UNIVERSITI TEKNOLOGI MARA

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITY TEKNOLOGI MARA

(PERAK)

SEPTEMBER 2015

It is recommended that the report of this practical training provided

By

FAIZATUL AZLIN BINTI GANI

2013231848

Entitled

Structural Work of 8 Storeys Car Park Podium (Post Tension Method)

accepted in partial fulfilment of requirement has for obtaining Diploma in Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at TJ CIVIL & STRUCTURAL CONTRACTOR SDN BHD for duration of 5 months starting from 25 May and ended 9 October 2015. It is submitted as one of the prerequisite requirements of DBN307 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Date	: 25 May 2015

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I would also like to thank all the UiTM lectures that have taught and nurtured me in becoming a better student and person. I would also like to extend my deepest appreciation to the lecturers who are directly involved during my training stint. To Pn Sahidah Samsuddin, Supervising Lecturer, Pn Wan Nordiana Binti Wan Ahmad, Practical Training Coordinator, Dr. Mohd Rofdzi Bin Abdullah, Faculty Coordinator, I value the time, effort, encouragement and ideas that they have contributed towards the successful completion of my training, his report and the valuable knowledge that have been shared over the last few semesters.

Last but not least, my special thanks to my beloved parents for their sacrifices over the years.

Thank you so much.

ABSTRACT

A podium car park (also known as parking garage, parking structure, parking ramp, parkade, parking building, parking deck or indoor parking depend on where it takes place) is a vertical building designed and where there are a number of floors or levels on which parking takes place. This report aims to study the installation method of car park podium using post tension method and the requirement needed to construct podium. There are many method of study were used in obtain information for this report. For examples through observation, interview or by reading written material. The result will showed that there are certain requirements that must to follow when want to use this method. This method will decrease the beam designed and will reduce the time to complete the work.

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CHAPTER 1.0

PREFACE

1.1 Introduction

As urbanisation expands and the number of cars on our streets continues to grow, the lack of parking places is forcing us to reconsider our use of space, to maximise its potential, and to investigate the possibility of vertical development. Modern offices, apartment blocks and shopping centres use a combination of hard and soft landscaping on their flat roofs and underground parking facilities to make the most of their limited open space.

Consideration for the layout of car park is the number of vehicles to be accommodated with the space available. Beside those factors that need to be considered is type of vehicle which motorcycle, ambulance, vans, and etc. Vehicle flow rate to be consider for estimate the number of space to be provided to meet demand at peak time in, especially for commercial building like shopping centre or hospital. (https://www.thenbs.com)

Multi storey car park generally consist of basic layout like flat deck, split level, ramp floor, vehicle access to parking area, vehicle lifts and etc. to overcome the problem of vehicle circulation, can be organize by using combined or separate entry/ exit, one-way or two way traffic, arrow sign, and degree of parking alignment. The new upgrading for the podium is the light sign to tell either the parking is still vacant or not. If the parking is empty, the green light will warn, or otherwise it will become red. The payment method also affects the design which is use pay machine on parking deck or in stair lobbies, or pay by phone and also grace periods allowed after payment, prior to vehicle exit (if pay on exit is selected). (https://www.thenbs.com)

1.2 Objective

Objective of this study include the comprehensive about the usage of standard operation procedure in construction. From the above statement, objective intently to be achieve are as follow:-

i. To study the standard operation procedure of podium car park.

ii. To determine the requirement to construct podium.

1.3 Scope of study

This report is focusing on a construction method and also the requirement needed for construct podium at Lot No.74256, Jalan Putra Murni 3/1, Putra Height Mukim Damansara, Daerah Petaling, Selangor Darul Putra Height Mukim Damansara, Daerah Petaling, Selangor Darul Ehsan

1.4 Method of study

There are two methods of study were used in obtain information for this report. The methods are primary and secondary. Primary sources are materials that have not been processed or printed the resources or materials that are still in original condition. These resources are original and not interpreted. Primary sources are divided into observations and interviews method.

i. Observation method

This observation method is done directly that is with site visits. This observation is also supported by the used of camera. This camera is used to take pictures at the project site for more information on a project for example, a photo of the machine and the progress of the construction site.

ii. Interview method

Other methods that can be used to obtain information for this report are interview. Interview was conducted to obtain more detailed information about the project. This method are done with interview someone who is experienced or involved in the project for example, interviewing engineers, site supervisors, contractors and project manager.

The secondary source of the latter is made up of materials or documents reviewed by reading written material. These sources include magazines, journals, newspapers, newsletters, and blogs. The second source is the material that has been processed, printed and disseminated to the public. In this project, for secondary sources to obtain information by making reference such as referring books, magazines, blogs, internet and any references related to the construction industry. Besides that, for other information may refer the drawing or document.

i. Journal

Journal is one of the reading materials prepared from a person create. There is a lot of information that can be obtained from the use of journal. Journals are usually done for an individual work, and sometimes a small group.

ii. Books

In this project, the book has been used as a secondary source to get more information about the construction of a swimming pool. There are several books that have been used to obtain information. These books are available from the internet, the use of the websites Google books.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Incorporated in May 1996, T.J Civil & Structural Contractors Sdn Bhd (TJCSC) was established for the principle business of carrying out general contract works for both the private and public sectors.

From its humble beginning as a contractor of small projects in Kedah, it has grown progressively over the years. Today, it is a reliable and quality housing contractor with a captive clientele base of reputable; standing. Over the years of its incorporation it has successfully completed many prominent projects including school, rice mills, factories, government buildings, roads and all types of residential houses.

It holds a CIDB Grade & certificate, PKK Class A license as well as an ISO 9001:2000 certification in Civil Engineering and Buildings Works.

Its core activities are in civil engineering, building works, steel structures construction and infrastructures works. It is intent on maintaining excellence and steady growth through continual enhancement of its core assets, its human resource, via training and skills development.

Today, the company is poised for further growth and expansion. It is keep to pursue projects that are sustainable, balanced, well planned and integrated.

2.2 Company Profile

Company Logo	
	Figure 2.1: Company Logo.
Registration No	386236-D
Date of Incorporation	May 6,1996
Head Office	No 7B, 2nd Floor, Jalan M U8/M, Seksyen U8, Bukit Jelutong, 40150 Shah Alam, Selangor Darul Ehsan.
	Email: info@tjgroup.com.my URL: www.tjgroup.com.my
Alor Setar Office	No 230, 1st Floor, Jalan Shahab 2, Shahab Perdana, Lebuhraya Sultan Bahuyah, 05150 Alor Star, Kedah Darul Aman.

Board of Directors	Derren Teoh Teik (Managing Director)
	Anny See Ai Gaik (Executive Director)
	Nicole Teoh Xin Yi (Director)
Principle Bankers	Hong Leong Bank Bhd, Jalan Teluk Wanjah, 05250 Alor Star, Kedah
	Maybank Berhad, Jalan SS 16/4, Subang Jaya, 47500 Subang Jaya
	CIMB Bank, 1519-B 1st Floor Jalan Tungku Ibrahim, 05000, Alor Star, Kedah Darul Aman
Business Activities	Civil Engineering, Building Work, Steel Structure Construction and Infrastructure Work are the main core activities of the company.

2.3 Organization Chart (Site Based)

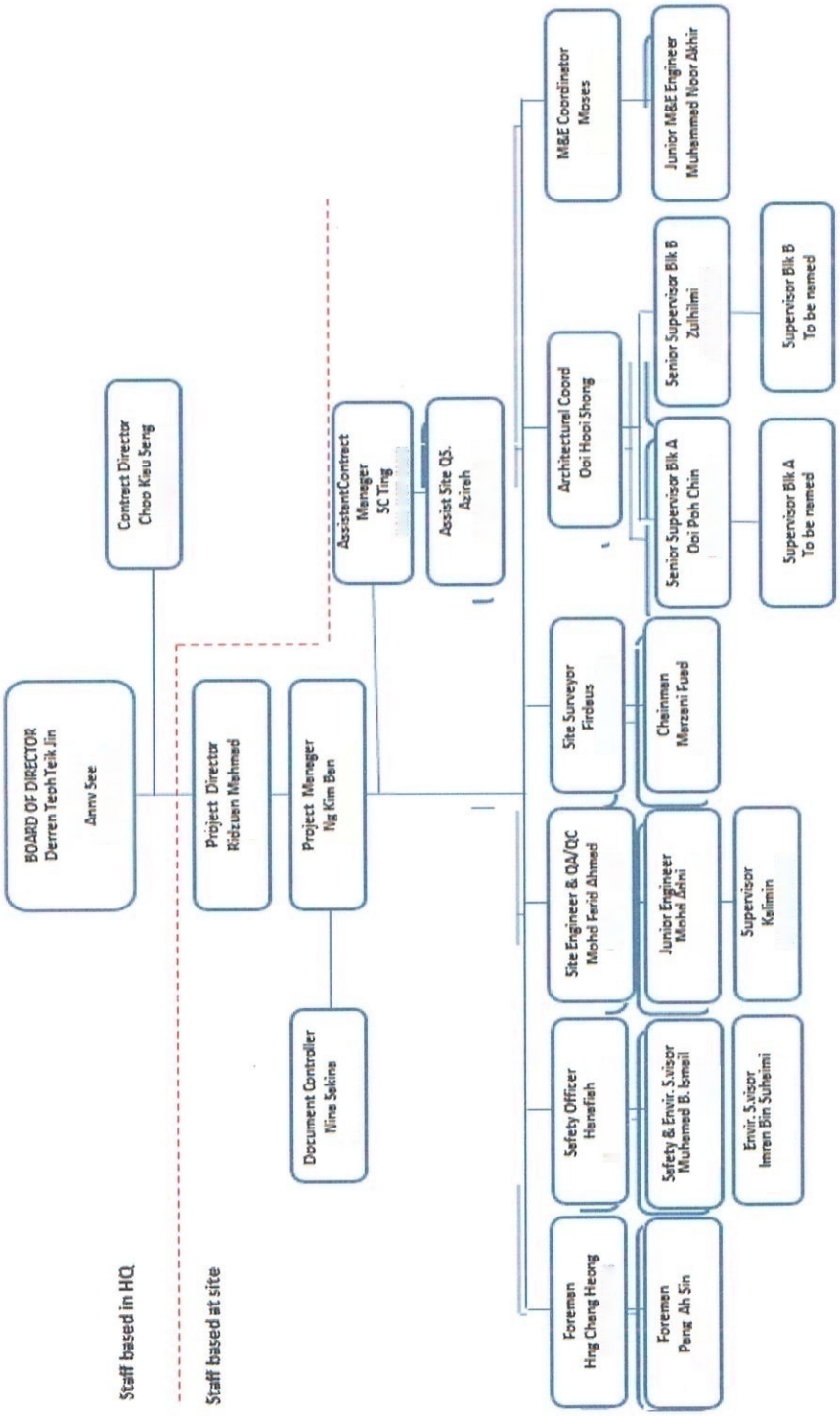


Figure 2.2: Organisation Chart.

