T H E S I S

for

B.Sc. in Civil Engineering

"Complete Plans and Specifications

for a

Seven Storey Office Building

in

Damascus

By

Ramiz Kamil 'Id 1951

Complete Plans and Specifications
for
A Seven Storey Office Building
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May 1951

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A.U.B.
Beirut, Lebanon

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A C K N O W L E D G M E N T

I wish to thank the staff members of the Engineering Department for their assistance throughout the past years, that has made the writing of this thesis possible.

Ramiz K. 'Id

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I N T R O D U C T I O N

I need hardly point out the urgent need of well planned office buildings in the Near East. Very few satisfactory ones exist, and then, only to belong to private enterpreners . To the best of my knowledge there is no building in Beirut or Damascus that meets all the requirements of a modern office building. There are efforts to accomplish the like, but a deficiency in the mastery of the essentials, a lack of foresight by the owners, and an obscure impression of an efficient office building render the project half done , if not more undone.

The writings that follow are to supplement the plans, and to point out certain details that cannot be expressed in plan. They are divided into three major sections. The first discusses the general planning of the building. The second section shows the structural design, and the third points out the general specification for the contractor to follow.

CH.I — Planning of the Building

Location: The site for the office building is in a commercial area in the heart of Damascus. It is a developed area and occupies a very important position, specially so, after it had undergone a new town planning scheme. This scheme is in the stage of rapid execution. The square meter in the area is reported to cost L.S. 150 , a value far too high to allow for extravagant and wasteful planning.

At present the site has on it an old and shabby structure which adds no credit to the environment. It is apt to be demolished.

The Building: The building has seven storeys: a ground floor of eight shops and restaurant and six other floors to hold offices.

Architectural Aspect: A glance at the perspective shows that the building does not have a fantastic shape; it couldn't have, since the shape and value of the land restrict innovations. The aim in the architectural design is to characterize the building and present it in its simplest but most efficient form. In other words, functional design is the contolling factor.

From the exterior the building has a stone facing with a pink tint. Projections over the window protrude beyond walls all round the building.

Soil Conditions: While excavating for the foundation of a building in an adjacent plot, the following layers listed in order of appearance were encountered :

1. layer of dark soil 0.50 - 1.00 m thick
2. " " hard rock 0.50 - 1.00 m "
3. " " soft soil 1.00 - 1.50 m "
4. " " hard pan (conglomerate of gravel and sand)

The last layer, found at a depth of 2 - 3 1/2 meters, is utilized to bear the building at a power of 4 kg/cm^2. Water is encountered at a depth of some 5 - 7 meters below origional ground level.

In the structural design that follows, I assume the same formation condition to exist, and use a safe bearing power of 4 kg per cm^2.

Ground Floor: Damascus regulations require a minimum height of 5 m for a ground floor that contains shops. A 5.80 meter height is chosen. This allows the stores to have mezzanines which greatly increase their rentability.

The ground floor consists of :

I. Eight shops numbered 1, 1a, 2, 2a, 3, 3a, 4, 4a on the plan
II. Restaurant, bar and their serving units.
III. Boiler room
IV. Main entrance, stair-case, Hallway, shafts and ducts.

I shall discuss each of the above items seperately.

I. Shops :

All floor shops are on the same elevation as the curbs, or negligeably higher: curb elevation is henceforth considered as zero elevation.

All shops have wooden stair-cases (not more than 1.20 m or less than 0.8 m wide) that lead up to their mezzanines at a height of 3.06 m. The stair-case consists of 18 steps each having a 17 cm rise and a 32 cm tread. Shops 1 and 1a have the advantage of using a large storage area in the mezzanine of the hallway. This requires five or six wooden steps to reach to, from their respective mezzanines.

Shops 1, 2, and 3 share a common lavatory. The same condition exists for shops 1a, 2a, and 3a. Shops 4 and 4a have each a private lavatory tucked under the stair-cases that lead to their mezzanines.

Show windows 1.00 meter deep and 2.50 meters high are supplied in abundance to all stores.

Mezzanines: The floor of the mezzanines of shops is at elevation of 3.06 m and the mezzanines have a clear height of 2.5 meters.With the exception of the stair case the mezzanines cover all the shop area. They can be used either as stores, or offices for the stores to which they belong.

II. Restaurant; bar and their Serving Units :

The restaurant is divided into four main units as follows:

1. Kitchen and serving unit
2. Dining hall
3. Entrance lobby
4. Bar

Each of the units is discussed seperately.

1. Kitchen and Serving Units:

The kitchen and its service units occupy around one third of tho whole restaurant area; it has a private entrance. As indicated

in the plans the lavatories for the servants are placed 1.02 meters below curb level. Such an arrangement has the following advantages:

a. The space above the lavatory is utilized by a part of the stair-case leading from shop No. 3 to its mezzanine. This gives the shop more floor area.

b. The lavatory is exclusively isolated from the cooking center.

There is a wooden stair-case leading from the kitchen to its mezzanine. This mezzanine is used for general storage purposes. As for the service to and from the mezzanine two dumb-waiters are installed.

The arrangement of the service unit in the ground floor is designed to give maximum efficiency. The waiter enters the service unit from the "in" door; he deposits the dirty dishes and cutlery on the serving table of the dish-washing room; he proceeds to the service window of the kitchen where he collects his order and leaves the service unit through the "out" door. This circulation guards against the bumping of one waiter with another.

The "In" and "Out" doors are the swinging type. They have metal plates attached to their lower parts to resist the kicks from the waiters as they swing them open.

2. Dining Hall: The ground floor of the dining hall has an area of 60 sq.m. The mezzanine floor (which extends over the bar) has also an area of 60 sq.m. One hundred and twenty sq.m. provide enough room to accomodate 100 persons thus allowing 1.2 sq.m. per person.

The grcund floor area is one step higher than curb elevation. This slight raise affects the psychology of a person and gives a better feeling.

The mezzanine floor is at elevation of 3.06 m. Its area is included within the dotted line drawn on the ground floor plan. As seen from this plan, the part of the floor area adjacent to the main hallway of the building is left open of mezzanine floor.

3. Entrance lobby: The entrance hall in level with curb line, acts as a buffer between the dining hall and the bar.

From the entrance hall a central stair-case curves to the mezzanine. On its sides are stair-cases of 6 steps down each, one leading to men's toilets and another to ladies' toilets. This is made possible after 7 steps up of the central stair-case have been covered. A total of 13 stairs (7 up & 6 down) will cause a clearance of 2.2 m minus the thickness of the landing at the seventh step. This clearance is enough for toilet rooms.

From the landing just mentioned, access is made to another ladies lavatory to be used by those on the mezzanine. This is shown in section. Further the reservoir can mark that a lavatory on top of the latter is quite feasable, and can be used by the men. The last, however, is accessible from the mezzanine by a couple of steps up. The above arrangement is made in order to utilize fully the excessive elevation of the ground floor which otherwise would have been a waste.

In all, 2 toilets have been furnished for ladies and 2 for gents, the latter toilets, of course, include urinals as shown.

4. The Bar: The bar is only some 25 meters^2 in area. Though called a bar, it can be used as an isolated section of the dining room to recieve women in veils who may require privacy.

III. Boiler Room: The building is furnished with central heating equipment. The TWO PIPE SYSTEM is used where water reaches the radiators thru one pipe and comes back to the boiler thru another.

The necessary units are: 1. Two boilers, 2. Burners, 3 reservoir, 4. radiators, 5. pump, 6. pipes. According to experts in central heating a floor area of 6 sq.m. is sufficient to install a boiler and its auxiliaries. In my design I have found that the required capacity of boilers is 2 cu.m. Two boilers of 1.2 X 1 X 1 meters each, are chosen and a floor area of 14 sq.m. is alloted for them. Both, fuel and water tanks are kept on the mezzanine of the boiler room. Fuel will have to be pumped thru an intake pipe that connects its tank to the outside.

