RESIDENTIAL COLONY FOR EMPLOYEES IN OIL PIPELINE TERMINAL

By

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AMERICAN UNIVERSITY OF BEIRUT

CIVIL ENGINEERING DEPARTMENT

RESIDENTIAL COLONY
FOR EMPLOYEES IN OIL PIPELINE TERMINAL

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A Thesis in Town Planning submitted to the Civil Engineering Faculty in Partial fulfilment of the Requirements for the Degree of Bachelor of Science in Civil Engineering

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

In Selecting this Thesis for the Bachelor of Science Degree, the candidate had in mind the following considerations:-

1. The Development of the Near East Oil Resources being accelerated on a tremendous scale, the major problems of the Executive Concerns have been to plan accommodation for workers in places varying from Temperate Mediterranean shore, to Dry and Excessive Desert, to Moist and Excessive Persian Gulf climates.

2. Having worked with the Iraq Petroleum Company Ltd. for periods totalling 18 months, he has shared in the construction for the expansion of three of the desert stations (H-4, T-3, T-4), and in the creation of a new Auxiliary Water Pumping station at Wadi Hafna, in Syria.

3. The presence of an Oil Station anywhere in a country is bringing about either the creation of a new town living directly or indirectly on workers in the station, or the expansion of the neighbouring town at such a rate that conditions of hygiene and sanitation are often neglected.

4. For economic and perhaps political reasons, some Oil concerns have decided to run pipelines from inland oil wells to the Mediterranean shores of Syria and the Lebanon. We thus find plans being made and put under execution for the construction of pipeline terminals in the neighbourhood of Saidon in Lebanon, Tartous and Banias in Syria.

5. Following the development of these Oil Settlements, the

respective Governments are bound to plan improvements on and perhaps creation of villages for their Rural and Urban populations.

6. For all the above considerations and also because this field in Town Planning is relatively new, the candidate found it worth while to work on the solution of some of its problems, especially those confronting the site engineer in charge of such a scheme.

II

S C O P E

Selected a plot of land in the Southern outskirts of Tartous in Syria, and defined by the Geographic Service of the French Army on Map No. 1510/3711 of June 1943 (a copy is presented) as falling between vertical coordinates 167-168 and horizontal coordinates 325-326, the exact nature of the land having been worked out and plotted by the candidate on the Thesis Maps A-1 and A-2, the candidate undertakes to make the plans for the construction of a residential colony that can accommpdate 105 Families and 400 Bachelors.

The work consists of:-

1. Preliminary Architectural Design of various buildings for Dwelling, Administrative, Educational, and Recreational purposes.
2. Distribution of these buildings over respective districts
3. Design of recreation fields and of roads.
4. Design of a Sewage System.
5. Design of a Water Distribution System.
6. Design of a Hot Water Distribution System for Central Heating
7. Design of the Electric Distribution Main Lines.

ACKNOWLEDGEMENTS

Though the work was carried out personally by the candidate under the supervision and guidance of Professor N. Manasseh, acknowledgement should be made to the following parties who had a direct or indirect influence on the training of the candidate for the solution of the problems involved in this Thesis:-

1. All Professors and Instructors who taught and teach in the Civil Engineering Department.

2. The Civil Engineering Department of the Iraq Petroleum Company Ltd. where the candidate worked for 18 months.

3. Authors of Books enumerated in the Bibliography.

IV BUILDINGS

This is only a preliminary Architectural design subject to modifications and approval by a Buildings Committee which is usually designated when such a scheme is to be put in execution.

Though the dimensions are proportional, they have been kept with strict minimum specifications, so that in case the budget allows it, the buildings committee has simply to agree to a factor which will multiply all the dimensions and make the rooms more spacious.

Bungalow Type A is meant for the accommodation of two Bachelors occupying high posts such as Manager or Department Head.

Bungalow Type B accommodates four staff Bachelors in positions such as Doctor, Engineer, or Head of an Administrative or Technical service. Each one is given a Private Room and a Private Bath Room.

Bungalow Type C accommodates six class I Staff Bachelors on temporary stay. Each one is given the same accommodation as in the previous Type. Type A has two Rooms instead of one.

Staff Mess and Club block is meant primarily as a restaurant and recreation place for class I Staff Bachelors, but families may be admitted, subject to regulations by the Colony Superintendant.

