ARCHITECTURAL DESIGN
OF A

TEXTILE FACTORY
AT

HADETH

BY
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Supervision

This thesis was made under the supervision of Professor K. Yeramian. Valuable data and advice regarding size and position of the various units were obtained from the supervisor.

Introduction

The Middle East during the last war had a great industrial boom. World shortages of manufactured products along with a stiff blockade made it impossible to find even the most necessary foreign-produced commodities. Prices soared up here as elsewhere with terrific speed. At the same time the British Army by spending great sums of money on fortifications and the maintenance of its men provided very profitable business for the local population. People soon had a lot of money but nothing to buy with it. Consequently factories sprang up everywhere to supply their needs.

These factories were erected for the most part on a make-shift basis by persons who had no qualifications or experience whatever in factory building but had enough money and enterprise to set them going. No attention was paid to such important matters as efficiency, sanitation or safety of workers. The result as may be expected was deplorable. Goods were of inferior quality but sold at high prices, the health of labor deteriorated alarmingly, As a result the Communist Party won new adherents.

By 1943; the Middle East Governments in general and the Lebanon in particular took action to remedy the situation. Fines were imposed on industrialists

failing to provide proper sanitation for their workers but the result was far from satisfactory as most factories preferred to pay the small fine rather than go into the heavy expenses of building even the most rudimentary toilets. The manufacturers merely passed on the cost of these fines to the consumer by raising the already high price of the goods they produced.

The Middle East Governments also passed laws awarding indemnities for workers sick or disabled. This law was the natural outcome of a great many accidents some of which were fatal and could have been avoided by the most elementary safety devices such as covering flywheels and belts. In one of these factories, a girl was scalped when her hair got caught in a flywheel.

Still nothing was done to improve conditions of safety and these factories kept paying compensations for disabled laborers and also incurred heavy loss through sickness of the workers and the difficulty of replacing the absentees.

The situation remained unchanged till the end of the war. In 1945, when the war ended and the blockade was lifted, foreign goods began to trickle in slowly. Within a short time the country was litterally flooded with every conceivable commodity.

Prices fell as rapidly as they had mounted in 1942 and factories closed up as rapidly as they had opened then. Any farsighted industrialist could have predicted this disaster and put himself in a more favorable position by eliminating these unnecessary expenses. Most, however, were so blinded by the quick and easy money they were making that they failed to look ahead.

The few who were farsighted enough to study carefully the planning of their factories and choose manufacturing lines with which they could compete with foreign countries have been able to survive successfully the crisis. These industrialists produced goods varying from textile as in the case of Messrs. Arida, Badaro, Abroyan, etc.. to iron work as Messrs. Polycarpos, from tanning of hides as Messrs. Debs to spaghetti and brick.

A prominent industrialist who successfully survived the crisis summed up the situation in the following words: " bad design of the factory, poor hygiene and lack of safety for the workers, are responsible to a very large extent for considerable losses. A poorly designed factory cannot produce efficiently or cheaply specially in the case of textile factories

where a small jerk of the machine may break several threads thereby spoiling the pattern of the cloth and making it of inferior quality. Poor hygiene and lack of safety of the workers, not only draws on the profits in the form of indemnities but also makes the workers inclined to sabotage the work.

Consequently, most of these industrialists are redesigning their factories at great expense, or even in some cases, building completely new and modern ones as in the case of Messrs. Abroyan.

It is the object of the candidate in presenting this thesis to attempt an architectural study of an ideal textile factory. The importance of the choice of this subject should be apparent from the foregoing discussion.

Textile was chosen because it is one of the most successful industries in the Lebanon and one in which the factories need very careful design especially concerning spacing of machines, correct placing of the various units with respect to one another in order to ensure maximum efficiency.

In the following pages, the main problems that have arisen will be enumerated and discussed.

General Design

In the course of the design of the factory several problems have arisen. Some of the most important ones will be discussed here and solutions suggested.