The plans indicate the floor of the boiler room to be at elevation 1.02 m. This is so to make possible the circulation of hot water in the restaurant area. However, some authors state that a one meter difference is not enough for that purpose. In that case a pump will have to be installed as foundation condition may not permit deeper construction.

IV. Main Entrance and Hallway, Shafts and Ducts.

Few comments to supplement the plans may be helpful.

As the difference of level between the hallway and the first floor is 5.10 m, thirty steps each of 17 cm rise are needed. They are divided into three flights of ten steps each. By the end of the first flight an elevation of (10 plus 4) X 17 = 2.38 meters is reached. Enough vertical clearance, therefore, is provided for the common toilets of shops Nos. 1, 2 and 3 and also for shops 1a, 2a and 3a. Further-

more a few steps up the second flight will cause enough vertical clearance for shops Nos. 2 and 2a, and a small mezzanine for each of those shops is also provided.

The mezzanine of the hallway is at elevation of 4.15 meters. Its height is therefore 1.40 meters. As mentioned previously this space is utilized for storage by shops 1 and 1a. Another use for it is to allow thru the pipes coming from the central duct. Those pipes are carried thru to one of the side ducts.

As seen from the plans most lavatories are ventilated through ducts 2.20 X 0.75 = 1.65 sq.m. opening. The plumbing fixtures are placed in the ducts.

While the side ducts start from the ground floor the central duct starts from the first floor. This is so in order not to have it project in the center of the main hallway. All ducts shall be covered by slabs at 30 cm above the top of the duct. This arrangement prevents rain from entering and yet allows efficient suction.

As regard to the elevator shafts, each has an area of 2 X 1.50 = = 3 sq.m. Two elevators, each large enough to hold six persons can be installed in them.

A TYPICAL FLOOR:

One of the plans given is that of a typical office floor 850 sq.m. in area. It is planned for a variety of tenants and therefore it is quite clear that the specific needs of those tenants cannot be fully imagined at the time the plan is made. To be successful, the floors are designed to allow a large range of flexibility to serve the owners through changing periods. It is too laborious and technical a

work to go into the numerous forms and shapes that the plans can assume. A little stretch of imagination on the part of the observer should point out a number of such possibilities.

Suites of offices as wall as individual ones have been designed. The plan is self-explanatory. As for the openings, they account for 25 % of wall space in most offices. The need for sufficient light is obvious. However, being in Damascus where the sun's riase is too bright to be comfortable, one meter projections beyond and above the windows are necessary to give shade to the various offices. The window panes recommended are those that have a blue tint from the outside though are colorless from the inside. Those panes filter out 30 % of the sun's heat.

Telephone System:

Each of the office units shall have a telephone. Damascus telephones are run on the automatic system. It is therefore advisable that each telephone be connected directly to the outside. This eliminates the necessity of having a central telephone switch board and also gives quicker service to the individual offices.

Electricity:

There shall be installed in each office unit the following:

1. Watt-hour meter
2. 4 plugs (sockets)
3. 1 switch
4. 1 outlet

The folowing tables show the recommendation given for lighting offices and drafting rooms.

Offices	Foot candles
Book-keeping, typing and accounting	50
Business machines (power driver)	100
Conference room	30
Corridor and stair way	5
Desk work	30 - 50

Drafting	
Prolonged close work	50
Filing and index references	30
lobby	20
Stenographic work	50

Janitors Quarters

During the day the janitor can occupy any of the areas devoted by "store". His living quarters, however, shall be on the roof of the building where a couple of rooms will accomodate him nicely. Also any of the "store" areas can be used as cigarette windows or a refreshment unit.

CH. II – STRUCTURAL DESIGN

Slab Design – One Way Ribbed

L.L.	300 kg/m^2	
D.L.	350 kg/m^2	20 cm slab (taken as 2500 14 full)
	75 kg/m^2	tiles
	75 kg/m^2	sand
	800 kg/m^2	

Load on rib 50 cm c-c. = 0.50 x 800 = 400 kg/m.r.

$\therefore$ M = 1/10 x 400 x $(5.5)^2$ = 1200 kg m.

$d = 0.4\sqrt{M/b}$; b = 0.50 , b' = 12 cm

$d = 0.4\sqrt{1200/.50}$ = 19.5 use 20 - 22 cm as overall depth

As = Ms/fsjd = 1200 x 100/ 1200 x 0.87 x 19.5 = 5.88 cm^2

use 1 - 18 mm ø 2.54
1 - 20 mm ø 3.14
5.68 cm^2

Check for shear Allow 15 kg/cm^2

$v = V/bjd$ $\frac{(400 \times 5.5)/2}{12 \times 0.87 \times 19.5}$ = 5.6 kg/cm^2 Safe

The above loading permits the use of partition any where on the slab.

SLAB DESIGN - MEZANINE

L.L.	100 # /ft'	=	500 kg/m^2
D.L.	15 cm slab x 2500	=	375 kg/m^2
	Tiles and sand	=	150 kg/m^2
			1025 kg/m^2

$\alpha = \frac{5.5}{6.0} = 0.91$; $B_s = 0.43$, $B_l = 0.25$

Short Direction

$M_{short} = \frac{1}{10} \times 1025 \times (5.5)^2 \times 0.43 = 1320$

$d = 0.367 \sqrt{1320} = 13.5$ over all 15

Use more bars of smaller diameter (7-8) / m. width

$As = \frac{1320}{1200 \times 0.87 \times 13.5} = 9.85$ cm^2 Use 5 - 16 mm ø / m

As = 10.05 cm^2

Long direction

$M = \frac{1}{10} \times 1025 \times (6)^2 \times 0.25 = 920$

$As = \frac{920}{1200 \times 0.87 \times 13.5} = 5.8$ cm^2 Use 6 - 12 mm ø /m

As 6.78 cm^2

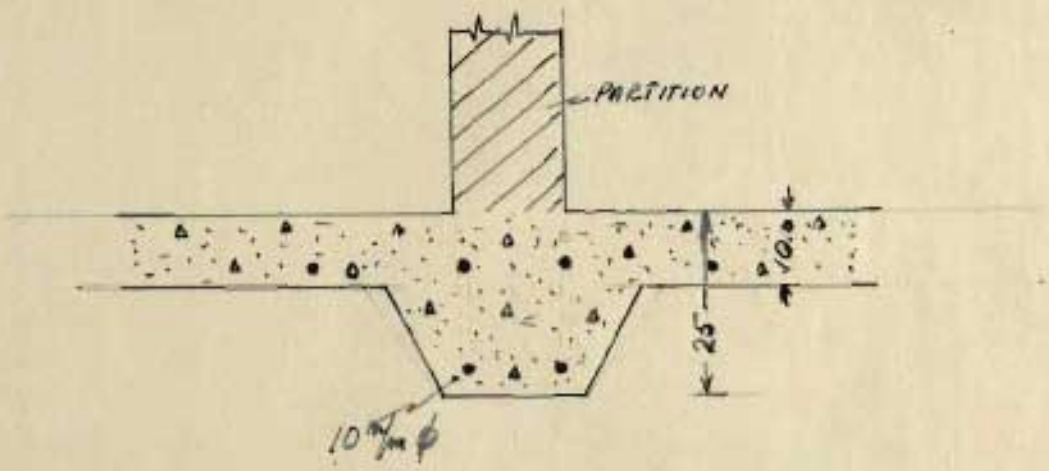
Slab Design - Ground Floor

A reinforced slab for the ground floor is designed imperically as follows :

Slab thickness 10 cm

Reinforcement 10 mm ø at 20 cm spacing

Under partitions a depth of 25 cm and a reinforcement of 2 - 10 mm ø at the bottom are recommended



SECTION OF SLAB.

The above design annuls the necessity of having ground floor beams.

