY: (Project Manager)	Naveed Anwer		
APPROVED BY: (Chief Executive Officer)	Ali Zaidi		

ISSUE/REVISION INDEX

Issue Code	Revision					Revision Details
	No.	By	Rev'd.	App.	Date	
RD	01	AR	NA	AZ	02/12/2019	

Issue Codes: RC = Released for Construction, RD = Released for Design, RF = Released for Fabrication, RI = Released for Information, RP = Released for Purchase, RPA = Released for Permit Application, RQ = Released for Quotation, RR = Released for Review and Comments.

SOIL TESTING SERVICES

Geotechnical Investigation for Maternal & Child Health Care Facilities in Sindh | K19-1229-101

EXECUTIVE SUMMARY

Geotechnical Investigation for extension of Maternal & Child Health Care Facilities at Liaquat University Hospital, Jamshoro, Sindh was carried out in order to determine geotechnical parameters of subsoil and allowable soil bearing pressure for shallow foundations. The scope of fieldwork included drilling of eight boreholes: four boreholes up to the depth of 30.0 meters and four boreholes up to the depth of 15.0 meters below the existing ground level. Rock core samples were collected via double tube core barrel. Laboratory testing of these samples has been carried out in the Soil Testing Services' laboratory, Karachi.

The deposition of the area mainly consists of *'weak to medium strong,* highly weathered & fractured, limestone', *'weak,* moderately weathered & fractured, *sandstone' and 'extremely weak, moderately weathered, claystone'*. A thin layer of clay with limestone was found in BH-03. Ground water table was not encountered up to the maximum explored depth of 30.0 meters below the existing ground level in any of the boreholes drilled at the site during investigation.

Keeping these conditions under consideration:

- Allowable net bearing pressures have been given for shallow foundations at a depth of 1.5 meters below the existing ground level.
- Seismic soil profile has been recommended as *'S_C'* for shallow foundations in accordance with UBC-97.

The exposure of underground concrete to aggressive chemicals is found to be '*negligible'* for rock, for sulphates and chlorides. Therefore *Ordinary Portland cement* may be used for underground concrete works.

Soil Testing Services, Karachi

CONTENTS

1. INTRODUCTION

Planning for the extension of Maternal & Child Health Care Facilities at Liaquat University Hospital, Jamshoro, Sindh is underway. In order to determine the geotechnical parameters of the subsurface deposits, *M/s. Soil Testing Services (STS)* were entrusted by *M/s. Fukunaga Architects-Engineers* to carry out the detailed geotechnical investigation at the site.

Scope of work included drilling of eight boreholes: four boreholes up to the depth of 30.0 meters and four boreholes up to the depth of 15.0 meters below the existing ground level. Drilling platform was almost equal to the adjacent road level. Boreholes in rock were advanced through continuous coring. Rock core samples were collected with the help of core barrel. The samples retrieved from the field work were tested in the laboratory and this report is prepared from the information obtained from the field and laboratory tests.

The report consists of five chapters with *Chapter 2* describing the site's existing condition, *Chapter 3* describing the Geological Setup, *Chapter 4* discusses the subsurface deposits in detail, *Chapter 5* includes the recommendations for foundation design, and *Chapter 6* contains a summary of conclusions regarding the ground conditions, with respect to geotechnical engineering for this project.

2. THE SITE

The project site is located in Jamshoro in the neighborhood of Jamshoro Railway Station. Nearby landmarks included Pak-Turk Maarif International School, PPHI Sindh District Office Jamshoro and Mehran University of Engineering & Technology.

LUMHS started as a medical school in 1881, and upgraded to Medical College in 1942 that was renamed as Liaquat Medical College in 1951. In 2001, it was upgraded to university named as ''Liaquat University of Medical and Health Sciences''.

The topography of the plot is plain with no major changes in elevation observed across the site. Filling material was found across the site. Figure 2.1 shows the google image of the site

Figure 2.1 Satellite image of the site

3. GEOLOGICAL SETUP

Liaquat University of Medical & Health Sciences is located on the right bank of River Indus. It is 160 kilometres north from the Port City of Karachi and 16 kilometres from the historical city of Hyderabad.

Area consist of two main formations:

1. Lakhra Formation
2. Laki Formation

Geologically this area contains the exposed Cenozoic rocks from Paleocene to Recent deposits. Khadro, Bara & Lakhra formations of Paleocene age are exposed in the area under study. The Lakhra formation conformably overlies the Bara formation and consists of evenly bedded impure limestone alternating with bioclastic sandstone and calcareous shale. Laki formation of Eocene age is also exposed in the area. Nari formation of Oligocene age, Gaj formation of Miocene age and Manchhar formation of Miocene-Pliocene ages are exposed at various localities in the district.

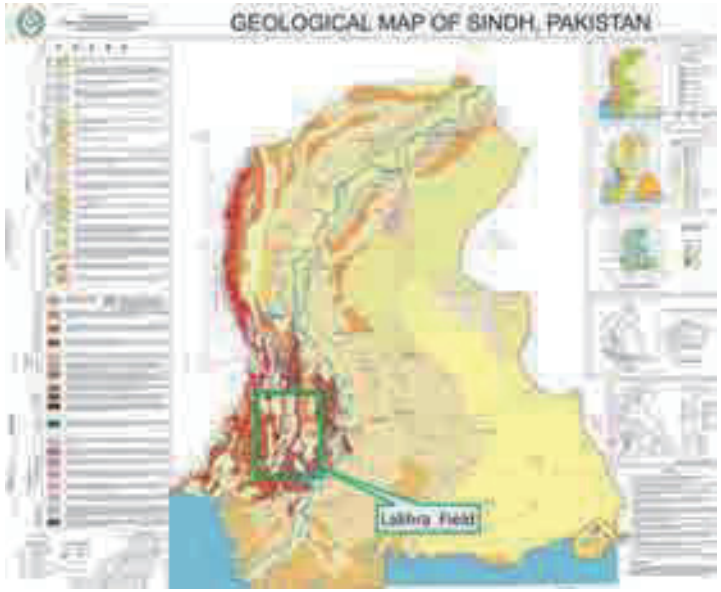


Figure 3.1: Geological Map of Sindh

4. GROUND CONDITIONS

The subsurface deposits up to the explored depth consist of the following units:

- Fill Material
- Limestone
- Sandstone
- Claystone

Following sub-sections describe the strength characteristics of the geological units and the groundwater conditions.

4.1 FILL MATERIAL

Deposits of filling material including limestone gravel, silty clay and sand. These deposits were found up to the maximum depth of 1.5 meter. Table 4.1 summarizes the details of these deposits.

Table 4.1 Deposits of Fill material

Borehole No.	Depth (meters)
BH-01	0.0 – 0.7
BH-02	0.0 – 0.5
BH-03	0.0 – 0.5
BH-04	0.0 – 0.5
BH-05	0.0 – 1.5
BH-06	0.0 – 0.5
BH-07	0.0 – 1.5
BH-08	0.0 – 1.5

4.2 CLAY

Deposits of clay with pieces of limestone were encountered in one of the boreholes drilled at the site. State of compactness according to SPT 'N' counts has been determined as *'hard'*. Table 4.2 summarizes the details of these deposits.

Table 4.2 Deposits of Clay

Borehole No.	Depth (meters)
BH-03	0.5 – 2.0

4.3 LIMESTONE

Deposits of limestone were encountered in all the boreholes drilled at the site. Disturbed and undisturbed rock core samples were collected from these deposits which were tested for moisture content, density and unconfined compressive strength. According to BS 5930, these deposits are classified as 'weak to medium strong' rock. Table 4.3 summarizes the details of these deposits.

Table 4.3 Deposits of Limestone

Borehole No.	Depth (meters)
BH-01	0.7 – 19.9 27.0 – 30.0
BH-02	0.5 – 21.0 23.5 – 24.0
BH-03	0.5 – 21.6 22.8 – 26.5
BH-04	0.5 – 15.0 17.5 – 21.0 27.0 – 30.0
BH-05	1.5 – 15.0
BH-06	0.5 – 15.0
BH-07	1.5 – 15.0
BH-08	1.5 – 15.0

4.4 SANDSTONE

Deposits of sandstone were encountered from four of the boreholes drilled at the site. Disturbed and undisturbed rock core samples were collected from these deposits which were tested for moisture content, density and unconfined compressive strength. According to BS 5930, these deposits are classified as 'weak' rock. Table 4.4 summarizes the details of these deposits.

Table 4.4 Deposits of Sandstone

Borehole No.	Depth (meters)
BH-01	19.9 – 27.0
BH-02	21.0 – 23.5 24.0 – 30.0
BH-03	21.6 – 22.8 26.5 – 30.0
BH-04	21.7 – 27.0

4.5 CLAYSTONE

Deposits of claystone were encountered from one of the boreholes drilled at the site. Disturbed and undisturbed rock core samples were collected from these deposits which were tested for moisture content, density and unconfined compressive strength. According to BS 5930, these deposits are classified as 'extremely weak' rock. Table 4.5 summarizes the details of these deposits.

Table 4.5 Deposits of Claystone

Borehole No.	Depth (meters)
BH-04	21.7 – 27.0

4.6 GROUNDWATER CONDITIONS

Groundwater was not encountered up to the maximum explored depth of 30.0 meters in any of the boreholes at the time of this geotechnical investigation.

5. ENGINEERING DESIGN CONSIDERATIONS

Foundation type for a structure depends on the expected loads taken by the foundation and the type of soil underlying it. The characteristics of subsurface soil deposits have been discussed in the previous section. As per the information provided by the client, following structure type is proposed for construction at the project site:

Table 5.1: Details of proposed building types and foundations

Structure type	Boreholes	Proposed Foundation Type
G+1 / G+2 storey building	BH-01 – BH-08	Shallow foundation

Keeping in view the subsoil conditions prevailing at the site and the loads expected to be transferred to the foundations and as per the requirement of the project, recommendations for shallow foundations (including isolated, strip and raft footings) are provided. Following sections discusses the recommendations and allowable bearing pressure for shallow foundation, in detail.

5.1 FOUNDATIONS – DESIGN CRITERIA

A suitable foundation for any structure must satisfy two basic independent criteria with respect to the underlying foundation soils. First, the foundation must have an adequate factor of safety against exceeding the bearing capacity of the foundation soils. Second the vertical movements of the foundation due to settlement or swelling of the foundation soils must be within tolerable limits for the structure.

Dynamically loaded foundations, such as those supporting vibrating machinery, must satisfy additional criteria as follows:

- vibrations transmitted to the foundation soils must not cause excessive settlement of the structures or its surroundings; and
- vibrations of the dynamically loaded structure, and its surroundings, must not interfere with planned operations and adjacent structures.

The foundation bearing pressures should be limited so that settlements do not exceed tolerable limits for the structures.

5.2 SHALLOW FOUNDATIONS - ALLOWABLE BEARING PRESSURES

The allowable bearing pressure for shallow footings i.e. isolated, strip and raft foundations supported on natural soils at the site will be limited either by the settlement tolerance of individual structures, or by the bearing capacity of the soil, depending on the foundation width and depth of influence. Typically, for shallow isolated/strip footings, the bearing pressure should be limited so that the total foundation settlement does not exceed 25 mm, with differential settlements of about 50 percent of the total settlement, or so that the bearing capacity is not exceeded, whichever is the lower of the two values.

The ratio of differential to total settlements for raft foundations is typically half that of an isolated footing (Terzaghi, Peck and Mesri, 1996). Consequently, the amount of settlement that a raft foundation can tolerate is twice that of an isolated foundation, usually 50 mm. However, the actual settlement tolerance of various structures should be defined by the structural engineer.

The allowable bearing pressure has been calculated following shear strength determination through in-situ field tests and settlement analysis. *Table 5.2* gives the net allowable bearing pressures for shallow foundations at the depth of 1.5 meters from the existing ground level.

Table 5.2 Net Allowable Bearing Pressures

Minimum Embedment below EGL (meter)	Isolated/Strip Foundation (kPa / tsf)	Raft Foundation (kPa / tsf)
1.5	200.0 / 2.0	300.0 / 3.0

Proper drainage shall be provided to avoid infiltration of water into foundation soil. It should be ensured that the foundation is not placed on the fill material. The settlement of isolated/strip and raft foundations due to net allowable pressure has been estimated to be within the allowable limit of 25mm (1-inch) and 50mm (2-inches) for isolated and raft foundations, respectively.

5.3 MODULUS OF SUBGRADE REACTION

The modulus of subgrade reaction, k_s, may be required to design raft foundations. The modulus principally depends on the soil stiffness, raft foundation stiffness and foundation size.

We recommend computing the modulus of subgrade reaction values for raft foundations at the site using the allowable bearing pressures that could be obtained from the bearing pressures presented in this report and the following equation:

$$k_s = \frac{1}{A} (SF)\, q_a$$

where:

k_s = Modulus of subgrade reaction, kN/m^2/m;
SF = Factor of safety;
q_a = Allowable bearing pressure, kPa; and
A = Allowable settlement, m.

The above equation assumes that the rafts will tend towards flexible rather than rigid behaviour. For perfectly rigid rafts the modulus values obtained from the above equation should be doubled.

Mat foundations will behave as:

Perfectly rigid if h/B > 1/5

Perfectly flexible if h/B < 1/5

where:

h = thickness of raft foundation; and
B = width of raft foundation

Table 5.3 shows the values of modulus of subgrade reaction for given pressure.

Table 5.3 Modulus of subgrade reaction based on allowable bearing pressure

Minimum Embedment below EGL (meter)	K_s for Shallow Foundation (MN/m^3)
1.5	18.0

5.4 SWELLING POTENTIAL OF CLAY

Based on swelling potential, SP, the clayey soil with limestone encountered at site is classified as having 'Low' expansion/swelling potential (BIS, 1997). The Activity class, Ac, of the soil as classified as Skempton (1953) is found to be 'inactive' which corresponds

that the soil at site have very less to no potential for expansion or swelling. Results are appended in Appendix D.

5.5 SOIL PROFILE TYPE (ACCORDING TO UBC-97)

Chapter 16, Division V, Section 1636 of UBC-97 deals with the determination of Soil Profile Types. Design practice involves using seismic parameters of zone 2A for the area under consideration.

5.5.1 SEISMIC ZONE FACTOR

Table 16-I of UBC-97 defines the seismic zone factor to be used in choosing seismic coefficients for a location. The seismic zone factor **"Z"** will be taken as 0.15.

5.5.2 SOIL PROFILE TYPE

Table 16-J of UBC-97 defines the soil profile types to be used for determining seismic coefficients. Based on the field data obtained from downhole seismic test, the soil profile will be taken as **"S_C"**.

5.5.3 SEISMIC COEFFICIENTS

Seismic coefficients are as under:

For S_C: C_a = 0.18 & C_V = 0.25

5.6 TYPE OF CEMENT

Tests on rock samples obtained from the boreholes indicate '*negligible*' sulphate and chloride exposure. Under these conditions it is recommended to use *Ordinary Portland Cement (OPC)* for all underground concrete works.

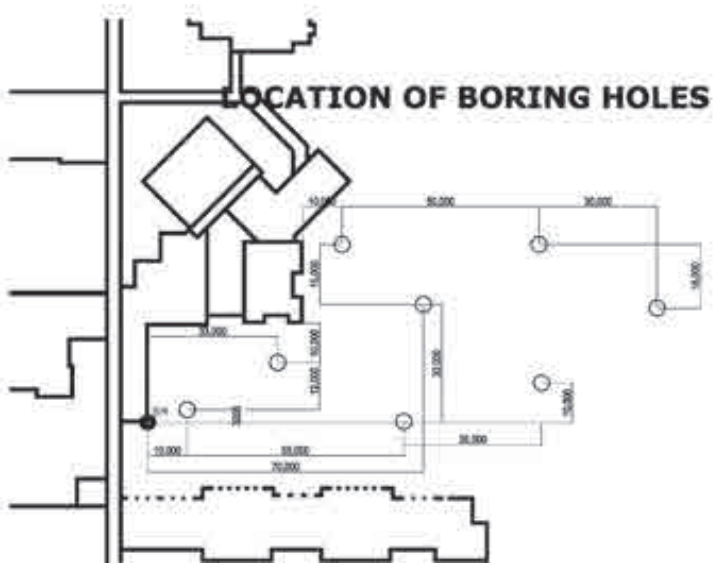
6. CONCLUSIONS

Geotechnical Investigation for extension of Maternal & Child Health Care Facilities at Liaquat University Hospital, Jamshoro, Sindh was carried out in November, 2019. Scope of work included drilling of four boreholes up to 15.0 meters deep and four boreholes up to the depth of 30.0 meters below the existing ground level. Laboratory testing of rock samples has been carried out in the lab and includes determination of index properties through natural moisture content, density, unconfined compressive strength, point load test, swelling test etc. Chemical characteristics of rock samples have also been assessed through determination of sulphate content, chloride content and pH.

Keeping in view, the results from field, and laboratory tests and the expected loads being transferred to the founding stratum, allowable bearing pressures for shallow foundations at depth of 1.5 meters is recommended. Exposure to chloride and sulphate salts is '*negligible*' for rock; therefore, *Ordinary Portland Cement (OPC)* should be used for underground concreting.

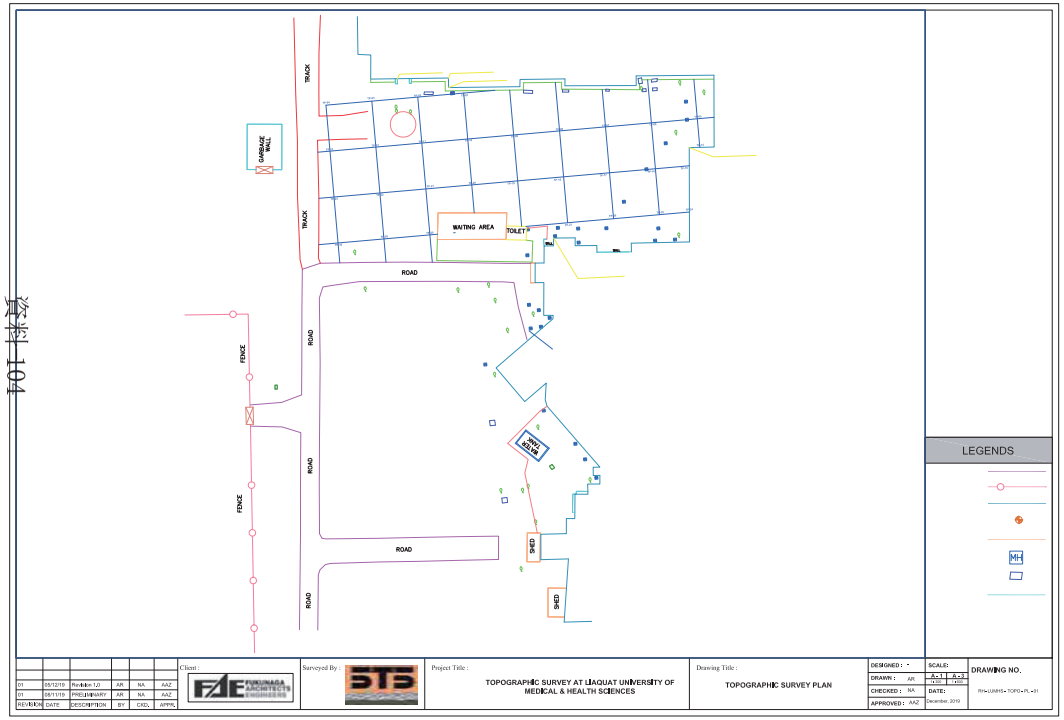
Appendix A

Borehole & Test Pit Location Plan



Borehole Location Plan
K19-1229-101
Geotechnical Investigation for the Maternal & Child Health Care Facilities at Liaquat University Hospital, Jamshoro

Soil Testing Services



Borehole & Test Pit Logs

Log BH-01

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:05.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0			**FILLING MATERIAL** *Filled with yellowish brown limestone, gravel and silty sand*			0																						0	
1			**LIMESTONE** *Whitish yellow, highly weathered and fractured, nodular, calcareous, very poor quality of rock, interbedded with silty sand, gypsum at places*			1																						1	DS - 1
2		U		5		2																			6.8	0.01	0.2	2	SPT(C) - 1 SPT Drive - 50mm Run - 1 CR - 10% / RQD - Nil
3		U		5		3																						3	SPT(C) - 2 SPT Drive - 50mm Run - 2 CR - 10% / RQD - Nil
4		U		5		4																						4	SPT(C) - 3 SPT Drive - 25mm Run - 3 CR - 15% / RQD - Nil
5		U		5		5																						5	SPT(C) - 4 SPT Drive - 75mm Run - 4 CR - 18% / RQD - Nil
6		U		5		6																						6	SPT(C) - 5 SPT Drive - 50mm Run - 5 CR - 20% / RQD - Nil
7		U		5		7																						7	SPT(C) - 6 SPT Drive - 25mm Run - 6 CR - 15% / RQD - Nil
8						8																						8	
9						9																						9	
10						10																						10	

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-01

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:05.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10			**LIMESTONE** *Whitish yellow, highly weathered and fractured, nodular, calcareous, very poor quality of rock, interbedded with silty sand, gypsum at places*			10																						10	
11		U		5		11																						11	SPT(C) - 7 SPT Drive - 50mm Run - 7 CR - 10% / RQD - Nil
12		U		5		12																						12	SPT(C) - 8 SPT Drive - 50mm Run - 8 CR - 10% / RQD - Nil
13		U		5		13																						13	SPT(C) - 9 SPT Drive - 25mm Run - 9 CR - 10% / RQD - Nil
14		U		5		14																						14	SPT(C) - 10 SPT Drive - 75mm Run - 10 CR - 13% / RQD - Nil
15		U		5		15																						15	SPT(C) - 11 SPT Drive - 50mm Run - 11 CR - 45% / RQD - Nil
16		U		5		16																						16	SPT(C) - 12 SPT Drive - 25mm Run - 12 CR - 40% / RQD - Nil
17		U	**LIMESTONE** *Yellowish brown, highly weathered and fractured, argillaceous, very poor quality of rock*	5		17																						17	Run - 13 CR - 40% / RQD - 10%
18		U		5		18																						18	
19		U		5		19																						19	
20		U	(continued ...)	5		20																						20	

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log BH-01

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:05.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
20		+	**SANDSTONE** *Yellowish brown, weak, moderately weathered and fractured, very poor quality of rock, interlayered with claystone*			20																						20	LDG - 1+29.00 - 29.10m
21		+				21																						21	Run - 15 CR - 42 % RQD - 20% LDG - 2+21.52 - 21.64m
22		+				22									17.3	1.82	2.13							86.35				22	
23		+				23																						23	Run - 16 CR - 25 % RQD - 15% LDG - 3+22.72 - 22.84m
24		+				24									5.3	2.25	2.37							152.99				24	Run - 16 CR - 25 % RQD - %
25		+				25																						25	
26		+	**SANDSTONE** *Yellowish brown, weak, moderately weathered and fractured, very poor quality of rock*	SPT(N) - 13 SPT Dwe - 25mm		26									7.3	2.37	2.54							133.96				26	Run - 17 CR - 45 % RQD - 20%
27		+				27																						27	LDG - 4+22.22 - 22.35m Run - 18 CR - 40 % RQD - 15%
28		+	**LIMESTONE** *Yellowish brown, weak, highly weathered and slightly fractured, arenaceous, very poor quality of rock*			28																						28	LDG - 5+27.00 - 27.15m
29		U				29									3.6	2.14	2.22							107.07				29	Run - 19 CR - 20 % RQD - 10%
30			End of Log @ 30 (m)			30																						30	LDG - 6+29.00 - 29.10m

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-02

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:10.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0			**FILLING MATERIAL** *Filled with yellowish brown limestone, gravel and silty sand*			0																						0	DS - 1
1		●	**LIMESTONE** *Whitish yellow, highly weathered and moderately fractured, calcareous, nodular, interbedded with sand, gravel and little silt*			1	SP-SM	30.6	59.1	10.3		NLL	-	NPI	3.6	1.85	1.92											1	
2		U		SPT(N) - 9 SPT Dwe - 25mm		2																						2	SPT(N) - 1 SPT Dwe - 25mm Run - 1
3		●				3																						3	DS - 2
4		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, nodular, chalky, very poor quality of rock, interbedded with gypsum at places*			4																			6.8	0.01	0.19	4	SPT(N) - 2 SPT Dwe - 75mm Run - 1 CR - 25 % RQD - %
5		U		SPT(N) - 50 SPT Dwe - 75mm		5																						5	SPT(N) - 3 SPT Dwe - 75mm Run - 2 CR - 20 % RQD - %
6		U				6																						6	SPT(N) - 4 SPT Dwe - 60mm Run - 3 CR - 20 % RQD - %
7		U		SPT(N) - 50 SPT Dwe - 60mm		7																						7	SPT(N) - 5 SPT Dwe - 60mm Run - 4 CR - 25 % RQD - %
8		U				8																						8	
9		U		SPT(N) - 50 SPT Dwe - 25mm		9																						9	SPT(N) - 6 SPT Dwe - 25mm Run - 5 CR - 20 % RQD - %
10						10																						10	

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-02

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:10.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, nodular, chalky, very poor quality of rock, interbedded with gypsum at places*	SPT		10																						10	SPT(C) - 7 SPT Drive - 50mm Run - 6 CR - 30% / RQD - Nil
11						11																						11	
12		U				12																						12	SPT(C) - 8 SPT Drive - 75mm Run - 7 CR - 28% / RQD - Nil
13						13																						13	
14		U		SPT		14																						14	SPT(C) - 9 SPT Drive - 50mm Run - 8 CR - 25% / RQD - Nil
15			**LIMESTONE** *Yellowish brown, weak, highly weathered and fractured, argillaceous, very poor quality of rock*			15																						15	
16		U		SPT		16																						16	SPT(C) - 10 SPT Drive - 75mm Run - 9 CR - 30% / RQD - Nil
17						17																						17	
18		U		SPT		18									8	2.12	2.29							138.09				18	SPT(C) - 11 SPT Drive - 25mm Run - 10 CR - 20% / RQD - 10% UDC - 1 (17.00 - 17.10m)
19						19									5.4	2.24	2.36							155.43				19	Run - 11 CR - 25% / RQD - 10% UDC - 2 (18.30 - 18.42m)
20						20																						20	Run - 12 CR - 20% / RQD - Nil

SampleTypes
- Disturbed
- Undisturbed
- Shelby / U4
- Core Cutter
- SPT Sample
- Water Sample
- Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

Log BH-02

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:10.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
20		U	**LIMESTONE** *Yellowish brown, weak, highly weathered and fractured, argillaceous, very poor quality of rock*	SPT		20																						20	
21			**SANDSTONE** *Yellowish brown, moderately weathered and fractured, vrey poor quality of rock, interlayered with claystone*			21																						21	SPT(C) - 12 SPT Drive - 50mm Run - 11 CR - 15% / RQD - %
22		U		SPT		22																						22	
23						23																						23	SPT(C) - 13 SPT Drive - 75mm Run - 12 CR - 5% / RQD - 1% UDC - 3 (23.60 - 23.73m)
24		+	**LIMESTONE** *Yellowish brown, weak, thin layer of argillaceous limestone*			24									6.1	2.24	2.38							143.93				24	Run - 13 CR - 20% / RQD - %
25			**SANDSTONE** *Yellowish brown, moderately weathered and fractured, vrey poor quality of rock, interlayered with claystone*			25																						25	
26		U		SPT		26																						26	SPT(C) - 14 SPT Drive - 50mm Run - 14 CR - 25% / RQD - %
27						27																						27	
28		U	**SANDTONE** *Dark grey, weak, moderately weathered and fractured, very poor quality of rock*	SPT		28									17.9	1.92	2.26							57.44				28	SPT(C) - 15 SPT Drive - 50mm Run - 15 CR - 20% / RQD - 15% UDC - 4 (27.22 - 27.36m)
29						29																						29	Run - 16 CR - 5% / RQD - %
30			End of Log @ 30 (m)			30																						30	

SampleTypes
- Disturbed
- Undisturbed
- Shelby / U4
- Core Cutter
- SPT Sample
- Water Sample
- Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

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Log BH-03

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:13.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILLING MATERIAL** *Filled with yellowish brown limestone, gravel and silty sand*			0																						0	
1		U	**CALCAREOUS CLAY** *Reddish brown, highly weathered, very poor quality of immature rock, embedded with silty sand and nodular limestone*	50/		1																			6.8	0.01	0.21	1	
2		■				2																						2	
3		U	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of rock, nodular, interbedded with silty sandy clay and calcareous clay*	50/		3																						3	
4		■				4																						4	
5		U		50/		5																						5	
6		■				6																						6	
7		U		50/		7																						7	
8		■	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock*			8																						8	
9		U		50/		9																						9	
10		■				10																						10	

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; ⁙ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-03

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:13.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock*	50/		10									10.4	2.42	2.67							160.96				10	SPT(C) - 7 SPT Drive - 25mm Run - 7 CR - 15% / RQD - Nil
11		■				11																						11	
12		U		50/		12																						12	SPT(C) - 8 SPT Drive - 50mm Run - 8 CR - 20% / RQD - Nil
13		■				13																						13	
14		U		50/		14																						14	SPT(C) - 9 SPT Drive - 25mm Run - 9 CR - 25% / RQD - Nil
15		■				15																						15	
16		U		50/		16																						16	SPT(C) - 10 SPT Drive - 25mm Run - 10 CR - 24% / RQD - Nil
17		■	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of argillaceous rock, interbedded with clay at places*			17																						17	
18		U		50/		18																						18	SPT(C) - 11 SPT Drive - 25mm Run - 11 CR - 40% / RQD - Nil
19		■				19																						19	
20		U	(continued ...)	50/		20																						20	SPT(C) - 12 SPT Drive - 50mm Run - 12 CR - 25% / RQD - Nil
																													SPT(C) - 13 SPT Drive - 45mm Run - 13

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; ⁙ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log BH-03

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:13.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
20		+	**LIMESTONE** *Yellowish brown, weak, highly weathered and fractured, very poor quality of arenaceous rock*			20									10.4	2.42	2.67							160.96				20	CR - 65 % RQD - 20 % LDQ - 1+20 0C - 25 20mm Run - 4 CR - 45 % RQD - %
21						21																					21	
22			**SANDSTONE** *Dark brown, moderately weathered, very poor quality of rock, interbedded with claystone*			22																					22	SPT(51 - 4 SPT Dive - 20mm Run - %
23		U				23									4.7	2.25	2.36							95.71				23	CR - 22 % RQD - 10 % LDQ - 2+23 0C - 27 15mm
24			**LIMESTONE** *Yellowish brown, weak, highly weathered and fractured, very poor quality of arenaceous rock*			24																					24	Run - 5 CR - 45 % RQD - 15 %
25		+				25									7.5	2.28	2.45							240.33				25	LDQ - 3+23 0C - 25 13mm Run - %
26						26																					26	CR - 40 % RQD - %
27		U	**SANDSTONE** *Dark grey, moderately weathered, very poor quality of rock, thin layer of arenaceous limestone at bottom*			27																					27	SPT(51 - 5 SPT Dive - 25mm Run - 6 CR - 20 % RQD - %
28						28																					28	
29						29																					29	SPT(51 - 6 SPT Dive - 25mm Run - 7 CR - 20 % RQD - %
30			End of Log @ 30 (m)			30																					30	

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-04

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:30 (m)
GWL:- Not Encountered
Drill Date:16.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0			**FILLING MATERIAL** *Filled with yellowish brown limestone, gravel and silty sand*			0																			6.9			0	
1		●	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of rock, nodular, interbeded with silty sand and calcareous clay*			1																			0.01			1	DS - 1
2		U				2																					2	SPT(51 - 1 SPT Dive - 15mm Run - 1 CR - 20 % RQD - %
3		U				3																					3	SPT(51 - 2 SPT Dive - 25mm Run - 2 CR - 25 % RQD - %
4						4																					4	
5		U	**LIMESTONE** *Whitish yellow, weak to medium strong, highly weathered and fractured, very poor quality of nodular rock*			5																			0.19			5	SPT(51 - 3 SPT Dive - 100mm Run - 3 CR - 70 % RQD - 10 % LDQ - 1+50 - 1+50mm
6		+				6									7.8	2.14	2.31							198.07				6	Run - 4 CR - 22 % RQD - %
7						7																					7	
8		U				8																					8	SPT(51 - 4 SPT Dive - 15mm Run - 5
9		+				9									5.7	2.31	2.44							382.8				9	CR - 25 % RQD - 08 % LDQ - 2+50 - 5 11mm
10						10																					10	Run - 6 CR - 20 % RQD - %

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-04

Project Info.	Borehole Info.		Company Info.
Project :GI at LUMHS	Depth:30 (m)	Elevation:Equal to R/L	SOIL TESTING SERVICES
Client :Fukunaga Architects-Engineers	GWL:- Not Encountered	Easting:	Geotechnical Engineering & Material Testing Laboratory
Location :Jamshoro, Sindh	Drill Date:16.11.2019	Northing:	www.sts.com.pk
Job No.:K19-1229-101	Logged By:SH	Rev. BY:FA	

Columns: Depth (m) | GWL (m) | Sample Type | Lithology Description | Filed Tests (SPT 10 20 30 40 50) | Symbol | Depth (m) | USCS | Sieve Analysis Test: Gravel (%), Sand (%), Silt (%), Clay (%) | Aterberg Limits: LL (%), PL (%), PI (%) | w (%) | Unit Weight (gr/cm3): Dry, Bulk | Direct Shear Test: Test Type, C (kg/cm2), Fi (o) | Consolidation: Cc, Cs, Pc (kg/cm2) | qu (kg/cm2) | Chemical Tests: PH, SO3, CL | Depth (m) | Remarks & Comments