2.4 List of Projects

2.4.1 Completed Projects

Table 2.1: List of Completed Project.

Project Title	Contract Value RM	Date of Commencement According to Contract	Date of Completion
Cadangan Pembangunan Skim Perumahan Yang Mengandungi 44 Unit Rumah Berkembar 2 1/2 Tingkat Jenis G2, 18 Unit Rumah Berkembar 3 Tingkat Jenis G3, 1 Unit Pencawang Elektrik Dan 1 Unit Pondok Pengawal, Di Atas Lot' 1024 Mukim Cheras, Sungai Sekamat Daerah Hulu Langat Selangor Darul Ehsan.	53,138,000.00	1 July 2012	21 October 2014
Cadangan Untuk Membina Skim Perumahan Fasa 1A 68 Unit Rumah Berkembar 2 Tingkat, (Jenis C), 76 Unit Rumah Berkembar 2 Tingkat (Jenis D), Fasa 1B 10 Unit Rumah Berkembar 2 Tingkat (Jenis C), 16 Unit Rumah Berkembar 2 Tingkat (Jenis D), Fasa 7A 2 Unit Rumah Berkembar 2 Tingkat (Jenis C), 4 Unit Rumah Berkembar 2 Tingkat	23,335,596.13	15 October 2011	02 May 2013

(Jenis D), 3 Unit Pencawang TNB, 1 Unit Pondok Pengawal di atas Lot 1725, 1727, 1728, 1729 & Sebahagian Lot 1686, 1768, 1781 & 1789 Mukim 14, Seberang Perai Tengah			
Proposed Construction and Completion seven (7) Bungalow Units on Lot: PT6733, PT6734, PT 6735, PT6736, PT6738, PT6740 & PT6761 At Seri Beringin (Area S4) Bukit Damansara, Kuala Lumpur	22,880,000.00	25-Nov-10	28-May-12
Cadangan Membina 72 Unit Rumah Berkembar 2 1/2 Tingkat Diatas Lot 1431, Bandar Mahkota Cheras, Mukim Cheras, Daerah Hulu Langat, Selangor Darul Ehsan. Pakej 2: 34 Unit Dan 1 Unit Pondok Pengawal.	22,500,000.00	4-Jul-11	25-Jun-13
Cadangan Mendirikan Rumah Banglo Sesebuah Diatas Lot 108, No.2, Jalan Begonia (PT13222) Di Planters' Haven– Desa Impian Menghijau, Mukim Labu, Daerah Seremban, Negeri Seremban.	871,940.94	6-Jan-10	5-Aug-10.

Cadangan Membina Dan Menyiapkan Sebuah Pusat Perniagaan 2 Dan 3 Tingkat Yang Mengandungi 18 Unit Lot Perniagaan, 1 Unit Rumah Sampah, 1 Unit Perhentian Bas Dan Teksi, 1 Unit Pencawang Elektrik, 1 Unit Pondok Pengawal Diatas Lot No 14, Jalan Serambi U8/24, Seksyen U8, Taman Bukit Jelutong, 40150 Shah Alam, Selangor Darul Ehsan.	11,480,000.00	29-Mar-07	30-Jan-09
The Supply, Erection & Completion Of 1 Block 4-Storey School Building Comprising 12 Classrooms, Meeting & Computer Rooms And Multi-Purpose Space (Ground Floor) Within Existing S.R.J.K. (C) Chung Hwa School Compound On Lot No. 123, Mukim Kuah, Daerah Langkawi.	1,288,105.65	28-Oct-05	27-Oct-06
Proposed Construction And Completion Of 92 Units Double Storey Linkhouses At Phase L4, Bukit Jelutong, Shah Alam For Guthrie Property Development	18,759,104.68	26-Jul-04	6-Mar-06

Cadangan Membina Sebuah Kilang dan Gudang 1 Tingkat kepada premis sediada no1, Jalan Ganggur 28/30, Seksyen 28, 40000 Shah Alam Selangor Darul Ehsan untuk Tetuan MPI Polyester Industries	13,540,000,00	20-Nov-06	20-Apr-07
Proposed Loading Platform and Roof at No. 1, 3, 5, Jalan gunggur 28/30 and No. 2, 4, 5 Jalan Hulu Teris 28/31 (Lot 1228 & 1229) Seksyen 28, Shah Alam, Selangor Darul Ehsan Untuk Tetuan MPI Polyester Industries Sdn. Bhd.	126,000.00	26-Oct-05	30-Nov-05
Cadangan Pindaan Dan Tambahan Kepada Blok 'D' Bangsal Terbuka Setingkat Bagi Kilang Sediada, Di Atas Lot 1000 Dan Lot 608, Mukim 8, Jalan Bandar Baru, Seberang Perai Selatan, Pulau Pinang	3,800,000.00	01-Nov-01	01-Jun-02

2.4.2 Project in Progress

Table 2.2: Project in Progress.

Project Title	Contract Amount RM	Date of commencement according to contract	Date of completion
Proposed Construction & Completion Of Two (2) Towers Of Serviced Apartment Consisting Of 1. Tower A – 19 Story (130 Units) 2. Tawer B – 32 Story (210 Units) Including 8 Story Of Carpark Podium 3. Other Facilities Consisting Of Muliti Purpose Hall, Surau, Reading Romm 1&2 At Common Facilities Level 19 (Tower A) & Children Care Centre, Swimming Pool At Level 9 (Tower B), Gym, Reading Room 1 & 2 At Level 32 4. 7 Units Of Retail At Level 1 5. 1 Units Of Guardhouse On Lot No.74256, Jalan Putra Murni 3/1, Putra Heights, Mukim Damansara, Daerah Petaling,	121,278,110.31	15 April 2015	14 Feb 2017

Selangor Darul Ehsan Fo Messrs. Sime Darby Usj Development			

CHAPTER 3

CASE STUDY

3.1 Introduction of Projects

This project is proposed construction & completion of 2 towers (A and B). This tower is serviced apartment consisting of 19 storeys (130 units) and 32 storeys (120 units). Other facilities consisting of multipurpose hall, surau, reading rooms 1&2 at common facilities level 19 for tower A. while for tower B consist of children care centre, swimming pool at level 9, gym, reading room 1&2 at level 32 and 7 units of retail at level 1. Last but not least is 1 unit of guardhouse.

The location of this stucy is on Lot No.74256, Jalan Putra Murni 3/1, Putra Height Mukim Damansara, Daerah Petaling, Selangor Darul Putra Height Mukim Damansara, Daerah Petaling, Selangor Darul Ehsan. This project is for Messrs Sime Darby USJ Development Sdn. Bhd.

Figure 3.1: Illustration of Finish Project

3.2 Case Study

3.2.1 Podium

This study, explain about the "Structural Work of 8 Storeys Car Park Podium (Post Tension Method)". It will start from construction of podium including the slab (post tensioning method), column, ramp and parapet wall. Last but not least it will discuss about concreting work, steel design and formwork of the structure.

As urbanisation expands and the number of cars on our streets continues to grow, the lack of parking places is forcing us to reconsider our use of space, to maximise its potential, and to investigate the possibility of vertical development. A podium car park (also known as parking garage, parking structure, parking ramp, parkade, parking building, parking deck or indoor parking depend on where it takes place) is a vertical building designed and where there are a number of floors or levels on which parking takes place. It is essentially a stacked car park that usually construct at basement/underground or flat rooftop area. Usually podium will built at modern office, apartment block, or shopping centre to make the most of their limited open space. Any design will need to accommodate specific construction requirements such as the required build-up depth for elemental paving, the depth of growing medium required by the planting scheme, the maximum permissible surface loads, the provision of a suitable waterproofing system and fire fighting system, and so on.

In this project, the 8 storeys of podium is constructing at block B. It is because the tower B with 32 storeys is higher than tower A which is made up from 19 storeys. At tower A there are 130 units house while tower B have 210 units house. At the level 5 and 6 of tower B, they will build link bridge between this two towers. The ground floor of block B will have 7 retail and water features.

This report discuss about podium at level 3&3A. This podium will divide into several zones as shown at drawing "Level 3 & 3A Floor Layout Plan". The gridline 5-9a/G-S is level 3A, while the gridline 9a-11a/G-S is level 3. The ramp will construct at gridline 9-10/H-J and another one at 9-10/P-Q. This podium will have

lift at gridline 9-10/L-M and stair that play role as emergency exit. The parapet wall will be built around the podium and also to divide between the two zones. The column will use conventional method where will use timber formwork. The special of this podium is, there is no beam to support the load. The beam will replace by post tension slab (PT slab). This method is more practical where it can save time, manpower and space.