The land

The land is an almost rectangular plot situated about 600m. from the center of Hadeth to the South having an area of 6220 square meters with a width of about 70 meters and a length of about 86 meters. It has an easy access to the Beirut-Sidon highway by means of a public road 8 meters wide. It is level with the exception of the North East corner which drops quite abruptly a depth of about 1.50 meters. At this corner the garages are located.

This plot was chosen because of its cheap value and its suitability as a site for a factory. It is at the same time near enough from Beirut, the main commercial centre, to cut down transport costs and far enough from the city to become a public nuisance. It is also within easy reach of labor communities.

The building

The location of the building is clearly shown in the location plan. Care was taken to provide sufficient space for the construction of gravel paths that will join the public road with the three entrances of the building. The visitors' entrance is reached by a path three meters wide that can easily accomodate one car. Space for turning around is provided. The garages are reached by a lane four meters wide that spreads out on reaching the garages so that the trucks may unload in any one of the three bays.

The architecture of the buildings was governed mainly by functional and economic considerations, as it is believed by the candidate that beauty in a factory is incidental to proper function.

Attention was paid, however, to obtain façades that look businesslike and invite confidence. No exterior decorations whatever were used, but a decorative effect was obtained by proper spacing of large windows and the extension of window sills over the whole façade in order to break the large monotonous surface.

The building is composed of two storeys. The ground storey contains by order of importance: factory hall, engineer's workshop, store room for raw materials (marked store room 1 in the plans), lift, management

department, toilets and coat rooms for workers.

The second floor contains a room for looms, a packing room, a store room for finished products (marked store room 2 in the plans) and dining rooms for the workers.

Each of the elements enumerated above will be discussed separately.

Factory hall

In the design of the factory hall the following problems have arisen and solutions suggested:

1) The installation of the machines.

The importance of this operation will be apparent if it is remembered that these machines weigh nearly two tons and have to be carried across a great length. The easiest and most economical way to perform this operation seems to be to leave the part of the wall at the back of the factory hall unbuilt until all the machines have been installed in order to allow the truck bringing the machines to enter the factory hall and deliver them to their final sites. When this is done, the wall is then built leaving an emergency door.

It might prove convenient to provide rubber cushions and anchorage bolts for the machines in order to minimise vibration and achieve the stability of the machines, but that will be decided upon by the mechanical

engineer installing the machines.

2) Spacing of the machines.

The spacing of the machines should be such as to allow easy and safe access to any part of the machine without interfering with any of the adjacent ones. Two laborers must be able to stand in each aisle and have sufficient room to move freely about in any direction. Further the maintenance engineer should have enough space to check the running order of the machines and perform any repairs necessary. An aisle of about 2.00 meters between each machine is considered ample. Hence the spacing of columns should be 7.00 meters centre to centre in a direction parallel to the axis of the hall and 7.50 meters in a direction perpendicular to it. In such a case two rows of two machines each having a maximum operational width of 1.60 to 1.70 meters and a length of about 2.00 meters could be placed side by side in each bay leaving 1.80 to 2.00 meters net space between each. This spacing of columns will be seen to approach the most economical i.e. about 7.50 meters. Reference should be made to the floor plan in which the position of the machines is shown.

3) Light and ventilation.

Light and ventilation are required in abundance in a textile factory. Since small particles that come off the threads and are carried in the air may cause

serious injury to the health of the workers, the air should be frequently changed. Light is also needed abundantly since the workers have to keep watch over very thin threads that break off frequently and have to replace them. Consequently, it is necessary to provide very generous openings in the factory hall. Windows extending clear from column to column and having a height of 1.90 meters have been provided along three sides.

At night, light is provided from twin fluorescent lamps over each machine.

4) Humidity.

An excess of humidity must be avoided at all costs since it prevents the proper running of the machines, spoils the cloth and affects the energy of the workers. For this reason, the factory hall is raised about 50 cms. (three 16.5 cm. steps) above the level of the ground and the walls made of coarse masonry 40 cms. thick. This will not increase the cost appreciably and may even be cheaper than 25 cm. thick sandstone.