Depth (m)	Sample Type	Lithology Description	SPT	w (%)	Dry	Bulk	qu (kg/cm2)	Remarks & Comments
10–15	U ■ (10.3); U ■ (12); U ■ (13.7)	**LIMESTONE** *Whitish yellow, weak to medium strong, highly weathered and fractured, very poor quality of nodular rock*	50 (10.3); 50 (12.2); 50 (13.7)					SPT(N) - 5 / SPT Drive - 50mm; CR - 20 / RQD - %; SPT(N) - 6 / SPT Drive - 75mm / Run - ; CR - 15 / RQD - %; SPT(N) - 7 / SPT Drive - 50mm / Run - 8; CR - 18 / RQD - %
15–17.5	U ■ + (15); ■ (16.3); + (16.8)	**CLAYSTONE** *Yellowish brown, extremely weak, moderately weathered, very poor to poor quality of rock*	50 (15)	15.6	1.66	1.92	8.46	SPT(N) - 8 / SPT Drive - 50mm / Run - 9; CR - 55 / RQD - 33%; LDC - 3 (15.70 - 15.80m); Run - 10; CR - 40 / RQD - 15%; LDC - 4 (17.00 - 17.15m)
17.5–20	■ (18.1); U ■ (19.8)	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of nodular rock, interbedded with gypsum at places*	50 (19.8)					Run - 11; CR - 20 / RQD - %; SPT(N) - 9 / SPT Drive - 25mm / Run - 12

Log BH-04

Project Info.	Borehole Info.		Company Info.
Project :GI at LUMHS	Depth:30 (m)	Elevation:Equal to R/L	SOIL TESTING SERVICES
Client :Fukunaga Architects-Engineers	GWL:- Not Encountered	Easting:	Geotechnical Engineering & Material Testing Laboratory
Location :Jamshoro, Sindh	Drill Date:16.11.2019	Northing:	www.sts.com.pk
Job No.:K19-1229-101	Logged By:SH	Rev. BY:FA	

Depth (m)	Sample Type	Lithology Description	SPT	w (%)	Dry	Bulk	qu (kg/cm2)	Remarks & Comments
20–21	+ (20.5); ■ (21)	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of nodular rock, interbedded with gypsum at places*						CR - 20 / RQD - 15%; LDC - 5 (20.50 - 20.62m)
21–21.8		**CLAYSTONE** *Yellowish brown, moderately weathered, very poor quality of rock*						Run - 13; CR - 70 / RQD - %
21.8–27	U + ■ (22.5); ■ (24); + (25); ■ (25.5); + (26.5); ■ (27)	**SANDSTONE** *Dark grey, weak, moderately weathered, very poor to poor quality of rock*	50 (22.5)	5.8	2.2	2.33	158.58	SPT(N) - 10 / SPT Drive - 25mm / Run - 14; CR - 50 / RQD - 35%; LDC - 6 (22.70 - 22.85m); Run - 15; CR - 45 / RQD - 30%; LDC - 7 (25.00 - 25.17m); Run - 16; CR - 60 / RQD - 20%; LDC - 8 (26.50 - 26.60m)
27–30	U ■ (28.5)	**LIMESTONE** *Yellowish brown, weak, highly weathered and fractured, very poor quality of arenaceous rock*	50 (28.5)	5.3	1.82	1.92	127.86	Run - 17; CR - 50 / RQD - %; SPT(N) - 11 / SPT Drive - 15mm / Run - 18; CR - 69 / RQD - 15%; LDC - 9 (29.00 - 29.11m)

End of Log @ 30 (m)

Sample Types		Abreviations					
● Disturbed	U SPT Sample	LL : Liquid Limit	C : Cohesion	Cc : Cc	w : Moisture Content	CD : Consolidated, Drained
+ Undisturbed	Water Sample	PL : Plastic Limit	Phi : Friction Angle	Cs : Cs	qu : Unconfined Compression qu	UU : Unconsolidated, Undrained
□ Shelby / U4	∇ Groundwater Level	PI : Plastic Index	C' : Cohesion (CU)	Pc : Pre-Consolidation Pressure	F : Fast	CU : Consolidated, Undrained
■ Core Cutter		NPI : None PI	Phi' : Friction Angle (CU)	K : Permeability Coeff.	S : Slow	

Log BH-05

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:20.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0			**FILLING MATERIAL** *Yellowish brown, highly weathered pieces of limestone with silty sand and calcareous clay*			0																			6.9	0.01	0.22	0	DS - 1
1		U				1																						1	SPT (N) - 7 SPT Drive - 25mm Run - 1 CR - 25 / RQD - %
2		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous clay*			2																						2	SPT (N) - 8 SPT Drive - 25mm Run - 2 CR - 25 / RQD - %
3		U				3																						3	SPT (N) - 9 SPT Drive - 25mm Run - 3 CR - 20 / RQD - %
4		U				4																						4	SPT (N) - 7 SPT Drive - 25mm Run - 4 CR - 25 / RQD - %
5		U				5																						5	SPT (N) - 8 SPT Drive - 25mm Run - 5 CR - 25 / RQD - %
6		U				6																						6	SPT (N) - 9 SPT Drive - 60mm Run - 6 CR - 20 / RQD - %
7		U				7																						7	SPT (N) - 4 SPT Drive - 60mm Run - 7 CR - 22 / RQD - %
8		U				8																						8	SPT (N) - 5 SPT Drive - 25mm Run - 8 CR - 20 / RQD - %
9		U				9																						9	SPT (N) - 6 SPT Drive - 25mm Run - 9 CR - 25 / RQD - %
10						10																						10	

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log BH-05

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:20.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous clay*			10																						10	SPT (N) - 7 SPT Drive - 25mm Run - 1 CR - 25 / RQD - %
11		U				11																						11	SPT (N) - 8 SPT Drive - 25mm Run - 2 CR - 25 / RQD - %
12		U				12																						12	SPT (N) - 9 SPT Drive - 25mm Run - 3 CR - 20 / RQD - %
13		U				13																						13	SPT (N) - 7 SPT Drive - 25mm Run - 4 CR - 25 / RQD - %
14		U				14																						14	SPT (N) - 8 SPT Drive - 25mm Run - 5 CR - 25 / RQD - %
15		U	End of Log @ 15 (m)			15																						15	SPT (N) - 9 SPT Drive - 60mm

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log BH-06

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:20.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0			**FILLING MATERIAL** *Filled with silty sand and limestone pieces*			0																						0	
1		●	**LIMESTONE** *Yellowish brown, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous clay*			1																			6.6	0.01	0.2	1	DS - 1
2		U				2																						2	Run - 1 SPT Drive - 75mm CR - 90 / RQD - %
3		U				3																						3	Run - 2 SPT Drive - 60mm CR - 90 / RQD - %
4		U				4																						4	Run - 3 SPT Drive - 60mm CR - 25 / RQD - %
5		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand*			5																						5	
6		U				6																						6	Run - 4 SPT Drive - 60mm CR - 20 / RQD - %
7		U				7																						7	
8		U				8																						8	Run - 5 SPT Drive - 30mm CR - 20 / RQD - %
9		U				9																						9	Run - 6 SPT Drive - 25mm CR - 30 / RQD - %
10						10																						10	

Sample Types
- ● Disturbed
- + Undisturbed
- □ Shelby / U4
- ■ Core Cutter
- U SPT Sample
- ⁙ Water Sample
- ▽ Groundwater Level

Abbreviations
- LL : Liquid Limit
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- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

Log BH-06

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:20.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10			**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand*			10																						10	
11		U				11																						11	Run - 7 SPT Drive - 25mm CR - 20 / RQD - %
12		U				12																						12	Run - 8 SPT Drive - 25mm CR - 25 / RQD - %
13		U				13																						13	Run - 9 SPT Drive - 25mm CR - 15 / RQD - %
14						14																						14	
15		U	End of Log @ 15 (m)			15																						15	Run - 10 SPT Drive - 25mm

Sample Types
- ● Disturbed
- + Undisturbed
- □ Shelby / U4
- ■ Core Cutter
- U SPT Sample
- ⁙ Water Sample
- ▽ Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
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- F : Fast
- S : Slow
- CD : Consolidated, Drained
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Log BH-07

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:21.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILLING MATERIAL** *Yellowish brown silty clayey sand with limestone pieces*			0																			6.6	0.01	0.26	0	DS - 1
1		U	**LIMESTONE** *Whitish yelow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous material*			1																						1	SPT(C) - 1 SPT Drive - 75mm Run - 1 CR - 45% / RQD - Nil
2		■				2																						2	SPT(C) - 2 SPT Drive - 50mm Run - 2 CR - 31% / RQD - Nil
3		U				3																						3	SPT(C) - 3 SPT Drive - 50mm Run - 3 CR - 34% / RQD - Nil
4		■				4																						4	SPT(C) - 4 SPT Drive - 25mm Run - 4 CR - 25% / RQD - 10% UDC - 1 (6.40 - 6.50m)
5		U				5																						5	SPT(C) - 5 SPT Drive - 25mm Run - 5 CR - 30% / RQD - Nil
6		■				6																						6	SPT(C) - 6 SPT Drive - 50mm Run - 6 CR - 27% / RQD - Nil
7						7																							
8						8																							
9						9																							
10						10																							

SampleTypes
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter
U SPT Sample
Water Sample
Groundwater Level

Abbreviations
LL : Liquid Limit
PL : Plastic Limit
PI : Plastic Index
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Phi : Friction Angle
C' : Cohesion (CU)
Phi' : Friction Angle (CU)
Cc : Cc
Cs : Cs
Pc : Pre-Consolidation Pressure
K : Permeability Coeff.
w : Moisture Content
qu : Unconfined Compression qu
F : Fast
S : Slow
CD : Consolidated, Drained
UU : Unconsolidated, Undrained
CU : Consolidated, Undrained

Log BH-07

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:21.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10		U	**LIMESTONE** *Whitish yelow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous material*			10																						10	SPT(C) - 7 SPT Drive - 25mm Run - 7 CR - 24 / RQD - \
11		■				11																						11	
12		U				12																						12	SPT(C) - 8 SPT Drive - 25mm Run - 8 CR - 19 / RQD - \
13		■				13																						13	
14		U				14																						14	SPT(C) - 9 SPT Drive - 25mm Run - 9 CR - 20 / RQD - \
15			End of Log @ 15 (m)			15																						15	SPT(C) - 10 SPT Drive - 25mm

SampleTypes
● Disturbed
+ Undisturbed
□ Shelby / U4
■ Core Cutter
U SPT Sample
Water Sample
Groundwater Level

Abbreviations
LL : Liquid Limit
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C : Cohesion
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Phi' : Friction Angle (CU)
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S : Slow
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UU : Unconsolidated, Undrained
CU : Consolidated, Undrained

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Log BH-08

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		U	**FILLING MATERIAL** *Yellowish brown, silty sand with nodular limestone*			0																			7	0.01	0.18	0	DS - 1
1		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous material*			1																						1	SPT-N(1 - 1 SPT Drive - 25mm Run - 1 CR - 25 / RQD - %
2		U				2																						2	SPT-N(1 - 2 SPT Drive - 25mm Run - 2 CR - 20 / RQD - %
3		U				3																						3	SPT-N(1 - 3 SPT Drive - 60mm Run - 3 CR - 40 / RQD - %
4		U				4																						4	SPT-N(1 - 4 SPT Drive - 25mm Run - 4 CR - 28 / RQD - %
5		U				5																						5	SPT-N(1 - 5 SPT Drive - 75mm Run - 5 CR - 21 / RQD - %
6		U				6																						6	SPT-N(1 - 6 SPT Drive - 60mm Run - 6 CR - 22 / RQD - %
7						7																						7	
8						8																						8	
9						9																						9	
10						10																						10	

Sample Types
- Disturbed
- Undisturbed
- Shelby / U4
- Core Cutter
- SPT Sample
- Water Sample
- Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

Log BH-08

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:15 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SH
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
10		U	**LIMESTONE** *Whitish yellow, highly weathered and fractured, very poor quality of nodular rock, interbedded with silty sand and calcareous material*			10																						10	
11						11																						11	SPT-N(1 - 7 SPT Drive - 25mm Run - - CR - % / RQD - %
12						12																						12	SPT-N(1 - 8 SPT Drive - 25mm Run - 8 CR - 29 / RQD - %
13						13																						13	SPT-N(1 - 9 SPT Drive - 25mm Run - 9 CR - 26 / RQD - %
14						14																						14	
15		U	End of Log @ 15 (m)			15																						15	SPT-N(1 - 10 SPT Drive - 25mm

Sample Types
- Disturbed
- Undisturbed
- Shelby / U4
- Core Cutter
- SPT Sample
- Water Sample
- Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
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- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

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Log TP-01

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.5 (m)
GWL:- Not Encountered
Drill Date: 22.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-2
			End of Log @ 1.5 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

page 1 of 1

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Log TP-02

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.5 (m)
GWL:- Not Encountered
Drill Date: 22.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-2
			End of Log @ 1.5 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

page 1 of 1

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Log TP-03

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.22 (m)
GWL: - Not Encountered
Drill Date: 22.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty, sandy, calcareous clay* End of Log @ 1.22 (m)			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-04

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.2 (m)
GWL: - Not Encountered
Drill Date: 22.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty, sandy, calcareous clay* End of Log @ 1.2 (m)			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-05

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1.2 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-1 DS-2
			End of Log @ 1.2 (m)																										

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-06

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-1 DS-2
			End of Log @ 1 (m)																										

Sample Types: Disturbed; Undisturbed; Shelby / U4; Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-07

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	10 20 30 40 50		0																						0	DS-1
		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @0.1 (m) calcareous clay*																									1	DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; ∪ SPT Sample; ⁘ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-08

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	10 20 30 40 50		0																						0	DS-1
		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @0.1 (m) calcareous clay*																									1	DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; ∪ SPT Sample; ⁘ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-09

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	* SPT 10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @0.1 (m) calcareous clay*			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-10

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	* SPT 10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @0.1 (m) calcareous clay*			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-11

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	* SPT 10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @1.0 m) calcareous clay*			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-12

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	* SPT 10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty clay @1.0 m) calcareous clay*			1																						1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-13

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1 DS-2
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	

End of Log @ 1 (m)

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; ∪ SPT Sample; ⁘ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-14

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	FI (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0						0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-1

End of Log @ 1 (m)

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; ∪ SPT Sample; ⁘ Water Sample; ⌅ Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-15

Project Info.	Project :GI at LUMHS Client :Fukunaga Architects-Engineers Location :Jamshoro, Sindh Job No.:K19-1229-101	Borehole Info.	Depth:1 (m) GWL:- Not Encountered Drill Date:22.11.2019 Logged By:SA Elevation:Equal to R/L Easting: Northing: Rev. BY:FA
Company Info.	SOIL TESTING SERVICES Geotechnical Engineering & Material Testing Laboratory www.sts.com.pk		

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0–1		●	**FILL MATERIAL** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, slight cavities are present* **LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay* End of Log @ 1 (m)			0–1																						0–1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-16

Project Info.	Project :GI at LUMHS Client :Fukunaga Architects-Engineers Location :Jamshoro, Sindh Job No.:K19-1229-101	Borehole Info.	Depth:1 (m) GWL:- Not Encountered Drill Date:22.11.2019 Logged By:SA Elevation:Equal to R/L Easting: Northing: Rev. BY:FA
Company Info.	SOIL TESTING SERVICES Geotechnical Engineering & Material Testing Laboratory www.sts.com.pk		

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0–1		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand* **LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay* End of Log @ 1 (m)			0–1																						0–1	DS-1 DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-17

Project Info.	Project :GI at LUMHS Client :Fukunaga Architects-Engineers Location :Jamshoro, Sindh Job No.:K19-1229-101	
Borehole Info.	Depth:1 (m) GWL:- Not Encountered Drill Date:22.11.2019 Logged By:SA	Elevation:Equal to R/L Easting: Northing: Rev. BY:FA
Company Info.	**SOIL TESTING SERVICES** Geotechnical Engineering & Material Testing Laboratory www.sts.com.pk	STS

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1
1			**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy calcareous clay*			1																						1	DS-2
			End of Log @ 1 (m)																										

SampleTypes	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	U SPT Sample Water Sample Groundwater Level				
Abreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained	page 1 of 1

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Log TP-18

Project Info.	Project :GI at LUMHS Client :Fukunaga Architects-Engineers Location :Jamshoro, Sindh Job No.:K19-1229-101	
Borehole Info.	Depth:1 (m) GWL:- Not Encountered Drill Date:22.11.2019 Logged By:SA	Elevation:Equal to R/L Easting: Northing: Rev. BY:FA
Company Info.	**SOIL TESTING SERVICES** Geotechnical Engineering & Material Testing Laboratory www.sts.com.pk	STS

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy calcareous clay*			1																						1	DS-2
			End of Log @ 1 (m)																										

SampleTypes	● Disturbed + Undisturbed □ Shelby / U4 ■ Core Cutter	U SPT Sample Water Sample Groundwater Level				
Abreviations	LL : Liquid Limit PL : Plastic Limit PI : Plastic Index NPI : None PI	C : Cohesion Phi : Friction Angle C' : Cohesion (CU) Phi' : Friction Angle (CU)	Cc : Cc Cs : Cs Pc : Pre-Consolidation Pressure K : Permeability Coeff.	w : Moisture Content qu : Unconfined Compression qu F : Fast S : Slow	CD : Consolidated, Drained UU : Unconsolidated, Undrained CU : Consolidated, Undrained	page 1 of 1

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Log TP-19

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
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Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0				10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-1
			End of Log @ 1 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-20

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:22.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0				10 20 30 40 50		0																						0	
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS-1
			End of Log @ 1 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations:
LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI
C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU)
Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.
w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow
CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-21

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.22 (m)
GWL:- Not Encountered
Drill Date: 23.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test			Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)		PH	SO3	CL		
0–1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0–1																						0–1	DS-1
			End of Log @ 1.22 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; ▽ Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-22

Project Info.
Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Borehole Info.
Depth: 1.22 (m)
GWL:- Not Encountered
Drill Date: 23.11.2019
Logged By: SA
Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test				Aterberg Limits			w (%)	Unit Weight (gr/cm3)		Direct Shear Test			Consolidation			qu (kg/cm2)	Chemical Tests			Depth (m)	Remarks & Comments
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)		Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)		PH	SO3	CL		
0–1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0–1																						0–1	DS-1
			End of Log @ 1.22 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; ▽ Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-23

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1.22 (m)
GWL:- Not Encountered
Drill Date:23.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0																						0	
1			End of Log @ 1.22 (m)			1																						1	DS-1

Sample Types
- ● Disturbed
- + Undisturbed
- □ Shelby / U4
- ■ Core Cutter
- U SPT Sample
- ⁘ Water Sample
- ▽ Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

Log TP-24

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1.22 (m)
GWL:- Not Encountered
Drill Date:23.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0																						0	
1			End of Log @ 1.22 (m)			1																						1	DS-1

Sample Types
- ● Disturbed
- + Undisturbed
- □ Shelby / U4
- ■ Core Cutter
- U SPT Sample
- ⁘ Water Sample
- ▽ Groundwater Level

Abbreviations
- LL : Liquid Limit
- PL : Plastic Limit
- PI : Plastic Index
- NPI : None PI
- C : Cohesion
- Phi : Friction Angle
- C' : Cohesion (CU)
- Phi' : Friction Angle (CU)
- Cc : Cc
- Cs : Cs
- Pc : Pre-Consolidation Pressure
- K : Permeability Coeff.
- w : Moisture Content
- qu : Unconfined Compression qu
- F : Fast
- S : Slow
- CD : Consolidated, Drained
- UU : Unconsolidated, Undrained
- CU : Consolidated, Undrained

Log TP-25

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Depth: 1 (m)
GWL:- Not Encountered
Drill Date: 23.11.2019
Logged By: SA

Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH	SO3	CL	Depth (m)	Remarks & Comments
0–1		□	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0–1																						0–1	DS-1
			End of Log @ 1 (m)																										

Sieve Analysis Test: Gravel, Sand, Silt, Clay; Aterberg Limits: LL, PL, PI; Unit Weight (gr/cm3): Dry, Bulk; Direct Shear Test: Test Type, C, Fi; Consolidation: Cc, Cs, Pc; Chemical Tests: PH, SO3, CL.

SampleTypes: ● Disturbed, + Undisturbed, □ Shelby / U4, ■ Core Cutter, SPT Sample, Water Sample, Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-26

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Location : Jamshoro, Sindh
Job No.: K19-1229-101

Depth: 1 (m)
GWL:- Not Encountered
Drill Date: 23.11.2019
Logged By: SA

Elevation: Equal to R/L
Easting:
Northing:
Rev. BY: FA

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Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	LL (%)	PL (%)	PI (%)	w (%)	Dry	Bulk	Test Type	C (kg/cm2)	Fi (o)	Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	PH	SO3	CL	Depth (m)	Remarks & Comments
0–1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			0–1																						0–1	DS-1
			End of Log @ 1 (m)																										

SampleTypes: ● Disturbed, + Undisturbed, □ Shelby / U4, ■ Core Cutter, SPT Sample, Water Sample, Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-27

Project Info.	Borehole Info.		Company Info.
Project :GI at LUMHS	Depth:1 (m)	Elevation:Equal to R/L	SOIL TESTING SERVICES
Client :Fukunaga Architects-Engineers	GWL:- Not Encountered	Easting:	Geotechnical Engineering & Material Testing Laboratory
Location :Jamshoro, Sindh	Drill Date:23.11.2019	Northing:	www.sts.com.pk
Job No.:K19-1229-101	Logged By:SA	Rev. BY:FA	

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1
		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*																										
1			End of Log @ 1 (m)			1																						1	DS-2

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

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Log TP-28

Project Info.	Borehole Info.		Company Info.
Project :GI at LUMHS	Depth:1 (m)	Elevation:Equal to R/L	SOIL TESTING SERVICES
Client :Fukunaga Architects-Engineers	GWL:- Not Encountered	Easting:	Geotechnical Engineering & Material Testing Laboratory
Location :Jamshoro, Sindh	Drill Date:23.11.2019	Northing:	www.sts.com.pk
Job No.:K19-1229-101	Logged By:SA	Rev. BY:FA	

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (SPT 10 20 30 40 50)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*			0																						0	DS-1 DS-2
			LIMESTONE *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*																										
1			End of Log @ 1 (m)			1																						1	

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; SPT Sample; Water Sample; Groundwater Level

Abreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

page 1 of 1

Log TP-29

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:0.76 (m)
GWL:- Not Encountered
Drill Date:23.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*	10 20 30 40 50		0																						0	DS-1
			End of Log @ 0.76 (m)																										

Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Log TP-30

Project Info.
Project :GI at LUMHS
Client :Fukunaga Architects-Engineers
Location :Jamshoro, Sindh
Job No.:K19-1229-101

Borehole Info.
Depth:1 (m)
GWL:- Not Encountered
Drill Date:23.11.2019
Logged By:SA
Elevation:Equal to R/L
Easting:
Northing:
Rev. BY:FA

Company Info.
SOIL TESTING SERVICES
Geotechnical Engineering & Material Testing Laboratory
www.sts.com.pk

Depth (m)	GWL (m)	Sample Type	Lithology Description	Filed Tests (* SPT)	Symbol	Depth (m)	USCS	Sieve Analysis Test: Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Aterberg Limits: LL (%)	PL (%)	PI (%)	w (%)	Unit Weight (gr/cm3): Dry	Bulk	Direct Shear Test: Test Type	C (kg/cm2)	Fi (o)	Consolidation: Cc	Cs	Pc (kg/cm2)	qu (kg/cm2)	Chemical Tests: PH	SO3	CL	Depth (m)	Remarks & Comments
0		●	**FILL MATERIAL** *Multicolour, bricks, silty clay sand*	10 20 30 40 50		0																						0	DS - 1
1		●	**LIMESTONE** *Whitish yellow, moderately fractured and highly weathered, nodular, fossiliferous, very poor quality of rock, interbedded with silty sandy, calcareous clay*			1																						1	DS - 2

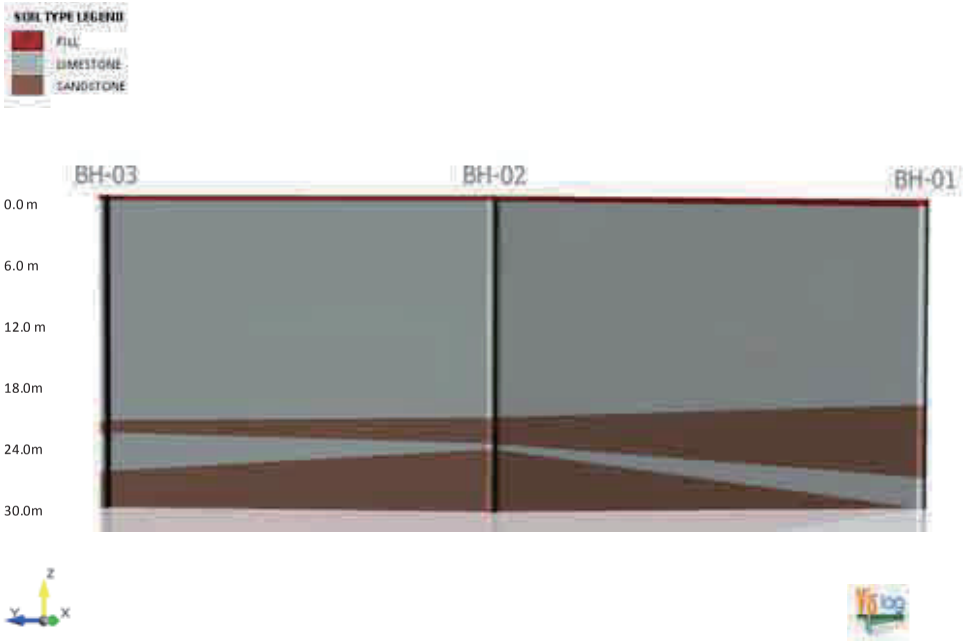
Sample Types: ● Disturbed; + Undisturbed; □ Shelby / U4; ■ Core Cutter; U SPT Sample; Water Sample; Groundwater Level

Abbreviations: LL : Liquid Limit; PL : Plastic Limit; PI : Plastic Index; NPI : None PI; C : Cohesion; Phi : Friction Angle; C' : Cohesion (CU); Phi' : Friction Angle (CU); Cc : Cc; Cs : Cs; Pc : Pre-Consolidation Pressure; K : Permeability Coeff.; w : Moisture Content; qu : Unconfined Compression qu; F : Fast; S : Slow; CD : Consolidated, Drained; UU : Unconsolidated, Undrained; CU : Consolidated, Undrained

Appendix C

Soil Profile

Soil Profile-01



Soil Profile-02

Laboratory Test Results

Summary of Lab. Tests

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

SOIL TESTING SERVICES

Sieve Analysis Test

Borehole	Sample Depth (m)	Soil Class	D10	D30	D60	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	LL	PL
BH-02	0.75	SP-SM (A-2-4)		0.237	2.319		10.3	59.1	30.6		-1	-1

Density & Moisture Test

Borehole	Sample Depth (m)	Soil Class	Moisture Content (%)	Dry Density (gr/cm3)
BH-01	21.4		17.29	1.82
BH-01	22.7		5.3	2.25
BH-01	26.2		7.28	2.37
BH-01	29		3.58	2.14
BH-02	0.75	SP-SM (A-2-4)	3.65	1.848
BH-02	17		8.01	2.12
BH-02	18.3		5.42	2.24
BH-02	23.6		6.1	2.24
BH-02	27.2		17.9	1.92
BH-03	20		10.36	2.42
BH-03	23		4.67	2.25
BH-03	25		7.46	2.28
BH-04	5.5		7.84	2.14
BH-04	8		5.69	2.31
BH-04	15.7		15.61	1.66
BH-04	25		5.84	2.2
BH-04	29		5.26	1.82

Unconfined Compression Test

Borehole	Sample Depth (m)	Soil Class	Diameter (cm)	Height (cm)	qu (kg/cm2)
BH-01	21.4		6.023	9.537	86.35
BH-01	22.7		5.722	9.045	152.99
BH-01	26.2		5.722	10.642	133.96
BH-01	29		6.023	10.537	107.07
BH-02	17		6.023	9.035	138.09
BH-02	18.3		6.023	9.738	155.43
BH-02	23.6		5.521	10.541	143.93
BH-02	27.2		5.722	10.842	57.44
BH-03	20		5.22	10.04	160.96
BH-03	23		5.722	10.742	95.71
BH-03	25		5.823	11.043	240.33
BH-04	5.5		5.622	8.634	198.07
BH-04	8		5.722	10.341	382.8
BH-04	15.7		5.622	10.642	8.46
BH-04	25		5.622	10.04	158.58
BH-04	29		5.421	9.035	127.86

Density & Moisture Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

SOIL TESTING SERVICES

ASTM D7263, D2216

Borehole	Sample Depth (m)	Moisture Content (%)	Dry Density (gr/cm3)	Wet Density (gr/cm3)
BH-01	21.4	17.29	1.82	2.13
BH-01	22.7	5.3	2.25	2.37
BH-01	26.2	7.28	2.37	2.54
BH-01	29	3.58	2.14	2.22
BH-02	0.75	3.65	1.85	1.92
BH-02	17	8.01	2.12	2.29
BH-02	18.3	5.42	2.24	2.36
BH-02	23.6	6.1	2.24	2.38
BH-02	27.2	17.9	1.92	2.26
BH-03	20	10.36	2.42	2.67
BH-03	23	4.67	2.25	2.36
BH-03	25	7.46	2.28	2.45
BH-04	5.5	7.84	2.14	2.31
BH-04	8	5.69	2.31	2.44
BH-04	15.7	15.61	1.66	1.92
BH-04	25	5.84	2.2	2.33
BH-04	29	5.26	1.82	1.92

Density & Moisture Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

SOIL TESTING SERVICES

ASTM D7263, D2216

Borehole	Sample Depth (m)	Moisture Content (%)	Dry Density (gr/cm3)	Wet Density (gr/cm3)
BH-01	21.4	17.29	1.82	2.13
BH-01	22.7	5.3	2.25	2.37
BH-01	26.2	7.28	2.37	2.54
BH-01	29	3.58	2.14	2.22
BH-02	0.75	3.65	1.85	1.92
BH-02	17	8.01	2.12	2.29
BH-02	18.3	5.42	2.24	2.36
BH-02	23.6	6.1	2.24	2.38
BH-02	27.2	17.9	1.92	2.26
BH-03	20	10.36	2.42	2.67
BH-03	23	4.67	2.25	2.36
BH-03	25	7.46	2.28	2.45
BH-04	5.5	7.84	2.14	2.31
BH-04	8	5.69	2.31	2.44
BH-04	15.7	15.61	1.66	1.92
BH-04	25	5.84	2.2	2.33
BH-04	29	5.26	1.82	1.92

Unconfined Compression Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

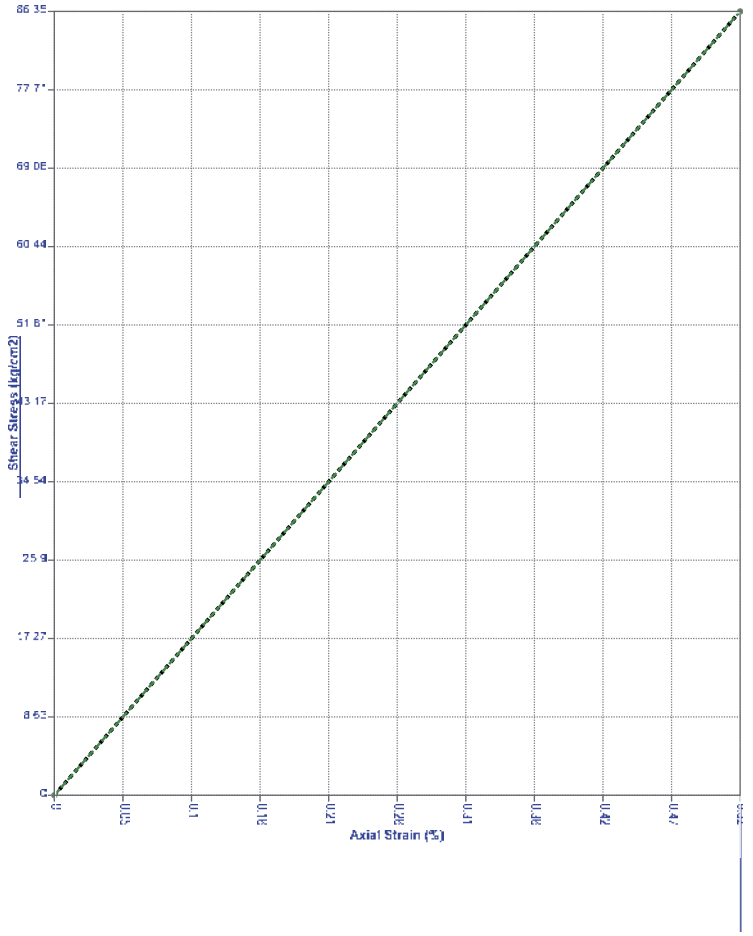
Borehole : BH-01
Sample Depth : 20 (m)
Rock Name : Sandstone
Sample Type : Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
6.023	9.537	2	Moist	17.29	1.82	86.35	43.18