Design of Typical Floor Beams

In the design the following points were considered: -

1. The load transmitted from the slab to the beams is distributed among the two end beams on which the ribbs rest.

2. Loadings are : -

Description	Thickness	Load	Load Analysis
Ribbed Slab	20 cm	800 kg/m^2	Refer to slabs
Interior partitions (Hollow blocks)	15 cm	770 kg/m	Wt. of blocks =1600kg/m^3 1600(1x0.15x3.70)=770kg
Interior partitions (Hollow blocks)	10 cm	550 kg/m	1600(1x0.10x3.20)=550kg
Exterior Walls (20 cm hollow blocks plus 5 cm facing)	25 cm	1440 kg/m	20cm hollow block=1100 5cm Stone facing = 340 1440kg
Stair case		800 kg/m	

3. Exterior beams are designed as L - beams

   Interior beams " " " T - beams

4. The following are constants for all beams

   Effective depth = 45 cm

   Thickness = 25 cm

   Over all depth = 50 cm

5. $As = \frac{Ms}{fsjd}$ for tension reinforcement. Half this reinforcement is bent up at 1/5 the span and continues to 1/4 the adjacent span, to take care of negative bending moments

6. Beams are taken as partially continuous and partially fixed therefore $M = 1/10\ wl^2$

7. At intersection of beams 2 - 10 mm ∅ are placed at top and bottom for better anchorage.

8. The mezzanine beams have been designed in a similar manner as the typical floor beams. The beams are found to be in agreement with the floor beams mentioned above.

Example of Design of Beams

Beam A2 A3 : L - beam

Load from slab 800 x 1.5 = 1200 kg/m

Load from exterior wall = 1440 kg/m

W = 2640 kg/m

$M = 1/10\ wL^2 = \frac{2640}{10} \times (6.7)^2 \times 100 = 1{,}189{,}000$ kg cm

$As = \frac{11890}{1200 \times 0.87 \times 45} = 26.3\ cm^2$

Use 6 - 18 mm ø As = 15.26 cm^2

And 3 - 22 mm ø As = 11.40 cm^2

26.66 cm^2

Allow. Ss = 0.06 f'c = 0.06 x 250 = 15 kg/cm^2

$v = \frac{V}{b'jd} = \frac{(2640 \times 6.7)/2}{25 \times 0.87 \times 45} = 9\ kg/cm^2$; safe

Check for bond Allow. 0.04 f'c = 0.04 x 250 = 10 kg/cm^2

$u = \frac{V}{ojd} = \frac{(2640 \times 6.7)/2}{33.6 \times 0.87 \times 45} = 4.15\ kg/cm^2$; safe

Design of STIRRUPS - Use 8 mm ø As = 3.01 cm^2 (6 sections)

Spacing = $\frac{As\ fs\ jd}{V - Vc}$

Vc = v_c bjd = 5 x 25 x 0.87 x 45 = 4900 (v_c 0.02 x 250 5 kg/cm^2)

V = 8900 at reaction

$S = \frac{3.01 \times 1200 \times 0.87 \times 45}{8900 - 4900} = 34$ cm

Stirrups are spaced 20 cm between supports and one-third points and increased to 30 cm in the middle third of the span.

TABLE OF DESIGN OF TYPICAL FLOOR BEAMS

BEAM DESIGNATION OF		SHAPE SECTION	SPAN m	MOMENT Kg.m.	AS cm^2	TENSION BARS	COMP. BARS
A1 A2	A5 A6	L	4.30	6100	13.5	9 - 16	3 - 14
E_1 E2	E3 E4	L	4.60	"	"	"	"
L_1 L2	L5 L6	L	4.15	"	"	"	"
A2 A3	A4 A5	L	6.70	11890	26.3	6 -18) 3 -22)	3 - 16
D4 E_1	D5 E4	L	3.00	2916	6.5	6 - 12	3 - 10
A1 C_1	A6 C4	L	4.25	2880	6.4	6 - 12	3 -10
B3 D4	D4 D5	L	"	"	"	"	"
I_1 K_1	I_{10}K6	L	"	"	"	"	"
K2 L_1	K5 L6	L	"	"	"	"	"
C_1 D_1	C4 D8	L	3.10	1296	2.9	2 - 14	2 - 10
A3 B4	A4 B4	L	"	"	"	"	"
D_1 C_1	D8 G_{10}	L	6.50	6100	13.5	9 - 16	3 -14
L2 L3	L4 L5	L	6.30	14500	32.0	9 - 22	3 -16
L3 L4		L	6.60	"	"	"	"
E2 E3		L	6.90	"	"	"	"
I_1 G2	G9 I_{10}	L	3.75	3200	6.8	6 - 12	3 -10
B2 B3	B4 B5	T	6.70	15000	34	9 - 22	3 -16
F3 F4		T	6.90	"	"	"	"
C_1 C2	C3 C4	T	4.30	4600	10.2	9 - 12	3 -10
D_1 D2	D7 D8	T	"	"	"	"	"
X_1 X2	X3 X4	T	"	"	"	"	"
F2 F3	F4 F5	T	4.60	"	"	"	"
K2 K3	K4 K5	T	4.15	"	"	"	"
D2 D3	D6 D7	T	2.00	1050	2.33	3 - 10	3 -10
D3 D4	D5 D6	T	4.70	4200	9.40	6 - 14	3 -10
E_1 E2	E4 E5	T	"	"	"	"	"
D3 F_1	D6 F6	T	6.20	11150	24	3 -20) 6 -18)	3 -14
A2 B2	A5 B5	T	3.10	450	1	2 - 10	2 -10
B2 D2	B5 D7	T	4.25	894	2	2 - 10	2 -10

TABLE OF DESIGN OF TYPICAL FLOOR BEAMS (Cont'd)

BEAM DESIGNATION		SHAPE of SECTION	SPAN m.	MOMENT Kg.m.	AS cm^2	TENSION BARS	COMP. BARS
D2 X2	D7 X3	T	3.30	1560	3.5	3 - 12	3 - 10
G4 I2	G7 I9	T	3.80	2200	4.7	6 - 10	3 - 10
F_1 F2	F5 F6	T	3.50	1560	3.5	3 - 12	3 - 10
X2 G3	X3 G8	T	4.50	2600	3.75	3 - 16	3 - 12
E2 F3	E3 F4	T	4.70	1000	2.2	2 - 12	2 - 10
F3 H2	F4 H3	T	3.40	"	"	"	"
J_1 J3	J4 J6	T	6.30	15600	33.2	9 - 22	3 - 16
J3 J4		T	6.60	"	"	"	"
I3 I4	I7 I8	T	3.40	3300	7.4	4 -12) 2 -14)	3 - 10
I_4 I_5	I_6 I_7	T	3.00	"	"	"	"
I_5 I6		T	6.60	13500	30	6 -20) 3 -22)	3 - 16
H2 J3	H3 J4	T	5.00	1420	3.0	2 - 14	2 - 10
J3 L3	J4 L4	T	5.60	1500	3.1	2 - 14	2 - 10
J_1 L2	J6 L5	T	5.60	1650	3.67	2 - 16	2 - 12
G_1 G3	G8 G_{10}	T	4.25	7190	16	2 - 12) 7 - 16)	3 - 12
G3 G5	G6 G8	T	5.25	12240	2.7	9 - 20	3 - 16
F5 H4	F2 H_1	T	3.40	3300	7.35	4 - 12) 2 - 14)	3 - 16
H_1 H2	H3 H4	T	5.00	8000	17.80	9 - 16	3 - 12
H2 H3		T	6.60	11500	24.8	3 - 20) 6 - 18)	3 - 14

Design of Columns

In the design of columns the following points are considered:

1. ~~Wt.~~ Wt. of wall is divided equally among the columns that carry it
2. Load from slab " " " " " " " "

with no distribution factor considered.