Humidity caused by rain falling on the roof is avoided by giving the slab a slope of 0.75% ample enough to drain the rain effectively yet is not large enough to be seen by a casual observer or cause trouble in placing the forms. This would make it necessary to

raise the slab 20 cms. higher in the centre and sloping toward each of the four corners of the hall where a 16 cm. drainage pipe is placed.

The Engineer's workshop.

This room was placed adjacent to and opening on the factory hall in order to facilitate and speed up the maintenance engineer's work. It should have sufficient room for storing all the spare parts and tools the engineer might need in his repairs. It might be a good idea to design this room in conjunction with the maintenance engineer if possible as he might have special requirements to make. In any case, it is believed that the size and position of this room as shown on the plans will meet almost every requirement.

Store room for raw materials.

This room was made large enough to store all the raw materials that may be needed for a reasonnably short time as it is expected that the owner would have other large stores elsewhere. There is space enough in this room to open crates and distribute the material to the various part of the building in addition to storage space. This is marked store room 1 in the plans.

Garages.

There are three garages with a net width of 3.40 meters each. Deducting the width of one truck (2.20 meters, a clear space of about 60 cms. on each side is left. The garages, favored by the natural slope of the land, are made 1 meter lower than the store room so that raw material crates can be wheeled in from the truck straight into the store room without the use of impractical inclined planes. The length of the garages is 9.50 meters net. All doors opening on the garages are either sliding or rolling to prevent needless waste of space.

Lift.

The lift is a standard commercial lift the size of which will be specified by the owner but in any case it should accomodate at least one crate.

Management.

The management occupies the following rooms all in the right wing of the building:

1) Combined waiting and secretary's room.

This room is divided clear across by a low wooden railing in order to separate the visitors from the secretary. In order to isolate the factory proper from visitors, a special visitors' entrance is provided

opening directly on this room. A large window is provided to furnish the light required by the clients examining samples of the products of the factory. A door opens from this room on the manager's office.

2) Manager's office.

This office should be at the same time inaccessible to the noise of the factory and within easy reach of any part of the building. This and the fact that it had to be directly accessible to the visitors' and secretary were the main considerations in placing it on the front of the building and under a relatively queit part of the factory.

3) Design room.

This room is described as the brains of the factory. It should be accessible only to the manager and secretary. It is very important that this room be kept completely closed to the public and every measure taken to prevent outsiders from seeing the designs. Since it is necessary to have plenty of sunlight for proper mixing of paints, large windows had to be provided but in order to secure privacy, translucent glass is used on the lower panels of the windows and a low hedge of shrubs planted around them

4) Labor control room.

A labor control room that controls the workers entrance in order to check the workers as they come in the morning is provided. This room can also check the amounts of raw material dramn from store room 1 and make certain that nothing is smuggled out.

5) A special toilet and washbasin for the staff is provided. This toilet has no window but is ventilated by means of 20 cm. vertical pipe. The position of this pipe should be fixed in such a place as to cause least inconvenience in the room above.

Room for looms.

A room to house the looms is placed on the second floor as is usually done in most factories in order to keep the factory hall exclusively for weaving and because these machines do not need as constant a supervision as the weaving machines do. The installation of these machines creates a problem similar to the one met in the installation of the weaving machines in the factory hall except that in addition they must be hoisted to the second floor. To do so, a special scaffolding must be erected in the first bay of the factory hall just under the room designed to receive these machines. The installation

of the looms has to be done before the weaving machines are installed in the factory hall otherwise the truck will not be able to deliver them at the scaffolding.

This room, as can be seen in the plan of the second floor has no wall but just a railing over the factory hall. This is done in order to allow additional light to come in from the hall and to facilitate the transfer of the spools to the hall by lowering them in a basket or by other means.