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

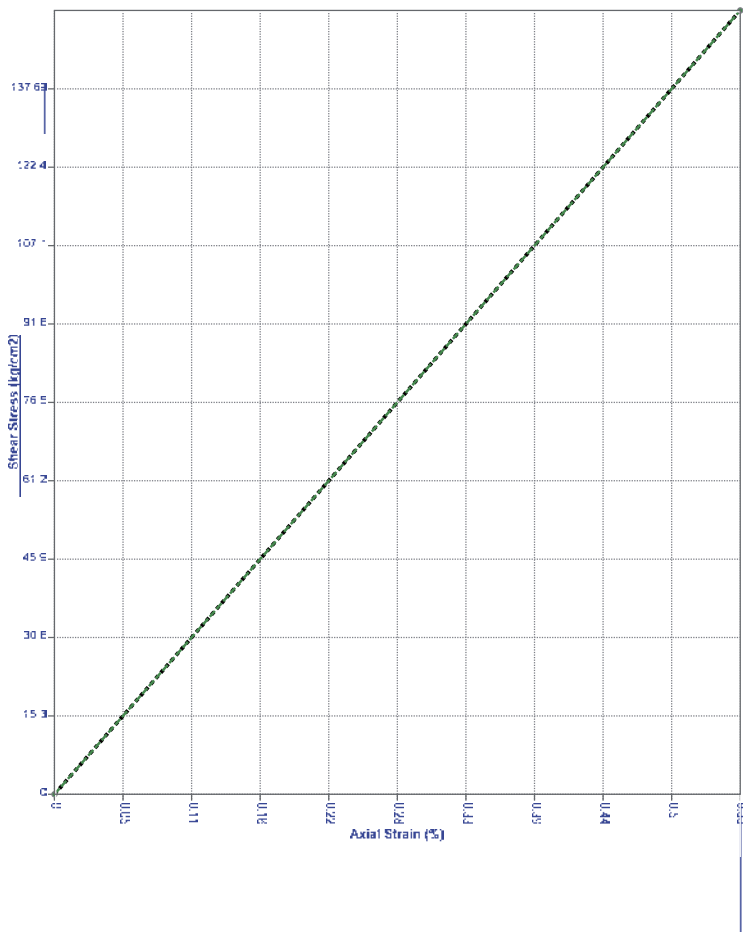
Project :	GI at LUMHS	Borehole :	BH-01
Client :	Fukunaga Architects-Engineers	Sample Depth :	22.7 (m)
Job No.:	K19-1229-101	Rock Name :	Sandstone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.722	9.045	2	Moist	5.3	2.25	152.99	76.5



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

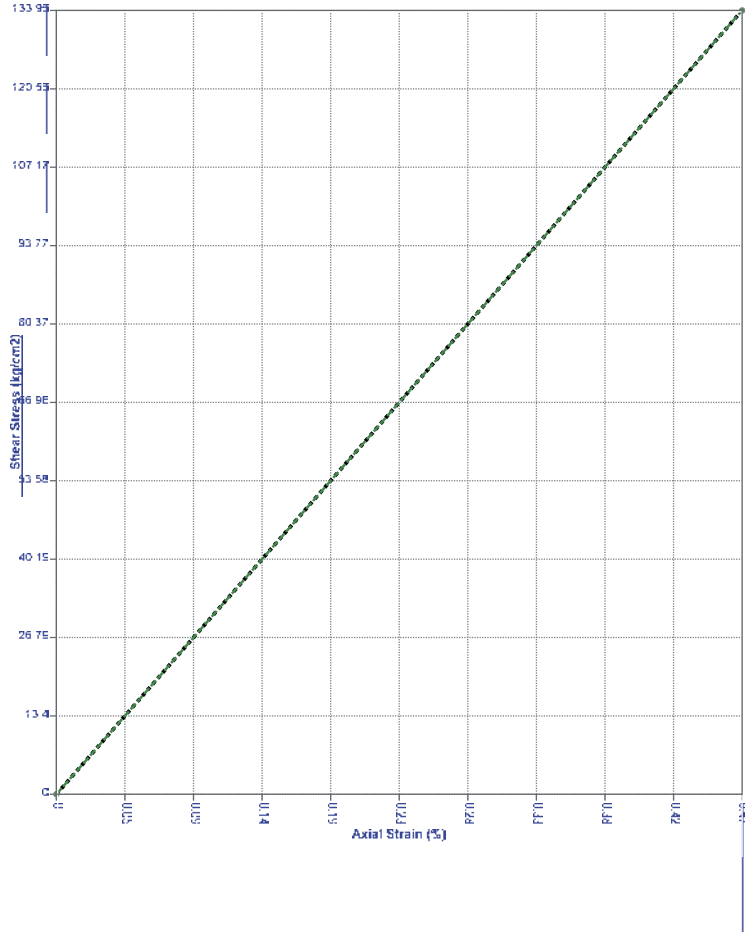
Project :	GI at LUMHS	Borehole :	BH-01
Client :	Fukunaga Architects-Engineers	Sample Depth :	26.2 (m)
Job No.:	K19-1229-101	Rock Name :	Sandstone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.722	10.642	2	Moist	7.28	2.37	133.96	66.98



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

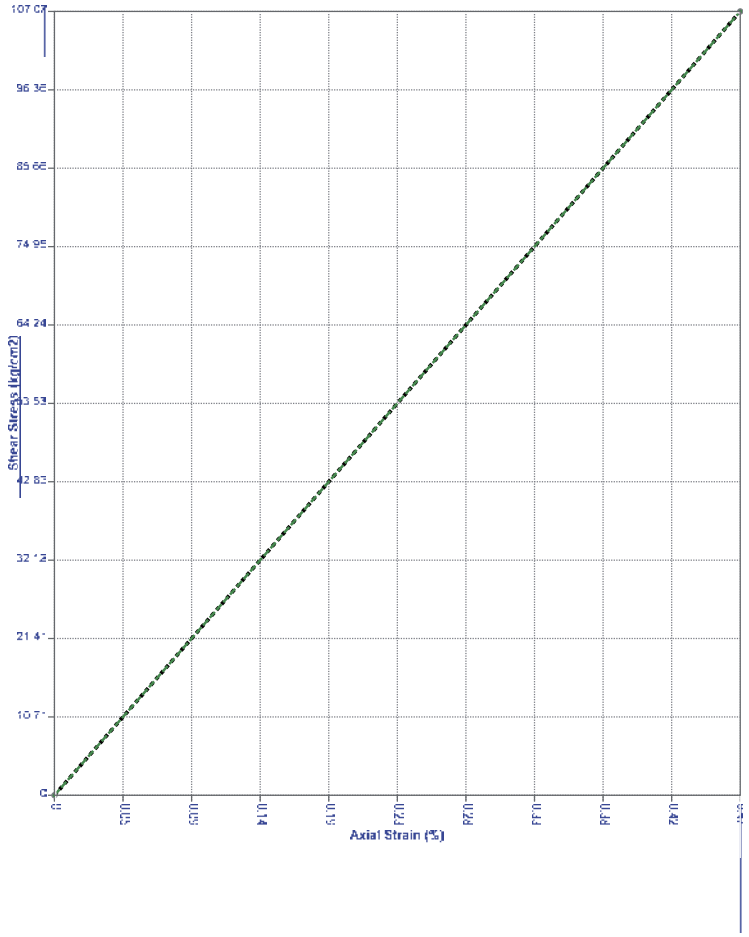
Borehole : BH-01
Sample Depth : 29 (m)
Rock Name : Limestone
Sample Type : Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
6.023	10.537	2	Moist	3.58	2.14	107.07	53.54



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

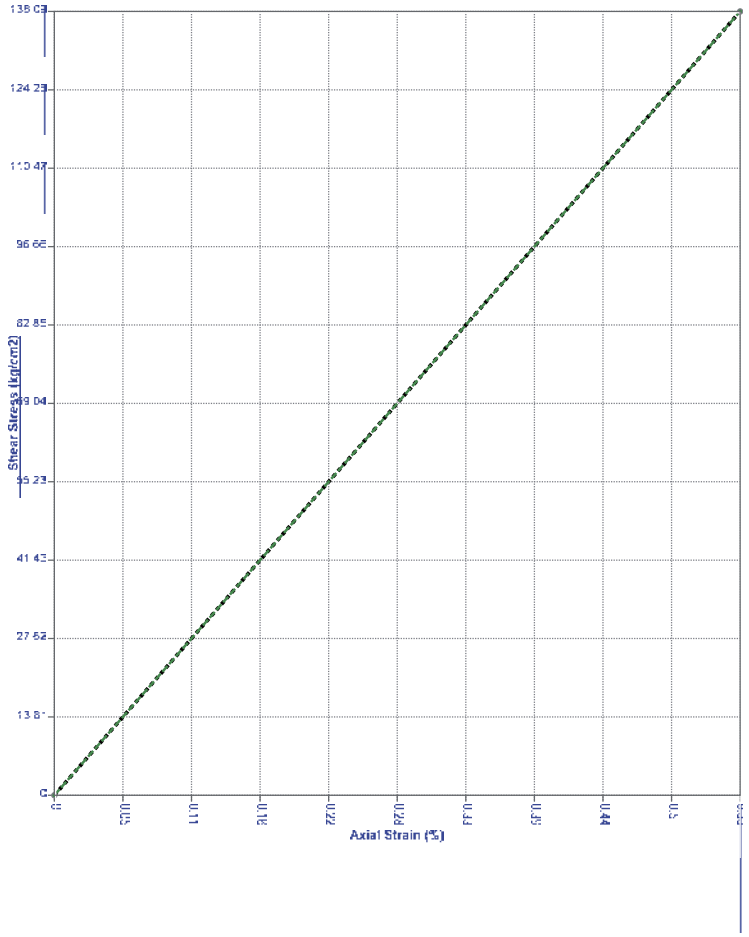
Borehole : BH-02
Sample Depth : 17 (m)
Rock Name : Limestone
Sample Type : Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
6.023	9.035	2	Moist	8.01	2.12	138.09	69.04



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

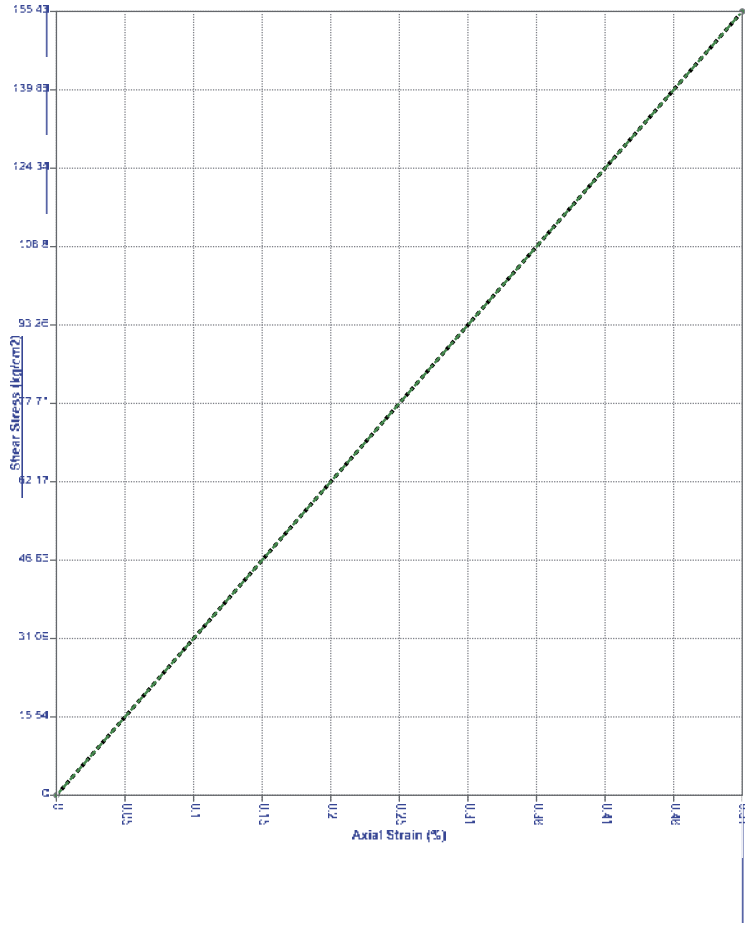
Project :	GI at LUMHS	Borehole :	BH-02
Client :	Fukunaga Architects-Engineers	Sample Depth :	18.3 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
6.023	9.738	2	Moist	5.42	2.24	155.43	77.72



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

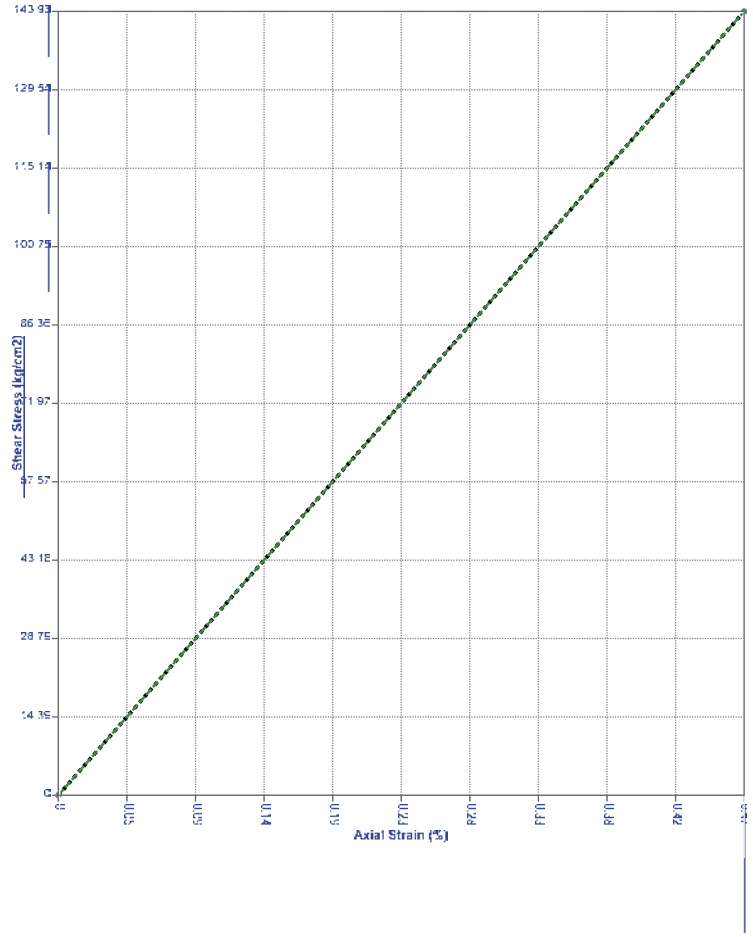
Project :	GI at LUMHS	Borehole :	BH-02
Client :	Fukunaga Architects-Engineers	Sample Depth :	23.6 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.521	10.541	2	Moist	6.1	2.24	143.93	71.96



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

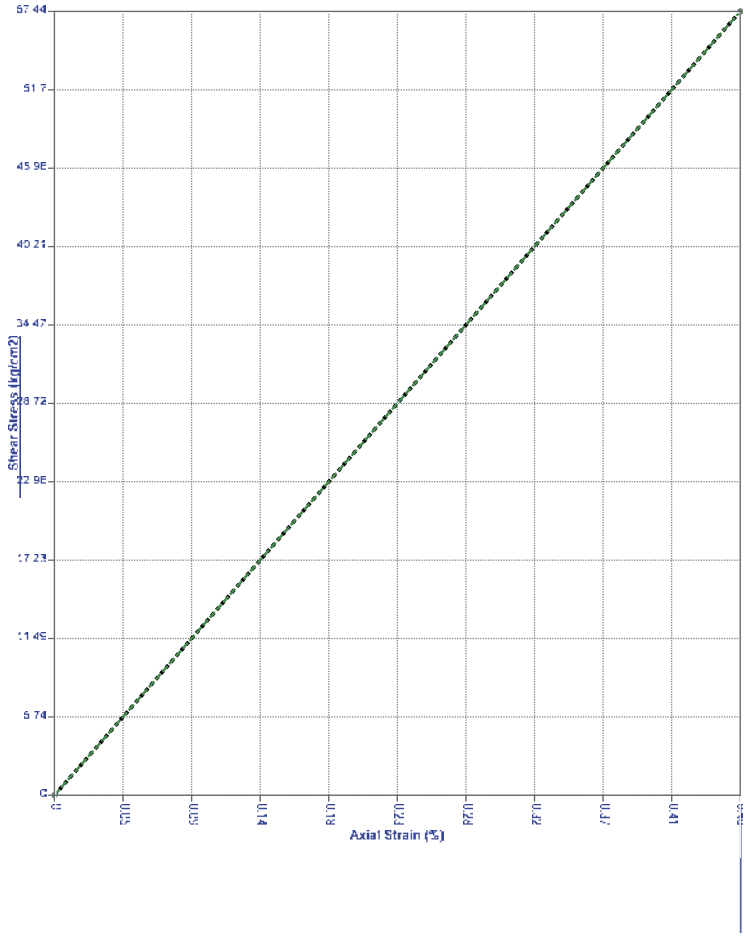
Project :	GI at LUMHS	Borehole :	BH-02
Client :	Fukunaga Architects-Engineers	Sample Depth :	27.2 (m)
Job No.:	K19-1229-101	Rock Name :	Sandstone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D-2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.722	10.842	2	Moist	17.9	1.92	57.44	28.72



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

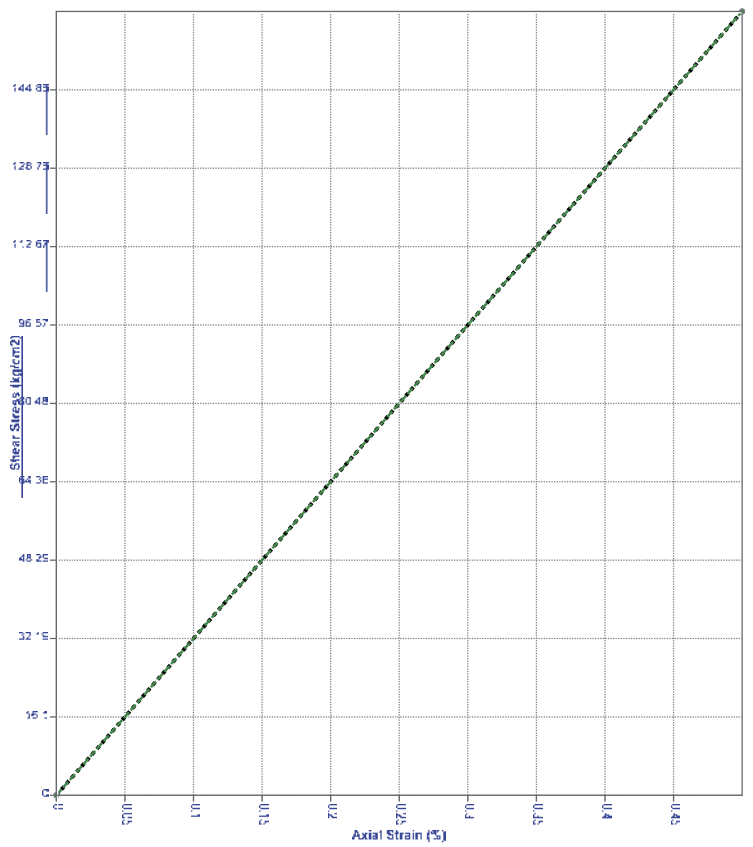
Project :	GI at LUMHS	Borehole :	BH-03
Client :	Fukunaga Architects-Engineers	Sample Depth :	20 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.22	10.04	2	Moist	10.36	2.42	160.96	80.48



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

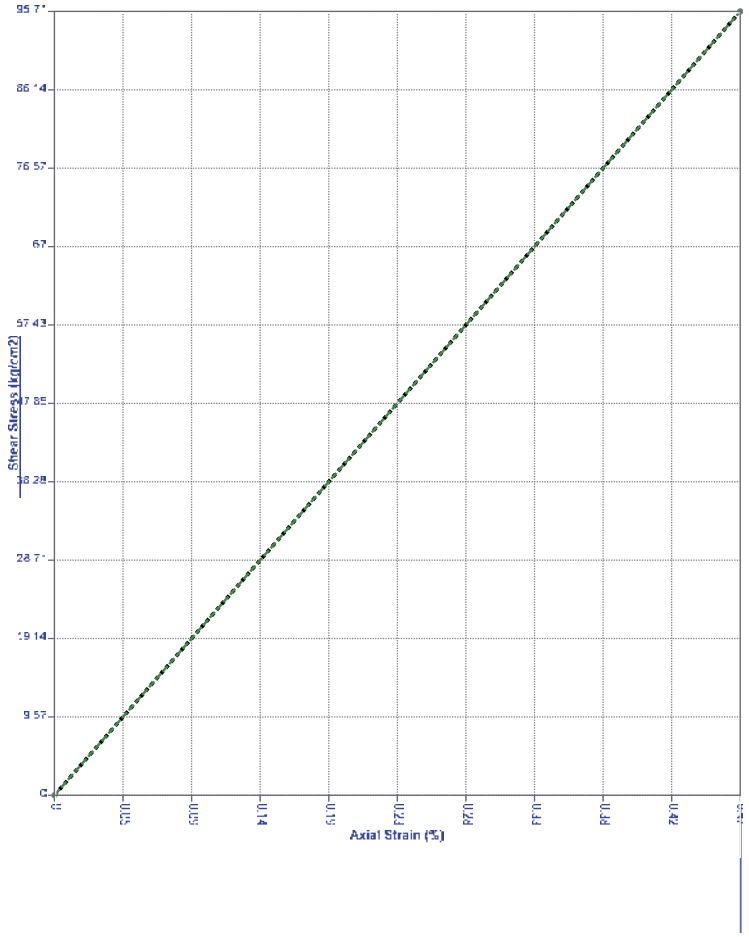
Borehole : BH-03
Sample Depth : 23 (m)
Rock Name : Limestone
Sample Type : Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.722	10.742	2	Moist	4.67	2.25	95.71	47.86



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

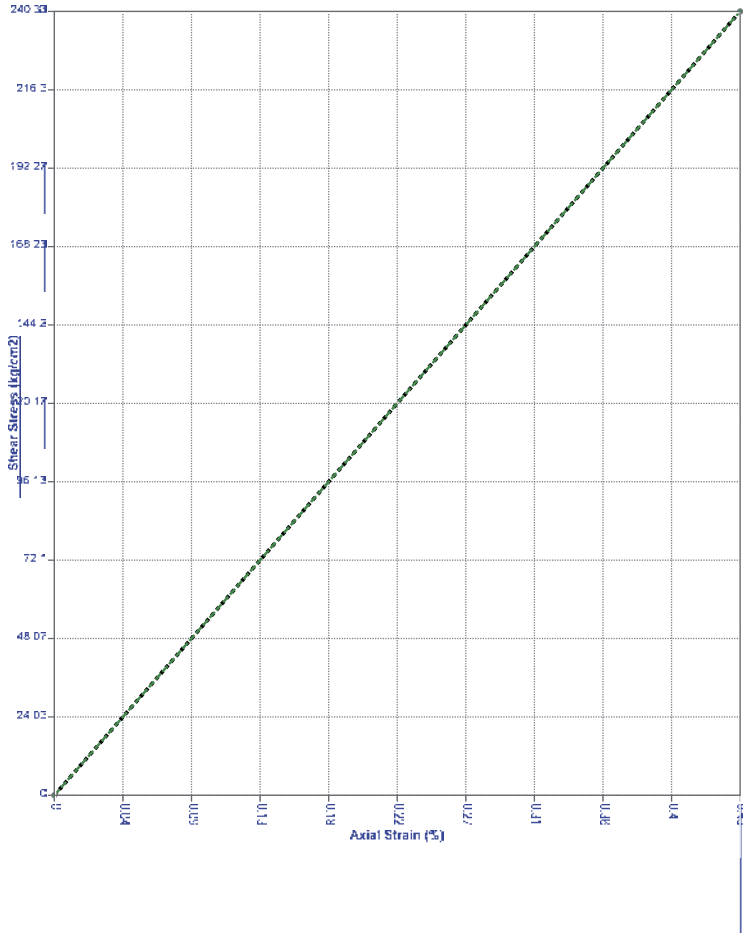
Borehole : BH-03
Sample Depth : 25 (m)
Rock Name : Limestone
Sample Type : Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.823	11.043	2	Moist	7.46	2.28	240.33	120.16



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

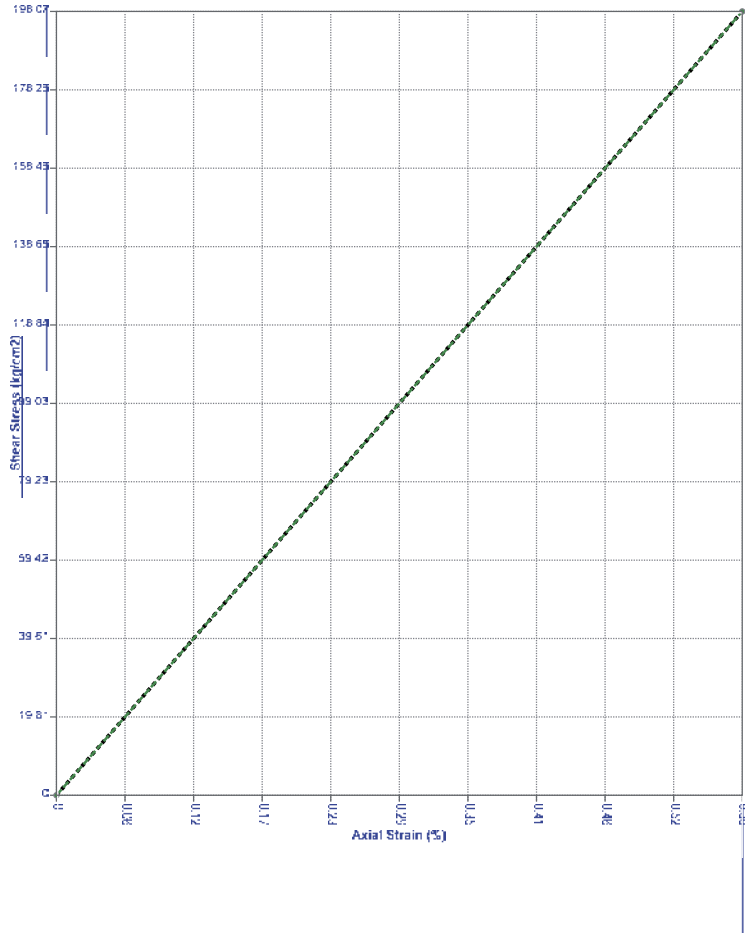
Project :	GI at LUMHS	Borehole :	BH-04
Client :	Fukunaga Architects-Engineers	Sample Depth :	5.5 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.622	8.634	2	Moist	7.84	2.14	198.07	99.04



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

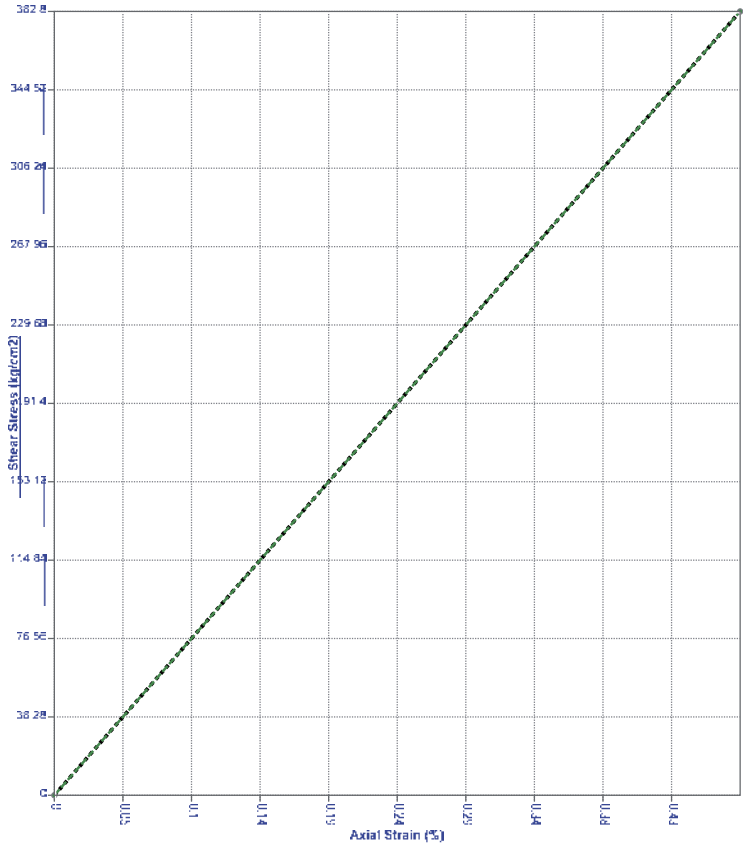
Project :	GI at LUMHS	Borehole :	BH-04
Client :	Fukunaga Architects-Engineers	Sample Depth :	8 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.722	10.341	2	Moist	5.69	2.31	382.8	191.4



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

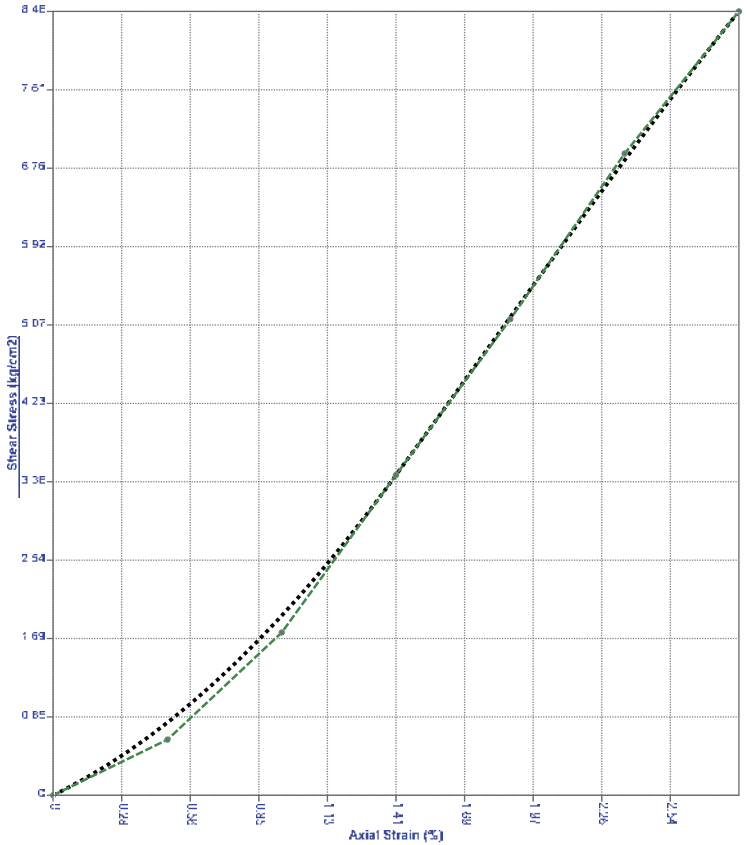
Project :	GI at LUMHS	Borehole :	BH-04
Client :	Fukunaga Architects-Engineers	Sample Depth :	15.7 (m)
Job No.:	K19-1229-101	Rock Name :	Claystone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.622	10.642	2	Moist	15.61	1.66	8.46	4.23



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

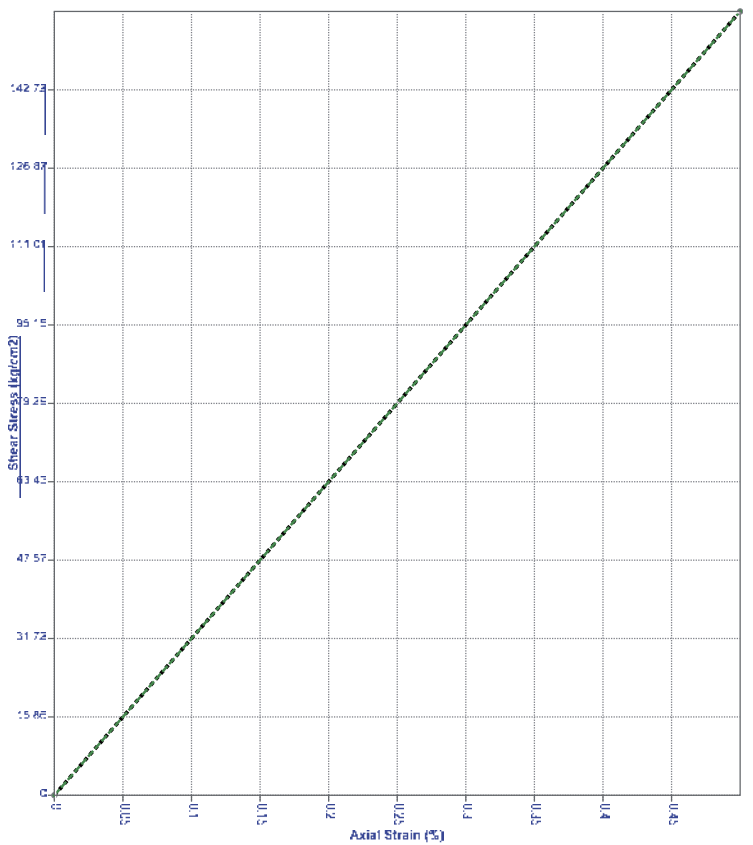
Project :	GI at LUMHS	Borehole :	BH-04
Client :	Fukunaga Architects-Engineers	Sample Depth :	25 (m)
Job No.:	K19-1229-101	Rock Name :	Sandstone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.622	10.04	2	Moist	5.84	2.2	158.58	79.29



Unified Description :
AASHTO Description :

Tested By :