Servants Quarters accommodates eight servants, one butler and

Refer to Drgs. B-1, C-1, C-2, D-1, D-2, E-1, F-1, F-2, F-3.

one chief cook; one of these blocks is located in each of the class I, II, and Labour Districts.

Cottage Type A accommodates two class I staff families with one small or no children.

Cottage Type B accommodates two class I staff families with one or two children.

Cottage Type C accommodates one class I staff family with two or more children.

Lodge Type A accommodates four class II staff bachelors occupying such positions as foreman, head clerk, head storekeeper, or chief operator. Each one is given a private room.

Lodge Type B accommodates eight class II staff bachelors in such positions as clerk, storekeeper, operator, typist... (white collar workers). Each two are given a room.

Lodge Type C is the same as the above one but placed on a more slopy ground, giving farther views.

Restaurant and Recreation House is meant to give messing and recreation to class II staff and class I Artizans Bachelors. Families may be admitted, pending regulations by the Colony Superintendant.

Housing Blocks Type A accommodate four class II staff families each. Only one bed room and one sitting room are provided.

Housing Block Type B accommodates four class II staff families with one or two children.

Housing Block Type C accommodates two class II staff families with two or more children.

Married Artizans Quarters Type A accommodates four class I Artizans families with one small or no children.

Married Artizans' Quarters Type "B":- Accommodates four class I artizans' families with one or two children.

Dormitory Block Type "A":- Accommodates eighteen bachelor artizans of second class category such as Drivers, mates, apprentices; nine are put in one dormitory.

Dormitory Block Type "B":- Accommodates Thirty-two labourers. Each sixteen labourers are put in one dormitory.

Cafeteria:- Is meant as a restaurant for Class II artizans and for Labourers' dining-hall.

Steward's Block:- contains the Steward's office and store for daily goods, canteen with cold room, bread and laundry distribution rooms.

Colony Superintendant's Block:- contains superintendant's office, clerks' room, chief accountant's office and his clerks' room.

Medical Block:- contains Doctor's office, clerk's and waiting room clinic and two emergency rooms. These emergency rooms are meant for patients pending their evacuation to a hospital.

Watchmen's Quarters:- accommodate eight watchmen. The Gateman's shed falls right at the entrance gate.

Communications Block:- contains communications engineer's office, wireless and battery room, operators' room and traffic office.

School for Sixty Pupils:- contains two class rooms with a capacity of twenty-five to thirty pupils each, with one teacher's room for each class. Two lavatory rooms are provided, one for each sex.

Sanitary Block Type "A":- is divided into three parts: one for class I, one for class II, and one for Labour. Each part has in turn two sections, one for each sex.

Sanitary Block Type "B":- is to serve class II personnel.

Sanitary Block Type "C":- is to serve class III personnel and Labou

Laundry Block:- contains a reception, a washing , a boiler, and ironing rooms.

Bakery Block:- contains a store room, a flour mixing room, a fermentation room, and a baking room with an oven.

Electric Power Block:- contains an engine room, the attendant's quarters, and a switch control room.

Garages and Workshops:- contains a store room for auto parts, three repair shops and one petrol filling station.

General Stores:- Each block is divided into three independant rooms, each of which may be entrusted to a different department.

Maintenance and Construction Offices:- Shelter all construction tradesmen such as carpenters, electricians, painters, plumbers, welder and their foremen. It also provides offices for the civil engineer in charge of the execution of the project, for his clerks, and assistant.

Boiler Rooms:- will boil the water to be used for Central Heating.

Residential Buildings are located in Three distinct Districts:-

1. Class I Staff District:- Subdivided into two areas.

A. Bachelors' Area. This includes Bungalows A B C, Staff Mess and Club, and the Servants' Quarters. It has a ring of road surrouding it, and in front of the mess building, ample space is provided for parking. The blocks are at least ten meters apart, but no provision should be left for cars to pass between buildings.

B. Married Area. This includes all the Cottages; They are surrounded by a road. Around each cottage there is enough space left over for future development of lawns or for gardening or parks which may be used as playgrounds for children.

The prevailing wind being in a North Easterly direction, it should be pointed out that the Staff I District is placed in a more favourable location with respect to the other districts.