The design code podium with post tensioning slabs is in accordance with B.S. 81 10: Part 1: 1997 and Technical Report 43.The post tensioned transfer slab is analysed and design with RAM Concept which is Finite Element Method program. In this project, the sub-contractor for the post tension slab is PBB ENGINEERING SDN BHD. The flow of work will roughly be like this

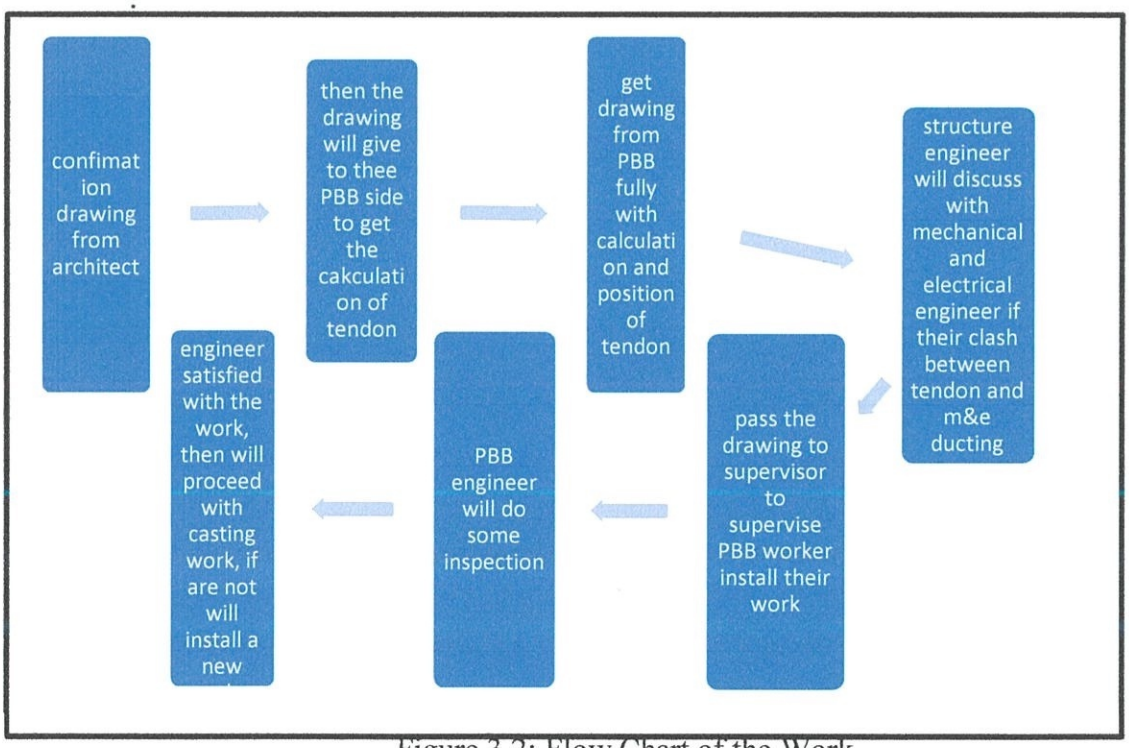


Figure 3.2: Flow Chart of the Work.

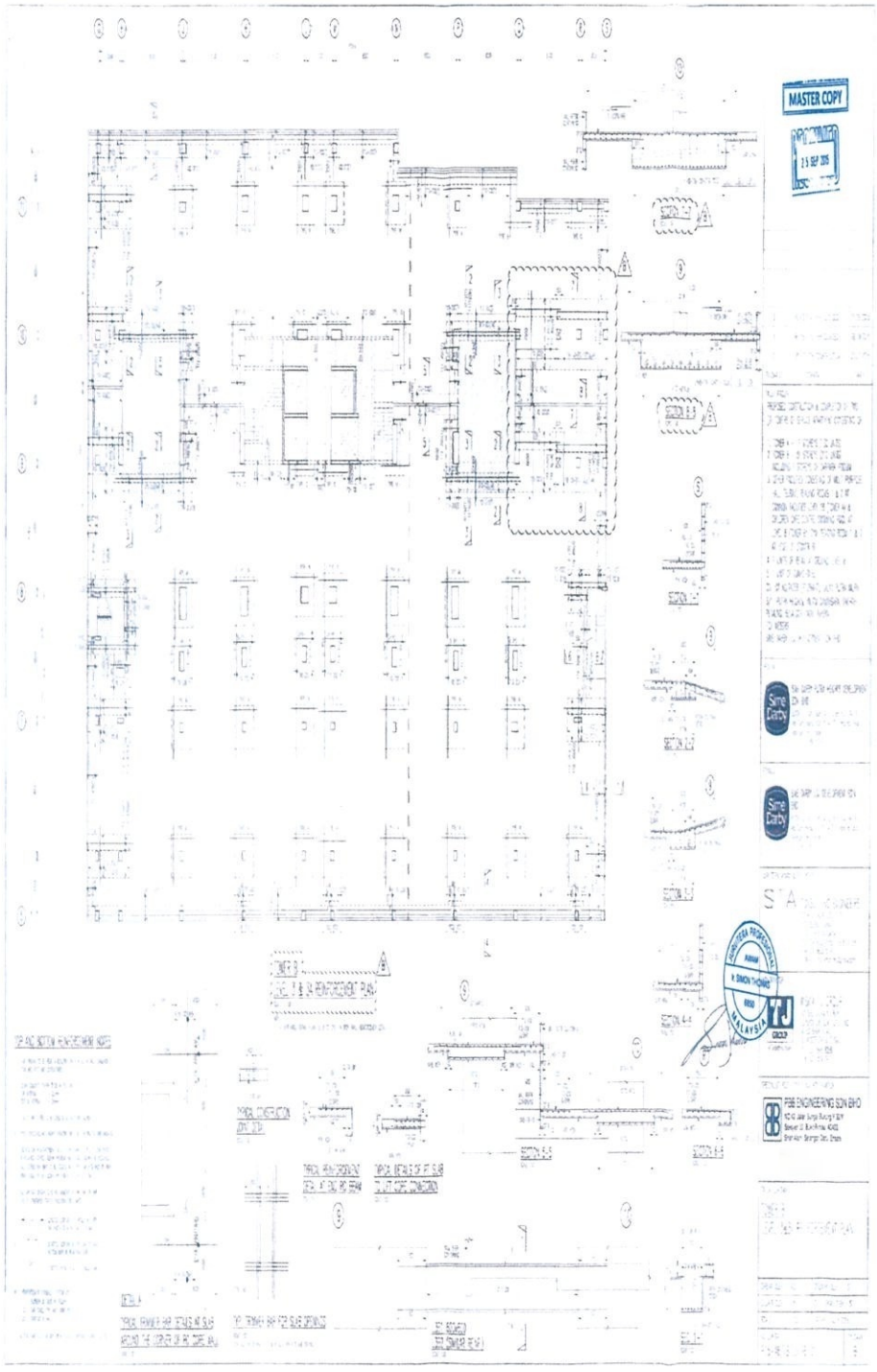


Figure 3.3: Drawing Level 3 & 3A Floor Layout Plan.

3.2.2 Concreting Works

Concrete is a product of cement, fine and coarse aggregates, and water, which is mixed at a specific ratio. Usually, ratio of mixture for cement, sand and aggregate will be fixed according to the weight or volume. The principal constituent of concrete is the binding medium used to bind the aggregate particles together to form hard composite material. The binding medium is the product form by chemical reaction between cement and water. Water used in concrete mix is usually according to water cement ratio. The mixture hardened due to chemical reaction between cement and water. When concrete is wet, it can be shaped according to the mould. Other than being widely used in building construction, especially in column, beam and floor slab, concrete is also used in other constructions such as road, dam, offshore structure and tunnel.

3.2.2.1 Slump Test

Slump is the tests that use to see the workability of the concrete. When concrete is in fresh condition, it will flow to the sides and sink in height. This vertical settlement is known as slump. A concrete is said to be workable if it is readily placed in the form where it is intended. The correction of slump will get by adjusting the proportions of the sand and aggregates used without change the amount of the water specified for each bag of cement. There are three type of slump which is true, shear and collapse.

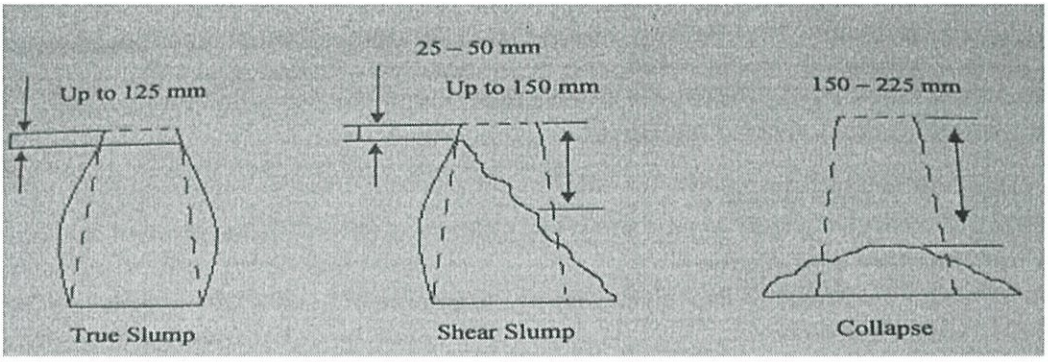


Figure 3.4: Types of Slump.