Unconfined Compression Test

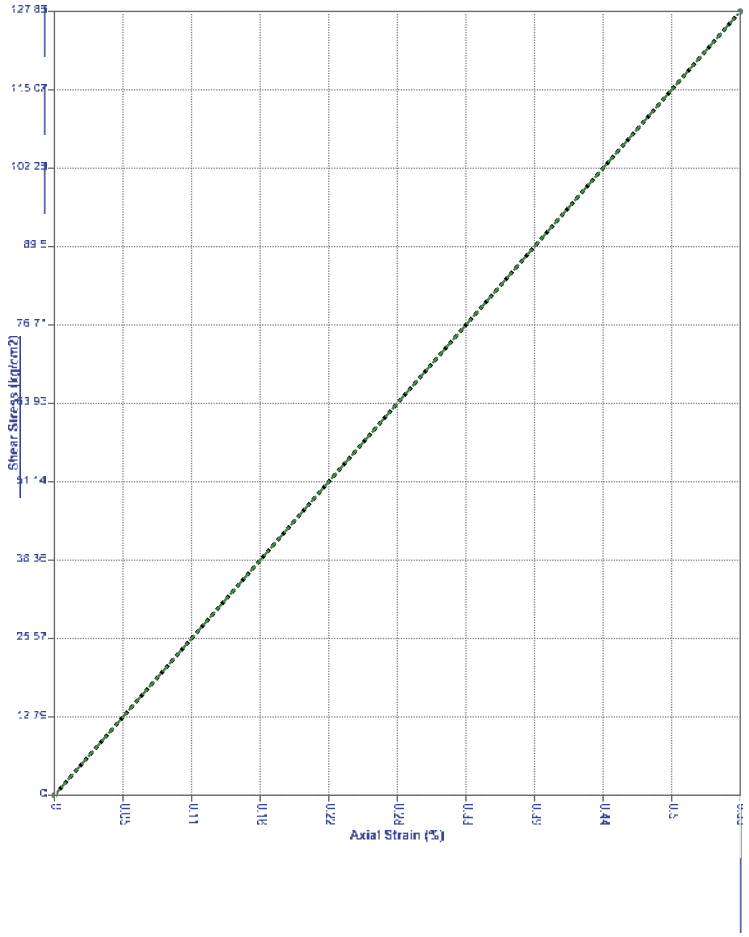
Project :	GI at LUMHS	Borehole :	BH-04
Client :	Fukunaga Architects-Engineers	Sample Depth :	29 (m)
Job No.:	K19-1229-101	Rock Name :	Limestone
Location :	Jamshoro, Sindh	Sample Type :	Undisturbed

SOIL TESTING SERVICES

ASTM D2938

Test Results

Diameter (cm)	Height (cm)	Loading rate (mm/min)	Moisture Status	Moisture Content (%)	Dry Density (gr/cm3)	Unconfined Compression qu (kg/cm2)	Cu (kg/cm2)
5.421	9.035	2	Moist	5.26	1.82	127.86	63.93



Unified Description :
AASHTO Description :

Tested By :

POINT LOAD TEST

Project :	GI at LUMHS
Client :	Fukunaga Architects-Engineers
Job No.:	K19-1229-101
Location :	Jamshoro, Sindh

Soil Testing Services

Borehole	Sample Depth (m)	Strength Is_{50} (MPa)
BH-01	1.5	1.212
BH-01	4.5	1.623
BH-01	9.0	1.737
BH-01	12.5	3.474
BH-02	1.0	1.364
BH-02	3.0	1.947
BH-02	6.0	0.483
BH-02	10.5	3.885
BH-02	13.5	0.869
BH-03	3.0	3.230
BH-03	6.0	2.457
BH-03	9.0	4.684
BH-03	12.0	0.989
BH-03	15.0	2.397
BH-03	19.5	0.350
BH-04	3.5	1.887
BH-04	13.5	1.715
BH-05	3.0	2.645
BH-05	6.0	3.664
BH-06	4.5	1.978
BH-06	7.5	2.664
BH-07	3.0	2.015
BH-07	4.5	3.334
BH-08	3.0	2.612
BH-08	9.0	3.454

SWELLING TEST

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

Soil Testing Services

Borehole	Sample Depth (m)	Swelling Value (%)
BH-02	1.5	0.021
BH-03	2.0	0.034
BH-04	3.0	0.024

Chemical Test Results

Project : GI at LUMHS
Client : Fukunaga Architects-Engineers
Job No.: K19-1229-101
Location : Jamshoro, Sindh

SOIL TESTING SERVICES

ASTM C1580, D1411 D4972

Borehole	Sample Depth (m)	Description	Value
BH-01	1.9	valuepH	6.85
BH-02	3.4		6.75
BH-03	1.5		6.78
BH-04	0.75		6.88
BH-05	0.75		6.88
BH-06	0.75		6.65
BH-07	0.75		6.55
BH-08	0.75		6.98
BH-01	1.9	Sulphate Content (%)	0.01
BH-02	3.4		0.01
BH-03	1.5		0.01
BH-04	0.75		0.01
BH-05	0.75		0.01
BH-06	0.75		0.01
BH-07	0.75		0.01
BH-08	0.75		0.01
BH-01	1.9	Chloride Content (%)	0.2
BH-02	3.4		0.19
BH-03	1.5		0.21
BH-04	0.75		0.19
BH-05	0.75		0.22
BH-06	0.75		0.2
BH-07	0.75		0.26
BH-08	0.75		0.18

Appendix E

General Information on Testing Procedures

A. DRILLING METHOD, FIELD TESTING & SAMPLING

The field testing program consisted of drilling works, rock coring and in-situ testing including Standard Penetration Test Cone (SPT), collection of rock samples. The following sections describe these activities in further detail.

A.1. DRILLING METHOD

All the boreholes were drilled by using rotary/wash boring method; in this method soil is cut by the constant rotation of various types of bits. Drilling fluid, which is either water or bentonite slurry, is circulated through drilling rods. The returning fluid lifts loosened material. Tricone bit was used for cohesive and granular soils.

The drilling in rock was carried out by double tube core barrels in conjunction with carbide or diamond bit. In a double tube core barrel the outer barrel is rotated by the drill rods, while, the inner barrel, which is mounted on a swivel, does not rotate during the drilling process. The core cut by the coring bit passes into the inner barrel. Core was prevented from dropping out by a steel core catcher. It was then extruded and wrapped with waxed bandage tape, to preserve the natural moisture of the recovered core.

Details of the boreholes are given in Table A.1.

Table A.1 Details of Boreholes

Borehole No.	Borehole Depth (meters)	Water table Depth (meters)
BH-01	30.0	Not encountered
BH-02	30.0	Not encountered
BH-03	30.0	Not encountered
BH-04	30.0	Not encountered
BH-05	15.0	Not encountered
BH-06	15.0	Not encountered
BH-07	15.0	Not encountered

Borehole No.	Borehole Depth (meters)	Water table Depth (meters)
BH-08	15.0	Not encountered

Figure A-1 Drilling works in progress

A.2. FIELD TESTING

Field testing forms a crucial part of the soil investigation process and its results are used in the geotechnical design. As part of the field testing programme, following tests were executed at site:

- Standard Penetration Test Cone (SPT)

A.2.1. STANDARD PENETRATION TESTS CONE

The standard penetration test (SPT Cone) was carried out at interval of 1.5 meters in the boreholes where RQD was nil. The standard penetration test was carried out by “Safety” type sliding hammer.

The standard penetration test cone was carried out by an assembly of the following parts:

- Drive-weight assembly, consisting of a drive head and a 63.5kg impact hammer, a hammer fall guide and the drop system. The drop mechanism will ensure a constant free fall of 760mm.
- Drive rods connect the drive-weight assembly to the sampler.
- Cone is attached to split spoon sampler to carry out the test, no sample is retrieved in this test.

The base of the borehole was made clean and reasonably undisturbed at the test elevation. Following precautions were taken during the testing sequence:

- The level of water or bentonite slurry was maintained at a sufficient level above the groundwater level, to ensure any entry of water through the bottom of the borehole.
- The casing was not driven below the level at which the test will start.

The test was executed in the following steps:

- The cone attached to sampler and the drive rods were lowered in the borehole and the hammer assembly added to it.
- The cone attached to sampler is penetrated over seating drive of 150mm and the numbers of blows are recorded.
- In the same way the cone attached to sampler is driven over a test drive of 300mm in two increments of 150mm.
- The numbers of blows are recorded during each of the last two increments.

- The test was deemed finished when total number of blows equal to 50 was reached.

The standard penetration test cone was carried out in accordance with the procedure given in BS 1377-9:1990.

A.3. SAMPLING

Sampling forms an essential part of the geotechnical investigation process and good sampling is essential for proper laboratory testing of samples for determining strength and compressibility characteristics of soil.

Rock samples were extracted from all the boreholes with the help of following tool:

- Rock cores through Core barrel

Following section indicates the processes carried out in each of the field tests and sampling.

A.3.1. ROCK CORE SAMPLES

Rock core samples were collected from the deposits through coring. Double tube core barrel (HQ size) was used to collect these samples. The samples were recovered in core barrel, packed in aluminium foil, and then stored in rock core boxes. The storage of rock core samples in aluminium foil ensured retention of natural moisture. Unconfined compressive strength, natural moisture content, density, etc. of these samples was determined in the laboratory. Figure A-3 shows the rock core samples stored in core box.

Figure A-2 Rock cores preserved in core box

Figure A-3 Rock cores preserved in core box

B. LABORATORY TESTING

Laboratory testing was carried out on retrieved disturbed soil samples. The following section enlists and gives details of relevant tests carried out on selected samples as required for determining the subsurface conditions and correlating with the information obtained from field testing and sampling.

B.1. NATURAL MOISTURE CONTENT

Natural moisture content is the quantity of water contained in a soil or rock sample. It is the ratio of the weight of water to the weight of solids in a given volume of soil or rock sample. Natural moisture content of seventeen (17) samples was determined in accordance with *ASTM 2216-05.*

B.2. DENSITY

The weight per unit volume of the solid portion of soil is called particle (dry) density. Whereas, the oven dry weight of a unit volume of soil inclusive of pore spaces is called bulk (wet) density. The bulk density of a soil is always smaller than its particle density. Density of seventee (17) samples was determined in accordance with the procedure described in *ASTM D 7263-09*.

B.3. UNCONFINED COMPRESSION TEST

Unconfined compressive strength test involves axially loading a cylindrical rock core or undisturbed clay sample to failure. The term unconfined is used because the lateral force on the sample is zero. The unconfined compressive strength test was carried out in accordance with *ASTM D 7012*. The strength of the retrieved samples tested came out to be ranging from 8.46 Kg/cm2 to 382.80 Kg/cm2. The results of the unconfined compression test are summarized in *Appendices.*

B.4. POINT LOAD TEST

The point load tester is used to determine the Point Load Strength Index (Is(50). This index provides a method for establishing rock strength classification. The index can also be used to determine the rock anisotropy as well as to predict other rock strength properties, such as uniaxial tensile and compressive strengths. The point load test Is carried out in accordance with ASTM D 5731 – 16.

B.5. ONE DIMENSIONAL SWELL TEST

The test is used for measuring one-dimensional wetting-induced swell of individual intact samples. This method can be referred to as *single-point wetting-after-loading test*. The vertical pressure at wetting for the specimen is chosen equal to the vertical in-situ stress (overburden stress plus structural stress, if any) corresponding to the sampling depth. The test result indicates the amount of heave that can result when the soil at a given fill depth is wetted from the current moisture condition to full inundation condition. If intact specimens from various depths are tested, the swell strain data can be used to estimate heave of the ground surface. The swell test Is carried out in accordance with ASTM D 4546 – 14.

B.6. CHEMICAL TESTS

Sulphate in groundwater or soil can attack concrete placed in the ground or on surface. A reaction takes place between the sulphate and the aluminate compounds present in the cement, causing crystallisation of complex compounds. The expansion, which accompanies crystallisation, induces stresses in the concrete, which results in mechanical disintegration.

In moist conditions, such as exposure to seawater, the presence of chloride ion, Cl^-, presents a serious possibility of the corrosion of the reinforcement. The presence of $Ca(OH)_2$ provides a strong alkaline environment in which a thin film of iron oxide is formed on the metal surface which protects it against corrosion. However, if the concrete is permeable to the extent that the soluble chlorides can reach up to the reinforcing steel, then in the presence of water and oxygen, the corrosion of the reinforcement will take place. Rust occupies more volume than the original steel, and hence the ensuing expansion of concrete, results in cracking and spalling.

Due to adverse effect of sulphates and chlorides on the quality of concrete it is essential to conduct chemical tests on soil and groundwater. This helps in quantifying the expected exposure of concrete to these chemicals and in devising precautionary measures to ensure integrity of concrete.

The following chemical tests were carried out on rock samples:

- Chloride & Sulphate content
- TDS & pH

Chemical tests were carried out in accordance with *ASTM D 512, D 516, and D 1293*. The selection of cement for underground concreting and is discussed in *Chapter 4*.

Table B.1 ACI standards for concrete for sulphate exposure

Sulphate Exposure	Water Soluble Sulphates in Soil (%)	Sulphate in Water (mg/L)	Cement Type
Negligible	0.00-0.10	0- 150	OPC
Moderate	0.10-0.20	150- 1500	Type II
Severe	0.20-2.00	1500-10000	Type V
Very Severe	Over 2.00	Over 10000	Type V plus pozzolan

Appendix F

Test Pit Images

Figure 1: Test Pit Excavated

Figure 2: Test Pit Excavated

Figure 3: Test Pit Excavated

Figure 4: Test Pit Excavated

SOIL TESTING SERVICES

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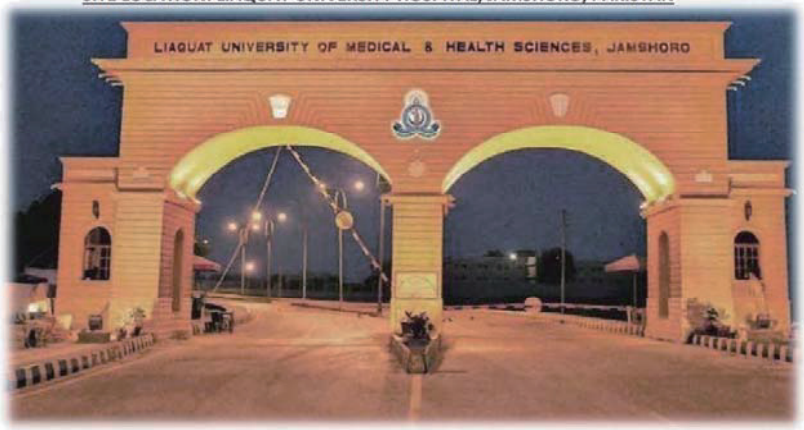
2019

PREPARATORY SURVEY FOR EXTENSION OF MATERNAL AND CHILD HEALTH CARE FACILITIES IN SINDH

SITE LOCATION: LIAQUAT UNIVERSITY HOSPITAL, JAMSHORO, PAKISTAN



FINAL INFRASTRUCTURE SURVEY REPORT

(Water Supply, Waste Water and Electrical Power Supply)

JICA Japan International Cooperation Agency

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TABLE OF CONTENTS

1 Background

The Liaquat University Hospital, Hyderabad/Jamshoro, is a tertiary care hospital in Sindh Province of Pakistan. It is one of the largest teaching hospitals affiliated with Liaquat University of Medical and Health Sciences (LUHMS), Jamshoro, the first medical university of the public sector in Pakistan.

The Japan International Cooperation Agency (JICA) has planned to construct Maternal and Child Health care building at Liaquat University hospital. In this regard, a preparatory survey has been carried out to understand & collect information regarding the existing water supply, sewerage, and electrical systems to the hospital buildings and to provide useful information to design stable and safe systems for the proposed building.

The information presented in this report have been gathered after performing detailed visits to the project site along with the relevant LUHMS staff.

2 Water Supply System

2.1 Introduction

Jamshoro, is situated on the right bank of Indus River at south-west position of Province of Sindh and is about 18 kilometers far from Hyderabad and at a distance of 150 kilometers from Karachi. The primary source of water supply is River Indus while other source include tube wells.

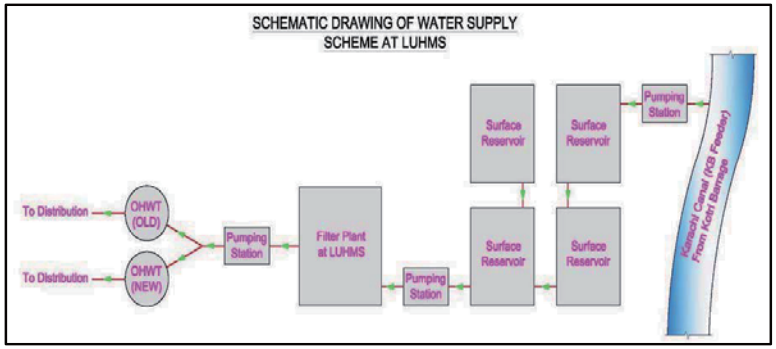
As per the technical assessment survey report Pakistan Council of Research in Water Resources (PCRWR), total 57 number of water supply schemes are present in Jamshoro district. Out of these, 5 water schemes are nonfunctional, mainly due to lack of funds, theft and damages of electrical and mechanical Components. These functional scheme get their 42% of water from ground water while 58% water is drawn from surface water sources. The supply hours mainly ranges in between 1 to 10 hours a day. No Proper treatment is being done to the raw water except for chlorination in some of the schemes and the major causes of contamination are turbidity and Biological.

2.2 Scope of Work

1. To collect information regarding existing water supply scheme to the hospital
2. To analyze the current water quality with respect to WHO drinking water guidelines

2.3 Water Supply Scheme in LUHMS

The LUHMS gets its water from Kalri Baghar (KB) feeder also known as Karachi Canal. This canal originates at Kotri Barrage which is constructed on the Indus River between Jamshoro and Hyderabad in the Sindh province of Pakistan. The water from canal is delivered to LUHMS via integrated system of pumping stations, surface reservoirs, filter Plant and overhead tanks. The schematic drawing of water supply scheme of LUHMS is shown below



A brief description of each components is presented below based on the information gathered from site staff of LUHMS.

2.3.1 Source of water

Around 3.45 km from Kotri Barrage, intake structure (pumping station) is present to draw water from the canal. The intake pumping station has space for 4 pump set, but currently two pumps horizontal centrifugal are present, each having a flow rate of 557 m3/hr and Head of 40 ft, which delivers water to 4 existing surface reservoirs, constructed near the canal.

Each reservoir has the storage capacity of 2 mgd, thus making the total combine capacity of 8mgd. All reservoirs are interconnected with each other and serves as emergency storage for LUHMS.

Another pumping station is present near these reservoirs which contains 3 vertical turbine pumps to further pump water to LUHMS filter plant via 12" diameter MS pipeline. These pumps appeared to be quite old and their flow and head configurations are not available.

The location plan of canal, intake structure and reservoirs are shown below

Pump's Suction from Canal

Intake Pumping Station

Surface reservoir

Pumping Station that pumps water to Filter Plant

2.3.2 Filter Plant

The filter plant is present inside the boundary of LUHMS and it's maintained by its own staff. It comprises of 4 Mixing tanks, 3 filter beds and filtered water tanks. The raw water enters into the mixing tank where alum is added and water flows horizontally. The baffle walls help to create turbulence and thus facilitate mixing. The water then enters into filter beds are used for filtration purpose. The water after filtration goes into the interconnected filter water tanks. The location Plan is shown below

Due to poor maintenance the filter plant is currently in bad condition. Neither chlorination nor any type of disinfection is taking place in the plant and merely alum is used for silt settlement. The raw water enters the mixing tank and simply travel through filtration system and collected in filter water tanks.

Intake Channel to mixing tank

Mixing Tanks

Filtration tanks

Filtered water tanks

2.3.3 Pumping Station

A pumping station is present alongside of filtered water tanks to pump water to two central overhead reservoirs to gravitate filtered water to whole LUHMS. It comprises of 4 pumps, each having flow rate of 153 m3/hr and head of 140 ft. Out of 4, currently three pumps are present. One pump is made operation at a time. The operating time of pump varies between 4 to 5 hours daily. A small sump is present adjacent to pump room from where the pump sucks the filtered water and delivers it to Overhead tanks.

Pump house

Suction Sump

Currently Installed pumps

Motor Control panels

2.3.4 Central Overhead Tanks

Two overhead reservoirs are present to gravitate the water to LUHMS. Out of these tanks, one is quite old while another is constructed recently. Delivery main from both tanks are interconnected in order to facilitate distribution from either tank during emergency. Old tank serves the colony area while new tank serves the university and hospital buildings. The condition of old tank is very poor and its structure is badly damage while new tank is in good condition except one or two spots where column's concrete has weathered and reinforcement is exposed.

The details of these overhead tanks are given below

New Overhead tank details	
Height till bed slab of Ohwt from Ground	83'-6"
Internal depth of Tank	9' approx.
Volume of overhead tank	120,000 gal approx.
Time required to fill the tank	3 to 4 hrs.

Old Overhead tank details	
Height till bed slab of Ohwt from Ground	56 '
Internal depth of Tank	12' Approx.
Volume of overhead tank	50,000 gal approx.
Time required to fill the tank	N/A

2.4 Water Supply Distribution to Hospital:

From Overhead tank, different pipe diameter offtakes water to different areas of LUHMS. Out of these, a 6" diameter HDPE pipe PN-10 takes water towards hospital buildings. Near RBC building, 4" diameter pipe branches off from this 6" inch line, which then further distribute into smaller pipe diameters of 1.5" to 2" to fill 5 underground tanks which served different hospital buildings. The volume of these tanks varies from 10,000 gallons to 15,000 gallons.

The water to the hospital building is supplied for 4 hours daily from 8 am to 12 am and is controlled by the gate valve. The daily supply amount to the hospital buildings is not available as no flow measuring device is present anywhere in the system.

No detail record of water shortages in the past is currently available. After examine all the existing reservoirs and tanks, it is evident that the sufficient amount of water is available to cope up any emergency shortage of water from the source. The information collected from the operators revealed that the supply of water has been interrupted in the past due to breakdown of electricity and as a result the pumps installed at intake and filter plant could not operate, however, these interruptions are infrequent and happened 1 or 2 times in month.

The location of hospital buildings, tentative route of pipe line from ohwt to storage tanks, incoming, outgoing pipe diameters and serving buildings, based on the collected information from site staff are shown below

New OHWT

Old OHWT

As per provided information by the site staff, the water coming from filter plant is mainly used for washing, toilet and similar purposes while for drinking purpose, and one Reverse Osmosis Plant (RO) is installed near Gynecology and Intensive Care Unit (ICU), having treatment capacity of 6000 GPD. Currently RO plant is non operation as its motor is burned out. Another water Purification Plant is present inside the Hospital building which further treats the filter plant water. A tape system exist at RO and filter Plant, from where the people drink the water.

RO Plant Room

RO Plant inside the room

Filtration Plant inside hospital building

Water Tank No. 1 for Gynaecology & ICU

Water Tank No. 2 for Hospital Building

Water Tank No. 3 (not connected to any building)

Water Tank No. 4 for X-ray & General Ladies Ward

Water Tank No. 5 for Operation thetar & Orthopedic ward

2.5 Water Quality Test

A joint site visit was conducted by team JICA & EA on 12th Nov, 2019 to study the existing water & sewerage scheme. It was decided that the water sample will be collected from the following locations

- Sample 1 from raw water sample from mixing tank (before Filter Plant)
- Sample 2 from OHWT (filtered water)
- Sample 3 from Purification Plant of Hospital building (Initially it was decided to tank sample from hospital building, but since the water from ohwt and building tap would be the same, therefore instead of building's tap , the sample was taken from existing water purification plant which is used for drinking purpose)

These locations were selected to assess the incoming raw water quality from Karachi canal, to evaluate the functioning of filter plant and to check the variation in water quality. Sampling of water was carried out on 27th Nov, 2019 in the presence of team EA and LUHMS staff. For the collection and testing of water quality, the services of Pakistan Council of Research in Water Resources (PCRWR) was employed. Samples from the identified locations were collected by the sample collection team.

Collection of sample from mixing tank

Collection of sample from OHWT delivery pipe

Collection of sample from Purification Plant

The sample collection location is shown below

2.5.1 Test Results

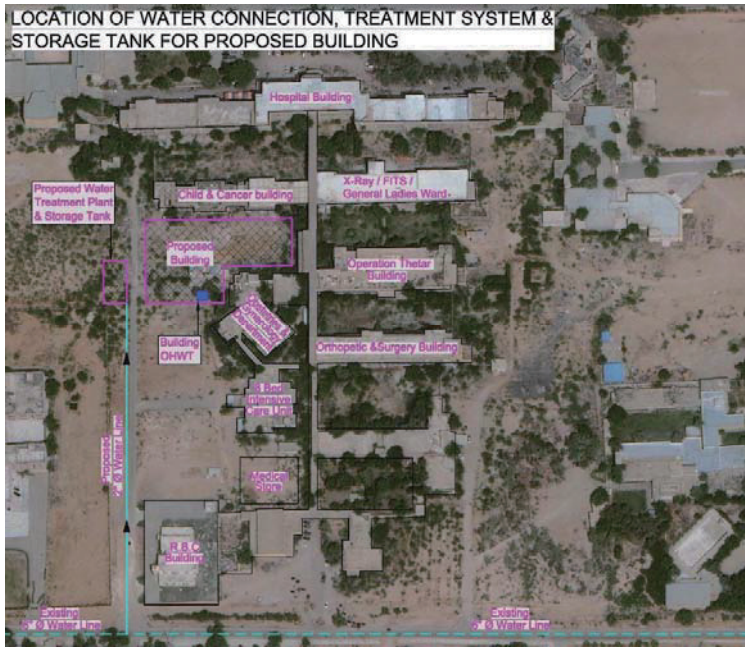
Following are water quality test results

Water Quality Parameters	WHO permissible limit	Sample 1 (Raw water from mixing tank)	Sample 2 (Filtered water from OHWT)	Sample 3 (from water purification Unit)
Aluminum	0.2 ppm	0.0	0.0	0.0
Arsenic	10 ppm	0.0	0.0	0.0
Cadmium	0.03 ppm	0.01	0.01	0.01
Chloride	200 ppm	60	60	60
Chromium	0.05 ppm	0.03	0.03	0.03
Cyanide	0.07 ppm	0.0	0.0	0.0
Color	Colorless	Light Transparent	Light Transparent	Colorless
Copper	1.0 ppm	0.02	0.02	0.02
Fluoride	1.5	0.02	0.02	0.02
Hardness as CaCo3	250 ppm NVGS	110	110	110
Lead	0.01 ppm	0.0	0.0	0.0
Magnesium	150 ppm	14	14	14
Manganese	0.05 ppm	0.03	0.02	0.02
Nitrate	10 ppm	0.21	0.19	0.19
Iron	0.3 ppm	0.01	0.01	0.01
Selenium	0.01 ppm	0.0	0.0	0.0
Sodium	250 ppm	55	53	53
Solids (total dissolved)	500 ppm	454	450	450
Taste & Odor	Un-Objectionable	Un-Objectionable	Un-Objectionable	Un-Objectionable
Turbidity	5 NTU	11	10	0.0
Sulfate	250 ppm	32	31	31
Phenols	0.001	0.0	0.0	0.0
pH	6.5-8.5	7.4	7.3	7.3
Zinc	3.0 ppm	0.05	0.04	0.04
Total Mercury	0.001 ppm	0.0	0.0	0.0
Mineral Oil		0.0	0.0	0.0

The water quality results revealed that the raw water quality parameters falls within permissible limits except for color and turbidity and after passing through filter plant the water quality almost remains the same, however, the purification plant installed inside the brings the color and turbidity within permissible limit.

2.6 Recommendation for Water Supply Scheme

Water supply connection for proposed building can be tapped from 6" HDPE line neat RBC building. Taping diameter of 2" diameter would be enough for the water demand of 100 m3/day. A small treatment system comprises of roughening filter and slow sand filtration should be installed to treat the turbidity and pathogenic bacteria. The treated water will be installed in underground storage tank with minimum 2 to 3 days storage. The location water connection and treatment plant is shown below



3 Wastewater System

3.1 Introduction

The sewerage & drainage System of Jamshoro district consists of a combination of underground pipe sewers, concrete covered and open drains. These works as a combine system for collection and transportation of sewage and storm runoff. No treatment systems or plants are available. The wastewater is either used for irrigation purpose or directly discharge into Right Bank Outfall Drain (RBOD) which carries effluent from upper Sindh and Balochistan to the Arabian Sea through the Gharo creek in Thatta district.

3.2 Scope of Work

3. To collect information regarding existing wastewater collection, transportation and treatment systems for hospital buildings
4. To assess the condition of existing waste water system and treatment plant
5. To recommend safe and stable collection, transportation and disposal system for proposed building

3.3 Existing Sewerage scheme

The current scheme of sewerage system in the hospital comprises of manholes and sewer lines as collection and transport it to the Septic tank. The existing manholes varies in shape i.e rectangular and circular. The rectangular manholes have plan area of 5'-6" x 4'-6" while depth varies from 2'-6" to 4'-0". Circular manholes have internal diameter of 3'while depth varies from 2'-6" to 3'-6". Structurally the manholes are in fair condition, however, from inside most of them were found chocked, full with sludge, garbage and mud, due to poor maintenance.

The pipe is buried inside the ground except at some location where it is running on the ground. Mostly the manholes are filled with sludge therefore it was difficult to check the diameter of pipe, however at exposed location and collected information from site it is estimated that the diameters ranges from 9 inch to 12 inch and its material is RCC.

No waste water treatment plant is currently present except a collection chamber (Septic Tank).The size of septic tank is 9'-6" x 7'-6" x 5'-4". The septic tank is nothing but an open chamber without any baffle walls to separate sludge, scum and waste water. No soakage pit or any other percolation system currently exist, however, an over flow pipe line is present in septic tank which takes the wastewater towards an open area where it spreads on the ground and eventually infiltrate into the ground. The accumulated sludge inside the tank is removed periodically. The waste water from the septic tank is also used for irrigating green areas near by the hospital. Upon query, the site staff also informed that

this septic tank never overflowed. The location plan of existing sewer line and location of septic tank is shown below

Building pipe connection to manhole

RCC pipe running above ground

Sewerage manholes near X-ray building

Manhole filled with garbage & dust

Manhole Sludge and garbage

Circular manhole near Operation theater

Measurement of depth of manhole

Septic Tank from outside

Septic Tank inside

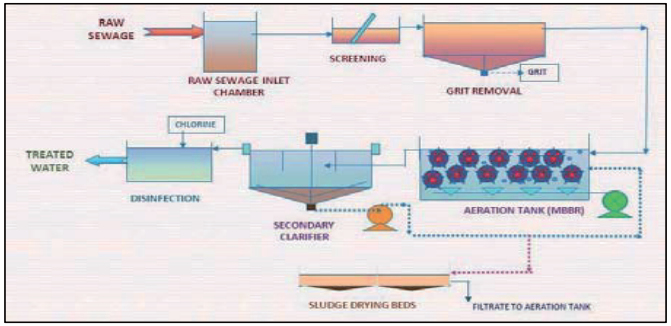
Wastewater from septic tank spreads on the ground

3.4 Regulations on Water supply and Wastewater

Sindh Building Control Authority (SBCA) is a regulatory and supervisory body whose prime function is to ensure that the approval of building plans and NOCs etc. are in conformation with the existing Building & Town Planning Regulations. The byelaws and ordinance related to Water Supply and Sanitation is attached in Annexure 2.

3.5 Recommendations for Sewerage Disposal

Considering the existing condition of manhole, it is recommended to lay a separate sewer line instead of connecting to the existing sewer network. The existing septic tank is in poor condition and will not be able to treat the incoming sewage, therefore it is recommended to construct a separate Packaged Sewerage treatment Plant based on Moving Bed Biofilm Reactor (MBBR) technology to ensure the treatment of incoming waste to National environmental quality standards (NEQS), while for temporary measure septic tank & Soakage pit can be constructed. A typical flow diagram of STP is shown below



The location Plan showing the proposed build location, proposed sewer pipeline route and location of sewerage treatment plant is shown below

4 Electrical System:

Electrical survey was conducted at Liaquat University Hospital, Hyderabad/Jamshoro according to the scope provided by JICA. During the survey we EA Consulting Pvt. Ltd collected the following information:

1. Existing source of electrical supply in the hospital.
2. How the 11kV network is distributed in the hospital.
3. Backup supply system/ Generator in the hospital.
4. Capacity in the 11kV feeder coming from the near located 132/11kV Grid station.
5. Electrical Power supply quality in the hospital.
6. Frequency of power breakdowns.
7. Frequency of voltage fluctuations

4.1 Source of Electrical supply:

- Electrical supply to the hospital is provided by Utility company/WAPDA(Water and Power Development Authority) through 11kV overhead line/feeder.
- HESCO is the Power distribution company of WAPDA which has provided single way 11kV overhead Feeder supply to Liaquat University Medical Hospital.

11kV Overhead Feeder

4.2 Grid Station:

- 11kV feeder is coming to the Hospital premises from nearly located Old Jamshoro 132/11kV Grid Station.
- The name of 11kV feeder provided by Utility company to the hospital facility is "New LMC Feeder" and it is load shedding free. Electrical supply gets interrupted only in case of fault or maintenance.
- The New LMC Feeder has total Loading Capacity of around 460Amperes and is currently loaded with 150Amperes during Peak Demand. Thus have about 310Amperes future loading capacity.
- Utility company is upgrading the Old Jamshoro Grid station. Now, the capacity of power transformer at Grid station is 20/26 MVA. Considering the future load requirement of the region, they are upgrading the transformer rating to 20MVA/40MVA.