3. Loads on 6th floor columns are:

   a. Parapett 80 cm x 10 cm x 2500 = 200 kg/m
      5 cm facing x 2500x80 = 125 kg/m } 325 kg/m

   b. Ribbed slab 800 kg/m^2

4. Loads on columns of typical floor :

   a. Exterior walls 20 cm hollow blocks plus 5 cm stone facing
      450 x 3.20 = 1440kg/m

   b. Interior walls 15 cm hollow blocks 240 x 3.20 = 770 kg/m

   c. " " 10 cm " " 160 x 3.20 = 510 kg/m

   d. Slabs 800 - 150. This reduction is 50 % of live load.
      It is recommended by Shedd and Vauter for a 7 storey-
      building. (Ref. Theory of Simple structures p.16)

5. Loads from Mezzanine

   Exterior walls 20 cm hollow blocks plus 5 cm stone facing
   = 450 x 2.50 = 1125 kg/m

   15 slab of reinforced concrete 1025 minus 250 (50% L.L)
   = 775 kg/m

6. No load is considered as transferred from show windows on to columns.

7. Bearing power of concrete 50 kg/cm^2

8. As 0.5 % of column section

9. Section area found is gross area

10. If loads on different floors have no appreciable difference the same section may be carried thru 2 consecutive floors.

Example of Design of Columns

Column A

6 th floor column loads from roof

1. Walls (2.25 plus 2) x 325 = 1380
2. Slab (2.25 x 2) x 800 = 3600

4980 say 5000 kg

Area of column $\frac{5000}{50} = 100\ cm^2$

Minimum section used is 400 cm^2 hence 20 x 20 is chosen

As 0.005 x 100 0.5 cm^2

Minimum allowable As is 4 - 10 mm ϕ 3.14 cm^2

5th floor column Loadsfrom 6th floor

1. Wall (2.25 plus 2) x 1440 = 6000
2. Slabs 2.25 x 2 x (800 - 150) = 3000
3. Roof = 5000

14000

Area of column $\frac{14000}{50} = 280\ cm^2$

Use 20 x 20 ; As = 4 -10 mm ϕ = 3.14 cm^2

4th floor column

1. 5th floor 14000
2. Walls and slabs 9000 (as found on 5th floor col)

23000 kg

$a = \frac{23000}{50} = 460\ cm^2$

Column = 25 x 25 = 625 (to have same section as 3rd floor column. a section of 25 x 20 could have been used)

As = 2.3 Use 4 - 10 mm ϕ = 3.14

3 rd floor col.

1. 4th floor 23000
2. Walls and slabs 9000
32000

$a = \frac{32000}{50} = 640\ cm^2$ Col = 25 x 25 = 625 (accepted)

As = 3.2 ; Use 4 - 10 mm ϕ = 3.14 cm^2 (accepted)

2 nd floor col.

1. 3rd floor load 23000
2. Walls and slabs 9000
41000

$a = \frac{41000}{50} = 820\ cm^2$; 30 x 30

As = 4.1 ; use 4 - 12 mm ϕ = 4.52

1 st floor col.

1. 2nd floor 41000
2. Walls and slabs 9000
50000

$a = \frac{50000}{50} = 1000$; Col 35 x 30 = 1050

As = 5.0 ; Use 4 - 10 mm ϕ plus 2 - 12 mm ϕ

Ground floor

1. From 1st floor 50000
2. Mezanine wall (2 plus 2.25) x 1125 4800 } 8300
3. Mezanine slab (2 x 2.25) x 775 3500 }
58300

$a = \frac{58300}{50} = 1160$; Col 35 x 35

As = 5.83 cm^2 Use 8 - 12 mm ϕ = 6.28

Foundation Columns.

As there are only show windows below the mezanine there will be no excess loading on foundation column.

However, an addition of 5 cm on a side is recommended, and foundation as well as ground floor will have the same section of 40 x 40 and same As = 5 - 12 mm plus 3 - 10 mm ϕ.

TABLE OF DESIGNS OF COLOMNS

COLOMN DESIGNATION	SIXTH - FLOOR SIZE	BARS	FIFTH - FLOOR SIZE	BARS	FOURTH - FLOOR SIZE	BARS	THIRD - FLOOR SIZE	BARS
A_1 A2 A3 G_1 A4 A5 A6 G_{10}	20x20	4 - 10	20x20	4 - 10	25 x 25	4 - 10	25 x 25	4 - 10
B2 D3 G3 B5 D6 G8	20 x 20	4 - 10	25 x 25	4 - 10	35 x 30	4 - 10 2 - 12	40 x 35	6 - 10 2 - 12
F_1 F2 E_1 E2B3D_1 L2L3K2F5F6E3 E4B4D8L4L5K5	20 x 20	4 - 10	25 x 20	4 - 10	30 x 30	4 - 12	35 x35	4 - 10 2 - 12
C_1D2 X2D4$I_1L_1I_3$ C4D7X3D5 I_{10}L6 I_4	20x20	4 - 10	20 x 20	4-10	30 x 30	4 - 12	30 x 30	4 - 12
F3 J_1 F4 J6	20 x 20	4 - 10	30 x 30	4-12	35 x 35	8 -10	45 x 40	8 - 12
H_1 H2 J3 I_4 H3 H4 J4 I7	20 x 20	4 - 10	30 x 25	2-10 2-12	35 x 35	8 - 10	45 x 40	8 - 12

COLOMN DESIGNATION	SECOND - FLOOR SIZE	BARS	FIRST - FLOOR SIZE	BARS	GROUND - FLOOR SIZE	BARS	FOUNDATIONS SIZE	BARS
A_1 A2 A3 G_1 A4 A5 A6 G10	30 x 30	4 - 12	35 x 30	4 - 10 2 - 12	40 x 40	5 - 12 3 - 10	40 x 40	5-12 3-10
B2 D3 G3 B5 D6 G8	45 x 40	8 - 12	45 x 45	5-14 3-10	55 x 50	6 - 14 6 - 10	55 x 50	6-14 6-10
F_1F2E_1E2B3D_1 L2L3K2F5F6E3 E4B4D8L4L5K5	40 x 35	6 - 10 2 - 12	45 x 40	8-12	50 x 50	8 - 10 4 - 14	50x50	8-10 4-14
C_1D2X2D4$I_1L_1I_3$ C4D7X3D5I_{10}L6I_4	35 x 35	8 - 10	40 x 35	6-10 2-12	45 x45	5 - 14 3 - 10	45x45	5-14 3-10
F3 J_1 F4 J6	45 x 45	5 - 12 3 - 14	50 x 50	8-10 4-14	60 x 60	5 - 16 7 - 12	60x60	5-16 7-12
H_1 H2 J3 I_4 H3 H4 J4 I7	50x45	6 - 14 2 - 12	55 x 50	6-14 6-10	65 x 60	7 - 16 5 - 12	65 x 60	7-16 5-12

Design of Footings

In the design of footings the following points are taken into consideration:

1. In a recent excavation for the foundation of a building in an adjacent plot, hard pan (a conglomerate of sand and grovel) was struck at a depth of some 3 meters below original ground level. I assume in my design of footings that the same foundation conditions exist and load the hard pan with an allowable bearing power of 4 kg/cm^2.

2. Formulas used are:

$$A = \frac{P}{S}$$

$$M_{x-x} = M_{yy} = \frac{w}{2}(a \quad 1.2c)c^2$$

$$d = \frac{(A-A')w}{p \times Ss}$$

$$As = \frac{M}{fsjd}$$

3. Where an excessive As is required " " d is increased to save on steel.

4. 5 cm are added on each side to cover steel while 6 - 8 cm are added at the bottom.

5. The No.of bars is calculated in the basis of putty 6 - 8 bars/m

6. fsj is often taken as 1000 instead of 1040 to simplify calculations at time however when the difference is appreciable.

A = section area of footing cm^2.

P = load on footing kg.

S = Allowable bearing power of soil = 4 kg/m^2.