2. Class II Staff District:- Subdivided into two areas.

A. Bachelors' Area. This area includes Lodges A B C, the Restaurant and Recreation House, and the Servants' Quarters. In front of the REstaurant and Recreation House, enough space is provided for parking. In this area , Class II Staff (white collar workers) are installed in the proximity of ClassI Artizans. Although these are usually of differe nature,viz. the former being educated and young, and the latter less educated and older, it has been found out that they form a rather compatible neighbourhood.

(I) Refer to Drbs. A-1, A-2, A-3, A-3x, A-6, A-6x.

B. Married Area . This includes Class II Staff Families and Married artizans quarters, a road separating these two units. Although thay may have more or less the same income, it is probable that the social standard of a white collar worker's family is different from that of an artizan's, and this suggests the seperation of this area into two units. Around each block, enough space is left over for gardening or for the development of lawns as playground for children.

3. Labour District.

At some three hundred meters from the other residential district and forming a distinct unit, the Dormitory Blocks are distributed arou the cafeteria. This is meant to form a district independant of the others, with its own servants and its own cafeteria. No married accommodation is provided for employees below the grade of skilled artizan, because the employment of such a person may be considered of temporary nature. The Colony Superintendant may, however, make some exceptions and allocate married quarters to such third grade employees as a gardener, a chief cook or a chief watchman, in which cases they will have to be accommodated in the married artizans quarters.

Public service buildings are located in centers where their functio may give the best desired results. Five centers can be distinguished:-

1. Administrative Center:- This is located at the gate.

This is meant for the administration of the colony as a residential place only, the residents coming to their lodgings after their work at places outside the fenced area. Naturally, it looks

after problems concerning the colony proper, and personnel employed in running the colony. The location of the buildings is of a nature to give control to the life of the colony. The watchmen's quarters, right at the gate, control everything that goes in and out, while the traffic office makes a close check on vehicles entering and leaving the colony. The medical block is equidistant from all districts, and its location near the gate gives a proximity to patients and visitors from outside the colony.

2. Workshop Center.

This contains the garages which are meant for repairing vehicles which belong to the running of the colony proper, and to give emergency repairs to vehicles belonging or allocated to residents in the colony.

The Construction and Maintenance unit is meant to shelter gangs employed in the creation of the colony, and when this is finished, in the construction of future developments. It is appreciated that a colony of this size will always be in need of various artizans' services for the maintenance of its grounds and buildings.

3. Undesirable Neighbourhood Center.

This is located on the North Western corner from which wind will drive away the noise and the bad smell. It contains:-

a. The Sewage Filter bed and pump. (bad smell)

b. The Electric Power generator house. (noise)

c. The Laundry block. (smoke)

d. The Bakery block. (smoke)

The last two blocks are put next to each other and parking

facilities will be arranged in front of each of their reception and delivery rooms. A service truck will carry the laundry and the bread from these blocks to their respective distribution rooms located in the steward's block at the center of the colony.

4. The Shopping Center.

This is the steward's block and stores. It contains the canteen and stores, a cold room, and the bread and laundry distribution rooms. An area of Three Thousand and Six Hundred ~~xxxxxx~~ square meters is left available for the purpose of future developments.

The materials to be available in the canteen will be of daily and immediate consumption nature. Although the size of the colony may justify more than one shop's presence, the erection of other shops, such as the barber's shop for example, is left to the natural development of the colony after the initial set of buildings (as in thesis) is completed and the buildings occupied.

5. The Sports Center.

The various fields and courts are located at such places as will give nearest reach to those making use of them. The discussion of each activity is left to the next chapter.

RECREATION AREAS (1)

The recreation areas are to provide outdoor recreation for adults and children. The main activities are:-

1. Tennis:- Four separate courts are provided and meant for the use of Class I and Class II employees only.

The type of floor for these courts, concrete or of compacted soil, is left to the decision of the grounds and buildings committe. It should be pointed out however, that though the first cost of a concrete floor is greater than that of compacted soil, the maintenance cost of the latter is much higher, and in the long run, it proves to be much more expensive.

In case the concrete floor type is selected, it is suggested to secure permanent color to the divide lines, and also perhaps to the main floor, by mixing the surface layer with Silexine, a chemical product supplied in varieties of colours, and whose use is harmless to the strength of the concrete.

2. Croquet:- Two courts are provided.

The floor of such courts is preferably lawn, but compacted soil may be used, provided it makes with the ball a sufficiently high coefficient of friction.

Because this is mainly a women's game, the courts are located within easy reach of the married areas.