4.3 11kV Distribution network:

- 11kV feeder coming to hospital is a shared feeder and the same feeder is also serving other premises of LUMHS University, Nimra Cancer Hospital and Housing society through T-Connection joints.
- There is no dedicated substation for the hospital facility.
- For entire hospital 11kV distribution is through overhead line.
- All hospital buildings have dedicated transformer and these transformers are connected via 11kV overhead line.
- The entire 11kV overhead distribution network of the hospital is maintained by Utility company/HESCO (Hyderabad Electric Supply Company).

4.4 Distribution Transformers:

Currently in the hospital there are total 5 Nos. Transformers, their capacities are as follows:

- 1 No. 630kVA (11kV/400V)
- 4 Nos. 200kVA (11kV/400V)

These transformers are feeding the following hospital facilities.

- **1 No. 630kVA (11kV/400V)**
  Serving Operation Theatre (Wards 9 and 10), Neuro Surgery ward, Medical and Surgical Departments.

- **4 Nos. 200kVA (11kV/400V)**
  - One 200kVA transformer serving: X-Ray (07 Ward) & CT Scan.
  - One 200kVA transformer serving: OT 9 and Paeds Ward.
  - One 200kVA transformer serving: Laundry and Nursing Hostel.
  - One 200kVA transformer serving: Intensive Care Unit (ICU) and Regional Blood Center (RBC). This transformer is at nearest location from the New building Construction Area.

In total, 5 Transformers (One 630 kVA and Four 200 kVA) are serving 20 blocks (18 Wards and 2 OTs (Wards 9 & 10) of the hospital. Incoming 11kV supply to all these 5 Transformers is coming from one Overhead Single way Feeder supply.




4.5 Utility company Metering/Billing:

CT meters are installed at all transformers by Utility Company and billing is done through the reading on these meters.


4.6 Backup Source Generator:

- 250kVA generator is serving as backup power to Utility supply. This generator is supplying power only to lighting loads of the entire hospital.
- This 250kVA generator starts manually without any Auto Mains Failure sensing or Auto Transfer Switching.
- There is another 90kVA generator which is serving as standby for 250kVA generator.


4.7 Analysis for Power quality, Voltage fluctuations & Power failures:

- To measure and record the power quality, frequency of voltage fluctuations and power failures we placed the Energy analyzers at 3 places for 7 days in the ICU building which is located near to the JICA site.
- We observed following parameters through the data recorded by the Power analysis equipment.

i. **Voltage fluctuations:**

It is observed that voltage magnitude is above the normal range most of the time.

Whereas the average fluctuation of voltages is between 195 to 260 V (L-N)

ii. **Power failure:**

In 7 days, only 3 power breakdowns were recorded for very short durations ranging from 2 minutes to 14 minutes.

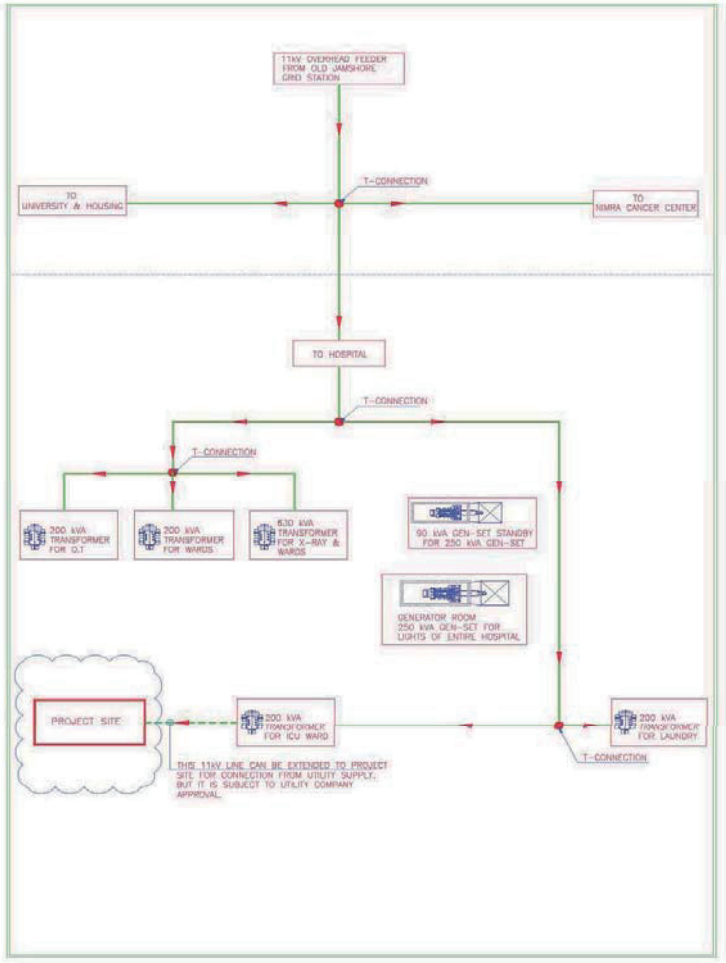
iii. **Harmonic analysis:**

Voltage harmonic is recorded under the acceptable range, only at one instance it was observed over the acceptable limit.

Current harmonic at one location is mostly over the acceptable range, even average values of THD-I is over the acceptable limit.

The detail report of power and voltage analysis is attached as an Annexure –3.

4.8 Existing 11kV Distribution System block diagram:



4.9 Conclusion / Recommendations:

- Apparently, it seems that existing 11kV feeder has capacity to cater the load of new JICA building but final decision regarding this matter can only be provided by HESCO/Utility company officials, once the demand load and metering application is applied to the HESCO Operations Department for the new JICA building.

- 11kV connection for the new JICA building can be obtained by extending the overhead line from near ICU building but it is subject to Utility company approval.

- Dedicated transformer to be installed for the new JICA Construction Facility according to its load requirement for its reliable operation.

- Presently, there are no load shedding issues in the hospital and Utility company is providing 24/7 uninterrupted power. However, power failures do occur in case of faults. Our energy analyzers recorded the Power breakdowns/failures for very short duration. Considering this, a dedicated generator to be installed for the new JICA building only for necessary loads (lighting and life safety systems) not for entire building electrical load.

- Currently, only one 250kVA Diesel Generator is serving Small Power and Lighting Load of entire hospital so for the new Building Facility a separate Independent Generator must be installed to cater the necessary loads (lighting and life safety systems).

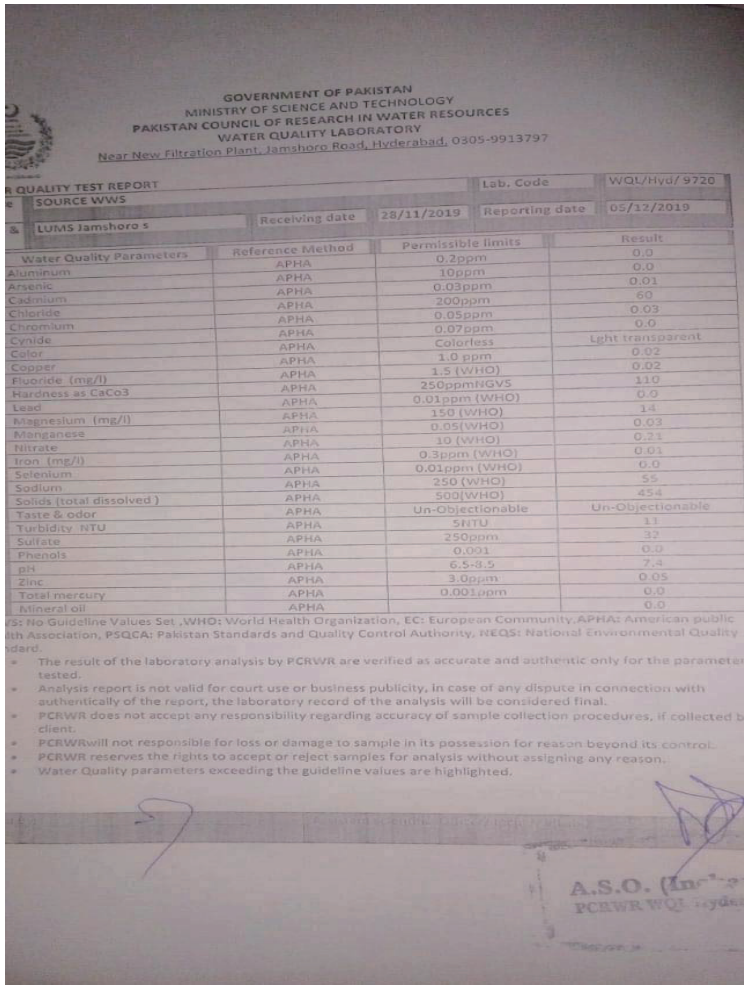
- Voltage magnitude was recorded above the normal range most of the time. Therefore, AVRs can be installed for new JICA building. Presently, there is no AVR in any building of the hospital.

- Current harmonics were measured through power analyzer and were recorded above the minimum allowable threshold level. Therefore, detuned filters with reactors to be added with capacitor bank during design to eliminate the current harmonics for new JICA Building.

Annexure 1

Water quality Test Results

SAMPLE- 1 TEST RESULT



GOVERNMENT OF PAKISTAN
MINISTRY OF SCIENCE AND TECHNOLOGY
PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES
WATER QUALITY LABORATORY
Near New Filtration Plant, Jamshoro Road, Hyderabad. 0305-9913797

R QUALITY TEST REPORT | Lab. Code | WQL/Hyd/ 9720
e | SOURCE WWS
& | LUMS Jamshoro s | Receiving date | 28/11/2019 | Reporting date | 05/12/2019

Water Quality Parameters	Reference Method	Permissible limits	Result
Aluminum	APHA	0.2ppm	0.0
Arsenic	APHA	10ppm	0.0
Cadmium	APHA	0.03ppm	0.01
Chloride	APHA	200ppm	50
Chromium	APHA	0.05ppm	0.03
Cynide	APHA	0.07ppm	0.0
Color	APHA	Colorless	Lght transparent
Copper	APHA	1.0 ppm	0.02
Fluoride (mg/l)	APHA	1.5 (WHO)	0.02
Hardness as CaCo3	APHA	250ppmNGVS	110
Lead	APHA	0.01ppm (WHO)	0.0
Magnesium (mg/l)	APHA	150 (WHO)	14
Manganese	APHA	0.05(WHO)	0.03
Nitrate	APHA	10 (WHO)	0.21
Iron (mg/l)	APHA	0.3ppm (WHO)	0.01
Selenium	APHA	0.01ppm (WHO)	0.0
Sodium	APHA	250 (WHO)	55
Solids (total dissolved)	APHA	500(WHO)	454
Taste & odor	APHA	Un-Objectionable	Un-Objectionable
Turbidity NTU	APHA	5NTU	11
Sulfate	APHA	250ppm	32
Phenols	APHA	0.001	0.0
pH	APHA	6.5-8.5	7.4
Zinc	APHA	3.0ppm	0.05
Total mercury	APHA	0.001ppm	0.0
Mineral oil	APHA		0.0

VS: No Guideline Values Set ,WHO: World Health Organization, EC: European Community,APHA: American public
lth Association, PSQCA: Pakistan Standards and Quality Control Authority, NEQS: National Environmental Quality
ndard.

- The result of the laboratory analysis by PCRWR are verified as accurate and authentic only for the parameter tested.
- Analysis report is not valid for court use or business publicity, in case of any dispute in connection with authenticity of the report, the laboratory record of the analysis will be considered final.
- PCRWR does not accept any responsibility regarding accuracy of sample collection procedures, if collected b client.
- PCRWRwill not responsible for loss or damage to sample in its possession for reason beyond its control.
- PCRWR reserves the rights to accept or reject samples for analysis without assigning any reason.
- Water Quality parameters exceeding the guideline values are highlighted.

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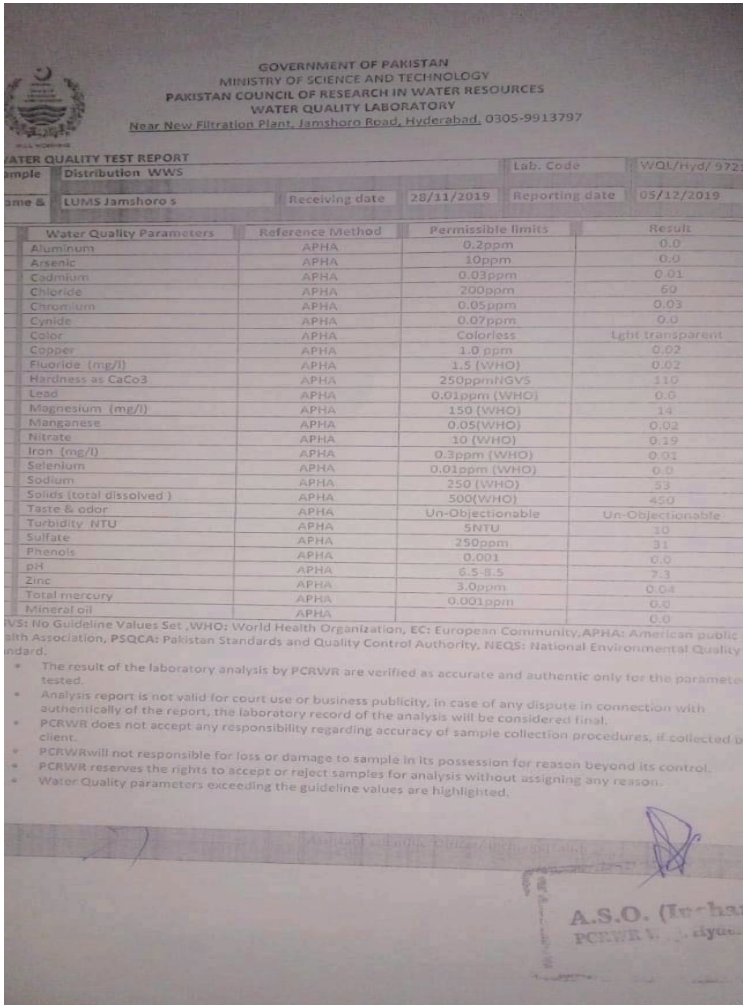
PCRWR WQL Hyde

SAMPLE- 2 TEST RESULT



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WATER QUALITY LABORATORY
Near New Filtration Plant, Jamshoro Road, Hyderabad. 0305-9913797

ATER QUALITY TEST REPORT | Lab. Code | WQL/Hyd/ 972
mple | Distribution WWS
me & | LUMS Jamshoro s | Receiving date | 28/11/2019 | Reporting date | 05/12/2019

Water Quality Parameters	Reference Method	Permissible limits	Result
Aluminum	APHA	0.2ppm	0.0
Arsenic	APHA	10ppm	0.0
Cadmium	APHA	0.03ppm	0.01
Chloride	APHA	200ppm	60
Chromium	APHA	0.05ppm	0.03
Cynide	APHA	0.07ppm	0.0
Color	APHA	Colorless	Lght transparent
Copper	APHA	1.0 ppm	0.02
Fluoride (mg/l)	APHA	1.5 (WHO)	0.02
Hardness as CaCo3	APHA	250ppmNGVS	110
Lead	APHA	0.01ppm (WHO)	0.0
Magnesium (mg/l)	APHA	150 (WHO)	14
Manganese	APHA	0.05(WHO)	0.02
Nitrate	APHA	10 (WHO)	0.19
Iron (mg/l)	APHA	0.3ppm (WHO)	0.01
Selenium	APHA	0.01ppm (WHO)	0.0
Sodium	APHA	250 (WHO)	53
Solids (total dissolved)	APHA	500(WHO)	450
Taste & odor	APHA	Un-Objectionable	Un-Objectionable
Turbidity NTU	APHA	5NTU	10
Sulfate	APHA	250ppm	31
Phenols	APHA	0.001	0.0
pH	APHA	6.5-8.5	7.3
Zinc	APHA	3.0ppm	0.04
Total mercury	APHA	0.001ppm	0.0
Mineral oil	APHA		0.0

VS: No Guideline Values Set ,WHO: World Health Organization, EC: European Community,APHA: American public
lth Association, PSQCA: Pakistan Standards and Quality Control Authority, NEQS: National Environmental Quality
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- Water Quality parameters exceeding the guideline values are highlighted.

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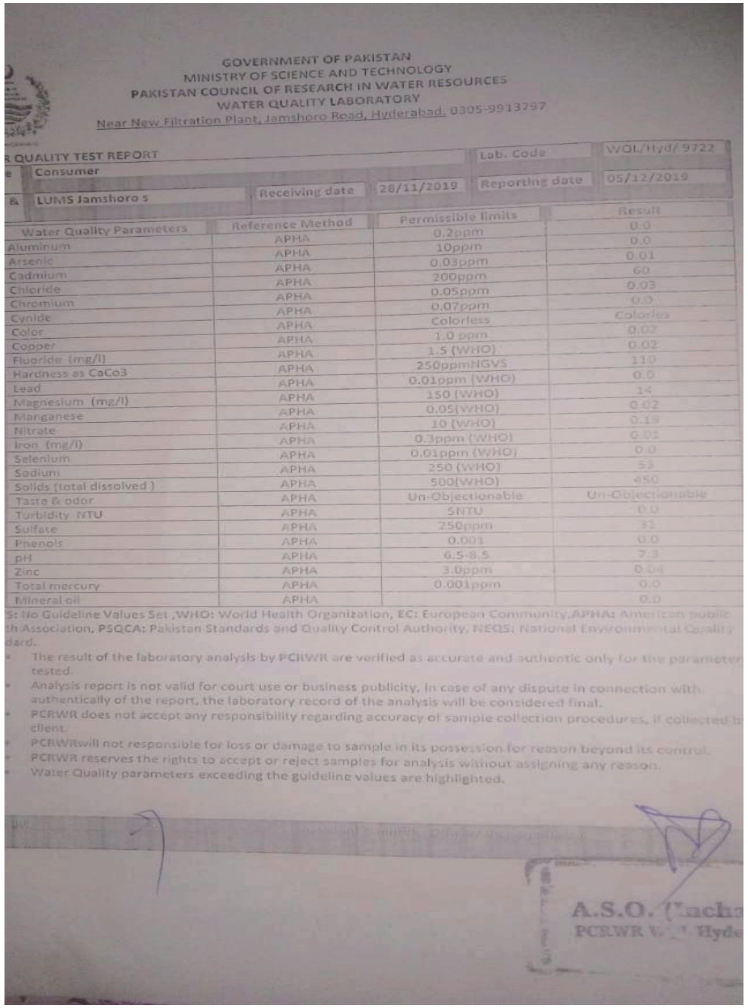
PCRWR W

SAMPLE- 3 TEST RESULT



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WATER QUALITY LABORATORY
Near New Filtration Plant, Jamshoro Road, Hyderabad. 0305-9913797

R QUALITY TEST REPORT

e	Consumer			Lab. Code	WQL/Hyd/ 9722
&	LUMS Jamshoro s	Receiving date	28/11/2019	Reporting date	05/12/2019

Water Quality Parameters	Reference Method	Permissible limits	Result
Aluminum	APHA	0.2ppm	0.0
Arsenic	APHA	10ppm	0.0
Cadmium	APHA	0.03ppm	0.01
Chloride	APHA	200ppm	60
Chromium	APHA	0.05ppm	0.03
Cynide	APHA	0.07ppm	0.0
Color	APHA	Colorless	Colorless
Copper	APHA	1.0 ppm	0.02
Fluoride (mg/l)	APHA	1.5 (WHO)	0.02
Hardness as CaCo3	APHA	250ppmNGVS	110
Lead	APHA	0.01ppm (WHO)	0.0
Magnesium (mg/l)	APHA	150 (WHO)	14
Manganese	APHA	0.05(WHO)	0.02
Nitrate	APHA	10 (WHO)	0.19
Iron (mg/l)	APHA	0.3ppm (WHO)	0.01
Selenium	APHA	0.01ppm (WHO)	0.0
Sodium	APHA	250 (WHO)	53
Solids (total dissolved)	APHA	500(WHO)	450
Taste & odor	APHA	Un-Objectionable	Un-Objectionable
Turbidity NTU	APHA	5NTU	0.0
Sulfate	APHA	250ppm	31
Phenols	APHA	0.001	0.0
pH	APHA	6.5-8.5	7.3
Zinc	APHA	3.0ppm	0.04
Total mercury	APHA	0.001ppm	0.0
Mineral oil	APHA		0.0

S: No Guideline Values Set ,WHO: World Health Organization, EC: European Community,APHA: American public h Association, PSQCA: Pakistan Standards and Quality Control Authority, NEQS: National Environmental Quality dard.

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- Water Quality parameters exceeding the guideline values are highlighted.

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PCRWR W... Hyde

<u>Annexure 2</u>

<u>SBCA Regulation</u>

CHAPTER 12 – WATER SUPPLY DRAINAGE AND SANITATION

THE SINDH GOVT. GAZETTE APRIL 04, 2002 478

12-1. Water Service Pipe

12-1.1. Except as permitted in the following paragraph (12-1.2), underground water service piping and the building sewer line shall be not less than 7ft. (2.13m) apart horizontally and shall be separated by undisturbed or compacted earth.

12-1.2. The water service pipe may be placed within 7ft. (2.13m) of sewerage line provided that the bottom of the water service pipe is at least 12 inch (300mm) above the top of the sewer line.

12-2. Minimum Storage Capacity for Category "IV" buildings

Minimum capacity of water storage tanks in buildings of Category "IV" shall be:

12-2.1. Overhead tank = 1 day+ 25% reserved for fire fighting

12-2.2. Underground tank = 21/2 days out of the reserved capacity 25% shall be kept reserved for firefighting purposes by making suitable arrangements.

KARACHI BUILDING &TOWN PLANNING REGULATIONS-2002
CHAPTER 12 – WATER SUPPLY DRAINAGE AND SANITATION

12-2.3. Distribution of Water within the premises.

The design of water supply pipe work, underground and overhead tanks shall be in accordance with the following schedule:-

Per capita water requirements/demand for various occupancies.

Sr. No	Type of occupancy	Consumption per head/day(in liter)
1	Residential	135
2	Industrial a) Day Schools b) Boarding Schools c) Medical Hospitals d) Medical Quarters & Hostels	 45-100 135-225 450 135
3	Assembly-Cinema, Theater Auditorium etc. (per seat of accommodation).	45
4	Government or Semi-public business.	45

THE SINDH GOVT. GAZETTE APRIL 04, 2002 479

12-Water Supply, Drainage & Sanitation

5	Mercantile (commercial) a) Restaurants 90 b) Shopping Centers, Stores (per toilet fixture) c) Other Business Buildings	 90 200 45
6	Hotels	225

7	Industrial	45-135
8	Storage including warehouse	30
9	Service Station 200	200
10	Bus/Truck Stands (per vehicle) 200	200
11	Live Stock (per animal) 45-150	45-150
12	Poultry (per chicken) 45	45

12-3. Recycling Plant and Treatment of Effluent/Sewage.

In case recycling plant or treatment of effluent/sewage are provided, all requirements for construction and maintenance as set by National Environmental Quality Standard (NEQS) shall be followed:

12-4. Sanitation and Solid Waste

12-4.1. All medical & hospital waste shall be safely collected, transported and disposed off in accordance with the public health standards (as prescribed by Sindh Environmental Protection Agency) and up to satisfaction of the Authority.

12-4.1.1. All industrial waste shall be treated in accordance with the National Environment Quality Standards (NEQS).

12-4.1.2. All hospitals shall provide the disposal of medical waste as per National Environment Quality Standard (NEQS).

12-4.1.3. In all public sale projects the central waste disposal system shall be provided by the developer.

12-5. Digestor/Septic tank

Where no public sewer is in existence, all sewage shall be disposed of after properly treating, through digestor or septic tank, and effluent shall be discharged safely into a soak pit as a temporary measure till such time as a system is laid out.

12-6. Soil Pipes, Waste Pipes and Ventilating Pipes

12-6.1. A trap shall be used to maintain the water seal and make system fool proof against closing and blockages.

KARACHI BUILDING &TOWN PLANNING REGULATIONS-2002
CHAPTER 12 – WATER SUPPLY DRAINAGE AND SANITATION

THE SINDH GOVT. GAZETTE APRIL 04, 2002 480

12-Water Supply, Drainage & Sanitation

12-6.2. In no case shall the internal diameter of a soil pipe or waste pipe be less than the internal diameter of any pipe or of the outlet of any appliance which discharges into it.

12-6.3. All the joints shall be:-

12-6.3.1. properly prepared by the use of rubber gasket or water sealant materials for jointing;

12-6.3.2. adequately supported throughout its length without restraining thermal movements, any fitting which gives such support being securely attached to the building;

12-6.3.3. so placed as to be reasonably accessible for maintenance and repair.

12-6.4. Ventilating pipe shall be provided in all stacks carrying wastewater or sewage, in accordance with the plumbing code.

12-6.5. Drain water pipe of appropriate dimension shall be provided as per approved standard.

12-7. Sanitary Provisions

The minimum requirements/sanitary provisions as prescribed hereunder shall be followed:

12-7.1. For every five (5) single room units or servant quarters: one wash-basin, one W.C. and one(1) bathroom shall be provided.

12-7.2. For every 10(ten) bedrooms or less in a Boarding House or Guest House there shall be at least two(2) W.C.'s, two(2) washbasins and two(2) showers.

12-7.3. For every 20(twenty) persons in a Dormitory and Hostel there shall be at least three(3) W.C.'s, three(3) wash-basins and three(3) showers, and for every 10(ten) additional persons one(1) W.C., one(1) wash-basin, and one(1) shower are to be added.

12-7.4. In an office with 30(thirty) persons (calculated at a rate of one(1) person per 100Sqft.(9.29Sq.m)), there shall be minimum of three(3) W.C.'s, two(2) washbasins and one(1) urinals. For every additional 20 (twenty) persons there shall be one(1) W.C., one(1) wash-basin and one(1) urinal. One (1)

THE SINDH GOVT. GAZETTE APRIL 04, 2002 481

12-Water Supply, Drainage & Sanitation

Wash-basin or equivalent washing space per 25(twenty five) or less persons shall be provided for ablution purposes.

12-7.5. In factory with 30(thirty) persons (calculated at a rate of one (1) person per 100Sq.ft. (9.29Sq.m)), there shall be minimum of three W.C.'s, two(2) wash-basins and one(1) urinals. For every

additional 20(twenty) persons there shall be one(1) W.C., one(1) wash-basin and one(1) urinal. One (1) wash-basin or equivalent washing space per 25(twenty five) or less persons shall be provided for ablution purposes, and shall be divided proportionately amongst the genders.

12-7.6. Shopping Center - a minimum of three(3) W.C.'s, one(1) urinals, and one(1) wash-basin shall be provided for 3000Sq.ft.(278.8Sq.m) or less total floor area. For every additional 2000Sq.ft.(185.8Sq.m) floor area, one(1) W.C., one(1) wash-basin, and one(1) urinal shall be provided.

12-7.7. Public Assembly building – two(2) W.C.'s, one(1) wash-basin, and three(3) urinals shall be provided for 1500Sq.ft.(139Sq.m) or less of total floor area and for every additional 1500Sq.ft.(139Sq.m) of floor area one(1) W.C., one(1) wash-basin and two(2) urinals shall be provided.

12-7.8. For Mosque, five(5) ablution space for every Hundred(100) Namazis' and two(2) W.Cs, one shower room shall be provided, for every additional (100) Namazis' the number of ablution space will be extended by 8,6,4 respectively plus special arrangement for the female having a capacity of 300 Namazis' three(3) ablution and one(1) W.C shall be provided.

12-7.9. Cinema and Auditorium - for every 50 seats or less, two(2) W.C.'s, two(2) urinals and two(2) wash-basins shall be provided, and for every additional 50 seats one(1) W.C., two(2) urinals and two(2) wash-basin shall be provided and shall be divided proportionately amongst the genders.

12-7.10. School: – four (4) W.C's and two(2) wash-basins per Hundred(100) students and for every additional fifty(50) students, one(1) W.C. and one(1) wash-basin shall be provided.

12-7.11. Hospital:- For every 10 beds in a general ward there shall be at least one(1) water closet, one(1) wash-basin, one(1) ablution tap and one(1) bathroom with shower. One (1) kitchen sink shall be provided in each ward.

12-7.12. For 50 seats or part thereof of Restaurant, one(1) water closet, one(1) urinal, one(1) wash-basin shall be provided.

12-7.13. Two urinals may be replaced by W.C., while proportionately dividing the fixtures among the genders.

12-7.14. Provision of one (1) W.C. for special persons shall be provided.

12-7.15. All fixtures shall be divided proportionately amongst the genders.

12-8. Manholes and Inspection Chambers

12-8.1. At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manholes as far as possible. The spacing of manholes in case of pipe having a diameter 6inch/8inch (150mm./200mm) shall be 50ft./110ft. (15.2m./35.5m) according to respective diameter, and in case of diameter more than 8inch (200mm) the distance shall be not more than 150ft.(45m).

KARACHI BUILDING &TOWN PLANNING REGULATIONS-2002

CHAPTER 12 – WATER SUPPLY DRAINAGE AND SANITATION

12-8.2. The chamber shall be so designed to make the cleaning and inspection conveniently.

12-8.3. Proper benching shall be provided equal to half the diameter of pipe in semi-circular shape with proper slope in either direction so that no solid shall accumulate in the Manhole/Inspection Chamber.

12-8.4. C.I. Rungs shall be provided at 16inch(400mm) center to center in all manholes over 4ft.(1.2m) in depth. The size of the manhole cover shall be such that there is a clear opening of at least 2ft.(60cm) in diameter for manholes exceeding 4ft.(1.2m) in depth.

12-9. Storm water drainage.

12-9.1. The roofs of every building, and the floor or balconies abutting on a street or constructed over a street, shall be so constructed or framed as to permit effectual drainage of the rain water therefrom, by means of a sufficient number of leaders of adequate sizes, so arranged, jointed, and fixed as to ensure that

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12-Water Supply, Drainage & Sanitation

the rain water is carried away from the building without causing dampness in any part of the walls, or foundations of the walls, or foundations of the building, or those of an adjacent building, provided the fall is not greater than 20ft.(6m) in case of spouts.

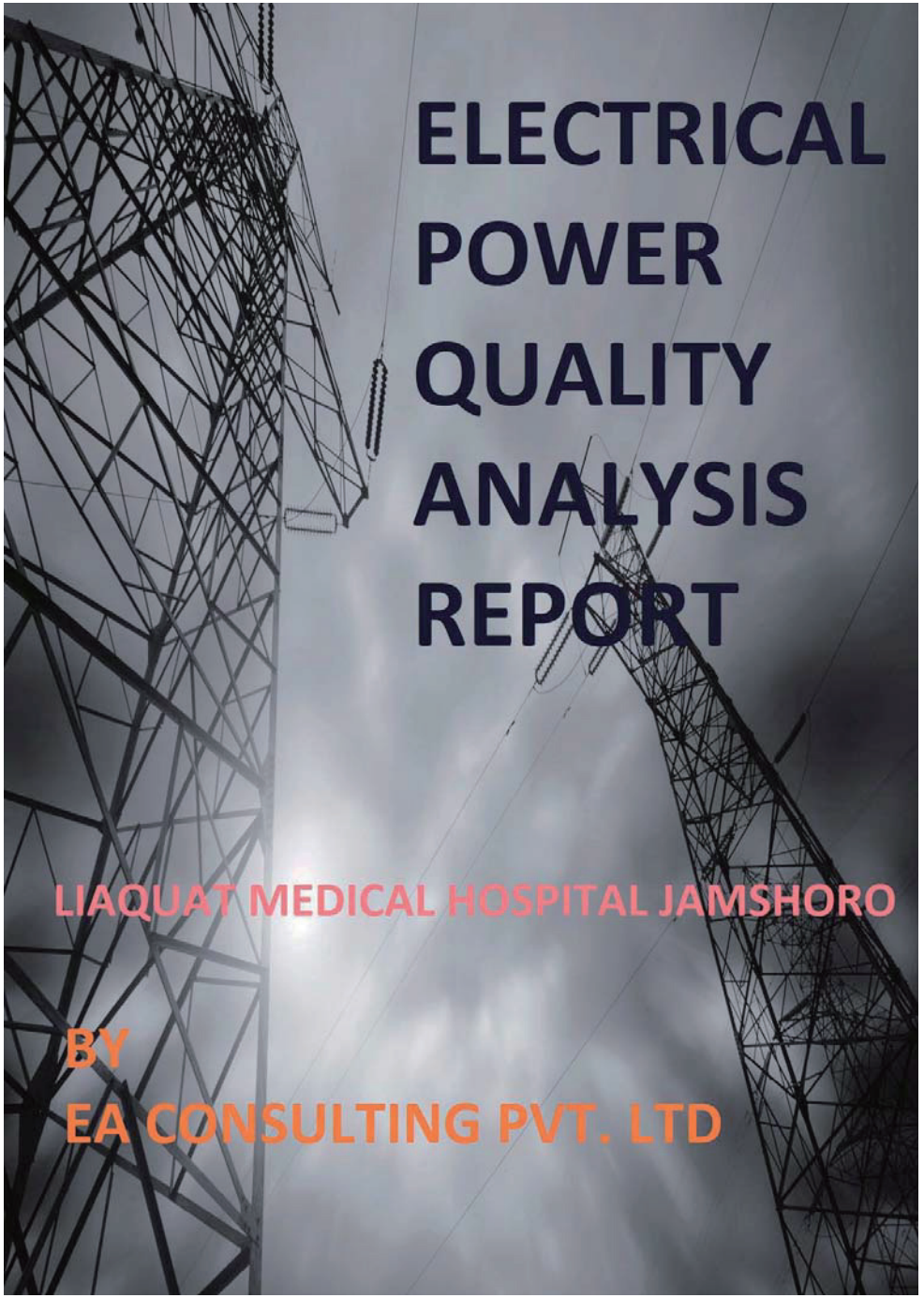
12-9.2. A leader shall not discharge into or connect with any soil pipe or its ventilating pipe, or any waste pipe or its ventilating pipe, nor shall it discharge into a sewer.