The apparatus and equipment that use in this test is wheelbarrow and shovel, steel plate, ruler, trowel, scoop, steel tamping rod, frustum set. The procedure for this test is take representative sample from the fresh concrete. Then, make sure the frustum is clean and place the steel plate as a base on the flat surface. Next, put the cone on the plate and stand on the foot-pieces. After that, fill the cone with concrete in three layers. Each layer is approximately one third of the cone. Rod each layer in turn 25 times. After top layer has been tamp, fill the frustum, smooth of the top fill by passing the rod over the frustum and level with a trowel. Clean the plate from concrete which may have dropped or leaked out. Carefully and slowly lift the frustum in vertical direction. Then, place the empty frustum beside the concrete. The rod is place on top of the frustum. Measure with a ruler the differences between the rod and the concrete. Last but not least, record the measured slump to the nearest 5 mm, and determine the type of slump.

3.2.2.2 Cube Test

Concrete cube test are prepared to ascertain the hardened concrete compressive strength at 7, 14 and 28 days. Extra concrete volume was prepared to allow for casting additional concrete test cube.

The equipment for cube test is 6 mould for cube (usually 150 x 150 x 150)mm, grease, curing tank, bolts and nuts, brush and vibrating table. The procedure of this task is check the moulds are clean and joint faces have been greased. Make sure they are assembled in the right way with tight bolt. Then, fill the mould with the concrete by three layer which mean each layer is 50mm. compact each layer by vibration by mean of pneumatic hammer or vibrating table until the specified condition is achieved. Label each cube. Next, store the cube under the shade, away from wind and where it will not be disturbed. After 24 hours, loosen al the bolt. Gently remove the mould. Put the cube in the water (22°c - 25°c). Make sure to leave the cubes covered with water and wait until 7, 14 or 28 days. Remove and wipe the test cube that where cured in water. Weight the cube before carrying out the compression test. Remember to remove any grit or projecting fins from the surface of the cubes, which will be in contact with the platens. Clean the bearing surface of the testing machine. Place cube centrally on the lower platen. Apply the load and record the maximum load. Record the type of failure and crack.

3.2.3 Steel reinforcement

This is includes reinforcing bars, wire fabric and pre-stressing steels. Reinforcing bar or rebar is manufactured as grade 250 and 460. Grade 250 is usually known as mild steel bar that is plain round in shape which is small sizes. Grade 460 is usually known as deformed high yield steel bar. Deformed bars provide good bond performance in concrete. It will minimal the cracking of the concrete. It also to protect the steel from rusting and to make sure the steel is well engaged by the mass concrete. Spacing is a concern as related to the thickness of the concrete.

3.2.3.1 Tensile Test

This test is to specify the characteristic strength of grades 250 and 460, the elongation at fracture length of five times the size of the bar must at least 22% or 12%. The yield stress is measured at 0.33% and 0.43% strain for the two grades, the tensile strength must exceed the yield stress by 10% or a value between 5% and 10% according to yield stress and tensile strength.

The apparatus and equipment for this test is tensile test machine] extensometer, weighing machine, steel ruler and vernier scale. The procedure is starting by take the measurement of reinforcing bars according to grade of steel. Then, mark position on gauge length by first identifying the mid position on the bar. Mount sample by inserting it into the gripping section of machine. Position sample in the grips and tighten the screws. Next, place extensometer to record the elongation of gauge length. Remove extensometer when proportional limit had been reached. Last but not least, record elongation, ultimate load and failure load.

3.2.3.2 Bend Test

The tensile behaviour of ductile materials is usually determined using tensile test, in which the sample is pulled uniformly in tension until it fractures. This is to determine any transverse rupture on the metal during bending. Ultimate load, displacement and crack visibility are to be recorded.

The apparatus and equipment that use in this test is three point bending test set up, steel ruler and former. The procedure in this test is take appropriate measurement of reinforcing bar. Then, identifying specified former according to the bar diameter. Place reinforcing bar on a specified span on the three point bending test set up. Next, grip the former into the gripping section of the machine and tighten it. Finally, collect the data by record displacement and ultimate load.

3.2.3.3 Steel Fabric Test

Welded fabrics are wires or bars welded into sheet form. Fabric produced comprises in square or rectangular welded together or the entire cross over points in a shear resistance manner. The full test on steel fabric includes tensile test and bend test for cross end longitudinal bars. Two samples are required for each test, thus a total of 4 samples need to be prepared. Another two sets of samples are to be prepared to test the strength of weld, where each sample must contain the intersection of the cross bar on the longitudinal bar.

The apparatus and equipment use in this test is vernier scale, steel ruler, steel cutter, testing machine, wire mesh. The procedure for this test is preparing steel fabric to the required size for tensile, bend and strength of weld test. Determine dimension of samples. Next, conduct tensile and bend test and record results of test accordingly. For strength of weld test, place one end of the bar in the grip, and a hook at the intersection weld of the bar in the opposite grip longitudinally. Lastly, the ultimate strength and mode of failure is recorded.

3.2.4 Formwork

Formwork generally forms a part of the concrete construction and influences the performance of hardened concrete. The formwork may be defined as moulds made of timber or some other material into which the freshly mixed concrete is poured which hold the concrete till it sets. A good formwork should be strong to support load of workman, easily to stripped safe, economical, stiff, leak proof, and smooth. Selection of material to be used for formwork largely depends on material available and cost. Usually timber or plywood is very economical. But for a big project, usually will use steel or aluminium formwork.

Table 3.1: Types of Formwork.

No	Type of Formwork	Detailing
1	Timber formwork	-Cheap -Easily available and easy to work (manually /machines). -Light for easy handlings and lifting. -Stiff for not giving excessive deflections. -Usually free from knots, knots holes and bad flaws. -Sawn timber is preferable for rough surfaces to be rendered afterwards. -Planned timber gives smooth surfaces. -It should not be green, dry and shrink, but at the same time not too dry as it would absorb water from the concrete. -Partially seasoned timber is the most suitable. Suitable allowances for bulging and shrinkage should be made in preparing the surface. -For timber formwork, due to its temporary nature, higher stress

		may be allowed in design than that used in permanent timber works. -It is better to use clamps and screws, rather than nails, in the formwork I to facilitate its stripping and reuse.
2	Plywood formwork	-Plywood sheets bound with synthetic resin adhesive are being widely used. -The thickness of the plywood varies from 3 to 18 mm. -Sizes less than 6 mm thick are used for lining the timber formwork for curved surfaces. -The common sizes are 1200 x 1200 mm to 3000 x 3000mm. -The main advantage is that large panel surfaces are available. -The fixing of forms is rapid and economical. -It does not warp, swell or shrink during the setting of the concrete. -It has high impact resistance
3	Steel formwork	-It has high impact resistance. -Commonly employed for big projects where the forms are to be repeatedly used. -Can be easily fabricated and do not require many adjustments as the units are standardized. -Gives smooth surfaces that need very little finishing. -Prove to be very economical for the circular columns and flat slab construction. -Square steel plates 500 mm sizes are generally used. -Fight steel sheet panels of 500 mm sizes and stiffened with its angles are also available.

To preparing formwork for reinforced concrete slab, column parapet wall and ramp need apparatus and equipment like plywood, hammer, nail, L elbow, steel tape, sand paper, sawing machine, hand saw, steel ruler and 2 by 2 timbers. The procedure is start with identify total number of pieces required to form the formwork. Then, mark measurements of each piece accordingly incorporating extra length for base and end pieces. Make similar marking to supporting members and braces. Cut to size based on the measurement marked. Then, clean from dust and any material that will affect the properties of concrete by using sand paper. Fasten the formwork according to the dimension using nails. Secure formwork from collapsing by placing supporting members and braces. Check for any possible defects in the formwork especially from leaking.

3.3 Method Statement for Podium

3.3.1 Material Properties

a) Concrete

b) Concrete cube strength at 28 days, fcU — 35 N/mm2

c) Reinforcement

Mild Steel

a) High Tensile Steel

b) BRC

Strand Type and Properties

a) Strand to be 12.7mm diameter supa grade, low relaxation with UTS of 183.7 lcN per strand to ASTM A416-80

b) Jacking force per strand = 138 IcN per strand

Seven-Wire Low Relaxation Strand

Nominal Diameter 12.7 mm

Nominal Area 98.7 mm2

Nominal Weight Minimum Ultimate Strength Modulus of Elasticity, Eps Minimum Breaking Load

Relaxation, low 2.5 % at 0-7 U TS after 1000 hrs

Prestressed Frictional Parameter

a) Angular Friction, p = 0.2

b) Wobble Friction, k = 0.0017

Design Load

a) Superimposed Dead Load (Carpark) = 0.5 kN/m2

b) Imposed Live Load (Carpark) =2.5kN

3.3.2 Material for Post Tension

Table 3.2: Material for Post Tension.

No	Material	Description
1	Strand  Photo 3.1: Strand.	-Seven wire low relaxation strand -Nominal diameter :12.7mm -Nominal area :98.7mm^2 -Nominal weight :0.7775 kg/m -Minimum ultimate strength :1860 N/mm^2 -Modulus elasticity :195 kN/mm^2 -Minimum breaking load :183.7 kN -Relaxation, low 2.5% at 0.7 UTS after 1000 -Temporary corrosion protection : water soluble oil -Identification : metal tag for each oil -Certificates : certificate of each shipman -Strand grade in accordance with BS 5896 : 1980 super
2	Duct	-Duct or sheathing shall consist of corrugated spirally wound, rounded or flattened type, made from galvanised steel strip of 36.5mm width by 0.27mm thickness or equivalent.