(1) Refer to Drgs. A-3, A-3x, A-6, A-6x, F-4, D-3.

3. Swimming:- Though the sea is only at some fifteen hundred meters from the colony, the swimming pool is expected to be quite desirable and popular. It can accommodate 150 persons.

The apparent allowance in space is in the order of two square meters per person, but even on a crowdy day, everyone is not expected to make use of the pool at the same time, and therefor the actual capacity of the pool may be assumed substantially higher.

The swimming pool area is expected to form a unit by itself. It is encircled by trees beyond which runs the main road. Enough space is provided for the development of sun bathing areas, lawns and sand boxes for children; but the distribution of these is left for future developments, when a closer examination of the site is possible.

4. Basket-Ball:- One court is provided. This sport may be open to all employees, but due to its nature, it may not have many adherents. The dimensions of the courts being flexible, those nearer the minimum specifications are recommendable, so as to make it handier for use by the smaller school kids.

5. Soccer:- This sport will be open to all employees and it is bound to have more adherents than basket-ball, the players being recruited mainly among bachelor white collar workers and class II artizans. Though the dimensions of the field are flexible, average dimensions should be selected, again to provide oppurtunity for school children to make use of it. The playground may be lawn or of compacted soil, but the former is a preferable choice.

All roads will be six meters wide. Only the one in front of the canteen will be ten meters wide, to provide for parking.

At junctions and crossings, angles formed are eased by an eight meter diagonal, such as shown on the general layout map. Wherever possible, cross intersections have been avoided.

Trees are planted on each side of the road at two meters from the curb and five meters apart. The kind of these trees is left to the choice of the grounds and buildings committee.

The construction of these roads should supercede that of the buildings so as to make use of stone chips left over from the masonry works. Because of the nature of traffic they are to carry, no foundations are necessary and the roads may be constructed in four steps:-

1. Lay chips and broken stone pieces over natural ground to a maximum thickness of fifteen centimeters per layer, and to give the desired camber.

2. Spread sand and clay and topsoil over the broken stones to fill the insterstices and form a cover layer of not more than five centimeters thick. Then pass 3 or 4 times a roller not heavier than five Tons.

3. Spray with crude oil at the rate of ten liters per square meter, cover with two centimeters of clay and sand in the ratio of 1:1, and pass a roller not heavier than five tons ten to fifteen times.

4. After two or three days, spray with crude oil at the rate of five liters per square meter, but in very thin layers, if possible

(1) Refer to Drgs. A-3, A-6

one liter at a time. Leave the crude oil to get soaked in or dry by itself. Capillarity will do the rest.

Not later than one month after step 4 is completed, the road will look like an ordinary asphalted road, and capable of carrying ordinary light traffic. It is clear that this process of road making can take place only during the dry season.

Because of the nature of the site, an accentuated camber may not be necessary, but a minimum rise at the center of twenty centimeters over the sides is advisable. On each side of the curb of the road and connecting the trees, a thirty centimeter ditch is to be dug.

Upon examination of the contours, it is seen that the general grading lies between one and six percent, deviating from this average in a few places, but never running below 0.5% nor higher than 10%: the former being the minimum requirement for drainage, and the latter the maximum allowable grade.

Although no section of the road imposes the construction of a bridge, an examination of the contours would define clearly the places where runoff water is bound to collect on one side of the road, and the necessity to provide an escape for it to the other side becomes clear. At such sections, the construction of a culvert or of an Irish Crossing becomes imperative. The exact location of such problems and their solution will be left to the site engineer, who will be in closer contact with the place where the problem is to be solved.

VIII SEWAGE DISPOSAL (1)

The general scheme is to collect all sewer waters at the lowest point, filter them coarsely to remove any solid matter that has not dissolved in the septic tanks, then pump the water to the filter tank on top of the hill. From there, distribute it by gravity to sundry points to irrigate plantation within the colony.

The minimum slope of sewage pipes from a building to the septic tank or main sewer shall be 1:40, while the minimum slope of sewage pipes from the septic tank to the main sewer and filter bed may be 1:150.