12-9.3. Rain water from leader spouts etc. shall not discharge onto a public street at a height greater than 12inch (300mm) from that street, or onto a neighboring property.

http://www.sbca.gos.pk

Annexure 3

Electrical Power Quality Analysis Report



Contents

Acknowledgment & Summary

This report provides observation and conclusion of Power Quality Analysis at **Liaquat Medical University Hospital** that was conducted by EA Consulting Pvt. Ltd.

The purpose of the activity was to determine the Electrical Power Analysis according to EN 50610, for further system improvement. More specifically the purpose of this activity was to analyze Voltage fluctuations and frequency of Power breakdowns in the system

During the 7 day Activity Electric Energy Monitoring and reporting system was used.

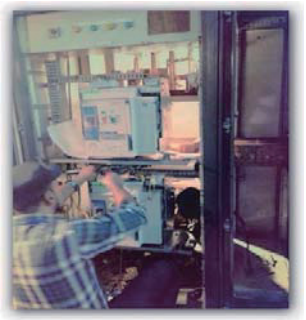
Observations are mentioned in this report

Specific Details:

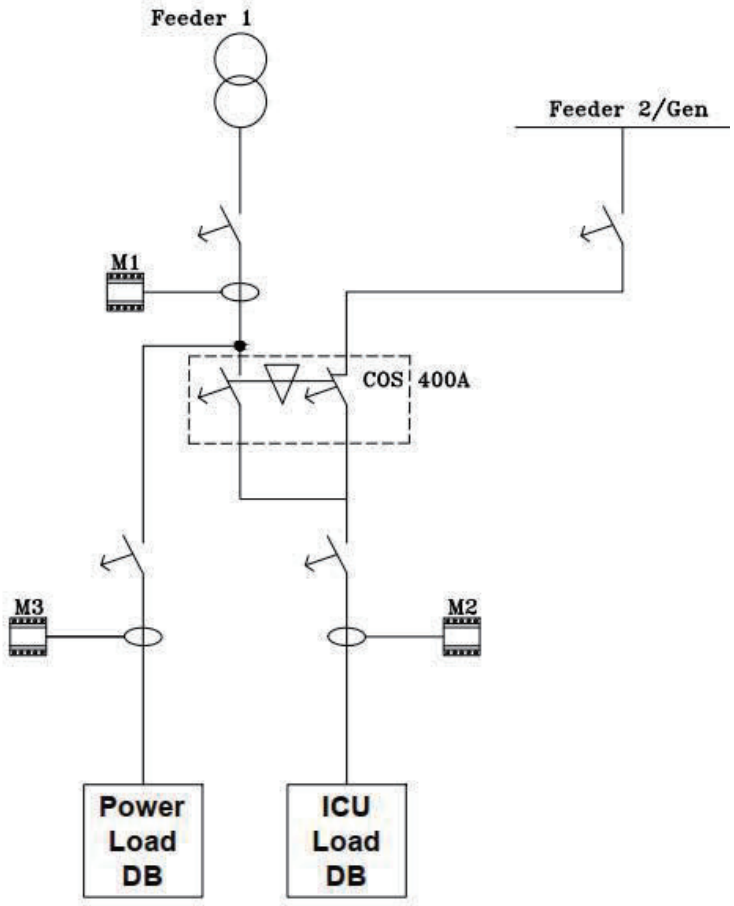
Date of Activity: from 16th November 2019 to 23rd November 2019

M/s. Liaquat Medical University Hospital

Location: Jamshoro, Sindh Pakistan



Analysis Points:



ENERGY CONSUMPTION:

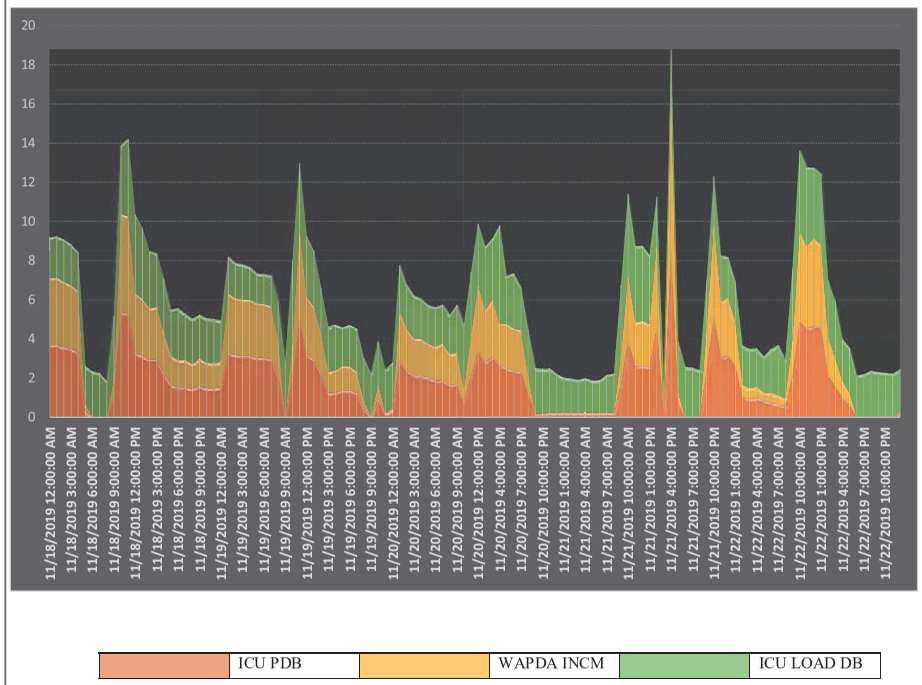
TOTAL CONSUMPTION of 7 DAYS:

ICU PDB- KWH	WAPDA INCOMING - KWH	ICU LOAD DB- KWH
276.54	247.92	365.6

PER HOUR CONSUMPTION TREND

PER HOUR CONSUPTION	ICU PDB	WAPDA INCM	ICU LOAD DB
MIN	0	0	1.49
MAX	8.52	8.16	5.01
AVERAGE	1.87	1.67	2.47

TREND

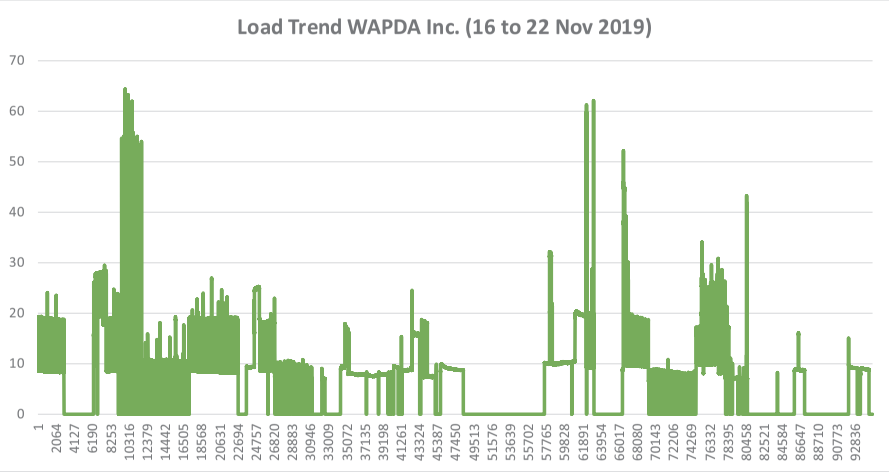


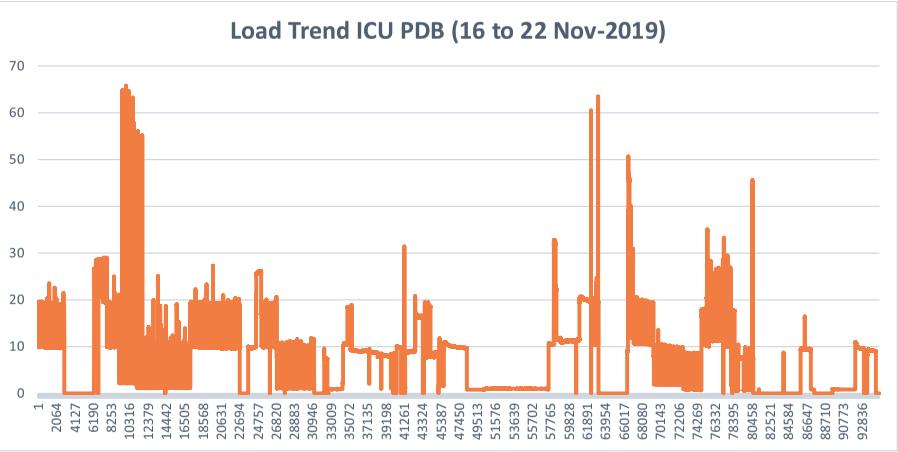
ICU PDB | WAPDA INCM | ICU LOAD DB

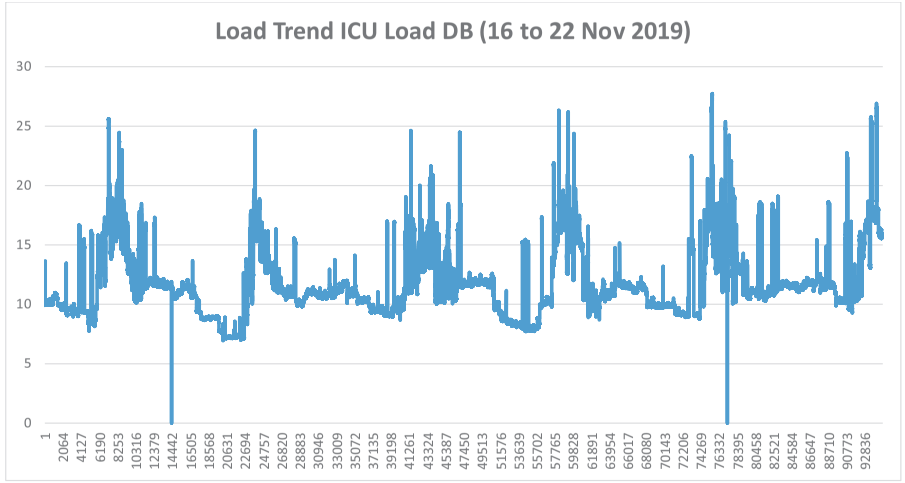
LOAD PROFILE (Amperes)

LOCATION	ANALYZERS (LOCATIONS)	MIN	MAX	AVERAGE
WAPDA INCOMING	WAPDA INCOMING - A EQV	1.94	64.38	15.96
	WAPDA INCOMING - A L1	0	20.26	3.03
	WAPDA INCOMING - A L2	0	44.78	1.67
	WAPDA INCOMING - A L3	0	56.71	2.15
ICU POWER DB	ICU POWER DB - A EQV	0.88	65.81	10.64
	ICU POWER DB - A L1	0	23.69	3.25
	ICU POWER DB - A L2	0	47.39	2.01
	ICU POWER DB - A L3	0	58.27	2.27
ICU LOAD DB	ICU LOAD DB- A EQV	6.94	27.74	11.62
	ICU LOAD DB- A L1	4.6	16.58	7.02
	ICU LOAD DB- A L2	1.19	19.76	4.39
	ICU LOAD DB- A L3	0.62	3.48	0.97

Load Trend (Location wise)







VOLTAGE TRENDS

LOCATION	ANALYZER	MINIMUM	MAXIMUM	AVERAGE
WAPDA INCOMING	WAPDA INCOMING - V EQV	231.09	254.68	244.40
	WAPDA INCOMING - V L-L EQV	400.21	441.15	423.32
	WAPDA INCOMING - V L1	231.61	256.16	245.25
	WAPDA INCOMING - V L2	216.73	254.52	239.60
	WAPDA INCOMING - V L3	229.93	257.57	248.37
ICU POWER DB	ICU POWER DB - V EQV	235.33	254.63	244.34
	ICU POWER DB - V L-L EQV	406.62	441.05	423.21
	ICU POWER DB - V L1	236.47	256.24	245.23
	ICU POWER DB - V L2	216.4	254.49	239.54
	ICU POWER DB - V L3	235.31	257.53	248.25
ICU DB	ICU LOAD DB- V EQV	183.28	254.15	243.98
	ICU LOAD DB- V L-L EQV	317.42	440.15	422.46
	ICU LOAD DB- V L1	201.86	253.05	242.71
	ICU LOAD DB- V L2	198.97	257.53	240.93
	ICU LOAD DB- V L3	205.8	260.19	248.31

Observations:

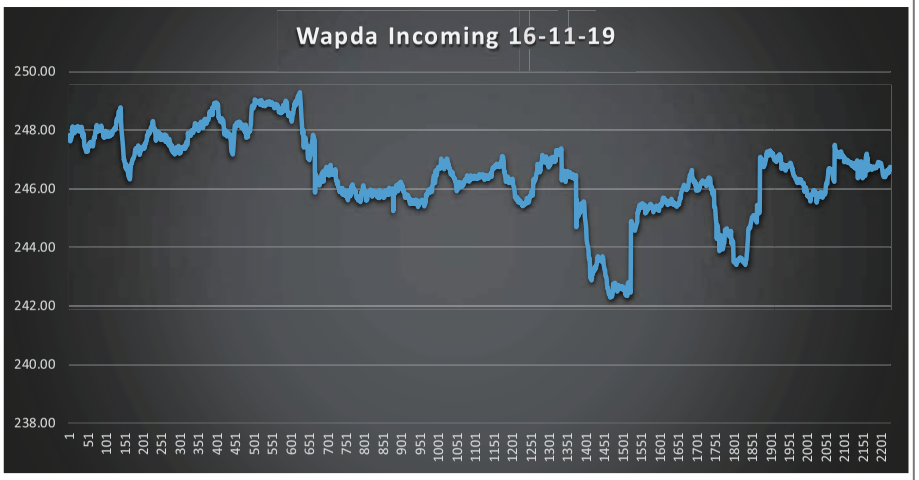
It is observed that voltage magnitude is above the normal range most of the time.

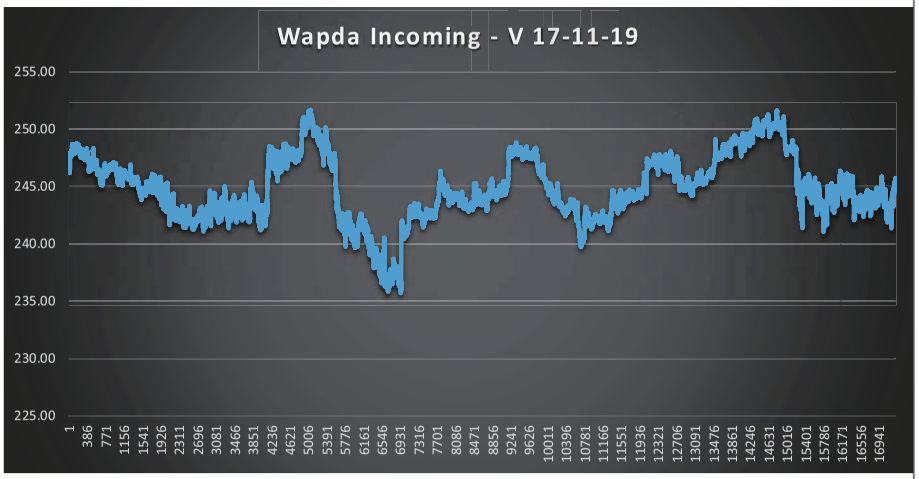
Whereas the average fluctuation of voltages is between 195 to 260 V (L-N)

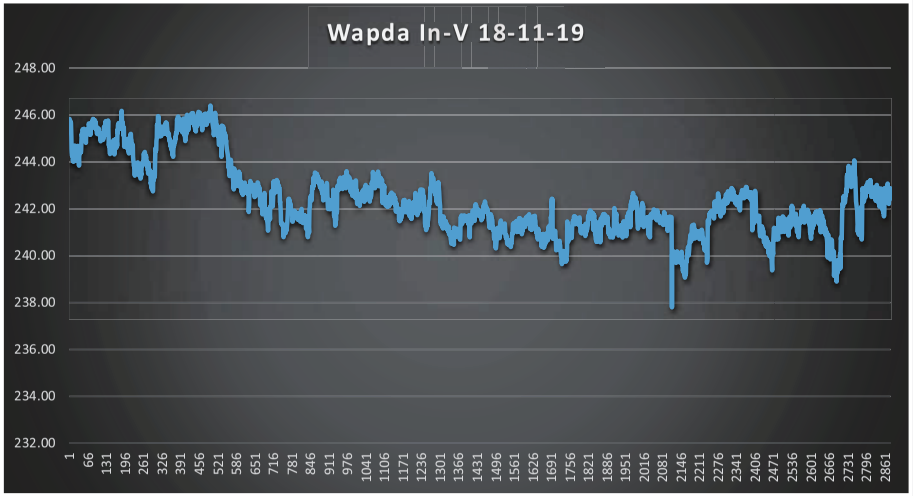
**For fluctuations please refer voltage trends*

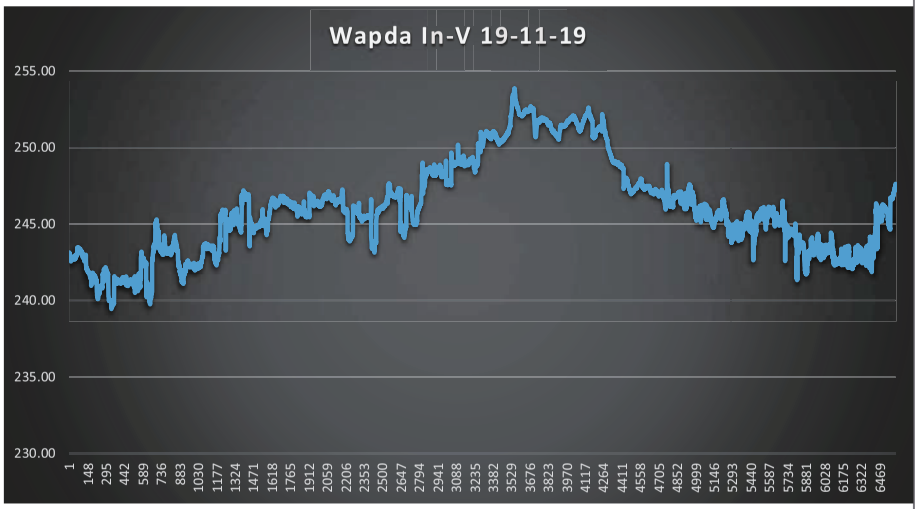
Voltage trends (Day wise)

Wapda Incoming (location) Trend






Wapda In-V 18-11-19
248.00
246.00
244.00
242.00
240.00
238.00
236.00
234.00
232.00
1 66 131 196 261 326 391 456 521 586 651 716 781 846 911 976 1041 1106 1171 1236 1301 1366 1431 1496 1561 1626 1691 1756 1821 1886 1951 2016 2081 2146 2211 2276 2341 2406 2471 2536 2601 2666 2731 2796 2861


Wapda In-V 19-11-19
255.00
250.00
245.00
240.00
235.00
230.00
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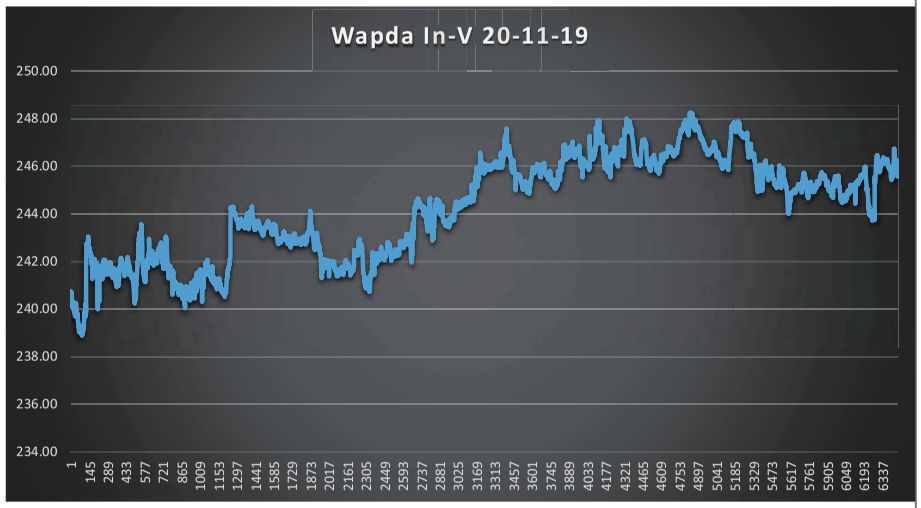
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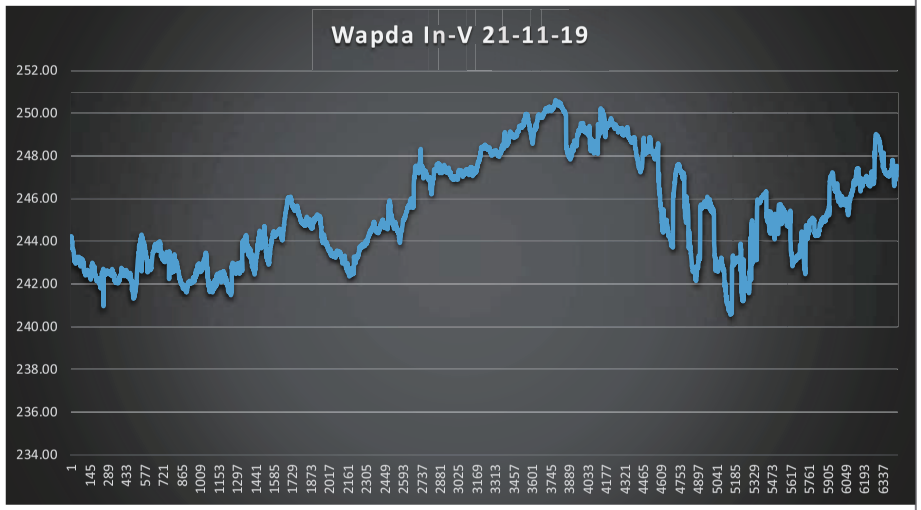
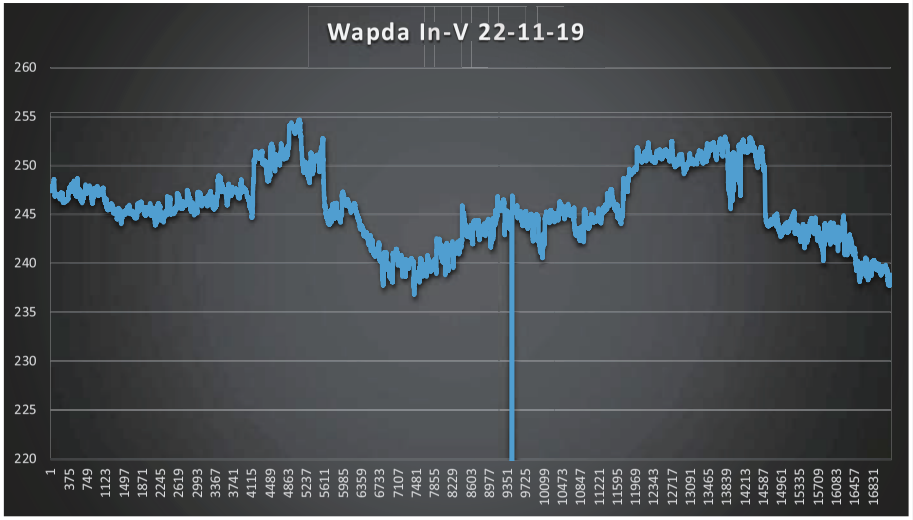
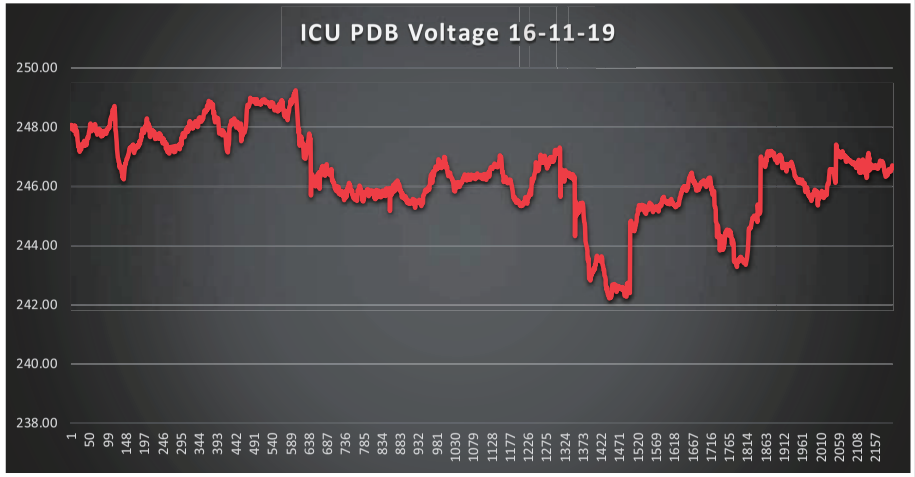
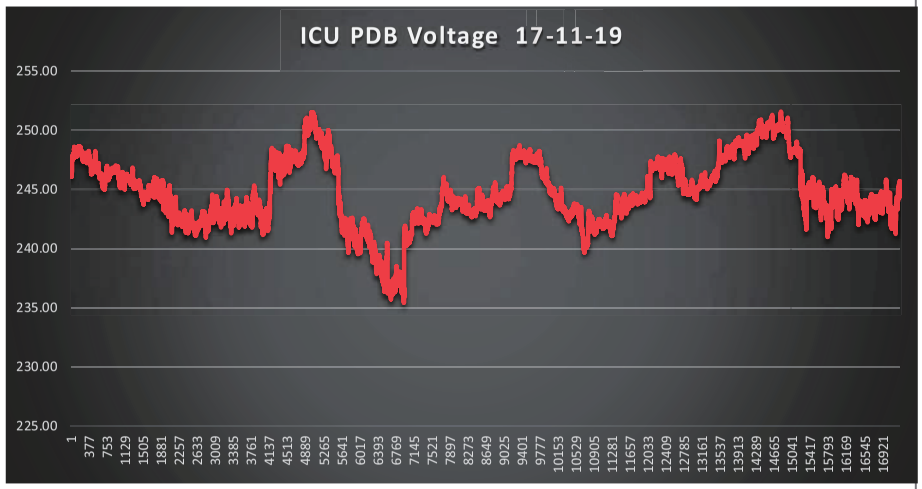
250.00
248.00
246.00
244.00
242.00
240.00
238.00
236.00
234.00
1 145 289 433 577 721 865 1009 1153 1297 1441 1585 1729 1873 2017 2161 2305 2449 2593 2737 2881 3025 3169 3313 3457 3601 3745 3889 4033 4177 4321 4465 4609 4753 4897 5041 5185 5329 5473 5617 5761 5905 6049 6193 6337

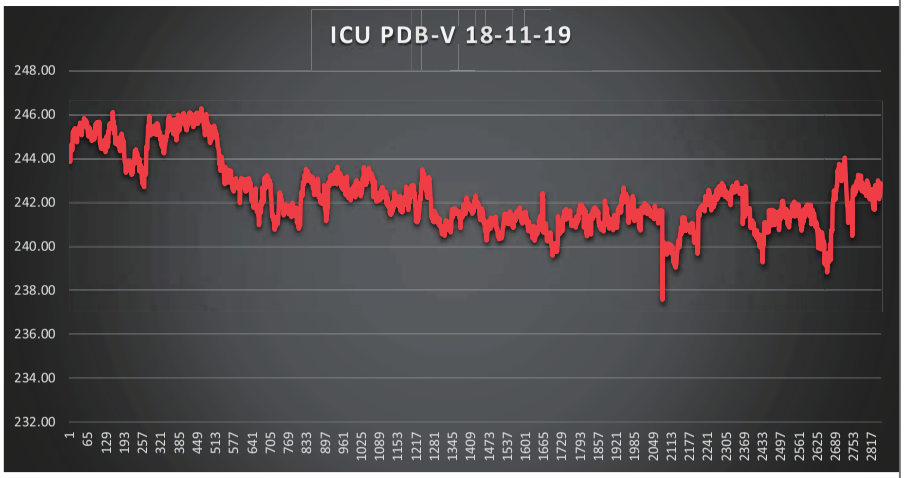

Wapda In-V 21-11-19
252.00
250.00
248.00
246.00
244.00
242.00
240.00
238.00
236.00
234.00
1 145 289 433 577 721 865 1009 1153 1297 1441 1585 1729 1873 2017 2161 2305 2449 2593 2737 2881 3025 3169 3313 3457 3601 3745 3889 4033 4177 4321 4465 4609 4753 4897 5041 5185 5329 5473 5617 5761 5905 6049 6193 6337