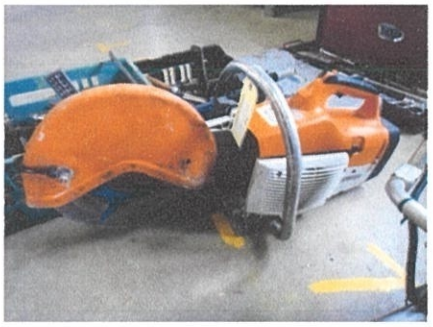
	 Photo 3.2: Duct.	-The galvanized steel strip material shall be In accordance with JIS G3141 SPCC-1 B or equivalent. -Duct size: oblong shape for flat tendon 20 x 70mm (max. 5 strands) -Bound shape for multi-strands tendon -52mm diameter (max. 5 to 7 strands) -65mm diameter (max. 6 to 12 strands) -90mm diameter (max. 1 3 to 19 strands) -Coupling of the ducts for oblong duct shall be affected by making slits at the side of one duct and enlarge it to slide into the next duct. -Coupling of the round duct shall be via a duct coupler of 3mm bigger in diameter by 200mm long. -Further taping the joint with a plastic masking tape shall be carried out to prevent grout ingress
3	Anchorages 	-Anchorages to be designed for up to the max. 95% of the ultimate tendon force. -At this time of stressing, minimum concrete cube strengths of 25 N/mm^2 is required. -Anchorages to comply with the requirements of AS 1314-1972.

	Photo 3.3: Anchorages.	-The live anchorage to be used shall of cast-iron anchorage block or steel bearing plate. -The dead end anchorage shall be of exposed strand with bulb head anchorage. -Corrosion of the gripping and anchorage system {wedges and anchor heads) is prevented by oil for wedges and by corrosion protective agent on the anchor head. Oil and corrosion protection agent should e non-aggressive and non-degrading.
4	Grout  Photo 3.4: Grout.	-Grout should consists of :Ordinary portland cement is 50 kg bag -Portable water -Grout additive type Methocel K 15 MS or equivalent water/cement ratio : < 0.45 % -Additive/cement ratio : 0.45% by weight of cement -Compressive strength : 17 N/mm^2 at 7 days
5	Anchorages Recess	-The anchorage recesses should be patched up by dry packing. -Cement sand mortar ratio shall be 1:3

Photo 3.5 : Anchorages Recess.

3.3.3 Equipment for Post Tension

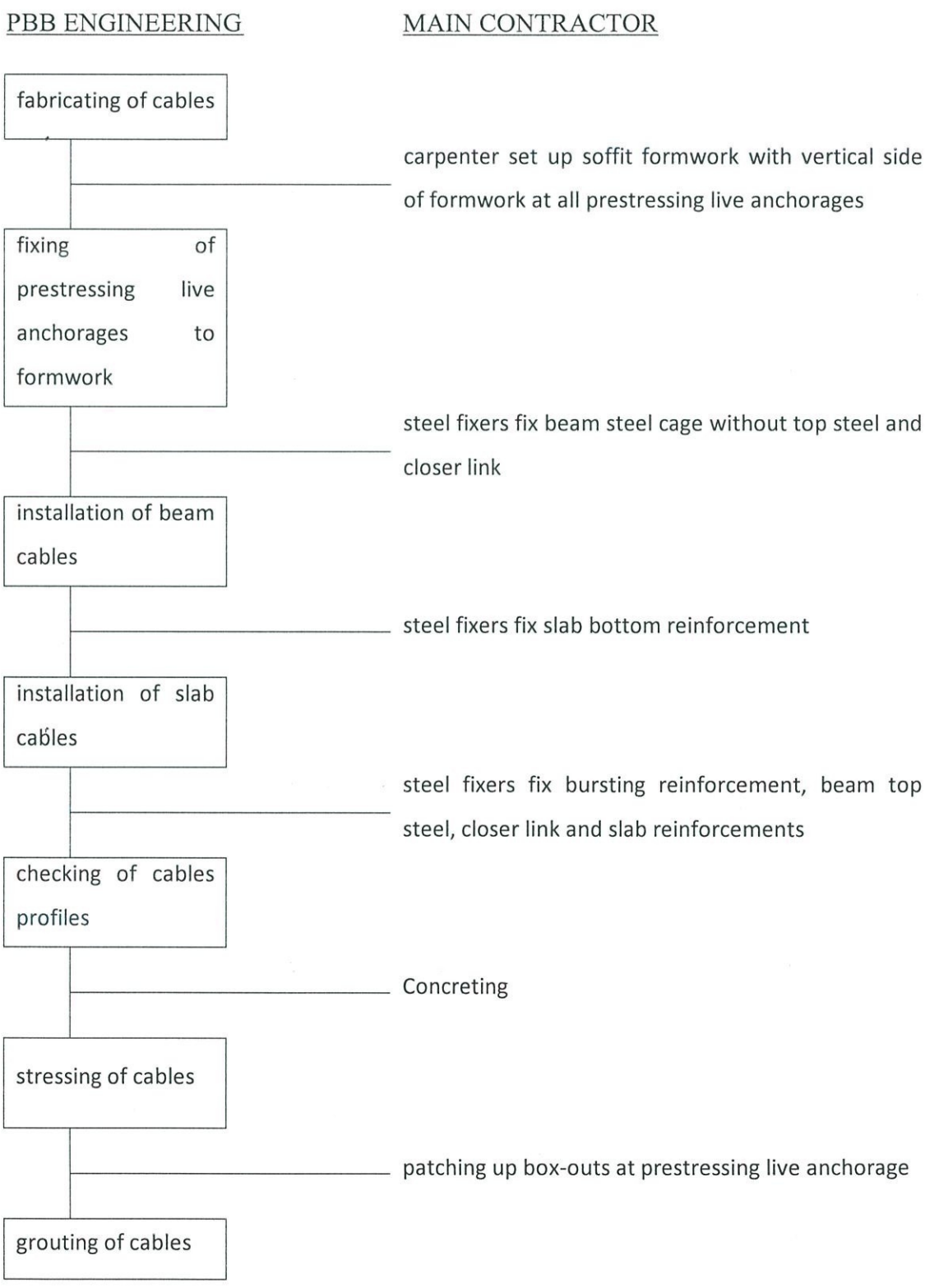
Table 3.3: Equipment for Post Tension.

ITEM	PLANT	QTY	USAGE
1	Bripad	1 nos	Uncoiling prestressing strand
2	Disc cutter  Photo 3.6: Disc Cutter. Source: https://www.google.com	2 nos	Cutting pretressing strand
3	Dead end device  Photo 3.7: Dead End Device.	1 nos	Fabricating dead ends
4	200 tons jack -Mono-strand and multi-strands jacks of double-acting type shall be used.	1 no	Stressing of cables

	-Jacks and pressure gauges shall be accompanied by a calibration chart to ensure accurate measuring of the applied force.  Photo 3.8: 200 Tons Jack.		
5	Hydraulic stressing pump "OTC"  Photo 3.9: Hydraulic Stressing Pump.	2 no	Operating jack
6	Motorised/ electric grout pump cum mixer -Grout mixers to be specially designed for the purpose of mixing and agitating the grout and carrying out the grouting operating in a single unit of equipment.	1 no	Mixing and pumping cement grout

	-Grout mixer must enable the grout constituents to be metered accurately with an absolutely homogeneous mixture passes through a standard sieve to the pump.  Photo 3.10: Motorised / electric grout pump cum mixer.		
7	100mm test cube mould  Photo 3.11: 100mm test cube mould.	6 nos	Making test cubes

3.3.4 Construction sequence



3.3.5 Construction method (slab)

1) Fabricating of cables

Cutting list shall be made from measuring the approved shop drawings. The cutting list consists of cable lengths to be fabricated including allowance for stressing length, quantity of anchorages and sheathings. The pressurising cables are 7 wire strand of 12.7 mm dia. packed in circular coils of 12,000 feet long each. For the cables, the outer packing materials of the coil of strand shall be removed before fixing the bripad. After fixing the bripad the steel strips tying the coil of strand shall be cut and the strand be pulled out from the bripad in reasonable straight manner. Bripad to be used where applicable. The strand shall be cut according to the cutting list using the disc cutter and dead ends being made using dead end device. Sheating is made of galvanized steel and come in 6 metre lengths with one end belled for joining to required length.

Photo 3.12: Fabricating Method

Photo 3.13: Fabricating of Method

2) Installing of stressing anchorages to formwork

Following the erection of soffit formwork, the carpenter shall fix vertical side formwork at all prestressing live anchorages. All live anchorages points shall be marked and drilled on the vertical side formwork. Slab casting together with polystyrene blockouts shall be then fixed to the vertical side formwork.

Photo 3.14: Installing of Stressing Anchirages to Formwork

Photo 3.15: Installing of Stressing Anchirages to Formwork

3) Installation of beams and slab tendons

After fixing of beams steel cage without top bars, profile bars shall be fixed at approximately one meter spacing according to the parabolic profiles of the approved shop drawings. The prestressing strands for beam tendons shall be assembled into the sheathings and installed into the steel cage supported by profile bars. After fixing of beam top and slab bottom reinforcement the prestressing strands for slab tendons shall be assembled into the sheatings and installed at required spacing. The prestressing tendons shall be supported by bar chairs to the required profile. Grout vent pipes shall be placed at both ends of the tendon with an additional intermediate grout vent at one high point location for tendons up to 30 metres long. For tendons up to 60 metres long three intermediate grout vent shall be provided at a high point location. Joints and connections shall be sealed with tape to avoid ingress of concrete materials.

Photo 3.16: Installation of Beams and Slab Tendon.

Photo 3.17: Installation of Beams and Slab Tendon.

4) Checking of tendons profiles

All cables profile shall be checked with measuring tape and adjusted if necessary before concreting with a tolerance of ± 5mm for slab and beam tendons. Pretressing tendons shall be supported by profile bar tied to bar chair.

Photo 3.18: Checking of Tendon Profile.

5) Casting Work

After get approval from PBB engineer, the casting work will take place.

Photo 3.19: Casting Work.