Packing room

A packing room of a size large enough to perform all the necessary operations involved in the folding, packing and crating of the cloth is provided on the second floor. Since the noise of hammering, sawing and handling of crates is strongly objectionable in the management zone, this room was placed as far from that zone as possible and it is not probable that the present position of this room will cause any objection in that respect. If, however, the noise is still felt, special provisions can then be taken such as the building of a door or a partition in the lower corridoor. The packing room has direct access

to the store room for finished products marked store room 2 in the plans.

Store room for finished products.

This store room lies directly above the garages and has about the same area. It opens on the packing room by means of a large sliding door and on the garages by means of a trapdoor in the floor through which the crates could be lowered by pulleys straight into the waiting truck.

Worker's facilities.

The workers facilities include toilets, coat rooms and dining rooms. Separate facilities are provided for each sex.

Toilets

Toilets are provided at each wing of the factory hall. On the right are the women's toilets and on the left are the men's. There are four W.C.'s for each sex and three washbasins. The men have in addition one urinal.

Coat rooms.

Coat rooms which might also be used as dressing rooms are provided for each sex. Since the worked involved in this factory is not dirty, it is not probable that workers would want to change their clothes. Hence the size of these rooms is reduced considerably.

Dining rooms

Dining rooms where workers can have their meals and rest a little are provided on the second floor. These dining rooms are designed to contain about forty workers each. They may be merged into a single large dining room at the discretion of the owner thereby saving space. The furniture of these rooms is composed of long narrow tables (55 to 6o cms. in width) and benches.

Miscellaneous problems.

Walls and beams

In view of the relatively large spans necessary and the heavy load from the machines, dead load had to be cut down considerably. Consequently, all inside walls are made of hollow cement stone 15 cms. thick. These walls although light will remain quite effective in absorbing noise. Outer walls are made either of 25 cms. thick sandstone masonry or of cyclopean concrete of the same thickness. They are then plastered properly and distempered or coated with stucco as the owner prefers. All the interior beams are designed as T-beams and all spandrel beams are designed as L-beams.

Stairs

Stairs are to be made 16.5 cms. high per step and 1.60 meters wide (net) up to the second floor and 1.40 meters (net) up to the roof. These sizes are

selected because it might be necessary to carry crates on them to the second floor in case the lift is out of order or the electric current cut. The height of each storey is 20 steps or 3.30 meters gross. That would leave a net height of 3.15 to 3.18 meters.

Theft

Workers dealing with more or less expensive cloth are often tempted to steal. Every step was taken to discourage them and to present the least chance possible. Steps were also taken to prevent the least distraction of the workers while working. High windows in the factory hall prevent them from looking out or from communicating goods to the outside.

Gardens

The space left around the building if planted properly can provide a nice contrast with the sober and bare façades. Low shrubs intersperced by flowers and a few trees will be found very convenient.

References

The candidate, unable to find adequate information in books or magazines on this subject, and believing that the best information and advice could be obtained from people who have already had large experience in textile factories, has frequently consulted his supervisor, Professor Yeramian who has built several textile factories in Lebanon and Syria and consequently is well-qualified, Messrs. Abroyan and Badaro both of whom are important textile industrialists and others. These consultations complemented by trips to factories have enabled the candidate to obtain valuable information that could not have been obtained otherwise.

Information and data of an engineering character were obtained from Professor Yeramian while some of the common requirements were given by other authorities. It was clear from the start both to Professor Yeramian and to the candidate that in view of the wide scope of the textile industry and variety in size and shape of the machines, only through a careful study and selection of data could average specifications with regards to the various units and their position with respect to one another be determined and an ideal factory designed. The sizes used above were considered most usual and common.

Conclusion.

In conclusion, the candidate wishes to stress again that this factory was designed as an ideal factory of average size. Only general problems were considered. In most cases, however, the owner would have spacial requirements to make either regarding the size, position or shape of the units. He might add some units or reject some that are included here. At any rate it is believed that this design can act as a basis for most requirements./.