ICU Power DB Voltage Trend



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236.00
234.00
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129
193
257
321
385
449
513
577
641
705
769
833
897
961
1025
1089
1153
1217
1281
1345
1409
1473
1537
1601
1665
1729
1793
1857
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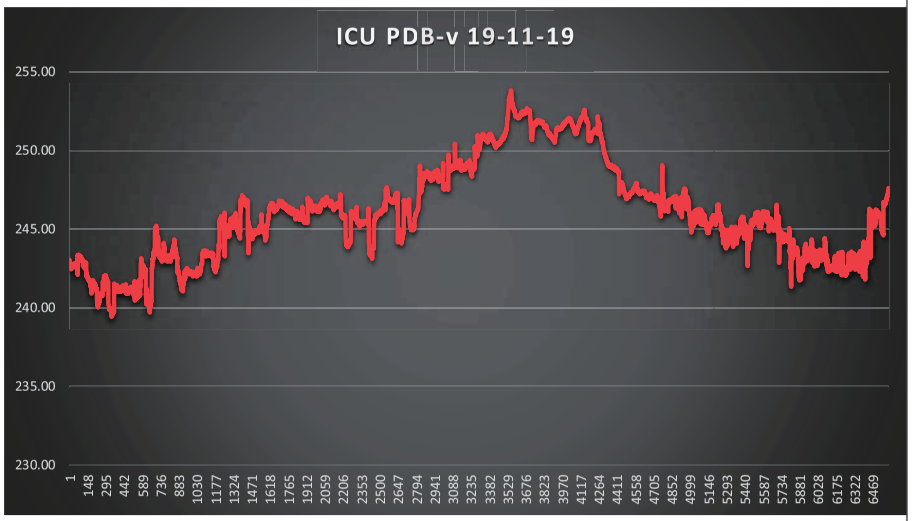
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295
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883
1030
1177
1324
1471
1618
1765
1912
2059
2206
2353
2500
2647
2794
2941
3088
3235
3382
3529
3676
3823
3970
4117
4264
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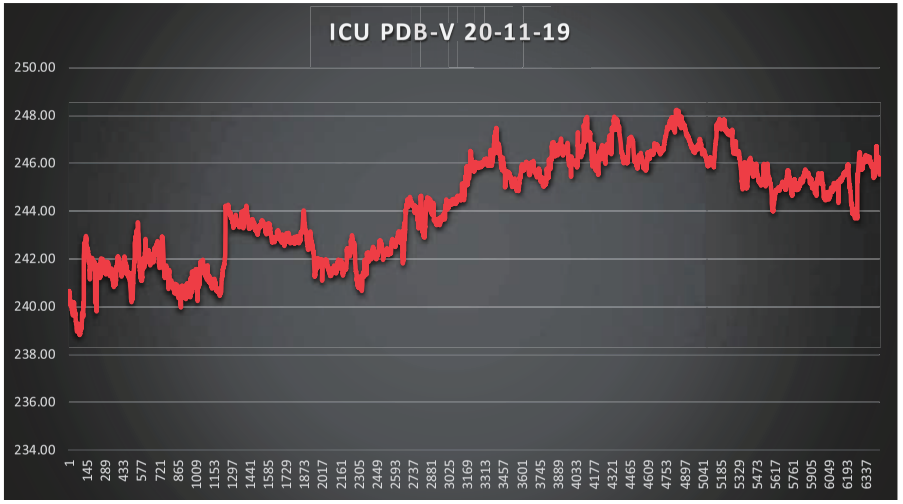
ICU PDB-V 20-11-19
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1729
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4033
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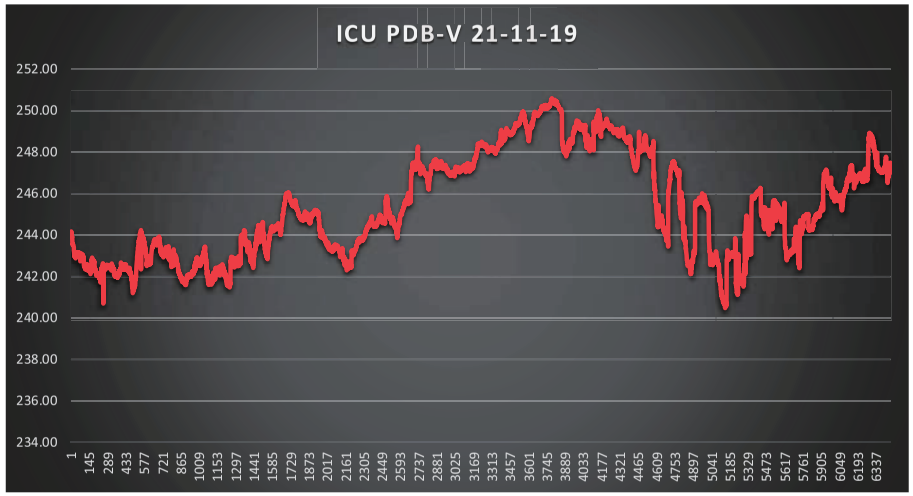
ICU PDB-V 21-11-19
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250.00
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246.00
244.00
242.00
240.00
238.00
236.00
234.00
1
145
289
433
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3169
3313
3457
3601
3745
3889
4033
4177
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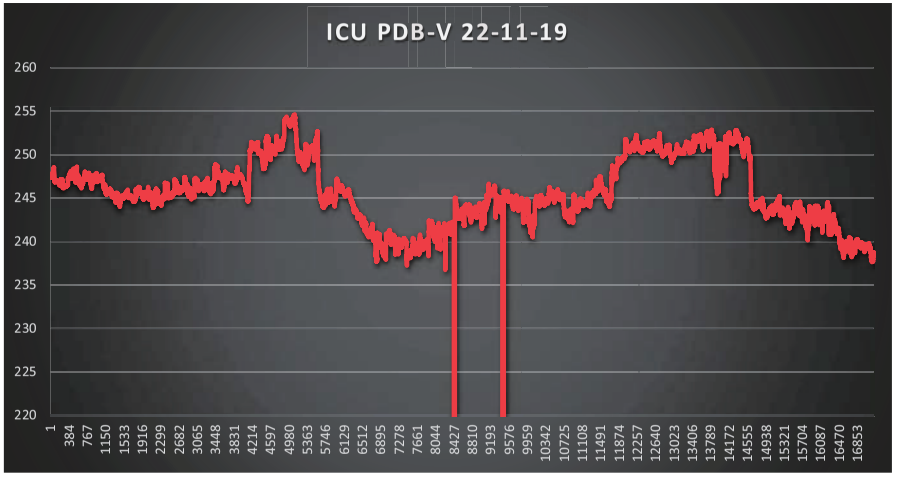
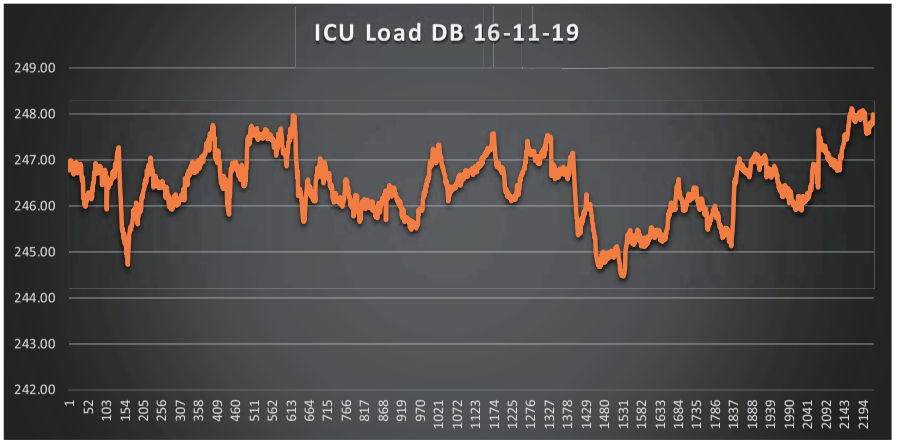
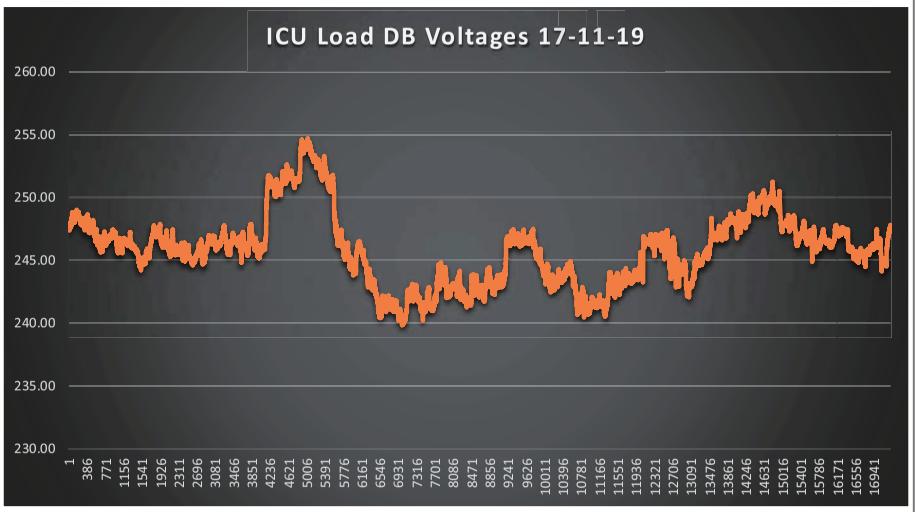
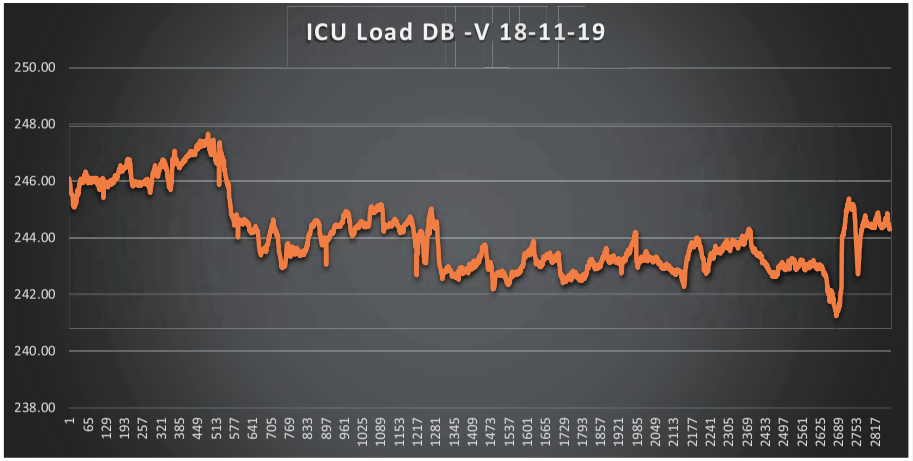
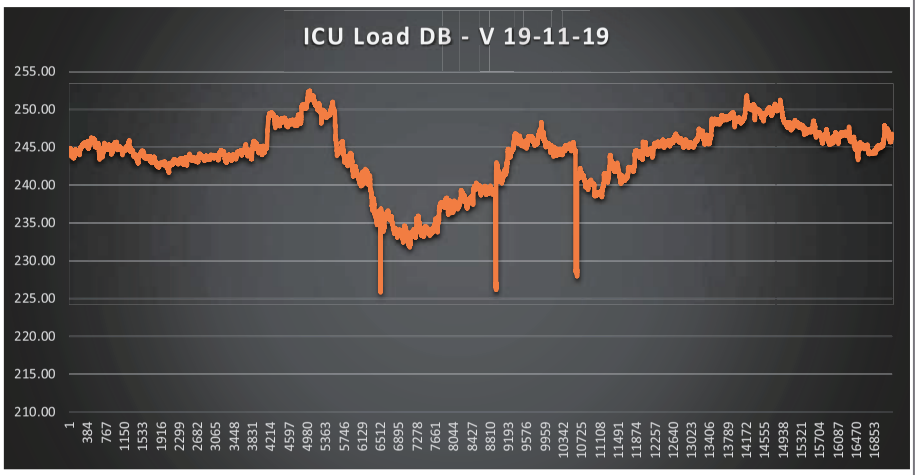


ICU Load DB Voltage Trend






ICU Load DB -V 18-11-19
250.00
248.00
246.00
244.00
242.00
240.00
238.00
1 65 129 193 257 321 385 449 513 577 641 705 769 833 897 961 1025 1089 1153 1217 1281 1345 1409 1473 1537 1601 1665 1729 1793 1857 1921 1985 2049 2113 2177 2241 2305 2369 2433 2497 2561 2625 2689 2753 2817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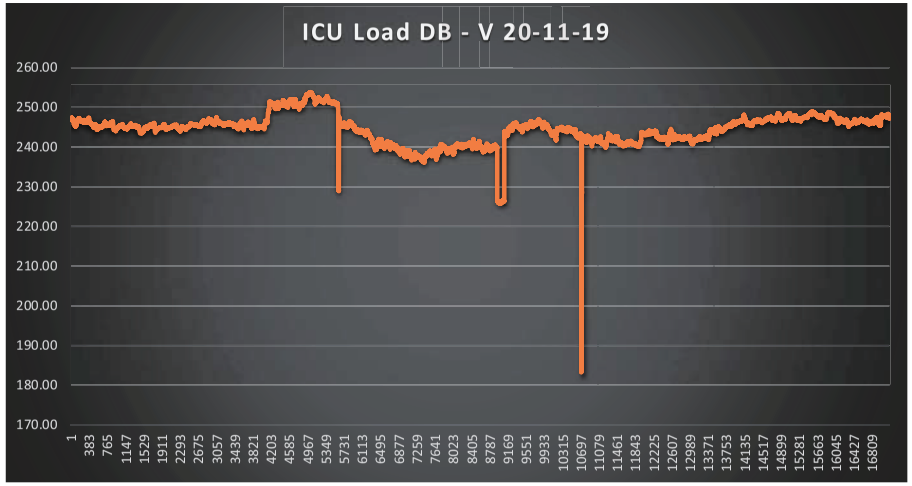
250.00
245.00
240.00
235.00
230.00
225.00
220.00
215.00
210.00
1 384 767 1150 1533 1916 2299 2682 3065 3448 3831 4214 4597 4980 5363 5746 6129 6512 6895 7278 7661 8044 8427 8810 9193 9576 9959 10342 10725 11108 11491 11874 12257 12640 13023 13406 13789 14172 14555 14938 15321 15704 16087 16470 16853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250.00
240.00
230.00
220.00
210.00
200.00
190.00
180.00
170.00
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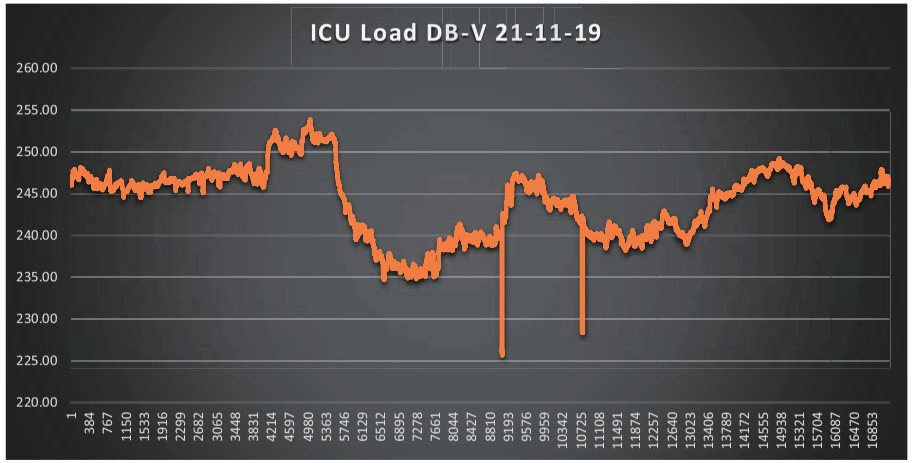
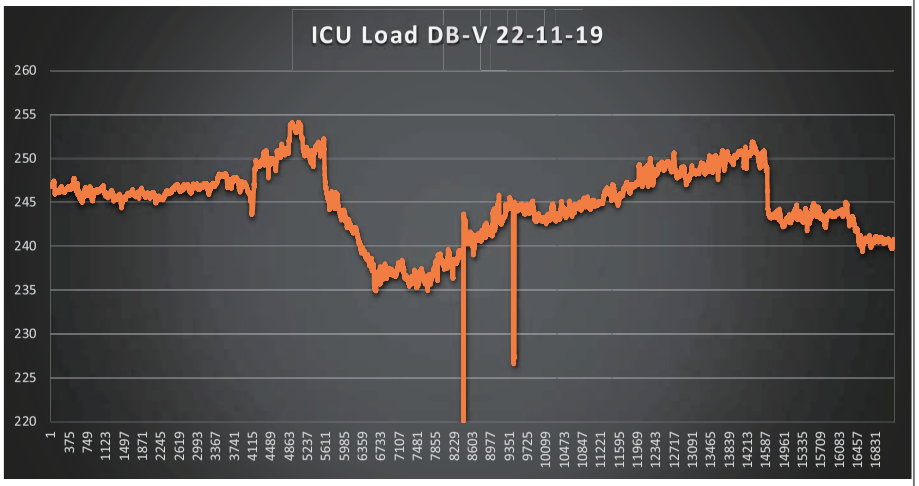
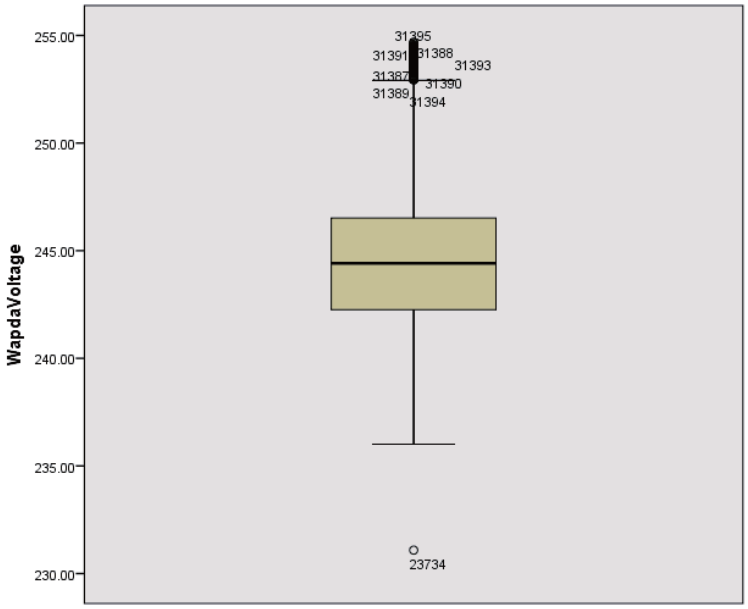

ICU Load DB-V 21-11-19
260.00
255.00
250.00
245.00
240.00
235.00
230.00
225.00
220.00
1 384 767 1150 1533 1916 2299 2682 3065 3448 3831 4214 4597 4980 5363 5746 6129 6512 6895 7278 7661 8044 8427 8810 9193 9576 9959 10342 10725 11108 11491 11874 12257 12640 13023 13406 13789 14172 14555 14938 15321 15704 16087 16470 16853



Voltage Box Plot for conclusion (Overall)

Box Plot of Wapda Incoming Voltages



Looking at the box plot of Wapda Incoming Voltages, we can observe that Phase Voltage rarely falls below 235v (L-N). Whereas majority of the voltages lies between 242-248V.

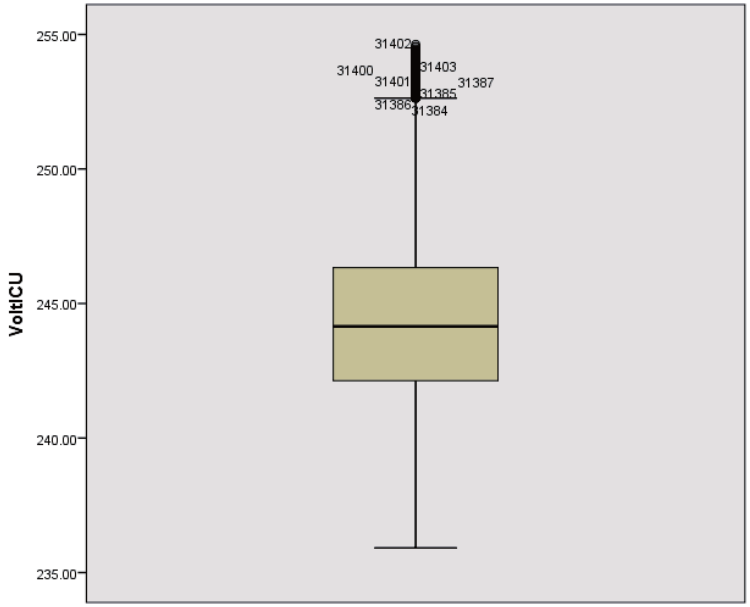
1st Quartile: 242v

Median 244v

3rd Quartile: 247v

Therefore, we can conclude that majority of time Voltages are high.

Box Plot of ICU Load DB Voltages



Majority of the voltages at this point lies between 243-247V.

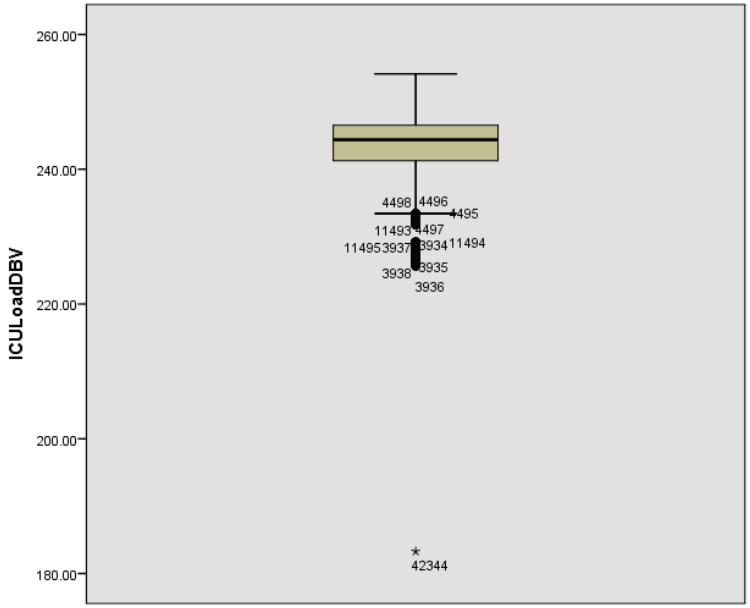
1st Quartile: 243v

Median 244v

3rd Quartile: 247v

Therefore, we can conclude that majority of time Voltages are high.

Box Plot of ICU PDB (AC Load)



This point shows Major Fluctuations in Voltages. Ranging from 220 to 260 volt regularly, whereas majority of the voltages lies between 241-247V and some data samples also fall at 185-195 volt

1st Quartile: 242v

Median 244v

3rd Quartile: 247v

Therefore, we can conclude that majority of time Voltages are high and shows fluctuations as well

FREQUENCY TREND

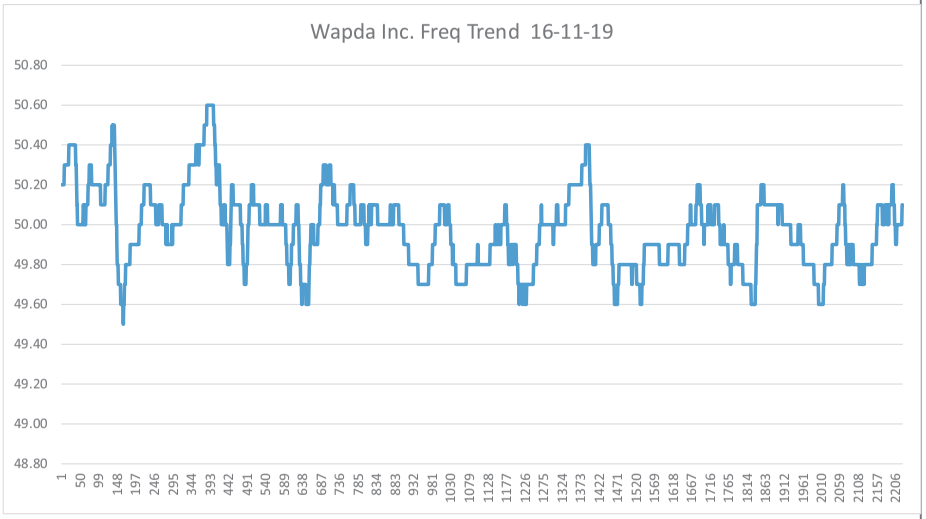
LOCATION	ANALYZER (LOCATION)	MINIMUM	MAXIMUM	AVERAGE
WAPDA INCOMING	WAPDA INCOMING - HZ AVG	49.3	50.68	50.07
	WAPDA INCOMING - HZ	49.4	50.7	50.06
ICU POWER DB	ICU POWER DB - HZ AVG	49.38	50.68	50.07
	ICU POWER DB - HZ	49.4	50.7	50.06
ICU LOAD DB	ICU LOAD DB- HZ AVG	49.37	50.68	50.07
	ICU LOAD DB- HZ	49.4	50.7	50.06

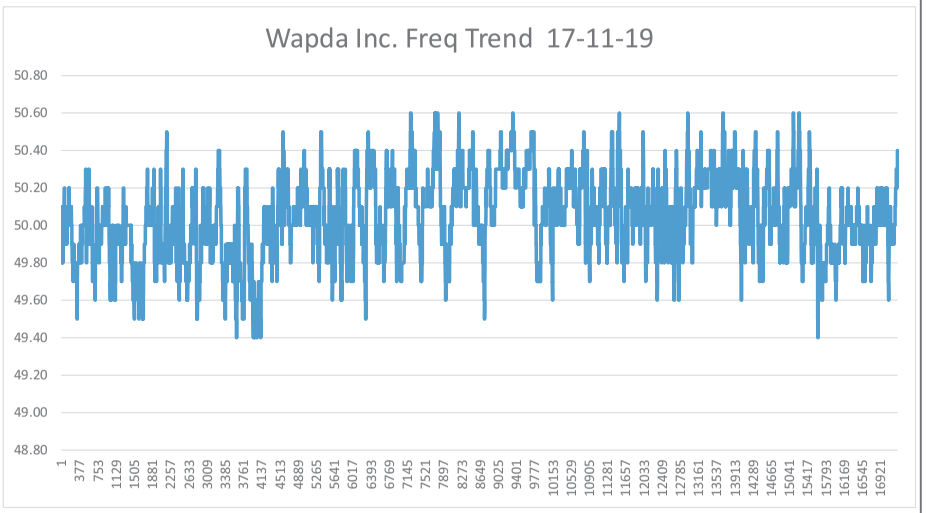
Observations:

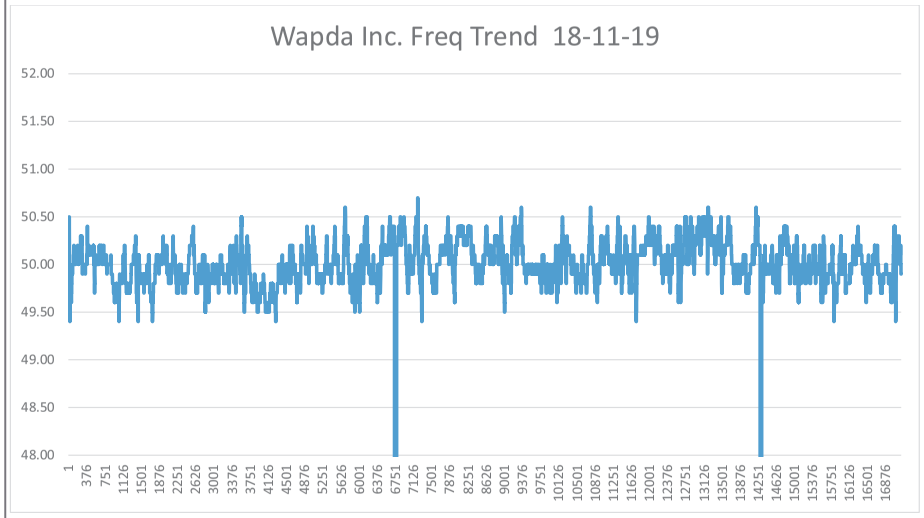
Frequency trend for analysis of 7 days shows the variation between 49.3Hz to 50.7Hz.

Frequency Trend (Day Wise)

Wapda Inc. Frequency Trend



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50.50
50.00
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1
376
751
1126
1501
1876
2251
2626
3001
3376
3751
4126
4501
4876
5251
5626
6001
6376
6751
7126
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7876
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9001
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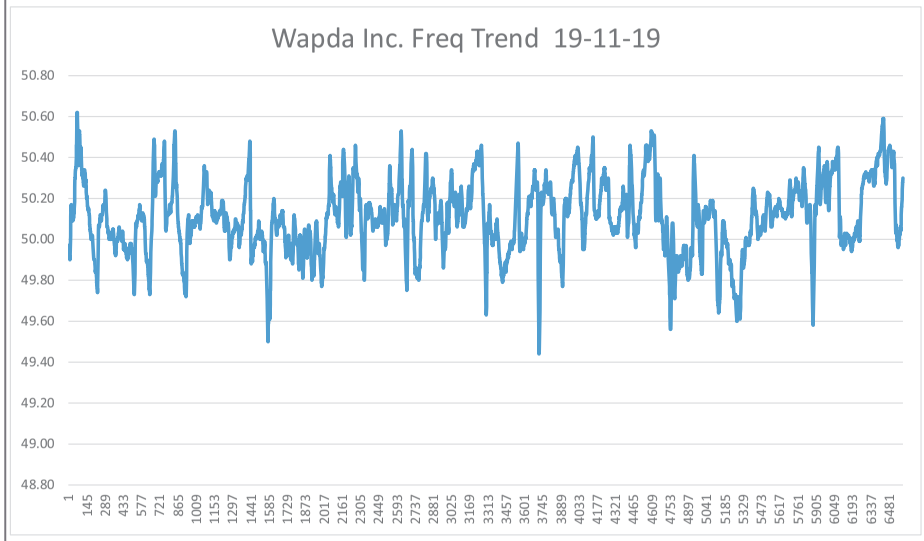
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2305
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3313
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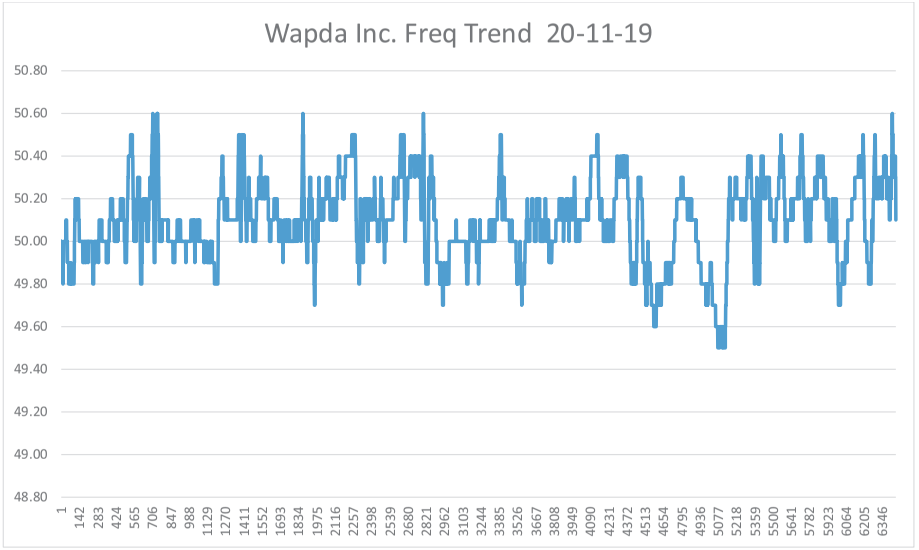
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48.80
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283
424
565
706
847
988
1129
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1693
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2116
2257
2398
2539
2680
2821
2962
3103
3244
3385
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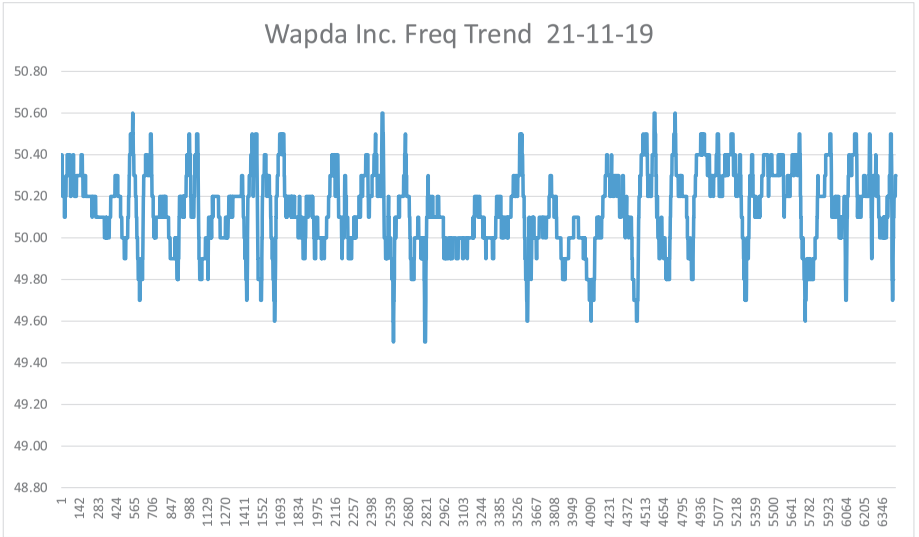
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2680
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2962
3103
3244
3385
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3667
3808
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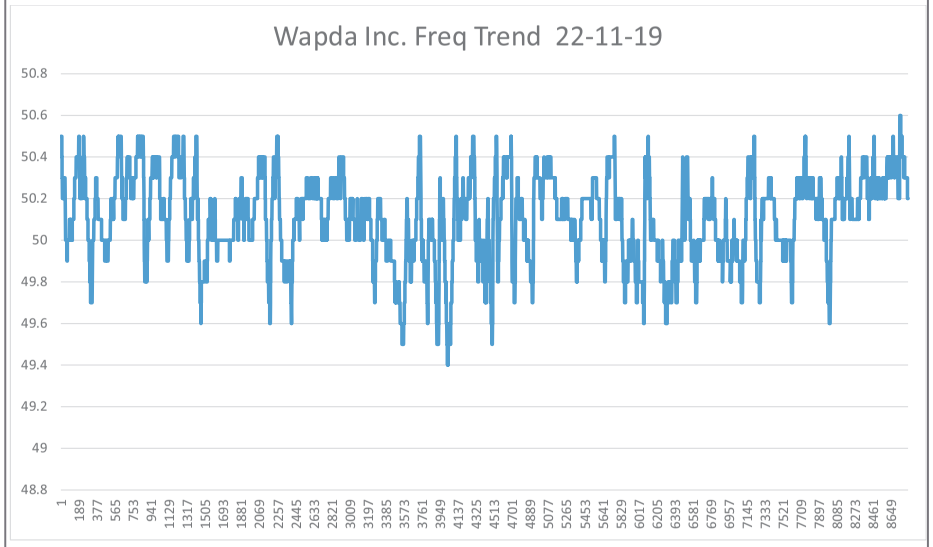
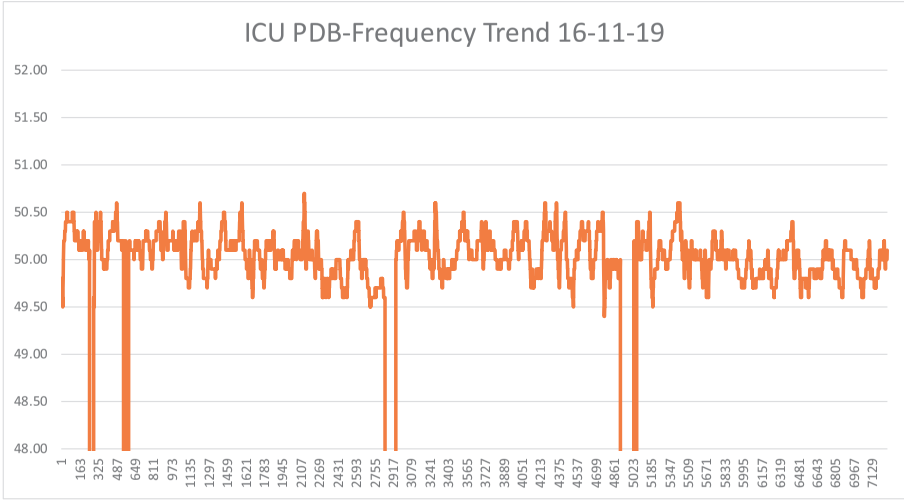
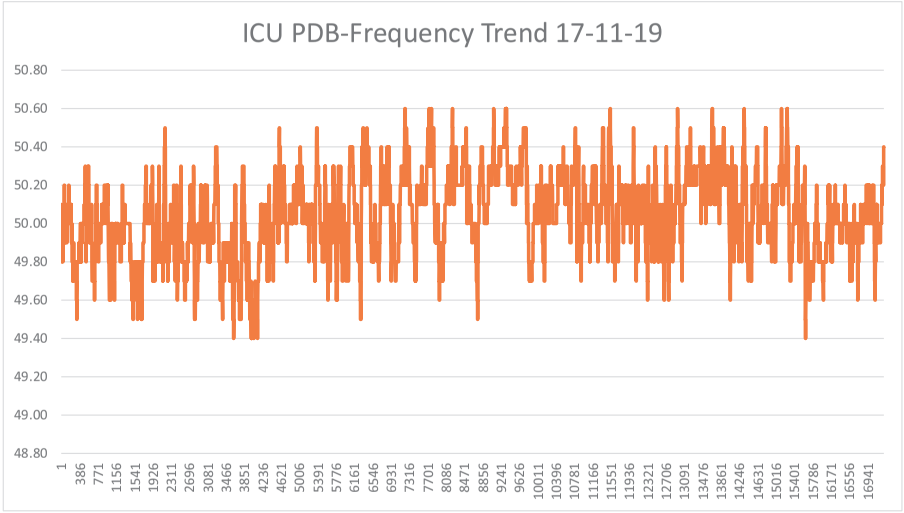
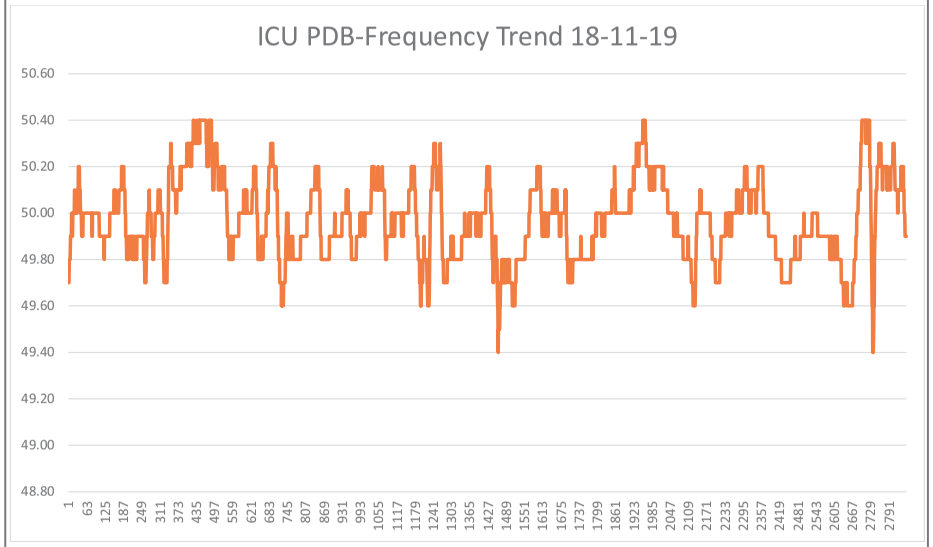