6) Stressing of tendons

After 24 hours of concreting, the carpenter shall remove the vertical side formwork at all prestressing live anchorages. Prestressing anchor heads and wedges shall be fixed to all pretressing casting. Spray paints all strands at wedges. When concrete have reached the specified transfer strength, stressing of cables shall be carried out using hydraulic jack. 1 set 3 days concrete cube test are provide to determine the transfer strength. All cables shall be stressed to the required pressure according to the calculated stressing pressure. When all strands are stressed, the distance between wedges and paint mark shall be measured to an accuracy of 1 mm and the value entered in the stressing record.

Photo 3.20: Stressing Tendon.

Photo 3.21: Stressing Tendon.

7) Control of stressing operation

Stressing operation shall be carried out by experienced personnel. Calibration certificate of gauges shall be provided once every one year. Calibrated instruments test certificate shall be provided before stressing work commence, as we were unsure which instruments is going to use. During stressing, the supervisor will calculate the actual extension and compare with the calculated extension. All stressing length of cables shall be cut after approval of stressing records.

Photo 3.22: Control of Stressing Operations.

8) Approval of stressing record

During stressing operations, information of the stressing record shall be kept for each cable with copies submitted to the engineer's site representative and pre-stress transfer slab designers. The engineer shall check, comment or give approval to these records immediately within 24 hours after receipt. The approval durations shall be in reasonable working day. In general, the approval of the stressing work at the final stage is based on the difference of the actual extension and the calculated extension with the following criteria:-

-Within +/- 6%

- Approved without comment.

-More than +/- 6% but within +/- 10%

-Engineer to check extension of all tendons in the beam as a group

- If the average falls within tolerance (+/-6%), then it okay.

-more than +/- 10%

-de-stress tendon

- flush duct with water soluble oil & air to check for blockage in duct.

-replace wedge

-spray paint at wedges

-stress tendon to required pressure

-record extension and submit to engineer approval

-Upon approval, grout tendon.

9) Grouting of tendons

Grout shall be mixed according to the design mix. Grout shall be mixed for at least for minutes or until a consistent colloidal mix of thick cream or heavy point is produced. The water should be poured into the container first, followed by non-shrinkage additive and the cement. All grout shall pass through a screen with 1.8mm maximum clear openings prior to being introduced into the grout pump. Grout shall then be injected into each duct with a minimum pressure of 25 psi and maximum pressure shall not exceed 75 psi. Grouting shall be done from one end of the duct until clear grout flow out from the other end. The grout hose at the end shall be sealed and maintain pressure before sealing the injecting end. Six number of grout test cube shall be made for every batch of grouting.

Photo 3.23: Grouting of Tendon.

10) Patching of stressing recess

Remove all loose and deleterious material from stressing recess and flush clean with water. Mix 1 part cement to 3 parts sand (dry pack).Fill stressing recess with dry pack using trowel. Trowel finish flush with concrete face.

Photo 3.24: Patching of Ftressing Recess.

3.4.5 Construction Method (parapet wall, ramp and column)

1) Procedure step rebar

Usually rebar cutting, bending and tying will be based on the Contracts Shop Drawings. For better understanding of the Rebar Installation sequence, sketches may be developed at site and will identify by Site Engineer. Delivery notes, mill certificates, steel origin, supplier, manufacturer and other details of all delivered steel consignments will be checked on site with appoint consultant. The records will be available for consultant reference and contractors or any future use. Install rebar's accurately in position and secure against displacement that might be caused during concrete pouring. Ensure all embedded items are fixed accurately at required locations and secure tightly against any possible displacement and take note for any modification done during the installation embedded items shall be indicated in the check sheets as required. Embedded items shall not be supported by welding to rebar. Lapping and chairs shall be provided as per the approved drawings. For every 100 tons in each shipment two samples of each bar shall be tested as per specification to sure the bar follow the specification.

2) Formworks

Formwork will consist of plywood, steel or aluminum. Based on the drawings requirements, the carpenters will fabricate suitable panels and erect in place. Construction of formwork will be to the dimensions, shapes and sizes required to obtain the accurate alignment, location and plumb of the finished structure. Formwork will be installed ensuring that the shape, size, alignment, level and any other irregularities are maintained within the specified tolerances before and after concrete placement. Concrete placement can only commence upon approval of inspection request by the client / consultant. Request for inspection shall be submitted only up on approval of

QC Engineer and at least 24 hours before the casting schedule. Ensure that all embedded items required are installed and secured at their correct location and levels. Ensure that all required inspections are performed. Ensure concrete is placed and compacted in its final position within 2 hours of addition of water to the mix.

3) Concrete width (thickness)

The required thickness shall be fixed by providing pre-cast concrete spaces and casting level shall be fixed by providing 20mm x 20mm wooden strips on two sides of forms top opening as per the approved plan & specifications and the approved method statement.

4) Procedure concrete placement

Prior to start the walling concrete works the reinforcement, cutting, bending and installation shall be completed as per the ADWEA specification (civil works concrete and reinforced concrete) and approved by the consultant. It is also assumed that the formworks have been completed as per ADEWA specification (civil works concrete and reinforced concrete) and approved by the Consultant. Concrete delivered to site will be as per the approved design mix and checked for slump and temperature. Concrete temperature when discharged in the formwork shall not be more than 30°C. Structural concrete works can only commence upon completion of the formworks and reinforcement activities. Inspection request for pre concreting checks shall be submitted to Client / Main Contractor. Expansion, Contraction, Isolation, Control and construction joints will be located as shown on the drawings. Concrete placement sequence will be planned in a manner so that to have minimum repositioning of the truck mixer or concrete

pump. Adequate number of vibrators, pokers, Hessian cloth, polythene sheets including standby will be ensured. All safety precautions will be followed as per the approved HSE plan.

5) Testing of concrete

Testing of concrete for temperature and workability shall be carried out at the site before discharge. After the concrete meets the required temperature and workability cube sample shall be prepared. An area shall be designated near the pouring area for testing and for casting of cubes. We shall deploy one technician with one labour for this work or as per the site requirement. Six cube samples shall be taken for every 100 m^3 of concrete for compressive strength test. Additional one sample each set of cubes may be cast to carry out any additional testing requirement if any or as directed by the Consultant. These cubes sample shall be removed from the moulds on the following day and shall be transferred to the approved independent laboratory.

6) Finishing of concrete

The movement of persons on the placed wet concrete shall be avoided as far as possible. Once the concrete surface is touch dry the top surface shall be provided with rough in finishing works. The finished area shall be covered with polythene sheet to avoid rapid hydration. As top of the RC parapet Walls is supposed to receive roof slab, we shall provide rough in finish as instructed by the Siemens Engineer/Consultant Engineer.

7) Concrete curing and protection

Curing of the concrete will began immediately after finishing of the concrete surface and in line with the requirements. By covering polythene sheet immediately after finishing.

8) Horizontal

After final set has taken place, after 8 to 12 hours, the polythene sheet will be replaced by wet Hessian cloth and covered with polythene sheet. The Hessian cloth shall be kept wet for at least 7 days.

9) Vertical

Inspect the curing operation effectiveness regularly to avoid any drying of the placed on top of the covers. Ensure damage is occurred to the polythene sheets by the timber pieces. All vertical surfaces shall be applied with membrane of curing compound immediate after removing shutter

10) Inspection & testing

Steel inspection prior to start shuttering works and MEP installation. Final inspection prior to pour concrete.

3.4 Safety Precautions

Table 3.4: Safety Precautions.

No	Step of precaution	Description
1	Anchor block (bearing plate)	-Anchor blocks with polystyrene or plastic block-outs should be Installed securely to the end form-work by bolts or equivalent to avoid any displacement during concreting. -Anchor blocks shall be oriented perpendicular to the cable axis complete with a grout tube connected to it at distance not more than 300mm away. -The position and location shall be fixed in accordance with the drawings.
2	Anchor head & wedges	-Tendon anchor head should be installed after concreting and removal of the polystyrene or plastic block- outs. Anchor head complete with wedges would then form a locking system bearing against the anchor block.
3	Bulb head dead end	-Bulb heads should be formed by using hydraulic equipment which would open up the strand wires to form an onion shaped bulb.
4	Anti-burst Reinforcement	-Anti-burst reinforcement should be the ordinary reinforcement steel bars fabricated to form the spiral or square cages by the bar bender according to the drawings. -Anti-burst reinforcement shall be placed! behind every tendon anchorage.
5	Tendon	-Tendons, which comprise of strands inside the ducts, should be assembled at the working level. Strands for the tendons shall be cut at the fabrication yard on ground and cut strands shall be

		then coiled up for ease of lifting.
6	Stressing tendon	-Stressing operation final stressing should be carried out when the concrete has achieved cube strength minimum of 25 N/mm2 unless otherwise stated in the tendon layout drawings. -Jacking force and stages if any should be in accordance with the tendon layout drawings.
7	Cutting away excess strand length	Upon confirmation from the engineer on the stressing result, the extra length of strand should be cut away by using an angle grinder. No burning is allowed. The strands are to be cut to provide sufficient cover from the finished edge. Safety precaution to be observed to prevent the cut strands from falling during cutting. Preferably the strands should be cut with the formwork still underneath.
8	Grouting tendon	-Grouting operation grouting of the tendons should be carried out as soon as practicable after stressing. Prior to grouting the strand excess length shall be cut and the anchorage patched up by dry packing with cement sand mortar. -Grout should be mixed in a special mixer and injected into the tendons from one end. As the grout flow, residual water or entrapped air would be flush out from the outlet. -When regular grout outflow appears at the outlet, stop pumping and close outlet hose. Apply pressure to the grout. -Do not apply unnecessary pressure to the grout as it might crack the thin cover in the slab and to avoid segregation.