Sewage from the gate area shall be carried to a septic tank, from which it will be dumped into a covered soak pit located outside the colony area. The shape and size of this soak pit depends on the nature of the sub-soil encountered. In case it is porous or cracky, a small soak pit may be necessary; in case it is not porous but soft, a deep soak pit may be excavated and given a solid cover, after which it will be covered with earth and forgotten. In the worst case, when the sub-soil is rocky and without cracks, the most economical solution would be to dig a series of shallow soak pits, and disinfect them periodically with lime or some other substitute. No use can be made of the stream running near the colony and to the south, because this stream does not run the whole year, its bed being dry in summer.

Sewage from the class I staff district is collected into two

(1) Refer to Drgs. A-4, A-6, A-6x, B-2, B-3, B-4, C-3, D-3, D-4, E-2, F-5.

septic tanks, then it is made to flow across to the main sewage lines, collecting on its way the sewage from the schools. Although at first examination the lines seem to follow an uneconomical path, running into greater lengths than the minimum necessary, a close examination of the contours will show that the proposed solution is the most economical one, because it tries to follow the natural slope of the ground, thus causing least excavation. It may be worth while to point out that the excess in length between the present solution and the one with the shortest lengths does not go beyond 50 meters.

Sewage from the housing blocks is collected in one septic tank and made to flow directly into the main sewage lines; similarly, sewage from the married artizans quarters flows into a septic tank, from which it connects with the main sewers. It should be pointed out here that the nature of the ground is such that the lines causing least excavation are also those with shortest lengths, giving thus a natural hint for the most economical solution.

Sewage from the class II staff bachelors area has to be dealt with as a separate unit. An examination of the proposed solution shows that economy in design has been sacrificed in favour of securing greater ease in construction and better sanitary conditions. The candidate hopes for a favourable consideration of his point of view in taking this decision.

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Sewage flows in manhole 7 from the sports area without passing through a septic tank, because it is considered that water emptying the swimming pool will be flowing at such frequent intervals and in such quantities, that it will be sufficient to carry away with it all the sewage from the sanitary blocks on its way. Solid matter from this area will be dissolved in the septic tanks immediately before entering the filter bed.

The paths of the sewage lines from the labour area are so arranged that the shortest lengths are found to be the ones necessitatin the least amount of excavation. Two septic tanks are deemed necessary to dissolve sewage from this and from the workshops area.

It must be pointed out in this connection that wherever a sewage line crosses a main road, the pipes should be completely covered with concrete 1:3:6 mix, and forming a top layer of at least five centimeters. The fill over this portion should be of selected soil, watered and well rammed in layers not exceeding fifteen centimeters. If this measure is not taken, it will be found out that frequent repairs would be necessary to pipes at such sections of the lines, and the inconvenience to traffic and to the neighbourhood when such a repair takes place does not need to be emphasized.

Vent pipes of two inch diameter are taken from each septic tank to the nearest building and prolonged to at least one meter above the

roof. The top of such a pipe is mounted by a hollow vase some six inch in diameter and filled with charcoal in small pieces (over a grating) to prevent the diffusion of smell. The first manhole starting each sewage line is also mounted by a hollow vase with a vent pipe fixed in the same way as that for the septic tank. The importance of these vent pipes and the care to be taken in their proper installation cannot be overemphasized.

Sewerage coming from the labour area is made to flow directly into the filter bed. Sewerage coming from the staff and school areas passes into the filter bed after passing into a special septic tank. The function of this septic tank is to dissolve any solid matter which has not been dissolved in previous processes; if one tank is not sufficient, enough space is provided for the construction of a series of septic tanks, from which a connection is made directly with the filter bed. The idea in this process is to allow into the filter bed the least amount of solid matter.

The construction of the filter bed is to be carried out to lines and levels as set clearly in Drg. F-3. It should be pointed out in this respect that the stones are meant to filter the water coarsely and not in the proper sense of the word, only the retention of gross solid matter being desired. It can be reasonably assumed that under normal operation, the stones of the filter may have to be changed, or cleaned, every four to five years.

From the filter bed, water flows into a reservoir chamber over which a pump is installed which will function automatically every time water reaches a definite maximum level.

From the filter pump house, water is pumped to a storage tank on top of the hill. This water will be distributed to various points in the colony and used for watering trees planted on each side of the road, in park areas, and in orchards. Water from the filter ~~hex~~ tank will flow by gravity in wrought iron pipes; although tap locations have been shown on the map, the exact location of valves and the construction of protective structures around these valves will be left to the site engineer. Filter water may be used only for trees, because its use for watering vegetables is questionable and perhaps to be forsaken.