M_{x-x}= moment about x-x in kg cm

M_{y-y}=moment about y-y kgcm

The two moments are equal for all practical purposes since both c & c' are nearly equal.

w = Allow.bearing power = S

d = effective depth cm.

p = perimeter of column cm

Ss= Allow. shearing stress = 15 kg/cm^2

As= Area of steel reinforcement required.

M = M_{x-x} = My-y

fs = Unit tensile stress

j = 0.87

Example of Design of Footings

Footings A_1 A_2 A_3 G_1 A_4 A_5 A_6 G_{10}

$A' = 40 \times 40$ Colomn $P = 70000 + 3000 = 73000$ kg (3000kg is assumed wt. of footing)

$S = w = 4$ kg/cm^2

$A = \frac{P}{S} = \frac{73000}{4} = 18250$ cm^2

or $A = 135 \times 135$

Adding 5 cm in each side ← $135 + 5 + 5 = 145$ cm.

$A = 140 \times 140$

$M_{x-x} = M_{y-y} = \frac{w}{2}(a + 1.2c)c^2$

$= \frac{4}{2}(40 \quad 1.2 \times 50)50^2$

$= 500000$ kg cm

$d = \frac{(A - A')\ w}{p \times S_s}$

$= \frac{(18250 - 1600)4}{160 \times 15} = 28$ cm $+ 7 = 35$ cm overall

$A_s = \frac{M}{f_s j d}$

$= \frac{500000}{1200 \times 0.87 \times 28} = 17.8$ cm^2

use 12 - 14 mm ø

Check on assumed weight of footing

$(0.35 \times 1.40 \times 1.40)\ 2500 = 175$ kg O.K.

TABLE OF DESIGN OF FOOTINGS

FOOTINGS DESIGNATIONS	SIZE OF COLOMN	P Kg	DIMENTIONS L x B x H	d cm	M Kgcm	As cm^2	BARS no. mm.
A_1 A2 A3 G_1 A4 A5 A6 G_{10}	40x40	73000	140 x 140 x 35	28	500000	17.80	12-14
B2 D3 G3 B5 D6 G8	55 x 50	137000	185 x 185 x 50	44	1320000	30.00	6-18
F_1F2 E_1E2B3D_1 L2L3K2F5F6 E3E4B4D8L4L5	50 x 50	115000	170 x 170 x 50	43	950000	21.20	14-14
C_1D_1X2D4I_1I3L_1 C4D2X3D5I_{10}I4L6	45 x 45	95000	155 x 155 x 40	33	630000	17.25	6-12 7-14
F3 J_1 F4 J6	60 x 60	170000	210 x 200 x 60	50	1530000	29.40	15-16
H_1 H2 J3 J4 H3 H4 J4 I7	65 x 60	190000	220 x 220 x 60	50	2180000	42.0	17-18

Design of Main Stair Case

Wall of stair case = 15 cm hollow blocks

Therefore the stair case is designed for 33 % cantilever action and 66 % for slab action.

The load w = 800 kg/m^2

Design as Slab = 66 %

$L^2 = 4^2 + (1.8)^2 = 20$ $\quad$ $w = 2/3 \times 800 = 530$ kg/m^2

$M = 1/8 \times 530 \times 20 = 1300$ kg/m

$d = 0.4 \sqrt{M} = 0.4 \sqrt{1300} = 0.4 \times 36 = 14.4$ cm say 15

$A_s = \frac{1300 \times 100}{1200 \times 0.87 \times 15} = 8.3$ cm^2

Use 7 - 12 mm Ø / meter

Design as cantilever = 33 %

$L^2 = (1.5)^2 = 2.25$ $\quad$ $w = 1/3 \times 800 = 270$ kg/m^2

$M = 1/2\ wL^2 = 1/2 \times 270 \times 2.25 = 290$

$d = 0.4 \times \sqrt{290} = 5$ Use d as governed by slab action

$A_s = \frac{290 \times 100}{1200 \times 0.87 \times 15} = 1.90$ cm^2

Use 3 - 10 mm Ø at top of every 3rd step.

Design of water tank

Utilized or rentable area of floor = 700 sq.m.

Area estimated per person = 14 sq.m.

Occupamts per floor = 700/14 = 50

Total number of occupamts = 50 x 7 = 350

Estimated requirment per person = 1/12 cu. m. per day.

350 x 1/12 = 30 cu.m.

Adding 50% for peak demand, we get 45 cu.m.

Total consumption = 45 cu.m. per day.

Maximum probable hourly demand = 45/15 = 3 cu.m. per hour.

Average hourly demand = 45/24 = 2 cu.m. say.

Required capacity of tank = (3-2) x 15 = 15.cu.m.

According to Time Savor Standards the capacity of the hot water tank is found as follows :

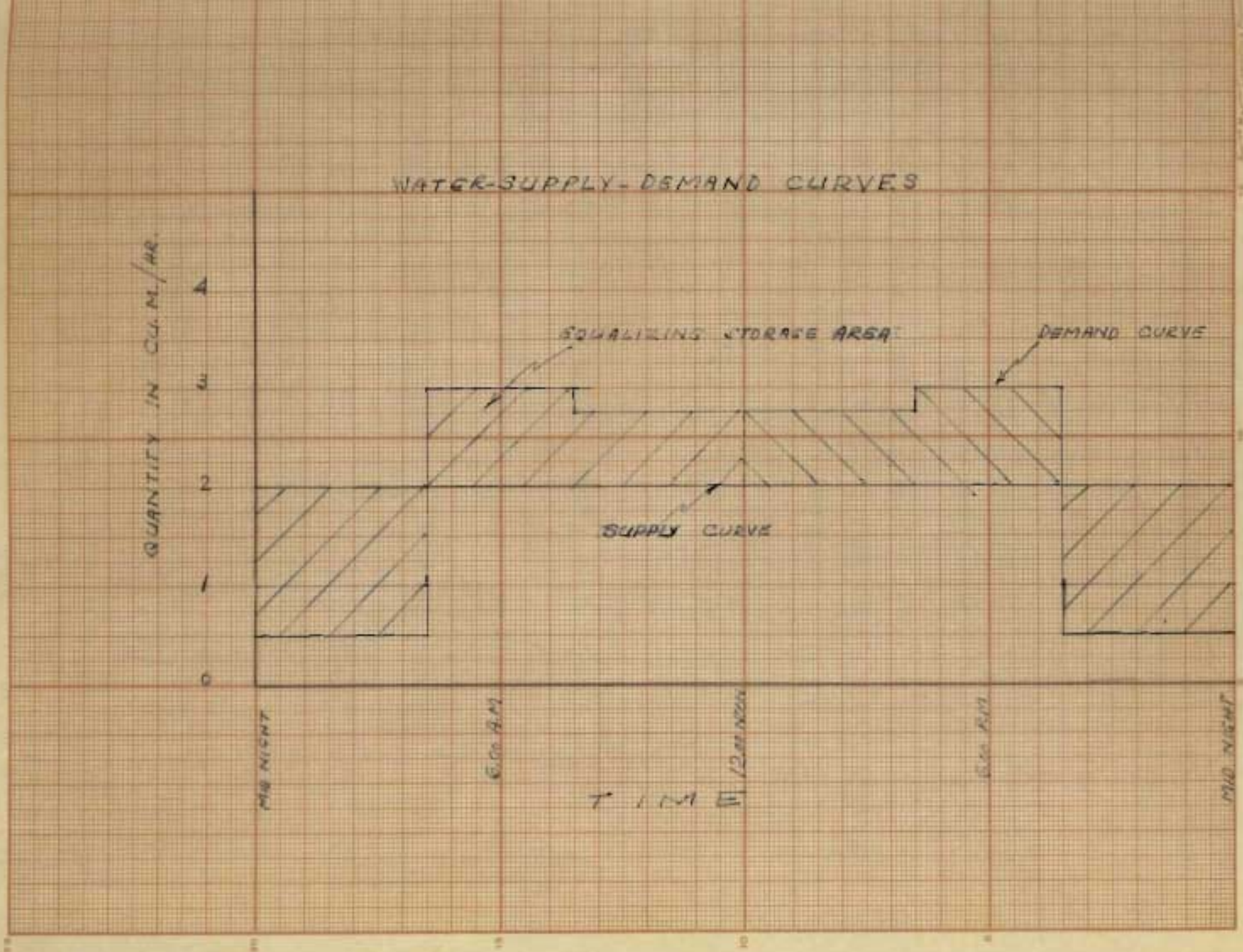
Total hot water consumption = 45/3 = 15 cu.m.