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

From the studies that have been carried out, we can know about the method of post tension. Post tension is the way to make the slab without beam. It can transfer the load trough from the slab directly to column. From this method, it can save time.

The observation from site, we can know in detail about the post tension. In roughly, the first step is cutting the coil. Then, install the coil inside the duct. Next, install that tendon above the formwork slab. After casting work, PBB labor will stress the tensile to get maximum strength. Lastly, force cement into the ducting to void gap between them so can avoid corrosion.

The most important in this study is about safety. All staff and labor must follow the rule and apply the safety ay site. At least they must wear safety boots, safety helmet, body harness and etc depends on the work to do. Each of them must take serious in this matter.

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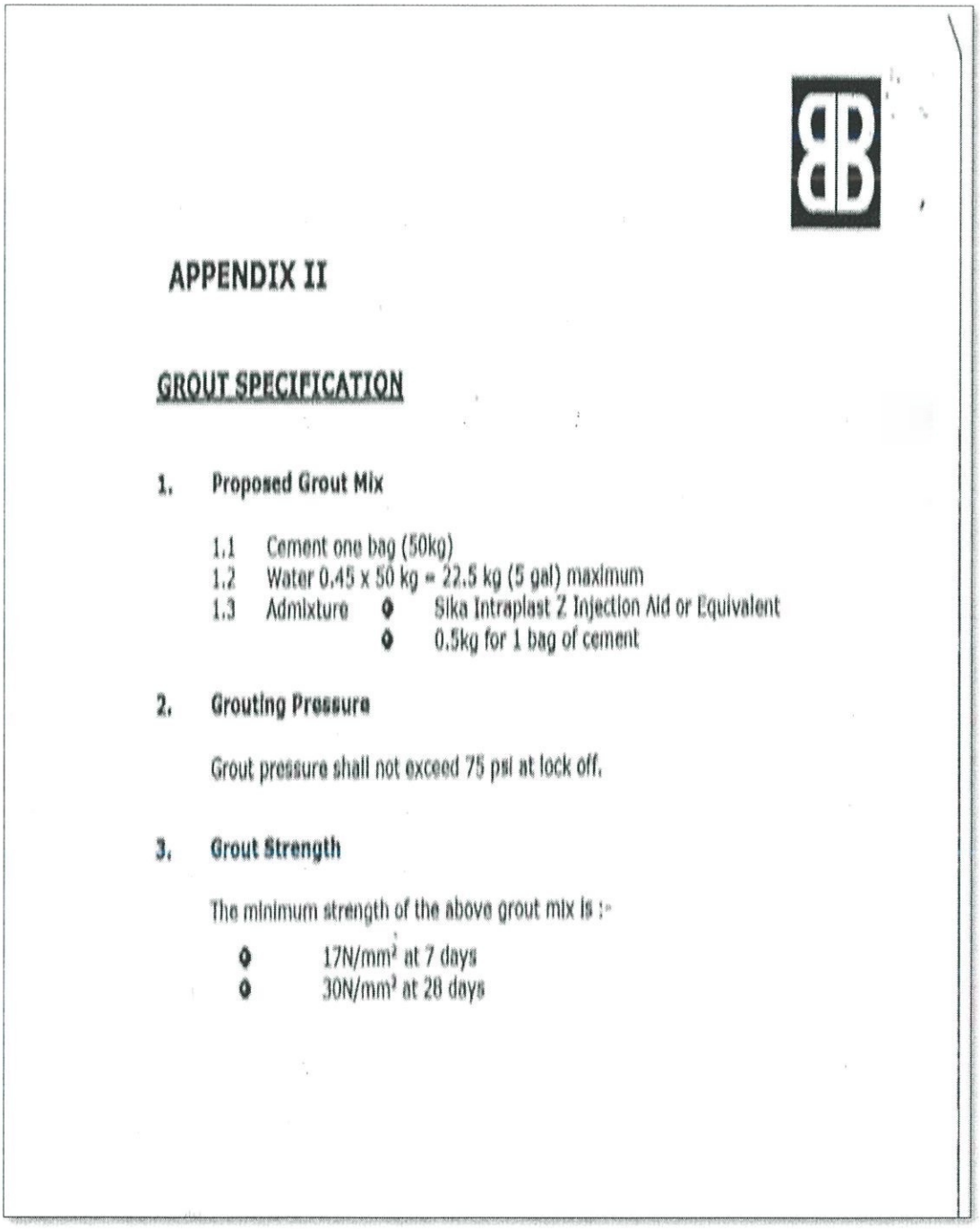
APPENDIX

Appendix A: Grout Specification.



APPENDIX II

GROUT SPECIFICATION

1. Proposed Grout Mix

1.1 Cement one bag (50kg)
1.2 Water 0.45 x 50 kg = 22.5 kg (5 gal) maximum
1.3 Admixture
- Sika Intraplast Z Injection Aid or Equivalent
- 0.5kg for 1 bag of cement

2. Grouting Pressure

Grout pressure shall not exceed 75 psi at lock off.

3. Grout Strength

The minimum strength of the above grout mix is :-

- $17N/mm^2$ at 7 days
- $30N/mm^2$ at 28 days

Appendix B: Work Sequence in Floor.

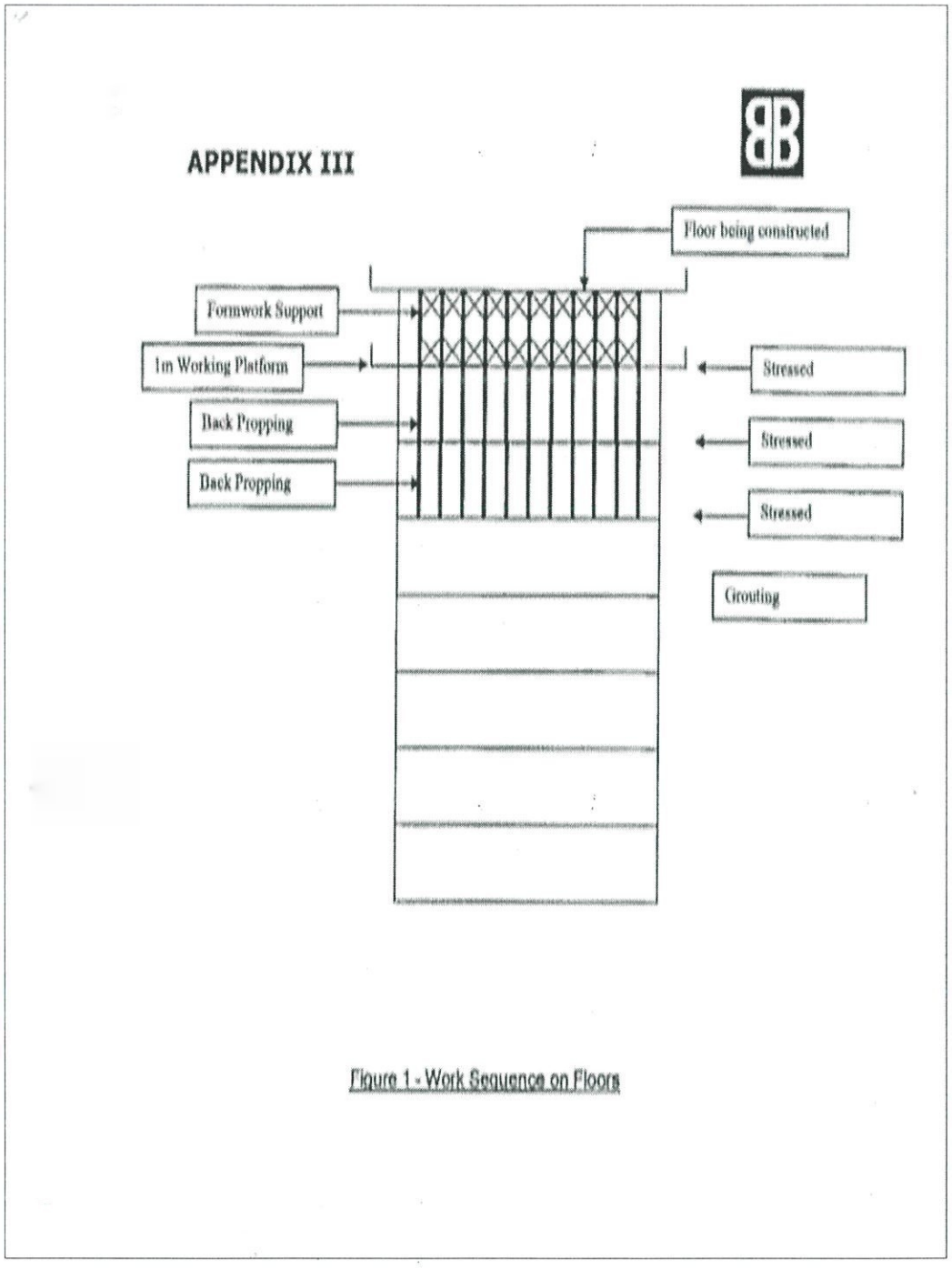
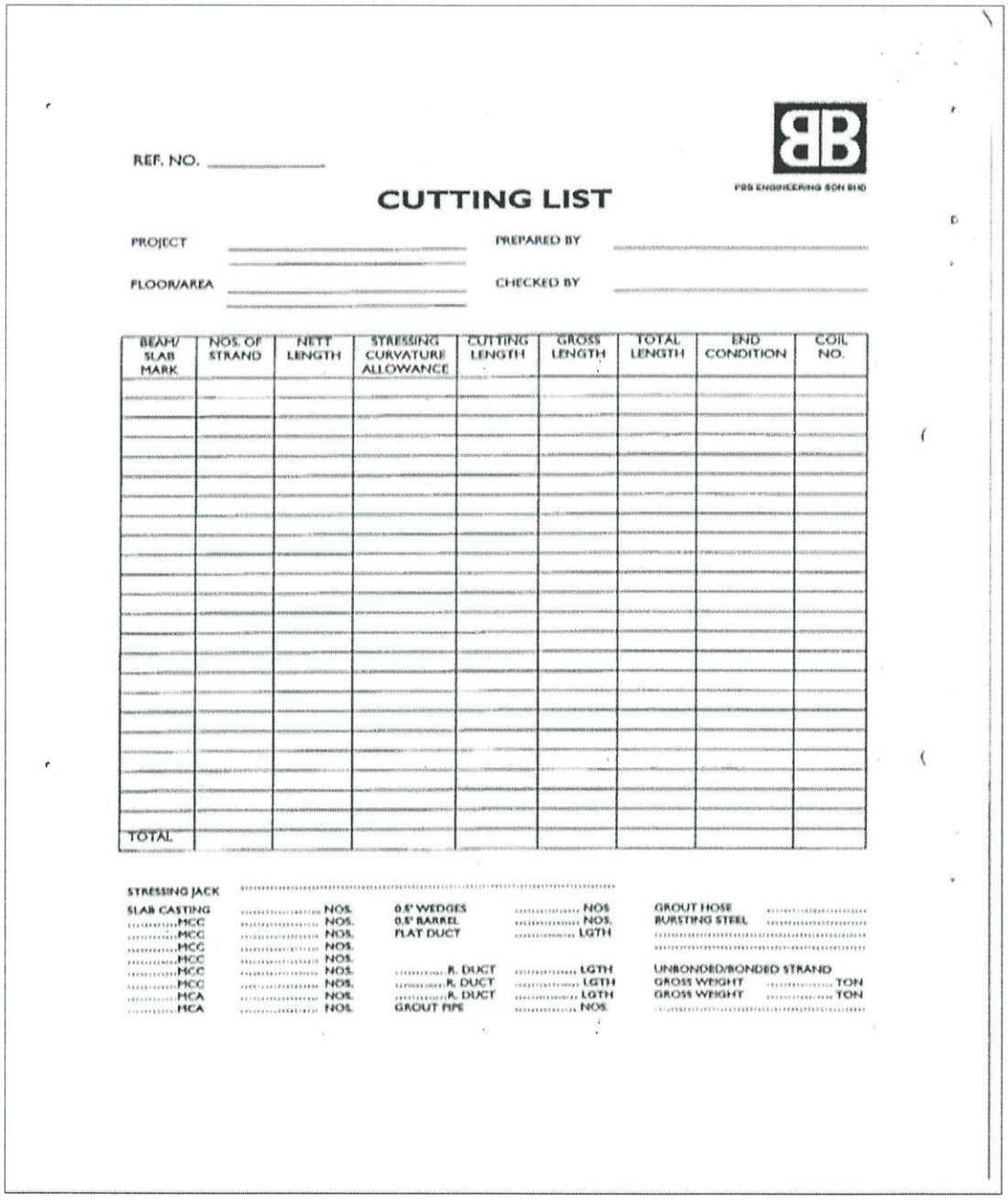