ICU PDB-Frequency Trend



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311
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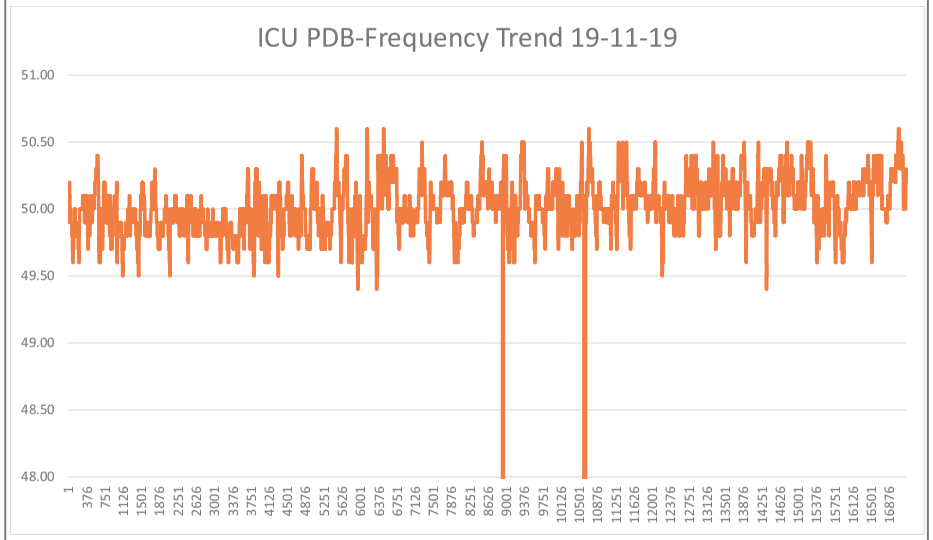
ICU PDB-Frequency Trend 19-11-19
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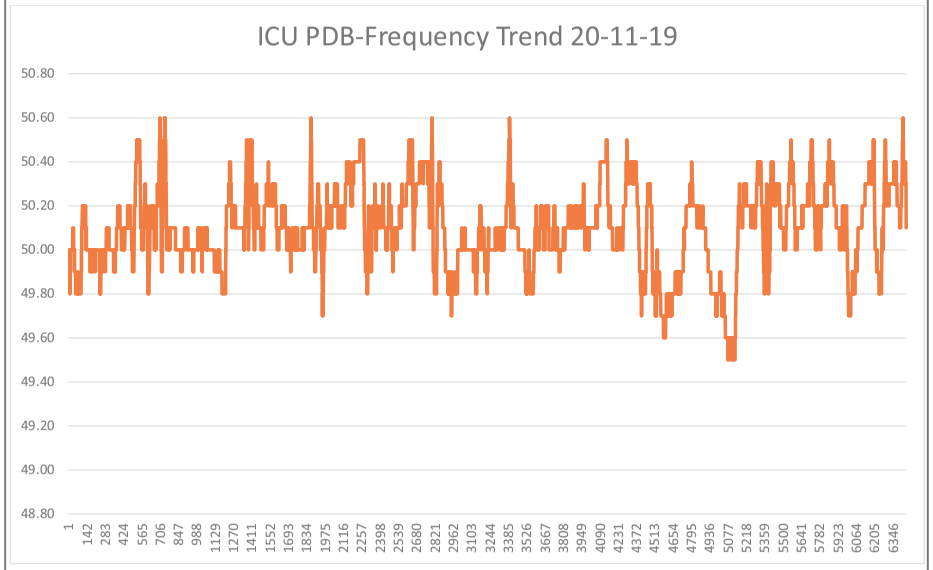
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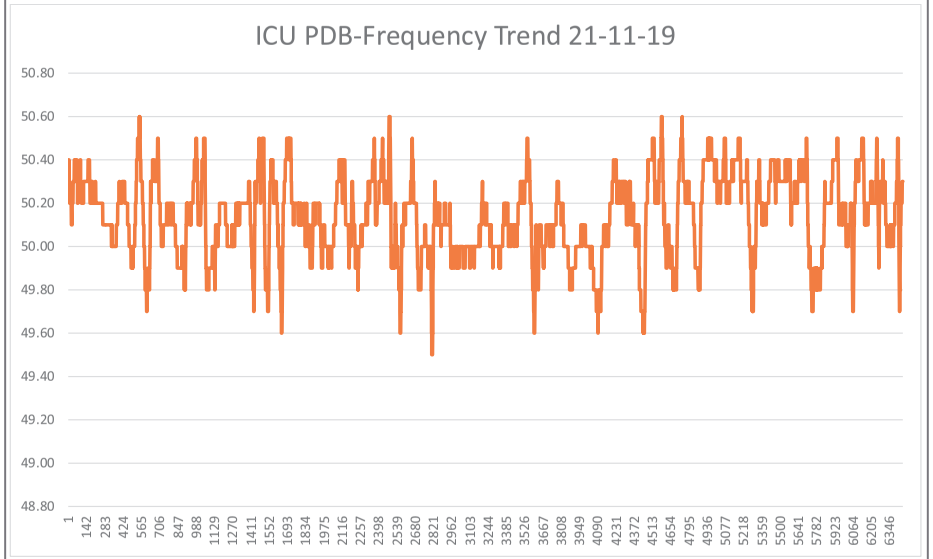
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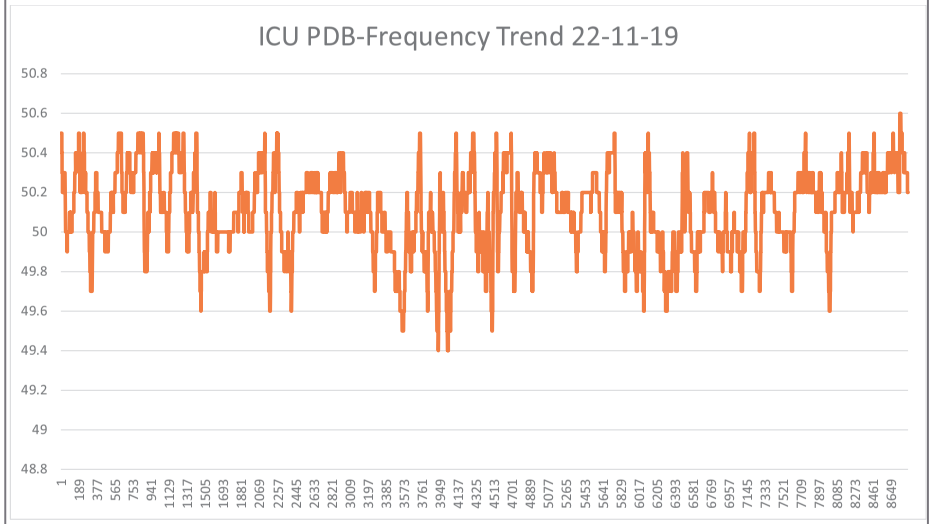
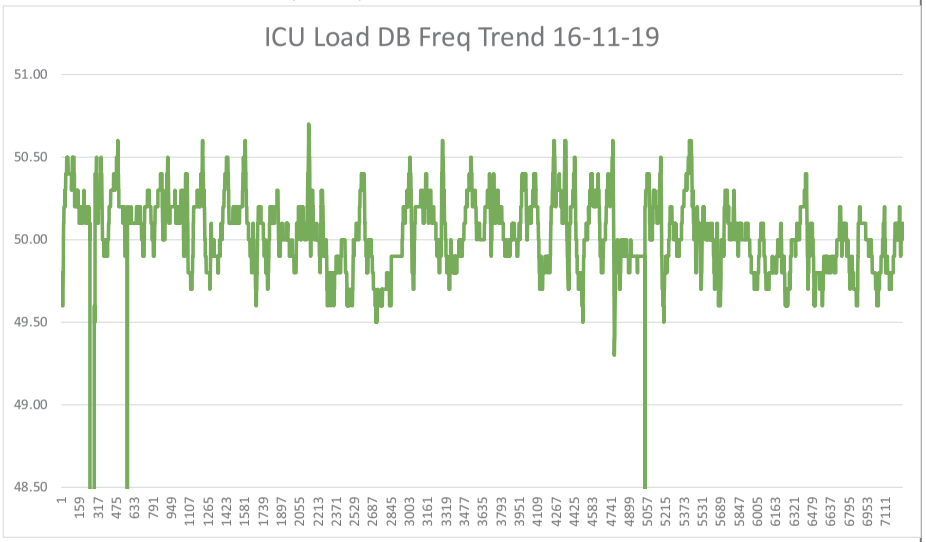
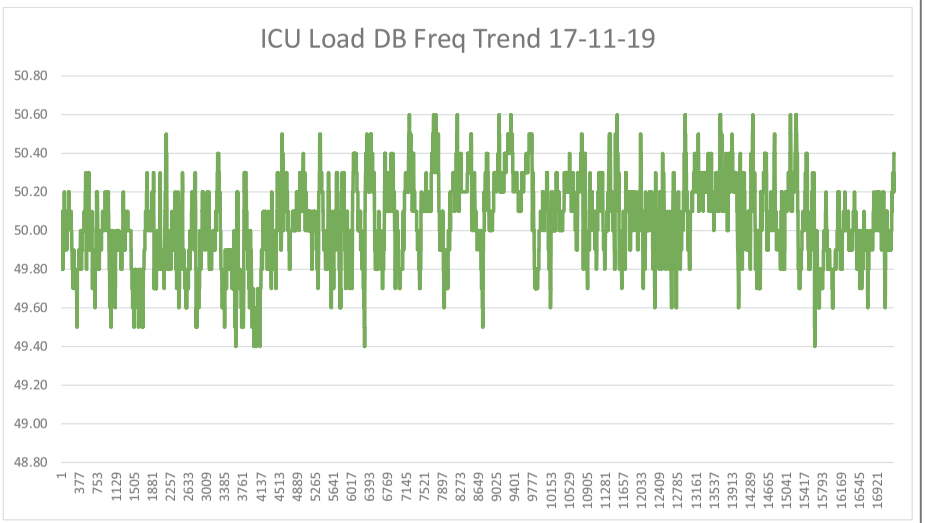
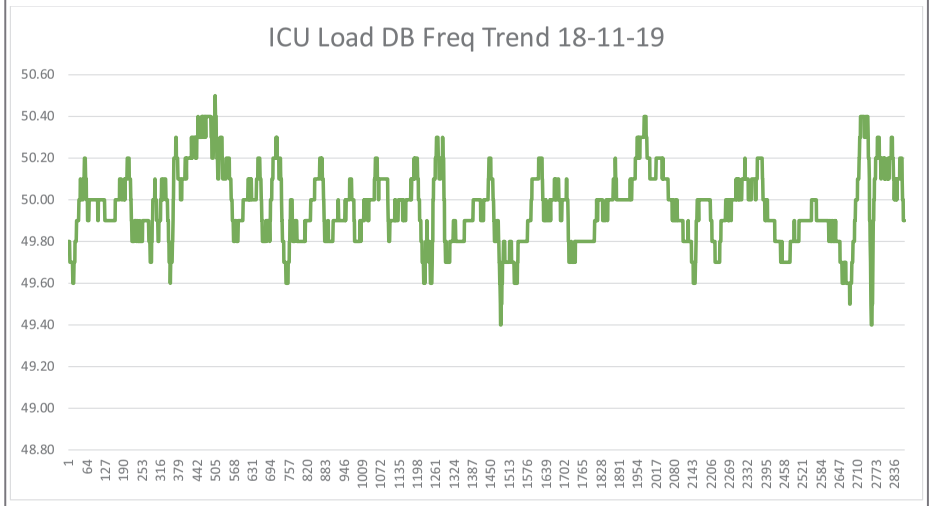


ICU Load DB Frequency Trend



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48.80
1
64
127
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694
757
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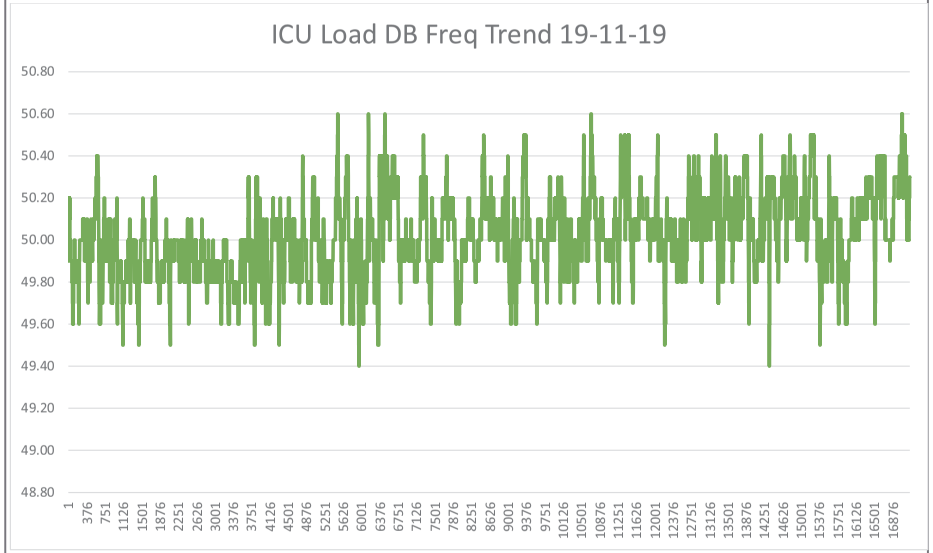
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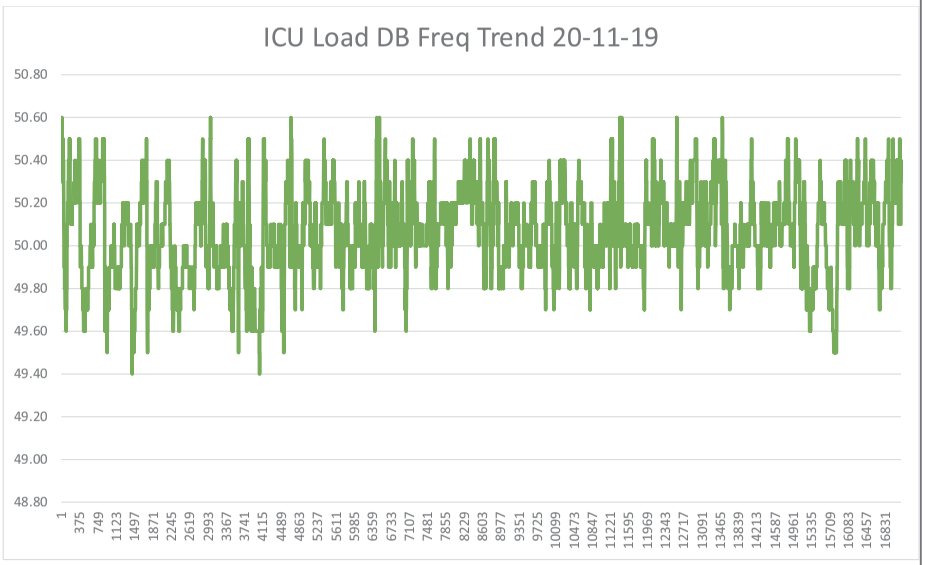
ICU Load DB Freq Trend 20-11-19
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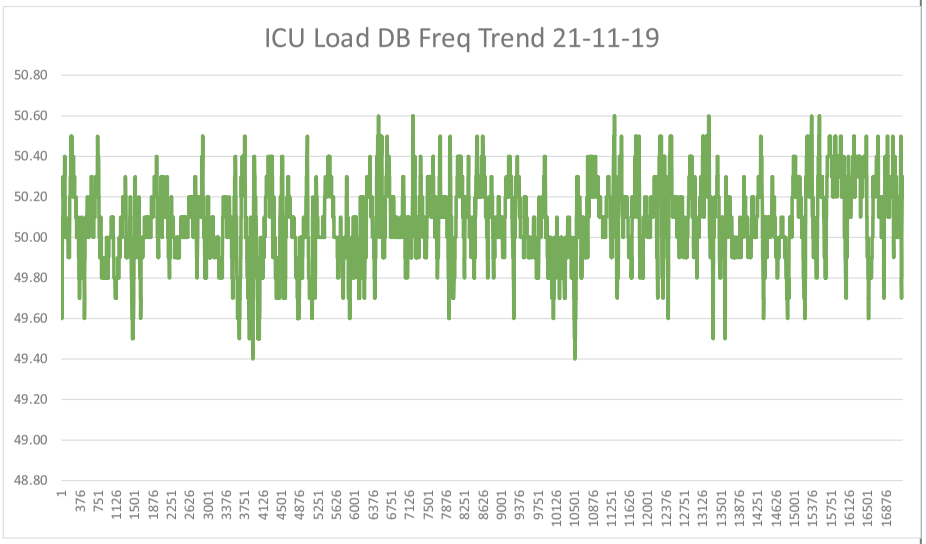
ICU Load DB Freq Trend 21-11-19
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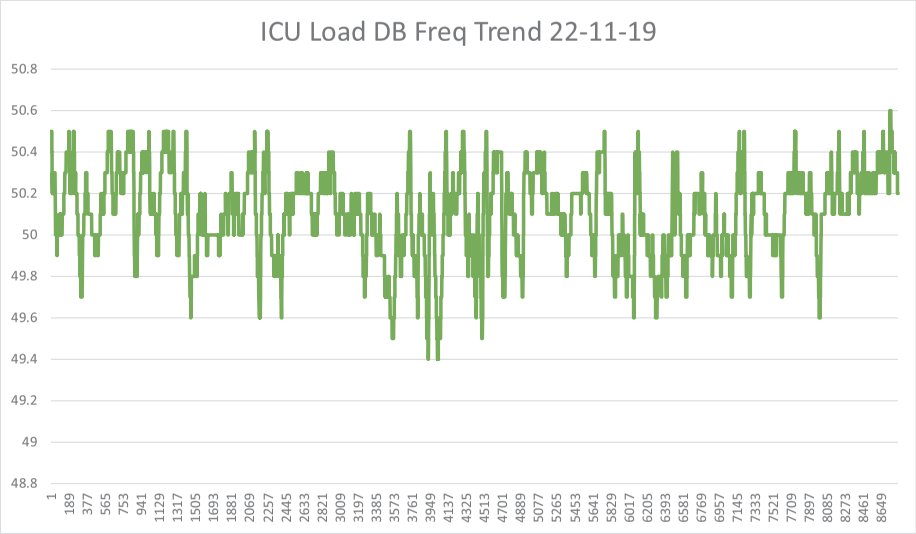

POWER BREAKDOWN/FAILURE

During 7 days of Analysis, following instance of power failure is observed:

Power Fail:	**11/16/2019 8:42:45 PM**
Power resume:	**11/16/2019 8:56:25 PM**

Power Fail:	**11/16/2019 5:47:35 PM**
Power resume:	**11/16/2019 5:56:00 PM**

Power Fail:	**11/22/2019 1:11:40 PM**
Power resume:	**11/22/2019 1:13:55 PM**

HARMONICS

A harmonic is a signal or wave whose frequency is an integral (whole-number) multiple of the frequency of some reference signal or wave. The term can also refer to the ratio of the frequency of such a signal or wave to the frequency of the reference signal or wave.

Also most electronic power supply switching circuits such as rectifiers, silicon controlled rectifier (SCR's), power transistors, power converters and other such solid state switches which cut and chop the power supplies sinusoidal waveform to control motor power, or to convert the sinusoidal AC supply to DC. Theses switching circuits tend to draw current only at the peak values of the AC supply and since the switching current waveform is non-sinusoidal the resulting load current is said to contain **Harmonics**.

Non-sinusoidal complex waveforms are constructed by "adding" together a series of sine wave frequencies known as "Harmonics". Harmonics is the generalized term used to describe the distortion of a sinusoidal waveform by waveforms of different frequencies.

Then whatever its shape, a complex waveform can be split up mathematically into its individual components called the fundamental frequency and a number of "harmonic frequencies". But what do we mean by a "fundamental frequency".

PROBLEMS CREATED BY HARMONICS:

- Excessive heating and failure of capacitors, capacitor fuses, UPS, PLC's, transformers, motors, fluorescent lighting ballasts, etc.
- Nuisance tripping of circuit breaker or blown fuses.
- Presence of the third harmonic & multiples of the 3rd harmonic in neutral grounding systems may require the darting of neutral conductors, especially in Data Centers.
- Noise from harmonics that lead to erroneous operation of control system components, UPS Controlling Cards, PLC's, Controller, HMI, & other components.
- Damage to sensitive electronic equipment.
- Electronic communications interference.
- Deterioration in voltage wave quality affecting sensitive receivers.
- Overload and possible parallel resonance between line inductance and power factor correction capacitors.
- Worst power factor, the capacity of the system to supply a certain power will be decreased.
- Cables and mainly transformers overheated and significant increase iron & copper losses.
- Problems with unexpected tripping, burning of electronic card and damaged protection systems.

STANDARD LEVELS OF HARMONIC DISTORTION:

In order to prevent harmonics from negatively affecting the Utility supply, IEEE STD 519 has been established as the Recommended Practices and Requirement of harmonic control in electrical power system. This standard has been widely adopted, but has often been misinterpreted and/or misapplied creating installation that have either been expensively overbuilt or critically under designed.

Specified in IEEE 519 and IEC 61000-3.4 & 2.2 Standards for public low-voltage power supply systems

VOLTAGE HARMONICS IN SYSTEM:

- THD-V under 5% - normal situation, no risk of malfunctions.
- 6 to 10% - significant harmonic pollution, some malfunctions are possible.
- The objective of the Voltage limits are to limit the maximum individual frequency voltage harmonic to 5% of the fundamental of the systems.
- Higher than 10% - major harmonic pollution, malfunctions are possible and in-depth analysis and the installations of attenuation devices are required.

VOLTAGE HARMONIC LIMITS:

Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems (Voltage Distortion Limits) are:

Low-Voltage System Classification and Distortion Limits

	Special Applications[1]	General System	Dedicated System[2]
Notch Depth	10%	20%	50%
THD (voltage)	**3%**	**5%**	10%
Notch Area (A_N)[3]	16 400	22 800	36 500

NOTE: The Value A_N for other than 480 V systems should be multiplied by V/480

1 **Special applications include hospitals and airports**

2 A dedicated system is exclusively dedicated to the converter load

3 In volt-microseconds at rated voltage and current

Table-1

VOLTAGE HARMONICS

Location: ICU Power DB (AC Load)

LOCATION & VOLTAGE HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
ICU POWER DB - 03.H VL1	0	0.8	0.35
ICU POWER DB - 05.H VL1	0.8	2.4	1.53
ICU POWER DB - 07.H VL1	0	0.7	0.28
ICU POWER DB - 11.H VL1	0	0.5	0.16
ICU POWER DB - THD VL1	1.02	2.4	1.59
ICU POWER DB - 03.H VL2	0	6.4	1.29
ICU POWER DB - 05.H VL2	0.6	3.1	1.61
ICU POWER DB - 07.H VL2	0	1.5	0.46
ICU POWER DB - 11.H VL2	0	1	0.25
ICU POWER DB - THD VL2	1.01	6.58	2.38
ICU POWER DB - 03.H VL3	0	0.7	0.25
ICU POWER DB - 05.H VL3	1	2.5	1.63
ICU POWER DB - 07.H VL3	0	0.9	0.38
ICU POWER DB - 11.H VL3	0	0.5	0.16
ICU POWER DB - THD VL3	1.14	2.58	1.68

Observation;

It was observed that the Voltage harmonic at this location was under the acceptable range, but at one instance at 6.58 THDV at phase 2 is observed which is over the acceptable limit (as described in table 1 above)

Location: Wapda Incoming

LOCATION & VOLTAGE HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
WAPDA INCOMING - 03.H VL1	0	0.9	0.34
WAPDA INCOMING - 05.H VL1	0.9	2.4	1.53
WAPDA INCOMING - 07.H VL1	0	0.7	0.27
WAPDA INCOMING - 11.H VL1	0	0.5	0.16
WAPDA INCOMING - THD VL1	1.03	2.38	1.58
WAPDA INCOMING - 03.H VL2	0	6.4	1.29
WAPDA INCOMING - 05.H VL2	0.5	3	1.62
WAPDA INCOMING - 07.H VL2	0.1	1.3	0.46
WAPDA INCOMING - 11.H VL2	0	1.2	0.25
WAPDA INCOMING - THD VL2	1.03	6.5	2.38
WAPDA INCOMING - 03.H VL3	0	0.7	0.24
WAPDA INCOMING - 05.H VL3	1	2.5	1.62
WAPDA INCOMING - 07.H VL3	0.1	0.9	0.38
WAPDA INCOMING - 11.H VL3	0	0.5	0.16
WAPDA INCOMING - THD VL3	1.14	2.57	1.67

Observation;

It was observed that the Voltage harmonic at this location was under the acceptable range, but at one instance at 6.5 THDV at phase 2 is observed which is over the acceptable limit (as described in table 1 above)

Location: ICU Load DB

LOCATION & VOLTAGE HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
ICU Load DB - 03.H VL1	0.4	3.2	1.29
ICU Load DB - 05.H VL1	1.5	3.3	2.20
ICU Load DB - 07.H VL1	0.2	1.2	0.63
ICU Load DB - 11.H VL1	0	0.7	0.23
ICU Load DB - THD VL1	1.76	4.7	2.68
ICU Load DB - 03.H VL2	0.3	3.5	1.16
ICU Load DB - 05.H VL2	1.4	3.1	2.24
ICU Load DB 07.H VL2	0.1	1.8	0.49
ICU Load DB B - 11.H VL2	0	0.7	0.21
ICU Load DB - THD VL2	1.72	4.94	2.63
ICU Load DB - 03.H VL3	0.8	3.6	1.34
ICU Load DB - 05.H VL3	0.7	3.8	1.50
ICU Load DB - 07.H VL3	0	1.3	0.46
ICU Load DB - 11.H VL3	0	1.1	0.23
ICU Load DB - THD VL3	1.41	5.39	2.12

Observation;

It was observed that the Voltage harmonic at this location was under the acceptable range, but at one instance at 5.39 THDV at phase 3 is observed which is over the acceptable limit (as described in table 1 above)

CURRENT HARMONICS IN SYSTEMS:

Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems (Current Distortion Limits for 120V-69KV DS)

Harmonic Limits

Current Distortion Limits for General Distribution Systems (120 V Through 69000 V)

Maximum Harmonic Current Distortion in Percent of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{sc}/I_L	<11	11≤*h*<17	17≤*h*<23	23≤*h*<35	35≤*h*	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.

Current distortions that result in a dc offset, e.g. half-wave converters, are not allowed.

* All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

Where

I_{sc} = maximum short-circuit current at PCC.

I_L = maximum demand load current (fundamental frequency component) at PCC.

TDD = Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand).

PCC = Point of common coupling.

Table-2

Isc/IL:

Isc/IL is a measure of the ratio of the available short circuit fault current at PCC to maximum demand load current (fundamental frequency component) at the same point. It is a measure of the stiffness of the electrical system relative to the load. If process plant is available to feed a small load the ratio is larger (>1000). If a small transformer with just enough capacity for the load is the only available power source, the ration is small (<20).

TDD:

TDD stands for Total Demand Distortion, based on the maximum demand load current (fundamental frequency component). It is a measure of the Total Harmonic current distortion at the PCC for the Total connected load. TDD is not intended to be the limits for any individual load within the distribution system.

Harmonic Order (h<11, 11<h<17, etc.):

These columns indicate the Limits for any individual harmonic current at the PCC, expressed as a percentage of the fundamental frequency portion of the maximum demand load current.

PCC-01:

As the Measuring Point, the data from Table-02 shows that TDD permitted for Isc/IL ratio, the 5^{th} and 7^{th} harmonics are each permitted to be 12%. The values measured (10% TDD, 9% 5^{th}, and 4.4% 7^{th}) are within the permitted limits and no further action is warranted, This should be expected, since a relatively small 1000 amp (830 KVA) load is being fed by a relatively stiff (20 mVA) systems transformer.

OBSERVED CURRENT HARMONICS

Location: ICU Load DB

LOCATION & CURRENT HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
ICU Load DB - 03.H CL1	0	9.5	2.96
ICU Load DB - 05.H CL1	0	11.9	3.47
ICU Load DB - 07.H CL1	0	1.7	0.32
ICU Load DB - 11.H CL1	0	0.8	0.12
ICU Load DB - THD CL1	0	33.11	4.70
ICU Load DB - 03.H CL2	0	24.5	3.38
ICU Load DB - 05.H CL2	0	14.6	3.14
ICU Load DB - 07.H CL2	0	4.3	0.65
ICU Load DB - 11.H CL2	0	3.2	0.24
ICU Load DB - THD CL2	0	48.22	4.95
ICU Load DB - 03.H CL3	0	14.8	2.24
ICU Load DB - 05.H CL3	0	10	1.86
ICU Load DB - 07.H CL3	0	5.6	0.74
ICU Load DB - 11.H CL3	0	4	0.35
ICU Load DB - THD CL3	0	20.12	3.38

Observation;

It was observed that the Current harmonic at this location was under the acceptable range, but maximum 50% of THD-I at one instance was observed which is over the acceptable limit (as described in table 2 above)

Location: WAPDA Incoming

LOCATION & CURRENT HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
WAPDA INCOMING - 03.H CL1	0	10.9	2.96
WAPDA INCOMING - 05.H CL1	0	12.2	3.46
WAPDA INCOMING - 07.H CL1	0	3.1	0.41
WAPDA INCOMING - 11.H CL1	0	2.2	0.29
WAPDA INCOMING - THD CL1	0	71.36	4.94
WAPDA INCOMING - 03.H CL2	0	11.9	2.38
WAPDA INCOMING - 05.H CL2	0	14.8	2.42
WAPDA INCOMING - 07.H CL2	0	7.4	0.45
WAPDA INCOMING - 11.H CL2	0	4.8	0.21
WAPDA INCOMING - THD CL2	0	17.3	3.68
WAPDA INCOMING - 03.H CL3	0	13.8	1.15
WAPDA INCOMING - 05.H CL3	0	10.1	0.78
WAPDA INCOMING - 07.H CL3	0	7.8	0.19
WAPDA INCOMING - 11.H CL3	0	7.6	0.07
WAPDA INCOMING - THD CL3	0	13.96	1.49

Observation;

It was observed that the Current harmonic at this location was under the acceptable range, but maximum 71% of THD-I at one instance was observed which is over the acceptable limit (as described in table 2 above)

Location: WAPDA Incoming

LOCATION & CURRENT HARMONIC LEVEL	MINIMUM	MAXIMUM	AVERAGE
ICU POWER DB - 03.H CL1	31.6	58.1	46.55
ICU POWER DB - 05.H CL1	15.1	38.1	26.73
ICU POWER DB - 07.H CL1	3.3	18.5	9.77
ICU POWER DB - 11.H CL1	0	8.7	2.62
ICU POWER DB - THD CL1	36.97	73.64	55.30
ICU POWER DB - 03.H CL2	0.7	54.3	33.44
ICU POWER DB - 05.H CL2	1.3	38	16.10
ICU POWER DB - 07.H CL2	0.4	21.4	5.87
ICU POWER DB - 11.H CL2	0.6	11.8	5.64
ICU POWER DB - THD CL2	5.26	69.34	40.23
ICU POWER DB - 03.H CL3	0	64.5	4.05
ICU POWER DB - 05.H CL3	0	42.3	2.50
ICU POWER DB - 07.H CL3	0	21.6	1.05
ICU POWER DB - 11.H CL3	0	8.7	0.34
ICU POWER DB - THD CL3	0	79.06	5.00

Observation;

It was observed that the Current harmonic at this location is mostly over the acceptable range, even average values of THD-I is over the acceptable limit (as described in table 2 above)