Maximum probable hourly demand = 15/10 = 1.5 cu.m.

Average " " " = 15/24 = 0.625 cu.m.

Required tank capacity (1.5 - 0.625)/0.75 = 1.16 cu.m.

Required size of tank is 1 x 1 x 1.20 m.


WATER-SUPPLY-DEMAND CURVES
QUANTITY IN CU. M./HR.
4
3
2
1
0
EQUALIZING STORAGE AREA
DEMAND CURVE
SUPPLY CURVE
MID NIGHT
6:00 A.M.
12:00 NOON
6:00 P.M.
MID NIGHT
TIME

Structural Design of Water Tank

Volume = 15 cu.m.

Dimensions = 2^m x 5^m x 1.5 ^{m} = 15 cu.m.

Design of Walls

The walls are designed as cantilevers with a triangular loading.

"w" for water = 1000 kg/ cu.m.

$P = 1/2\ wh^2 = 1/2 \times 1000 \times (1.5)^2 = 500 \times 2.25 = 1125$ kg

Maximum moment = $\frac{PL}{3}$ = 1125 x 0.50 = 560 kg m

$d = 0.367 \sqrt{560} = 8.5$

overall = 12 cm or 15 cm

$A_s = \frac{560}{8.5} = 6.5\ cm^2$

Vertically use 6 - 12 mm Ø / m $A_s = 6.78\ cm^2$
Horizontally use 5 - 8 mm Ø / m

Design of Floor

The bottom of the tank is designed as a slab with a load of 1500 kg/m^2

Investigation in short direction = 2/5 = 0.4 = 0.95

$M = 1/10\ wL^2 = 1/10 \times 1500 \times 0.95 \times (2)^2 = 600$ kgm = 0.013

$d = 0.4 \sqrt{600} = 9.8$

Overall = 15 cm therefore d can be taken as 12 cm

$A_s = 60/12 = 5\ cm^2$ Use 6 - 12 mm Ø / m

Investigation in long direction

$M = 1/10 \times 1500 \times (5)^2 \times 0.013 = 50$ kg m

$A_s = 5/9.8 = 0.5$

Use 5 - 8 mm Ø / meter

CHAPTER III

Specification Clauses

I. General Conditions

Contractor to verify all dimensions: Before commencing the work the contractor shall check the accuracy of all drawings, specifications and bills of quantities. The engineer shall be notified in case of error. In case of ommission the engineer shall supply them.

Quality of material and workmanship

All materials and workmanships shall be the best of their kind. All should meet the approval of the engineer. The contractor shall supply all the material; however, the owner shall have the right to supply any part of it.

Care of the Works

The contractor shall, during the period of the control, be responsible for the safety of the work and material. He shall also provide all watchmen and lighting required.

Dimensions

Unless otherwise indicated, dimensions on drawings shall be read as follows: -

a. Vertical dimensions linked to floor levels, refer to finished floor levels.

b. Vertical dimensions related to windows refer to top of completed masonry sill

c. Vertical dimensions linked to ceilings refer to soffit of ceilings without plaster.

d. All horizontal dimensions refer to walls, piers, etc... without plaster.

e. All dimensions given for doors and windows refer to openings in walls before foames are fitted.

Excavation, Demolition and Earthwork

General Excavation

The rates given by the contractor shall include for clearing the area of any obstruction and excavating in all materials except those that cannot be removed by normal excavators tools, as picks, shovels, spades, etc...

Excavation in Rock

In case blasting is needed the contractor should secure the permission of the engineer. The contractor shall be responsible for any damage that results from blasting.

Demolition Works

The contractor shall demolish any existing structure that the engineer requires. Masonry, doors, windows and fittings shall be carefully handled and stored.

Excavation and Earth Work Measurement.

Excavation and earth-work shall be measured in cu.m. and shall be based on measurements taken before and after excavation.

Water in Excavation:

The contractor shall remove all water accumulating in excavation whatever the source may be. He shall do that at his own expense.

Upholding Trenches.

The contractor shall make sure that faces of excavation are upheld. Otherwise all damages done will have to be paid for by the contractor.

Examination of Foundations

No contractor shall commence the installing of foundation of any sort unless he obtains the permission of the engineer.

II. Concrete Work

Cement. All cement used in the work shall be fresh Checka or Damascus cement or other good quality portland cement approved by the engineer.

The engineer may sample every shipment of cement delivered to site and carry tests on it. Any shipment found defective shall be forthwith hauled away from site and any work executed with it shall be demolished and rebuilt at the contractor's expense.

Sand. The sand used shall be clean, sharp, gritty sand free from clay, organic matter or other impurities from approved source. Sand shall be so graded that the whole passes a 3 millimetres mesh, not more than 25 per cent passing a No. 50 sieve and not more than 5 per cent passing a No. 100 sieve. The various classes of sand for use on the works shall be stored in separate bins. If ordered the sand shall be thoroughly washed in clean fresh water before being used on the works. No quarry dust shall be used in any concrete work.

Aggregate. The aggregate used on the works shall be hard sharp-edged broken stone from an approved quarry, free from earth, dust, loam, clay, organic matter or other impurities. No soft stone may be used. The successful contractor shall submit samples for approval before starting the work.

Concrete work. The proportion of the mix shall be as follows :

	Cement Kgs.	Aggregates in liters Sand	lime	coarse
Footings	300	350	300	550
Columns	300	350	300	550
Slabs	350-400	350	300	550
Beams	350-400	350	300	550

The aggregate, sand and cement shall be mixed in mechanical concrete mixing machines.

Depositing of Reinforced and Mass Concrete

No concrete shall be poured from a height exceeding 1 meter. Each layer poured should not exceed 15 cm thickness.

No concrete shall be poured without the permission of the engineer.

Water content in concrete

The engineer shall decide upon the water cement ratio and can reject any batch he thinks improper to use.

Striking of formwork

a.	For columns (one side)	2 days after casting
b.	" " (other 3 sides)	4 " " "
c.	" Beams (side)	3 " " "
d.	" " (soffits)	14 " " "
e.	" floor slabs	7 " " "
f.	" cantilever slabs, cornices etc....	14 " " "

The concrete shall be watered for seven consecutive days after pouring.

Mild Steel Reinforcement

Steel reinforcement shall be good grade mild structural steel of an approved and known provenance. The wire shall be annealed black wire at least 1 1/2 mm

The contractor shall cut, bend, place, fix and tie all reinforcement as instructed and as shown on drawings, bending lists or as specified. No concrete shall be placed until the reinforcement has been inspected in position and approved by the engineer. All mill scale, loose or scaly rust, shall be thoroughly cleaned off the reinforcement, with a stiff wire brush, before the reinforcement is placed in position.

Fabric reinforcement shall be lapped at least 15 centimeters at side laps and 30 centimeters at end laps and securely wired. Fabric reinforcement shall be properly flattened before being placed in position.

Construction Joints

When concreting of any one section is not completed in one operation construction joints will be provided. These joints will be arranged, to lie in a plane normal to the line of thrust likely to occur and at a point or section of minimum shear. The joints shall be fixed in accordance with the instructions of the engineer. Columns shall be poured continuously to a position just below soffit of beams and left to settle for a period of approximately two hours before depositing new concrete in beams or slabs supported by the column concerned, capitals, haunches etc.. and the whole floor system in vicinity of the column head must be cast in one operation.