A general rule for deciding the slope of sewage pipes before reaching the septic tank will be to allow 1:10 for every inch of diameter i.e. 4" pipes will have a minimum slope of 1:40, 5" pipes 1:50, 6" pipes 1:60 and so on. This rule, used in practice on many occasions, has given quite satisfactory results.

IX Water Distribution System. (I)

According to specifications by the American Water Works Association, The minimum rate of demand of water in the United States is 60, and the maximum 300 gallons per person per day. In rough approximation, it is generally assumed to be 100 gallons per person per day. This figure includes all forms of demand except that for fire.

Assuming the demand for water in the residential colony is roughly the same as that in an average city, 100 gallons per person per day would be a fair choice. But, deducing from this quantity that used for gardening (due to the use of the filter water), it may reasonably be assumed that an allowance of 50 gallons per person per day will give a satisfactory result. A study of the figures of water consumption in a number of the desert stations run by the Iraq Petroleum Company Ltd.will give a figure not far from this one, a similar system for use of sewage water being in practice in most stations.

An estimate of the total residential capacity of the colony gives an average of 700 persons. In calculations for the capacity of the storage tanks, requirements for 1000 persons will be assumed, thus providing for future expansion, or for supply of some water to points outside the colony.

(I) Refer to Drgs. A-5 ,, -6x, E-3, A-6, A-6x

Provision for fire demand is made according to specifications by the American Water Works Association which requires that for a colony of this size, a reservoir capable of supplying 1000 gallons par minute for a period of 5 hours will be necessary.

The swimming pool is assumed to require filling every 3 days. Because of its relatively high capacity with respect to other demands, allowance for its requirements will have a large importance in the calculations for the capacity of the storage reservoirs necessary.

The calculations will then run as follows:-

Consumptive Demand :-

for domestic use:	.2 x 1000	= 200 m-3
for swimming pool:	1/3 x 25 x 1,5 x I2	= 150 M-3
Fire demand:-	4x60 x 5	= 1200 M-3

Total 1550 Cubic Meters.

Two tanks twelve meters in diameter by six meters in height will be sufficient. The details for the construction of these tanks fondations are shown on Drg. F-3. Their stucture serial No. is 116 & 117.

Under normal conditions and when the colony is at its full capacity, the daily rate of water consumption will be 200 cubic meters when the swimming pool is not in use, and 350 cubic meters when the pool is to be

Fire hydrants location is shown clearly on map A-5. For protective reason, each hydrant will be fixed in a box elevated enough above ground to be noticed from any reasonable distance, and painted in any striking color, preferably red. The use of water from hydrants for purposes besides fire extinguishing may be allowable, provided it is subject to regulations that would be set by the buildings committee or by the colony superintendant.

A close examination of the contours and of the elevation of the water tanks with respect to other buildings shows that water will flow by gravity from the tank to any portion of the colony. A check for quantity and pressure at various points with Hazen and William's solution table (see Drg. No. A-5x) denotes a satisfactory supply at any point in the colony.

Main valves have not been located on the lines, because in the opinion of the candidate, the location of these valves and their numbering, as well as the location of the contraction joints needs a closer examination of the site, and therefor, should be left to the care of the site engineer; it should be pointed out, however, that each main valve should be surrounded with a protective structure, against sand and humidity and any

other exterior injuring factors. The type and design of such a structure is left to the judgement of the site engineer.

The ramifications and sizes of the main distribution lines is shown clearly on map A-5. From the size of the pipes, it is understood that the best choice would be wrought iron pipes, sprayed with bitumen,and, if possible, rolled in bitumen paper and buried at a depth of at leas t 30 cms.

X. Hot Water For Central Heating.

Refer to Drgs. A-5, F-2. A-5, A-6 x

Two pipes running one over the other will be buried at least 40 cms deep. One pipe will carry the hot water into the blocks (the Feeder Pipe), while the other one will bring the cooled water back to the boiler (the Suction Pipe). These pipes should be surrounded by an insulating material such as cork or asbestos putty or any other available substitute.

Central heating is provided for class I and II staff, and the schools only. One boiler serves the class I staff district and one school, while the other boiler serves the class II staff district and the other school.

It shoul be pointed out that in the distribution of the pipes for central heating as well as for service water, crossings with sewage lines have been, where possible, avoided, and therunning of water pipes alongside sewage lines have been totally shunned.