Figure 1 - Work Sequence on Floors

Appendix C: Form Sample Cutting List.



REF. NO. _____

PBS ENGINEERING SDN BHD

CUTTING LIST

PROJECT _____ PREPARED BY _____

FLOOR/AREA _____ CHECKED BY _____

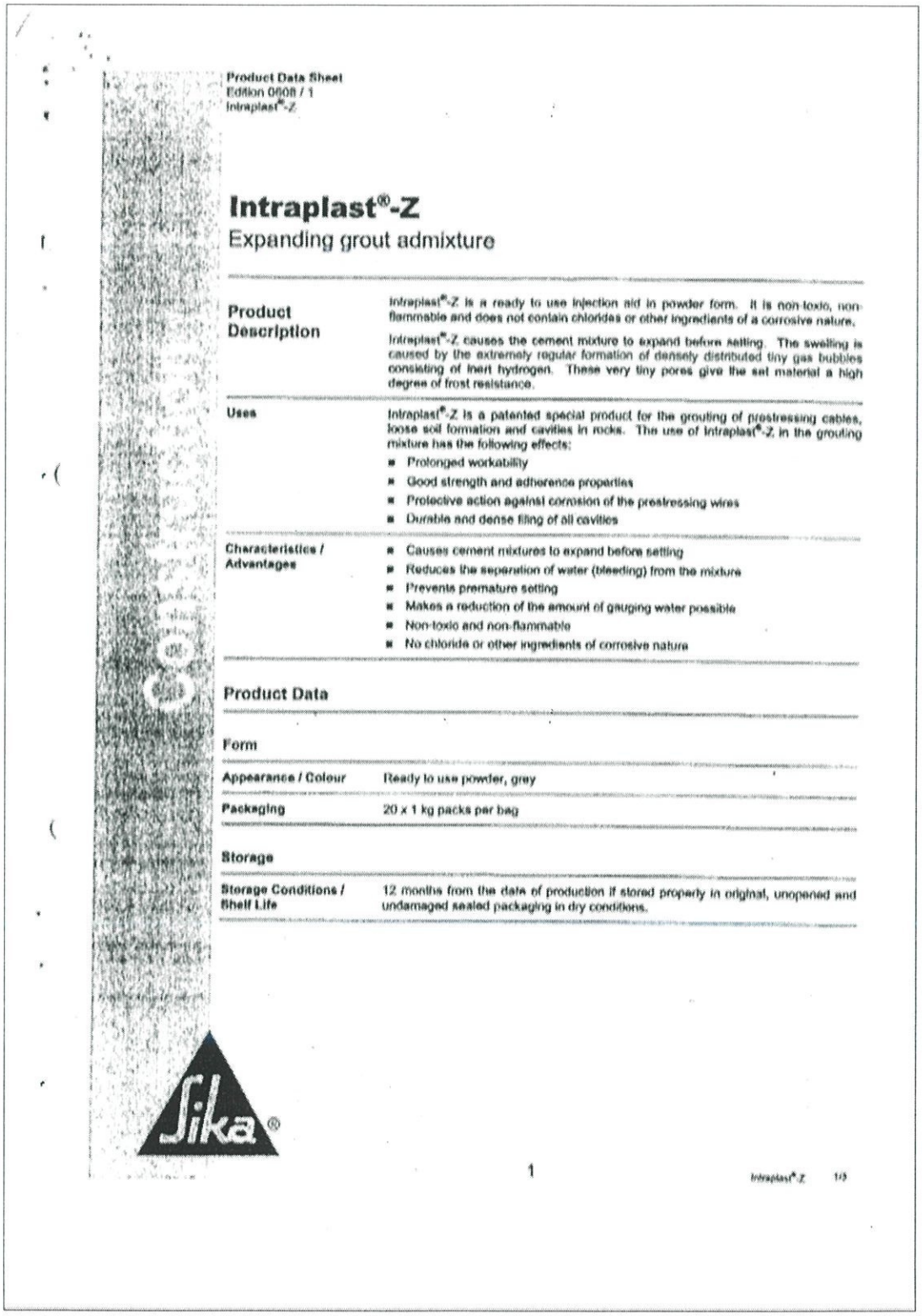
BEAM/ SLAB MARK	NOS. OF STRAND	NETT LENGTH	STRESSING CURVATURE ALLOWANCE	CUTTING LENGTH	GROSS LENGTH	TOTAL LENGTH	END CONDITION	COIL NO.
TOTAL								

STRESSING JACK .....

SLAB CASTING

.....MCC	..... NOS.	0.6" WEDGES	..... NOS	GROUT HOSE	.....
.....MCC	..... NOS.	0.5" BARREL	..... NOS.	BURSTING STEEL	.....
.....MCC	..... NOS.	FLAT DUCT	..... LGTH	.....	.....
.....MCC	..... NOS.			.....	.....
.....MCC	..... NOS.				
.....MCC	..... NOS.	..... R. DUCT	..... LGTH	UNBONDED/BONDED STRAND	
.....MCC	..... NOS.	..... R. DUCT	..... LGTH	GROSS WEIGHT	..... TON
.....MCA	..... NOS.	..... R. DUCT	..... LGTH	GROSS WEIGHT	..... TON
.....MCA	..... NOS.	GROUT PIPE	..... NOS.	.....	.....

Appendix D: Catalogue, Intraplast-z.



Product Data Sheet
Edition 0608 / 1
Intraplast®-Z

Intraplast®-Z

Expanding grout admixture

Product Description

Intraplast®-Z is a ready to use injection aid in powder form. It is non-toxic, non-flammable and does not contain chlorides or other ingredients of a corrosive nature.

Intraplast®-Z causes the cement mixture to expand before setting. The swelling is caused by the extremely regular formation of densely distributed tiny gas bubbles consisting of inert hydrogen. These very tiny pores give the set material a high degree of frost resistance.

Uses

Intraplast®-Z is a patented special product for the grouting of prestressing cables, loose soil formation and cavities in rocks. The use of Intraplast®-Z in the grouting mixture has the following effects:

- Prolonged workability
- Good strength and adherence properties
- Protective action against corrosion of the prestressing wires
- Durable and dense filling of all cavities

Characteristics / Advantages

- Causes cement mixtures to expand before setting
- Reduces the seperation of water (bleeding) from the mixture
- Prevents premature setting
- Makes a reduction of the amount of gauging water possible
- Non-toxic and non-flammable
- No chloride or other ingredients of corrosive nature

Product Data

Form

Appearance / Colour	Ready to use powder, grey
Packaging	20 x 1 kg packs per bag

Storage

Storage Conditions / Shelf Life	12 months from the date of production if stored properly in original, unopened and undamaged sealed packaging in dry conditions.

Sika®

1

Intraplast®-Z 1/3