Concrete in beams shall on no account be stopped at or near the supports, or over any other beams, column or wall.

Horizontal joints in slabs will not be allowed. Any construction joints in slabs shall be located near the point of minimum shear.

Surface Finish

Concrete in floors and roof slabs shall be finished with a wooden trowel true to level or falls, as required. In cases where a smooth finish is specified or required the finishing shall be made with a steel trowel before the concrete is finally set.

Mode of Measurement - Concrete

No part of the structure shall be measured twice or under two different items in the Bills of Quantities unless expressly stated.

a. Concrete in foundations shall be measured net in meters cube according to dimensions shown on drawings.

b. Columns shall be measured in meters cube up to underside of floor slabs or beams.

c. Beams (depth under slabs) shall be measured in meters cube between concrete columns.

d. Floor and roof slabs shall be measured net (openings deducted) in meters super as constructed.

e. Concrete walling shall be measured net, all openings and reinforced concrete sections being deducted. Prices and rates must include for forming all angles, rebates, chases, cutting holes, etc.....

f. Belts, lintels, etc... shall be measured in meters cube and deducted from slabs, walls, etc....

g. Shuttering together with the supply of timber, cutting waste, erecting, centering, strutting wedging, casing, striking, and

removal shall be included in concrete rates.

h. Steps, copings, sills, cornices, floor channels and the like in meters run, or shall be numbered and described. These itmes to include for all shuttering, moulds etc... as shown on drawings.

i. Mild steel reinforcement shall be normally included in concrete rates unless it is explicitely indicated that it will be paid for separately in which case it shall be billed by weight according to finished dimensions shown on drawings with no addition for waste. One tonne = 1000 Kgs.

III Masonry

Stone Facing

The stone facing 3-5 cm thick shall be chosen by the engineer. For tying the facing the engineer shall decide upon the method.

Sills

The sills to be of stone similar to the course in which they occur and generally to be sunk, weathered, rebated, stooled at ends cut and pinned in cement at the ends, set with wall face and back jointed to concrete backing.

Lintels

Lintels to be of stone similar to the course in which they occur, and unless otherwise specified, set flush with face of wall and similarly dressed on face as the general surface of the wall. Soffit of lintels to have an even camber in the proportion of 1/2 cm to 1 meter span.

Doors and Windows

The contractor shall cut neat mortices for and build in lugs for windows, doors, etc... Lugs shall be grouted in with cement and all frames pointed with mastic.

Steps

All stone steps are to be made of approved hard stone and dressed on all exposed faces "Nahcet Wasaat" i.e.- medium punchooned dressing, and nosings slightly rounded with side joints 1 cm. wide finished to match the adjacent masonry. The ends of steps shall be cut and pinned into masonry. Back joints of top steps are to be cut to a straight sharp line for connection to flooring. Steps up to a length of 1.20 meters, are to be made in one stone. Longer steps may be made in two or more stones, laid with broken joints, but each piece is to be made as long as practicable. Steps are to be laid in cement mortar 1:3 and joints pointed.

Pointing.

At the completion of the masonry building the contractor shall clean down the face of the building, rake out, clean and point the joints with mortar composed of one part with cement and three parts sand. The pointing is to be finished with a neat hallow joint locally known as "Kuhleh Franjieh" so that the mortar is well pressed into the joints by means of a special tool consisting of 5 mm dia. bar. The contractor shall exercise care to avoid mortar spreading on to the face of stonework.

Lime

The contractor shall supply unslaked lime, produced in an approved lime-kiln similar and equare to sample submitted to the

engineer for approval.

The contractor will be permitted to excavate, at his own expense, a temporary pit for lime slaking. The position of pit will be agreed upon by the engineer.

At the completion of works the contractor shall fill pit with selected material, well rammed, in layers 30 cm deep and level off site of lime pit to the approval of the engineer.

The lime shall be slaked through the addition of sufficient water and constant stirring, and shall be sieved through a fine wire mesh before being let into the lime pit.

The slaked lime shall be covered with a layer of fine beach sand 10 cm thick. The lime shall be slaked for a minimum of three weeks before being used.

Mortar

Mortar for masonry work shall consist of 300 kgs. cement to 1 cu.m. of well graded sand mixed with slaked lime to improve workability. Where mortar comes in contact with metal parts such as dowels, lugs, holdfasts, etc... it should not contain lime:

All mortar if not mixed in a mechanical mixer shall be turned over at least three times to ensure a uniform and even distribution of the ingredients before any water is added.

All mortar which has been mixed with cement shall be used within 30 minutes of mixing, and hardnened mortar shall not be remixed with water and used.

Mode of Measurement - Masonry

The masonry face work shall be measured in square meters.

Measurement shall be from edge to edge, edge to corner, or corner to corner respectively.

Jambs, sills and lintels are measured in meters run and shall be given as "extra over"

IV Block Walling

Supply

The contractor shall supply the following:

20 cm. hollow blocks (knapper) for exterior walls (having 3 - 5 cm stone facing)

10 cm. hollow blocks (knapper) for interior partitions as shown on working drawings.

Concrete blocks shall be thoroughly soaked in water before being used in the building.

Mode of Measurement - Block work

a. Walls and partitions shall be measured in sq.m.

b. Block work shall include for all scaffolding. Also for bedding and pointing of frames.

c. All deductions shall measure the net "day light" sizes of openings.

V Plastering

Preparation of surfaces

Concrete Surfaces: The contractor shall thoroughly clean all concrete surfaces from oil, grease, asphalt, dirt or loss particles, protruding nails, and brush down with a hard wire brush and hack up where required to form key for plaster work.

Concrete surfaces shall be thoroughly wetted before plastering commences.

Internal Plaster Work :

The internal plaster work shall be applied in two coats to a minimum total thickness of 15 millimeters on vertical faces and 10 mm on ceilings, in addition to slurry coat.

The plastering of each face between two corners shall be carried out in one operation. The work must not be interrupted and continued the following day. All reveals for jambs, lintels, etc... shall be plastered in one operation with the respective wall faces.

At least one day shall elapse after the first coat has been applied before the second coat is started.

External Plaster Work:

External Plaster shall be applied in general accordance with description above on "Internal Plaster Work"where applicable.

The first coat shall be "tartasha" slurry mixed in the proportion of 1:3 cement to sand and evenly dashed on to the surface with a steel trowel to provide a key for the second coat.

The second coat shall be 15 mm. thick with the surface scored to form a key for the third coat.

The third coat shall be 5 mm. thick finished with a wood float.

At least two days shall elapse after "tartasha" and the second coat have been applied before the application of the second and third coat, keeping the surface thoroughly wet during the interval.

Mortar for Plaster Work

a. Internal Walls and ceilings For internal application the mortar shall be composed of 300 kgs. of cement to one cu.m. of clean

coarse sand with enough lime added to it to improve its work ability.

b. External Walls: For external application the mortar shall be composed of 400 kgs. of cement to one cu.m. of clean coarse sand.

Mode of Measurement - Plaster Work

a. External and internal plaster work shall be measured in meters superficial

b. The materials, the mixes in which they are to be used and the labour shall be described.

c. The number of coats and the finished thickness shall be stated. Raking out joints of brickwork, or blockwork or hacking face of wall to form key shall be included in the rates.

d. Plastering on ceilings may be given separately

e. Plaster on jambs, lintels and corners and edges will not be measured separately.

VI Tiling and Terrazzo Work

General

Wall tiles to be white glazed tiles 15 X 15 cms. of the best make available in the country and of first choice. Tiles in end courses to have rounded edges. Internal and external corners to be tiled with quarter round tiles.

Concrete and Terrazzo tiles are to be of the best make. Their color, mixture and tint to be chosen by the engineer.

Marble tiles to be of the best kind found in the country. Before tiling work is started the contractor shall submit for the approval of the engineer, specimen of all kinds of tiles required for the works.