The main hot water pipes will be two inches in diameter. Branching from these, one inch pipes will supply hot water to three or four buildings whose radiators will be connected in series.

X. Hot Water For Central Heating.

Refer to Drgs. A-5, F-2. A-5, A-6 x

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Though it is a matter of course that radiators should be located, wherever possible, under a window, the type of radiators (whether on legs or on hooks in the wall) to be used will be left to the choice of the buildings committe, who will be guided by the availability of the material on the market, when the project is to be put in execution. In case both types of radiators are available, the one supported on hooks in the wall is preferable, because it proved to be more rigid, and it gives no obstruction to the stretching of a carpet or rug that may cover the whole area of the room . The number of tiers composing each radiator will be left to the judgement of the site engineer, but it may be proposed that radiators located nearer to the main line should be considerably smaller in size than those at the far end.

Hot water should leave the boiler from the top into the feed pipe, and after running through the line, return to the boiler through a connection at the bottom. Difference in densities between hot and cold water being insufficient to cause proper circulation, the installation of a centrifugal pump becomes imperative. The speed at which this centrifugal pump is made to rundepends upon the rate of heating desirable. If this rate should be great, in a very cold weather, the pump should run at maximum speed, while if the rate should be small, in

a warmer weather, the pump would be run at a slower speed. This shows the advantage in the use of a centrifugal pump for this purpose, over any other types of pump available.

At high points in the line, and at other points where pressure may be too low, exhaust valves should be installed, to dispose of air pockets that may be formed at operation intervals. Similarly, each radiator should be equipped with an exhaust valve. Frequent inspection of these valves to secure their proper functioning is absolutely necessary. Every year, prior to the first use of the boilers, at the beginning of the cold season, all valves should be unscrewed, inspected thoroughly, cleaned, and fitted back in place. Deficiency in valves have been the cause of many accidents such as the bursting of pipes inside and outside buildings, the obstruction to flow causing a disorder in the whole system, and even damage to the pump originating the flow pressure. The importance for the proper care to give to these valves cannot be overemphasized.

Wherever hot or cold water pipes cross a road, they should be surrounded by another pipe which will form a sort of culvert around them, protecting them from shocks; when the pipes are covered with an insulating material, the surrounding pipe must contain the whole line. The idea is that the larger pipe will recieve the thrust

and the deformation, avoiding to the water carrying pipes any deformation that may cause leaks. This measure or any other one similar is indispensable for avoiding frequent leaks. Under no circumstance should any portion of a water carrying pipe be embedded in concrete or any other rigid fixture, because this will discontinue the general elasticity of the pipe, causing cracks and leaks at critical points.

XI. Electric Distribution System.

Refer to Drg. A-6

A layout for the main lines is provided. The maximum distance between poles will be 40 meters. Where it is convenient, the corner of a building may be used as a post, provided when such is the case, the electric wires are at least two meters higher than the roof top.

Taking villages and settlements of similar size as a basis, it may be assumed that the system will be running on 220 volts A.C. Without going into a detailed analysis of the distribution system, it may also safely be assumed that if this voltage is supplied directly from the plant, losses on the way will be of such scale that at any point in the colony, the voltage will be very near to that at the source; that is the reason why no provision was made for transformer kiosks.

At any section of the distribution line, the wires should be at least five meters above the ground; wherever the line has to cross a road, they should be at seven meters.

It may be generally noticed that electric poles fall farther from the road than the jointly running trees lines; this arrangement is made for esthetical reasons; the candidate believes that though a wire along a road is permissible, its striking exposition along a road with

trees on each side would give a bashful appearance; -

visualization of the fact will give a natural deduction .

The roads will be lighted at junctions and, in long stretches, at approximately 100 meters intervals. So as not to let the trees be an obstruction to the lighting of the road, the lamps should hang from cantelever beams attached to the pole, and long enough to give direct lighting to the road. When the canilever is long, it shoul be bracketed, or a special post for the lamp should be installed. Though the latter is a little more expensive, it may prove to be safer structurally; that it is preferable esthetically goes without hesitation.

Fuses in main lines and in branches should be located on poles or on buildings at places that are not within easy reach, or otherwise, inside boxes under lock and key; this precaution, though it seems futile, should be taken against the interference of children, or of some adults who may be gifted sometimes with peculiar sense of humour.