Wall Tiling

Wall tiling shall be set with straight horizontal and vertical joints as shown or specified, bedded in 1:2 cement mortar and jointed in white cement. Walls which are to be tiled shall be screeded with 1:3 cement mortar. The surface of the screeding shall be left slightly rough.

Immediately before the screed is applied the wall shall be well soaked with clean water and the screeding coat shall be similarly treated just before the tiles are bedded.

Tiles shall be submerged in water for at least 6 hours immediately before setting.

Terrazzo Floor Tiles:

Pre-cast concrete or terrazzo flooring tiles shall be laid on a bed of sand of 2 1/2 cm. thickness and solidly bedded in mortar 10 to 15 mm. thick. The tiles shall be laid with straight or broken joints as shown or directed, finished to true levels and falls, pointed in neat cement and cleared off on completion. The rates shall include for execution all cuttings and notchings required. Tiles shall be submerged in water for at least 6 hours immediately before laying.

All joints shall not exceed 1/2 mm in thickness. Tiled floors shall not be walked on for 72 hours after laying and floors shall be kept wet throughout this period by frequent watering or covering with clean wet bags.

The contractor shall thereafter fill all joints with cement, flush with the surface level and shall clean thoroughly, wax and polsih all tiling after completion of all painting of the works to the entire satisfaction of the engineer.

The contractor shall safeguard all flooring against soiling and shall remove and relay all tiles spoiled by oil, grease, paint etc... until the completion of the works and the taking over of the building by the owner.

Pre-cast Concrete and Terrazzo Tile Skirtings.

Pre-cast concrete and terrazzo cove skirting tiles, together with internal and external angle tiles, returns, end tiles, and other specials shall be supplied by the contractor.

The contractor shall allow for the tiles being solidly bedded in mortar 10 to 15 mm. thick finished to true levels or falls and where x specified, to exact projections beyond the finished wall or plaster face.

Tiles shall be pointed in neat cement and cleaned off on completion. All cutting shall be neatly executed where required. Tiles shall be submerged in water for at least 6 hours immediately before laying.

Mode of Measurement - Tiling and Terrazzo work

a. Floor tiling and paving slabs shall be measured (net) in meters superficial and the measurements shall include all small quantities, narrow widths and cuttings. Measurements will be from finished wall to finished wall according to drawings.

b. Skirtings will be measured in meters run (net) according to dimensions. All apertures will be deducted. Unit rates to include all edges, corners, internal and external meters.

c. Wall tiling will be measured in meters superficial (net) according to dimensions. All openings will be deducted. Unit prices to include for all cutting, fitting, chamfers. Internal and external beads, curved tiling etc....

d. Sills and thresholds in terrazzo or marble will be measured net in meters run, or numbered and described.

e. Terrazzo or marble steps will be measured in meters run or numbered and described. The rates shall include for the supply and building in of treads and risers, Measurement shall be net i.e. the visible length of the steps only between staircase wall and banister will be measured.

VII Joinery and Carpentry Work

Supply of Materials

The contractor is to supply all materials, articles, fittings and all ancillary materials for fixing such as glue screwe,belts, holdfasts, etc... and workmanships necessary for the completion of the work according to the follwoing specifications and drawings and to the instructions of the engineer.

The contractor shall submit samples of all items for selection and approval by the engineer.

Timber

All timber supplied by the contractor shall be sound, well seasoned, well cut, and free of deformations, knots, or cracks. There shall be no sign of rot, worm or other infestation in the timber. The contractor shall show proofs that timber is of 1st grade quality.

Joinery Workmanship.

All joiner's work executed by the contractor shall be accurately set out, framed and executed directly after the commencement of the building, but shall not be wedged up and assembled until it is required for fixing into position.

Windows, Doors and frames

All windows, doors and frames shall be fixed according to the details shown by the working drawings. Interior panneling of offices shall also be done according to the working drawings.

Mode of Measurement - Joinery and Carpentry

a. Doors, windows (steel or timber) shutters, fanlights, partitions, cupboards etc... will be measured in numbers and described.

b. Timber shall be given in meters run except where otherwise stated. Wrought timber shall be given separately.

c. Sheetings, boarding etc.. of plywood, asbestos cement compressed wood pulp etc.. shall be measured the net area covered and given in meters superficial. Rates shall include for cutting and fixing and all raking and circular cuttings.

VIII Glazing

Glazing Generally

The contractor shall supply all glass, putty, nails, dowels, clips, etc.. and all labour, transport, tools and everything necessary for the execution of all glazing in accordance with drawings and bills of quantities and to the complete satisfaction of the engineer. Glass shall be 5 mm thick and 3 mm thick as shown by working drawings. The glass should have a tint blue colour from the outside while from the inside it should be clear.

Putty

The putty shall be prepared from washed whiting and boiled linseed oil of the best quality procurable, well kneaded together and with a proportion of not less than 10 per cent of white lead ground

in oil worked into it, during preparation. Only best quality linseed oil putty shall be used in wooden frames. For steel framed windows red oxide or other approved putty shall be used.

Mirrors

Mirrors shall be of first grade plate glass beveled and well finished and shall be fixed with at least four screws each in an approved manner. All screws to have chromium-plated heads.

Mode of Measurement

Supply, cutting and fixing or glazing shall be measured in meters superficial (net). Only glass panes actually fixed will be measured. Unit rates shall include for all wire nails, dowels, clips, etc...

IX Manholes

All new manholes, unless otherwise shown or specified, shall be of the following minimum inside dimensions:

a. Medium Manholes.- (i.e. not exceeding 1.50 meters deep)

i. With 3 or less branches on side 120 X 75 cm.

ii. With 4 branches on one side 140 X 75 cm.

iii. With 5 branches on one side 170 X 75 cm.

Cut and pin or build in and make good ends of all pipes to wall of manholes. Finish internal walls of manholes with 1:3 mortar.

The concrete tops shall be of pre-cast concrete 10 cm. thick perforated for C.I. cover and frame, reinforced with four 1/2" (13mm) mild steel bars with hooked ends placed round the perforation, and 1/4" (6mm) diameter mild steel bars at 10 cm centres. Bed top in 1:3 cement mortar.

Cost iron frames and covers of a special "anti-malaria" type shall be provided for every manhole and shall be bedded in 1:3 cement mortar and haunched with concrete: and covers shall be sealed with grease.

All manholes over one meter deep to invert shall be provided with foot irons consisting of 1" diameter steel tubing 54 cm. long with flattened ends built into angle of manholes 30 cm. apart and so arranged that the top step shall be approximately 60 cm below the surface of the cover.

In measurement manholes shall be enumerated and fully described.

X Plumbing

Plumbing, Generally

All work in connection with sanitation shall be subject to the approval of the engineer. The work described in this specification and the cost quoted in the bills of quantities is to include supply and fixing of all sanitary fixtures,pipping, fittings, stop cocks, ball cocks, jointing materials, nails, wall hooks etc'... The contractor is to carry out all cutting chases, making holes, excavations etc.. as required.

All plumbing should be according to working drawings or as specified by the engineer.

Asiatic Toilets

Toilets to be vitreous China squating pans of the best make available and provided with an integral connection for flush pipes.

Flushing-Tanks

Flushing tanks to be either cast iron "Niagara" type overhead 3-gal.tanks or white enamelled low level tanks. Both types to be the best of their kinds and approved by the engineer.

Lavatories

To be best American or British make enamelled fire clay wash hand basins, sizes 60 X 42 cms. and resting on G.I. brackets fixed to walls.

Lavatories shall be fitted with hot and cold water supply with good quality imported chronium plated faucets and easy-clean waste traps and plug.

Urinals

Wall urinals to be of the best enamelled fire clay approved by the engineer.

Stall urinals to be of the best enamelled fire clay, two or three stalls to every unit, approved by the engineer, and to include a plated intermittant siphon and flush pipes.