Wherever there is a spot where operation may be dangerous, and therefor, no one should be allowed inside the area except authorized persons, notices to this effect should be legibly written and hanged at proper places. The use of hideous signs to scare people away, though used extensively in some locations, is to be totally avoided, because, in the opinion of the candidate, it spoils an environment which might otherwise be pleasant. (Imagine a

person walking nonchalantly somewhere, and suddenly appears, painted in striking colors, a death or other such mark!)

For further details, the American Institute of Electrical and Civil Engineers' specifications should be followed.

XII. General Considerations.

Telephone lines have not been shown on the map in order to avoid confusion. Although the candidate does not feel qualified to make a detailed design of a whole system, he will suggest the following points of information which he picked up from publications and from Mr. Nicholas Fafalios, a communications engineer in the service of ~~the service of~~ the Iraq Petroleum Co. Ltd.

1. In making an installation, enter the mains into the building from the opposite side from which the electric main is entered.

2. In the process of wiring, avoid letting your wires cross with electric wires; in case they have to, double the insulation at the crossing point.

3. Under the telephone plug, make a casing in the wall for the battery or cells connected with the telephone instrument.

4. In case you are installing underground cables (latest practice), make sure they are layed properly, with the minimum depth underground all through, and special protection where crossing a road.

5. Plot accurately on the map the exact path of the line layed, so as to make it easier for future location. Obtain more than one copy of such a map.

6. If wires have to be supported on electric

poles carrying a voltage not grater than 55 Volts, the minimum horizontal distance between a telephone and an electric wire should be 60 cms.

Although telephone facilities may be extended to many other blocks, the candidate believes that at least one point should be installed in the following blocks: - Communications, Watchmen, Superintendant's, Medical, Garage, Maintenance, Electric Plant, Laundry, Cafeteria, Schools, Canteens, Steward's, Restaurant and Recreation House, Lodge type A, Staff Mess and Club, Bungalows types A , Staff Mess and Club, Bungalows types A and B, Cottages type C.

Garages shops or car shelters have not been provided, because in the Opinion of the candidate, cars belonging or assigned to employees living in the colony will be parked for the night either in the proximity of their owners' quarters, or in stretches allocated by the colony superintendant. An examination of the map will suggest clearly such locations. In case of unusual inclement weather, temporary sheds may be devised, but the presence of such sheds being perhaps detrimental to the general aspect of the colony, they should be of a removable type, so as to be able to clear them away during the calm season.

The general scheme in the distribution of the buildings is that future expansion will take place towards the center of the colony, filling the substantial areas which have been left clear. Before such an expansion takes place, however, these areas may be turned into parks and lawns. The location of beaches and the detailed design of geometric forms of areas into which sundry types of flowers may be planted, though of interesting and perhaps passionating nature, is left to future development,because the candidate believes that such designs require an extensive and perhaps specialized study, and therefor may not be included in the solution of the problem in hand.

Swimming pool water should have a special treatment with chlorine before it is allowed to flow into the pool. The chlorine dose should be in the order of 3 parts per million, though a slightly lower quantity may be permissible. The presence of such a high dose of chlorine in the water, though it has no harming effect on the skin, yet may give it a tense feeling, becoming a little scorchy around the eyes after a dive. To remove this uncomfortable effect, 0.25 p.p.m.Ammonia may be added to the water, hindering this effect of chlorine, but giving no interference to its bactericidal action. In order to prevent the contamination of the water and the transmission of foot skin diseases (such as Athlete's Foot), a special wading pool, containing the proper chemicals, should be provided, and every one

should be requested to dip his

making use of the swimming pool,or strolling over the sunbathing stretches. A good idea would be to provide special showers where swimmers may soap themselves before going into the pool. These measures are taken for the sole pupose of keeping the swimming pool as clean and as handy as possible during the whole period of its use.

The solution of problems involved in this thesis is by no means final. The assumptions made and suggestions forwarded are meant to serve as a basis for detailed study with more factual data in hand, when such a project is to be put in execution. The candidate believes that the scheme presented may be adapted to any landscape,with slight alterations in local arrangements, but without interference with the general ideas in design. The flexibility of arrangement, then, resides in the general solution of the problem, and any more detailed considérations may enter within the realm of a special case, which is not the fundamental purpose of this thesis.

Before ending this paper, the candidate wishes to express his gratitude to Professor Nicholas Manasseh, whose help has been of great importance in making this work possible.

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